# The Planning and Management of California's Coastal Resources

USC Sea Grant Institutional Program

## 1982-83

## TRAINEE REPORT

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

# Contents



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# USC Sea Grant Graduate Student Trainee Program (E/M-1)

Dorothy M. Bjur, Director of Training, Institute for Marine and Coastal Studies, University of Southern California

Since 1975, the USC Sea Grant Graduate Student Trainee Program has offered students the opportunity to apply classroom knowledge to actual working situations. In this program, students work on marine-related research under the direction of faculty members on selected Sea Grant projects.

The program accomplishes several objectives:

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

2) It provides students with marine research projects that help graduate research requirements for their degrees.

3) It provides Sea Grant principal investigators with qualified students who will substantially contribute to research results.

4) It provides students with experience in their chosen fields to help prepare them for leadership roles in the research and development of marine-related topics.

An important measure of the success of the trainee program is shown by the percentage of students who successfully finish their research projects and receive their graduate degrees.

Of the eight Sea Grant trainees for 1982-83, three received their doctoral degrees in the spring of 1983: Kamran Iradjpanah, Engineering, is now a project engineer with a firm in Naples, Florida; Seyed Mehdi Sobhani, Engineering, is an assistant professor at Northrop University in Inglewood, California; and Ann Marie Muscat, Biology, is assistant director of the USC Catalina Marine Science Center.

The remaining five students are expected to finish their programs in 1984.

A highlight of the year was the selection of Alexander Andrasi as USC's first recipient of the national Sea Grant Associaton Award for his research on the development of an assay method for paralytic shellfish poisoning.

Another student trainee, Mary Dempsey, coauthored an article, with her two principal investigators, for Marine Biology, "Apparent Predation of Ichthyoplankton by Zooplankton and Fishes in Nearshore Waters of Southern California."

During the year, monthly luncheons were held for the trainees, their principal investigators and the Master of Marine Affairs Program students at USC. At these luncheons, trainees presented their research progress, helping to keep students, researchers and others abreast of the various Sea Grant projects.

## 1982-83 USC SEA GRANT GRADUATE STUDENT TRAINEES

Alexander Andrasi, Biological Sciences, doctoral candidate.
"Problems of Paralytic Shellfish Poisoning," R/EQ-31.
Principal Investigators: B. Abbott, M. Ross, G. Kleppel and A. Siger.

Mary Bergen, Biological Sciences, doctoral candidate.
"Scientific Information and the Valuation of Ecological Resources in the Coastal Wetlands," R/CM-22.
Principal Investigator: L. Wingo.

John H. Costello, Biological Sciences, doctoral candidate.
"Food Availability, Feeding and the Potential Competition for Food Between Larval Northern Anchovies and Adult Copepods," R/RD-16.
Principal Investigators: R. Pieper and G. Kleppel.

Mary E. Dempsey, Institute for Marine and Coastal Studies, master's candidate in Marine Affairs.
"Factors Affecting the Survival of Nearshore Larval Fishes," R/RD-13.
Principal Investigators: G. Brewer and G. Kleppel.

Kamran Iradjpanah, Civil Engineering, doctoral candidate in Hydraulics.
"Wave Uplift Pressures on Horizontal Platforms," R/CE-7.
Principal Investigators: J.J. Lee and L. Wellford.

Ann Marie Muscat, Biological Sciences, doctoral candidate.
"Aspects of the Biology of the Sea Cucumber, Parastichopus parvimensis, A Developing Commercial Fishery," R/RD-14.
Principal Investigator: J. Kastendiek.

Seyed Mehdi Sobhani, Civil Engineering, doctoral candidate.
"Wave Uplift Pressures on Horizontal Platforms," R/CE-7.
Principal Investigators: J.J. Lee and L. Wellford.

James Yumeji, Urban Planning, doctoral candidate.
"Scientific Information and the Valuation of Ecological Resources in the Coastal Wetlands," R/CM-22.
Principal Investigator: L. Wingo.

# Problems of Paralytic Shellfish Poisoning (R/EQ-31)

Alexander Andrasi, Biological Sciences, University of Southern California

During the first funding year of this project, my goals as a Sea Grant trainee were fourfold:

1) To develop an efficient and reproducible protocol for the fly bioassay, so that dinoflagellate neurotoxin concentrations in phytoplankton and molluscan extracts can be quickly and reliably measured.
2) To develop methods for producing large quantities of the toxic dinoflagellate Protogonyaulax catenella (syn. Gonyaulax catenella) to provide sufficient material for large-scale feeding experiments.
3) To extract the toxin(s) from the P. catenella cultures and measure the toxicity of the extracts.
4) To conduct preliminary feeding of toxic dinoflagellates to Mytilus edulis (bay mussels), in order to establish basic guidelines for designing experiments to measure rates of toxin accumulation and elimination in this species.

RESULTS:

1) The fly bioassay is based on the observation by a technician of a behavioral response in the test animal, specifically, the impaired neuromuscular fitness of the fly in response to injection of a phytoplankton or molluscan extract. To ensure reproductibility of results, the criteria for assessing neuromuscular fitness must be explicitly and quantitatively stated. To eliminate interpretive errors, a strict quantitative criterion has been established to evaluate the performance of the flies after injection of the sample; the fly is considered to be affected by neurotoxin if it is incapable of displacing itself by a minimum of one body length within the specific period of time. With this task-related criterion, the technician now has a clear and fixed method to evaluate the results, free of possible qualitative misinterpretation. This method would produce consistent results among different operators in various laboratories, if the fly bioassay should be adoped as part of the routine shellfish monitoring programs conducted by public health agencies in coastal states.

2) Experiments to determine optimum growth conditions for P. catenella have indicated that toxin production is high under specified conditions of light, temperature and nutrient availability. I now routinely grow 5-15 l batches of the

dinoflagellate under sterile conditions in a single culture vessel. Each vessel with yield approximately 100 million dinoflagellates within 6-8 weeks.

3) Toxicity of the mass-cultured dinoflagellates have been determined with the fly bioassay. An individual cell contains approximately $4.5 \times 10^{-12}$g Saxitoxin-equivalents each, sufficient to make 100 g of shellfish exceed the legal standards by a factor of 5.

4) Preliminary feeding of *P. catenella* to *M. edulis L.* in the laboratory have been conducted. At feeding densities of 100-500 dinoflagellates per ml over 3-5 days, an overall incorporation of 40%-60% of the toxins into the mussels has been observed. These measurements are based on extraction of all soft parts of the animal.

These experiments are being repeated to correlate these results with toxicities measureable with the mouse bioassay, and to estimate error factors associated with the fly and mouse bioassay procedures. Additional experiments to measure tissue-specific toxin uptake and elimination are in progress.

# Scientific Information and the Valuation of Ecological Resources in Coastal Wetlands (R/CM-22)

Mary Bergen, Department of Biological Sciences, University of Southern California

This project was designed to elucidate the implicit and explicit propositions that underly the judgments made by scientists when they are asked to make recommendations about the protection, rehabilitation or alternative uses of California coastal wetlands. Such concepts as diversity, equilibrium and disturbance, or health of a wetland help to structure the valuation of ecological resources.

A Delphi excercise was used to address three topics:

1) Current valuation approaches of scientists in policy recommendations with respect to alternative uses of coastal wetlands;
2) The organization of scientific information for the comparative valuation of the biological content and quality of coastal wetlands; and
3) Scientific specifications for "shadow projects" relating to the preservation, enhancement or replacement of ecological values in coastal wetlands.

A Delphi project consists of questionnaires that are circulated to a panel of experts. The group response is then sent to each member with his/her original response so participants may modify his/her answer in light of the group response. This allows for the formation of a group consensus, including informational feedback, without personal contact between the panel members.

Questions addressing the above topics were developed and randomly sorted into six questionnaires. A panel of 30 wetland experts was established and divided into three subpanels: one of academic scientists, one of government employees, and one of environmental consultants. The questionnaires were sent to all participants. Because the consultants were unable to complete the excercise, we disbanded the consultant panel at the end of the first phase of the Delphi procedure. A total of 19 people completed the questionnaires.

After compiling the data from the six questionaires, we chose the questions that showed a lack of consensus among the panel members and recycled these questions so that the members could consider and perhaps modify their response in light of the group response.

The recycled questions have been returned and the data has been compiled. We are presently analyzing the data from the original and recycled questions and will give a partial summary of the results to the panel members in 1984.

# Food Availability, Feeding the Potential Competition for Food Between Larval Northern Anchovies and Adult Copepods (R/RD-16)

John Costello, Department of Biological Sciences, University of Southern California

My initial tasks centered around preparation of culture facilities for the project. Competition studies between anchovy larvae and copepods for food require that three trophic levels be maintained: algal and rotifer food stocks, copepods, and fish larvae. I maintained the first two groups while three others assisted with the latter two groups.

Set up of culture facility took several months, followed by good progress on algal and copepod culturing. Our first experiment was designed to determine feeding patterns of the copepod Acartia californiaensis upon the algal food source Gymnodinium splendens. Testing of three food densities found that egg production by Acartia was linearly related to algal food density at concentrations up to 300 Gymnodinium per ml. Unexpectedly, we encountered problems in accounting for all the Acartia female bodies for the full length of the experiment. This information was critical because estimates of egg production per female required knowledge of the number of females in the experimental container on each day. Due to uncertainty concerning the fate of the copepods, the experiment was repeated with several improvements in design. This yielded better results.

Once this phase was completed and the feeding pattern of Acartia on Gymnodinium documented, we sought to rear anchovy larvae. Again, we encountered several problems and we were forced to switch to working with Anchoa anchoa, the bay anchovy. Eggs were collected from Newport Bay and high hatch success enabled us to run initial feeding experiments utilizing Gymnodinium as a food source.

Simultaneously, feeding experiments were run with anchovy larvae feeding on the rotifer Brachionus plicatus. Feeding experiments involving Acartia and Brachionus were also run at that time.

Once data was collected on both copepod and anchovy feeding alone, experiments involving simultaneous feeding on the same food source could be run. Difficulty rearing the larvae may have influenced our results, although our hatch results do not appear entirely out of line with the experience of others doing similar work.

The data suggest that copepods do influence larval anchovy and copepod survival at some prey densities, but the interactions between copepods and fish larvae feeding on the same food source are far from decided.

# Factors Affecting the Survival of Nearshore Larval Fishes (R/RD-13)

Mary E. Dempsey, Master of Marine Affairs Program, University of Southern California

This was my first year as a trainee on R/RD-13 and I have been very fortunate to learn some of the techniques, statistical methods, and theories used in fisheries biology. This is due in part to working under two investigators who have a wide range of expertise. Without this traineeship, my educational experience in the Master of Marine Affairs Program at the University of Southern California would have suffered greatly.

During the 1982-83 period:

1) I participated in two 5-day cruises in Santa Monica Bay during September 1982 and April 1983. I learned techniques of plankton and ichthyoplankton sampling and became familiar with the research equipment on board.
2) I assisted in sorting the samples from these cruises.
3) I helped summarize the data into chart and graph form. Some of our findings have been written into an article entitled "Apparent Predation in Ichthyoplankton by Zooplankton and Fishes in Nearshore Waters of Southern California," which has been accepted for publication in Marine Biology.
4) I presented a brief history of our project and other similar projects that preceded ours in the same general sampling area during one of the monthly trainee luncheons.

I will also serve as a trainee on the project for 1983-84, and there is not a lack of things to accomplish. With all the data we have collected, a considerable amount of statistical analysis will take place. We are concentrating on the major relationships and I have started to computerize the data. We want to conduct feeding experiments in the laboratory to explore further some of our field observations. Additional field studies will involve net feeding experiments.

Because this is the last year of this three-year project, time will be spent summarizing as much of the data as possible for presentation in reports and articles for future publications.

Lastly, at this year's trainee luncheon, my presentation will examine how managers and marine advisors can use our research information in formulating regulations and giving advice to fishermen.

# Wave Uplift Pressure on Horizontal Platforms (R/CE-7)

Kamram Iradjapanah, Department of Engineering, University of Southern California

The major objective of the present investigation has concerned the study of wave hydrodynamic effects on a horizontal platform that result from the incidence of a solitary wave.

In the analysis, a two-dimensional finite element model was considered for the case of an inviscid, incompressible and irrotational fluid region. The geometrical configuration of the fluid domain was described by a horizontal channel bottom and a flat horizontal platform. The conditions chosen for the study are relevant to prototype conditions of interest.

Solitary wave was used as a model incident wave because it represents a relevant model of ocean waves in the region where marine structures are located. To construct the finite element model, the fluid region was discretized into small elements of convenient shape. To handle the moving free surface boundary, isoparametric mapping technique was adapted to transform the fluid region into a regular geometry. To generalize the finite element mesh, each rectangular cell in the parent computational domain was separately mapped to a new isoparametric plane. Finite element discretization of the governing equations was performed by employing the Galerkin weighted residual method. To construct the free surface motion, the free surface equations were integrated with respect to time. This was done by invoking a mass-lumping technique to eliminate any coupling between the time derivative of unknown at adjacent nodes. The time derivatives at computational node were then simulated using explicit forward difference scheme.

The stability of the numerical model was tested for propagation of a solitary wave in a fluid region of constant depth. Using the CFL convergence condition, it was found that the algorithm was conditionally stable, restricting the time increment to be less than a bounded value. A platform was inserted in the model to simulate the flow transient beneath the platform due to an incident wave. The sequence of the wave impact was studied by the numerical model. An artificial viscosity term was included in the kinematic free surface equation to smooth the rapid oscillation of the free surface, caused by the front edge of the platform.

Numerical experiments were performed to determine the numerical value of the viscosity parameter, which maintained a smooth surface profile in front of the platform. A multi-grid solution algorithm was developed and used to speed the repeated solution of linear algebraic equations resulted from finite element discretization of the transformed Laplace equation. It was found that the multi-grid algorithm could effectively be used to reduce the convergence time by several orders of magnitude.

A two-dimensional Laser-Doppler Velocimeter (LDV) developed by Raichlen & Lee (1982, 1983) was used to measure the water particle velocities in the fluid region. Wave gauges were used to measure the incident and transmitted waves upstream and downstream of the platform.

The major difficulty encountered in LDV measurements was due to air entrainment in the fluid region, near the surface and near the leading edge of the platform, especially for incident waves of relatively large amplitude. The measurement of vertical velocity was troublesome because of the noise and irregularities present in output data. Several experimental runs were conducted to measure the depthwise variation of the water particle velocities.

To ensure that the development finite element model could be applied with confidence to the problem of wave impact on a platform, the water particle velocity components induced by an undisturbed solitary wave were computed for several depths and compared with that of Boussinesq's theory and avaliable LDV experimental data. The computed horizontal velocities were found to agree reasonably well with the LDV measurement with maximum deviation of 2%. The computed vertical velocities agreed well with that of Boussinesq's theory, but LDV experimental data showed more critical comparison, and the deviation was not very large considering the magnitude of the vertical velocity and the rapid phase changes from positive to negative. Comparisons f numerical model results and the velocity data obtained by an LDV measurement were made for the case of positive as well as zero soffit clearances and at different locations along the platform. Different depthwise positions were considered to define the vertical variation of water particle velocity. The numerical results were found to be in good agreement with experimental data obtained by LDV measurement.

For the case of the platform with zero soffit clearance, the horizontal velocity profiles demonstrated similar trend as in the case of undisturbed solitary wave except with the reduction of amplitude and increase in base-width. In addition to velocity components, transmitted waves downstream the platform were computed and compared to that of experimental measurement. This problem may be of interest to breakwater problems.

The transmitted wave from a platform with positive soffit clearance appeared to be separating into individual waves of smaller amplitude. However, the maximum amplitude was less than the incident wave. For the case of a platform with zero soffit clearance, the transmitted wave profile consisted of a single wave which appeared to have similar trend as a solitary wave but with significant reduction and in wave amplitude.

The uplift pressure time-history were computed and compared to that of French's (1969) experiment using pressure transducers. The pressure profile was characterized by a sudden rise to a peak followed by slowly-varying pressure, which was first positive and then negative. The variation of the pressure was obtained for different soffit clearances and different locations along the platform. The positive pressure was predicted at the advancing wave front.

It was found that the ratio of the duration of positive uplift pressure to negative uplift pressure decreases with the increase of the relative distance from the front edge of the platform, and pressure induced by a wave of slightly higher than the platform soffit clearance causes an insignificant positive uplift but a negative uplift of considerable duration.

# "Aspects of the Biology of the Sea Cucumber, Parastichopus parvimensis, A Developing Commercial Fishery" (R/RD-14)

Ann M. Muscat, Department of Biological Sciences, University of Southern California

In Southern California, a new commercial fishery has recently developed around the sea cucumber Parastichopus parvimensis. Although this species is common in many shallow subtidal habitats, there is little known about its natural history, behavior or population interactions.

The overall goal of this project was to gather data on the natural history, behavior and population interactions of Parastichopus parvimensis as they pertain to the successful utilization and management of the resource. The following population parameters were documented for P. parvimensis: 1) distribution and abundance patterns; 2) activity patterns; 3) reproductive cycle; 4) seasonal losses of internal viscera; 5) recruitment and growth; and 6) predation and disease pressures.

Concurrently, a manipulative field experiment was designed to test the hypothesis that deposit feeding by P. parvimensis on soft sediments influences the distribution and abundance of infaunal populations. In addition, I sought to increase communication and contact with commercial cucumber fishermen and buyers.

The distribution and abundance patterns of P. parvimensis show a strong seasonal component. Each year, from August through November, most of the individuals in depths less than 13 m migrate downslope into the deeper, colder waters below the seasonal thermocline. Those remaining in shallower water are found principally on the surfaes and under sides of rocks and show little activity. Sea cucumbers are up to ten times more abundant on rock substrates than on soft sediments in Big Fisherman Cove on Catalina Island and are about two-thirds less active. This is correlated with the increased amount of organic matter found on the rocks. Within the entirety of Big Fisherman Cove, the dispersion paterns of P. parvimensis show clumping on the available rock surfaces.

In the sand-dominated habitat, the sea cucumbers also aggregate on or around isolated rock patches; in rocky areas,they either distribute randomly or clump as if in response to local substrate heterogeneity. The mean proportion of recaptures for tagged sea cucumbers was greater in rock populations, another indication of less movement.

Overall survival rate was high and was not significantly different between sand and rock populations. Immigration accounts for most of the population gains, emigration for most of the losses. The mean number of gains and loses was not significantly different between rock and sand.

The size of individual sea cucumbers varies with season. Regardless of depth or substrate, sea cucumbers are largest during winter and spring and get significantly smaller during late summer and fall. Juvenile (0.5-2.0 cm) P. parvimensis recruit into kelp holdfasts; subadults (2.0-6.0 cm) are found under rocks. Intermediate (8.0-12.0 cm) adults live on and under rocks, while large adults (12.0-20.0 cm) occur on sand. What maintains this separation of the two adult size classes is not clear. Recruitment occurs from October through December. The individuals in kelp holdfasts, on rocks and on sand represent different year classes. Juvenile sea cucumbers (2.5 cm or less) are prey for several fishes common in the area, which may account for their cryptic behavior. Crustaceans occasionally encounter juveniles but do not eat them, and neither fish nor crustaceans prey upon healthy adults. Periodically, a microbial infection may kill both adults and juveniles, but its impact varies year to year.

Spawning occurs in May and June, probably in response to increasing water temperatures. The gonads are completely resorbed by September and October, followed by maturation and growth from November through April. As many as 40% of the sea cucumbers examined between August and December had no viscera, but the data do not indicate if this is due to evisceration or resorption. There were no differences in size, reproductive potential, behavior or distribution patterns between sexes or between shallow and deep populations. The stability, from year to year, of the size-frequency distributions and of the population density suggest the P. parvimensis is slow-growing and long-lived. Large individuals on the sand are at least five years old.

Feeding rates varied throughout the year and were significantly higher for sand- vs. rock-dwelling sea cucumbers. The period of maximum feeding coincides with the period of ganadal growth and maximum total body weight. From August through November, deposit-feeding pressure from holothurians is greatly reduced in waters less than 13 m deep, due to migration and the loss of the digestive system.

The caging experiment demonstrated that the deposit-feeding activities of P. parvimensis do not affect the distribution or abundance of the invertebrate infaunal populations in the soft sediments of Big Fisherman Cove. There is also no apparent direct effect of sea cucumber feeding on the distribution or abundance of the algae associated with soft sediments in Big Fisherman Cove.

# Wave Uplift Pressures on Horizontal Platforms (R/CE-7)

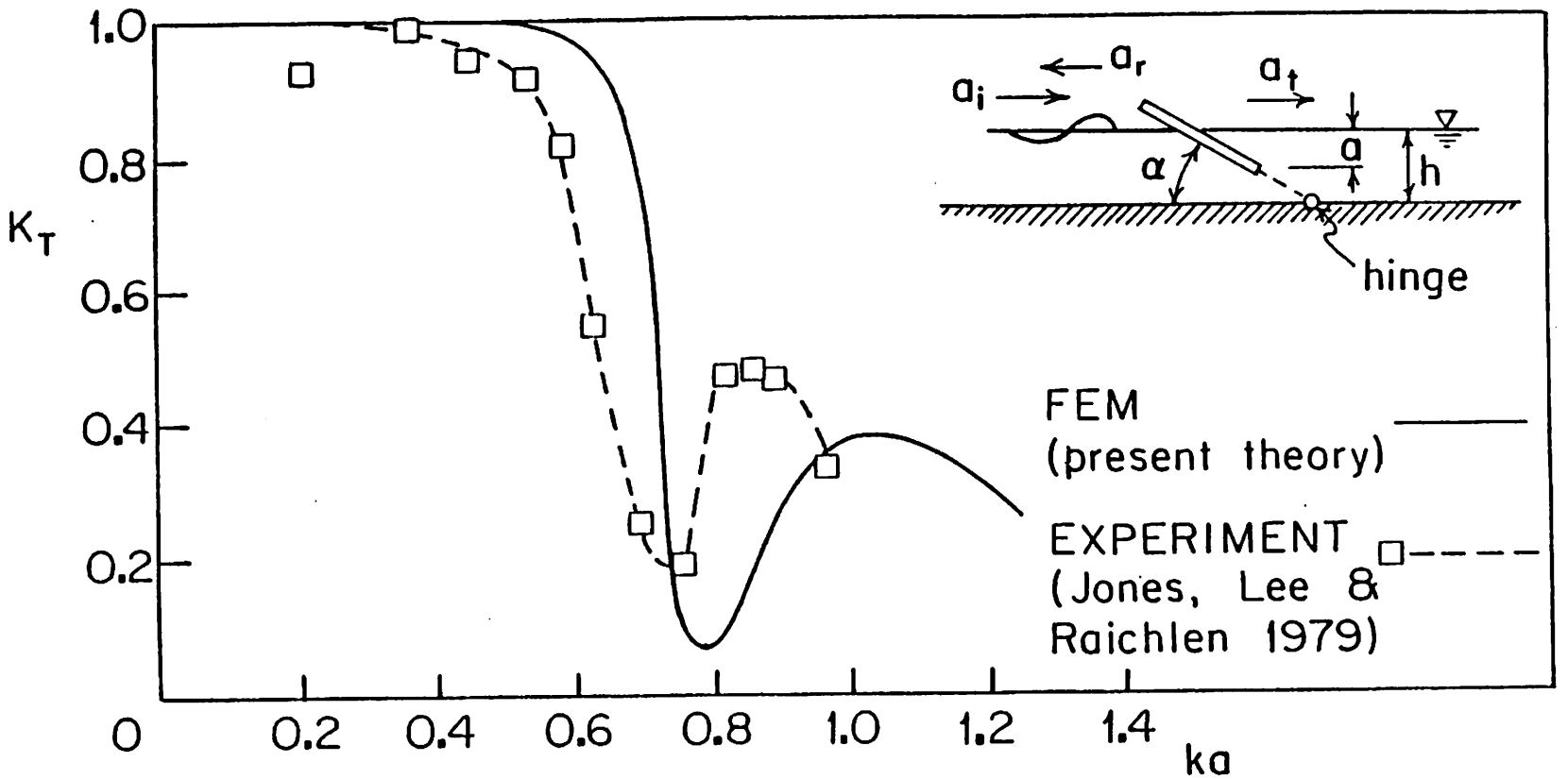
Seyed M. Sobhani, Department of Engineering, University of Southern California

In this study, I investigated, both theoretically and numerically, the two-dimensional problem of the interaction of periodic incident wave with a hinged inclined barrier.

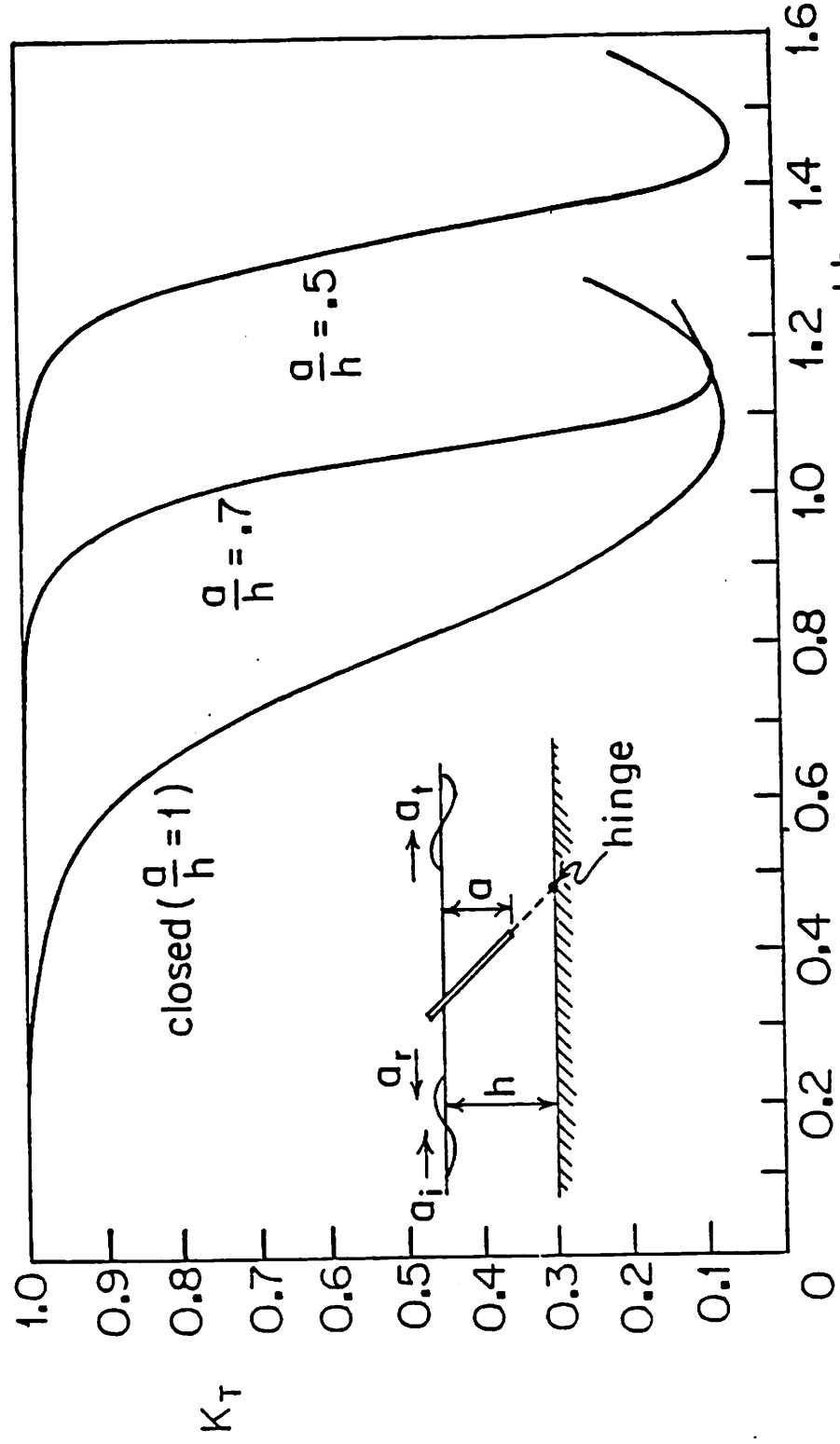
The fluid domain under consideration was divided into three sub-domains: Region I, which surrounds the inclined barrier and may have an irregular bottom, and Regions II and III (to the left- and right-side of the body), which are assumed to have constant depths. The finite element method approximation is applied near the body (Region I) and the eigen-function expansion everywhere else (Regions II and III). The solutions are then matched at the common boundaries to obtain the final solution.

Investigation of this two-dimensional problem involves solution of a system of equations for the nodal velocity potentials, coupled with the unknown coefficients of the eigen-function expansions (on both imaginary boundaries) and the unknown amplitude of the rotational motion of the barrier. Therefore, in this technique, predetermination of the amplitude of the motion of the barrier is not required as in the classical naval architectural approach.

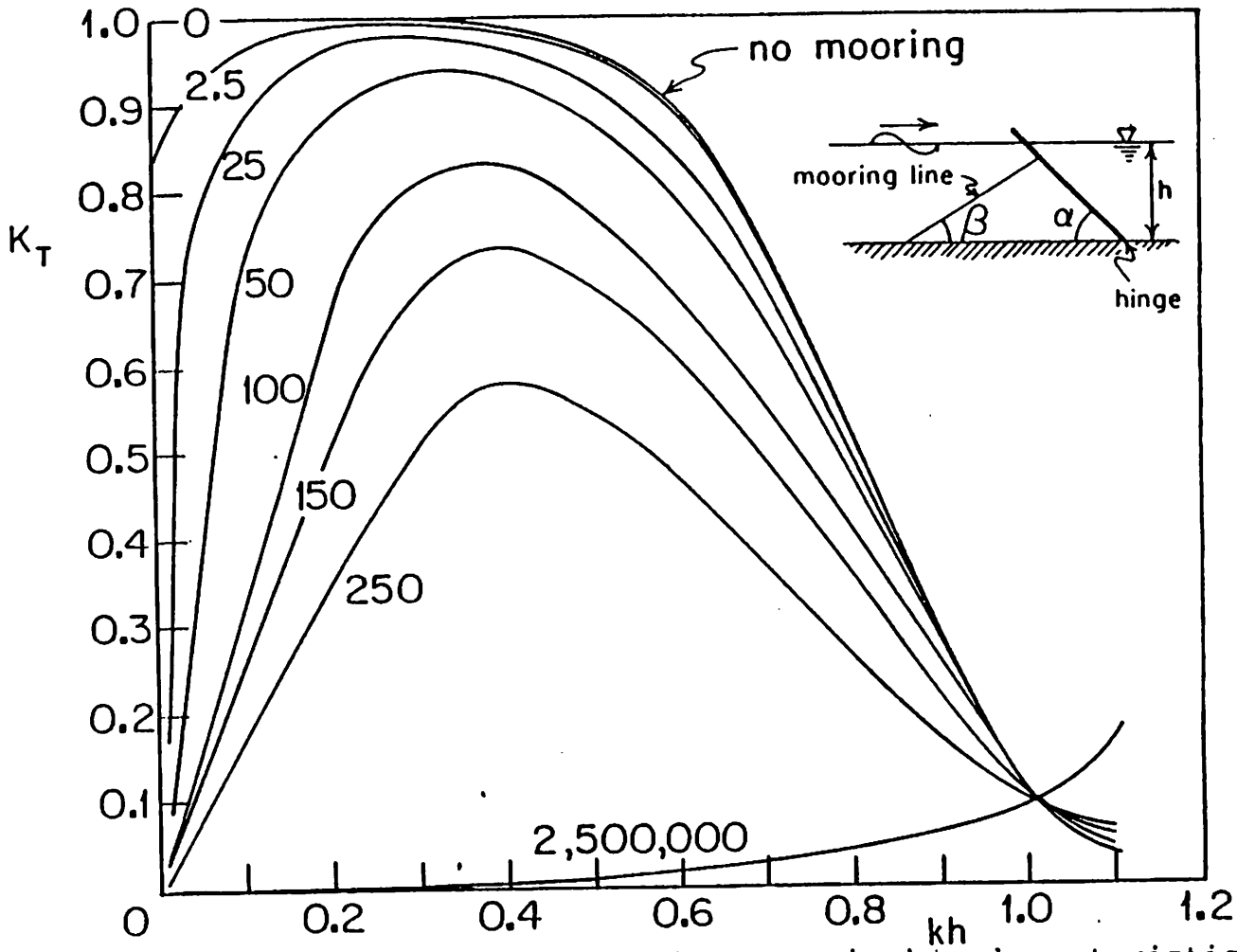
Studies covered the transmission characteristics and the effectiveness of this partially afloat, inclined breakwater as a function of the wave period, angle of inclination of the barrier and the effect of a gap at the bottom. The mooring effect has been investigated where it is assumed that a linear spring is attached to the top of the board in the seaward side. Results obtained by the numerical method compared fairly well to the experimental as well as other theoretical data obtained by others whenever available. Some typical results are shown in the following figures.




Comparison between the present theory and the experimental results of an inclined plate with a gap (a/h = 0.7 and $\alpha = 18.43^{o}$).




Comparison between the transmission coefficients of an inclined plate with different gap sizes.




Effect of the mooring line on the transmission characteristics of an inclined breakwater ($\alpha$=18.43°, $\beta$=30° and the numbers on the curves represent the spring constant of the mooring line).

# Scientific Information and the Valuation of Ecological Resources in Coastal Wetlands (R/CM-22)

James Yumeji, School of Urban and Regional Planning,
University of Southern California

The focus of this research, begun during the fall of 1982 and which is still continuing, is on the communication of scientific information between scientists and policymakers with respect to wetlands. Here we have a situation where scientists working on wetlands biology and other closely related phenomenon have a fundamental difference in perspective from those who advise policy makers in the creation of laws which govern state wetlands management policy. This difference in perspective has resulted in philosophical clashes over the future of many California wetlands, which are threatened by the pressures of numerous land development projects.

The purpose of this project was to uncover the underlying reasons for these differences - the independent variables, if you will, which are involved in different valuation perspectives. At the completion of the survey, there were 19 participants in two basic groups (academic scientists and government policy advisors) selected from prominent positions in California education and government who answered an extended series of questions in a "Delphi" questionnaire format conducted in eight parts (including the Delphi recycle rounds) over a period of 10 months.

The questionnaires involved more than 2,400 questions in 18 "issue" categories, including wetlands definitions, threats, societal values compared with wetlands values, health, processes, policies, size, shadow projects, species, models, regions, attributes, habitats, restoration cost estimates, mitigation strategies, habitat resources and research topics. These 19 panelists represent a majority of the "population" of California wetland scientists and advisors to policy makers on wetlands management.

Various hypotheses have been constructed to account for the differences in perception discovered. My doctoral dissertation, which is still in progress and is entitled "The Ecological Valuation of Coastal Wetlands Resources Through Risk Assessment," presents a hypothesis that it is relative attitudes toward uncertainty which act as the primary independent variable responsible for the differences in perspective between the scientists and policy advisors.

Other more inductively derived hypotheses postulate background differences among the participants as independent variables.

It is the hope that findings made here may ultimately lead to an improved basis for communication between these groups over wetlands management policy -- currently a legal and political battle ground between developers and environmentalists in California and the nation.

The Sea Grant traineeship made it possible for me to engage in this very valuable exercise and will be instrumental in providing me with sufficient information to complete a very innovative doctoral dissertation. I am very grateful for this opportunity.