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HAWAII AND THE SEA – 1974

Prepared for the Governor's Advisory Committee on Science and Technology

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GC58.H35/1974
3188847
OCT 14 1997

GOVERNOR'S ADVISORY COMMITTEE ON SCIENCE AND TECHNOLOGY

February 11, 1974

The Honorable George R. Ariyoshi
Acting Governor of Hawaii
State Capitol
Honolulu, Hawaii 96813

Dear Sir:

Your Advisory Committee on Science and Technology is pleased to transmit to you through the Department of Planning and Economic Development a report entitled, "Hawaii and the Sea–1974" for your review and consideration. The fourteen "Most Critical Recommendations" are reviewed in the Summary Chapter 2 with cost estimates and action agencies indicated for each recommendation.

This report is an updating of the very valuable and widely distributed report, "Hawaii and the Sea, A Plan for State Action", published in 1969. It reviews the important actions taken by the State in response to recommendations made in 1969, emphasizes areas of urgent concern such as the environment and population growth, explores new economic opportunities such as manganese nodule processing and takes into consideration in making recommendations the current fiscal atmosphere of the State and Nation.

This revision of Hawaii and the Sea also represents a further extension of the State's comprehensive planning process. It follows broad goals established in our General Plan Revision documents and suggests pragmatic economic development options for both the public and private sector. It recognizes that marine development can not and must not proceed without environmental safeguards and long range planning perspective, and plans are meaningless without a developmental or community enhancement purpose. The Department of Planning and Economic Development thus urged the Governor's Advisory Committee on Science and Technology to set up a task force, with departmental planning and technical assistance, to undertake the study. At a meeting in January 1973, the Committee approved this recommendation, and George Wilkins of the Naval Undersea Center's Hawaii Laboratory was appointed Task Force Chairman.

The Task Force members listed in the Introduction included State, Federal, University and industry representatives and were supported by many professionals from all segments of the Hawaii community. Of special importance was the participation and inputs of other State agencies, particularly the Department of Land and Natural Resources, and Department of Transportation. The Task Force worked on a voluntary basis with staff support from the Economic Development Division and the Center for Science Policy and Technology Assessment, both part of the State Department of Planning and Economic Development.

While individual chapters were prepared by subgroups, the Task Force as a whole reviewed all the material and discussed and rewrote many sections so that the output represents the consensus of the entire Task Force. The Task Force members have requested that *Hawaii and the Sea–1974* be dedicated to Scott McLeod who made valuable contributions to the report and whose untimely death came during the preparation of the final draft.

At a meeting on December 19, 1973 your Advisory Committee approved the report and the recommendations.

The contributors are to be commended on the long hours and extra effort that went into completing this report on schedule. We wish to express special appreciation to Chairman George Wilkins and Vice Chairman Jack Harmon for their leadership of the Task Force and for their contributions to both the organization and content of the report.

Your Advisory Committee takes pleasure in submitting this study to you, and we feel strongly that the ideas and recommendations put forward will assist you in your continuing efforts to further marine affairs in the State.

Sincerely,

LOUIS G. NICKELL, Chairman
Governor's Advisory Committee on
Science and Technology

SHELLEY M. MARK, Director
Department of Planning and
Economic Development

Committee Members

Mr. Wilson Cannon
Dr. John P. Craven
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APPENDIX A Summary of Actions Based on The 22 Major Recommendations Made in *Hawaii and The Sea, A Plan For State Action, 1969*

APPENDIX B* *An Evaluation of Public Access to The Oahu Shore,* Samuel Herrick and Ann Hayward Rooney, Sea Grant Programs, Summer 1973

APPENDIX C* *A Survey of Public Attitudes Toward Inter-Island Transportation,* Ann Hayward Rooney and Samuel Herrick, Sea Grant Programs, Summer 1973

* Under Separate Cover

CHAPTER 1: INTRODUCTION

In 1969, *Hawaii and the Sea, A Plan for State Action* was prepared by a Task Force on Oceanography at the request of Governor John A. Burns and his Advisory Committee on Science and Technology. This comprehensive report made a series of recommendations for a five-year action plan on marine topics ranging from research to recreation, to help Hawaii better adapt to, benefit from and coexist with the sea.

The original *Hawaii and the Sea* was a monumental document, the result of a summer of intensive work and cooperation by more than one hundred representatives of science, industry, academia and government. It made Hawaii the first State to answer the Federal report, *Our Nation and the Sea;* and the State's responses to the recommendations have precipitated a series of highly beneficial results.

THE TASK FORCE FOR HAWAII AND THE SEA --1974

The past four years have seen first an upswing in State and Federal budgets for marine programs, a leveling off, and finally, for many projects, an abrupt downward trend. Under these circumstances it was highly appropriate that a *Hawaii and the Sea–1974* Task Force be formed to make a new evaluation of the technical, economic and political environment for marine affairs in Hawaii. Accordingly, the 1974 Task Force was established at the request of the Governor's Advisory Committee on Science and Technology early in 1973, and George Wilkins, Consultant at the Naval Undersea Center's Hawaii Laboratory, was named Chairman. The Task Force was requested to finish its report before the end of 1973 so that its findings would be available to the 1974 Legislature.

Objectives

The objectives of the Task Force were: (a) to assess developments since 1969 to determine what progress has been made, how funds have been spent and what the benefits to the State have been; and (b) to identify problems and new opportunities which had not been apparent in 1969. At the beginning of the study, four constraints were adopted:

- Recommendations would be made within the context of austere State and Federal budgets. In 1969, it had appeared that the nation was beginning a major initiative in marine affairs. Our recommendations showed this influence; and our reach clearly exceeded our grasp. The 1974 Task Force has selected realistic goals and has tried to make recommendations which would achieve these goals at reasonable costs. We have given special emphasis to recommendations which can be self-supporting; several recommended alternatives to planned actions can save millions of dollars.
- Where research and scientific surveys are recommended, they are practically oriented and justified in terms of existing State needs. Although most of the Task Force members are strong advocates of the value of basic research, it is almost nonexistent as a subject for recommendations in this report.
- Each recommendation indicates a specific State agency for action. For those cases where legislative action at the State or Federal level is needed, a State agency is indicated for initial action.
- Where possible an estimate of cost is attached to each recommendation. These cost figures should be interpreted as preliminary estimates.

Membership and Approach

The Task Force members are marine affairs experts from State and Federal government, the University of Hawaii, and

industry. In addition, advice and suggestions were sought from scores of individuals in the scientific and industrial community.

The Task Force membership follows:

Dr. John Bardach, Director
Hawaii Institute of Marine Biology
University of Hawaii

Dr. John Belshe', Chief
Environmental Resources Section
U.S. Army Corps of Engineers (Pacific)

Mr. Gene Blackburn
Private Consultant

Dr. Charles Bretschneider, Professor
Department of Ocean Engineering
University of Hawaii

Mr. Robert Chuck, Manager-Chief Engineer
Division of Water & Land Development
Department of Land and Natural Resources

Dr. Salvatore Comitini, Associate Professor
Economic Research Center
University of Hawaii

Dr. Doak Cox, Director
Environmental Center
University of Hawaii

Dr. John Craven
State Marine Affairs Coordinator

Dr. Jack Davidson, Director
Sea Grant Program
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Mr. Andrew Gerakas, Head
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Dr. Richard Grigg, Assistant Marine Biologist
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Mr. Jack Harmon, Manager
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RAdm. William Heaman, USN (Ret.), Consultant
Hawaii Institute of Geophysics
University of Hawaii

Dr. Frank Hester, former Director
Honolulu Laboratory
National Marine Fisheries Service

Mr. Scott McLeod, General Manager
Hawaiian Tuna Packers

Mr. Howard Pennington, Consultant
State Office of Marine Affairs Coordinator

Mr. Justin Rutka, Advisory Specialist
Sea Grant Program
University of Hawaii

Mr. Richard Shomura, Director
Honolulu Laboratory
National Marine Fisheries Service

Mr. Cliff Slater, President
Maui Divers of Hawaii, Ltd.

Dr. Manley St. Denis, Professor
Department of Ocean Engineering
University of Hawaii

Mr. John Wheaton, Director
Corporate Development, Dillingham Corporation

Mr. George Wilkins, Consultant
Naval Undersea Center, Hawaii Laboratory
(Task Force Chairman)

RAdm. E. Alvey Wright, USN (Ret.), Director
Department of Transportation

A number of meetings of the entire Task Force were held in the spring of 1973; first to review progress on *Hawaii and the Sea–1969* recommendations and then to gather ideas on new opportunities and

strategies for *Hawaii and the Sea–1974.* These proposals were classified by subject and used as the basis for establishing a number of Task Groups for specific areas.

Each of the Task Groups was responsible for drafting a chapter in its assigned subject area. These drafts were completed and then reviewed by the Task Force as a whole. The final manuscript thus represents several iterations of rewriting, additions and transfer of material from one chapter to another. Finally, the draft was submitted to the Governor's Advisory Committee on Science and Technology for its review and approval.

Several valuable contributions have been made to this study by students of the Marine Option Program at the University of Hawaii. Initially, two of these students had been asked to conduct two surveys and to evaluate and report the results. The first was an on-site appraisal of the true condition of all legal beach access routes on Oahu. The second was a survey of Hawaii's residents to determine the performance factors considered most important in an inter-island marine transportation system. The results of both surveys are included as appendices to this report.

The students became so interested in our task that we invited them to write a student chapter––*Kamali'i o Kai,* or *Children of the Sea*––a view from the next generation. The results appear as Chapter 9 of this report. While this chapter duplicates some of the topics covered in other chapters, the students' point of view is clearly different from our own. We regard this difference to be of considerable value. A description of the Marine Option Program is given in the introduction to Chapter 9.

PROGRESS SINCE 1969

The 1969 report contained a list of 22 major recommendations for State action in marine affairs, plus a much larger number of subordinate recommendations. All of these, especially the first 22, were presented in the belief that Federal support for marine science would increase rapidly, Hawaii was a natural focus for national programs in oceanic research and development, and seed monies invested by the State would flourish in this environment.

In many critical areas, these expectations have not been fulfilled. Federal support for ocean science has remained level or, in some cases, has diminished (as evidenced by the pullback and retirement of both National Marine Fisheries Service vessels from their Hawaiian support bases). Federal research interests have retreated, not only from the frontiers of space and oceans, but also in an absolute monetary sense.

Until recently, Hawaii's support of marine activities has been outstanding. All but 4 of our 22 major recommendations have resulted in some degree of action. It is important to be aware of the "multiplier effect" that projects begun with State seed money or State matching funds can have in bringing major Federal, foundation and industry funds into the State's economy.

The position of Marine Affairs Coordinator was created and staffed within the Office of the Governor in response to a 1969 recommendation that the Governor appoint an Executive Director for Marine Affairs. To date, the Legislature has appropriated $870,000 and staff funding to the Marine Affairs Coordinator's office to address marine problems in Hawaii.

In response to another major recommendation, a total of $3,300,000 was appropriated for the planning and construction of a University of Hawaii Oceanographic Expeditionary Center at Snug Harbor, and construction has started. Response to other recommendations is detailed in Appendix A with funding details. A short summary of major expenditures and commitments is shown in the funding table. Within the Legislature, a vital awareness of marine problems and potential is evident. More than 170 Senate or House bills or

FUNDING OF MARINE AFFAIRS PROGRAMS IN THE STATE OF HAWAII
FOR THE PERIOD 1969 - 1973 ($000's)

Area and (1969 Recommendation)	Responsibility	State Funding		Federal Funding		Industry
		MAC	Other	Sea Grant	Other	
Marine programs (1 & 20)	MAC	550	32	266	640	165
Research park (2)	DPED	-	100(CIP)	-	-	-
Floating platforms	MAC	50	-	85	-	25
Ocean environmental forecasting (3)	-	-	-	-	-	-
Marine expeditionary center (4)	MAC	-	3,300(CIP)	-	-	-
IDOE & manganese nodules (5)	MAC & UofH	106	-	-	1,411	130
Workshop on geoscience (6)	MAC	25	-	-	-	-
Hawaii Marine Exhibition (8)	MAC	30	-	-	-	-
Underwater preserves (12)	DLNR	-	150	-	-	-
Oil spill disasters (13)	DOD	-	3	-	-	-
Fisheries (14, 15, 16)	DLNR & DOH	22	132.5	-	-	-
Aquaculture (17)	UofH	10	-	220	-	-
Precious coral (18)	UofH	75	104	152	-	62
Geothermal energy	UofH	5	100	-	252	16
Total operating value		873	489.5	723	2,303	398
Total Capital Improvement Program (CIP) value			3,400			

resolutions dealing with marine affairs were considered in the 1973 session. Some of the more significant measures passed are listed below.

Act 118 Amends the State's environmental protection laws to comply with new Federal water pollution control requirements. This enables the State to obtain planning and construction grants from the Environmental Protection Agency.

Act 107 Establishes minimum depth and offshore distance limits, within which mining of sand, coral, rock and other minerals is prohibited.

Act 124 Authorizes the Department of Land and Natural Resources to establish and maintain marine reserves and refuges.

Act 125 Gives legal protection to the "Good Samaritan" who renders assistance at the scene of a boating accident.

Act 143 Mandates counties to adopt ordinances requiring a developer, as a precondition to project approval, to dedicate rights-of-way from a public road to the State beach through his development.

Act 164 Authorizes the Department of Planning and Economic Development to prepare plans for management of the State's coastal zone which comply with requirements of the National Coastal Zone Management Act of 1972.

Senate Resolution 151 requests the Legislative Reference Bureau to determine the feasibility of converting the Waikiki Aquarium into a marine education center.

Senate Resolution 136 and House Resolution 241 request the Land Use Commission to reclassify Heeia Fish Pond and adjacent lands from urban to conservation.

Probably the most conspicuous and important event of the past four years has been the designation of the University of Hawaii as a Sea Grant College, one of seven in the Nation. *The value of this program cannot be overemphasized.* Sea Grant funds are specifically directed towards projects which address state, regional and national needs. Up

to two-thirds of the total project funds come directly from the Federal government, and the remaining one-third can be supplied by local or state government, or by private industry——in money, goods or services. In Hawaii, predominantly outside funds can be used to solve local problems in a way that encourages pooling of local resources. This is a most effective way for government, at all levels, and private enterprise to cooperate in facing and solving marine problems. The excellent work of the University of Hawaii in marine research, coupled with the organization and integration of marine programs in Hawaii under the guidance of the State Marine Affairs Coordinator, and the impact of *Hawaii and the Sea—1969* were important factors in the University of Hawaii becoming a Sea Grant College.

STATE POLICY CONSIDERATIONS

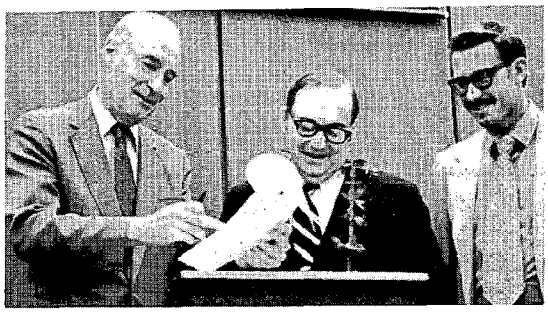
Several areas of deep concern over present State policies have set the tone of our 1973 investigation. These areas are discussed briefly below and appear directly or indirectly in all the chapters of this report.

Federal Standards

Within the State government, there is an increasing awareness that Federal standards, generally designed for a continental environment, often have little relevance to oceanic Hawaii. Chapter 4, concerning Hawaii's marine environment, provides additional areas that should be studied in this respect. There, it is pointed out that direct adherence to the Federal requirement for secondary treatment of all sewage before discharge could cost an additional $20,000,000 for the Sand Island plant alone, but does little more to improve the offshore environment than a much lower-cost system.

Funding

The upward surge in State support to marine science which followed *Hawaii and the Sea—1969* appears to have hesitated and



University of Hawaii President Harlan Cleveland is shown signing an official document received from National Oceanic and Atmospheric Administration Administrator Robert White on October 17, 1972, formally designating the University a Sea Grant College. At right is Jack Davidson, Director of the Sea Grant College Program.

fallen backward. The 1970 appropriation by the Legislature was $470,000 (nonlapsing), followed by $400,000 for the 1971-73 biennium. The proposed 1973 project and facility operating budget of $940,000 for the Marine Affairs Coordinator stalled in the Legislature. This leaves the Marine Affairs Coordinator's office with only carryover funds to continue support of programs which have been of great importance to the State.

At the same time, ship support funds for the University of Hawaii have been cut back to the point that critical research projects have been curtailed or cancelled.

We realize that the State has had to reduce expenditures in all areas due to projected budget deficits. We would like to point out, however, that withholding funds for marine affairs is especially detrimental in the case of funds appropriated to match Federal contributions to joint State/Federal programs; for example, the water quality programs under Sea Grant. If the State passes up opportunities to participate in matching fund programs, the serious problems these programs address will not disappear. What may disappear is the Federal support which has been amounting to over two-thirds of the total program cost.

The State of California, by recently appropriating $500,000 specially earmarked for use as Sea Grant matching funds, has virtually assured itself of continuing Federal support for its Sea Grant and other marine programs.

Population

When *Hawaii and the Sea–1969* was published, the Task Force on Oceanography recognized the interactions among the land, its people and the sea. The title of the report was selected to reflect these influences. Awareness of these interrelationships has expanded tremendously during the past four years as the population of our islands, especially Oahu, has grown. The limitations recently imposed by the energy crisis make the problem of population growth critical.

The Governor's Temporary Commission on Environmental Planning (TCEP) deliberated on the subject of population pressures in Hawaii, clearly highlighted the dangers of excess population and warned of an environmental "overload". The Task Force shares the TCEP group's concern.

We believe that Hawaii, as a whole, is not overcrowded at the present time; it is Oahu that is overcrowded. While the population of the Neighbor Islands has long been essentially static, the population of Oahu has skyrocketed. This imbalance in our population distribution will be hard to overcome.

Throughout the studies leading to this report, we have asked the question: "What can marine science, industry and commerce do to alleviate Hawaii's problems of population and population distribution?" The reverse question was also asked: "What can Hawaii do to alleviate the pressures that population will place on marine resources and marine activities?"

*The Tragedy of The Commons**

Chapter 4 considers the population carrying capacity of Hawaii, defining it in terms not only of the capacity set by its "vital" resources, but also in terms of the non-vital environmental resources––forests, beaches, coral reefs, etc.––which make these islands such a beautiful place to live. Our most immediate danger lies in overloading the environment.

Environmental carrying capacity is not like a bucket, which fills and then spills. We will not wake up some morning, look outside and note that our carrying capacity has finally been exceeded. We will gradually find that there is less space, more crowding, less privacy, more tension; that our eyes water and, ultimately perhaps, that it hurts to breathe. Wise planning can expand or make better use of our environmental resources; however, utilization of each resource beyond its capacity can only degrade its quality.

Few people would argue with this statement; yet, most would resist efforts to do anything about it. This paradox stems from the fact that what is best for the individual is not always best for the group, a situation which has been referred to by Garrett Hardin as "The Tragedy of the Commons". The tragedy arises when an individual overloads the carrying capacity of a common resource––the individual may benefit, but only at the expense of the group, which must collectively share the impact of the individual's action.

For example, we live in Hawaii because we want to, because it is a highly desirable place to live. We must expect that, unless laws or public and private attitudes change, people will continue to migrate to and increase in Hawaii *until it is no longer* a desirable place to live. Without controlling laws and changes in public attitudes, growth will be curtailed only by the overall degradation of the quality-of-life for the people of Hawaii.

The choice for Hawaii is clear. Either it will gradually succumb to "The Tragedy of the Commons", or steps will be taken to control both population growth and distribution. Initially, the problem of overload on Oahu can be alleviated by dispersion of the population to the Neighbor Islands. Eventually, it must be recognized that there is an "optimum" ceiling to Hawaii's population.

* "The Tragedy of the Commons", by Garrett Hardin, Science, Vol. 162, page 1243, 1968.

CHAPTER 2: SUMMARY

Hawaii and the Sea–1974 differs in several fundamental aspects from the original 1969 State planning document. The basis for some of these differences was touched on in the introductory chapter. Funding is more austere today than it was nearly five years ago. County, State and Federal budgets are more restricted and restrictive. The trend in public attitudes may be toward increased questioning of science and technology; toward a feeling that these disciplines must have more than their own allegations of value as proof of worthiness of public support.

The public atmosphere in which *Hawaii and the Sea–1974* was debated and written has changed in other ways since 1969. Growth is no longer welcomed for its own sake. Many citizens of Hawaii have come to realize that indiscriminate growth is like a cancer that defaces, degrades and ultimately may destroy the vital body in which it spreads. State and county policy makers have begun to question uncontrolled growth although no positive cure has yet been found for it. We sense and accept a new ethic in Hawaii, a belief that growth must be contained, controlled and redirected if it is to benefit the people of the State.

The Task Force expects this report will be a controversial document in the sense that nearly every recommendation will arouse both advocates and opponents. Few of our readers will find themselves in agreement with all of our recommendations. We believe that this type of reception is meaningful, perhaps even necessary, because therein lies the greatest difference between the 1969 and 1974 reports.

Hawaii and the Sea–1974 is a problem-oriented document. It attempts to identify the problems––*the dangers and the opportunities*––which face Hawaii and its marine environment. We have tried to be as specific as possible in presenting and characterizing these problems. We have gone on to recommend solutions, highlight State agencies which should have (at least) initial responsibility for action, and estimate the costs involved in effecting the solutions.

Why do these marine-related problems exist? To some extent, it is because conscientious, dedicated, public and private citizens cannot agree on the definition of the problem or on the form of the solution. To a greater extent, it is because, in debating such definitions and solutions, many of these citizens have shown little awareness of the unique, all pervasive role taken by the sea in influencing Hawaii's historical, cultural and physical environment. This land-oriented attitude was described by one member of the Task Force as the "Anti-Lemming Instinct"––as an unreasoning drive away from the sea.

Our recommendations cover a wide range of uses for the sea: from marine transportation to forge new links among the islands and to substitute for conventional links on land, to a uniquely Hawaiian "best" way to treat and dispose of municipal sewage, to new and potential marine resources which should be utilized and which are in danger of uncontrolled exploitation. If these recommendations only excite argument and controversy, we will have succeeded in our minimum objective, which was to bring the associated problems to the public attention. If our recommendations are accepted as reasonable solutions––not necessarily "best"––we will have succeeded in our major objective.

We have tried to be farsighted in identifying and recommending new paths for Hawaii to take in more fully utilizing its marine environment. At the same time, we accept the inevitability that a *Hawaii and the Sea–1979* Task Force will find problems and opportunities we have overlooked, steps we have recommended that were not in the right direction, and distant vistas we have scanned that turned out, in retrospect, to be the ends of our noses.

One of these distant vistas, for example, may lie in the direction of energy and power technology for Hawaii. We are uncomfortably aware of the magnitude and probable duration of the national energy crisis. We are especially aware of Hawaii's sensitivity, as an energy-importing state, to any general energy shortage. This factor has helped support our recommendation of energy-conserving techniques for sewage treatment (Chapter 4) and sand mining (Chapter 7).

In Chapter 7 we also note that Hawaii has a unique potential to derive large amounts of power from systems which exploit (1) energy inputs from geothermal and solar sources and (2) the higher conversion efficiencies ("difference temperature" or ΔT) possible when deep, cold ocean waters are used as the heat sink. In Chapter 8 we discuss the added potential of such a system to support production of hydrogen fuels for local consumption and export. The only recommendation made, however, is that the Marine Affairs Coordinator should "take a leading role in development of a proposal--with shared support from the State, the Federal government and industry--to demonstrate the feasibility of a geothermal/solar/ocean energy producing system in Hawaii".

This proposal should draw upon the extensive surveys or analyses already done by the University, the U.S. Corps of Engineers and the Department of Planning and Economic Development, and upon the high level of interest shown by the County of Hawaii. If a partnership can be arranged, the State should be immediately responsive in supplying its share of the costs for the demonstration project.

AN OVERVIEW

Hawaii and the Sea–1974 makes more than 70 specific recommendations for State action, in subject areas ranging from Environment to Roles for Government, from Recreation to Industry, from Marine Resources to Commerce. Of these, 14 are highlighted as being of "critical" importance and are synopsized in this chapter.*

A number of themes appear and reappear in the various chapters of this report, to the point that they warrant special mention here.

- *A Concern For the Environment.* All recommendations have been assessed for their real or potential impact on Hawaii's environment. This has resulted, for example, in a recommendation that the environmental impacts of and effluent water from prototype mining of offshore sand should be monitored and analysed before the decision is made to utilize this resource. It has made the Task Force especially wary of alternative futures for the marine manganese industry in Hawaii, and supports our recommendation that the impact of candidate processing techniques should be carefully assessed to determine whether this potentially huge industry should be encouraged to settle here. It has led to a plea that sewage effluent, on the highest possible priority, should be diverted from Kaneohe Bay. It has also, however, resulted in a recommendation that Hawaii's open ocean waters are sufficiently robust and self-purifying to allow sewage treatment and disposal techniques which would be environmentally impossible in the coastal, riverine and lake waters of the continental United States. The common element here is a conviction--stated in Chapter 4 by the Task Force as a recommendation--that environmental standards should be based on a philosophy of "humanism" (greatest good for mankind) rather than

* We are painfully aware that "Hawaii and the Sea–1969" became known primarily for its 22 summary recommendations and that little action resulted from the many other recommendations stated only in the body of the report. On one hand, we feel it is necessary to emphasize those recommendations we consider to be "most important". On the other hand, topics which did not reach this priority level may be nearly as important, or more easily implemented, or have an emerging importance which was not yet apparent to us. Therefore, in addition to the top 14 recommendations we have included all others in tabular form in this chapter.

"naturalism" (return to pristine conditions). We believe these two standards need not be antagonistic.

- *The Need For Public Education.* Many of Hawaii's marine problems result from a general lack of understanding by the public of the ways in which Hawaii affects the sea and is affected by it. We believe that much greater emphasis on education is needed in this area. Recommendations to accomplish this include: (1) addition of an education function to the law enforcement arm of the Department of Land and Natural Resources, (2) additional training courses for fisherman, (3) a guidebook which explains reasons and techniques for control of erosional runoff, (4) extension of marine-oriented courses down into the primary grades of our schools, and (5) creation of a "Hawaii Ocean Center" which, among other functions, will display Hawaii's oceanic past and future.
- *Protection of our Marine Resources.* This has two key elements. The first is protection from *ourselves* (e.g., by licensing, exclusion and enforcement); the second is protection of the resources from uncontrolled foreign exploitation through extension of United States or State jurisdiction and control--but not necessarily sovereignty--over the waters and seafloors of the Archipelago.
- *Fixing of Responsibility.* We have examined many facets of Hawaii's marine affairs and the often confusing way in which responsibilities for its marine problems are allocated among agencies of the State government. We have noted that those recommendations in the 1969 report which most successfully resulted in State action were the ones which nominated specific agencies for action responsibility. And we have benefited from these observations. Except for a few generalized recommendations in the student chapter, all of our recommendations are coupled with nomination of a State agency to take initial action. In some cases, we may have pointed the finger in the wrong direction. If so, the nominated agency should still respond, at least to the point of finding a proper home for the recommendation.

Hawaii and the Sea–1974 has one characteristic which may make it totally unique in the annals of advisory reports. The dollar value of those recommendations which can save the State money, or which can generate new State income, is higher than the dollar cost of those recommendations which will require additional expenditures by the State. In a year of budget crunches, the temptation will exist to skim off the cream; to pay more attention to the first group of recommendations than the second. We hope this does not happen, and actions instead will be based upon proper assessment of the relative needs of the people of Hawaii.

Also, we need to point out that these cost savings are a direct result of past research, development and analyses in marine science and technology. When research in any field shows an ability to return a profit, industry has learned to continue or increase its support of that research. In the context of our report, this should be interpreted as a need to reinvest a part of these cost savings toward solution of those marine problems we have identified.

"MOST CRITICAL" RECOMMENDATIONS

In its final meeting, the Task Force selected 14 recommendations considered to be of such high priority that they warranted flagging with a "most critical" status. The criteria for selection required these recommendations--in competition with all others--to fit in one or more of the following categories.

- The recommendation must face a clear and imminent opportunity or danger of considerable magnitude.

- The recommendation must require rapid action by the State government. Such action can be expected to have a highly beneficial impact on Hawaii's future.
- The recommendation can result in a major cost savings to the State.

1. The Manganese Industry

Recent discoveries of metal-rich manganese crusts on the seafloor of the Hawaiian Archipelago have excited a high level of interest among mining companies of the United States and several foreign nations. Japanese, French, West German and United States industrial groups have already supported expeditionary ships to explore this resource. Preliminary analyses (Chapter 7) show a metal content with a post-refining value of nearly $800 per ton of ore at current market prices. About one-third of this value lies in the platinum content of the ore.

These manganese crusts are located in water depths of 3,000 to 6,000 feet, making them much easier and cheaper to harvest than the manganese nodules of the deep seafloor. The lifetime, at anticipated mining rates, of the identified deposits appears to be at least several centuries. While the economic value (profit potential) of the resource is not well established, it appears certain that it could be exploited at a healthy profit. An operation based on three to five mining ships, with the ore processed ashore in Hawaii, could result in manganese becoming Hawaii's largest single industry. Hawaii has several alternative futures as it faces this new industry.

- As a minimum, Hawaii's role would be limited to onshore support of the ships, crews and staff of a totally offshore industry. Environmental impact *should* be negligible, and economic impact would be both relatively small and limited to Oahu.
- At the next level, enrichment (beneficiation) of the ore would be carried out ashore, but with the final refining process done outside the State. This operation, which could be carried out on any island having a deep-draft port, would have economic and environmental impacts of yet unknown magnitude.
- At the highest level, refining would also be done in Hawaii. Expenditures in the State could approach a billion dollars per year. Potential environmental impacts would increase accordingly.

At these second and third levels of impact, the marine manganese industry would also become a powerful tool to carry out the State's announced policy of dispersion of population and industry to one or more of the Neighbor Islands.

The dangers are twofold. First, the beneficiation and refining processes needed by the industry are not presently known in Hawaii. *Neither are their environmental impacts.* Timely knowledge in these areas is critical to a wise decision on the desirability of the industry and its optimum location on shore.

Second, the resource is located on the seafloor, beyond all present limits of United States jurisdiction and control. Until this jurisdiction is resolved, neither the State nor the Federal governments can exercise legal control over the mining side of the industry, even though the resource is located within the geological boundaries of the Hawaiian Archipelago. This situation will probably inhibit United States mining of the manganese crusts. It may *accelerate* foreign involvement.

A detailed treatment of the resource value of the manganese crusts is given in Chapter 7, while Chapter 8 discusses potential industrial impacts on Hawaii. In Chapter 7, several recommendations are made for State action. These deal primarily with (1) rapid evaluation of the plans and processing techniques of all candidate mining companies, (2) assessment of candidate industrial sites on shore, and (3) recommended steps to an informed State position and policy on control of the resource.

2. Inter-island Marine Transportation

Chapter 8 assesses the need for a complete inter-island marine transportation system, and concludes that such a system is needed to economically and socially unite the islands and to support an infusion of light industry into the Neighbor Islands. A system having three components is recommended.

- A bulk-cargo transportation system.
- A passenger-only transportation system.
- A hybrid or ferry system, able to accomodate both passengers and roll-on/roll-off vehicles.

Of these needs, only the first two can be met by existing (Young Brothers' inter-island barge) or planned (Pacific Sea Transportation's Jetfoil) systems. Immediate State action is recommended to create the third system, for operations among *all* of Hawaii's major islands.

No recommendation is made concerning the question of State versus private ownership of the ferry system. It *is* pointed out that 70 percent of the total cost of a State-owned ferry can now be paid by the Federal Aid to Highways Act. It is further pointed out that industry will use the ferry system to support location or relocation to the Neighbor Islands only if it has complete trust in continuity of the service. If the ferry system is built and operated under private ownership, the State should be prepared either to guarantee (subsidize) its operation, or to buy the system outright if it proves unable to operate at a profit.

A new survey of public attitudes toward marine transportation, researched and written by students of the University's Marine Options Program, is presented as Appendix C. Subordinate recommendations, also included in Chapter 8, deal with the subjects of:

- Development of harbors and harbor facilities in the Neighbor Islands to support ferry operations, with special emphasis on a leeward port for the island of Maui.
- The need to monitor sea trials of the Navy-developed semi-submersible ship, because of the potential of that concept for inter-island ferry operations.
- The potential for in-Hawaii construction of such ferry ships if the semi-submersible ship concept proves feasible for local waters.

3. Restoration of Kaneohe Bay

The flora and fauna of Kaneohe Bay are deteriorating rapidly under the combined onslaughts of sedimentation, storm water and sewage effluents. The Kailua end of the bay is now heavily carpeted with fine sediments and has become so overfertilized by discharges from the nearby secondary-treatment sewage plant that even the algae--classic harbingers of pollution--are dying or have died. Algae infestations are now found on the corals of the outer edge of the barrier reef.

Kaneohe Bay is dying. Much of it is already dead. It is not certain whether even complete cessation of environmental assaults on the bay can, within our lifetimes, fully restore life to waters which, less than a generation ago, were world famous for the beauty of their corals and other marine communities.

This subject is treated in Chapter 4, which also makes recommendations dealing with control of runoff and sedimentation. Our most critical recommendation for Kaneohe Bay deals with sewage effluent, because its effects touch the entire bay, and because it is the most easily acted on. As a matter of highest priority, it is imperative that the State take rapid action to divert effluent from the Air Station and Kaneohe/Kailua sewage treatment plants *out* of Kaneohe Bay and into the open ocean. There is no reason for further delay, and every reason to have done it years ago.

4. Sewage Treatment Alternatives

Public Law 92-500, the Federal Water Quality Act Amendments of 1972, requires that all municipal sewage be subjected to

secondary treatment before discharge into navigable waters. (Today, Honolulu pumps untreated sewage into relatively shallow water just beyond the reef.) The club in the Federal law lies in the fact that compliance is necessary before the local government can be eligible for Federal cost sharing of the necessary treatment plant.

We believe this law is designed for a continental environment, and is appropriate where discharges must be made into rivers, lakes or the nutrient-rich shallow waters of a continental margin. It is not appropriate to Hawaii where our offshore waters tend to be:

- Deficient in nutrients; in fact, almost a marine desert.
- Extremely deep within a short distance offshore, so that deep outfalls can be used to trap effluent below the thermocline.
- Constantly swept clean by the gigantic oceanic currents which flow by the relatively minute land area of our islands.

As Chapter 4 argues in more detail, imposition of the continental standard to Hawaii would be more expensive in land, energy, capital investment and operating costs; and might do more harm to the environment than would a much less expensive advanced primary treatment system. The total cost difference, for Honolulu's Sand Island treatment plant alone, could amount to $20 million. For the entire State, additional costs for the first decade of compliance could approach $100 million.

Chapter 4 recommends that the State appeal for an exemption to Public Law 92-500 so that it can be allowed to replace secondary treatment of sewage with advanced primary treatment followed by deep discharge into the ocean. Such exemption should be granted without loss of or prejudice to Federal sharing of the cost of the treatment plants.

This will require a modification of Federal law; therefore, active support by Hawaii's Congressional Delegation is needed. The exemption should be granted on a case-by-case basis, with each case decided by application to the Environmental Protection Agency. Certain of Hawaii's coastlines more closely fit the continental standard than they do the model described above. We do not wish to see a blanket exemption for the entire State.

5. Marine Rapid Transit

The Task Force believes that a waterborne rapid transit system is a viable alternative to a fixed-roadbed transit system for Honolulu. Its advantages include:

- It could be built for about 15 percent of the enormous cost presently proposed for the fixed-roadbed system (approximately $200 million compared with approximately $1 billion).
- It would not add another barrier (like H-1) down the axis of the long thin strip which constitutes urban Honolulu.
- It would, in fact, require no roadbed at all. Except for harbor improvements and construction of relatively spartan terminal facilities, all costs could be invested in "people movers".
- Port-to-port transit times should be at least competitive with today's express bus system.
- The marine system could be placed in operation one route at a time. It could achieve first operations years ahead of any fixed-roadbed system.

Candidate craft include the Jetfoil and the semi-submersible ship. Both offer a stable comfortable ride in high seas and can use relatively unimproved harbors.

The system might be put into initial operation as an express run between Hawaii Kai and downtown Honolulu. We recommend that plans be made to offer fast service also to the Waianae coast, at least as far as Pokai Bay. As with present bus systems, government subsidy could support lower fares for students, free transit for senior citizens and similar incentives.

Chapter 8 points out that the marine rapid transit system is not recommended as a replacement for the current bus system. Instead, we see it taking enough pressure off conventional land transit that the combination of buses and ships can handle the total passenger load without the need for a third (fixed-roadbed) system. To work efficiently, the marine system must have operating schedules which are closely coordinated with local runs by Honolulu's buses. Chapter 8 also contains a recommendation for harbors to support the marine rapid transit system.

6. Resource Surveys

Chapters 6 and 7 contain recommendations that three resource surveys be carried out within the Hawaiian Archipelago. The Task Force decided that they should be grouped together and presented as a "most critical" recommendation. Each of the three surveys, however, has its own unique justification.

Fisheries Survey. The fisheries potential of the Northwestern Hawaiian Islands is not well known, and little survey effort has been invested in these islands. There is now increasing Federal pressure to have them declared a "natural wilderness area", which would effectively close them to fishing. We believe that Hawaii's increasing needs for fishery products, coupled with the recent introduction of vessels able to economically reach and fish these islands, and emphasized by their potential loss as fishery resources, are sufficient reasons for a survey of the fishery potential of the Northwestern Hawaiian Islands. This survey should be completed within three years. In the meantime, the Federal government should be asked to delay any declaration of wilderness status for these islands. As an alternative, it should be asked to include a stipulation that selected portions of the islands can be reopened to controlled fishing after the results of the survey have been analyzed.

Survey of Offshore Sand Deposits. For several years, Sea Grant has supported the University of Hawaii in a search for deposits of offshore sand and development of a prototype system to mine these deposits. Extensive offshore sand deposits have been found and technical feasibility of the sand mining system has been demonstrated. Potentially, these deposits could satisfy the needs of Hawaii's construction industry and furnish a viable alternative to crushing of basalt for sand or further mining of our beaches. Several important questions have not yet been answered.

- Is the sand of sufficient quality for industrial use?
- What are the environmental impacts of effluent water which results from the mining operation?
- Is the University's sand-mining system economically feasible?

Chapter 7 recommends that the State support a resource survey program to answer these questions.

Precious Coral Survey. Hawaii's precious coral industry is a highly visible and exotic symbol of the State's close involvement with the sea. Its size (about $7.5 million per year) and growth are limited by the availability of the raw material. The only Hawaiian beds known to have commercial feasibility are off Makapuu Head on Oahu and on Milwaukee Bank just beyond the northwestern end of the archipelago.

Japan is the traditional supplier of precious coral for Hawaii's jewelry industry, but is beginning to limit its exports and may stop them completely in the near future. Such an action would place the Hawaiian industry in hazard. It is ironic that most of the precious coral harvested by Japan is obtained from Milwaukee Bank.

A survey effort is needed to discover additional precious coral beds within the Hawaiian Archipelago. The most likely areas for survey are in the Northwestern Hawaiian Islands. We believe that a precious coral survey of these islands could readily be amalgamated with the fisheries survey described above.

7. Ship and Facilities Support

Hawaii and the Sea–1969 recommended Legislative support for operations of the University's research and survey vessels at a level of $500,000 per year. Until recently, this support has been given. In the 1973 session, ship support was cut back to $300,000. The result, greatly aggravated by the withdrawal of both National Marine Fisheries Service vessels from their Hawaiian port, has been a serious curtailment of the University's ability to support resource surveys of the type described in the previous section.

In addition, the 1973 Legislature failed to authorize the $200,000 for marine facilities support requested by the Marine Affairs Coordinator. This support *had* been given by previous sessions of the Legislature. Its abrupt withdrawal crippled a number of valuable programs in applied marine research.

We recommend that the Legislature restore these funds, to at least the former levels of $500,000 for ship support and $200,000 for facilities support. This $200,000 is included within House Bill 2263, the Marine Affairs Coordinator Bill, and is therefore assigned as a cost to "most critical" recommendation Number 12. At the same time, the University should be instructed to give a higher priority to allocation of ship support funds toward resource surveys within the Hawaiian Archipelago.

8. Archipelago Status

Under current marine law, as subscribed to by the United States, all of the channels which separate Hawaii's major islands contain a strip of international waters. The manganese and precious coral resources discussed in previous sections lie on international seabeds, beyond the limits of United States jurisdiction and control, and subject to exploitation by any nation which chooses to do so. These resources also lie within the general boundaries of our inter-island channels.

To protect these resources, Chapter 3 recommends that the State should press for a national policy of exclusive jurisdiction and control over all marine resources of the Hawaiian Archipelago. This control would be exercised within a boundary which contains all islands *and channels* of the archipelago. If possible, the recommended policy should be put into effect through negotiations at the 1974 International Law of the Sea conference. If this is not possible, it should be achieved by the Federal government through unilateral declaration.

Several aspects of this policy need emphasis. First, it does not claim *sovereignty* over areas not now sovereign territory, but only *jurisdiction and control.* This is the minimum legal position which can give the protection needed for the issuing of licenses for resource utilization, and the exclusion of foreign operators. Second, it allows the historical right of "Innocent Passage" for any foreign ship which asks to transit an inter-island channel. Finally, it is an *inward* extension of jurisdiction and control; an extension which is solidly based on the geological continuity of the Hawaiian Islands. As such, it need not set a precedent for *outward* extensions of sovereignty, jurisdiction or control by other nations over the waters and seafloors off their own coasts.

9. Hawaii Ocean Center

In 1970, the Legislature appropriated $100,000 for use by the Department of Planning and Economic Development in planning toward an oceanographic research park. Because of the State's financial austerity, these funds were not released. The Task Force now believes that events have caught up with the idea and, in Chapter 3, recommends that these funds should be redirected toward a facility called the "Hawaii Ocean Center".

Chapter 3 recommends also that a nonsalaried committee should be named to assist in the planning of this center. We

envision a facility which should eventually be self-supporting with the characteristics shown below.

- It would have an educational function, one attractive to both residents and tourists, to display and teach Hawaii's past, present and future involvement with the sea.
- It would be sited on the shoreline and would be an operating facility. Typical users of dockside space would include fishing vessels, University research ships, and non-Hawaiian or foreign ships of either type.
- It would furnish office and laboratory space to local research and (light) industrial activities. Similar space would be offered to firms or activities which have come to the islands on a temporary or tentative basis, which need or desire to be near a focus of marine activity, or which wish to avoid the expense of setting up an independent facility.
- It could--but need not--be located on a single site. Branch activities or traveling displays might be located on all of our major islands. Present facilities such as the Waikiki Aquarium might be brought under the management umbrella of the Hawaii Ocean Center.

10. Division of Marine Resources

We believe that the State's ability to plan and manage its marine activities has been inhibited by two serious deficiencies. First, responsibilities in this area are too broadly diffused among nearly all agencies of the State government. This makes communication cumbersome, and coordination difficult--since it is often not a simple task for officials of one agency to know who is or is not exercising responsibility in areas of uncertain jurisdiction.

Second, many of these areas of marine responsibility are allocated to agencies or Divisions which historically are land-oriented. This approach does not work. Hawaii's marine problems will not be solved, and its marine opportunities will not be realized, with a philosophy of management which considers the ocean simply as an extension of the land.

As an interim measure, Chapter 3 recommends that a Division of Marine Resources be established within the Department of Land and Natural Resources. Initially, this Division would be assigned most or all of the areas of marine responsibility now held by the Department. Ultimately, it should be raised to Department status--by addressing new marine opportunities and problems, or by accepting responsibilities transferred from other Departments, or by some combination of these.

11. Coastal Zone Management

In 1973, the Legislature passed Act 164 which mandated the Department of Planning and Economic Development to prepare a Coastal Zone Management Plan. This plan was to be written in response to the National Coastal Zone Management Act of 1972. Its completion would make the State eligible for Federal sharing of part of the costs of management of the coastal zone.

This plan will be difficult to write, and we have little quarrel with actions taken to date. We would like to ask for consideration, before it is too late to affect the plan, of three points we consider vitally important.

- Except for high altitude regions which extend above the trade winds, all of Hawaii is part of the coastal zone. Whatever happens in any part of our watershed is likely, sooner or later, to affect the coastline and offshore waters. Planning for the coastal zone must not stop at the vegetation line, or at the landward limit of the shoreline setback, or even at the edge of our palis.
- At least as much effort should be invested to determine the goals of coastal zone management as is spent to devise the management structure and techniques which will be used to achieve these goals.

- Too often in our marine experience, we have been subjected to management structures and techniques which were set up primarily for the convenience of management--to the point that they interfered with solutions of problems, rather than aiding these solutions.

Certain of the Federal and State water quality standards might illustrate this problem. It is much easier to manage and enforce standards consisting (for example) of fixed numerical limits for temperature of heated effluent water, oxygen concentration, or coliform count than it is to enforce standards based on environmental impacts. But the result is (or can be) a totally irrational set of standards which, even if achieved, do a disservice to both mankind and the environment.

12. Marine Affairs Coordinator

We believe that Hawaii's Marine Affairs Coordinator (MAC) has performed in an outstanding manner since that office was created more than three years ago. He has ably represented the State's marine interests locally, in Washington and in several foreign countries. He has brought a number of important, highly visible marine technology projects to Hawaii, notably the diving physiology program and the "Floating City" program, both at the University of Hawaii. Through his second position as Dean of Marine Programs, he has had a major beneficial impact on marine education in the State, especially in educating the student destined for nonmarine professions.

But the multiversity of his talents and accomplishments is also the source of a problem. MAC and his small staff are overloaded, required to be in too many places at conflicting times, and have too many responsibilities for the minimal staff resources of the office. The Task Force considered a recommendation that the MAC and Marine Programs offices be separately headed, but decided that this step would cause more problems than it would solve by disrupting a very effective relationship between MAC and the University.

In Chapter 3, we recommend that additional staff funds be granted to the MAC office, earmarked to increase that office's technical staff. We also recommend that MAC recruit a nonsalaried Marine Affairs Advisory Council and use it both as a sounding board and an aid to coordination with State, public and private marine activities.

Finally, we recommend that the Legislature pass the Marine Affairs Coordinator Bill (HB 2263). This bill creates a fund for rapid response to unexpected problems in marine affairs, administered by a manager of high technical competence who is subject to close legislative scrutiny on an annual basis. In practice, over half of the fund has also been usable as critically needed State matching funds for the Federal Sea Grant program.

13. Groundwater Injection

With some concern, the Task Force has noted (Chapter 4) an escalation of plans to inject municipal and industrial wastewaters into Hawaii's groundwater strata. We also note that pre-injection surveys of the characteristics of these strata, migration and alteration patterns for these injected waters, and possible influences on nearby coastal waters have, at best, been sketchy. In many areas of the State, these groundwater strata also serve as primary sources of our fresh water. We are concerned that an action which could have serious and lasting impact on the quality of our groundwater is being taken with inadequate knowledge of the consequences. The risk, based on present knowledge, appears far too great for the relatively minor economic benefits to be gained.

The Water Resources Research Center has requested that pre-injection surveys be made of marine flora and fauna in adjacent coastal waters and these areas be periodically monitored after injection begins so that environmental impacts can be quickly discovered. No such actions have been taken.

In Chapter 4, the Task Force recommends that the recommendations of the Water Resources Research Center should be carried out.

14. Shoreline Development

Hawaii and the Sea–1969 recommended that "...on all publically-owned shoreline lands which are less than fully developed, irrespective of zoning or land-use classification, there should be 300 feet of open space dedicated to public use...".

In 1970, the Legislature passed the Shoreline Setback Law. This law prohibits sand mining and regulates construction within a shoreline setback zone not less than 20 feet and not more than 40 feet inland from the upper reaches of the wash of the waves.

The Task Force believes that an additional step is needed beyond the 1970 legislative action. In Chapter 4, we recommend that environmental impact statements should be required by law for all developments and major construction *on both public and private land,* within 300 feet of the present inland boundary of the shoreline setback zone.

Such new legislation should not affect minor construction, such as would be carried out for or by the individual homeowner. For example, construction of a privacy fence, or a single-family dwelling, would be adequately covered under existing law. The intent of our recommendation is to gain a further measure of environmental control over large development and civil engineering projects.

LIST OF RECOMMENDATIONS

The two tables which follow synopsize all recommendations made in *Hawaii and the Sea–1974.* The first table lists the 14 recommendations we consider to be most critical. The second table, which includes these 14, contains *all* recommendations made in the report.

In the tables, estimated cost savings and incomes are shown in parentheses. Entries that represent additional expenditures are expressed as *total* costs––that is, without further comment on the origin of the funding required. These do not necessarily represent cost to the State. For example, 90 percent of the cost of the Marine Rapid Transit System and 70 percent of the cost of the Marine Inter-island Transportation System can be funded under existing Federal programs, if these systems are owned by the State.

The following abbreviations are used to identify the State agency nominated for action responsibility.

AG	Office of the Attorney General
CONG	Hawaii's Congressional Delegation
DLNR	Department of Land and Natural Resources
DMP	Dean of Marine Programs, University of Hawaii
DOA	Department of Agriculture
DOE	Department of Education
DOH	Department of Health
DPED	Department of Planning and Economic Development
DOT	Department of Transportation
GOV	Office of the Governor
LEGIS	The State Legislature
MAC	Office of the Marine Affairs Coordinator
UH	University of Hawaii

Capital Improvement Program costs are entered in the tables as "CIP".

Hawaii And The Sea--1974; "Most Critical" Recommendations (Page 1)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
7-10	A series of recommendations relating to a marine manganese industry in Hawaii:		
	• Increase State support for the University of Hawaii Manganese Research Program.	UH	250/yr
	• Analyze the manganese industry and its potential economic benefits.	DPED	50
	• Analyze potential industrial sites, processing techniques and environmental impacts.	DPED	100
	• Define a legal position for the State in jurisdiction and control of this industry.	AG	25
8-7	Prepare a Bill for the ferry-ship component of an inter-island marine transportation system. (Cost estimated for 4 ships, each of 1,000-to-1,500-ton displacement. Harbors are recommended separately.)	DOT	20,000 CIP
4-12	Accelerate "as rapidly as possible" present plans to divert effluent of all sewage treatment plants from Kaneohe Bay.	DOH	—
4-12	Press for exemption, on a case-by-case basis, from Federal requirements for secondary treatment of municipal sewage.	DOH	(20,000) (1,000/yr)
8-9	In cooperation with the City and County of Honolulu, prepare plans and submit Bill for a marine rapid transit system, as an alternative to a fixed-roadbed system. (Cost and savings are estimated for the complete system, less harbors which are recommended separately.)	DOT	150,000 CIP (850,000)
	Three surveys of Hawaii's marine resources:		
6-4	• To determine fishery potential of the Northwestern Hawaiian Islands	DLNR	100 CIP
7-3	• To determine commercial potential for mining of known offshore sand deposits	DLNR	100 CIP
7-5	• Discovery expedition to find new beds of precious coral.	DLNR	100 CIP
3-1	Form a Division of Marine Resources within the Department of Land and Natural Resources.	DLNR	75/yr
3-6	Restore, to pre-1973 levels, State support for research/survey ships and marine facilities. Funds for facilities are included within the Marine Affairs Coordinator Bill (House Bill 2263) and are listed below.	UH MAC	200/yr
3-4	Pursue "all possible avenues" toward a Federal policy of	AG	75

* Cost savings are shown in parentheses.

Hawaii And The Sea--1974; "Most Critical" Recommendations (Page 2)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
	jurisdiction and control over marine resources of the Hawaiian Archipelago.		
3-5	Use funds already appropriated to plan a "Hawaii Ocean Center"; to include expositional, educational, research and light industrial functions.	DPED	—
4-16	Place emphasis on goals and Hawaii's "uniqueness" factors in preparing a plan for management of the State's coastal zone. (DLNR, UH and County cooperation is needed.)	DPED	200 CIP
3-2	Increase technical staffing of the Marine Affairs Coordinator Office, establish a nonsalaried advisory council, and pass House Bill 2263.	GOV LEGIS	60/yr 460
4-14	Determine environmental impact of injection of wastewaters into the groundwater strata *before* allowing large-scale use of this disposal technique.	DOH	100
4-15	Require Environmental Impact Statements for all development and major construction, on public and private land, within 300 feet of the shoreline setback line.	DLNR	50/yr
	Estimated Additional Costs ($000's):	One Time Per Year	$171,310 635
	Estimated Cost Savings ($000's)	One Time Per Year	$870,000 1,000

For comparison, the costs and cost savings shown below summarize the impact of all recommendations made in *Hawaii and the Sea--1974.*

Estimated Additional Costs ($000's)	One Time Per Year	$205,295 2,930
Estimated Cost Savings ($000's)	One Time Per Year	$870,000 2,200

Hawaii And The Sea--1974; Summary Of Recommendations (Page 1)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
3-1†	Form a Division of Marine Resources within the Department of Land and Natural Resources.	DLNR	75/yr
3-2†	Increase technical staffing of the Marine Affairs Coordinator Office, establish a nonsalaried advisory council and pass House Bill 2263.	GOV LEGIS	60/yr 460
3-4†	Pursue "all possible avenues" toward a Federal policy of jurisdiction and control over marine resources of the Hawaiian Archipelago.	AG	75
3-4	Establish a "Uniqueness Commission" to safeguard interests of those states and territories which are unlike the continental standard.	GOV	50/yr
3-5†	Use funds already appropriated to plan a "Hawaii Ocean Center".	DPED	—
3-6	Request that the National Marine Fisheries Service vessel CROMWELL be returned to its Hawaiian base.	CONG	—
3-6†	Restore, to pre-1973 levels, State support for research/survey ships and marine facilities. (Costs for facilities included within House Bill 2263.)	UH MAC	200/yr
3-7	Develop a long-range CIP marine facilities program, to include research/survey ships.	DMP	25 CIP
3-7	Respond rapidly to Legislative Reference Bureau's recommendations on conversion of Waikiki Aquarium into a marine education center.	LEGIS	?
4-5	Supplement water quality monitoring program with a study of biological communities present at each monitoring station.	DOH	50/yr
4-7 4-8	Interpret the phrase "equivalent to best practicable treatment" (of effluent water) to mean treatment that is both technologically practicable and best in terms of long-term human welfare.	DOH	50/yr
4-9	Give higher priority to research concerning impacts of water quality on marine biosystems.	UH	—
4-9	Revise temperature standards for waste heat to incorporate upper and lower limits, as well as maximum allowable changes from ambient temperatures.	DOH	20
4-12†	Appeal for exemption, on case-by-case basis, from the Federal requirement for secondary treatment of	DOH CONG	(20,000) (1,000/yr)

* Cost savings are shown in parentheses.
† "Most critical" recommendation

Hawaii And The Sea––1974; Summary of Recommendations (Page 2)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
	municipal sewage.		
4-12†	Accelerate "as rapidly as possible" present plans to divert effluent of sewage treatment plants from Kaneohe Bay.	DOH	—
4-13	Set minimum performance standard for prevention and control of sedimentation due to runoff. Publish guidebook on techniques for control of such erosion.	DOH DLNR	50
4-14†	Determine environmental impact of injection of wastewaters into the groundwater strata *before* allowing large-scale use of this disposal technique.	DOH	100
4-15	Set new depth/distance limits on mining of offshore sand, based on conservation of the littoral cell.	DLNR	25
4-15	Monitor environmental impact of effluent water from initial prototype mining of offshore sand. (See also Chapter 7.)	DLNR	75 CIP
4-15†	Require Environmental Impact Statements for all development and major construction, on public and private land, within 300 feet of the shoreline setback line.	DLNR	50/yr
4-15	Test Oil Spill Disaster Plan through mock mobilizations.	DOT	20/yr
4-16	Establish Marine Natural Area Reserves off the shores of all of Hawaii's major islands.	DLNR	200 100/yr
4-16†	Place emphasis on goals and Hawaii's "uniqueness" factors in preparing a plan for management of the State's coastal zone. (DLNR, UH and County cooperation is needed.)	DPED	200 CIP
5-4	Select, and recommend for approval by the Governor, at least one additional marine park on each of Hawaii's major islands.	DLNR	50
5-4	Determine feasibility of public or privately owned undersea observation facilities at each of Hawaii's marine parks.	DLNR	10
5-4	Take immediate action to preserve Hawaii's natural recreational resources; e.g., through concept of zoning for specific uses.	DLNR	10
5-5	Take immediate steps to open all existing publically controlled beach access routes, and keep them	DLNR	200 100/yr

* Cost savings are shown in parentheses.
† "Most critical" recommendation

Hawaii And The Sea--1974; Summary of Recommendations (Page 3)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
	maintained and well marked. Determine need for new access routes where none now exist. (County cooperation needed.)		
5-5	Press for opening to public access of certain military lands that border the ocean.	DLNR	—
5-6	Develop plans, priorities and environmental impact statements for restoring the recreational potential of Hawaii's coastal waterways.	DLNR	125
5-7	Appropriate funds to implement recommendations of Department of Transportation for additional boat launching ramps for all of Hawaii's major islands.	DOT LEGIS	1,400 CIP
5-7	Conduct a survey, to include non-boatowners, to determine total State need for additional marinas.	DOT	50 CIP
5-7	Precede all construction of new launching facilities and marinas with an Environmental Impact Statement.	DOT	50/yr
5-8	Increase registration, moorage and (possibly) launching ramp fees for boating to the national average; e.g., double or triple current fees.	DOT	(700/yr)
5-8	Devise a water safety plan for Hawaii; to include education, training, enforcement and zoning.	DLNR DOT	30
6-2	Formulate two alternative fishery policies; one based on present State jurisdiction and the second based on extension of United States jurisdiction over the entire Hawaiian Archipelago.	DLNR	50
6-2	The new Division of Marine Resources (page 3-1) should include research, advisory service and public education functions.	DLNR	250/yr
6-3	Modify present policy for licensing of fisheries; to increase commercial fees, to levy landing fees, to establish fees for recreational fishing and to establish limited entry into certain fishery stocks.	DLNR	(500/yr)
6-4†	Complete intensive fishery survey of the Northwestern Hawaiian Islands within three years. (With University of Hawaii and National Marine Fisheries Service.)	DLNR	100
6-4	Request that Federal declaration of the Northwestern Hawaiian Islands as a "natural wilderness area" follow and be based upon survey of the fishery and precious coral stocks in those islands.	DLNR	—

* Cost savings are shown in parentheses.
† "Most critical" recommendation

Hawaii And The Sea--1974; Summary of Recommendations (Page 4)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
6-6	Continue to support fishery programs of the Pacific Islands Development Commission, and press for direct Federal funding of these programs.	DPED CONG	25/yr
6-6	Explore, with Hawaiian Tuna Packers, ways to continue operation of this cannery in Hawaii.	DPED	—
6-6	Explore setting State standards for fishery products landed by Hawaiian vessels and consumed within the State.	DOH	—
6-6	Investigate possible uses for shark meat in Hawaii. If not successful, reestablish the nonbounty program for regional eradication of sharks. (Costs shown are for nonbounty program.)	DOH DLNR	100/yr
6-7	Develop a "status of the stock" report for inshore fisheries, together with a plan for management of this resource.	DLNR	100
6-7	Determine population dynamics for snappers, akule, opelu and Kona crab. Investigate policy of limited entry to these fisheries.	DLNR	150
6-8	In management of recreational fishing, update fish and game laws, improve enforcement efficiency and add an educational function for enforcement officers.	DLNR	100/yr
6-8	Accumulate data necessary to support an effective coral reef management system.	DLNR	100
6-10	Continue support of Hawaii's developing aquaculture programs, including a possible demonstration operation in a fully-restored fishpond.	DLNR DPED DOA DOH	100/yr
6-11	Sponsor a series of harbors or basins, throughout the State, for support of Hawaii's fisheries (to be eventually self-supporting).	DOT DLNR	5,000 CIP
6-11	Add additional funds to the (self-supporting) Fishing Vessel Loan Program.	DLNR	1,000
6-11	Investigate availability of loans for fishing vessels under the Federal Farm Credit Act of 1971.	DLNR	—
6-12	Support expanded fishery training program at the Leeward Community College.	UH DPED	75/yr

* Cost savings are shown in parentheses.
† "Most critical" recommendation

Hawaii And The Sea--1974; Summary of Recommendations (Page 5)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
7-2	Complete, within 2 years, a report estimating the volume and quality of all sand and gravel resources, land and marine, within the State.	DLNR	75
7-3†	Investigate quality of known offshore sand deposits, and support prototype mining to determine commercial feasibility. (See also Chapter 4.)	DLNR	100
7-5†	Support discovery expedition to find new commercially-feasible beds of precious coral.	DLNR	100
7-5	Develop policies to manage and protect Hawaii's precious coral resource on a principle of sustained yield, and encourage development of low-cost, selective harvesting techniques.	DLNR	25
7-5	Promote identification of Hawaii, and its interest in the sea, with precious coral.	DPED	—
7-10†	A series of recommendations relating to a marine manganese industry in Hawaii:		
	• Increase State support for the University of Hawaii Manganese Research Program.	UH	250/yr
	• Analyze the manganese industry and it potential economic benefits.	DPED	50
	• Analyze potential industrial sites, processing techniques and environmental impacts.	DPED	100
	• Define a legal position for the State in jurisdiction and control of this industry.	AG	25
7-11	Develop a proposal to demonstrate economic and environmental feasibility of a geothermal/solar/ocean energy-producing system in Hawaii.	MAC	15
8-7	Appoint a nonsalaried Hawaii State Transportation Committee to assist the Department of Transportation in planning a total State transportation system.	GOV DOT	50/yr
8-7	Prepare a master plan for a complete inter-island marine transportation system; to include ship types, schedules and harbor facilities.	DOT	100 CIP
8-7†	Prepare a Bill for the ferry-ship component of an inter-island marine transportation system. (Cost shown is estimated for 4 ships, each of 1,000-to-1,500-ton displacement. Harbors are recommended separately.)	DOT	20,000 CIP
8-7	Monitor and evaluate Navy sea trials of its 190-ton semisubmersible ship model to determine potential of	DOT	100 CIP

* Cost savings are shown in parentheses.
† "Most critical" recommendation

Hawaii And The Sea--1974; Summary of Recommendations (Page 6)

Page	Recommendation	Action Agency	Added Cost Or Cost Saving* ($000's)
	this approach for use as inter-island ferry.		
8-9†	In cooperation with City and County of Honolulu, prepare plans and submit Bill for a Marine Rapid Transit System for Honolulu as an alternative to a fixed-roadbed system. (Costs and savings are estimated for the complete system, less harbors.)	DOT	150,000 CIP (850,000)
8-12	In the State master plan for primary harbors, assign highest priority to upgrading the capabilities of Kawaihae, Kaunakakai and Barbers Point Harbors.	DOT	—
8-13	Prepare and submit a Bill for a series of harbor and terminal facilities to support an inter-island passenger boat and ferry system, with special response to the need for a protected harbor for leeward Maui.	DOT	10,000 CIP
8-13	Prepare and submit a Bill for a series of small harbor and terminal facilities to support a marine rapid transit system for leeward Oahu.	DOT	15,000 CIP
8-15	If the semisubmersible ship is chosen as an element of Hawaii's inter-island or marine rapid transit systems, explore with local industry the possibility of its construction in Hawaii.	DOT	
NOTE: Recommendations summarized from Chapter 9 are those which are unique; i.e., not treated in chapters written by the Task Force.			
9-4	Establish breathing-air standards and nonpunitive controls for commercial SCUBA air stations.	DOH	25/yr
9-4	Establish system of emergency, portable decompression units which can be more rapidly available at the site of a diving emergency.	DOH	50/yr
9-4	Require State licensing of diver training programs and diving instructors.	DLNR	30/yr
9-5	Establish a nonsalaried commission to set guidelines and priorities for State support of marine research and facilities.	GOV	20/yr
9-6	Establish a commission, similar to the Land Use Commission, to safeguard the public's interests when proposals are made to develop within the coastal zone.	GOV	50/yr
9-8	Establish marine-oriented education programs at all age levels, beginning with the elementary grades.	DOE	1,000/yr

* Cost savings are shown in parentheses.
† "Most critical" recommendation

CHAPTER 3: THE ROLE OF GOVERNMENT

The Task Force takes the position that institutions should not be lightly changed or reorganized unless there is a major mismatch between the program goals and content and the institutional arrangement. As a corollary, we believe that modification or adaptation of existing institutions to better match program goals is a continuing requirement of a dynamic society. We sense this philosophy in the original recommendations of *Hawaii and the Sea–1969.* Those which dealt with the role of State and local government included the following:

- The establishment of a Marine Executive Director, Staff and Council to advise the Governor.
- The creation of a Marine Programs entity at the University of Hawaii and the establishment of a College of Marine and Geological Science.
- The development of a marine science park.
- The development of a Pacific Center of Marine Science and Information.
- Financial support for marine facilities.

Many of these recommendations have been implemented, largely (we believe) for the benefit of the State.

ORGANIZATION

In an oceanic state, almost every department of the State, the University, private institutions and private industry should have some interaction with the sea. Industries as land-oriented as the automotive industry, interior decoration or gardening and landscaping, on the one hand, must concern themselves with protection against the dampness and salt air, while industries such as tourism, recreation and transportation, on the other, must have a vital and major involvement in the ocean.

With this in mind, our report confines its recommendations to institutional changes which will broaden the awareness of ocean opportunities and problems on the part of the total society––national, state and private.

Marine Resources Division

In view of the broad interests of the State, our marine resources must receive increased emphasis. The licensing, regulation and monitoring of the mining of manganese nodules and sand resources; the development of open sea mariculture; the increasing interest in coral reefs for coral, fish, recreation, etc.; all suggest a strengthening of the Department of Land and Natural Resources in order to anticipate the opportunities and problems these resources will create.

Recommendation

A Division of Marine Resources should be created within the Department of Land and Natural Resources. Further, the Division should be established with the intent of eventually expanding into a Department of Marine Resources as an independent State agency.

Marine Affairs Coordinator

The recommendation for the establishment of an Executive Director for Marine Affairs in the Office of the Governor was fully met by the Legislature when it funded the position of Marine Affairs Coordinator. The initial appointee to that position also serves as the Dean of Marine Programs at the University of Hawaii. This post was created following a recommendation in the 1969 document that the University "gather the parts of its present program in marine sciences and engineering into a single entity".

The circumstance that the same individual has filled both positions since their inception in no way alters the fact that the positions of Marine Affairs Coordinator and Dean of Marine Programs are two different

and distinct areas of duty and responsibility. Both positions have important roles to fill in reaching Hawaii's objectives in regard to ocean resources and the total oceanic environment.

It is vital that both these offices be adequately and appropriately staffed to carry out the broad policy making, coordinating, advisory and executive functions intended by *Hawaii and the Sea–1969.* It is our conclusion that, within the limits of the resources that have been made available, significant progress has been made in carrying out the policies set forth in the 1969 report.

Much remains to be done, and we believe that the technical staff of the Marine Affairs Coordinator's office should be augmented so that all sectors of Hawaii's marine community can be more adequately serviced in the future.

We also believe that now, more than ever before, there is need for the establishment of a Marine Advisory Council to help guide the Marine Affairs Coordinator in his long-range planning. Such a Council should include representatives of all segments of the marine community, both public and private.

The council should include representatives from industry and the many State agencies involved in marine affairs; in particular the Departments of Land and Natural Resources, Transportation, Health, Agriculture, Planning and Economic Development and the University.

Finally, we recommend that the Legislature pass the Marine Affairs Coordinator Bill (HB 2263). This Bill creates a fund for rapid response to unexpected problems and opportunities in marine affairs, administered by a manager of high technical competence who is subject to close legislative scrutiny on an annual basis. In practice, over half of the fund has also been usable as a critically-needed State match for the Federal Sea Grant program.

Recommendation

The Legislature should provide increased, full-time, technical staffing for the Office of the Marine Affairs Coordinator.

The Governor should strengthen the Office of the Marine Affairs Coordinator through the establishment of a Marine Advisory Council composed of individuals representing all sectors of the community having vital interests in the ocean and its potential.

The Legislature should pass the Marine Affairs Coordinator Bill (HB 2263). In doing so, it should add a statement (or separate resolution) which recognizes the value of these funds as a State match to the Federal contributions to Hawaii's Sea Grant program.

TERRITORIAL JURISDICTION

The territories of the State stretch virtually the full length of an archipelago extending nearly 1,500 miles from the "Big Island" of Hawaii to northernmost Kure Island. The submerged portions of the Hawaiian Archipelago contain many valuable geological and biological resources, such as precious coral, manganese crusts, fisheries and sand. In the administration of such natural resources, reliance must be placed upon State, Federal and international law. It would be desirable if the State of Hawaii could have jurisdiction and management authority over these biological and geological resources which are part of the submerged archipelago land mass.

The primary problem relates to uncertainty of jurisdiction over the resources of the deep ocean. States have jurisdiction over the inner continental shelf, i.e., that area between the shoreline and the three-mile seaward limit of the territorial sea (Submerged Lands Act of 1953). Beyond the three-mile limit, the Federal Government

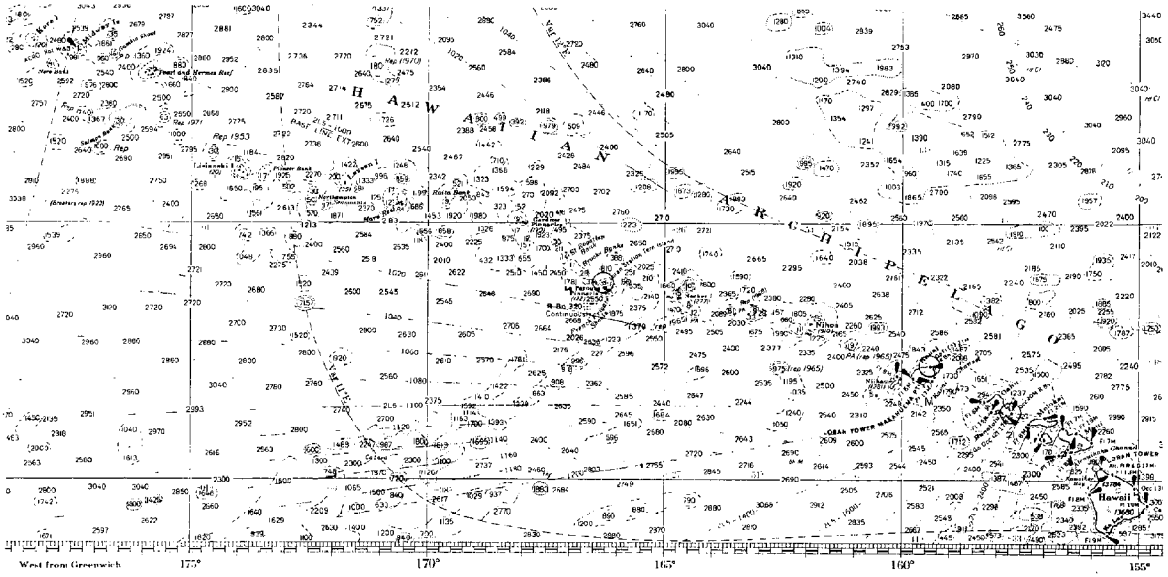
exercises exclusive jurisdiction. This jurisdiction, however, is defined in a number of ambiguous ways.

- The fishery resource is controlled in a "contiguous" zone which extends 12 miles from the shoreline.
- Under the Outer Continental Shelf Lands Act of 1953, the Federal Government has exclusive leasing authority over the adjacent seabed. The Act, however, fails to define a seaward limit for the "Continental Shelf".
- As a signatory to the 1958 Geneva Convention on the Continental Shelf, the United States has sovereign rights for the purpose of exploitation of seafloor resources to a water depth of 200 meters (656 feet) or, beyond that limit, to *"where the depth of the superjacent waters admits the exploitation of the resource"*. The meaning of the emphasized phrase is ambiguous and has been the subject of much controversy. Using only the 200-meter criterion, however, United States sovereignty over its seabed extends more than 100 miles offshore from the coast of the northeastern states.

These laws are seriously deficient as they do not take into account Hawaii's island and archipelago character. Under terms of the Admissions Act, Hawaii acknowledged the Outer Continental Shelf Lands Act as part of the Statehood Charter. Nevertheless, the Admissions Act is silent with respect to the width of sea under Hawaiian jurisdiction. Although silence might presume the standard three-mile limit for territorial delineation, the actual breadth of State jurisdiction may find its roots in Hawaiian history.

The Kingdom of Hawaii had in fact established its jurisdiction over the Archipelago on the basis of a line connecting the high points of each island with a zone of sovereignty on either side of such a line. Such a claim of sovereignty over the Archipelago was not abrogated by either the Territorial or Statehood Acts.

Early in 1973, the Governor requested the State Attorney General to make a study of State rights to resources in Hawaii's Archipelago waters. This is an ongoing project which will consider Hawaii's historical rights and jurisdictions and study possible positions the State might take in establishing claims. The State should also be prepared to take a



The Hawaiian Archipelago extends from the Island of Hawaii to Kure Island, a distance of nearly 1,500 miles.

position which supports Federal control over the waters and seafloor of the Archipelago as an alternative which offers sufficient protection for these resources.

Recommendation

The Attorney General should continue to pursue all possible avenues which could lead to State or United States jurisdiction and control over the marine resources of the Hawaiian Archipelago. The State should cooperate with the Federal Government to ensure that Hawaii's position is strongly stated in future International Law of the Sea Conferences.

HAWAII'S UNIQUENESS

There are serious deficiencies in certain Federal-State relationships because Hawaii is unique and often has needs and problems unshared by the other states. We note that Federal standards for the environment, transportation, agriculture, commerce and industry, the atmosphere, the coastal zone, and even the ocean, are based on the average climate of the North Temperate Zone and on a continental configuration of contiguous states. Such standards may not apply to Hawaii and may be inappropriate or deleterious. For example, Federal standards for sewage treatment are contrary to the best interests of our vast, nutrient-poor ocean; they establish a mainland standard which initally calls for secondary treatment of discharges and, ultimately, fresh water discharge with land disposal of nutrients. Such treatment may be appropriate for most mainland communities, but local studies (see Chapter 4) indicate that for Hawaii the most environmentally effective form of sewage disposal consists of advanced primary treatment with a deep ocean discharge.

Other regulations and standards established for mainland conditions are not suitable for Hawaii because of our unique characteristics: all interstate and intercounty transportation must be by sea or air; our island climate is dominated by mountains, sea and trade winds; we are isolated from other states and 2,000 miles distant from the nearest land mass; and almost the entire state is a coastal zone.

These peculiarities suggest either blanket legislation permitting Hawaii to set its own standards in lieu of Federal standards when conditions singular to Hawaii can be demonstrated or, in the alternative, individual clauses in each new Federal enactment recognizing this environment. Examples of uniqueness legislation include Hawaii's recent exemption from continental Daylight Saving Time and the specific rider to the Highway Bill which authorizes Trust Fund monies for Alaska and Hawaii to be employed for ferry systems which extend beyond the three-mile limit.

Other states and territories of the United States which find themselves in a similar position include Alaska, Guam, the Virgin Islands, Samoa, Puerto Rico and the Florida Keys (if not the entire state of Florida). Hawaii and the Pacific Territories formed the Pacific Islands Development Commission (PIDC) in February 1970 to represent common interests. The Commission consists of the Chief Executives of the governments of Hawaii, American Samoa, Guam and the Trust Territory of the Pacific. PIDC's first priority has been to stimulate the development of the considerable latent skipjack tuna fishery resource of the Central and Western Pacific.

We strongly endorse the Pacific Islands Development Commission and its goals and encourage its continued support by the State and Department of Planning and Economic Development, which currently is the secretariat for the Commission.

Recommendation

A noncontiguous United States Commission should be created, composed of representatives of the states and territories outside of the mainland forty eight. Such a

commission could review the impact of Federal legislation on the outer states and territories and recommend changes to correct any inequities created therein.

OCEAN CENTER

Hawaii and the Sea–1969 and this report bear witness to the overriding importance of the ocean in the economic, social and cultural life of Hawaii. Tourism, trade, fishing, enjoyment of nature, as well as Hawaii's historic roots, and even the State's weather, depend heavily on the sea. The execution of many plans and projects recommended in this updated document on *Hawaii and the Sea* will require public understanding of the State's dependence on the sea. We strongly endorse a recommendation made in the 1969 report concerning the establishment of an oceanographic research park. The earlier concept should be expanded, however, to include cultural, historic and light industrial marine activities. On the basis of the 1969 recommendation, $100,000 was authorized for initial planning studies for such a marine park, but the studies have not been done.

As now envisioned, the oceanographic park will become the Hawaii Ocean Center, with functions to include education, information exchange, the housing of permanent and temporary exhibits, and the provision--together with other State and private entities--of planning facilities for mission-oriented, sea-related research developments. Such a Center should be planned so that it will eventually become self-supporting.

The Center's education and information exchange functions are to be discharged through exhibits which deal with Hawaii's relation to the sea--past, present and future. Thus, we envision Center components that deal with life in the sea, the sea in Hawaii's history, the sea in Hawaii's industry and commerce, the sea as an inspiration for art and esthetic experiences, and imaginative projections of what the sea will mean in Hawaii's future (i.e., minerals, energy generation, new modes of travel, recreation, transport of goods, mariculture, etc.).

Plans for the 1976 United States Bicentennial celebration and exhibition, as well as those for Hawaii's own bicentennial celebration and exhibition in 1978, have sea-oriented components. These could well be coordinated with plans for the Hawaii Ocean Center.

Planning is needed to evaluate site selection, determine organization structure and propose a pattern of administration of a phased budget, to include ways to attract industry and other non-state funds into the venture.

In this effort, the Department of Planning and Economic Development should seek inputs from the Department of Land and Natural Resources, the Department of Education, the University of Hawaii, the counties of the State (Neighbor Island subcenters are contemplated which may be more development than information oriented), the Hawaii Bicentennial Commission, the Chamber of Commerce, certain Federal agencies, Hawaiian industry, Hawaiian art circles and cultural and public exhibit organizations such as the Bishop Museum and Sea Life Park.

Recommendation

The $100,000 appropriated in 1970 to the Department of Planning and Economic Development for planning an oceanographic research park on Oahu should be released and should include the additional activities envisioned for the Hawaii Ocean Center.

Also, the Governor should appoint an interim advisory committee to assist the

Department of Planning and Economic Development in planning the Hawaii Ocean Center and see the Center through to its establishment, at which time a more permanent administrative body would be formed.

FACILITIES AND SHIP SUPPORT

Some of the existing private oceanic institutions of the State have had difficult times since *Hawaii and the Sea–1969* was written. The organizations that occupy the Makapuu complex have all undergone reorganizations; the most successful venture, Sea Life Park, has had a change in ownership for the purpose of obtaining new capital. With the dissolution of the Makai Range, a central problem has been the maintenance and utilization of the extensive marine facilities associated with the complex which are, in a real sense, State assets. These include the Makapuu pier, the underwater diving habitat AEGIR, the STAR II submersible, a decompression chamber and numerous ancillary equipment.

A similar problem of support has been shared by the University, with precarious or inadequate support being available for the Aquarium, elements of Look Laboratory, the oceanographic ship KANA KEOKI, a marine laboratory support ship and support vessels for research and undergraduate oceanographic demonstrations.

Acquisition of the new research vessel, MOANA WAVE, is a big step forward, but will not meet all of the University's needs for classroom and research support. The withdrawal from Hawaiian waters of the National Marine Fisheries Service vessels, GILBERT and CROMWELL, further depleted the vessel support available for University projects. The ship support these vessels provided is urgently needed.

Recommendation

Hawaii's Congressional Delegation is requested to seek the early return and stationing here of the CROMWELL or a similar vessel to carry out needed Federal and State fisheries research and to support University programs.

In the past the problem of ship support has been met largely by the $500,000 per annum legislative appropriation for the University of Hawaii, as recommended by *Hawaii and the Sea–1969.* Currently, the appropriation has been reduced to $300,000. This amount is inadequate and vital research projects or procurement of vital equipment will have to be curtailed. We believe that the full $500,000 per annum is essential.

Elsewhere, we have recommended a number of resource surveys or "discovery" expeditions within the Hawaiian Archipelago, for example, a survey of fishery stocks among the Northwestern Hawaiian Islands (Chapter 6), a search for additional precious coral beds throughout the Archipelago (Chapter 7) and a detailed survey of known offshore sand reserves (Chapter 7). Completion of these surveys will require first that State ship support be raised at least to the levels of previous years, and second that a higher priority be given to assigning University ships to operations within local waters.

In the past, another appropriation of $200,000 for statewide facilities support was made through the Marine Affairs Coordinator. The appropriation was not made for 1973 and no support was given to a number of important marine projects. We believe that the facilities support program under the Marine Affairs Coordinator should receive a yearly appropriation of $200,000 from the Legislature.

Recommendation

The University of Hawaii should request, and the Legislature should fund, research vessel support at the level of $500,000 per annum. With increased ship

support, the University should assign a high priority to resource surveys within the Hawaiian Archipelago. The facilities support program under the Marine Affairs Coordinator should also be funded at $200,000 per annum.

Coordination of the support facilities requirements of the various University marine institutes and agencies (i.e. HIG, HIMB, PBRC, Look Lab, MEC, etc.) is also needed. Each agency is presently developing and submitting its proposals for CIP projects separately. Combining these proposals would provide an integrated package for CIP funding.

A long-range overall facilities support program, encompassing the needs of all the agencies, should be developed by the Dean of Marine Programs, with the advice of the University's Marine Council and Legislative coordination provided by the Marine Affairs Coordinator. The needs of each agency would be coordinated into one proposal with established priorities.

Recommendation

The University of Hawaii, through the Dean of Marine Programs, should develop a long-range CIP facilities program, including support ships, for a total integrated marine system. The Marine Affairs Coordinator should provide support as required.

A Senate resolution, S.R. 151, was passed in the 1973 legislative session dealing with the conversion of the Waikiki Aquarium into a marine education center. We endorse the resolution and urge that the Aquarium receive the support necessary to meet the needs of tourists and residents, as well as the research and education needs of the University scientists and students.

Recommendation

The Legislature should respond quickly to the recommendations of the Legislative Reference Bureau concerning the Waikiki Aquarium.

CHAPTER 4: HAWAII'S MARINE ENVIRONMENT

"A man and what he loves and builds have but a day and then disappear; nature cares not--and renews the annual round untired.

"It is the old law, sad but not bitter. Only when man destroys the life and beauty of nature, there is the outrage."

George Trevelyan, *Grey of Fallodon*

We believe that the actions taken on the environmental recommendations made in *Hawaii and the Sea–1969* have been, for the most part, encouraging. This has been particularly true in the establishment of coastal monitoring stations, the cooperation of government and industry in the partial control of runoff and effluent from the sugar industry and the passage of legislation to regulate construction in a setback zone 40 feet from the mean high water mark.

Concurrently, we believe that new guidelines are needed--to point out areas in which we are perhaps moving, but not necessarily in the right direction, to emphasize areas of concern which were not apparent in 1969, and to reemphasize the need for environmental programs which are goal-oriented rather than procedure-oriented.

First, in the area of population, we are much more aware today that Hawaii's carrying capacity is finite; in fact, it is disproportionately small in terms of our attractiveness as a place to visit or live. This problem has long-term implications in the need to set a target for Hawaii's ultimate population limit. It has immediate implications in the need to more uniformly distribute our population, our commerce and our industry among all the islands of Hawaii.

Second, in the face of Federal legislation which tends to treat the nation as a homogeneous ecosystem, we must convincingly make the point that Hawaii's mid-oceanic environment is unique. It has few points of comparison to areas on the continental margin or deep within the continental interior. In certain cases, identified within this chapter, this may mean an appeal for exemption from Federal standards in such areas as effluent discharge.

Third, we make a case for environment standards which are based on humanistic (people-oriented) criteria, rather than on the naturalistic (pristine) philosophy of many State and Federal laws.

Finally, to the extent that existing environmental regulations are not obviously inappropriate, we believe these regulations should be rigorously enforced. We know of no better way to test the true value of a law (or to effect the amendment or abolition of improper law) than through enforcement.

In writing the final drafts of this chapter, we have had the benefit of the report by the Governor's *Temporary Commission on Environmental Planning,* published in November 1973, and discussions with members of that Commission regarding their concern about population pressures in Hawaii. We share many of their concerns, perhaps with a heightened awareness, since many of us are trained in life sciences and know the terrible consequences that result when the population of a biological ecosystem exceeds the resources available to it.

We believe the problem is twofold. In the long run, there is a clear danger that Hawaii's population may exceed the optimum--not necessarily that it will exceed the carrying capacity of such vital resources as food, employment and housing, but certainly that it may exceed the capacity of those "nonvital" resources (open space, clean water, clean air, beaches, surfing sites, reefs and

forests) that contribute substantially to our enjoyment of life and characterize the Hawaii we love.

In the near term, we have a dichotomy. Oahu is approaching, and already may have exceeded, the population density that would

How much growth is enough? In 30 years a sleepy resort village became the Waikiki we see here.

be optimum in terms of those qualities we associate with life in Hawaii. Meanwhile, most of the Neighbor Islands, long quiescent in relation to Oahu's boom, are entering a period of gradual population growth. However, the opportunities they offer for youth are not clear.

We have tried, within the context and charter of *Hawaii and the Sea–1974,* to be responsive to the near term environmental problems noted above. This response has several dimensions.

1. In this chapter, we discuss current environmental problems and recommend approaches by which further deterioration of Hawaii's oceanic environment can be stopped, avoided or reversed.
2. In other chapters, we point out marine resources that can be tapped to relieve or eliminate certain environmental stresses on our finite land mass.
3. Where such resources are likely to attract new industry to Hawaii, we emphasize the opportunity for the State to divert such industry to carefully selected sites on the Neighbor Islands. We also warn of potential environmental impacts by such industry.
4. We recommend a modern marine transportation system; one with elements to more effectively tie our islands together in a symbiotic network, with other elements to serve as an alternative to a new fixed-roadbed rapid transit system through urban Honolulu.

THE STATUS OF HAWAII'S MARINE ENVIRONMENT

Although coastal water quality problems were recognized in *Hawaii and the Sea–1969,* awareness was not keyed to the magnitude and variety of the problems that then existed. The discussion and recommendations centered on health hazards, detrimental biological effects and esthetic impacts resulting from discharges from municipal sewage plants, agriculture and industry. The problems of oil spills, ship wastes and sedimentation were also considered.

Progress in Coastal Water Quality

Not only have the magnitude and variety of these problems been recognized since 1969, but certain of the hazards have been greatly abated through the water quality control program of the State Department of Health. The substantial abatement of other recognized hazards is now scheduled.

Agricultural Wastes

The most dramatic improvement has

been in the quality of the water around the island of Kauai, as judged by esthetic and biological effects. Over many decades the coastal waters had become increasingly muddied and burdened with trash from the discharges of cane-cleaning plants at the sugar mills of the island. Regulations for control of this type of pollution had been adopted in 1969. Although enforcement was initially lethargic, the rate of improvement was astonishing when effective enforcement was begun in 1969. Means were provided to store the cane-cleaner wash water and reuse it in irrigation systems. Even the tailwater discharges of the irrigation systems were brought under control. Water clarity was restored to a degree beyond our expectations, and the accumulations of trash on the beaches are rapidly disappearing. Before-and-after studies have indicated effective reversals of the marine biological effects of this long-continued coastal pollution.

Less dramatic, but nonetheless substantial, improvements have been made in the quality of those coastal waters around the islands of Maui and Oahu which had been affected by sugar mill wastewaters. Substantial problems remain only in the waters along the Hilo-Hamakua coast of Hawaii, where the mills are located on the shore and there are no irrigation systems in which to reuse the wastewaters. Means for eliminating the discharge of trash and baggasse from these mills are now being provided. Agreement has been reached on techniques for the substantial reduction of sediment discharge, if changes in harvesting practices do not essentially eliminate the problem.

Sewage Treatment and Disposal

Abatement of problems associated with the discharge of municipal sewage has been slower, but some improvements have been made and more substantial improvements are scheduled. Although there are minimal health hazards associated with the floatables in sewage discharged without treatment, Honolulu's raw sewage discharge at Sand Island creates a definite esthetic detriment. From an environmental standpoint, however, the most serious problems are those associated with the effects of other sewage components (especially the nutrients) on the biota in confined waters and estuaries. These effects have been most pronounced (Reference 1) in Kaneohe Bay, into which both a military system and a municipal system discharge secondary-treated sewage. In the southeast portion of the bay, where both

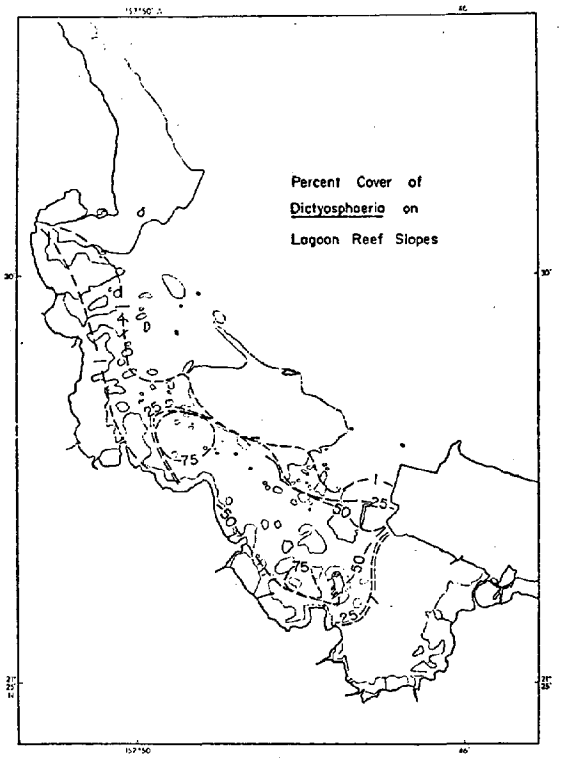


Chart shows geographic abundance of algae in Kaneohe Bay.

outfalls discharge, the corals have been killed, the algae have been severely depressed, and only biological species resistant to the effects of the sewage, such as certain sea cucumbers and sponges, persist. Beyond the area of most intense impact, an encrusting algae has smothered and killed the coral. These algae are spreading progressively northwestward. Similar though less extensive problems exist in Pearl Harbor. Algal growth seems to have been stimulated along a number of Hawaii's coastlines, in areas where effluent from sewage treatment plants is discharged in

shallow water close to shore.

The water quality of several natural estuaries and estuarine drainage canals is poor from both sanitary and esthetic viewpoints, but pollution here appears to be derived from nonpoint sources. Cesspool seepage is the most significant source of pollution in some urban areas, while drainage from intensive animal husbandry operations is blamed in many agricultural areas. Because they exceeded bacteriological standards, the waters of Keehi Lagoon in Honolulu and Kahului Harbor in Maui were closed to contact water sports in 1971, and the waters of Hanamaulu Bay were closed in 1972. All remain closed.

Coolant Water Discharges

Although offshore discharges of cooling water from power plants result in local exceedences of water temperature standards at a number of coastal points, identifiable biological impacts by these discharges are rare. The most significant effect has been the killing of coral over an area of about 8 acres by the thermal discharge from the Kahe power plant on Oahu.

Pesticides and Industrial Chemicals

Pesticide pollution of Hawaii's waters appears to be a relatively insignificant problem. In the studies that have been made, herbicides have been detected, but only in small amounts and for short time periods. The only insecticide widely detected is the ubiquitous DDT——no longer used in Hawaii. Heavy metal concentrations appear to be essentially at background levels in the coastal waters off agricultural lands, but high concentrations of heavy metals have been found in the sediments of harbors.

Oil Spills

No major oil spills have yet occurred in Hawaiian waters, but shore waters and beaches are occasionally polluted by clots of oil and tar resulting presumably from the offshore pumping of ship bilges. A large spill of molasses in Nawiliwili Harbor, which occurred in 1972, represents a form of harbor water pollution not foreseen in 1969. The ecological consequences of the spill appear to have been slight.

Sedimentation

The water pollution problem that may be most difficult to correct is that of turbidity and sedimentation associated with such nonpoint sources as subdivision development and highway construction. The magnitude of this problem is illustrated most dramatically by the finding at Kaneohe Bay that, between 1927 and 1969, the deepwater portions of the lagoon had shoaled by an average of 5.4 feet through the deposition of sediments (Reference 1). In contrast, no significant shoaling occurred between 1882 and 1927.

Overgrazing may also be a major contributor to accelerated erosion and sedimentation in areas such as the south coast of Molokai where fishponds have become progressively silted over during the past half century.

Coastal Water Monitoring

To provide a basis for carrying out its responsibilities for the quality of Hawaii's coastal waters, the State Department of Health operates an intensive monitoring program. The major elements of this program include: (1) monitoring the quality of ambient waters, (2) monitoring discharges, and (3) intensive surveys of water quality at selected sites. This statewide program involves periodic sampling at 148 stations, together with analyses of physical, chemical and microbiological characteristics of the samples. Distribution of the stations among the major islands is shown below.

Kauai	25
Oahu	58
Molokai	5
Maui	20
Hawaii	40

Specific parameters monitored include total

coliforms, fecal coliforms, dissolved solids, nutrients, dissolved oxygen and turbidity.

In compliance with the Federal Water Pollution Control Act, as amended in 1972, the Department of Health is installing a primary monitoring network to establish baselines and water quality norms for a broader array of water quality parameters. This network will include twenty or thirty stations, selected on the basis of intensive surveys, at which the sampling and analysis will be extended to sediments and biological responses. Thirty percent of this primary network should be operational by mid-1974; the entire network, by the end of 1975. At that time, most of the present network will be discontinued. Selected sampling, however, will continue to be carried out at beaches that are exposed to heavy recreational use and in other areas which may become critical.

Under provisions of the State permit system, those who discharge waste material into coastal and inland waters are responsible for monitoring their own effluent. The frequency of sampling and parameters to be analyzed are prescribed by the Department of Health, to which the results must be reported. The Department conducts its own check sampling and analyses at least once each year. This system, modified as necessary to comply with requirements of the National Pollutant Discharge Elimination System, will be continued by the Department of Health.

Detailed surveys of water quality have been conducted in a number of offshore and estuarine areas to establish baseline conditions. Past surveys have consisted of intensive sampling and analyses for periods of one to two weeks. In accordance with requirements of the Federal Water Quality Act (1972 amendments), the Department of Health has identified ten coastal segments in which intensive surveys will be completed by mid-1975. Those scheduled for the current fiscal year include Kaneohe Bay, Mamala Bay and Pearl Harbor on Oahu, and Kahului Bay on Maui. Samples will normally be taken twice a day, to reflect tidal changes and variations in discharge flow rates, and will extend over a two week period. Effluent as well as ambient waters will be sampled, and the surveys will include reviews of all pertinent historical data.

A computerized system for the storage, retrieval and statistical analysis of all water quality data is being developed for the Department of Health by the University of Hawaii. This system will be compatible with requirements of the Environmental Protection Agency's water quality information system. Finally, to assure quality and consistency of the data produced by the total monitoring system, a quality control program based on Environmental Protection Agency guidelines is being instituted.

Recommendation

The Department of Health's water quality monitoring program should be supplemented with a concurrent study of the biological communities which are present at each station.

This additional investigation is needed so that water quality parameters can be evaluated in terms of their impact on marine ecosystems. Only then can standards be set which have true relevance to the environment. The Department of Health should apply to the Environmental Protection Agency for Federal support of these additional investigations.

OBJECTIVES OF ENVIRONMENTAL MANAGEMENT

In assessing the adequacy of any program for management of environmental quality, it is critical that we determine the objectives against which the accomplishments of the program are to be measured. The objectives of water quality management are often expressed in numerical terms, such as maximum coliform count per unit volume. These have the advantage of being definite goals toward which progress may be

measured; however, the criteria used in setting such standards are often suspect and the standards poorly represent more fundamental objectives.

This is well illustrated by the case of the standards for nutrients, phosphorus and nitrogen in various forms or chemical combinations. At the limiting concentrations prescribed in current water quality standards, these nutrients are not detectable by any of the five human senses. The rationale for the standards, therefore, must lie in their effects and, in the case of the nutrients, in their biological effects. The establishment of nutrient standards in the form of maximum concentrations indicates the intent to avoid undesirable effects associated with nutrient concentrations. Nutrients are essential to marine life. Hence, there are desirable effects associated with nutrient concentrations. The standards should represent an optimum balance, one for which the effective net benefits--represented by the difference between the desirable and undesirable effects---are maximized. The determination of this optimum requires the assignment of values to all the effects.

The two fundamental objectives implied in current environmental quality standards are most simply distinguished by the terms "naturalistic" and "humanistic". The "naturalistic" objective can be defined as the greatest possible retention of (or return to) natural environmental conditions, or as the greatest possible reduction or elimination of human influences on the environment. There is no way by which the effects of millenia of human existence may be eliminated from the environment. *The minimization of human environmental effects would require minimization of the human race.* Since this is obviously unacceptable to the public, the "naturalistic" objective appears inescapably as an improper one on which to establish public policy.

The "humanistic" objective is considered as assuring the greatest overall, long-term welfare of the human race. Naturalism of the environment remains a matter of great concern, even with this objective, not only because humans, as biological beings, are dependent upon a considerable degree of environmental naturalism, but also because humans generally have innate esthetic and ethical concerns for environmental naturalism. With the "humanistic" objective, however, genuine requirements for human welfare take priority over environmental naturalism for its own sake when tradeoffs must be made.

WATER QUALITY

For an island state such as Hawaii, both fresh and salt water supplies are of paramount importance. Hence, a major portion of this chapter is devoted to water quality and associated problems.

History and Statutory Basis

Prompted by Federal water quality legislation, the Hawaii Legislature in 1965 broadened the jurisdiction of the State Department of Health over water quality from a narrow aspect of public health to a more general concern for public welfare. Standards applicable to coastal waters and a permit system applicable to wastewater discharges to coastal waters were established early in 1968 after a lengthy series of public hearings in 1966 and 1967. Established at the same time was a State permit system under which wastewater discharges that violated the standards would be abated over a period of 5 years.

The implementation of the water quality control program based on these standards and permits was just beginning in 1969 when the original *Hawaii and the Sea* was issued. The authority of the Department of Health was broadened somewhat by the omnibus Environmental Quality Act of 1972, which replaced earlier legislation on air, water, noise pollution and solid waste disposal. Under this Act, the authority to set quality standards was extended to effluents as

well as receiving waters.

The 1968 State water quality standards, and their amendments adopted in 1969 and 1971, were subject to the approval of the Federal Water Pollution Control Administration. However, enforcement authority remained with the Department of Health until 1971 when the Federal Refuse Act of 1899 was interpreted as applying to all discharges to navigable waters. Under the authority of that Act, the Army Corps of Engineers initiated a permit system for all such discharges, including those already subject to the State permit system.

In 1972 the Federal Water Quality Act was completely revised. In the revised Act, the elimination of the discharge of pollutants to navigable waters was identified as a goal to be achieved by 1985. In the interim, water quality goals were to provide for recreation as well as for the protection and propagation of fish, shellfish and wildlife. The Act:

1. Transferred to the Environmental Protection Agency authority over the Refuse Act permits, which were now termed the National Pollution Discharge Elimination System permits.
2. Prescribed effluent standards for municipal sewage discharges.
3. Required the Environmental Protection Agency to set effluent standards for other point sources and "standards of performance" for the discharges of certain industries.

This Act expressed a policy which leaves the primary responsibilities to control pollution in the hands of the states. Under the Act, the states are permitted to establish or continue water quality standards, so long as they do not violate the Act or Federal regulations developed pursuant to it, and administer a discharge permit program consonant with the National Pollution Discharge Elimination System. Nevertheless, the effect of the Act has clearly been to transfer power for the control of coastal water quality from the states to the Federal government.

Aside from its vagueness, the interim goal expressed in the Federal Water Quality Act Amendments should cause little difficulty in the program for quality control in Hawaii's coastal waters. However, its ultimate goal of eliminating all polluting discharges to the navigable waters would have social, economic and environmental detriments. This goal, which is consistent with the purely "naturalistic" objective of environmental quality management as discussed earlier, should be replaced by more "humanistic" objectives.

Best Practicable Treatment

The State water quality standards make reference to the "best practicable treatment or control" for various discharges, including those which require the establishment of zones of mixing. Similar phrases are used in various contexts in the Federal Water Quality Act Amendments of 1972. Interpretation of these phrases as meaning the most intensive treatment practicable is, in some environments, completely inappropriate. Such interpretation fails to recognize that treatment requires commitments of natural materials, energy and human effort, and increasing intensity of treatment may actually harm the environment. With very intensive treatment, these detriments may be greater than those associated with the untreated discharges. For example, where partially-treated sewage can be discharged in deep water off a Hawaiian coastline, there can be local environmental benefits rather than detriments.

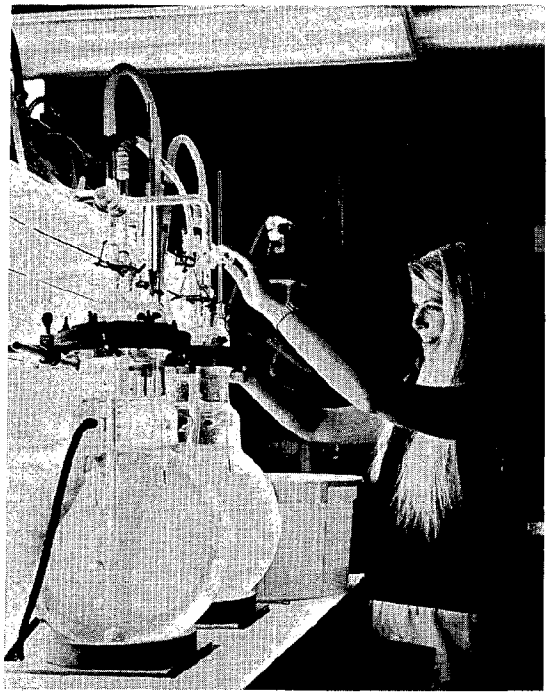
Recommendation

In accordance with the "humanistic" objective asked for environmental quality management, the phrase "equivalent to best practicable treatment" should be interpreted to mean treatment that is both technologically practicable and best in terms of overall, long-term, human welfare.

ADEQUACY OF WATER QUALITY STANDARDS

As indicated in the historical discussion,

the water quality standards have been in rapid flux. This was to be expected considering the lack of information at the time of their



HIMB scientists continually assess the nutrient requirements of algae under controlled conditions to serve as a baseline to compare with field conditions.

adoption. Further changes are still due in many respects. For example, the Oahu Water Quality Study and studies conducted by the University under the Sea Grant Program have indicated that phosphorus and nitrogen concentrations in the nutrient standards are often exceeded in nature. The standards should be revised toward more realistic values. Plans have been made by the Department of Health to reexamine the validity of these and other standards in the light of these findings.

At present, State environmental standards are being amended to comply with the Federal water pollution control requirements of Public Law 92-500. The Department of Health will issue permits for municipal and industrial discharges and enforce Federal standards. It also enables the State to obtain program grant and construction grant funds from the Environmental Protection Agency. *Even after this revision is completed, there will be a continuing need to update standards to reflect advances in our understanding of ecosystems in stress.*

Some particular problems with the standards and their interpretations are discussed in the following subsections.

Recommendation

The Department of Health, working with the Environmental Protection Agency, should reexamine and revise the water quality standards in the light of the "humanistic" objective of water quality management.

Biological Indicators

In the "humanistic" philosophy of environmental management, the purpose of the control of water pollution is not to make the waters "pure", and hence, sterile, nor necessarily restore and maintain them in their natural state, but to control their quality with respect to human needs. In this philosophy, the physical and chemical aspects of quality are important primarily in relation to their biological influences--their influences on human health and on the biota of concern to human welfare in relation to health, the production of food and other material resources and esthetic and recreational needs.

The water quality standards are only indirect indicators of the qualities that are of fundamental concern, most of which are biological in nature. The only biological standards now in force are microbiological standards, which are merely indicators of human health hazard. The inadequacy of these standards is well known, particularly as they apply to marine waters, but this problem is not peculiar to Hawaii. More deserving of discussion here are stresses that pollutants might impose on marine ecosystems. Unfortunately, relatively few studies have produced results that can be used directly in the

identification of such biological indicators of stress. One such study, recently completed at the Hawaii Institute of Marine Biology (Reference 3), has shown that larval fishes may serve as excellent indicators of stress. Similar conclusions have been reached by the Naval Undersea Center (References 4-7) in evaluation of response to environmental stresses by benthic, pile and volume biocommunities in Pearl Harbor.

Corals are also known to be excellent indicators of stress due to sedimentation. Some biological indicators of thermal stress are discussed in the next subsection.

Recommendation

The University should give priority to research programs which are concerned with identification of the impact of water quality on marine ecosystems.

Temperature Standard

A good example of an inappropriate water quality standard is the State temperature standard, which limits temperature departures to a maximum of 1.5° F (0.83°C) from "natural conditions". The regulation is not clear whether "natural conditions" refer to average conditions or to the natural ranges resulting from annual and diurnal cycles. Exceedence of the standard is probably of greater consequence when the departure occurs above the annual and diurnal maximum than when it occurs below the minimum. Further, the stringency of the standard is unreasonable. Technically, the heated water exhausting from a small outboard motor violates the present State standards.

A study of the effects of heated effluents on coral (Reference 2) has indicated that no measurable effects result from temperature increases as much as 2° C above the maximum natural ambient temperature. Paling and bleaching (due to loss of zooxanthellae) are noted when increases are between 2° and 3° C; heavy bleaching and some mortality occurs with increases between 3° and 4° C; and the mortality is complete with increases in excess of 5° C. A more appropriate standard would allow greater departures from the natural ambient temperature, possibly 2° C or even 3° C, as long as the temperature did not exceed some stated maximum; e.g., 30° C.

Biological indicators other than coral could be used to determine ecological impact of temperature change; for example, greater than natural abundance of blue green algae and changes in the distribution of algae and herbivorous fish.

Increases of temperature beyond the limits of the present standard occur at a number of coastal sites due to discharges of cooling water from steam power plants. Because the economic and environmental costs of alternative means of waste heat disposal are very great, close adherence to the present standard is quite unwise at most of these sites.

Recommendation

The Department of Health should revise current temperature standards for waste heat discharge to incorporate upper and lower limits, as well as maximum allowable changes from ambient temperatures.

The Department should modify the temperature standard in the light of current knowledge of the effects of thermal stresses on marine biota. In the interim, the zone-of-mixing provision should be used wherever local conditions warrant.

Sewage Treatment

The Department of Health regulations on sewage treatment, revised in 1973, appear to provide an appropriate basis for the control of sewage discharges into coastal waters. However, the requirement for secondary treatment of municipal sewage, incorporated in the Federal Water Quality Act Amendments of 1972, may not be appropriate when applied to deep-water discharges in the open ocean off Hawaii's

islands. The rationale for this conclusion is given below with special reference to the appropriate treatment of the discharge of Honolulu sewage at Sand Island.

Levels of Treatment and Their Effects

Raw sewage, now discharged at Sand Island, contains many ingredients of ecological significance including floating materials, settleable solids, organic compounds contributing to biochemical oxygen demand, nutrients, bacteria, viruses and heavy metals. Primary treatment, especially the advanced primary treatment now planned for the Sand Island discharge, effectively removes the settleable solids and floatables. The major effect of secondary treatment is the effective reduction of biochemical oxygen demand (85 percent reduction is commonly specified). Secondary treatment is ineffective in removing phosphorus and only partially reduces nitrogen. The effective removal of nutrients and heavy metals requires additional treatment means which are considered tertiary. Bacteria and viruses are reduced by both primary and secondary treatment, but chlorination of the effluents is necessary to eliminate them effectively.

Impact of Settleable Solids

Settleable solids are known to be ecologically harmful to the sea bottom (benthic) organisms. Off the Sand Island outfall, sedimentation from untreated sewage has measurably affected about 300 acres of bottom, although environmental degradation is significant only in an area of about 10 acres (Reference 9). This situation will be greatly improved by the advanced primary treatment, which will remove about 95 percent of the settleable solids.

Impact of Nutrients

Nutrients are essential to life. Their classification as pollutants results from the effects of increased nutrient concentrations in the confined waters of lakes and estuaries where they may stimulate overproductivity such as the "blooming" of phytoplankton. The surface waters of the open ocean, however, are deficient in nutrients and additional nutrients could result in beneficial stimulation of the biota in the food chain which provide the sustenance for fish. Good mixing conditions exist in these surface waters so that excessive local nutrient concentrations from sewage disposal are quite unlikely in the open ocean.

Impact of Organics

Organics are of importance in effluents primarily because they represent a biochemical demand for oxygen; i.e., the capacity to exhaust the oxygen supplies in the waters to which they are discharged. The resulting reductions of oxygen may be of serious consequence in lakes, rivers and estuaries. In the open ocean the mixing conditions, the oxygen exchange with the atmosphere and the effects of photosynthesis are such that only slight reductions of oxygen result even from very large biochemical demand discharges. Off Sand Island, for example, approximately 60 million gallons of raw sewage are now discharged every day at a depth of 40 feet; over an area about 600 feet in diameter, the dissolved oxygen has been reduced only 40 percent from the saturation level (Reference 9). This area of low impact would be even smaller if the sewage were treated by the planned advanced primary process.

Secondary treatment would effectively reduce the organic content, and hence, biochemical demand of the sewage effluent, but because the effects of the already small biochemical demand will be reduced with the deeper outfall, no significant environmental benefit would accrue from the imposition of secondary treatment. In fact, there may be some slight, though probably immeasurable, detriment. The nutrients in organic particles may be assimilated more rapidly into the marine food web, in most cases at least one full nutritional (trophic) level higher.

Bacteria, Viruses and Heavy Metals

Pathogenic bacteria and viruses are of concern primarily in relation to human health hazard, although no epidemiological evidences of such a hazard have been reported from the discharge of sewage in the open ocean at any Pacific Island.

Measurements made with indicator bacteria show a die-off rate in ocean water on the order of 90 percent fatalities each 30 minutes (Reference 9). The greatest potential hazard is associated with shellfish, since they are capable of concentrating the pathogens. Sewage outfalls, therefore, should discharge at depths and distances well removed from shellfish concentrations. It should be pointed out that secondary treatment without chlorination will not eliminate bacteria and viruses. Chlorination will destroy these, but not without imposing its own environmental detriment.

Heavy metals are a negligible problem in the municipal sewage of Hawaii, which has a low level of industrialization. In any case, heavy metal concentrations would not effectively be reduced by secondary treatment.

Land and Energy Costs

Secondary treatment requires allocation of additional land for the treatment plant and energy for the treatment process. Land is scarce in Hawaii, and the worldwide crisis in energy is well known. Allocation of these scarce resources to a treatment process which has questionable benefit does not, we believe, represent wise management. At Sand Island, where the planned advanced primary treatment plant (operating at maximum capacity of 82 million gallons per day) will require 15 million kilowatt hours of electrical energy per year, secondary treatment would require an additional energy consumption of almost 11 million kilowatt hours per year (Reference 8).

Economic Costs

A secondary sewage treatment plant on Sand Island would cost about $20,000,000 more, in land and facilities, than a modified primary treatment plant. The additional cost, if the State is forced to construct secondary treatment plants at all sites where modified primary treatment is environmentally preferable, could easily approach $100,000,000.

Higher and Better Uses?

In reply to the rationale we have stated above, the argument can be made that the day will come when we must regard the nutrient content in our sewage--and the water itself--as resources too valuable to be dumped into the sea. We agree, but we believe that the time is not yet here.

Hawaii has no present need for the water that could be reclaimed from a tertiary treatment plant and no effective way to store it. If we injected these waters back into our mountains, or under our coastal plains, they would leak rapidly back into the sea; the geological structure of the islands simply does not permit water storage over times as long as the period of probable adequacy of present basal water supplies. The effluent from a secondary treatment plant could be used in agriculture, but transmission costs would be high. If these waters were used to irrigate sugar cane (our primary agricultural consumer of water), they could not be applied during the latter stage of growth because their inherent nutrient content would retard the buildup of sucrose in the cane. Therefore, such use would require that two sources of water be developed for irrigation.

The day may come when Hawaii will need both the remaining nutrients and the water from its sewage. When and if that day arrives, we believe that our major sewage plants should be converted to tertiary treatment. But let the conversion be based on the additional knowledge and the advanced technology that will also exist at that time.

Recommendation

The Department of Health should press and publicize its continuing appeal for exemption from those sections of Public Law 92-500 which require secondary treatment of all sewage before discharge into an open ocean environment at depth. Such exemption should be determined on a case-by-case basis through State application to the Environmental Protection Agency. When allowed, it should be without loss of any State rights to Federal sponsorship.

Since such exemption will require modification of Federal law, Hawaii's Congressional Delegation must play a major role in presenting our case to Congress.

Kaneohe Bay

The case presented above for open ocean discharge does not apply to coastal waters such as Kaneohe Bay, an estuarine system with limited circulation. Most of that Bay's waters already are overfertilized; in fact, much of the marine community there is dead, dying, or has been severely stressed by the nutrients and sediments discharged into the bay by inflows from sewage treatment plants (Reference 1). The salvation and reclamation of Kaneohe Bay requires immediate cessation of dumping sewage into its waters.

Recommendation

The Department of Health should seek the earliest possible funding of plans to divert sewage effluents out of Kaneohe Bay and into the open ocean, and the City and County of Honolulu should give highest priority to their implementation.

Control of Sedimentation

Sedimentation of coastal waters, caused by natural erosion and activities of man, presents a potential threat to our marine life, especially to the benthos. Although it is a natural process, sedimentation is considerably augmented by cane-cleaner discharges at sugar mills on the Hilo-Hamakua coast, accelerated erosion associated with subdivision development and highway construction and, on Molokai, overgrazing.

Hawaii's most serious example of the impact of runoff and sedimentation is Kaneohe Bay, where shoaling of as much as 5.5 feet has occurred in the last 45 years

Erosion of unplanted highway and construction terraces adds to the sedimentation blanket that is choking marine life in Kaneohe and Kailua Bays.

(Reference 1). The combination of nutrient and sediment inflows has killed much of the interior coral in the southern half of the bay. Erosion of these coral structures has added to the sedimentation load on the bay. Unless strict controls are effected, the only logical conclusion we can see to this process is the complete, or near-complete, destruction of Kaneohe Bay.

Sedimentation may be controlled either by soil conservation at the source or by artificial sedimentation in settling basins prior to discharge. In Hawaii, conservation of the soil to minimize erosion is the most effective means of control because it retains the soil at the source. Artificial settling of sediment is of limited effectiveness because of the characteristically small size of the soil particles and their consequent low rate of settling.

Effective controls of soil erosion in intensive agriculture have been available for

several decades. Today, even irrigation tailwaters have been substantially brought under control in response to Department of Health requirements. The major problems related to intensive agriculture have been those associated with wastewater discharges from the cane cleaners at sugar mills. These problems either have been, or are being brought under control, except on the Hilo-Hamakua coast of Hawaii. Problems there are more difficult to solve because there is no potential for reuse of the wastewater in irrigation systems and the mills are located directly on the coast.

Schedules have been set for the control of sediment discharge from the Hilo-Hamakua sugar mills. The main goal is to effect controls through changes in harvesting techniques to retain the soil in the fields rather than by treatment of the discharges.

For more than half a century, coastal fishponds on Molokai have been seriously affected by sediments derived from erosion of grazing lands. Overgrazing is the most obvious cause of the problem, but decreased fishpond maintenance and climatic changes also are contributors. Effective controls have not been publicly proposed.

The State Division of Highways has recently introduced practices for the control of soil erosion associated with highway construction that should materially reduce the yield of sediments from that source; however, any quantitative benefits resulting from these practices will be difficult to measure.

Probably the most difficult part of the control of sedimentation relates to erosion control in subdivision development. The City and County of Honolulu, in 1972, revised its grading ordinance with the aim of reducing erosion as well as providing protection against slides and foundation failures. Guidelines for the effective enforcement of this ordinance have still to be provided. The other counties do not, at this time, have grading ordinances.

The Department of Health's water quality standards contain a turbidity standard. As with the standard for temperature, however, it is ambiguous and perhaps irrational in its incorporation of a range centered on the natural level. A potentially more effective basis for control is the prohibition of discharges of soil particles from land operations unless these operations incorporate acceptable soil conservation practices.

Recommendation

The Department of Health, in coordination with the Department of Land and Natural Resources, should set a minimum performance standard for the prevention and control of sedimentation due to runoff. This standard should contain enabling clauses to allow effective monitoring and enforcement of grading and agricultural practices.

The Department of Land and Natural Resources should prepare and publish a guidebook to educate Hawaii's public in effective techniques to control and prevent erosional runoff.

Groundwater: Underground Injection

At present there are no known problems of coastal water quality related to groundwater discharges. For several decades, low-quality surface water has been used to artificially recharge basal groundwater at several sugar plantations and storm water has been discharged underground on Maui for several years. The marine effects of these practices are probably inconsequential. Underground discharge of sewage from cesspools has been practiced on all islands for more than a century with little effect on coastal water quality. However, underground injection of sewage effluents of considerably greater and more concentrated loads has started at Waimanalo, Mokuleia and Ewa Beach, all of these sites on Oahu. Although recommended by the Water Resources Research Center, no preinjection surveys of marine flora and fauna have been conducted in adjacent coastal waters and plans to monitor the effects on the groundwater have not been fully implemented. In the meantime,

plans are well advanced to inject treated sewage in at least two places on Maui, one on Molokai, and industrial wastewater at Ewa on Oahu.

All natural discharges of basal groundwater in the islands reach the coastal waters. No processes are known by which certain pollutants of the groundwaters, such as nitrogen, would be removed by groundwater transport. Hence, the effects of considerable increases in underground injection of wastewater must be regarded with concern.

Recommendation

The Department of Health should continue its support of the research program at the Water Resources Research Center, University of Hawaii. This study to evaluate the effects of groundwater injections of wastewater should be continued and receive high priority for financial support at both State and Federal levels.

COASTAL ZONE ENVIRONMENT

Topics discussed earlier in this chapter have dealt mainly with preservation of coastal water quality and improvements of environmental standards to ensure that preservation. We are equally concerned with procedures for improvement or restoration of other aspects of the coastal zone environment.

Beach Sand and Offshore Sand

As recognized in *Hawaii and the Sea–1969*, our beaches are priceless resources to both the public and the visitor industry. Therefore, strong recommendations were made concerning their preservation, management and access. With respect to preservation, the taking of sand from Hawaii's beaches below the high water mark has been prohibited for 3 years. Legislation passed by the State in 1973 makes it illegal to take sand within 1,000 feet seaward of the shoreline, or in ocean water less than 30 feet in depth. Commercial mining of sand, coral, rock or other minerals in the territorial ocean seaward of the prohibited area, or in water deeper than 30 feet, will be allowed only with the written permission of all government agencies having jurisdiction.

Most beaches are subject to considerable changes in volume and configuration. Seasonal changes are generally the most noticeable. Sand may shift seaward or landward, or laterally from one portion of a beach to another. The oscillating shifts between the dry beach and the shallow water bottom deposits are generally the most frequent, but sand may be moved to and from areas inland that are reached infrequently by the waves of major storms and tsunamis. Thus, the beach is not a self-contained unit, but one element of a dynamic system. It is convenient to discuss the processes of this system in terms of littoral cells: a littoral cell is a sea and shore area (containing one or more beaches) within which the sand circulation process is essentially interlinked.

Sand located outside a littoral cell will not return and may be mined without damage to the associated beach or beaches which are part of the cell. We believe the present law should be amended so that permits are granted on the basis of conservation of the littoral cell. If an exception is granted, it should be for the situation where offshore sand is being mined to build up or restore beaches existing within the same littoral cell. In all cases, the law we have should be rigorously enforced until, and after, it is amended.

The mining of offshore sand is treated in detail in the chapter on marine mineral resources. The State should closely monitor and evaluate the environmental impact of the effluent which will result from the at-sea dewatering of mined sands during prototype mining operations.

Recommendation

The Department of Land and Natural Resources should seek legislation to modify the present depth and distance limits for the mining of offshore sand and other benthic minerals. The new limits should be based on conservation of the littoral cell.

In initial (prototype) offshore mining operations for sand, the Department of Land and Natural Resources should closely monitor and evaluate the environmental impact of effluent waters resulting from the dewatering of the mined sands.

Shoreline Development

Shoreline structures may modify the environment of the land-sea interface by alteration of wave and current patterns, interference with the movement of sand, blockage of public access or scenic vistas and contribution to coastal pollution. *Hawaii and the Sea—1969* recommended a 300-foot setback dedicated to public use. The Shoreline Setback Law passed by the 1970 Legislature (HRS 205-31) prohibits sand mining and regulates construction within a shoreline setback area of not less than 20 feet and not more than 40 feet inland from the upper reaches of the wash of waves*.

Recommendation

The Department of Land and Natural Resources should take the necessary steps to require environmental impact statements for all development and major construction on both public and private land within 300 feet of the shoreline setback line, as defined in Chapter 205, Hawaii Revised Statutes.

Oil Spills

Oil spills were recognized in *Hawaii and the Sea—1969* as a potentially serious threat to our marine environment. A number of recommendations were made relating to spill prevention, contingency planning and cleanup systems. Since 1969, the State Department of Defense has published a book entitled *Marine Oil Spill Disaster Plan.* The Coast Guard now conducts regular aerial patrols to spot oil spills at sea. The Department of Transportation expects, in February of 1974, to have assembled all hardware elements of a total containment and cleanup system.

No major oil spills have occurred in Hawaii. The November 1973 spill in Honolulu Harbor—typical of the worst spill we have had—amounted to no more than three or four barrels of oil. This experience makes it difficult to evaluate the effectiveness of either the hardware or the disaster plan.

Recommendation

We strongly support the intentions of the Department of Transportation to test the responsivity of the Disaster Plan through a mock mobilization, with all component groups tasked to rapidly respond to a sudden, unexpected "disaster". When all items of cleanup hardware are in hand, the entire system should again be tested, perhaps with a dye slick in the open ocean. This test should be repeated, with no advance warning, on at least an annual basis.

Natural Area Reserves

The 1969 report recommended optimum conservation and preservation of coral reefs. Conflicting uses were to be judged in terms of environmental costs and benefits. Since that time, the first natural area reserve has been established at Ahihi Bay, Maui. Recent concern over exploitation and depletion of reef table fish and aquarium fish has stressed the urgency of establishing more marine natural area reserves to ensure the continued reproduction of protected populations (breeding sanctuaries). These, in turn, would seed adjacent depleted areas.

Plans are currently underway to proclaim all of the Northwestern Hawaiian

* The State Supreme Court in a December 1973 decision established that the boundary of a property is determined by the vegetation line.

Islands as a National Wilderness Area. We wish to urge caution here, since the resource value of these islands is still relatively unknown and they may hold considerable potential as a fishery grounds. A better long-term solution, to be put into effect after the Northwestern Hawaiian Island resource has been surveyed, might be to intersperse wilderness reserves with other areas open to commercial fishing. Recommendations which relate to Northwestern Hawaiian Island fisheries are made in the chapter on marine fishery resources.

Recommendation

The Department of Land and Natural Resources should work to establish Marine Natural Area Reserves off the shores of all of Hawaii's major islands. A goal of one such reserve for every fifty miles of coastline appears reasonable.

Coastal Zone Conservation

The 1969 report stressed the importance of preserving--with accesses--the State's marine recreational resources such as beaches, shoreside parks, sailing, surfing and swimming areas. For the most part, these resources represent a strip of land and sea surrounding all the islands. This strip is the unexpandable border between land and sea; it is the most fragile ecosystem, the most easily polluted and the most vulnerable to insult.

In an ideal society, this zone would be untouched except for minimum corridors at right angles to the coast necessary to carry commerce, industry and people to and from the ocean. This strip, except for the corridors, would be devoted almost entirely to recreational uses, or other nonconsumptive uses which do not degrade the environment. We do not anticipate that Hawaii will be able to attain this idealized situation, but believe it can be approached through adequate long-term planning and strong State control and regulation.

The development of a coastal zone plan has been stimulated by the National Coastal Zone Management Act of 1972 and is authorized by Act 164 of the 1973 Legislature. In a very real way, the entire State of Hawaii is a coastal zone. Hence, to avoid conflict between planning activities, it is important that coastal zone planning be carried out in conjunction with comprehensive planning, including general land use planning.

Recommendation

The Department of Planning and Economic Development, in cooperation with the Department of Land and Natural Resources, the University and the County Planning Departments, should prepare a plan for management of the State's coastal zone. The plan should comply with the requirements of the National Coastal Zone Management Act of 1972, as authorized by Act 164 of the 1973 State Legislature.

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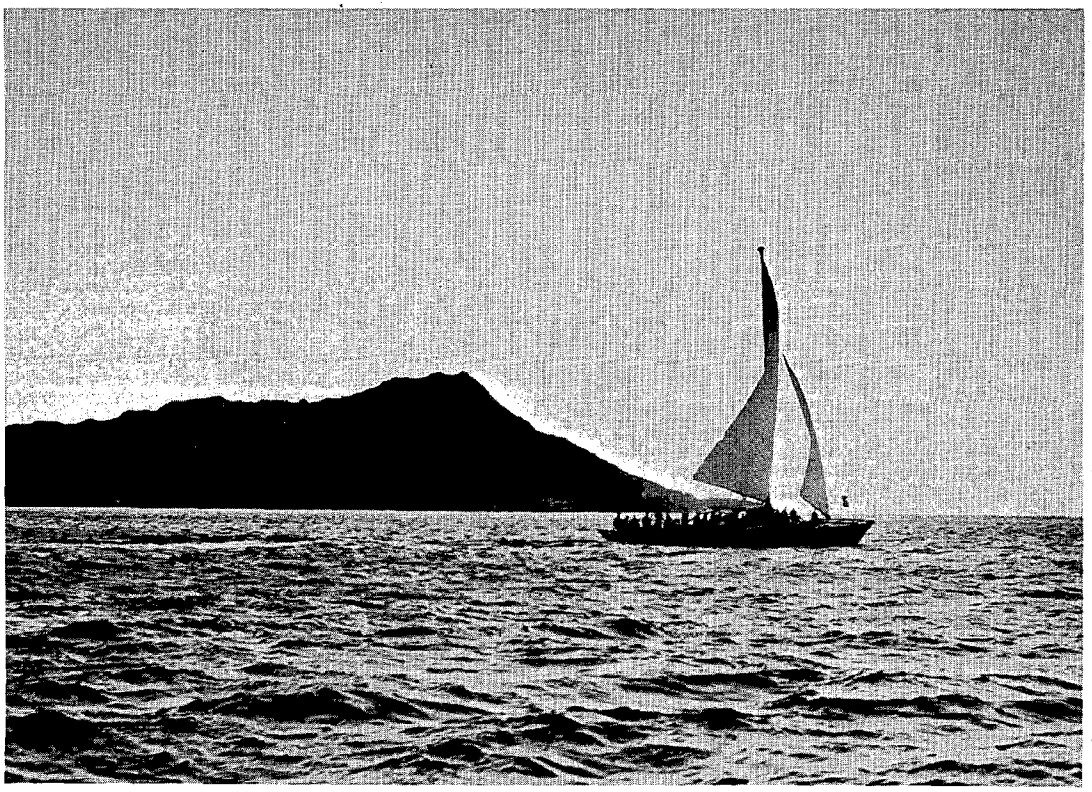


HVB Photo

CHAPTER 5: MARINE RECREATION

Two considerations pervade this chapter on marine recreation. First, we are well aware that available State funds are limited and a multitude of high priority needs compete for these funds. Second, Hawaii is rich in recreational opportunities, especially those involving the sea.

Many of our recommendations are directed toward the preservation of our marine recreational environment, at little direct cost, by the cessation of policies which allow, or even encourage, continued deterioration. The recommendation to establish additional marine/conservation parks seeks to preserve our marine resources. The recommendation concerning our inland waterways seeks to rehabilitate this resource for boating, fishing and other public uses.

Where suggesting expansion of existing facilities, for example, boat landings and marinas, we recommend that the user should pay a greater share of the cost.

Recreational fishing, not treated here, is discussed in considerable detail in the chapter on living marine resources.

We believe that Hawaii is uniquely blessed in the number and variety of recreational opportunities available to its citizens and visitors. We can think of few other states which offer such a combination of ocean and mountain, coastline and forests, warm waters and balmy climate. The problem is not how to create opportunities for recreation, but how to preserve recreational resources from deterioration or destruction and preserve public access to recreational sites despite developmental pressures.

Many of our recommendations could be carried out at little cost, especially the one to establish marine parks and zones of conservation on State-owned sites, or the ones requesting a change in government policies in the direction of a deeper concern for the preservation of recreational resources. Some recommendations could result in cost savings. Others could create additional income for the State.

MARINE PARKS

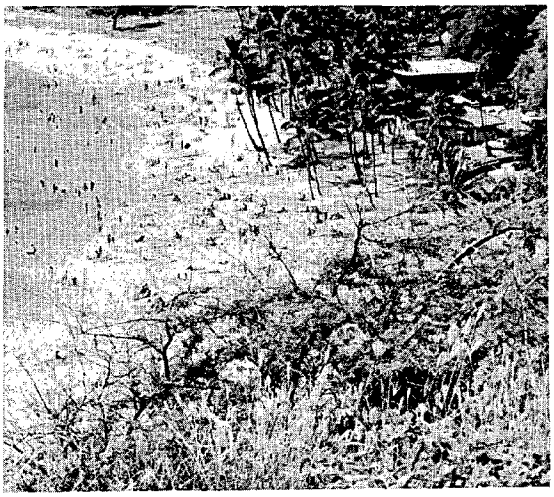
Marine parks are defined here as areas of subtidal land, and overlying waters, which are formally set aside for the conservation of certain ecological features and the public's enjoyment of them. All consumptive uses are prohibited, but public observation and esthetic enjoyment of the park is encouraged and aided. Hanauma Bay, on Oahu, is a marine park, according to this definition. The Kealakekua Bay Marine Life Conservation District is not a marine park, because certain consumptive uses within the park's boundaries are permitted. The Cape Kinau-Ahihi Bay (Maui) Natural Area Reserve exists to preserve a unique ecosystem and is more properly termed a marine wilderness reserve than a marine park. While public activities are not prohibited in the Maui reserve, neither are they encouraged. Hence, the distinction between a marine park and a marine wilderness reserve: in the former, resources are conserved for public appreciation and esthetic enjoyment; in the latter, the preservation of a unique or fragile ecosystem is the paramount concern and public enjoyment, a secondary consideration.

The Need – A Rationale

The need for marine parks is widely recognized. *Hawaii and the Sea–1969* recommended establishing parks on Maui and Hawaii. Recently, numerous articles in local newspapers have reported broad support for creation of more sites. In addition, the Hawaii Council of Diving Clubs is presently surveying the Pupukea-Waimea area and intends to submit a park plan to the Department of

Land and Natural Resources.

To date, however, only one marine park has been established along the more than 1,000 miles of State tidal coastline. Hanauma Bay is the only location in the State which the public can easily visit to view a relatively undisturbed example of Hawaiian reef life.



Hanauma Bay is an exciting attraction to kamaaina and tourist alike; facilities such as this are important to community education as well as recreation.

Many more parks are needed to provide residents and visitors alike with this opportunity. Parks are also needed to assure the conservation of marine ecosystems as their decimation by shell collecting, spear fishing, coral collecting, gill netting and other practices continues to increase.

Marine parks help conserve resources and, simultaneously, allow the public to enjoy these resources in a nonconsumptive manner. In addition, the protected species within park sanctuaries provide larvae and migrants for adjacent areas open to fishing and shelling.

Mechanism for Establishment

Marine Life Conservation Districts (as Hanauma Bay is legally classified) can be designated by the Department of Land and Natural Resources in the marine waters of the State under Chapter 190 of the Hawaii Revised Statutes. Regulations prohibiting exploitation of marine life within areas so designated may be established with the approval of the Governor, following the required notices and public hearings.

Chapter 195, HRS, establishes the Natural Areas Reserve System for protecting and preserving natural assets and designates a commission consisting in part of "persons possessing scientific qualification. . .in wildlife or marine biology, botany, forestry, zoology, or geology" to advise the Department of Land and Natural Resources. No such commission or committee is provided for the establishment of marine conservation districts (i.e., marine parks as defined above). A new commission, or the existing commission with an expanded role, could consult with the Department of Land and Natural Resources concerning the selection of coastal areas for designation as marine parks. Manpower for biological surveys and area mapping could be provided by Marine Option Students from the University of Hawaii, supported by National Science Foundation funds under the Student Originated Studies program.

Selection Criteria

The selection of sites for marine parks should be governed by several criteria. The site's potential, in environmental quality and biological significance, should be high. Although intensive exploitation may have decimated certain species in a proposed site, it is almost certain that diversity and abundance of species will increase after exploitation is prohibited. This renaissance was dramatically exemplified at Hanauma Bay, which is now rich in fish species that were rare, absent or abnormally secretive when the bay was open to spearfishing.

Safe public access to the site is also an important criterion. Land access is preferable, but sites should not be rejected because transportation to the site is primarily by boat (e.g., Kapapa Reef in Kaneohe Bay).

Sites which at present are rarely visited by the general public, but for which future use is predicted, should be considered for

park status as soon as possible. Anticipated public use should be a positive selection criterion, rather than a cause for delay on the basis of lack of present need.

Adjacent public land should be included as adjuncts to the marine parks, although this is not essential. Underwater locales of prime quality should not be rejected as park sites merely because they are partially or wholly bounded by privately owned lands. Indeed, a marine park located near a hotel development would make both more attractive to visitors. Public access to the subtidal area must be guaranteed in such cases.

Park boundaries which are naturally delineated will help in enforcement of regulations and prevention of public misunderstanding. Deeply set Hanauma Bay approaches the ideal in this regard; however, the boundaries of other less clearly defined sites can be marked by signs and buoys.

Areas for Consideration

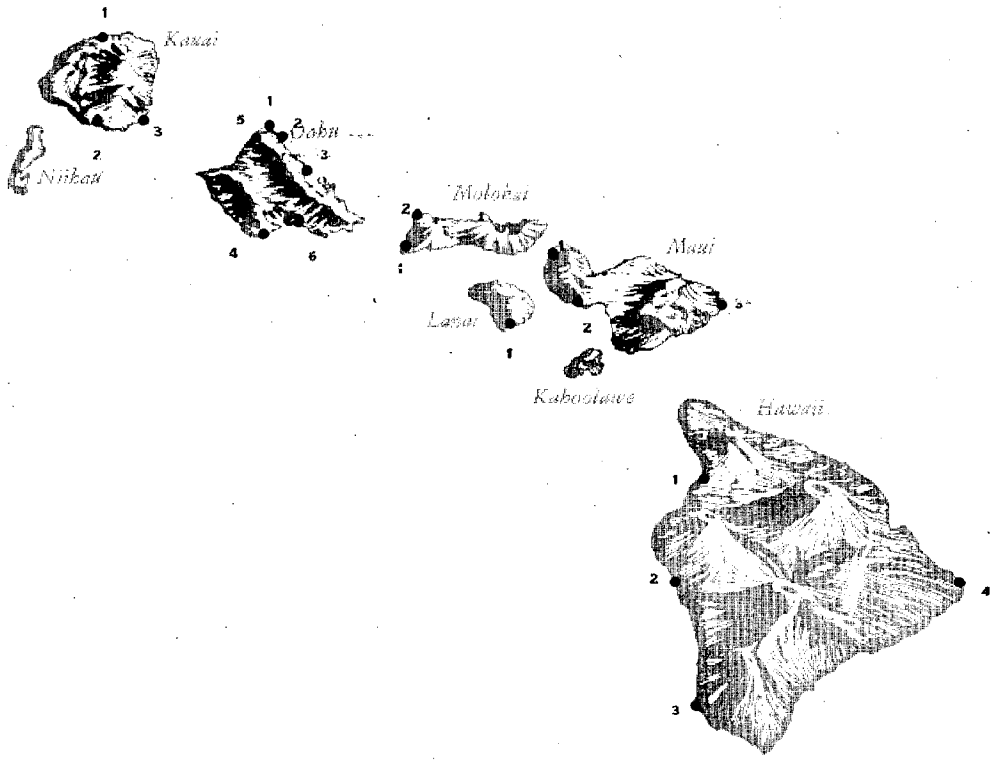
The following list was compiled on the basis of personal visits by members of the Task Force and from suggestions from the University of Hawaii and Bishop Museum biologists. It is not a complete list of potential sites and other areas should also be considered. The sites listed below are also shown on the map.

Kauai

1. Haena Beach area.
2. Area northeast of Poipu.
3. Shoreline and reef fronting Kuhio Park, Koloa.

Oahu

1. Area north of Laie Point.
2. Kaaawa Reef, near Swanzy Beach Park.
3. Kapapa Reef in Kaneohe Bay.



Early designation of additional marine parks will assure their availability at the least possible cost to the State.

Oahu

4. Kahe Point.
5. Waimea Bay—Pupukea Reef.
6. Portion of Waikiki Beach.

Molokai

1. Area between Laau Point and Puu Koa'i.
2. Area between Ilio Point and Kepuhi.

Maui

1. Honolua Bay.
2. Area between McGregor Point and Papawai Point.
3. Area near Hana.

Lanai

1. Hulopoe Bay, including Puupehe Rock.

Hawaii

1. Reef area south of Kawaihae.
2. Honaunau Bay adjacent to City of Refuge.
3. Manuka Bay.
4. Kumakahi Ponds near Kapoho.

Recommendation

The Department of Land and Natural Resources should select, and recommend to the Governor for his approval, a minimum of one additional marine park for each of Hawaii's major islands.

A commission of interested, independent citizens, including persons trained in marine life sciences, should advise the Department on the selection of sites.

These marine parks should be operated as Conservation Districts open to public enjoyment. If they are bounded on shore by private lands, steps should be taken to guarantee free access to the general public.

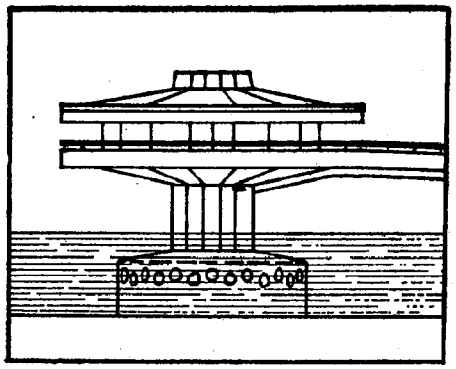
The Department should rigorously enforce restrictions against taking specimens from the marine parks.

Undersea Observation Structures

Sea Habitat Corporation of Hawaii has received approval from the Department of Land and Natural Resources to construct Hawaii's first undersea observation facility. The site selected for the structure is near McGregor Point on Maui. This area was recommended in the preceding section as a site for a marine park. The observation structure will be located 150 feet offshore, at a depth of 20 feet, and will be open to the public for a fee. This type of development provides educational and recreational enjoyment to both the public and visitors to Hawaii.

Recommendation

The Department of Land and Natural Resources should determine the feasibility of providing public or privately operated undersea observation facilities at each of Hawaii's marine parks. Future park plans should include such facilities where feasible.



"Picture windows" in the bays afford everyone the opportunity to enjoy the reef communities. This viewing facility will be operated by Sea Habitat, Inc. on Maui.

Unique Natural Recreation Areas

Recommendation

The Department of Land and Natural Resources should take immediate action to preserve Hawaii's unique recreational resources.

This might be accomplished by zoning specific areas for specific uses. For example, Point Panic and Makapuu could be zoned exclusively for swimming activities by categorically excluding boating and surfing.

Another method might be to declare certain unique areas, such as exceptional surfing sites, as ocean parks. A pending House Bill (H.B. 243) employs this approach by declaring all surfing sites to be ocean parks.

BEACH ACCESS

Approximately three-fourths of Oahu's 199 miles of shoreline are controlled by Federal and private interests. Of the remaining fraction, much is relatively inaccessible due to geographic obstacles, lack of roads and remoteness. A survey of 196 supposedly "legal" access routes on Oahu, carried out for us during the summer of 1973 by students of the Marine Option Program at the University, showed many routes were, in fact, closed to the public by fences, locked gates, overgrowth and other obstructions (including, in one case, a house). Some were impossible to locate. At a time when private development is crowding our beaches, and beach access through purchase is prohibitively expensive, it seems imperative that we should open and use all existing beach access routes.

Recommendation

The Department of Land and Natural Resources and County agencies, as appropriate, should take immediate steps to open all existing publicly controlled beach access routes and keep them maintained. All routes should be marked with conspicuously placed signs. In addition, these agencies should publish lists, with maps, of public access routes.

The Department should determine the need for, and cost of, beach access routes in areas where none presently exist.

Progress was recently made in this direction when the 1973 Legislature passed Act 143. This Act mandates the counties to adopt ordinances requiring developers to dedicate land for public access to the shoreline as a condition for approval of any development fronting a shoreline. Such routes should be clearly marked to show they are open to the public.

The amount of shoreline accessible to the public could also be increased by opening certain military lands. The 1971 State Legislature passed four House and Senate Resolutions calling for the City and County, Commander in Chief Pacific and the Marine Corps Air Station at Kaneohe to cooperate in opening North Beach on Mokapu Peninsula for public use. Unfortunately, these resolutions have not been acted upon, although a joint study is in progress.

Recommendation

The Department of Land and Natural Resources should press for the opening to public access of certain military lands which border the ocean.

Representative examples include North Beach on Mokapu Peninsula, Kahoolawe Island and much of the beach at Barbers Point Naval Air Station. The military might be persuaded to run security fences parallel, rather than perpendicular, to the shoreline, so that the public could move along a coastal corridor.

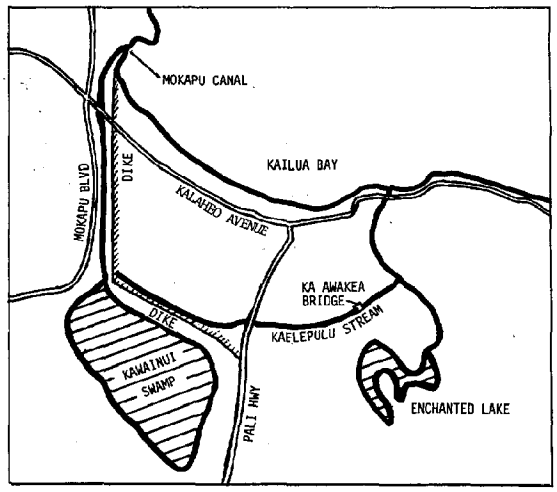
RECREATIONAL USE OF COASTAL WATERWAYS

Many of Hawaii's coastal towns are blessed with natural near-sealevel waterways, which meander through the populated areas between the inland valleys and the coast. The scenic and recreational potential of these waterways--for fishing, boating and parks--is high. Hawaii's record in fulfilling such potential is, for the most part, dismal.

As one example (of many) of nearsighted treatment of an existing waterway resource, we offer the case of Kaelepulu Stream in Kailua. This stream was formerly the main drainage route for Kawainui Swamp--running clean and clear to the sea--until its waters were diverted through the Kawainui Canal as a flood control measure. The diversion was complete to the point that upstream from the Pali Highway bridge the stream has become a stagnant, chocolate brown backwater. The waters of Kaelepulu Stream are still navigable, except at two points where man has introduced deliberate obstructions (the Ka Awakea Street bridge and the diversion dike which separates the stream from Kawainui Swamp). Access to the stream is also limited, the only known public access being at Kailua Beach Park.

The following remedies could restore Kaelepulu Stream to its full recreational potential.

1. Insert a flood control gate into the dike that blocks the canal end of the stream. This gate would normally be open to divide flow from the swamp between the two waterways, but could serve as a partial or total constriction on flow during times of heavy rainfall.
2. Reconstruct the Ka Awakea bridge to allow sufficient clearance for small boats to pass.
3. Establish several public access routes (and perhaps miniparks) along the waterway.



One of Hawaii's inland waterways, Kaelepulu Stream in Kailua, needs to be cleaned up and opened for boat traffic.

These changes would literally transform a part of Kailua into an island completely bounded by water from Kailua Beach Park to the mouth of the Kawainui Canal. They would add miles of protected recreational waterway, intimately tied to the planned Kawainui Park, and offer access to the open sea from any point along the waterway.

The restorations suggested above may not be possible in a time of stringent budgets and competing priorities. Other waterways, in other towns, may deserve a higher priority. Questions of priority are not, however, the point we want to emphasize. What is important is that streams like Kaelepulu should never have been subjected to actions that destroyed their potential for public recreation and such unnecessary destruction must never be allowed to happen again.

Recommendation

The Department of Land and Natural Resources, in cooperation with the County Departments of Parks and Recreation, should develop plans, priorities and environmental impact statements for restoring the recreational potential of Hawaii's coastal waterways. This task should be completed within two years.

With an even higher priority, these agencies should cooperate to cherish and protect the recreational values of our coastal waterways from future development pressures.

RECREATIONAL BOATING*

There is an increasing need for the improvement and construction of marinas and boat launching facilities in our State. A comparison of Hawaii with the mainland shows that per capita ownership of small boats here is less than one-fourth the national average. This is in spite of the fact that Hawaii's lands are surrounded and fragmented by water. Clearly, our potential for recreational boating is underutilized. We believe this is due, in large part, to a shortage of marina facilities and boat launching ramps.

Of Hawaii's 12,000 registered boats, about 75 percent are less than 20 feet in length and are trailerable. This could indicate a greater need for launching ramps than for marinas, based on a public preference for boats which can be drystored. We believe that, equally, it indicates a frustration on the part of the boat-owning public because of the shortage of marina spaces.

Should an either/or situation develop due to a shortage of funds for capital improvements, small boat launching facilities should receive priority over marinas relative to the existing demand. Conclusions based entirely on existing demand, however, should be treated with some caution. With more marina space available, we believe the demand would increase to match the supply. Given a choice, many boat owners prefer marina storage, even though it is more costly, because of the advantages of greater convenience, larger size, greater choice of potential usage, increased safety and opportunity for inter-island travel.

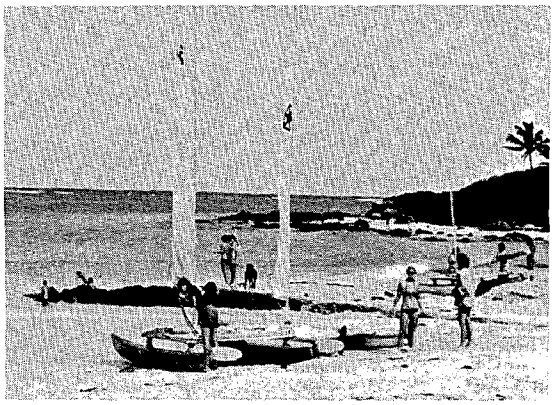
If improperly planned, such marinas and launching ramps could interfere with other valuable uses of the shoreline, such as picnicking, swimming, fishing and diving. With proper planning, we believe that marina sites could have valuable additional benefits as conservation areas for bird habitats and reef preservation. In the design of any new boating facilities, tradeoffs must be made which involve careful evaluation of the total environmental effect of the proposed construction.

A study by the Harbors Division of the Department of Transportation has shown that, on Oahu alone, there is an immediate need for 20 additional public boat launching lanes. The cost of a single lane at an existing ramp is about $20,000. A typical new ramp, which would include a loading dock, parking and a comfort station, is about $100,000. The Harbors Division study has pinpointed areas where current need is greatest.

Recommendation

The Department of Transportation should be provided with sufficient funds to implement the recommendations of the Harbors Division survey.

The Department of Transportation should conduct a similar survey to determine if there is a need for additional marinas. This survey should include non-boatowners to determine the potential size of the boating public and the type of support facilities preferred.



Boat ramps such as this one at Kailua Beach Park enable the small-boat owner to operate out of his home.

To minimize interference with other coastal recreation and to avoid degradation of

* This section deals only with facilities to support recreational boating. The general classification of harbors is treated in the chapter on commerce and industry.

existing shoreline environments, all construction of marinas and boat launching facilities should be preceded by an Environmental Impact Statement.

Boating Fees

In Hawaii, baseline monthly mooring costs range from about $.15/foot (cable mooring) to $.78/foot for a 40-foot boat in a slip. These fees are less than one-half of current charges in such states as California and Michigan, and much less than the facility's cost to the State. Annual registration fees range from $1.00 for a small boat to $9.00 for a 40-footer. These fees are less than the cost of processing the license application.

We believe that a sharp increase in both mooring and registration fees is long overdue and both fees should be raised at least to the national average. With the present fee structure, the relatively affluent boat owner is being subsidized by the general public, and the State is operating the support system at a deficit when it could be generating surplus for use in the construction and support of new facilities.

Recommendation

The Department of Transportation should increase registration and moorage fees at least to the national average. The possibility of charging fees for the use of launching ramps should also be evaluated. Funds derived from these fees should continue to be dedicated to operation of existing facilities and construction of new ones.

Moorage fees based on the plan area of a boat, or its displacement, should be charged to more fairly recognize the impact and cost-to-support of the large craft.

As a supplemental benefit to both the public and the State, an increase in moorage fees should encourage private enterprise to enter this field.

CONFLICTING USES AND SAFETY

Rapid population growth, especially on Oahu, has resulted in competing demands for marine recreation resources. For example, water skiing, sailing and swimming are clearly incompatible activities. Many of these problems have come to the attention of the Mayor's Water Safety Advisory Commission which makes recommendations to the City Department of Parks and Recreation. As stated earlier, there is a need for enforced zoning of specific areas for specific uses, especially off Waikiki and in Kaneohe and Kailua Bays. A system of testing and licensing boat users should be considered, especially if coupled to educational programs in boating techniques and safety.

Overcrowded surfing sites is another problem which frequently leads to injuries. Perhaps lifeguards should be given the authority to issue tickets to reckless or incompetent surfers. Usage of surfing areas is highly dependent on the irregular nature of wave conditions; therefore, the number of surfers who frequent a particular site at a particular time is highly variable. For this reason, lifeguards who are cognizant of these conditions should be allowed to rove and concentrate effort where it is most needed. It is advisable at some locations, such as Waimea Bay, for the lifeguard to patrol in the water. The helicopter emergency rescue unit is highly effective in preventing drowning during high surf on the North Shore. We believe that all surfing areas in the State should be prominently identified by signs, which can also warn of potential unsafe conditions.

Recommendation

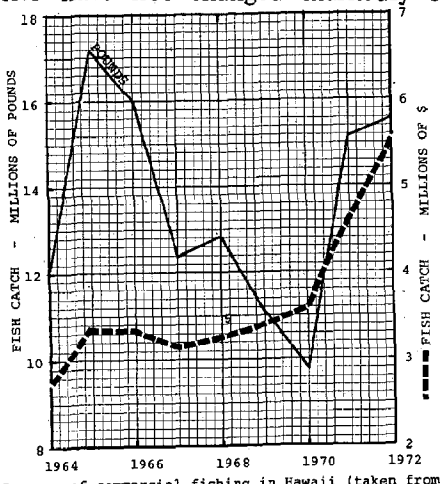
The Departments of Land and Natural Resources and Transportation should jointly devise a water safety plan for marine recreation in Hawaii. This plan should include, as a minimum requirement, elements which deal with education and training, licensing and enforcement, as well as exclusive zoning and sign posting for critical recreation areas.

CHAPTER 6: LIVING MARINE RESOURCES

This Task Force believes, as did the 1969 group, that fisheries afford a major development opportunity for the economy of the State. In the last four years the world demand for fish and fish products has increased, resulting in supply shortages and rising prices. Because fish products are an international commodity, recent currency adjustments have resulted in a more favorable outlook for American fishermen and boat owners.

For Hawaii, as an island state, fisheries are extremely important; they assure our residents of a supply of fresh fish and provide exportable products to strengthen our economy. Some United States and Hawaii fisheries will receive an additional boost if the next Law of the Sea Conference extends the fishery zone for the United States. This would greatly reduce the amount of fishing by foreign vessels in United States nearshore waters, allowing our restricted range fishermen a greater share of the resource. Hawaii would do well to keep abreast of the position the United States intends to take at the Law of the Sea Conference.

Despite the more favorable economic picture and increased interest in fisheries on the part of potential investors, Hawaii's fisheries have not changed markedly since 1969. The intervening years have seen some upgrading of the Hawaii fishing fleet and more growth in the fishing industry. However, the mercury scare caused reduced landings of billfish and increased expenses in other fisheries. During this time, government funds for resource surveys, research on new catching techniques and market development for unused species have greatly diminished.



Summary of commercial fishing in Hawaii (taken from State of Hawaii Data Book, 1973, published by DPED)

Action has been taken on many of the fishery recommendations in *Hawaii and the Sea–1969,* but they are contingent upon State and Federal funding of development projects over a long period of time. Because of recent severe Federal and State budget restraints, it appears that many of the recommended projects that require continued funding will be discontinued though they are still valid. Therefore, we have suggested actions that can be implemented with existing, or limited, additional funds.

A FISHERIES POLICY

A Federal fisheries policy is currently being developed through a series of proposals, several of which may be enacted into law in the near future. Among the proposals being considered are:

- The extension of Federal control to Hawaiian waters on an archipelagic basis.
- Federal management of the marine resources within this new area.
- Federal legislation to regulate the interstate transport of living marine organisms.
- Federal control and exclusion from the public domain of the lands and waters of the Northwestern Hawaiian Islands.
- Additional Federal controls over contaminants of fish products.

These Federal plans, while deemed to be in the national interest, are not necessarily in Hawaii's best interest. As an island state, Hawaii differs, in many respects, from the coastal states.

Recommendation

The State should formulate two alternative policies for fisheries management. One policy should be based on present State jurisdiction over the waters within the 3-mile limit; the alternative policy should be based on an extension of United States jurisdiction to an area enveloping the Hawaiian Archipelago (see Chapter 3).

State fishery policy should also establish guidelines to ensure an adequate supply of healthful seafood for State consumption and State control over the importation of living marine animals.

A DIVISION OF MARINE RESOURCES

The Task Force considered the need to manage and develop our marine resources, keeping in mind the structure of State agencies and the availability of funds. Presently, the Department of Land and Natural Resources contains the Fish and Game, Water and Land Development Divisions, and State Parks. All these agencies have some responsibility for marine activities, although their historic orientation is toward the land. Much of the State's long-term planning for marine resources development is accomplished by the Department of Planning and Economic Development. The Departments of Health and Agriculture also have organizational responsibilities in certain marine areas. At the University of Hawaii, a number of groups and institutes are concerned with research on marine resources and fisheries. The overall picture is fragmented, with responsibilities that sometimes overlap, sometimes leave gaps of unresolved jurisdiction and are difficult to coordinate.

We believe steps should be taken to bring these separate elements together into a coordinated organization as recommended in Chapter 3. As an interim step, a Division of Marine Resources could be set up in the Department of Land and Natural Resources.

The Task Force also believes that closer liaison is needed between the research and management aspects of the marine fishery resource. A prime rationale in establishing the Hawaii Institute of Marine Biology within the University of Hawaii system was that this Institute would serve as a research tool to provide the State with management-oriented data. Since its formation, the number of problems in marine biology have proliferated. In addition to fin-fisheries, these problems now include coral reef conservation, aku (skipjack tuna), baitfish research, aquaculture and precious coral population assessment. In all these areas, current research is being directed toward knowledge and technology which have a high probability of economic payoff. Transfer of this knowledge to the decision-making levels of State government has been hampered by the many layers of organizational structure which exist between the researcher and the users of the data.

An enlightened public is essential to wise, long-term, sustained-yield management of Hawaii's marine resources. We believe the State Division of Fish and Game has been hampered in the execution of a number of very sensible proposals by the lack of personnel and funds to reach the general public. For example, licensing of recreational fishing has been considered highly advisable by the Division for years, but, for lack of an adequate public information capability, the Division has been unable to convey its message to the public. Its duties should include liaison with various educational institutions and offices of the State and Federal Governments, and dissemination of pertinent information to Hawaii's marine community.

Recommendation

1. **The new Division of Marine Resources should have a fisheries aquaculture research arm associated with, or part of, the Hawaii Institute of Marine Biology.**
2. **The Division should create a Cooperative Fisheries Unit and give serious consideration to siting it at the Hawaii Institute of Marine Biology.**

3. **The scope of work for this unit should be defined to furnish background information for proposed regulations, or regulation changes, and provide details of management alternatives. The unit should not, however, engage directly in the implementation of the regulations or the passage of legislation.**
4. **The new Division of Marine Resources should include a competent, adequately funded, Public Information Branch.**

SOURCES OF REVENUE

Fishery resources management never pays for itself directly. Therefore, it frequently does not receive sufficient support to safeguard the resource. Such is the case in Hawaii. We suggest generating funds from the fisheries to help maintain the resource.

Funds are needed to collect meaningful data on fishery yields and populations, provide an effective management system, allow enforcement of state regulations and implement all or some of the suggestions for reorganization suggested here. Income from user and license fees currently charged by the State does not begin to approximate the cost of maintaining the fishery resource. In certain fisheries, especially where the resource is limited in magnitude or extent, fishing could be controlled through a system of special licenses or limited entry. In the case of recreational fishing, it is currently not possible to measure the stress on the resource (number of fishermen), the strain on the stock (population dynamics), or provide minimal enforcement of State fishing regulations.

Our rationale in recommending the above sources of funds is simple. The fishery resources of the State belong to the people. We believe that it is fair for the primary beneficiaries--those who profit from the resources either from sales or sport--to bear an equitable share of the cost of maintaining the fisheries in a healthy, self-sustaining state.

Recommendation

The Department of Land and Natural Resources should modify its policy on licensing marine fishing:

1. **To adjust present license fees for commercial fishing to make them equitable and commensurate to the benefits accruing to the fisherman.**
2. **To levy landing fees at public boat access sites.**
3. **To issue a limited number of special licenses for entry into certain fisheries that exploit limited stocks (such as Kona crab).**
4. **To explore licensing recreational fishermen to provide adequate statistical coverage of the fishery as well as revenues to offset the cost of its management.**

The Task Force recognizes that there are many problems associated with these recommendations, especially in the licensing of recreational fishermen. These measures seem clearly radical to a populace historically accustomed to free use of the resource. They are, nevertheless, necessary because of the increasing pressure on a limited resource. Implementation of these recommendations must be carefully planned by the State and will involve political courage on the part of the agencies involved as well as a public education program. The success of such an undertaking will depend to a large degree upon the ability of the State to document the need for resource management and the improvements in fishing that would result.

NORTHWESTERN HAWAIIAN ISLANDS STOCK ASSESSMENT

With increasing pressure on the fishery resources of Hawaii's main islands and the introduction of long-range fishing vessels, it is

becoming essential that the State undertake an assessment of the status of presently exploited stocks and the development potential of new areas and latent resources. In particular, the waters of the Northwestern Hawaiian Archipelago, stretching from Kauai to Kure Island, are within reach of the new vessels now entering Hawaiian fisheries. This new fishing capability, together with the recent proposal to establish a marine wilderness reserve among the Northwestern Hawaiian Islands, suggests that an effort to assess the commercial and recreational potential of the area should be undertaken in the near future. Specifically, information is needed on the distribution and abundance of inshore and demersal (ocean bottom) fish, shellfish and precious coral among the islands of the Northwestern Hawaiian Archipelago, including the offshore banks. A data base is necessary for effective utilization and management of this still unknown resource.

Recommendation

The Department of Land and Natural Resources, in a joint venture with the University of Hawaii and the National Marine Fisheries Service, should complete an intensive fishery survey of the Northwestern Hawaiian Archipelago over the next three years.

The new Cooperative Fisheries Unit recommended earlier might be assigned active responsibility for this survey. The State should seek matching fund support from the Federal government, specifically the National Marine Fisheries Service, the National Science Foundation and the Sea Grant Office.

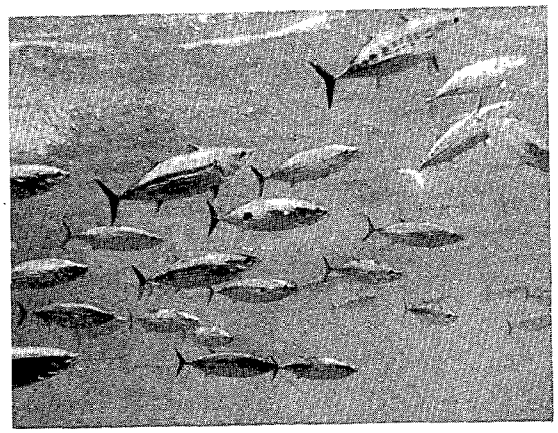
We are concerned about increasing pressures toward a Federal declaration of the Northwestern Hawaiian Islands as a "natural wilderness area", a step in advance of any meaningful knowledge of the extent and value of marine resources in these islands.

Recommendation

The Department of Land and Natural Resources should request that any Federal declaration of the Northwestern Hawaiian Islands as a "natural wilderness area" should follow, and be based upon, a survey of the fishery and precious coral resources in those islands. As a fallback position, the Department should request a stipulation in any such declaration that carefully selected areas of such a preserve can be opened to controlled resource utilization.

FISHERY RESOURCES OF THE HIGH SEAS

Over 75 percent of the weight and value of fish landings in the State come from high-seas species, chiefly the tuna. These fish constitute a global resource and, as such, are subject to international management as well as international marketing. In recent years, the value of tuna to Hawaiian fishermen, on a per pound basis, has more than doubled, resulting in an incentive to invest in new vessels and equipment. The increasing world demand for tuna, together with improvements in transportation, has resulted in a situation where the price in the Hawaii marketplace is independent of local market demand. An exception occurs at times of extreme shortage when local prices rise markedly. In other



Schools of Skipjack Tuna are the backbone of the local fishing industry.

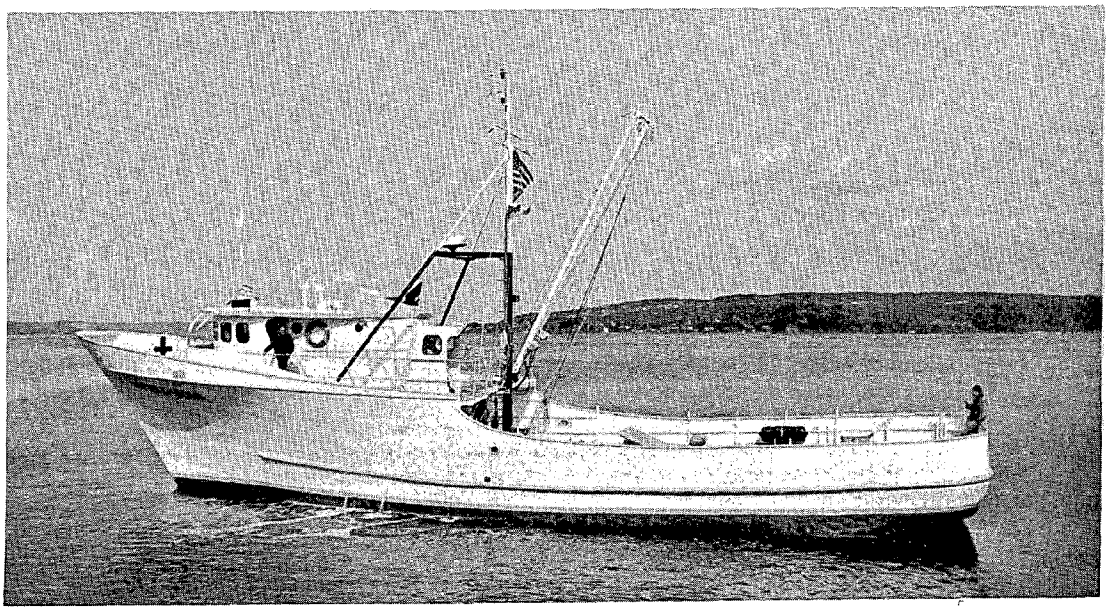
words, the price is normally set by international demand, which results in a price floor for all tuna landed in the State. This minimum price is equal to the world price for the product, less shipment cost to market.

The assurance of a ready market and a favorable minimum price have resulted in expanded operations for Hawaiian fishermen. All four of the new vessels constructed under the Hawaiian Vessel Loan Program have entered the tuna fishing industry. Those vessels fishing for the fresh fish market are assured of demand and a good price for their catch. Those vessels fishing aku (skipjack tuna) for the international market and the cannery are also assured of a constantly increasing demand and price.

The devaluation of the dollar, the increased demand for high grade fresh fish in Japan and the increase in air transport between Hawaii and Japan have resulted in a minimum price for most high quality fishery products in Hawaii that is approximately $.40 to $.50 a pound less than the wholesale market price in Japan. The result is that the Hawaiian consumer can expect to pay a price comparable to the price paid by the Japanese consumer, less the cost of air transport; the Hawaiian fishermen will receive a price comparable to that set by the fish auctions in Japan. There is little the State can do to reduce the cost of fish to the local consumer. However, if the State encourages the construction and operation of new vessels, the times when extreme scarcity of landed fish cause extraordinary costs to the consumer could be reduced.

There are problems that may limit expansion of the industry in the near future. There is the ubiquitous question of an adequate supply of suitable baitfish for aku pole and line fishing. The rising cost of building new vessels will probably require year-round operations for the pole and line vessels, and year-round operations cannot be confined solely to Hawaiian waters.

The first of these problems is being addressed by the National Marine Fisheries Service and the Hawaii Institute of Marine Biology; the second is addressed in the



MOKIHANA, one of the newest additions to the fleet is financed through the Hawaiian Vessel Loan Program.

program being developed by the Pacific Islands Development Commission, of which the State of Hawaii is a member (Chapter 3). We believe the programs sponsored by the Commission offer considerable benefit to Hawaii.

Recommendation

The State, through the Department of Planning and Economic Development, should continue to support the fishery programs of the Pacific Islands Development Commission. The State's Congressional Delegation should support such programs through continuing efforts to obtain direct Federal funding for the Commission.

Concerning the future of the tuna cannery, the State is faced with serious choices. The lease for the present cannery site will be renegotiated in 15 years, and the cannery will have to compete with other demands for the Kewalo Basin area. Also, increasing labor costs could make it economically impractical to operate a cannery in Hawaii in comparison to the cost of operations on other United States currency islands of the Central Pacific, such as American Samoa.

We believe the State should offer every reasonable inducement to encourage continuation of the tuna canning operation in Hawaii because of (1) the direct employment provided by the cannery, (2) the direct employment provided by the fishing vessels which the cannery supports, and (3) the increased cost that will have to be paid in the local marketplace if fresh tuna is no longer landed in Hawaii.

Recommendation

The Department of Planning and Economic Development, with the officers of Hawaiian Tuna Packers, should explore the problems the canning operation faces and ways in which the State can encourage its continued existence.

Another problem that the State faces is that Federal standards, still in the process of definitive formulation, have barred certain economically important fish from the market. For example, some large pelagic fish have been barred because of their mercury content.

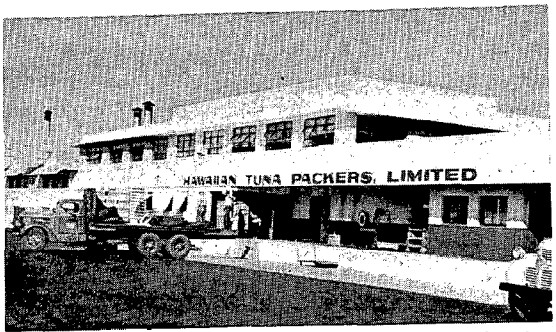
Recommendation

The Department of Health should explore the feasibility of setting its own standards for fishery products landed by Hawaiian vessels and consumed within the State. The standard should be such that the health of the public is not in the least endangered and be based on the best available scientific data.

The State has, on occasion, maintained a shark control program to assure that the inshore shark population is kept at a low level for the safety of swimmers, surfers and divers. These operations had to be underwritten by the State because there is no incentive to commercial shark fishing. However, if an eradication program were undertaken in selective areas where shark endanger people, perhaps shark flesh could be used for food--as shark meat, fishmeal, or in fish cakes.

Recommendation

Possible uses in Hawaii for shark meat should be investigated through various channels, such as the University, the Department of Health and the Division of Fish and Game. Funding to solve this problem should be sought from the Sea Grant Office. If these efforts are not successful, the State should reestablish, and fund, the nonbounty program of regional eradication.



The unique services provided by HTP are essential for the local fishing industry.

INSHORE AND DEMERSAL FISHERIES

In common with most tropical areas, the State is blessed with a diverse fauna of inshore and demersal species. Many of these are used for food but, with few exceptions, none occur in sufficient numbers to support major fisheries. The exceptions are the snappers, some of the *Carangids,* namely akule and its young, halalu and opelu. Little is known about the population biology of these species. Although the landings fluctuate from year to year, most likely due to natural causes, the total catch is such that it is possible that some of the fluctuations are fishery related. Management biology studies of these species should be undertaken, as should food technology research to extend shelf life and even out prices.

The populations of the other nearshore or neritic (the seafloor between the shore and the edge of the continental shelf) species are generally believed to be depressed, particularly around the island of Oahu. Proposals have been made to improve the abundance of these species by closing certain coastal areas around Oahu to fishing for extended periods of time. It is not known how productive this would be. Moreover, it is unlikely that the State presently has sufficient manpower to enforce such closures. The recent concern about the capture for export of colorful reef fish on Maui is an example of our need to know more about population biology. The data base does not exist for assessing the impact of netting the reef fish on the resource.

Recommendation

The Department of Land and Natural Resources should undertake a program of management biology of inshore and demersal fisheries, coupled with development of a "status of the stock" report, in order to better evaluate various management and conservation measures that may be implemented in the future. The new Cooperative Fisheries Unit discussed earlier could be given this task. It is almost certain that the report will pinpoint areas, geographic limits and management measures for marine preserves.

One of the fastest growing fisheries in the State is the Kona crab fishery. Its growth stems primarily from the development of new grounds on the Penguin Bank. The extent of this area is fairly limited and the sustained yield it can support is unknown. The Kona crab fishery appears to be one that could be controlled to sustain the resource through a special entry permit system restricting fishing. In addition, the Kona crab fishery appears capable of expanding into other areas, particularly into the Northwestern Hawaiian Islands.

Recommendation

The Department of Land and Natural Resources should carry out the necessary population assessment research for snappers, akule, opelu and Kona crab. If the outcome of this investigation warrants it, entry to any or all of these fisheries should be limited by licensing, regulation and enforcement procedures which prohibit fishing by vessels above that number necessary to maximize the yield. Again, this task could be assigned to the new Cooperative Fisheries Unit.

RECREATIONAL FISHING

Surprisingly, for a State completely surrounded and divided by water, participation in recreational fishing is moderate. For example, it is estimated that less than 15 percent of the State's population engaged in salt water recreational fishing during the past year, in part, because a boat is needed to get to the better fishing areas. To some degree, it is due to depletion of the readily accessible inshore species by heavy fishing pressures near populated areas. Depletion of the inshore species can be alleviated through selected stocking programs.

The key to recreational fishing management is updated, relevant regulations,

understood by the public and strictly enforced. Hawaii's record appears inadequate in some respects. Public education is inadequate and regulations need to be reviewed periodically for relevance. Furthermore, we suspect there are too few State Fish and Wildlife Enforcement Officers and they are not held sufficiently accountable for enforcing the regulations. For example, in 1972, these officers issued an average of one violation ticket per officer per month.

Fine structures, license suspension, fish and game violation tribunals are some possible approaches for enforcing regulations.

Recommendation

The Department of Land and Natural Resources should upgrade recreational fishing by: (1) periodically updating fish and game laws, (2) increasing its educational capabilities, and (3) examining mainland enforcement procedures for applicability in Hawaii. These measures will require an increase in the number and efficiency of the officers who must realize that their role includes education as well as law enforcement.

CORAL REEFS

Hawaii's coral reefs are limited in extent, yet provide an important habitat for inshore marine fauna. They are also used for snorkeling, spearfishing and shell collecting. Many of our reefs have been subjected to extensive abuse for many years and some are probably past saving. At present, little is known about the fishery productivity of tropical reefs and less is known about how they are destroyed. The management of such reefs can be accomplished now only on an intuitive basis.

Hawaii has the opportunity--perhaps even an obligation to most of the Pacific area--to develop fishery and coral management methods for coral reefs. All classes of reefs--atolls, fringing and barrier--can be studied in Hawaii.

Recommendation

The Department of Land and Natural Resources should support a program to accumulate the scientific data necessary to design an effective coral reef management system. Possible funding sources for this program include the Sea Grant Office, National Science Foundation and the Department of Interior (through its responsibility for the Trust Territory).

AQUACULTURE

Aquaculture in Hawaii has received substantial emphasis in the last decade. The husbanding of marine plants and animals has considerable significance for the future and Hawaii is a suitable place for its pursuit.

Largely as a result of the State's support of recommendations in *Hawaii and the Sea–1969,* Hawaii is generally considered the center for technology in this emerging industry. Much research already has been conducted and many lessons have been learned that form a solid foundation for the future of the industry. Several Hawaiian firms now are profitably engaged in commercial aquaculture and dozens more are in planning. Important, too, is the fact that State scientists are exporting this technology to the Trust Territories, Guam, and many other areas. The Hawaii Institute of Marine Biology hosted a conference in February 1973 to determine the directions for aquaculture research for greatest benefit to the peoples of the Pacific Islands. From this conference, specific directives were made that will enable the early establishment of a viable aquaculture industry in the Islands.

Continuing legislative support is needed in some areas, but the aquaculture industry in Hawaii has the gratifying potential for carrying its own weight while subsidizing its own research. When this occurs, the State will reap the benefits of its foresight in nurturing this fledgling industry which is destined to

play a critical role in future worldwide food production.

The development of aquaculture has potential in at least five different areas.

Production of Food for Hawaii

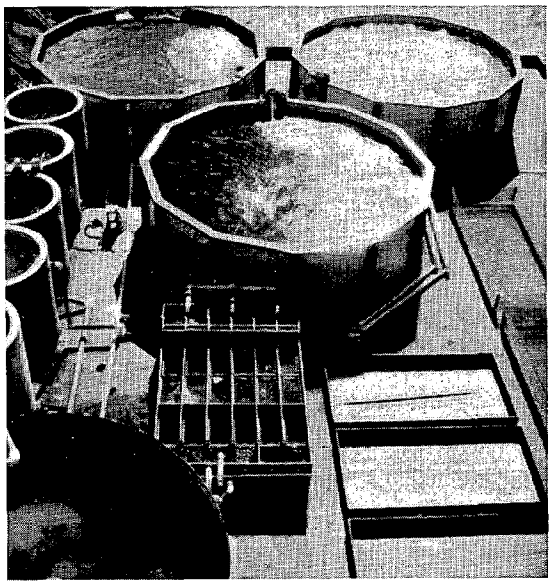
Aquaculture can be done in fresh, brackish and marine waters: only the latter two will be considered here. Because the value and demand for shorelands is high and aquaculture must compete with other demands for the land, it appears that aquaculture in Hawaii must produce high value commodities such as shrimp, prawn and kumu in order to make a profit. Of these, only the culture of prawn has progressed sufficiently to be a commercial enterprise. Channel catfish are being successfully raised and marketed on Maui and Oahu, but these markets may be limited. In most respects, marine aquaculture is at the stage where land agriculture was a century or more ago. Therefore, it needs considerable application oriented development work. However, the aquaculture market in Hawaii is relatively limited because of the State's small size.

Production of Food for Export

It appears feasible to raise for export a large number of food products of animal aquaculture--again, the high value varieties. This depends, however, on world commodity prices, transportation factors and, to a certain extent, on the development of the feed-producing schemes outlined below.

Production of Industrial Products

Attached marine algae furnish valuable industrial products (phycocolloids). The algae can be grown in tropical waters, but require large shallow areas and a large supply of cheap labor. Their culture is likely to receive emphasis on other Pacific islands. However, research and development for the improvement of algae culture has been undertaken and will continue to flourish in Hawaii.



Tap Pryor's Systemculture, Inc. foresees a $50 million industry in the next decade through series-farming of turtles, algae, shellfish, crustaceans and seaweed.

Feeds for aquaculture production must be imported and are costly. Fishmeal and vegetable material are the customary feed ingredients. These can be produced through a type of aquaculture, now being developed, in which domestic and livestock waste is recycled through aquatic plants and animals. When perfected, these schemes will reduce the cost of aquatic and domestic feed stock while helping to alleviate the costs of sewage and waste disposal.

Production of Sport Fish and Baitfish

Hawaii's stock of sport fish is dwindling as more people pursue our naturally limited fish populations and pollution takes its toll. Demand for sport fish may therefore increase their economic value enough to stimulate the production of juveniles of certain sought-after angling fish. The Hawaii Institute of Marine Biology is engaged in pilot research projects to make possible such replenishment of Hawaii's waters. As our tuna fishing industry expands, bait becomes a critical limiting factor. Supplemental bait can either be imported or homegrown. Several species, especially mullet, juvenile kumu, and perhaps

mollies, seem promising for production here. Experimentation is in progress at the Oceanic Institute and the Hawaii Institute of Marine Biology to develop reliable and economically sound rearing practices for bait.

Aquaculture Research and Development

The outlook for aquaculture is promising, but the industry needs the support of local research and development expertise. Hawaii now occupies a leading position in aquaculture research and development in tropical marine species, and these capabilities should be strengthened and expanded.

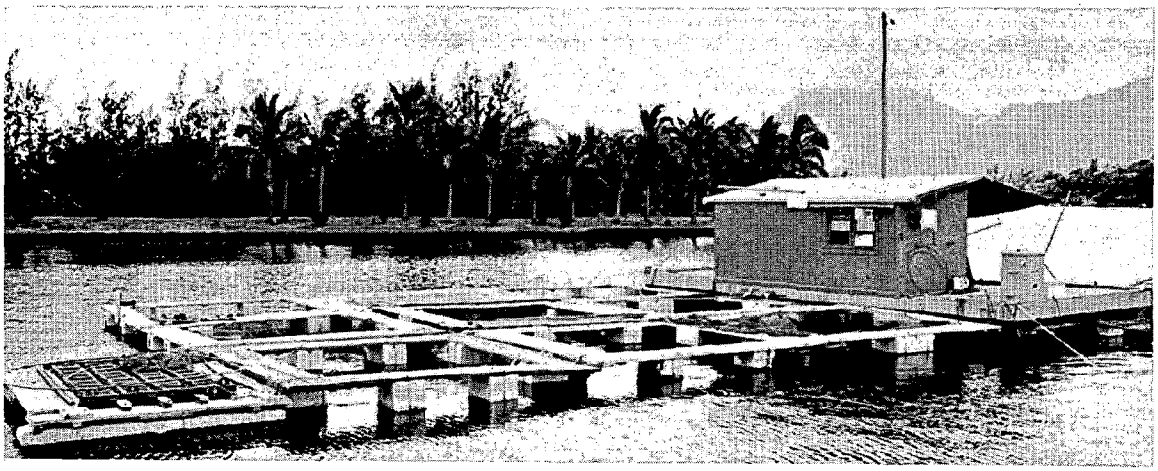
An aquaculture farm in Hawaii may make sound economic sense when all its multiple uses are considered. The restoration of at least one ancient Hawaiian fishpond to its original physical appearance, and its subsequent operation as a commercial aquaculture facility, would have many benefits. First, it would give an impetus to the restoration of other fishponds which are deteriorating rapidly. Second, it would help to maintain a viable nucleus of aquacultural expertise in Hawaii when other pressures are driving this expertise from the State. Finally, the aquatic plants and animals would furnish another source of locally produced food. The fishpond operator could supplement his income by simultaneously using the pond for commercial recreational fishing.

Recommendation

1. **As a fledgling industry with promise of considerable benefits to the State, aquaculture research and development should receive special consideration for State support from the Legislature and the Departments of Health, Land and Natural Resources, Agriculture, and Planning and Economic Development.**
2. **The Department of Planning and Economic Development should investigate the economic potential of, and possible sites for, at least one pilot aquaculture farm to operate in a fully restored ancient Hawaiian fishpond. Also, since the Department of the Interior, the National Parks Service and the United States Geological Survey are considering a study of ancient Hawaiian fishponds, the State should manifest an active interest in this endeavor.**

HARBORS FOR FISHERIES

Hawaii and the Sea—1969 recommended that: "The State should (1) formulate and adopt firm plans for a new industrial fishery center on Oahu, e.g., at Keehi Lagoon as proposed in a 1961 Master Plan prepared by Donald Wolbrink and Associates; (2) formulate plans for the



Floating net cage laboratory is used for experimental rearing of marine fishes; baitfish availability may be solved through HIMB research programs on mullet larvae.

redevelopment thereafter of Kewalo Basin to provide increased wharfage for charter boats and cruise ships; and (3) initiate long-range plans for the creation or expansion of similar fishery-industrial and charter-cruise boat centers on the Neighbor Islands."

Neither the 1961 nor 1969 recommendations seem to have resulted in the desired action; the situation at Kewalo Basin, for example, is becoming critical.

Recommendation

The State should sponsor a series of harbors and commercial marine basins for fisheries throughout the State, which should eventually become self-supporting or revenue-producing. Action responsibility, we believe, should be shared between the Department of Transportation and the Department of Land and Natural Resources.

We have been informed that Honolulu's fresh fish fishermen feel that Kewalo Basin is, and will continue to be, hopelessly overcrowded and they want to relocate to the Pier 15-18 area. This would place them nearer the fresh fish markets, more effectively utilize an underused part of Honolulu harbor and add a touch of local color to the downtown waterfront. We have also been told that the Department of Transportation supports this request. The Task Force thinks the relocation request is reasonable and should be granted.

LOANS TO ENCOURAGE FISHERIES

The development of viable commercial fisheries depends upon suitable port facilities and favorable market conditions. The latter condition appears to be developing, but needs further State encouragement. The State should set realistic product standards, provide training opportunities for potential fishermen and provide financial aid to the industry in form of loans.

The State presently has a good Fishing Vessel Loan Program, which was instrumental in the construction of four new fishing boats and will probably help finance more in the future. The Task Force feels that this program has been a most important factor in the recent growth of Hawaii's fisheries.

Recommendation

The Fishing Vessel Loan Program in the Department of Land and Natural Resources should be continued and, if possible, should be expanded.

Under the existing program, there are certain limitations on the fishery that these vessels may enter. We would like to point out that under the Farm Credit Act of 1971, through local Production Credit Associations or the Federal Intermediate Credit Bank of Berkeley, which services the State of Hawaii, it is now possible for prospective fishermen to obtain financing through the Farm Cooperative Bank. This type of financing is especially favorable for the construction of small vessels for inshore fisheries.

The Departments of Land and Natural Resources and Agriculture should investigate the availability of loans for fishing vessels under the Farm Credit Act of 1971 and prepare a brochure of this information for distribution to active and prospective fishermen in the State.

FISHERIES EDUCATION

We noted that Hawaii's fisheries have not been sufficiently profitable to attract new fishermen; few new vessels have entered our fisheries. Furthermore, in our largest fishery (aku), nearly half the fishermen are foreign nationals. Thus, Hawaii's fisheries will soon be seriously hampered by a lack of technically skilled manpower. The State has the capability, through its University system and assisted by the Department of Planning and Economic Development, to train citizens in the skills necessary to operate fishing vessels. In addition, the State, perhaps through the

East-West Center at the University of Hawaii, has an opportunity, if not an obligation, to provide training in fisheries for people elsewhere in the Pacific area.

Recommendations

The embryonic commercial fishing training program at Leeward Community College should be given sufficient support to turn out 20 graduates of the program per year and provide short intensive courses on specific subjects to fishermen who wish to upgrade their skills. Here, action should be the responsibility of the University of Hawaii and the Department of Planning and Economic Development.

CHAPTER 7: MARINE MINERAL RESOURCES

The material considered here was presented in *Hawaii and the Sea–1969* in a chapter entitled *Living and Nonliving Resources.* The decision to separate this chapter from the one on living resources is due to the increased potential now envisioned for marine mineral resources and the distinctly different management needs for these two types of resources. The increased potential is evident in the high industrial interest which has arisen in the mining of ocean manganese deposits. The management needs peculiar to seafloor mineral resources are obvious considering the problems of their exploitation and (territorial) jurisdiction.

In studying marine mineral resources, we had a special mandate to examine sand and gravel, manganese ores and precious coral. Separate sections of this chapter deal with each of these resources. An additional section summarizes present opportunities and problems for a variety of other nonliving marine resources; including ocean-derived power, minerals of the sea volume and nonmetallic minerals from the seafloor.

Precious coral has been included in this chapter, though it is a living resource, for four reasons: (1) it is a sessile (nonmobile) resource, (2) it occurs relatively deep, (3) its mode of exploitation has much in common with the technologies needed for seafloor mining, and (4) its renewal rate is extremely slow compared with rates typical of fishery resources.

SAND AND GRAVEL

Hawaii's supply and demand situation for sand and gravel has not changed significantly since the 1969 report was published. Approximately 800,000 cubic yards of sand and gravel were mined from land sources in Hawaii at that time. Local industry representatives now estimate that total sand consumption in Hawaii will reach 1,200,000 to 1,400,000 cubic yards per year by 1985.

Most of the sand being mined in Hawaii comes from Papohaku Beach, Molokai. Mining operations there are presently involved in litigation with the State and, in any event, are scheduled to terminate in 1975 in accordance with the Shoreline Setback Act of 1970, as amended in 1973. That Act will prohibit mining after 1975 between the coastal setback line and an offshore point which is (1) at least 1,000 feet from shore and (2) in water at least 30 feet deep.

Since the cost of importing sand from outside the State is generally agreed to be prohibitive, the only remaining sources of sand for Hawaii after 1975 will be:

1. Dunes or backbeach deposits located inland from the shoreline setback area.
2. Coralline limestone, lithified sand or basalt, via crushing into manufactured sand.
3. Offshore deposits of the seafloor, taken from beyond the exclusion zone.

Basalt is currently being crushed for gravel and sand on Oahu. After July 1975, the firm that is presently removing sand from Molokai also plans to increase their manufacture of sand from basalt rock on Oahu. Its plant will have an initial capacity of 520,000 tons (approximately 500,000 cubic yards) per year and this output could be doubled. Another firm has received approval to mine about 112,000 cubic yards of sand per year for the next 15 years from backbeach deposits at Mokuleia, Oahu.

It is probable that these sources could supply Hawaii's construction needs for the next decade and perhaps for an indefinite time. They do have certain disadvantages.

- Neither of the two planned sites will be directly responsive to the needs of the Neighbor Islands, which must either develop alternative sources or pay a premium for inter-island shipment.

- We have witnessed considerable and growing opposition to the use of shoreside sand for construction. First, it requires that mining operations take place within the coastal recreation and living zone, in just those places which are likely to have the finest beaches. Second, it may be decided that a higher and better use for deposits of this type would be, because of their consistency, in replenishment of eroded beaches.
- The crushing of basalt, if carried out at the level now planned, poses potential dangers to the environment because of dust, noise and aesthetic degradation.
- We are equally concerned about the energy cost required to crush basalt into sand-sized particles. At a time when energy is in short supply and becoming shorter, we believe that a concerted effort should be underway to avoid such energy-intensive mining techniques.

The need for benthic (ocean bottom) sand must be considered as part of the total needs for sand within the State. This requires consideration of the availability of alternate land deposits, from the backbeach area and rock deposits suitable for crushing. Some deposits have already been committed to urban development, which effectively removes them from potential use. Many other areas may be similarly committed to development over the next 30 years. Furthermore, the noise, dust and traffic caused by rock-crushing operations generally make them unacceptable in close proximity to urban areas if environmental quality is to be preserved.

Recommendation

The Department of Land and Natural Resources should complete, within the next 2 years, a report estimating the volume and quality of all potential sand and gravel deposits, both land and marine, which are available within the State. The report should stipulate any conservation measures necessary to assure their continued availability.

Offshore Sand

Working under Sea Grant funding, researchers at the Hawaii Institute of Geophysics have inventoried sand deposits off leeward Oahu, Molokai and Maui. Support for these resource surveys is being discontinued under Sea Grant. Over 300 million cubic yards of sand have been located off Oahu and about 4 billion yards of sediment (an undetermined amount of which is sand) have been located off Molokai and Maui. Furthermore, research personnel in the Ocean Engineering Department at the University of Hawaii have designed and tested a hydraulic sand mining system, operated from a small

The University of Hawaii sand mining dredge has proven successful in pilot tests.

vessel with minimum crew, which should reduce the adverse environmental effects caused by the more conventional dredges. The system has yet to be tested and proven effective in an actual sand mining operation. A test is planned for execution within the next year.

The Shoreline Setback Act, as amended

by the 1973 Hawaii State Legislature (Act 107), permits sand removal in the offshore zone of the territorial sea if the mining takes place at least 1,000 feet from shore or in water depths greater than 30 feet. This alleviates a major obstacle to offshore mining in the 1970 Act. Additional obstacles remain. Doubt still exists as to the environmental effects and the economics of offshore sand mining; much of the sand located has not been of suitable quality for use in structural concrete. Also, there appear to be uncertainities within the Department of Land and Natural Resources concerning the application of the restrictions to offshore mining. The intent of the changes to Act 107 was to prevent the removal of sand which was part of the natural beach system. Sand located at depths and distances specified in the Act is believed to be effectively removed from the natural system in many instances, but this premise may not be true for all environments. This subject is discussed further in Chapter 4.

It should be recognized that benthic sand could, in 10 to 20 years, replace the land as the major source of sand for construction and beach nourishment in Hawaii. The use of such sand as a supplemental supply could begin almost immediately. This is especially true on Neighbor Islands such as Hawaii, where sources for land mining are not available. The successful use of these sand deposits depends on continued research to determine the quantity and quality of the material.

We believe that the offshore sand deposits already discovered under the University's Sea Grant research project have the potential of satisfying State needs for many decades. The recommendations we make below address the problems not yet solved. What is the total volume and thickness of the most promising offshore sand deposits? What is the quality of the sand in these deposits and how does it vary with sub-bottom depth? Can commercially economic mining of offshore sand be demonstrated? What are the environmental impacts of such a mining operation? Can current law be clarified to replace arbitrary distance and depth limits for exclusion zones with limits which are based on specific knowledge of environmental conditions? The last two questions are discussed in Chapter 4.

Recommendation

The Department of Land and Natural Resources should begin immediately to clear the way for an orderly transition to use of offshore sand by:

1. **Encouraging and supporting small, well-monitored, pilot, sand mining operations by both private and University groups.**
2. **Conducting more detailed resource surveys and sampling selected offshore sand deposits through increased support of the University of Hawaii's sand research project.**
3. **Supporting additional research by the University of Hawaii into the environmental and technical aspects of offshore sand mining.**

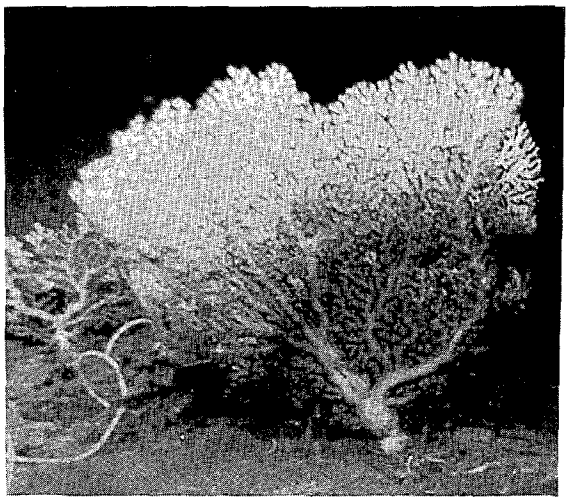
PRECIOUS CORAL

When *Hawaii and the Sea–1969* was published, the precious coral industry in Hawaii was about 10 years old. Since that time, it has grown from an industry employing about 200 persons and producing retail sales of $2.5 million to one employing about 500 persons and producing retail sales of $7.5 million. This figure compares to the world annual production at the retail level of $200 million. Clearly, there is considerable room for continued growth of this industry, which at the present time is dominated by production in Japan and Italy. The very rapid recent growth of the precious coral industry in Hawaii is due primarily to three factors: (1) a steady rise in tourism, (2) vigorous merchandising efforts by those locally involved in the industry and (3) the results of a current State, Sea Grant and industry-supported research program at the University of Hawaii.

The precious coral industry in Hawaii began about 1958 with the discovery of a large bed of black coral off Maui. A second impetus to its growth came with the discovery of pink coral off Makapuu, Oahu, in 1966. Both varieties have increased value from processing and setting in jewelry. The value of the raw material may be as little as 10 percent of the retail sales price. An economic report on the industry has been prepared by Kok-Kian Poh.

The local supply of black coral appears to be adequate for the current needs of the Hawaiian industry, although there is a need for regulations to control the rate of harvest. Recovery of pink coral locally has been supplemented by Midway coral obtained in Japan (dredged from the Milwaukee Bank at the northwestern tip of the Hawaiian Archipelago). Ironically, a depression in the world market for pink coral, which occurred around 1967, was caused by Japanese exploitation of shallow banks off the Midway portion of the Hawaiian Archipelago.

In addition to the beds off Makapuu and Midway, pink coral has been found off Kaena Point, Necker Island, Brooks Bank and French Frigate Shoals. Commercial feasibility has been demonstrated only for the Midway and Makapuu beds. All of the occurrences are in depths near 1,200 feet. The Makapuu beds have been surveyed extensively, using advanced underwater techniques such as photography, underwater television and submersibles. Estimates of the standing crop of that bed and a description of a method to harvest it have been made by Dr. Richard Grigg.



Pink coral colonies have supported a successful jewelry industry in Hawaii.

The potential for growth of the precious coral industry was emphasized in *Hawaii and the Sea–1969,* which made the following recommendations:

1. The Secretary of the Interior should be informed of the importance of precious coral as a potential growth industry in Hawaii and be urged to include corals in the list of creatures of the Continental Shelf.
2. The State should take the lead in conducting a survey of the precious coral resource along the Hawaiian Archipelago, especially in the Northwestern Hawaiian Islands area.
3. The State should encourage the development of a more economical harvesting technique.
4. The Federal Government should clarify the ownership status of offshore banks which geologically form part of the Hawaii Archipelago.

Considerable progress has been made in response to these recommendations and in other aspects of the industry. First, precious coral was included as a creature of the Continental Shelf by amendment to the Bartlett Act (Public Law 88-308) in 1971.

Second, the Sea Grant program at the University of Hawaii has conducted a partial survey of the resource. However, considerably more exploration, especially off islands of the northwestern end of the chain, is needed before the entire resource can be accurately assessed. The economic value of pink coral in the Makapuu bed has been estimated at $2 million. The annual maximum sustained yield of raw coral from that bed is estimated to be worth $100,000. Two other species of

potentially valuable precious coral, bamboo and gold coral, have been discovered in Hawaiian waters.

Third, a technique for harvesting coral using a manned submersible has been developed and is currently being used commercially off Makapuu. This method permits selective harvesting, which is desirable in order not to overexploit the renewable resource. Management guidelines currently being developed by the University of Hawaii Sea Grant program will result in recommendations to the State concerning size limits and annual quotas.

Fourth, it has been repeatedly pointed out to the Secretary of Commerce that precious coral resources are currently being harvested in 1,200-foot depths in Hawaii. Following the definitions and policy of the 1958 Law of the Sea Conference in Geneva, this fact established that precious coral in Hawaiian waters is a Continental Shelf fishery resource and should support prohibition of all foreign vessels engaging in its exploitation. Nevertheless, it is not likely that the United States will enact specific legislation concerning this problem until the next International Law of the Sea Convention has convened this year.

Recommendation

1. **The future of the precious coral industry in Hawaii depends on a continuing supply of raw material. The Department of Land and Natural Resources, working with the Office of the Marine Affairs Coordinator, should undertake sufficient exploration, mapping and documentation of the total state resource to ensure that adequate raw material is available to the coral industry and adequate knowledge is available in the public domain.**
2. **In the meantime, the Department of Land and Natural Resources should develop measures to manage and protect this valuable natural resource.**
3. **Concurrent with efforts to promote exploration and discovery of precious coral beds, the Department of Land and Natural Resources should encourage development and demonstration of techniques (e.g., tethered, controllable, unmanned systems) to lessen the present high costs of both exploration and harvesting.**
4. **The Department of Planning and Economic Development, working with members of the local precious coral industry, should promote the identification of Hawaii with precious coral and ensure that this knowledge and other information concerning quality of the product reaches the tourists who visit Hawaii.**

MANGANESE DEPOSITS

In *Hawaii and the Sea–1969,* seafloor deposits of manganese were considered to be a potentially valuable resource for future exploitation. Today, pilot programs for their mining are underway and backed by private capital. The Pacific deposits appear certain to be the first to be mined.

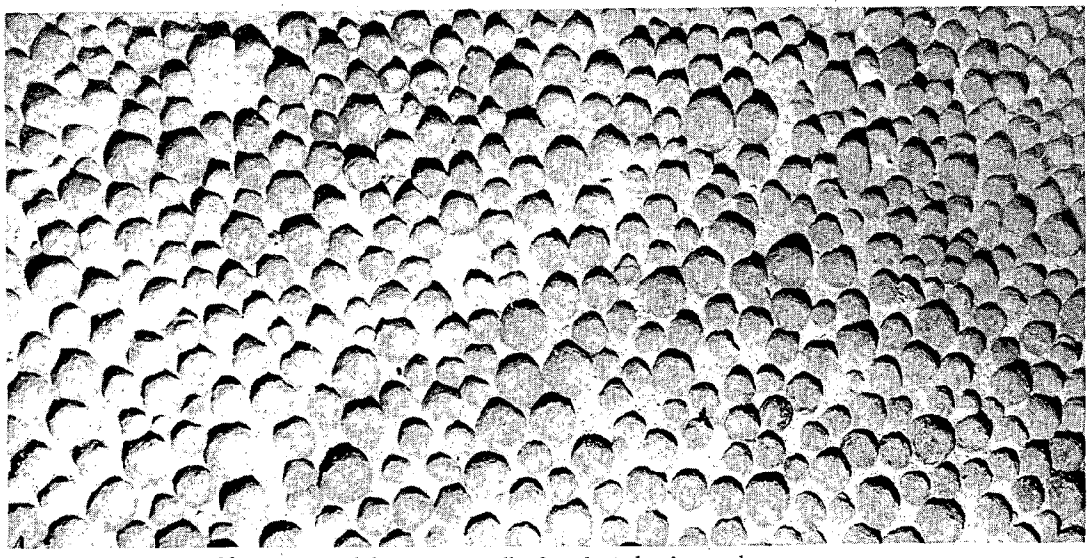
Since 1969, knowledge of the origin, distribution, concentration and seafloor properties of manganese nodules has greatly increased. Much of the knowledge which has reached open literature is due to acceleration of academic studies, many at the University of Hawaii, caused by the initiation of a project supported by the National Science Foundation's Office of the International Decade of Ocean Exploration (IDOE). Industrial participation has been related to the potential of marine nodules for copper, nickel, manganese and iron recovery. Such industrial companies include:

1. *Deep Sea Ventures, Inc./Tenneco, Inc.,* who have identified several candidate ore bodies, demonstrated a successful airlift hydraulic dredging technique in 2,400 feet of water, provided a successful operation of a 1-ton/day

"pollution-free" hydrochlorination chemical process pilot plant for the extraction of pure metals, and conducted preliminary marine environmental studies associated with recovery operations of nodules at sea.

2. *Hughes (Summa Company)* has developed a 51,000-ton prototype ocean mining ship, the Hughes GLOMAR EXPLORER, and has tested a hydraulic dredge head for nodule recovery.
3. *Kennecott Copper* has participated in several ocean survey cruises, has a huge data bank on the chemical and physical properties of nodules in the Pacific Ocean, has defined mine sites in the Pacific, and is researching processing technology.
4. *Ocean Resources, Inc. (ORI)* has conducted exploration cruises in conjunction with the Japan Resources Association (Sumitomo Shoji Kaisha, Ltd.), has developed and successfully tested a mechanical dredging system using a continuous line bucket (CLB), and has applied to the State of Hawaii for rights to survey the Kauai Channel for the purpose of economic recovery of manganese crust deposits.
5. *International Nickel Company (INCO)* has conducted research, exploration, engineering and systems studies for nodule recovery.
6. *Sumitomo Group (MITI)* consists of the Japanese firms and government agencies which conducted the CLB test in conjunction with ORI. This group has proposed the creation of a $227 million semi-public venture scheduled for 1977.
7. *West Germany Group (AMR)* has conducted research on nodule mining recovery, origin, distribution and metallurgical recovery, and supported the vessel R/V VALDIVIA which has been active in Hawaii since 1971.
8. *Societe' le Nickel (CNEXO)* has organized exploration cruises close to French Polynesia, participated in the CLB test, and done work in Hawaii.

Each of these eight major industrial companies has been in contact with the University of Hawaii Manganese Research Project (UHMRP). These contacts are normally cooperative research ventures concerning knowledge of the origin and distribution of manganese deposits in the Pacific. The UHMRP is a leading center for Pacific Ocean mining research and development on both a national and international scale. Under an IDOE-NSF research program, it is coordinating all international exchanges and research in these



Manganese nodules are generally found at depths much greater than the "crusts" of the Kauai Channel.

fields. In 1972 and 1973, international conferences on the subject took place in Hawaii.

At this time, there are two types of manganese deposits recognized in the Pacific:

1. Deep-ocean nodules with high copper and nickel concentrations.
2. Archipelago crust deposits with relatively high cobalt and noble metal concentrations.

Manganese Nodules

The nodules constitute the major deposits. They are located on the international seabed and have been the principal interest in ocean-mining recovery operations. These deposits are generally located between the equator and 15°N latitude, and from 125°W to 165°W longitude in water depths greater than 6,500 feet. The richest deposits are about 600 to 1,000 miles southeast of Hawaii. Hawaii is, therefore, the closest land mass and commercial center.

The crust types of deposit were recently discovered in Hawaiian waters; i.e., in the channels of the main Hawaiian Islands. So far, they have not been fully researched for distribution, element concentrations or economic feasibility for exploitation. Accessibility and the potential for legal control enhance interest in these deposits.

For both types of deposit, Hawaii is the central land mass for ocean mining. It can, if the State chooses, create a social and legal base favorable to investment by this industry. Investment would involve both the operations and research and development phases of the industry. Research units within the State, such as UHMRP, would be direct beneficiaries of initial industrial investment. Specific problems, such as the legal jurisdiction of deep sea marine deposits in the absence of an international authority vested to grant concessions and control mining activities, complicate the investment opportunities of private industry. This also complicates State versus Federal policy in areas of economic exploitation of the seabed.

The legal basis for ocean mining is only defined in the *Convention on the Continental Shelf* agreements made in Geneva in 1958. These agreements, however, are too vague to serve as a reliable legal basis for ocean mining. This uncertain legal picture regarding the deep sea is inconsistent with the rapid technical development of ocean mining capabilities, land-based pilot plants, research and mine site exploration. As a consequence, ocean mining may well result in international litigations.

Ecological concerns in ocean mining require consideration of the recovery operation at sea, transhipment and the metal reduction plant at a land base. In regard to the ecological equilibrium in the deep sea, evidence to date suggests that it will not be detectably disturbed by actual mining activities. Monitoring procedures to verify this premise still need development. In connection with a metal reduction plant and its solid and liquid waste products, the Environmental Protection Agency, in conjunction with State agencies, can provide proper guidelines for industrial operations. The technology is available to remain within current environmental constraints. There is some evidence to show that the by-products of ocean mining can be utilized in subsidiary industries, such as the construction materials industry.

Although the resource is termed manganese (or ferromanganese) nodules or deposits, much of the current industrial interest focuses on the economic importance of other metals contained within the ore. The deep sea nodule deposits of ore quality in the Pacific commonly contain about 1.4 percent nickel, 1.3 percent copper, 0.5 percent cobalt, and 30.0 percent manganese. With a metal recovery of 90 percent, 1 ton of manganese nodules yields about 25 pounds of nickel, 24 pounds of copper, 9 pounds of cobalt and 540 pounds of manganese.

Hydrometallurgical processing seems to be the best process for metal reduction. The sulfating, chlorinating or ammine-carbonating

reactions lead to concentrated metallic solutions which have to be further refined. Copper, nickel, cobalt and other metals can be removed from these metallic solutions by solvent extraction and electro-winning. Two plants are in operation today: Ranches Bluebird Mine at Miami, Arizona, and Bagdad Copper at Bagdad, Arizona. This process, however, may not be cost effective for manganese nodules.

The hydrochloric acid (HCl) leach process seems to be the most favorable for recovery of Ni/Co/Cu/Mn. This process includes an HCl leach, then an HCl roast + leach, Cl_2-roast + leach, NaCl + FeS_2 roast + leach, a reducing roast, a NH_3 /NH_4 Cl pressure leach, a chlorinating regeneration step and, finally, the segregation of metals and electro-purification.

In order to effectively run a hydrochloric acid leach process, chlorine gas, ammonia and electric power are required. A chemical corporation based in Hawaii is planning a chlorine production plant in the Islands and probably can supply sufficient quantities of chlorine to fully support the hydrometallurgical process. Electric power would not be economical for the process at the high energy costs of the present rate structure of the Hawaiian Electric Company. Therefore, an energy plant must be constructed for the hydrometallurgical process, or present facilities must be made less expensive.

Hawaiian Manganese Crusts

To illustrate the potential importance of these deposits as metal ores, the accompanying table has been prepared. The metal content is based on actual analyses which have been made of samples recovered from the crust deposits of the Kauai channel. These deposits are of immediate importance to Hawaii. The quantity of one million tons of crust is believed to be representative of what a projected dredging operation might recover in one year. The value of the recovered metal represents current market prices. No attempt has been made to calculate operational costs of mining, handling, or benefaction and hence, the values given are for the gross product and in no way represent net values.

Cost of transportation for raw ores to a plant may run as high as 25 percent of the total costs for production and mining. Mining costs can be as high as 38 percent, or as low as 13 percent and processing can range from 44 percent to 72 percent. In order to minimize costs of production, an ideal base of refining operations should:

1. Be close to the mining site.
2. Have cheap electric power.
3. Have adequate ship dock facilities.
4. Have reasonable land prices for the metallurgical plant base.
5. Be in a trade route to the mainland, Japan or other markets.
6. Have a research center engaged in a marine nodules project.

In addition, the mining site should be in relatively shallow water. Several sites within the State could provide most or all of the ideal conditions necessary to attract a complete manganese nodule industry.

A processing facility for one million tons of crust per year might be visualized as being the size of an oil refinery, requiring a deep-draft harbor, needing as much as 200 megawatts of electrical power, using chemical reagents such as chlorine and ammonia and possibly requiring large quantities of fresh water. The deep-draft ports of Kawaihae and Hilo on Hawaii, Honolulu Harbor, or the proposed site at Barbers Point on Oahu and Port Allen or Nawiliwili on Kauai, would be suitable examples of sites which could be considered. The Big Island areas have potential energy resources that might be developed in future conjunction with this need, either from volcanic heat or from deep ocean thermal engines.

From the State's point of view, the siting and specifications for a refinery must be environmentally acceptable. To ensure that such a facility is constructed and operated in

ESTIMATED GROSS PRODUCT VALUE OF ONE MILLION TONS OF HAWAIIAN MANGANESE CRUST

Metal*	Range ppm**	Projected Concentration ppm***	Concentration Tons per Million Tons	$ / Ton****	Gross Product Value in Millions of Dollars
Gold	1.0 - 10.0	5	5	2,400,000	12.0
Silver	1.0 - 10.0	5	5	88,000	0.4
Iridium	0.5 - 2.0	1	1	8,000,000	8.0
Osmium	15.0 - 38.0	20	20	6,400,000	130.0
Palladium	5.0 - 20.0	10	10	2,600,000	26.0
Platinum	1.0 - 100.0	50	50	5,300,000	270.0
Cobalt (Shot Cathode)	7500 - 14000	8800 (0.88%)	8800	6,400	56.0
Nickel (Cathode)	3500 - 8000	5000 (0.50%)	5000	3,060	15.0
Manganese Metal Regular Grade	150 - 250 x 10^3	200 x 10^3 (20%)	200 x 10^3	660	130.0
Iron	80 - 150 x 10^3	100 x 10^3 (10%)	100 x 10^3	80	8.0
Titanium (Bar)	15 - 45 x 10^3	16 x 10^3 (1.6%)	16 x 10^3	8,300	130.0

Total at 100% Recovery in millions of dollars	785
Total at 50% Recovery in millions of dollars	372
Total at 100% Recovery without Mn, Fe, Ti	515
Total at 50% Recovery without Mn, Fe, Ti	236
Total at 100% Recovery without Mn, Fe, Ti, Ni, Co	444
Total at 50% Recovery without Mn, Fe, Ti, Ni, Co	164

Notes:

* This column represents the highest possible grade for each metal considered.

** These are the observed ranges in parts per million (ppm) for one deposit in the Kauai Channel. These analyses are based upon a very limited survey and number of samples.

*** The projected concentration represents a minable deposit which may be found in the Hawaiian Archipelago after extensive surveys and analyses. Those concentrations are calculated as being part of the reducible oxide phase of the ore.

****Metals Week, Oct. 8, 1973

This table does not allow for excessive mining of associated sediment (i.e., the silicate phases), nor does it imply any analysis of processing techniques or potentials based on deposit mineralogy. These and other problems must receive attention prior to any serious approach to exploitation.

the best interests of Hawaii's citizens, several planning steps are needed. If necessary, the State should be prepared to offer the potential refiners tax and/or lease advantages to attract the type of new industry that environmentally concerned citizens can accept. Here is an opportunity for the scientist, the architect, the engineer and the industrialist to prove that technological and economic progress can be made without harm or danger to the environment. The recommendations stated below concern: first, a demonstration by the State of its interest in a potential manganese nodule industry for Hawaii; and, second, a rapid compilation of data on industrial requirements and environmental impacts of that industry so that decisions can be both timely and informed.

Recommendation

1. **Accelerated support should be given by the State to the University of Hawaii Manganese Research Program. The scope of that program should be expanded to produce a group which will have outstanding competence and knowledge in all phases of the marine manganese industry, especially mining and processing. Marine environmental effects of the mining operations should be researched by the University and its work coordinated with Federal agencies such as EPA and NOAA.**
2. **The Department of Planning and Economic Development should engage a consulting firm to research and write a manganese industry report similar to the OCEAN POTENTIAL FOR HAWAII report made in the 1960's. The report should look at the total mining industry system, from research, development and exploration, through recovery of the ore and processing, to considerations of by-products and of potential economic revenues.**
3. **The Department of Planning and Economic Development should begin to investigate and evaluate alternative processes and sites which might be used by the onshore manganese processing plants. These assessments should include environmental, social and economic impacts. They should consider not only the processing plant, but supporting plants for power and chemicals. The major companies involved might be invited to Hawaii to confidentially discuss their plans and sufficiently disclose their processes, allowing such assessments to be made.**
4. **The Attorney General's Office should assemble a special task force of lawyers and scientists to define and recommend a legal position for the State of Hawaii regarding mineable deposits on the deep seafloor of the Hawaiian Archipelago.**

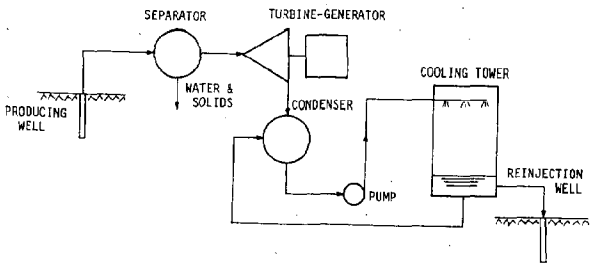
For efficiency, economy and speed, these studies should be closely coordinated; perhaps through a State interdepartmental council. (Note that specific recommendations regarding a policy of sovereignty based on an archipelago concept are made in Chapter 3, and recommendations concerning harbors are made in Chapter 8.)

OTHER OCEAN RESOURCES

In addition to precious corals, sand and gravel, and manganese nodule/crust enriched deposits, there are possibilities of additional economically exploitable ocean minerals or resources near Hawaii. These include such minerals of the seafloor as zeolites, siliceous and calcareous oozes, clays and bauxite. They also include minerals of the ocean volume, such as bromine, chlorine, hydrogen and magnesium. While their economic viability in sustaining new Hawaiian industries is not yet clear, it may be that the synergism of a Hawaiian manganese industry would furnish the catalyst necessary to make any of these resource areas economically profitable.

The Marine Affairs Coordinator should monitor developments in the technology of extracting minerals from seawater and from generalized seafloor deposits. If technologies

are developed that are in keeping with Hawaii's standard of environmental quality and offer possibilities of new industry, the Marine Affairs Coordinator should make this fact known to the people of the State. Because of the relationship of this technology to the interests and responsibilities of the University of Hawaii Manganese Research Project, that group might be assigned working responsibility for this task.

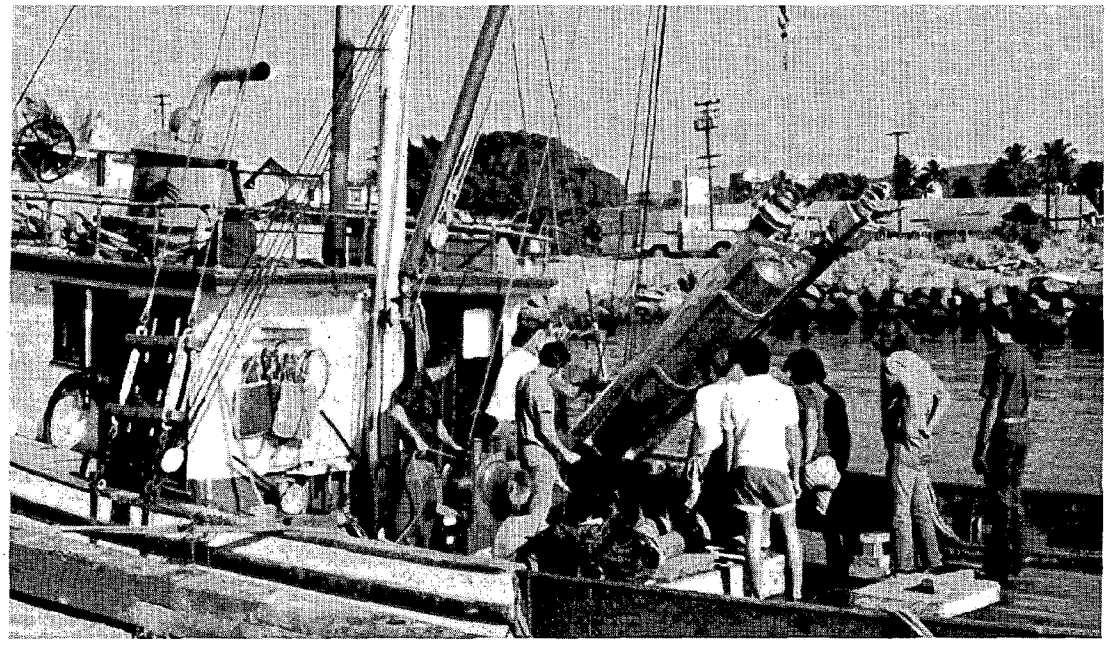


Schematic of planned geothermal condensing-type generator.

Hawaii's interest in geothermal energy is accelerating rapidly and presently is focused on a joint Federal/State/County investigation of the energy-producing potential of the volcano area on the Big Island. A more recent concept would join the high temperatures available from the geothermal rock mass to the low temperature of nearby deep ocean water, to increase the difference temperature and, therefore, the effectiveness of the power conversion system. Additional features of the concept include an input of solar heat to increase energy flux, and generation of nutrient flows from deep water to the surface in support of aquaculture. Local and Federal interest in, and funding of, the geothermal research project is high; in fact, considering the general austerity of research and development budgets, it is very high. We believe this geothermal/solar/ocean energy system has even greater potential and national interest. Hawaii is uniquely blessed as a candidate site for a demonstration project, since it combines in a single area volcanically heated rock, nearby deep water and high solar elevation angles.

Recommendation

The State Marine Affairs Coordinator should take a leading role in development of a proposal--with shared support from the State, from the Federal government and from industry--to demonstrate the feasibility of a geothermal/solar/ocean system to produce energy in Hawaii. The demonstration should determine both economic and environmental feasibility of the system.



CHAPTER 8: MARINE TRANSPORTATION AND INDUSTRY

We believe that Hawaii's economic health is closely tied to its ability to wisely and completely utilize its many marine resources. As these resources are developed, we also believe it is an environmental imperative that the goals and methods chosen be in a direction to divert future increases in economic opportunity and population away from Oahu and toward the Neighbor Islands.

Marine opportunities to support such diversion are especially evident in those industries for which Hawaii has, or can have, an essentially "throughput" role; i.e., as a way station for minerals or foods which touch our shores only for processing, then are exported to foreign or mainland consumers. Primary candidates for such industries include processing of manganese nodules and crusts, refining of crude oils, conversion of geothermal/solar/ocean energy into exportable fuels such as hydrogen and, to a lesser extent, processing of fish, shipbuilding and fabrication of jewelry from precious corals.

We therefore suggest that marine industries described here and in Chapter 7 be considered both for their absolute economic value to Hawaii and their potential value as tools for the wise development of the Neighbor Islands. For this development to take place, we suggest that Hawaii must have a more versatile inter-island transportation system. This system, in fact, must *precede* the development needed by the Neighbor Islands.

THE NEED FOR DISPERSION

Data from the recently published "Atlas of Hawaii" and the "State of Hawaii Data Book" show that the Neighbor Islands are apparently just reversing a long downward slide in population. Molokai and Maui have approximately the same population they had in 1832. Hawaii and Kauai have populations equal to the levels of 1920. Oahu, on the other hand, has more than 20 times the population it had in 1832 and more than 5 times the population of 1920. Some enlightening statistics are summarized below.

While Oahu has a highly diversified employment base, the Neighbor Islands are primarily dependent on industrial agriculture (sugar and pineapple) and tourism. Both industries have a high demand for unskilled and slightly-skilled labor and are noted for their relatively low wages. The median family income in the Neighbor Islands is uniformly $3,000 per year lower than on Oahu.

Another insight is gained from a look at population-age statistics for the islands. Compared to Oahu, the Neighbor Islands are characterized by a higher percentage of children (through high school age), and a much higher percentage of adults above age

Indicators and Trends	Oahu	Neighbor Islands
Population	Large and growing	Low growth rate, except for Maui
Age Distribution	Normal curve	Low in the age group 20-40
Labor Base	Diversified	Agriculture and tourism
Employment	Increasing	Declining, except for tourism
Family Income	High	Uniformly $3,000 less per year than Oahu
Income Trend	High	Falling farther behind
Density (people per square mile)	More than 1,150	About 28
People Per Mile of Shoreline	More than 3,300	About 190

55. They have a sharply lower percentage of residents in the 20 to 40-year-old wage-earning age group. This implies that many residents of the Neighbor Islands emigrate to Oahu (or out of state) in order to find employment. The median population ages are 4.3 to 5.1 years greater in the Neighbor Islands than on Oahu. With the higher percentage of children on the other islands, this difference should be almost reversed.

Industrial agriculture, as practiced in the past, does not seem to hold the answer to the needs of the Neighbor Islands. If anything, the employment trend in sugar and pineapple seems to be accelerating downward. Replacing their single-industry economy with another (tourism) leaves little freedom of choice and vulnerability to the peaks and valleys of that industry. We advocate a strong continuing effort on the part of the State to infuse enough varied industry into the Neighbor Islands so that, for their citizens, the place and type of employment can be a matter of choice, not of necessity; so that median family incomes can provide normal living conditions; so that some of the pressure of increasing population can be removed from Oahu.

Industrial Candidates for Dispersion

Possible immediate candidates for such dispersion include diversified agriculture (especially truck gardening), light manufacturing (especially of goods for export or as alternatives to goods now being imported), education and research (as transfers from Oahu) and tourism (especially if it can be entered at the level of the small entrepreneur).

We are accustomed to thinking of Hawaii as a "pocket market", one for which it is normally easier to import a product than to produce it locally. This attitude has been particularly true in the case of table-crop agriculture. We submit that if Hawaii is a "pocket market", it is a very large one. In 1970, for example, the islands imported $172,000,000 worth of food. The percentage distribution of sources for a number of fresh foods is listed below.

Note the high dependence on imports for many products that could readily be produced in the islands. Note also that crowded Oahu, in the face of high land costs and encroaching urbanism, equals or out-produces all the other islands put together, except for beef products.

Chapters 6 and 7 discuss a number of new or growing industries which could logically be located on a Neighbor Island. For example:

- Hawaii's fishery industry should extend its reach into the Northwestern Hawaiian Islands, as well as into the equatorial upwelling zone to the south. The northern fishery could be supported from Kauai. The Big Island harbor at Hilo should be considered as a support base for equatorial fisheries.
- Oil refining was described earlier as an example of a "throughput" industry, and need not (in fact, should not) be located near a population center. Once the constraints of an adequate harbor or

	Imported From		Produced in Hawaii	
	Mainland	Foreign	Oahu	Non-Oahu
Fruit/Vegetables	56%	5%	19%	20%
Beef/Veal	26%	26%	4%	44%
Pork	64%	—	25%	11%
Poultry	68%	—	27%	5%
Butter	93%	7%	—	—
Rice	100%	—	—	—
Eggs	4%	1%	69%	26%

offshore terminal and suitable environmental safeguards are met, plants of this type could be located on any of our islands.

- The ocean manganese industry seems certain to come to Hawaii, although the time and magnitude of its coming is not yet known. This industry, and the supporting industries it will require, are major candidates for location on a Neighbor Island.

- The Big Island should be a "best" (perhaps only) site for a geothermal/solar/ocean energy complex and the hydrogen export industry it could support.

A number of other examples are readily found where industry is economically ripe for location or relocation on the Neighbor Islands. But creation or installation of these industries cannot precede the transportation system which must sustain them. This is especially true for the truck farmer, whose natural market will continue for the indefinite future to be located on Oahu. The Neighbor Island farmer must have access to an efficient transportation system which can help reduce the number of commercial interfaces between him and the consumer. Presently, he must operate remotely from that consumer, separated by the shipper, jobber, wholesaler and retailer. Often he must ship produce by consignment to the Honolulu wholesaler, where it is placed in competition with mainland produce already purchased and owned by the wholesaler. Understandably, in such cases, the local produce is given a lower sales priority and may suffer severe wastage or deterioration.

As a goal, the Neighbor Island truck farmer should be able, individually or as part of a cooperative, to take his own product to the market and deal directly, if he so desires, with the consumer. Understanding that other fundamental changes in farming technique are necessary, we believe that a comprehensive inter-island transportation system will help achieve this goal.

INTER-ISLAND MARINE TRANSPORTATION

Hawaii is unique among the fifty states in that it is an archipelago, a small group of land masses separated from the continents and isolated from each other by broad expanses of open ocean. The economic, commercial and cultural integration of our islands must take place with only two alternative inter-island links——the airplane or marine transportation.

Two other states, Washington and Alaska, have environments which pose analogous problems. Both have a geography which interposes broad stretches of water between and among their population and industrial centers. While they do have the alternative of building roadbeds around the water barriers, both have responded directly to the challenge through the construction and operation of thriving marine transportation systems. The multi-purpose ships of these systems carry foot traffic, cargo, automobiles, buses and trucks, and do so at a fair profit. Hawaii, on the other hand, has at present only a barge system in operation.

This has not always been the case. Regularly scheduled service among the islands began in the 1850's with the steamships CONSTITUTION and AKAMAI. Between 1877 and 1949, as many as a dozen steamships operated in inter-island service. World War II curtailed inter-island surface traffic. The postwar impact of inexpensive air service, with low cost surplus aircraft, subsidized rates and short travel times, finally resulted in the discontinuation in 1949 of commercial steamship service among the islands.

Two abortive attempts have been made to reestablish this service. In 1950, Hilo Navigation Company attempted to operate a surplus ship from the now-defunct Inter-Island Steam Navigation Company. Service was terminated in 1952. In 1958 and 1959, Hawaiian Water Transportation Corporation operated four converted patrol

boats in inter-island ferry service.

Current Status

Today, Hawaii's primary inter-island surface transportation service is that offered by Young Brothers' tug/barge cargo system. That company is not allowed to carry passengers aboard either tug or barge, so Hawaii has had no inter-island marine passenger service since 1959. This has forced the islands into a commercial and cultural relationship totally unlike that of any other state. On the mainland, and in most foreign countries, people and goods can travel by air, auto, truck, bus, train or ship--singly or in any combination of these. In Hawaii, people must travel inter-island by air, with no commercial options. Commerce must move by ship, except for that small percentage of high value freight which can be carried by our airlines. People and goods cannot travel together.

We have described the impact of this situation on the truck gardener or small manufacturer. The same situation affects the private citizen. Today's Hawaii resident pays more to travel inter-island than a tourist, yet disembarks with the status of that tourist, supported only with the hand baggage he can carry with him. A family could ship its automobile by barge while traveling by air, but suffers a number of logistic obstacles in the process--different departure and arrival times, for example, with different departure and arrival ports.

During the summer of 1973, two students from the University of Hawaii's Marine Option Program conducted a public opinion survey of citizen attitudes toward inter-island transportation. Their report is included in this document as Appendix C. The survey attempted to determine what factors were considered most important by residents as they traveled or planned to travel among the islands. The students found that more than half of those interviewed were dissatisfied with the present (air) system, primarily because of its expense (37 percent) and a feeling that there should be alternative ways to travel (21 percent). In looking at surface alternatives to air transportation, respondees felt that such systems should offer comfort, safety, cost savings, dependable scheduling and the ability to carry automobiles, sports equipment and boats.

The main conclusions reached by the survey were that Hawaii's citizens are ready to accept and use inter-island surface transportation, if it can offer a comfortable safe ride and can be operated at reasonable fares.

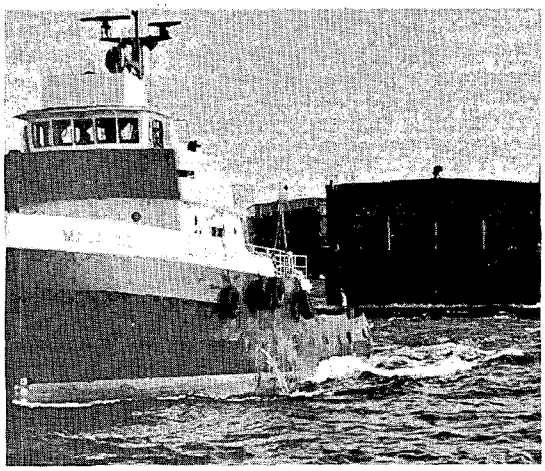
Currently Planned Systems

Four additions to Hawaii's inter-island surface transportation capability are either nearing reality or have reached the stage of public discussion of plans.

Barge Ship

Young Brothers, Ltd., is studying the concept of a self-propelled barge to replace its older barges in inter-island commerce. These ships would probably serve all harbors now reached by the existing tug/barge system and would make direct round trips between Honolulu and each destination.

The barge ships would be designed and scheduled to carry cargo, including roll-on/roll-off heavy vehicles, but may be



Dillingham's Young Brothers barges serve the bulk and container needs of the Islands. The tug, MALANAE, is owned by Hawaii Tug and Barge Company.

designed to carry passengers and vehicles. Their slower and rougher ride and their cargo scheduling emphasis, probably, would not allow them to compete freely with the hydrofoil for passengers or with a more conventional ferry ship for auto/passenger traffic.

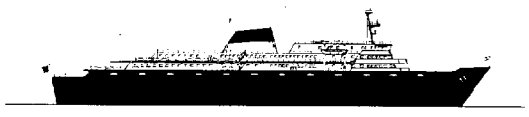
Boeing 929 Jetfoil

Pacific Sea Transportation, Ltd. expects to have the first of these crafts operating in Hawaii by late 1974. Two additional units are on order and should arrive early in 1975.

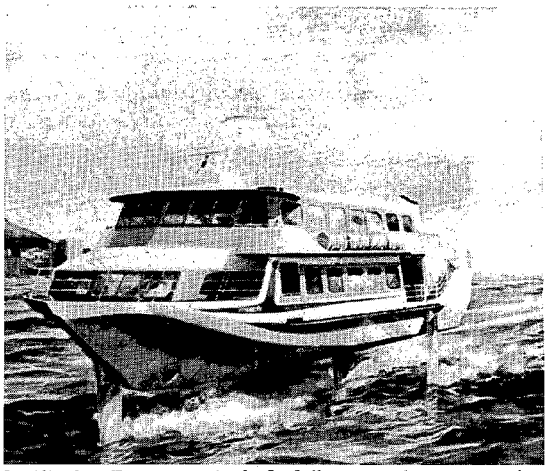
Advantages expected for the jetfoil include high speed (45 knots) and a smooth ride in moderate seas. The jetfoil will carry passengers and their hand baggage, but no heavier cargo. Present plans call for travel between Oahu and Maui, Kauai and Hawaii. If traffic conditions warrant, Molokai and Lanai could be added to the trip schedule.

Hulten Ferry

Under the leadership of Senator John Hulten, Hawaiian Inter-Island Ferry System, Ltd. plans to operate two conventional ship-type ferries, each having approximately 6,000-tons displacement. The ships will be equipped with roll stabilization devices that should provide a comfortable ride under most weather conditions. Without major harbor improvements, Senator Hulten's ships cannot provide service to Molokai, Lanai or the leeward side of Maui. They will be designed to carry automobiles and trucks.



Hulten Ferry concept offers roll-on/roll-off capability.



Pacific Sea Transportation's Jetfoils are under construction and planned for passenger service in 1974.

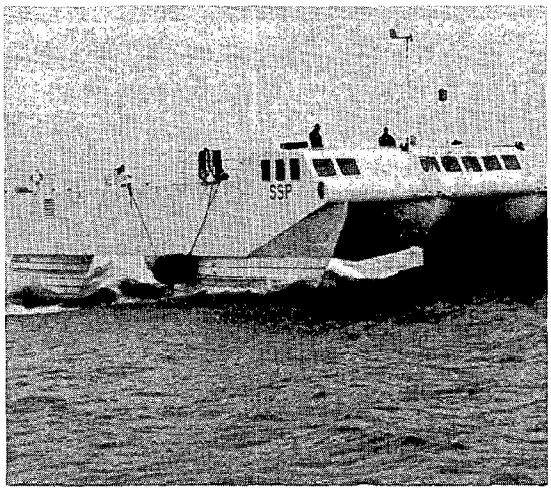
Semi-Submersible Ship (SSS)

The semi-submersible ship is being developed by the U. S. Navy as a potential replacement for conventional monohull ships in the 200 to 10,000 ton displacement range. Stability at all speeds is gained through the use of fully submerged buoyancy hulls. This approach also reduces wave drag, allowing a higher speed-to-power ratio.

A 190-ton seagoing model, designed by the Naval Undersea Center's Hawaii Laboratory, has been built at the Coast Guard shipyard in Baltimore, Maryland. This craft is presently undergoing sea trials, the results of which should be available early in 1974.

House Bill 1518, introduced in the 1973 legislative session, but not yet passed, would build a copy of the Navy model for demonstration in Hawaii and at the 1975 Okinawa Marine Fair. The primary advantages of the ship concept include: (1) a high degree of stability in heavy seas, (2) the ability to use relatively unprotected harbors, (3) a box-type

superstructure for more efficient packing of cargo and (4) a design based on simple cylinders and box frames which might allow



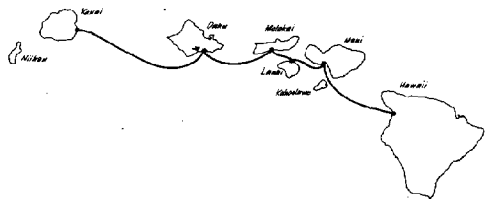
The Navy's Semi-Submersible Ship (SSS) should be closely monitored for the unique solutions it offers in high speed, rough water operation.

the ship to be built in Hawaii. Its primary disadvantage is the current lack of verified data on performance in high seas.

Federal Sponsorship

An important new factor entered the picture this year when the President signed Public Law 93-87, the Federal Aid to Highways Act of 1973. This law specifically grants to Hawaii the right to apply for Federal support for an inter-island ferry system. Until this year, such funds could not be used for any system whose ships crossed international waters. (All of the channels between Hawaii's islands are wider than six miles and therefore contain a section of international waters.)

The new law makes a state-owned ferry system, including highway approaches and terminals, eligible for Federal sponsorship of 70 percent of its design and construction cost. If the ships are privately owned, only the access roads are eligible for Federal support.



Proposed inter-island route would provide daily service to each island.

Elements Of An "Ideal" Marine Transport System

Here, "ideal" is defined as a best working compromise among (1) where we are today, (2) the marine transportation system we believe the State needs and (3) those private and government resources which should be available to close the gap. The general characteristics which are desirable for all ships of the system include:

- (At least) those ships carrying passengers should offer a comfortable ride in Hawaiian waters, e.g., in the 8 to 12-foot waves of a fully developed Sea State Five.
- The system should allow stops at least once a day at each of Hawaii's six major islands. This minimum service should be guaranteed so users can count on its long-term continuance. On the same basis, runs should be scheduled to connect the Neighbor Islands.
- The combination of ship speed and scheduling should allow daylight service (12 hours maximum) between Oahu and any Neighbor Island.
- Fares must be set to take into account the needs of the low-income citizen and the small businessman.
- The total system must be able to accommodate cargo, foot passengers and roll-on/roll-off vehicles.
- It would be highly desirable if the design of each ship allowed it to be built in Hawaii, to retain funds within the State and to foster a local shipbuilding industry.

We believe that a close approximation of this "ideal" system can be put together if it is based on three primary marine transport components.

Primarily Cargo Ships. This need can be met by the present tug/barge system (suitably expanded), or, preferably, the planned Young Brothers barge ship. It would be used primarily for bulk and nonperishable cargos and need not operate on a daily schedule.

Primarily Passenger Ships. This type is exemplified by Pacific Sea Transportation's Jetfoil and should offer an exciting scenic ride among the Hawaiian Islands. While its greatest appeal will be for the tourist, most Islanders will probably make at least one trip just for the experience. The greatest value of the Jetfoil may lie in the fact that, in the relatively near future, it will entice many Hawaii residents and tourists into making a trip to sea.

Ferry Ships. These ships would have a hybrid nature; able to carry passengers as well as roll-on/roll-off vehicles from automobiles to trucks. Key ship features would include a comfortable ride in Hawaiian waters, moderately high speed (perhaps 25 knots), rapid turnaround in port and the ability to operate out of at least one port on every major island. As is the case in Washington, ships of this type would support primarily the passenger-with-automobile and the trucker carrying perishable or high value cargo.

We note that the first two of these three ship systems are either well established or are well underway with private funding. We believe that the third system named, the ferry ship, is a critically-needed addition to Hawaii's marine transportation capability, and the State should move rapidly to develop plans and obtain Federal sponsorship for this element. If private enterprise can convincingly demonstrate its ability to create and operate the ferry ship component of the system, the State should give whatever assistance it can; but the State should not delay planning the establishment of the complete inter-island transportation system.

Recommendation

The Governor should appoint a Hawaii State Transportation Committee, similar in function to the Oahu Transportation Policy Committee, to assist the Department of Transportation in planning a total State transportation system.

With the assistance of the Committee, the Department of Transportation should quickly develop, and put into action, a master plan for inter-island marine transportation, including ship types, schedules and harbor support facilities. This plan should take into account current industry commitments, Public Utilities Commission authorities already granted, Coast Guard licensing options, the 1973 Federal Aid Highway Bill and possible new State/industry partnerships in order to provide the citizens of Hawaii the best possible marine transportation system to meet present and future needs.

Based on the best available information, the Department of Transportation should prepare and substantiate, for submission to the 1974 Legislature, a bill to authorize and appropriate the State's share of the cost of a Federally-sponsored inter-island ferry system, including the cost of design and construction of both ships and shore facilities.

Because of the unique potential of the semi-submersible ship as a ferry ship component of the inter-island transportation system, the Department of Transportation should closely monitor and evaluate results obtained by the Navy during sea trials of the 190-ton model of that ship.

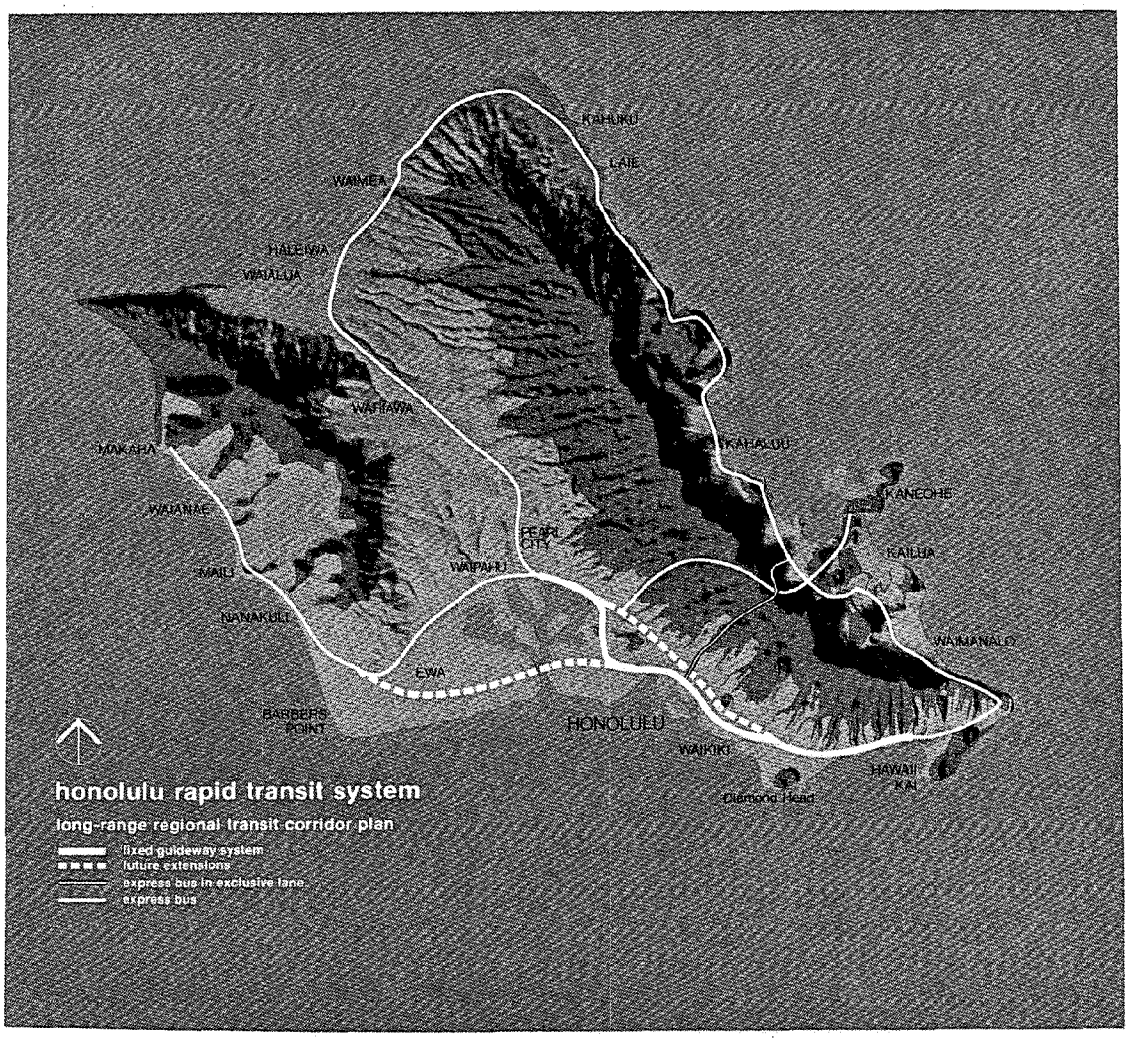
INTRA-ISLAND MARINE RAPID TRANSIT

The State of Hawaii and the City and County of Honolulu are both deeply involved in a transportation debate which will have

profound impact on the citizens of this State for many decades. At stake is a rapid transit system for Honolulu, specifically the arterial route which is planned for operation between the Pearl Harbor area and Koko Head. Alternatives include a fixed rail system, expanded busing with special highway lanes for rapid transit and a water-borne transportation system.

We recognize that the issue is complex, that it goes deeper than the technical background we can bring to bear and we may be trespassing beyond our assigned political bounds. At the same time, there are factors we have not seen publicized in past debates; factors which involve marine transportation and, therefore, State responsibility. We think these factors must be considered:

1. Urban Honolulu, at least that portion directly influenced by all proposed forms of the rapid transit system, is a strip city. In a 25-mile corridor between Hawaii Kai and Pearl City, it is never more than 5 miles wide, and in many places is much narrower.
2. All proposed transit systems would run



The Honolulu fixed-roadbed transportation concept entails the dedication of many acres of valuable real estate; yet the City's shape and geographic setting is ideal for a unique marine rapid transit system that would link up with shoreside bus terminals.

along this corridor.

3. The proposed fixed-rail transit system, like the Lunalilo Freeway, will form a permanent wall the length of this narrow corridor. Like that freeway, it could have a degrading impact on population and housing trends in urban Honolulu.
4. The proposed fixed-rail system will have an estimated construction cost (1974 dollars) of $1,000,000,000. Of this amount, a minimum of $500,000,000 is estimated to obtain rights-of-way and build the roadbed. (San Francisco's experience with the BART system would lead us to double or triple these figures.)
5. If a marine rapid transit system were built as an alternative to the fixed-rail system, the roadbed would be free with an essentially unlimited number of lanes available. Almost all funds expended could be invested in people movers.
6. Additional costs would primarily involve terminal facilities and improvement of ocean access channels. The only major dredging requirement would be for the channel to Hawaii Kai and could be included in the boat harbor already authorized by the Federal River and Harbor Act of 1965.
7. The marine rapid transit system would operate parallel to the shoreline, but well makai of established surfing zones. Its acoustic and visual impact on the shoreline and land would be minimal and it would transit the reef only through well established channels.
8. The marine rapid transit system could be installed one section or route at a time. Its flexibility would allow reallocation of vehicles as needed.
9. It seems likely that a marine rapid transit system able to compete in passenger capacity with the fixed-rail system could be built for 10 percent to 20 percent of the latter's cost. All systems should have equal access to Federal mass transit support, although the uniqueness and environmental compatibility of the marine system might give it an advantage.

We are not recommending that only a marine rapid transit system be built. We are, however, suggesting that the marine system could take up such a large fraction of the total transit load that the remainder could readily be handled by conventional buses. It must be emphasized that our recommendation does not touch the question of trans-Koolau transit, since it is highly doubtful if marine transport around the island can compete for passengers with a direct cross-island route.

For the marine rapid transit system to work, it must be closely integrated with bus routes and schedules ashore. This problem was described to us as one of the most serious yet unsolved at the Seattle terminus of the Washington State Ferry System. (Nearly a million passengers a year are put ashore on the Seattle waterfront, then must walk three uphill blocks to the nearest bus stop.) Cooperation between State and City and County governments will be required to ensure that bus and ferry stopping points and times are closely coordinated and a bus system is developed to connect homes to the marine terminals.

We believe that the hydrofoil, or perhaps the semi-submersible ship (190-ton class), would work well in this marine rapid transit system. During off-peak hours, the boats might be operated on short runs to other islands or on short round trips around Oahu under charter as excursion craft. As an initial test of the system, we suggest that a marine "bus" be operated between Hawaii Kai and downtown Honolulu to alleviate the traffic burden that exists on Kalanianaole Highway.

Recommendation

The Department of Transportation should, in close cooperation with appropriate offices of the City and County of Honolulu, private industry and the Oahu Transportation Policy Committee, prepare a design, cost and operating plan for the marine craft, terminals, access channels and intersystem connections necessary to provide an integrated

Marine/Shore Rapid Transit System for Oahu.

This Marine Transit System should be planned to give service along the entire leeward coast of Oahu from Pokai Bay to Hawaii Kai. Longer term plans should be made to (1) bring Molokai into the network and (2) establish an independent marine commuter network to connect Molokai, Maui and Lanai.

HARBORS

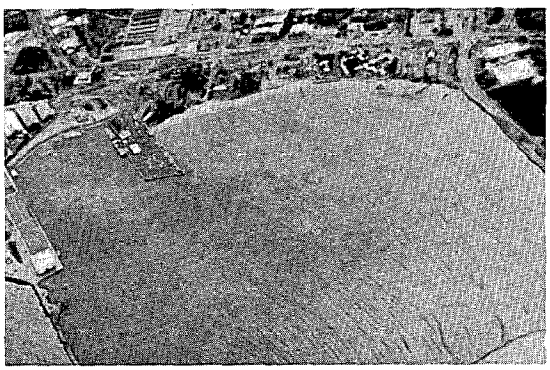
In the interviews and deliberations leading to this report, we have noted a tendency to regard the State as uniquely blessed with a system of natural harbors which offer sanctuary for ships of all types and drafts against the seas and winds of our mid-oceanic climate. This is not the case.

Honolulu Harbor, one of the world's finest port systems.

Today, the State does have an extensive harbor system, but it is not natural and its achievement has not been simple.

Pearl Harbor, for example, has been described as the largest natural harbor in the Pacific. But the deep channels and extensive anchorages that we know today in Pearl Harbor did not exist at the turn of the century. In fact, nearly a decade of dredging and blasting was required before the first capital ship could transit the entrance channel and enter the protected waters of the inner harbor.

Oahu, and Kauai to a lesser extent, have been blessed with a series of drowned valleys which could be converted into spacious harbors. This is not true of the other Neighbor Islands. There, the construction of harbors began with geographic assets which seldom consisted of more than an open bay, a slight concavity in the shoreline, or the leeward side of a headland. On these less fortunate islands, protected water was created through construction of costly breakwaters. Consider Kahului Harbor, Maui's only deep-water port, for example. That harbor, as it is today, is the result of decades of continuing war against the elements; of reconstruction following storms which



Kahului Harbor, Maui

damaged or destroyed earlier breakwater construction; of storms so intense that 30-ton concrete tetrapods were torn from the breakwater and thrown on the beach.

Today, as a result of often heroic efforts on the part of the State, the Federal Government and private enterprise, Hawaii has what can best be described as an "adequate" system of harbors--adequate, that is, in terms of our past and perhaps our current needs. We submit that major improvements are needed to support Hawaii's needs over the next one or two decades.

- Additional primary harbors will be needed to support transoceanic shipping. This will be especially true if the Neighbor Islands are to break free of the historic pattern which has forced their lines of commerce to flow through Honolulu and if they are to accommodate the "dispersion" industries noted in the introduction to this chapter.
- Inter-island harbors and terminals will be needed to support the marine transport system described earlier.
- Small local harbors and terminal facilities will be needed for the Marine Rapid Transit System.
- Additional marinas for recreational boating are required, as are more fishery harbors. These have been described in Chapters 5 and 6, respectively.

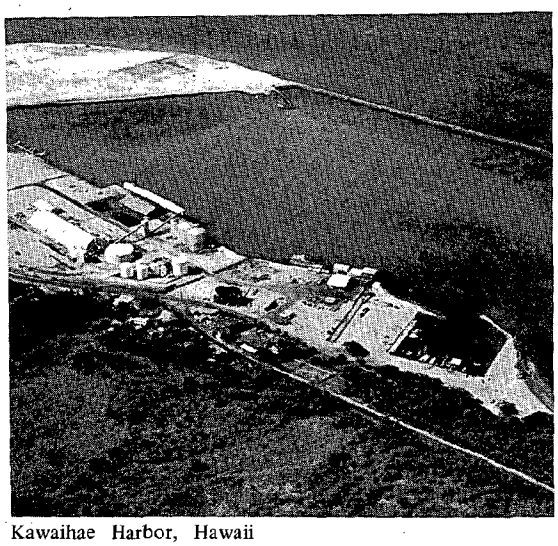
These needs should not be considered independently. It is possible, in fact, highly probable, that a typical primary harbor might simultaneously accommodate each of the other functions noted above, or that an inter-island harbor might also support craft for recreation, fishing and rapid transit.

Primary Harbors

As a goal, Hawaii should plan to have at least one primary, deep-draft harbor on each of its six major islands. These harbors may differ considerably in shoreside support capability and in total area of protected water, but all should be able to dock and protect transoceanic shipping. In both plan and practice, the Department of Transportation is approaching this goal. We believe priority emphasis should be given to the three harbors described below.

Kawaihae Harbor, Hawaii

The logical future of the northwest corner of the Big Island, we believe, lies in industrial development. This is especially true

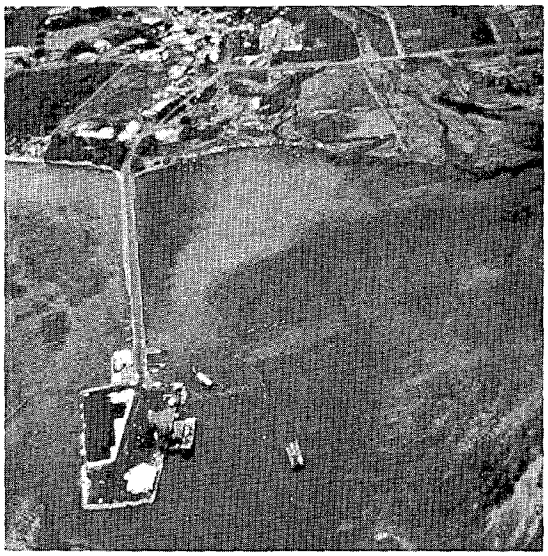


Kawaihae Harbor, Hawaii

for those "throughput" industries identified earlier, including oil refining, processing of ocean manganese ores and production of hydrogen for fuel. To support this future, a major expansion of Kawaihae Harbor is needed, including more docking space, additional support facilities and installation of offshore terminal pipelines.

Kaunakakai Harbor, Molokai

This harbor seems destined for multiple usage, including functions as Molokai's only primary harbor, as a harbor for inter-island commerce and as a potential link with an Oahu Marine Rapid Transit System. To support these functions, the harbor needs additional support facilities and protection from Kona storms. Because of the potential of such a harbor in helping to reverse Molokai's current economic depression, we believe its construction should be given high priority.



Kaunakakai Harbor, Molokai

Barbers Point Harbor, Oahu

With major new developments being planned for the Ewa plains, Oahu's center of population is expected to move westward. Also, expansion of Campbell Industrial Park indicates a need for a second primary harbor in the Barbers Point area. This appears logical from two points of view. First, with the requirement for increased shipping to support Oahu's economy, Honolulu Harbor will become overcrowded. Second, the increasing shipment of industrial materials in and out of Oahu will overload our urban transportation system unless an alternate harbor is developed.

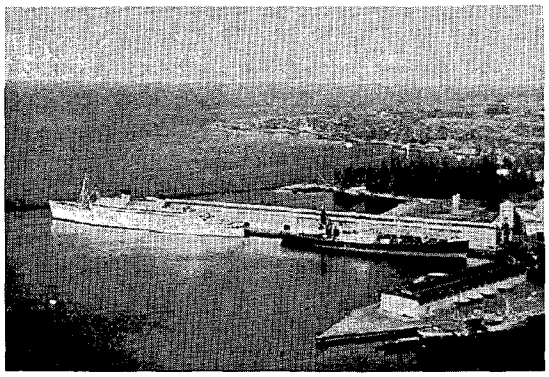
Recommendation

In completing and implementing its Master Plan for primary harbors, the Department of Transportation should assign highest priority to upgrading of the capabilities of Kawaihae, Kaunakakai and Barbers Point Harbors.

Inter-island Harbors

Each of Hawaii's six major islands should have at least one harbor which can accommodate and support inter-island

passenger and ferry ships. The Big Island should have two such harbors; initially Kawaihae on the Kona side, with Hilo planned as a destination port when the system



Hilo Harbor, Hawaii

is expanded. A second harbor should also be considered for Oahu--e.g., at Barbers Point, Kaneohe Bay or Haleiwa--to relieve congestion in urban Honolulu.

Kauai (Nawiliwili), Molokai (Kaunakakai) and Lanai (Kaumalapau) offer straightforward choices of sites for

Nawiliwili Harbor, Kauai

inter-island harbors. The choice is much more difficult in the case of Maui, whose only adequate harbor is on the windward side, subject to storm waves and isolated from the most direct lines of inter-island traffic. A major planning effort is needed to locate, design and construct a harbor and inter-island terminal on the leeward side of Maui.

Recommendation

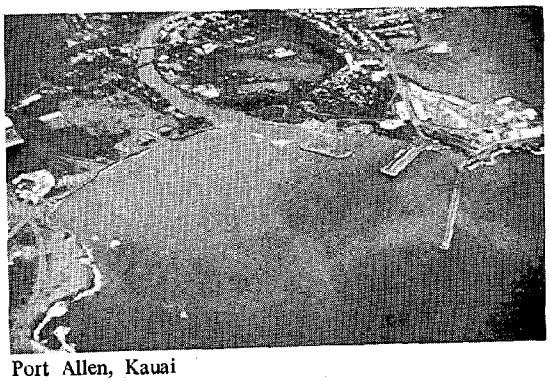
The Department of Transportation should prepare and submit for approval and funding a Master Plan for a system of harbors to support an inter-island passenger and ferry system. The most critical point to be resolved in this plan is the location of a leeward harbor for Maui.

Harbors for Rapid Transit

A series of harbor facilities will be needed to support the Oahu Marine Rapid Transit System recommended earlier. Since this system will carry only foot passengers, docking and terminal facilities can be relatively simple and inexpensive. These harbors should extend from Pokai Bay to Hawaii Kai and include several stopping points.

Recommendation

The Department of Transportation should prepare and implement a plan for a series of small harbors for marine rapid transit along the leeward coast of Oahu. Close coordination with the City and County of Honolulu will be needed to ensure that these facilities interface effectively with land transit systems. The harbors should be sized to support craft of the approximate size and draft of the Boeing Jetfoil and the (190-ton) semi-submersible ship.



Port Allen, Kauai

MARINE INDUSTRY

The potential benefits to Hawaii of such ocean-derived resources as sand, manganese, geothermal/solar/ocean power, precious coral and fishery products have been discussed at length in Chapters 6 and 7. A number of recommendations for State action were made in those chapters. Discussion here will be limited to comments on potential impacts by some of these industries on Hawaii and considerations of industrial siting.

Manganese Deposits

It appears certain that a manganese industry, or at least major elements of it, is coming to Hawaii and its impact will probably be felt within five years. The major Pacific deposits of this resource are located closer to the Hawaiian Islands than to any other land mass offering an industrial base. In the case of the manganese crusts which lie within the Hawaiian Archipelago, the resource is located in relatively shallow water (3,000 to 6,000 feet). This allows mining to be carried out with technology much less complex and less expensive than will be needed for mining of deepsea nodules.

What is less certain is the total impact of this industry on Hawaii. We have a number of alternative futures and a great deal of choice in which path to follow.

- The minimum impact would result if mining of the ores were to be followed by beneficiation (enrichment) at sea, transfer to bulk ore carriers and direct shipment to a mainland facility for final refining. Hawaii's role would be limited to ship support; maintenance, refueling, recreational leave for crews and support of staff operations ashore. This could still be a multi-million-dollar industry.
- At the next level of impact, beneficiation would be carried out on shore in Hawaii, with final refining still done elsewhere. This would increase support requirements for harbors, physical plant, work force, power and water. It would also force the State to face the question of environmental impact. It is possible that the residue from this beneficiation process might have considerable economic value as a partial replacement for sand.
- Finally, the entire ocean manganese industry, including refining, might be located in Hawaii. At this stage, by adding in the chemical industries necessary for support, it could become Hawaii's largest industry. The potential environmental impact would correspondingly increase.

We lack the background to fully assess these alternatives, or recommend which path Hawaii should follow. We do feel that the opportunities and the dangers are great. The State must move rapidly to prepare itself for the time when decisions concerning the future of this industry in Hawaii must be made and to ensure that these decisions are as wise as possible.

One factor seems certain if the second or third of the alternative futures discussed above comes to pass. Wherever this plant is located on shore, it will become the center of a very large industrial complex. If the State Government is really serious in its desire to disperse industry, opportunity and population away from Oahu and toward the Neighbor Islands, the manganese industry is a powerful tool with which to effect this policy.

Geothermal/Solar/Ocean Power

This concept, which is more fully described in Chapter 7, should be considered as an industrial area with long-term potential, on the order of 10 to 20 years. Its application may be limited to the geothermal reservoirs of the Big Island, although localized areas of high temperature rock may be found elsewhere, for example, in the Haleakala region of Maui.

On the island of Hawaii, geothermal/solar/ocean power potentially could supply all requirements for power,

including those of major new industries such as manganese. Second, it could serve as the energy source to disassociate water into oxygen and hydrogen, supporting a major hydrogen fuel export industry.

Precious Coral

In dollar volume, this industry will probably never be a large one in Hawaii, although annual sales at the retail (jewelry) level could amount to tens of millions of dollars per year. The industry's chief values may lie in its symbolism of our State's exotic marine environment and Hawaii's dedication to the sea.

The growth and health of the precious coral industry are tied to two constraints. First, additional commercially viable sources of coral must be found. This is especially important as Japan, our historic source of the raw material, begins to restrict its exports. Second, less expensive techniques to harvest precious coral are needed—techniques which still allow harvest to be both selective and controllable. The most promising approach, we believe, would be to use an unmanned system, cable-controlled from the surface and sized to operate from a relatively small fishing or charter boat. This system should be considered as a candidate for development under Sea Grant funding, or perhaps as a joint project between State and local industry. The relatively low development cost involved might allow local industry to do it alone.

Shipbuilding

A major economic benefit to the State would be achieved if some or all of the ships needed for the inter-island and marine rapid transit systems could be built in Hawaii. Of all the ship types considered earlier in this chapter, only the semi-submersible ship appears to be a likely candidate for such local construction.

If the semi-submersible ship is chosen as a component of Hawaii's marine transportation systems, a sufficient number would be needed to sustain, for several years, a sizable shipbuilding program in Hawaii. That program should be able to continue through the construction of similar craft for local commercial use or for export.

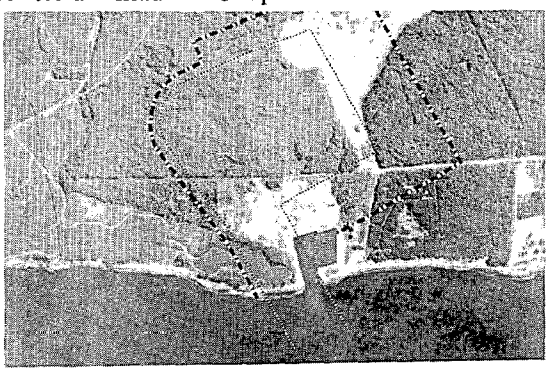
Recommendation

If the semi-submersible ship is chosen as an element of Hawaii's inter-island and/or marine rapid transit systems, the Department of Transportation should explore with local industry the possibility of its construction in Hawaii.

Ocean Research and Engineering

Research laboratories, "think" factories and design shops are a clean, high-salaried, desirable industry. Hawaii's growing capabilities, talents and know-how in marine-related fields deserve continued encouragement and support by the State and local governments. The 1972 *Directory of Hawaii's Scientific Resources,* published by the Department of Planning and Economic Development, details these capabilities.

Some efforts are underway to tie the needs and objectives of this industrial group together with those of the Bicentennial Exposition Commission (1976), the Hawaii Marine Exposition (1978) and several culturally oriented institutions. This unity of direction has great merit and is probably necessary for real progress to be made by any of the groups involved. Specific recommendations related to a Hawaii Ocean Center are made in Chapter 3.



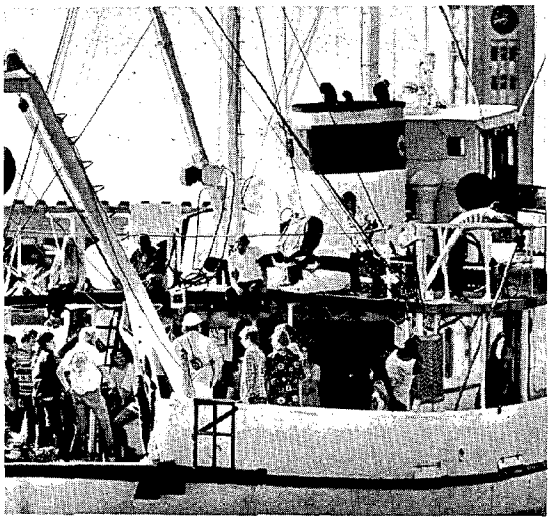
Oahu's other deep water port at Barbers Point. Dotted lines depict planned expansion.

CHAPTER 9: *KAMALI'I o KAI*

Introductory Note From the Task Force. The Marine Option Program (MOP) was established at the University of Hawaii in the spring of 1971. Its primary objective is to provide the opportunity for any undergraduate student at the University (or its community colleges) to achieve a basic familiarity with the marine environment. This familiarity is gained through a combination of class work (a minimum of 12 credit hours for a MOP certificate) and field tours or work experience. The typical MOP student is not a science or engineering major, in fact, will normally be in a nontechnical field.

The interests and activities of these students have been highly pervasive since the program was founded. Fifteen students conducted a detailed ecological study of the proposed Kailua Bay outfall. A second group of twelve performed an onsite study of a possible artificial reef site at Pokai Bay. On their own initiative, eight MOP students installed an offshore, underwater pipeline for the Pacific Biomedical Research Center--at a cost to the State of $10,000, compared to the lowest contractural bid of $150,000 for the same job. Probably the most visible service these students have given the State has been the development of a guided snorkeling tour of Hanauma Bay and the introduction of more than 4,000 students and adults to the subsurface life in that marine park.

Perhaps the most impressive and far-reaching program originated and run by MOP is the Blue Water Marine Laboratory (BWML). This is a program that takes high school and community college students to sea, aboard the University's R/V TERITU and the specially-equipped research schooner MACHIAS, for several hours of instruction and actual participation in such oceanographic activities as plankton tows and bottom sampling. All instruction is by student Cruise Instructors. To date, 1,000 students from Oahu, Maui, Molokai, Hawaii and Kauai have participated, as have 100 science teachers. Through a special arrangement with the Department of Education, a selected group of high school students fill the majority



R/V TERITU is being used to introduce high school students to the ocean; the Blue Water Project, supported by Sea Grant, ensures the continuation of this effort.

of Cruise Instructor positions and receive a formal science credit for their considerable efforts. One offshoot of the program was the recent formation of the Hawaii Council of Marine Science Teachers, which acts as an advisory group for the BWML. The program at present is booked solidly, with more interested teachers and students than it can serve with its present level of funding. (To keep the BWML program going after the spring of 1974 will require additional funding; we hope it is forthcoming.)

The Task Force initially encountered the MOP students when two of them volunteered to carry out two surveys for us. The first was an onsite evaluation of the true condition of all public beach access routes on Oahu. The second was a poll of public attitudes toward inter-island surface transportation. Both reports are included as appendices to this document.

In working with students of the Marine Option Program, there is no way to limit one's contacts to two, three or a dozen of them. Soon, many of our members were involved in exciting discussions with most of the MOP students and were increasingly impressed by the ways in which their points of view differed from our own. These differences were not necessarily disagreements--any more than one can say that the south end of an elephant necessarily "disagrees" with the north end. We concluded that it was important for these different points of view to be included as a part of our document.

Their work is presented here with the appropriate chapter title *Kamali'i o Kai*--literally, "Children of the Sea", or a view from the next generation.

INTRODUCTION

Hawaii's youth have traditionally been identified with close involvement with the sea. We all hold, from local-born to "transplanted local", a deep-rooted appreciation for the sea as a place to swim, surf, sun and dive. Many of us engage in the prudent commercial exploitation of its resources. Whatever the interest, we share equally in Hawaii's heritage in the sea and in our dedication to the maintenance of its unique integrity.

Rather than demand, using the premise that the sea will be our heritage, an input to today's policy planning process, we instead have asked for the opportunity to showcase our commitment to the sea. This chapter is the result. We will suggest plans for future directions to be taken by the State, based on our knowledge and competence in a subject area; this, in turn, usually based on empirically-oriented accomplishments as students.

ENVIRONMENT

Given present planning practices and economic priorities, it is our consensus that the attendant inevitable increases in Hawaii's population via immigration and natality make it inconceivable that the general quality of the environment will show any trend toward improvement.

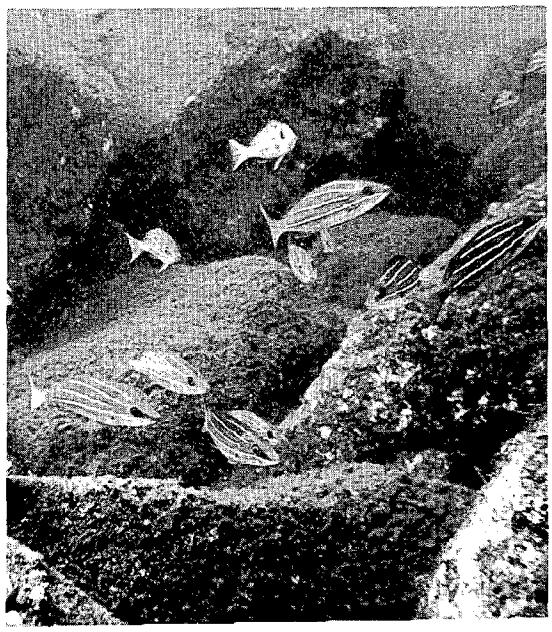
Almost one-half the total land area of Hawaii lies within five miles of the coast. Considering this, and the fact that population centers have traditionally been associated with these narrow coastal margins, it follows that man's activities (e.g., grading, construction and agricultural practices) which have led to the accelerated alteration of the terrestrial biome have subsequently influenced the ecology of the marine community.

State and local governments, time and time again, have ignored sound environmental considerations when dealing with the problems associated with management of the coastal zone. Witness the modification of the Kaneohe Bay watershed (Keapuka, H–3 extension, etc.).

"Man has reigned supreme on this planet primarily due to his ability to adapt to changing environmental conditions and, still further, to modify the conditions existing in his habitat, hence, ecosystem. Whatever else this may be, it does present us with a grave situation, recognizing that, historically, man's ability to initiate changes has often far exceeded or preceded his understanding of the results.

*"...In Hawaii, many case histories can be cited illustrating the deleterious effects of man on the ocean environment, but none can approach the state of degradation exhibited in Kaneohe Bay, Oahu."**

*"Biochemical Considerations in a Marine Aquatic System: The Role of Marine Microorganisms in the Ecology of Kaneohe Bay", Kelvin Char, Senior Honors Thesis, University of Hawaii, 1973.



Marine life abounds in the waters off Papaloa Mill.

It is grossly unfair to violate the inheritance of Hawaii's future generations by permitting such *laissez-faire* attitudes to persist in government. At the same time, we are convinced that there are other alternatives in planning to the "preservationist" attitude of *Life of the Land, Save Our Surf* and similar organizations.

The State would be well advised to work harder at providing attainable compromises between interest groups desiring the maintenance of environmental quality and those wanting the exploitation of coastal and open-ocean or seabed resources. This would include living, as well as nonliving, and renewable, as well as nonrenewable resources. In essence, there must be a comprehensive, long-term plan to meet the needs of Hawaii's future environmental/commercial/industrial requirements--an "open boat" case, in which moral and legal questions are raised, requiring judicious appraisal and just solutions.

Recommendation

Realistic appraisal of socio-economic priorities; e.g., population growth, within the constraints of sound environmental policies as determined by the carrying capacity of the system.

Review and, if necessary, revise traditional planning policies which, too often, are landbased in concept and, consequently, are inadequate when applied to problems of the coastal zone and ocean. (The City and County of Honolulu's grading ordinance and the Coastal Zone Management Act of 1972 are positive steps in the right direction.)

In reference to the paragraph above, avoid proposing stopgap solutions when dealing with long-term problems. The Kapuku Plan and the idea of conservation districts are offerings which do not win the confidence of the community.

Establish and ensure the maintenance of reasonable water quality standards; i.e., the Federal Water Pollution Control Act of 1972, Public Law 92-500.

Assess the State's offshore sand resources; e.g., commercially valuable deposits for construction and beach fill, environmental qualities (not part of a known beach system), rates of attrition and accretion. This may require changes in present laws and the initiation of comprehensive (statewide) resource surveys.

Recognize the needs for population controls and move to establish immigration and birth control policies. (Seek ways in which Hawaii can be given special consideration under the Constitution?)

Seek an exemption by which the State may construct "advanced" primary sewage treatment facilities, recognizing that the characteristics of the Hawaiian marine environment are dissimilar to mainland areas and, therefore, not necessarily affected by the introduction of such wastes. (Secondary treatment, in addition to being much more expensive to construct and operate, is also detrimental to natural waters due to the introduction of treatment chemicals.)

RECREATION

In this highly mobile society of ours, where the trend is toward shorter work weeks and more free time, the increasing need for recreational areas is quite obvious. Marine-related recreational areas should include improved as well as unimproved beaches, parks and rights-of-way. It would be ideal for the State and local governments to

Water sports are exciting enough! Zones should be clearly marked to separate surfers from swimmers from boats.

take every step necessary to ensure the maximum availability and utilization of marine recreational sites--the problem of public access being considered a priority.

Recommendation

Evaluate proposed public recreational areas, as outlined in the SCORP Report, especially the section dealing with ideal recreational acreage per capita and the proportion of land areas to coastal/beach areas.

Establish breathing-air standards and non-punitive controls of commercial SCUBA air stations.

Establish additional hyperbaric units (decompression chambers) throughout the State. All Neighbor Islands require these facilities. (This might be accomplished by having one-man, portable units and trained medical personnel ready to be flown to emergency sites to shorten the time between diagnosis and treatment.)

Identify potential underwater park areas and submit them to evaluative process; e.g., present use, access, safety and other socio-economic considerations.

Require State licensing of Diver Training Programs and instructors, now required for chauffeurs and Department of Education certification.

Ensure the maintenance of and safety standards at public, small craft launching facilities.

COMMERCE

When one speaks of commerce in Hawaii, one should think about transportation throughout this island state. We are not unique; our population concentrations are distributed along routes of trade. We do experience a problem uncommon to the other 49 states; that is, the terrestrial discontinuity which eliminates overland, vehicular traffic among the islands of the State. It is primarily for this reason that the greatest population densities occur in the City and County of Honolulu. Unless there is an expansion of the types of inter-island transportation available to the public, it would be absurd to expect any major shifts in present demographic trends--in advance of the means that would make such population redistribution possible.

The cost of materials on the Neighbor Islands could be lowered considerably if ships of trade were routed to any number of suitable ports; e.g., Kawaihae, Kahului Kaunakakai and Nawiliwili. This would serve to attract and encourage industry, followed by the subsequent immigration of workers and residents.

Recommendation

Increase the number of suitable

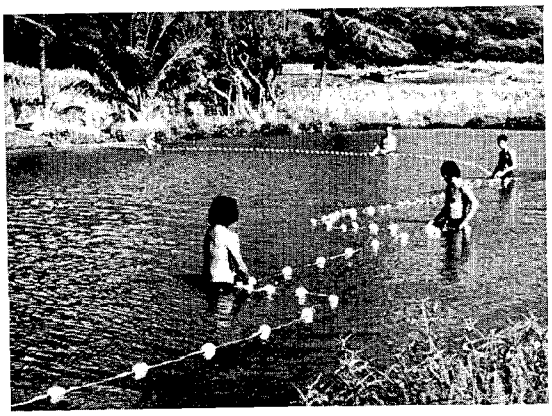
deep-water ports throughout the State. (This would include preparation to receive container craft, drive-on/drive-off loading, etc.)

Encourage and support a marine transportation system; one with freight, auto/passenger and passenger configurations.

Seek an exemption for the State of Hawaii from the articles of the Jones Act. (Hawaii's geographical location, and its dependence upon the maritime lifelines that support the economy, should be reason enough for this request.)

RESEARCH

Hawaii's role in the area of marine-related research programs should be, by virtue of its geographical location, manifold. As a member of the Pacific Ocean community of islands, Hawaii should play a



Students harvest prawns at Oahu prawn farm in an East-West fishing program.

lead role in the development and export of marine-related technology throughout the vast Pacific basin. Hawaii and its people should accept this mandate to provide the initiative required to bring economic stability to other islands of the Pacific.

However, do not forget the realities of our own economic system, and its funding constraints, before we task it to make possible such an ambitious plan for development. The State must judiciously apply its resources in support of the various domestic and exportable research projects conducted by State agencies, recognizing that funds for support are limited.

Furthermore, it has been recommended by a number of persons in State and local government that an evaluative process be applied to assess research projects supported by the State. *Members of the scientific community have strongly objected to this form of control,* suggesting that it would be an encroachment upon their academic freedom. Apparently, there will have to be some compromise effected to maintain a balance between academic and economic priorities.

Recommendation

Encourage investigators to solicit technological assistance from areas outside the United States, primarily to avoid duplication of research efforts. (For example, Japanese "know how" in the area of aquaculture should be tapped by local researchers to shorten research and development times and maximize production. A similar operation can be tapped involving sea turtles, with a current operation in the Caribbean serving as a resource area.)

Establish a commission to set priorities and guidelines for researcher/institutional support. (This commission would determine the needs (short- and long-term) for marine development in the State and, to a lesser degree, the State's commitment to the other islands of the Pacific. Hopefully, it would include members from the academic community as well as government planners. Since Federal assistance would be called for in the many phases of operation, it is strongly suggested that a representative (i.e., Sea Grant or National Science Foundation) be considered for membership.

Encourage cooperation between the agencies of the State to prevent unnecessary

dispensation of research monies. Traditionally, there has been a sad lack of cooperation between the University of Hawaii (and its research institutions) and agencies within the State administration (i.e., Division of Fish and Game, Board of Agriculture).

INDUSTRY

Marine-related industry in this State has suffered as a result of the same kind of thinking (or lack of understanding) that has contributed much to the degradation of natural marine ecosystems. As we have witnessed the slow deterioration of our near-shore marine resources (coral reefs, sand, floral/faunal communities) due to the increasing pressures exerted by man-induced modifications, so have we witnessed slow growth, or no growth, in our marine-related industries. We believe this is mute testimony to the State's traditional, land based concepts of development.

The State's economy is becoming, with ever increasing dependence, based on the tourist-related industry. Agriculture, specifically sugar and pineapple, is presently struggling to maintain its position as a major industry in the State, hurt primarily by rising costs and the encroachment of urban requirements upon limited fertile agricultural areas. This dependency upon a single industry can lead to a very unstable situation. Diversification has been the answer, in other areas, to the problem of oversimplication and instability. Hence, the State should attempt to broaden its economic base to include non-tourist-related industries.

In this island state, we should address ourselves and our energies to the development of marine and coastal resources; e.g., fisheries, aquaculture, seabed mining (precious corals, manganese nodules), etc.

Recommendation

Provide tax incentives to encourage and support marine-related industries, thereby stimulating a necessary diversification of the State's economic base.

Establish a cooperative program between industry and government in the area of marine development and, conceivably, in the long-range planning process.

Industry, as well as other groups, requires a sound policy for planning and management. This can be developed through the efforts of well-informed, knowledgeable (about marine systems) people. Our policy planners must be able to recognize the uniqueness of the ocean, as well as its similarities to the land. The State must strive to reduce the influence of traditionalists who don't "think ocean" when dealing with problems intimately involving the sea and its resources. A commission, similar to the Land Commission, should be established to "watchdog" the public's interests whenever proposals are made to develop within the coastal zone.

Combine the efforts of all State marine-related administrative agencies to eliminate the overlap in authority that now exists. For example, why should the Board of Agriculture deal with aquaculture permits and not the Division of Fish and Game? Look at all the similarities that exist in the Department of Planning and Economic Development, the Department of Land and Natural Resources, Health, and Environmental Quality and, still further, the confused web within the Department of Land and Natural Resources--Parks and Recreation, Agriculture, Fish and Game, Water and Land Development, and Land Management. Why not establish a separate department dealing with all marine-related matters? Such a department could handle all matters involving aquaculture, marine research, marine recreational areas, marine water quality, marine resource development, coastal zoning and management, etc. Hawaii should lead, not lag, the nation in marine management.

MILITARY

The military, and its related civilian work complement, represent a large segment of the population and economy of the State. As such, the Federal government should be called upon to contribute to the planning process. In addition, of the 1,050 miles of tidal shoreline in our major islands, some 7 percent is owned by the military or other Federal agencies. Nine percent of all sandy shorelines are in this Federal category. It is important that this factor be considered by the state in any comprehensive plan for the coastal zone.

Recommendation

The military should contribute heavily to the planning process; e.g., the joint use of existing recreational areas owned by the military and the establishment of additional recreational areas in presently unimproved military beach properties.

The military should continue to transfer coastal properties to the State, but with the requirement that these be developed for marine-related recreation and/or industries (e.g., research facilities, aquaculture).

In the long run, debug Kahoolawe and render it and its surrounding waters safe for use by the public. Planning processes should include the eventual return of the area to the State.

ACADEMIC

Hawaii is a unique blend of eastern and western attitudes which are manifested in the life styles, cultures and traditions of the people. The State should enhance this quality by emphasizing educational systems sympathetic to the needs of the community. Since the sea has always played a part in the lives of Hawaii's citizens (witness the number of people seeking recreation and livelihoods in the sea), education should play an important role in the search for solutions to ocean-related problems.

For example, one can't imagine a successful enforcement program without an equally successful community education program. Will increasing fines for violations, and/or the number of wardens, provide better enforcement, given today's attitudes? Given a greater number of wardens, we might statistically create a veritable crime wave.

Also, Hawaii should be the first to recognize the need for specialists in the field of applied ocean sciences. Hawaii should once again assume a leadership role in educational trends. For example, we should establish marine courses in areas of traditional nonmarine involvement--marine law, marine business, marine humanities, etc. This could be established at several levels: a "Sesame Street" approach in the elementary grades, relating to simple marine concepts, becoming more problem oriented as a student progresses through intermediate and high school levels.

Students learn differences between coral specimens at Hanauma Bay.

At the university level, programs similar to the Marine Option Program would ensure the continued "marine orientation" of the student.

Recommendation

Establish a "game plan" for the marine education of Hawaii's youth. The Department of Education should recognize the important role that the sea plays in the lives of Hawaii's youngsters and tailor an educational program that would encourage success (by allowing for an individual student's identification with the theme).

The Department of Education should recognize that an educational program that works in the Honolulu district might not have the same results in the Leeward district, where the program degenerates into a confinement process for "student inmates" up to age 16.

Emphasize marine-oriented programs such as the Marine Option Program at the university level.

Emphasize, once again, the importance of selecting the right personnel to administer marine-related programs. Too often, program goals are not met due to a program manager's inability to relate to marine problem areas.

Establish a statewide public community education program to carry the message from government to the people. This open access is vital if government is to win support for programs and policies. In these efforts, the State must not forget that it consists of more than one county. For example, more than 55 percent of the personnel employed by the Division of Fish and Game are situated on the island of Oahu. This is typical of many agencies within State government. Also, why is the College of Tropical Agriculture located on the Manoa Campus? Doesn't it make more sense to move this operation and its affiliated services to an area that would be better served by its programs?

SUMMARY

Reflected in this chapter are attitudes that students of the Marine Option Program felt deeply enough to share with the people of Hawaii. We have tried to remain as objective as possible and accurately represent the consensus of our peers--both those in the Marine Option Program and, hopefully, those throughout the State of Hawaii. We respectfully submit to the evaluation process and thank the State for the opportunity to be heard. Mahalo!

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ACKNOWLEDGEMENTS

The Task Force wishes to express its appreciation to the following individuals and organizations who contributed their time and talent in support of the preparation of this document.

Mary Chaney
Betty Funayama
Barbara Garrett
Mardi Stewart
Norrie Thompson
Walter Uchida
Marian Wilkins
Michele Wilkins
Teresa Wilkins
Wanda Williams

Coast Guard Omega Navigation System,
Operations Detail, Kailua
CDR George P. Asche, Commanding

Windward Graphics, Kailua

Jeanne Halpin Brady, who was responsible for all that was good about the style for this document.

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4-17	Hawaii Visitors Bureau
5-2	Earl Correa, Kailua
5-7	Earl Correa, Kailua
6-12	Hawaiian Tuna Packers Association
8-8	DMJM Report to Honolulu DOT
9-1	Honolulu Star Bulletin
9-4	R. Grigg, Honolulu
9-7	W. B. Robinson, Honolulu

SUMMARY OF ACTIONS BASED ON THE 22 MAJOR RECOMMENDATIONS MADE IN "HAWAII AND THE SEA, A PLAN FOR STATE ACTION", 1969

As a result of the 22 major recommendations made in *Hawaii and the Sea–1969*, the following actions have been taken.

- A State of Hawaii Marine Affairs Coordinator (MAC) was established in the Office of the Governor, by Legislative Act 137, 1970 in response to Recommendation No. 20. A Coordinator was appointed in September 1970 and his office has been active in marine programs since that time. The MAC office staff of four is supported separately from project funding.

- As the result of this document, effective coordination by the MAC Office, excellent research work by the University, and strong State support, the University of Hawaii was designated as a Sea Grant College––one of seven in the nation. The Sea Grant program provides substantial impetus to Hawaii's marine ambitions.

- The total marine programs appropriations by the State has been $870,000. An initial appropriation of $470,000 (non-lapsing), was earmarked in the original Act that created the position of MAC for specific purposes or areas of marine studies, surveys, coordination, research and development. The following year the Legislature appropriated $200,000 per year for each year of the 1971-1973 biennium (total of $400,000) for the support of marine programs in Hawaii. Except for about $23,000, all of these funds have been allocated. (Recommendation No. 1).

- The study of the use of a floating platform for a State Oceanographic Research Park was carried out with $50,000 funding from the MAC Office. (Recommendation No. 2). The design studies resulted in an $85,000 grant from the Sea Grant Program for construction of a scaled-down model of a floating platform. The unit has been constructed and tested. A Japanese expert on floating marine communities worked on this project as a visiting professor. He is now involved in building a floating platform for the Okinawa Marine Exposition to be held in 1975.

- The Legislature appropriated $100,000 for design studies of a land-based Oceanographic Research Park. (Recommendation No. 2). These funds have not been used as of this date.

- The State has appropriated $3,000,000 for construction and $300,000 for planning for a new University of Hawaii Oceanographic Expeditionary Center at Snug Harbor (Recommendation No. 4). Ground was broken for construction in 1973.

- The State, through the University of Hawaii Institute of Geophysics, has received substantial support from the State of Hawaii, the National Science Foundation, International Decade of Ocean Exploration (IDOE) Office and from industry for deep-sea explorations of the Pacific. The total funding has been $398,000 with the following breakdown: State, $130,000; Federal, $106,000; and industry, $130,000. The work has included research on manganese nodule deposits and two major international conferences on manganese nodules have been held in Hawaii (1972 and 1973) with joint support from the State and IDOE. (Recommendation No. 5).

- An "International Workshop on Marine Geosciences" was held in Hawaii on September 20-24, 1971. The workshop made recommendations to UNESCO's Intergovernmental Oceanographic Commission and to IDOE. Funding of $25,000 came from the MAC Office and was specifically authorized by the Legislature in Act 137. Support by NSF/IDOE from 1971 to December, 1973 (not including manganese nodule programs) was $1,281,000 to HIG. (Recommendation No. 6)

- A study of the feasibility of an International Marine Exposition in Hawaii in 1978 is in progress. (Recommendation No. 8). MAC Office funding is $30,000.

- The East-West Center sponsored a "Giant Prawn Culture Training Program" from June to October 1972. The training was done by the State Department of Land and Natural Resources, Fish and Game Division. The East-West Center also has made studies of fisheries and aquaculture programs for the Pacific Island region and Southeast Asia. (Recommendation No. 9).

- A Shoreline Setback Law has been passed which prohibits mining of sand from beaches and regulates construction in the 40 feet setback area. Legislative Act 123 1970, amended 1973. (Recommendations No. 10 and No. 11).

- Underwater parks and reserves have been studied for Hawaii, Maui, Molokai and Kauai. A total of $150,000 has been appropriated to DLNR. There was an understanding that $100,000 of this would be for Kealakekua Bay on the Big Island, and $50,000 for Hanauma Bay on Oahu. So far, only $17,000 has been spent or encumbered all for Hanauma Bay. The Hanauma Bay marine park on Oahu has been highly successful. (Recommendation No. 12).

- Plans for coordinating efforts to sense and avoid oil spills and other hazardous materials in Hawaiian waters are under way. The State Department of Defense has published a booklet entitled, *Marine Oil Spill Disaster Plan.* Total cost has been $3,000. (Recommendation No. 13).

- Some standards for water quality have been revised. (Recommendation No. 14). The Water Resources Research Center of the University of Hawaii has been the focus of water quality programs in the State and a computerized data system on water quality is being developed under a $30,000 contract with the State Department of Health. The State Office of Environmental Quality Control was formed in 1970 to provide statewide coordination.

- The State has supported industry in developing new fishing methods and assisting Hawaiian fishermen to increase their catch of skipjack tuna and other fish. (Recommendation No. 15)

  The Hawaii New Vessel Construction Loan Program (1965 and 1968 Acts): Act 175 appropriated $750,000 for fishing vessel construction loans. In 1971, $250,000 was loaned to Angel Fishing Company to build the ANELA. In 1972, a loan of $270,000 was made to Honolulu Fishing Company to build the MOKIHANA, and $240,000 was loaned to Gengo Nabeshima to build the BETTY N. This totals $760,000, but of course loan repayments will build the fund back up again. DLNR estimates that program operating costs were about $12,000.

  Other expenditures have included: Monitoring of commercial catch statistics, $32,000; projects to develop bait, $15,000; joint-effort programs in tuna purse seine fishing, $52,500; and shark control, $48,000.

- The MAC has supported a $7,000 study of fishing by SCUBA divers in Hawaii (Recommendation No. 16).

- The MAC, Sea Grant Program, HIMB, the Fish and Game Division (DLNR) and DPED have been active in support and implementation of aquaculture programs. An Aquaculture Revolving Loan Fund was established by Act 181, 1971, and is administered by the State Department of Agriculture. An Assessment of the "Legal and Administrative Aspects of an Aquaculture Policy for Hawaii" was carried out by DPED. The current Sea Grant Program provides $220,000 for aquaculture projects. Recycling of sewage for aquaculture is being studied under research grants. (Recommendation No. 17).

- Regulation of the precious coral industry is being studied by the State Attorney General's Office. A total of $393,000 has been spent on discovery and research programs as follows: Federal Sea Grant $152,000, State $179,000 (including $75,000 MAC funds); and industry $62,000. The Governor of Hawaii commissioned a study of possible rights to offshore minerals in January 1973. (Recommendation No. 18).

- University of Hawaii Marine Science programs have been partially combined and coordinated. The Marine Affairs Coordinator for the State is also Dean of Marine Affairs at the University. (Recommendation No. 19).

- No actions have been taken on Recommendations Nos. 3, 7, 21 and 22, due to the lack of Federal funding or because they were not considered necessary.

A list of the major recommendations made in *Hawaii and the Sea–1969* appears below.

Hawaii and the Sea - 1969

Recommendations of the Advisory Group

1. We endorse the idea of combining many of the interelated studies, surveys, and marine research and development activities recommended in this report into a single integrated program which could be called the *Hawaii 5-M Program* for *Five Marine-Science Years.*

2. We recommend that the State complete a determination of need for an Oceanographic Research Park by the beginning of the 1970 session of the State Legislature so that research park requirements can be learned, considered, and provisions made for meeting them.

3. We recommend that the State organize and assist public and private oceanographic interests in seeking the establishment of an Ocean Environmental Forecasting Center in the Islands.

4. We recommend the allocation of land at Snug Harbor to the University of Hawaii for an Oceanographic Expeditionary Center be made as soon as possible. Further, we recommend that $1.5 million be included in the next State Capitol Improvements Budget for construction of urgently needed facilities there.

5. We recommend that the Governor urge the President and the Congress to take appropriate actions to bring the International Decade of Ocean Exploration into being.

6. We recommend that the Governor convene a meeting of the leading scientists, technologists, and businessmen from the nations of the Pacific Basin and from the West Coast States in order to recommend a program for the exploration of the Pacific Basin as part of the International Decade of Ocean Exploration.

7. If the National Administration does not endorse the International Decade of Ocean Exploration, then we urge the Governor to seek a Pacific Decade of Ocean Exploration in order for the State to reap the benefits of an intensive study of the Pacific Ocean as soon as possible.

8. We recommend that the State study the feasibility of an International Marine Exposition in Hawaii in *1980.*

9. We recommend that the State create a Pacific Center for Marine Sciences to aid developing nations in the Pacific Basin as well as local fishermen.

10. We strongly urge Hawaii's Counties to initiate a program to assure their people that beaches will not be walled out by buildings, and to develop additional permanent public rights-of-way and access routes to Hawaii's shorelines. We also recommend that the Counties inspect present and future routes on at least an annual basis to insure that they are properly maintained and unobstructed.

11. We recommend that on all publicly-owned shoreline lands which are less than fully developed, irrespective of zoning or land-use classification, there should be 300 feet of open space dedicated to public use; and that this setback be measured from the most inshore on-record line of wave action, or from the top of the *pali* landward, should that type of topography be involved.

12. We recommend that the program of establishing underwater parks and preserves be expanded to include Maui, Molokai, and Kauai.

13. We recommend that the Hawaii Civil Defense Agency be appointed to organize and head a coordinating body of State and Federal agencies to plan and implement the required sensing and response to spills of oil and other hazardous materials in water.

14. We recommend that the State give high priority to its rigorous enforcement of State water quality standards.

15. We recommend that the State give increased assistance to industry and give further encouragement to the U.S. Bureau of Commercial Fisheries to accelerate their development of new fishing methods that will help Hawaiian fishermen increase their catch of skipjack tuna.

16. We urge the State to make a thorough study of the tablefish industry and make recommendations that will help it establish itself and grow.

17. The State should continue to encourage research in aquaculture. At the same time, the Federal Government should take the lead in sponsoring research which would show how to recycle sewage into food through fish farming.

18. The precious coral industry in Hawaii needs the support of the Federal Government to dissuade foreign coral fishermen from operating in waters near the Hawaiian Islands, and the help of the State in conducting a survey of the precious coral resources along the Hawaiian Archipelago.

19. We recommend that the University of Hawaii gather the parts of its present program in marine sciences and engineering into a single entity. We also recommend that the present level of funding of the State's contribution of approximately $1 million for operating funds for marine activities be accelerated on a 25 percent annual incremental basis for the next five years.

20. We find that there is a definite need for an Executive Director for Marine Affairs in the State Government. He can do his job effectively only in the Office of the Governor, and we recommend that he be placed there.

21. We recommend that the scope of the Governor's Task Force on Oceanography be enlarged, and that its name be changed to the Governor's Advisory Council for Marine Affairs.

22. We recommend that the Governor create a Cabinet for Marine Affairs designating as members the heads of those departments having responsibilities in the marine field. We further recommend that its staff arm be the Office of the Executive Director for Marine Affairs.

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