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SEA GRANT

ANNUAL REPORT

1972-1974

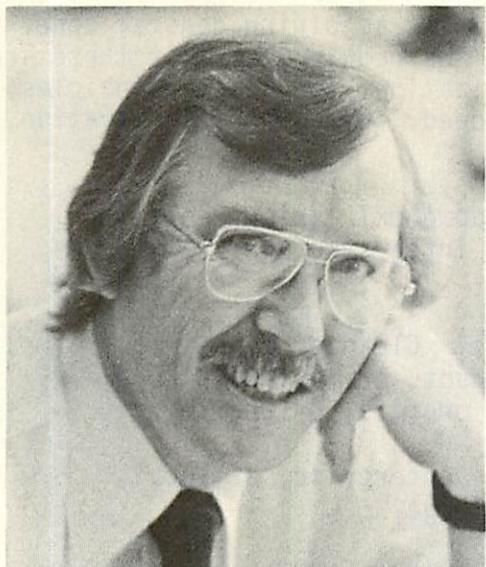


ANNUAL REPORT

USC-SG-5-75

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PROGRAM ADMINISTRATION

Improvement in the management of coastal resources is an important social goal. The capacity of the coastal zone to support the various activities demanded by the urban population may be expanded by careful administration of existing and future legislation. Successful management will include sensitivity to demands from user beneficiary populations, full use of improved information about coastal resources, systematic monitoring of environmental conditions, regular evaluation of ongoing and planned developments and activities, and continuous awareness and utilization of technologies.

The term "marine resources" no longer means just fisheries, petroleum, minerals, fresh water, or sand and gravel, but it now includes harbors, shipping, recreation, and even the coastal land area itself to a distance of some miles back from the shore. There is scarcely a single, broad area of the physical, economic or social life in a coastal urban complex like that of southern California that does not depend to a considerable degree on what happens in the adjoining ocean, often in some quite unexpected ways, and it is with these kinds of interrelationships that we are concerned.

During the fall of 1972, both California and the federal government made special provisions for the planning and management of coastal resources.

The Coastal Zone Management Act, a federal Act to establish a national policy and develop a national program for the management of the nation's coastal zones, was passed in Congress in October 1972. On November 8, 1972, a majority of the California electorate voiced their concern regarding coastal resources and enacted the California Coastal Zone Conservation Act.

Within a few weeks of each other, these Acts initiated change of yet undefined impact. The federal Act, because of lack of appropriations, will lag behind the State Act in effecting change; nevertheless, it must be considered in long-range planning for the State's coastal resources. On the other hand, the California Coastal Zone Act, created by the initiative system (often referred to as Proposition 20), was enacted with a limited and inadequate budget. The Coastal Commissions, which it established, commenced their activities February 1, 1973, for the long-range planning of coastal resources.

The Act requires that the State Commission, with assistance from the Regional Commissions, provide the California Legislature by 1976 with a comprehensive plan for future use and conservation of coastal resources. The plans are to guide future use of coastal resources and constitute the major goal of the legislation. In effect, the 1976 completion deadline gives all planning matters the greatest urgency and priority.

Despite all that is known about the theory and practice of management, there is relatively little in the current body of knowledge that can be applied to the specific task of managing the continental shelf and its adjoining coastal zone. There are too many significant differences between the requirements for these areas and those met by the usual public or private organizations for which principles, structures and operational methods have been developed. By way of illustration, some of the important issues are:

What should be encompassed in the management complex? Which people? Which resources? Transportation and/or other infra-structures? The urban development of the coastal zone?

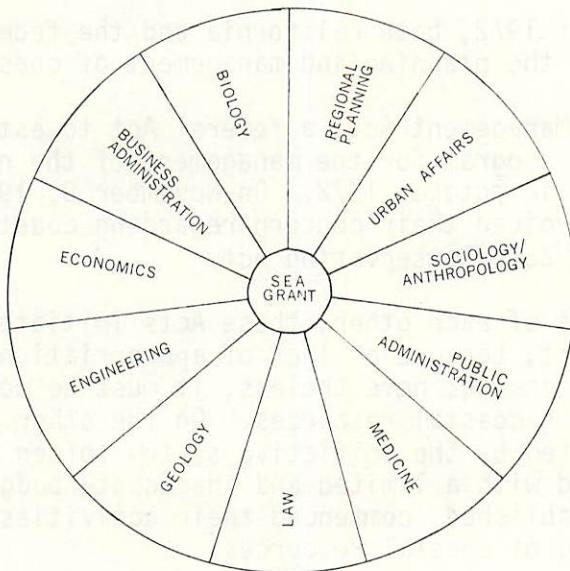
Managed for what purposes? What are the goals? Clean air and water? Or other aesthetic values, or maximum net product, or maximum tax revenue, or high standards of living, or maximum profits, or what?

What should be the respective roles of private enterprise, of local, state, federal government, and the public-at-large?

This brief, incomplete listing of some of the important but unresolved issues simply portrays the current inchoate state of affairs.

The problems are vast and complex, but the knowledge and theoretical bases from which answers should be developed are sparse.

For this reason, USC Sea Grant feels it is wise and appropriate that its program be a multi-thrust one, involving teams reflecting various combinations from the following University components:



Research from the 11 components all relate to an attempt to develop bases for the establishment of management policies and systems for optimizing marine-associated resources of the California coastal areas.

Ronald B. Linsky
Sea Grant Program Director

COASTAL ZONE MANAGEMENT

COASTAL POPULATION STUDY

Judith Friedman

One of the predominant, recent population movements within the United States is that from the center of the country to the coasts. The resulting buildup of coastal population complicates problems of coastal water protection. Additional information about the interrelationships among population growth and water pollution will help those planning for the coast.

Along the coast (and elsewhere in the country), the areas of most rapid growth are the urban areas near the larger, older cities. These jurisdictions (as well as the older cities) work out policies to deal with their population changes, including policies about water resources and population growth and distribution itself. The impact that populations have upon the coastal environment, then, is not necessarily a simple function of population size and growth. Local communities mediate the effect by the actions they do or do not take.

Our national study focused upon the community characteristics that determine the nature and the degree of response a community makes to the problem of water pollution. We asked such questions as: What are the characteristics of communities that have used HUD Water and Sewer Grants or EPA Grants for capital construction on sewage facilities? That impose a surcharge or restriction on local industries using the public sewage system? If a city takes one kind of action, is it likely to take other kinds as well, or do some kinds of cities respond in one way and other kinds of cities respond in a different way? Are cities on the coast more or less likely to act than inland cities?

We began the study with an existing set of data about each of the 109 largest, standard metropolitan areas in the country and their central cities. Using published sources (largely Federal Government publications), we added information needed to answer questions like those above for the central city and for the set of other jurisdictions in the county surrounding each central city; our definition of its "suburban" area. This information included details about employment within different kinds of manufacturing, funds received from the HUD and from the EPA grant programs, whether or not the city utilized industrial surcharges or restrictions, local government expenditures on sewerage, an estimate of the city's need for EPA grants, and information about the organization of responsibility for sewage treatment.

Our analysis of the distribution of EPA grants among the cities showed that: the dollars received per capita increased with the estimate of overall need, but the relationship is weak enough to demonstrate that grant distribution is not simply a matter of need. Those cities with extensive employment in polluting industries, however, do not get more grant money. The EPA dollars received per capita by a city are inverse to the proportion of the local labor force employed in industries that especially contribute to water pollution. Cities with an especially strong financial base do not appear to make more use of these grants.

Use of HUD grants and of surcharges and restrictions is more common in cities outside the Northeast and in those that have developed recently. Cities on the coast or on a navigable river are more likely to have surcharges and/or restrictions than are inland cities.

Among the suburban areas, those located in the more densely settled and older sections of the country have acquired more EPA and HUD dollars per capita than have others. In part because of this, coastal suburban areas have more grants than do inland suburban areas.

The results of our national study have immediate application for Federal, regional, and state administrators developing programs for local areas or enforcing new standards of water quality. Knowing characteristics of cities which acted (or did not act) on problems of water pollution in the 1960's will help such administrators organize new programs in ways that maximize local use. It also will help them predict those communities likely to be slow in responding to new standards and programs; this will help them take special action to encourage these cities to deal with their water quality problems.

The findings also clarify relationships between population growth and water pollution, relationships which both state and Federal administrators, as well as local planners and officials, need to understand in order to plan effective programs. This is especially important in coastal states such as California.

THE MANAGEMENT OF COASTAL ZONES IN METROPOLITAN REGIONS

Robert Warren, Louis Weschler and M. Cox

Diverse pressures for access to and utilization of the coastal zone generated by population centers are producing rapid transformations in the physical, economic and social characteristics of adjacent water and land. Continued growth of these population concentrations will increase competition among market-oriented uses of coastal resources, public facilities in the coastal zone and conservation ethics. The most frequent response to this problem of sorting out conflicts in allocation of land and water resources in the coastal zone has been to call for the establishment of sub-regional or regional agencies.

The people of California established a new set of such public agencies in 1972. The Statewide and sub-regional Coastal Commissions have responsibilities for sorting out among uses and users and for providing the State with a plan for future development in the coastal zone. The Commissions' regulations and processes relating to air and water quality, land use, environmental reporting, impact evaluation and the like have potential impact on future use of the coastal zone. The way in which such regulations and processes affect utilization of a metropolitan coastline is a major concern of this project, with the overall objectives being: 1) to improve the basic data available to agencies charged with management of coastal resources, 2) concurrently, to map out and evaluate current and emerging patterns of resource allocation, and 3) to examine and evaluate the capacity of local and regional governments to manage the coastal zone of southern California. These three sub-projects, as a package, are intended to assist public agencies and citizens in securing good use of their coastal resources.

To improve the basic data available to agencies, a Coastal Data File was created which secured information regarding identification of basic use patterns, emerging trends in coastal resource use (spatial and social relationships between the location of particular uses and their consumers and beneficiaries), and basic regulatory mechanisms available in allocation of air, water and land resources along the coast. The Data File, when completed, will be used as a base from which to anticipate possible impacts of major changes in the structure of coastal and regional populations, distribution of costs and benefits of proposed projects in the coastal zone, and spillover effects of major land use decisions.

Once basic descriptive information about current use patterns in the coastal zone are established, emerging trends and conflicts may be projected and assessed. "New" developments and uses may actually conflict with established uses and/or with each other. Public officials charged with regulation of the allocation of coastal resources need information about current and probable impacts of efforts to develop and redevelop the coast, and here is where the project's products have been in great demand, not only in the southern California area, but nationwide as well.

Much of the baseline data on population structures, existing land use and social characteristics of users has been assembled. An atlas, Socio-Economic and Housing Characteristics: Los Angeles County, is done. Its tables, maps and analysis compare coastal jurisdictions with each other and the rest of the county. The data are based upon information from the U.S. Census materials, county assessor's tapes and local zoning materials and will permit historical comparisons as well as

base information in assessing future changes.

An in-depth, developmental study of Marina del Rey was also completed. Its detailed examination of land use as shaped by financial contingencies in relation to the world's largest, man-made marina, has been a most noteworthy product. Upcoming are three more studies. One concerns spacial and social characteristics of boaters (in relation to facilities) which illustrates the use of aggregate and survey data in describing a recreational market. A second publication concerns the leasing policies and life-style of Marina del Rey, while a third tackles the problems associated with securing accurate information on current land use patterns and economic activities within the small city of Hermosa Beach. This study was done to fix the cost parameters of securing accurate land use information and to develop a method whereby local jurisdictions might improve the information base used in planning, environmental impact analysis and policy making.

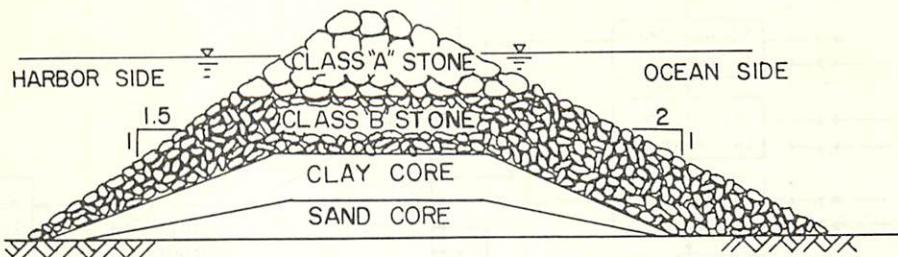
The third component of the project concerned the capacity of the Coastal Commission to actually undertake: 1) the regulation of (proposed) uses of the coastal zone much in the way a utility commission functions, 2) the gathering and processing of information about current and proposed activities in its territorial bounds, 3) the responsibility to act as a means of communication and consideration of values and perspectives not normally considered in land use decisions by local agencies, and 4) the engagement in research and development activities pertinent to land use planning for the region's coastal resources.

A crucial problem for administrators and planners in the jurisdictions along the coastal zone is the lack of adequate information. The immense pressures placed upon the coastal zone and the uneven character of its development and redevelopment makes management of its resources difficult. This project specifically wishes to improve the information base upon which public decisions are made, to develop techniques which may be used by officials in anticipating policy impacts, and to critically evaluate performance of officials in providing additional capacity for information exchange and public decisions aimed at resolving conflicts.

COASTAL ENGINEERING

BREAKWATER PERMEABILITY

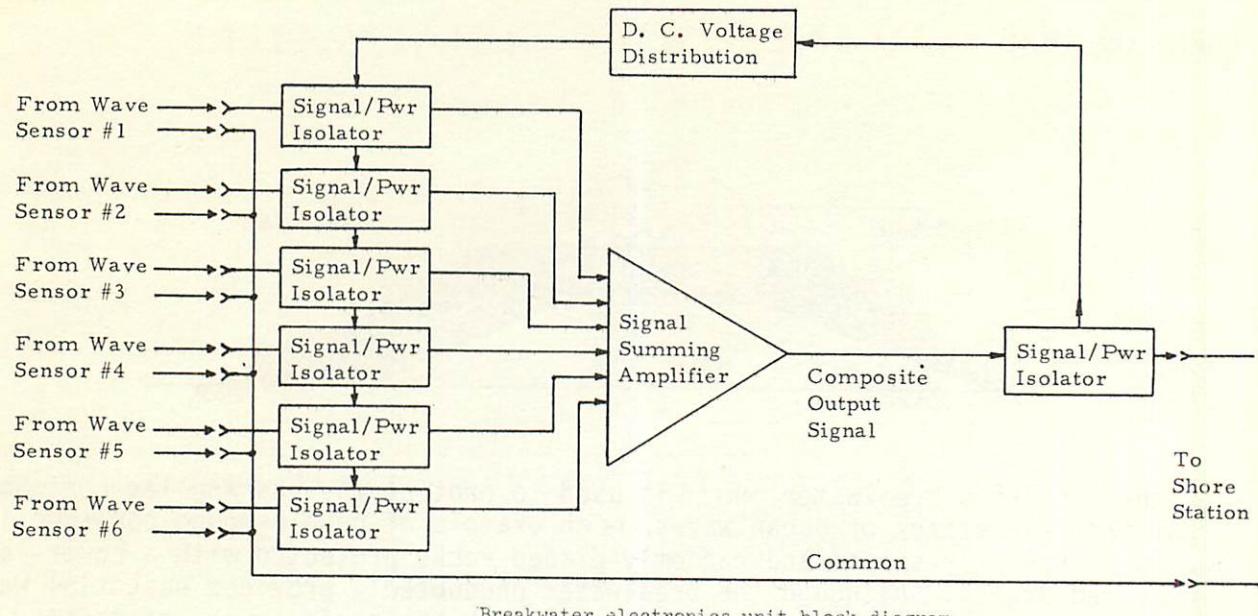
Jiin-Jen Lee



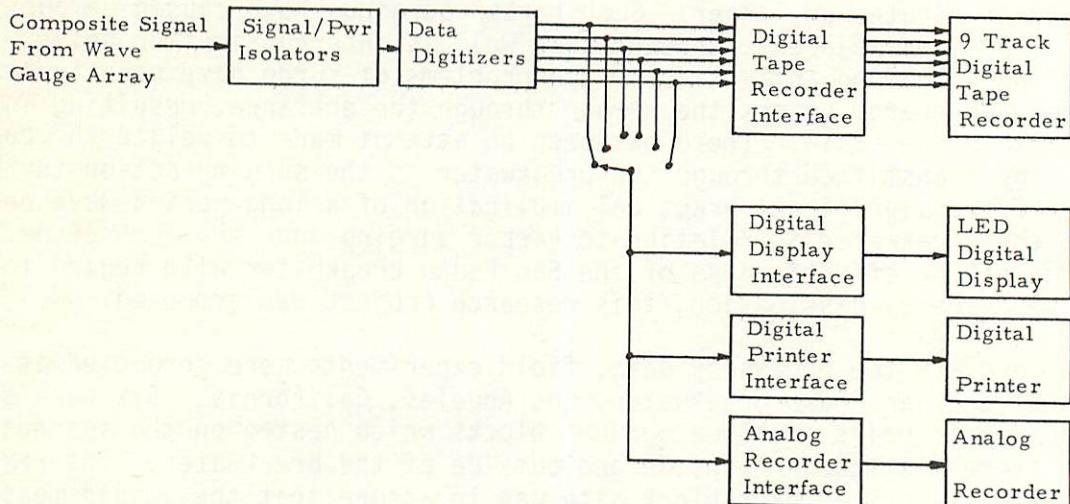
The San Pedro breakwater, which is used to protect the Los Angeles-Long Beach Harbor from the attack of ocean waves, is an example of rubble-mound construction made up of randomly-shaped and randomly-placed rocks protected with a cover-layer of selected stones. Although the breakwater undoubtedly provides essential wave protection for the main harbor and various branch basins for waves of shorter periods, this type of breakwater is still liable to wave penetration, especially with waves of longer periods. Harbor surging (also called seiche) has repeatedly been reported to occur in the main Los Angeles-Long Beach Harbor and its branch basin. The surging wave periods are longer than ordinary wind waves and are on the order of minutes or longer. Such harbor surges have caused damage to ship mooring lines and adjacent structures as well as interruptions or delays in ship loading and unloading activities. Such problems of surge have been analyzed by assuming wave energy enters the harbor through the entrance, resulting in resonant motion within the basin. There has been no attempt made to relate the portion of wave energy transmitted through the breakwater to the surging action in the harbor. Because of the significant practical implication of a long-period wave penetration through the breakwater in relation to harbor surging and the lack of detailed knowledge of the effectiveness of the San Pedro breakwater with regard to long-period wave energy dissipation, this research project was proposed.

To generate the necessary data, field experiments were conducted at the center section of the San Pedro breakwater, Los Angeles, California. Six wave sensors were mounted in pairs on three anchor blocks which nested on the sea bottom at three different sites, both inside and outside of the breakwater. The reason for placing two sensors at each block site was to assure that they would measure the same water surface elevation. Thus, at a later time, when each of the wave sensors are to be used to form sensor arrays, confidence in the wave records can be assured. To accompany the sensors, a breakwater electronic unit on top of the breakwater and a shore station electronics unit, all connected by undersea cables, were utilized. Information concerning the transmission characteristics of ocean waves through the breakwater and possible sources of wave energy through the breakwater that contribute to water surface oscillation within the harbor will be gleaned from these measurements. The sensors, along with their associated electronic systems, were both developed and installed by the project's researchers.

The permanent data record, which is used for later analysis, is recorded on a nine-track, digital tape recorder located at Battelle Memorial Laboratory. The tape format, compatible with that of the IBM 360 computer, is read directly into the computer memory and is capable of recording the data from each of the wave sensors every two seconds.



Breakwater electronics unit block diagram.



Shore station electronics block diagram.

Of late, frequency spectrum-analyses of the taped data have been undertaken, revealing that 30-35 percent of wave amplitude was transmitted through the breakwater for wave periods of 16.5 seconds depending on the tidal stage.

During this past year, a theory on harbor surging has been developed to account for wave energy permeation through the breakwater. The method is to theoretically calculate the harbor response to ocean waves by dividing the breakwater enclosing the harbor into a series of small, solid boundaries spaced at small intervals. The ratio between spacing length and the length of the solid boundaries depends on the transmission characteristics which varies for different breakwaters and must be determined by experimental means.

Upcoming are two papers: one on the electronics developed for the project and one covering the new harbor surge theory and its vital importance to future breakwater design.

STORM DRAINAGE AND ENVIRONMENTAL QUALITY OF SEMI-ENCLOSED COASTAL WATERS

Frank Bowerman and Ken Chen

Working in conjunction with two other USC Sea Grant programmatic areas, Coastal Zone Resources and Environmental Maintenance, Drs. Frank Bowerman and Ken Chen of the USC Civil Engineering Department have completed a two-year study of the effects on water quality in southern California when subjected to continual storm and surface runoff.

They chose as their subjects of investigation eleven rivers, storm drains and industrial channels in the Los Angeles Basin. These included: the Ventura River, Santa Clara River, Collegas Creek, Malibu Creek, Ballona Creek, Dominguez Channel, Los Angeles River, Santa Ana River, San Diego Creek, and San Juan Creek, with an expanded study initiated at Ballona Creek, the major storm drainage system emptying parallel to the Marina del Rey breakwater. For this intensified investigation, a hydraulic model of the Ballona Creek-Marina del Rey interface was constructed.

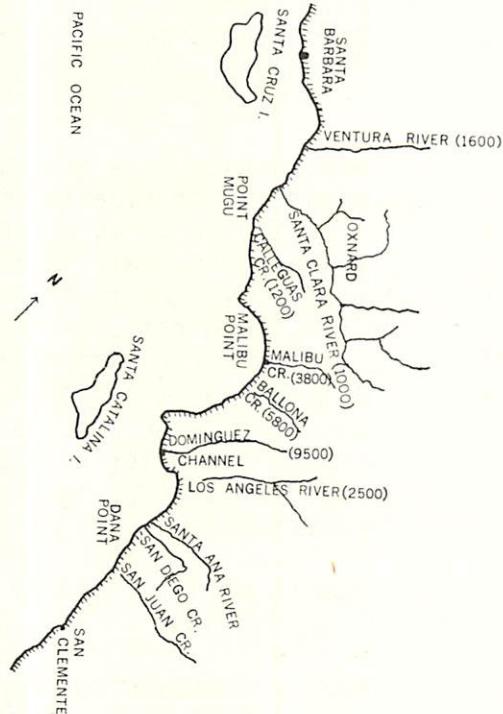


Figure 1 - Lead content in suspended solids of river runoff in southern California. Number in parentheses represents lead content in suspended solids.

especially lead, are discharged from industrial drains, such as Ballona Creek and Dominguez Channel; the concentrations of nutrients, such as nitrogen and phosphorus, are quite similar in most cases.

Sediment data showed substantial sedimentation and accumulation of trace contaminants at the freshwater-seawater interface.

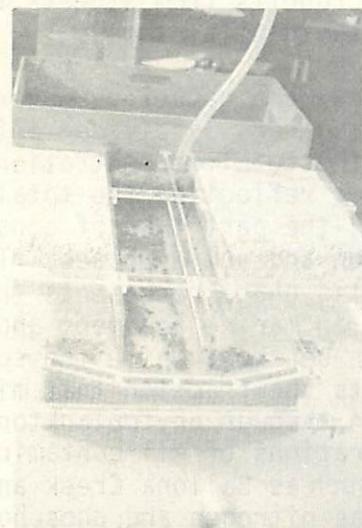
Because of the commercial and recreational importance of Marina del Rey, the expanded study of Ballona Creek, its nearest, major flood channel, was initiated; divided basically into two components. First was a hydrology study of Ballona Creek, whose initial data was gathered from the gaging station on Ballona Creek. Their records showed that the volume of sediment accompanying the discharge was very small because of the developed nature of the drainage area and the existence of a debris basin upstream. By combining eight recorded storm hydrographs from the gaging station and the Los Angeles Flood Control District's frequency curve for peak discharge, the researchers were able to design a reasonable flood hydrograph corresponding to any desired recurrence interval. This hydrograph information gave the inflow to the breakwater-harbor area at the outlet from Ballona Creek.

The results of this analysis provided the researchers an index point from which reasonable conclusions could be drawn regarding the order of magnitude of the amount of water flowing into the harbor caused exclusively by the rising water at the outlet from Ballona Creek. When this information was evaluated in light of possible pollutant transport into Marina del Rey, it was concluded that the rising water due to outflow from Ballona Creek would not cause much water to flow into the harbor. The effects of tides and winds appeared to be the primary mechanisms influencing the transport of debris into the Marina. However, particularly in the case of small floods (of recurrence intervals of two to five years occurring after a dry spell of several months) the storm drain water could contain considerable debris from the streets. This could then be carried to the mouth of the Creek and into the harbor on a rising tide.

The second phase of the research consisted in the construction of a hydraulic model study which examined the physical transport characteristics of floating materials discharged from Ballona Creek to the ocean, with particular focus on the effect of such floating materials on the Marina del Rey entrance channel. Results

obtained from this hydraulic model showed that the floating materials from the Creek did not significantly affect the amount of debris in the Marina entrance during the flood period and scarcely at all during the ebb periods. Repeated experiments showed that only approximately 10 percent of this material discharged in the rainy season will be transported into the Marina del Rey entrance channel.

The results of these studies will be used by such agencies as the Los Angeles County Flood Control District, the County Sanitation District, the Harbor Authority and Corps of Engineers to the improvement of existing hydraulic structures in preventing localized pollution of coastal waters. It will also enable regulatory agencies to estimate the contribution of pollutants from storm and surface runoff in comparison with other sources, such as aerial fallout and sewage discharges. These data will also provide guidelines for future design of flood control channels in the coastal zone.



A STUDY OF NATURAL OIL SEEPS IN SOUTHERN CALIFORNIA

Peter Fischer and R. Berry

Because of the growing national need to locate and develop marine sources of energy and construction materials to augment the rapidly depleting land reserves, a project spanning two years assessed the environmental parameters, the sand and gravel deposits and the natural oil seeps along the southern California coast.

The major findings of this study included the distribution of relict and modern clastic sediments - future shelf sand and gravel deposits. These deposits fill ancient, fluvial channels out into the shelf, are pocketed against ancient wave-cut sea cliffs, and even exist as subaqueous sand dunes.

Shelf clastic deposits in high energy environments are transitory. Off Coal Oil Point in the Santa Barbara Basin, sequential sediment data from 1946 to 1973 were plotted as isopachous (thickness) maps of the unconsolidated shelf sediments. These maps demonstrate a net thinning of these sediments of nearly seven meters (25 cm/year). Bottom current velocities in the area average 25 cm/sec with net transport directions to the southwest or into the basin. This implies that this middle-outer shelf sediment could be "mined" without effecting the rate of sediment supply to the beach. Indeed, unless this sediment is utilized, it will be lost into the deep basin.

A continuing investigation in the Palos Verdes to Newport Beach area has revealed a series of subaqueous sand dunes off Seal Beach. These dunes probably represent sand lost from the local beaches and the Army Corps of Engineers' beach replenishment programs. To the south off Newport Beach, our ongoing study is concentrating upon the effect of the Newport Submarine Canyon. Opinion as to the net effect of this canyon as an active or inactive sediment path to the San Diego trough is diametrically opposed.

A masters thesis in progress has revealed sharp, clean-cut, v-shaped profiles along the canyon axis which indicates active erosion. Data lent to the study indicates filling of the canyon bowl and active sediment transport down-canyon. This is contrasted by the negative indications of canyon activity shown by other researchers. This is a problem of immediate relevancy for one major sand and gravel source area is represented by the mouths of the Santa Ana river along the Huntington-Newport Shelf. The fate of this sediment is of vital concern to the mining companies and their environmental impact upon the shelf.

The second major thrust of this study was the location, activity and controls of natural oil and gas seeps (Figure 1). Using historical data obtained from industry sources and seeps mapped with the high resolution profiling system, oil and gas seeps were mapped from Point Conception to Newport Beach.

Aside from the environmental concerns of oil and gas seeps, their energy implications are obvious. In a review of oil and gas fields of the Los Angeles-Ventura Basins, over 80 percent of the major fields were associated with seeps or very shallow hydrocarbon occurrences prior to discovery. The most southerly seep lies off of Huntington Beach; our newly-discovered seep location is over an actively growing geologic structure some 20 kilometers south of the Huntington seep. The presence of hydrocarbons in this location greatly enhances the oil-gas producing potential of the Newport Shelf area.

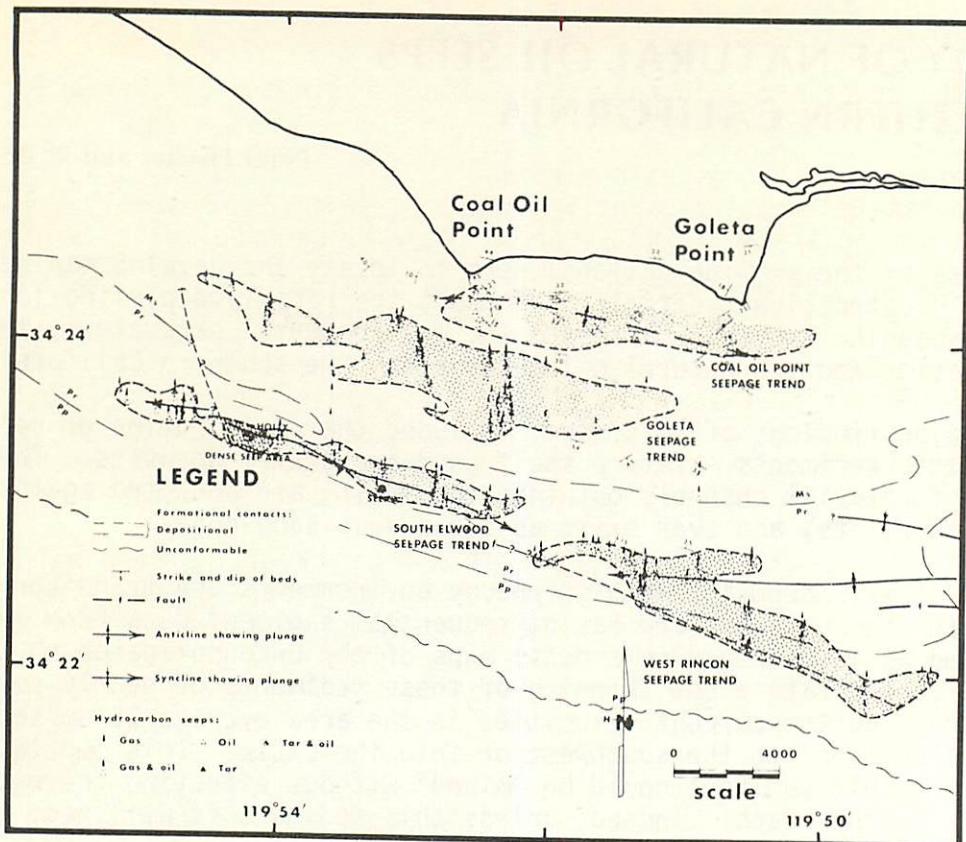


Fig. 1 - Coal Oil Point Area: Major oil and gas seepage trends

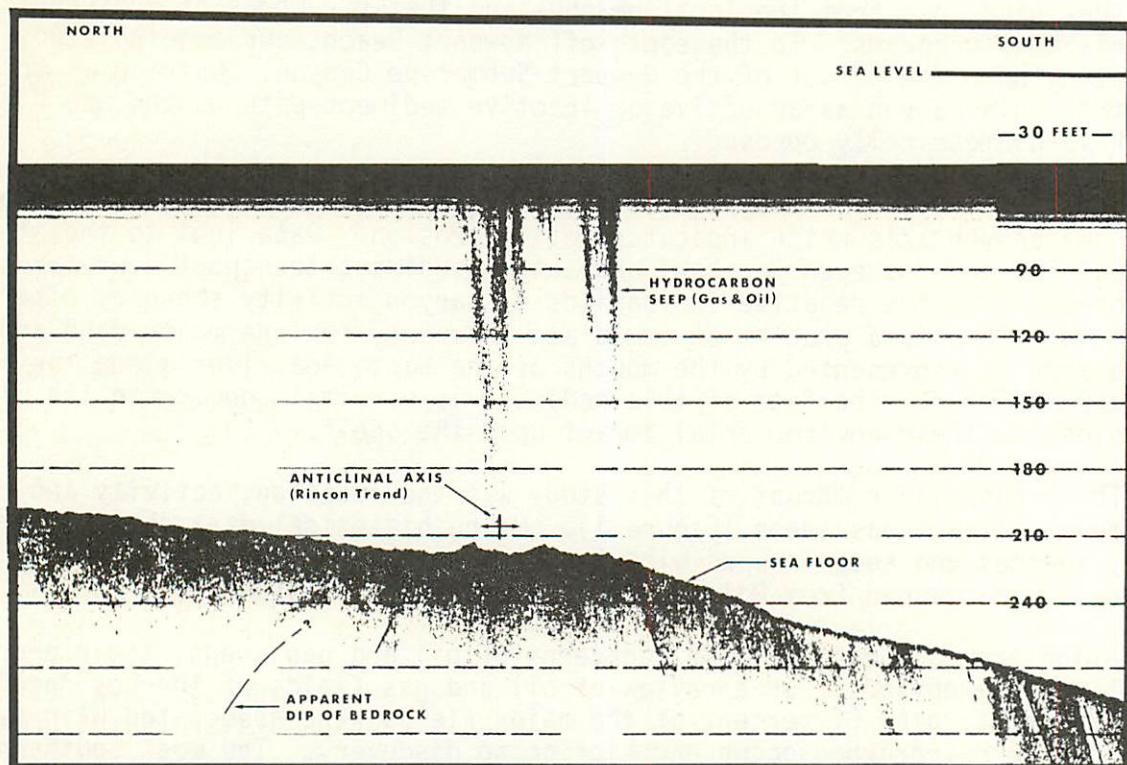


Fig. 2 - 3.5 kHz. high resolution N-S sub-bottom profile record showing natural hydrocarbon seeps in the Coal Point area.

From the study areas in the Santa Barbara basin and off Newport, these seeps were found to be:

1. most common along basin margins,
2. associated most frequently with young sediments recently uplifted, and
3. denser in areas of little or no cover by unconsolidated sediments.

To these general controls, more specific data obtained from the Santa Barbara shelf, and evidently also valid off Newport Beach, include:

1. Natural hydrocarbon seeps are located along structural trends. About 75 percent of the mapped seeps occur within 2000 feet of a mapped anticlinal axis or major fault. Other seeps may relate to the outcrop of beds correlative with deeper, down-dip hydrocarbon-bearing reservoir horizons.
2. Structural trends with evidence of continuing structural growth are the areas of most active seepage.
3. In the Coal Oil Point (Figure 2) area, much of the seep oil and tar may be deposited in the trough of the Santa Barbara basin. Therefore, volumetric estimates may be at least an order of magnitude too low.
4. Declining seep activity in Coal Oil Point area during the interval between 1946 and 1972 is considered to be due to increasing rates of offshore production along the Rincon-South Elwood anticlinal trend. A "new area of dense seepage around platform Holly in the Coal Oil Point area (Figure 2) may be related to fracturing of the shelf bedrock during the construction of the platform, or production practices such as gas injection.
5. Man's control of natural and artificial seeps may be feasible. Production or pressure reduction is probably the best method of seep control. Alternatively, control of seeps might be effected by covering the seep areas with a thick veneer of alternating fine- and coarse-grained clastic sediment.

Evidence of Recent (Holocene) structural activity along faults and folds along the shelf-slope was documented. Areas of oil production unfortunately coincide with these areas of Recent tectonism. Current work is centered along the Palos Verdes and Newport-Inglewood faults. The preliminary evidence is that both of these trends show shallow signs of Recent movement. Seismic activity is well documented along the Newport-Inglewood fault responsible for the Long Beach earthquake in 1933, but not for the Palos Verdes fault off San Pedro and the Los Angeles Harbor area.

Recent tectonism (fault activity) in the Santa Barbara Channel is indicated on a revised Tectonic Map of the basin, which is to be published by the Division of Oil and Gas. Recent faulting off Coal Oil Point was reported, but a detailed report is still in preparation.

In addition to these major contributions to the study of the southern California shelf, a map series covering shelf geology, unconsolidated sediments and bottom currents are being published by the Division of Oil and Gas. These maps have already been requested by: California Division of Mines and Geology, California Division of Oil and Gas, California State Lands Division, California Department of Navigation and Ocean Development, U.S. Geological Survey, Naval Civil Engineering Laboratory (Port Hueneme), the Naval Undersea Center (Point Loma), and various private concerns.

ENVIRONMENTAL QUALITY

DEVELOPMENT OF ENVIRONMENTAL MAINTENANCE SYSTEMS IN LOS ANGELES-LONG BEACH HARBOR

Dorothy Soule and Mikihiko Oguri



The Los Angeles-Long Beach Harbor is now said to be the third largest port in the United States; a focal point for seven million southern California residents. Unfortunately, pressures for pollution abatement, for aesthetic improvement and for recreational usage are often in conflict with pressures to develop deep-water port facilities, modernize commercial facilities and expand industrial capabilities.

A major, long-term need of both public and private sectors is for thorough baseline studies, conducted as integrated, multi-disciplinary investigations, and carried out prior to, or during, design and construction phases of port development.

Assistance and advice are needed during planning phases so that the required federal NEPA and California CEOA provisions may be met by their projects. Also, data are needed, evaluation of which provides long-range impact assessment.

Meeting short-term needs has become an equally critical matter as a result of the pressures brought by California Coastal Zone legislation and Water Quality Board regulations. Numerous projects are seriously slowed in order to comply with new requirements for Environmental Quality Reports or Statements. The Harbors project team makes every effort to advise on design of field work or to respond to emergency needs. By doing so, it is possible to fit information gained in short-term projects into the long range objectives, while assisting the local, state and national users.

Beyond these stages, implementation phases following planning require that baseline inventory and subsequent monitoring be carried out as an integrated, sequential program, with standardized techniques so that maximum value can be gained by the systems analysis of the parameters examined.

It is towards these ends that USC Sea Grant-Allan Hancock Foundation personnel have undertaken a comprehensive study of the harbor and adjacent waters, in cooperation with local, state and federal agencies, private industry, and local colleges and universities.

It is clear that the Sea Grant Program initiated in the 01 year predicted an increase in the need for field and experimental information which has proven to be even greater than anticipated. The program's worth is being recognized locally, for funds for expanding the monitoring program to cover the Long Beach Harbor and river mouths southward have been provided by the U.S. Army Corps of Engineers. The U.S. Navy has recently made inquiry about including the Long Beach Naval Base in the

field work program, an area which has not previously had a biological baseline inventory.

This particular project, acting as the organizational nucleus for the total Environmental Quality research package, has provided funds for the design and some of the management of the inventory and monitoring program. It also has carried out the field needs of the project on marine microbiology and Red Tide, for benthic communities study, for the project on fish populations, and for the anchovy study.

A data bank has been initiated so that information is being assembled on various harbor locations. This is of considerable value to the local agencies and to private industries who are required to submit an environmental inventory and mini-impact evaluation as a condition of lease renewal in the Los Angeles Harbor.

Cooperation has been extended to the Los Angeles Harbor Department for quick response to needs for information in Coastal Zone Commission hearings even on 48-hour service in identification of terrestrial weeds, insects and birds, and for sediment analyses. The Harbor Department Testing Laboratory cooperates extensively in field work and in exchange of information or advisement. One example of such assistance provided by the Harbor Project personnel was the emergency monitoring of "ground truth" thermal data of the whole harbor to correlate with several NASA remote sensing overflights in May and September 1973. When two serious raw sewage line breaks occurred, it was the environmental quality personnel who were called, and on one-hour-notice, took field samples to determine the possible release of coliform organisms and the effects of emergency chlorination.

Assistance has been provided to TRF (Tuna Research Foundation) in the form of daily oxygen monitoring demanded by the Regional Water Quality Control Board as a condition for not closing the local fish canneries, and to the Los Angeles Harbor Department in determining the natural background levels of trace and heavy metals and chlorinated pesticides in the areas outside the harbor, across to Santa Catalina Island. The information gained will be used by EPA to evaluate existing standards and by the Corps of Engineers and Harbor Departments to plan dredge and disposal operations. Also, procedures developed by the Harbor Project team and by Hancock Foundation researchers for environmental impact assessment are becoming accepted as standards for field studies used for lease renewal requirements by the Los Angeles Harbor Department and will be followed in the Corps of Engineers studies.

On the national scene, the Office of Naval Research has sponsored filming of a documentary on Red Tide in which USC Sea Grant personnel alerted New York and Washington offices, handled demonstration sampling and obtained helicopter and boat support; laboratory demonstrations were arranged by Dr. Abbott at the Hancock Foundation. And as far as the credibility of the environmental research being done, a Department of Interior spokesman cited the monitoring program at an NAE meeting in Washington as an example of the kind of program needed to develop offshore leasing baseline information and regulations.

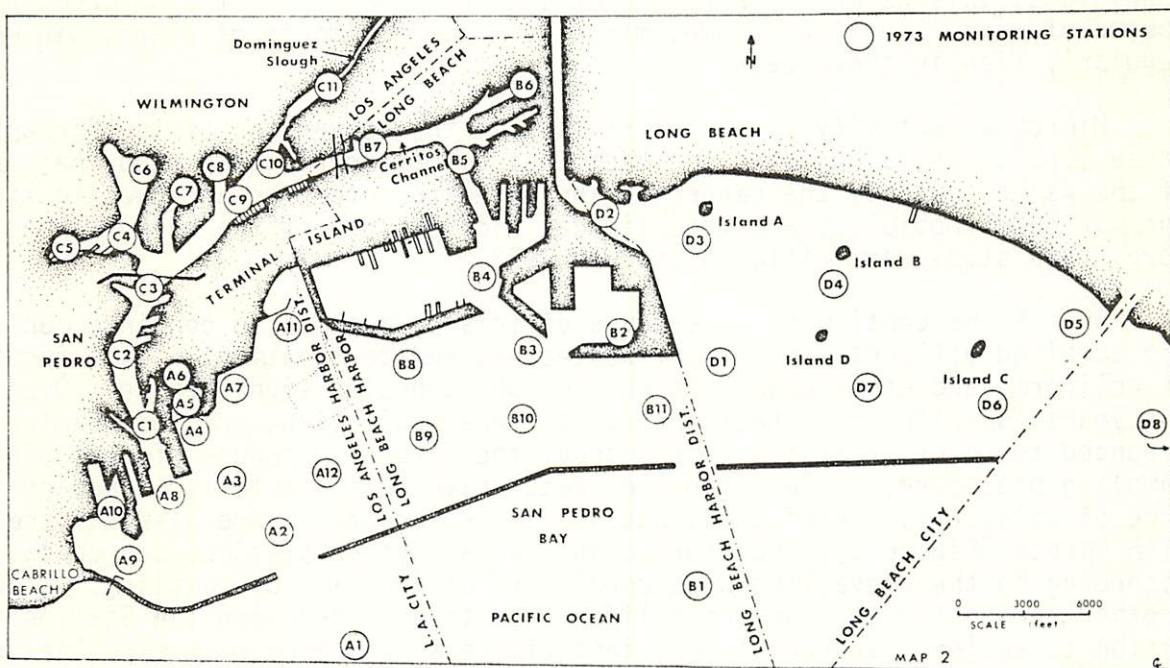
Even an international aspect was introduced in 1973, when five persons spent two weeks surveying and collecting at Mazatlan, Mexico Harbor, in cooperation with the Federal Fisheries Institute.

The Sea Grant concept has been the nucleus of effort and has furnished the applied science philosophy or mandate and its interdisciplinary mode has encouraged extensive cooperation between the Environmental Engineering personnel and the biol-

ogists at all the various institutions involved. In a tabulation of community interaction it was discovered that more than 160 people has been involved directly in Harbors Project, either for pay, or as volunteers, in the past two years. Students from the USC School of Engineering, Occidental College, UCLA, Fullerton College, California State University, Long Beach, Loyola University and Immaculate Heart College have participated in shipboard or laboratory work together. USC students from Public Administration and Urban Semester have acted as observers in the field work and participated in exchanges of information.

Several students who participated in Harbor Projects programs have found employment in environmental consulting firms. One student became the first Los Angeles Harbor Department Environmentalist in the Engineers Office.

Preliminary capabilities are in hand and the first attempts at predictive measurements have been made. The verification of these measurements awaits future developments in the harbor. Scientific results of the Harbor Projects show that a broad-spectrum, integrated monitoring program can produce data which shows early evidence of correlations, and which is of immediate use to the industrial community and the public.



THE ROLES OF MICROBIOLOGICAL ACTIVITY IN HARBOR ECOSYSTEMS

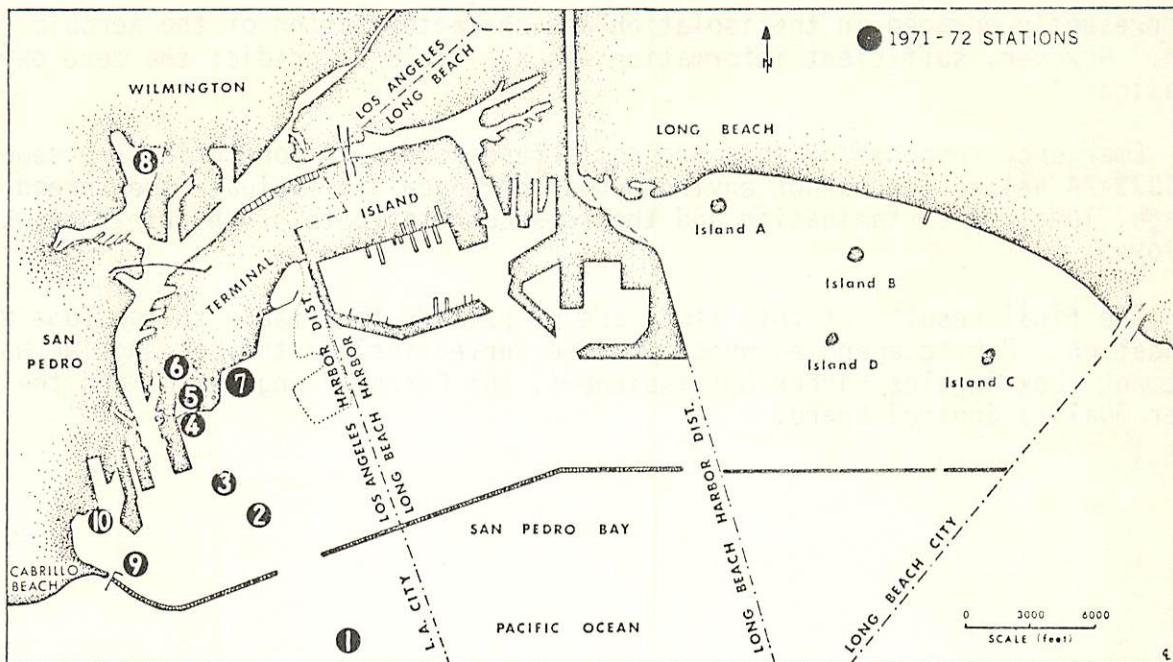
Damian Marie Juge (IMR) and Bernard C. Abbott

Periodic episodes of biological stress have occurred in the Los Angeles Harbor in which dissolved oxygen content dropped from normal to near zero levels. These episodes have been linked in some cases with the processing of unrefrigerated anchovies by the canneries, but they also appear to have a cyclic relationship to severe Red Tide blooms as well as to seasonal changes in water temperature.

The excessively high bacterial counts obtained during the October-November, 1971 episode indicated that a potential health hazard might exist. At this time preliminary investigations were made under emergency funding by the USC Sea Grant Program. Cultures in several types of common media revealed the presence of large numbers of aerobic, anaerobic and facultatively anaerobic organisms. Seawater cycled for unloading fishing boats contained bacterial counts in excess of seven million per milliliter. The process water which reaches the cannery outfall with gross solids removed, mixes with the effluent from a primary treatment sewer outfall in an area with limited circulation. Although the high protein content of the cannery effluent would support bacterial growth, it might result in a selection of a few species to the exclusion of others. The high protein content may also protect non-marine species from the ultra-violet effect as well as the otherwise antimicrobial action of the marine environment. The latter is particularly important in the case of the cannery effluents because of the close proximity of the domestic sewer outfall of the Terminal Island primary treatment plant. This situation has public health significance because under certain tide and weather conditions, this water is carried back into Fish Harbor. It also could be a source of danger for low-income, minority group residents of nearby San Pedro who regularly fish in these waters.

Microbial activity is the first step in the conversion of the harbor ecosystem. These conditions, along with the fact that no bacteriological study has been made of the waters outside the canneries indicated the need for an investigation of both the marine microbiology and the clinical microbiology of the harbor area. Therefore, this study was initiated in June 1972.

One of the continuing objectives of this project is to continue monitoring the combined effluents of cannery wastes and sewage treatment plants for the presence of coliforms and other organisms having public health significance. Over the past two years, sampling for the indicator of fecal pollution, coliform bacteria, has expanded to cover 32 stations throughout the harbor. Because of this monthly sampling procedure, a few "trouble spots" have been identified based on the presence of coliforms; one of these was Station 7 located at the disposal area east of Fish Harbor (Figure 1). Coliform counts at all other stations seemed to fluctuate according to the prevailing wind conditions at the time of sampling. Of course, another reason for the varying coliform counts depended upon the Station's location to an input source of "nutrient richness" combined with circulation patterns. A study of circulation patterns in the area of the cannery and sewer outfall (Stations 4-7) was initiated. The project personnel continuously introduced a Rhodamine B dye solution into the cannery system at the pumping station and at the domestic sewer outfall at both high and low tide. Periodic sampling of the dye plume made evident the fact that water in this area had very limited circulation.



The nature and number of the aerobic, heterotrophic bacterial population from surface water samples were found to vary considerably. However, standard plate counts have been in accord with expectations based on location and conditions (effluent load, circulation, etc.) at each station sampled. Again, counts at Station 7 were significantly higher than found outside the breakwater. Although data analysis is still incomplete, there seems to be a seasonal variation which may relate to that observed in plankton studies and to Red Tide blooms.

For determination of Biochemical Oxygen Demand (BOD) for waters adjacent to the cannery effluent, the project personnel developed an innovative and far more relevant method adapted to the marine environment using seawater instead of distilled water. With few exceptions, BOD values correlated very well with the estimated waste loads of the effluent. The investigators are becoming convinced that the effluent is an important nutrient in the harbor's ecosystem, although peak loads frequently overtax the system in the receiving waters.

The cannery industry has relied on the technology and interest of the Harbor research projects to the extent that fish catches were limited according to predictions of low oxygen periods during the fall of 1973. With a few exceptions, the dissolved oxygen levels in Fish Harbor remained above the 5 ppm requirement set by the California State Water Quality Board from January through December in 1972. However, through a sequence of events whose interrelationships are just beginning to emerge, the dissolved oxygen levels during the last week in September and the first week in October 1973 again reached zero. The dissolved oxygen level did not come back to above 5 ppm until after the rain and high tides in January 1974. Available data accumulated from September 1971 through January 1974 reveals that two of the principal factors involved are the waste load from the canneries, primarily but not exclusively that of the wet fish process, and the time and volume of the Red Tide bloom. The parameters which have been examined in this area during the last three years do not provide all of the answers as to why water conditions in 1971 and 1973 led to an October crisis and those in 1972 didn't. There is evidence that the bacterial population may provide another significant factor, and we

are presently engaged in the isolation and characterization of the aerobic population. However, sufficient information was available to predict the zero oxygen on occasion.

Emergency response by this project's researchers in monitoring two sewer breaks in 1973-74 helped the harbor environmental personnel to evaluate the spread of the sewage, level of contamination and the subsequent effects of chlorination when employed.

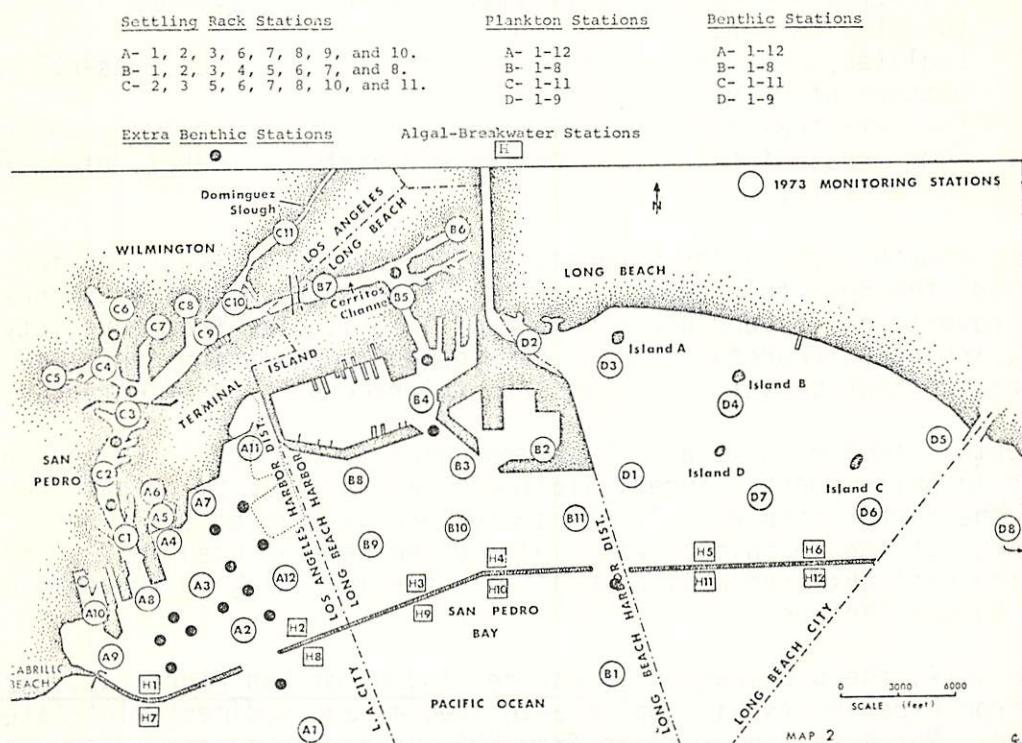
The final results of this study are of primary importance to the Tuna Research Foundation. Public agencies which will be served include the Los Angeles Harbor Department, Los Angeles Harbor Commissioners, the Corps of Engineers, and the State Water Quality Control Board.

POPULATION CHANGES IN BENTHIC COMMUNITIES FOLLOWING POLLUTION ABATEMENT

Donald J. Reish

The Los Angeles-Long Beach Harbor is an area presently undergoing changes in the biota due to pollution abatement activities which have been measured by this program. Presently, development of the area is virtually halted by requirements for filing of Master Plans by the Corps of Engineers and harbor departments. These plans also require evaluation of the impact of dredging and of effluents on the benthic communities identified by these and previous studies, evaluations which cannot be made unless these investigations are pursued. The new procedures developed this year and the organisms being investigated will enable tests to be performed to answer some of the pressing questions while carrying out the sampling and computer correlation program as planned.

Under the auspices of the University of Southern California Sea Grant Program, with some funding to California State University, Long Beach, benthic sampling of outer Los Angeles Harbor was initiated in March 1971. Sampling at the original eight stations has continued to date on a quarterly basis and was expanded in 1972 to eleven stations (Figure 1, Series A). Sampling was also expanded in 1972 to include eight stations in inner Los Angeles Harbor (Series C) and eleven in Long Beach Harbor (Series B). Eight stations (Series D) east of the harbor proper are being sampled but are not currently funded for biological analysis.



In the fiscal year 1972-73, these four series of stations were each sampled three times: November/December 1972, March 1973 and August 1973. Duplicate samples were taken at each station and for biological purposes were washed through a screen with openings of 0.5 mm. The animals which were retained on the screen were fixed

and preserved for later identification and counting. Sub-samples were also taken from each sample and frozen for later physical and chemical analyses of the sediments.

Also, 63 stations in Series A to D were sampled, and at least one sample from 40 of these stations has been processed biologically (i.e., animals identified and counted). In this regard, the scope of biological treatment has been expanded somewhat during the past year. Whereas only polychaetous annelids were identified in early samples, efforts are now being made to identify to species level, all molluscs, arthropods and representatives of lesser phyla. To date, more than 100 duplicate samples have been collected from the Los Angeles Harbor and over half of these have been processed biologically.

When the full year's samples are completely worked up, the data will be subjected to intensive mathematical analysis with classification and ordination techniques. For these analyses, the biological data will be supplemented with physical and chemical data obtained by other USC Sea Grant research groups. These parameters include: temperature, salinity, dissolved oxygen, and nutrient levels in water column, grain size, and pesticide, petroleum and heavy metal levels of the sediments.

A cursory examination of the existing data indicates several noteworthy features:

1. An increase in macroscopic, benthic life in the harbor since 1954.
2. A general increase in diversity of animal life along a gradient from inner to outer harbor.
3. Isolated areas of very low diversity (1-5 species) resembling the overall pattern of 20 years ago.
4. The numerical dominance over wide areas by the polychaete Tharyx sp.
5. Some areas of the harbor bottom are virtually devoid of macroscopic animal life.

The fourth observation suggests the importance of Tharyx in the harbor ecosystem and the need to know more of its life history. During the next year, the Tharyx population of Long Beach Harbor will be studied from a variety of standpoints, including reproduction and development, population dynamics, food habits, relation to other benthic organisms and tolerances to abiotic factors.

Benthic studies have also been conducted by USC Sea Grant personnel for inclusion in Environmental Impact Statements as required by private companies operating in the harbor complex. These studies are usually of small scope and limited duration, but the techniques employed are the same as used in the general program. Thus, the data obtained will be available for inclusion in the comprehensive picture of the harbor benthos.

In 1974, the publication in Marine Studies of San Pedro Bay, Part IV of results from experiments with polychaete species and sediment elutriates was well received. Requests for reprints from EPA, Corps of Engineers, the Los Angeles Harbor Department and Southern California Gas Company were filled so that these entities might obtain information on possible dredging impact. The State Water Quality Board has also requested our research-generated data.

THE EFFECTS OF POLLUTION ON FISH POPULATIONS IN LOS ANGELES-LONG BEACH HARBOR

John S. Stephens and D. Chamberlain

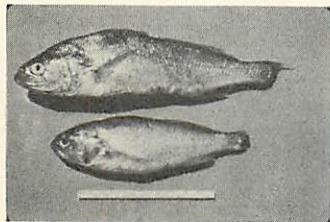
The acquisition of information on the varieties of fish that are now present in the Los Angeles-Long Beach Harbor area to be used as critical baseline studies for defining this community structure and species associations was, and continues to be, the articulated goals of this project. Innately linked to this task is also the assessment of the general physical condition of these fish with regard to the incidence of disease, types of abnormalities and parasites as they relate to environmental conditions.

We now have a much better idea of the kinds of fish that are present in this harbor complex, their relative abundance, some information on spawning, information on seasonal changes in population structure and changes in concentrations of certain species. Various sampling techniques have been employed, including bottom trawling, SCUBA-diving observations, use of gill nets and census of hook-and-line anglers, along the shore. Diving surveys have also been done along the inside of the outer breakwater of Los Angeles-Long Beach Harbor. The advent of gill net use in the summer of 1973 aided sampling in areas of the harbor where it was difficult to trawl. Concurrently, substrate and plankton samples were taken along with hydrographic data. The gut content for all common species of fish were checked and correlated with invertebrate fauna and substrate characteristics of the various sampling areas.

Between May 24, 1972 and October 1973, 76 trawls were made in Los Angeles-Long Beach Harbor using Occidental College's Vantuna as command research vessel. A total of 57,647 fish were collected for an overall average of 738.5 fish per trawl. If larval fish are excluded, the average 423.2 fish per trawl is still exceptionally high, with a fish density of one per 8.9 square meters....the highest recorded locally. One rather interesting fact uncovered was that the diversity and richness within the harbor ($\bar{X}_D = 1.29$, $\bar{X}_R + 10$) approximates that recorded for similar depths outside of the harbor. Three areas of distribution are recognized within the harbor: an area rich in flatfishes, an area of high croaker abundance, and an area demarcated by the presence of rockfishes. The area rich in croakers seems to correlate with nutrient enrichment (sewage) and perhaps low oxygen tension. While changes in seasonal abundance are documented with fewer fishes present in winter than summer, the standing crop of fishes in the harbor is estimated between 700,000 - 1,600,000 kg. The annual productivity is estimated at 56 percent of the standing crop, or 392,000 - 896,000 kg representing 7.3 - 16.5 g/m². When dealing with figures of this size and the major industry that they represent within the Los Angeles area, it goes without saying that the final, analyzed data from this project will be of major significance to those individuals involved in the planning and managing of harbor development.

A species list of fish from Los Angeles-Long Beach Harbor has been compiled consisting of 125 species representing 49 families. Figure 1 lists the sampling sites that are now being occupied for collection of fish and related data.

Thus far, the general condition of fish taken from Los Angeles-Long Beach Harbor has been quite good with a few exceptions. The white croaker, Genyonemus lineatus, is especially noteworthy in regard to its high incidence of parasitism (Nematodes and Cestodes), diseased liver condition (23%), high incidence of tail and caudal fin rot, and a number of this species have been taken with head, gill,



White croaker, Genyonemus lineatus: caudal fin rot

catch and eat, and whether they have ever seen any diseased fish and the fate of the fish caught. A number of anglers have said that fishing was better a few years ago. The most popular shore fishing site is Belmont Pier (HLA in the figure). On a weekend day with good weather, over 200 people may be found fishing here at one time. This is contrasted with the Cabrillo Beach sportfishing Pier (HLD) where fishing is usually reported as poor.

Queenfish, Seriphis politus, were the fish caught most frequently by shore anglers with white croaker next in abundance. Black surfperch, Embiotoca jacksoni, walleye surfperch, Hyperprosopon argenteum, and shiner surfperch, Cymatogaster aggregata, were caught in decreasing numbers respectively. Twenty-six different species of fish were taken by anglers interviewed.

Not only will the information derived from this project be applied to the regulation and control of the water and substrate quality in Los Angeles-Long Beach Harbor in relation to its present effect on bottom fish, but it will also aid in assessing the potential of bottom fishery in this area and establishing guidelines by which comparison of present and future populations and environmental changes may be calculated. Since 1956, there has been little or no study of the bottom fish fauna in this harbor, so the responsibility to fill the need for such vital baseline data has fallen to this project. The Southern California Coastal Water Research Project and the California Department of Fish and Game have already expressed interest in this project and in the information which it continues to generate.

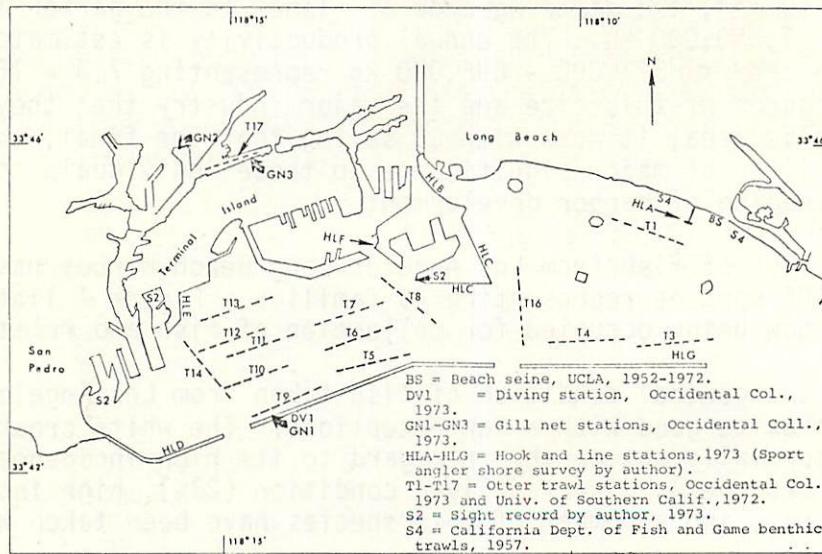


Figure 1. Location of Los Angeles - Long Beach Harbor Data Collecting Stations.

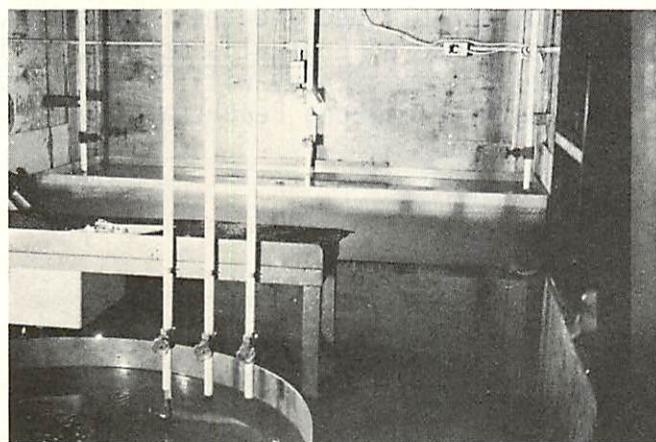
ASPECTS OF THE BIOLOGY OF THE ANCHOVY, ENGRAULIS MORDAX, IN THE SAN PEDRO-LONG BEACH HARBOR

Basil Nafpaktitis and Gary Brewer

The northern anchovy, Engraulis mordax, has been described as the most abundant species with immediate harvest potential in the California Current System. Apparently the Los Angeles-Long Beach (San Pedro) Harbor is a favorable environment for this small, pelagic, schooling fish, for anchovies are found in quantity within the harbor throughout the year. A valuable live bait fishery for anchovies has grown to meet the needs of hundreds of private and commercial sportfishing boats, and the southern California bait fishery is centered within the harbor.

The potential threat of fossil fuel and nuclear power plants and proposed liquified natural gas (LNG) conversion plants for discharging substantial volumes of heated and chilled effluents, respectively, requires an understanding of the thermal requirements of this important species. Little information is available from laboratory experiments on the lethal temperature relations of various stages of the anchovy's life cycle and the fish's requirements for development, growth and reproduction.

Objectives of the project have included: 1) the design, construction, operation, and maintenance of an experimental seawater system that provides temperature-controlled seawater lines to a series of aquaria suitable for maintaining E. mordax in a healthy state; 2) the determination of aspects of the natural history of the anchovy in the Los Angeles-Long Beach Harbor by routine sampling of the commercial catch and a routine plankton survey for anchovy eggs and larvae; and 3) the determination of the effects of various temperature regimes on several stages of the anchovy's life cycle.



A portion of the interior of the seawater system. Lower left - one 250-gallon experimental aquaria; Three pipes - ambient, heated and chilled seawater; water table - for rearing anchovy eggs and tests on temperature selection by juveniles and adults.

In February of 1973, a small, experimental seawater system was constructed in Long Beach, California, largely from funds provided by the Pacific Lighting Company. The system delivers filtered, ultraviolet, sterilized seawater to five, 250-gallon aquaria and a single, 100-gallon aquarium, along with "day" and "night" light bulbs above each to simulate photoperiod, allowing light intensity to be precisely regulated.

The experimental system has successfully maintained stocks of northern anchovies for indefinite periods while experiments were conducted on the thermal tolerance and resistance of this commercially important species.

Results of experiments conducted this past year indicated that juvenile fish averaging 70 mm standard length succumbed to lower lethal temperatures of 11.5°, 9.5°, and 8.5° C when acclimated to 19.5°, 16.0°, and 12.0°C respectively. An ultimate lower lethal temperature of 7.0°C was estimated by extrapolation.

Anchovy eggs were held at incubation temperatures between 9.0° and 15.0°C. Temperatures below 9.5°C inhibited hatching of the eggs or development of yolksac larvae.

The behavior of juvenile anchovies in a 2.3 m horizontal thermal gradient with a temperature differential of 5.0°C indicated significant selection of the warmest water available to the fish (acclimated to 16.0°C) at experimental temperatures between 13.0° and 25.0°C. The fish actively avoided temperatures above 25.0°C.

Experiments which were designed to determine the effects of sub-normal temperatures on reproductive potential had to be postponed due to malfunctioning water refrigeration equipment. Such experiments are being planned for the near future.

Bimonthly plankton samples taken at 18 stations within the harbor have shown large numbers of anchovy eggs and larvae present in the spring and lesser numbers in the fall. Monthly samples of adult anchovies from the live bait catch are being examined for gonad maturation stages; some of these are being preserved for later histological examination.

The results of these thermal investigations are crucial to decision-makers in public agencies and private industry. Design criteria for the LNG plant depend on recommendations for acceptable effluent temperatures. The Los Angeles Harbor Department, the Regional and State Water Quality Boards, the State Fish and Game Department, and the U.S. Corps of Engineers are agencies which have expressed need for the study's results. With the data already established and the proposed avenues of continued research into the thermal tolerance of Engraulis mordax, it is hoped that the preservation of this commercially vital anchovy will be achieved within the ever-changing environment of the Los Angeles-Long Beach Harbor.

THE CITY OF AVALON SEWER OUTFALL AS AN ISOLATED CASE STUDY



Robert Given

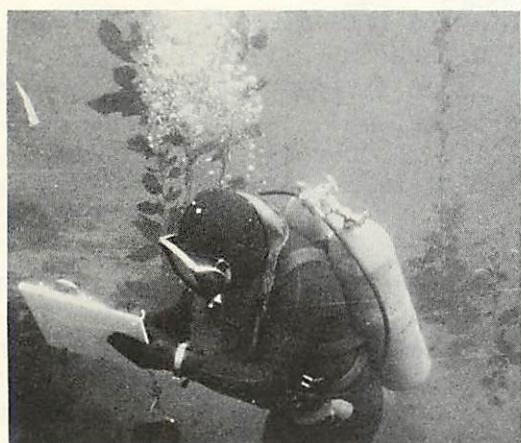
Santa Catalina Island lies about 20 miles off the mainland coast of southern California. Its center of population is the city of Avalon, with a permanent population of about 1500, which may rise to four or five thousand daily visitors and summer residents during the four-month summer tourist season. There is no "industry" as such, recreation being the main source of revenue. The domestic wastes from the inhabitants, both permanent and temporary, are carried through a single pumping plant to a single sewer outfall lying $\frac{1}{2}$ -mile east of town, 400 feet offshore in 130 feet of water. Except for some mechanical breakdown by the pumping process, the effluent, mixed with seawater to "soften the blow," is totally untreated and reaches the marine environment technically designated as "raw" sewage.

To comply with the Federal Clean Water Bill of 1972 (Porter-Cologne Water Quality Control Act), the city was ordered to install a treatment plant (primary or better) and to begin the treatments necessary to redefine the effluent as having undergone some modification from its "raw" state. Such treatment usually includes some mechanical pulverizing and sterilization (chlorination). A bond issue was raised and passed for funding and the plant was to be in operation by July 1973. Some financial and logistical reasons caused that date to be extended to an operations date late in 1975.

Avalon has dumped its "raw" sewage in the same area for a number of years, as evidenced by the presence of three abandoned outfall lines paralleling the one presently in use. In 1969, Dr. Given went under contract with the City of Avalon to conduct three biological studies per year in the outfall area in compliance with the State of California Water Quality Control Board requirements. There was no record of a pre-installation "baseline" study having been done, so these thrice-yearly reports were essentially their own baselines and were done at a very minimal level of sophistication. To all appearances, the only effect of the effluent on the benthos is in a small radius immediately surrounding the pipe terminus at the 130 foot depth. Kelp beds in the area are healthy, "clean water" organisms grow on the entire length of the outfall line, and the plume is never seen to

reach the surface. In short, the area appears to have reached a biological "equilibrium" over the many years of discharging there and could be thought to exist in a somewhat altered "natural" state. Primary treatment of the effluent will undoubtedly affect that equilibrium - but for better or for worse? Of particular interest is the fact that sterilizing amounts of chlorine will be added as a part of the treatment. Coupled with this will be a change-over from the seawater sewer system to a freshwater one. With the absence of the seawater to soften the blow and with the chlorination process, there will undoubtedly be some effect on the biota.

The objectives of the project are to: 1) determine the effect on the environment (particularly the benthos) of the long-term dumping of raw sewage (compared to similar but unaffected natural areas); 2) establish a biological "baseline" for the area as it now stands, preparatory to future monitoring of the effects of treated effluent; 3) test, evaluate and modify present methods of conducting baseline and monitoring studies of this type; and 4) compare the Avalon discharge with the only other system where the effluent is partially mixed with seawater before discharge. During the past two years, project personnel made numerous SCUBA-diving visits to the area, establishing thirteen permanent sampling locations, gathering biological and physical data to define study parameters and developing sampling and analytical techniques for both field and laboratory. All this is preparatory to a very detailed baseline study to begin in late 1974, running for one year prior to the beginning of effluent treatment in late 1975. Advances were made in sampling techniques, especially in the use of surface-air-supplied, full-face diving gear, to allow longer stays in the area and less body exposure to the effluent field. Consultation with medical personnel enabled the researchers to determine what human pathogens could be present in the effluent and inoculations against these were obtained. Using the research being conducted for this project, two spin-off, "mini"-research projects have been stimulated. In conjunction with the Pathology Department, USC Medical School, a student is studying the effect of sewage on the tissues and enzyme systems of fish. Another graduate student, working under the principal investigator, has begun a study of the meiofauna in the core samples collected and has been developing techniques for systematic sampling and analysis of the material.



Above and beyond the importance of the strictly scientific data which this project has and will generate, other sideline benefits seem to be a natural occurrence. For example, algae collections from the study area have resulted in a number of new forms being described, and natural history data on both plants and animals have been used by the City of Avalon and the Santa Catalina Island Company to update tourist attractions, making them more scientifically accurate. Also, during the course of sampling along the sewer pipeline, the principal investigator discovered a section of the pipe which was about to break. Immediate notification of the City Council prevented a rather economically serious incident.

The City of Avalon is vitally interested in this project and has contributed matching funds in the form of boat time and manpower in the field. To date, no formal publications have resulted from this project. At the end of the 1974-75 period, however, a rather voluminous, historical and baseline study will be written; this document will form the basis for the long-term monitoring study to begin after the effluent treatment is initiated.

**EDUCATION
AND
TRAINING**

EDUCATION IN OCEAN AND COASTAL ENGINEERING

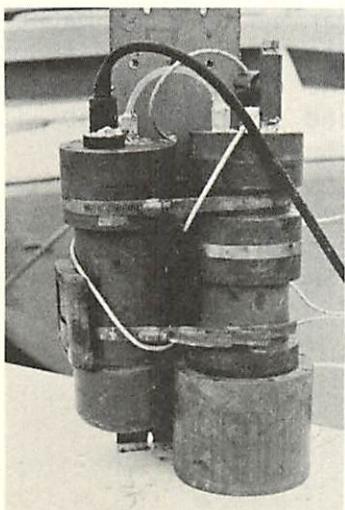
John Laufer and Fred Browand

The graduate program in Ocean Engineering at USC was instituted to prepare students for a professional career in any one of a variety of ocean-oriented engineering activities. The 1972-73 fiscal year saw the Sea Grant funding of two courses (Ocean Measurements and Ocean and Coastal Engineering) which related to the Program's objectives of applicability of research to real and current coastal zone problems. Since then, the Ocean Engineering Program at USC has steadily grown. Three students were graduated from the curriculum in June 1973 and there are presently six students working towards an MS degree in the field.

The overall program is interdisciplinary by nature with students taking courses in the Departments of Biology and Geology, as well as in the School of Engineering. Electives include choices from an even broader range, i.e., Urban Planning (Coastal Zone Management) and Environmental Sciences.

Offered on a rotating basis, some of the Ocean Engineering courses are: Ocean and Coastal Engineering, Ocean Measurements and Underwater Acoustics. The most recent is Ocean Measurements. Through this course, the professors can actively involve their students in the ocean environment, both by holding weekly seminars and by having students creatively tackle a real problem.

1973-74 ushered in the final year for Sea Grant support for these courses. In the Spring of 1973, students designed and used pressure instrumentation incorporating hydraulic filtering to study long-period harbor oscillations in Marina del Rey. The hydraulic filter portion was conceived and designed by the students and was fitted to an available pressure transducer to produce a simple, reliable instrument. The calibration was performed in the laboratory in a unique apparatus also constructed by the students.



Hydrodynamic Low Pass Filter and Pressure Transducer

Once designed and built, the transducer was placed on the bottom at various locations within the Marina del Rey Harbor. A time history of the pressure transducer output showed that the lowest mode harbor oscillation had a period of 45 minutes; the second and third modes had periods of twelve and five minutes respectively. The importance of this work lies not only in the training of the students, but in the possibility of making detailed comparisons between the measurements and theoretical models for the purpose of prediction of general harbor response.

In conjunction with the practical experience given the students, internationally-recognized authorities in the field of ocean-related science and engineering, such as Walter H. Munk and Robert L. Wiegel, were brought to campus. It has been found that participation by the graduate students

in these Sea Grant-sponsored courses is an invaluable aid and could be the difference between a mediocre or a truly successful ocean engineering experience for the students. These courses, now firmly established within the University curriculum, attest to the USC Sea Grant's concern for both the Institution and the public.

GRADUATE PROGRAM IN MARINE AFFAIRS

Ross Clayton

Serving as part of a program leading to a Master's Degree in Marine Affairs from the School of Public Administration, two Sea Grant-sponsored core courses have been able, during the last two years, to attract able students and faculty from a variety of backgrounds. Public Administration 576--Problems and Issues in the Coastal Zone and Public Administration 578--Marine Affairs, are taught with an interdisciplinary flavor, drawing upon materials from biology, geology, engineering, economics, political science, urban planning, and law. Participating students come not only from a variety of disciplines within the University, but also from the public sector active in coastal zone management; i.e., assistant general manager, Port of Los Angeles, urban planner, City of Los Angeles, and senior civil engineer, City of Long Beach.

In general, the major objective of this instructional program is the training of professional administrators interested in marine affairs and those working toward initial degrees. Specific course goals include: 1) knowledge of state and federal legislation for coastal zone planning, regulation and management; 2) examination of emerging policies for energy production, pollution control, land use planning, resources allocation, and access to public facilities in the coastal zone; 3) study of community inputs into local, regional, state and federal management policies, plans and priorities; 4) introduction to social inquiry and research methods in the analysis of coastal zone problems, including current state-of-the-art and potential for futuristic techniques; and 5) production of student research in selected policy problems related to use of coastal and marine resources.

Following the Sea Grant theory of applicability to real problems, these courses have been able to set into motion the following: 1) conceptual and empirical skills for public officials in positions with responsibility for management of marine and coastal resources; 2) the training and education in marine resource management of persons employed in the private sector; 3) improvements in the capacity of public agencies to make informed and rational decisions in the allocation of marine and coastal resources; and 4) knowledge of the research and advisory capability of the total Sea Grant Program by present and future administrators.

Even though Sea Grant sponsorship has ceased as of the 1973-74 fiscal year, these two courses are now well-established within the University curriculum and continue to serve their vital educational function with their Sea Grant philosophy of applicability to the real world.

LABORATORY-WORKSHOPS IN COASTAL ZONE PLANNING

Margarita McCoy

The Graduate Program of Urban and Regional Planning has now completed its fourth and final year under Sea Grant sponsorship and it has had a pervasive influence over these academic courses. Sea Grant provided opportunities for faculty and student research, and this research has, in turn, served as basis and resource for laboratory-workshops as well as generating new instructional materials, new topics, new perceptions of old problems and definitions of new ones.

At the program's onset, it became almost immediately apparent that here, in the coastal zone, planning was more than usually critical and that there was beginning to be a public awareness of the need for improved planning and management to head off some of the conflicts, particularly in land use and environmental issues, that threatened to assume crisis proportions. In dealing with coastal zone planning in an urban area, the students came to grips with the fact that one is handling the allocation of a scarce resource--the land of the coastal zone. Intertwined with this aspect of the situation are economic issues, social impacts, administrative tangles and environmental problems, all underscored by political dynamics. The students also learned that perhaps the most significant aspect of plan-making is the creative synthesis of the available, albeit fragmentary and disjointed, information into making proposals for the future. Admittedly this is a difficult, and by no means objective process, but it is one required of all planners. Suggesting alternative scenarios is among the most important of the planner's functions.

During the 1972-73 fiscal year, the Graduate Program of Urban and Regional Planning had two laboratory-workshops in progress. Planning 680L was concerned with "Coastal Zone Planning in Santa Monica" and had 24 students enrolled. The second lab, Planning 681L dealt with "Techniques and Methods of Environmental Impact Assessment in the Coastal Zone" and had 22 students enrolled. The 1973-74 fiscal year saw lab students involved with the Intensity of Development Plan Element being created by the Region V California Coastal Zone Conservation Commission.

Maintaining the overall, dual goal of producing both professional planners with special interest and training in coastal zone management and planning and information and technical assistance to current planning agencies, lab students in 680L tackled the City of Santa Monica.

With the Santa Monica City Planning Commission as their clients, the students began their work with a planning survey and analysis of the City. Products of this phase of the work included an analysis of the Santa Monica voting on Proposition 20 by census tract, a detailed land use map of the Santa Monica coastal zone, copies of which are in use by the Coastal Commission in Long Beach and Sacramento, an economic base study, population studies, and reviews of local ordinances and existing master plan, as well as regional data.

Following the preliminary surveys, students began developing plans for the Santa Monica coastal zones. Three teams worked on three alternative concepts which were developed and refined for presentation in May to two members of the Santa Monica community, representing the clients for the work of the laboratory. Later, two students who had developed a special project for a marina within one of the alternative plans, presented their work in a class conducted on closed circuit television by the Coordinator of the Sea Grant Marine Advisory Program.

The second laboratory-workshop of 1972-73 was concerned with developing methodologies for assessing environmental impacts of projects, for it is the planners who are involved in all stages of the permit process. Therefore, the objectives of this lab were to research, review and develop a set of predictive and evaluative models/techniques specifically oriented toward the Environmental Impact Statement process. To do this, however, the students had to: 1) familiarize themselves with the Environmental Impact Statement process; 2) investigate potential applications of existing techniques in the Environmental Impact Statement process and compile a relevant set with specific recommendations; 3) investigate techniques of evaluations, their suitability and possible adoption in evaluating Environmental Impact Statements; and 4) test the method, techniques, etc., investigated, reviewed and compiled in preparing one or more Environmental Impact Statements using real-life examples.

A manual for preparing and evaluating Environmental Impact Statements and an annotated bibliography will be products from this lab group.

The 1973-74 laboratory-workshop worked in active conjunction with the California Coastal Zone Conservation Commission in gathering data and making recommendations for the Commission's Intensity of Development Plan Element. Topics such as carrying capacity, transportation, displacement of selected social/economic groups, and zoned population capacity were studied in-depth by individual students. At the conclusion of the semester, there was an oral presentation to members of the Region V Commission Staff. The work of these students was cited in the final Intensity of Development Plan Element.

The students from these Sea Grant-initiated classes have become actively involved in coastal zone management and planning. The City of Long Beach Planning Department, the U.S. Environmental Protection Agency, the Commonwealth of Massachusetts Department of Natural Resources, and the California Coastal Zone Conservation Commission have all become employers of these young people. Last summer, five of the lab participants worked for the Coastal Commission and one other literally wrote the Commission's Transportation Plan Element.

Applicability of research to real problems in coastal zone planning and management has been and will continue to be the USC Sea Grant's major thrust as these laboratory-workshops so vividly demonstrate.

ADVISORY SERVICES

MARINE ADVISORY PROGRAM

Byron J. Washom

Historically, vast scientific information has been stored in the universities and government agencies; however, the public and decision-makers are seldom aware of, or given ready access to, this array of knowledge. The Marine Advisory Program of the Sea Grant Program is a mechanism designed to deliver this scientific information to the user-communities. Simply stated, it is the process of taking the information off the shelves and putting it into the hands of the user at a level that can be understood and consumed.

The volume of informational needs concerning coastal resources management and planning is unprecedented within the southern California region. Legislation and court decisions have drastically restructured the management and development processes within this area. Noteworthy amongst this legislation are the National Environmental Policy Act of 1970, the California Environmental Quality Act of 1970, and the California Coastal Zone Conservation Act of 1972. Landmark court decisions include the Friends of Mammoth decision (1972). Each of these Acts or decisions basically require that public decision-makers increase their considerations to include environmental and socioeconomic impacts. Much of the information needed already exists at university and government laboratories. The charge of the Marine Advisory Program is to deliver this information in a tangible form to the decision-makers, as well as the affected communities.

During the past two years, the Marine Advisory Program has sought the identification of the numerous and widely diverse sectors which either play an active role in the management process or eventually feel its impact. This identification of user-groups has been achieved and functionally exists as a mailing list, 13,000 entries strong, of local, regional, state and federal legislators and agency officials, as well as businessmen, engineers, educators, scientists, sportsmen, environmentalists, planners, and concerned citizens. These interested parties are broken down into three major audience levels in relation to information dissemination. They are the "proximate" decision-makers, i.e., those individuals, agencies and interest groups who affect and make public decisions concerning coastal resources management and planning; the communities affected by these decisions; and those publics and parties outside of the State. A rapport has been established with these individuals and groups, and the Marine Advisory Program is now able to identify and anticipate their coastal zone management needs.

MAP's reputation for its willingness to become involved as a nonpartisan participant within the field of coastal zone management has been spreading. Examples of this would be its co-sponsorship with the Marine Technology Society on the "Coastal Zone Management and the Future of the Western States" Conference and its creation of the "Scorecard" project, involving successful contractual negotiations with the State (through the California Coastal Zone Conservation Commission) for these services. The "Scorecard" is an information management tool developed by MAP to delineate developmental patterns and trends within Region V (Los Angeles-Orange Counties) based on the data obtained from each permit decision.

The Marine Advisory Program also participates in three different information networks. Within the State, the California Marine Advisory Program (CMAP) provides a coordination and communication link between the other Sea Grant Programs at the University of California, CSU-Humboldt, and Moss Landing Marine Laboratories. At the regional level, the Pacific Basin states, plus British Columbia, have an active advisory program in the Pacific Sea Grant Advisory Program (PASGAP). Finally, there exists the NOAA Marine Advisory Services (NMAS) for all National Oceanic and Atmospheric advisory functions. Collectively, these networks provide for the free flow of available information, thus assuring access to this data by all user-groups.

Joining the MAP staff was an Editor and a Marine Resources Specialist. Under the latter's direction, MAP has tied in to existing data banks for the purpose of information retrieval. This program will hopefully be expanded within the upcoming fiscal year so that MAP can service not only the Sea Grant family, but also the three identified user-groups with on-line data for competent decision-making.

Publications is a frequent method of communicating with the identified user-groups. During the past two years, nearly 19,000 copies of 13 different reports were distributed, including one joint publication with the University of California. The "best sellers" of the 1972-73 included the Coastal Commission's Permit Procedures Flow Chart, Coastal Landslides in Southern California, and Procedures and Programs to Assist in the Environmental Impact Statement Process. From 1973-74, these included Atlas of Beaches in Los Angeles County: Their Location, Characteristics and Facilities, Statistical Handbook of Coastal Zone Socio Economic and Housing Characteristics: Los Angeles County, and The Urban Marina: Managing and Developing Marina del Rey. The last publication has been selected for use as a textbook in an Engineering seminar sponsored by the University of Wisconsin Sea Grant Program.

Three public education functions are also provided. The first is a regularly featured radio spot, "Marine Recreational Watch," over CBS radio in Los Angeles that reaches two million people daily. The second is a free course, entitled "Urban Man and the Marine Environment," which is offered over the USC Interactive Instructional Television System. Finally, the medium of the newsletter has been firmly established. The new "Coastal Studies Information Communique" is now in production which deals with events which affect or occur in the coastal zone, reaching 13,000 individuals per issue. Just acquired was the copyright to the "Coastline Letter," a newsletter keeping readers abreast of the latest State and Region V Coastal Commissions meetings.

The 1973-74 year saw the movement of the Advisory Program to Marina del Rey, 4676 Admiralty Way, Suite 1102. These new offices will locate us closer to the coastal constituents that we serve.

The Marine Advisory Program has sought to create an awareness on all societal levels of the existence of Sea Grant--whether it be one of a thousand beach-goers or boaters who listen to the "Marine Recreational Watch" on the radio, or whether it be the decision-maker who utilizes our information. The point is, an awareness, dependency and utility of Sea Grant is being established.

1972-74

**BACKGROUND
DATA**

UNIVERSITY OF SOUTHERN CALIFORNIA ADVISORY PANEL

1972-73

Mr. Victor Adorian
Department of Real Estate Management
Los Angeles County

Captain Jack Boller, Director
Marine Board
National Academy of Engineering
Washington, D.C.

Col. Ted Gillenwaters
Oceanic Research Institute
Newport Beach, California

Dr. Arie Haagen-Smit
Division of Biology
California Institute of Technology

Mr. George Hatchett, President
Dillingham Corporation

Mr. Robert D. Kleist, Regional Manager
Pacific Far East Lines, Inc.

Dr. Dean Mann
Department of Political Science
University of California, Santa Barbara

Mr. Edward Nixon

Captain T.K. Treadwell
Department of Oceanography
Texas A & M University

Cmdr. Don Walsh
Department of the Navy
Washington, D.C.

O.D. Waters, Jr., Rear Adm. USN (Ret.)
Head, Department of Oceanography
Florida Institute of Technology

Dr. Edward Wenk, Jr.
College of Engineering
University of Washington

Mr. Elmer P. Wheaton, Vice President
Lockheed Missiles and Space Company

UNIVERSITY OF SOUTHERN CALIFORNIA ADVISORY PANEL

1973-74

Mr. Victor Adorian
Department of Real Estate Management
Los Angeles County

Mr. Willard Bascom, Director
Southern California Coastal Water
Research Project
El Segundo, California

Captain Jack Boller
Marine Board
National Academy of Engineering
Washington, D.C.

Dr. Richard A. Geyer, Chairman
Department of Oceanography
Texas A & M University

Col. Ted Gillenwaters
Oceanic Research Institute
Newport Beach, California

Dr. Arie Haagen-Smith
Division of Biology
California Institute of Technology

Mr. George Hatchett, President
Dillingham Corporation

Mr. Robert D. Kleist, Regional Manager
Pacific Far East Lines, Inc.

Dr. Dean Mann
Department of Political Science
University of California, Santa Barbara

Dr. Giles Mead, Director
Los Angeles County Museum of Natural
History
Los Angeles, California

Mr. Howard R. Talkington, Head
Ocean Technology Department
Naval Undersea Center
San Diego, California

Captain T.K. Treadwell
Department of Oceanography
Texas A & M University

Cmdr. Don Walsh
Woodrow Wilson International Center
for Scholars
Washington, D.C.

O.D. Waters, Jr., Rear Adm. UNS (Ret.)
Head, Department of Oceanography
Florida Institute of Technology

Mr. Elmer P. Wheaton, Vice President
Lockheed Missiles and Space Company

ACTIVITY BUDGET SUMMARY

<u>PROJECTS</u>	<u>1972-73</u>		<u>1973-74</u>	
	<u>OSG</u>	<u>MATCH</u>	<u>OSG</u>	<u>MATCH</u>
Program Administration	82,083	47,840	67,980	47,850
Coastal Zone Management				
The Management of Coastal Zones in Metropolitan Regions	94,290	41,090	74,790	26,810
Coastal Population Study	13,076	5,005		TERMINATED
*Coastal Resources Data File	_____	_____	_____	_____
Coastal Engineering				
Breakwater Permeability	39,330	16,860	36,000	17,450
Storm Drainage and Environmental Quality of Semi-Enclosed Coastal Waters	36,320	25,040	47,760	25,150
A Study of Natural Oil Seeps in Southern California	47,070	50,000		TERMINATED
Environmental Quality				
Development of Environmental Maintenance Systems in Los Angeles-Long Beach Harbor	71,280	98,040	47,460	40,730
The Roles of Microbiological Activity in Harbor Ecosystems	27,690	17,663	11,098	2,800
*Plankton Productivity and Red Tide Cycles	_____	_____	_____	_____
Population Changes in Benthic Communities Following Pollution Abatement	14,530	4,328	9,500	1,270
Aspects of the Biology of the Anchovy, <u>Engraulis mordax</u> , in San Pedro Harbor	0	2,320	3,870	1,500
The City of Avalon Sewer Outfall as an Isolated Case Study	9,500	7,840	5,400	6,930
The Effects of Pollution on Fish Populations in Los Angeles- Long Beach Harbor	11,000	7,203	8,100	20,440
Education and Training				
Education in Ocean and Coastal Engineering	1,000	11,153		6,700
Graduate Program in Marine Affairs	18,540	9,330	13,390	7,040
Laboratory-Workshops in Coastal Zone Planning	12,000	6,000	10,280	14,470
Advisory Services	59,784	50,612	51,900	26,200

* Combined with another funded project

INSTITUTIONAL PROGRAM SUMMARY

PROJECTS

71-72

72-73

73-74

Program Administration

C	C	C
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Coastal Zone Management

- The Management of Coastal Zones in Metropolitan Regions
 Coastal Population Study
 Coastal Resources Data File

N	N	C
	N ⁺	T

Coastal Engineering

- Breakwater Permeability
 Storm Drainage and Environmental Quality of Semi-Enclosed Coastal Waters
 A Study of Natural Oil Seeps in Southern California

	N	C
	N	R
N	R	T

Environmental Quality

- Development of Environmental Maintenance Systems in Los Angeles-Long Beach Harbor
 The Roles of Microbiological Activity in Harbor Ecosystems
 Plankton Productivity and Red Tide Cycles
 Population Changes in Benthic Communities Following Pollution Abatement
 The Effects of Pollution on Fish Populations in Los Angeles-Long Beach Harbor
 Aspects of the Biology of the Anchovy, Engraulis mordax, in San Pedro Harbor
 The City of Avalon Sewer Outfall as an Isolated Case Study

C	C	C
N	C ^o	C
	N	C
	N	C
	N	C
	N	C

Education and Training

- Education in Ocean and Coastal Engineering
 Graduate Program in Marine Affairs
 Laboratory-Workshops in Coastal Zone Planning

N	N	C
N	C	C

Advisory Services

	N	C
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+ integrated with Management of Coastal Zones due to restricted funding.

^o integrated with Microbiological Activity due to restricted funding.

C = Continued

N = New

R = Redirected

T = Terminated

SOURCES OF MATCHING FUNDS

1972-73

California State University, Long Beach
City of Avalon, Santa Catalina Island
CONOCO
Edington Oil
Los Angeles Harbor Department
Occidental College
Pacific Lighting Service Company
Star Kist Foods
Todd Shipyards
Tuna Research Foundation
U.S. Army Corps of Engineers
U.S. Borax

SOURCES OF MATCHING FUNDS

1973-74

Battelle Memorial Institute
Bendix-Marine, Inc.
California State Department of Motor Vehicles
California State University, Long Beach
City of Avalon, Santa Catalina Island
County of Los Angeles
Datatronics Systems Corporation
EXXON
KNX Radio Station
Los Angeles County Small Craft Harbor Commission
Los Angeles Harbor Department
Pacific Lighting Service Company and subsidiaries: Southern California Gas
Company and Pacific Alaska LNG Company
Signal Oil and Gas Company
Star Kist Foods
Tuna Research Foundation
U.S. Army Corps of Engineers

ORGANIZATIONS INTERACTING WITH USC SEA GRANT

1972-73

Institutions of Higher Learning

Occidental College (Harbor Projects)
California State University - Northridge (Marine Geology)
California State University - Long Beach (Harbor Projects)
University of California - Irvine (Coastal Resource Planning)
Fullerton Junior College (Vocational Marine Training)
University of Washington
University of Michigan
University of California - Santa Barbara

Local, State and Federal Agencies

California Marine Commission
U.S. Army Corps of Engineers
California Department of Fish and Game
California Department of Navigation and Ocean Development
California State Water Resources Board (and their Regional Water Quality Control Boards)
Southern California Coastal Water Research Project
Los Angeles County Sanitation District
Los Angeles County Flood Control District
Port of Long Beach
Port of Los Angeles
County of Los Angeles
County of San Diego
City of Newport Beach
City of Avalon
Long Beach Ocean Industries Committee
Southern California Association of Governments (SCAG)

Industry

Pacific Lighting Company, Inc.
Southern California Edison

Pacific Ocean Farms, Inc.
Tuna Research Foundation
Associated Sport Fishermen of Southern California
Bendix-Marine, Inc.
Battelle Memorial Institute
Shell Oil Company
Los Angeles Chamber of Commerce
Campus-Industry Action Committee

ORGANIZATIONS INTERACTING WITH USC SEA GRANT

1973-74

Institutions of Higher Learning

California State University - Long Beach (Harbor Projects)
California State University - Northridge (Coastal Resources)
Fullerton Junior College (Vocational Marine Training)
Immaculate Heart College (Harbor Projects)
Loyola University of Los Angeles (Harbor Projects)
Occidental College (Harbor Projects)
Oregon State University (Recreation - PASGAP)
University of Alaska (Recreation - PASGAP)
University of British Columbia (Recreation - PASGAP)
University of California - Irvine (Coastal Resource Planning)
University of California - Santa Barbara (Coastal Resource Planning)
University of Hawaii (Recreation - PASGAP)
University of Michigan (Coastal Resource Management, Recreation)
University of Washington (Recreation - PASGAP)

Local, State and Federal Agencies

California Advisory Commission on Marine and Coastal Resources
California Department of Fish and Game
California Department of Navigation and Ocean Development
California State Department of Motor Vehicles
California State Highway Department

California State Water Resources Board (and their Regional Water Quality Control Boards)
City of Avalon
City of Hermosa Beach
City of Los Angeles Bureau of Sanitation
City of Santa Monica
County of Los Angeles
County of San Diego
Environmental Protection Agency
Kern County Department of Parks and Recreation
Long Beach Harbor Department
Los Angeles County Department of Parks and Recreation
Los Angeles County Flood Control District
Los Angeles County Sanitation District
Los Angeles County Small Craft Harbor Commission
Los Angeles Harbor Commission
Los Angeles Harbor Department
Southern California Coastal Water Research Project
State and Southern Regional Coastal Zone Commissions
U.S. Army Corps of Engineers
U.S. Coast Guard

Industry

Battelle Memorial Institute
Bendix-Marine, Inc.
Bodkin, Breslin and Luddy, Attorneys
Campus-Industry Action Committee
Chancellor and Ogden
Datatronics Systems Corporation
KNX Radio Station
Los Angeles Chamber of Commerce
Los Angeles Yacht Club
Pacific Lighting Service Company and subsidiaries: Southern California Gas Company and Pacific Alaska LNG Company
Shell Oil Company
Signal Oil and Gas Company
Southern California Edison Company
Tuna Research Foundation

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- Allan Hancock Foundation. 1972. Preliminary data report to Pacific Lighting Service Company on environmental investigations in Los Angeles Harbor, 1971-1972. (Private report by Soule, Oguri, et al.).
- Brandsma, Maynard G., Jiin-Jen Lee and Frank R. Bowerman. Marina del Rey: Computer Simulation of Pollutant Transport in Semi-Enclosed Water Body. USC-SG-1-73.
- Brewer, G.D. "A Small Experimental Sea Water System." (Manuscript submitted for publication).
- Brewer, G.D. "Preliminary Observations on the lower minimum temperature requirements of the northern anchovy," In: Marine Studies of San Pedro Bay, California, Part III: Thermal Tolerance and Sediment Toxicity Studies. USC-SG-1-74. Allan Hancock Foundation Publication.
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- Fischer, P.J. and A.J. Stevenson. 1973b. "Natural hydrocarbon seeps along the northern shelf of the Santa Barbara basin, California," In: Santa Barbara Channel Region Revisited, Amer. Assoc. Petrol. Geol. Trip #3. pp. 17-38.
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- Kanter, Robert. Susceptibility to Crude Oil with Respect to Size, Season and Geographic Location in *Mytilus californianus* (Bivalvia). USC-SG-4-74.
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- Soule, D.F. and M. Oguri (Eds.), 1972. Marine Studies of San Pedro Bay, California, Part One: Circulation Patterns in Los Angeles-Long Beach Harbor. Drogue Study Atlas and Data Report. USC-SG-6-72. Allan Hancock Foundation Publication.
- Soule, D.F. and M. Oguri (Eds.), 1973. Marine Studies of San Pedro Bay, California, Part Two: Biological Investigations. USC-SG-2-73. Allan Hancock Foundation Publication.
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- Soule, D.F. and M. Oguri (Eds.), 1974. Marine Studies of San Pedro Bay, California, Part Four: Environmental Field Investigations. USC-SG-2-74. Allan Hancock Foundation Publication.
- Soule, D.F. and M. Oguri (Eds.), 1974. Marine Studies of San Pedro Bay, California, Part Five: Data Report: Temperature, Salinity, Oxygen and pH in Outer Los Angeles Harbor, June 1971-November 1973. USC-SG-3-74. Allan Hancock Foundation Publication.

- Stephens, J.S. Jr., D. Gardiner and C. Terry. 1973. "The demersal fish populations of San Pedro Bay," In: Marine Studies of San Pedro Bay, California, Part Two: Biological Investigations. USC-SG-6-72. Allan Hancock Foundation Publication.
- Stephens, J.S., C. Terry, S. Subber, and M.A. Allen. 1974. Abundance, distribution, seasonality, and productivity of the fish populations in Los Angeles Harbor, 1972-73. (In press).
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- Weschler, Louis F. and Phillip J. Symonds. "Site Selection by Boaters." University of Southern California, 1973.

In addition to these published monographs and papers, several members of the Sea Grant Program attended professional meetings and wrote professional papers related to their Sea Grant research. The following are a sampling of those.

- Chen, Kenneth Y. et al. "Environmental impact of storm drain on a semi-enclosed coastal water," 8th Annual MTS Conference, 1974. pp. 763-770.
- Fischer, P.J. 1973a. "Environmental hazards of the northern Santa Barbara shelf, California," Geol. Soc. America Abs. with Program (Cordilleran Section), 4(3).
- Fischer, P.J. 1973b. "Quaternary evolution of the Santa Barbara basin, California," Geol. Soc. America Abs. with Programs (Cordilleran Section), 4(3).
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- Fischer, P.J. and R.W. Berry. 1973. "Marine geology and natural seeps of the northern Santa Barbara Shelf, California," Amer. Assoc. Petrol. Geol. Abs. with Programs (Pacific Section). 49th Annual Meeting, San Diego.
- Fischer, P.J. and C. Lee. 1974. "Evidence for late Quaternary (Holocene?) structural growth, southern California shelf," Amer. Assoc. Petrol. Geol. Abs. with Programs (Pacific Section), 49th Annual Meeting, San Diego.
- Fischer, P.J. 1974a. "Natural seeps along the southern California shelf," Amer. Assoc. Petrol. Geol. Abs. with Programs (Pacific Section), 49th Annual Meeting, San Diego.
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- Lee, J.J. and James Walther. "Wave energy permeation of San Pedro breakwater," Offshore Technology Conference, OTC 2124, Texas, 1974.
- Moss, Mitchell L. and Jens C. Sorensen. "Development of Procedures and Programs to Assist in the Preparation and Review of Impact Statements," Amer. Assoc. Adv. Sci. Symposia: "The National Environmental Policy Act: at the Interface of Law and Science," Washington, D.C., December 1972.
- Moss, Mitchell L. "Emerging Patterns of Resources Development," Marine Technology Association, Pacific Rim Section, Seattle, Washington, February 1973.
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- Symonds, Phillip J. "Urban Marine Recreation: Boat Ownership Trends in the Los Angeles Region," Conference on Coastal Zone Management and the Western States' Future, Newport Beach, California, December 1973.
- Symonds, Phillip J. "Coastal Zone Management," Conference on Science and Man in the Americas, Mexico City, June 1973.
- Symonds, Phillip J. and Louis Weschler. "A Regional Market for Marine Based Recreation Goods," Annual Meeting of the Marine Technology Society, Washington, D.C., September 1972.
- Van Arsdol, Maurice D., Jr. and Edward P. Radford, "Methods of Studying Social and Economic Effects of Environmental Agents on Groups," Proceedings of the Karolinska Institute Symposium on Methods for Measuring and Evaluating Human Annoyance Reactions from Exposure to Environmental Agents, August 1971, Stockholm, Sweden.
- Van Arsdol, Maurice D., Jr, "Moderator's Statement, Session 7: Demographic Aspects of Housing and Urban Development," Proceedings of Indian Census Centenary, October 1972, New Delhi.
- Warren, Robert. "Marina del Rey: A Case Study in Coastal Management," Second Coastal and Shallow Water Research Conference, Pacific Station, Los Angeles, October 1971.
- Warren, Robert, Robert Bish, Mitchell L. Moss, and Lyle Craine. "Allocating Coastal Resources: Trade-off and Rationing Processes," Proceedings of the Coastal Zone Workshop, Woods Hole, Massachusetts, May 1972.