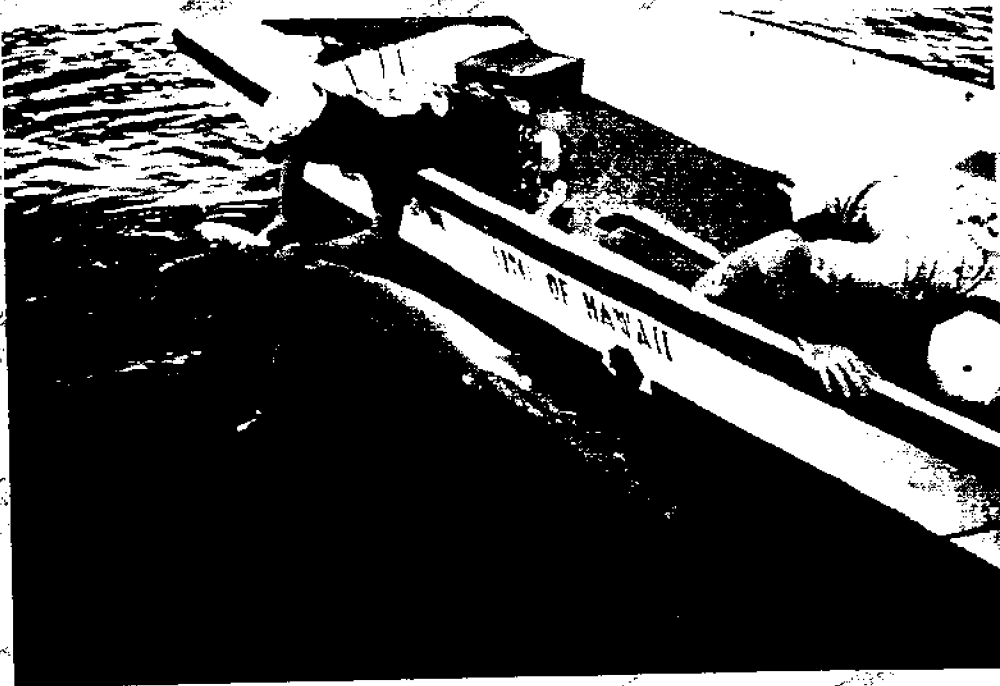


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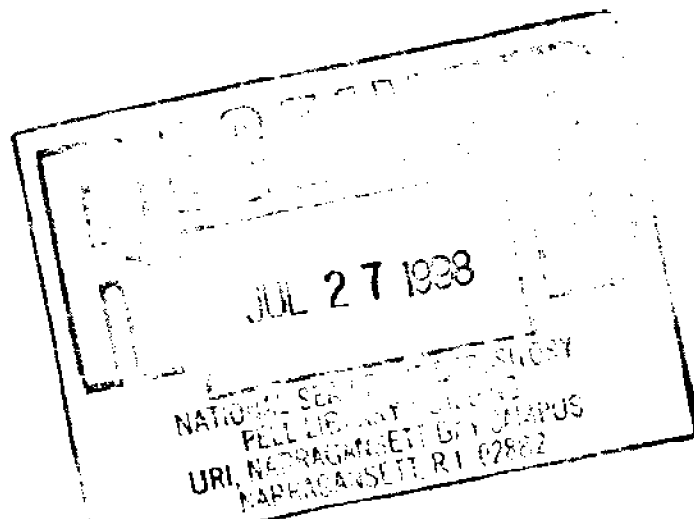
Hawai'i Sea Grant



Program Directory

School of Ocean and Earth Science and Technology
University of Hawaii

1997-1999
Hawai'i Sea Grant
Program Directory



*The University of Hawai'i Sea Grant College Program
supports an innovative program of research, education and
extension services, directed to the improved understanding,
management, and use of marine resources of the state,
region and nation.*



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Sea Grant in Hawai'i

In October 1972, the University of Hawai'i was designated a Sea Grant College for sustained excellence in research, education and public service dedicated to the wise use of America's marine resources. Today, the University of Hawai'i Sea Grant College Program is housed within the School of Ocean and Earth Science and Technology on the campus of the University of Hawai'i at Mānoa. The program is part of a nationwide network of 29 institutional programs of the National Oceanic and Atmospheric Administration, Department of Commerce, that promote the understanding, development, sustainable use and conservation of marine resources through university-based research, education, community outreach and communication efforts.

Sea Grant Extension Service efforts in the U.S.-affiliated Pacific islands have expanded from an initial focus on coastal resource management to initiatives in environmental education, sustainable economic development, and capacity building and training. The addition of specialist positions with joint responsibilities in Hawai'i and the Pacific, and the increasingly regional program focus, have rendered the division of extension efforts into separate Hawai'i and Pacific programs artificial. Eliminating this geographic distinction, the program has been redefined as the regional Hawai'i/Pacific Sea Grant Extension Service and now serves Hawai'i and its Extended Economic Zone, the U.S. flag territories and the U.S.-affiliated insular states of the Pacific, including the Republic of the Marshall Islands, Commonwealth of the Northern Mariana Islands, Guam, Federated States of Micronesia, Republic of Palau, and American Samoa.

Sea Grant research, education and outreach activities have focused on providing scientific data to policy makers and legislators in Hawai'i and the western Pacific to help them make informed decisions, as well as transferring scientific and technical methodologies to marine resource managers.

RESEARCH PROJECTS

Developing Sustainable Aquaculture

R/AQ-58, *Cost-effective Methods for Reef Fish Culture*, Christopher L. Brown

The aquarium industry is big business around the world and the harvest of reef fish to stock that business is becoming a problem in Hawai'i. Not only are Hawai'i's reefs and reef fish populations beginning to suffer, but user conflicts are emerging between reef fish harvesters and commercial dive operators, whose businesses depend on the beauty and diversity of the reef environment. The overall goal of this project is to develop inexpensive methods of culturing ornamental reef fish, which will provide the fish suppliers an alternative to live harvest. Dr. Brown and his students are screening a number of popular species to identify those which will grow well in a simple, but effective, green-water culture method. They will also experiment with using wild-caught late-phase larvae for growout studies. Collecting larvae which have survived the early, critical developmental stages should improve their survivability. At the same time, since the larvae have not reached reproductive stage, their harvest should not impact recruitment to the reefs.

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R/AQ-59, *Molecular-cloning of a Cytoplasmic Actin Promoter Gene from Shrimp *Penaeus vannamei, Piera S. Sun**

Acceleration of growth rate and control of infectious diseases are the two most important factors in promoting economic shrimp aquaculture. Recombinant DNA technology may allow the production of animals with new and desirable traits. However, it is often difficult to control or even to predict the way foreign genes will be expressed in transgenic animals. The objective of this project is to identify and to clone a genetic mechanism, a cytoplasmic actin promoter gene, that can be used to direct the expression of commercially important genes in transgenic shellfish and crustaceans.

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Aquaculture has been practiced in Hawai'i for at least 600 years. Marine aquaculture was conducted in walled fishponds along the coastlines. The fish farmers depended on the natural ebb and flow of the tides for circulation, restocking and entrapment. A number of traditional Hawaiian fishponds remain, however, most have fallen into disuse, and become clogged with silt. Because of their historic, cultural and

potential economic significance, there is high interest in their restoration. Two projects address this problem.

R/AQ-60, Molokai Fishponds: Circulation Studies, R. Cengiz Ertekin

In this project researchers will survey a number of fishponds to create a database of environmental parameters and to model numerically the circulation within the ponds. Armed with this information the engineers hope to be able to suggest design parameters, such as the location and number of sluice gates, which will improve circulation and reduce silt accumulation.

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R/AQ-61, Assessment and Characterization of Water Quality in Traditional Hawaiian Fishponds, Clyde S. Tamaru

State and federal permitting processes represent primary restraints to revitalizing Hawaiian fishponds. The most onerous of these is the requirement to comply with federal water quality guidelines for discharge into coastal waters. In this project researchers hope to solve the problem by determining the normal baseline water quality parameters of active and inactive fishponds and comparing these parameters to the current federal guidelines. The information developed will be used to establish whether the federal guidelines should be applied to the Hawaiian fishpond operations.

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R/AQ-46, Development and Evaluation of Virus Detection and Cell Culture Technologies for Viral Diseases of Cultured Penaeid Shrimp, Philip C. Loh

Viral disease constitutes a major problem in intensive and superintensive penaeid shrimp aquaculture. Two viruses, the yellow head virus (YHV) and the Chinese baculovirus (CBV) have caused massive mortalities in farms worldwide. In this continuing project, researchers hope to adapt the successful virus detection methods they have developed to detect these two viruses. Field evaluation studies will be extended to include shrimp farms in S.E. Asia and Asia.

This researcher was the first to successfully grow crustacean viruses in fish cell lines and to establish viable shrimp cell lines. He has also established important protocols for shrimp viruses. His virus detection protocol has been used to monitor the distribution of the rhabdovirus of the penaeid shrimp (RPS) infection in shrimp populations in various farms in Hawai'i. Both the indirect immunofluorescence antibody technique (IFA) and infectivity assay in cell cultures were employed to corroborate the studies. An NC-EIA/SAB procedure employing a new enzyme substrate

to reduce potential false readings also was developed for the specific detection of YHV in infected shrimp.

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Commercial Biotechnology

R/MP-11, *Novel Antibiotics from Benthic Microorganisms*, Sophia Kathariou

The recent emergence of antibiotic-resistant bacteria poses serious clinical and pharmacological problems and underscores the need for identification of new antibiotics. Marine microorganisms represent a vast pool of biota whose biotechnological and pharmaceutical potential remains largely untapped.

This researcher will screen microorganisms from deep sea sediments, microbial mats and deep ocean water for unique ecological and bacteriological features. When she finds an antibiotic producer Dr. Kathariou will use both bacteriological and molecular genetic methods to optimize the production and the activity of the agent.

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R/MP-3, *Bioactive Marine Metabolites*, Paul J. Scheuer

In this continuing project researchers collect and evaluate marine organisms from Hawai'i and the southwest Pacific for their antimicrobial potential. Active constituents are isolated, purified, characterized, and submitted to a collaborating laboratory for detailed biological evaluation.

Two recent discoveries, kahalalide F and palau'amine have advanced to in-vivo experiments. An Investigative New Drug (IND) license is being processed for kahalalide F, and okadaic acid, which was characterized under this project, has been made commercially available as an important molecular probe.

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R/MP-4, *Industrial Microbiology of Blue-Green Algae (Cyanobacteria)*, Gregory M.L. Patterson

Cyanobacteria are prolific producers of potentially useful drugs, research tools, and fine chemicals, but will only be commercially useful if economical methods for production are available. This continuing project will use process engineering and

applied microbiology to develop a dependable culture and production process. Researchers will conduct scale-up studies, in collaboration with Cyanotech Corporation of Kailua-Kona, to demonstrate the feasibility of aquaculture-type commercial-scale production methods.

Researchers have discovered an inducible mechanism for increasing synthesis of chemical defense compounds (phytoalexins) in cyanobacteria and have characterized the range of pure compounds capable of eliciting the defense reaction. An optimized culture media has been developed for cyanobacterial secondary metabolite production and scale-up studies show that secondary metabolites are produced in large-scale laboratory cultures. These researchers also have developed methods for isolation and identification of genes controlling secondary metabolism.

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R/MP-8, *Bioactive Macrocycles from Soft Coral*, Marcus A. Tius

Chemical synthesis is often the most reliable way to secure an adequate supply of a natural product. The discovery of the antitumor promoting properties of sarcophytols A and B, which were isolated from the marine alga *Sarcophyton glaucum*, provided the impetus for this work. The objectives of this continuing project are to develop and implement efficient protocols for the construction of antitumor promoting marine natural products and their analogs, and to design and evaluate analogs patterned after sarcophytol A. The goal is to discover the minimum structural requirements for activity, as the least complex structure that retains the activity is the best candidate for drug development, and to demonstrate a new paradigm for the chemical synthesis of a family of 14-membered ring marine natural products.

A brief total synthesis of sarcophytol A has been completed and researchers have developed an improved synthesis of canventol, which has been applied to large-scale studies. The material from the large scale synthesis is being used in an animal feeding study by the National Cancer Institute to screen for cancer chemopreventive agents. Caventol and S9 have also been demonstrated to inhibit HIV-1 replication.

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Coastal Communities in Transition

R/PO-1, *Policy Options for Coastal Zone Management—Kamaoa-Puueo Hawaiian Home Lands, Ka'u, Hawai'i*, Joseph R. Morgan

KaLae National Historic Landmark District encompasses about 710 acres in an 11,000-acre tract of Hawaiian Home Lands at the southern tip of the Big Island of

Hawai'i. Its six miles of shoreline and adjoining offshore fisheries are rich in coastal and marine life and cultural significance. While the shorelines and oceans of Hawai'i have a long history of virtually unrestricted public access and use, many native Hawaiians now urge that explicit limitations on this access and use be imposed upon non-native interests. This project will employ a multidisciplinary, participatory approach, incorporating archival research, comparative management studies, field investigation, and community-based planning, in an attempt to define and achieve fair and equitable access to and use of the coastal resources at Kalae.

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Coastal Ecosystem Health

R/EL-11, Disease and Tumors in Corals: Natural Agents of Change in Hawaiian Reef Ecosystems? Heinz G. DeCouet

Diseases and tumorous growths have been documented recently in major reef-building corals in Hawai'i. A high frequency of occurrence of these growths has been observed in Hanauma Bay, a popular visitor destination, while lower or rare occurrences of disease have been recorded in other areas of Hawai'i. In this project researchers will employ a multi-disciplinary approach, ranging from field surveys to genetic background analysis, to examine coral disease and tumors. This research will produce the first mechanistic and quantitative understanding of the implications of disease and tumors in reef-building corals and provide scientists and managers a means to assess the health and stability of coral reefs more definitively.

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R/EL-12, Impact of Pulsed Stream Flow on the Delivery of Land-derived Materials to the Nearshore Marine Environment of Kaneohe Bay, Paul L. Jokiel

Stream flow patterns and interactions between streams and estuaries are critical economic and conservation issues in Hawai'i. Development in watersheds and channelization of stream beds have altered the delivery patterns of land-derived materials into most estuaries. To test the hypothesis that short-lived pulses of stream discharge are the dominant mode of delivery of new material into tropical estuaries,

these researchers will measure and describe the fate of land-derived materials in the coastal water column over time and compare the changes in water quality associated with pulsed stream flow with normal base-load situations.

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R/EL-13, Use of Molecular Genetic Techniques to Co-detect Bacterial Pathogens and Their Survival Phases to Stresses in Hawai'i's Coastal Waters, Maqsudul Alam

A recently completed study of the waters off Waikiki concluded that some portions of Hawai'i's marine environment are contaminated with various pathogens in a viable but not culturable (VBNC) state. Although some of the pathogens in the VBNC state maintain their infective potential, there is no test that will quickly establish whether they are infective.

It is known that a regulatory protein (RpoS) plays a crucial role in the formation of the VBNC state. This researcher will use molecular genetics techniques to investigate the role RpoS plays in the formation of VBNC pathogens and determine how long the cells remain in the VBNC state before they die or become viable. The overall goal is to develop a screening technique for rapid and simultaneous detection of pathogens in coastal waters using express PCR methods.

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R/EL-14, Effects of Environmental Endocrine Disrupters in the Tropical Fish Tilapia (*Oreochromis mossambicus*), E. Gordon Grau

Many agricultural and industrial chemicals can disrupt the endocrine physiology of wildlife and humans, producing a variety of pathologies. Environmental Endocrine Disrupters (EEDs) often persist in the environment, spread easily into aquatic ecosystems through rainwater runoff, and bioaccumulate in animals. EED contamination in inland and coastal waters threatens fish populations which are a direct link to humans through the food chain.

In this study researchers will identify possible biological effects of EEDs on the sex and reproductive development of tropical fish, using the tilapia as a model. The pesticides, DDD, chlordane, dieldrin and heptachlor, which have been used extensively in Hawai'i, will be tested first. The researchers are testing the hypotheses that the EEDs act as estrogens and that exposure of tilapia to EEDs may alter sex differentiation, gonadal size and circulating gonadal steroid hormone levels, depending at which developmental stage exposure occurs.

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R/EL-15, Heavy Metals Fluxes to the Nearshore Ocean Derived from Non-point Source Pollution in Two Small Estuaries, Oahu, Hawai'i, Eric H. DeCarlo

Coastal ecosystems are a source of diverse resources that form the base of Hawai'i's tourism industry. At the same time, they are sensitive to stress induced by anthropogenic activity. On Oahu rapid development over the last 30 years has led to a public perception of degradation of our coastal ecosystems. Although this is accurate in some estuaries, there exists little evidence demonstrating widespread coastal ecosystem degradation attributable to anthropogenic activity. Fluxes of heavy metals derived from non-point source pollution (NPP) remain unknown, as do their variability and effects on nearshore biota. This study will quantify fluxes of metals derived from NPP to estuaries and the adjoining coasts and evaluate their fate and transport under varying flow regimes. Results of this work will be used to identify specific indicators of NPP that will be useful to local agencies in revising metals criteria in the aquatic environment and be helpful in developing best management practices for urban and suburban watersheds and the adjoining coastal recreational resources.

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R/EL-16, Uptake of Anthropogenic Lead and Other Metals by *P. lobata* in Areas Subject to Point and Non-point Pollution Stresses Around Oahu, Hawai'i, Khalil J. Spencer

Closely related to R/EL-15, this project will deal with the accumulation of lead in corals and, using the bay, stream and sediment data collected in a previous study for comparison, researchers will estimate the present-day flux of lead and other metals entering the estuarine environments. Corals seaward of estuaries will be studied also to determine how much lead escapes to the ocean and whether there is a measurable relationship between the metals accumulating in estuaries and the amount that escapes.

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R/EL-17, Oceanic Climate Change and Non-point Source Pollution as Revealed by 100 Year Old Corals in Hawai'i, Richard W. Grigg

In this project researchers will analyze core samples from 100-year-old coral heads, growing off four different islands spanning the Hawaiian Archipelago. An assessment of the differences between the linear growth and calcification in the main Hawaiian Islands and that of the coral heads off the undeveloped islands is expected to

provide an indication of the impact of urban runoff on reef building corals. Calibration of the ratios of strontium to calcium in the coral heads will produce a 100-year record of sea surface temperature spanning 10 degrees of latitude, and may contain an estimate of greenhouse warming over a significant area of ocean surface.

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R/EL-1, Field Verification of Mass-transfer Model for Nutrient Uptake to Coral Reefs, Marlin J. Atkinson

Researchers will determine whether natural reefs are taking up nutrients at their maximal rate, or the mass-transfer rate, as is predicted in the model developed in this continuing project. To demonstrate that natural communities have uptake rates consistent with their mass-transfer predictions, the researchers will measure nutrient changes across the barrier reef in Kaneohe Bay, measure the mass transfer coefficient for calcium and compare the mass-transfer coefficients for all the nutrients to determine whether they are all at mass transfer rates. Experiments will be conducted, using the Biosphere II reef, to determine the relationship between net production and nutrient uptake.

Flume experiments have shown that uptake of nutrients into living coral communities can be predicted from a set of equations derived from heat transfer studies in the engineering literature. The dissolution of calcium from dead, gypsum-covered coral and associated rubble follows the same parameterization, thus proving that nutrient uptake is controlled by diffusion through nutrient-depleted boundary layers, and that these "mass-transfer" rates are maximal rates to a coral reef community. Eleven papers have been published so far on this topic.

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R/FM-2, Tiger Shark Tracking II: Archiving Transponding Transmitters to Monitor Long-term Movements, Kim N. Holland

In this project researchers are collaborating with a private engineering company to develop archiving transponding transmitters and anchored data loggers to receive data from sharks. This pioneering use of archiving transponding transmitters will remotely monitor the daily movements of tiger sharks over long periods of time and provide much more detailed information about tiger shark movements than has been previously available.

Researchers have used a combination of sonic tracking, tag-and-release and long-life implanted transmitters to begin to construct a consistent picture of tiger shark behavior around the Hawaiian Islands. Preliminary findings seem to show that the animals may be territorial, but the territory is much larger than was predicted. Sonic

tracking showed that the animals are far from coastal, ranging far to sea, and although animals return to the same location they were caught, the time between visits varies by individual from two weeks to over a year.

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R/FM-3, Evaluation of Harvest Refugia II: Effects of Fishing Pressure on Fish Assemblage Structure and Movements, Kim N. Holland

Fisheries conservation zones (harvest refugia) are recently receiving attention as the best hope for the management of reef fisheries. Although there are many potential and practical benefits to the establishment of these areas, there are very few empirical data with which to evaluate their effectiveness or to support the establishment of these refuges on a wide scale. The objective of this project is to describe and quantify the impacts of annually alternating 'fishing' and 'no-fishing' regimes on reef fish assemblages in a fisheries management area. Results will be compared to an adjacent control area, a permanently closed marine life conservation district.

In this ongoing program, researchers have described the movement patterns of mobile reef fishes within conservation zones and demonstrated that even modestly sized refugia afford significant protection to adults of these species.

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Coastal and Natural Hazards

R/EP-6, Analysis of a 5-year Series of Sea Surface Temperature Images Around Hawai'i, Pierre Flament

A variety of processes contribute to generate patterns of Sea Surface Temperature (SST) within the Hawaiian region. Eddies and fronts affect the depth of the thermocline, and are associated with vertical circulation and upwelling of cold subsurface water, potentially bringing nutrients into the euphotic layer, increasing primary productivity and, therefore, affecting the ecosystem. In this project researchers will use newly available observational tools to conduct a complete statistical study of these phenomena. They expect to produce the first calibrated series of SST for the Hawaiian region, as well as a locally tuned algorithm for estimating SST from satellite infrared measurements. The algorithm then will be applied to images produced by a 6-year series of SST and the time series will be compared with in-situ observations from buoy samples to elucidate causal links.

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R/EP-7, Sedimentary Record of Climate Variations and Holocene Sea Level Fluctuations on Oahu, Jane S. Tribble

Lake sediments are among the best geologic recorders of climatic and environmental change. Because seasonal temperature does not vary dramatically in Hawai'i, changes in lake conditions can be correlated with the hydrologic cycle. Researchers will investigate the sedimentary record in a pond and an evaporite pan at Barber's Point, O'ahu. Sediments in the pond represent 1,500 years of continuous deposition. The evaporite pan record is compressed and discontinuous, but contains evidence for major changes in sedimentation over the last 7,200 years. An analysis of the sediment composition and lamination of the cores, and the salinity regimes of the various sediment types should yield records of rainfall variation, storm and tsunami frequency, Holocene sea level, and anthropogenic effects on the Barber's Point environment.

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R/EP-8, Mapping Historical Shoreline Changes on Maui and Oahu, Charles H. Fletcher III

The goal of this project is to provide state and county coastal managers with data on coastal erosion rates, and with the technology to monitor coastal erosion on a continuing basis. Researchers will produce coastal erosion maps which will display the annual erosion rate determined at cross-shore transects with a 45-meter spacing. The 30-year and 60-year erosion hazard zones will be depicted as well as the FEMA V-zone, A-zone, and base level elevations and gutter lines. Segments falling into various classifications of erosion hazard will be color coded. The maps will be made available to city and state departments dealing with coastal use and development.

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R/EP-9, Dynamical Models of Erosion and Sand Transport for Island Beaches, Janet M. Becker

Beach erosion is a widespread problem throughout the Hawaiian Islands. While sediment transport has been an active area of research for many years, still no consensus has been reached on how to best model sediment transport for realistic

oceanic conditions. The objective of this study is to develop dynamical models of beach erosion and sediment transport that account for the feedback between the underlying seabed morphology and the nearshore wave field. Researchers will determine the relative importance of nearshore wave-induced stresses versus porous percolation on sediment transport and beach erosion, and make recommendations for improving existing sediment transport models.

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R/EP-10, *West Maui Shoreface Sediment Dynamics*, Charles H. Fletcher III

Because of a rapid relative sea-level rise, heavy shoreline development, and extensive upland use by soil-disturbing activities, the island of Maui is particularly prone to environmental impacts from sedimentation effects in the nearshore region. These include the seasonal and longterm movement of sand related to changing wave and current conditions and coastal erosion, as well as the short-term, event-related genesis of silt plumes in coastal waters related to upland erosion and run-off.

This project will improve our understanding of seasonal and longterm littoral dynamics and sediment movement on the West Maui coast. Researchers will analyze the time history of alongshore sediment movement, the location and internal dynamics of discrete littoral cells, the impact of wave- and tide-generated coastal currents on sediment exchange across the shoreface, and the quantity and direction of sediment movement in the zone from the upland dune environment to offshore sand flats. The goal is to improve our ability to answer why shoreline change is occurring on Maui.

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Enhancement of Environmental Monitoring and Assessment

R/ES-2, *Development of a Fiber-optic Ocean Color and Fluorescence Probe and Data Analysis Algorithms for in situ Measurements of Phytoplankton Productivity*, Thomas F. Cooney

Phytoplankton found within 100 meters from the sea surface are responsible for the bulk of the Earth's primary biological productivity. This narrow zone is subject to natural variability in temperature, sunlight, salinity and nutrient availability on spatial, diurnal and seasonal scales, as well as to chemical and biological changes brought about by human activities. All these variables have an impact on the health and density of the plankton community, which are the target of intense monitoring. These researchers are hoping to develop and test miniature deployable optical instrumentation and on-site

data-analysis capabilities for unattended monitoring of planktonic density, species composition and productivity.

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R/ES-4, Intelligent Motion Planning and Navigation for Unmanned Underwater Vehicles, Junku Yuh

The development of unmanned underwater vehicles which can navigate on their own, automatically modifying their path to avoid obstacles which they encounter on the way to their target, will greatly expand human's capability to explore and exploit the ocean and its resources. In this project researchers are developing an intelligent motion planning and navigation system based on genetic algorithm and advanced control systems (neural network control and an adaptive-learning control). The systems will be evaluated and tested on a UH unmanned underwater vehicle, ODIN, in the fall of 1998.

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Remediation

R/ES-3, Electro-deposition of Carbonate Structures in Tropical Marine Environments, Bruce E. Liebert

The potential utility of electro-deposition for producing environmentally benign and economically feasible offshore structures has been established and demonstrated by a number of researchers in the last two decades. However, the technology has not yet been defined adequately to permit its conventional, commercial use. In this project researchers will take the technology into the field to determine the critical parameters of the accretion process as they relate to construction of offshore structures. The goal is to work with local industry to demonstrate that the method can be used to build an artificial reef.

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R/MC-2, Tailings Management for a Marine Minerals Industry, John Wiltshire

This project will examine ways that ferromanganese processing tailings can be recycled and put to productive use in the construction industry to document the feasibility of recycling as a means of tailings management. Four product areas will be

investigated: cold cast products; sprays and coatings; antibiofoulants; and ceramic-glasses. These products will be manufactured, chemically analyzed, and sent out for standard construction testing.

The first year of work concentrated on resin casting with tailings, plastic and rubber fillers, anti-rust coatings, ceramic glazes and soil amendments. All of these applications worked, producing usable products. The economic evaluation of the castings indicated only marginal promise. In commercial testing, Akron Rubber Development Corporation concluded that the tailings grain size would have to be finer and more even to be an ideal rubber or plastic filler, although significant promise existed for tailings modification to achieve this end. A large agricultural experiment indicated significant stimulation of growth of Hawaiian koa trees by tailings. Three hundred melt mixes produced a high quality glaze, considered commercially viable by Ceramics Hawai'i. A one-year exposure test on a tailings-based coating indicated superior rust inhibiting characteristics over a standard mix. Two papers have been published as a result of this work.

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New Projects

Nonindigenous Species

R/NI-1, Survey of Introduced Marine Invertebrates on Guam, Gustav Paulay

Accidental and deliberate introductions of species into areas outside their natural ranges have been rapidly increasing this century, with the improvement of transport technology and the increase of transport. Deliberate marine introductions to Guam are limited to a relatively few fish and shellfish species, but there is very little information on the impact of inadvertent marine introductions (those that come in on ship hulls, in ballast water, or in association with intentionally introduced organisms) on Guam's marine ecosystem, or on most Pacific islands. In this study researchers will assess the impact of non-indigenous species on Guam and evaluate the potential of any of these species becoming nuisance species elsewhere. The work should allow a general evaluation of the impact of non-indigenous species in a coral reef ecosystem and provide a model for use in other areas. Researchers will work with agencies in Guam and elsewhere, especially Hawai'i, to propose regulatory safeguards to prevent or lessen future impacts.

Marine Biotechnology

R/MPI-12, TNF-alpha Inhibitors from a Marine Source, Marcus Tius

Sarcophytol A, an organic molecule which was isolated from a widely distributed Indo-Pacific soft coral, *Sarcophyton glaucum*, has significant anti-tumor promoting activity. The synthesis of initial analogs of this molecule was too costly to allow it to be

considered as a drug candidate. In previous work these researchers designed and prepared a small number of simpler analogs, one of which was found to be much more potent than sarcophytol A. These analogs exert their action through the inhibition of protein farnesyl transferase (PFT) and the inhibition of the production of tumor necrosis factor α (TNF- α). PFT is necessary for the upregulation of the ras oncogene, which is mutated in a large percentage of the most lethal solid tumors. TNF- α plays a key role in one of the up-regulatory pathways for the replication of HIV-1.

The two related objectives of this project are first, to prepare a large and diverse library of analogs of the natural product to find a more potent TNF- α inhibitor; and second, to use the bioassay data to formulate a testable hypothesis for the molecular mechanism of action. The long-range objective is to develop a pharmaceutical product for the treatment of diseases associated with the over-production of TNF- α .

R/MP-13, Isolation, Characterization, and Molecular Cloning of the Crustacean Androgenic Hormone for Sex Control Ratio in Shrimp Aquaculture, Piera S. Sun

Aquaculture of the domestic marine shrimp *Penaeus vannamei* could be greatly improved through the use of alternative species and sex groups which take advantage of the prominent sexual dimorphism in which females reach 20-30% larger body sizes than males.

NOAA Partnership and Outreach (NSI)

R/MP-51, Phylogenetic Systematics and Cephalopod Biodiversity, Richard E. Young

The systematics of cephalopods will be examined using modern methods to gain an understanding of their evolutionary relationships and the selection processes that led to present patterns of diversity. Cephalopods were chosen because their low species diversity and higher familial diversity make them a manageable size group. The new cladogram which will result from this combination of traditional morphological methods and molecular methods will result in a more stable classification that reflects actual evolutionary relationships.

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Sea Grant Extension Service

A/AS-1, Hawai'i Sea Grant Extension Service, Bruce Justin Miller

The Sea Grant Extension Service has expanded services to all of the Hawaiian Islands, and to all of the U.S.-affiliated Pacific islands. That has required an increase in staff and, due to level Sea Grant funding, an increase in external support. All our projects and positions are now maintained through cooperative agreements with agencies at all local, state, federal and regional levels.

With the state and the region experiencing economic decline, we are concentrating more on problems that retard our economy, such as natural and human-induced hazards, and on opportunities for environmentally sustainable development, such as diversified aquaculture and ecotourism. We have also expanded our cooperative efforts to involve youth in volunteer environmental activities throughout the region, and have refined our programs designed to train Pacific islanders for entry into resource management careers.

Aquaculture Development

Faced with the inevitable economic crisis brought on by the loss of traditionally dependable sources of income, such as plantation agriculture and federal aid, Sea Grant has made a significant investment in aquaculture development as a way to diversify our regional economic base. Two aquaculture projects demonstrate how Sea Grant is working in a coordinating role to further the development of the freshwater aquarium industry in Hawai'i, and industries for giant clam, black pearl, sponge, and saltwater aquarium species in the Pacific islands.

Coastal Resource Management

Hawai'i and the U.S.-affiliated Pacific islands lie in the coastal zone where anything happening on the land can potentially impact our fragile coastal resources. Since most residents reside, work, and recreate on or within a few miles of the coast, natural hazards such as tsunamis, hurricanes, and high surf affect everyone and can devastate our economy. With this level of vulnerability, as well as the heightened concern about the impact of natural and man-made hazards, Sea Grant has a unique opportunity to apply our technical expertise toward mitigation of both natural and man-made hazards. Our on-going efforts to develop a response scenario for catastrophic oil spills in Hawai'i, and to develop guidelines for environmentally sensitive dredging in Pohnpei are continuing. Our new cooperative initiative with Maui County has already resulted in the development of a comprehensive beach management plan.

Coastal Recreation and Tourism

Tourism is our largest industry, and in that statement lies both a danger and an opportunity for Hawai'i. Traditional tourism is energy-intensive and resource exploitive. As visitor counts grow and tourist-related infrastructure proliferates, the danger is that valued lifestyles will be diminished. And, with that loss we may also lose

the special appeal that makes Hawai'i a top visitor destination. The opportunity is that we can encourage a new type of tourism: ecotourism or heritage tourism. In the process, we help to protect and restore the spectacular natural and cultural resources that residents and visitors have come to take for granted. Because of their importance to the ecotourism industry, we are particularly pleased with our progress in the development of the Hawai'i Ecotourism Association, as well as our part in the building of a statewide day-use mooring system that will protect popular dive sites.

Healthy Coastal Ecosystems

Coral reefs, marshes, anchialine ponds, and other unique Hawaiian coastal ecosystems, once pristine and highly productive, have greatly suffered as rapid residential and resort development have spread along our coast. Progressive degradation has not only damaged the beauty of these environments, but has resulted in a decline in many of the seafood species once plentiful in the shallow waters. Our program has devoted a considerable effort toward restoring already degraded habitats, and creating new habitats that enhance stocks of commercially or recreationally valuable species. We have taken the lead in research and extension work devoted to preserving Hawai'i's remaining anchialine ponds, and continue our work with creating artificial reefs that not only increase stocks of inshore fishes, but also provide attractive sites for recreational and commercial diving operations.

Environmental Education

No matter how much effort is put into programs designed to protect intact ecosystems and restore degraded ones, we will ultimately fail to succeed without public support. For that reason, we must find better ways to reach people of all ages. In Hawai'i we are taking several approaches to reach a large and diverse audience. Through our Youth for Environmental Service (YES) we are involving increasing numbers of K-12 students in volunteer programs with the expectation that they will become lifetime volunteers. At Hanauma Bay we are designing an innovative educational program that has the potential to reach, and hopefully educate, a million visitors a year from around the world. And, we have been working for nearly a decade to develop a cadre of trained individuals who are able to teach global change topics to the public.

Building Local Technical Capability

State and federal resource managers have been providing technical assistance to communities in Hawai'i and the Pacific islands for more than two decades. While this has solved immediate problems, it has not empowered local communities to solve complex environmental problems themselves. In an effort to remedy this situation, we have recently embarked on several training initiatives designed to upgrade the skills of existing local personnel, and to enlist and train islanders currently attending the University of Hawai'i system so they can assume technical positions in their home communities. Two programs, MASSIP and HIP, recruit Pacific island and native Hawaiian undergraduates to enroll them in internships so they can return home and begin careers as resource managers.

Communications

Sea Grant Communications provides access to scientific and technical publications, filling order requests from around the world. Public access to these publications is made easy by an in-house library and its online publication directory, as well as links to the more comprehensive Sea Grant National Depository. Communication services provided to program management, extension and researchers include editorial and graphic arts support in the form of substantive and mechanical editing, layout and design, and production support.

Sea Grant's monthly newsletter, *Makai*, as well as the full-color version available online as the *Electronic Makai*, provides a focal point for the Student Writers Project which supports young writers interested in developing skills in the field of science journalism. A media query service fields requests from local and national media through ProfNet, an international cooperative of public information officers linked by the Internet to provide journalists convenient access to expert sources who can provide newsworthy information.

To help heighten public awareness, news releases and public service announcements are distributed to media sources on research progress and outreach activities for coverage by local and national press, development of radio public service announcements and interviews, and development of television broadcasts and guest appearances.

An ongoing effort of the Communications Program is the Sea Grant website development, its expansion via links to partnering institutions, and the debut of Sea Grant online for kids called "Sea Squirt." Visit the Hawai'i Sea Grant College Program online at www.soest.hawaii.edu/SEAGRANT.



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