

Sea Grant Depository

ANNUAL REPORT

1972-1973

year 05



Sea Grant
College Program
university of hawaii

A report on the University of Hawaii's Sea Grant College Program from September 1972 through August 1973

ANNUAL REPORT
1972 - 1973
YEAR 05

Miscellaneous Report
UNIHI-SEAGRANT-MR-75-01
December 1974

SEA GRANT COLLEGE PROGRAM
UNIVERSITY OF HAWAII



This report describes Sea Grant College Program activities during the period September 1, 1972 through August 31, 1973 which were supported by NOAA Office of Sea Grant, Department of Commerce, under Grant No. 04-3-158-29. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

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YEAR 05 SUPPORTING ORGANIZATIONS AND PERSONNEL

Governmental Organizations

Gilbert and Ellice Islands Colony
Government
Philippines Fisheries Commission
Trust Territories
Philippines National Science Development Board, Trust Territories
National Marine Fisheries Service,
Honolulu Office
Government of American Samoa
County of Hawaii, State of Hawaii
City and County of Honolulu,
State of Hawaii
County of Kauai, State of Hawaii
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Naval Undersea Research and
Development Center (Kaneohe)
U.S. Bureau of Sport Fisheries and
Dept. of Land and Natural Resources,
State of Hawaii
Dept. of Health, State of Hawaii
Dept. of Planning and Economic
Development, State of Hawaii
Marine Affairs Coordinator, State
of Hawaii
PASGAP (Pacific Sea Grant Advisory
Program)
Hawaii Civil Air Patrol

Academic Institutions

University of Hawaii at Manoa
Leeward Community College
University of Hawaii at Hilo
University of Washington
University of Guam
Bishop Museum

Industrial Participants

Marine Colloids Inc.
Dillingham Corporation
Hawaiian Tuna Packers
Oceanic Institute
Makai Range Inc.
Cement and Concrete Products Industry
of Hawaii
Amfac (American Factors)
Fish Farms Hawaii
Van Camp Sea Food Company
Mr. S.L. Gaines
Ocean Resources, Inc.
Kilauea Plantation Co.
McBryde Plantation Co.
Maui Divers, Inc.
Huehue Ranch
Kamehameha Development Corporation
Mr. Ed. Bilderback

director's report

program management

The University of Hawaii became a Sea Grant College on October 17, 1972 in recognition for achieving the standard of excellence required for this designation. Ceremonies at the East-West Center were attended by Lt. Governor George Ariyoshi, U.S. Senator Hiram Fong, University administrators, and Sea Grant principal investigators and staff. Dr. Robert White, Director of the National Oceanic and Atmospheric Administration and Dr. Robert Abel, Director of the National Sea Grant Office represented the Department of Commerce with Dr. White making the presentations.

The optimism generated by the commitment implied by the Sea Grant College designation and the continued growth of the National Sea Grant network was short-lived, however.

In autumn 1972, it became apparent that the National Oceanic and Atmospheric Administration was faced with severe budget cutbacks and that Sea Grant would not emerge unscathed. Near the end of the fiscal year, we were requested to defer all possible expenditures until after July 1, 1973. Hence, although the University of Hawaii's award for Year 05 was \$1.4 million (see



accompanying table and graph), an increase of about \$200,000 over Year 04, the constraints on spending necessitated some difficult program adjustments. Furthermore, all Sea Grant Colleges were asked to plan Year 06 programs in line with a projected 25 percent decrease. This required strategies to mitigate damage and avoid curbing program productivity.

Nor was the fiscal problem confined to federal budgets. The State of Hawaii, in the face of projected budget deficits, cut the University's budget by \$7 million. This affected many of the programmed Sea Grant matching funds. In addition, the Marine Affairs Coordinator's Office which provides matching support for Sea Grant projects of high potential value to the State of Hawaii failed to obtain any new funding.

Hence, Year 05 presented high points in achievement but must be colored grey in terms of future budget outlook. It was not a year to generate much optimism or dreams. However, in spite of the cutbacks and general financial gloom, University of Hawaii projects and programs moved ahead.

As a result, Sea Grant programs and projects such as the evaluation and recovery of offshore sand, ecology and development of precious coral, and human performance in the sea, attracted much favorable attention in the state and nation.

With respect to internal management, the public information and education thrust of the program expanded with the addition of an information specialist. Through the specialist's efforts and the cooperation of participating depart-

ments and research units, e.g., Hawaii Institute of Geophysics, Hawaii Institute of Marine Biology, Department of Physiology, Look Laboratory, and the Waikiki Aquarium, state legislators and state and local administrative personnel were provided tours of marine facilities and demonstrations of work in progress. These efforts received commendations and should prove beneficial not only to Sea Grant efforts but to the marine community *in toto*.

During the year, the problem of generating timely expenditure data from the University's decentralized accounting system was largely solved by instituting a quarterly reporting requirement.

In program areas, a total of 23 projects besides Program Management and Advisory Services were approved for funding. The breakdown into categories, as presented in the institutional proposal for Year 05, is as follows:

| Categories | No. of Projects | Sea Grant funding |
|--|-----------------|-------------------|
| Program Management | | \$134,552.00 |
| Education | 6 | \$101,913.00 |
| Advisory Services | | \$129,268.00 |
| Aquaculture | 2 | \$370,185.00 |
| Fisheries | 4 | \$ 76,784.00 |
| Coastal Environment Management | 5 | \$251,158.00 |
| Human Performance in the Sea | 1 | \$128,234.00 |
| Ocean Bottom Resources and Ocean Engineering | 5 | \$251,158.00 |

Sea Grant projects during Year 05 made possible the involvement of a total of 61 students in marine-related studies

NO. OF STUDENTS INVOLVED IN SEA GRANT PROJECTS
DURING YEAR 05 AT MANOA CAMPUS

| Discipline | UG | G | Degree earned/to be earned | | | | Total |
|-------------------------------------|----|----|----------------------------|-------|-----|-----|-------|
| | | | BS | MS | MA | PhD | |
| Agricultural Economics | | 3 | | | 1/ | 1/1 | 3 |
| Animal Sciences | | 1 | | /1 | | | 1 |
| Biology | 4 | | 2/2 | | | | 4 |
| Business | 1 | | /1 | | | | 1 |
| Chemistry | | 1 | | /1 | | | 1 |
| Civil Engineering | | 1 | | /1 | | | 1 |
| Economics | | 1 | | | | /1 | 1 |
| Food Science | | 4 | | 3/1 | | | 4 |
| General Science | 1 | | /1 | | | | 1 |
| Liberal Studies | 1 | | /1 | | | | 1 |
| Marine Ecology | | 1 | | /1 | | | 1 |
| Microbiology | | 1 | | 1/ | | | 1 |
| No major | 9 | 1 | /9 | 1/ | | | 10 |
| Ocean Engineering | | 8 | | 4/4 | | | 8 |
| Oceanography | | 9 | | 1/8 | | | 9 |
| Psychology/ Occupational Therapy | 1 | | /1 | | | | 1 |
| Physics/Astronomy | | 1 | | /1 | | | 1 |
| Physiology | | 4 | | | | /4 | 4 |
| Zoology | 3 | 5 | 1/2 | 1/4 | | | 8 |
| TOTAL | 20 | 41 | 3/17 | 11/22 | 1/0 | 1/6 | 61 |

and activities on the Manoa campus. The involvement of students in the marine technician training program is discussed in the section on education.

Of the 61 students, 41 or about 66 percent of the students were graduate students in a wide variety of disciplines. The accompanying table gives the detailed breakdown of numbers and areas of interest of the students.

Of the four students who earned graduate degrees in Year 05, one doctoral and three masters, three have found positions in academic institutions and one has been hired by a private firm.

| Discipline | Degree Earned | Academic Inst. | Private Firm |
|----------------|---------------|----------------|--------------|
| Ocean Eng. | MS | 1 | 1 |
| Physiology | PhD | 1 | |
| Marine Affairs | MA | 1 | |

Early in Year 05, the annual report of the programs and research of the Hawaii Sea Grant Program for Year 04 and a much needed brochure describing the goals and activities of Sea Grant institutions as mandated by the National Sea Grant College and Program Act of 1966 were published. These publications have been used to promote better understanding of the Hawaii Sea Grant College Program among our congressional and state legislators, state department heads, and county councilmen and administrators. As with our other publications, these have also been sent to interested organizations and individuals upon request.

The fiscal report of the federal and matching funds for Year 05 is shown in the accompanying table and graph. Also, the Hawaii Sea Grant Program continues to receive support from a wide segment of governmental, academic, and industrial institutions and agencies as indicated by the list compiled for Year 06.

Jack R Davidson

Jack R. Davidson, Director

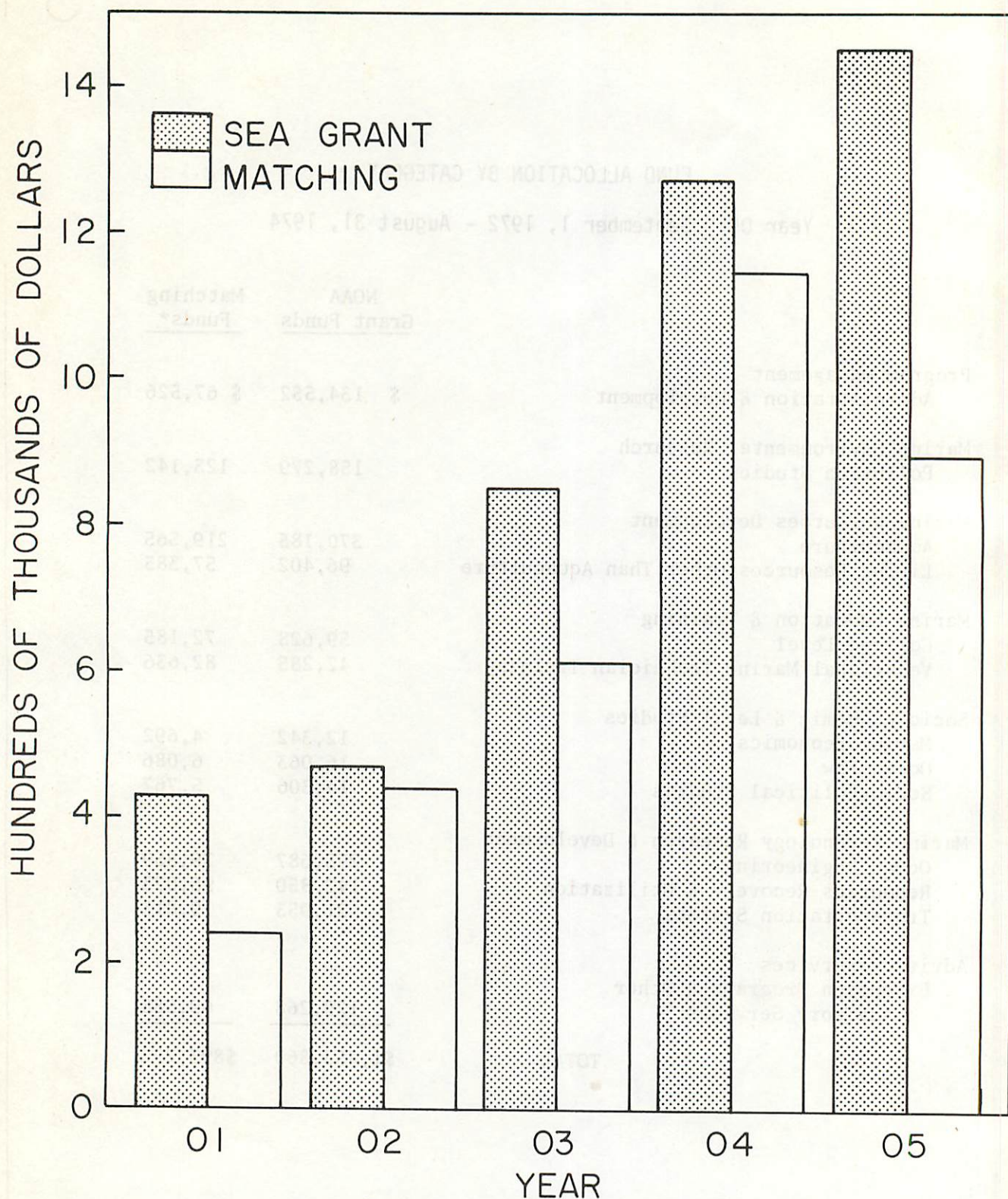
FUND ALLOCATION BY CATEGORY

Year 05: September 1, 1972 - August 31, 1974

| | <u>NOAA Grant Funds</u> | <u>Matching Funds*</u> |
|--|-----------------------------|----------------------------|
| Program Management | | |
| Administration & Development | \$ 134,552 | \$ 67,526 |
| Marine Environmental Research | | |
| Pollution Studies | 158,279 | 123,142 |
| Marine Resources Development | | |
| Aquaculture | 370,185 | 219,565 |
| Living Resources Other Than Aquaculture | 96,402 | 57,385 |
| Marine Education & Training | | |
| College Level | 59,628 | 72,185 |
| Vocational Marine Technician Training | 42,285 | 82,636 |
| Socio-Economic & Legal Studies | | |
| Marine Economics | 12,342 | 4,692 |
| Ocean Law | 16,063 | 6,086 |
| Socio-Political Studies | 14,306 | 5,767 |
| Marine Technology Research & Development | | |
| Ocean Engineering | 255,687 | 79,859 |
| Resources Recovery & Utilization | 142,850 | 96,023 |
| Transportation Systems | 21,953 | 9,813 |
| Advisory Services | | |
| Extension Programs & Other | | |
| Advisory Services | <u>129,268</u> | <u>69,588</u> |
| TOTAL | \$1,453,860 | \$893,272 |

*NOTE: The matching funds shown for Year 05 continuing proposals are somewhat arbitrary since Years 05 and 06 were combined and the work period overlapped. Therefore, for expenditure reporting, this summary must be considered as an interim report.

SEA GRANT/MATCHING FUNDING



Cover drawing of a Synodont II egg and "activities" section page (see facing page) drawing of a Diodontid II egg were taken from *Ichthyoplankton of Kaneohe Bay, Hawaii: A One-year Study of Fish Eggs and Larvae* by W. Watson and J.M. Leis, Sea Grant Technical Report 75-01.

Activities year 05

September 1972 through August 1973

1972

| | | | | | | | |
|----|----|----|----|----|----|----|---|
| | | | | | 1 | 2 | |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 | S |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | E |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | P |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 | O |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | C |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 | T |
| 29 | 30 | 31 | | | | | |

| | | | | | | | | | |
|----|----|----|----|----|----|----|---|---|--|
| | | | | 1 | 2 | 3 | 4 | | |
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| 12 | 13 | 14 | 15 | 16 | 17 | 18 | | O | |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 | | V | |
| 26 | 27 | 28 | 29 | 30 | | | | | |

| | | | | | | | |
|----|----|----|----|----|----|----|---|
| | | | | | 1 | 2 | |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 | D |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | E |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | C |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| 31 | | | | | | | |

1173

| | | | | | | | |
|----|----|----|----|----|----|----|---|
| | | | | 1 | 2 | 3 | |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 | M |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | A |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 | R |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 | |

| | | | | | | | |
|----|----|----|----|----|----|----|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 | A |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | P |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 | R |
| 29 | 30 | | | | | | |

| | | | | | | | |
|----|----|----|----|----|----|----|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 | M |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 | |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | |

| | | | | | | | |
|----|----|----|----|----|----|----|---|
| | | | | | 1 | 2 | |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 | J |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | U |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | N |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 | |

| | | | | | | | |
|----|----|----|----|----|----|----|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 | J |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | U |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 | L |
| 29 | 30 | 31 | | | | | |

| | | | | | | | |
|---|---|---|----|----|----|----|---|
| | | | 1 | 2 | 3 | 4 | |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 | A |
| | | | 15 | 16 | 17 | 18 | U |
| | | | | 23 | 24 | 25 | G |
| | | | | | 31 | | |



STATUS OF PROJECTS: YEAR 05

| Project | new | continuing | completed |
|---|-----|------------|-----------|
| marine environmental research | | | |
| quality of coastal waters | | X | |
| succession and stimulation of succession on denuded coral reef substrates | | | X |
| ecological investigations of fish eggs and larvae | | X | |
| measuring beach and surf parameters | | X | |
| marine resources development | | | |
| tropical animal aquaculture | | X | |
| tropical plant aquaculture | | X | |
| pre-management study of tuna bait resources of hawaii and the trust territory | | X | |
| evaluation and recovery of offshore sand resources | | X | |
| ecology of precious corals and the development of precious coral fisheries | | X | |
| seafood processing and utilization of marine proteins as human food | | | X |
| marine education and training | | | |
| marine technician training program | | X | |
| marine option program | | X | |
| development of a graduate program in nearshore environmental-ocean engineering studies | | | X |
| formation of a marine pathology teaching collection | | | X |
| marine agronomy course | | X | |
| marine and freshwater aquaria | | | X |
| socio-economic and legal studies | | | |
| economic and institutional aspects of multiple uses in hawaii's coastal zone | | | X |
| economic analysis of pacific tuna fisheries development | X | | |
| law of coastal zone management in hawaii | | X | |
| marine technology research and development | | | |
| human performance in the sea | | X | |
| recovery of offshore sand resources | | X | |
| marine alternatives for rapid transit in hawaii | | | X |
| floating community design | | X | |
| cost effectiveness of floating platforms for alternative uses | | | X |

Marine Environmental Research

Land-generated stress in inshore waters was monitored in three of the four projects concerned with marine environmental research. It was determined that it is the inshore waters that are most affected by activities on coastal lands. The effects of stress are manifested in low diversity and smaller numbers of flora and fauna. In the project which attempted to transplant coral on clean substrates, growth did not occur in the polluted southern sector of Kaneohe Bay.

Is it possible to predict the effect of certain physical parameters on the stability or instability of beaches? Circulation current may be such a parameter although presently available data are inconclusive.

Quality of Coastal Waters

Monitoring activities in Kahana Bay, Oahu and Maunalua Bay, Oahu (Hawaii Kai) focused on water quality and biological studies in Year 05 in this continuing project. Kahana Bay is a pristine area and data obtained indicate that the state's Water Quality Standards for Class AA waters are being met with the exception of nitrogen levels. Baseline nitrogen levels exceed the state standards of 0.10 mg/l. Heavy metals, such as lead, zinc, copper, chromium, and nickel, were found in the sediment. DDT was also present in all the sediment samples, but other chlorinated hydrocarbons were present only sporadically.

As expected, nutrient values in the Class A waters off Hawaii Kai exceeded those for Kahana Bay. The level of total phosphorus was above that for Class A waters. Lead, copper, zinc, chromium, and nickel were found in significant quantities in the sediments although less than that found at Kahana Bay. However, the pesticide levels were greater than that of Kahana Bay sediments.

In the biological studies, assessment of mercury levels in a wide range of biota collected from nearshore areas of Kauai indicates that benthic feeders at all trophic levels show a greater ability to accumulate mercury than animals feeding above the sediment-water interface. Hence, the pathway of mercury transport may not be through a linear food chain from plankton to herbivore to carnivore, but the greater concentrations of mercury may be found in benthic feeding organisms associated with short food chains.

Land-generated pressures affect shallow coastal waters to a greater degree than deeper waters. The

affected ecosystem changes from one with a diversity of grazing herbivores and frondose algae to one that

may be rubble-strewn or eutrophic with many suspension feeders and low diversity.



Succession and Stimulation of Succession on Denuded Coral Reefs

The final year of this project concentrated its field work on transplants of the hardy and most resistant to man-influence species, *Montipora verrucosa*, and the fastest growing species, *Porites compressa*.

In addition to observing and acquiring information on coral colonization on substrates less than three years old, three sites were selected to scuttle aluminum boats which served as clean substrates for the settlement of coral larvae. Cement pipes were also emplaced to attract fishes.

Coral colonization initially proceeded very slowly or was postponed for several months to over a year. The boats were first covered with a succession of algae and invertebrates. By the ninth month, bryzoans, tunicates, sponges, barnacles, alpheid shrimp, and crabs had settled on the boat wrecks. After a year, oysters and barnacles were present and

continued to be present thereafter. Only two small *Pocillopora* settlements were present at the mid-bay site and none at the other two: one in the northern sector of the bay and the other to the south. After 18 months, only six *Pocillopora* colonies were present at the mid-bay site.

The inadvertent sinking of the boat wreck to nearly 8 m below sea level is the probably cause of failure for the northern site. Pollution in the southern sector of the bay is the probable cause of failure at that site.

The results of the transplant study indicate that *Porites compressa* is very sensitive to environmental stress. However, even *Montipora*, which was somewhat more resistant to pollution, did not exactly thrive in the stressed section of Kaneohe Bay.

An interesting sidelight was the fact that larger coral heads survived better when they were transplanted and it was not necessary to fasten the transplanted head to a stationary substrate, especially where the water was calm. In the more surge-affected northern section of Kaneohe Bay, growth rate was good where the surge was not too excessive, even though the *Porites* colonies were partially buried in sediment.

In the monitored rate of colonization of a new substrate, the year-long period of non-activity apparently is necessary to properly condition the substrate before colonization is possible. In any case, the environment has to be conducive to coral growth before such growth can occur either naturally or by transplant. The benefit of transplanting coral is to hasten the colonization.

Ecological Investigation of Fish Eggs and Larvae

It was long suspected that a correlation existed between stress and depression in numbers and species of inshore fishes. However, because of the difficulty in identifying fish larvae, such suspicions remained in the realm of speculation only. But during Year 05, a definite correlation was established as a result of summer and winter sampling off Kauai, Maui, Oahu, and Lanai. The 28 stations included the entire gamut from pristine waters to the Sand Island sewage outfall and coastal land activities from undeveloped land to harbors.

When this project was begun, fewer than 5 percent of the larvae of 580 species of Hawaiian fishes could be identified with any certainty. By the end of Year 05, it was possible to identify 210 species. Although the number now known is less than half of the total number of Hawaiian fish species, it represents the most common inshore species.

Results of sampling the inshore waters of unstressed Anahola Bay on Kauai indicated the presence of 245 individuals/18 species in 1000 m³ of

water as compared with 4 individuals/3 species per 1000 m³ of water in nearby Nawiliwili Harbor. On Maui, the results of samples collected in La Perouse Bay and Kahului Harbor are 326 individuals/42 species and 3 individuals/1 species, respectively.

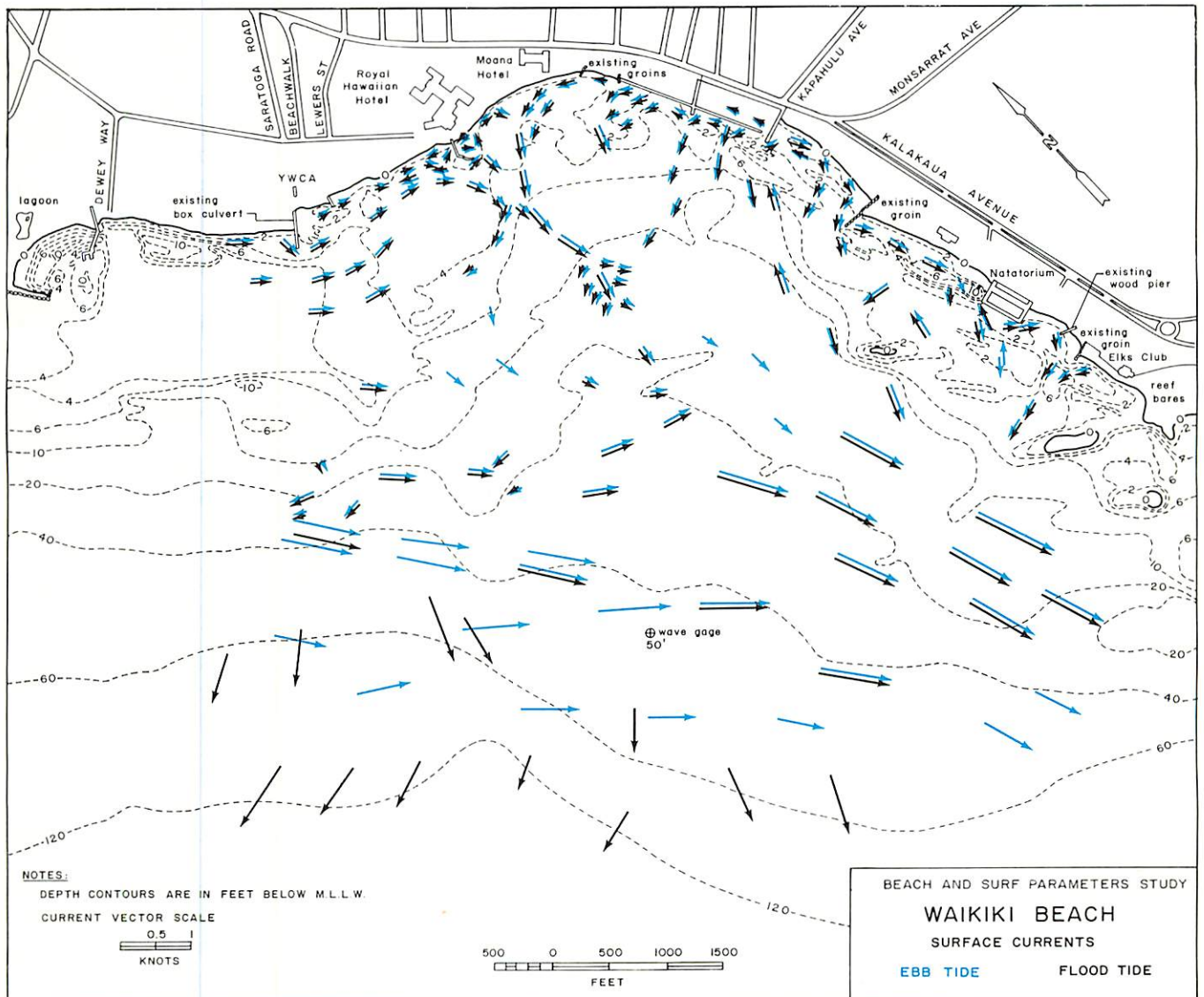
The final year of study during Year 06 will concentrate on providing data for a resource inventory map for planning and regulatory agencies. Stations will be established along areas which are being contemplated for development.

Beach and Surf Parameters

In the circulation currents established for Waikiki during the ebb and flood tides, respectively, the general set of the flood current is toward the northwest. The ebb current flows in the opposite direction to the southeast. An eddy trails off the primary offshore flood current, resulting in nearshore circulation pattern that has a dominant southeasterly set.

The nearshore flood currents averaged 01. to 0.3 knots while the average ebb velocity, which was higher, ranged from 01. to 0.5.

Although several profiles were taken during the past two years, it was not possible to determine, with any degree of certainty, the net effect of the currents on the beach processes. Ongoing beach fill and shoreline alteration programs being carried on made it impossible to obtain "uncontaminated" data. However, a net loss was evident, if sand-fill projects are excluded.



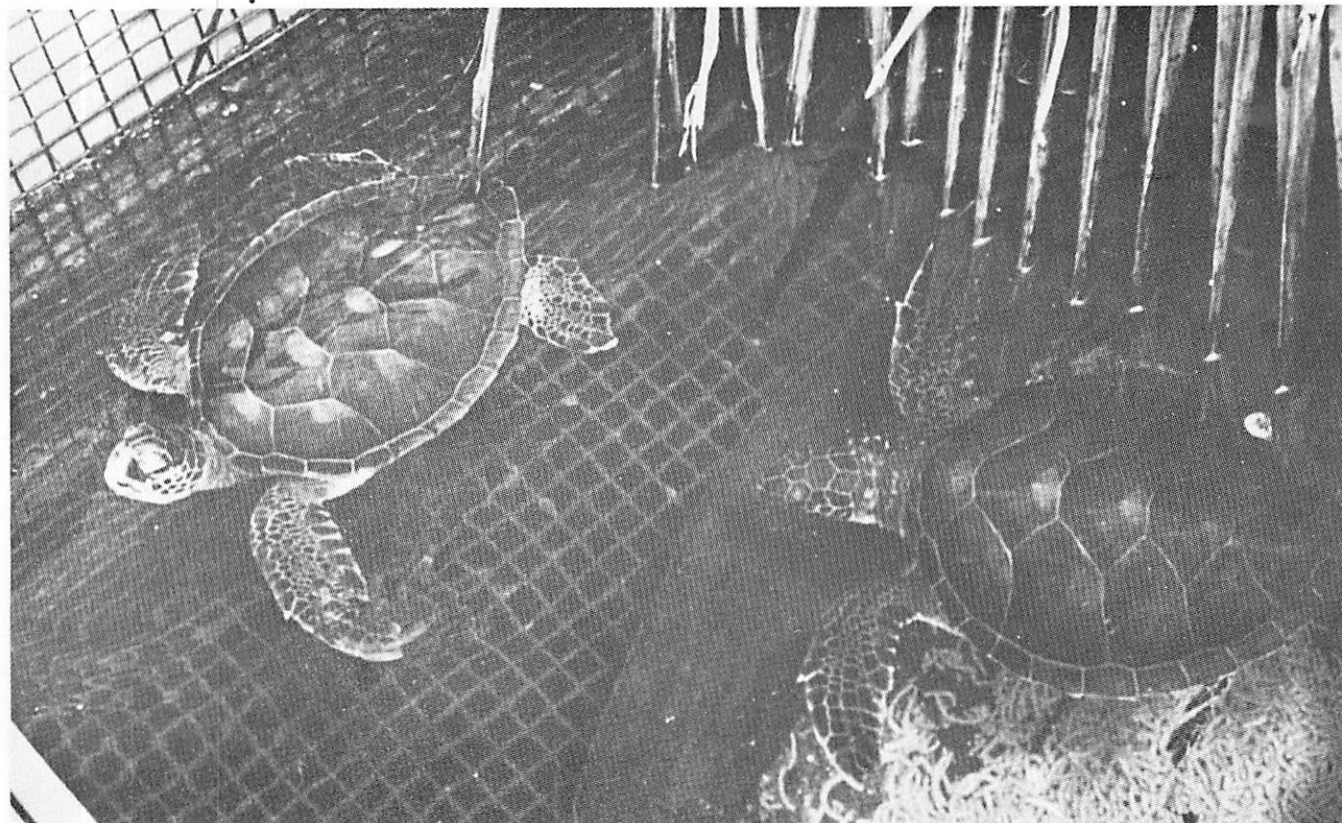
publications

- Bevenue, A., J.W. Hylin, Y. Kawano, and T.W. Kelley. 1972. "Organochlorine pesticide residues in water, sediment, algae, and fish, Hawaii--1970-71." *Pesticide Monitoring Journal* 6(1):56-64. Also UNIHI-SEAGRANT-JC-73-13. Sea Grant Program, University of Hawaii, Honolulu. June.
- Bevenue, A., J.W. Hylin, and T.W. Kelley. 1971. "Pesticide residues in our waters." *Hawaii Farm Science* 20(3):1-3. Also UNIHI-SEAGRANT-JC-73-16. Sea Grant Program, University of Hawaii, Honolulu.
- Bevenue, A., J.N. Ogata, and J.W. Hylin. 1972. "Organochlorine pesticides in rainwater, Oahu, Hawaii, 1971-72." *Bulletin of Environmental Contamination & Toxicology* 8(4):238-241. Also UNIHI-SEAGRANT-JC-73-15. Sea Grant Program, University of Hawaii, Honolulu.
- Bretschneider, C.L. 1972. "Revisions to hurricane design wave practices." In *Proceedings of the 13th Coastal Engineering Conference*. p. 167. Also UNIHI-SEAGRANT-JC-73-14. Sea Grant Program, University of Hawaii, Honolulu. July.
- Klemmer, H., and S.N. Luoma. 1973. *Mercury levels in marine biota*. Project Bulletin No. 6. Water Resources Research Center and Sea Grant College Program, University of Hawaii, Honolulu. January. (NTIS Accession Number COM-73-10508)
- Miller, J. 1973. "A quantitative push-net system for transect studies of larval fish and macrozooplankton." *Limnology and Oceanography* 18(1):175-178. Also UNIHI-SEAGRANT-JC-73-02. Sea Grant College Program, University of Hawaii, Honolulu. January.
- Smith, S.V., K.E. Chave, and D.T.O. Kam. 1973. *Atlas of Kaneohe Bay: a reef ecosystem under stress*. UNIHI-SEAGRANT-TR-72-01. Sea Grant College Program, University of Hawaii, Honolulu. 128 pp., 65 fig., 3 tables. February. (NTIS Accession Number COM-173-10604)
- Water Resources Research Center. 1972. *The quality of coastal waters: first annual progress report*. Technical Report No. 60. Water Resources Research Center, University of Hawaii, Honolulu. 213 pp., 48 fig., 65 tables, 3 app. September. (NTIS Accession Number COM-73-10144)
- Water Resources Research Center. 1972. *A summary: quality of coastal waters progress report*. Project Bulletin No. 5. Water Resources Research Center and Sea Grant College Program, University of Hawaii, Honolulu. November.
- Young, R.H.F. 1972. *Bacterial indicators of water quality*. Project Bulletin No. 7. Water Resources Research Center and Sea Grant College Program, University of Hawaii, Honolulu. December.

Marine Resources Development

To meet present and future resource needs of the state and, in the case of one study, Pacific basin countries, six projects examined the feasibility for culturing marine animals and plants, managing bait resources, surveying offshore sand deposits and precious coral beds, and pre-cooking aku as a method for preserving flavor.

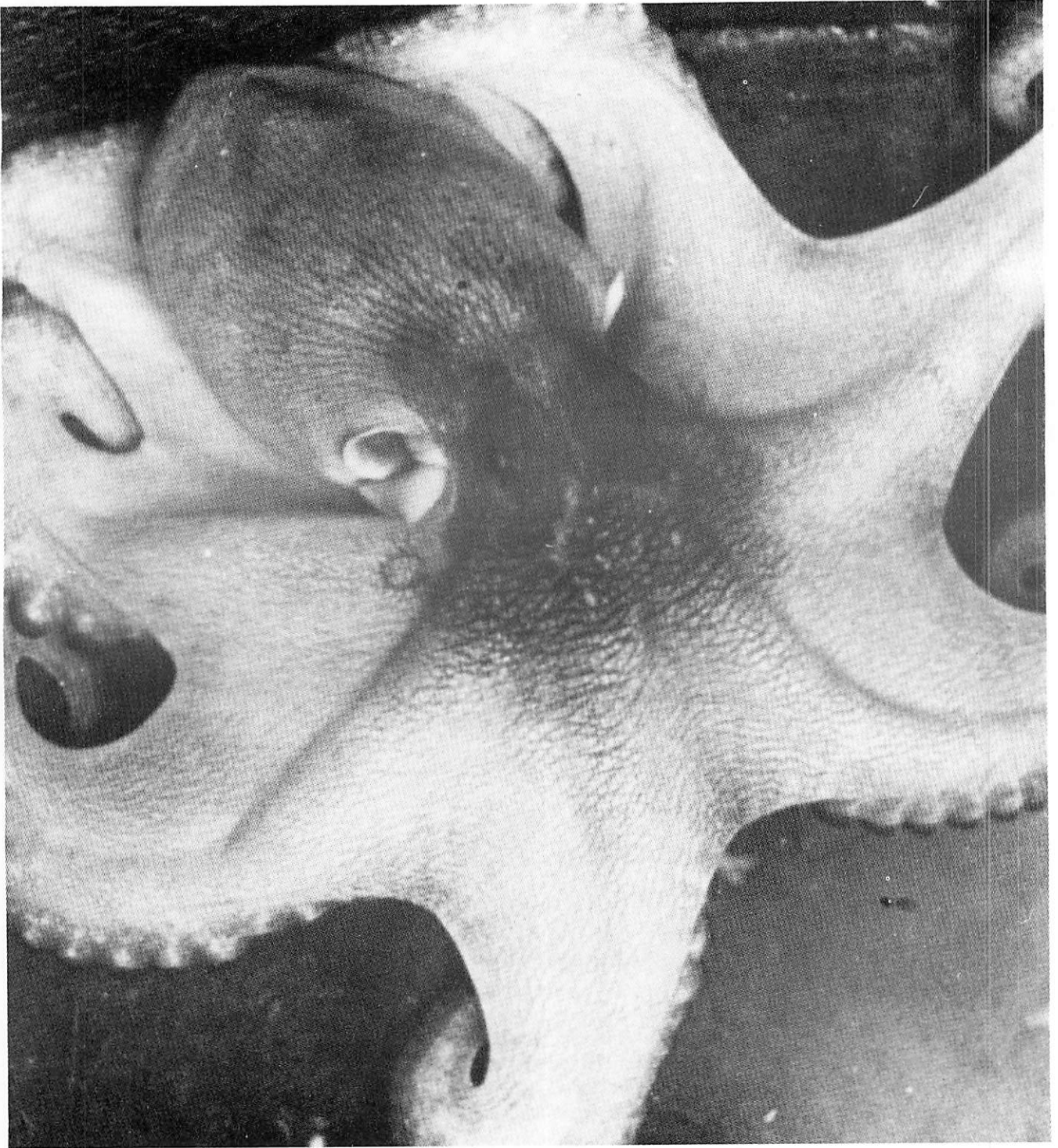
Animal Aquaculture



The goal of the Hawaii program for aquaculture is to develop systems for culturing marine or brackish water animals suitable for Hawaii and other tropical areas.

During Year 05 focus for research activities at the Hawaii Institute of Marine Biology (HIMB) has shifted to two crustaceans, *Macrobrachium rosenbergii* and *Penaeus* sp., two

marine fishes, *Parupeneus porphyreus* (kumu) and *Polydaetylus sexfilis* (moi), and the green sea turtle, *Chelonia mydas*.



Research efforts for these species have shifted to nutritional studies and the development of artificial feed. In diet studies of *Macrobrachium*, radioactive lysine and glucose have been used to study the transport of these substances and a perfusion apparatus for *in vitro* preparations has been designed and is now operational. Fifteen different C rations have been tested at the Anuenue Fisheries Research Center of the State Fish and Game Division.

Similar studies on nutrition and diet have been conducted with Penaeid shrimp, moi, kumu, and green sea turtles. An interesting sidelight in research with penaeids was the discovery of what appears to be four separate amino acid carrier systems in the shrimp gut and an adaptation for absorbing nutrients at much lower concentrations.

Kumu and moi represent two valuable sport fish species. In the nutritional studies that were conducted, kumu only took artificial feed when a chemical attractant was added. This species has champagne taste, being attracted to ground crab. The moi were not so finicky and took to artificial rations readily.

The green sea turtles culture centered on the nutritional requirements of hatchlings and juveniles. Eighty-five turtles were raised on several different diets which include copra, fish, and soybean meal combinations. Juveniles grew rapidly on diets high in soybean meal.

Although primarily interested in biological studies, researchers at the Hawaii Institute of Marine Biology have developed culturing systems for animals other than *Macrobrachium* which is reared successfully in ponds. Best developed scheme is the space-intensive stacked trays with vertical flow of water which were developed by engineers at the University of Hawaii in cooperation with Lokahi Pacific, an Office of Economic Opportunity venture.

The green sea turtle and two species of fishes appear to do well in cages which are suspended from rafts in the sheltered lagoon at Coconut Island.

During Year 05, studies of three species, *Artemia salina* (brine shrimp), *Octopus maya* (Mexican octopus), and *Cellana* sp. (opihi or limpets) were terminated as part of HIMB's Sea Grant supported research. A final report on the feasibility of rearing *Artemia* on Christmas Island commercially was submitted to the Gilbert and Ellice Island Development Authority. Although basic rearing techniques have been developed, the *Octopus maya* proved to be economically infeasible. The work with the opihi will be carried forward with funding from the County of Hawaii to develop management measures for the conservation of natural populations of this resource which is valued highly by local residents.

Tropical Plant Aquaculture

At the end of Year 05, there were over 500 seaweed farms exporting over 40 tons of dry *Eucheuma* per month from 30 hectares. A scheme for the management of production on these farms was designed and implemented. A significant step toward capital intensive production methodology was the successful growing of *Eucheuma* on concrete poured over rock fill. Posters and training manuals to teach natives how to farm *Eucheuma* were developed this year.

Field tests and inspection trips indicated that

it would be profitable to expand and improve existing natural beds of *Eucheuma* by weeding and planting on the reef flats. First, demonstration farms were installed near Makassar, Celebes Island, Indonesia. A school for training seaweed farmers was established near Zamboanga, Mindanao in the Philippines.

Washing experiments conducted indicated that regardless of the variety, all washed samples showed an increase of 13 to 17 percent in carrageenan content over the unwashed samples of *E. cottonii*, *E.*

striatum, and *E. spinosum*. Drying experiments at 50 degrees C conducted on the three species caused a weight loss of 84 to 87 percent. Seaweed in storage containing moisture of over 30 percent deteriorates noticeably in value.

Several new gels have been obtained, some of which show commercial promise and one, *ahnfeltan*, appears to be a new carrageenan with properties of greater elasticity and apparent ability to hold fats in suspension.

Pre-management Study of Tuna Bait Resources in Hawaii and Palau

In an interesting parallel, skipjack tuna is commercially valuable both to Hawaii and to the Trust Territories. In both cases, the fishery is limited by the bait used. Catches of *Stolephorus purpureus* (nehu) by commercial fishermen, which is used as live bait both in Palau, Trust Territories and in Hawaii, were sampled extensively in both places.

The population ecology and effects of exploitation of the baitfish fishery will provide the baseline data which will enable a management scheme and a monitoring system to be established for Palau during work scheduled for Year 06. In Hawaii, the extensive sampling will provide data to complete the rather fragmentary biological information presently available for the nehu and to ascertain

the peculiar proclivity of the nehu for those areas of Kaneohe Bay where coastal flats are laced with dredged channels.

Preliminarily, an extensive study has determined that the anchovetta (*Centengraulis mysticetus*), which is found in tropical and subtropical America, is a possible substitute for the short-lived, delicate nehu.



Evaluation and Recovery of Offshore Sand Resources

With increasing demand for sand by the construction industry as the level of construction in the islands continue to rise, an alternative for beach sand must be found and offshore sand is a potential source.

Surveys of sand deposits were made off Waimea, Kahana, and Sand Island, Oahu; Penguin Bank; and part of the west coast of Hawaii. The results are tabulated in the next column.

| <u>Location</u> | <u>Volume</u> |
|-----------------|---|
| Mokuleia | 20×10^6 |
| Waimea | 70×10^6 |
| Kahana | 25×10^6 |
| Sand Island | 20×10^6 |
| Penguin Bank | 3.5×10^6 |
| West Hawaii | sediment deposits at several locations but analysis of data not completed |

In all cases, however, the quality of the sand is unknown. Although a vibrating coring device was constructed, it would not penetrate more than about a foot when tested at sea. Several modifications also proved to be unworkable.

Precious Coral

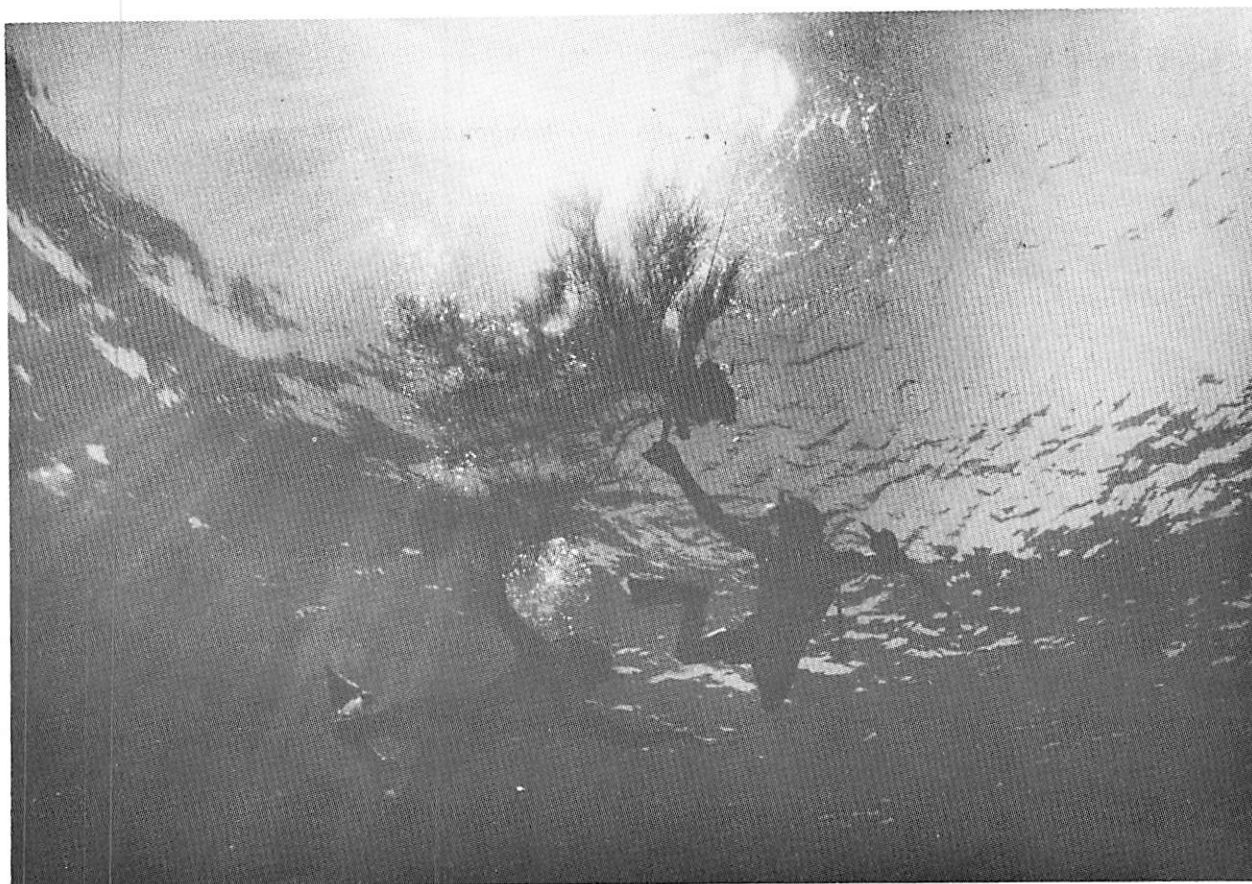
Beginning late in Year 05, a subsidiary of Maui Divers, Deep Water Exploration, Inc., has been harvesting precious coral using the submersible that was developed during the previous year. Approximately 3,000 lb of coral valued at \$90,000 have been harvested.

During Year 05, further surveys were done. Three small beds of pink coral were discovered off Kaena Point, Oahu, the northwestern tip of Molokai island, and the western tip of Kahoolawe island. The preliminary survey does not provide sufficient data to determine whether the beds are of commercial size.

Gold coral beds discovered off Koko Head and Kaena Point, Oahu are relatively large.

In the Trust Territories, large quantities of black coral were found. While no pink coral was discovered in the southern Marianas, there is evidence that it exists to the north.

Meanwhile, current information on growth and harvest rates of black coral off Maui indicates that that resource is being depleted. Dr. Richard Grigg, UH Sea Grant researcher for precious coral, will assist in formulating regulations to conserve the precious coral resources in Hawaii.



Seafood Processing

Experiments conducted during the final year of the seafood processing project found that pre-cooking was the most effective method for preserving inosine monophosphate (IMP), a nucleotide, which is a compound that gives fish their fresh flavor. Skipjack tuna muscle was pre-cooked at 175 degrees F and 212 degrees F.

When chilled (35 degrees F), the tuna muscle pre-cooked at 175 degrees F deteriorated slightly in texture while that pre-cooked at 212 degrees F showed no deterioration. However, there was no difference in the flavor value of either specimen.

In 0 degree F storage, good flavor quality was maintained up to ten to eleven weeks.

publications

- Baldwin, W.J. 1973. "Results of tests to investigate the suitability of fish pumps for moving live bait-fishes." *The Progressive Fish-Culturist* 35(1):39-43. Also UNIHI-SEAGRANT-JC-73-17. Sea Grant College Program, University of Hawaii, Honolulu. January.
- Campbell, J.F. 1972. *Erosion and accretion of selected Hawaiian beaches, 1962-1972*. UNIHI-SEAGRANT-TR-72-02. Sea Grant College Program, University of Hawaii, Honolulu. 30 pp., 6 fig., 10 tables. November. (NTIS Accession Number COM-73-10321)
- Doty, M.S. 1973. *Eucheuma farming for Carrageenan*. UNIHI-SEAGRANT-AR-73-02. Sea Grant College Program, University of Hawaii, Honolulu. 21 pp., 7 fig., 6 tables. April.
- Grigg, R.W., B. Bartko, and C. Brancart. 1973. *A new system for the commercial harvest of precious coral*. UNIHI-SEAGRANT-AR-73-01. Sea Grant College Program, University of Hawaii, Honolulu. 6 pp., 3 fig. February. (NTIS Accession Number COM-73-10774)
- Helfrich, P., and others. 1973. *The feasibility of brine shrimp production on Christmas Island*. UNIHI-SEAGRANT-TR-73-02. Sea Grant College Program, University of Hawaii, Honolulu. 173 pp., 33 fig., 35 tables, 57 plates. July. (NTIS Accession Number COM-73-11895/2AS)
- Morgenstein, M. 1971. "A study of the growth morphologies of two deep-sea manganese meganodules." *Pacific Science* 25(3):308-312. Also UNIHI-SEAGRANT-JC-73-07. Sea Grant Program, University of Hawaii, Honolulu. July.
- Morgenstein, M., and J. Andrews. 1971. "Manganese resources in the Hawaiian region." *Marine Technological Society Journal* 5(6):27-30. Also UNIHI-SEAGRANT-JC-73-06. Sea Grant Program, University of Hawaii, Honolulu. November/December.
- Struhsaker, J.W., D.Y. Hashimoto, S.M. Girard, F.T. Prior, and T.D. Cooney. 1973. "Effect of antibiotics on survival of carangid fish larvae (*Caranx* mate), reared in the laboratory." *Aquaculture* 2:53-88. Also UNIHI-SEAGRANT-JC-73-12. Sea Grant College Program, University of Hawaii, Honolulu.
- Van Heukelem, W. 1973. "Growth and life-span of *Octopus cyanea* (Mollusca: Cephalopoda)." *Journal of Zoology London* 169(3):299-315. Also UNIHI-SEAGRANT-JC-73-03. Sea Grant College Program, University of Hawaii, Honolulu. March.

Marine Education & Training

Marine education and training programs in Year 05 ranged from graduate to non-degree undergraduate programs. The six programs, one of which is being offered at Leeward Community College and the rest on the Manoa campus, with a sub-program at Hilo College, received just over \$100,000 in Sea Grant funds. Sea Grant support is adding to the scope and depth of curricula in marine-related areas and has enriched the undergraduate program by giving lower classmen the opportunity to see the beauty and richness of the ocean that surrounds Hawaii.

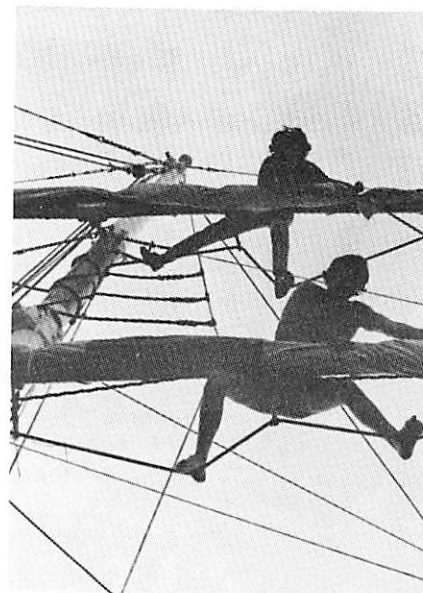
Marine Technician Training Program

A total of 375 students was enrolled in 22 classes in the marine technician training program at Leeward Community College during Year 05. Of these students, 78 were students who entered the program for the first time, 195 were taking classes for avocational rather than vocational reasons, and 102 were taking advanced courses in the program. Student drop out rate was 20 percent for the avocational students and 6 percent for those in the program.

Hands-on programs, such as participating in the annual drydock overhaul of the *Kaiolohia* at the Hawaiian Tuna Packers shipyard and doing plankton tows in several areas off the leeward side of the island of Oahu from Waikiki to Ewa Beach, are being carried on.

During Year 05, of the five students who earned Associate of Science degrees under the marine technology program, two were employed as technicians, one joined the U.S. Navy and is receiving additional training in electronics, another is employed by the local commercial fishing industry, and the fifth, a Peruvian national, returned to Peru to join the fishing industry there.

In Year 06, this continuing Sea Grant program will expand the Associate of Science degree and certificate options.





Marine Option Program for Undergraduates

The much acclaimed undergraduate program, the Marine Option Program, continues to win support and funding as an ongoing project of the Sea Grant educational program. Currently the main activity center is on the University's Manoa campus, but a small active cadre of students on the Hilo campus has formed a nucleus for a MOP-Hilo unit.

The two-pronged approach of academic and marine skills development continued to provide the framework for the activities in Year 05.

"Myths of the Sea," a new course, is undergoing review by the Curriculum Committee. A second course, "Natural history of marine mammals," has also been developed and will be offered in Year 06.

Under the skills development thrust of the program, twelve students participated in the marine mammal research project at the Naval Undersea Center at Kaneohe, Oahu under the \$22,500 UH-U.S. Navy training contract. In addition, seven students interned at the Hawaii Institute of Marine Biology and participated in thermal reef pollution and octopus and green sea turtle aquaculture projects.

Students participated as volunteers at the Waikiki Aquarium to give lectures and provide other services. Five students trained as guides for the marine life snorkeling tours at Hanauma Bay and two others who had been previously trained were hired during the summer by the County Parks and Recreation Department as ocean recreation specialists.

Other student involvement included serving as ocean research technicians on UH and NOAA research vessels and on the Coast Guard ship, the *Mellon*.

Two student-originated projects were funded by the National Science Foundation: the Oahu-based group examined the artificial reef at Pokai Bay and five students on the Hilo campus conducted reef transects along the Kona coast during summer 1973.

Under a MOP sponsored lower education program, over 200 high school students attended a two-day camp at Kaneohe. A student exchange program between Molokai High School (on the island of Molokai) and Oahu students made it possible for eight Molokai students to come to Honolulu. In turn, Honolulu students were hosted by students on Molokai.

Graduate Program in Nearshore Environmental - Ocean Engineering Studies

In response to needs in Hawaii and the Pacific Basin, a one-year project developed graduate curriculum in nearshore environmental ocean engineering.

An information gathering survey was conducted to determine the present and future needs of Pacific basin countries

for environmentally oriented ocean engineers and the skills and knowledge they would have to possess. Three specialized areas were identified: marine surveys and environmental studies, water quality preservation and monitoring, and coastal pollution and waste disposal.

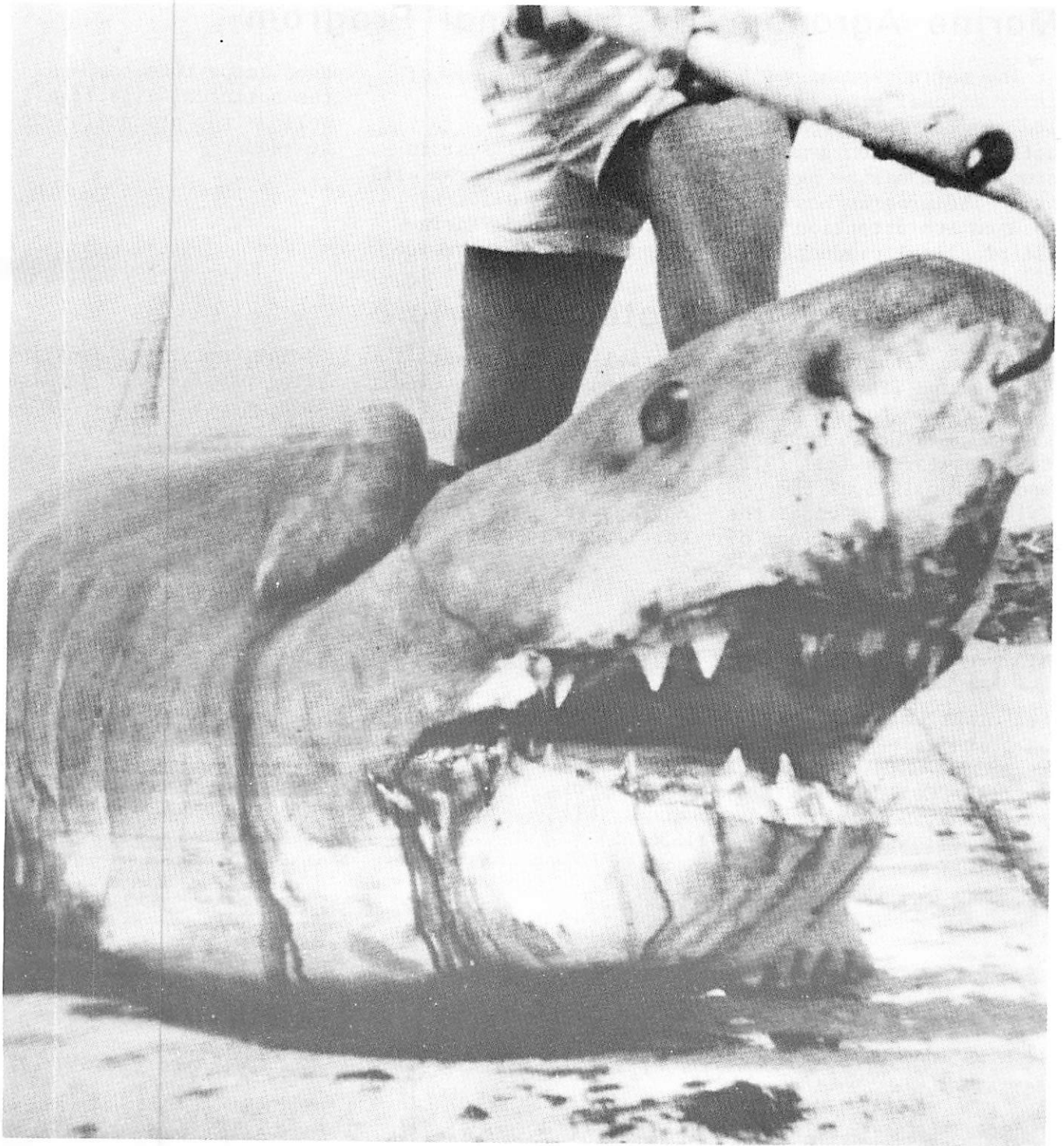
Outlines of four new courses were developed: OE 603--Oceanography for ocean engineers, OE 651--Instrumentation seminar, OE 652--Nearshore marine survey techniques, and OE 691--Estuaries. The first three courses were incorporated into the ocean engineering curriculum in fall 1972. The last course will be added to the curriculum next fall.

Formation of a Marine Pathology Collection

A course "Pathology in Marine Animals" was offered at Hilo College and a marine pathology laboratory was completed and students were trained in its operation during Year 05, the final year of this three-year project.

To add to the instructional capability on the Hilo campus, ten teaching slide sets of basic pathological lesions on marine animals were assembled. These include sets on fish-heart granuloma, fish hepatoma, turtle fibroma, and fish lymphocystis, among others.

A paper entitled "Intestinal tumor in the sea cucumber, *Holothuria leucospilata*", has been published in the *Journal of Invertebrate Pathology*.



Marine Agronomy Instructional Program

The marine agronomy instructional program has led to greatly increased activity of seven graduate students in marine agronomy. The program has focused its attention on the practical production

and broad usefulness of algae.

In its final year in Year 06, this program will be offered as a formal course entitled "Marine Agronomics," with broad-

ened scope to encompass the botanical aspects as well as the production of seaweeds.

Marine and Freshwater Aquaria

A course entitled "Marine and Freshwater Aquaria" was taught with minimal Sea Grant support for one year in fall 1972 and spring 1973 at the Waikiki Aquarium under the auspices of the College of Continuing Education.

Initially, 25 students enrolled in the non-credit course in the fall. Given an option to take the course either for two credits or non-credit during spring 1973, the enrollment rose to 100.

The course syllabus is being prepared for publication as a Sea Grant Advisory report entitled *Marine and Freshwater Aquarium Systems for Tropical Animals*.

publication

Sea Grant College Program. 1973. *First biennial report: marine option program*. UNIH-SEAGRANT-MS-73-02. Sea Grant College Program, University of Hawaii, Honolulu. 64 pp. June. (NTIS Accession Number COM-73-11535/AS)

Socio - Economic & Legal Studies

The, as yet undefined, effect of the coastal zone act on coastal states needs to be considered by each coastal state within the context of governmental agencies that influence the activities in that state. For Hawaii, a state that may well be considered a coastal zone, the act will have great impact.

The skipjack tuna industry seems to be evidencing a holding pattern in its volume of catch despite the drop in number of vessels.

Economic and Institutional Aspects of Multiple Uses in Hawaii's Coastal Zone

A compendium of federal agencies concerned with Hawaii's coastal zone was published to provide basic information needed by governmental agencies, private businesses, citizen organizations, and others as the first cut in understanding the complexity of dealing with the coastal zone. A similar compilation of state and county agencies is being prepared.

A series of newsletters (*Coastal Zone Communiqué*, ed. Justin Rutka) discussing the various aspects of the coastal zone management act and its ramifications to the state were issued. The advisory specialist for coastal zone management provided testimony before the State Legislature, conferred with state and county officials, and advised lay citizen groups.

The popular concept that the entire state of Hawaii is a coastal zone makes any activity related to the coastal zone a vital one and Sea Grant's effort in the arena of coastal zone management is clear and very visible and will continue through advisory services even though this project is completed.

Economic Analysis of Pacific Tuna Fisheries

Begun in Year 04, the economic analyses of skipjack tuna, the most important commercial fishery in the central and western Pacific, seek to provide information that will assist the fishing indus-

try in improving its operations and public officials in formulating policies which will lend assistance to the industry.

What perhaps is a surprising discovery is the fact that the catch of skipjack tuna over the years is relatively constant, even though the fleet is declining. This study reveals that the explanation lies

in the greater number of trips made by the active fleet. Another not too surprising fact is that, although the catch has remained constant, the revenues per vessel and per fisherman have increased. The answer, of course, lies in rising ex-vessel prices.

Similarly, in the long-line industry, even with dropping catch rates because of fewer trips and fewer days at sea per trip, the increasing ex-vessel prices have led to increasing levels in the

total revenue for this industry.

Results of a production-function relationship between vessel catch and such input as labor, capital, and fishing trips indicate that the number of fishing trips or fishing days was the most important factor. The size of the crew and capital invested also were significant factors in explaining the catch rates per vessel.

Collection of data on skipjack catches in Palau, Trust Territories will be completed in Year 06 and analyzed to effect a comparison with Hawaiian data.

Law of Coastal Zone Management

In this summer project, law students prepared papers on the role of multi-national corporations in the Pacific and the legal problems resulting from such an activity.

With the addition of a professor of Asian-Pacific law to the Law School, the examination of ocean law

as it applies to Hawaiian interests and to Pacific-Asian interest can be addressed in Year 06.

publications

Comitini, S. 1972. "An approach to evaluating alternative fishing techniques in the hawaiian skipjack tuna fishery." *Proceedings of the 15th Session of the Indo-Pacific Fisheries Council*. pp. 1-6. Also UNIHI-SEAGRANT-JC-73-11. Sea Grant College Program, University of Hawaii, Honolulu. October.

Rutka, J., and C. Gopalakrishnan. 1973. *Spheres of influence in Hawaii's coastal zone: volume 1. federal agency involvement*. UNIHI-SEAGRANT-AR-72-03. Sea Grant College Program, University of Hawaii, Honolulu. 89 pp., 5 fig., 3 tables. March. (NTIS Accession Number COM-73-10776)

Marine Technology Research & Development

As man's activities on land expand, the need to utilize the ocean to carry on some traditional land-based activities is an option that is both real and viable. But can human beings exist and function effectively and safely in the hyperbaric undersea world? This is a question that must be answered. Futuristic and science fictionish though they may seem, stable floating platforms and how they can support societal needs are legitimate areas for research. As population continues to increase, space becomes a scarce commodity. A method to mine offshore sand resources and a marine mass transit system were two other areas of study in marine technology research and development in Year 05.

Man in the Sea

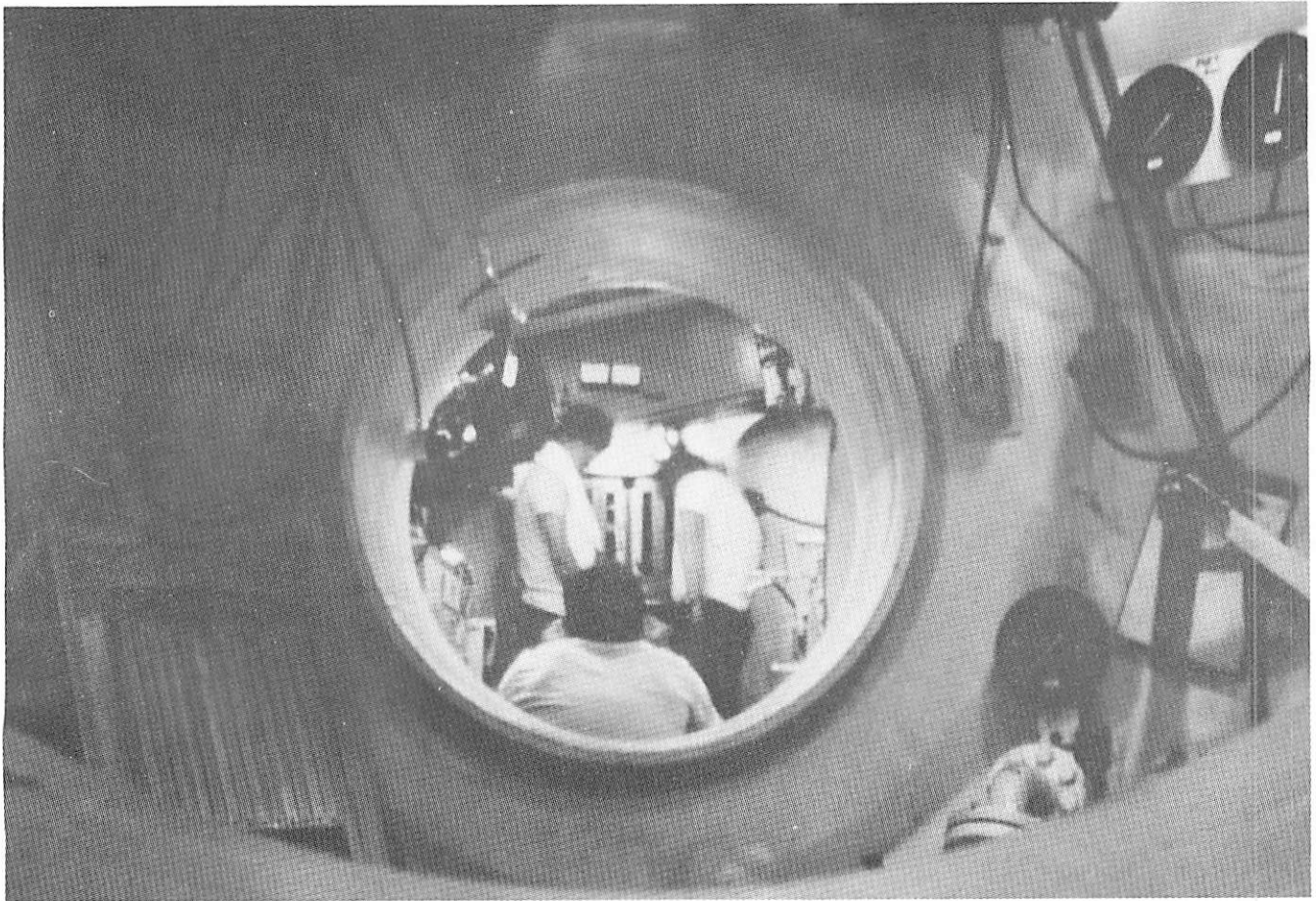
The achievements of the project, "Human Performance in the Sea," represent a wide spectra of information on the effects of diving on the human physiology.

Perhaps most exciting is the study by Dr. Richard Strauss on decompression sickness. His bubble formation studies indicate that it is possible to control growth or disappearance of bubbles without changing the ambient pressure, as is now done according to the Haldane hypothesis. He found that bubble formation can be controlled by switching gas, as was concluded by other researchers.

Heat loss studies found that subjects lost 3.34 times as much heat in water as compared with air per degree C between rectal and ambient temperatures. Interestingly, it was found that immersion in water at 25.7 degrees C, which is the average ocean temperature around Hawaii, causes the same heat loss as being exposed to relatively still air at 0 degree C.

Experiments with pharmacological agents disproved, in some cases, studies conducted by others. Helium did not demonstrate antiarrhythmic effects at 1 ATA in cats and rats. Sodium salicylate and hyperbaric air act as additive rather than multiplicative agents in lowering body temperatures on both normal and febrile rats.

The anesthetic effect of central nervous system depressant, pentobarbital, was enhanced by hyperbaric air in mice, but not in cats, guinea pigs, and rats. Mice also were protected from the lethal effects of central nervous system stimulants, picrotoxin and pentylenetetrazol, but not from caffeine.



Work was begun to make the 4 ATA hyperbaric facility at Look Laboratory operational as a 10 ATA man-rated chamber. A four-component commercial-type diving system, the "mini-bell," was procured on a long-term \$1 per year lease. In addition, a man-rated deck decompression chamber to about 7 ATA has been acquired and work begun to make it operational. These facilities, in addition to those at Makai Range and

the various departments at the University of Hawaii, give Hawaii a unique capability and versatility in the United States, which researchers will utilize in Year 06.

Experiments with argon, nitrogen, and helium gases indicate considerable curtailment of ability to function at depths common to sport divers. In water-immersed bicycling exercises, the maximal oxygen uptake was the same in

water temperatures of 25, 30, and 35 degrees C as it was in air of 22 degrees C. Hence, water immersion does not limit exercise capacity.

In July 1973, four divers spent 15 days in Japan in the Phase I dive under the Japanese-U.S. cooperative effort, JAMSTEC. The next cooperative diving experiments will be conducted in Hawaii sometime in 1975.

Submarine Sand Recovery System

State statutes prevented the commercial sized 6-inch prototype of the submarine sand recovery system from being tested. Early in 1973, a field survey indicated that Keauhou Bay, located off Bishop Estate lands, would be a suitable site for the testing of the prototype model.

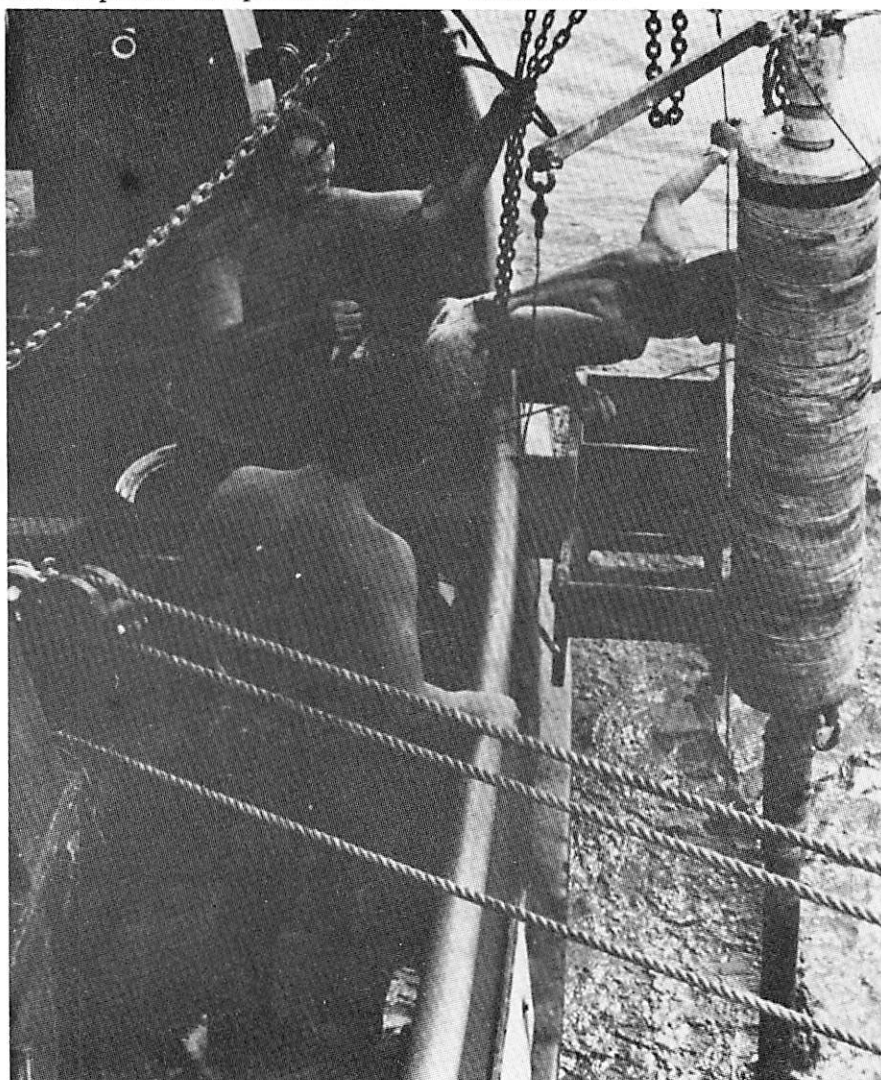
Although legislation was passed, a technicality in the language prohibited the taking of sand except under conditions that were infeasible. The Harbors Division, Department of Transportation has issued a permit allowing the experimental mining, but the Corps of Engineers is awaiting an environmental impact statement before it issues a permit and the State Department of Land and Natural Resources will not issue a permit prior to legislative amendment of Act 107 passed by the 1973 State Legislature.

A bill, which will correct the language in Act 107 to allow the experimental mining to proceed in Keauhou Bay in Year 06, will be introduced in the 1974 session of the State Legislature.

This project has attracted national attention because of articles in *Sea Technology*, *Ocean Industry*, *World Dredging*, and *Marine Construction*, among other journals.

Presently, Kamehameha Development Corporation

has agreed to provide \$10,000 for supplies and to reimburse the captain of the *Valiant Maid*, the vessel which will be charged with carrying on the project. The venture is in "hold" status until the language of Act 107 is clarified.

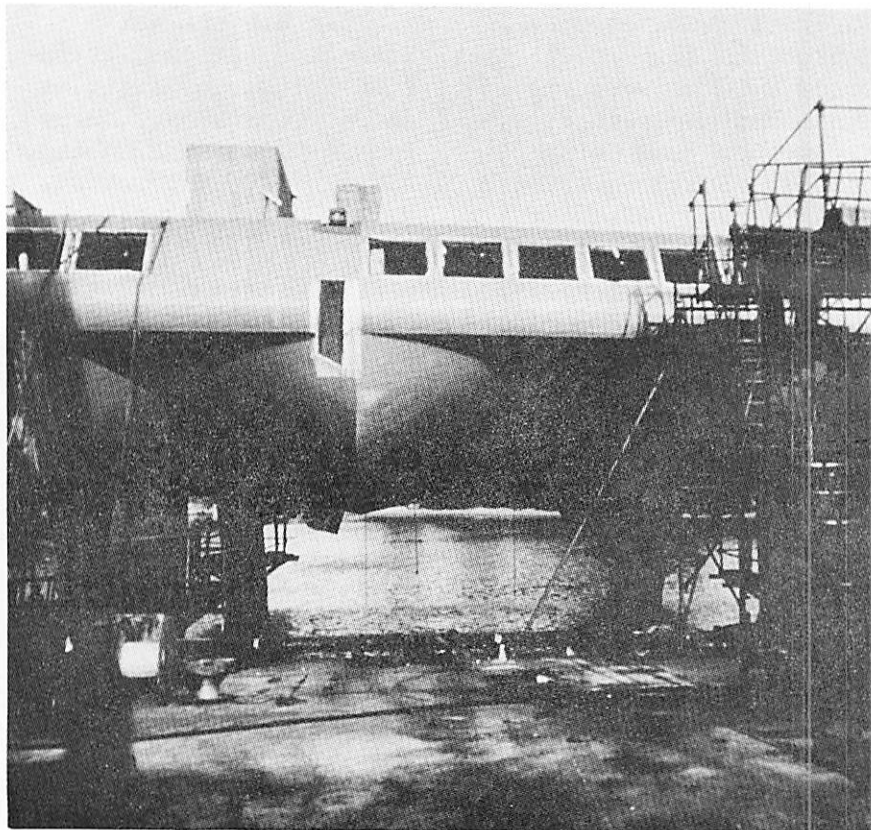


Marine Transit System

Although the use of a marine transit plan as the primary and principal mass transit system declined because of the improvements and relocations demanded by the implementation of such a system, interest in a marine system as a supplement to a land-based system is still very much alive.

Detailed studies of the Ala Wai, Manoa-Palolo, Nuuanu, and Kapalama canals included a bathymetric survey of the four canal routes, sediment yield during a 100-year storm, dredging requirements to maintain proper canal dimensions for safe navigation, and a preliminary cost analysis of vessels, canal improvements, and dredging.

Although the immediate implementation of a marine system is not possible, the study presents sufficient data to initiate the engineering aspects of any improvements and maintenance of such a system.



From the standpoint of seakindliness considerations, the usability of the Boeing 929, the PT 150, the "Duplus" type, and the SSP was considered. Difficulties are associated with each type of vessel. From the standpoint of lower initial and operating costs the PT 150 would be the most desirable, but its use is not possible commercially because of provisions in the Merchant Marine Act of 1926 which is commonly known as the "Jones Act."

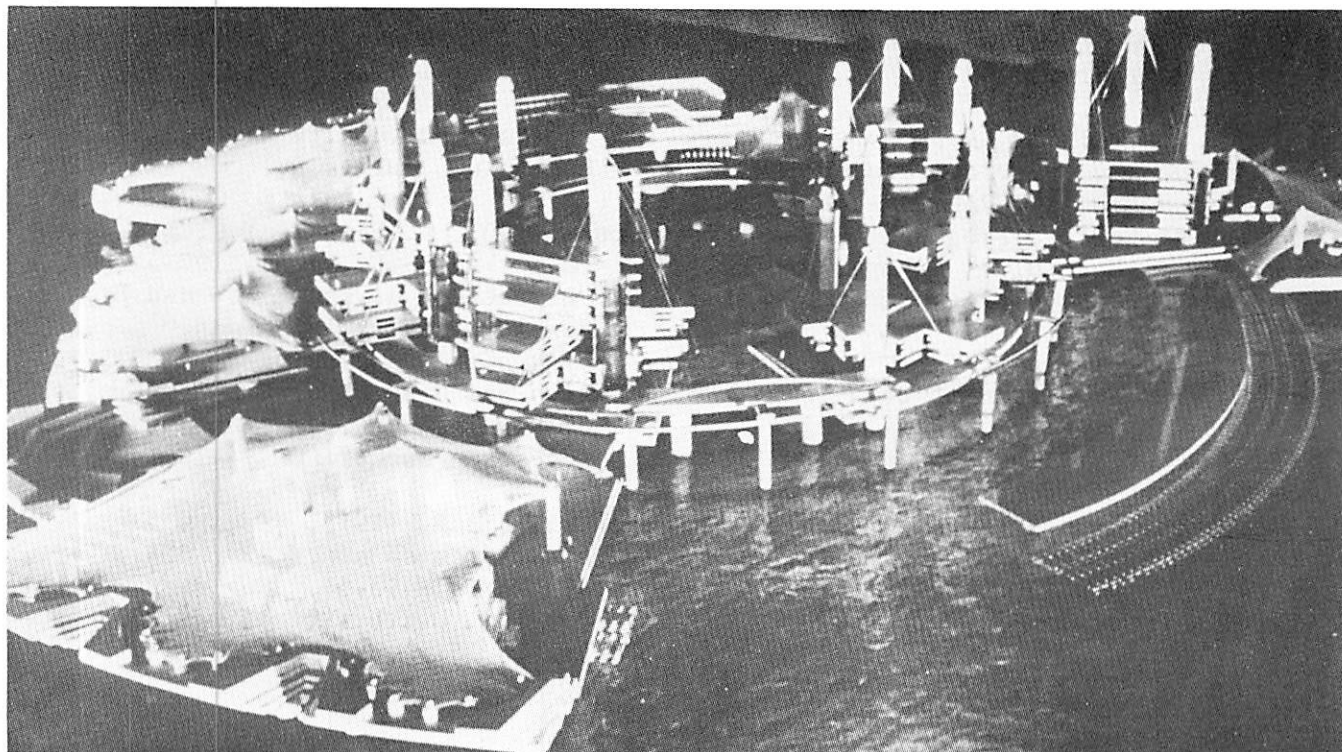
At present there are only two possible sites which can accommodate vessels of the size needed and have sufficient area to accommodate the mass transit vessel in addition to existing traffic. Honolulu Harbor and Pearl Harbor meet all criteria; however, in the latter case, there may be problems of land acquisition.

Floating Community Design

Hawaii's contribution to futurism is the on-going and continuing studies on floating platforms. Engineering and mathematical analyses of the hydrostatics and hydrodynamics of large stable platforms have been completed.

Ludwig Seidl's theoretical basis for optimization of the seakeeping characteristics of stable platforms has been published as a technical report by Oceanic Institute.

Also being investigated are concrete strengths, bottle and strut configurations, frame loads, and bulkhead locations for large stable platforms. Four publications discussing results of these studies are currently in press.



Cost Effectiveness of Floating Platforms

This two-year project which was completed in Year 05 indicates that a floating platform of 7.34 million square feet will cost \$336 million. An urban spatial

activity allocation model has been developed for a floating visitor center. The estimated revenue is \$308,000/day as a visitor center or \$176,000/day if

it has the dual function of housing workers and their families in addition to being a visitor center.

publications

- Casciano, F. 1972. "Is offshore sand mining feasible." *Hawaii Business Magazine* 17(11):63-67. Also UNIHI-SEAGRANT-JC-73-01. Sea Grant Program, University of Hawaii, Honolulu. May.
- Casciano, F. 1973. "Research checklist-'sand mining'." *Washington Science Trends* XXIX(20):118. Also UNIHI-SEAGRANT-JC-73-05. Sea Grant College Program, University of Hawaii, Honolulu. February.
- Casciano, F.M. 1973. *Development of a submarine sand recovery system for Hawaii*. UNIHI-SEAGRANT-AR-73-04. Sea Grant College Program, University of Hawaii, Honolulu. 14 pp., 4 fig. July. (NTIS Accession Number COM-73-11738/AS)
- Casciano, F. "Development of a sand recovery system for Hawaii." In *Proceedings of the 1st Caribbean Oceanengineering Conference in Puerto Rico, February 7-14, 1973*. Also UNIHI-SEAGRANT-JC-73-04. Sea Grant College Program, University of Hawaii, Honolulu. (In press)
- Hart, J.L. 1973. *Effects of hyperbaric conditions on the responses of animals to central nervous system stimulants*. UNIHI-SEAGRANT-TR-73-03. Sea Grant College Program, University of Hawaii, Honolulu. 16 pp., 2 fig. August. (NTIS Accession number COM-74-10185)
- Hong, S.K., T.O. Moore, D.A. Lally, and J.F. Morlock. 1973. "Heart rate response to apneic face immersion in hyperbaric heliox environment." *Journal of Applied Physiology* 34(6):770-774. Also UNIHI-SEAGRANT-JC-73-10. Sea Grant Program, University of Hawaii, Honolulu. June. (NTIS Accession Number COM-74-10144)
- Moore, T.O., Y.C. Lin, D.A. Lally, and S.K. Hong. 1973. "Effects of temperature, immersion, and ambient pressure on human apneic bradycardia." *Journal of Applied Physiology* 33(1):36-41. Also UNIHI-SEAGRANT-JC-73-09. Sea Grant College Program, University of Hawaii, Honolulu. July.
- Moore, T.O., R. Elsner, Y.C. Lin, D.A. Lally, and S.K. Hong. 1973. "Effects of alveolar P_{O_2} and P_{CO_2} on apneic bradycardia in man." *Journal of Applied Physiology* 34(4):795-798. Also Sea Grant Program, University of Hawaii, Honolulu. June. (NTIS Accession Number COM-74-10358)
- O'Reilly, J.P. 1973. *Behavioral effectiveness at 16 ATA*. UNIHI-SEAGRANT-TR-73-01. Sea Grant College Program, University of Hawaii, Honolulu. 75 pp., 16 fig., 11 tables. April.
- Seidl, L.H. 1973. *Hawaii's floating city development program: theoretical investigation and optimization of the platform's seakeeping characteristics*. Technical Report No. 2, Oceanic Institute, Makapuu. Also UNIHI-SEAGRANT-CR-73-01. Sea Grant College Program, University of Hawaii, Honolulu. 100 pp., 71 fig. May. (NTIS Accession Number COM-73-11632/AS)

Advisory Services

In Year 05, the Marine Advisory Program consisted of two distinct components: information and publications and marine specialists. The Marine Advisory Program during Year 05 began to lay the foundation for educating decision-makers on the goals and accomplishments of the Hawaii Sea Grant College Program with the addition of an information specialist.

The information and publications component handled all such functions for the entire program although housed under the Marine Advisory Program section. During the year, the following publications were completed:

- 7 advisory reports
- 6 technical reports
- 2 miscellaneous reports
- 12 issues of the *Sea Grant Newsletter*
- 4 issues of *Coastal Zone Communiqué*
- 17 journal contributions
- 8 information sheets

In addition, three atlases are currently in preparation.

As part of information dissemination, a legislative workshop for Sea Grant principal investigators was held on May 24, 1973. Twenty university staff and faculty participated in the hard-hitting dialogue with Senators Kenneth Brown and Robert Taira and Representatives Tats Kishinami and Richard Wong. University personnel learned about the power structure, legislative processes, and how and where to make input that counts.

To educate legislators about marine research activities and to show them facilities under the aegis of the University, eleven members of the Finance Committee of the State House of Representatives toured marine-related research facilities on or affiliated with the University's Manoa campus. The day-long tour included the Waikiki Aquarium, Look Laboratory and hyperbaric chambers, R/V *Kana Keoki*, Hawaii Institute of Geophysics laboratories, and Hawaii Institute of Marine Biology on Coconut Island.

The coastal zone specialist has provided information to such legislative committees as Water and Land Use, and Parks, Fish and Game among others to aid state legislators in promulgating sound legislation which govern the management of the state's coastal zone. The *Coastal Zone Communiqué* has acquired the reputation of being informative and current and has done much to disseminate available information on the Coastal Zone Management Act and its ramifications.

Under the leadership of the coastal zone specialist, an advisory report, *Spheres of Influence in Hawaii's Coastal Zone: Volume 1. Federal Agency Involvement*, was published in March 1973.

The education specialist continued to provide management leadership to the undergraduate non-degree program, Marine Option Program. The activities of this program are reported elsewhere under "MARINE EDUCATION AND TRAINING."

Two members of the advisory services staff joined state, county, and federal agencies, the Bishop Museum, and private interests in gathering information to establish a statewide network of shoreline trails. *Ala Kahakai: Alternatives for Administering a Coastal Trail System*,

published in July 1973, is an advisory report which outlines feasible options for management of a statewide coastal trail network. It was incorporated into the state's comprehensive document on a master plan for Hawaii by the State Department of Planning and Economic Development.

The Coordinator analyzed the economic feasibility of culturing brine shrimp on Christmas Island. The report on the total project was published in July 1973 as a 173-page technical report entitled, *The Feasibility of Brine Shrimp Production on Christmas Island*.

publications

Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Bacteria and you*. Cooperative Extension Service Leaflet 170. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.

Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Checklist for retail handling of fish*. Cooperative Extension Service Leaflet 172. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. July.

Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Cleaner boat... better fish*. Cooperative Extension Service Leaflet 173. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.

Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Come clean*. Cooperative Extension Service Leaflet 177. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.

Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Fish temperature and icing*. Cooperative Extension Service Leaflet 176. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.

Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Fish with a thermometer*. Cooperative Extension Service Leaflet 174. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.

- Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Handling frozen seafood in the retail store*. Cooperative Extension Service Leaflet 171. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.
- Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Sport fishermen's guide to holding and freezing fish*. Cooperative Extension Service Leaflet 169. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.
- Hayes, K.M., W.E. Schumacher, and C.J. Wilder. 1973. *Why eat fish?* Cooperative Extension Service Leaflet 175. Cooperative Extension Service, College of Tropical Agriculture and Sea Grant College Program, University of Hawaii, Honolulu. August.
- Hoffman, R.G., and H. Yamauchi. 1973. *Impact of recreational fishing expenditures on the state and local economies of Hawaii*. UNIH-SEAGRANT-AR-72-02. Sea Grant College Program, University of Hawaii, Honolulu. 28 pp., 4 fig., 12 tables. June.
- McCain, J.C., and J.M. Peck, Jr. 1973. *The effects of a Hawaiian power plant on the distribution and abundance of reef fishes*. UNIH-SEAGRANT-AR-73-03. Sea Grant College Program, University of Hawaii, Honolulu. 16 pp., 5 fig., 6 tables. June. (NTIS Accession Number COM-73-11291)
- Rutka, S.S. 1973. *Ala Kahakai: alternatives for administering a coastal trail system*. UNIH-SEAGRANT-AR-73-05. Sea Grant College Program, University of Hawaii, Honolulu. 38 pp., 2 fig. July. (NTIS Accession Number COM-73-11933/1AS)

LIST OF PROJECTS AND PRINCIPAL INVESTIGATORS FOR YEAR 05

marine environmental research

quality of coastal waters
 succession and stimulation of succession on
 denuded coral reef substrates
 ecological investigations of fish eggs and larvae
 measuring beach and surf parameters

l. stephen lau
 keith e. chavez
 john m. miller
 frans gerritsen
 ralph moberly, jr.

marine resources development

tropical animal aquaculture

 tropical plant aquaculture
 pre-management study of tuna bait resources of
 hawaii and the trust territory
 evaluation and recovery of offshore sand resources

 ecology of precious corals and the development of
 precious coral fisheries
 seafood processing and utilization of marine
 proteins as human food

john e. bardach
 philip helfrich
 maxwell s. doty

 garth i. murphy
 ralph moberly, jr.
 robert q. palmer

 richard w. grigg

 francisco s. hing

marine education and training

marine technician training program
 marine option program
 development of a graduate program in nearshore
 environmental-ocean engineering studies
 formation of a marine pathology teaching collection
 marine agronomy course
 marine and freshwater aquaria

john benson
 barry h. hill

 karl h. bathen
 albert c. smith
 noel p. kefford
 george s. losey, jr.

socio-economic and legal studies

economic and institutional aspects of multiple
 uses in hawaii's coastal zone
 economic analysis of pacific tuna fisheries
 development
 law of coastal zone management in hawaii

chennat gopalakrishnan

 salvatore comitini
 george m. sheets

marine technology research and development

human performance in the sea

 recovery of offshore sand resources

 marine alternatives for rapid transit in hawaii
 floating community design
 cost effectiveness of floating platforms for
 alternative uses

suk ki hong
 terry o. moore
 john t. o'brien
 ralph moberly, jr.
 robert q. palmer
 theodore t. lee
 john p. craven

 john p. craven