HAWAU-Q-79-001

FIFTH ANNUAL REPORT

FROM THE

MARINE AFFAIRS COORDINATOR

TO THE

GOVERNOR

AND

LEGISLATURE

STATE OF HAWAII

JULY 1978 TO JUNE 1979

FIFTH-ANNUAL REPORT

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MARINE AFFAIRS COORDINATOR

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AND

LEGISLATURE

STATE OF HAWAII

FISCAL YEAR 1978-1979

CONTENTS

"PROMOTING OCEAN OPPORTUNITIES"

Keynote Luncheon Address
by
Governor George R. Ariyoshi

Hawaii Ocean Law Association Seminar
November 30, 1979
Hawaiian Regent Hotel

It is my pleasure to be here today to speak with you about the ways in which our State government is promoting ocean opportunities.

Many people see Hawaii only as islands, beautiful but small, gradually becoming crowded, and isolated from the rest of the world by thousands of miles of ocean waters.

Many people who look at a map of the North Pacific Ocean are impressed with how small Hawaii appears — only a few dots in the middle of that vast ocean.

However, that is not how I see these Islands, or their very considerable resources.

To the ancient Hawaiians, the ocean was a natural extension of the land — a place to work and play and travel. Far from being adrift, we are surrounded and blessed by a bountiful resource, rich in minerals, food, and energy.

My Administration is dedicated to promoting ocean opportunities, and today I would like to discuss briefly the manganese nodule industry, aquaculture, fisheries, and ocean thermal energy conversion.

One of our goals is to establish industries that are environmentally clean and compatible with our unique Hawaiian life-style.

These goals are set forth very clearly in the Hawaii State Plan, which is the first legislatively-adopted plan in the United States.

Under a section of this Plan, regarding potential growth activities, it is our stated objective to "generate new ocean-related economic activities in mining, food production, and scientific research."

In this regard, we are actively pursuing this objective with our manganese nodule, aquaculture, and fishery programs.

The State government's public interest in manganese nodules began a decade ago with the publication of a document called "Hawaii and the Sea," and has continued ever since with increasing intensity.

The estimated potential benefits from a manganese industry are substantial — $262 million in annual revenues, 6,000 jobs during the construction stage, and 2,415 permanent new jobs after construction is completed.

The annual revenues of a single processing plant could rank sixth in comparison with the sales of the major corporations in Hawaii.

We have worked with the National Oceanic and Atmospheric Administration — "NOAA" — to produce further research on transportation and processing aspects of the industry.

We are now working with NOAA on a new volume which expands our research.

At this point, we believe that the problem of waste disposal from the processing of nodules — or so-called "tailings," is the most important one to be solved. Thus, we have initiated a three-year program to study waste disposal both on land and at sea. As a first step, we have entered into a joint study program with Ocean Minerals Company.

To our knowledge, we will be the first government entity in the nation to obtain actual tailings from a manganese nodule consortium for study purposes.

We have recently contacted the various consortia to invite them to join with us in an application to the Environmental Protection Agency for a research permit for ocean disposal.

By obtaining the permit, we intend to establish a marine test site area which will be useful to the consortia in their own ocean disposal research.

Hawaii is the only State in the Union with a manganese nodule program, and we are the only State actively seeking this new industry.

U.S. Senator Spark M. Matsunaga has introduced and is leading the Senate toward passage of a bill which will allow mining to begin. Concurrently, our own State program has begun research which will help assure that processing is a clean industry and the excess products are either useful, or at least environmentally harmless.

Hawaii also is in the forefront in aquaculture development. We completed a State aquaculture development plan in 1978, making us the first State in the union to have such a plan, and also one which is now being used as a model by national planners designing the Federal program. Our Aquaculture Development Program is also working with President Carter's Joint Subcommittee on Aquaculture.

Our State aquaculture plan has two sectors: a commercial production sector, and a research, training, and technology-transfer sector.

This Aquaculture Development Program is developing new species through research and development projects.

Our College of Tropical Agriculture at the University of Hawaii has been instrumental in building up our local industry and assisting developing countries in the Pacific Basin.

Hawaii now leads the world in prawn research, and will be the site of the world's largest commercial freshwater prawn farm.

Lowe Aquafarms, Inc. on Oahu now has 110 acres in prawn production, and expects to have 400 acres in production in a few years.

Close behind is Kilauea Agronomics, the C. Brewer prawn farm on Kauai, which currently is at 100 acres, and is expected to be 300 acres at full size.

Projections indicate that by the year 1990, we may have 5,700 acres in commercial aquaculture production, with 2,134 direct and indirect jobs, and wholesale revenues of $71 million.

By the year 2000, these figures could be five times larger: 28,000 acres, 9,000 jobs, and $330 million in revenues.

The cultivation of fish in ponds has long been a part of Hawaii's heritage. The same is true of fishery activities. Through the Department of Planning and Economic Development, the State is now offering financial assistance to fishermen through its Fishing Vessel Loan Programs. Last year, the Pacific Tuna Development Foundation sponsored a cooperative effort with the National Marine Fisheries Service to develop an anchored fish-aggregation system in Hawaii's waters.

This year, the Legislature responded by funding 26 fish aggregation buoys, which will soon be installed, and will attract fish for more efficient fishery activity.

The Pacific Tuna Development Foundation also has worked with the fishermen of Truk, the Marshall Islands, Guam, and American Samoa on fishing techniques.

Even with all this significant activity to benefit the fishing industry, I have felt that the industry needs a master plan for development.

Therefore, I am pleased that the first draft of the Hawaii Fisheries Development Plan by the Department of Land and Natural Resources is under review.

The fisheries development plan will note the enigma of having an ocean of fish around around us, and a population of fish-lovers, yet years of decline in our fishing industry. Last year we produced only 13 million pounds of fish.

The new plan will provide the rationale for the expansion of the fishing industry and envisions an industry in 1990 that will produce close to 19 million pounds with a fleet of more than 100 fishing vessels of all sizes, and more than 1,000 new jobs.

I believe that our fishing industry is now on the threshold of major expansion, given the proper business initiative, capital investment, and government support.

In another bounty from the sea, the Hawaii State Plan includes the objective of "increased energy self-sufficiency."

Ocean thermal energy conversion, or OTEC, is an ocean opportunity we are actively promoting.

The State of Hawaii has already accumulated an impressive record in OTEC.

Interest in OTEC developed rapidly after the foundation in 1974 of the Hawaii Natural Energy Institute, located at the University of Hawaii, and the Natural Energy Laboratory of Hawaii, located at Ke-ahole Point on the Big Island.

As you will hear further this afternoon, Mini-OTEC, floating near Ke-ahole Point, became on August 2, 1979 the world's first closed cycle, self-sustaining OTEC system operating at sea.

In my telegram to President Carter announcing that historic moment, I pointed out that OTEC is a workable, renewable, essentially inexhaustible energy resource which can be brought on-line soon.

Mini-OTEC has proven that the concept is sound and large OTEC plants can be practical. I believe that Ke-ahole Point deserves to be recorded in history as

the site of an important technological turning point, just as Kitty Hawk, North Carolina, does with the first flight by the Wright brothers.

Next Spring, OTEC-1 will be positioned off the coast of the Big Island near Kawaihae.

While Mini-OTEC was built without federal funding, the federal government is sponsoring OTEC-1 and has agreed to spend $2,235,000 on warm water experiments at the Seacoast Test Facility.

I am pleased to announce that by July 1, 1980, we expect to be pumping water to begin onshore experiments for the U.S. Department of Energy at the Seacoast Test Facility at Ke-ahole Point.

Our next goal is to make Hawaii the location of a 10/40 megawatt OTEC plant which the federal government is expected to build at a cost of $150 million as a proto-type before full-scale commercialization.

One consortium, consisting of Westinghouse, Dillingham, Gibbs & Hill, Inc., Brown & Root Development, Inc., and the Hawaiian Electric Company, has already announced plans to compete for the 10/40 plant.

We will counsel and cooperate with any consortium which proposes Hawaii as a 10/40 site, because we believe it is in the State's best interests to have several proposals specifying Hawaii as the plant site.

If one of the Hawaii proposals is successful, our research indicates that a 10/40 plant would create 2,100 new jobs and add $76 million to our economy. The siting of a 10/40 plant would also continue Hawaii's world leadership in OTEC development.

I have mentioned manganese nodules, aquaculture, fisheries, and OTEC as major ocean opportunities which my Administration is actively promoting. Now I would like to discuss very briefly two areas of effort and concern which I believe are essential to promoting all of these opportunities.

One involves permit procedures and the other is marine education.

First, it is important that our governmental machinery does not become an obstacle to the development of new ocean industries.

Large number of permits are required and time-consuming procedures must be followed before a new industry can be established.

I am concerned that potential industries which are environmentally clean, may be prevented from being established because of these requirements.

It is now time to make effective efforts to cut some of the red tape, while not compromising our environment, health, or safety.

My Administration has responded to this problem in two major ways.

First, existing permits and procedures have been studied to assist industry and the public in understanding which permits are required, which governmental entities issue them, and how long it is likely to take to obtain them.

An initial survey of permits and procedures for OTEC plants is now under way.

Far more important, however, is our second response to the permit system: our intention to reform it.

Our Coastal Zone Management Program has studied this problem for nearly two years. A number of suggestions have been made, such as a master permit application form, the simultaneous consideration of an application by all agencies concerned, the institution of deadlines by which the government must act, and the designation of a lead agency for each application.

In 1977 the Legislature passed Act 74, which called upon each County to designate a central coordinating agency to collect permit information, to coordinate applications and hearings, and to research the possibility of a master application form. Our reform efforts are continuing. My Administration is committed to giving the green light to those new industries which are environmentally sound and compatible with the life-style of our people.

The second area of concern is marine education.

We are an ocean State, and our future will largely depend on our ability to understand this and to make wise use of our ocean resources.

I am pleased, therefore, to report that we have just completed our State Master Plan for Marine and Aquatic Education. This plan will provide students from kindergarten through high school with exposure to, and knowledge of, marine opportunities.

It will support innovative and practical programs at the Community College and University levels, and will further provide advanced studies for business executives, scientists, and other citizens interested in marine policy issues.

Our master plan will help educate our people in recognizing the importance of our ocean resources, to discover and promote new opportunities, and to be trained and prepared to fill the new jobs which those opportunities create.

In closing, I congratulate the Hawaii Ocean Law Association for organizing and sponsoring this seminar, and I congratulate all of you who are here today for giving ocean resources this priority.

We are proud of what we have accomplished in Hawaii, and I pledge the strong effort of my Administration in continuing to work for even further achievements in the almost unlimited opportunities our ocean offers us.

Mahalo and Aloha.

THE OCEAN CHALLENGES OF THE EIGHTIES

A decade of exploration and encouragement of Hawaii's ocean programs has been completed. These efforts have been successful. A number of infant enterprises have been born whose growth as major economic entities in the State of Hawaii is assured. Success, however, often brings its own problems. If we do not respond properly, these enterprises could very well overwhelm us. The new technologies and industries of the ocean will come to Hawaii with a force and magnitude that could outstrip our present ability to control. We must be prepared.

Two major challenges face us now:

1) *We must ensure that these industries develop in a manner that enhances--not degrades--our environment and our quality of life.*

2) *We must ensure that the people of Hawaii have every opportunity to participate in every phase of that development.*

It is now clear that aquaculture has become a healthy and expanding industry, attracting not only Hawaii entrepreneurs, but major outside corporate interests as well. The development of fish aggregation buoys and various other fish attractant techniques--plus the incipient development of OTEC-related aquaculture--puts Hawaii in the forefront of the inevitable global shift from energy-devouring highly mobile pursuit of the ocean's living resources to the stationary cultivation of salt water animals and plants. Sea farming is the wave of the future, and Hawaii rides on the precarious crest of that wave.

It is now clear that OTEC, or ocean thermal energy, will be developed; that the United States as a whole is committed to such a development; and that the major part of the national effort to develop OTEC as a viable and reliable form of alternate energy will take place in Hawaii.

The energy potential of OTEC is enormous. On a world-wide basis, OTEC could produce more energy than the U.S. now consumes annually (70 "quads" for OTEC, vs. 65 current "quads" for the U.S.). With the major research and development of OTEC based in Hawaii, it would not be incorrect or inappropriate to assert that Hawaii could be American's "MIDDLE EAST" for the production of energy.

National funding and scientific participation doesn't happen in Hawaii because Hawaii is a national priority, but because what Hawaii is doing will be used on a national and international scale. We must recognize that--without proper preparation on our part--Hawaii's role could change from that of a partner, to that of a pawn.

It is now clear that Hawaii will also be the prime center of activity for deep sea manganese nodule mining, and eventually for other forms of ocean industry. Estimates of the capital investment required for a full-scale, commercial manganese nodule mining and processing operation range from 500 million to one billion. Such an enterprise would rank among the largest of Hawaii's corporations.

It is now clear that Hawaii's eminence in ocean science and technology will continue to expand. The impending award of funding for a National Underwater Laboratory System, utilizing the Hawaii-owned habitat AEGIR and submersible STAR II, the increasing support for Project DUMAND, and the technological development connected with OTEC complement the continued development of the University's Oceanographic Expeditionary Center at Snug Harbor. These advances are joined by the current construction of the University's Ocean Science Building and the continued in-migration of the nation's foremost ocean scientists. In ocean science and technology, Hawaii has arrived.

Finally, as if all of these successful efforts were not enough, it is now clear that modern forms of marine transportation will return to Hawaii, in the form of American flag cruise ships, in the form of jet hydrofoils, and possibly in the form of the Hawaii-pioneered semi-submersible ferry.

To be prepared for all this, what must Hawaii do? To ensure that our environment and life style are not casualties of national and global movements, to ensure that Hawaii's people are not passed over for the jobs and opportunities that ocean industries offer, Hawaii must accomplish three things.

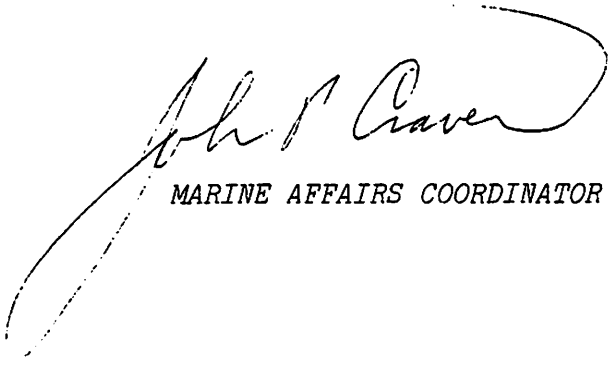
FIRST, we shall have to greatly accelerate our education efforts if we want even a modest chance of meeting this goal. The establishment and support of a Marine Education Plan is a first step, but this endeavor must continue until such time that an ocean orientation and an ocean education are automatic components and considerations of those institutions and agencies having a responsibility for education in Hawaii.

SECOND, the assistance and support of Hawaiian facilities, Hawaiian institutions, and Hawaiian legal and regulatory procedures that provide the appropriate Hawaiian incentives and constraints that permit us to meet our own goals.

THIRD, the support of second generation institutions across the spectrum of marine opportunities. If Hawaii does not build and run the infrastructure associated with these enormous marine industries, someone else will.

Were it not for these three challenges, the role of the Marine Affairs Coordinator would be greatly diminished. Ultimately, the functions of such an office could easily be included in a regular department. But for the immediate future, the need is still there.

Hawaii must move swiftly if the opportunities of the ocean are not to become an economic, environmental, or social burden. Hawaii is now an ocean state, and we need to begin to adjust ourselves to this reality.



MARINE AFFAIRS COORDINATOR

M A H A L O

A special "thank you" and "mahalo nui loa" to University of Hawaii Marine Option Program students Phyllis Ha and Jeanette Hedenshau, for the outstanding contributions they made to this Annual Report while working as MAC Office Interns.

COORDINATION OF MARINE AFFAIRS

HRS Chapter 218 requires the Marine Affairs Coordinator to *"Develop plans...conduct systematic analysis...assist those departments having interests in marine affairs...coordinate those activities which involve the responsibilities of multiple state agencies...coordinate the state's involvement in national and international efforts to investigate, develop and utilize the marine resources of the Pacific basin..."*

In pursuit of this mission, MAC has funded over 200 projects from 1971-1979. Nearly 70% have attracted matching funds. In fact, for every dollar MAC has spent, three additional dollars in matching funds have been attracted for MAC funded projects. A large number of these matching dollars have come from federal sources, especially Sea Grant. Sea Grant has worked with MAC on 37% of all projects, and 56% of those with matching funds. Nearly a quarter of the projects have received matching funds from more than one source.

The attraction of matching funds reflects MAC's role in coordination. Given a limited budget with tremendous demands, the decision to support a project is made only after a thorough review of other sources of potential funds. It is partially through this process that MAC facilitates the cooperation and coordination required for Marine Programs.

In addition, there are at least four other ways in which MAC fulfills its mission to coordinate:

1) Regular monitoring of the projects it funds;
2) The management of certain special programs;
3) The development of plans;
4) Participation by the MAC as the "marine" representative on various agency "teams" to implement state and federal programs.

1) MONITORING AND RECORD KEEPING

MAC monitors the projects it funds, usually through constant contact with principal investigators. Frequently, funds are released on a quarterly basis, in increments, permitting MAC to review any excessive or unusual expenditures during any phase of the project's life.

Since the shifting of funds to newer categories is common for projects proposed literally months in advance, principal investigators produce a regular stream of memos and phone calls to receive MAC authorization for needed adjustments. Progress reports are now required by law for all task orders, and this in itself generates significant interaction between MAC and all of its current projects. A complete file is kept on each project, which includes the RCUH monthly computer printouts on expenditures, and these figures are recorded in MAC's own records to evaluate the financial progress of each and every project.

In order to adequately monitor, analyze, and coordinate marine projects in Hawaii, MAC keeps the following records:

a. MAC project and funding summaries: 1971-1979. Includes Task Order number, RCUH number, principal investigator, project duration, funding year, Legislative Act, MAC funding, and matching funds.

b. Current MAC projects: by individual Task Order. Includes:

Project expense records (*QUARTERLY UPDATE)*
Running balance of MAC funds for current FY *(QUARTERLY UPDATE)*
Breakdown of projects by category *(QUARTERLY UPDATE)*
List of current funding commitments *(QUARTERLY UPDATE)*
Amount of MAC money not yet committed *(MONTHLY UPDATE)*

c. RCUH budget status report, from the monthly computer printouts. Includes project by project category of expenditure, amount awarded, previous costs, current costs, and available balance *(MONTHLY UPDATE)*

d. CIP appropriations and expenses.

e. MAC personnel expenses.

f. MAC office expenses.

g. A separate Task Order folder on each project, including contract, memos, correspondence, progress reports, and other data.

h. General files on marine topics of interest to the state.

Below is a breakdown of MAC and Sea Grant funding of MAC projects, indicating the scope of mutual involvement and cooperation in all marine areas:

FUNDING	# of Projects Funded	% of Total # Funded	% of # with Matching Funds
MAC Alone	68	31%	--
Matching Funds (all sources)	151	69%	100%
Sea Grant Matching Funds	81	37%	54%
Sea Grant as only source of matching funds	52	24%	34%
More than one source of matching funds	47	21%	31%
TOTAL	219		

We can further arrange our data according to funding category:

CATEGORY	# of PROJECTS FUNDED	MAC ALONE	% of TOTAL	MATCHING FUNDS	% of TOTAL
I. MARINE EDUCATION AND TRAINING	65	17	26%	48	74%
II. RESOURCE & INVENTORY ASSESSMENT	36	13	36%	23	64%
III. ECONOMIC DEVELOPMENT	51	14	27%	37	73%
IV. FACILITIES SUPPORT	46	18	39%	28	61%
V. CONFERENCES	21	6	29%	15	71%
TOTAL	219	68	31%	151	69%

Reviewing the above figures, a number of patterns begin to emerge. First, facilities support has been one area where matching funds were not as available as for other categories, although MAC was able to coordinate with other sources of funding in 61% of the facilities projects.

Second, marine education had the highest percentage of matching support, in terms of number of projects funded.

Third, nearly one third of the projects had to rely solely on MAC for funding, 68 out of 219.

Fourth, nearly two thirds of the projects that Sea Grant funded were funded solely with MAC and Sea Grant funds.

These patterns seem to indicate that Sea Grant and MAC play extremely important roles for the projects MAC chooses to fund. If we look at only the projects supported solely by these agencies, we find nearly 55% of the projects completely dependent on these two sources of funds.

Another way to look at it, is to compare the numbers of projects that "required" MAC support in each category. If we rank the numbers of MAC projects by category, we find:

1) marine education: 65 projects
2) economic development: 51 projects
3) facilities support: 46 projects
4) resource & inventory assessment: 36 projects
5) conferences: 21 projects

On the one hand, these could be said to reflect MAC's priorities. On the other, they could reflect the areas where other agencies have been unable fully to support needed projects, thus requiring MAC assistance.

2) THE MANAGEMENT OF SPECIAL PROGRAMS

While the MAC Office does not generally have responsibility for the management of programs, there are instances when MAC carries the management of a program until a regular department can take on the full burdens of administration.

One such instance is in the installation and management of new hyperbaric chamber facilities. Two Task Orders cover this program, and their specific objectives are as follows:

T.O. #155: OBJECTIVES: To ready three multi-lock, multi-person recompression chambers for use in treating victims of diving disorders (decompression sickness, air embolism). One chamber is to be used on Oahu, one on Kauai, and one on Hawaii (Kona area).

T.O. #147: OBJECTIVES:

a. To reduce significantly the number of diving disorders requiring emergency recompression treatment.
b. To alleviate, as much as possible, the long-term ill effects suffered by those divers requiring emergency recompression treatment.
c. To minimize the future incidence of Dysbaric Osteonecrosis among Hawaii's scuba divers, with special emphasis on Neighbor Island divers.

These objectives are being met by the complete refurbishing of two recompression chambers purchased by MAC, plus a recompression chamber given to the University of Hawaii by the Federal Government, and by developing a program to operate these chambers with volunteer staff. In addition, MAC is providing support to the Department of Physiology, of the John A. Burns School of Medicine, for further development of the Department's hyperbaric research and treatment facility, located at Look Laboratory.

Perhaps more than any other MAC activity, the administration of these programs at the request of the Department of Health has required endless written and verbal communication to monitor the progress of volunteer training and chamber refurbishment. To date, this task has produced a 131-page, single spaced, MAC log of the office's efforts.

3) THE DEVELOPMENT OF PLANS

The Marine Affairs Coordinator has been deeply involved in the production of Hawaii and the Sea, a series of Annual Reports, and as a contributing "team" member for numerous other documents.

MAC also can be called upon to generate plans itself, such as the State Master Plan for Marine and Aquatic Education, recently announced by the Governor in a speech to the Hawaii Ocean Law Association's seminar.

The Legislature assigned the duty of developing a master plan for marine education to MAC. The Plan includes both programmatic and administrative goals and objectives, and recommendations for the financial support required for implementation. In addition, the Plan includes funding priorities that are applicable to federal matching funds, and which can be utilized by all agencies evaluating proposed projects. An initial section of the Plan summarizes some of the relevant State goals, as expressed in the State Constitution, the State Plan, and various statutes.

In preparation of the master plan, the MAC has conducted numerous interviews with state officials, representing every significant effort in marine education. Existing data, documents, and budgets have also been analyzed, especially in light of the need to effectively utilize existing financial, institutional and human resources. The Plan also contains recommendations for the assignment of tasks to appropriate agencies for this purpose.

Since many departments can assign only limited human and financial resources to marine education, MAC has sought to provide whatever assistance is appropriate to improve and promote existing programs. The Plan thus includes some MAC funding recommendations which assist in departmental implementation for limited periods of time, until the agencies involved can adjust to, and incorporate expanded duties and programs. In most cases, MAC financial assistance is conditional: based on the departmental agreement to assume financial responsibility after a specified period of time. Since the regular budgetary process is complex and lengthy, such assistance can accelerate implementation even when a department or agency is ready and willing to assume financial responsibilities.

The Plan is carefully tailored to develop an administrative system designed to coordinate information and programs. The Major emphasis on administrative objectives speaks to this goal. The Plan also establishes a data collection system that should result in a periodic update on important marine information, thus encouraging independent efforts to coordinate marine programs throughout the system.

4) PARTICIPATION ON TEAMS

Of special importance is the participation of the Marine Affairs Coordinator on numerous committees, boards of directors, panels, and ad-hoc groups involved with marine affairs. The constant circulation of the MAC, in touch with all elements of the marine community, is a primary souce of coordination. The following is a list of some of the governmental and private participation of the MAC:

CURRENT STATEWIDE RESPONSIBILITIES

Member, Governor's Marine Affairs Advisory Council
Member, Governor's Advisory Committee on Alternate Energy
Member, Marine Mammals Advisory Council
Member, Aquaculture Advisory Council
  Subcommittee member, Research and Development and Demonstration
  Subcommittee member, Government Planning
Board member, Natural Energy Laboratory of Hawaii
Member, Seacoast Test Facility Development Group
Member, Technical Review Committee for Humpback Marine Sanctuary
Director, Law of the Sea Institute, UH

CURRENT NATIONAL AND INTERNATIONAL RESPONSIBILITIES

National Academy of Sciences
  °Member, Ocean Policy Committee
  °Advisor, Ocean Policy Board
  °Member, Freedom of Ocean Science Task Group
  °Member, Marine Technical Assistance Group

National Academy of Engineering
  °Member of the Academy since 1970
  °Member, Assembly of Engineering
  °Chairman, NOAA Panel on Ocean Engineering

US Department of State/National Research Council
  °Member, Public Advisory Committee on the Law of the Sea
  °Ad Hoc Delegate, United Nations Conference on the Law of the Sea

National Science Foundation
  °Member, Ad Hoc Subcommittee of the Ocean Sciences Advisory Committee on Ship Construction and Operation

US Department of Commerce
  °Ad Hoc Advisor to the Administrator of the National Oceanic and Atmospheric Administration (NOAA)
  °Member, Scientific and Statistical Committee of the Western Pacific Regional Fishery Management Council
  °Member, Marine Facilities Panel of the United States-Japan Natural Resources Commission

US Department of Defense
  °Ad Hoc Advisor to the Defense Science Board

Visiting Professor, Nihon University, Japan

Member, Advisory Committee to the Japan Ocean Development Association

RECENT RESPONSIBILITIES/MEMBERSHIPS

Member, National Weather Modification Advisory Board

RECENT RESPONSIBILITIES/MEMBERSHIPS

Member, National Weather Modification Advisory Board

National Academy of Engineers
- °Member, Marine Board

National Academy of Sciences
- °Advisor/Participant, Academy Forum

US Department of Defense
- °Member, Cruise Missile Advisory Committee

US Department of Energy
- °Member, Board of Consultants

Member, National Advisory Committee on Oceans and Atmosphere

TABLE I

STATE AGENCIES' INVOLVEMENT IN MARINE AFFAIRS (FY 1978-79)

		DOA	DOD	DOE	DLNR	DOH	DPED	DOT	MAC	UH	TOTAL
I.	MARINE RESOURCES ASSMT/INVENTORY										
	1. Baseline Studies								16,544	1,530,821	1,547,365
	2. Resource Assessment/Inventory								1,350,987	271,592	1,622,579
	3. Coastal Zone Management						1,140,010			259,943	1,399,953
II.	MARINE CONSERVATION, PRESERVATION, & RESTORATION										
	1. Resource Management				326,119				21,850		347,969
	2. Water Pollution					1,228,812			140,012	211,474	1,580,298
	3. Regulation & Enforcement								23,625	230,851	254,476
III.	MARINE RESOURCE ECONOMIC DEVMPT.										
	1. Marine Regulation				278,468				25,250	54,044	357,762
	2. Foreign Trade Zone						522,680				522,680
	3. Fisheries				27,486						27,486
	4. Aquaculture--General	3,000					200,499				203,499
	5. Aquaculture--Crustaceans						415,128				415,128
	6. Aquaculture--Seaweed						18,000		6,372		24,372
	7. Aquaculture--Finfish						36,000				36,000
	8. Aquaculture--Molluscs					35,000	32,133				67,133
	9. Aquaculture--Baitfish								38,000		38,000
	10. Natural Energy Lab. of Hawaii						101,870				101,870
	11. Ocean Mining/Manganese Nodules						70,000				70,000
	12. Fishing Vessel Loans						249,992				249,992
IV.	MARINE EDUCATION & TRAINING										
	1. Technical								30,350		30,350
	2. Post Secondary								404,362	1,308,000	1,712,362
	3. General Public								29,415	204,000	233,415
	4. Primary & Secondary			34,750					134,868		169,618
V.	FACILITY SUPPORT & DEVELOPMENT										
	1. Facility Support								26,173	2,558,020	2,584,193
	2. Facility Development									342,226	342,226
	3. Coastal Zone Support		312,000								312,000
	4. Comm. Harbors--oper/maint.							14,775,190			14,755,190
	5. Comm. Harbors--CIP							6,115,000			6,115,000
	6. Small Boats--oper/maint.							1,912,347			1,912,347
	7. Small Boats--CIP							4,556,000			4,556,000
	8. Marine Parks--oper/maint.				2,028,460						2,028,460
	9. Marine Parks--CIP				6,244,700						6,244,700
	10. Hyperbaric Chambers					16,441*					16,441
	11. CIP		168,000				750,000		150,700	2,225,000	3,293,700
VI.	CONFERENCES								76,755	4,000	80,755
VII.	RESEARCH									4,976,838	4,976,838
VIII.	OTHER	500,000								3,235,399	3,735,399
	TOTAL	503,000	480,000	34,750	8,905,233	1,280,253	3,536,312	27,338,537	2,475,263	17,412,208	61,965,556

NOTE: Every effort has been made to avoid duplication or double reporting of the same funds in this matrix. In some cases, the figures reflect Federal, as well as State Funds. For a breakdown of State and Federal funding for various State Agencies, see the following page.

[*Does not include C.I.P.]

TABLE IA

STATE AND FEDERAL SHARES OF MARINE-RELATED BUDGETS
for FY(1978-1979)

AGENCY	STATE FUNDS	FEDERAL FUNDS	TOTAL
Marine Affairs Coordinator	$ 634,650	$ 1,840,613	$ 2,475,263
Dept. of Agriculture	503,000	-0-	503,000
Dept. of Defense	240,000	240,000	480,000
Dept. of Education	34,750	-0-	34,750
Dept. of Health	464,053	816,200	1,280,253
Dept. of Land and Natural Resources	8,230,420	674,813	8,905,233
Dept. of Planning and Economic Development	2,625,705	910,607	3,536,312
Dept. of Transportation	27,338,537	-0-	27,338,537
University of Hawaii	6,170,318	11,241,890	17,412,208

All budgets reported above show appropriations, not expenditures.

TABLE IB

UNIVERSITY OF HAWAII'S INVOLVEMENT IN MARINE AFFAIRS
(FY 1978-79)

COLLEGE & DEPARTMENT	STATE	FEDERAL	TOTAL
COLLEGE OF ARTS & SCIENCES			
Anthropology	-0-	2,600	2,600
Botany	-0-	109,700	109,700
Chemistry	-0-	140,950	140,950
General Science	7,133	1,553	8,686
Geography	6,250	-0-	6,250
Meteorology	-0-	234,072	234,072
Oceanography*	19,200	12,447	31,647
Pacific Urban Studies and Planning	175,000	-0-	175,000
Physics and Astronomy	-0-	1,115,000	1,115,000
Psychology	-0-	83,012	83,012
Zoology	-0-	49,000	49,000
COLLEGE OF ENGINEERING			
College of Engineering	-0-	110,676	110,676
Hawaii Natural Energy Institute**	2,263,700	689,538	2,953,238
Civil Engineering	-0-	37,825	37,825
Mechanical Engineering	-0-	280,000	280,000
Ocean Engineering*	360,421	296,410	656,831
MARINE PROGRAMS*	158,000	2,500	160,500
SCHOOL OF MEDICINE			
Pathology	-0-	500	500
Physiology	109,484	48,932	158,416
RESEARCH ORGANIZATIONS			
Office of Research Administration	-0-	14,960	14,960
Hawaii Institute of Geophysics*	1,793,744	5,662,467	7,456,211
Hawaii Institute of Marine Biology*	533,524	472,261	1,005,785
Pacific Biomedical Research Center	-0-	305,896	305,896
Sea Grant College Program*	539,862	1,150,000	1,689,862
Water Resources Research Center	-0-	246,824	246,824
COLLEGE OF TROPICAL AGRICULTURE	-0-	125,000	125,000
WAIKIKI AQUARIUM*	204,000	49,767	253,767
TOTAL	$6,170,318	$11,241,890	$17,412,208

*Administrative Support Included
**Sea Coast Test Facility included

TABLE II

ACT 243, SESSION LAWS OF HAWAII 1978

A. Payroll	$ 42,293
B. Others	583,657
Total	$ 625,950
restricted	65,374
NET APPROPRIATION	$ 560,576

TABLE IIA

MAC C.I.P. FUNDS

Three-inch Pipeline (MAC CIP T.O. #1)	35,700
OTEC Aquaculture Phase 1 (MAC CIP T.O. #2)	115,000
For NELH Road & Facilities (spent through DPED)	330,000
MINI-OTEC (original State funding: through DPED)	600,000
MINI-OTEC (second State funding: through DPED)	450,000
TOTAL	$1,530,700
Original CIP Appropriation Total:	$2,525,000
Remaining balance (12/28/79)	994,300

TABLE III

MAC PROJECT EXPENDITURES, FY 1978-1979

I. RESOURCE ASSESSMENT		MAC FUNDING	MATCHING FUNDS	TOTAL
T.O.#				
149	MANGANESE NODULES	18,000	-0-	18,000
157	HAWAII COASTAL ZONE DATA BANK	15,000	-0-	15,000
173	NORTHWESTERN HAWAIIAN ISLANDS FISHERIES INVESTIGATIONS	103,621	State Dept. of Fish and Game (20,000) University of Hawaii (80,000) Sea Grant (194,366) NMFS (580,000) U.S. Fish and Wildlife Service (75,000) U. of Washington (10,000)	1,062,987
183	SAND SAMPLING ANALYSIS	1,544	-0-	1,544
188	PHYTOPLANKTON MONITORING AT KE'AHOLE POINT	32,000	Department of Energy (238,000)	270,000
	TOTALS	170,165	(1,197,366)	1,367,531

MAC PROJECT EXPENDITURES, FY '78-'79

II.	MARINE CONSERVATION, PRESERVATION, RESTORATION	MAC FUNDING	MATCHING FUNDS	TOTAL
T.O.#				
164	OPIHI MANAGEMENT STUDY	1,850	-0-	1,850
175	MICROBIOLOGICAL INDICATORS FOR ASCERTAINING FECAL CONTAMINATION	8,266	University of Haw. (9,041) Sea Grant (12,705)	30,012
176	KANEOHE BAY SEWAGE RELAXATION STUDY	20,000	EPA (90,000)	110,000
189	PUAKO BAY RESOURCES STUDY	20,000	-0-	20,000
193	HAWAIIAN MONK SEAL RESEARCH	2,625	MMC (10,000) NMFS (11,000)	23,625
	TOTALS	52,741	(132,746)	185,487

III.	MARINE ECONOMIC DEVELOPMENT			
T.O.#				
156	MAUI TUNA BAITFISH PROJECT	20,000	DPED (18,000)	38,000
187	SALT WATER LAND PLANTS	6,372	-0-	6,372
198	CIGUATOXIN TESTING	5,250	Sea Grant (20,000)	25,250
	TOTALS	31,622	(38,000)	69,622

MAC PROJECT EXPENDITURES, FY '78-'79

IV. MARINE EDUCATION AND TRAINING		MAC FUNDING	MATCHING FUNDS	TOTAL
T.O.#				
147	STATEWIDE DIVING SAFETY PROGRAM	5,535	-0-	5,535
174	MAC INTERNSHIP PROGRAM	10,000	Sea Grant 45,626	55,626
177	AQUARIUM EDUCATION PROGRAM	20,000	-0-	20,000
178	FIELD AND INSTRUCTIONAL SUPPORT FOR AN UNDERGRAD. AQUACULTURE CURRICULUM	9,170	University of Haw. (4,779) Sea Grant (13,296)	27,245
179	NEW UNDERWATER TECHNOLOGY COURSE	5,551	Sea Grant (15,041)	20,592
180	BLUE-WATER MARINE LABORATORY	30,000	Dept of Education (26,750) Others (44,600)	101,350
181	SHIP SUPPORT FOR LEEWARD COMMUNITY COLLEGE TRAINING PROGRAM	20,000	-0-	20,000
182	HAWAIIAN MARITIME MUSEUM	3,125	-0-	3,125
184	SEA GRANT MARINE ADVISORY PROGRAM	40,000	County of Hawaii (11,029) Sea Grant (229,870)	280,899
190	HIGH VISIBILITY UNDERSEA OBSERVATION STRUCTURE	8,400	Sea Grant (6,375)	14,775
191	MARINE EDUCATION MASTER PLAN	24,050	-0-	24,050
192	MARINE ENVIRONMENTAL EDUCATION AT KING INTERMEDIATE SCHOOL	3,518	Other (10,000)	13,518
195	A COMPARISON OF SURVEY METHODOLOGIES APPLICABLE TO MARINE RESOURCE ASSESSMENT STUDIES	6,300	-0-	6,300
197	MINI MAKAHIKI KAI EXHIBIT 1979	3,150	University of Haw. (300) Sea Grant (2,530)	5,980
	TOTALS	188,799	410,196	598,995

MAC PROJECT EXPENDITURES, FY '78-'79

V. MARINE FACILITIES SUPPORT		MAC FUNDING	MATCHING FUNDS	TOTAL
T.O.#				
155	REFURBISHMENT OF HYPERBARIC FACILITIES	15,000	-0-	15,000
186	AEGIR FACILITY SUPPORT	6,050	-0-	6,050
194	KEWALO BASIN MARINE SUPPORT FACILITY	3,677	-0-	3,677
196	POLISHER/GRINDER FOR MICROBE FACILITY	1,446	-0-	1,446
	TOTALS	26,173	-0-	26,173

VI. MARINE CONFERENCES				
T.O.#				
148	WORLD MARICULTURE CONFERENCES	9,450	-0-	9,450
185	LAW OF THE SEA INSTITUTE CONFERENCES/WORKSHOPS	5,000	University of Haw. (24,150) Sea Grant (24,155) Others (14,000)	67,305
	TOTALS	14,450	62,305	76,755

VII. CAPITAL IMPROVEMENT PROJECTS				
T.O.#				
CIP #1	THREE-INCH PIPELINE AT KE'AHOLE POINT	35,700	-0-	35,700
CIP #2	AQUACULTURE COMPONENT AT NATURAL ENERGY LABORATORY OF HAWAII (NELH)	115,000	-0-	115,000
	TOTALS	150,700	-0-	150,700
	GRAND TOTALS	634,650	1,840,613	2,475,263

PROGRESS REPORTS
ON
MAC TASK ORDER PROJECTS

I. MARINE RESOURCES INVENTORY AND ASSESSMENT

FERROMANGANESE RESEARCH IN THE HAWAIIAN ARCHIPELAGO
Task Order No. 149

FINAL REPORT

MAC INVESTMENT: $18,000 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: DEPARTMENT OF OCEANOGRAPHY & HAWAII INSTITUTE OF GEOPHYSICS

PRINCIPAL INVESTIGATOR: DR. JAMES E. ANDREWS

OBJECTIVES

This project is examining the potential of an offshore dumping site at Puna, Hawaii to evaluate environmental and mechanical problems of slurry dumping related to possible nodule processing activity in the Puna District. Near shore ocean dumping will be perhaps the least expensive and environmentally the least difficult method of nodule tailing disposal. This preliminary investigation is being made to establish the feasibility and acceptability of such activity offshore Puna.

METHODS

Existing charts were examined and a candidate site selected. This is a broad, steeply descending sea valley which comes very near shore between Hilo and Cape Kumukahi. A near shore bathymetric survey was run over the head of the valley and 57 bottom samples and 2 bottom photos were obtained in July 1978. All stations and tracks were controlled by Trisponder navigation.

Bottom samples are being analyzed for grain size and chemical components--particularly trace heavy metals and materials anticipated in nodule tailings.

Bathymetric results have been submitted previously. Chemical analyses are still underway. Possible trends observed include a strong positive manganese:Iron (Me:Fe) correlation and a probable correlation between Cadium(Cd) and distance from Hilo. The latter is at very low levels (<10 ppm) and appears to show man's input to the environment. In the Hawaiian Islands this information could prove to be an extremely useful tracer of recent sedimentary processes.

DISCUSSION

Data obtained to date is adequate in terms of sampling but deficient in bathymetric coverage and bottom photo coverage. On the basis of results to date the site appears appropriate for ocean dumpling use in relation to future nodule processing.

SUMMARY/CONCLUSIONS

The project is scheduled for continuation in order to complete the analytical work and to collect date (bathymetry and bottom photos) not obtained in 1978. Support is anticipated from Coastal Zone Management (CZM) ($20,000) with matching from MAC ($10,000). This is all part of the on-going State evaluation of the nodule processing industry and plant sites in the Hawaiian Islands.

HAWAII COASTAL ZONE DATA BANK
Task Order No. 157

PROGRESS REPORT

MAC INVESTMENT:	$45,000 (FY 1978-79)	MATCHING FUNDS $7,573 (FY 1978-79) HAWAIIAN ELECTRIC CO.
OPERATING AGENCY:	DEPARTMENT OF OCEANOGRAPHY University of Hawaii	$2,937 (FY 1978-79) OTHER PROJECT FEES
PRINCIPAL INVESTIGATOR:	DR. KEITH CHAVE	

OBEJCTIVES

The Hawaii Coastal Zone Data Bank (HCZDB) is a RCUH administered project within the Department of Oceanography at the University of Hawaii. The HCZDB has functioned since 1972 as a computerized repository of marine biological data collected through environmental research in the nearshore waters of the Hawaiian archipelago. HCZDB data files include results of surveys of fish abundance, benthic communities, plankton, water quality variables and physical factors including temperature, salinity and tides. The HCZDB serves as an efficient source of such information for investigators from state and federal agencies, university research projects and private companies with environmental data needs. The HCZDB also performs statistical analyses and had developed computer routines for summarizing and presenting data in graphical and table formats.

METHODS

The HCZDB makes use of several computer systems for data analysis and storage. A major feature of the HCZDB is the master taxonomic listing of Hawaiian marine organisms. Each of over 15,000 species occurring in Hawaiian waters is identified by a ten digit hierarchical code. The list provides a basis for standardizing species identifications. During FY 1978-79, authorities on Hawaiian algae, fishes, molluscs and marine mammals were consulted and suggested changes which were incorporated into the master listings.

The MAC has been a major supporter of HCZDB activities. MAC funding in FY 1978-79 has supported the general management of the HCZDB, the maintenance of computerized data files, the development of more efficient means of data entry, retrieval and analysis, and the expansion of the HCZDB user community.

MAC funds provided in October of 1978 created the position of project manager of the HCZDB. The project manager was charged with evaluating the function, performance and potential of the HCZDB, expanding the number of users of HCZDB services, and increasing the amount of alternate funding for HCZDB activities.

RESULTS

MAC funding during 1978-79 supported major revisions of the HCZDB master species lists for algae, fishes, mollusks, and marine mammals. Methods of interactive data entry and graphical data presentation were developed through MAC support. During 1978-79 a fee system was instituted for assigning charges to users for specific HCZDB services. The fee system is generating funds to cover basic data file maintenance and supervision.

The HCZDB user community has grown significantly in 1978-79. The following projects were among those utilizing HCZDB data files or analytical services and provided funding:

* Hawaiian Electric Company Environmental Division monitoring of the impact of the Kahe power plant operations on marine biological communities.

* The Kaneohe Bay Sewage Abatement Study, sponsored by the Environmental Protection Agency and MAC. The HCZDB has provided data storage, analysis, graphical and tabular summaries and comparative data from previous investigations.

* The Marine Option Program Program-National Science Foundation Student Study Project. The HCZDB provided guidance in sampling design and statistical analyses, computer facilities and analytical routines to the students involved.

* The Northwestern Hawaiian Islands Studies (Task Order No. 173) sponsored by Sea Grant and MAC. The HCZDB provided archived data, statistical routines, and specific analyses to several of the individual projects involved.

* The Hawaii State Fishery Master Plan Project. The HCZDB is providing assistance in interpreting computerized catch and effort data on Hawaiian fisheries, and has developed routines for the graphical presentation of catch and effort data.

* The University of Hawaii Environmental Center study of ocean dredge spoils dump sites. The HCZDB advised on and carried out statistical analyses of data collected at control and dump sites to evaluate the effects of dumping on selected benthic organisms.

* The HCZDB also provided analytical and computer support for Bishop Museum projects, graduate student research at the University of Hawaii, and researchers from the University of Guam, the Palau Marine Laboratory and the fisheries branch of the government of American Samoa.

SUMMARY/DISCUSSION

The major accomplishments of the HCZDB during FY 1978-79 were the revisions of the master species list, the institution of a standarized fee system, and the increase in the number of HCZDB users. The major problem encountered was the inability to obtain funding for the development of a more efficient means of data storage and retrieval. Existing computer data base management sytems are inadequate to handle the intricacies inherent in scientific survey results. The HCZDB has been cooperating with Naval Ocean Systems Command (NOSC) personnel and others in developing a computer data base management system for scientific data. Attempts by NOSC at obtaining funding for such a system have been unsuccessful. The HCZDB will continue to be involved in developing such a system.

PROJECT CONTINUENCE

The HCZDB is an ongoing project; its usefulness should increase as its data files expand. MAC funding in FY 1979-80 will enable the HCZDB to make more efficient its data file structure in certain selected areas and will aid the seeking of additional users for its data files and analytical services. The HCZDB will be preparing proposals for federal funding to support continued development of the centralized data bank concept.

HCZDB personnel will be carrying out MAC Task Order No. 202 a study of the possible effects of pollution on marine biological communities in the Kapahulu Groin to Black Point area of Oahu. The study will include the analysis and summary of scientific data collected in the area over the past ten years by various investigators and archived within HCZDB files.

NORTHWESTERN HAWAIIAN ISLANDS FISHERIES INVESTIGATIONS
Task Order No. 173

AN OVERVIEW

FY 1978-79 FUNDING: *(Also shown in Table 1 on following page)*

MAC INVESTMENT: $103,621

MATCHING FUNDS: $194,366, SEA GRANT
250,000, NATIONAL MARINE FISHERIES SERVICE
330,000 (ship time), NATIONAL MARINE FISHERIES SERVICE
75,000, U.S. FISH AND WILDLIFE SERVICE
10,000, UNIVERSITY OF WASHINGTON

OTHER STATE SUPPORT: $ 20,000, STATE DIVISION OF FISH AND GAME
80,000, UNIVERSITY OF HAWAII

OPERATING AGENCY: NATIONAL MARINE FISHERIES SERVICE (NMFS)

The following five progress reports are descriptions of the MAC Office-assisted projects within the Northwestern Hawaiian Islands Fisheries Investigations, Task Order No. 173 (hereafter called "the program").

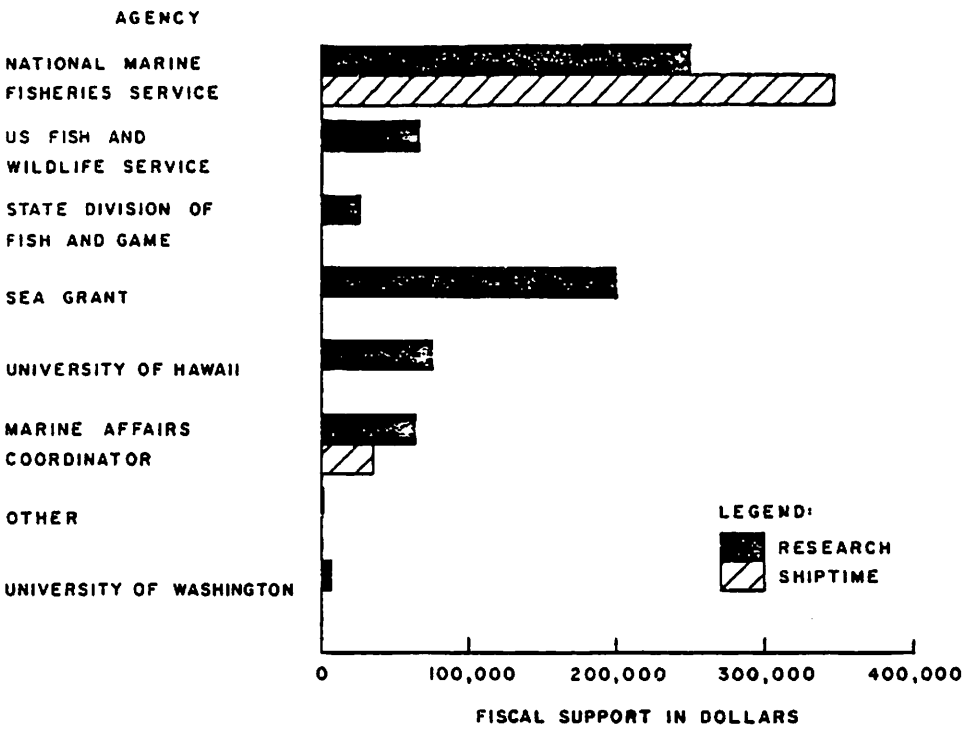
The program was introduced this year to facilitate assessment of the potential for fisheries development and for management of the living resources of the Leeward or Northwestern Hawaiian Islands (NWHI); it is a cooperative Sea Grant, State of Hawaii and NMFS undertaking which complements an existing Tripartite Cooperative Agreement between the NMFS, the U.S. Fish and Wildlife Service and the State Department of Fish and Game to make a five-year stock assessment of fisheries and avian resources of the NWHI.

The NWHI region consists of islets, reefs, shoals, guyots, and seamounts which span three-quarters (1,150 miles) of the entire Hawaiian Archipelago. The NWHI have served principally as a wildlife refuge since 1909 (see figure 1) but a shift toward use of them for both continued wildlife refugia and selective utilization of fisheries is anticipated because of the accelerating competition and interest in the tuna and other marine food resources in the NWHI area of the North Central Pacific Ocean. Other factors, such as implications of the 200-mile limit, with its creation of new mechanisms for fishery management and planning, and disputes between the state and the federal governments over boundries and over development versus preservation further compels the program's work.

MAC funding of the program [and related research on monk seals (T.O. No. 193) and ciguatoxin (T.O. No. 198)] represents a major part of the State's share in the functional responsibilities of the Tripartite Cooperative Agreement. The set of projects which comprise the program will be revised and increased in Fiscal Years 1979-'80, '80-'81, and will remain a closely coordinated multidisciplinary effort to address questions that deal with the potential productivity of the Hawaiian Archipelago as a system (or set of systems).

The joint programs will contribute toward the development of an ecological model of the area by NMFS, utilizing the Dynamic Numerical Marine Ecosystem (DYUMES) model developed at the Northwest Center of NMFS in Seattle. These data and analyses will provide the scientific basis for the rational management of the NWHI fisheries resources and contribute significantly to the area of marine science.

Table 1. Agency Support for Research and Shiptime in the NWHI in FY 1978-79



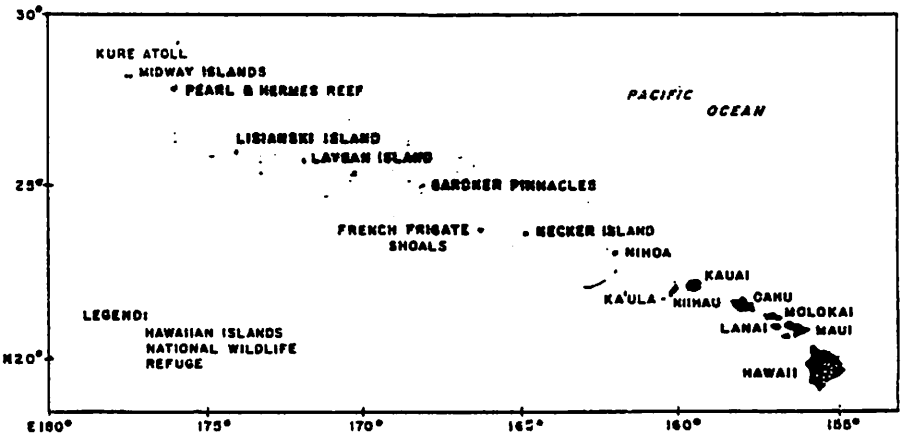


Figure 1. Location of the Hawaiian Islands National Wildlife Refuge

NWHI/PRIMARY AND SECONDARY PRODUCTIVITY AND POTENTIAL FISHERY YIELDS IN THE HAWAIIAN ARCHIPELAGO
Task Order No. 173(4050)

PROGRESS REPORT

MAC INVESTMENT: $13,583 (FY 1978-79) MATCHING FUNDS (SEE OVERVIEW)

OPERATING AGENCY: HAWAII INSTITUTE OF MARINE BIOLOGY

PRINCIPAL INVESTIGATOR: DR. JED HIROTA

OBJECTIVES

To research on the levels of primary and secondary plankton productivity, the base of the oceanic food web, for an evaluation of the potential sustained yield of epipelagic fisheries (those in the portion of the oceanic zone into which enough light penetrates to allow photosynthesis) of the Hawaiian Archipelago. Specific goals are to:

1) Evaluate differences between the main and the Leeward Hawaiian Islands levels of production and potential fishery yields.
2) Describe distributional patterns in abundances of lower trophic nutritive levels by season, region, and stations.
3) Determine whether plankton stocks are greater over nearshore shoals than at oceanic locations.
4) Determine differences in vertical distribution of the macrozooplankton over shoals and offshore.
5) Compare the distribution of and relationships among water column properties along windward-leeward transects.
6) Make a distributional study of offshore ichthyoplankton species with commercial value.

METHODS

Two thirty-day surveys were made to document oceanographic information necessary to the project's objectives. FY 1978-79 MAC funds allocated for this project covered the salary of a biological oceanographer postdoctoral fellow and management fees. Dr. Andrew E. Jahn is carrying out the study of the distribution and abundance of various species of larval fishes which are of commercial and sport fishing value (e.g., tunas, billfish, and mahimahi), and several other fish families which are of ecological value to the pelagic, near-surface oceanic system around Hawaii (e.g., flying fishes, goatfishes and halfbeaks). Dr. Jahn also has assisted in the field work for the other parts of the study, including the sampling of zooplankton and water chemistry and hydrography.

RESULTS

All of the project goals have been met, including two successful cruises on the TOWNSEND CROMWELL with data collection at forty stations between Hawaii Island and Midway. Briefly, three major generalizations may be postulated from the ongoing oceanographic research:

1) The physical-chemical NWHI environment and its biotic components show strong uniformity and low variability of average values in both time and space (with the exception of considerable seasonal changes in the mixed-layer depth).
2) Small but consistent mean differences in fishery potential between the "low" and "high" Northwestern Hawaiian Islands are suggested by the differences in stocks of plankton and daily rates of primary productivity. There are a few areas of unusually high productivity.
3) Variations in primary productivity are related more to the seasonal upward flux of micronutrients and the temperature-density of the water than to amounts of light and plankton.

DISCUSSION

No significant setbacks have been encountered in carrying out this project and completion is expected by late spring or early summer, 1980. Detailed studies will continue at French Frigate Shoals, an area of very high productivity and fisheries potential. Research papers are being prepared for publication and for a joint agency symposium on the Northwestern Hawaiian Islands scheduled for April 1980.

NWHI/OBSERVATION AND DATA COLLECTION OF REEF AND PRECIOUS CORAL RESOURCES USING STAR II
Task Order No. 173 (4051)

FINAL REPORT

MAC INVESTMENT:	$30,000 (FY 1978-79)	MATCHING FUNDS (SEE OVERVIEW)
OPERATING AGENCY:	HAWAII INSTITUTE OF MARINE BIOLOGY	
PRINCIPAL INVESTIGATOR:	DR. RICHARD GRIGG	

OBJECTIVES

Resource assessment of lobsters, snappers and groupers and precious corals in the vicinity of Midway Islands.

METHODS

Observation and data collection with the use of the STAR II submersible.

RESULTS/DISCUSSION

A cruise to Midway Island scheduled for August of 1979 had to be canceled because the permit application to enter Midway Island was not approved by the Navy. Between June 1 and September 1, 1979, entry and exit from Midway was very limited. Approval was granted only on a case by case basis. The reason for the curtailment is classified. Approval was obtained for entry into Midway Island in June 1979 for the research vessel EASY RIDER for research on resource assessment of reef fish and corals, and snappers and groupers. Therefore a request to the MAC was made and approved to use Project 4051 funds for the June EASY RIDER cruise. The cost of this cruise was $24,200. The remaining funds in the project were utilized for purchase of an air compressor (for SCUBA tanks) in support of all shore based projects in the NWHI-FI.

SHIP SUPPORT FOR RESEARCH SURVEYS IN NWHI
Task Order No. 173 (4052)

PROGRESS REPORT

MAC INVESTMENT: $30,000 (FY 1978-79)

MATCHING FUNDS (SEE OVERVIEW)

OPERATING AGENCY: HAWAII INSTITUTE OF MARINE BIOLOGY

PRINCIPAL INVESTIGATOR: DR. RICHARD GRIGG

OBJECTIVES

Contract of R/V EASY RIDER. Ship Support is vital to the achievements of the NWHI investigation.

METHODS

Contract of R/V EASY RIDER.

RESULTS/DISCUSSION

Use of Project 4051 funds for the June EASY RIDER cruise allowed

additional ship charter time to be scheduled in 1979. Supported with funds from project 4052, two cruises of 19 and 21.5 days each were conducted in FY 79-80. Research on these cruises included resource assessment of lobsters, snappers, turtles, and groupers and reef coral and fish ecology.

Results from the cruises are varied and complex, however, some of the high-points of the NWHI investigations made possible by the ship support can be briefly listed:

1. LOBSTERS: Preliminary results indicate that islands do not support independent populations. It is likely that larval transport creates substantial intermixing between the islands. The management of lobsters might therefore be placed on an archipelago-wide basis, rather than island by island. Methods are being worked out to identify the larvae of lobsters to species and sex. In contrast to the larvae, research at Kure Island has disclosed that the adult lobsters are relatively sedentary. The movement of individuals has not exceeded several hundred meters over a nine month period in Kure Lagoon. This research is expected to greatly improve the management plans for spiny and slipper lobsters which are now being developed by the Western Pacific Fisheries Management Council and the State Fish and Game. (See Task Order No. 173[4054].)

2. TURTLES: Research has disclosed that the major breeding ground of the Hawaiian green turtle is French Frigate Shoals where a population of about 100 to 240 animals has been present for the past seven years. Very slow growth rates (about 3/8" year) suggest that animals do not reach sexual maturity until an average age of 48 years. (See Task Order No. 173[4053].)

3. SNAPPERS AND GROUPERS: Patterns of distribution and abundance indicate that snapper/grouper stocks vary considerably between the northwestern islands. Management plans for specific islands or island groups may be necessary to conserve these resources.

   In the high islands, an analysis of commercial catch data shows that two distinct assemblages occur which appear to be segregated on the basis of depth.

4. REEF AND CORAL BENTHIC RESOURCES: Part of FY 1979-80 studies.

5. REEF FISH TROPHIC DYNAMICS: Beginning in FY 1979-80, this long term study will investigate the feeding habits of reef fishes including sharks. French Frigate Shoals has been selected as a representative island where an intensive analysis is underway.

6. PRIMARY AND SECONDARY PRODUCTIVITY: (See Task Order No. 173 [4050].) An archipelago wide survey has revealed the existence of several "hot spots" where productivity and zooplankton biomass appear to be enhanced. One such area is South Point on the island of Hawaii. The waters of northwestern islands in general appear to be more (1.2 to 1.5 times) productive than the major "high" islands, especially in the summer months. This may in part account for higher catch rates of fishes such as bottom-fish, ono, and kawakawa. An intensive survey is planned for French Frigate Shoals in FY 1979-80.

NWHI/SURVEY AND ASSESSMENT OF THE GREEN SEA TURTLE RESOURCES
Task Order No. 173 (4053)

PROGRESS REPORT

MAC INVESTMENT: $20,504 (FY 1978-79)

MATCHING FUNDS (SEE OVERVIEW)

OPERATING AGENCY: HAWAII INSTITUTE OF MARINE BIOLOGY

PRINCIPAL INVESTIGATOR: GEORGE H. BALAZS

OBJECTIVES

The overall objective of this study is to develop basic biological and ecological information relevant to the wise, long-term management and conservation of the Hawaiian green sea turtle population. Specific objectives include:

1. locating and censusing aggregations of turtles in their nearshore feeding pastures;
2. ascertaining productivity and population trends at the sole colonial breeding site of French Frigate Shoals;
3. determining the developmental migrations of immature turtles;
4. gaining information on natural growth ages and ages of sexual maturity;
5. determining the food sources used by each size category; and
6. determining the factors that limit the population.

Life history information of this nature will be of direct use and benefit to the State of Hawaii in developing compatible programs of fisheries resource utilization, particularly in waters of the Northwestern Hawaiian Islands. The recent designation of all U.S. populations of green sea turtles as "threatened" increases the need to gather this management-oriented information.

METHODS

Intensive land-based and underwater field studies are periodically conducted at various locations throughout both the major and Northwestern Hawaiian Islands. Research activities are focused on population sampling through capture and tagging, as well as direct observations of feeding, basking and breeding activities. In addition, an extensive network of informants comprised of the general public and cooperating military agencies has been assembled to gather information on the locations and activities of turtles.

RESULTS

A. A series of lengthy and comprehensive field studies has provided basic life history information on turtle aggregations occurring at Necker, French Frigate Shoals, Laysan, Lisianski, Pearl and Hermes Reef, Midway, Kure, Oahu, Lanai and the Big Island (Hawaii).

B. Natural growth rates of immature turtles in resident pastures at French Frigate Shoals and Midway/Kure have been determined for periods of up to 37 months in the wild. Rates of growth have ranged from only .01 to .21 cm. per month. At the Big Island off the Kau District, rates of growth have ranged from .38 to .52 cm. per month.

C. Comprehensive food studies, involving samplings of stomach contents, have identified two genera of algae *(Codium and Caulerpa)* as major dietary components of turtles residing in the Northwestern Hawaiian Islands. In the major islands, *Pterocladia, Codium, Amansia and Ulva* have been found to be principal sources of food.

D. Monitoring of the breeding assemblage at French Frigate Shoals has indicated that approximately 250 adult females were present during the 1978 reproductive season.

DISCUSSION

The availability of travel to remote areas of the Leeward Islands has been enhanced by the charter arrangements made by the MAC Office with the Easy Rider Corporation. Support of this project by the MAC Office has made it possible to develop within Hawaii an authoritative source of information on sea turtles that can be drawn upon internationally and, most importantly, by island nations of the Pacific region.

Research results and conclusions to date are contained within the numerous publications and reports authored by the Principal Investigator. Lectures on the Northwestern Hawaiian Islands and the Hawaiian green sea turtle research project were presented to audiences throughout the state on seven occasions. An invitational ad hoc meeting of the IUCN Marine Turtle Specialists Group was attended in Toronto, Ontario to formulate international research strategies. All travel expenses were paid by IUCN/WWF of Switzerland and an invitational meeting on sea turtles convened by NMFS was attended at the National Space Technologies Laboratory, Mississippi at the expense of the NMFS, Washington, D.C.

PROJECT CONTINUENCE

Research being conducted is on schedule, with significant contributions being made to our knowledge of the biology and ecology of the Hawaiian green turtle population.

NWHI/POPULATION BIOLOGY OF SPINY LOBSTERS THROUGHOUT THE HAWAIIAN ARCHIPELAGO
Task Order No. 173(4054)

PROGRESS REPORT

MAC INVESTMENT: $9,534 (FY 1978-79)

MATCHING FUNDS (SEE OVERVIEW)

OPERATING AGENCY: DEPARTMENT OF ZOOLOGY
UNIVERSITY OF HAWAII

PRINCIPAL INVESTIGATORS: CRAIG D. MACDONALD & JOHN STIMSON

OBJECTIVES

The objectives of this study are:

1. To improve the precision of spiny lobster stock assessment and determine the degree to which island populations are autonomous to derive more reliable estimates of maximum sustained yield.
2. To evaluate the utility of monitoring female reproductive rates as a tool in the management of the spiny lobster fishery.
3. To evaluate the feasibility of predicting year class strength by monitoring annual differences in relative abundance of settling larvae and juvenile density.
4. To determine the relationship between availability of shelter and patterns of shelter use to explain variance in density measurements and further improve estimates of abundance.

Accurate estimates of population size, knowledge of the extent of stock autonomy, and annual measures of larval recruitment will enable the Western Pacific Regional Fisheries Management Council to decide what maximum sustained yield is appropriate within the Northwestern Hawaiian Islands and whether or not that fishery can be expanded. This information will further assist the Hawaii Division of Fish and Game in evaluating their existing management policy for spiny lobsters around the eight major Hawaiian Islands at the southern terminus of the Archipelago and in the nearshore waters within their jurisdiction throughout the island chain.

METHODS

This investigation uses several standard techniques for the study of spiny lobster population biology. The basic procedures include (1) trap sampling, (2) diver sampling, and (3) lobster larvae sampling.

DISCUSSION

Field work began as planned in January 1979. The U.S. Coast Guard gave the authorization to work at Kure Atoll and to hire their off-duty personnel to assist with our field operations. All permanent equipment purchases have been made and a student assistant has been hired. All traps and lobster larvae collectors have been constructed. The program of continuous field sampling began in May 1979.

The initial field trip to Kure Atoll revealed the presence of a wide range of lobster densities and great relative abundance. Both species were present in proportions that approximated the commercial catch composition. These findings in combination with the established feasibility of working year-around reinforce our commitment to undertake this study at Kure Atoll.

Our most significant findings to date is that juveniles and adults are not broadly segregated geographically by habitat. This is in noted contrast with what is known of all other commercially important species of spiny lobsters. This finding is of great management and theoretical importance and may be a characteristic of lobsters occupying insular marine habitats rather than continental shelves.

The program to continuously sample lobster larvae at French Frigate Shoals that was originally proposed will be eliminated, at least for the first year of field research, due to a scheduled closure of the Coast Guard station at that location in July 1979. The U.S. Fish and Wildlife Service is attempting to establish a field station at French Frigate Shoals will be postponed until the second year of field research.

SUMMARY/CONCLUSIONS

The expected completion date of this project is January 1982. There have been no setbacks or problems encountered thus far and the project is on schedule as planned in the proposal.

SAND SAMPLE ANALYSIS
Task Order No. 183

FINAL REPORT

MAC INVESTMENT: $1544 (FY 1978-79)

MATCHING FUNDS: NONE

OPERATING AGENCY: HAWAII INSTITUTE OF GEOPHYSICS

PRINCIPAL INVESTIGATOR: J. FRISBEE CAMPBELL

OBJECTIVES

The objectives of this project were to analyze, by grain size, offshore sand samples obtained in FY 1977-78 by Ocean Innovators along the windward and north shores of Oahu and incorporate the results with those from Leeward Oahu offshore analyses done by the Pacific Concrete and Rock Company, Limited (PR&R) in 1977. Since offshore sand mining is receiving substantial consideration as an alternative for concrete aggregate and beach replenishment, such definitive assessments are necessary for the State's use of the resources.

METHODS

Standard methods of grain-size analysis using nested sieves were used for the sediment analysis at HIG. Random samples of 50 to 150 grams were weighed and put into the stack of sieves which were then shaken in a Ro-Tap machine for 10 minutes. The amount of sediment accumulated on each sieve was weighed and the cumulative percentage calculated. These data were then plotted on a graph of size versus cumulative percentage, and smooth curves drawn through the data points. The values necessary to calculate statistical parameters that describe the sediment were then picked off these curves.

Unfortunately, due to the passage of time, several of the earlier samples were lost and so an analysis of all the samples collected was impossible. Of the 380 individual samples collected by Ocean Innovators, 84 had been in the report by PC&R, 82 were lost, and the remaining 214 were analyzed by the staff at HIG.

RESULTS

The proposed use of the sand will determine what interpretation is to be made of the data from the size analyses. If the sand is to be used as aggregate in concrete, it must meet standards set by the American Society for Testing and Materials (ASTM), and if it is to be used for beach restoration, it must meet specifications that will vary depending on what size of sand is currently on the beach to be restored. Since the offshore sand analyzed during this study could conceivably be used for either aggregate or beach replenishment, the tables of the data list information appropriate for either use.

RESULTS/CONCLUSIONS

Of the almost 300 samples analyzed, either by PC&R or HIG, approximately 30 per cent fit within either the ASTM or Papohaku beach sand size ranges. (The Papohaku criteria is a qualitative measure based on the fact that for almost fifteen years Papohaku Beach, Molokai, provided a major part of the sand used in Hawaii for aggregate and beach replenishment.) Visual inspection of the samples analyzed by HIG indicates, however, that at least a third of the samples passing the size specifications would probably be rejected, either because they have too much organic content or because they are too friable. This still leaves about 50 samples that appear to be excellent for concrete or for use in beach replenisment projects.

The samples that meet the size criteria are found at nearly all the locations sampled by Ocean Innovaters, across essentially the complete depth range of 38 to 226 feet that was sampled, and at various distances below the sea bottom. Preliminary attempts to discern patterns of offshore sediment distribution based on the presently available information were not overly successful. This is understandable when the reconnaissance nature of the HIG geophysical surveys and the Ocean Innovaters sampling program are considered. The important information that can be surmised from the work to date is that usable sand has been found in several offshore locations thus showing that a substantial part of the large volume of offshore sediment found by the HIG geophysical surveys and summarized in the statewide report by Moberly, Campbell, and Caulbourn, 1975, is sand that could be used as aggregate or for beach replenishment projects.

The information gained from the offshore sampling program is enough to show that further efforts of the sort already done will not increase our knowledge of deposits significantly. If there is to be serious consideration of using the offshore sand as a natural resource, what is needed now is a detailed survey and sampling program of a specific area. With the use of modern shore-controlled navigation techniques, a geophysical survey and sampling program could clearly delineate the size and quality of a specific deposit. Then a test mining program based on these surveys could be the basis of an economic study of the cost of mining offshore sand deposits.

PHYTOPLANKTON MONITORING AT KE'AHOLE POINT, HAWAII RELATED TO OTEC ENVIRONMENTAL RESEARCH PROGRAM

Task Order No. 188

PROGRESS REPORT

MAC INVESTMENT:	$32,000 (FY 1978-79)	MATCHING FUNDS $238,000 (1978-79) US DEPT. OF ENERGY through LAWRENCE BERKELEY LABORATORY
OPERATING AGENCY:	JKK LOOK LABORATORY OF OCEANOGRAPHIC ENGINEERING UNIVERSITY OF HAWAII	
PRINCIPAL INVESTIGATOR:	DR. EDWARD K. NODA	

OBJECTIVES

The MAC-sponsored Phytoplankton Monitoring Program at Ke'ahole Point, Hawaii, is a matching funds contribution to the Lawrence Berkeley Laboratory (and Department of Energy)-sponsored Ocean Thermal Energy Conversion (OTEC) environmental research program aimed at acquiring baseline data to assess the environmental consequences of an operating OTEC plant. The following progress report describes the program of which the MAC-funded project is an integral and important task item.

The objectives and scope of this study involve the evaluation of the variability in physical, chemical and biological parameters at an OTEC benchmark site off Ke'ahole Point, Hawaii. Although the primary focus of this project is the study of environmental variability, the long-range objective of this project is to utilize the field results to aid in the design of subsequent OTEC monitoring programs. In particular, the measurements are intended to provide, at a specific location, one year of background data which will form the basis, in conjunction with previously obtained pertinent information for the region, for defining longer term and more extensive environmental surveys necessary to permit the siting and eventual operation of an OTEC plant in the region.

The present contract which terminates in February 1980 is sited off the Kawaihae-Ke'ahole Point area and is at the location of the OTEC-1 platform to be deployed in about April 1980. Thus, the present program provided the baseline environmental data for the environmental impact assessment for the OTEC-1 project. Upon completion of this program and with the simultaneous operation of the OTEC-1 system with its own environmental monitoring project, it is anticipated that the present LBL-sponsored project will move to another site. We have suggested that the new site for this environmental monitoring program be located along the Barbers Point-Waianae area of Oahu in anticipation of the OTEC 10/40 program leading ultimately to commercialization.

METHODS

To achieve the project objectives the following task items are being performed:

TASK 1. Literature Review

A thorough review of the historical data-sets and literature (including physical, chemical and biological studies) is an essential segment in the design of a meaningful and viable long-term sampling program. As a result, the available data-sets will be reviewed to determine environmental conditions that are relevant to OTEC. This information will supplement the baseline data acquired in the proposed field program, with the entire data package providing the basis for the final recommendations.

TASK 2. Standard Bi-monthly Measurements

There will be six (6) bi-monthly occupations of a benchmark station. The location of the station will be appropriately selected so that the environmental conditons at the station are representative of those that will be found at prospective OTEC sites. During each bi-monthly cruise the following measurements will be performed. Whenever possible standard verification checks will be utilized to ensure data reliability.

a. Parameters to be measured from each sampling depth are 1) temperature 2) salinity, and 3) dissolved oxygen, with laboratory analysis for the following nutrients: Kjeldahl nitrogen, ammonia, nitrate plus nitrite, orthophosphate, total phosphorus, silicate, and urea. Replicate analysis of each sample will be performed.

b. Additional water casts, one at dawn and one at dusk, will be made to a depth of 300m. Phytoplankton identification and enumeration, photic zone chlorophyll maxima, temperature, salinity, dissolved oxygen, primary productivity, ATP, chlorophyll a/phaeopigments, and light levels throughout the photic zone will be measured as defined in Task 2a.

c. Recordings of temperature, salinity, and depth profiles will be taken with each cast to a depth of roughly 1000 meters using a CSTD instrument which will be supplemented with XBT profiles to 750 meters.

d. Eight zooplankton samples and analyses will be done for each cruise day.

e. A chart recording depth sounder (12 khz) will be used to record the migration of the deep scattering layer (DSL).

f. Navigation and meteorological observations as well as observations of bird, fish, and mammal sightings on station shall be recorded in an appropriate logbook.

DISCUSSION

The project was initially started on September 1, 1978 with Gary Niemeyer, Department of Ocean Engineering, as the principal investigator. Dr. Niemeyer carried out the first scheduled cruise in October 1978 utilizing the vessel M/V HOLOHOLO. During the second scheduled cruise in December 1978, the M/V HOLOHOLO with 10 personnel onboard including 7 scientific personnel were lost. Gary Niemeyer was one of the individuals lost in that tragic incident.

Edward K. Noda was named principal investigator to continue the contractual obligations with both LBL and MAC. The contract with LBL was amended in April 1979 to reflect the above circumstances with particular regard to a time extension to complete the project and the second cruise was carried out in April 1979. Subsequently bi-monthly scheduled cruises in June, August, and October 1979 have been successfully completed on schedule with the final 6th cruise on the present contract scheduled for early December 1979.

SUMMARY

Following the tragic loss of the chartered survey vessel and M/V HOLOHOLO and its entire crew, the OTEC environmental benchmark survey program has satisfactorily recovered with no requirement for additional cost from either MAC or LBL. The program schedule was delayed approximately 4-5 months, but is presently on the amended schedule and it is anticipated that the project will be completed by February 1980 as contracted with LBL.

II. MARINE RESOURCES PRESERVATION, CONSERVATION, AND RESTORATION

OPIHI MANAGEMENT STUDY
Task Order No. 164

PROGRESS REPORT

MAC INVETMENT: $2,000 (FY 1977-78)
$1,850 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: RESEARCH CORPORATION OF THE UNIVERSITY OF HAWAII

PRINCIPAL INVESTIGATOR: DR. E. ALISON KAY

OBJECTIVES

To provide baseline data for the State of Hawaii on effects, if any, on the recent Division of Fish and Game harvesting regulations on opihi, and to provide parent material for culture work on opihi funded by DPED.

METHODS

Monthly monitoring of opíhi populations at Keaau, Hawaii; quarterly census of opihi populations on Maui, Hawaii, Molokai, Lanai and Kauai, and; checks of "midden" material (cast off shells found in opihi fishing areas).

RESULTS

Opihi have been monitored at Keaau, Hawaii each month since January, 1978, with the exception of November, 1978, when storm waves precluded collections. As in previous years, juvenile opihi (those less than 10 mm in length) were detected between January and May, 1978, and in December 1978 and January 1979. Very few juveniles (less than 5% of the total) were found between July and November.

It is apparent that both species of opihi, Cellana exarata, the black foot, and C. sandwicensis, the yellow foot, show similar features. Numbers of opihi in most years are reasonably steady, varying only slightly from month to month, but exaggerated numbers occurred in 1977. These numbers are due to recruitment, i.e. to settlement of juveniles.

These data are of interest not only for this study, but for studies of the dynamics of shoreline biota in general because they demonstrate what biologists have long instinctively known: that populations of organisms in the intertidal can show extreme fluctuations in numbers but it is only by patient year-in and year-out monitoring that we will either detect or understand these population fluctuations. We are now in the process of attempting to associate the upsurge in the opihi populations at Keaau, Hawaii during 1977 with climatic

factors such as temperature, rain, cloud cover, and wind.

Monthly monitoring of opihi populations also provided parent material for the opihi culture studies funded by DPED.

In addition to monitoring opihi populations in the field, we have continued to analyze midden material collected from fishing shelters and camp sites on Maui, Hawaii, Molokai, and Kauai. On Kauai and on Hawaii from Waipio Valley around the windward (Hilo to Kalapana) coast to the National Park (approximately at Halape), mean size of opihi shells in the middens is just about or less than regulation size. On Molokai and Maui, and on Hawaii from the National Park (Halape) and along the Kona coast, mean size of the midden shells is well above regulation size. The pattern can be interpreted in either of two ways. One explanation is that opihi on Kauai and the windward coast of Hawaii are naturally smaller than they are elsewhere in the Hawaiian Islands. The other explanation is that fishing pressures on Kauai and Hawaii from Waipio Valley to the National Park shoreline are heavier than they are on Molokai and Maui and on the Kona Coast, resulting in smaller opihi along the shorelines. That the latter explanation may be more plausible than the former is indicated by the observations that opihi on Kauai do attain larger size than mean regulation size and at Keaau, Hawaii (in the middle of the Waipio Valley-Halape coastline) opihi in our experimental non-fished populations easily attain regulation size and larger. A second indication that fishing pressure may be affecting the size of the opihi comes from a game warden on Maui who noted that his impression is that opihi fishing pressure is increasing and he predicts that even with the harvesting regulations we will detect a shift in size of the Maui and Molokai opihi toward a smaller size within the next couple of years.

DISCUSSION

The project is going as planned. Maui, Molokai and Kauai are scheduled for visits and we will continue to monitor opihi populations on Hawaii.

MICROBIOLOGICAL INDICATOR FOR ASCERTAINING FECAL CONTAMINATION OF MARINE RECREATION WATERS
Task Order No. 175

FINAL REPORT

MAC FUNDING:	$8,266 (FY 1978-79)	MATCHING FUNDS SEA GRANT $12,705 (FY 1978-79) OTHER STATE SUPPORT $9,041 (FY 78-79)
OPERATING AGENCY:	WATER RESOURCES RESEARCH CENTER University of Hawaii	
PRINCIPAL INVESTIGATOR:	DR. ROGER S. FUJIOKA	

OBJECTIVES

The goals of this research are to resolve the uncertainties regarding the fate of indicator bacteria in marine waters and to evaluate the adequacy of using fecal coliform (FC) and fecal streptococci (FS) as measurements of fecal contamination and possible spread of infectious diseases in marine waters.

Results of this study will be of importance to the Environmental Protection Agency and the State of Hawaii, Department of Health which are charged with the responsibility of determining the best assay procedures to use for the monitoring of fecal pollution in marine waters and also to the Department of Wastewater Management, City and County of Honolulu, who have the responsibility of discharging sewage into ocean water off Oahu in a safe and effective manner. The results may also be applicable for the growing aquaculture industry which may use sewage contaminated waters to grow their products as well to the Division Fish and Game which regulates the harvesting of shellfish.

METHODS

For most of this study, fecal coliform (FC) and fecal streptococci (FS) bacteria naturally present in sewages of Hawaii and representative bacteria isolated from sewages and grown as pure cultures were used. These bacteria were added to marine waters obtained from the coastal waters of Oahu and their survival rates observed under laboratory and simulated field conditions. As experimental controls, the cultured bacteria were added to buffer solutions or fresh mountain stream water and their survival rates compared under similar conditions. To substantiate some of the laboratory findings, natural populations of FC and FS were isolated from marine water sources.

RESULTS AND DISCUSSION

Sunlight was determined to be the primary factor controlling the stability of FC and FS bacteria suspeneded in marine waters. Results suggest that the bactericidal effect of sunlight is a general biological phenomenon which has not been adequately characterized. Recovery of FC and FS from popular beaches

on Oahu consistently revealed that the FC:FS ratio was less than 4. These results indicate that the same interpretation of the FC:FS ratio established under fresh water conditions is not applicable under marine water conditions.

SUMMARY/CONCLUSIONS

1. The expected stability of FC and FS bacteria in the marine water environment is primarily determined by the absence or presence of sunlight. In the absence of sunlight, these bacteria can be expected to survive for days whereas in the presence of sunlight they are effectively destroyed within a few hours.

2. The bactericidal properties of sunlight were determined to:

   a) be effective when the bacteria was suspended in marine water but relatively ineffective when the bacteria was suspended in fresh mountain stream water;

   b) be associated with the visible light spectrum of sunlight rather than the UV light spectrum;

   c) be just as effective against FC and FS from animal sources as well as against some genera of human bacteria; and

   d) be approximately the same for FC and Salmonella bacteria, a pathogenic human enteric bacteria.

3. The same interpretation of the FC:FS ratio established under fresh water conditions cannot be directly applied to the marine water environment since FC and FS is much more unstable in the marine water environment as compared to the fresh water environment.

4. Although FC appears to be an adequate indicator for the presence of pathogenic Salmonella bacteria, this indicator bacteria is very unstable in the marine water environment. Thus, in the marine environment the more stable FS bacteria appears to be superior to FC as an indicator for the presence of the more resistant sewage-borne pathogens such as viruses and protozoans.

EPA/HIMB KANEOHE BAY SEWAGE RELAXATION STUDY
Task Order No. 176

PROGRESS REPORT

MAC INVESTMENT: $20,000 (FY 1978-79)

MATCHING FUNDS
$90,000 (FY 78-79)
FEDERAL EPA

OPERATING AGENCY: HAWAII INSTITUTE OF MARINE BIOLOGY

PRINCIPAL INVESTIGATOR: DR. STEPHEN V. SMITH

OTHER STATE SUPPORT
$14,900 (FY 78-79)
UH SALARIES

COMMENT: *In addition to the direct funding provided by EPA, MAC, and the salary matching funds provided by U.H., this program receives cooperative support of the Naval Ocean Systems Center, Hawaii Laboratory. The City of Honolulu Sewers Division and the State Department of Health have also made substantial contributions to this study.*

OBJECTIVES

The primary goal of this project has been to study the effects of sewage diversion on Kaneohe Bay, Oahu. Kaneohe Bay had been the site of increasing sewage pollution since the early 1960's. In the early 1970's, the decision was made to divert that sewage from the bay by constructing a deep ocean outfall which was completed in late 1977. This event provided the opportunity to conduct a well-controlled experiment in ecosystem perturbation.

Recounted briefly, the objectives for this study are:

1) To identify the major components of the Kaneohe Bay ecosystem and determine how they work and interact.
2) To determine how the components responded to the introduction of sewage into the ecosystem.
3) To observe and measure how the components respond to the termination of sewage input.
4) To answer the question "Will the ecosystem return to the 'pre-stress' condition; if so, how long will it take?"
5) To determine if results of this study of Kaneohe Bay can be generalized and used as predictive tools for the management of similar ecosystems.

The potential benefits to the State are to be found in the thoughtful use of the results of this study in the wise management of Hawaii's coastal resources.

METHODS

Originally two basic approaches were used to study Kaneohe Bay and its responses to the relaxation of sewage stress. They were: 1) documentation of the chemical, biological and physical processes of the bay by establishing a sampling program designed to measure water column and benthic characteristics and their spatial and temporal variablility; and 2) experimentation to measure productivity and nutrient fluxes and to test hypotheses developed by analysis of data collected in the field monitoring.

A third approach has been incorporated into the study. Historical data, from a variety of sources, is being gathered to give a more complete picture of long-term natural effects on the bay ecosystem. These data include wind speed and direction, rainfall and stream discharge. A better understanding of these inputs into the ecosystem will permit a more thorough analysis of the ecosystem responses to sewage-related changes.

RESULTS

The chemistry and biology of "pre-diversion" Kaneohe Bay are now well-described and the data analyzed to date show that Kaneohe Bay is responding to the diversion of sewage. Some of the variables measured appear to be approaching pre-sewage concentrations. The response of the benthos is slower than that of the water column variables. It has become apparent during the course of this study that other controlling functions (e.g. wind and rainfall/runoff) have a significant effect on the bay ecosystem

Field efforts ended in August 1979. Several technical publications have been published or submitted; others are in preparation.

CONCLUSIONS/PROJECT CONTINUENCE

In order to fully understand the effects of sewage input and its diversion on Kaneohe Bay, it is necessary to separate those effects from responses to natural controlling functions. To accomplish this analysis, a time-series collection of data of sufficient length to pick up long-term oscillations is necessary. In addition, the longer the sampling program continues, the more confidently we can predict the eventual status of ecosystem components, such as the benthos, that exhibit long-term recovery processes. We therefore wish to continue the sampling program through May 1980. Additional funds from the U.S. Environmental Protection Agency are being requested for this purpose.

The results of this study provide convincing evidence of the value of carefully collected time-series biological data in environmental analysis.

STUDY OF PUAKO BAY RESOURCES FOR MANAGEMENT PLANNING
Task Order No. 189

PROGRESS REPORT

MAC INVESTMENT: $20,000 (FY 1978-79) MATCHING FUNDS NONE

OPERATING AGENCY: DIVISION OF FISH AND GAME
HAWAII COOPERATIVE FISHERY RESEARCH UNIT

PRINCIPAL INVESTIGATOR: KENJI EGO

OBJECTIVES

To determine and assess the physical and biological characteristics of the nearshore and reef areas of Puako Bay, South Kohala, for purposes of monitoring:

a. trends in fish populations
b. changes in the marine environment
c. effects of man-induced ecological disturbances upon fishes

To determine and assess:

a. fishing patterns and pressures
b. fish catch compositions

To obtain other information that may be useful in assessing the effects of proposed developments in the area and for the formulation of suitable management measures.

METHODS

Field studies were carried out by divers using SCUBA. Dives were made at depths from 0-80' along the length of the Puako reef tract in order to determine local habitat types and to compile species lists for each of the habitats. Permanent transects were set up in order to obtain more detailed information on the distribution and abundance of the larger invertebrates and fish. Additional dives were also made at seven other locations on the Kona coast to be used as a basis for comparison with Puako reef. Collection of fish from each of the habitats was begun using standard fishing methods. Measurements and weight were taken prior to removal of the gut contents and otoliths for further study.

Assessment of the local fishery was initiated by conducting informal interviews with the residents of the Puako beach-front in order to obtain background information on the type and frequency of the fishing observed, as well as any long-term patterns or changes noted.

In addition, passive observation of the fishing activity was begun. The number of fishermen, methods used, time of day, and day of week were recorded. Whenever possible, the catch composition was also noted.

RESULTS

Repeated observations at the Puako reef tract have resulted in the establishment and descriptions of six habitat zones. No area has yet been found on the Kona coast whose physical characteristics closely resemble those at Puako.

Assessment of the fishery by informal interviews and passive observations indicate taht the present fishing is generally recreational in nature, consisting largely of families who often come to fish for the weekend. The long-term nature of the fishing pressure has no apparent pattern, but has been marked by sporadic increases and a sharp decline following the Labor Day weekend. Occasional large-scale collections of limu (edible seaweed) and sea urchins were noted. In addition, commercial dive boats and recreational divers have been observed.

DISCUSSION

Analysis of the early data has not yet been carried out. However, several steps have been made toward completion of the stated goals of this project. Field work carried out to date has resulted in the identification of the habitat types present at the Puako reef tract. Establishment of permanent transect lines, combined with systematic surveys of the entire area, has yielded much information on species composition and spatial distribution throughout the area. A formal report will substantiate the findings.

Assessment of the local fishery by informal interview of residents and by passive observation of the fishermen is proceeding as planned. Quantitative information on species and amounts of fish caught has yet to be determined.

CONCLUSIONS

Until more complete and quantitative data can be accumulated, any definite conclusions would be premature. It appears that the area is a rather distinctive environment with considerable resource values (both fish and invertebrate) and that at least the shallow reef top and surge zone is subject to fairly intense recreational use, including fishing. It will be important to characterize and quantify the fishing effort further.

PROJECT CONTINUENCE

The continuance and completion of this MAC-initiated project will be federally funded through the Department of Land and Natural Resources. Completion of the project is expected to be on schedule--Summer 1981.

HAWAIIAN MONK SEAL RESEARCH
Task Order No. 193

FINAL REPORT

MAC INVESTMENT:	$2,625 (FY 1978-79)	MATCHING FUNDS $10,000 (FY 1978-79) MARINE MAMMAL COMM. $8,000 (FY 1978-79) NMFS OFFICE OF ENDANGERED SPECIES $3,000 (FY 1978-79) NMFS HONOLULU LAB.
OPERATING AGENCY:	NATIONAL MARINE FISHERIES SERVICE (NMFS)	
PRINCIPAL INVESTIGATOR:	DR. RICHARD S. SHOMURA	

OBJECTIVES

To enhance the present understanding and knowledge of the Hawaiian monk seal so that an effective and reasonable method of dealing with the problems that may arise with the preservation of these mammals and the surrounding environment in the Northwestern Hawaiian Islands can be developed. While the State is fully committed to preserve and enhance the population of the Hawaiian monk seal, an endangered species protected by Hawaiian as well as Federal Law, the Governor, the Marine Affairs Coordinator and the Division of Fish and Game were all convinced that what was needed at this time was not a declaration of "critical habitat," as the National Marine Fisheries Service has proposed, but a comprehensive study of the Hawaiian monk seal. This research would lead to a more adequate understanding of this species and its problems of survival. Also, the timing of the researchers' return in 1979 to Laysan Island, the principal site of this research, is crucial so that their results could be added to previously collected data on fertility and mortality rates, fecundity(i.e. reproductive rate data),and other variables which would have been lost if field studies were not continued.

METHODS

The third year of the continuing field study of the Hawaiian monk seal began with researchers, Brian and Patricia Johnson's, arrival at Laysan Island on March 12, 1979. The field observations ended on August 17, 1979 with their departure from the island. As in past years, the study was observational, concentrating on estimating population size and composition, determining reproductive and survivorship rates, and monitoring the daily and seasonal activity patterns of individually recognizable seals. Observations were made from a distance to avoid any disturbance to the seals. Individual seals were recognized on the basis of natural marks or by artificial bleach marks applied to sleeping animals. In order to determine causes of mortality as well as dietary habits, tissue samples, stomach contents, and skeletal materials were collected from dead animals. Tissues were preserved in several ways, including freezing for analysis of ciguatoxin levels. Skeletal materials from seals dying prior to the researchers' arrival were also collected, as were fecal samples. Two observation methods, the Lincoln-Peterson Index and "molt estimate," were used and their success evaluated.

RESULTS/DISCUSSION

Analysis of the data is not complete. Preliminary results show that the Laysan Island monk seal population has stablized to approximately 115 seals after the major and as yet unexplained population decline which occurred in 1978. The reproductive rate, based on three years data, for identifiable females appears to fall between 50% and 60%. Both the Lincoln-Peterson Index and molt estimate methods were found to be good because they were conducted without causing disturbance to the seals and therefore may have advantages over other methods which require handling of the animals. The results of the 1979 field work will be incorporated into a comprehensive report.

III. MARINE-RELATED ECONOMIC DEVELOPMENT

MAUI TUNA BAITFISH PROJECT
Task Order No. 156

FINAL REPORT

MAC INVESTMENT:	$20,000 (FY 1978-79)	MATCHING FUNDS $74,000 (FY 78-79) MAUI COUNTY
OPERATING AGENCIES:	MARINE AFFAIRS COORDINATOR'S OFFICE & DEPARTMENT OF ECONOMIC DEVELOPMENT, MAUI COUNTY	OTHER STATE SUPPORT $12,000 (FY 78-79) DEPT. OF PLANNING & ECONOMIC DEV.
PRINCIPAL INVESTIGATORS:	DR. STANLEY SWERDLOFF & ERIC SOTO	

OBJECTIVES

To establish and develop a pilot baitfish facility at Kealia on Maui for the culture of Poecilia vittata, the cuban tabai or topminnow. The success of this project would open the opportunity for the establishment of a permanent commercial baitfish operation on Molokai which would open up major fishing grounds east of the Big Island and northeast of Kauai, and permit long-range aku vessels to fish in the Northwestern Hawaiian Islands and the Line Islands south of Hawaii.

METHODS

Encouraged by preliminary findings (that the topminnows were 70% as effective as nehu in attracting and holding aku to a vessel, could live for 20-25 days in a fishing vessel baitwell, and are easily bred) and generated by the present decline of the Hawaiian aku fishing industry--the mainstay of the State's commercial fishery (due to the lateral decline in the number of nehu--the popular but fragile baitfish currently used)--the methods developed to carry out the project were:

1) The construction of culture facilities and the development of culturing methods for Poecilia vittata, based on HIMB studies.

2) The production of 15,000 pounds of bait size cuban topminnows.

3) Sea testing of the baitfish to determine the economic feasibility and effectiveness of its use as live-bait for the skipjack fishing industry.

MAC funds allocated for this project covered purchase and/or rental of equipment, building materials, and supplies.

RESULTS

The Kealia Baitfish Facility consists of six rearing ponds, three brood ponds, an injection and a sump well, two storage sheds and an access road. The

actual amount of bait used in the 1979 sea trials was 8,500 pounds. The topminnow harvest was less than expected for reasons such as cannibalism of young fishes, predation by mosquito fish, and especially because of predation by birds. Disease did not pose a major threat to the project.

The ORION and TRADEWIND, two aku boats with similar fishing power, were contracted from their owner for the sea trials comparing topminnows and natural bait. In 29 fishing days a total of 25,897 pounds of fish were caught with 7,200 pounds of topminnow bait, a catch ratio of 3:6 pounds of tuna per pound of bait chummed. During the same period, 49,764 pounds of fish were caught with 2,140 pounds of natural bait, a catch ratio of 23:2.

DISCUSSION

The comparison of the catch ratios indicates a rather poor attracting ability of the topminnows. Its limited success in catching tuna is related to its purported sounding behavior (diving below the surface), slow movement, and disorientation when being chummed. However, the topminnow does show potential to sustain feeding in a standing school of tuna (i.e. those aggregated near a floating object). Due to strong oriental tradition, the fishing methods existing today have evolved as a result of nehu use and thus, when applied to the topminnow, may have reduced the catching ability of that baitfish. The biggest advantage of the topminnow is its ability to survive on fishing vessels and its easy proliferation. Thus, study of p. mexicana, reported to be a faster swimmer and a jumper when endangered--a highly desirable baitfish behavior--may provide a solution to the deficiencies found in p. vittata.

The results show that the catch must be substantially increased through use of better techniques or that more bait should be produced to reduce the cost per pound of bait. This can virtually be achieved through a normal rather then experimental operation and through educating the fishermen regarding the use of topminnows.

SALTWATER LAND PLANTS
Task Order No. 187

PROGRESS REPORT

MAC INVESTMENT: $6,372 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: DEPARTMENT OF BOTANY
University of Hawaii

PRINCIPAL INVESTIGATORS: DR. BARBARA Z. SIEGAL and
DR. SANFORD M. SIEGAL

OBJECTIVES

This project seeks to examine the feasibility of using sea water as an agricultural resource and to establish the requirements and limitations for resource development. Fresh water shortage is a reality for a great deal of coastal Hawaii, in part as a result of topography, wind and soil features, and in part as a consequence of escalating population demand.

Our goal - in the interests of greater agricultural self-sufficiency for Hawaii - is to extend agriculture to currently marginal semi-arid and arid coastal lands and reduce fresh water irrigation demands on land currently under cultivation.

METHODS

Our three-fold approach to the stated goals and objectives involves (1) crop plant selection; (2) substrate ("soil") management, and (3) screening of saline water regimes.

To implement basic methodology, use has been made of
* screening seed germination and seedling growth for salt tolerance
* physiological and biochemical analysis of plant responses to salinity
* hydrophonic and pot culture in laboratory and greenhouse
* drip-irrigation under field conditions
* comparison of substratum candidates (eg. soil, sand, cinder, coral chips, etc.)

RESULTS

The first field trial using drip-irrigation on corn grown in half-strength sea water was successfully carried out in lava cinder-coral chip beds on Coconut Island. This study was initiated under Sea Grant funding and chemical analysis was completed under the present MAC grant. A paper was submitted to Nature.

Biochemical supplementation studies have been initiated along the following lines:

* effects of RNA constituents (nucleotides) on corn germination
* effects of ionic balances
* further definition of sodium toxicity
* screening of a newly discovered species of corn from the highlands of Manantlan in Mexico and other species, including Koa Haole and Taro, for saline tolerance.

DISCUSSION

The success of selected crop culturation in saline waters suggests that our approaches (and philosophy) are valid, and our methodology sound. Other candidate species and varieties will continue to emerge from laboratory-greenhouse studies and we are looking toward the next phase - a study combining resource development and field demonstration.

SUMMARY/CONCLUSIONS

The feasibility of applying saline waters of up to 16,000-17,000 ppm for agricultural use has been established. The crops of choice for field R&D and demonstration purposes include corn, chinese cabbage, tomatoes and peppers.

Management procedures involving growth medium (substratum) and salinity as well as crop selection have been defined if not elaborated in detail.

Ongoing physiological, biochemical and developmental studies are seeking to obtain a better picture of saline stress and support treatment for its management.

PROJECT CONTINUANCE

We have submitted a continuation request involving supplemental funding. A new site has now been established at Oceanic Institute and with projected funding will advance our program into the development and demonstration stages.

Our timetable is projected as:

* site preparation to begin with authorization of new funds
* site ready for first planting as of authorization date plus 30-35 days
* crop evaluations 6-12 weeks after planting (depending upon crop)
* preparation of a demonstration trial while legislature is in session.

DEVELOPMENT OF TESTING OF FISHES FOR CIGUATOXIN
Task Order No. 198

FINAL REPORT

MAC INVESTMENT:	$5,250 (FY 1978-79)	MATCHING FUNDS $3,200 (FY 78-79) SEA GRANT $5,000 NMFS (FY 78-79) $5,000 UNITED FISHING INDUSTRY (FY 78-79)
OPERATING AGENCY:	SCHOOL OF MEDICINE, UH	
PRINCIPAL INVESTIGATOR:	DR. YOSHITSUGI HOKAMA	

OBJECTIVES

The major objective of the studies is to develop a testing procedure for ciguatoxin in fish consumed by the public. Efforts will be focused on testing Seriola dumerilii (amberjack or kahala), a species which has been implicated in a number of ciguatera outbreaks in the past few years. A previously developed testing method for ciguatoxin (i.e. radioimmuno-assay [RIA]) is being used to analyze these fishes caught in waters surrounding Hawaii, including the Leeward Islands. In addition, attempts are being made to develop an enzyme-linked test (ELISA) for detecting ciguatoxin in fish flesh with the hopes of simplifying the present tests which use mongoose from a wild population and rats for the routine screening and tracing of CTX.

Ciguatoxin (CTX) is produced by certain dinoflagellates attached to algae on coral reefs in tropical ocean waters. Small fish feed on the algae and are in turn eaten by larger bottom fish and CTX is thus passed up the food chain. The larger the fish, the more potentially toxic. The cause of the blooms or profuse growth of the dinoflagellates is unknown, but may at times be associated with ocean disturbances that result from the activities of man such as construction and refuse and sewage dumping. More than 400 fish species have been implicated as CTX carriers between latitudes of 34°N and 35°S. These fish do not look or taste spoiled and ordinary cooking does not destroy the heat-stable toxin. Ciguatera poisoning has been reported frequently on Midway and other islands of the Hawaiian archipelago. Last year ulua and other fish from Pokai Bay and the reef runway were implicated in a number of ciguatera poisoning cases. CTX manifests itself in humans with symptoms ranging from slight itching of the skin, to nausea, to paralysis and at times, death.

Expansion of the domestic fishery into the Northwestern Hawaiian Islands makes the possibility of ciguatera poisoning more likely to occur in the future so that the need for a quick test and pharmacological work for CTX is important to the economic success of commercial fishing in Hawaii.

METHODS

The methods tested were the RIA test, developed by this laboratory and the enzyme-linked test.

The kahala tested in these studies were caught by commercial fishermen and brought to the United Fishing Agency where the fish were sampled for CTX and subsequently sold to retail outlets the following day if test results were negative. Three parts of the fish were tested in duplicate. Radioactive counts per gram of tissue designated the toxicity level. Comparison of results from the two procedures and preparation of an enzyme-linked anti-ciguatoxin antibody was done.

RESULTS

Following initiation of the RIA testing of kahala for CTX, there have been no reported cases of ciguatera poisoning from commercially caught and tested kahala. Between April 17 and August 14, 1979, a total of 534 kahalas were tested and 18% were rejected for sale to the public. Differences between RIA and ELISA results were found even when the two tests were carried out under as similar conditions as possible. The ELISA method gave a larger number of positive tests for samples from abdominal muscle tissues while the RIA method gave a larger number of positive tests for samples from posterior muscle tissue.

DISCUSSION

Comparisons of results obtained by the RIA and ELISA methods indicate that further work is needed on the ELISA method. Three hypotheses explaining the discrepancies between RIA and ELISA results have been developed.

PROJECT CONTINUANCE

The National Marine Fisheries Service has observed that the gonads of commercially caught kahalas have been decreasing in size. It would be interesting to determine whether there is a relationship between the spawning habits of these fish and their levels of toxicity. Therefore, continuing studies are necessary for defining factors affecting the toxicity of fish.

A supporting test for both the RIA and ELISA methods will be a guinea pig test for CTX developed by Dr. Miyahara of the UH Department of Pharmocology. Extracts of negative, borderline and positive as determined by RIA and ELISA, are being tested by this pharmacological assay.

IV. MARINE EDUCATION AND TRAINING

STATEWIDE DIVING SAFETY PROGRAM
Task Order No. 147

PROGRESS REPORT

MAC INVESTMENT: $5,535 (FY 1978-79)

OTHER STATE SUPPORT
$16,441 (FY 1978-79)
DEPARTMENT OF HEALTH

OPERATING AGENCY: OFFICE OF THE MARINE AFFAIRS COORDINATOR

PRINCIPAL INVESTIGATOR: HOWARD G. PENNINGTON

OBJECTIVES

1) To reduce significantly the number of diving disorders requiring emergency recompression treatment.

2) To alleviate, as much as possible, the long-term ill effects suffered by those divers requiring emergency recompression treatment.

3) To minimize the future incidence of Dysbaric Osteonecrosis among Hawaii's scuba divers, with special emphasis on Neighbor Islands divers.

METHODS

There has been a major change in the methods employed. The original method was to hire a medical doctor with interests in diving who would serve as a "hyperbaric specialist" and would act as a liaison between the medical and medical research communities engaged in diving medicine and diving medicine research and the diving community. Support for the program was expected to also come from Sea Grant and the University of Hawaii, with MAC, Sea Grant and UH acting as three partners in establishing the program. A major setback was the failure, for whatever reason, of Sea Grant and the University of Hawaii, to join with MAC in establishing a statewide diving safety program. Another was the apparent lack of interest and incentive displayed by the person selected to be the "Hyperbaric Specialist," and his leaving the project well over a year ago. The current P.I. has devoted all time available for hyperbaric projects to attempting to establish a working recompression chamber in Kauai and Hawaii Counties. This was a deliberate decision based on the need for a chamber in those Counties. The Kona and Kauai recompression chambers (see report on Task Order No. 155 are now being administered by the Marine Affairs Coordinator at the request of the State Department of Health. MAC is developing a program to operate these chambers with volunteer staff.

In addition, MAC is providing support to the Department of Physiology, of the John A. Burns School of Medicine, for further development of the Department's hyperbaric research and treatment facility, located at Look Laboratory.

The State Department of Health last year provided the sum of $16,441, via RCUH, for the installation of the Kauai recompression chamber at Kauai Veterans Memorial Hospital. Funds from this project are being used to meet installation costs above that amount.

RESULTS

A new professional medical organization, the Hawaii Undersea Medical Association (HUMA), has been formed and is in the process of being incorporated as a non-profit professional group. Support in the amount of $500 has been given to the organization, which consists of medical doctors, all with either experience or interest in diving medicine, plus others involved with diving in a medical or professional capacity. HUMA will act in an advisory capacity to MAC in regard to achieving the objectives of this project.

The State Health Planning and Development Agency issued a Certificate of Need, to the Big Island Chamber Association, Incorporated (BICA), a volunteer, non-profit organization, for operation of the Kona chamber for hyperbaric treatment of diving disorders.

BICA members were trained and certified in chamber treatment of diving accidents by members of the School of Medicine. Travel and per diem costs for the training team were paid by this project. Their salaries were paid by the School of Medicine. Liability coverage was finally obtained, and the Kona chamber was opened.

The Kauai recompression chamber has been installed at Kauai Veterans Memorial Hospital, with some support from this project. A group of volunteers, known as the Kauai Underwater Association (KUA), has been formed to operate the chamber, under the administration of MAC, as is done by the BICA. A team from the School of Medicine is to provide a 10-day training course in chamber operation and treatment to KUA volunteers.

Funds for administration of these two chambers, plus some operating funds, are being, and will continue to be, provided under this project.

DISCUSSION

Recent activities have focused primarily on Objectives (2) and (3); activities aimed at reaching Objective (1) are, at present, being carried on by the Sea Grant Marine Advisory Program, with MAC support. Operational recompression chambers on the major Neighbor Islands are vital to Objectives (2) and (3). The Kona chamber is now operational; the Kauai chamber became operational in FY 1979-80.

SUMMARY/CONCLUSIONS

The establishment and operation of recompression chambers on the major Neighbor Islands provides an extremely important service to scuba divers in Hawaii, both residents and visitors. These chambers, when taken over by the Department of Health, will also be able to provide valuable (sometimes even life-saving) hyperbaric oxygen therapy to the general population.

MAC INTERNSHIP PROGRAM
Task Order No. 174

PROGRESS REPORT

MAC INVESTMENT: $10,000

MATCHING FUNDS
$113 (FY 1978-79)
SEA GRANT

OPERATING AGENCY: OFFICE OF THE MARINE AFFAIRS COORDINATOR

OTHER STATE SUPPORT
$300 (FY 1978-79)
UH/MOP

PRINCIPAL INVESTIGATOR: DR. JOHN P. CRAVEN

OBJECTIVES

To provide opportunities to undergraduate Marine Option Program (MOP) students at the University of Hawaii who wish to receive on-the-job training in the government field of marine affairs.

METHODS

MOP screens and recommends intern candidates to the MAC for this Program. After selection is made, MOP is responsible to fund the initial three-month training period for each new intern. Thereafter, those qualified and interested students who wish to continue in the program will be funded from this MAC Internship Program account. The MAC is responsible for the training and work supervision of the interns.

RESULTS/DISCUSSION

During the fiscal year (1978-79) the Marine Affairs Coordinator has had four interns participating in this Program. Two interns have graduated from the University since then and have found promising marine-related jobs in the private sector. The other two interns are newcomers and are learning the roles and responsibilities of the MAC Office through daily assignments, such as monitoring marine legislative bills and attending hearings during the 1979 Legislative Session, writing reports and correspondences, researching various marine topics, accompanying the MAC and his staff to project sites for project monitoring, and doing other various routine office tasks.

SUMMARY

Thus far, the benefits from this Program have been valuable for both students and the MAC Office. The students receive first-hand experience in working with the Legislature and learning the ropes of government and the roles different agencies play in marine affairs. For many of the students who have interned at the MAC Office, it has been their first experience working for and learning about Hawaii's State government. Hopefully, this Program expands the student's interests beyond the University's classroom learning and gives them the opportunity to meet people and take on new challenges directly related to marine affairs.

WAIKIKI AQUARIUM EDUCATION PROGRAM
Task Order No. 177

FINAL REPORT

MAC INVESTMENT: $20,000 (FY 1978-79)

OPERATING AGENCY: WAIKIKI AQUARIUM

PRINCIPAL INVESTIGATOR: DR. LEIGHTON TAYLOR

MATCHING FUNDS
FRIENDS of THE WAIKIKI AQUARIUM BOOKSHOP
VOLUNTARY ENTRANCE DONATIONS

OBJECTIVES

a. General Background and Description of Project -
This project was devoted to supporting the marine educational programs of the Waikiki Aquarium. General fund monies received by the Aquarium from the University of Hawaii are adequate only to insure day to day operation of the physical plant and to pay University salaries. These funds are not adequate for the operation of the multi-faceted educational programs. Hence emergency monies from MAC Office supported educational projects for the first half of the fiscal year 1978-79.

b. Major Program Goal -
To provide entertaining and educational experiences about the Hawaiian marine environment to residents and tourist-visitors through classes, workshops, publications, and live and static exhibits; to emphasize the value and uniqueness of Hawaiian acquatic resources; to encourage non-consumptive marine participatory activities by both residents and visitors; to interpret the ancient Hawaiian cultural importance of marine resources, and to interpret marine scientific discoveries (particularly in Hawaii) to the general public.

Major Program Objectives:

1. To maintain displays and exhibits of living aquatic organisms (principally of Hawaii) designed to reflect ecological relationships and biological principles.

2. To provide Hawaiian residents and visitors with an entertaining, educational, and comprehensive exposition of marine science (concentrating on University of Hawaii projects).

3. To provide a facility for University of Hawaii instructors to demonstrate living animals to classes.

4. To provide research opportunities for University of Hawaii scientists (including graduate students) and to provide them with filtered seawater and live organisms for study.

5. To provide marine educational curricula to the State's students and school teachers.

5. To increase the level of professionalism of the Aquarium staff from a maintenance level to standards worthy of a University facility and which are congruent with those of outstanding aquariums in other states.

7. To improve the appearance of the facility in order to increase attendance and hence entrance revenues.

c. Potential Benefits to the State -
It is vital that the general public (whether residents or visitors) be well-informed about marine affairs. This will be of benefit to the State of Hawaii in terms of the appreciation and wise use of marine resources. In addition, an awareness of the University of Hawaii's marine research activities will build public support for both federally and state funded research programs. In addition, the many tourists that visit Hawaii will gain a greater appreciation for Hawaii's marine environment.

METHODS

In order to meet the specified objectives, it was necessary to augument the staff of the Waikiki Aquarium by hiring an Aquarium Scientist, a part-time Administrative Assistant for the Director (please note that the University position count does not include any office support for the Aquarium Director), a Scientific Education Advisor, and some part-time Aquarium Apprentices. These additional staff members were responsible for the design of new exhibits, the hygiene, nutrition, and maintenance of rare animals not formerly displayed, the design of special education programs and classes. MAC monies also supported related expenses including publication of course materials, purchase of exhibit materials, and materials related to research on the maintenance of rarely-displayed animals which have been well received by the general public. A special need this year which MAC helped to support was the leasing of a vehicle for assistance in collection of marine animals.

RESULTS

During the period July 1, 1978 through December 31, 1978, (the first half of fiscal year 1978-79) the Aquarium's total attendance was 129,385 persons, of which 69,824 were adults and remainder were children under sixteen. A total of 4,006 children participated in the guided tour program (it should be noted that this number appears low because it includes two and one-half summer months when school children do not visit). Our general number of toured children exceeds 15,000 annually. Projections for the full fiscal year 1979 indicate that overall attendance will exceed 282,000 and touring children will approach 20,000. In addition, formal classes and lecture series have served over 3,000 people in fiscal year 1978-79 so far. Also, the neighbor island Docent program in Hilo, Hawaii is serving over 4,000 school children in that area.

FIELD AND INSTRUCTIONAL SUPPORT FOR AN UNDERGRADUATE AQUACULTURE CURRICULUM
Task Order No. 178

FINAL REPORT

MAC INVESTMENT: $9,170 (FY 1978-79)

MATCHING FUNDS
$13,296 (FY 1978-79)
SEA GRANT

OPERATING AGENCY: COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES (CTAHR)

PRINCIPAL INVESTIGATORS: DR. SHOSUKE GOTO and SUSAN MORITA

OBJECTIVES

The goal of the project is to prepare individuals for present and future requirements as skilled practitioners and professional specialists in aquaculture.

The objectives are (a) to develop a core curriculum in aquaculture which provides classroom instruction and field laboratory experience in aquaculture and related subjects; (b) to develop a "systemculture" relating production ponds with the utilization of run-off water by agricultural crops; and (c) to coordinate the core curriculum in aquaculture with courses from other university departments and with programs of the Department of Education and the Community College System.

The potential benefit to the state is the creation of a pool of technicians and skilled labor for production, and scientists and technicians for research and development. These will provide a strong base for an economically profitable aquaculture/agriculture infrastructure appropriate to Hawaii conditions.

METHODS

A student-training complex in aquaculture is being developed at the Pearl City Instructional Facility (PCIF), an agricultural practice area for undergraduates. The aquacultural curriculum plan, developed in 1977 by an ad hoc committee, envisioned (a) an introductory lecture course in aquaculture, (b) a field laboratory course in pond management and (c) an aquaculture seminar, from which areas needed for further course development could be identified.

The project was designed for one year, September 1, 1978 to June 30, 1979 with the expectation that by the fall of 1979, the CTAHR would have provided a position for a full-time instructor and operational support. Thus, in fall 1978 and spring 1979, three courses were offered.

Equipment used included water pumps and irrigation lines. Maintenance tools, truck use, land, water security and general upkeep were provided by the

PCIF. Prawn juveniles were obtained from the Anuenue Fisheries Research Center. Feed and fuel were purchased with MAC funds. Harvesting equipment was borrowed from private sources.

RESULTS

Student Enrollment in Curricular Offerings

In Fall 1978 and Spring 1979, the total enrollments in the three courses of the aquacultural curriculum were 63 and 74 respectively. The course enrollments are shown in Table 1.

Table 1
Enrollments in Aquacultural Courses

COURSE	FALL 1978	SPRING 1979
Agriculture 200-Introduction to Aquatic Agriculture	38	44
Agriculture 390-Pond Management	18	24
Agriculture 490-Problems in Aquacultural Production	7	6
TOTALS	63	74

DISCUSSION

The strong response to the three aquacultural courses is indicative of the wide interest in a new industry for Hawaii. Students see future job opportunities in both small-scale, full or part-time family activities and in large-scale corporate-type operations.

AGRICULTURE 290, AN INTRODUCTION TO AQUATIC AGRICULTURE presented the general principles of aquaculture and techniques of production. The fall and spring enrollments were 38 and 44 respectively. The course was highly regarded by the students, although perhaps the material covered too wide a range for a two credit course.

AGRICULTURE 390, POND MANAGEMENT

A .3 acre pond was developed at the Pearl City Instructional Facility in 1977-78 to provide an additional field experience for Ag. 201, Agriculture Practice. The fall and spring enrollments were 18 and 24 respectively. The primary effort was "hands-on" work at the PCIF pond. Through this experience the students realized that pond management involved much more than feeding and harvesting prawns. The maintenance and operation of pumps, machinery, water lines, ground maintenance, security, fencing, use of effluent water for agricultural production added to the experience. Moreover, pond management, like dairy and poultry operation, demanded continuous day-by-day dedication.

AGRICULTURE 490, PROBLEMS IN AQUACULTURE PRODUCTION

A seminar provided opportunities for students to relate to research and industry people. This series emphasized lectures by government and research specialists in the fall, but in the spring more time was given to students.

The aquaculture project has stimulated student participants to seek advanced experience in established state and private facilities. Others are considering entrepreneurial enterprises.

A curriculum pattern involving (1) introduction to aquatic agriculture, (2) field laboratory exercises in pond management and (3) individualized reading and research work, has been developed. It utilizes expertise from successful aqua-farmers and state agency experts.

PROBLEMS ENCOUNTERED

The uncertainty of support from the CTAHR created difficulties in advising students regarding the continuity of the aquacultural program.

SUMMARY/CONCLUSIONS

a) Although jobs are scarce in initial stages of local aquacultural development, the high potential suggests that a base of trained technicians and researchers be developed.
b) Aquacultural studies have a strong appeal to college students.
c) The high satisfaction with the three agricultural/aquacultural courses indicate that a base of expertise can be provided by an aquacultural curriculum.
d) Many of the supporting fields such as agricultural engineering, nutrition, marketing, disease prevention, breeding, biology, etc. can be provided by existing departments of the College of Tropical Agriculture and the College of Arts and Sciences.
e) The project accomplished its goals and objectives in showing that a core curriculum is feasible and desirable.

DEVELOPMENT OF A NEW COURSE IN UNDERWATER TECHNOLOGY
Task Order No. 179

PROGRESS REPORT

MAC INVESTMENT:	$5,551 (FY 1978-79)	MATCHING FUNDS $15,041 (FY 78-79) SEA GRANT
OPERATING AGENCY:	JKK LOOK LABORATORY OF OCEANOGRAPHIC ENGINEERING	
PRINCIPAL INVESTIGATOR:	DR. EDWARD K. NODA	

OBJECTIVES

To develop a three-credit graduate course in Ocean Engineering entitled, "Underwater Technology" beginning with the 1978 fall semester and continuing through the 1980 spring semester. Graduating ocean engineers at UH are well trained academically, but few receive actual experience in the ocean environment. This course will offer students the chance to work in the ocean thus acquainting the future ocean engineers with their working atmosphere and its specific problems. This preparation will contribute greatly to the increased use of Hawaii's major asset, the ocean.

METHODS

An initial evaluation of the project objectives, and the preparation and organization necessary for in-water experiments and demonstrations were done. After selection of an instructor and textbook, people from both the academic and commercial sectors were contacted to provide specialized equipments and/or guest lectures. Field demonstrations and experiments at various sites on Oahu were also arranged.

RESULTS/DISCUSSION

Both the development of the curriculum and the acquisition of equipment for use as teaching aids were successful. Spring 1979 was the first semester that offered OE 791, Special Topics in Ocean Engineering--"Underwater Technology" and five students completed the course. Classes consisted of approximately 50% lecture and 50% "on site" demonstrations.

MAC funds allocated for the project covered the necessary salary support for the development of the course and for some permanent underwater educational equipment. Shoreside facilities of the Look Laboratory of Ocean Engineering and Leeward Community College's resources were incorporated into the program to maximize use of the existing facilities and hardware. Support of this project has enabled the Department of Ocean Engineering to obtain the necessary equipment and expertise to provide students with a thorough understanding of the state-of-the-art of present underwater technology.

The course is now being modified somewhat, so that it can serve as basis for providing training in managing and using equipment for NULS-2. (This is NOAA's Undersea Laboratory System-2, for which Hawaii is, in late 1979, the leading contender in the nation.)

BLUE-WATER MARINE LABORATORY
Task Order No. 180

PROGRESS REPORT

MAC INVESTMENT:	$30,000 (FY 1978-79)	MATCHING FUNDS TUITION & LAB FEES $10,123 (FY 78-79)
OPERATING AGENCY:	BLUE-WATER MARINE LABORATORY UNIVERSITY OF HAWAII	
PRINCIPAL INVESTIGATOR:	JOHN J. McMAHON	OTHER STATE SUPPORT $26,750(FY 78-79) DOE

OBJECTIVES

The Blue-Water Marine Laboratory (BML) is an educational cruise program sponsored by the University of Hawaii, the Department of Education and the Office of the Marine Affairs Coordinator. The BML provides Hawaii's students with opportunities to go to sea on half-day educational cruises.

The BML runs half-day cruises from October through May each academic year for students in grades 7 through 12, and also accepts requests from college and community groups. Each four-hour cruise provides student with an opportunity to see, feel, smell, and touch the Hawaiian marine environment through hands-on activities aboard a sailing research vessel.

METHODS

The BML is a two-phase program designed to provide at-sea marine education activities to students throughout the state. The primary phase involves approximately 2,400 students annually in marine education cruises. The secondary phase of the BML involves up to forty students each summer in an intensive summer training program where they learn the fundamentals of oceanography, seamanship, first aid, and lifesaving. Approximately twenty and thirty of these students are selected as cruise instructors during the academic year. Student instructors receive DOE credit for the summer training program and for each semester they participate in BML.

RESULTS

The 1978-79 academic year was one of change for the BML. The usual research vessel--the R/V MACHIAS-- was not available that year and other adequate sailing vessels were also unavailable, so the BML chartered the University of Hawaii's R/V NOI'I in the fall semester and the privately owned R/V EL GRECO during the spring. Neither vessel offered the range of instructional opportunities the BML was accustomed to; however, the ships and their crew worked well with the BML to provide good educational cruises for Hawaii's students.

Fifteen high school students served as cruise instructors, and a total of 1,052 students participated in forty-six BML cruises during 1978-79. This was about half the previous yearly average of students and cruises, due to the difficulties in obtaining ships and the substantially higher daily ship charter rate.

MAC funds allotted were used for ship charter and for management fees. The BML funded, through DOE, a graduate assistantship in oceanography to upgrade BML's scientific capabilities. This was successful in helping obtain more precise data. The assistantship will not be continued because BML is now able to maintain the higher precision internally.

The 1979 Summer Training Program was upgraded and modified to more closely parallel cruise activities. The development of a more clearly defined Summer Training Program was a major advance for the BML. A five-day training cruise provided an opportunity for the students to apply their knowledge at sea.

Also during 1978-79, the BML was recognized by the DOE as one of the outstanding environmental education programs in the state. Upon recommendations by the DOE, a description of the BML will be included in the national Directory of Projects and Programs in Environmental Education for Elementary and Secondary Schools published through ERIC at Ohio State University. This honor is one more step in BML's maturing process.

DISCUSSION

A suitable sailing vessel--R/V DIAMARESA--has been identified and is working out well for Fall 1979 cruises. Increases in funding are necessary to obtain and retain professional staff and to keep up with steadily increasing charter fees.

MARINE TECHNOLOGY TRAINING PROGRAM SHIP SUPPORT
Task Order No. 181

FINAL REPORT

MAC INVESTMENT: $20,000 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: MARINE TECHNOLOGY TRAINING PROGRAM
LEEWARD COMMUNITY COLLEGE

PRINCIPAL INVESTIGATOR: HAL OLSEN

OBJECTIVES

An effective and practical education and training program in marine technology requires that students be given the opportunity to experience the actual conditions under which they may later be required to work. Theoretical, and some practical presentations can and are made in the classroom, but much of the subject matter in the basic courses can only be given aboard a vessel at sea. MAC funds allocated for this project shall cover ship charter of the NOI'I for the LCC Marine Technology Programs.

The Marine Technology Program at Leeward Community College is intended to provide job-entry level skills for its graduates in shipboard, ship support, and marine-related occupations such as diving, aquaculture, marine biology, oceanography, etc. The program's successful execution will provide the State of Hawaii with a group of people with training and experience in marine and marine-related occupations.

METHODS

The skills and techniques learned in the classroom are practiced in the practical sessions at sea so that further proficiency is achieved. Field trips to various industrial operations further expand the students' knowledge of marine occupations.

RESULTS

Graduates of the marine technology program have found employment in marine occupations such as professional diving, charter boat operation, vessel maintenance, marine sales and in the developing aquaculture industry. Reports from employers have been favorable concerning the level of knowledge and training brought to their jobs by program graduates.

DISCUSSION

Program goals are generally being achieved, with substantial development in commercial fisheries being anticipated. Increased emphasis is being placed on vessel maintenance, repair, and support.

There was no significant problem in ship support for the marine technology program this past year. NOI'I, used for at-sea practical training, was not ideal but was generally adequate for seamanship, navigation, and marine biology classes. It was not suitable for diving or fisheries training, however. Financial support for charter of an adequate fishery training vessel is needed.

SUMMARY/CONCLUSIONS

The project accomplished its goal of providing a realistic environmental at-sea setting for training of marine technology students. Its continuation is strongly requested until such time as funding from other sources is available for charter of training vessels.

HAWAII MARITIME MUSEUM AND EDUCATIONAL CENTER
Task Order No. 182

FINAL REPORT

MAC INVESTMENT:	$3,125 (FY 1978-79)	MATCHING FUNDS SEA GRANT PROGRAM IN-KIND SERVICES
OPERATING AGENCY:	THE ALOHA TOWER CENTER COMMITTEE	
PRINCIPAL INVESTIGATORS:	TOMMY HOLMES, JAMES KLEINSCHMIDT, DAVID LYMAN	

OBJECTIVES

To establish a Maritime Museum and Education Center at Aloha Tower which would serve to:

1) preserve and enrich Hawaii's maritime heritage
2) foster understanding of Hawaii's present maritime heritage
3) create an awareness of Hawaii's future with the sea.

The Center would serve as a focal point for public marine activities and fulfill the need for a place to provide information on ocean-related activities and career opportunities in the traditional areas as well as those which are developing in the State. The Center would house visual aids and educational materials, provide marine-related information, and protect artificats and historic records from being lost.

The Center would also be used for seminars, and interdisciplinary interaction between educators, business representatives, and the military, and for demonstration, discussion and display of ocean literature, music, and art from Hawaii's past and present.

METHODS/RESULTS

The Aloha Tower Center Committee was formed with members from academic, commercial and governmental sectors. It was incorporated as a non-profit organization and is working with the Marine Advisory Program (MAP) of the UH Sea Grant Program to establish the policies for the Aloha Tower Center (ATC).

The first priority of the ATC committee has been to establish a maritime museum since the majority of respondents from three separate surveys indicated the creation of a maritime museum at Aloha Tower as the highest priority. To reach this goal, sub-committees have been set up to handle acquisition of artifacts, exhibits, and financial support. An architect has been retained to provide preliminary sketches and plans for each floor of the ATC. The Pacific Fleet Memorial Submarine Association will prepare an exhibit for the 8th floor, in conjunction with the possible mooring of the submarine BOWFIN nearby. The ATC Committee anticipates that both the eighth and ninth floors of Aloha Tower will be fully utilized in the initial phase of the Maritime Museum.

Other ATC activities included an on-going series of marine-related lectures and seminars. The Propeller Club has started a small library as the nucleus for the resource center and contributions have been received from public and private sources.

The marine seminar of ATC has been utilized by other groups including: The Hawaii Undersea Medical Association, the Hawaii Ocean Law Association, the Law of the Sea Institute, the Micronesian Maritime Commission, and the Maritime Affairs Committee of the Honolulu Chamber of Commerce. The U.S. Coast Guard Auxiliary will begin an evening Boating Safety series and the Aquaculture Development Program will sponsor a luncheon lecture series for the downtown community in January, 1980.

MAC funds allocated for this project were used to cover office expenses, printing, supplies, architect fees, rental of Aloha Tower, and other miscellaneous costs such as legal fees, permits and expenses required to publicize, solicit funds, draw up Articles of Incorporation and establish the independent legal non-profit status of the Aloha Tower Center. The project will be continued under the Marine Advisory Program.

MARINE ADVISORY PROGRAM (MAP)
Task Order No. 184

PROGRESS REPORT

MAC INVESTMENT: $40,000 (FY 1978-79)

MATCHING FUNDS
$229,870 (FY 78-79)
SEA GRANT

OPERATING AGENCY: UH/SEA GRANT
MARINE ADVISORY PROGRAM

OTHER STATE SUPPORT
$11,029 (FY 78-79)
COUNTY OF HAWAII

PRINCIPAL INVESTIGATORS: DR. ALF PRATTE

OBJECTIVES

To identify and meet the marine informational needs of various sectors of the marine community, and to foster the communication of ideas, information, and problems between the centers of marine interest and the general public. The advisory service helps educate the public in marine affairs and the Sea Grant reserchers of the community's needs thus ensuring optimal and environmentally sound use of Hawaii's marine environment.

METHODS/RESULTS

MAP serves as the primary channel through which existing marine information, such as Sea Grant research and marine legislation can be passed on to the public. Approximately 2800 fishermen, 80,000 surfers, 20,000 divers, and 500 affiliated aquaculturists, as well as the general public, are target groups for MAP services.

Five marine advisors on four islands are retained to enhance and increase the public's knowledge of marine affairs which include commercial/recreational fisheries, boating and navigation, marine education, marine legislation, water recreation and the maritime museum.

Twenty-seven audio-visual shows ranging from Hawaiian Coastal Flora to careers in aquaculture, are available for community groups and teachers.

The *MAP NEWSLETTER* (recently retitled *MAKAI*), and the *COASTAL ZONE NEWS*, with circulations of 4,700 and 7,200 respectively, are available to the public along with pamphlets and charts (e.g. the Fish and Game fish regulation poster). Sea Grant Research Reports, and thirty MAP of Hawaii advisory publications.

A large number of the general public are reached by water safety newspaper columns, marine conservation radio spots, and marine exhibits at shopping centers and county fairs. Richardson's Ocean Center in Hilo introduces many students, visitors and citizens groups to marine biology and aquaculture.

MAC funds allocated for FY 1978-79 covered salaries, supplies, travel, hororaria, publication, film production, and management fees to implement various MAP projects. MAC-funded projects included:

1. Ika-shibi fishing workshop
2. Fishermen's business management workshops
3. Oral-fishing history videotape
4. Marine engine repair workshop
5. Outboard engine repair instructor workshop
6. Loran-C survey
7. Wood-hull maintenance videotape
8. Richardson Ocean Center support
9. Marine Environment Cruises
10. Seafood/limu workshop for low/middle income families
11. Hawaii Marine Science Studies training workshops
12. Marine Bills '79 information distribution
13. Water safety education film
14. Precious Corals film
15. Hawaii Maritime Museum and Education Center development

PROJECT CONTINUENCE

MAC, Sea Grant, and the County of Hawaii will continue support of MAP in FY 1979-80.

HIGH VISIBILITY UNDERSEA OBSERVATION STRUCTURE
Task Order No. 190

FINAL REPORT

MAC INVESTMENT:	$8,400 (FY 1978-79)	MATCHING FUNDS $6,375 (FY 78-79) SEA GRANT
OPERATING AGENCY:	DEPARTMENT OF MECHANICAL ENGINEERING UNIVERSITY OF HAWAII	
PRINCIPAL INVESTIGATOR:	DR. RONALD KNAPP	

OBJECTIVES

A primary objective of this project is to establish the technical and economic feasibility of constructing high visibility undersea structures which utilize a new structural concept and employ transparent acrylic plastic as the primary construction material and viewing surface. A secondary objective is to carry out additional small scale model tests and computer analyses for different geometric configurations. Practical design procedures must be determined for this concept if it is to be successfully utilized by industry.

A detailed design for a land-based ocean aquarium using a high visibility undersea structure was designed with Sea Grant funding in 1976.

The aquarium exhibit would consist of an in-ground reinforced concrete tank holding approximately 42,000 gallons of seawater with a 12-foot diameter transparent observatory centrally located within. The concept represents an inverted approach to the design of aquariums; that is, the observer is located inside the acryllic shell with the marine life exhibits on the outside, thus permitting longer and more realistic undersea observations.

The construction of the transparent observatory portion of the exhibit will provide valuable data which can be used to design offshore undersea observatories. In support of this concept, the 1974 Governor's Advisory Committee on Science and Technology, State of Hawaii, recommended that Hawaii's marine parks should include recreational undersea observatories.

METHODS

The objectives will be demonstrated by construction of a large scale model of an offshore facility; the model will be utilized as a marine aquarium exhibit. Forty identical acrylic plastic triangular elements will be bonded with a transparent acrylic adhesive and shop assembled into a pseudo-cylindrical shell which has been shown to exhibit markedly increased buckling resistance in comparison to circular cylinders. Each triangular element of the PC shell will be polished for high optical clarity and thermal annealed to reduce residual stress concentration. Once assembled, the model aquarium will be strain-gaged in locations of highest stress, and proof tested. Strain gage data will be compared with numerical analysis results. The structure will then be installed at the Waikiki Aquarium.

RESULTS/DISCUSSION

Construction of the transparent observation structure was completed in May 1979 and resulted in the manufacture of the first completely transparent marine aquarium. A practical method of assembling the acrylic triangles was developed. The greatest difficulty encountered during its construction was the joint bonding techniques. Voids in the bonded joints will be repaired before the structure is used as a Waikiki Aquarium exhibit. While the concept still promises to provide improved approaches to the design of cylindrical pressure hulls in the ocean, the current technology associated with bonding acrylic plastic needs additional research before it can be an economical procedure.

GOVERNOR'S MASTER PLAN FOR MARINE AND AQUATIC EDUCATION

Task Order No. 191

PROGRESS REPORT

MAC INVESTMENT: $24,000 (FY 1978-79)

MATCHING FUNDS: NONE

OPERATING AGENCY: MARINE AFFAIRS COORDINATOR'S OFFICE

PRINCIPAL INVESTIGATOR: DR. JOHN P. CRAVEN

OBJECTIVES

To produce a Marine Education Master Plan for the State of Hawaii.

METHODS

Extensive interviews, committee advice, and data collection.

Following the preparation of initial drafts, discussions were held with key departmental decision makers.

RESULTS

A number of preliminary documents have been produced and distributed for comment throughout the marine education community, including: data on coastal recreation, data on marine education programs, a compilation of legal and quasi-legal goals, objectives, and policies that apply to marine education, and several drafts of the Master Plan's goals, objectives, and recommendations. In addition, the current MAC budget has been adjusted to conform to the latest draft, and project proposals are now being reviewed for conformance with goals and objectives of the plan. The MAC 1980 Supplemental Budget Request is based in part on the needs as outlined by the Plan, and the MAC 1980 regular Budget has been adjusted to conform to the goals of the Plan.

Day to day operations of the MAC Office with respect to marine education coordination have been adjusted to conform to the goals of the new Plan.

DISCUSSION

Discussions and data collection for the Plan have resulted in a greater awareness of marine education efforts, both among decision makers and within the marine education community itself.

The goals and objectives in the Plan are already under consideration, and in some cases are being implemented, by state programs and agencies.

Since the Plan straddles the biennium budgetary process, it is not easy to incorporate immediate needs into departmental priorities. Thus, the need to request a supplemental budget for 1980.

The project is scheduled to be completed at the end of 1979, and is on schedule.

SUMMARY/CONCLUSIONS

The final implementation of this Plan will depend on the 1980 Legislative financial support, and subsequent departmental acceptance and support for on-going programs.

MARINE EXPERIMENTAL EDUCATION: PILOT PROJECT AT KING INTERMEDIATE SCHOOL

Task Order No. 192

PROGRESS REPORT

MAC INVESTMENT:	$3,518 (FY 1978-79)	MATCHING FUNDS $10,000 (FY 78-79) PRIVATE FOUNDATIONS
OPERATING AGENCY:	SEA TREK HAWAII	
PRINCIPAL INVESTIGATOR:	DOUGLAS PENDLETON	

OBJECTIVES

The Sea Trek Hawaii pilot project at King Intermediate School is designed to use marine experimental education to create positive learning experiences for students, and to test a new Department of Education (DOE) curriculum design in environmental education. This is the first time students have participated in a DOE program which provides the opportunity to explore Kaneohe Bay's cultural history and to experience its many unique natural features.

The project meets the following objectives:

1. It is a motivational as well as educational experience.
2. It relates to the students' everyday lives since they reside on the Windward side.
3. It is presented as a community effort supporting an important need in the public schools.
4. It is designed to be continued in the future and for other schools on the Windward side, Oahu, and throughout the state.
5. It supplements classroom studies.
6. It has potential for teacher-training in basic marine studies.
7. It relates to the humanities and social sciences, as well as the natural sciences.

METHODS

The first semester of the pilot project provided 1/2-day marine experience at Kaneohe Bay for students of King Intermediate School. After orientation and introduction to the facilities at Heeia State Park, students spent four hours on two different boats learning about ecology, history, Hawaiiana, environmental appreciation, water safety, and the importance of teamwork and discipline, an important sociological need at King Intermediate School.

RESULTS

Between February 1 and May 31, 1979, fifty-eight trips were conducted. A total of 725 people participated in an average group size of 12.5 people per trip as follows:

1. 671 Intermediate 7th, 8th, and 9th grade boys and girls
2. Six parents of students and interested community residents
3. 28 King Intermediate School teachers
4. Three Windward District Principals
5. One Windward District Superintendent
6. Three state DOE and Marine Affairs administrators
7. One legislator
8. 12 assorted guests (TV crews, observers from other programs, etc.)

DISCUSSION

Sea Trek Hawaii and the DOE are extremely pleased with all aspects of the program thus far. Though still in the early stages of expansion, there is every indication that the Sea Trek/DOE program:

1. has the potential to serve all 7th graders in the state
2. will be programmatically and financially "institutionalized" by the DOE in the next few years.

A COMPARISON OF SURVEY METHODOLOGIES APPLICABLE TO MARINE RESOURCE ASSESSMENT STUDIES

Task Order No. 195

PROGRESS REPORT

MAC INVESTMENT:	$6,300 (FY 1978-79)	MATCHING FUNDS NONE
OPERATING AGENCY:	MARINE PROGRAMS, UNIVERSITY OF HAWAII	
PRINCIPAL INVESTIGATORS:	LAURIE SANDERSON & JOHN J. McMAHON	

OBJECTIVES

To consider the impact of various demands on marine resources requires a knowledge of baseline conditions in the nearshore environment. Coastal zone management decisions made by government agencies are based in part on marine resource assessments, including censuses of fish, algae, and coral populations. Numerous survey techniques have been described; comparisons between these techniques are lacking and information on the relative selectivity or bias of the methods is not available. To assure a sound data base, comparative studies of various survey methodologies were made. This project compared two frequently employed survey methods: the transect and rapid visual techniques, described by Brock and Jones-and-Thompson, respectively. Replicability, number of species recorded, minimal number of surveys required to adequately represent the specific community under study, and degree of correlation between the data obtained using the two methods were compared in coral, boulder, and flat pavement habitats. This project also examined the social and legal constrainsts affecting the use of various methods.

Since the island of Molokai is in the early stages of urban development and the rural lifestyle of the residents traditionally involves a close cultural communion with the ocean, including partial food subsistence, the residents have voiced concern regarding the increasing uses of Molokai's marine resources. They were concerned with increased commercial and local fishing, establishment of management and conservation districts, and erosion resulting from shoreline development and agriculture. In 1977, Fred D. Bicoy, Coordinator of the Molokai Community Action Council, in conjunction with other Molokai community leaders, compiled a list of high priority areas which guided the selection of the survey sites.

Therefore, replicates of the two survey methods performed at five such sites--Palaau, Moanui, Halawa Bay, Keawanoi, and Ilio Point--not only permit a comparison of the two methods, but fulfilled a need for quantitative assessments of the fish, algae, and coral populations at the sites.

METHODS

Throughout the month of June 1979, data were collected by four pairs of observers using the Brock and the Jones-and-Thompson methods on four transect

lines at Hanauma Bay, Oahu. Baseline data on fish, algae, and coral populations at the five Molokai sites were acquired from July 1 through July 18, 1979. The charter of the R/V MACHIAS permitted the study of sites which were difficult to survey with a shore-based operation due to rough sea conditions and/or limited overland access.

RESULTS

The data, including 200 Molokai fish surveys, 320 Hanauma fish surveys and 35 algae and coral surveys, were entered into and are being analyzed by an HP 2000 computer. The data will be permanently stored in the Hawaii Coastal Zone Data Bank where they will be available to interested persons. State Division of Fish and Game personnel are presently determining the dominant fish species at each of the five Molokai sites.

Preliminary results suggest that approximately the same number of species are recorded using the two methods and that the same number of surveys of each method are required to adequately represent the specific community under study. However, surveys conducted using the Brock method are significantly more replicable than those conducted using the Jones-and-Thompson method. Correlation coefficients were calculated between the Brock, and Jones-and-Thompson surveys and added to the data.

DISCUSSION

Since September 1978, we have been in communication with Molokai community leaders, the Division of Fish and Game, the State Marine Affairs Coordinator. the National Science Foundation, and researchers at the University of Hawaii, the Naval Ocean Systems Center, and the National Marine Fisheries Service. We integrated the various concerns and developed an experimental design which provided information relevant to social as well as scientific concerns.

SUMMARY/CONCLUSIONS

Replicates of two frequently used survey methods performed at five high priority sites on Molokai not only provided data for a comparison of the methods, but met a need for quantitative assessments of the fish, algae, and coral populations at the sites. The acquisition of such baseline information will assist political and community leaders in their response to resident concerns. The comparison of survey methodologies augmented the collection of data representative of the sites and provided relevant information to researchers involved in survey work elsewhere. Data analysis is nearing completion. We expect to submit the final report to the Marine Affairs Coordinator by December, 1979.

MINI-MAKAHIKI KAI
Task Order No. 197

FINAL REPORT

MAC INVESTMENT:	$3,150 (FY 1978-79)	MATCHING FUNDS $2,530 (FY 78-79) SEA GRANT
OPERATING AGENCY:	SEA GRANT PROGRAM	
PRINCIPAL INVESTIGATOR:	ROSE PFUND	

OBJECTIVES

The goals of Mini-Makahiki Kai were to promote a better understanding and knowledge of the marine environment by providing an opportunity for the residents and visitors of Hawaii to see marine heritage in a cultural and historical perspective thereby promoting the spirit of "malama"-care and conservation for the ocean environment. The exhibits and aquaria were displayed in Ala Moana Shopping Center for the education and enjoyment of children and adults.

METHODS

Held at the Ala Moana Shopping Center lanai exhibit area on July 3-8, 1979, Mini-Makahiki Kai was a mini version of the Makahiki Kai - festival of the sea - held five times throughout the islands between 1973 and 1978. The 1979 Mini-Makahiki Kai used 1977 and 1978 displays and aquaria with Hawaiian fish and invertebrates; they contained three themes: the "ocean's places," marine mammals, and whaling of the 1800's. MAC funds allocated for this project were used for the pick up, delivery and return of display boards from storage at Kaimuki Intermediate School to Ala Moana Center, the set up of aquaria, acquisition of specimens, touch up of displays, and the use of security guards for six show days.

RESULTS/DISCUSSION

A conservative estimate is that there were 50,000 adults and children--residents and visitors--who streamed through the exhibits which were set up at the Lanai stage area. Many asked for future exhibit dates and expressed their appreciation for the exhibit. The rapt interest of children, as well as the numerous adults, was shown as they went from one display board to another carefully reading the text. The Ala Moana Shopping center employee who coordinates exhibits indicated that it was one of the most successful exhibits held at the center and that they received many calls from the public in appreciation of the exhibit. Therefore, if public reception is an index of success, Makahiki Kai '79 was indeed a success.

V. MARINE FACILITIES SUPPORT

REFURBISHMENT OF HYPERBARIC FACILITIES
Task Order No. 155

PROGRESS REPORT

MAC INVESTMENT: $15,000 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: OFFICE OF THE MARINE AFFAIRS COORDINATOR

PRINCIPAL INVESTIGATOR: HOWARD G. PENNINGTON

OBJECTIVES

To ready three multi-lock, multi-person recompression chambers for use in treating victims of diving disorders (decompression sickness, air embolism). One chamber is to be used on Oahu, one on Kauai, and one on Hawaii (Kona area).

METHODS

By completely refurbishing two recompression chambers purchased by MAC under Task Order #119 (FY 1976-77), plus a recompression chamber given to the University of Hawaii by the Federal government, and made into a mobile chamber (mounted on trailer with equipment) by MAC T.O. #130 (FY 1976-77). This includes providing working air compressors and certified air storage tanks for each chamber; it does not include the costs of actually installing the "non-mobile" chambers purchased by MAC.

RESULTS

All refurbishment work is complete. MAC traded one of the non-mobile chambers to the University for the mobile chamber; this later was shipped to the Kona area some months ago (transportation was not paid by MAC) and became an operating unit within four months. The Kauai chamber has been installed at Kauai Veterans Memorial Hospital with Department of Health and MAC (Task Order #147) funds.

DISCUSSION

Costs of installing the Kauai chamber were met primarily by $16,441 from the Department of Health; the balance came from MAC Task Order #147. Costs of installing the Oahu chamber will come primarily from Task Order #147 and the chamber is in the process of being installed and made ready for operation at Look Laboratory for the John A. Burns School of Medicine, University of Hawaii.

AEGIR FACILITY SUPPORT
Task Order No. 186

FINAL REPORT

MAC INVESTMENT: $6,050 (FY 1978-79) MATCHING FUNDS NONE

OPERATING AGENCY: MARINE AFFAIRS COORDINATOR'S OFFICE

PRINCIPAL INVESTIGATOR: DR. JOHN P. CRAVEN

OBJECTIVES

The undersea habitat AEGIR was given to the University of Hawaii; it has an estimated replacement value of $3,600,000. Objective of this Project Task Order is to provide at least the minimum necessary maintenance until major projects and financial support for the habitat can be obtained.

METHODS

To provide funds for necessary minimum maintenance. Also help support proposals to secure funding for AEGIR.

RESULTS/DISCUSSION

Communications support equipment for AEGIR, employed on the Hana Kai II dive (see report on T.O. No.6 in MAC 3rd Annual Report) were purchased, for future use with AEGIR, using funds from this project.

The Office of Manned Undersea Science and Technology (MUST) of the National Oceanic and Atmospheric Administration (NOAA) conducted a two-stage "competition" among institutions interested in providing what MUST called NULS-2, for National Underwater Laboratory System-2. (NULS-1 is a small habitat in the Virgin Islands.) Hawaii was declared to have the winning proposal (prepared with the aid of this Task Order) for its plans to utilize AEGIR and the STAR II submersible.

KEWALO BASIN MARINE STORAGE FACILITY
Task Order No. 194

FINAL REPORT

MAC INVESTMENT: $3,677 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: HAWAII INSTITUTE OF GEOPHYSICS

PRINCIPAL INVESTIGATOR: DR. MARTIN VITOUSEK

OBJECTIVES

The rental of Kewalo Basin temporary storage area/marshalling yard for the marine facilities and equipment of the Pacific Equatorial Research Laboratory (PERL) and the Joint Institute of Marine and Atmospheric Research (JIMAR).

METHODS/RESULTS

The MAC funds allocated for this project covered the rental and water charges of the Kewalo Basin area used by the above mentioned programs for 17 months. The Kewalo Facility is in constant use and now serves as a support base for the University of Hawaii's aircraft also.

DISCUSSION

PERL and JIMAR will continue to rent the Kewalo Basin site from the Department of Transportation until Phase II of the University Marine Center at Snug Harbor is completed and activities transferred to the new Center.

POLISHER/GRINDER SYSTEM FOR MICROPROBE
Task Order No. 196

FINAL REPORT

MAC INVESTMENT: $1,446 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: DEPARTMENT OF OCEANOGRAPHY
UNIVERSITY OF HAWAII

PRINCIPAL INVESTIGATOR: DR. JAMES E. ANDREWS

OBJECTIVES

A National Science Foundation (NSF) grant was awarded to investigators at the Hawaii Institute of Geophysics (HIG) at the University of Hawaii for the purchase of a Cameca microprobe to serve as a focus for an instrumental analysis facility. The marine facility will give new emphasis to marine sedimentary and petrologic studies and is an important expansion of UH's capabilities in marine geology, marine geochemistry, and petrology. The NSF grant, however, did not cover one equipment item, a polisher/grinder which is critical for preparation of probe mounts. MAC funds were used to purchase a polisher/grinder, thus assisting the establishment of this important microprobe facility. It is the only microprobe in the State of Hawaii and it is anticipated that it will be used a great deal by investigators at HIG.

METHODS

A polisher/grinder system was purchasd from Buehler, Limited and installed in the thin-section laboratory in HIG.

RESULTS/DISCUSSION

Users of the polisher/grinder system are investigators from Oceanography and Geology-Geophysics departments, HIG, and their students. It is a primary tool in the preparation of polished sections for microprobe studies and of thin-sections for petrographic work.

VI. MARINE CONFERENCES

WORLD MARICULTURE SOCIETY CONFERENCE
Task Order No. 148

FINAL REPORT

MAC INVESTMENT: $10,450 (FY 1978-79)

MATCHING FUNDS
NONE

OPERATING AGENCY: OCEANIC INSTITUTE
Waimanalo, Oahu

PRINCIPAL INVESTIGATOR: DR. COLIN E. NASH

OBJECTIVES

To assist with the planning of the World Mariculture Society's annual meeting in Honolulu, Hawaii from January 22 to 26, 1979 with the belief that the local aquaculture community would benefit from the State's involvement in the functions and activities of this meeting.

METHODS

Through the appointed arrangements-chairman (the principal investigator) and the ad hoc committees supporting him, hire an island ground handling agent, reserve conference and accommodation space, develop program agenda, invite island leaders and keynote speakers, distribute correspondence, advertise generally and in technical journals, arrange Trade Show, etc.

RESULTS

A successful Conference and Trade Show was held at the Hilton Hawaiian Village from January 22-26, 1979. A record 500 members of the Society registered and attended the conference. In addition to the high attendance, the conference was noteworthy for the attendance by many international aquaculturists.

The conference was opened by the Governor of the State of Hawaii, George Ariyoshi. The keynote speaker for the conference was Dr. John Bardach of the Resource Systems Institute of the East-West Center. A record 150 papers were presented to the conference, and were divided into papers for technical sessions and papers for a poster session. A separate Trade Show was attended by over 30 exhibitors. The participants to the conference were also treated to three tours in the islands, visiting aquaculture centers and research institutes. The funds provided by the State of Hawaii were used particularly for the expenses of overseas visitors who were invited to give

technical papers or to take part in the special sessions on international aquaculture activities. Seven international experts received some support for attending the meetings. The funds were also used for hiring ground coordinators. During the final two months of the project, a coordinator was appointed full time, and during the conference itself, four assistants were appointed together with a photographer and a slide projectionist.

INTERNATIONAL GUESTS

Dr. Liao I. Chiu, TFRI, Taiwan
Dr. Chen Foo Yan, SEAFDEC, Singapore
Dr. Herminio Rabanal, UNDP, Philippines
Dr. Michel Girin, CNEXO, France
Dr. F. Apud, SEAFDEC, Philippines
Dr. Martin Bilio, Italy
Dr. Jesus Juario, SEAFDEC, Philippines

PUBLICATIONS

The Proceedings of the Conference will be published by the World Mariculture Society as the tenth volume in the series.

LAW OF THE SEA INSTITUTE
Task Order No. 185

FINAL REPORT

MAC INVESTMENT: $5000 (FY 1978-79)

OPERATING AGENCY: LAW OF THE SEA INSTITUTE

PRINCIPAL INVESTIGATOR: SCOTT ALLEN

MATCHING FUNDS
$24,155 (FY 1978-79)
SEA GRANT
$19,500 (FY 1978-79)
PRIVATE CORPORATIONS
AND FOUNDATIONS

OTHER STATE SUPPORT
$24,150 (FY 1978-79)
UNIVERSITY OF HAWAII

OBJECTIVES

To provide a neutral forum for the discussion of issues pertaining to the uses of the sea and its resources. Some of these issues include international management of fisheries, pollution-control activities, offshore exploration for oil and gas, the jurisdictional problems of archipelagos, transportation issues, and control of harvesting of such sea-based resources as manganese nodules. Through its conferences, workshops and publications, the Law of the Sea Institute (LSI) disseminates information about decisions, institutions, and arrangements. It encourages communication and research among those concerned with all aspects of the exploration and exploitation of the oceans.

METHODS

The principle emphasis is on the international law of the sea as it exists now and as it may be expected to evolve in the future. As the home office of the Institute, Hawaii will host international conferences every other year and in alternate years, the conference will go to another location. MAC funds are used to further the participation of individuals from the State of Hawaii in these conferences and thus support the Institute in its endeavors.

RESULTS

The year 1978 marked the 12th Annual Conference and the first to be held outside of the United States.

Since matters of rapid change and/or national sensitivity have been neglected, the Board chose to discuss them at The Hague in the Netherlands in 1978; the theme for the conference was *"Neglected Issues of the Law of the Sea."* Policies which were heretofore implicit and unannounced were laid open in meetings for evaluation and judgment which national policy makers may find informative and helpful. At the same time, those who would be affected by these issues had the opportunity to examine them thoroughly.

LSI exchanged views regarding the need for a workshop on deep seabed issues with the many legitimately concerned persons and organizations. It was concluded that it would be appropriate to hold a workshop on the alternatives which confront the industry and policy makers, so in December 1978, the Institute held a workshop on *"Alternatives in Deepsea Mining"* in Ka'u, Hawaii. Joined in this project by the Hawaii Ocean Law Association, the Aspen Institute, and the Oceanic Society, the Institute's workshop (attended by leaders of the United Nations Law of the Sea Conference such as Elliot Richardson, Paul Engo, Alan Beesley, Christopher Pinto, and by industry leaders) provided a small duplicate of the more formal Geneva forum. The workshop raised the basic issues of the North and South, the international economic order, and the use of an international public economic enterprise under United Nations' sponsorship as a custodian of ocean resources. The workshop served to inform the public as to the status of the negotiations, and it introduced representatives from the State and County of Hawaii to some of the principal diplomatic and commercial factors in the industry.

The conference and workshop proceedings were published as a permanent addition to the knowledge of the law, politics, and technology of the oceans. The outcome of both of these conferences have significance to the State of Hawaii in terms of 200-mile economic zone, the status of islands and archipelagos, and the ability to develop a manganese nodule processing industry. The precedents that are established in the Law of the Sea Conferences concerning deepsea mining of manganese nodules will apply in the future as well, when other uses of the deep seabed are contemplated.

MAC funds allocated were used to assist the Law of the Sea Institute in preparation of the 1978 12th Annual Conference of the Law of the Sea Institute and the Ka'u workshop, and covered travel, communications, printing, and management fees.

SUMMARY/CONCLUSIONS

The rapid growth in the stature of the Law of the Sea Institute over the past fourteen years is indicative of the primacy of issues of ocean law and development of ocean resources in the modern world. Rapid change in the ocean regime has been the lot since 1945 and will continue beyond current ability to predict. Therefore a Hawaii-based Institute has a unique capability to inform business and government of important developments as they appear, and to involve Hawaii in the ongoing development of law and the utilization of ocean resources.

PROJECT CONTINUANCE

The Institute will continue its activities and will seek balanced funding from federal, state, and private sources.

CAPITAL IMPROVEMENT PROJECTS

3-INCH PIPELINE AT THE NATURAL ENERGY LABORATORY OF HAWAII
Capitol Improvement Project Task Order No. 1

PROGRESS REPORT

MAC INVESTMENT: $35,700 (FY 1978-79)

MATCHING FUNDS: NONE

OPERATING AGENCY: THE NATURAL ENERGY LABORATORY OF HAWAII

PRINCIPAL INVESTIGATOR: HENRY J. WHITE

OBJECTIVES

To install a 3" flexible pipeline from the offshore biofouling/corrosion buoy to an onshore site and compare the results of identical biofouling experiments at each location. This will permit the state to conduct biofouling and corrosion experiments on shore with a high degree of confidence that the results are representative of true oceanic conditions.

The installation of this pipeline is a sub-project of an ongoing project studying the biofouling effects on heat transfer devices in OTEC projects.

METHODS

Deploy this apparatus (now 3/4 complete and all components have been purchased) so experiments can commence simultaneously on shore and on the buoy. A 3" polyethelene hose descends from the moored offshore buoy to the bottom of the ocean and follows the power cable to shore. At the shore line, the 3" pipeline is taken to a data acquisition shack by means of a traverse system.

RESULTS/DISCUSSION

The difficult offshore deployment of the 3" pipeline to the submerged buoy and its attachment cable was accomplished by Professional Divers of Hawaii. Mounting holes on the submerged offshore pumping station have been drilled and confirmation of their geometric accuracy has been made. Pumps have been modified and cables made up to power the submerged pumping station. The onshore traverse system was designed, constructed, and fabricated by Incom, Incorporated and it remains only to connect a short 200' length of hose from the transistion zone (at the ocean side of the traverse system) to the pumping station for completion of the piping system. In addition, the test apparatus and the data acquisition system used on the test apparatus have been completed.

SUMMARY/CONCLUSIONS

1) There are no conclusions from the research at this time.

2) Project completion is estimated to be on or about January 15, 1980; however, operational phase of the project will continue through July-August 1980 and any remaining funds may be required for maintenance and revisions of the 3" pipeline at least through that date.

3) It should be noted that this project is primarily for the installation of a facility and not experimental operations associated therewith. The operational phase of the project is being funded under an Argonne National Laboratory grant in association with the current biofouling and corrosion project at Keahole Point.

PHASE I OF AQUACULTURE COMPONENT AT THE NATURAL ENERGY LABORATORY OF HAWAII
Capitol Improvement Project Task Order No. 2

PROGRESS REPORT

MAC INVESTMENT:	$115,000	MATCHING FUNDS NONE
OPERATING AGENCIES:	OFFICE OF THE MARINE AFFAIRS COORDINATOR RESEARCH CORPORATION OF THE UNIVERSITY OF HAWAII	
PRINCIPAL INVESTIGATORS:	DR. JOHN P. CRAVEN WILLIAM R. COOPS	

OBJECTIVES

To provide administration, planning and design of a facility suitable for using the deep, nutrient-rich water from OTEC and readily available warm surface waters from the Seacoast Test Facility (STF) at Ke'ahole Point for aquaculture research, thus developing the potential and economic values of cultivating ocean plants and animals. By maintaining a close working relationship with NELH, DPED, and other agencies connected with alternate energy development, this Aquaculture Component will make NELH a more complete and useful facility to carry out ocean-energy research and development projects, thereby attracting more major projects and funds to bolster the State's economy. The Aquaculture Component will also fill the State's critical need for outdoor aquaculture research and demonstration facilities.

Extensive preliminary planning and design will be done so that a fully utilitarian facility can be developed.

METHODS

The C.I.P. funds allocated for this project shall cover the Phase I of the Aquaculture Component at NELH. This includes:

a) PROGRAM PLANNING: develop the types of ocean plants and animal life which would be susceptible to economic development utilizing the deep nutrient rich and warm surface ocean waters; provide planning as to types of tanks, troughs, ponds, etc; utilize the services of eminently qualified agencies such as the University of Hawaii Center for Engineering Research, Hawaii Institute of Marine Biology, Oceanic Institute, Department of Planning and Ecnomic Development, etc;

b) PRELIMINARY DESIGNS: based on planning results, develop actual preliminary site development plans and preliminary construction drawings, specifications and cost estimates;

c) PROGRAM ADMINISTRATION: provide efficient administration and management of the many different agencies involved in the planning and design of the Aquaculture Component.

RESULTS

A "Planning Study for Aquaculture Research and Facilities Development at Ke'ahole Point" was developed by researchers at Oceanic Institute. The 41 page report presents summaries of the results obtained so far. These include:

a) A survey of research opportunities and interests which are perceived to exist within the aquaculture community for exploitation of OTEC byproducts. This survey was accomplished through a literature search, a questionnaire and/or interviews with researchers, government officials and interested persons in the private sector.

b) A brief analysis of trends in OTEC development, with comments on the significance of these trends for future economic prospects for OTEC-related aquaculture in Hawaii.

c) Identification of the basic elements of a working OTEC aquaculture station, with several options for obtaining such a facility. Order of magnitude figures are presented for each option.

d) A budget proposal for OTEC aquaculture developments, developed from a review of the progress report.

DISCUSSION/PROJECT CONTINUENCE

Phase I of the aquaculture component at NELH is on schedule for completion by the end of FY 1980-81. Existing funds are being used to support construction plans for augumentation of the STF system, a floating laboratory, and onshore aquaculture facilities, as well as existing related research efforts. The effect of these decisions is to maintain momentum and to avoid lost time, while hedging against uncertainties in the timing of federal STF funding.

TABLE IV. SUMMARY OF MAC FUNDED PROJECTS, YEARS 1970-1979

(By Categories)

CATEGORY I. MARINE RESOURCES INVENTORY AND ASSESSMENT

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Precious Coral Survey	01	01/71 - 06/71	$ 45,000	$62,276 Makai Range in-kind $177,826 NSF	$285,102
Marine Atlas	10	09/71 - 06/75	70,000	-0-	70,000
Precious Coral Survey	32	06/73 - 06/74	30,000	In ship time and support	30,000
Continued Work on Atlas of Marine Resources	39	12/73 - 09/75	5,000	-0-	5,000
Continuation of Marine Atlas Fish Data Computerization	46	07/74 - 12/75	5,000	-0-	5,000
Exploratory Dives for Precious Coral	59	11/74 - 06/77	30,000	In ship time and support	30,000
Bibliography for Ocean Science Information Center	66	04/75 - 06/75	5,000	$3,795 Sea Grant	8,795
Hawaii Coastal Zone Data Bank	90	07/75 - 06/76	12,000	$8,000 Hawaiian Electric $10,000 MEMO/NUC	30,000
Molokini Island-Papohaku Beach Baseline Study	110	07/76 - 06/77	10,000	$3,000 Maui Land & Pineapple	13,000
Hawaii Coastal Zone Data Bank	122	09/76 - 06/77	20,000	$24,000 NUC 5,000 Hawaiian Electric 2,000 EPA	51,000
Leeward Archipelago Resource Study	128	11/76 - 06/78	23,500	$320,500 NMFS 59,500 Fish and Wildlife Service	403,500

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Precious Coral Management	134	01/77 - 06/77	$ 1,050	-0-	$ 1,050
Stoney Coral Resource Study	138	06/77 - 02/78	9,854	-0-	9,854
Preparation of the Leeward Archipelago Proposal	153	11/77 - 01/78	1,260	-0-	1,260
Coastal Zone Data Bank	157	02/78 - 12/78	25,000	-0-	25,000
1978 Baseline Study of Papohaku Beach	167	02/78 - 06/78	1,634	1,784 Sea Grant	3,418
Studies of Skipjack and Other Fish Species by Nuclear Lens Protein Analysis	170	04/78 - 11/78	4,000	-0-	4,000
Marine Resource Planning Project	172	05/78 - 06/78	1,500	-0-	1,500
TOTALS			$299,798	$677,681	$ 977,479

CATEGORY I. MARINE RESOURCES INVENTORY AND ASSESSMENT FY (1978-1979)

TITLE	T.O. NO.	DURATION	FUNDING			
			MAC	MATCHING	TOTAL	Pg.
Manganese Nodules	149	8/78 - 6/79	$ 18,000	-0-	$ 18,000	20
Hawaii Coastal Zone Data Bank	157	12/78 - 6/80	15,000	-0-	15,000	21

TITLE	T.O. NO.	DURATION	FUNDING			
			MAC	MATCHING	TOTAL	Pg.
North Western Hawaiian Islands Fisheries Investigations	173	9/78 - 6/80	103,621	$20,000 State Dept. of Fish & Game. $80,000 U.H. $194,366 Sea Grant. $580,000 NMFS. $75,000 Fish and Wildlife Service $10,000 U. of Washington	1,062,987	24
Sand Sampling Analysis	183	11/78 - 7/79	1,544	-0-	1,544	34
Phytoplankton Monitoring at Ke'ahole Point	188	10/78 - 6/80	32,000	$238,000 Dept. of Energy	270,000	36
Sub Total			$170,165	$1,197,366	$ 1,367,531	
Running Total			$469,963	$1,875,047	$ 2,345,010	

CATEGORY II. MARINE RESOURCES PRESERVATION, CONSERVATION, AND RESTORATION

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Marine Park Design	02	01/71 - 06/71	$ 25,000	-0-	$ 25,000
Marine Park Design	08	07/71 - 06/76	25,000	$220,000 Sea Grant	245,000
Micromollusks Project	83	08/75 - 06/76	5,000	$5,000 U.S. Army Corp of Engineers	10,000
Kauai Coastal Zone Resource Survey	89	07/75 - 06/76	10,000	$3,250 Sea Grant $2,334 National Coastal Zone Act 1975	15,584
EPA/HIMB Kaneohe Bay Sewage Relaxation Study	99	12/75 - 06/76	14,500	$167,000 EPA	181,500
Green Sea Turtle Management Study	113	07/76 - 09/77	4,236	-0-	4,236
EPA/HIMB Kaneohe Bay Sewage Relaxation Study	111	07/76 - 06/77	30,000	$184,000 EPA	214,000
Green Sea Turtle Management Study	118	09/76 - 06/78	18,362	-0-	18,362
Microbiological Indicators for Ascertaining Fecal Contamination	142	09/77 - 08/78	10,000	$19,270 Sea Grant	29,270
EPA/HIMB Kaneohe Bay Sewage Relaxation Study	145	07/77 - 06/78	32,000	$206,000 EPA	238,000
Green Sea Turtle Management Study	151	09/77 - 08/78	21,550	$20,000 Sea Grant	41,550
Opihi Management Study	164	01/78 - 08/78	2,000	-0-	2,000
TOTALS			$ 197,648	$826,854	$1,024,502

CATEGORY II. MARINE RESOURCES CONSERVATION, PRESERVATION, AND RESTORATION, FY (1978-1979)

TITLE	T.O. NO.	DURATION	FUNDING			
			MAC	MATCHING	TOTAL	Pg.
Opihi Management Study	164	1/78 -12/78	$ 1,850	-0-	$ 1,850	40
Microbiological Indicators for Ascertaining Fecal Contamination	175	7/78 - 6/79	8,266	$9,041 U.H. (in-kind) $12,705 Sea Grant	30,012	42
Kaneohe Bay Sewage Relaxation Study	176	7/78 - 6/79	20,000	$90,000 EPA	110,000	44
Puako Bay Resources Study	189	7/79 - 5/81	20,000	-0-	20,000	46
Hawaiian Monk Seal Research	193	3/79 -12/79	2,625	$10,000 MMC $11,000 NMFS	23,625	48
Sub Total			$ 52,741	$132,746	$ 185,487	
Running Total			$250,389	$959,600	$ 1,209,989	

CATEGORY III. MARINE-RELATED ECONOMIC DEVELOPMENT

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Aquaculture Studies - Fish Farms Hawaii	04	06/71 - 05/72	$ 21,915	In-kind from Fish Farms Hawaii	$ 21,915
Aquaculture and Ocean Energy Studies	05	06/71 - 06/72	5,000	$5,000 County of Hawaii	10,000
Tuna Baitfish Study (Threadfin Shad)	06	06/71 - 01/73	15,000	In-kind tuna industry	15,000
Manganese Resource Study	21	07/72 - 06/73	60,000	$20,000 NSF $20,000 NOAA In-kind Ocean Resources	100,000
Development of High Density Prawns and Catfish Culture	24	06/72 - 12/72	31,800	$6,000 Maui County In-kind Fish Farms Hawaii	37,800
Geothermal Energy Investigation	29	04/73 - 04/74	5,000	$10,000 Atherton Richards $252,000 NSF $16,000 Others	283,000
Ship Support for HIMB Aquaculture Program	31	06/73 - 06/75	20,000	$250,000 Sea Grant aquaculture funding	270,000
Aquaculture Research Facility Modifications	38	06/73 - 06/75	10,000	Partial funds from Sea Grant funding--see T.O. 31	10,000
Sand Mining Experiment, Monitoring, and Inventory	42	08/74 - 06/75	17,985	$29,450 Kamehameha Development Corporation	47,435
Further Support for Sand Mining Test, Monitoring and Sand Inventory (Amend)	42	12/74 - 06/75	12,000	-0-	12,000
Manganese Nodule Investigation in Hawaiian Channels	43	07/74 - 06/75	50,000	$43,694 Sea Grant	93,694
New Area Manganese Resource Survey	45	07/74 - 06/75	45,000	-0-	45,000

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Providing Ponds for Aquaculture Research	57	11/74 - 06/75	$ 10,000	Part of Sea Grant monies under T.O. 31	$ 10,000
International Center for Living Aquatic Resources Management (ICLARM)	58	11/74 - 06/75	20,000	$215,000 Rockefeller Foundation	235,000
Skipjack Tuna Baitfish Project	64	01/75 - 06/75	1,500	$1,250 Sea Grant In-kind support from NMFS	2,750
CHANOS CHANOS Aquaculture Project	70	06/75 - 06/76	17,700	$16,221 Molii Fishpond and Mr. George Uyemura	33,921
Technical Training Film on Mullet Aquaculture	71	06/75 - 06/76	10,000	$7,500 ICLARM (Part of T.O.58) $2,500 Oceanic Foundation	20,000
MOI Aquaculture Research at HIMB	74	06/75 - 06/76	3,000	Part of matching funds in T.O. 31	3,000
Natural Energy Laboratory	76	06/75 - 06/76	30,000	-0-	30,000
Natural Energy Laboratory	236	11/74 - 12/78	50,000	$50,000 County of Hawaii	100,000
Hilo Lobster Investigation	79	07/75 - 06/76	6,300	$4,000 Sea Grant $3,100 Hawaiian Sea Foods $1,500 Restaurant owners $500 Horizon Air Freight $444 Private	15,844
International Center for Living Aquatic Resources Management (ICLARM)	80	07/15 - 06/76	20,000	$300,000 Rockefeller Foundation	320,000
Malaysian Prawn Genetics	87	07/75 - 06/76	10,000	Partial matching funds from T.O. 93	10,000
Tuna Baitfish Project	88	07/75 - 06/76	3,000	-0-	3,000

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Natural Energy Proposals	91	07/75 - 06/76	$ 38,000	-0-	$ 38,000
HIMB Animal Aquaculture Project	93	07/75 - 06/75	25,250	$268,136 Sea Grant	293,386
Offshore Sand Mining Development, Phase I	102	01/76 - 06/77	14,729	In-kind	14,729
Ocean Metals (Manganese Nodules)	103	10/75 - 06/77	87,000	$36,678 Sea Grant	123,678
Ocean Energy Farm Project	107	03/76 - 06/77	10,000	$116,702 Sea Grant	126,702
Tuna Baitfish Project	114	07/76 - 08/77	10,000	$25,000 Sea Grant	35,000
Malaysian Prawn Genetics	115	07/76 - 08/77	30,400	$54,000 Sea Grant	84,400
MOI Aquaculture	116	07/76 - 08/77	15,000	$40,000 Sea Grant	55,000
Ocean Metals (Manganese Nodules)	117	07/76 - 08/77	66,000	$18,000 Sea Grant	84,000
Offshore Sand Mining Development, Phase II	120	07/76 - 12/77	30,000	-0-	30,000
Brine Shrimp Production	124	09/76 - 06/77	10,000	$94,126 Department of Labor and Industrial Relations	104,126
International Center for Living Aquatic Resources Management (ICLARM)	129	07/76 - 12/76	10,000	$103,000 Rockefeller Foundation	113,000
AFRC Prawn Production System	132	12/76 - 02/78	15,000	$35,000 Sea Grant	50,000
Ornamental Fish Culture Project	136	03/77 - 09/77	10,000	-0-	10,000
Ocean Metals (Manganese Nodules)	149	09/77 - 08/78	60,000	-0-	60,000

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Maui Tuna Baitfish Project	156	01/78 - 11/79	33,000	Maui County--In-Kind	$ 33,000
Catfish Project	166	02/78 - 11/78	10,000	-0-	10,000
Aquaculture Pond Management Project	162	01/78 - 08/78	5,600	-0-	5,600
Sand Sampling Project	163	01/78 - 08/78	16,120	-0-	16,120
Project Dumand	168	04/78 - 06/79	10,000	-0-	10,000
TOTALS			981,299	2,044,801	$3,026,100

CATEGORY III. MARINE-RELATED ECONOMIC DEVELOPMENT, FY(1978-1979)

TITLE	T.O. NO.	DURATION	FUNDING			Pg.
			MAC	MATCHING	TOTAL	
Maui Tuna Baitfish Project	156	1/78 - 1/79	$ 20,000	$18,000 DPED	$ 38,000	51
Salt Water Land Plants	187	12/78 -12/80	6,372	-0-	6,372	53
Ciguatoxin Testing	198	5/79 - 6/80	5,250	$20,000 Sea Grant in-kind NMFS	25,250	55
Sub Total			$ 31,622	$38,000	$ 69,622	
Running Total			$1,012,921	$2,082,801	$ 3,095,722	

CATEGORY IV. MARINE EDUCATION AND TRAINING

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Hyperbaric Diving Studies	03	01/71 - 01/72	$ 55,000	$187,000 Office of Naval Research $44,000 Sea Grant In-kind Makai Range	$ 286,000
Marine Exhibit Booth	07	07/71 - 06/72	10,000	$10,000 Hawaii marine industry	20,000
Hyperbaric Diving Studies In-Situ	09	08/71 - 06/72	55,000	In-kind Makai Range $334,325 ONR	389,325
I.D.O.E. Conference	11	09/71 - 06/73	25,000	-0-	25,000
Innerspace Pacifica '71	13	10/71 - 06/72	6,000	$6,000 Hawaii Council of Dive Clubs	12,000
At-Sea Training Cruises for Future Marine Technicians	14	01/72 - 06/75	20,000	In-kind NMFS	20,000
Diving Training Tank for LCC	15	01/72 - 09/72	3,000	$3,000 Sea Grant	6,000
Shell Structures Conference	16	10/71 - 10/72	6,000	$20,000 ONR $15,900 NSF $4,420 Private	46,320
Innerspace Pacifica '72	22	07/72 - 03/73	10,000	$10,000 Hawaii Council of Dive Clubs	20,000
Microtubule Conference	23	05/72 - 09/72	800	$800 Private	1,600
Okinawa Expo Planning	25	07/72 - 06/75	27,000	-0-	27,000
S.N.A.M.E. Conference	26	01/71 - 03/72	4,000	$4,000 SNAME	8,000
Diving Survey by Daniel Kali	27	04/72 - 12/72	3,500	$3,500 NIH	7,000
Manganese Nodules Symposium	28	09/72 - 03/73	6,000	In-kind	6,000

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Blue-Water Marine Laboratory	33	06/73 - 06/75	$ 10,000	$11,000 Sea Grant $5,000 McInerny Foundation $2,700 Student Lab Fees	$ 28,700
Maintenance of Two LCC Marine Tech Training Boats	36	06/73 - 06/75	5,000	$10,000 Sea Grant	15,000
Makahiki Kai 1974	40	05/74 - 06/74	3,000	$5,650 Local industry	8,650
Blue-Water Marine Laboratory	47	07/74 - 06/75	20,000	$24,000 Sea Grant $18,500 McInerny Foundation	62,500
Aquarium Redevelopment Project	48	07/74 - 06/75	9,000	$9,000 Sea Grant	18,000
International Woollard Symposium	49	09/74 - 06/76	15,000	$30,000 NSF $20,000 ONR	65,000
Conference on Physiology of Man in the Sea	50	09/74 - 06/76	6,000	$130,000 Sea Grant	136,000
Conference on Seaward Advancement of Industrial Societies	51	09/74 - 06/75	5,000	$31,889 Sea Grant $4,675 Oceanic Foundation	41,564
Makahiki Kai 1975	63	11/74 - 06/75	5,000	$3,760 Sea Grant $7,525 Private	16,285
LCC Marine Technology Training Program	67	04/75 - 06/75	10,000	$25,392 Sea Grant	35,392
Providing Sea Time (Ship Support) for LCC Marine Tech Program	68	04/75 - 06/75	3,000	Sea Grant--see T.O. #67	3,000
Continuation of Aquarium Redevelopment Program	69	06/75 - 06/76	5,000	-0-	5,000
Polynesian Voyaging Society's Hawaii-Tahiti Canoe	72	06/75 - 06/76	2,000	$50,000 PVS $7000 Hawaii Bicentennial (1976) Commission in private and Federal funds	59,000

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
International Conference on Coastal Engineering	73	06/75 - 07/76	2,000	$20,072 Sea Grant	$ 22,072
Aquarium Education Program	81	07/75 - 10/76	18,500	$7,000 Junior League	25,500
MOP Reef Habitat Project	82	07/75 - 06/76	6,000	-0-	6,000
15th International Conference on Coastal Engineering	85	08/75 - 06/76	18,000	-0-	18,000
Blue-Water Marine Laboratory	86	07/75 - 06/76	30,000	$14,020 Lab Fees $18,589 Sea Grant $7,500 McInerny Foundation	70,109
Innerspace Pacifica '75	94	07/75 - 01/76	1,000	$1,000 Hawaii Council of Dive Clubs	2,000
Aquarium Lecture Series	95	07/75 - 06/76	1,820	$500 Sea Grant	2,320
High Visibility Undersea Observation Structure	96	07/75 - 06/77	5,250	$29,911 Sea Grant $2,580 Pan Pacific Institute	37,741
HI-IMPORT	98	07/75 - 06/77	1,000	-0-	1,000
Makahiki Kai '76	101	01/76 - 06/76	5,000	$19,621 Sea Grant	24,621
Symposium on Marine Affairs	104	01/76 - 06/76	5,300	$2,705 Sea Grant	8,005
LCC Marine Technology Program	106	02/76 - 06/77	6,600	-0-	6,600
LCC Marine Technology Program Ship Support	108	04/76 - 06/76	4,000	-0-	4,000
LCC Shark Fishery Training	109	06/76 - 06/77	7,000	$3,500	10,500

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Blue-Water Marine Laboratory	121	09/76 - 09/77	$ 30,000	$15,300 Department of Ed. $10,676 Laboratory Fees	$ 55,976
LCC Marine Technician Shark Fishery Training	123	09/76 - 06/77	7,500	$7,500 Department of Planning and Economic Dev.	15,000
Makahiki Kai 1977	125	11/76 - 06/77	11,231	$28,450 Sea Grant	39,681
Aquarium Education Program	127	11/76 - 06/77	16,000	$ 7,000 Junior League $10,000 Private Gifts	33,000
NOI'I Ship Time for LCC Marine Technology Program	131	12/76 - 06/78	10,000	-0-	10,000
Marine Conservation Education Program	135	03/77 - 08/77	17,864	$27,112 Sea Grant	44,976
Voyages Into Ocean Space Lecture Series	139	08/77 - 10/77	3,850	-0-	3,850
Aquarium Education Program	140	09/77 - 06/78	26,500	-0-	26,500
Makahiki Kai 1978	141	09/77 - 06/78	12,000	$24,000 Sea Grant	36,000
Blue-Water Marine Laboratory	144	09/77 - 06/78	30,000	$26,750 DOE $10,800 Student Lab Fees $ 6,000 Summer Training $23,852 MOP (In-kind) $ 5,000 Ocean Charter Serv.	102,402
MAC Internship Program	146	10/77 - 06/78	6,000	MOP - Initial 3 months salary support	6,000
Statewide Diving Safety Program	147	10/77 - 06/78	15,000	-0-	15,000
World Mariculture Conference	148	10/77 - 01/79	1,050	-0-	1,050

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Sea Grant Publications	152	09/77 - 08/77	$ 7,511	$104,000 Sea Grant	$ 111,511
High Visibility Undersea Observation Structure	154	11/77 - 08/78	9,644	$26,099 Sea Grant $19,984 UH $ 1,000 Pan Pacific Inst. $ 4,000 Boris Auksmann	60,727
Marine Affairs Student Symposium	158	01/78 - 01/78	2,000	$4,471 Sea Grant	6,471
Marine Advisory Program	160	01/78 - 08/78	41,000	$34,809 Sea Grant	75,809
LCC Marine Technology Program Ship Time	161	01/78 - 06/78	17,500	-0-	17,500
PMA Education Program	171	04/78 - 06/78	640	-0-	640
TOTALS			$706,060	$1,562,837	$2,268,897

CATEGORY IV. MARINE EDUCATION AND TRAINING, FY (1978-1979)

TITLE	T.O. NO.	DURATION	FUNDING			
			MAC	MATCHING	TOTAL	Pg.
Statewide Diving Safety Program	147	10/77 - 6/80	$ 5,535	-0-	$ 5,535	58
MAC Internship Program	174	7/78 - 6/80	10,000	$45,626 Sea Grant	55,626	60
Aquarium Education Program	177	7/78 - 6/80	20,000	-0-	20,000	61
Field And Instructional Support Curriculum	178	9/78 - 6/79	9,170	$4,779 U.H. $13,296 Sea Grant	27,245	63

TITLE	T.O. NO.	DURATION	FUNDING			Pg.
			MAC	MATCHING	TOTAL	
New Underwater Technology Course	179	9/78 - 6/80	5,551	$15,041 Sea Grant	20,592	66
Blue-Water Marine Laboratory	180	7/78 - 6/80	30,000	$26,750 $44,600 Others	101,350	67
Ship Support for Leeward Community College Training Program	181	9/78 - 8/79	20,000	$ -0-	20,000	69
Hawaiian Maritime Museum	182	7/78 - 6/79	3,125	in-kind Sea Grant	3,125	70
Sea Grant Marine Advisory Program	184	11/78 - 6/80	40,000	$11,029 County of Hawaii $229,870 Sea Grant	280,899	72
High Visibility Undersea Observation Structure	190	2/79 - 8/79	8,400	$6,375 Sea Grant	14,775	74
Marine Education Master Plan	191	2/79 -12/79	24,050	-0-	24,050	75
Marine Environmental Education at King Intermediate School	192	2/79 - 6/80	3,518	$10,000 Private	13,518	76
A Comparison of Survey Methodologies	195	6/79 - 2/80	6,300	-0-	6,300	78
Mini Makahiki Kai Exhibit 1979	197	5/79 - 6/80	3,150	$300 U.H. $2,530 Sea Grant (in-kind)	5,980	80
Sub Total			$ 188,799	$410,196	$ 598,995	
Running Total			$ 894,859	$1,973,033	$2,867,892	

CATEGORY V. MARINE FACILITIES SUPPORT

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Porpoise Facility Support	12	09/71 - 08/72	$ 5,000	$300,000 National Science Foundation	$ 305,000
R/V VALIANT MAID	17	01/72 - 12/72	10,000	$10,000 OED Maui Community Development Corporation	20,000
Diving System Hahn-Clay Hyperbaric Chamber	18	01/72 - 06/73	25,000	In-kind Hahn and Clay	25,000
Makai Range Acoustic Propagation Program	19	05/72 - 06/73	25,000	$49,300 ONR In-kind Makai Range	74,300
HIG-ONR Long Range Acoustic Propagation Program	20	07/72 - 06/73	38,000	$180,000 ONR	218,000
Maintenance Makapuu Pier	30	06/73 - 06/75	5,000	-0-	5,000
Look Lab Facilities - Mini Bell Diesel Engine Facility/AEGIR	34	07/73 - 01/75	54,000	In-kind	54,000
Manganese Nodule Analytical Facility	35	06/73 - 06/76	41,000	$67,771 NSF	108,771
Special Maintenance Support for University's R/V KANA KEOKI	37	06/73 - 06/74	25,000	$640,000 NSF	665,000
Charter of VALIANT MAID for HIMB	41	07/74 - 06/75	6,500	$238,000 Sea Grant	244,500
Manganese Nodules Analytical Laboratory	44	07/74 - 06/75	45,000	-0-	45,000
Kewalo Basin Temporary Marine Marshalling Area	52	10/74 - 06/75	3,472	-0-	3,472
Refurbishment of 1 to 20 Scale Model of Floating City	53	10/74 - 06/75	5,000	-0-	5,000

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Maintenance and Repair of Three Small Workboats	55	10/74 - 06/75	$ 6,700	In-kind Look Lab	$ 6,700
Additional Charter of VALIANT MAID for HIMB	56	11/74 - 06/76	13,500	Part of Sea Grant monies in T.O. 41	13,500
Salinometer for University Research Ship MOANA WAVE	60	11/74 - 06/75	4,000	$26,500 various Federal agencies	30,500
Refurbishment of Habitat AEGIR	61	11/74 - 06/76	37,300	$221,569 Sea Grant $5,000 NOAA	263,869
Development of Oceanic Foundation Wave Sensor Buoy	62	11/74 - 06/75	5,500	$70,000	75,500
Maintenance of Makapuu Oceanographic Pier	65	01/75 - 06/75	5,000	-0-	5,000
KAIMALINO - Preparing Semi-Submerged Platform (SSP) for State testing	75	06/75 - 06/76	7,000	In ship charter and crew services of Naval Oceans System Center	7,000
Ocean Energy-Related Wave Study	54	10/74 - 06/75	5,000	$37,000 Sea Grant	42,000
NUC-MEMO Marine Microcosm Facility and Processing Center	77	07/75 - 06/76	5,000	$25,000 NUC	30,000
Renovation of a Coastal Zone Research Vessel	78	07/75 - 06/77	13,500	-0-	13,500
Kewalo Basin Marine Support Facility	84	08/75 - 06/76	2,800	-0-	2,800
SSP KAIMALINO	92	07/75 - 06/76	59,000	In-kind	59,000

TITLE	T.O. NO.	DURATION	FUNDING		
			MAC	MATCHING	TOTAL
Pipeline Survival Under Ocean Attack	97	07/75 - 06/77	$ 15,600	$52,179 Sea Grant	$ 67,779
Makapuu Pier Maintenance	100	12/75 - 06/78	5,000	-0-	5,000
Wave Attenuation Project	112	07/76 - 08/77	12,000	$32,000 Sea Grant	44,000
Three Recompression Chambers	119	07/76 - 06/78	45,830	-0-	45,830
Maui Recompression Chamber	126	08/76 - 06/77	20,000	$24,000 Maui Recompression Chamber Service	44,000
Mobile Recompression Chamber	130	10/76 - 06/78	8,100	$74,525 Sea Grant	82,625
Kewalo Basin Marine Support Facility	133	01/77 - 06/77	2,000	-0-	2,000
HIMB CHN Analyzer	137	05/77 - 09/77	10,915	-0-	10,915
Wave Attenuation Project	143	09/77 - 08/77	12,150	Sea Grant--In-kind support	12,150
AEGIR Prospectus	150	01/78 - 06/78	4,200	-0-	4,200
Refurbishment of Hyperbaric Facilities	155	01/78 - 06/78	32,000	-0-	32,000
Kewalo Basin Marine Marshalling	159	01/78 - 06/78	4,500	-0-	4,500
Makapuu Pier	165	02/78 - 12/79	5,000	-0-	5,000
HIMB Slide Collection	169	04/78 - 06/78	500	-0-	500
TOTAL			$ 630,067	$ 2,052,571	$ 2,682,911

CATEGORY V. MARINE FACILITIES SUPPORT, FY (1978-1979)

TITLE	T.O. NO.	DURATION	FUNDING			
			MAC	MATCHING	TOTAL	Pg.
Refurbishment of Hyperbaric Facilities	155	1/78 - 6/80	$ 15,000	-0-	$ 15,000	82
AEGIR Facility Support	186	10/78 -12/79	6,050	-0-	6,050	83
Kewalo Basin Marine Support Facility	194	2/79 - 6/80	3,677	-0-	3,677	84
Polisher/Grinder for Microbe Facility	196	4/79 - 6/79	1,446	-0-	1,446	85
Sub Total			$ 26,173	-0-	$ 26,173	
Running Total			$656,240	$2,052,571	$ 2,708,811	

CATEGORY VI. MARINE CONFERENCES, FY (1978-1979)

TITLE	T.O. NO.	DURATION	FUNDING			
			MAC	MATCHING	TOTAL	Pg.
World Mariculture Conferences	148	10/77 - 1/79	$ 9,450	-0-	$ 9,450	87
Law of the Sea Institute Conferences/ Workshops	185	12/78 - 6/79	5,000	$24,150 U.H. $24,155 Sea Grant $14,000 Others	67,305	89
Sub Total			$ 14,450	$62,305	$ 76,755	

CAPITAL IMPROVEMENT PROJECTS, FY (1978-1979)

TITLE	C.I.P NO.	DURATION	FUNDING			
			MAC	MATCHING	TOTAL	Pg.
Three-inch Pipeline at Ke'ahole Point	01	2/79 - 6/80	$ 35,700	-0-	$ 35,700	92
Aquaculture Component at Natural Energy Laboratory of Hawaii (NELH)	02	6/79 - 6/81	115,000	-0-	115,000	93
Sub Total			$150,700	-0-	$ 150,700	