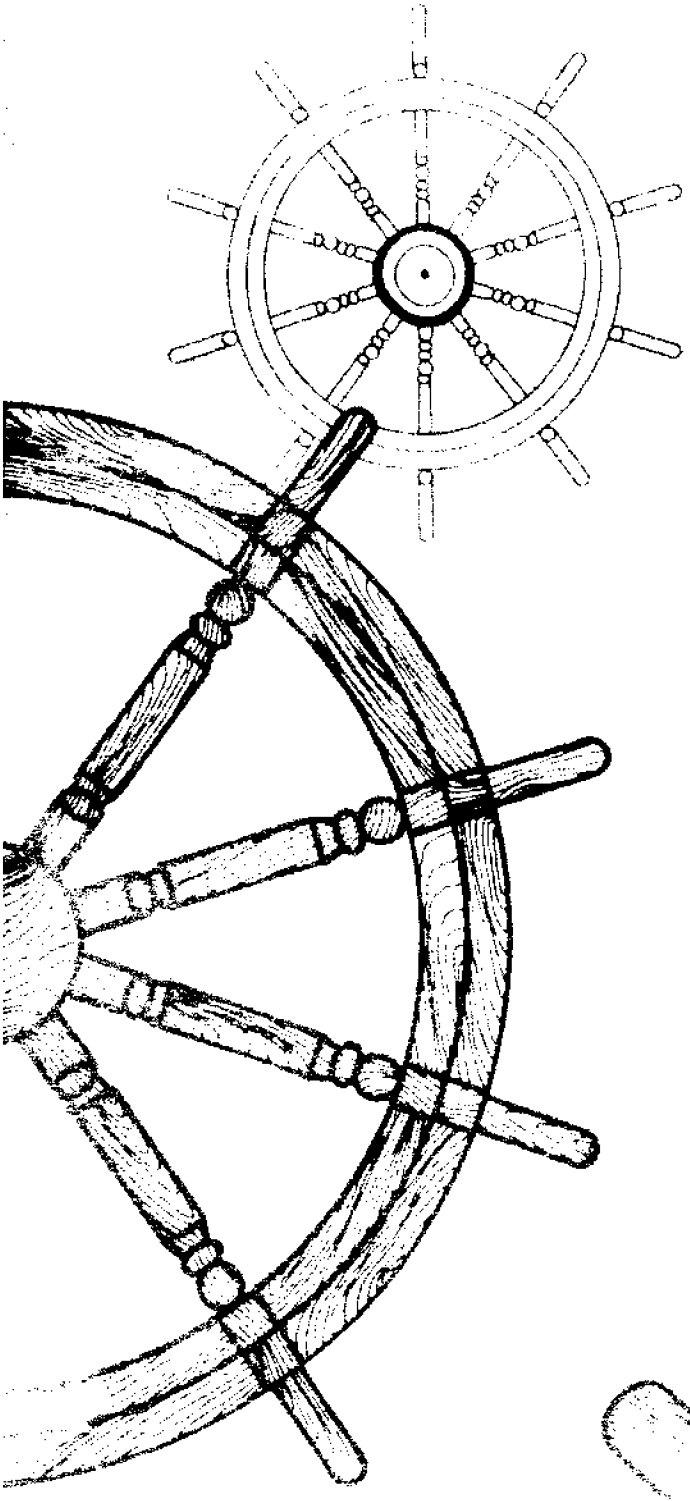

proceedings of the
first annual

student symposium on marine affairs

may 21, 1976

UNIHI - SEAGRANT - MR - 76 - 03
Sea Grant College Program
University of Hawaii

PROCEEDINGS OF THE
FIRST ANNUAL STUDENT SYMPOSIUM
ON MARINE AFFAIRS

Sea Grant Miscellaneous Report
UNIHI-SEAGRANT-MR-76-03

April 1976

This proceedings of the First Annual Student Symposium on Marine Affairs, which will be held at the Hilton Hawaiian Village, May 21, 1976, is published with funds provided by the Office of the Marine Affairs Coordinator, State of Hawaii, under [illegible] under #104 and personnel support provided by the Sea Grant College Program, University of Hawaii, under Grant No. [illegible].

PREFACE

This first volume of the Proceedings of the First Annual Student Symposium on Marine Affairs, which will be held on May 21, 1976, at the Hilton Hawaiian Village Hotel, contains twelve papers in four categories: aquaculture; coastal zone management issues; aku (skipjack) fishery; and law of the sea issues.

We have not attempted to edit the papers but wish instead to give credit where credit is due, to the twenty students and their teachers:

SCHOOL	STUDENT	TEACHER
Castle High School	Gordon Miyamoto Gregory Won	Mr. Robin Otagaki
Farrington High School	Kathy S. Tamada	Mrs. Jo Kanehiro
McKinley High School	Craig T. China Carl R. Onoye	Mr. John Hawkins
Pahoa High School	Alfred Calantoc Betsy Iwashita Richard Okamura	Mrs. Sandy White
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Waialua High School	Kathleen L. Bajo	Mrs. Helen Wesley

The support and cooperation of the Office of Marine Affairs and the Department of Education is gratefully acknowledged.

Rose Pfund, Coordinator
Student Symposium on Marine Affairs

TABLE OF CONTENTS

AQUACULTURE

AQUACULTURE: Problems and Potential

Kathy S. Tamada Farrington High School

From early times, man has farmed the seas. Archaeologists have found evidence of ancient civilations which kept oyster beds, kept fishes in ponds to use when they needed them. But that was when the population was small, and food was plentiful enough. But now, in these times of need, we must turn to the oceans for food. The overcrowded lands, now scarred and defaced, can not provide for all the people living upon it. The lands and waters we once thought of as so plentiful and endless, we have found, are indeed, limited. As we once again turn to the oceans for food, we must be sure to not adversely alter and destroy it, for the delicate organisms in the oceans cannot be replaced once they are gone. They cannot be re-created.

Aquaculture: Problems and Potentials

Aquaculture, the "farming of the seas" is an ideal program for development in Hawaii. The year-long warm climate, the calm waters, facilitate the growth of fishes. Such "seafarms" would provide a dependable, abundant supply of food, unlike the unpredictability of the supply of fish available from direct fishing from the oceans. We would, in effect, become farmers of the seas instead of hunters.

One of the main problems facing the formation of an aquaculture program is the sensitivity shown by marine fishes. The water surrounding the fish is like an extention of the fish's body. Any thing dissolved or suspended in the water eventually comes into contact with the fish, usually through the gills. The gills filter what they can out of the water, but what is in the water eventually passes into the body or into the gills. Because of this intimate relationship with its environment, the regulation of all aspects of its environment must be carefully controlled. So sensitive are most fishes that two parts of copper dissolved per hundred million parts of water , one part pesticides per billion parts of water, will kill them in less than twenty-four hours. Ammonia, a chemical found in the excretions of fish, will cause gill deterioration if one part is left inevery ten million parts of water.

Besides chemical factors, physical factors such as heat, salinity, are critical to the fishes' survival. A drastic temperature change of just a few degrees places great stress on the fish, and may cause death. Salinity is also a vital factor. A

Drastic increase or decrease in the salinity can cause death in a fish. The water concentration in a fish is equal to that of its surrounding water. Therefore, if the water suddenly becomes more fresh, fresh water will diffuse into the fish to balance the salt concentration in the fish, and this causes the internal organs to swell, often killing the fish. Inversely, if the water becomes suddenly too saline, the fresh water diffuses out of the fish, causing the organs to contract, which also may kill the fish.

Pollutants such as oil spills, the dumping of chemicals and garbage, discharging of fresh water, are all factors which pose threats to the well-being of the organisms living in the water.

In order to form such a "farm", the "farmer" must develop a pen in which he can keep the fish. This pen must duplicate as closely as possible the original habitat of the animal, yet not adversely altering the environment.

Food for the fishes must be provided in a plentiful and readily available. The diet must be carefully planned and analyzed, so that the species is able to attain a maximum size and quality. There are five major types of food utilized by animals inhabiting the seas. The first type, living plankton and small non-living particles suspended in water is probably the most important food source. Bacteria,and other organic matter deposited on the bottom compose the second group. Large organic matter of decomposing plants and animals compose the third group, and larger animals compose the fourth, and plants form the fifth group. The diet of the species bred must be analyzed and the amount, time, and specific type of food must be known before the seafarm is even begun.

Also important for the species to flourish is a parasite and predator free environment. This can be accomplished in a number of ways which would not adversely affect the environment. One way to keep the fishes parasite-free is to use cleaner shrimp or wrasse. These animals eat the parasites from fishes, and will clean the gills, skin, and under folds under the fins. Since they live on these parasites, they would also need no additional diet. Certain types of bacteria also will feed on parasites, and are also benificiary. Nets may serve as a means of keeping the fishes in. These nets would have to vary in size of the net holes in accordance to the size of any predators, and would also have to be small enough so that the fish and their offspring cannot escape. Also important is that the water be able to flow freely through the nets, allowing the fish to obtain oxygen, and preventing the water from becoming stagnant, and cleansing the water, replacing it with new water. This last factor will also prevent the build-up of ammonia, which becomes dangerous as before mentioned. (Page II, Paragraph 2 line 13)

Breeding must be facilitated, and the offspring separated and bred, to insure against the parent fish eating them. The fertilized eggs, or newborn babies must therefore be kept separatly, and studies must be conducted on the diet, temperatuer, and a any other factors which would affect the development of the offspring.

By succeding in farming the seas, we would be able to provide the parts of the world with protien-deficient diets with an inexpensive, palatable form of protien.

Along with such seafarms, would be the opening up of new job opportunities. These farms would provide new jobs without endangering the men who hunt fish for a living, for ther are still the large game fish which cannot be raised or domesticated, just as some animals, such as the bear, and the elephant, which, although some people eat them, even if the demand was there, it would be impractical to attempt to raise them for food purposes.

With such seafarms, the prices of seafood would experience more stability because of a more readily available supply. Whereas prices now fluctuate in accordance to supply and demand, such a constant supply would serve to keep prices more stable. Ahi for sashimi during the winter months, for example, would not jump in price to almost ten dollars a pound for New Year or Christmas dinners. The price would probably still jump, but not as much, if we have a supply already on hand.

People in Hawaii have just begun to realize what an aquaculture program could mean in Hawaii. At the moment, we only have one fish hatchery, but many people have begun to raise fresh-water prawns. Research is being done in Hawaii, the United States, all over the world. We now realize what great possibilities the oceans hold, and also that they are not endless, that they must be used carefully, and wisely. And we've only just begun...

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THREE EXAMPLES OF AQUACULTURE: Lobster; Turtle; and Fish

Alfred Calantoc Pahoa High School

EXPLOITING THE SEA

"Man will use the oceans in the future as completely as he uses land. He will essentially occupy the sea as an extention of the land creating space to live equivalent to 15 extra continents."[1]

Man is now looking to the ocean to answer his problems of food, waste, and even space. He must gain necessary knowledge and use it wisely. By controlling his numbers, and exploiting land and sea intelligently, man can save himself from himself.

By finding, catching, weeding, farming, and breeding, we hold great promises to the problems of feeding the earth's population, and the many which suffer from malnutrition.

The worlds oceans can be bountiful as long as we do not harvest faster than nature or ourselves can replace.

The U.S. is a member of eight nations in the international commissions. They were organized to regulate fishing on the high seas. Increasing consideration is given to the creation of a single international agency, a world fisheries group to work on the scientific, legal, political, and economic problems of exploiting the wealth of the sea, living and non-living. There would also be a clearing house for information on new fishing gear, techniques, and progress in such fields as transplanting, sea farming, and selective breeding.

The ultimate idea in exploiting the sea, is to fence off a part, raise fish, and shellfish as we do cattle, crops, and others.

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[1] Solhaus, Athelstan, "A Lingering Look at Lobster Culture", Oceans, pp. 26-31, May-June 1974.

FARMING THE SEA

Asian and Pacific islanders have farmed the sea for over 500 years. Mainland and China gets half its fish through this method.

U.S. commercial fish farms produce about 6 million pounds of trout annually. Some raise bass, buffalofish, catfish or sunfish as a money crop.

Salt water farms were increased after World War II. Commercial fishermen are now thinking of making a living off of "seafood farms".

Southeast Africa already has 1,000 acres cut off to form simple farms. Fish enter flood tides, but are prevented from leaving by the ebb tides. They feed on what's available (other fish, plankton, etc.). Pesticides or nets get rid of unwanted predators. Fertilizers encourage seaweed and plankton growth.

Eggs are cultured or caught in the sea. They are raised through their most rapid growth, then sent to markets.

Farming the sea is called mariculture or aquaculture.

MARICULTURE AND EXAMPLES OF MARICULTURE

"I'm using theocean like a pasture"[2] says Lauren R. Donaldson. His salmon and trout returned to his pond like a herk of cows wandering to the barn.

He has reduced reproductive age of Chinook Salmon from 4-3 to 2 years. He nas also increased their weight, length, and egg production. Early maturation gives the young a boost. They are reduced exposure to predators in the sea 10 to 30 times.

This may help the decline of the Pacific Northwest once great salmon fisheries.

He has also crossed rainbow and steelhead trout producing a strong mean breed. Some try to breed chum salmon (fine tasting) with pink salmon. (quick to take a lure).

Others want to breed oysters, resistant to 30 diseases, which kill many of them.

Gonadtropin may nelp breeding of improvised stocks in numbers that begin to compare with Mother Nature's offspring.

"Artificial breeding ought not to be contended to do as it's best only what nature does unaided. It obtains its real justification only when it is in a position to surpass nature in her achievements. Only thus can it accomplish the task set it, to fill up the gaps caused by years of excessive fishing."[3]

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[2] The Living World of the Sea, (Englewood Cliffs, N.J., Prentice Hall, 1966).
[3] Mead, A.D., "A lingering Look at Lobster Culture", Oceans, May-June, 1974, pp. 26-31.

"The lobsters were made more numerous on the main coast. . . and the fishermen who are dependent on the same for a livelihood are better satisfied with their condition"[4] said Commissioner Nickerson of the Sea and Shore Fisheries of 1900.

The northern lobster, ranges from the Labrador to Cape Hatteras. They support the nation's sixth most valuable fishery. It's the Atlantic coast's most valuable fishery product. There is a rising demand for lobster from increasing population expansion of markets through faster and cheaper air transportation. One and a half million lobsters which were consumed in the past 20 years, came from Canada. Lobster grounds are not replenishing themselves due to new fishing methods and inshore, offshore diving fishermen diving licensed or not. Fishermen struggle with the law asking "What does land bound scientist know anyway?"

Fishermen and scientists are learning a lot from each other. Lobsters inhabit rocky areas where they can construct burrows and live in crevices. They maintain the salt level in their blood so that it matches their enviroment. They are found in waters with high salinity (salt content) in fresh water is lethal. Lobsters extract dissolved oxygen from seawater with gills and so they require moisture to survive. They can live out of water for several days as long as there is moisture in the air. They have lived through 72 hours of flying in one experiment.

Although these creatures live in the cold waters of the Atlantic, mating, growth, and hatching depends on the warmer seas of summer. In 1936, heating systems for fisheries were developed. It sped up lobsters metabolism (growth, sexual reproduction, etc.).

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[4]Mead, A.D., "A Lingering Look at Lobster Culture", Oceans, May-June 1974, pp. 26-31.

Lobsters mate in spring or early in summer. One year later, the female extrudes eggs. In 10 to 20 months they will hatch. She carries 15,000, however, a large lobster may carry 60,000 eggs. Females are smaller than males their age. They only molt once every two years. Males molt once or twice a year.

In Massachusettes State Lobster Hatchery, John Hughes has been able to speed up the female's cycle to less than a year. Normally it takes 18 to 20 months. He does this by simply warming the water. They have discovered that warm water makes lobster grow three times faster.

When the eggs hatch, they are already lobsters. In the ocean, the larvae has a very high mortality rate. One tenth of 1% live. In the lab, 40% will live. The hatchery tries to raise the fry through their most crucial periods of life. After they have molted four times they are let go. This takes approximately 10 days. It is crucial because they maust stay in the upper layers of water where they are easily predation.

Once hatched they are drawn by circulating water tanks to a screen where they are caught and transferred in groups of 3,000 to rearing tanks. The water in the tank circulates and keeps the fry away from each other. The tank is made of fiber glass. It is round and has a concave bottom.

The fry are fed brine shrimp every three hours.

After four moltings their tails straighten and their claws develop. They are released where their mothers were taken.

At first lobsters were allowed to hatch their eggs naturally in tanks but their mortality rates were too high.

The Massachusettes Fisherymen are experimenting with spray fountains. Jets of water are sprayed above the surface saturating the water in the tanks with oxygen. As mentioned before, lobster extract disolved oxygen through their gills so this is important for faster growth.

They have also learned compartments affect growth rate. Breeding different colors and experimenting with special diets are some things that they do. Certain diets will turn the lobsters different colors. They have created red, green, gold, and blue. Besides trying to create colors, they have experimented with foods for the nutritional value. Cat and dog foods have been tried.

Twenty-five thousand tourists visit this hatchery each summer. The state government believes it's important to let people know what's going on so they built a public room in the hatchery.

John Hughes would prefer to work in partnership with a large established company. One with a chemist, physicist, biologist, and engineers already on the payroll of the company with unlimited resources and manpower. They would manufacture a lot of material a lobster culture project would need.

If lobster culture doesn't start soon, lobstermen better get new jobs. Prices will go up in shortages but no one will buy them after a while. If we choose not to raise prices, we'll have to do what Canada does, regulate license, pots, and number of lobsters which can be caught. Culturing could supply lobsters in the wild. With that partnership everybody could stay in business.

Turtles are rated high among food producing animals since their percent of food intakes and conversion to meat is low. It is higher than beef or beef cattle.

Unfortunately the population of turtles has been dwindling since the 1720's when the first commercial fisherman appeared.

In 1968, Mariculture Ltd. achieved a major goal, to raise turtles from eggs to marketable meat. This is the world first turtle farm.

They are raised in huge tanks filled with circulating water, 2.6

million gallons are pumped every hour.

Turtle produce 52 pounds of edible meat, 7 pounds calipee, 11 pounds oil, 15 pounds shell, 2 pounds hide, and 13 pounds waste. Turtle fat becomes oil used for soap, shaving soap and cosmetics. Turtle skin is made into leather in Europe. The belly plate used for turtle soup.

Land based tanks work better than penned off areas or floating pens. In their land based tanks it took four years before they reproduced. In 1972 the females crawled up their special prepared beach and lay eggs. The eggs take 60 to 90 days to hatch. To get enough eggs to work with, Mariculture collects wild eggs from Ascension Island, Surinam and Costa Rica. In the Ascension Islands volcanic sands, there is a substance in the ash which make the eggs sterile. In Surinam misguided turtles lay their eggs on eroding beaches. High tide washes them away. Of wild turtles hatched by nature, 0.2 percent return to their birthplace. Artificially bred, 1 percent return.

They are fed catfish for two years. Now a high protein feed is used. They come in pellets.

Left over pellets have caused a problem. They wash into the sea and fertilize it, for they are nutrient rich. Soft corals are suffering from an over abundance of algae. Fish life is striving. Fishermen come from all over to cast away the hours.

A solution to the coral problem would be to put a bottom dweller in the tank, such as lobsters, shrimps or mullet. The pellets float but sink when they are saturated with water. Instead of being washed out to sea these creatures will eat them up.

Mariculture Ltd. hopes to contribute actively to the development of similar projects around the world. Through possible franchise agreements with developing countries, the firm may have opportunities to expand in

places where the required food and waste requirements turtle meat could feed the hungry nation.

In Hawaii, on Oahu, the Oceanic Foundation is located next to Sea Life Park. Sea Life Park was built for the profit of the institute. Their objective is to continue making major contributions to scientific progress. The reproductive physiology program examines the gonadal developement of grey mullet, its relation to enviromental conditions, and the mechanism of ovulation. The program is to extend the successful reproductive and larval rearing work of the mullet to model hatcheries for countries where the need for increased protein resources is so acute.

Captive fish live in rubber lined ponds and reach sexual maturity if they're fed their natural diets (benthic diatoms) in an open seawater system. Successful nutrition and growth experiments have been conducted by increasing thesurface with plastic strips for diatom attachment.

The main objective of the reproductive program is to develope - out of season spawning - techniques, and to control gonad maturation throughout the year. This produces the supply of mullet finerlings for farming purposes all the time.

Larvae feed on marine plankton. Then in 42 days flakes and eventually pellets. Ten thousand eggs can be saved from one million. Survival depends on tank size and larval density. Light control is important.

Zooplankton is the best feed for the larvae, for three reasons:

1) The quantities required
2) The undependable nutritional value
3) The abundance

The effects of such availability on any aquaculture practices are obvious. Variable qualities and quantities of food can only produce variable yields of cultured product.

Grey mullet is the principle crop. It is believed that the principles of the model will apply to other species in their farming operation. Other fish have been studied. They are white mullet, aholehole, papia have been studied. Investigation on temperature and salinity have been done from mullet metabolism.

Mullet metabolism will be studied as responding to temperature and food composition.

(In my visit the President of the institute told us mullet are ideal for aquaculture because they can adjust to saltwater or fresh water).

Farming the sea of shore and below the surface are two methods I tried to put across. I also tried to give three examples of aquaculture - a fish, a lobster and a turtle I would like to end my report with a quote from the world reknown oceanographer, Jaques Yves Cousteau, "Anything our contemporaries can do on the surface, the mermen of tomorrow will do under the sea."

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AQUACULTURE: Its Potential for Development in Hawaii

Kathleen L. Bajo, Waialua High School

Aquaculture should be emphasized to Hawaii's people much stronger. with all our natural resources right around us, we should take advantage of it. The problem is I believe, not enough people even give any thought to it or maybe just never knew about it. All you do is just pick up a fish or two at the supermarket. You wouldn't have to worry about when the tide was going to change or when the next full moon would be so, you could catch them for dinner. Their fresh or frozen, packaged or canned and ready to be cooked by the time you get home. It's really no big deal and people just don't think about it. I never knew of such a thing called aquaculture till my zoology teacher announced that we were going on an excursion to visit a Dr. Bardach at the University of Hawaii's Marine Institute at Coconut Island. Then she offered the class to write this paper on one of the given topics. Until I visited the Marine Institute did I know what aquaculture was about. It's really a very intersting subject once you've seen all the work they've put into it. The fact remains that we know, about aquaculture in books and pamphlets. what I mean by all that "we" know, about aquaculture is to whom I'm referring it to. Other people who do not study in this field have no knowledge of aquaculture.

Hawaii's people should know about things like this. Instead of fighting against the H-3 freeway and hotel risings. I feel they should look for things they could go with and push for things worthwhile. If more people could know the importance of aquaculture and back up research here in Hawaii, perhaps we would progress much more rapidly and help feed a majority of the world and cut down prices here. Probably the only way to stir people's attention is to tell them with posters at supermarkets, seals on their packaged fish saying "aquaculture could feed you" They would definitely want to know how. But than again there must be better ways.

Simply think, where could all fish live in such a naturally warm climate, environment here in Hawaii? Secluded ponds in the mountains, rivers and streams

in the valleys. Recevoirs from the sugar canes and pineapples. All the way to ocean shores, bays, harbors, and docks. There's many terrific places to spawn and raise fish as well as crawfish and other shelled fished.

Perhaps we could divise a place in the mountains where we could raise 1mountain spawning fish. People could buy mountain fresh fish in hawaii from their mountains or we could have brackish water- spawning fish (from the mountains too).

We could expand resevoirs in the middle of the sugar cane fields and spawn Macrobachia. There's plenty of resevoirs. All we need is one. We have research centers already set up in bays and ocean shores. Why can't we stick them in harbors and docks. Fishing boats that catch nehu could bring some in at dock aguaculture centers and spawn them there.

School Aquaculture

Suppose we have research labs near high school where students of science , teachers, or science clubs could become involved in their own fish farming experiments. My school is very close to the ocean. It's ashame we students couldn't have a lab area to study the ocean when it is so abundant. We could start fish farming from salt water and slowly move to brackish. Than experiment with pond water, then mountain pond water.

The expense on building a large research center, to study aguaculture would probably be to great. I think with all the smaller research centers we could start a aquaculture program for our state and parts of the world.

AKU FISHERIES

CONDITIONS OF THE SKIPJACK TUNA INDUSTRY IN HAWAII

Craig China and Carl Onoye McKinley High School

Abstract

The skipjack (Katsuwonus pelamis) resource is generally believed to be relatively unutilized and that there lies great potential for its development.

Skipjack is the major commercial species for the Hawaiian fishing industry. The total annual catch for skipjack in Hawaii is a combination of a sharp summer peak and a change in the dominant size of the skipjack. The Hawaiian fishermen use very old methods in fishing for skipjack. In Hawaii, the pole and line technique is used to catch the skipjack. The Hawaiian fishermen use birds to locate skipjack schools, however, this method makes it hard to locate skipjack beyond the bird flock range. Lack of navigational equipment also limits the vessel's range. Nehu (Stalephorus purpureus) is a big factor in catching skipjack, since it is the principle baitfish the fishermen use to catch the skipjack. Nehu limits the amount of skipjack caught because fishermen spend 40% of their time catching nehu, and also the mortality rate of nehu limits the vessel's range. Skipjack is a hard fish to catch, and in one study 52% of 92 schools fished produced no catch. Low annual catches are caused by several factors, some being water temperature, and currents. Fishing is competitive because of the traditional fixed sharing system.

The old methods in fishing for skipjack is not sufficient to capitalize on the potential skipjack resource. Improvements must be made in order to capitalize on this resource. Some improvements mentioned are: the location of better fishing areas during the winter months, new fishing techniques, culturing of nehu, and experimentation on floating objects.

We concluded that the expansion of the fishing industry in Hawaii should be looked into. We felt that the fishing insdustry could provide Hawaii with a consistent source of income

Introduction

Fishing seems very related to Hawaii and its lifestyles. The early Hawaiians fished from the sea as a family food source. The sea is a practical resource for Hawaii because it surrounds the Hawaiian Islands. With the beautiful waters that surround the Islands, one can just imagine the fishes that lie in it. Contrary to this belief, Hawaii hasn't fully developed fishing as a real productive resource. The commercial fishing industry in Hawaii accounts for a little of the State's economy. About .25% of the value gross State product in 1955 was contributed by the commercial industry, and in 1967 the industry contributed only .12% of the value gross State product. The decrease is not due to a decline in the value of commercial catches, but to a very rapid growth of other industries. Why is this so? We hope the following report will answer this question. This paper is an attempt to inform the reader about the skipjack and the fishing industry.

In our report we will concentrate mainly on the skipjack, Katsumonus pelamis, or locally known as Aku. The skipjack is the major commercial species for the fishing industry. It comprises about 2/3's of the annual weight of the total marine and shell fish catch. The skipjack also accounts for 40% of all ex-vessel prices (fishermen prices).

Skipjack Resource

It is generally believed that the skipjack resource is relatively unutilized and that there is a great chance for potential development.

The range of the skipjack in the Pacific consists of a broad band from forty degrees north to forty degrees south extending clear across the ocean. Skipjacks are said to be found in all warm seas with water temperature above the twenty degrees centigrade. The total world catch of skipjack is approximately 300,000 tons, and about 2/3 of this catch is being taken from the Northwestern Pacific by Japanese vessels. The area producing the next largest catch is the coastal waters of the Eastern Pacific extending from Baja California to N orthern Chile where about 50,000 to 100,000 tons of skipjack is caught each year.

The ratio of skipjack larvae as compared to total tuna larvae is about 3 to 4 in waters west of 180 degrees and south of latitude 25 degrees. Skipjack juvenile appear in large number in stomachs of other tunas and billfishes which inhabit the same waters as do the skipjack.

It can be assumed from these facts that the skipjack resource is at least several times as great as the resource of the other tunas and billfishes. While there is considerable potential for development of the skipjack resource, Dr. Kasahara of the Tohoku Laboratory reported in October of 1971 that, "Research in skipjack is not sufficient at present. Even the estimates of the resource size appear to be in need of further evaluation. Even if the resource is as large as estimated, it is certainly not inexhaustible. In order not to let the skipjack resource follow in the footsteps of some other unfortunate species, it is desirable to base its utilization on sound considerations." (6:6)

Hawaiian Fishing Industry

The Hawaiian Fishery produce from six to fourteen million pounds of skipjack per year. A combination of a sharp summer peak in the catch and an accompanying change in the dominant size lends itself to the interpretation that the "season fish" migrate annually into Hawaiian waters from elsewhere.

If we were to analyze the quarter of the year (the following figures is an average of an 18 year period of 1948–1965) we would find that the first quarter of the year, Jan.–Mar. the fishing is usually poorest at this time. The abundance of skipjack is low, and the fishing effort (amount of trips a vessel goes out to catch skipjack) is about 15% of the annual effort. In the second quarter (April–June) the first appearance of the "season fish" marks the real beginning of the skipjack tuna fishing season. The second quarter fishing effort is about 32% of the total annual effort, and 33% of the average annual catch is caught at this period of the year.

Fishing effort is usually maximized and leads to peak catches in the third quarter (July–Sept.). Fishing effort is about 36% of the annual effort and catch is about 46% of the annual catch. The fourth quarter is characterized by a decline in abundance. Fishing effort is about 17% of the annual effort, and the catch is about 12% of the annual. By this analysis we find that the "season fish" occurs during the summer season.

The fishermen go out daily after a sufficient supply of baitfish has been captured. Most of the boats used by the fishermen are old and modeled after the early Japanese Sampans. After leaving the dock

the fishermen have no way of really knowing where the school of skipjack will be. The fishermen can't count on migration patterns to locate skipjack because no real good patterns have been discovered. Although tagging experiments have produced some information about skipjack movement within the island chain no clear pattern has emerged. Migration patterns within the island chain are unpredictable because the skipjace seem to move with the currents. We believe that the fishermen know where to fish by experience. They go to places where they think the skipjack would be based on past experience.

The distances the boats venture from shore is not very far. The fishermen use birds as their only way of locating skipjack. The birds feed on the baitfish on the top while some sort of fish is feeding on the baitfish underneath the surface. Hopefully the fish that is feeding on the baitfish is skipjack or some sort of tuna. Fishermen even observe the behavior of the birds to give them some characteristic about the school. For instance, the number and spread of the birds is an indication of the school's size. If the birds dive and circle fast and erractically the size of the fish is usually small. If the birds are seen diving into the water the fish have driven their prey to the surface and are actively feeding. If the birds scatter or sit on the sea surface, the school of fish have sounded.

This method of locating skipjack limits the range of a vessel because as one goes farther out to sea the number of birds decrease, and soon the likelihood of finding bird flocks will be negative.

Another problem that faces the fishermen as they go farther out to sea is that their old fishing boats have little navigation wquipment aboard. When going out to sea the fishermen usually keep land in sight. Another factor limiting the vessel's range is nehu. This will be discussed in the next section. Most fishing trips last one day. When the fishermentrun out of bait or when night is coming they usually call it quits and head back to the home dock and unload their day's catch.

Nehu

Nehu, Stalephous purpureus or the Hawaiian anchovy is the principle baitfish that the skipjack fishermen use for bait. Without Nehu it would be very hard for the Hawaiian fishermen to catch any fish. The fishermen spend about 40% of their time catch nehu. In fishing for skipjack the bait is chummed. Nehu is used because it is a silvery and darting

swimmer, and it has a homing instinct which makes it return to the aku boat when attacked by skipjack. This brings the skipjack close to the boat, and when the skipjack feeds on the nehu they become excited and go into a feeding frenzy. During a feeding frenzy the skipjack will bite at anything that looks like the baitfish, even a hook. The nehu is generally taken at Kaneohe Bay, Pearl Harbor, and Keehi Lagoon.

Nehu is a factor in the ammount of skipjack caught because the fishermen spend so much of their effort attempt to catch the bait fish. Theoretically, if a fisherman was to spend half that amount of time catching skipjack the catch rate would increase by roughly four million pounds per year or 900,000 dollars.

In other ways nehu limits the distance skipjack boats are able to go because of its high mortality rate, and on the average this rate is about 25% per day. If the nehu were a hardier fish the fishermen would be able to fish for a longer period of time and possibly catch more skipjack.

Skipjack Behavior

A problem facing the fishermen after they locate a skipjack school is whether or not the skipjack will want to feed. In one study of the Hawaiian fishery it was found that 52% of 92 schools produced no catch, and the most widely used method of catching the fish require that the skipjack be hungry.

If during feeding the skipjack exhibit vertical bars along its body, it has been known that the catch will be good. Japanese scientists say that good biting tuna are orderly in formation "liking marching troops" while poor biting ones are disorderly. One scientist has found that between the extremes of starvation and satiation the less food the fish have in their stomachs, the less likely they are to bite well.

Skipjack appears to seek out floating objects and use them as forms of shelter. It also appears that nehu are attracted to floating objects, and in this case the floating object plays the part of an artificial reef. A log in the water for instance is a good attract for both the nehu and the skipjack. The baitfish (nehu) stay near the log because it is their source of food and protection, and the predators of the baitfish stay near the log because that is where their meals are and so on along the food chain. Japanese scientists say that schools of tuna have been known to wonder

seven to eight miles from an object and then return to it. So that implies that tuna might have some sort of navigational system.

Low Annual Catches

With all the talk about the potential of the skipjack resource, people might wonder; "How come the fishing industry had a low annual catch last year." A look at the total catch over the years is quick to reveal that it is not very consistent. There are many factors contributing to a low annual catch or a high annual catch year. Water temperature, cuurents, and salinity are some factors to name a few. Over the many years it was found that if the water temperature is warm in February the annual catch of skipjack will be good. However, if the warm water temperature is delayed until March the annual catch for that year will be poor.

Another way of telling if the annual catch will be good is by the year-class. A year-class represents the reproductive status of skipjack for a particular year. Therefore a good year-class will provide a good annual catch in a year or two to come. For example, if the 1969 year-class was good, fishermen can expect 1971-1972 to have a good catch of skipjack tuna.

Competition

The fishing industry is very competitive. There are roughly fifteen individual fishing vessels now in operation. The people on a boat usually consist of a captain, engineer, and a group of fishermen. The number of fishermen varies from boat to boat, and the fishermen are usually paid once a week. The fishermen's earnings are based on a traditional fixed sharing system. In a traditional fixed sharing system, the operating cost is subtracted from the gross revenue and the remainder is shared by the boat owner and the fishermen. The boat owner gets 63% and the fishermen share equally 37%. The more fish the fishermen catch the more money they make, therefore there is always pressure to catch fish. There is hardly ever cooperation between boats as to where to scout or search for skipjack. For instance, fishermen of one boat hardly ever tell another boat where they caught their fish and vice versa.

The fishermen sell their fish to the fresh fish market and to the cannery. It is best for the fishermen to sell more fish to the fresh fish market because of better profits. The cannery pays an amount considerably less than the fresh fish market, and also the cannery buys only if the tuna is of good quality

The cannery at Kewalo Basin buys frozen tuna from Japan and the Pacific Islands. The reason why tuna is imported is because of the insufficient and unpredictable local supply. It is believed that if the total catch were to be expanded at the current prices, there would be no need to purchase imported frozen tuna.

Improvements

Although there is a large resource known to exist nearby, the Hawaiian skipjack fleet is not able to fish large quantities of fish because if its inadequacies. Fishing for skipjack in Hawaii could increase if other areas with more fish, particularly in the winter, are discovered, and if the area is far from the islands more able and modern vessels are obtained. Also new fishing and scouting techniques would probable have to be developed. Cooperative scouting with sharing of information among the boats of the fleet, might well produce a large total catch than the highly competitive and secretive individual operation that exists now.

The boats the fishermen use are very old, and perhaps new and modern boats will help the fishing industry. Modern fishing vessels that have improved baitwells might help to keep the mortality rate of the nehu low thereby enabling the vessels to venture farther out to sea. Navigational equipment on modern vessels will help with locations in the open sea, and the use of sonar to locate fish schools instead of birds will help improve the total catch.

The pole and line technique used today by the Hawaiian skipjack fishermen are too old. Today most Japanese boats use automatic hydraulic machines that replaces the fisherman. For one thing the machine doesn't tire out like a human, and it could be more consistent and more efficient. Another advantage is that the machine doesn't need to be paid. This machine could probably be used in the Hawaiian vessels.

Another technique that could be substituted for the pole and line is purse seining. This technique was tried in the summer of 1970 without too much success probably due to the lack of cooperation among the boats of the fleet, and another attempt will be tried in the near future.

It is believed that expansion of the Hawaiian Skipjack Fishery has been limited because of the shortage ofnehu. Because nehu is hard to get at times , culturing nehu so that the supply is predictable and availabe and the possibility of extending the range beyond the twenty mile range where 75% of the skipjack are currently caught, is now being attempted with

varying degrees of success by the National Marine Fisheries Service, the State Fish and Game Division, and the University of Hawaii's Institute of Marine Biology with Sea Grant support.

Alternative baitfish like the threadfin shad, the topminnow, and the tilapia have been used, however the fishermen do not accept them and still rely on nehu as the principle bait fish.

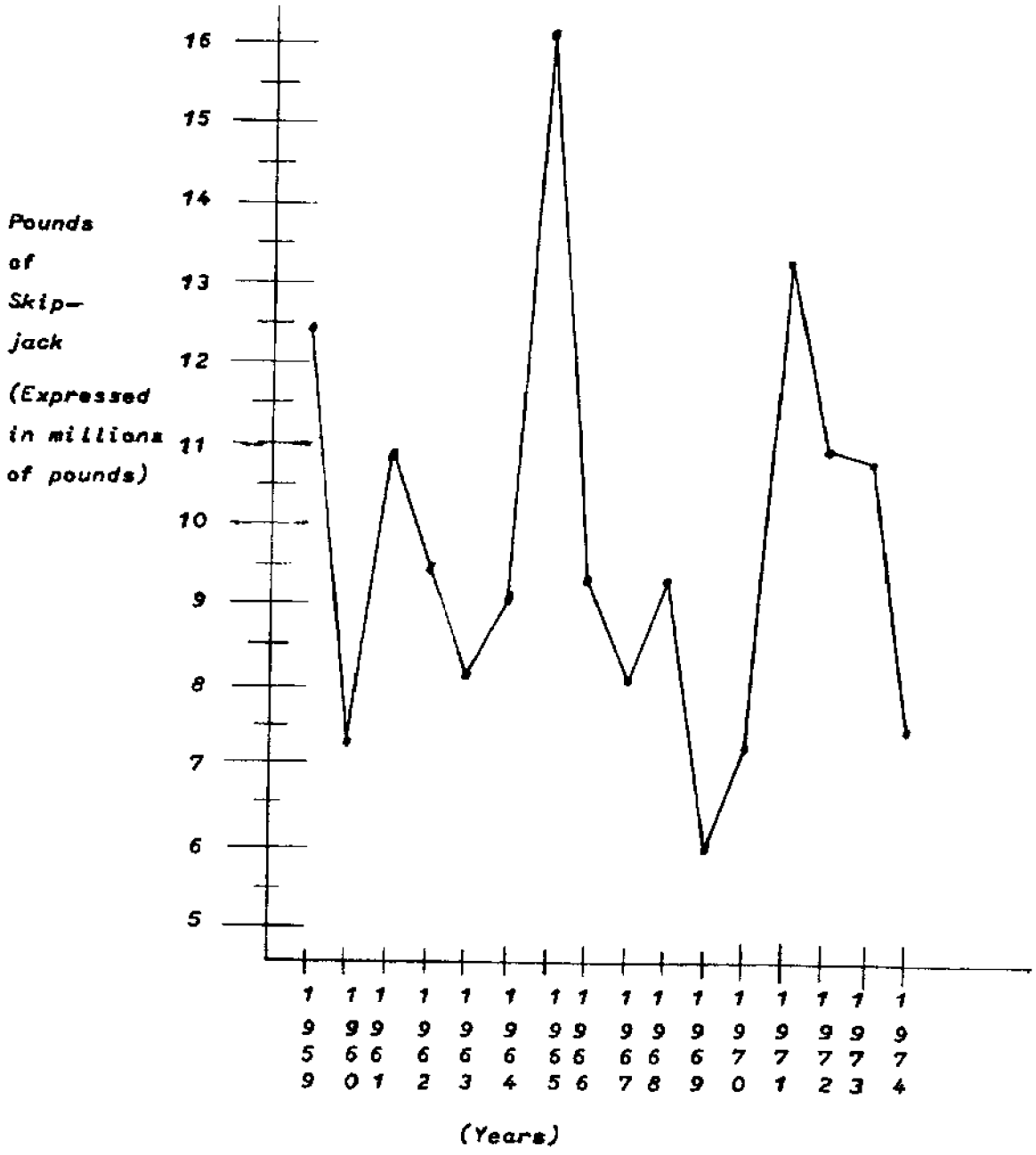
Japan is currently experimenting on the behavior of tuna with respect to their being attracted to floating objects. The Japanese are making artificial rafts and are hoping that in due time these rafts will attract tuna. If this method is or should be successful, the fishermen would then be able to control the tuna catch. This experiment will also be tried in Hawaii soon.

Conclusion

The commercial fishing industry in Hawaii is not apparently capitalizing on the potential resource that is known to exist. The skipjack fishermen use very old techniques to catch the skipjack tuna, and this technique is not enough to keep up with today's economy. Too much valuable time is spent on catching bait instead of catching skipjack. New methods of catching skipjack should be developed with newer and greater range vessels. Sonar and air search should be added to the techniques of locating fish schools with cooperation among the boats of the fleet. Culturing nehu will lessen the time needed to obtain bait and with cross-breeding develop a much hardier bait fish.

It appears that if the Hawaiian Skipjack industry, in the future, want to increase their catch improvements in techniques must definitely be made. In conclusion we feel that the expansion of the skipjack industry in Hawaii could provide a consistent source of income and food for the State.

Total Annual Catches for Skipjack



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HAWAII's AKU INDUSTRY: Problems and Prospects

Jonathan Ego and Brian Ezuka University High School

ABSTRACT

Aku (Katsuwonus pelamis)also known as skipjack is Hawaii's most important commercial fish species in terms of total landings and value. It makes up about two-thirds of the total fish caught within Hawaiian waters. At present there are 15 vessels in the aku fleet. These aku sampans, which range in size from about 60 to 80 feet, use the pole and line method together with live bait to catch aku. The principal live bait used is the nehu, a type of anchovy found only within certain near-shore waters of the state. Although it is estimated that the stock of the central Pacific aku is extensive and capable of expanding many times over present yield, the aku industry is declining economically due to the out-moded pole and line and live-bait fishing method used. To increase fishing efficiency, trials and experiments have been or are being conducted with the use of purse seines, aerial spotting, gill nets, supplemental bait and bait keeping studies.

INTRODUCTION

Aku (Katsuwonus pelamis) otherwise known as skipjack is by far the most important commercial species in the fisheries of Hawaii in terms of value and total harvest. It makes up about two-thirds by weight of the total Hawaiian marine catch of fish and shellfish and accounts for about 40 per cent of the total annual ex-vessel value (price received by the fishermen) which in terms of average annual landings and earnings amount to about 5,000 tons of aku having a value of about $2,000,000. There are two major markets for aku here in Hawaii, one of them being the fresh fish market for aku, which incidentally is the largest in the nation. People in Hawaii alone consume over two million pounds of fresh aku annually. The other major market is the cannery which receives the bulk of the catch at prices lower than the fresh-fish market.

THE PRESENT AKU FISHERY

The Aku Sampan

At the present time the Hawaiian aku fleet consists of 17 vessels. These vessels evolved from the Japanese tuna sampans which were introduced into Hawaii around 1900. The Hawaiian aku sampans, generally built of wood, range in length from about 60 to 80 feet. The present Hawaiian aku sampan has a distinctive type hull with a high narrow bow and a moderate freeboard aft. All of the vessels are powered with diesel engines. Each vessel has six baitwells

installed below the afterdeck. As the bait is used up during the fishing operation, the baitwell is then utilized to stow the aku. The boats do not have mechanical refrigeration systems but they do carry ice. Depending upon the size of the boat and also on the availability of men, these vessels carry a crew ranging from 6 to 14 men during each fishing trip.

Fishing Operation

The aku fishing gear used in Hawaiian waters is similar to that used in other pole and line tuna fisheries in the Pacific. It consists of a bamboo pole to which is attached a length of line bearing a feather jig with a barbless hook. The poles vary from about 8 to 15 feet in length.

The aku vessels leave for the fishing grounds before dawn and start to scout and fish when daylight comes. The Hawaiian fishermen rely mostly on bird flocks to locate aku schools. When a school is sighted, the boat circles it in an attempt to cross ahead of it. As the boat nears the school the vessel speed is reduced and live bait is tossed overboard to attract the aku near the boat. When the aku begins to bite, the fishermen stand along the stern of the vessel to fish. Fishing continues until the aku no longer bite. Then the school is abandoned and scouting is resumed to locate another school of aku. Scouting and fishing are discontinued as darkness approaches, and the vessels usually head for port to unload the day's catch.

Bait and Baiting Areas

The nehu (Stolephorus purpureus), a type of anchovy, makes up more than 90 per cent of the bait used in the aku fishing. Another bait of minor importance is the iao or silverside (Pranesus insularum). Each vessel catches its own bait and spends considerable amounts of time doing so. Nehu are caught during the day ("day-bait") and at night ("night-bait") by two different methods. For "day-bait" a skiff with outboard motor and a "surround net" is used to capture the nehu during the daylight hours, while "night-bait" is taken during the hours of darkness by hanging an underwater light from the side of the aku sampan to attract the nehu to the light and using a "lift net" to capture the nehu schooling under the light.

The principal bait fishing grounds on the island of Oahu are Kaneohe Bay and Pearl Harbor, which supply the bulk of the nehu, and Honolulu Harbor and Keehi Lagoon. On Maui, the principal baiting grounds are Maalaea Bay and the Kihei area. Oahu and Maui (particularly Oahu) are the major sources of nehu. The islands of Hawaii, Kauai and Molokai contribute only small amounts of bait, largely because their baiting grounds are small in area.

It should be stressed here that in the aku fishery, the bait must be live for the actual fishing operation. Dead bait is useless for aku pole and line fishing.

THE POTENTIAL, THE PROBLEMS AND ATTEMPTED ALTERNATIVES

Potential of the Aku Industry

Among the several species of tunas, the most plentiful, many people believe, is the aku. At the present time, the Hawaiian aku fleet is harvesting about 5,000 tons annually. However, certain fishery scientist postulate that the central Pacific is habitat for one of the major fishery resources of the world and that this resource, the aku, is capable of yielding a minimum of 150,000 tons a year with no noticeable harm to the basic stock. Why then has the aku industry not expanded? Instead it has declined as indicated by the decreasing size of the aku fleet since 1948. In 1948, 32 aku sampans were in operation. Today, the number is down to 15.

The Problems Facing the Aku Industry

As mentioned above, the decline of the aku industry is not due to overfishing. The problem seems to lie with the inefficiency of fishing the pole and line method together with increasing operational costs. The solution would be to increase the catch without increasing the cost. A similar situation faced the West Coast tuna industry more than ten years ago. In this case the fishing efficiency of the purse seiners was increased eight times by the use of nets of synthetic fiber and powerblocks to haul the nets. This brought about a technological revolution in the purse seine fishery.

Purse Seining and Aerial Spotting as Alternatives

A review of modern fishing practices on a world wide basis seems to show that the purse seining method offers the greatest promise for greatly increasing the aku catch in Hawaii. To test this technique, a West Coast tuna purse seiner M/V Jeanne Lynn was chartered and brought to Hawaii from San Diego, California in 1970 to conduct 70 days of experimental purse seining in Hawaiian waters. The test showed that aku can be caught in Hawaiian waters, especially when the purse seine is used together with live bait. Unfortunately, the experiment was inconclusive because it was conducted during an extremely poor aku season and there were few good seining opportunities mainly because of the scaroity , small size and erratic behaviour of the aku schools. This did indicate however a need for more such investigations to see if aku are available in sufficient concentration that would justify a purse seine fishery in the islands.

With the use of aircraft, which give rapid and extensive coverage, the Hawaii Division of Fish and Game is presently conducting an aerial aku spotting project to assess the number, size, distribution and if possible, the behavioural characteristics of aku schools in Hawaiian waters. This study, which was started in the summer of 1975, is of state-wide scope and will cover al least three consecutive aku seasons to cut down the danger of coming to erroneous conclusions based on one or two especially good or bad aku seasons. Although the main purpose of the aerial spotting

program is to gather information necessary for the establishment of a purse seine fishery in Hawaii, it does have important spill-over benefits to the present pole and line fishery by locating and directing aku boats to nearby schools or to more distant areas of aku concentrations.

Although the purse seining method is perhaps one of the more promising alternatives, the following factors could reduce the fishing efficiency of this gear or even negate its use:

1. The clarity of Hawaiian waters as compared to other areas where tuna are seined indicates that the aku may be able to see and evade the seine more readily in Hawaiian waters.
2. The normally stiff trade winds and resulting choppy waters as well as the unpredictable nature of ocean currents around the Hawaiian islands make it more difficult to set and retrieve purse seines in local waters.
3. The aku schools in Hawaiian waters appear to change course as well as to sound unpredictably which may make it more difficult to set a net around the school of fish as compared to other areas.
4. It is postulated that the aku does not readily enter the thermocline(that level at which the water temperature drops suddenly). In the eastern Pacific, where purse seining is successful, the thermocline

is shallow and therefore the bottom of the seine enters the thermocline. In Hawaiian waters, the thermocline is far deeper than the reach of the deepest purse seine, therefore there is often no bottom barrier.

The above factors are mentioned to point out that although purse seining appears to offer an alternative to the problem the actual solution may not be so easy to reach and that a great deal of gear and method modifications may be needed before the method can be used in Hawaiian waters.

Gill Netting as as Alternative

On the basis of modern developments in monofilament nylon fibers and the success of monofilament gill nets in other fisheries, netting methods for catching aku were investigated by the Federal Bureau of Commercial Fisheries and the State of Hawaii Division of Fish and Game working together.

The major part of the study was spent in active methods of fishing the monofilament nylon gill nets. Basically, these methods involved attracting a school of aku to the stern of the boat by chumming with live nehu, setting the net while continuing the chumming, and finally hauling in the net with a powerblock. Field trials showed that while aku can be taken by this method, the catches were too small for commercial fishing. It was the opinion of experienced fishermen that a far greater quantity of aku could have been caught by the pole and line method with the amount of bait-fish needed in the gill net tests.

The passive method of fishing gill nets for aku consisted of setting the nets in the regular way used by other fisheries. This involves the laying of the nets at sunset, allowing the nets to drift passively with the currents, and finally hauling in the gear and catch the following morning. The passive method resulted in very poor catches of aku. The findings from these experiments clearly showed that the gill net can not be used for commercial aku fishing in Hawaiian waters.

Other Alternatives Investigated

The use of live-bait is absolutely necessary for the pole and line aku fishery. The constant shortage of nehu, the main live-bait, has limited the growth of this fishing industry. Although the nehu is regarded as the best available bait by Hawaii's aku fishermen, one of it's greatest faults as a bait fish is its extremely fragile nature. For normal fishing purposes, the nehu can not be kept alive in the bait-well of aku vessels for more than three days. This very short useful period of the nehu greatly limits the operating range of the aku fishermen. Also, the crew of an aku sampan may spend as much as half of their time fishing for bait with the result that there is less time for actual aku fishing. Obviously, finding another bait-fish with aku attracting qualities similar to those of the nehu but without its faults would be an important step toward solving some fo the existing problems of the fishery.

In addition being able to keep the nehu alive longer in the live-well of aku vessels would greatly increase overall fishery efficiency. Also, having a separate bait fishery apart from the actual aku fishing operation should make more time available for actual aku fishing. All of these alternatives have been or are being investigated at the present time.

As other possible bait fish, tilapia, as well as threadfin shad and mollies, have been or are being reared and tested. Tilapia are a failure as live bait because they tend to sound immediately after being tossed into the water, thus attracting the aku to the depths rather then the stern of the vessel. Preliminary results with threadfin shad also show that this species also may tend to sound immediately after release. In addition to the rearing of other possible bait fish, importing other live bait fish such as the northern anchovy from California are being investigated.

To extend live-keeping qualities of the nehu and for possible use by a separate bait fishery, in addition to devising and testing various capture and holding techniques, the use of oxygen and reduced salinity were investigated by the University of Hawaii, State and Federal scientists, with pretty good results, but as yet techniques for practical applications have not resulted.

SUMMARY AND CONCLUSIONS

The Hawaiian aku fishery is showing signs of economic trouble, particularly when the run of aku during the summer aku season falls below the average annual yield. While the factors responsible for the problems of the aku industry are not simple, it can not be blamed on overfishing, for all available scientific data show that the aku stock within the central Pacific is capable of yielding an annual harvest many times over the present landings. The basic problem is probably due to the method of fishing with pole and line and live-bait which has remained almost unchanged since the beginning of the fishery. This unchanging level of fishing efficiency, together with constantly rising operational costs, has had serious effects on the industry, particularly during poor seasons. The solution to the problem of improving the Hawaiian aku fishery appears to be dependent on increasing the level of fishing efficiency by (1) improving the existing pole and line method and/or (2) introducing an entirely different mode of fishing. Both approaches should be studied at the same time. The first approach would be of immediate practical use to the present aku fleet, while the second approach may not be useful now to the present fleet but offers the future potential of expanding greatly the Hawaiian aku industry.

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COASTAL ZONE MANAGEMENT

HAWAII COASTAL ZONE MANAGEMENT PROGRAM: Public Participation*

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I. Introduction

The Coastal Zone Management Act of 1972 requires that citizens participate in the programs in order to qualify for grants. The Act maintains that the states must make an effort to consult interested citizens or those who might experience the consequences and purposes of such Coastal Zone Programs.

In this paper, I will examine the structure of citizen participation programs developed by the State. Since no research on this subject has been undertaken this paper will only be a preliminary exploration of the subject.

II. The Federal Mandate

Section 920.30 of the CZM Act of 1972 notes that the State "Should seek to obtain extensive public participation in the development and administration of a coastal zone management program." Citizen participation is needed because it provides a means to make a two-way flow of information between the public and different political, citizen groups, agencies and organizations. It clarifies the planning and decision process and the views of all the relevant groups through trust, and to win support for public decisions. It promotes justice and makes it easier to enforce the administrative programs which depend on public cooperation. It would also make the people and communities more aware of their surroundings. Citizens would understand the social and political process a lot better by participating and getting involved in the program, which would improve the efficiency of the government.

* In this paper, I wish to discuss the public participation in the Coastal Zone Management Program. Do the members represent the "public"? If not, who do they represent, and why?

III. Hawaii's Response

To advise the State on the program from the public viewpoint, a statewide Citizen's Forum was established. The forum is composed of representatives of 45 non-governmental organizations concerned withe coastal zone. They are listed on the last few pages on figure II. There are spokesmen from Life of the Land, Friends of the Earth, Sierra Club, and the heads of the General Contractors' Association and Construction Industry Legislative Organization.

The committee has been meeting twice a month since last August. About 75 people attend each meeting. Those meetings are open to the public and anyone can be recognized and may speak if he wants to. Committee Chairman, Aaron Levine, proposed that they ban the idea for now because people talk too much and start unnecessary discussions. The forum has elected a Citizen Steering Committee which consists of 15 members. Each island has formed Citizen Advisory Committees, and their chairman automatically became members of the forum and the Steering Committee. Now all the islands including Molokai and Lanai may participate in the programs and decisions.

Do these members of the Steering Committee represent the public? I would say they do not. I don't have the specific names of the members, but if they are the chairmen of each of their own Advisory Committees, it's most likely that they are high-ups, rather than the "public" representatives.

Who represents the young beachcombers? Or the Waimanalo Surfer? If you look at the list of the members of the Ctizens Forum, you will see that the representatives are from big organizations and are in a high position in each organization or association.

Figure I shows the organization of these committees in relation to DPED and Federal Advisory contacts dealing with CZM.

The Statewide Citizens Forum will include members from statewide groups such a consumer, environmental, business, and labor, etc. The main function of the committee will be to review the progress and content of the program to see the preferences of the citizens, from a statewide perspective.

The Coastal Zone Management Program is voluntary, but by April 1975, 30 states plus Guam, Hawaii, Puerto Rico, and the Virgin Islands were involved in the planning part of the program.

In 1974-75 the Federal Government gave $250,000
State gave $125,000
$375,000

In 1975-76 the Federal Government gave $400,000
State gave $200,000
$600,000

In 1976-1977 it is predicted to be quite similar to last years amounts.

Five technical consulting groups are assisting DPED:

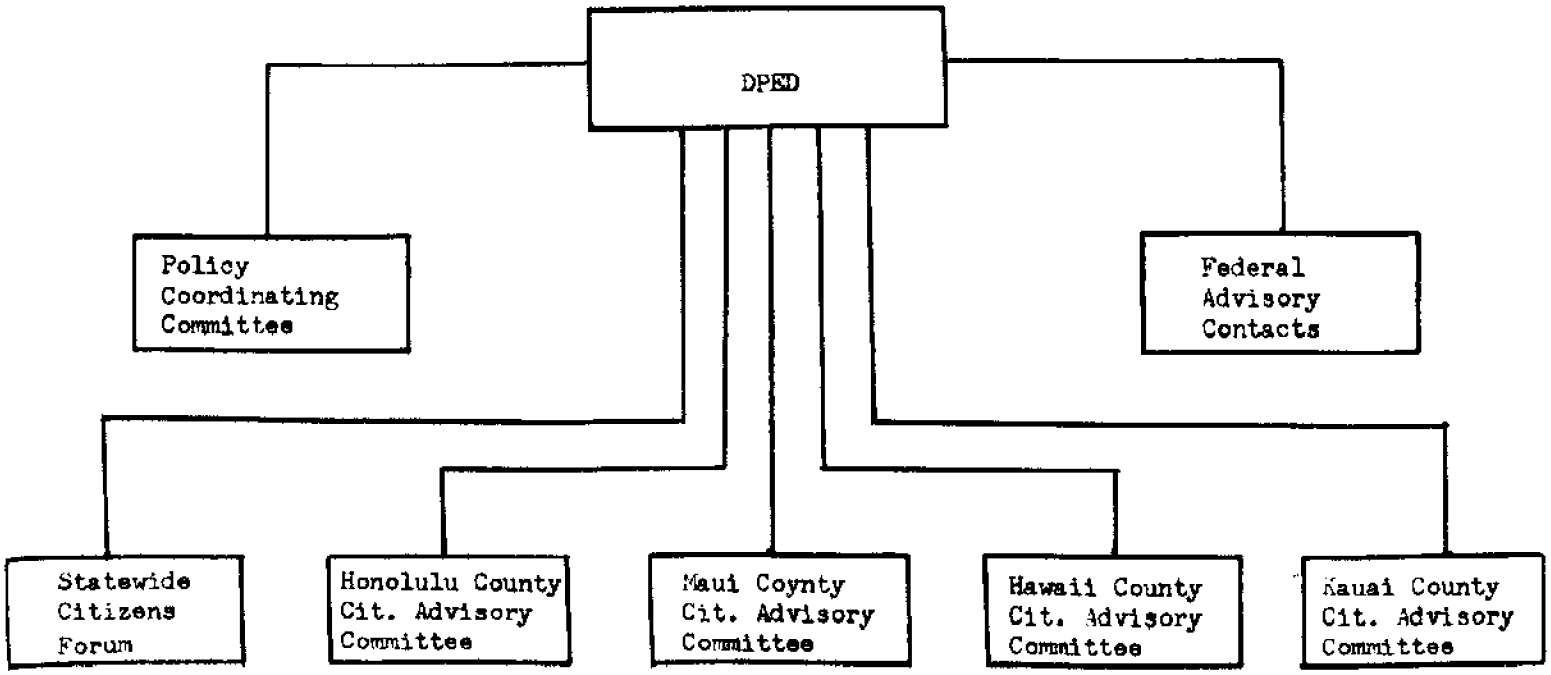
1. Pacific Urban Studies and Planning Program - U of H
2. H. Mogi-Planning and Research, Inc.
3. A. J. Catanese and Associates
4. Dr. Daniel Mandelker
5. Electromagnetic Systems Laboratories, Inc.

IV. Conclusion

I think that the public is not being adequatly represented by the Citizens Forum. It would be hard for say, a president of a large organization or association, to know what a young surfer thinks about the program and its purposes because of difficulty in communication between the people of Hawaii and their government agencies,etc. Most people in the state aren't aware of the Forum meetings, which causes lack of knowledge. I think that the committee should inform more of the citizens, to then get them to all participate in the programs and discussions.

Figure I

Coastal Zone Public Awareness and
Involvement Program Committee
Organization*



Hawaii Coastal Zone Management Program
Statewide Citizens' Forum

Organizations	Representatives
Hawaiian Organizations	
Aloha Association	Dawn Wasson
Congress of Hawaiian People	Douglas Ah Leong
Professional Associations	
Bishop Musium	Dennis Deraney
Hawaii Public Health Association	James W. Morrow
American Institue of Planners	Gerald P. Daly
American Institue of Architects	John McAuliffe, Jr.
American Society of Civil Engineers	Frank Doyle
American Society of Landscape Architects	Tom Papandrew
Public Interest/ Community Groups	
League of Women Voters	Dorothy March
Common Cause	James Shon
Council of Presidents	Donna Duran
Windward Action Group & Resource Center	Ms. Valerie R. Humphries
Conservation/ Recreation Organizations	
The Outdoor Circle	Julia Crane
Audobon Society	Dr. Robert Shallenberger
Sierra Club	Dave Raney
Life of the Land	Carolyn Corrigan
Friends of the Earth	Unlisted
Shoreline Protection Alliance	Douglas Meller
Conservation Council for Hawaii	Charles Burrows
Soil Conservation Society of America	John Bedish
Environment Educ. Association of Hawaii	Sam Casalino
Hawaii Council of Dive Clubs	Dick Van Horn
Labor Organizations	
United Public Workers	George Joy
Hawaii Carpenters' Union	Stanley Ho
Hawaii Government Employees' Association	Mike Y. Miura

Visitor Industry

Hawaii Hotel Association	George Rafael
Ha aii Marine Association	Michael T. Rurey

Estates, Developers, Contractors

General Contractors Association	Kennth Chong
Development Association of Hawaii	Joe Ramia
Home Builders Association of Hawaii	Eddie N. Nagao
Construction Industry Legislative Organ	Jon. T. Eicholtz, Pres.
Amfac Communities	Mervin Gilliland
C. Brewer & Co.	R. L. Herberg
Alexander & Baldwin	Richard Cox
Castle & Cooke, Inc. (Oceanic Properties)	Warren Haight
Bishop Estate	William Van Allen
Campbell Estate	Fred Trotter
Hirano Bros. Ltd.	Jimmy Oshiro
Mike McCormack Realters	Michael Mc Cormack

Business/ Community Groups

Chamber of Commerce of Hawaii	Harold Luscomb
Oahu Development Conference	Aaron Levine
Tax Fo ndation of Hawaii	Randolph H. Lee, Jr.

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Author's name not available to me at this time
Chapter IV - Public Participation

Excerpts from Speech

Aaron Levine
Section - CZM Policy Committee and Citizens' Forum)

* Hawaii Coastal Zone Management Program
DPED 1974-75

ABSTRACT

THE WAIAHOLE-WAIKANE ISSUE

BY
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In this paper we plan to discuss the adequacy of the Shoreline Protection Act and the "Special Management Area" to minimize the amount of negative effects to the marine environment from the proposed development plan for the Waiahole-Waikane area. We will examine sections of the Shoreline Protcetion Act and discuss the problems arising from excluding the Waiahole and Waikane valleys from the"Special Management Area."

INTRODUCTION

Waiahole and Waikane valleys in windward Oahu, near Kaneohe (see map on following page), are located on a flood plain. The valleys have very heavy run-off with a high flood probability. These factors affect Joseph Pao's proposal to develope low-cost housing on his property in this area.

According to Marianne A. Hung, Marine Social Studies Project, Curriculum Research and Development Group, University of Hawaii:

"As Kaneohe Bay curves north towards Ka'a'awa on the windward coast of Oahu, it passes by two ancient Hawaiian valleys called Waiahole and Waikane. By looking at their names, their topography and the remnants of the culture they once supported, we can reconstruct a little of these valleys' distant past. Their names begin with "wai", the Hawaiian word meaning "water" or "sea"; "kane" is both the name of a god and the word for "man". According

to the words of an old chant, "The name of this land is Waikane because it was here that Kane first dug for water for the benefit of Palihli." Waikane can also be translated as the place of "men of the sea". This second name fits well with the meaning of Waiahole-named for the waters which provided an abundance of the "ahole" fish. "

Developer Joseph Pao is planning to build 6,700 low-cost housing units on this land if he can get 1,337 of the acres he owns rezoned from agricultural land to residential land. The homes, he claims, will be available to people with low to average incomes(teachers, firemen, etc.) who need them. If he can get the rezoning approved now, the homes would cost approximately $40,000. This price is way below the actual market value, which is $65,000.

We propose to discuss whether or not Waiahole and Waikane should have been included in the "Special Management Area". We considered three main factors that will hinder Pao if he persists in Building his "Brand New City", flooding, runoff and drainage. In using sections of the Shoreline Protection Act in this report, we found enough evidence to prove that the two valleys need to be under the jurisdiction of the Shoreline Protection Act to maintain its present condition.

Let's look at the firstfactor: flooding.

Most of the Waiahole-Waikane land is not included in an officially proclaimed map stating it as a flood plain area. But, as we have previously stated, the area is in the vicinity of flood plain areas. If Mr. Pao decides to continue his proposed development, his chances of profit are minimized by that fact.

When flood waters pour over urban or surburban areas, there would be very little soil to absorb water. The result would be destruction of homes, businesses (i.e.--his proposed shopping centers) and personal lives. Pao's development would be useless.

According to the Hawaii Environmental Simulation Laboratory(HESL), Waiahole-Waikane's probability of flooding will increase 30% for the 100 year storm in an area where much of Mr. Pao's proposal would be situated.

The HESL reports state that urbanization will cause continued flooding problems. Development replaces vegetated surfaces with roofs, sidewalks and roads and decreases the ability of the land to absorb the rainfall. In this way greater amounts of water will be discharged during a flood. Urbanization also brings roads, gutters, and storm drains that increase the speed with which the water reaches and is discharged in the channels. The combination of these two factors will result in an overflow of the passages carrying rainfall and cause a flood.

The Shoreline Protection Act prohibits "alterations to existing land forms and vegetation except crops,and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of earthquake. " Therefore, if Joseph Pao persists in building his "city", the end result would be a greater chance for floods in the Waiahole-Waikane area, which is not permitted under SPA regulations.

Another factor to be considered is run-off.

Run-off increases the probability of flooding. HESL also claims the heavy runoff rate in Waiahole-Waikane is the second highest in the islands. The max-

imum run-off for the Waikane watershed was 8,800 cubic feet per second for the years 1960 to 1973. Other watersheds of approximately the same size averaged 2000 cubic feet per second. The drainage area per square mile is one of the lowest, and with high floods and slow drainage, we can see that Waikane is a flood plain.

Development in a run-off area replaces vegetative space with roos and sidewalks which shed rainfall, therefore causing more run-off. This results in larger peak flow rates even with the same amount of water discharged.

The Shoreline Protection Act states "that the development will not have any substantial adverse environmental or ecological effect is clearly out weighed by public health and safety." If the Waiahole-Waikane area already has a high flood probability with heavy run-off, the increased peak flow rates would make flash floods inevitable. This in no way is out wieghed by the fact that the public needs low cost housing. The SPA would not allow such developement in this area.

The third factor we must consider is drainage.

The HESL report also states that in order to meet City Drainage Standards, Joseph Pao must re-channel 10,000 feet of streams and replace "currently in adequate bridges." This will cost him approximately nine million dollars. The channelization will keep water from the flood plain, but it will also increase the amount of sediments carried to Kaneohe Bay.

The Shoreline Protection Act attempts to minimize dredging or changing any body of water in any way. With new drainage, if Pao decides to rechannel, a high flood would push rain water,which is fresh water, into the salt water

of Kaneohe Bay, therefore harming the biota and the environment. If the two valleys were included in the "Special Management Area", this would be prohibited.

The Land Use Guidance Policy includes this statement: "land use amendments shall be approved only as reasonably necessary to accomodate growth and development provided there are no significant adverse effects upon agricultural, cultural, environmental, recreational, scenic, historic, or other resources of the area." The Land Use Commision urged that Waiahole-Waikane not be developed. In this report, W/W is not considered reasonably necessary to accodate growth and development.

Governor George Ariyoshi emphasizes development in the Ewa area and concern about over-development in the Windward side. The state doesn't consider Mr.Pao's proposal desirable. It's policy encourages future population growth on Neighbor Islands and to promote diversified agriculture.

Joseph Pao's plan is in disagreement with this policy. The W/W land is not deemed necessary to accomodate growth and development but rather it is better left as is where it's advantage is agricultural.

The people of the Waiahole-Waikane area have fought back by forming an organization called the Waiahole-Waikane Community Association (WWCA). They have prepared a testimony against Pao. They were regarded as the voice of the community at Pao's hearing. The residents feel that the land is best left as farm land because it is among the best on the island.

CONCLUSION

In CONCLUSION we would like to say that the Waiahole and Waikane valleys would be at their best advantage as they are now, agricultural areas. We also feel that the "Special Management Area" should be extended to include the two valleys in order to preserve and protect them from becoming metropoli.

There seems to be no main factor of excellent development since Waikane is labelled as a flood plain. Growth of a "brand new city", as Mr. Pao claims, is without effect if there is danger of flooding, run-offs, and drainage problems. Previous efforts to develope there had been rejected before Pao decided to develope and now once again the same issue over Waiahole- Waikane is experiencing a rebirth.

In analysis, we feel that there is enough evidence to support the fact that Waiahole-Waikane should be included in the "Special Management Area" and protected under the Shoreline Protection Act.

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COASTAL ZONE MANAGEMENT: 1. Erosion of Kaimu Beach 2. Sinking of Kalapana

Richard Okamura and Betsy Iwashita Pahoa High School

INTRODUCTION

The first part of this report tells you about the erosion of sand at Kaimu. The beach has been talked about very much over the past few years. People talk and ask questions about the beach such as: Why is the sand disappearing? How much of the sand has been lost so far? Where is it all going? Is anything being done to stop it? In this report, we hope to answer some of these questions. We also give you some information so you can make your own assumptions.

The second part deals with the sinking of Kalapana. This includes all the sinking before and after the earthquake hit.

We hope that this report helps you gain some knowledge of what is happening to the Puna area of Hawaii. If you don't already know what is being done or what has happened, we suggest that you read it.

Betsy I. and

Richard O.

EROSION OF KAIMU BEACH

Kaimu Beach (formerly known as Kalapana Black Sand Beach), has been eroding away slowly over the years. Studies show that at one time the beach used to be level but as the waves washed away the sand, the beach became more and more slanted. As the beach became steeper, the erosion took place faster.

The sinking of Kaimu Beach land has evidently made a change in the ocean current there. Now the wave pattern favors washing out the sand where before the waves washed sand in from the nearby ancient exploded lava area by Kalapana. Photographs taken in the early 1900's show Kaimu's smooth black sand beach extending much farther out into what is now under ocean waves and a much larger grove of coconut trees.

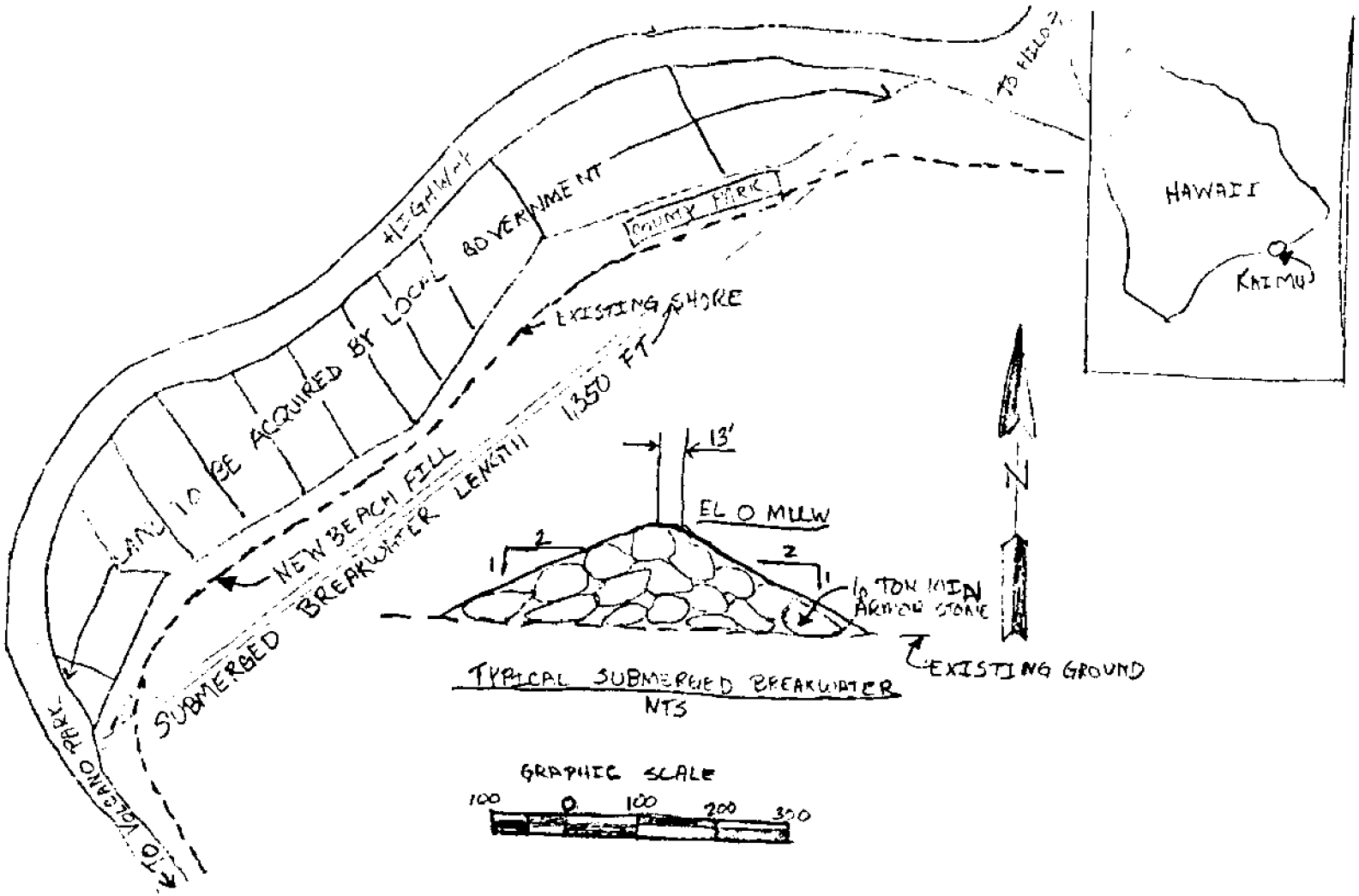
In 1970, a proposal was made to stop the erosion of sand. The plan included the construction of a 1,250 foot-long submerged breakwater across the width of the bay. The breakwater would be built approximately 400 feet from the existing shoreline. It also provided for replacement of a dry beach area of about 100,000 square feet. Altogether, the plan would cost over $83,000.

The breakwater was proposed to help stop or slow down the erosion of sand, but how will they stop the other causes of erosion? Some studies by a group of students showed that the wind was also a factor of the erosion. Will a windbreaker be built to stop the wind? Another factor is the tourists. They come from all over the world to see our famed Black Sand Beach. This is all right, but when they leave, so does some of our precious sand. It's not only the tourists, but also people who own tourist shops. The sand is collected by them and sold to these tourists. The same thing is happening to our Green Sand Beach. People should stop taking sand before it's too late.

EROSION OF KAIMU BEACH AFTER THE EARTHQUAKE

For a long time, Kaimu Beach had been eroding away slowly. Now that an earthquake has caused the land to sink about 3 feet, the beach is eroding away faster than ever. Records of the amount of sand being lost were being kept about 5 months prior to the quake. It was estimated that over the 5 month period there was a total amount of 2½ feet of sand lost. The profiles of the beach also showed that while one part of the beach was eroding away, the smaller part of the beach was slowly growing. This may have been caused by a shoreline current that carried the sand from the larger beach and deposited them on the other side of the beach.

Now, after the quake, the same thing seems to be happening to Drainpipe Beach. While sand is eroding from Kaimu, Drainpipe Beach is slowly growing.



KAIMU BEACH

PROPOSED KAIMU BEACH EROSION CONTROL PLAN-The U.S. Army Corps of Engineers has proposed an erosion control plan for the Big Island's famous Kaimu Black Sand Beach at Kalapana, Puna. Under the plan (shown above), a 1,350 foot long submerged breakwater across the bay would be constructed and 100,000 square feet of dry beach area would be developed. The County, in the meantime, is acquiring the lots behind the beach for expansion of the park.

Corps of Engineers Sketch

A 1968 report said that Drainpipe Beach was a shingle beach. (A shingle beach is a beach that is more pebbly than most beaches.) Now this beach, which was covered with fine sand before the quake, is either being replaced or covered by coarser sand, the same grain size and color as the sand that is being washed away from Kaimu. The sand is believed to be coming from Kaimu Beach on a longshore current.

Also along this shoreline is a sand deposit of the same type of sand. This may be where the disappearing sand from Kaimu has been going all these years. There is a similar deposit on the other side of the bay. No one knows exactly how large this deposit is, but it must be fairly large because there are no peices of coral sticking out of the sand.

The erosion of sand before the earthquake was slight, but now the quake has speeded up erosion so fast that soon there won't be any black sand beach. Maybe Drainpipe will be our future black sand beach. If the sand keeps moving to the beach we won't lose the beach, we'll just have it moved.

BREAKWATER PROJECT DELAYED

The breakwater project has been delayed because of some drastic changes which have taken place. There may have to be a new survey and modification of the existing erosion control plan (breakwater project) for Kaimu Black Sand Beach.

The Kalapana area has sunk about three feet and the tide pattern has dramatically changed as a result of the two earthquakes which hit the Big Island on November 29, 1975. Although the Kalapana area has sunk about three feet, the breakwater might still be appropriate for the sand erosion problem. A proposal was made to call a moratorium on the breakwater project saying that the county would be just pouring money down the drain. It was suggested that the money be spent to build a road mauka of the Kaimu Black Sand Beach.

Acouncil request was made to ask the Senate Appropriations Subcommittee on Public Works in October to set aside $456,000 to begin construction on the Kaimu Beach erosion project (breakwater). The U.S. House and Senate conference committee has approved $800,000 for "small beach erosion" control projects in the country in 1976.

This building of sea walls to bolster Kaimu would (as you can see) be costly and probably temporary measure, for there is every likelihood that the land will continue to sink and the sand to erode away as a result.

SINKING OF KALAPANA

Kalapana, located in the Puna district of Hawaii, is sinking slowly due to a major earthquake that shook the island of Hawaii on November 29, 1975. Studies show that the entire island of Hawaii has been sinking at a rate of four millimeters a year (about four-hundreths of an inch). Prior to the quake, Kalapana had already been sinking at a rate of 1½ inches per month. The quake has just accelerated the sinking. Now the area is sinking at about 3 inches per month. "The major changes have already taken place during and right after the quake, but smaller changes will continue for some time." The quake has caused Kalapana to sink 3-5 feet in several places. In spite of the sinking of some portions, other parts have been actually rising. The sinking between Kaimu Beach and Queen's Bath, which has dropped by at least three feet, has been the most noticeable since about 300 people live in that particular section.

After the initial subsidence, which dropped the Kaimu and Kalapana beach lines as much as three feet, changes were found to be in the range of three to four centimeters (slightly more than an inch to just over an inch and a half) every couple of hours, then two centimeters (less than an inch) in two days, and at an even smaller rate a few days later.

In the bay area of Kaimu, there has also been some changes. Some places on the ocean floor has risen 3 feet wile other places have sunk 11 feet or more. The pinic area has sunk completely. The beach area is almost completely covered at high tide except for the crest of the beach. Where there used to be a marker before at Kaimu, the land has sunk about 4 feet. It once was 12 feet above the mean low water level (lowest water level for the year), but now a conservative estimate is only 8 feet above the mean low water level. This proves the drop.

SLIPPING SEAWARD

It is safe to assume that the slippage has been going on continuously for some time, with sudden large movement during and after major earthquakes. Prior to the November 29 quake, the Kalapana area had been moving toward the sea at a rate of about 1.5 inches a month. Following the huge slippage on Nov. 29, the area has continued to move seaward at a rate of about 3 inches a month. The area will probably continue to slip at least at the rate prior to the earthquake, even when aftershock activity has ended.

The slippage is continuing because of the injection of magma or molten rock, into the rift zones and into crack systems in the area makai of the rifts. The rifts and cracks are being "pried apart" by the magma, which is causing all the land makai to slip.

CONCLUSIONS

The erosion of sand has been taking place for many years. The earthquake has definitely increased the erosion. Before the quake, surf, wind, and tourism were the major factors of erosion. The quake is going to cause the beach to disappear completely in a few years or less if the waves that cover the beach

now, continue to take the sand away. The sand that is missing has been found under the water in the bay area, and also it seems to be riding the longshore currents to another beach directly outside the bay. Although a breakwater was proposed to help stop the erosion, nothing has been done about other factors. In event of the earthquake, the project has been delayed until new information is received.

The earthquake has caused a great deal of sinking in some Kalapana areas. It has also caused some places to rise as much as 3 feet. The area had sunk 3-5 feet during and right after the quake. Now it sinks at a smaller rate every day. The sinking probably won't stop for a long time, and maybe some day soon, the residents will have to be evacuated permanently.

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LAW OF THE SEA

ABSTRACT

"Social Considerations in
Precious Coral Mining in Hawaii"

by
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In this paper we will explore precious corals. These corals are bringing in big profits for the precious coral industry. It will discuss the ownership and control over the corals and the kinds of corals there are. Certain questions that we had about the corals are brought up in this report.

Right now there is no law regulating harvesting corals. In this report, we confide suggestions by CORMAR (represented by Richard W. Grigg) on the development of regulations governing the precious coral industry.

INTRODUCTION

Precious corals are colored corals wanted by man. They are found in the deep ocean which takes skilled divers to get it. The main use of it is to make beautiful jewelry which is manufactured and sold here in Hawaii. But, if people aren't cautious of how they harvest it, the corals will begin to disappear.

When you actually think about it, there are many questions that could be brought up about precious corals. Such questions are: What kinds of different precious corals are there? Where is it found? Who produces it? Who owns it? What is being done to save it from too much harvesting?

Precious corals are mainly found in the Western Pacific Ocean where 95% of the world's catch is harvested. They are found at depths of 1,200 - 1,400 feet below sea level. One would most likely find it in clear waters because even a thin layer of sedimentation on the water could kill it.

Black coral is the most common of precious corals. At one time, there was more black coral than demanded for. They are found 30 - 40 meters deep at a number of places in the Pacific. There has been a black coral industry in Hawaii for some time producing good results.

Not much is known of black corals' quantity and quality outside Hawaii. In Palau, there is a small factory which produces crude

blach coral jewelry. The coral used seemed to be of very good quality. So, one would wonder why such good coral is used for this kind of jewelry.

Gold and bamboo coral also exist along the Hawaiian chain. Hardly anything of its existance is known outside the Islands. These seem to quite scarce and perhaps more valuable than the other corals. There is a bed of gold coral off Keanu point and Koko Head. Fern black coral, when polished, is similar to gold coral.

Pink coral is another major group of precious corals. It was first discovered in Hawaii in 1902 by an exploring expedition on the Albatross (a U.S. vessel). Not much dredging occured till the mid-1960's when two huge beds were located among the Islands.

Pink coral of high quality were found among Palau Islands. Also, in the Molokai Channel, Dr. Vernon E. Brock and Dr. Theodore C. Chamberlin found a bed of pink coral. Since pink coral is not as common as black coral, industries depend on import. These corals cost about $10 - $50, depending on size, state and color.

About 1959, a precious coral industry was built. It is now located across Ala Moana Shopping Center. Because of the steady rise in tourism, the industry has grown since then, with profits getting higher each year.

In 1970, an investigation was conducted by the University of Hawaii. They were to establish and independant coral industry in Hawaii. Local people became more involved with the industry when it was backed up by the research program at the University.

Presently, no one owns the precious corals. Its hard to get and costs money just to dive for it. Because of this, there is only a handful of divers in Hawaii. For them, there is no regular diving season. It all depends on good weather.

Presently, the corals are under the "Common Heritage Idea", as explained in the following statements by George Kent:

> "Traditionally, all oceanic resources has been understood as either res nullius or res communis. Res nullius resources are understood to be no one's and subject to appropiation. Res communis resources are understood as being anyone's, and not subject to appropiation. They are equally accessible to all, available for anyone's use. Under res communis, resources belong to those who first use or take them. Fish taken on the high seas, for example, are res communis reosurces. They are public goods like the air, or like highways or parks or open pastures which anyone may use freely. Both res nullius and res communis are very different from the common heritage, by which some resources should be regarded as everyone's, and subject to their joint management."[1]

The daily harvest ranges from 0 - 100 pounds. In 1966, they were selling for $5 per pound. Then, prices started rising. In 1968, the divers and buyers compromised to prices of no less than $7.50 per pound. They hope that this way there will be no surprising increase of prices in the near future. At that time, they should have also changed the way of dredging because alot of people use tangle nets which kill the smaller corals.

To help save these corals which is in great demand, there is CORMAR (Coral Reef Management and Research). CORMAR's project is

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[1]George Kent, The Common Heritage Idea, page 1.

to provide information relevant to Coastal Zone Management. Since they have no governmental power, it's up to agencies like State Division of Fish & Game and the Department of Land & Natural Resources to make use of the information.

Richard Grigg is an active member of CORMAR and has done a lot of study on precious corals (mostly on black and stony coral). The growth and maturity rate of these corals take 50 years which is quite some time. With this fact, and also the number of black and stony corals harvested and sold, Grigg came up with reccomendations to State Division of Fish and Game. These reccomendations are to get appropiate regulations and better permit systems.

The reccomendations include: Banning harvest of black coral colonies (Antipathes grandis and Antipathes dichtoma) less than four inches tall; certain white corals (Pocillopora meandrina) less than six inches wide; and pink coral (Corallium secundrum) less than ten inches high.

There are no set laws for precious coral, but there is a recommended policy for the government:

> "Government Policy - The State should assist in the management of coral beds by regulatory measures. Once the coral fishery has become competitive control of entry and fishing effort may be necessary. Regarding the legal aspects, the Department of Interior should be urged to include precious coral as a certain creature of the Continental Shelf. In addition, if extensive beds are discovered in areas which geologically form part of the Hawaiian Archipelago but legally are excluded from the Continental Shelf, clarification of ownership will be necessary."[2]

If the government follows this policy, they should also put in

taxation. As of now there is no law for it at all. We think they should at least put a 4% tax on all corals caught. This way, it may discourage them from catching toomuch.

SUMMARY

Right now, the State needs rules and regulations governing the usage and control over precious corals. If the State doesn't soon begin to regulate this resource, there may be very few corals left.

CORMAR seems to be a good research group. However, they should try to coordinate their efforts with State governmental agencies like State Division of Fish & Game and the Department of Land & Natural Resources. CORMAR did alot of research and came up with good reccomendations on how to preserve the precious corals. If these reccomendations are followed, then the precious corals could be saved. Let us all do what we can to save these precious corals.

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ABSTRACT

THE COMMON HERITAGE OF OFF-SHORE OIL

BY
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This paper describes the idea of "Common Heritage" in respect to off-shore oil. It discusses the current international policies and claims of undersea oil exploitation.

The first chapter describes the geological location of the oil. Chapter II explains technological developments in off-shore oil exploitation. Chapter III discusses the importance of off-shore oil, now and in the future. Chapter IV discusses existing management by coastal states of off-shore lands.

INTRODUCTION

The idea of "Common Heritage" is the sharing of the ocean's resources beyond national jurisdiction with all countries of the world. The more technologically advanced countries were to mine the resources and put them into an international pot. The resources were then to be allocated to the different countries according to their needs, especially developing countries.

But the developing countries want the resources to be divided among coastal states for 200 mile state jurisdictions. By doing this, about 90 percent of off-shore oil would come under national, instead of international jurisidction thereby defeating the idea of "Common Heritage".

Off-shore oil and natural gas are currently the most important economic resources. This paper will be based upon the importance of off-shore oil now, and in the future. Today, the majority of oil which we consume comes from land oil deposits. Much of it comes from the Middle East. But the Middle Eastern countries, particularly the Arab states are taking advantage of the oil shortage by greatly increasing the prices of oil, thus making themselves a great profit by strangling the consumer countries' economies. The United States is rapidly depleting its land oil reserves and is beginning to rely greatly on imported oil from the Middle East and limited amounts from South American countries. With the Arabs making countries pay such exorbitant prices for the oil, the United States has a choice to either pay those prices, look for another energy resource, or start exploiting off-shore oil reserves. Scientists have discovered off-shore oil deposits in the continental shelves off the United States coast but we have not made much exploitation of these reserves because of the cost. But with the world supply of oil depleting, the land reserves exhausted, we must now turn to exploiting the off-shore oil.

Already, off Louisiana, and the California coast, American petroleum companies have, in operation, off-shore oil drills and in the near future more off-shore drilling is planned. Not only the United States but other countries are also beginning to exploit off-shore oil. Under the North Sea, are large reserves of oil which the Dutch and British are exploiting.

There were some debates as to who actually owned what on the ocean floor. In the third United Nations Law of the Sea Conference, three committees were organized to handle the exploitation of the seabed resources. Committee I was to work out the character of the seabed regime and its machinery. Committee II worked out the rights and responsibilities of states in different zones of the sea. Committee III developed rules to protect the ocean environment, scientific research, and the transfer of technology.

GEOGRAPHICAL ASPECTS

The sea-bed covers more than 70 percent of the earth's surface. It consists of some of earth's deepest valleys, highest peaks, and the largest mountain ranges, including volcanoes not always fully extinct. The sea-beds' geological composition varies widely: from the continental crust areas of the shelf and the slope, which are essentially similar in formation and composition to the adjoining lands and contain many of the same resources, to the area of the deep sea floor, which belongs to a different layer of the earth's primordial matter.

The top, or sialic layer of the earth's crust is confined to the continental areas and immediate environment. The composition of the sialic layer is largely of granite, but they also consist of sedimentary deposits laid down at later times.

Beneath the sialic layer, is the simatic layer, which encirlces the whole of the earth, including the floor of the deep sea. It consists largely

of basic magmatic rocks, often covered with a thick sediment of silt, including the red clay that covers part of the oceans, sand, volcano dust, plankton, shells, teeth, and bones of sharks and whales. This simatic layer probably contains great quantities of minerals such as nickel, cobalt, platinum, and copper. However, it is unlikely to contain the sedimentary rocks, in which gas, coal, and other organic deposits are found. Here, therefore, the resources of greatest interest lie upon rather than below the bed.

The geological character of these areas varies widely. Much of what we now call the continental shelf was dry land during the latter part of the lee age that is within the last 100,00 years. At that time, the sea sank two or three hundred metres because of the formation of glaciers, and subsequently rose again. It is largely for this reason that the shelf area is so rich in resources. The existence of plant and animal life in this period, and the weathering that the shelf underwent when the area was dry, were responsible for proclaiming some of the organic materials beneath the sea which are not so valuable to us, especially oil and natural gas.

The resources of the ocean can be classified in a number of ways: according to origin and method of formation or according to their composition are two.

Although manganese nodules may eventually prove to be the most important of the riches of the sea-bed, it is when we turn to the resources below it, that we discover those that are at the present, of the greatest economic significance. Some resources beneath the sea have been exploited for many years. Coal and iron are mined from beneath the sea through shafts sunk on land in England, Japan, Newfoundland, and Finland: about 30 per cent of Japan's coal now comes from beneath the sea. Salt and sulphur are obtained from the caps of salt domes in the Gulf of Mexico. Fresh water is pumped from beneath the continental shelf to supply many communities on the southeast

coast of the United States.

However, we are concerned mainly with oil and gas. Their extraction is, of course, economically feasible. They have been produced from beneath the sea for over a quarter of a century, during which time underwater operation has shown a spectacular growth.

Some oil was taken from wells in shallow waters off the coast of California in the last century. The first underwater oil drilling took place in Venezuela in 1923. However, to all intent and purposes off-shore drilling began only at the close of the second World War, when large new reserves of oil were found beneath the Gulf of Mexico. There off-shore production began on a large scale though usually in comparatively shallow water, less than 30 metres in depth, and remained at first only a small proportion of the total. In 1950 it was only about 3 per cent; even in 1960 it was still under 10 percent. Today it is over a fifth of all oil production and is expected to be over a third by the end of this decade. By the end of the century the greater part of oil production may be from beneath the oceans. There are already indications that there is more petroleum beneath the sea than on land. Production from off-shore sources increased sixfold between 1960 and 1969 and off-shore expenditure is increasing at present by 18 percent per year.

Similar developments are affecting production of gas. Indeed, the rate of growth is in some ways even more spectacular. Because gas and oil are both hydrocarbons derived from similar organized material they are often found in similar locations. A number of the areas where under-sea oil has been found in recent years, in the North Sea, in the Persian Gulf, and elsewhere, have also proved to be large sources of natural gas. Some of the undersea gas fields, such as the Gronengen field off the Netherlands in the North

Sea, are among the largest gas fields known anywhere: the Gronengen field alone is said to contain 40 billion cubic feet of natural gas. United States off-shore gas reserves are estimated at 200 trillion cubic feet. Off-shore gas production in the United States doubled between 1960 and 1965 to nearly 1,000 million cubic feet, and has more than doubled again since. Total world production of natural gas is expected to triple within the next decade, and a substnatial part of these supplies will be presented by undersea gas.

So far, most off-shore production of both oil and gas has been within the continental shelf itself, mainly in depths of under 100 metres. The deposits exploited have largely been in areas adjoining others known on land: the Gulf of Mexico, the Persian Gulf, and off the coast of California. But as exploration intensifies, as the demand for oil increases, and as the technology of off-shore production improves, exploitation is taking place at greater depths.

Although in 1960, most off-shore production was in depths of 30 metres or less, today much takes place at 100 metres and more. Exploration or "wild-cut" wells today are often at depths up to 200 metres, and have been sunk at nearly 600 metres (for example, off the California coast). During geophysical reconnaisance, work shallow core holes have been drilled in waters as deep as 1,500 metres. Production may even take place as deep as 500 metres, well beyond the average physical continental shelf, in the next few years.

It is known that oil exists well beyond the edge of the continental shelf, at least to the edge of the continental margin. A drilling in August, 1968, part of the Deep Sea Drilling Project sponsored by the National Science Foundation in the United States, found traces of oil and gas as deep as 3,500 metres in the Gulf of Mexico. At least in relatively small oceanic basins not too far from the land, there are good chances that oil may be found

even beneath the abyssal plain of the deep ocean. One study has concluded: "Becase of mans' limited knowledge, no definite seaward limit for the existence of petroleum deposits can be inferred at this time, and it is not impossible that small portions of the abyssal floor and oceanic trenches may have some potential."

TECHNOLOGICAL ASPECTS

Until recently (the past half century), there was not much technological advancement in off-shore oil drilling. The U.S. started offshore oil production off Louisiana in 1938. The off-shore oil reserve at that time, located off the coasts of Louisiana, Texas, and California was estimated at 14 billion barrels. Presently, United States off-shore wells produce almost 608 million barrels annually. To drill the off-shore oil, oilmen use portable drilling platforms which are towed to the site. Then spuds (legs) are lower until they rest on the sea bottom. This oil rig can operate in waters of up to 100 feet deep and can drill to a depth of 20,000 feet. The platforms also have air-conditioned living quarters for its 45 man crews. In 1971, the United States was the leading oil producing nation in the world producing 3 and one half billion barrels with the Soviet Union producing 2 billion, 800 million barrels.

By 1971, more than 16,000 wells had been drilled in off-shore federal lands. Of these, about 10,000 wells are still producing 616 million barrels of oil and 3.8 trillion cubic feet of gas. This is about 17% of the total amount of oil produced by the United States in 1971.

The United States as of 1971 had the most advanced technology to drill off-shore oil. To locate oil, a system called seismic surveying is used. In a seismic survey, an energy source is used to generate sound waves, which are reflected and refracted by the underlying geologic material. The echoes

are picked up on hydrophones and are recorded on magnetic tape. These data are used to prepare cross sections of the subsurface structure in the area being surveyed. Combinations of cross sections can be used to obtain a three dimensional picture showing the location of geologic structures of the type known to be favorable for the accumulation of oil and gas.

Methods of Drilling

Drill ships such as the Discoverer III can drill in water depths of 600 feet or more and can move from one place to another without the assistance of a tug. (See Figure I)

Jack-up rigs are platforms with legs that can be moved up and down. When the legs are extended, the platforms can elevate itself above water. When legs are retracted, it floats and can be towed by tugboat from one location to another. Jack-ups can drill to a depth of 350 feet (See Figure II)

Semi-submersibles are one of the newest and most advanced drilling rigs developed by the United States. They are positioned with mooring systems. A semi-submersible can operate up to a depth of 2,000 feet but are being developed to drill at any depth.

These three examples indicate that the U.S. is technologically advanced in the production of off-shore oil. And its off-shore oil production (616 million barrels annually, 1971) is the largest in the world. (See Figure III)

OFF-SHORE OIL PRODUCTION - PRESENT AND FUTURE

The following figures indicate off-shore oil reserves as of 1973.

Location	Oil	Gas
Artic Island	0	12
Alaska	.5	2.0
California	4.2	0
Texas	.1	2.5
Mexico	1.9	0
Peru	.1	1.0
North Sea	12	64
East Canada	0	10
Louisiana	5.3	35
Venezuela	35	26
Tobago-Trinidad	1.3	4.0
USSR	1.5	1.0
W. Africa	4.7	0
Persian Gulf	87	250
Southeast Asia	2	35
Australia	3	22
New Zealand	0	20

Oil in billion barrels, gas in trillion cu.ft. This table indicates that as of 1973, the Persian Gulf has an enormous amount of off-shore oil and natural gas waiting to be exploited. Also Venezuela has a large amount of oil and gas.

Lewis G. Weeks, farmer chief for Exxon and a past president of the American Association of Petroleum Geologists, estimates potential ultimate production of petroleum liquids and gas off-shore to a water depth of 1,000 feet to be equivalent of 1,550 billion barrels of oil.

In 1972, approximately 9.1 million barrels of oil were produced off-shore. This was about 18% of the total worldwide oil production.

Three off-shore areas produce more than 500,000 barrels a day - Venezuela (2.4 million), the U.S. (1.8 million) and the Persian Gulf (3 million). The North Sea is expected to become a major off-shore source of petroleum. In 1971, North Sea prodcution was 61,000 barrels a day. By 1985, it is estimated that the daily rate will be 3.7-4.9 million barrels.

It is anticipated that worldwide off-shore production will continue to increase, and by 1980 account for 25-42 percent of total worldwide production. This would acquire a daily production rate of 25-35 million barrels as compared to the 9.1 million barrels produced daily in 1972.

Existing Juridical Regimes

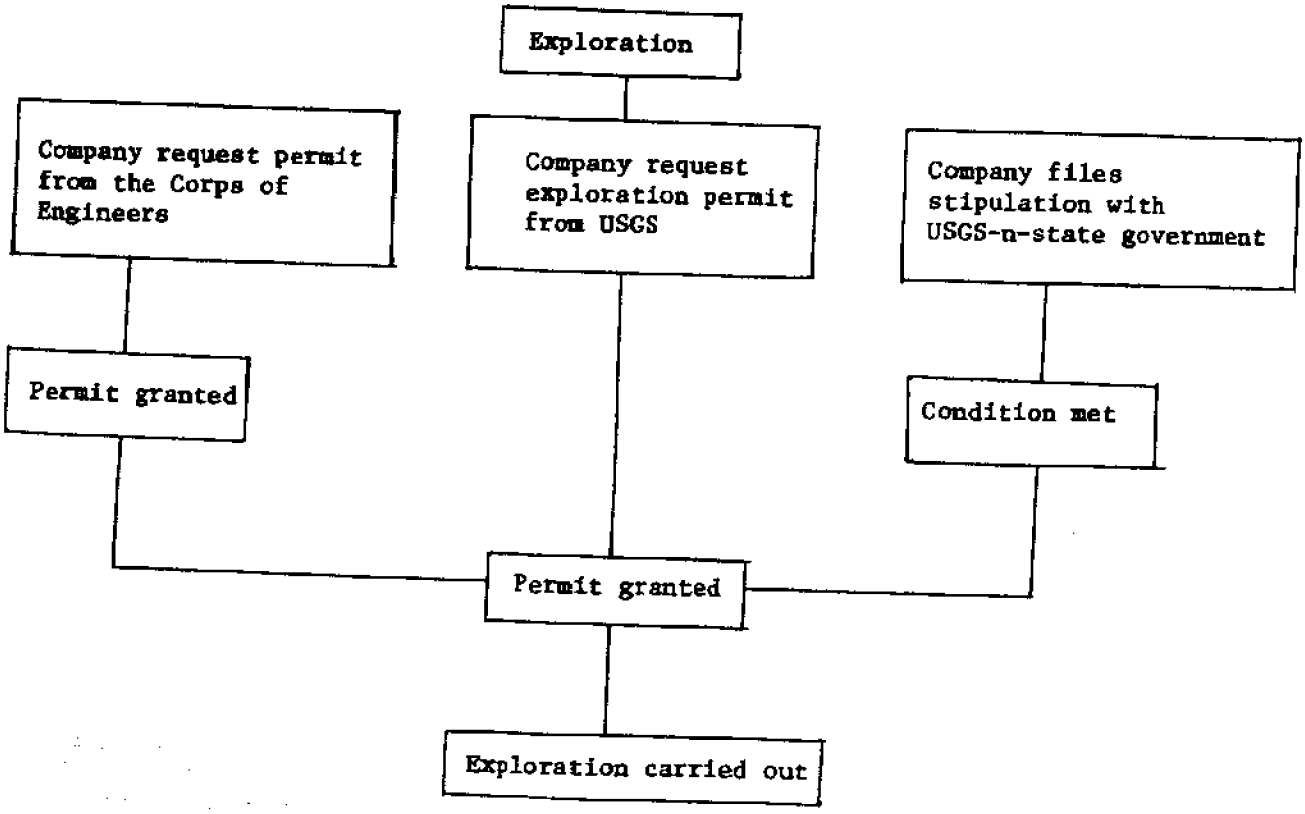
National jurisdictions in the oceans are based on two criteria: (1) codified international law particularly as expressed in the fourth Geneva Convention of 1958; and (2) customary international law as it has evolved over the years. In general coastal states exercise sovereignity over a territorial sea up to a maximum distance of twelve nautical miles from their coast, subject only to the right by foreign vessels to innocent passage through territorial waters. At present, some fifty-five countries claim twelve miles, forty-six claim breadths between three and twelve miles in extent of which more claim two hundred miles (refer to table III.) and those countries claiming less than twelve miles as the breadth of their territorial sea, twenty-four exercise jurisdiction over fisheries in the zone between the outer breadth of their territorial waters and the twelve mile limit off their coasts.

A second off-shore boundary is that on the seabed. According to the Geneva agreements, a coastal state exercise sovereign rights for exploring and exploiting the natural resources fo its contimental shelf extending out to the two hundred meter isobath (657 ft.) or beyond "to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas" (refer to United Nations Conference on the Law of the Sea: Convention on the Continental Shelf, UN Doc. A/CONT.13/55 (1958), Article 1.)
To date no country has claimed jurisdiction over the seabed beyond the two hundred meter depth on the grounds of its ability to exploit the resources, but the times for such claims may not be far off if one country demonstrates its ability to exploit to a depth, say, of one thousand meters, and thus justifies

its claim to jurisdiction to that depth, presumably all other states would have the right to extend their control to a similar depth off their own coasts.

Beyond these boundaries of national jurisdiction are the high seas which are free to the use of persons from all countries. Freedom of navigation, overflight, fishing, and scientific research are features of the high seas, with such profits as are involved increasing to those who carry out the operations. These freedoms, obviously, are of particular benefit to states with well-developed maritime industries which can utilize the oceans to the best advantage. For many of the developing countries high seas freedoms may be viewed as being to them of only limited advantage.

Table IV. Chart of U.S. Exploration Procedures



USGS - U.S. Geological Survey

Table 1

Basic Facts about the Ocean and Its Floor

Total Surface of the ocean:	360 Million km^2 (or 71% of the earth's surface).
Average depth of the ocean;	3,795 m
The area with depths between 4,000 and 5,000 m represents 36%of the ocean floor surface.	
Total volume of the ocean:	1,370 million km^3
Continental Shelf (0-200m)	8% of the ocean floor
Continental Slope (290-2,440m)	11% of the ocean floor
Area to 2,000 m isobath	16.3% of the ocean floor
Area to 3,000 m isobath	24.8% of the ocean floor
Continental Margin	21%of the ocean floor
Abyssal Plain (2,440-5,750m)	79% of the ocean floor
Deep sea trenches is (more than 5,750)	3%of the ocean floor
The deepest trench= is the Mariana Trench in the Pacific	11,394 M

Table 2

Minerals from the Sea Annual Production

(Value in Millions of U.S. Dollars)

From Sea Water	
Salt	172
Magnesium Metal	75
Fresh Water	51
Bronium	45
Magnesium Compounds	41
Heavy Water (D_2O)	21
Others(Potassium, Calcium Salts, Sodium, Sulphates)	1
Total Value from Sea Water	412
From Sea Floor (Surface Deposits)	
Sand and Gravel	100
Shell	30
Tin	24
Heavy Mineral Sands (Ilmenite, Rutile, Zircon) Garnets, etc.	13
Diamonds	9
Iron Sands	4
Total Value of Surface Deposits	180

Table 2 Continued

From Sea Floor (Sub-Surface Deposits)	
* Oil and Gas	6,100
Sulphur	26
Coal	335
Iron Ore	17
Total Value of Sub-Surface Deposits	6,478
Total	7,070

*Main Topic

Summary

The states of the world are facing a time of rapid change in the rules and arrangements relating to the control of ocean resources. The old regimes, based on the principle of maximizing the freedom of the seas, are fast disappearing, despite the best efforts of the developed maritime powers to hold the trend. But opposing the drive toward expansion of coastal state jurisdiction to include virtually all the valuable resources of the world's off-shore waters are the interests of many of the land-locked and shelf-locked states. All these, together with the dozen or so major maritime powers which border on the open ocean, may be able to effect some sort of compromise between conflicting interest at the forthcoming Law of the Sea Conference. Only through the use of flexibility and skillful bargaining can there be any hope of viable and acceptable new regines energing from the Conference which will permit the continued and orderly development of ocean resources through the years ahead.

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THE SAN DIEGO LAW REVIEW
LAW OF THE SEA VII

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University of San Diego
pp. 655-664

ABSTRACT

HAWAII AND THE ARCHIPELAGO DOCTRINE

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One of the most important issues facing the Third United Nations Conference on the Law of the Sea is the "archipelago doctrine" forwarded by nations such as Indonesia, Phillipines, and Micronesia. In this paper we will discuss the archipelago concept and the potential effect it could have on the State of Hawaii, should the claim be made. We will discuss the benefits Hawaii could receive if it were to declare the archipelago status and also look at the view the United States has on this issue.

INTRODUCTION

There have been three law of the sea conferences held in the past. The First UN Conference on the Law of the Sea was held in Geneva, 1958. The Second UN Conference on the Law of the Sea was held in 1960, and the third was held in 1973, which opened in New York.

The main objective of the UN law of the sea conference is to determine the ownership of the oceans. The decision on an international regime is urgently needed, but due to the difficulty on reaching agreement, the process has been considerably hindered. Difficulties such as rich nation vs. poor nation, Communist vs. non-Communist, and distant-water fishing vs. coastal fishing etc. all affect the countless points of views.

At the beginning of the Third UN Conference on the Law of the Sea, many issues were still undecided upon. After the ten week summer session in Caracas, it was quoted by the conference president, Ambassador H. S. Amerasinghe of Sri Lanka, that there was "no agreement on any final text on any single subject or issue..."

The major work of the Conference took place in formal and informal meetings held within the three committees. Committee I produced articles dealing with an international seabed authority and a body of rules. Committee II produced articles covering a wide range of sea-law issues, from the territorial sea, the proposed economic zone, the rights of landlocked countries and the special problems of archipelagos. Committee III produced articles concerning the preservation of the marine enviroment, anti-pollution rules and rules governing marine scientific research.

(Article subjects taken from The Oceans and Seabeds.)

In this paper,we would like to look at the single issue concerning the "archipelago doctrine" because of its effect on Hawaii. The definition of the words "archipelagic state" and "archipelago" are defined by the Informal Single Negotiating Text Part II, Article 117;2.

a) "archipelagic State" means a State constituted wholly by one or more archipelagos and may include other islands;

b) an "archipelago" means a group of islands, including parts of islands, interconnecting waters and other natural features which are so closely interrelated that such islands, waters and other natural features form an intrinsic geographic, economic and political entity, or which historically have been regarded as such.

The proceedure in which an archipelago is formed is stated in Article 118 of the Informal Single Negotiating Text Part II.

1. An archipelagic State may drew straight baselines joining the outermost points of the outermost islands and drying reefs of the archipelago provided that such baselines enclose the main islands and an area in which the ratio of the area of the water to the area of the land, including atolls, is between one-to-one and nine-to-one.

2. The length of such baselines shall not exceed 80 nautical miles, except that up to ... per cent of the total number of baselines enclosing any archipelago may exceed that length, up to a maximum length of 125 nautical miles.

Countries such as Indonesia, Phillipines, Micronesia, and some others, supported the"archipelago doctrine". United States, on the other hand, being a major maritime nation, opposed the doctrine. The reason for this being that if countries such as Indonesia, Phillipines and Micronesia, were to get the archipelago plus the 200 mile economic zone, a large portion of the oceans would no longer be regarded as international. This could possibly mean that United States' passage through these parts of the waters and air would no longer be possible. As stated in Article

120. Informal Single Negotiating Text PartIII.

1. The sovereignty of an archipelago State extends to the waters enclosed by the baselines, described as archipelagic waters; regardless of their depth or distance from the coast.

2. This sovereignty extends to the air space over the archipelagic waters, the bed and subsoil thereof, and the resources contained therein.

The question of the United States' opinion of opposition has been argued by the people of Hawaii. We will discuss the many benefits Hawaii will receive if it were to gain the archipelago status. Benefits such as the access to the unique seabed minerals, the fish and the precious corals. Even the United States' opposition can be argued with the provisions made in Article 124 of the Informal Single Negotiating Text Part II;nos. 2 and 4

2. Ships and aircraft of all States, whether coastal or not, shall have the right of archipelagic sealanes passage in sealanes and air routes through the archipelago.

4. Such sealanes and air routes shall traverse the archipelago and the adjacent territotial sea and sahll include all normal passage routes used as routes for international navigation or overflight through the archipelago, and, within such routes, so far as ships are concerened, all normal navigation channels, provided that duplication of routes of similar convenience between the same entry and exit points shall not be necessary.

The next law of the sea conference will be held on March 29, 1976. There isn't very much time left for the people of Hawaii to claim the archipelago status before the conference begins. Dr. Athelstan Spilhaus has been quoted, urging the people of Hawaii to "declare archipelago status, do it before the law of the sea people declare laws on sovereignty over the sea areas. Never mind what the U. S. government will say. They will probably back you up."

AN ARCHIPELAGO CLAIM FOR HAWAII

A. Historical

B. Cost/Benefits

Historical

Hawaii's claim for the archipelago status falls under three main catagories, The first being historical, the second being geographical, and the third being economic.

The historical claim Hawaii can make refers back to the sovereignty rights which have been reconized in the past. King Kalakaua has demonstrated the power of the states jurisdiction over the seabed in the years 1887, 1888, and 1890, by signing his name to legislation which enabled the installation of sub-marine telegraph cables on the seabed between Hawaii and Kauai.

Crown lands transfered from territory to state during the past. Except for the federal governments holdings on military bases, the jurisdiction of the other Crown lands stayed with the state.

The geographical aspect of the archipelago doctrine is whether to claim archipelago plus a 12 mile territorial sea,or archipelago plus a 200 mile territorial sea. If Hawaii should happen to be forced to go by the water to land ratio of 9 to 1 then it would fit perfectly. If Hawaii isn't then we would gain more water space. We calculated we would have 144,000 square miles with the 12 mile territorial sea. With the 200 mile territorial sea we calculated we would have 6,000,500, 000 square miles.

The economic aspect of the archipelago doctrine has been discussed in the Cost/Benefits section.

Cost/Benefits

The price the United States will have to pay for letting Hawaii claim the archipelago status will be suffered not only by Hawaii but by the United States as well. They will suffer in the way of international water space, natural resources, and over who has jurisdiction over certain waters. If Hawaii were allowed to claim the archipelago status without using the water to land ratio then other nations such as Micronesia, Indonesia, Phillipines would also try and claim the archipelago status. With a nation such as Micronesia if they claimed their islands to be a archipelago with the 200 mile territorial sea, then they would have almost as much water space as the United States has land. That is a awful lot of natural resources that the United States can't touch without the permission of that nation. If the United States wanted to build a army base in Micronesia's archipelago for defensive reasons. They could only build it if Micronesia says okay. So if Hawaii is allowed to claim the archipelago status the United States will suffer as a nation.

Cost/Benefits

Commercial Fishing

Hawaii has over 700 different species of fish in which only 15 are caught commercially. These fish live in waters of 100 feet and deeper. The Hawaiian islands have over 2000 fishermen and we estimate there to be just a little over 1000 fishing boats. The fishermen of Oahu catch most of their fish outside of Kewalo Basin with the outside of Kaneohe Bay coming in the next highest. The total fish catch of all the Hawaiian islands for the fiscal year 1973 to 1974 was 13,997,435 pounds. Oahu alone caught 11,149,809 pounds. The nearest to that was Hawaii with 1,551,815 pounds. We noticed on the table of total landings the size

of the total fish catch of all the Hawaiian islands has been going down in the past four years.

If Hawaii should gain the archipelago status then the fishermen would have more room in which only they can fish.

Mollusks

Around the Hawaiian islands there are over 1000 different types of mollusks, some edible, some not. Some mollusks, like the many different types of clams and oysters are hunted for their meat. Others like the abalone have multiple uses such as their meat is good eating and the shell is used to make inexpensive jewelry and fancey fishing lures.

Limu

Hawaii has many types of limu which is harvested commercially.
In the fiscal year 1973 to 1974 43,366 pounds of limu was harvested.

Cost/Benefits

Precious Corals

Precious corals are found in waters of 1,200 to 1,400 feet deep. These precious pink, black, rare gold, and bamboo colored corals are found mainly in the western pacific ocean where 95% of the total is harvested. Gold and bamboo colored corals are being harvested off of Keanu Pt. and off of Koko Head. Pink coral is being harvested on the outskirts of the Palau islands which is located in Micronesia. Molokai Channel is also being used for as a pink coral source. Daily harvests usually range from 0 to 100 pounds. These harvests are brought to the factory which is located across from the Ala Maona Shopping Center. There it is made into expensive, but beautiful jewelry. Since we have a processing plant in the islands we won't have to export

it to another country for processing. So that means we have everything we need right here in the islands.

Manganese Nodules

The chemical make up of Hawaii's manganese nodules is very unique. Studies have shown that the nodules around the Hawaiian chain grows at a faster rate than anywhere else in the pacific.

The economic advantage in processing these nodules for the State of Hawaii would be most tremendous. It has been estimated in Hawaii and the Sea- 1974 that"the annual gross products from a million tons per year of Hawaiian manganese crusts, could possibly have a total value of $372 million at a 50% recovery rate." It is also brought up by Flipse 1974; Flipse, Dubs, and Greenwald 1973; Rothsteen and Kaufman 1973, that the "minimal amount of exploitation would be one million tons a year." The more likely figure would be as much as 5 million tons per year. The international race for the nodules can be obviously speculated.

Each year more companies are entering the race to gather and mine the nodules around Hawaii.

The nodules have been located off the northwest corner of Oahu on the Waho shelf, Kauai channel has turned up some nodules and crusts. Some future sights for manganese research is east of Molokai and Maui where submarine platforms extending to the 200 meter isobath are obsreved. Molokai channel is another possible source for manganese nodules and crusts.

The reason manganese is so good is because it has precious metals in it. With this break down we show you that it is 23% Manganese,

9% Iron, 1.04% Nickel, .81% Copper, and up to 2% Cobalt. The nodules and crusts have other precious metals but they are not mentioned.

Jurisdiction Over The Waters

Hawaii would have jurisdiction over more water space than it has right now. This means that the state would decide who would be able to pass through our water, and what would happen to those ships who pollute our water. We would also decide if we would let anyone from a foreign country exploit our natural resources.if we are unable to.

CONCLUSION

The major potential benefits the State of Hawaii could receive, if it were to claim the archipelago status, has been discussed in this paper. Benefits relating to the high economic gain Hawaii could acquire plus jurisdiction rights have been argued for the State.

Because of its historical background and geographical make up, the State of Hawaii would probably have no trouble in gaining its status as an "archipelago State". But in order to claim the archipelago status, Hawaii must first convince the Federal government to support the issue and to bring it up in the United Nations Conference on the Law of the Sea.

The United States, being a major maritime nation, definitely does not support the "archipelago doctrine". The cost of having large bodies of water shut-off for passage is too great a loss for the Federal government to accept in place of the benefits one state could receive. Because there is no real guarantee that nations such as Indonesia, Phillipines, Micronesia etc... will al-

low passage through their "archipelagic waters" once they gain their archipelago status, the United States must oppose the doctrine without any hesitation.

Although the State of Hawaii will benefit a great deal, the cost to the Federal government does not even come close in comparison. The claims Hawaii and its people can make are very optomistic, but is it worth it in the long-run?

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AN APPROACH TO EFFECTIVE OCEAN ALLOCATION

President Lyndon Johnson proclaimed in 1966, "We must be careful to avoid a race to grab and to hold the lands under the high seas. We must insure that the deep seas and the ocean bottoms are, and remain, the legacy of all human beings." These words, and remarks like them, have stirred an outcry from both political circles and the Scientific community calling for a new order agreements that will regulate the development and allocation of scarce ocean resources.

The romantic portrait we once had, of our oceans is now giving way to the realization that the oceans are the "Cradle of life" on earth. The seas, which cover over 70% of the Earth's surface, spawned life, and in order to survive it seems apparent that we must return to the sea. It is on this premise that Gordon and I affirm that the development and allocation of ocean resources should be controlled by an international authority.

* * *

A key assumption in our position is that the seas are the legacy of all man. The Idea of the Common Heritage is, of course, by no means new. But Status Quo politics, and interests, thrusts an inherent and structural barrier to the realization of such a criteria. Because the problems faced are inherent to the framework of international law, an international authority to oversee the use of ocean resources is clearly called for.

Gordon Miyamoto, March 1976
Gregory Won, March 1976

Castle High School

The concept of "Common Heritage", if applied realistically, would seem to encompass two criteria: 1) The wealth of the oceans should be equally enjoyed and shared by all, and 2) The exploitation of these resources should not be at the expense of a precariously balanced environment.

In regards to the first criteria, we find the status quo unable to develop an effectiv method of resource allocation. The market economy that much of the world endorses leaves little room for the philosophy of "Common Heritage". It functions through a profit motive, respecting all resources as Res Communis wealth, that is wealth free to all, yet wealth not subject to appropriation.

The conclusion is clear: Only the rich, and affluent can benefit from the seas. That same conclusion was reached by George Kent, professor of Political Science. He wrote in February of this year:

> "The disparities are due primarily to the normal operation of the economic process. It increases the wealth and power of some while reducing the wealth and power of others. Poverty and malnutrition are the inevitable results."

At the root of this problem are the basic tools of modern industry in the market economy: Technology and Capital. University of Washongtion Professor A, T. Pruter remarked in 1973:

> "As fish supplies in the waters of the rich countries become depleted, and as capital and new technology enable the fishing fleets of the rich nations to harvest the oceans everywhere, the fleets of the industrialized nations are fishing off the coasts of the poor countries in the Southern Hemisphere."

Only the affluent nations of the world (unfortunately a small minority) can afford to reap the benefits from the oceans. Only in a handful of countries does there exist the technolgy and capital to farm, harvest, or mine the oceans.

To compound an already serious problem it has been discovered that the wealth of our oceans does not extend itself to much of the third world. The San Diego Law Review observed in 1975:

> "The countries which are either land-locked or where off-shore petroleum shows no promise comprise the poorest areas of the world. These include every nation in the African Hunger Belt."

Poor allocation of ocean resources can only result in widening the gap between the developed and underdeveloped third world.

* * *

The minister of Ocean Affairs for the United Nations Development Program, Arvid Pardo, commented in 1973:

> "Of one thing we can be sure, marine mining activities will grow and without effective safety and pollution control standards, accidents will occur which will endanger human life and pollute the marine environment."

The need for strict controls over the use and exploitation of ocean resources, both living and non-living, clearly exists. But we have reached a conclusion that such regulation must be international in nature. One, because the laws which currently protect American shores from the danger of oil spills, and protect our fisheries from over-use, only apply to waters under our jurisdiction. And, two, because most of these regulations work Ex Post Facto--closing the barn door only after the horse has escaped. They serve as little deterent to the large American industries who can readily absorb penalties of hundreds of thousands of dollars.

Abroad, the media reports of Cod Wars--disputes arising because no international regime exists to define economic zones. Lack of proper regulators also results in over-fishing, which is fast depleting certain species of fish.

Furthermore, how can any nation, the United States in particular, expect to regulate large industries when our politics have been marred by milk, and fuel scandals? When the oval office remains powerless because it "owes" too many "favors" to too many friends.

And when the economy minded leaders of our nation fail to even compromise with environmentalists, as they bursh aside every problem; from the danger of nuclear wastes, to the problems involved in strip mining; in the name of increasing energy reserves.

These two criteria mandate a major reform in International policy concerning the seas. And action on this reform is increasingly more urgently needed, as we turn more and more to the sea for survival. The real significance of our oceans has been too long ignored or over-booked. It is a complex bio-system that functions on a dangerous balance. Yet without this valuable resource, man would certainly die, as would much of the life on earth.

The oceans themselves support a vast array of life, from the complex cetacea, to microscopic plants that are known to provide nearly 80% of the Earth's supply of oxygen. And they continue to function although man persists in pouring millions of tons of sewage into them. We, tragically, do not recognize the importance of that important element of water although Americans use approximatdy 25 billion gallons per day. And we have yet to overcome, perhaps the most feared of enemies, ignorance; which will be an inherent flaw in the process through which effective laws are made.

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To correct this situation we advocate the following authority to be established, and serve as mechanism to monitor and regulate the oceans and ocean resources.

We endorse an international regulatory body, formed through the Law of the Sea Conference and Under the auspices of the United Nations. Its membership shall be world-wide and it shall promote co-operatbn amoung its constiuency.

The Star-Bulletin reported that:

> "...as nations quarrel over fishing rights and seize each others' vessels, the stocks of many species are rapidly being depleted.

The Authority shall act am an arbitrator and, through treaty,

or through a series of votes by an assembly within the organization (in all likelihood the strength of the thrid world in the assembly could be offset by a small baard represented by major national members, and their economic interests); create territorial waters and/or economic fishing or mining zones.

After such zones are established the authority would then claim jurisdiction over all waters lying outside national jurisdiction. The resources shall then be collected by private industry on a fee-for service basis.

University of Burmingham professor David Wightman, cited:

> "...the disparity in the level of per capita imports between rich and poor countries has been growing wider. Industrial countries have increased their purchases of internationally traded goods at a much faster rate than third world regions."

We hope to remedy this situation by allocating ocean resources or the revenue from the sale of such resources, to the developing world. Such nations would first be required to prove that they intend to use the revenues to increase their standard of living, and the organization would readily offer aid programs to enable the poor world to achieve self-sufficiency.

Strict quantitative controls shall be established and the private industries seeking to harvest the seas will not exceed these quotas. Each firm will consequently have to be licensed with the authority, and penalties including the loss of licensing will be the primary modes of enforcement. Licensing shall be dependent on several factors, including pollution control standards, which the applicant must meet

Member nations themselves will be expected to regulate industry, and violations of Law of the Sea agreements enforced by the regime shall result in penalties, initiated through economic sanctions, or policy action.

The need for such an authority does exist. Since recorded history man has accepted the oceans and their resources as Res Communis wealth. But today the idea of Common Heritage, an important feature of the International Law of the Seas now

being debated, is essential in a world where there exists great disparities and inequities between the developed and developing worlds.

Resource allocation on such a large level must be done through an international regime that will serve to regulate ocean activities. Treaties or bi-lateral agreements cannot effectively distribute ocean resources simply because such negotiations operate on the fundamental policies of self-interest.

We feel that an international authority cannot incorporate national interests, and yet serve to the benefit of all. At the present, many nations recognize the need for this authority, along with a set of comprehansive laws concerning the seas. Such mechanisms should serve to regulate ocean resources and insure their proper distribution, and provide for adequate control over the exploitation of ocean resources. These two vital facets of any Law of the Seas agreements, are essential to an age which will soon be upon us--an era that will; politically, scientifically and economically recognize the importance of the law of the Seas.

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