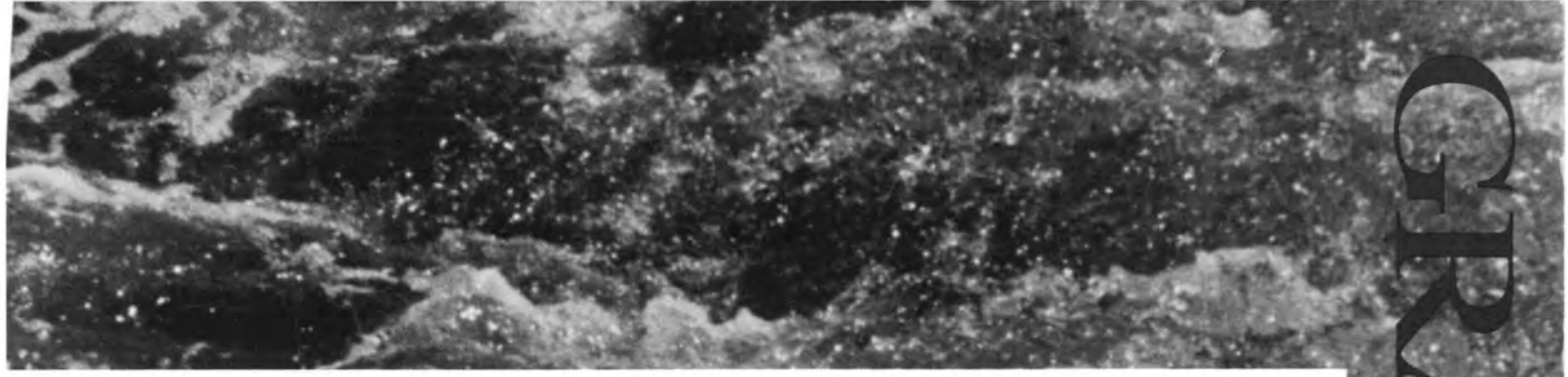
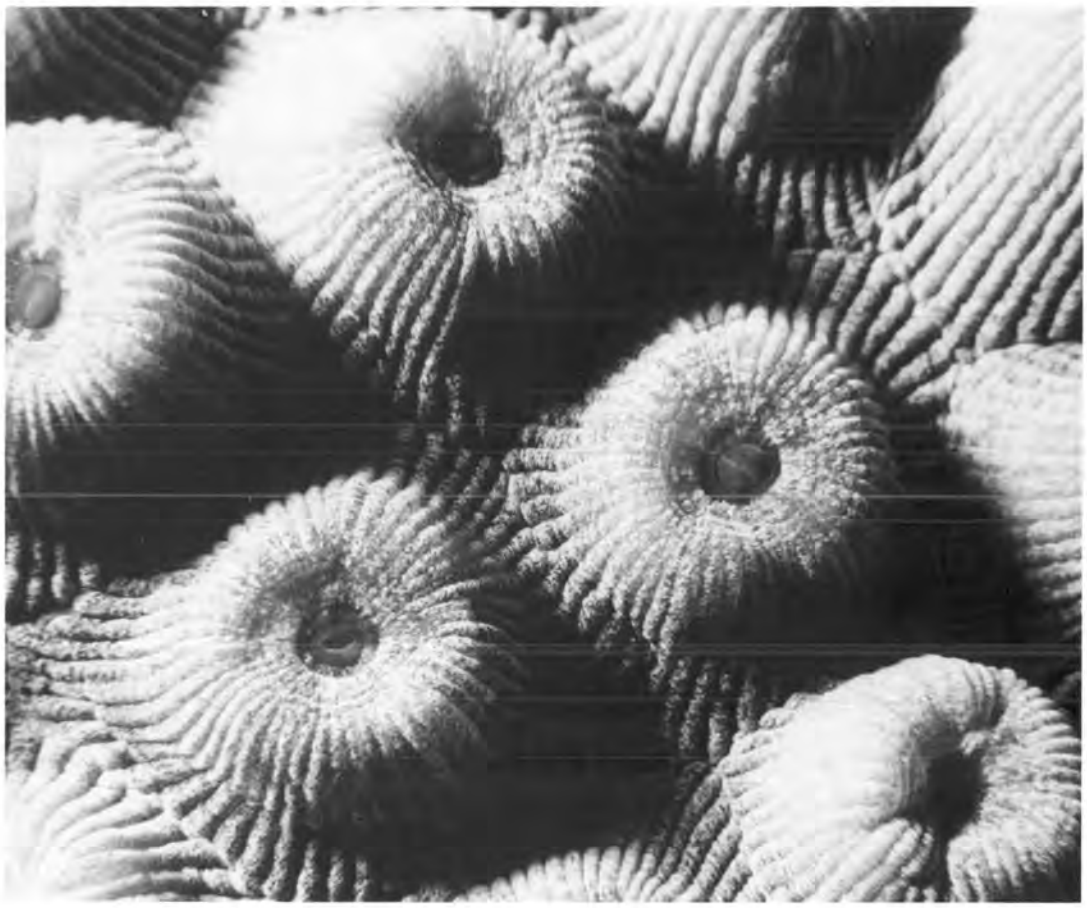


Marine Sciences Research Center 1992

The University at Stony Brook

GRADUATE STUDY



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Discrimination is unlawful. If you are a student or an employee of SUNY Stony Brook and you consider yourself to be a victim of illegal discrimination, you may file a grievance in writing with the Affirmative Action Office within forty-five (45) calendar days of the alleged discriminatory act. If you choose to file a complaint within the University, you do not lose your right to file with an outside enforcement agency such as the State Division of Human Rights or Equal Employment Opportunity Commission.

Table of Contents

Marine Sciences Research Center
... The Choice for Graduate Studies

The Marine Sciences Research Center (MSRC) is the center for marine research, graduate education, and public service for the entire State University of New York system. The Center's faculty, who are internationally known for their leadership in research, have been awarded research grants totalling $3.6 million over the past year, including more than $1.7 million from the National Science Foundation alone. This places MSRC as the eighth largest recipient of NSF ocean science awards in the nation, and first among all coastal institutions.

MSRC is situated on the north shore of Long Island, five miles from Long Island Sound and nearly 50 miles from New York City, in one of the world's greatest natural coastal laboratories. The diversity of coastal environments within an hour's drive of the Center is greater than any comparable region in the world:

- Long Island Sound, a deep estuary modified by glacial processes
- Great South Bay, a bar-built estuary
- Hudson River Estuary, a drowned river valley estuary
- Fire Island, a barrier island with a national seashore
- Fresh and saltwater tidal wetlands
- Open continental shelf waters.
- New York-New Jersey Harbor
- Peconics-Flanders Bay estuary system

Long Island Sound and the New York-New Jersey harbor estuary have been designated as estuaries of national significance in the U.S. Environmental Protection Agency's National Estuary Program, and the Peconics-Flanders Bay estuary system is currently being considered for this designation.

Nearly 10% of the entire population of the United States lives within 100 miles of MSRC. This large population, unmatched in any other area of comparable size, makes varied, intensive, and competitive demands on these marine environments, ranging from swimming to waste disposal.

The regional environmental stresses are characterized by a sharp west to east gradient. Coastal waters of New York Harbor and western Long Island Sound are seriously degraded, yet farther to the east, the waters of the central and eastern Sound and the Peconic Bay system are among the most pristine coastal environments in the United States. The combination of diversity of environments, their importance to society, and the stresses caused by society make Long Island a natural laboratory for students wishing to pursue careers emphasizing fundamental research on coastal

"MSRC is special among oceanographic institutions because of its commitment to the coastal ocean. Pursuing research at MSRC affords me the opportunity to apply general oceanographic principles to problems that impact our coastal environment."

–Christopher Sommerfield
M.S. Student

processes or the applications of research to improve environmental management.

MSRC is one of the few comprehensive coastal oceanographic institutions in the world. Although the focus is on coastal research, many of our graduate students conduct research on the deep oceans, as well. There is no shortage of local and regional coastal marine problems to study, but our students also work on global problems and regional problems in environments as far away as South America, Asia, the Antarctic, the Caribbean, the Mediterranean and Scandinavia.

Whether studying the deep oceans or coastal marine environments, the MSRC graduate student is given a comprehensive education across the disciplines that will enable him or her to work effectively on complex research problems in all marine environments. We at MSRC invite you to visit us so that you can personally discover the excitement and challenge of our Center, our university, and our diversity of marine environments.

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" When I chose the graduate program at MSRC, I was particularly interested in applying research science to policy and land use decision making. The mixture of basic core science, management, and environmental law courses and original field research allowed me to build a foundation that has been useful to me and attractive to employers."

— Betsy Adamson
Environmental Resources Planner, Natural Resources Unit, New York City Department of Environmental Protection
M.S., 1982

Graduate Study at MSRC

Approximately 106 students from 18 different nations currently work and study at MSRC. The primary focus of the MSRC faculty and students is on fundamental research designed to increase our understanding of the processes that characterize the coastal ocean. But the Marine Sciences Research Center is also committed to the use of the results of research to solve problems that result from society's uses and misuses of the coastal ocean.

Interdisciplinary Approach

MSRC prides itself on the interdisciplinary emphasis it places on research and education. Our faculty and students are making fundamental scientific breakthroughs across the breadth of disciplines representing marine sciences:

biological oceanography
fisheries sciences
chemical oceanography
geological oceanography
physical oceanography

One of our current interdisciplinary research projects, for example, is a study to understand fish egg and larval dispersal and recruitment around the island of Barbados. The research required the collaboration of one of our fisheries biologists and his students, who will contribute information on fish reproduction and larval behavior, with one of our physical oceanographers and his students, who are needed to determine the currents and eddies that might influence larval fish movements.

MSRC's Institutes

Over the past few years, MSRC has established three institutes to enable more effective responses to emerging problems and opportunities in coastal resource use and management:

The Living Marine Resources Institute (LIMRI)
The Waste Management Institute (WMI)
The Coastal Ocean Action Strategies (COAST) Institute.

Besides having basic research goals that overlap with those of many of our faculty, the institutes are valuable resources for students interested in coastal zone management, policy studies, and the translation of the results of research into usable forms for managers and policy makers.

WMI's focus is research that addresses the impacts of waste in our coastal marine environment and on policy development for

waste management. **LIMRI**'S focus, along with that of the Fisheries Biology Group, is research that increases knowledge for better management of marine resources such as fish, shellfish and seaweeds, and on related policy development. The **COAST** Institute's focus is working with policy makers on problems in the management of the coastal zone to develop strategies for taking action on the pressing issues affecting our coastal environment.

The Graduate Program

MSRC offers both a Master's Degree in Marine Environmental Science and a Ph.D. degree in Coastal Oceanography. Both programs are flexible and allow students to acquire a broad understanding of the processes that characterize the coastal ocean. Both programs require a solid foundation in the basic sciences: physics, chemistry, biology and geology. The graduate student must also concentrate on original work in an area of oceanography, most often with laboratory or field work involving the special problems posed for scientists who work at sea.

The Master's Degree

The Master's degree program is designed not only to provide students with the training required for successful pursuit of more advanced degrees, but also to equip them with the background needed for effective careers in coastal oceanography without additional training.

A research thesis is required, which must be an original work of publishable quality. The thesis may take any one of several forms. Most often it is based on laboratory and field research, but mathematical modeling and remote sensing are also routine approaches. The Master's thesis may also reflect the application of existing knowledge to develop a management strategy for an environmental problem; or it may be a critical assessment of the effectiveness of technologies, policies, approaches or strategies used in managing coastal marine resources.

The Ph.D. Degree

The doctoral program is designed to give students a professional command of oceanography at the highest level, and to provide them with the means to develop their capacity for creative research. Students must demonstrate the ability to formulate an important original problem and to address the problem effectively. Although oceanography requires an interdisciplinary course of study, the Ph.D. student must also achieve a profound knowledge of at least one basic science.

The doctoral program is designed for students who already have a Master's degree, but exceptional scholars in the Marine Environmental Science Program can have the requirement of a Master's degree waived. A doctoral dissertation is required of all candidates.

" The most valuable part of my experience at MSRC was the association with the faculty and their research— there were no barriers between faculty and students. The faculty were approachable when I needed research advice, and this accessibility provided me with the opportunity to develop research methodology and to learn ways to tackle problems."
— Kuo-Chuin Wong
Associate Professor
College of Marine Studies
University of Delaware
Ph.D., 1982

Coastal Marine Management and Policy Option

Graduate students who wish to pursue careers in management and policy can now enroll in a rich array of management courses offered by MSRC and the University's Center for Regional Policy Studies and Harriman School of Management and Policy. Students in this option take the four, one-semester core courses in biological, chemical, geological and physical oceanography. Beyond these courses, graduate students are free to choose from marine-related management courses, such as Environment and Public Health, Fisheries Management, and Regional Planning Applied to Marine Sciences. Students pursuing the Management and Policy Option have a wide range of opportunities to conduct their M.S. or Ph.D. research on management and policy problems and issues of local, state, regional, national and international importance. Acknowledged leaders with the appropriate expertise are included on all students' committees.

Admission to the Programs

Admission to MSRC's graduate programs is highly competitive. Minimum entrance requirements normally include a B.A. or B.S. degree; mathematics coursework through calculus; physics; and introductory courses in at least two of the following areas: chemistry, biology and earth sciences, with advanced work in at least one of these areas. An overall B (3.0) average is required with significantly better performance in the student's major field. Students must have taken the GREs and foreign students must take the TOEFL exam to complete admission requirements.

Because the program is both interdisciplinary and innovative, applicants who are exceptionally well qualified by experience or training, but lack certain undergraduate preparation, may be admitted on the condition that they complete some preliminary courses after admission.

"One of the unique things about the Center is its interdisciplinary nature. Thesis projects usually encompass various aspects of biological, physical, chemical and geological oceanography. The faculty are outstanding in all areas. It's great to be able to interact with so many different specialties all in one place."

— Lisa Clough
Ph.D. Student

Special Programs

Five-Year BS/MS Program— ESS and MSRC:

MSRC and Stony Brook's Department of Earth and Space Sciences (ESS) offer a cooperative undergraduate/graduate course of study in Geological Oceanography leading to the BS and MS degrees. Students enter the Geological Oceanography track in the ESS department to obtain the BS degree. In their senior year, students may, with approval, begin to take graduate courses offered by MSRC. Students doing well in the undergraduate program may be considered for admittance to an accelerated Master's program offered by MSRC. Most students in this program obtain their BS and MS degrees in five years.

Five-Year BE/MS Program—CEAS and MSRC

A joint program with the College of Engineering and Applied Sciences (CEAS) and MSRC enables a student majoring in Engineering Science to specialize in Marine Environmental Science and to obtain both an undergraduate engineering BE degree and a Master's degree in an additional 14 months. The student must include in their curriculum several marine sciences core courses.

Dillard University Articulation Agreement

MSRC is committed to increasing the number of African-Americans and other groups underrepresented in the environmental field and, particularly, in the marine sciences. MSRC has created a cooperative agreement with Dillard University, a historically African-American institution in New Orleans.

The agreement enables Dillard undergraduates to spend the spring semester of their junior year and the fall semester of their senior year at the the University at Stony Brook. Following the completion of their fall semester at Stony Brook, they return to Dillard to graduate. The following summer, they return to enter the graduate program at MSRC. By spending a year at Stony Brook as an undergraduate, Dillard students have a head start in the graduate program, making the transition from undergraduate to graduate study easier. All students in the Dillard Program are provided financial support both as undergraduates and as graduate students.

Financial Assistance

MSRC provides more than 95% of our students with complete funding through university graduate and teaching assistantships (GA/TA) and research project assistantships (RPA). The minimum amount of these assistantships for the 1991-92 nine-month academic year is $8,850. Most students are supported through sponsored research projects over the summer at a rate of up to $3,500. Full tuition scholarships can accompany the award of a fellowship, a full GA/TA or a full RPA.

Special Awards

MSRC has a variety of special awards available to graduate students. Increased stipends are available to the most outstanding students in recognition of their excellence. Special awards are available to assist students in completing their research and for travel to national and international meetings to present the results of their research.

Minorities Research Awards for Stony Brook Students

The Minorities in Oceanography Program provides limited funds to offer promising minority undergraduate students, who are matriculated at Stony Brook, an opportunity to actively participate in oceanographic research with an MSRC faculty member. The goal of these awards is to increase the students' awareness of the field of oceanography and to induce them to pursue graduate education in the marine sciences at MSRC.

Alumni Award

The MSRC Alumni Association annually provides a financial award for the best Master's degree student thesis project.

"MSRC's location, resources, and faculty and staff provide excellent opportunities for incoming students to get hands-on experience. Upon enrollment into the program, one becomes part of the MSRC family."

— Shawn Tisdell
M.S. Student

Special Fellowships

The M.P. O'Brien Fellowship Program

This fellowship program acknowledges the manifold contributions of Professor O'Brien and is intended to stimulate interest in graduate studies at MSRC in beach and nearshore processes and coastal engineering. Fellowships are awarded for two years and may be renewed. Each fellowship carries a stipend of $10,000 for the nine-month academic year and a full tuition scholarship. The stipend may be supplemented by up to $3,500 for the summer.

J. L. McHugh Fellowship

This fellowship is awarded each year to an outstanding first year student interested in fisheries or fisheries management.

Donald W. Pritchard Fellowship

This fellowship is awarded each year to an outstanding first year physical oceanography student interested in the physics of estuaries and nearshore waters.

Life at MSRC

"One thing that makes MSRC so special is the close, friendly yet professional relationships between students and faculty."

—Patrick Dooley
M.S. Student

Student-Faculty Interactions

MSRC's faculty have traditionally established personal, supportive relationships with the students. The breadth of expertise represented by our faculty allows students a great amount of flexibility in choosing a graduate advisor and also provides a large pool of resources for solving multidisciplinary research problems.

MSRC's graduate students are considered colleagues, as professionals who participate fully in the intellectual life of the Center. Graduate students serve on almost every committee, having a voice in such activities as hiring of new faculty and decisions about the graduate programs.

Sponsored Activities

Many activities exist to keep the graduate student active on south campus, where the Center is located, and an additional wealth of sponsored activities exists on main campus within each science department. MSRC sponsors several programs that bring visiting scholars to the Center for either one day to give a seminar, or for extended stays. These longer visits give students ample opportunity to question, exchange ideas, and get to know outstanding oceanographers from institutions around the world, who offer different perspectives.

Coastal Marine Scholar Program

This program brings an outstanding recent Ph.D. scholar to the Center each year. These scholars, who spend two years at the Center, are sought through an international search and have backgrounds in oceanography, engineering or mathematics. Coastal Marine Scholars play an important role in fostering interactions and collaborations with MSRC faculty and students on problems of common interest.

Lawrence Distinguished Visiting Scholar Program

Each year a committee of faculty, staff and students select four to six of the world's most outstanding scientists to spend a week at MSRC. During their week's stay, these scholars, who are world leaders in their own fields, present seminars and one public lecture, and interact extensively with the graduate students, discussing problems of common interest.

Graduate Seminar Program

This program brings more than a dozen of the most renowned marine scientists from all over the world each year to the Center to speak about their exciting research and latest discoveries at a weekly seminar. These seminars attract faculty, students and staff to interact with outside researchers. Speakers include researchers from around the world on topics ranging from physical oceanography in the Antarctic to fish resources in the Arabian Sea.

Friday Discussion Group

A more casual forum to exchange ideas and information is the Friday Discussion Group, a weekly ritual that brings faculty and students together over coffee, tea and cookies. Speakers are usually drawn from the Stony Brook community, and presentations include work-in-progress, reports of meetings, practice talks for students and slide shows of exotic field work.

Extracurricular Activities

Besides the more academic activities, a number of events draw MSRC students, faculty and staff together socially. Several events have become a tradition at MSRC. One is the annual international dinner, when faculty, students, and staff prepare and share dishes from all nations. Another is the annual Flax to Vax race, when students compete with the faculty in a five-mile race from Flax Pond to the Center. Everyone wins at the pot-luck festivities that follow the race. Every fall, the Graduate Programs Office sponsors a welcoming picnic for new students. Other events are more impromptu, such as softball games and volleyball at the sand court by Discovery Hall.

Resources and Facilities

One-half mile from Stony Brook's main campus, is the south campus, where MSRC is housed in four one-story buildings. Ample, well-equipped laboratories compose the central core of each building, with offices and dry laboratories along the perimeter.

Flax Pond Marine Environmental Laboratory

Located approximately five miles from the Center, on a tidal salt marsh preserve flushed by Long Island Sound, is the Flax Pond Marine Laboratory. This 8,000-square-foot research facility is equipped with running seawater circulating through more than 20 sea tables and aquaria and an 800-square-foot greenhouse.

Equipment and Instrumentation

MSRC has a major commitment in staff, equipment and instrumentation to provide researchers with the most recent technology to conduct experiments both in the lab and at sea. Equipment is often specially designed and pre-cruise tested for individual needs. Equipment and instruments maintained by individual faculty through research grants are also state-of-the art and includes some of the most sophisticated instrumentation used in the marine sciences today.

Research Vessels

At the head of our fleet of research vessels is the 60-foot steel-hulled *ONRUST* (Dutch for "restless"), built specifically for MSRC. The *ONRUST* is completely equipped for coastal oceanographic research with 168 square feet of wet laboratory, 21 linear feet of bench and sink space, a hydraulic gantry and 1 ton cargo boom on the 340-square-foot aft work deck. A recent addition to our fleet is the 48-foot trawler yacht, the *Lord Jim*, used as a floating classroom and meeting room. The Center also maintains several small boats and support vehicles for field research in sheltered waters around Long Island, including the R/V *Siome*, a 23-foot shallow draft cabin cruiser; two 17-foot Boston Whalers; and a 24-foot open workboat.

Computer Facilities

The Center maintains two microcomputing laboratories with IBM PCs and Apple Macintoshes for student use, a remote sensing laboratory with a VAXstation II/GPX, and a graphic lab with a Calcomp 910/563 and Calcomp 907/1051. There is also a terminal lab with four VT100 CRT terminals and two LA120 hardcopy terminals; a workstation lab with six VAXstation 2000s; and VAX 8530 and VAX 11/730 minicomputers.

Reference Room

The newly expanded reference room, under the direction of a professional librarian, comprises holdings in all the marine sciences disciplines, including important marine science core journals, beginning and advanced books and texts, MSRC Master's theses and doctoral dissertations, MSRC special reports, nautical charts and maps and a general science reference collection.

Our reference room computer capabilities include the Aquatic Sciences and Fisheries Abstract Database on CD-ROM, STARS (the on-line NOTIS catalog for all of Stony Brook's branch libraries) and the ability to search over 400 international databases through Dialog Information Services. Additional materials for study and research are available at the University main library and in departmental libraries of Earth and Space Sciences, Biology, Physics and Mathematics and Chemistry.

The State University of New York at Stony Brook

MSRC is a part of the University at Stony Brook, which has been designated by the Carnegie Foundation as a Type I Research Institution, a ranking based on academic excellence and research funding awards, among other criteria. Since its establishment in 1957, Stony Brook has grown to occupy 103 buildings on an 1,100-acre campus set amid fields, orchards, woods and a 26-acre nature preserve. Stony Brook's faculty have grown from 175 to 1,500 and the student body from 1,000 to 17,000, 6,000 of whom are graduate students.

One of the University's 103 buildings, the Staller Center for the Arts, is a modern concert hall-art gallery-office building that hosts national and international performances and exhibits. The campus recently added a new field house for larger sports matches and performances, with arena seating of 4,100 and a five-lane indoor track.

Research at Stony Brook pervades all disciplines, attesting to the diversity and vitality of its faculty. The annual research budget at Stony Brook currently exceeds $70 million. Stony Brook now ranks among the top 25 institutions receiving funding from the National Science Foundation. Graduate departments exist in all disciplines, with most of our science departments ranked among the nation's top 30 and several ranked among the top 20.

The presence on our campus of the many other fine departments, research institutes and centers, graduate school of business, college of engineering and tertiary care facility hospital-health sciences center complex offers the MSRC graduate student a wealth of additional resources for research, education and personal opportunities to augment and expand their marine sciences experience.

The Faculty at MSRC

Our faculty brings a high quality of research and teaching skills to MSRC. Their many achievements, awards and honors have contributed greatly to the continued growth in stature MSRC has experienced over the years, and their research brings in more than $3.6 million in external funds annually. Following are brief descriptions of each faculty member's current research.

Josephine Y. Aller

Associate Research Professor
Ph.D., 1975
University of Southern California

The activities of bottom-dwelling organisms modify the physical and chemical properties of sediments very near the sediment-water interface and thereby influence a variety of ecological processes. My research interests concern (1) the importance of macrofauna and meiofauna on microbial metabolism and the decomposition of organic matter in marine sediments and (2) the impact of physical disturbance on the structure and functioning of benthic communities in marine environments.

One of the areas of current research in my laboratory involves the study of the structure and dynamics (recruitment, growth, survival, and activities) of the benthic community on one of the most physically active continental shelf environments in the world—the Amazon. This research is part of a multidisciplinary project to understand the impact of seasonal variability in the discharge conditions of the Amazon River on shelf processes. We are interested in elucidating the major physical, chemical, and biological factors controlling diagenetic and benthic community patterns and evaluating the importance of biological activities to sedimentary and geochemical processes on the shelf.

Other active research areas include (1) the examination of spatial and seasonal variability in biomas and abundance of bottom infauna in relation to oxygen demand and nutrient fluxes from the sediments in Long Island Sound; (2) an investigation into the impact of chronic low oxygen on survival, growth, metabolic rate, and reworking activities of benthic infauna; (3) a study of the bottom dwelling fauna in a deep-sea habitat, which is periodically disturbed by strong near-bottom currents; and (4) understanding the role of meiofauna in influencing nutrient exchange near the sediment-water interface.

Aller. R.C.; Aller J.Y. Meiofauna and solute transport in marine muds. Limnology and. Oceanography (in press).

Greer, M.A.; Aller, R.C.; Aller J.Y. Carbonate dissolution and temporal abundances of foraminifera in Long Island Sound sediments. Limnology and Oceanography (in press).

Kristensen, E.; Aller, R.C.; Aller, J.Y. Oxic and anoxic decomposition of tubes from the burrowing sea anemone *Ceriantheopsis americanus:* implications for bulk sediment carbon and nitrogen balance. Journal of Marine Research; 49:1-28; 1991.

Aller, J.Y. Quanitfying sediment distrubance by bottom currents and its effect on benthic communities in a deep-sea western boundary zone. Deep-Sea Research 36(6):901-934; 1989.

Aller, J.Y.; Aller, R.C. General characteristics of benthic faunas on the Amazon inner continental shelf with comparison to the shelf off the Changjiang River, East China Sea. Continental Shelf Research 6:291-310; 1986.

Robert C. Aller

Professor
Ph.D., 1977
Yale University

I am interested in diagenetic reactions involving the decomposition of organic matter and dissolution, mobilization, and reprecipitation of metals sensitive to oxidation-reduction reactions. These reactions are most intense and rapid in the upper meter, and especially in the upper 10 centimeters, of marine sediment. It is in this upper zone where most benthic organisms live and interact with sediments and where exchange of material between sediment and overlying water is largely determined. Knowledge of diagenetic processes occurring in this zone is, therefore, essential for understanding the chemistry of sediments and of water overlying the sediment, certain ecological interactions and adaptations of marine organisms, and long-term recording of historical information in marine deposits such as fossil preservation.

My students and I are currently studying selected aspects of sediment diagenesis and exchange rates of dissolved material across the sediment-water interface in a variety of coastal and deep-sea marine areas, including Long Island Sound, Florida Bay, the Amazon shelf, and Panama Basin. Our research places particular emphasis on the way macrobenthic organisms influence these processes and how to quantitatively model them. Large scale diagenetic patterns related to sedimentary facies are also emphasized. We have several collaborative projects with other MSRC faculty, including Josephine Aller, J. Kirk Cochran, Cindy Lee, Chuck Nittrouer and James Mackin. Several of our research projects are listed here:

1) Interstitial water and sediment chemistry near the sediment-water interface, where Fe, Mn, Al, F, chloropigments and products of SO_4 reduction are of special interest.
2) Rates and kinetics of authigenic mineral dissolution-precipitation reactions (e.g., $CaCO_3$) near the sediment-water interface. Rates are obtained by diagenetic modeling as well as by direct laboratory measurements.
3) Animal-sediment interactions, particularly biogeochemical, of macrobenthos living in soft-bottom regions of the sea floor.
4) Studies of diffusion coefficients in fine-grained sediments.
5) Effects of macrobenthic organisms on microbial metabolic activity and on the rate and distribution of biogenic and abiogenic reactions in the bioturbated zone of sediments.
6) The distribution of natural radionuclides of the U-Th series, particularly U-238, U-234, Th-234, and Pb-210 in bioturbated near-shore and deep-sea marine sediments.

Aller, R.C., Bioturbation and manganese cycling in hemipelagic sediments. Phil. Trans. R. Soc. Lond. A 331:51-68; 1990.

Aller, R.C.; Mackin, J.E. Open-incubation, diffusion methods for measuring solute reaction rates in sediments. Journal of Marine Research; 47:411-440; 1989.

Rude, P.D.; Aller, R.C. Early diagenetic alteration of lateritic particle coatings in Amazon continental shelf sediment. Journal of Sedimentary Petrology; 59:704-716; 1989.

Aller, R.C. Benthic fauna and biogeochemical processes in marine sediments. In: Blackburn, T.H.; Sorenson, J., eds. Nitrogen cycling in coastal marine environments; New York: John Wiley and Sons; pp. 301-338; 1988.

Aller, R.C.; Rude, P.D. Complete oxidation of solid phase sulfides by manganese and bacteria in anoxic marine sediments. Geochimica et Cosmochimica Acta; 52:751-765; 1988.

Henry Bokuniewicz

Professor
Ph.D., 1976
Yale University

My research is concerned primarily with the behavior of coastal sedimentary systems and especially the fate of fine-grained sediment particles. My students and I are doing field work to study the transportation of fine-grained sediments in rivers and estuaries, shore changes and the partitioning of sediment particles at the shoreline, and the deposition of sediments and sedimentary evolution in coastal environments. Research into elements of coastal hydrology and the character of changes in relative sea level are included in these studies. For example, we are studying the evolution of Long Island Sound, the coastal processes at the south shore of Long Island, and the processes of resuspension and deposition of fine-grained sediments.

Much of this research is directly applicable to problems of coastal zone management. I am interested in applying my research to the problems of shore erosion, the dispersion of contaminants, siltation, dredging and disposal of the dredged sediments, and marine mining.

Gayes, P.T.; Bokuniewicz, H.J. Estuarine paleoshorelines in Long Island Sound, NY. Journal of Coastal Research (in press).

Kim, B.H.; Bokuniewicz, H.J. Estimates of sediment fluxes in Long Island Sound Estuaries; 14:237-247; 1991.

Bokuniewicz, H.J.; Pavik, B. Groundwater seepage along a barrier island. Biogeochemistry; 10:257-276; 1990.

Bokuniewicz, H.J. Sand mining in New York Harbor. Marine Mining; 7:7-18; 1988.

Malcolm J. Bowman

Professor
Ph.D., 1970
University of Saskatchewan

My research group and I are primarily interested in the dynamics of coastal fronts and eddies, island wakes, and circulation and mixing in coastal sea straits, especially in tidally energetic regions. We are investigating the dynamical mechanisms that lead to basin-wide eddies in wide coastal sea straits off the west coasts of Canada and Alaska. We are also interested in the applications of remote sensing to coastal ocean dynamics and biological production.

Robert Cowen and I are collaborating on an interdisciplinary study in the coastal seas of Barbados, West Indies to study island wake eddies and circulation, and their interaction with the life cycle of tropical reef fish.

Bowman, M.J.; Visser, A.W.; Crawford, W.R. The Rose Spit Eddy: evidence for its existence and underlying dynamics. Atmosphere-Ocean; (in press).

Visser, A.W.; Bowman, M.J.; Crawford, W. R. Dynamics of tidally forced basin-wide coastal eddies. In: Cheng, R., ed. Residual currents and long-term processes in shallow estuaries and bays. Coastal and Estuarine Studies; New York: Springer-Verlag; 1989.

Bowman, M.J. Estuarine fronts. In: Kjerfve, B., ed., Hydrodynamics of estuaries; Boca Raton, FL.: CRC Press; 1988.

Vincent Breslin

Research Assistant Professor
Ph.D., 1986
Florida Institute of Technology

My research activities primarily focus on understanding the chemical behavior of both particulate and stabilized combustion wastes in the coastal ocean. Combustion ashes, including such materials as coal fly ash, oil ash, and incineration ash, are rich in metals of environmental concern. These ashes impact our coastal ocean primarily via atmospheric deposition. However, in response to potential groundwater contamination and the scarcity of landfill space, ocean dumping of these ashes has been suggested as an alternative to the current landfilling practices.

Our research group is working to better understand the mechanisms that influence the ability of metals to leach from combustion ashes in seawater. By understanding the chemical behavior of these ashes in sea water, we can better assess the potential impacts of these wastes in the ocean. Thus far, our research has shown that the release of metals from the ashes can be controlled through the process of stabilization using additives to form blocks. These blocks are currently being used to create artificial reefs in our coastal waters, including Conscience Bay in Long Island Sound where we are monitoring their physical, chemical, and biological interactions.

I am also conducting research with other members of the Waste Management Institute to determine the rate and extent of degradation of biodegradable plastics in the environment. We placed samples of starch-based plastics in seawater, the strawline of a beach, compost, landfill and soil, and periodically retrieved samples to conduct a variety of physical and chemical tests. Results of this research program will be useful in defining the role of degradable plastics in waste management.

Breslin, V.T. Stony Brook researchers investigate uses for incineration residues. Waste Management Research Report; 2(2):3-8; Summer, 1990.

Breslin, V.T.; Swanson, R.L.; Reaven, S. Investigations of the degradability of a cornstarch-based plastic. Interim report submitted to Archer Daniels Midland Company, Decatur, IL; May, 1990.

Breslin, V.T.; Duedall, I.W. Vanadium release from stabilized oil ash waste in seawater. Environmental Science and Technology; 22:1166-1170; 1988.

Breslin, V.T.; Roethel, F.J.; Schaeperkoetter, V. Physical and chemical interactions of stabilized incineration residue with the marine environment. Marine Pollution Bulletin; 19(11B): 623-632; 1988.

Roethel, F.J.; Breslin, V.T. Unique method of ash disposal can benefit marine life. Solid Waste and Power; 2:42-48; 1988.

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V. Monica Bricelj

Assistant Professor
Ph.D., 1984
State University of New York
at Stony Brook

My research interests lie in the areas of physiological ecology, bioenergetics, population biology and aquaculture of benthic macrofauna, especially commercially exploited bivalve molluscs. In recent years, my research efforts have been directed towards (1) investigating the interactions between phytoplankton (microalgae) and filter feeding herbivores such as mussels and clams and (2) studying factors that influence survival and growth of post-settlement bivalves in seagrass meadows.

Noxious algal blooms exert a major impact on the production of filter feeding shellfish populations. In turn, their grazing may contribute towards regulating phytoplankton populations in shallow coastal bays."Brown tides" experienced in Long Island waters in the mid-1980s, and "red tides," which impact coastal shellfisheries worldwide, are only two well-publicized examples of such blooms. Using cultured dinoflagellates of varying cell toxicity, we are modeling the kinetics of toxin uptake and depuration by shellfish and investigating the transfer of toxins up the food chain.

Recently, the impact of paralytic shellfish poisoning has extended to the offshore fishery for surf clams on Georges Bank. Our future studies will therefore focus on the transfer and metabolic transformations of dinoflagellate toxins in surf clams, which are known to retain toxins for extended periods.

"Brown tides" in the mid-1980s decimated the bay scallop fishery on Long Island and reduced the biomass and extent of eelgrass cover, which provides an important nursery habitat for many benthic organisms. In turn, predation is the single most important source of natural mortality of juvenile bivalves, including scallops. We are currently investigating the role of eelgrass in providing post-settlement scallops with a refuge from benthic predators (primarily crab species) in Long Island bays. This research will be applied towards the optimization of reseeding programs required to rehabilitate the bay scallop fishery in several east coast states.

Bivalves experience heavy mortalities during larval and postlarval development, especially following metamorphosis, during their transition from a planktonic to benthic mode of life. We are initiating a study to determine the relative vulnerability of early development stages of bivalves to nutritional stress, with special emphasis on the effects of stress on protein metabolism of postlarvae. This work, initially focusing on oysters, will be carried out in collaboration with the Universidad Autonoma, Baja California, Mexico.

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Bricelj, V.M.; Shumway, S. Physiology: energy acquisition and utilization. In: Shumway, S., ed. Scallops: biology, ecology and aquaculture. New York: Elsevier. pp. 305-337; 1991.

Pohle, D.G.; Bricelj, V.M.; Garcia-Esquivel, Z. The eelgrass canopy: an above-bottom refuge from benthic predators for juvenile bay scallops, *Argopecten irradians*. Marine Ecology Progress Series; 74: 47-59; 1991.

Bruce Brownawell

Assistant Professor
Ph.D., 1986
Massachusetts Institute of Technology/
Woods Hole Oceanographic Institution

I am interested in biogeochemical processes that affect the transport and fate of organic compounds in coastal, estuarine, and groundwater environments. I have been particularly interested in the aquatic chemistry of hydrophobic pollutant compounds. Understanding the biogeochemistry of pollutant compounds is important for managing coastal zone and groundwater resources and for remediating already contaminated sites.

Anthropogenically derived compounds can also provide valuable analogs for understanding the cycling of naturally produced organic compounds in the ocean. My research has focused on the behavior and transport of a variety of neutral, ionizable, and ionic compounds. In these studies I have been concerned with elucidating adsorption mechanisms of various compound classes with either sediments, soils, aquifer materials, or dissolved organic matter. Development of methods for determining activities of organic compounds in natural waters has been an important aspect of my work.

The questions that I am interested in addressing center around how the physical and chemical form of organic compounds (i.e., dissolved, bound, or complexed) affects their transport, availability to organisms, and the rates at which they are transformed chemically or by bacteria. I have interests in selected research topics in several additional areas, including atmospheric deposition of organic chemicals, aquatic photochemistry, and the biogeochemistry of surface sediments and groundwater environments.

Brownawell, B.J.; Chen, H.; Zhang, W.; Westall, J.C. Adsorption of surfactants. In: Baker, R.A., ed. Organic substances and sediments in water. Vol. 2, Processes and Analytical; Chelsea, MI: Lewis Publishers; pp. 127-147;1991.

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Schuytema, G.S.; Krawczk, D. F.; Griffis, W. L.; Nebecker, A.V.; Robideaux, M.L.; Brownawell, B.J.; Westall; J.C. Comparative uptake of hexachlorobenzene by fathead minnows, amphipods, and oligochaete worms from water and sediment. Environmental Toxicology and Chemistry; 7:1035-1045; 1988.

Brownawell, B.J. The role of colloidal organic matter in the marine geochemistry of PCBs. Ph.D. Thesis, Woods Hole Oceanographic Institute/Massachusetts Institute of Technology Joint Program in Oceanography; 1986.

Brownawell, B.J.; Farrington, J. W. Biogeochemistry of PCBs in interstitial waters of a coastal marine sediment. Geochimica et Cosmochimica Acta; 50:157-169; 1986.

Edward J. Carpenter

Professor
Ph.D., 1969
North Carolina State University

Our group has two major interests. One concerns nitrogen fixation in the sea. We work in tropical and subtropical waters on the biology and ecology of nitrogen fixation in the cyanobacterium *Trichodesmium*. Recently we have begun to use remote sensing techniques to study its distribution and factors affecting bloom phenomena.

Our second major interest centers on the measurement of species-specific growth rates of phytoplankton in the sea. We are attempting to determine factors that limit phytoplankton growth, as well as to understand the role of a species as a primary producer. This research requires a field program to collect phytoplankton and environmental data, and laboratory measurements on the samples using markers of various stages in the cell cycle, and epifluorescence and video microscopy to determine growth rates.

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Cosper, E.M.; Lee, C.; Carpenter, E.J. Novel "brown tide" blooms in the Long Island embayments: a search for the causes. In: Graneli, E.; Sundström, B.; Edler, L.; Anderson, D.M., eds. Toxic Marine Phytoplankton; Proceedings of the Fourth International Conference on Toxic Marine Phytoplankton, Lund, Sweden; New York: Elsevier; pp. 17-28; 1990.

Carpenter, E.J.; Campbell, L. Diel patterns of cell division and growth rates of *Synechococcus* spp. in Long Island Sound. Marine Ecology Progress Series; 47:179-183; 1988.

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Robert M. Cerrato

Assistant Professor
Ph.D., 1980
Yale University

My research centers primarily around population and community dynamics of benthic animals. My students and I have been using information preserved as structural and morphological features in bivalve shells in a number of population studies. Recent and ongoing work includes studies of the population dynamics of three species (*Mya arenaria, Mercenaria mercenaria* and *Spisula solidissima*); an investigation of growth line periodicity in larval and postlarval bivalve shells; an analysis of age-structure and growth in a deep-sea Vesicomyid clam found at hydrothermal vents; and, using shell remains from middens on Shelter Island, the reconstruction of shellfish seasonal harvesting patterns by prehistoric hunter-gatherers. In the future, I hope to examine more closely the relationship between shell microgrowth patterns and physiological rate processes in bivalves.

With other MSRC faculty, I have also been studying the feasibility and environmental effects of several alternatives proposed for the disposal of dredged material in New York Harbor. As part of this research program, we have completed an extensive regional study of the benthos in Lower Bay of New York Harbor. This study was specifically designed to match the disparate sampling methods used in prior surveys of the bay conducted over the past 30 years. Analysis on this data base is allowing us to examine for the first time the detailed spatial and temporal structure of the benthos in Lower Bay.

Cerrato, R.M.; Wallace, H.V.E.; Lightfoot, K.G. Tidal and seasonal patterns in the chondrophore of the soft-shell clam *Mya arenaria*. Biological Bulletin 181:307-311; 1991.

Cerrato, R.M. Interpretable statistical tests for growth comparisons using parameters in the von Bertalanffry equation. Canadian Journal of Fisheries and Aquatic Sciences; 47:1416-1426; 1990.

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J. Kirk Cochran

Professor,
Associate Director of Research
Ph.D., 1979
Yale University

My research group and I are using natural radionuclides, as well as those produced by activities such as atomic weapons testing, to study earth surface processes. The fact that different chemical elements are represented in the suite of radioactive nuclides permits studies of chemical behavior, and the property of radioactivity provides a clock with which to measure rates. Research Scientist David Hirschberg and I are using naturally occurring thorium isotopes to determine rates of particle cycling in the open ocean. This work, part of the Joint Global Ocean Flux Study, has as its goal an understanding of the fate of carbon in the ocean. The thorium isotopes provide a means of determining particle (and carbon) fluxes from the upper ocean. In coastal waters and estuaries like Long Island Sound, naturally occurring radionuclides provide tracers to determine rates of removal of contaminants from the water column.

Together with graduate student Jing Wang, we are also evaluating the importance of the atmosphere as a pathway for trace metals and organic contaminants to the Long Island Sound. We are using salt marshes as a recorder of the chronological inputs of metals to the estuary and have found that for Long Island Sound, most of the Pb in the sediments of the Sound is supplied by the atmosphere.

Buesseler, K.O.; Bacon, M.P.; Cochran, J.K.; Livingston. H.D. Carbon and nitrogen export during the JGOFS North Atlantic Bloom Experiment estimated from Th-234:U-238 disequilibria. Deep-Sea Research (in press).

Cochran, J. K. The oceanic chemistry of the U- and Th-series nuclides. In: Ivanovich, M.; Harmon, R., eds. Uranium series disequilibrium-application to environmental problems. 2nd Edition, Oxford University Press; 1991.

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Landman, N.H.; Cochran, J.K.; Chamberlain, J.A.; Hirschberg, D.J. Timing of septal formation in two species of *Nautilus* based on radiometric and aquarium data. Marine Biology; 102:65-72; 1989.

Barnes, C.; Cochran, J.K. The geochemistry of uranium in marine sediments. In: Guary, J.C.; Guegueniat, P.; Pentreath, R.J., eds. Radionuclides: a tool for oceanography. New York: Elsevier; pp. 162-170; 1988.

David O. Conover

Associate Professor
Ph.D., 1982
University of Massachusetts

My research interests involve the ecology and evolutionary biology of fishes and fisheries science. I seek to understand the adaptive significance of reproductive, behavioral, physiological, or life history traits in fishes and then to extend this knowledge, where possible, to fundamental problems in resource management.

One long-standing interest of mine, for example, is to understand how the sex ratio evolves. My work has been the first to show that sex determination in fishes is influenced by temperature during larval development. Most of this work has involved the Atlantic silverside, *Menidia menidia*, but the phenomenon is probably widespread. These findings are important not only in designing approaches to sex ratio manipulation in aquaculture, but also to understanding the causes of fluctuations in sex ratio among natural populations.

Another project concerns the recruitment of juvenile bluefish *(Pomatomus saltatrix)* to estuaries along the U.S. East Coast. My students and I are testing the hypothesis that young bluefish acquire an important predatory size advantage over their principal prey by virtue of being spawned offshore early in the year and invading estuaries of the Middle Atlantic Bight at an advanced size, just as the growing season of the local prey species is beginning.

A new area of investigation concerns how growth rate is adapted to differences in seasonality that occur with latitude. In several species distributed along the Atlantic coast of North America, the length of the growing season declines with increasing latitude by a factor of about three. Yet body size at the end of the growing season is independent of latitude. Experimental studies on laboratory-reared fish from one of these species explain this paradox: high-latitude fish have a higher genetic capacity for growth and thereby grow two to three times faster within the growing

season than do low-latitude fish. This "countergradient variation" in growth rate appears to be widespread and may provide a general model for choosing natural stocks to be used in aquaculture: the natural populations with the highest capacity for growth may be found where the growing season is shortest.

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Chiarella, L.; Conover, D.O. Spawning season and first year growth of adult bluefish *(Pomatomus saltatrix)* from the New York Bight. Trans. Amer. Fish. Soc.; 119:455-462; 1990.

Conover, D.O. The relations between capacity for growth and length of growing season: evidence for and implications of countergradient variation. Trans. Amer. Fish. Soc.; 119:416-430; 1990.

Conover, D.O.; Present, T.M.C. Countergradient variation in growth rate: compensation for length of the growing season among Atlantic silversides from different latitudes. Oecologia; 83:316-324; 1990.

Conover, D.O.; Van Voorhees, D.A. Evolution of a balanced sex ratio by frequency-dependent selection in a fish. Science; 250:1556-1558; 1990.

Nyman, R.; Conover, D.O. The relation between spawning season and the recruitment of young-of-the-year bluefish *(Pomatomus saltatrix)* to New York. Fishery Bulletin; 86(2):237-250; 1988.

Conover, D.O.; Heins, S.W. Adaptive variation in environmental and genetic sex determination in a fish. Nature; 326:496-498; 1987.

Elizabeth M. Cosper

Research Associate Professor
Ph.D., 1981
City University of New York
City College

I am generally interested in the physiological ecology of marine phytoplankton. My research mainly involves the use of experimental laboratory systems to address environmental problems that are difficult to assess under field conditions.

In the past my research has involved a study of the effects on the production of a common marine diatom of fluctuation in light on natural time scales of variability. More recently, my research has centered on the factors affecting the ability of marine phytoplankton to develop resistance to toxic chemical pollutants and the ecological consequences of the development of this resistance. Concomitantly, one of my students and I have conducted studies of the significance of resting states of diatoms to their population dynamics and adjustment to stressful conditions, both natural and anthropogenic in origin.

Most recently, several of my students and I have become involved in both field and laboratory research into the causes of the "brown tide" blooms which have plagued Long Island embayments since 1985. I have isolated this microalga into culture and, along with other researchers at MSRC, we are conducting studies of its growth physiology to better explain its explosive growth during the summer months in local bay waters. We are also investigating any environmental conditions that could have contributed to the blooming of this previously undescribed phytoplankton species.

Cohen, M.K.; West, A.S.; Cosper, E.M.; Wurster, C.F. Mechanisms of resistance to polychlorinated biphenyls (PCB) in two species of marine diatoms. J. Mar. Biol. Ass. UK; 71; 1991.

Cosper, E.M., C. Lee, E. J. Carpenter. Novel "brown tide" blooms in Long Island embayments: a search for the causes. In: Graneli, E.; Sundström, B.; Edler, L.; Anderson, D.M., eds. Toxic Marine Phytoplankton. New York: Elsevier; pp. 17-28; 1990.

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Cosper, E.M. Culturing the "brown tide" alga. Applied Phycology Forum; 4:3-5; 1987.

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Cosper, E.; Snyder, B.J.; Arnold, L.M.; Zaikowski, L.A.; Wurster, C.F. Induced resistance and altered environmental fitness in a marine diatom. Marine Environmental Research; 23:207-222; 1987.

Robert K. Cowen

Assistant Professor
Ph.D., 1985
University of California at San Diego/
Scripps Institution of Oceanography

My main research interests are centered on the biological and physical factors that influence recruitment of nearshore fish populations. In particular, I am studying the various mechanisms that coastal fish species utilize to return their larvae from the open sea to coastal habitats. This work involves a very integrated approach whereby the biology of the organisms, their larval distribution, and the physical oceanography must be studied concurrently.

My laboratory is presently working on three separate projects. The first is focused on the oceanic transport of larval fish, with particular emphasis on bluefish *(Pomatomus saltatrix)* within the Middle Atlantic Bight. We are interested in both cross-shelf transport and larger scale processes involving the transport of fish from south of Cape Hatteras into the local New York waters.

The other two projects concern recruitment processes of coral reef fish within Caribbean waters. One of these, in collaboration with Malcolm Bowman, concerns the retention of larval fish in the lee of islands. Specifically, we are testing whether or not eddies are important in the entrapment and eventual return of larval fish to the reef habitat, and if not, then what features of the local current regime are important in the retention of larvae.

We are also interested in the length of time various larvae are capable of remaining in their pelagic phase. Through the study of the microstructure of otoliths (small ear bones) of larval fish, the duration of their various developmental stages can be determined and then compared among species with respect to their offshore distribution. Finally, my lab is just beginning a new project in St. Croix, U.S. Virgin Islands, where we are examining the movement and size of patches of larval fish just prior to their settlement on shore.

Cowen, R. K.; Chiarella, L.; Gomez, C; Bell, M. Distribution, age and lateral plate variation of larval sticklebacks *(Gasterosteus)* off the Atlantic coast of New Jersey, New York and southern New England. Canadian Journal Aquatic and Fisheries Science; (in press).

Cowen, R.K. Variation in the planktonic larval duration of the temperate wrasse *Semicossyphus pulcher*. Marine Ecology Progress Series; 69: 9-15; 1991.

Cowen, R.K. Sex change and life history patterns of the labrid, *Semicossyphus pulcher*, across an environmental gradient. Copeia; (3):783-791; 1990.

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Castro, L.R.; Cowen, R.K. Growth rates of bay anchovy *(Anchoa mitchilli)* in Great South Bay under recurrent brown tide conitions: 1987 and 1988. In: Cosper, E.M.; Carpenter, E.J.; Bricelj, V.M., eds. Novel phytoplankton blooms: causes and impacts of recurrent brown tides and other unusual blooms. Coastal and Estuarine Studies, Vol. 35. Berlin: Springer-Verlag; pp. 665-676; 1989:

Cowen, R.K. Large scale pattern of recruitment by the labrid, *Semicossyphus pulcher*: causes and implications. Journal of Marine Research 43:719-742; 1985.

Nicholas S. Fisher

Professor
Ph.D., 1974
State University of
New York at Stony Brook

My research is concerned with the interactions of marine organisms with toxic chemicals. Most of these biogeochemically oriented studies focus on marine plankton and their interactions with select metals and long-lived radionuclides emanating from the nuclear fuel cycle. I explore the bioaccumulation and trophic transfer of the chemicals, their impacts on the organisms, and the roles that the organisms play in mediating the cycling and vertical transport of these chemicals in the ocean. Laboratory experimentation generally employs radiotracer methodology, which enables working with environmentally realistic metal concentrations.

My research group and I are conducting experiments to determine the accumulation and cellular localization of metals in marine phytoplankton cells, the assimilation of metals in herbivorous animals, the gut pH of different types of planktonic herbivores, the bacterial degradation rate of different forms of biogenic debris, and the influence of these processes on the retention of metals in this debris. I am also currently trying to incorporate new production models to quantitatively assess the influence of different forms of sinking biogenic debris in vertically transporting metals in different water columns.

My other research interests include phytoplankton physiology and ecology, phytoplankton-herbivore interactions, the nature of element binding to particle surfaces, marine colloids, and metal geochemistry.

Fisher, N.S; Guillard, R.R.L.; Bankston, D.C. The accumulation of barium by marine phytoplankton grown in culture. Journal of Marine Research; 49:339-354; 1991.

Fisher, N.S.; Nolan, C.V.; Fowler. S.W. Assimilation of metals in marine copepods and its biogeochemical implications. Marine Ecology Progress Series; 71:37-43; 1991

Fisher, N.S.; Nolan, C.V.; Fowler, S.W. Scavenging and retention of metals by zooplankton fecal pellets and marine snow. Deep-Sea Research; 38:1261-1275; 1991.

Fisher, N.S.; Nolan, C.V.; Gorsky, G. The retention of cadmium and zinc in appendicularian houses. Oceanologica Acta; 14:427-430; 1991.

Fisher, N.S.; Reinfelder, J.R. Assimilation of selenium in the marine copepod *Acartia tonsa* studied with a radiotracer ratio method. Marine Ecology Progress Series; 70:157-164; 1991.

Reinfelder, J.R.; Fisher, N.S. The assimilation of elements ingested by marine copepods. Science; 251:794-796; 1991.

Fisher, N.S.; Honjo, S. Intraspecific differences in temperature and salinity responses in the coccolithophore *Emiliania huxleyi*. Biological Oceanography; 6:355-361; 1989.

Fisher, N.S.; Cochran, J.K.; Krishnaswami, S.; Livingston, H.D. Predicting the oceanic flux of radionuclides on sinking biogenic debris. Nature; 335:622-625; 1988.

Roger D. Flood

Associate Professor
Ph.D., 1978
Massachusetts Institute of Technology/
Woods Hole Oceanographic Institution

I am presently studying sedimentation in several marine and fresh water environments. I am particularly interested in the use of high-resolution methods, including geophysical techniques (side-scan sonar, seismic profiling, shear-wave analysis, and bathymetry); photography; submersible and diver sampling; and sediment analysis, to provide new insights into sedimentary processes. My current research interests focus on processes in active sedimentary environments (including the deep sea, continental margins, large lakes, and estuaries) and with the study of bedforms in cohesive sediment.

Recently, my students and I have been studying the structure and development of submarine fans on the continental margin. These major sediment bodies contain much of the sediment eroded from continents during sea level lowstands. Our intensive geophysical and sedimentological studies have demonstrated some of the complexity of these systems and helped to clarify processes responsible for fan development. Also, recent bedform studies have been conducted in the deep sea along the U.S. continental margin and in the Argentine Basin, in the Great Lakes, and in the Hudson River. Bedforms created by fluid flows can be used to understand both local and regional sediment transport and depositional patterns. Our studies help to understand both the complex flow-sediment interactions that cause and maintain bedforms in cohesive sediments and bedform-animal interactions.

Flood, R.D. Submersible studies of current-modified bottom topography in Lake Superior. Journal of Great Lakes Research; 15:3-14; 1989.

Damuth, J.E.; Flood, R.D.; Kowsmann, R.O.; Belderson, R.H.; Gorini, M.A. Anatomy and growth pattern of Amazon deep-sea fan as revealed by long-range side-scan sonar (GLORIA). American Association of Petroleum Geologists; 72:885-911; 1988.

Flood, R.D. A lee-wave model for deep sea mud wave activity. Deep-Sea Research; 35:975-983; 1988.

Flood, R.D.; Shor, A.N. Mud waves in the Argentine Basin and their relationship to regional bottom circulation patterns. Deep-Sea Research; 35:943-971; 1988.

Manley, P.L.; Flood, R.D. Cyclic development within the Amazon deep-sea fan. American Association of Petroleum Geologists; 72:912-925; 1988.

Valrie A. Gerard

Associate Professor
Ph.D., 1976
University of California, Santa Cruz

My research interests focus on the ecology and physiology of seaweeds, particularly species which are important as primary producers in marine ecosystems or as commercial aquaculture crops. Much of my recent research examines genetic variation among populations of the common kelp, *Laminaria saccharina*, which occurs throughout the northern hemisphere. The wide geographic range of this species is partly due to its ability to adapt genetically to different environmental conditions.

I have identified several genetic varieties, or ecotypes, of *L. saccharina* from Long Island Sound and the New England coast. These ecotypes show different responses to light and temperature conditions, and genetic differences are expressed in both the large, spore-producing phase and the microscopic, sexual phase of the life-cycle. My next step will be to explore how genetic adaptation in one of these phases influences the complementary phase, i.e., how natural selection works in an organism with a complex life-history.

Several other research projects have been conducted in my laboratory recently. One project developed a computer model to predict the population dynamics of giant kelp in California. Another project examined the relationship between nitrogen-fixing cyanobacteria and the green seaweed *Codium fragile*. A third project determined effects of high-frequency light fluctuations on the carbon metabolism of the red seaweed, *Chondrus crispus*. My newest research project will determine whether environmental stress that occurs during the early developmental stages of a seaweed influences the physiology and growth of that plant later on in its life.

Burgman, M.A.; Gerard, V.A. A stage-structured, stochastic population model of the giant kelp *Macrocystis pyrifera*. Marine Biology; 105:15-23; 1990.

Gerard, V.A. Ecotypic differentiation in the common kelp *Laminaria saccharina*: phase-specific adaptation in a complex life-cycle. Marine Biology; 107:519-528; 1990.

Gerard, V.A.; Dunham, S.; Rosenberg, G. Nitrogen-fixation by cyanobacteria associated with *Codium fragile* (Chlorophyta): environmental effects and transfer of fixed nitrogen. Marine Biology; 105:1-8; 1990.

Greene, R.M.; Gerard, V.A. Effects of high-frequency light fluctuations on growth and photoacclimation of the red alga, *Chondrus crispus*. Marine Biology; 105:337-344; 1990.

Gerard, V.A. Ecotypic differentiation in light-related traits of the kelp, *Laminaria saccharina*. Marine Biology; 97:25-36; 1988.

Gerard, V.A.; K. Du Bois. Temperature ecotypes near the southern boundary of the kelp, *Laminaria saccharina*. Marine Biology; 97:575-580; 1988.

Gerard, V.A. Hydrodynamic streamlining of *Laminaria saccharina* Lamour. in response to mechanical stress. Journal of Experimental Marine Biology and Ecology; 107:237-244; 1987.

Gerard, V.A.; Du Bois, K.; Greene, R. Growth responses of two *Laminaria saccharina* populations to environmental variation. Hydrobiologia; 151:229-232; 1987.

Theodore D. Goldfarb

Associate Professor
Department of Chemistry,
Joint with MSRC
Ph.D., 1959
University of California, Berkeley

In recent years my research interests have shifted from physical chemical investigations of the structure and reactivity of molecules to the application of physical chemical methods to real world environmental problems. The pollution problems resulting from the use of agricultural chemicals, the production of energy, and the disposal of waste encompass the range of issues that I have joined with scientists in other disciplines to explore.

Our present activities are focused on the environmental consequences of alternative means of addressing the need to dispose of both municipal and industrial waste, including incineration, waste reduction, reuse, and recycling. Related to this work is my interest in the interactions between science and public policy.

Harrad, S.J.; Malloy, T.A.; Khan, M.A.; Goldfarb, T.D. Levels and sources of PCDDs and PCDFs, chlorophenols and chlorobenzenes in composts from a municipal yard wast facility. Chemosphere; 23:181; 1991.

Goldfarb, T.D.; Maertz, M.; Roethel, F. J.; Iden, C.R.; Rieger, R. PCDDs and PCDFs in incineration ash from several types of facilities in the Northeastern United States. Chemosphere; 20:1833; 1990.

Goldfarb, T.D.; Harrad, S.J. Consideration of the volatilization of PCDD and PCDF from deposited particulates in combustion source risk assessments. Dioxin 90/EPRI Seminar Short Papers; 1: 529, Bayreuth, FRG: Ecoinforma Press; 1990.

Goldfarb, T.D. Evidence for post-furnace formation of PCDDs and PCDFs: implications for control. Chemosphere 18:1051; 1989.

Goldfarb, T.D.; Deutsch, D. PCDD/PCDF contamination following a fire in a university lecture hall building. Chemosphere 17:2423; 1988.

Goldfarb, T.D. Solid waste incineration: the need for stringent regulation and the vigorous pursuit of more environmentally acceptable means of solid waste disposal. New York State Legislative Commission on Solid Waste Management. September 1984. Proc. 1st Ann. Conf. for Government and Citizen Decision Makers; 1984.

William H. Greene

Clinical Associate Professor of Medicine,
Division of Infection Control
Health Sciences Center,
Joint with MSRC
M.D., 1968
State University of New York Downstate

My research interests have evolved from that of infectious complications in patients with neoplastic disease to the more general area of infectious complications of hospitalized patients. This latter field, hospital-acquired infections, has traditionally also included infection prevention methods for health-care workers and visitors, as well as patients.

In turn, recent priorities in society have brought to the fore the management of medical waste, particularly the minimization of infectious hazards in its generation, transport, and disposal. My current research interests revolve around the clinical investigation of experimental antibiotics; the prevention of hospital-acquired infection, particularly of the respiratory tract; and the medical implications of waste handling for health-care workers, solid waste personnel, and communities surrounding landfills.

Greene, W.H. Infection control policies and AIDS. New England Journal of Medicine; 316:1479-1480; 1987.

Marchese, J.T.; Marshall, G.B.; LaValle, R.F.; Greene, W.H. Regulated medical waste disposal at a university and university hospital: future implications. Preceedings, 3rd International Conference on Nosocomial Infections; Atlanta; August, 1990.

Herbert Herman

Professor
Department of Materials Science
Joint with MSRC
Ph.D., 1961
Northwestern University

My research activities in ocean engineering involve principally marine materials. We have a long-term program underway aimed at the protection of materials at sea. Our work, much of which is supported by the U.S. Navy, involves the thermal spray metallization of structural steel, yielding long-term corrosion protection in a wide range of industrial and marine environments.

We also have a joint program with the New York and New Jersey Port Authority on corrosion protection of marine-related structures. Research and testing programs, with use of the above and related corrosion control techniques, are being carried out cooperatively with industrial and government organizations.

Orehotsky, J. H. Weismann, A.R. Moodenbaugh, M. Suenaga, H.G. Wang, H. Herman. Microstructure and DC critical currents in textured Y-Ba-Cu oxides. IEEE Transactions on Magnetism; MAG-27; 1990.

Wang, H.; Gudmundsson, B; Neiser, R.A.; Herman, H. The effects of argon pre-annealing on the superconductive properties of plasma-sprayed Y-Ba-Cu-oxide coatings. In: Whang, S.H.; DasGupta, A; Laibowitz, R., eds. High temperture superconducting compounds II. The Minerals, Metals & Materials Society; pp. 141-150; 1990.

Wang, H.G.; Herman, H.; Bancke, G.A.; Adamski, A.; Wood, M. Flame rig testing of thick thermal barrier coatings. In: Yazici, R.M., ed. Protective coatings: proc. and char. The Metallurgical Soc.; 1990.

Sampath, S.; Herman H. Plasma spray consolidation of amorphous powders: microstructure and properties. In: Sampath, S.; Herman, H. Protective coatings: proc. and char. The Metallurgical Soc.; pp. 145-153; 1990.

Wang, H.G.; Fishman, G.S.; Herman, H. Plasma spray cordierite: structure and transformations. Journal of Materials Science; 24:811-815; 1989.

Wang, H.G.; Herman, H. Structure and properties of plasma sprayed spinel. Ceramics Bulletin; 68:97-102; 1989.

Richard Koehn

Professor
Department of Ecology and Evolution
Joint with MSRC
Ph.D., 1967
Arizona State University

I am studying the biochemical and physiological mechanisms of adaptation, including enzyme function, the energetic cost of the control of metabolism, and the genetic basis of physiological variation. I have had a long-standing interest in adaptation, particularly with respect to enzyme-encoding loci and have worked on both fishes and marine mollusks. I have also had an interest in systematics and am currently involved in a project on the systematics of species in the bivalve genus *Mytilus*, as well as their worldwide distribution.

My students have worked on a variety of organisms. Research projects have focused upon the relationship between multiple-locus genotype and energy metabolism and have been directed towards understanding the biochemical genetic basis of genotype-dependent energy balance.

Koehn, R.K.; Hilbish, T.J. Biochemical genetic mechanisms of adaptation. American Scientist. 75:134-141; 1987.

MacDonald, J.H.; Koehn, R.K. The mussels *Mytilus trossulus* and *M. galloprovincialis* on the Pacific coast of North America. Marine Biology 99:111-118; 1988.

Koehn, R.K.; Diehl, W.J.; Scott, T.M. The differential contribution by individual enzymes of glycolysis and protein catabolism to the relationship between heterozygosity and growth rate in the coot clam, *Mulinia lateralis*. Genetics 118:121-130; 1988.

Koehn, R.K.; Bayne, B.L. Towards a physiological and genetical understanding of the energetics of the stress response. Biol. J. Linn. Soc. 37:157-171; 1989.

Silva, P.J.N.; Koehn, R.K.; Diehl, W.J.; Ertl, R.P.; Winshell, E.B.; Santos, M. The effect of glucose-6-phosphate isomerase genotype on *in vitro* activity and *in vivo* flux in *Mytilus edulis*. Biochem. Genet. 27:451-465; 1989.

L. E. Koppelman

Professor
Center for Regional Policy Studies
Joint with MSRC
Ph.D., 1970
New York University

My major research over the past decade and a half generally has been concerned with the environmental policy aspects of regional planning and has been specifically directed towards coastal zone management. This has included being project manager over almost $20 million in directed research, including coastal regional planning, comprehensive water management, shoreline erosion practices, and related studies.

In addition to the development of legislation related to coastal zone management and the design of administrative mechanism for policy implementation, I am particularly involved in the development of synthesis techniques for relating coastal zone science into the regional planning process.

In October 1988 I was appointed Director of the Center for Regional Policy Studies, which currently is carrying out a number of research projects dealing with governmental productivity, strategic economic planning, and environmental planning. I also serve as Executive Director of the Long Island Regional Planning Board, and beginning April 1991 undertook staff responsibility for the Bicounty Temporary State Commission on Tax Relief for Long Island.

Koppelman, L. Jurisdiction. In: Schubel, J.R.; Bell, T.M.; Carter, H.H., eds. The Great South Bay. Albany, NY: State University of New York Press; pp. 75-82; 1991.

Koppelman, L. Uses, misuses and abuses of the bay. In: Schubel, J.R.; Bell, T.M.; Carter, H.H., eds. The Great South Bay. Albany, NY: State University of New York Press; pp. 83-88; 1991.

Koppelman, L. A management approach. In: Schubel, J.R.; Bell, T.M.; Carter, H.H., eds. The Great South Bay. Albany, NY: State University of New York Press; pp. 89-100; 1991.

Koppelman, L. Long Island case study. In: Page, G. W., ed. Planning for Groundwater Protection. New York: Academic Press; 1987.

Koppelman, L.; DeChiara, J. Time saver standards for site planning. New York: McGraw Hill; 1982.

Koppelman, L.; Tanenbaum, E. The Long Island segment of the nationwide urban runoff program. Available from: Hauppauge, NY.: L.I. Regional Planning Board; 238 pp.; 1982.

Koppelman, L.; DeChiara, J. Urban planning and design criteria, 3rd Ed. New York: Van Nostrand Reinhold Co., Inc; 1981.

Koppelman, L.; Kunz. A.; Tannenbaum, E. Special ground-water protection area project. Hauppauge, NY: Long Island Regional Planning Board; 425 pp.; 1991.

Cindy Lee

Professor
Ph.D., 1975
University of California at San Diego/ Scripps Institution of Oceanography

My research is concerned with the distribution and behavior of biogenic organic compounds in the marine environment. Understanding how organic compounds behave requires knowledge of the biological, geological, and physical processes in the sea. Most biogenic organic compounds are produced in surface waters by phytoplankton as a result of photosynthesis. These compounds can enter the marine food chain by acting as food for bacteria or zooplankton. Organic compounds can also be affected by chemical and physical processes such as adsorption, photochemical degradation, and transport by currents. I am interested in the rates and mechanisms of the transformation reactions which occur as organic compounds are affected by these processes. To study transformation reactions, my students and I use radiolabeled compounds as tracers to simulate the behavior of naturally occurring compounds. We also identify and measure the amount of individual organic compounds present in the environment with analytical techniques like gas chromatography, mass spectrometry, and high performance liquid chromatography (HPLC).

I am interested in the behavior of organic compounds in all environments, particularly, sediments and waters of open ocean and coastal areas, salt marshes, and lakes, as well as the atmosphere above these areas. A knowledge of the behavior of biogenic organic compounds in the environment will help us in practical ways. For example, we can better understand the formation of coal and oil deposits if we know how organic matter is produced, decomposed, and preserved. We may also be able to use the behavior of naturally occurring organic compounds as models in predicting the behavior of organic pollutants in the environment.

Wang, X-C; Lee, C. The distribution and adsorption behavior of aliphatic amines in marine and lacustrine sediments. Geochimica et Cosmochimica Acta; 54:2759-2777; 1990.

Wakeham, S.G.; Lee, C. Organic geochemistry of particulate matter in the ocean: the role of particles in oceanic sedimentary cycles. Organic Geochemistry; 14:83-96; 1989.

Lee, C.; Wakeham, S.G. Organic matter in seawater: biogeochemical processes. In: Riley, J.P.; Skirrow, G., eds. Chemical oceanography. New York: Academic Press; 9:1-51; 1988.

Lee, C.; Wakeham, S.G.; Hedges, J.I. The measurement of oceanic particle flux - are swimmers a problem? Oceanography; 2:34-36; 1988.

McNichol, A.P.; Lee, C; Druffel, E.R.M. Carbon cycling in coastal sediments: I. A quantitative estimate of the remineralization of organic carbon in the sediments of Buzzards Bay, MA. Geochimica et Cosmochimica Acta; 52:1531-1543; 1988.

Darcy J. Lonsdale

Assistant Professor
Ph.D., 1979
University of Maryland

I study the ecology and physiology of estuarine invertebrates, particularly copepods. In collaboration with Dr. Elizabeth Cosper, I currently am investigating phytoplankton-zooplankton coupling in several New York estuaries. Using radioactive tracers, we hope to determine the rates at which carbon is being fixed during photosynthesis, where the carbon is moving through the food chain after it is incorporated into the algal cells, and what factors such as cell size and food quality influence the extent of phytoplankton-zooplankton coupling.

Another area of my research addresses the ecological importance of reproductive resting stages in estuarine copepods and the significance of genetically based differences among populations.

The graduate students in my laboratory are undertaking diverse research projects. One project is an investigation of the impact of changing food resources, particularly biochemical changes that may be associated with species succession of planktonic microalgae, on the recruitment of important coastal species of copepods. Another study involves an investigation of the impact of a common ectoparasite on copepod energetics and resting egg production. In many seasonal species, resting eggs are an important source for copepod recruitment in the following year.

Additional student projects include a study of the grazing impact of microzooplankton (e.g., ciliates) on phytoplankton communities, and top predator effects (e.g., gelatinous zooplankton) on estuarine plankton dynamics.

Lonsdale, D.J.; Jonasdottir, S.H. Geographic variation in naupliar growth and survival in a harpacticoid copepod. Biol. Bull.; 179:113-120; 1990.

Lonsdale, D.J.; Levinton, J.S. Energy budgets of latitudinally separated *Scottolana canadensis* (Copepoda: Harpacticoida). Limnology and Oceanography; 34(2):324-331; 1989.

Lonsdale, D.J.; Levinton, J.S.; Rosen, S. Reproductive compatibility among populations of a widespread Harpacticoida. Hydrobiologia; 167/168:469-476; 1988.

Glenn R. Lopez

Professor
Ph.D., 1976
State University of
New York at Stony Brook

I am a benthic ecologist interested in many aspects of life in sediment. My students and I are investigating the detrital and microbial food sources of deposit feeders and the physiological mechanisms that animals use for digesting such foods. Because gut residence time is very short in juveniles of many species, we are interested in the control of the energy budget by the kinetics of ingestion and digestion. We are studying how deposit feeders grow and the biological meaning of observed allometric shifts. We are also studying population dynamics of benthic animals.

Forbes, T. L.; Lopez, G.R. The effect of food concentration, body size, and environmental oxygen tension on the growth of the deposit-feeding polychaete, *Capitella* species I. Limnology and Oceanography 35:1535-1544; 1990.

Forbes, V.E.; Lopez, G.R. The role of sediment type in growth and fecundity of mud snails (Hydrobiidae). Oecologia (Berl.) 83:53-61; 1990.

Lopez, G; Elmgren, R. Feeding depths and organic absorption for the deposit-feeding benthic amphipods *Pontoporeia affinis* and *Pontoporeia femorata*. Limnology and Oceanography 34:982-991; 1989.

Lopez, G.R.; Taghon, G.; Levinton, J., eds. Ecology of marine deposit feeders. New York: Springer-Verlag; 1989.

Lopez, G.R. Comparative ecology of the macrofauna of freshwater and marine muds. Limnology and Oceanography; 33:946- 962; 1988.

Lopez, G.R.; Levinton, J.S. Ecology of deposit-feeding animals in marine sediments. Quarterly Review of Biology 62:235-260; 1987.

Kamazima M.M. Luiza

Research Assistant Professor
Ph.D., 1990
University of Wales

My research interests are the structure and dynamics of the shelf-seas and remote sensing oceanography. Recently, I have been studying the dynamics of a shelf-sea front in the North Sea with colleagues from the United Kingdom. We have developed a technique capable of removing tides from ship-borne acoustic Doppler current profiler (ADCP) measurements.

Currently, I am working on a project in the North Sea to map the sea bottom topography (with sand waves of up to 4 m high) using a multi-sensor approach. We are using a helicopter-born scatterometer (HELISCAT) to measure the sea surface roughness backscatter, complemented by ship and aircraft measurements. The aircraft takes sunglint images with an Airborne Thematic Mapper (ATM), while the ship measures physical water properties and the near-surface current modulation.

Lwiza, K.M.M.; Bowers; D.G.; Simpson, J.H. Residual and tidal flow at a tidal mixing front in the North Sea. Continental Shelf Research; 11; (in press).

Lwiza, K.M.M.; Bigendako, P.R. Kunduchi tides. Tanzania Journal of Science; 14:65-76; 1988.

James E. Mackin

Associate Professor
Ph.D., 1983
University of Chicago

My research emphasizes theoretical and practical aspects of organic matter and clay mineral diagenesis in marine sediments. The goal of this research is to determine the influence of reactions involving major phases of sediments on both present day ocean chemistry and sedimentary rock chemistry and mineralogy. I am, therefore, interested in solid-solid transformations as well as the behavior of solutes during early diagenesis in sediments. Field and laboratory experimental work are essential components of this research.

Mackin, J.E. Relationships between Si, Al, and Fe deposited on filter-covered glass substrates in marine sediments and in suspensions of sediments and standard clays. Marine Chemistry; 25; 1989.

Mackin, J.E.; Aller, R.C. The nearshore marine and estuarine chemistry of dissolved aluminum and rapid authigenic mineral precipitation. Reviews of Aquatic Science; 1:537-554; 1989.

Mackin, J.E.; Swider, K.T. Organic matter decomposition pathways and oxygen consumption in coastal marine sediments. Journal of Marine Research; 4; 1989.

Michelson, A.R.; Jacobson, M.E.; Scranton, M.I.; Mackin, J. Factors controlling the distribution of acetate in anoxic marine and estuarine sediments. Limnology and Oceanography; 34:747-757; 1989.

Mackin, J.E.; Aller, R.C.; Ullman, W.J. The effects of iron reduction and nonsteady-state diagenesis on iodine, ammonium, and boron distribution in sediments from the Amazon continental shelf. Continental Shelf Research; 8:363-386; 1988.

John L. McHugh

Professor Emeritus
Ph.D., 1950
University of California at Los Angeles

I continue to be interested in fisheries research.

McHugh, J.L. Fisheries Management Under the Magnuson Act: is it working? Ocean Development and International Law 21: 255-261; 1991.

McHugh, J.L.; Hasbrouck, E. Fishery management in New York Bight: experience under the Magnuson Act. Fisheries Research 8:205-221; Amsterdam: Elsevier Science Publishers, B.V.; 1990.

McHugh, J.L.; Wise, W.M.; Young, R.R. Historical trends in the abundance and distribution of living marine resources. In: Cleaning up our coastal waters: an unfinished agenda. Regional conference co-sponsored by Manhattan College and the Management Conference for the Long Island Sound Study , the New York-New Jersey Harbor Estuary Program, and the New York Bight Restoration Plan, March 12-24, 1990 Riverdale, NY; pp. 71-85; 1991.

McHugh, J.L. Overview of bay scallop *(Argopecten irradians)* landings. In: Cosper, E.M.; Carpenter, E.J.; Bricelj, V.M., eds. Novel phytoplankton blooms: causes and impacts of recurrent brown tides and other unusual blooms. Coastal and Estuarine Studies, Vol. 35 Berlin: Springer-Verlag. pp. 487-492; 1989.

McHugh, J.L. Can we manage our Atlantic coastal fishery resources - II? Marine Fisheries Review 50(4):41-45; 1988.

McHugh, J.L. United States commercial fishing: what is it worth? Delaware Center for the Study of Marine Policy. Marine Policy Reports; 10(2):1-7; 1988.

McHugh, J.L.; Sumner, M. Annotated bibliography II. of the hard clam *Mercenaria mercenaria* - NOAA Technical Report National Marine Fisheries Service, Special Scientific Report, Fisheries Series. U.S. Dept. of Commerce, Washington, DC; iii + 59; 1988.

W. J. Meyers

Professor
Department of Earth and Space Sciences
Joint with MSRC
Ph.D., 1973
Rice University

The main focus of my research is the deposition and diagenesis of carbonate rocks and sediments. Through integrated field, petrographic, and geochemical studies, my students and I are investigating regional dolomitization, cementation, and compaction in a wide range of shallow-water reefal, platform, and peri-platform carbonate rocks from a range of ages and tectono-sedimentary settings. The main goals are to reconstruct the diagenetic histories of the rocks and to reconstruct the chemistry, sources, and dynamics of the diagenetic fluids that caused large-scale cementation and dolomitization. To this end we are applying standard and cathodoluminescent petrography, fluid inclusion studies, stable and radiogenic isotopes (C, O, Sr, Pb, B); trace elements (Mg. Fe, Mn, B, Sr, Pb, Na, Zn, REE, and others); and quantitative water-rock interaction modeling. The geochemical work is in close collaboration with Professor Gilbert Hanson, an effort resulting in development of innovative analytical and modeling approaches to studying diagenetic carbonates.

Current projects include studies of facies, stratigraphy, and diagenesis of carbonate sequences from the U.S. Midwest (Mississippian); Spain (Miocene); Netherlands Antilles (Mio-Pliocene); and Western Australia (Devonian).

Choquette, P.; Cox, A.; Meyers, W. Characteristics, distribution and origin of porosity in shelf dolomite: Burlington-Keokuk Formation (Mississippian), U.S. Midcontinent: J. Sed. Pet.; (in press).

Kaufman, J.; Hanson, G.; Meyers, W.J. Dolomitization of the Devonian Swan Hills Formation, Rosevear Field, Alberta, Canada: Sedimentology 38:41-66; 1991.

Kaufman, J.; Meyers, W.; Hanson, G. Burial cementation in the Swan Hills Formation (Devonian), Rosevear Field, Alberta Canada: J. Sed. Pet. 60:918-939; 1990.

Meyers, W.J. Calcite cement stratigraphy: an overview. In: Barker, C.; Kapp, O., eds., Luminescence microscopy and spectroscopy, SEPM Shortcourse #25; pp. 133-148; 1991.

Meyers, W.J. Trace element and isotope geochemistry of zoned calcite cements. Lake Valley Formation (Mississippian, New Mexico): insights from water-rock interaction modelling. Sedimentary Geology; 65:355-370; 1989.

Cander, H.S.; Kaufman, J.; Daniels, L.; Meyers, W.J. Regional dolomitization of shelf carbonates in the Burlington-Keokuk Formations (Mississippian). Illinois and Missouri: constraints from cathodoluminescent zonal stratigraphy. In: Baker, P.; Shukla, V., eds. Sedimentary and Geochemistry of Dolostones, SEPM Spec. Pub. 43:129-144; 1988.

Steven G. Morgan

Assistant Professor
Ph.D., 1986
University of Maryland at College Park

One of the most salient features of the life histories of marine animals is that they produce dispersing larvae. A single adult typically hatches thousands or millions of microscopic larvae that disperse from the adult habitat, feed and develop in the plankton and then return to adult habitats where they metamorphose. Most larvae suffer great mortality from starvation, predation, or advection into areas which are unsuitable for survival of adults. Fisheries biologists and ecologists have long been interested in explaining underlying causes of variation in larval recruitment in order to forecast harvests of commercially important species and to model fundamental ecological processes that regulate the abundance of marine populations.

What intrigues me is how adult and larval phases of life cycles have evolved in concert to reduce mortality of larvae and ensure successful recruitment to adult populations. Specifically, I examine (1) physical, chemical, and biological processes that regulate the timing of reproduction, larval dispersal, and larval settlement; (2) selective forces in the plankton that shape life histories; and (3) ecological and evolutionary consequences of complex life cycles. I work on different ecological scales with invertebrate and vertebrate animals, in several tidal regimes and in various habitats including coral reefs, mangroves, salt marshes, estuaries, marine bays, exposed coasts and continental shelves.

For example, I have studied the impact of planktivory and physical factors on the timing of larval release, dispersal patterns and larval morphologies of crabs. I also have studied the hatching rhythms of populations of crabs from various tidal regimes in the Caribbean, Pacific, Atlantic, and Gulf of Mexico to demonstrate that these rhythms are highly plastic and entrained by local environmental cues.

Furthermore, I have investigated adaptations of pigmented larvae that enable them to survive countervailing selective forces of ultraviolet radiation and visually-feeding fishes in illuminated surface waters. Another aspect of my research program examines the intersection of physical processes and behavior on larval transport and recruitment of fishes, crustaceans and bivalves in areas ranging from continental shelves to estuaries. Lastly, I have evaluated and ranked the relative importance of nursery habitats for blue crabs by determining settlement rates of postlarvae and postsettlement growth and mortality of juveniles in each.

Morgan, S.G. Impact of planktivorous fishes on the dispersal, hatching and morphology of estuarine crab larvae. Ecology; 71:1639-1652; 1990.

Morgan, S.G. The adaptive significance of spination in estuarine crab zoeae. Ecology; 70:464-482; 1989.

Morgan, S.G. Selection on hatching rhythms and dispersal patterns of estuarine crab larvae: avoidance of physiological stress by larval export? Journal of Experimental Marine Biology and Ecology; 113: 71-78; 1987.

Morgan S.G. Behavioral and morphological antipredatory adaptations of decapod zoeae. Oecologia; 73:321-480; 1987.

Charles Nittrouer

Professor,
Ph.D., 1978
University of Washington, Seattle

My research interests deal with understanding the formation of sedimentary strata in continental margin environments. The primary effort of my research group has been to examine environments of the continental shelf, but our work also extends to shallower (lagoon, tidal flat) and deeper (continental slope and rise) environments. An underlying philosophy is that emphasis should be placed on understanding strata formation where large amounts of sediment are accumulating in modern environments and where large amounts of sediment have accumulated in ancient environments. This has led much of our research effort toward fine-grained siliciclastic sediments tied to dispersal systems of rivers (e.g., Amazon, Columbia, Yangtze, Huanghe, Ebro, Po). In addition to these mid and low latitude studies, we have been working in the Antarctic (in particular, the Ross Sea and the peninsula area) to examine the contrasting character of glacial-marine sedimentation.

I am interested in documenting, within modern strata, sedimentary characteristics which will reach the geological record (e.g., grain size, mineralogy, sedimentary structure, seismic stratigraphy) and in examining how these characteristics are affected by physical and biological oceanic processes. A critical factor is the ability to evaluate temporal aspects of strata formation such as rates of accumulation, frequency of physical erosion, and rates of biological reworking. These parameters can be measured on time scales commensurate with oceanic processes by using several short-lived radioisotopes (Th-234, Pb-210, C-14) found in marine sediments.

The inclusion of geochemical, physical, and biological observations within sedimentological studies causes much of my research to be interdisciplinary in nature. Hopefully, the range of information obtained provides a more general understanding of strata formation and allows development of fundamental concepts that can be applied to other modern and ancient continental margins.

Alexander, C.R.; Nittrouer, C.A.; DeMaster, D.J.; Park, Y.A.; Park, S.C. Macrotidal mudflats of the southwestern Korean coast: a model for interpretation of intertidal deposits. Journal of Sedimentary Petrology; 61:805-824; 1991.

Nittrouer, C.A., et al. Sedimentology and stratigraphy on the Amazon continental shelf. Oceanography; 4:33-38; 1991.

Kuehl, D.A.; Nittrouer, C.A.; DeMaster, D.J. Microfabric study of fine-grained sediments: observations from the Amazon subaqueous delta. Journal of Sedimentary Petrology; 58:12-23; 1988.

Nittrouer, C.A.; Bergenback, B.E.; DeMaster, D.J.; Kuehl, S.A. Accumulation of mixed carbonate and siliciclastic muds on the continental shelf of eastern Spain. In: Doyle, L.; Roberts, H, eds. Carbonate-clastic transitions. Amsterdam: Elsevier; pp. 251-269; 1988.

Nittrouer, C.A.; Coleman, J.M.; Flood, R.D.; Ginsburg, R.N.; Gorsline, D.S.; Hine, A.C.; Sternberg, R.W.; Swift, D.J.P.; Wright, L.D. Sedimentation on continental margins: an integrated program for innovative studies during the 1990's. EOS; 69:58-68; 1988.

Akira Okubo

Professor
Ph.D., 1963
The Johns Hopkins University

One of my major research interests is dispersion—the spread and mixing of substances—in the sea. Dispersion (or diffusion) plays an important role in pollution in marine environments, in particular, coastal environments. Those pollutants include such substances as oil, toxic chemicals, sewage and sludge, and plastics.

Since oceanic motions are inherently nonlinear and three-dimensional, they are potentially capable of generating chaotic motion. Substances embedded in the ocean flow are subject to the chaotic motion that tends to spread substances in the environment. Another interesting manifestation of chaos is the fractal nature of the motion of particles in the sea. Thus, the fractal dimension of drifters in the sea is used to characterize the complex nature of their trajectories. Oceanic motions also have an important effect on marine organisms. The transport of fish eggs and larvae are mostly passive and, hence, the oceanic currents, turbulence, and waves can contribute to larval transport and recruitment.

Okubo, A. Crecimiento de al organizacion biologica en ambientes turbulentos (Growth of biological organization in turbulent environments). In: Wagensberg, J., ed. Sobre la Imaginacion Cientifica. Barcelona: Tesquets Editiors; pp. 121-137; 1990.

Sanderson, B.G.; Goulding, A.; Okubo, A. The fractal dimension of relative Lagrangian motion. Tellus; 42A:550-556; 1990.

Okubo, A.; Levin, S. A. A theoretical framework for data analysis of wind dispersal of seeds and pollen. Ecology; 70:329-338; 1989.

Okubo, A.; Maini, P.K.; Williamson, M.H.; Murray, J.D. On the spatial spread of the grey squirrel in Britain. Proceedings of the Royal Society of London; B 238:113-125; 1989

Okubo, A. Biological vortex rings: fertilization and dispersal of fish eggs. In: Hallam, T.G.; Gross, L.J.; Levin, S.A., eds. Mathematical ecology. New Jersey: World Scientific; pp. 270-283; 1988.

Okubo, A. Biological-physical interactions in the sea. In: Wolff, W.; Soeder, C.J.; Drepper, F.R., eds. Ecodynamics. New York: Springer-Verlag; pp.102-112; 1988.

Sanderson, B.G.; Okubo, A. Diffusion by internal waves. Journal of Geophysical Research; 93:3570-3582; 1988.

Yan, H-H.; Okubo, A; Schubel, J.R.; Pritchard, D.W. An analytical model for remote sensing determination of the mixed layer depth. Deep-Sea Research; 38:267-286; 1991.

Craig, C.L.; Okubo, A. Physical constraints on the evolution of ctenophore size and shape. Evolutionary Ecology; 4:115-129; 1990.

Mitchell, J.G.; Okubo, A.; Fuhrman, J.A. Gyrotaxis as a new mechanism for generating spatial heterogeneity and migration in microplankton. Limnology and Oceanography; 35:123-130; 1990.

Hartmut Peters

Assistant Professor
Ph.D., 1981
University of Kiel, Germany

Since my Ph.D. work, I have been interested in oceanic processes of small scales, in turbulent mixing and internal waves. I am continuing to analyze observations from the Equatorial Undercurrent of the Pacific, work that I began while being a postdoctoral investigator at the University of Washington before joining the MSRC faculty.

Measurements of velocity and temperature with a spatial resolution of a centimeter allow a quantification of turbulent mixing; the vertical turbulent fluxes of momentum, heat, and nutrients can be estimated. The analysis is thus focused on the role of mixing in the flow dynamics and in the biogeochemical environment; it will also enable an improved representation of small-scale processes in numerical models of the tropical circulation.

At MSRC, I have shifted my emphasis towards shallow waters, especially to estuaries, without changing my overall scientific interests. I am preparing field work in the Hudson estuary, which will encompass measurements of the basic flow, using acoustic Doppler current profilers, as well as measurements of the small-scale turbulent fluctuations using high-resolution CTDs and custom-designed fast-response velocity sensors. Imaging echo soundings make turbulent overturning, as well as internal wave activity, visible. This work will help to improve our understanding of the estuarine dynamics and the environmental effect of the physical conditions. In collaboration with Dr. Robert Wilson, I will be directly comparing numerical models that incorporate an advanced treatment of turbulent mixing ("second moment closure") with the turbulence observations in an attempt to advance capabilities of realistically modelling estuarine flows.

Peters, H.; Gregg, M.C.; Sanford, T.B. Equatorial and off-equatorial fine-scale and large-scale shear variability at 140° W. Journal of Geophysical Research; 96:16, 913-916, 928; 1991.

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Peters, H.; Gregg, M.C.; Toole, J.M. On the parameterization of equatorial turbulence. Journal of Geophysical Research; 93:1199-1218; 1988.

Sheldon Reaven

Associate Professor
Department of Technology and Society
Joint with MSRC
Ph.D., 1975
University of California at Berkeley

I have been working mostly in two areas of waste management: what to do with garbage, especially plastics, and what to do with nuclear wastes. My approach to these problems might be called "technology assessment." This means working on problems from both the scientific end (assessing expert disagreement over the relevant scientific theories, mathematical models, and methods of analysis) and from the ethical and policy end (focusing on fairness issues, competing values of interested parties, risk analysis, facility siting, and overall policy evaluation). My experience has been that all of the complex environmental problems we face today are characterized by thoroughgoing scientific and nonscientific disagreement, and I have tried to help both scientists and lay citizens untangle the web of conflicting evidence and argumentation surrounding these problems.

Current research projects include (1) a study with Drs. Vincent Breslin and R. Lawrence Swanson of the breakdown and environmental impacts of degradable plastics in landfills, seawater, and other environments; (2) a project to develop a recycling "audit service" (a walk-through, on-site list of options for reducing waste generation, increasing recycling, and using more recycled materials) for restaurants, including fast-food establishments; (3) a study of the energy impacts of recycled plastic "lumber" and construction blocks made from incinerator ash. I also work with towns and cities to develop recycling and waste management programs.

Reaven, S.J.; Tonjes, D.J. Waste avoidance in the restaurant industry. Waste Management Research Report: News from State University of New York at Buffalo and Stony Brook, and Cornell University; 3(1):15-16; 1991.

Breslin, V.T.; Swanson, R.L.; Reaven, S. Investigations of the degradability of a cornstarch-based plastic. Interim Report for Archer Daniels Midland Company, Decatur, IL; May 1990.

Reaven, S.J. Choosing among risk management alternatives for mitigating groundwater pollution. In: McTernan, W., ed. Groundwater risk assessment for pollution control. New York: American Society of Civil Engineers; pp. 225-245; 1989.

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Reaven, S.J. The methodology of probabilistic risk assessment: completeness, subjective probability, and the "Lewis Report." Explorations in Knowledge; V(1):11-3; 1988.

Reaven, S. One person's opinion: we need a model professional recycling curriculum. Resource Recycling, September/October; pp. 36-37, 66; 1988.

Reaven, S.J. New frontiers: science and technology at the fair. In: Bletter, R; Dickstein, M.; Miller, M.; Reaven, S., eds. Remembering the future: the New York World's Fair from 1939 to 1964. New York: Rizzoli Press; pp: 75-103; 1989.

Frank J. Roethel

Lecturer
Ph.D., 1982
State University of
New York at Stony Brook

My research group and I are investigating the feasibility of utilizing combustion by-products, including ash from the combustion of garbage and trash in novel marine and terrestrial applications. The efforts of my students were realized with the first artificial reef in the coastal waters of the United States constructed from blocks of stabilized incineration ash. Since placement of this structure in Long Island Sound in 1987, a multidisciplinary approach to evaluating the environmental acceptability of this novel recycling option has evolved.

Working with faculty from other Stony Brook departments and researchers from other institutions, our research team is evaluating the physical and chemical characteristics of the residuals, as well as changes in the engineering properties and alterations in the chemical composition of the blocks. Students interested in biology and toxicology are investigating the colonization of the habitat and the potential for uptake by marine organisms of both inorganic and organic constituents associated with the residue.

Recent state and federal funding to evaluate terrestrial applications of incineration ash reuse has resulted in the construction of a boathouse on this campus. The building and surrounding environment is currently being monitored for alterations in air quality and for soil contamination. Another terrestrial application for incineration ash that is being evaluated is the construction of a highway using asphalt made with ash. Following construction of the highway, MSRC researchers, along with scientists from New York and New Jersey, will monitor the performance with an in-depth multidisciplinary investigation and will conduct an environmental assessment of this material.

van der Sloot H. A.; Woodhead, P.M.J.; Hockley, D.; Roethel, F.J. The long-term behavior of stabilized coal ash in the sea. Proceedings of American Coal Ash Association's 9th International Coal Ash Symposium, January 22-25. Orlando, FL; 1991.

Goldfard, T.D.; Maertz, M.; Roethel, F. J.; Iden, C.R.; Rieger, R. PCDDs and PCDFs in incineration ash from several types of facilities in the Northeastern United States. Chemosphere; 20:1833; 1990.

Roethel, F.J.; Breslin, V.T. Stony Brook's MSW combustor ash demonstration programs. In: Proceedings of the 3rd International Conference on Ash Utilization and Stabilization. November 13-14; Arlington, VA; 1990.

Roethel, F.J.; Breslin, V.T.; Aldous, K. Mobility of dioxins and furans associated with stabilized incineration residues in the marine environment. In: Proceedings of the 16th Annual EPA Hazardous Waste Research Symposium; 3-5 April; Cincinnati, OH; 1990.

Breslin, V.; Roethel, F.J.; Schaeperkoetter, V. Physical and chemical interactions of stabilized incineration residue with the marine environment. Marine Pollution Bulletin; 19(11B):623-632; 1988.

Lechich, A.F.; Roethel, F.J. Marine disposal of stabilized metal processing waste. Water Pollution Control Federation, January; 60:93-99; 1988.

J. R. Schubel

Professor, Dean and Director
Ph.D., 1968
The Johns Hopkins University

My current research is concentrated in two general areas—coastal zone management in the broadest sense and marine policy. For many years, I have been frustrated by the long lag between advances in our understanding of processes, phenomena, and problems in the coastal ocean, and the translation and incorporation of that new knowledge into management policies and practices to conserve and, when necessary, to rehabilitate important coastal environments and their living resources. In an effort to shorten this lag, we created two new initiatives in 1989: the Coastal Ocean Action Strategies (COAST) Institute and the Long Island International Forum on the Environment (LIIFE). They are a couplet.

Each autumn, leading environmental scientists and policy makers from around the world participate in the Long Island International Forum on the Environment. We meet in Montauk at Long Island's East End to focus our attention on a single major environmental problem. Each problem selected must be global in scope and expressed with particular clarity within this region. The goals of the session are to state the problem in tractable form, to identify the full range of alternatives for dealing with it, to assess in broad terms the advantages and disadvantages of each alternative, and to incorporate the findings into an appropriate plan of action. The output of LIIFE serves as the input to the COAST Institute.

Each summer, the COAST Institute brings leading scientists together with important regional leaders to interact in an intensive one- to three-week session to produce a comprehensive short-term and long-term plan of action for the specific problem. The first problem that the COAST Institute tackled was floatable and medical-type wastes on the region's beaches, a problem which cost the Long Island economy an

estimated $1 billion in the summer of 1988. The staff of the COAST Institute were successful in working with relevant agencies to craft a comprehensive plan to deal with floatables the following summer and in the longer term. The second problem being attacked by LIIFE and the Coast Institute is eutrophication of coastal waters.

Schubel, J.R. Should the ocean receive protection? U. S. Environmental Protection Agency Journal, 14(5):20; 1988.

Yan, X.-H.; Schubel, J. R.; Pritchard, D.W. Oceanic upper mixed layer depth determined by satellite data. AGU Spring Meeting, Baltimore; 69(16):383; May 1988.

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Schubel, J.R.; Pritchard, D. W. Long Island Sound: resources, status, and management. Contribution No. 550 of the Marine Sciences Research Center, SUNY at Stony Brook, New York; 1987.

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Mary I. Scranton

Associate Professor
Ph.D., 1977
Massachusetts Institute of Technology/
Woods Hole Oceanographic Institution

My group and I are actively involved in studies of the processes controlling carbon diagenesis in marine environments. In particular, we have been investigating the relationship between concentrations and turnover rates of hydrogen and of low molecular weight fatty acids in both water column and sedimentary systems. In collaboration with Dr. Cindy Lee, I am also studying low molecular weight amines in the water column. These compounds are of interest because hydrogen and fatty acids are important intermediates in the anaerobic food chain, and low molecular weight amines are decomposition products of common osmoregulators. In our current studies of a permanently anoxic estuarine basin in Rhode Island, we are focusing on the relationship between bacterial populations and cycling of particular compounds, as well as on the influence of the presence or absence of oxygen in affecting turnover rates.

My group is also working on several aspects of the oceanic methane cycle. As a part of this research, we are investigating sources and sinks of methane within the Hudson River, where methane concentrations are up to 100 times equilibrium with the atmosphere. We are also studying methane cycling in the anoxic estuarine basin mentioned above, and have found (for the first time) what appears to be light-dependent methane oxidation within the anoxic zone. Further work in both systems will include measurements of methane oxidation rates and will permit us to determine directly the extent to which oxidation processes are controlling fluxes of the gas to the atmosphere.

Scranton, M.I.; McShane, K. Methane fluxes in the southern North Sea: the role of European rivers. Continental Shelf Research; 11:37-52; 1991.

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Lawrence B. Slobodkin

Professor
Department of Ecology and Evolution
Joint with MSRC
Ph.D., 1951
Yale University

My central concern is, given the enormous complexity, variability, variety, and fragility of ecological systems, can a theory of ecology actually answer questions, or must it be a discussion of over simplified and arbitrary models, suggested by, but not representing, nature? I have approached this problem by attempting to so thoroughly describe a simple group of organisms (Hydra) that their ecological and evolutionary responses to ecological perturbations in the field may be predicted. For reasons related to their developmental constraints they are, I believe, more amenable to such a description than almost any other metazoans.

The simplicity of Hydra has permitted the development of a theoretical model in which ecological and evolutionary properties can be predicted from physiological assumptions. I plan to test these predictions in the field, using a combination of ecological and molecular biological techniques.

Focusing on simplicity in biology led me to write a book on analysis of simplicity and complexity in more general contexts.

Slobodkin, L.B. Players and Pawns: The role of simplicity and complexity in games of the intellect. Cambridge: Harvard University Press; 279 pp; 1991.

Slobodkin, L.B.; Bossert, P. The Coelenterates. In: Thorpe, J.H.; Covich, A.P., eds. Chapter 5, Ecology and Classification of Freshwater Invertebrates. San Jose: Academic Press; 1991.

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Slobodkin, L.B. Looking again at blooms - the null case of the paradox of the plankton. In: Cosper, E.M.; Carpenter, E.J.; Bricelj, V.M., eds. Novel phytoplankton blooms: causes and impacts of recurrent brown tides and other unusual blooms. Coastal and Estuarine Studies. Vol.35. Berlin: Springer-Verlag; pp. 341-348;1989.

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Slobodkin, L.B. The role of minimalism in art and science. The presidential address to the American Society of Naturalists. American Naturalist; 127:257-265; 1986.

R. Lawrence Swanson

Adjunct Professor
Ph.D., 1971
Oregon State University

My broad research interests concern reducing the impact of waste generation on society. In the context of the ocean, this translates to understanding and identifying the appropriate use of the ocean as part of a comprehensive waste management strategy.

I have been interested in the impact of urban population centers and their infrastructure and waste management practices on coastal waters. Sewage, storm water, and municipal solid waste all have pronounced impacts on coastal waters. In some cases, near-field, short-term effects of these polutting activities have been reduced with advancing technologies; but the far-field, long-term effects are not well understood. Hypoxia, floatable wastes, and cycling of contaminants are major causes of impaired economic and societal uses of coastal resources. My interests have been in using scientific understanding of these issues, within the context of societal costs, to help influence and formulate sound public policy.

The development of secondary materials–materials made from post-consumer waste into new products that have different forms and uses than the original products – are a promising and growing means of reusing waste materials. Understanding the engineering properties, environmental, and public health effects, and the economic and social barriers associated with these materials is important. It is my desire to expand the work that the WMI has been doing in this area so that we might help create cost effective, beneficial markets for society's residue.

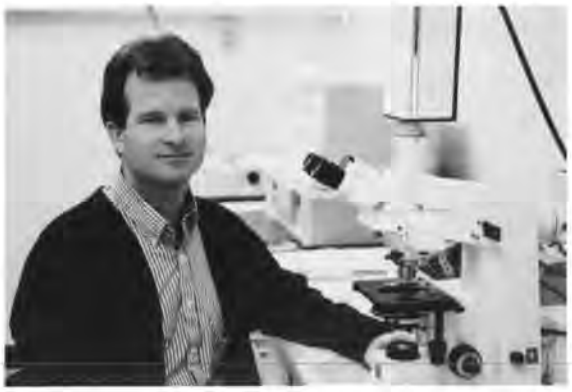
Swanson, R.L.; Bell, T.M.; Kahn, J.; Olha, J. Use impairments and ecosystem impacts of the New York Bight. Chemistry and Ecology; 5:99-127; 1991.

Swanson, R.L.; Zimmer, R.L. Meteorological conditions leading to the 1987 and 1988 washups of floatable wastes on New York and New Jersey beaches and comparison of these conditions with the historical record. Estuarine, Coastal and Shelf Science; 30:59-78; 1990.

Valle-Levinson, A.; Swanson, R.L. Wind-induced scattering of medically-related and sewage-related floatables. Marine Technology Society Journal; 25(2):49-56; 1991.

Gordon T. Taylor

Assistant Professor
Ph.D., 1983
University of Southern California



My broad area of interest is marine microbial ecology. My research activities have been concentrated in three major areas: microbial mediation of biogeochemical processes; microbial biofouling; and trophic interactions among microorganisms (bacteria, algae, and protozoans). I am particularly interested in dynamic interface habitats, such as particle-water and air-water. I have also been involved in novel application of optical techniques, such as Raman scattering spectrometry, infrared spectrometry, and fiber optic probes, to problems in marine biogeochemistry.

Most recently, my research group has been examining the earliest stages in marine biofouling from a molecular and microbiological perspective. We have been investigating the ways in which surface chemistry of inert materials determines the character of the dissolved organic matter adsorbed to its surface, as well as its influence on microbial biofilm formation. We are examining the specificity with which bacteria attach to submersed surfaces and the tolerance of some bacteria to "toxic" surfaces, such as copper. This research involves laboratory simulations, as well as field studies, and application of a variety of microbiological, biochemical, and novel spectroscopic techniques. Although the focus is applied towards engineering and material science issues, this research program has broader implications on problems in biogeochemistry and environmental microbiology.

Another ongoing research interest is the decomposition and microbial ecology of organic debris as it sinks from surface to deeper waters. The flux and decomposition of this material in the ocean has important implications on nutrient regeneration, ocean productivity, removal of pollutants, and the ocean's capacity to utilize excess atmospheric CO_2. I have been studying the complex taxonomic composition of microorganisms (algae, bacteria, protozoa, and zooplankton); their trophic interactions; and the biochemical processes associated with sinking particles to better understand the role of microorganisms in processing this material.

Taylor, G.T.; Karl, D.M. Vertical fluxes of biogenic particles and associated biota in the eastern North Pacific: implications for biogeochemical cycling and productivity. Global Biogeochemical Cycles; 5:289-303; 1991.

Taylor, G.T.; Sharma, S.K.; Mohanan, K. Optimization of a flow-through sampling system for quantitative analysis of dilute aqueous solutions using combined resonance and surface-enhanced Raman spectroscopy (SERRS). Appl. Spectrosc.; 44:635-640; 1990.

Taylor, G.T. Variability in the vertical flux of microorganisms and biogenic material in the epipelagic zone of a North Pacific central gyre station. Deep-Sea Research; 36:1287-1308; 1989.

Taylor, G.T.; Sharma, S.K. Advanced laser spectroscopy in marine sciences. In: Henderson, D., ed. Hawaii Institute of Geophysics Bi-annual Report; pp. 12-15; 1988.

Taylor, G.T.; Pace, M.L. Validity of eukaryote inhibitors for assessing production and grazing mortality of marine bacterioplankton. Applied Environmental Microbiology; 53:119-128; 1987.

Taylor, G.T.; Karl, D.M.; Pace, M.L. Impact of bacteria and zooflagellates on the composition of sinking particles: an *in situ* experiment. Marine Ecology Progress Series; 29:141-155; 1986.

Dong-Ping Wang

Professor
Ph.D., 1975
University of Miami

My research focuses on modeling and analysis of physical processes in estuaries and over continental shelves and slopes. My students and I are studying internal tides in the Gibraltar Strait, in the Gulf of California, and on the Celtic Sea slope. We also are investigating the generation of mesoscale inertial variability on the continental shelf off northeast Spain. We have developed sophisticated numerical models for process-oriented studies and used extensive data bases for model verification.

In addition to coastal process studies, we are collaborating with the Applied Mathematics and Statistics Department at Stony Brook on the massively parallel computing. Our long-term goal is to take advantage of the recent development in supercomputing to solve large-scale coastal ocean problems. We also are collaborating with the Naval Undersea System Center (NUSC) to explore the feasibility of predicting the acoustic variability in the coastal ocean. We plan to interface the NUSC acoustic model with our general circulation model to study shallow water acoustics.

Park, M.J.; Wang, D.P. Transient tidal vorticity over a hollow. In: Parker, B.B., eds. Tidal Hydrodynamics. New York: John Wiley; pp.419-436; 1991.

Wang, D.P. Prediction of coastal ocean thermal variability. In: Potter, J.; Warn-Varnas, A., eds. Ocean Variability and Acoustic Propagation; Bordrecht, Holland: Kluwer Academic Pub.; pp. 251-260; 1991.

Chen, D.; Wang, D.-P. Simulating the time-variable coastal upwelling during CODE 2. Journal of Marine Research; 48:335-358; 1990.

Chern, C.-S.; Wang, J.; Wang, D.-P. The exchange of Kuroshio and East China Sea shelf water. J. Geophysical Research; 95:16017-16024; 1990.

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Wang, D.-P. Models of mean and tidal flows in the Strait of Gibraltar. Deep-Sea Research; 36:1535-1548; 1990.

Wang, D.-P.; Chen, D.; Sherwin, T.J. Coupling between mixing and advection in shallow sea fronts. Continental Shelf Research; 10:123-136; 1990.

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Tintore, J.; Gomis, D.; Alonso, S; Wang, D.-P. A theoretical study of large sea level oscillations in the western Mediterranean. Journal of Geophysical Research; 93:10797-10804; 1988.

Wang, D.-P. Transport model for water exchange between coastal inlet and the open ocean. American Fisheries Society Symposium 3:9-15; 1988.

Wang, D.-P.; Vieira, M.E.C.; Salat, J.; Tintore, J.; LaViolette, P. A shelf-slope frontal filament off the northeast Spanish coast. Journal of Marine Research; 46:321-332; 1988.

Franklin F.Y. Wang

Professor
Department of Materials Science and Engineering, Joint with MSRC
Ph.D., 1956
University of Illinois

My research activities concern the synthesis of materials for specific applications and the study of their mechanical, chemical and electronic properties. My interests in the marine sciences concern the mechanical and chemical stabilities of artificially synthesized materials for the ocean environment. I am also interested in applying some aspects of materials processing theories and practices to the marine sciences, wherever there are valid features to be treated in common.

Peter K. Weyl

Professor
Ph.D., 1957
University of Chicago

The World Ocean, by interacting with the atmosphere, lithosphere, and biosphere, has stabilized the surface environment of our planet over several billion years. It acts as a superbly engineered stabilizer that has been able to cope with extraterrestrial impacts, global tectonics, and the changed biochemical interactions resulting from evolution. Unfortunately, we have neither the plans nor the specifications for the design. Instead, we must use the techniques of "reverse engineering" to determine if the system design can tolerate current rates of mechanized bioturbation.

Biologic stability requires adequate mixing of the waters of the World Ocean so that the deep waters remains ventilated and the illuminated surface waters are supplied with nutrients. Interactions with the lithosphere and biosphere must provide adequate buffering to stabilize the pH of seawater and limit the carbon dioxide content of the atmosphere. Near-surface mixing must be adequate to counteract the tendency of atmospheric moisture transport to increase the salinity at intermediate latitudes and freshen the water near the equator and in high latitudes.

In my research, I attempt to identify situations that could threaten stability. Using observational data and theory, I attempt to discover how excursions from viability are limited by physical, chemical, and biological processes in the sea.

Robert E. Wilson

Associate Professor
Ph.D., 1974
The Johns Hopkins University

My current research interests relate to transport processes in estuaries. They include specifically the description of time - dependent mixing processes in partially stratified estuaries, tidally induced residual currents in estuarine basins, and the interaction of buoyancy forced and tidally induced residual currents in estuaries.

I currently have projects related to the internal hydraulics in the the Hudson River estuary, which involve both numerical simulations and acoustic observations of the internal density structure.

Wilson, R.E.; Vieira , M.E.C. Residual currents in the Peconic Bays estuary. In: Neilson, B, ed. Circulation patterns in estuaries. New York: Humana Press; pp. 87-95; 1989.

Peter M.J. Woodhead

Research Professor
B.Sc. Hon. 1 cl., 1953
Durham University, England

I have long-standing interests in fishes and fisheries in many waters. Present research concerns the communities of fishes inhabiting the estuary system of the Hudson River, New York Harbor, Long Island Sound, and the New York Bight—their composition, distribution, and changes in space and time. The local estuaries and nearshore waters, which are being studied, are often very contaminated and stressed, with pronounced effects on behavior and abundance distributions of fish and benthic invertebrate populations. The influences of natural (climate) changes on fish populations of the northeast region are also of great interest.

I study the ecology of reef systems, both natural and man-made, and have wide experience on Pacific and Atlantic reefs. I direct the multidisciplinary coal waste artificial reef program, which considers many of the chemical, physical, and biological interactions of marine ecosystems with reef construction materials. My principal interests concern the habitation of reefs by fish, crustacea, and benthos, their abundance, biomass, and productivity.

Woodhead, P.M.J. The fish community of New York Harbor, spatial and temporal distributions of major species. Conference Report, Impacts of New York Harbor Development on Aquatic Resources; 1987. New York: Hudson River Foundation; pp. 123-143; 1991.

Woodhead, P.M.J. Inventory and characterizations of habitat and fish resources, and assessment of information on toxic effects in the New York-New Jersey Harbor Estuary. Report in 6 sections to U.S. EPA, concerning Tasks 3.2, 5.1 and 5.3 of the Harbor Estuary Program; 199 pp.; 1991.

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Woodhead, P.M.J. The Hudson River artificial reef study program. Report in 6 sections to New York City Public Development Corporation; 391 pp.; 1989.

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Woodhead, P.M.J. Evaluation of the fish community in selection of disposal sites for dredged materials in the Lower Bay Complex of the Hudson-Raritan estuary. Seventh International Ocean Disposal Symposium, Wolfville, NS, Canada; 14 pp.; 1987.

Woodhead, P.M.J. Coal waste artificial reef program. Reef measurements over four years in the sea. MSRC Special Report No. 58 (Ref. 85-3) State University of New York at Stony Brook;107 pp.; 1986.

Woodhead, P.M.J.; McCafferty, S.S. Report on the fish community of Lower New York Harbor in relation to borrow pits. MSRC Special Report No. 80 (Ref. 87-4) State University of New York at Stony Brook; 102 pp.; 1986.

Charles F. Wurster

Associate Professor
Ph.D., 1957
Stanford University

My research has been concerned with the effects of stable chlorinated hydrocarbon pollutants on marine plankton communities. Focusing on those chemicals found regularly in the environment (polychlorinated biphenyls, DDT, DDE, and dieldrin), we have studied the effects on individual species, mixed cultures, and natural phytoplankton and zooplankton communities in an attempt to understand the impact of these chemicals on aquatic ecosystems.

The growth of some species of algae is inhibited by chlorinated hydrocarbon concentrations as low as the parts per trillion range. This sensitivity varies greatly with the species, the supply of nutrients, the temperature, light intensity, and the site of origin of the clone. Selective toxicity may alter the species composition within the community.

Currently, we are studying the development of resistance to toxic chemical pollutants by phytoplankton. We have found that phytoplankton from chronically polluted areas are more resistant to toxic pollutants than are those from unpolluted areas. Cross resistance to other toxicants sometimes develops when resistant strains are produced in the laboratory. We are currently investigating the mechanisms whereby phytoplankton become resistant to toxic pollutants.

I am also interested in various aspects of ornithology, and with the integration of scientific information into environmental public policy.

Ruben, H.J.; Cosper, E.M.; Wurster, C.F. Influence of light intensity and photo-adaptation on the toxicity of PCB to a marine diatom. Environmental Toxicology and Chemistry; 9:777-784; 1990.

Cosper, E.; Wurster, C.F.; Bautista, M.F. PCB-resistant diatoms in the Hudson River estuary. Estuarine and Coastal Shelf Science; 26:215-226; 1988.

Cosper, E.; Snyder, B.J.; Arnold, L.M.; Zaikowski, L.A.; Wurster, C.F. Induced resistance and altered environmental fitness in a marine diatom. Marine Environmental Research; 23:207-222; 1987.

Jeannete Yen

Assistant Professor
Ph.D., 1982
University of Washington

Presently I am doing research on the reproductive ecology of an antarctic copepod and on sensory perception by zooplankton. I have spent three seasons—spring, summer and winter—on the Antarctic peninsula at Palmer Station sampling the zooplankton populations in a 1200 meter basin. We are studying the seasonal cycles in the reproductive ecology and lipid metabolism of the copepod *Euchaeta antarctica* and the interactions with their physiology, feeding ecology, and vertical migratory activity. I wish to characterize the life history traits that led to the evolution and success of this large, carnivorous marine copepod in this low temperature habitat.

My studies on sensory perception by zooplankton involve combining laser optics with state-of-the-art video technology to examine the ability of a mechanoreceptive carnivorous copepod to remotely detect fluid deformations produced by its mobile prey. This involves both target recognition by the predator as well as three dimensional spatial localization of hydrodynamically conspicuous prey.

To further examine sensory perception by copepods, I am collaborating with researchers at the Bekesy Laboratory of Neurobiology at the University of Hawaii. We have developed a technique for recording extracellular afferent nerve impulse discharges occurring within the first antennae of copepods. We find that the antennal receptors are extremely sensitive to mechanical stimuli. A model of hydrodynamic stimulation of zooplankton will be constructed to integrate the information on copepod behavioral responses, sensory neurophysiology, and morphology, with information on their species ecology.

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Yen, J. Predatory feeding behavior of an Antarctic marine copepod, *Euchaeta antarctica*. Polar Research; (in press).

Yen, J.; Sanderson, B.G.; Strickler, J.R.; Okubo, A. Feeding currents and energy dissipation by *Euchaeta rimana*, a subtropical pelagic copepod. Limnology and Oceanography; 36; 1991.

Yen, J.; Nicoll, N.T. Setal array on the first antennae of a carnivorous marine copepod *Euchaeta norvegica*. Journal of Crustacean Biology; 10(2):327-340; 1990.

Yen, J. Directionality and swimming speeds in predator- prey and male-female interactions of *Euchaeta rimana*, a subtropical marine copepod. Bulletin of Marine Science; 43(3):175-193; 1988.

Yen, J. Predation by *Euchaeta norvegica* Boeck on eggs and larvae of the North Atlantic cod *Gadus morhua* L. Journal of Experimental Marine Biology and Ecology; 112:283-296; 1987.

Yen, J. Selective predation by the carnivorous marine copepod *Euchaeta elongata*: laboratory measurements of predation rates verified by field observations of temporal/spatial feeding patterns. Limnology and Oceanography; 30:577-595; 1985.

Jonathan P. Zehr

Research Assistant Professor
Ph.D., 1985
University of California, Davis

My general research interests are the molecular aspects of ecology of microbes in the sea. I think we have only begun to realize what novel genetic information is contained in marine microbes, what we can learn using molecular tools, and what gains can be had from learning and using the genetic information of marine microorganisms.

Specifically, my current research projects are (1) an investigation of the molecular mechanisms involved in the ecological success and regulation of nitrogen fixation in the marine nonheterocystous cyanobacterium *Trichodesmium* and (2) the detection of nitrogen fixing microorganisms in microbial assemblages and various marine environments using the polymerase chain reaction (PCR).

Trichodesmium is important from a biological and biotechnological point of view, since it is able to fix nitrogen and photosynthesize simultaneously, even though it is well known that nitrogenase is rapidly inactivated by oxygen. My research program focuses on the characterization of the *nif* genes in *Trichodesmium*, as well as exploring the characteristics of the Fe protein of nitrogenase itself that may be involved in protection of nitrogenase from irreversible inactivation by oxygen.

The second project, the detection of nitrogen fixing microorganisms with PCR, is important not only because it will finally settle the issue of whether other nitrogen fixing organisms are present in the nitrogen-depleted surface waters of oligotrophic oceans, but because the use of the PCR for detection of genetic capabilities is likely to be a major contribution of molecular biology to marine sciences.

We know little of the genetic capabilities of microbes, plants and animals of the sea. Molecular biology provides techniques which can provide important new information on the structure and function of marine communities, and may identify useful and novel genetic information which can be exploited for biotechnological purposes.

Zehr, J.P.; Ohki, K.; Fujita, Y; Landry, D. Unique modification of adenine in genomic DNA of the marine cyanobacterium *Trichodesmium sp.* Strain NIBB1067. Journal of Bacteriology; 173:7059-7062; 1991.

Kirshtein, J.D.; Paerl, H.W.; Zehr, J. Amplification, cloning and sequencing of a *nifH* segment from aquatic microorganisms and natural communities. Applied and Environmental Microbiology; 57:2645-2650; 1991.

Zehr, J.P.; Limberger, R.J.; Ohki, K.; Fujita, Y. Antiserum to nitrogenase generated from an amplified fragment of *nifH* from natural populations of *Trichodesmium spp.* Applied and Environmental Microbiology; 56:3527-3531; 1990.

Zehr, J.P.; McReynolds, L. The use of degenerate oligonucleotides for amplification of a *nifH* gene from the marine cyanobacterium *Trichodesmium thiebautii.* Applied and Environmental Microbiology; 55:2522-2526; 1989.

Zehr, J.P.; Falkowski, P.G. Pathway of ammonium assimilation in a marine diatom determined with the radiotracer ^{13}N. Journal of Phycology; 24:588-591; 1988.

Course Offerings

The following is a list of courses offered during the current academic year. Many additional courses are available to be offered, and the list changes from year to year. Courses may also be developed as a response to student interest.

Benthic Ecology
Biological Oceanography
Chemical Oceanography
Coastal Geology Seminar
Continental Margins
Directed Study
Dynamics I
Dynamics II
Early Diagenesis of Sediments I
Emerging Technology in Solid Waste Management
Environmental Engineering
Environmental Law
Environmental Toxicology
Fishery Biology and Management
Geochemical Modeling
Geochemistry Seminar
Geological Oceanography
Global Change
History of Waste Management
Intro to Mathematics for Marine Scientists
Larval Ecology
Long Island Sound in the Year 2000
Long Island's Environment
Marine Geophysics
Marine Microbial Ecology
Marine Pollution
Marine Sedimentology
Oceanographic Problem Solving
Oceanography: The World Ocean
Organic Geochemistry
Physical Oceanography
Physiological Ecology of Marine Organisms
Primary Productivity in the Sea
Regional Planning Applied to Marine Sciences
Remote Sensing
Research
Seminar
Seminar Preparation
Special Topics
Special Topics in Biological Oceanography
Special Topics in Chemical Oceanography
Special Topics in Geological Oceanography
Special Topics in Marine Management
Special Topics in Physical Oceanography
Teaching Practicum
Time Series
Turbulence in coastal and Ocean Waters
Waste Management Issues
Waves
Zooplankton Ecology

Adjunct Faculty

Harold Berger, Professor, part time. Regional Director (Retired), Region I, New York Department of Environmental Conservation. Solid waste disposal; groundwater quantity and quality; air emissions; wetland formation and protection.

Douglas Capone, Adjunct Associate Professor; University of Maryland, Center for Environmental and Estuarine Studies. Marine microbial ecology; nitrogen cycling.

William Crawford, Adjunct Associate Professor; Institute of Ocean Sciences, Canada. Continental shelf and slope dynamics microstructure; tidal dynamics.

Eirik Duerr, Adjunct Assistant Professor Oceanic Institute, Hawaii. Aquaculture of marine phytoplankton, especially cyanobacteria.

William Eichbaum, Adjunct Professor The Conservation Foundation/World Wildlife Fund. Coastal zone policy and management; environmental conservation.

Paul Falkowski, Adjunct Professor Brookhaven National Laboratory. Marine phytoplankton ecology; phytoplankton physiology.

Gene Feldman, Adjunct Assistant Professor National Aeronautics and Space Administration, Goddard Space Flight Center. Remote sensing of phytoplankton; satellite oceanography.

Sarah Horrigan, Adjunct Assistant Professor National Association of State Universities and Land Grant Colleges, Washington, DC. Science policy.

Joel O'Connor, Adjunct Associate Professor U. S. Environmental Protection Agency. Environmental assessment, policy, and quality indicators; marine ecology.

Scott Siddall, Adjunct Associate Professor Kenyon College, Ohio. Shellfisheries resource management; computer-based image processing and software development for education.

Sharon Smith, Adjunct Associate Professor Brookhaven National Laboratory. Plankton ecology; nutrient regeneration by zooplankton.

Dennis Suszkowski, Adjunct Associate Professor; Hudson River Foundation. Estuarine sedimentology; ocean and estuarine policy and management.

Richard Thomson, Adjunct Associate Professor; Institute of Ocean Sciences, Canada. Coastal oceanography; continental shelf waves; slope currents.

James Vaughn, Adjunct Associate Professor Brookhaven National Laboratory. Transport fate and effects of viruses in the aquatic environment.

Mario Vieira, Adjunct Associate Professor U.S. Naval Academy Oceanography Department, Annapolis. Circulation and the dynamics of coastal and estuarine waters.

Professors Emeriti

H. H. Carter
J. L. McHugh
Donald W. Pritchard

Other Non-teaching Faculty

Francisco Borrero, Postdoctoral Fellow
Jeng Chang, Research Assistant Professor
Marie de Angelis, Postdoctoral Fellow
Patrick Hassett, Postdoctoral Fellow
Doreen Monteleone, Postdoctoral Fellow
Eric Schultz, Postdoctoral Fellow

Staff

Gina Anzalone, Secretary
Trudy Bell, Editorial Associate
George Carroll, Manager, Computing Facilities
Carol Case, Secretary
James Christie, Research Support Specialist
Joanne Cosgrove, Secretary
Maureen Flynn, Secretary
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Anne West-Valle, Editorial Associate
Mark Wiggins, Field Specialist
Thomas Wilson, Ocean Instruments Engineer
William Wise, Associate Director; Director, Living Marine Resources Institute
Bret Zielenski, Small Boats Captain
Mindy Zimmerman, Research Support Specialist

1990-1991 Ph.D. Recipients and Thesis Titles

Ahn, In-Young
Effects of the gem clam, *Gemma gemma*, on the settlement and the post-settlement migration, growth, and survival of the hard clam, *Mercenaria mercenaria*.

Barnes, Christina E.
Uranium geochemistry in marine sediments.

Davies, DeWitt S.
Allocating common property marine resources for coastal aquaculture: a comparative analysis.

Epler, Nathan A.
A multiple tracer study of shallow groundwater from an unconfined aquifer.

Greene, Richard M.
Physiological responses to high-frequency light fluctuations in the red alga, *Chondrus crispus*.

Jacobson, Myrna E.
Constraints on sulfate reduction in nearshore marine sediments.

Lee, SangHoon
Variation of natural bacterioplankton species compositions studied at the DNA level.

Park, Moon-Jin
Transient tidal vorticity in coastal seas.

Proctor, Lita M.
Marine viruses and the fate of bacteria in the ocean.

Tantichodok, Pitiwong
Relative importance of phytoplankton and organic detritus as food sources for the suspension-feeding bivalve *Mytilus edulis* L., in Long Island Sound.

1990-1991 M.S. Recipients and Thesis Titles

Castro, Leonardo R.
Early life history of bay anchovy in Great South Bay, NY: factors affecting recruitment.

Chant, Robert
The barotrophic tide in the Long Island Sound and its response to a rise in sea level

Cohen, Melissa
An evaluation of the mechanisms of resistance to PCB in a marine diatom.

Garcia-Esquivel, Zaul
A genetic and numerical approach for assessing the taxonomic status of north Atlantic *Laminaria* of the simplices section.

Green, Mark A.
Carbonate dissolution and temporal abundances of foraminifera in Long Island Sound sediments.

Hamukuaya, Hashali
Changes in fishery landings from the New York Bight, 1978-88.

Henry, Diane L.
Characterization of the light-harvesting complex and isolation of a cDNA clone of the marine chrysophyte, *Isochrysis galbana*.

Hutahaean, Walman
Upper layer circulation in the Banda Sea in response to the onset of monsoon winds.

Lagomarsino, Irma
Evolution of sex-determining mechanisms: the transition from environmental to genetic sex determination across a latitudinal gradient in *Menidia menidia*.

Lee, Byeong Gweon
Trace metal uptake by selected marine benthic organisms exposed to incineration ash residues.

Marks, Richard E.
Ontogenetic shift in the diet of spring and summer-spawned bluefish during the oceanic phase of the early life history.

Monaco, Cindy M.
Distribution and foraging behavior of northern gannets (*Sula bassanus*) in relation to wind stress in eastern Newfoundland.

Monetti, Matthew A.
The role of different microbial groups in the oxidation of low molecular weight fatty acids in anoxic marine sediments.

Olha, Joseph
Novel algal blooms: common underlying causes with particular reference to New York and New Jersey waters.

Pohle, David G.
The role of eelgrass, *Zostera marina*, as a refuge from benthic predators for juvenile bay scallops, *Argopecten irradians*.

Ranheim, Robert O.
Methane production in the sediments of the Hudson River estuary.

Sosebee, Katherine A.
Life history of a southern population of the Atlantic silverside, *Menidia menidia*, and comparisons with other latitudes.

Vigil, Heidi L.
The fate of dissolved oxygen distribution in Long Island Sound.

Wallace, Heather V.E.
A comparison of hard clam population characteristics between high and low density regions within Great South Bay.

Xia, Qing
A study of water quality in Fish Cove, Long Island.

Young, Randall R.
Prevalence and severity of shell disease among deep-sea red crabs of the Middle Atlantic Bight in relation to ocean dumping of sewage sludge.

1989 M.S. Recipients and Thesis Titles

Zhu, Ningli
Changes in the flux and composition of amino acids and pigment in particles collected in sediment traps under different preservation conditions.

McTiernan, Lawrence
The erosion potential of fine-grained sediments in Long Island Sound.

Shima, Michiyo
Oceanic transport of the early life history stages of bluefish (*Pomatomus saltatrix*) from Cape Hatteras to the mid-Atlantic Bight.

Wong, Saou-Lien
Nitrate effect on growth and storage of inorganic nitrogen (nitrate) in two different age groups of *Laminaria saccharina* (L.) Lamour.