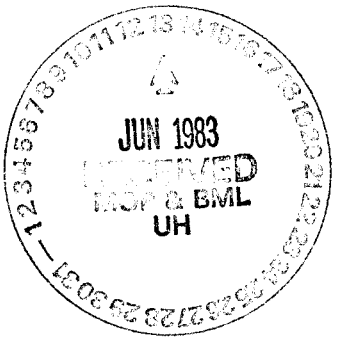


STUDENT PROJECT PROPOSAL TO THE
UNIVERSITY OF HAWAII MARINE OPTION PROGRAM
DYNAMIC PROCESSES OF HILO BAY

Duration

September 23, 1982 - May 31, 1983

Project Leaders

Nancy D. Bernard

Anne M. Orcutt

Advisors

Dr. Walter C. Dudley, Jr.

Dr. Leon E. Hallacher

Dr. Ernest B. S. Kho, Jr.

Mr. Thomas M. Hammond

ABSTRACT

As part of a long term study on the dynamics of Hilo Bay, temperature, salinity, and oxygen wil be measured from the surface to the bottom at 16 selected stations in the bay. Depth resolution of the sampling intervals varied from 0.25M at shallow stations, to 2M in deep water at the mouth of the bay. Turbidity of the water was measured at each station. Measurements were made twice monthly from September, 1982 through March, 1983. Preliminary results indicate that Hilo Bay has a complex structure in regard to all parameters measured. Lowest oxygen values were found in waters adjacent to the commercial pier. An extremely well developed salt wedge was observed to penetrate the bay as far as the Wailoa Estuary, maintaining a well defined stratification. This stratification is apparently tidally controlled under these conditions of low fresh water imput.

TABLE OF CONTENTS

INTRODUCTION

Hilo Bay is located on the northeast coast of the Island of Hawaii. The bay is crescent-shaped and partially enclosed by a breakwater beginning in the northeast corner and extending one mile. Hilo's commercial port is located in the northeastern corner of the bay as well, and facing the breakwater is a one mile black-sand beach bordered by the Wailuku and Wailoa Rivers. Due to these two fresh water sources, Hilo Bay has been described as one of only three estuaries found in the State of Hawaii. The other two being Kaneohe Bay on the Island of Oahu and Hanalei Bay on the Island of Kauai. This fact alone makes Hilo Bay worth studying as no other comprehensive study has yet been completed.

Therefore, the purpose of this study is to collect superficial baseline data on the physical and chemical parameters of Hilo Bay and the Wailoa Estuary for a period of one year, from Fall, 1982 to Fall, 1983. Data collected will identify polluted areas to be the focus of future environmental studies of Hilo Bay.

HISTORY OF HILO BAY

Historical Hawaiian legends and chants are the only evidence today of Hilo once being a flourishing townsite, inhabited continuously for centuries. Originally, the city of Hilo had several settlements situated within the boundaries of Hilo today. The most written about settlement was Waiakea, located on crescent-shaped Hilo Bay. This brief history of Hilo Bay will allude to major physical, biological, and chemical changes that have occurred during the past 200 years altering the Bay's pristine conditions.

As early as the 16th century references have been made to the fish ponds in the Waiakea River, a prime resource of Hilo. These spring-fed ponds or Royal Ponds' as they were often referred to in Kamehameha's era, included Ho'akimau pond, Mohouli, Kalepolepo, and Waihole pond as well as the largest pond, Waiakea.[1] These aqua-cultured ponds supplied copious amounts of mullet and milkfish for the alii.

The most accurate early description of these ponds' water sources was made by Chester Lyman Smith in 1846:

> "July 30, P.M. Took a walk with Mr. Coan to the Royal fish ponds, at the S.E. part of the harbor. They are of brackish water, rise and fall with the tide, and altogether cover several hundred acres. They are generally shallow, but in places of considerable depth. The fine mullet with which they are filled are tabu to all but Royal hooks or nets...I saw them collected in a corner of one of the ponds as thick as they could be crowded."[2]

In 1823, the American Mission asked William Ellis of the British Museum in the Society Islands to conduct a survey

of Hawaii preparatory to opening mission stations there. From his description we excerpt the following:

> "There are three streams of fresh water, which empty themselves into the bay. One on the western angle is called Wairuku. It rises near the summit of Mauna Kea, and, after taking a circuitous course for several miles, runs rapidly into the sea.
>
> "Two others, called Wairama and Waiakea, rise in springs, boiling up through the hollows of the lava, at a short distance from the shore, fill several large fish ponds, and, afterwards empty themselves into the sea. Waiakea, on the eastern side of the bay, is tolerably deep, and it is navigated by canoes and boats some distances inland."[2]

This clearly illustrates 3 principal fresh water sources entering Hilo Bay. Today, in 1983, there are only two; the Wailuku River and the Waiakea (Wailoa) River. Beach dredging to fill in the Waiolama River and marshlands commenced in 1912.

One of the most significant changes in Hilo was the dredging of blacksand from the Hilo Bay beach. The sand was used to fill-in the marshy area near the shore of Ponahawai and Waiolama including Waiolama River. Altogether, between the years 1912-1923, about 500,000 yds.[3] of fine black lava sand from the beach at Hilo Bay was pumped into the marshland near the shore. The Hawaiian people of Hilo had previously cultivated wet taro and developed several large fish ponds here. Today, the Waiolama River does not exist.

Sugar cultivation in Hawaii was first practiced by Hawaiians. The arrival of foreigners however, introduced the processing of cane into sugar and in the process sugar cane was transformed from a subsistence into a commercial

crop, cultivated for manufacture into sugar for sale.[3] But before Hilo could become the major sugar center it is now, it had to also develop an adequate transportation system and adequate port facilities.

The year 1900 marked the midpoint of a rapidly flourishing sugar industry. Growth of the sugar industry was closely linked to the development of harbor facilities at Hilo Bay, and the railroad at Hilo.

In 1899 the Hilo Railroad Co., Ltd. incorporated and had an approximate 35 miles of track by 1901. The most important segment pertaining to the proposed study, however, was laid across bayfront from Waiakea to Hilo town along the black sand beach. This occurred in 1901, at the request of "a number of leading citizens of Hilo," to extend the line one and a half miles from Waiakea along the beach at Hilo Bay, to Hilo town, "with branches to the present government wharf and to the proposed wharf."[4] The short segment of the railroad from Waiakea to the Wailoa side of town was completed in 1903.

According to Thurston, 1906 "marked the beginning of a new era for the Island of Hawaii." Trans-Pacific steamships and sailing vessels regularly began to stop at the port of Hilo, promoting much optimism in the business community. The idea of building a breakwater had again surfaced with the arrival of deep-draft vessels--a means of insuring calmer waters for Hilo's vital link to the other islands. Breakwater construction commenced in 1908 with rock fill hauled

by the railroad from the Kapoho Quarry in Puna. The Hilo breakwater was finally completed in 1929.

In 1923, Hawaiian Cellulose, Ltd., commonly known as the Canec Plant, was incorporated in Hilo. A method of using baggase, "trash from cane after the juice has been extracted," was devised for fabricating wall board as a building material. The plant opened in April, 1932 along the Waiakea Fish Pond, near the Waiakea Sugar Mill. As was disclosed to the public in 1973, the canec plant had "discharged approximately 3.5 mgd of waste water into the Waialoa estuary for 29 years" (Neighbor Island...1973:12).[5] This waste water included both toxic and lethal chemicals such as arsenic, hydrated lime, hydrosulfate, ethyl silicate, hydrosulfate, calcium, arsenate and arsenic acid.

Later the Department of Health conducted several water quality studies of Hilo Bay during the 1940's and 1950's. All the reports came to the same conclusion: "Hilo Bay was badly polluted."[6] One report by the Department of Health indicated the major pollutors of Hilo Bay in 1952 as the following: "the Hilo outfall sewer, cesspools along the shoreline, waste discharge into the Waialoa River, and the ships in the harbor, as well as industrial pollution from the Hilo Sugar Company mill and the Hawaiian Cane Products Company canec plant."[7] These reports still did not gain the attention of the Hilo community about the mounting and perhaps irreversible, pollution problem in Hilo Bay.

In 1960, Hawaii County voted to resolve the pollution problem of Hilo Bay, focusing on the Hilo Sewer Systems.

The County contracted the Honolulu consulting engineering firm of Belt, Collins & Associates, Ltd., to prepare a report on the bay's conditions.

The April, 1961 report strongly suggested "the cessation of pollution of Hilo Bay in order to avoid major public health problems." The study notes:

> The gross pollutional extent of Hilo Bay and Waialoa estuary is terrifying. It is remarkable that no water-borne epidemic has not occurred in the past; more so since marine recreational facilities and some sea food are enjoyed within and from Hilo Bay. The potentiality and capability of one happening exists and could conceivably occur if Hilo Bay and Waialoa estuary are not cleaned up fairly soon.[8]

This report concluded that the dissolved oxygen level in Hilo Bay approached the range near exhaustion and therefore considered evidence of "gross pollution." Following this report construction of a primary sewage treatment plant was begun in 1962.

In 1971, the Hilo Bay Pollution Study was conducted by the University of Hawaii-Hilo for the Department of Public Works, County of Hawaii. This project was conducted over a two-month period (June 14-August 16, 1971) involving chemical, biological, sociological, and governmental approaches toward the study of pollution in Hilo Bay. Water and fish samples were taken to evaluate the quality of water and its marine life. Fifteen sampling sites were used throughout the bay and in the three rivers (Honolii, Wailuku, and Wailoa). The number of samples collected from each site varied from 9 to 18 depending on the tests conducted. Conclusions suggested

the need for more quantitative sampling to be conducted year round before any valid statements can be made about the bay's actual environmental condition.

During the summer of 1972, the Army Corps of Engineers prepared a study on Hilo Bay called Hilo Harbor: Baseline Environmental Investigation; Summer 1972. Selected physical and chemical characteristics observed and analyzed in this study include water currents, mass transport characteristics, salinity, temperature, dissolved oxygen and turbidity patterns; as well as nutrients, documentation and analysis of the biological community included a review of coliform bacteria, phytoplankton, zooplankton, algae, fishes, benthic invertebrates, and infauna inhabiting Hilo Harbor. Data regarding present conditions within the environment of Hilo Bay were obtained from field investigations made during the period of July 17 through August 21, 1972. Comparisons of recent data with comparable, historical data, obtained in 1961, 1963, and 1971 are of limited value since these studies were of limited scope and accomplished within short periods. Consequently, the analysis made for the HHBEI, 1972 study do not fully characterize seasonal variations occurring within the environment.

In 1976, a five-year Hilo Area Comprehensive Study (HACS) was authorized by Section 144 of the Water Resources Development Act of 1976 (Public Law 94-587). HASC is "...a study of methods to develop, utilize, and conserve water, and land resources in the Hilo Bay area...."

The final report for the Hilo Harbor First Spring Season Environmental Studies was completed in August, 1977. Objectives outlined for this phase of HACS included providing descriptions of various ambient environmental conditions in Hilo Harbor and to define spring season water quality, beach, and biological conditions in Hilo Harbor. The scope of the study included water circulation, stratification, water quality, marine biology, fish catch inventory, beach erosion, storm effects, meterological and hydrological data. Actual data sampling occurred for water quality measurements, biological observations, and drogue measurements for three days at fifteen stations. Data measurements did not occur on the same days. Beach measurements were sampled for 2 days, and a fish catching survey conducted for only one day.

In discussing the results of the measurements made in this study to define the ambient environment conditions of Hilo Harbor, the HACS noted that these data were collected over relatively short periods of time. Their usefulness should be analyzed as part of a comparative baseline data set, and not as an in-depth study. Moreover, the two periods data were collected, March 31-April 7 and June 7-9, 1977, were quite different with respect to rainfall; especially in terms of the amount of fresh water entering Hilo Bay via the Wailuku River and through the water table and underground springs in Waialoa Estuary. Furthermore, sampling did not occur during stormy weather, which would certainly expose other facets of the bay's circulation and stratification

scheme. The limited data was scrutinized for patterns and trends. Recommendations suggested that more data was needed before specific problems in the bay could be pinpointed.

The 1980 study of Hilo Bay is also a part of HACS. This studying also added to the baseline data set collected in the 1977 HACS, as well as analyze significant changes that have occurred in the environmental parameters. This report primarily addressed the ambient water quality, biological, and geological characteristics of Hilo Bay. Data was obtained during the months of March through June, 1980. Field activities included water quality measurements and sampling, drogue studies, fishery resource surveys, marine biology reconnaissance surveys, and sediment probing and sampling. Data collected was evaluated with data collected in previous investigations. A heavy storm on March 18, 1980, allowed additional water and biological measurements to be made that day.

The following general conclusions were made about the environmental parameters studies. Firstly, there seems to exist a two layer salinity stratified pattern. A general circulation pattern indicated a net transport out of the harbor by the surface layer, and a new water transport into the harbor by the subsurface layer; Documental historical events of dumping into the bay have affected the water quality; Breakwater construction in 1908 has had a detrimental affect on the water quality in the bay; The biological community hasn't changed very much since the 1977 HACS; A black-sand-paper deposit was noted of Alealea Point in 25 feet of water;

Anaerobic conditions predominate in the bay's mud layer. High levels of arsenis were found in the Waiakea estuary and throughout Hilo Harbor; During the March 18th storm a reduction in salinity was noticeable; about 4000 tons of sediment flowed into the bay from the Wailuku River; Most fishing activities are confined to the shoreline although Hilo does support a small commercial fleet year round. In conclusion, the 1980 HACS also recommended that Hilo Bay be studied more intensively year round, to produce a feasible plan for making Hilo Bay what it once was: an enjoyable gathering place for all.

OBJECTIVES

The purpose of this study is to provide an analysis of selected physical, chemical and biological conditions which characterize Hilo Bay and the Wailoa estuarine system. This is a baseline study to pinpoint problem areas due to chemical pollution and beachfront erosion, so that in the near future other more specific studies can follow.

The long-range goal of this preliminary study is the eventual clean-up of Hilo Bay and the surrounding waters. The benefactors of this study are obviously numerous: commercially: fishermen as well as resort hotels along Banyan Drive; recreationally: canoe paddlers, boaters, swimmers, surfers, and tourists will benefit from a cleaner more asthetically pleasing bay in the absence of harmful poisonous pollutants.

At present no comprehensive data on water quality in Hilo Bay has been conducted. Previous studies have only superficially described the processes occurring in Hilo Bay. This has been mainly the result of limited time and lack of intensive repetitive samplings. The most obvious deficiency in all previous research is the fact that all data was obtained during the late spring and summer months. This study will provide data from the autumn and winter seasons as well as the spring and summer seasons, in addition to taking more thorough periodic samplings. The focus of this study covers three main problem areas. These are: arsenic pollution, low levels of dissolved oxygen, and beachfront erosion.

ARSENIC POLLUTION

In November of 1930 the Waiakea Sugar Mill Co. was awarded a patent to cover the manufacturing of wallboard from bagasse. The mill was established as an alternative means of disposing of bagasse; the trash from cane after the juice has been extracted. It was estimated that from the twelve plantations contributing bagasse to the canec plant, one million tons of bagasse would be available for the production of wallboard. The original patent for canec wallboard called for the bagasse to be mixed with hydrated lime, caustic soda, soda ash and similar chemicals to digest fiberous portions of the trash. In addition the wallboard was treated against termites with calcium arsenate and arsenic, and finally hydrosulfate was added to "set the size," inhibit the absorption of water, and harden the board. The wastes from these chemicals were disposed of into the Wailoa River. In turn, this effluent created a pollution problem in the estuary and Hilo Bay.

> "It has been estimated that the canec mill 'discharged approximately 3.5 mgd. of waste water into the Wailoa estuary' from the time it started production until it stopped in 1963. In 1962 an analysis of the industrial waste from the canec plant indicated it had 'a strength equivalent to residential sewage from 110,000 persons in terms of biochemical oxygen demand.'[9]

In December of 1978 the Hawaii State Department of Health conducted a survey of Hilo Harbor and Waiakea Mill Pond sediments and found "exceptionally" high levels of arsenic. It was suspected that the pioneer canec plant (which used arsenic

trioxide as a termite treatment agent) was responsible for these high concentrations. According to the patterns of distribution of arsenic in Hilo Bay and the Wailoa estuary, where decreasing concentrations were found with increasing distance from the mouth of the Wailoa River, it was suggested that the Waiakea Mill Pond was the source of the arsenic in the sediment. The health department noted: "levels of total arsenic in sediment samples taken in Waiakea Mill Pond were reported as high as 6370 ug/g."[10] The Army Corps of Engineers also took samples of the sediment and found arsenic concentrations to be at 10 parts per billion instead of the acceptable level of 5 parts per billion.

From the above information it is clear that the need for more extensive sampling and research is crucial, in order to accurately assess the levels and effects of this toxic pollutant.

LOW DISSOLVED OXYGEN CONTENT

Previous studies have indicated that dissolved oxygen content is low near the main Hilo Harbor commercial pier. Why this condition exists is not entirely known, and is one of the goals of this study; to research the contributing factors. It is possible that barge and ship activity may play a role through the discharge of oil products and other chemical pollutants.

In 1982 two oil spills were reported in Hilo Harbor. The first occurred in May when a large quantity of gas seeped

into the harbor from a broken underground pipe. The second spill took place on November 1 when approximately 5,500 gallons of heavy crude oil spilled into Hilo Harbor.[11] Apparently, this spill was the result of a break in neglected and overused pipes at state owned Bunker C while a barge was discharging oil. This low-grade oil was carried by the changing tide from Pier 1 along the coastline in front of Banyan Drive hotels, causing serious and hazardous pollution problems which resulted in the closure of certain beaches and recreational facilities.

When crude oil and/or industrial chemicals are deposited into coastline and estuarine waters a number of changes occur in the marine ecosystem. Initially plankton growth is stimulated due to the increase of an effluent containing nutrient rich chemicals. Eventually this loading of organic material can reach a point where the bacteria that breaks down organic material multiply rapidly. The end result is the consumption of too much oxygen. When this happens the net oxygen content is greatly reduced, and below the euphotic zone lower parts of water column become anaerobic. The lack of oxygen and the poisons from the decaying vegetation lead to the death of phytoplankton and fish.

It is one of the objectives of this study to concentrate samplings and data gathering at the Hilo Harbor pier and to assess why dissolved oxygen is low in this area, and to see what effects this condition has on plant and animal life.

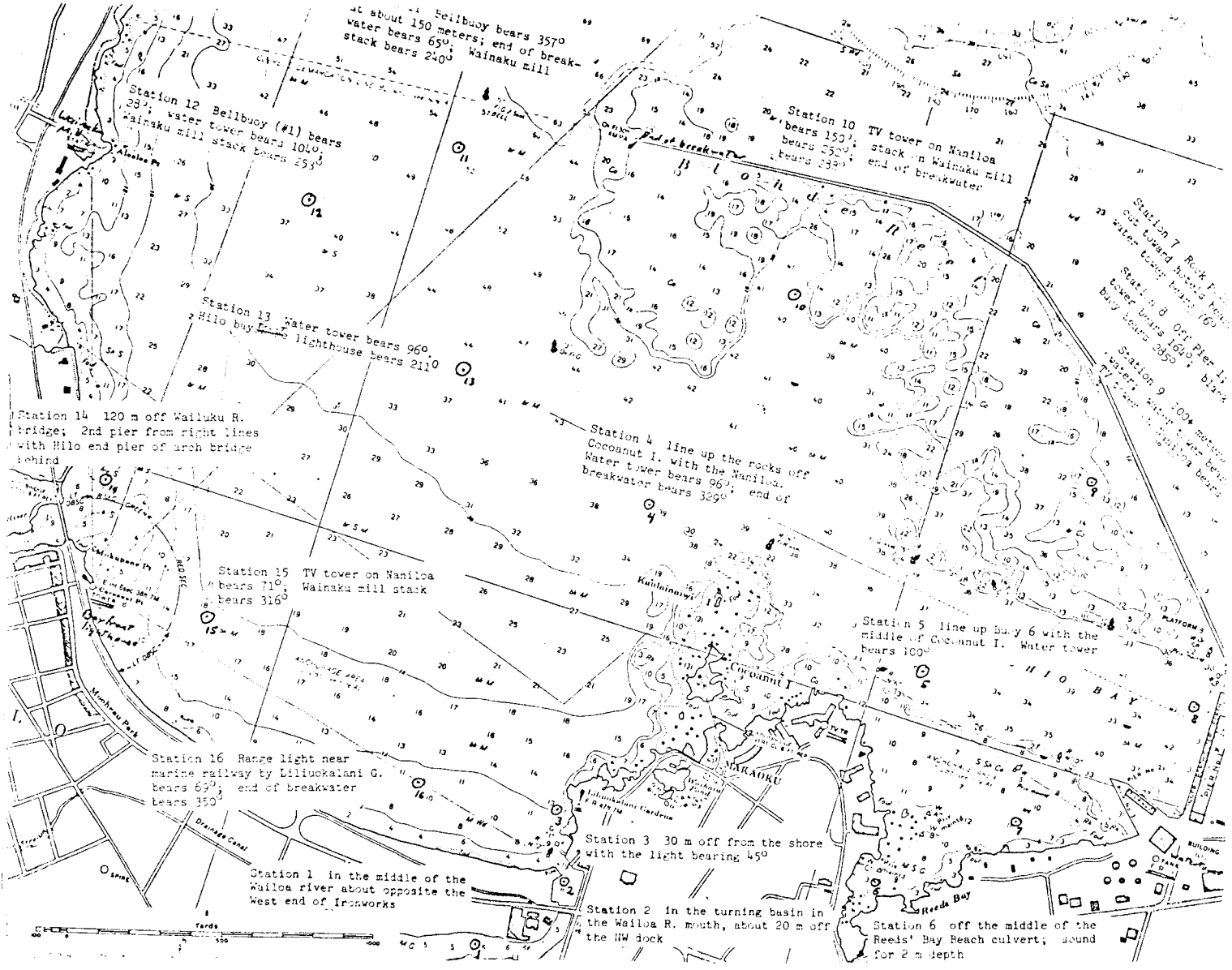
SEDIMENT TRANSPORT

The third area to be studied is sediment transport along Hilo bayfront. The beach stretching the length of the bay is eroding, and has been since the turn of the century. Research as to why, and what the major contributing factors are is one focus of this study. The parameters will include current velocity and direction, and sediment load, in addition to looking at the influence of the Wailoa River and the Wailuku River as they empty into the bay.

METHODOLOGY

In this study, measurements of physical and environmental water-column characteristics will be taken at sixteen selected stations in the Wailoa Estuary and Hilo Bay (Figure 1). The water quality parameters to be measured include salinity, temperature, dissolved oxygen and turbidity. The turbidity of the water will be determined with a Secchi Disc. The disc is attached to a chain, calibrated at one meter intervals, reaching a total length of seven meters. A series of verticle measurements will be taken at one meter intervals. At each depth interval, between the surface and the bottom, the temperature and salinity of the water will be measured with a YSI Model 33 Salinometer and the concentration of dissolved oxygen will be measured with a YSI Model 57 Oxygen Meter. Both the oxygen meter and the salinometer will be connected to a 50-foot line, and probes to each meter will be attached to the end of the line.

The procedure at each of the sixteen stations begins with the determination of depth by the anchor line which is calibrated in one meter intervals. The fifty-foot line with the attached oxygen meter and salinometer probes will then be lowered to the bottom of the water column. The Secchi Disc will also be lowered into the water. Temperature and salinity readings will then be taken from the salinometer and oxygen readings will be taken from the oxygen meter. The collected data, along with the ambient environmental conditions will be



Stations sampled from September 1982 to April 1983 during Hilo Bay study sponsored by the UH-Hilo Marine Option Program.

Figure 1
16a

will be logged in the field into a notebook and then later entered onto a computer data base for subsequent analysis.

APPLICATIONS

Preliminary data collected during this study will be used as part of a research proposal to be submitted to the Office of Research Administration for a "seed money" grant to continue the study of Hilo Bay during the summer, 1983. It is intended that a major research proposal for a four-year intensive study of the Wailoa arsenic pollution will be submitted to the MSB program in the fall of 1983, along with a companion matching funds proposal to ORA for the physical and geographical aspects of the research.

Further funding for studies of Hilo bayfront beach erosion and commercial pier low oxygen waters will be sought from the Hawaii County Research and Development funds and possibly state and federal agencies.

The results of the fall, 1982, winter, 1983 MOP sponsored Hilo Bay Study will be presented at the Big Island Science Conference in April, 1984 (see attached abstract).

BUDGET SUMMARY

HILO BAY STUDY

PROJECT LEADERS

Dr. Walter C. Dudley, Jr.
Dr. Leon E. Hallacher
Thomas M. Hammond
Dr. Ernest B. S. Kho, Jr.

A. Student Stipends (February-May, 1983)

Nancy Bernard	$50.00/month	$200.00
Anne Orcutt	$50.00/month	200.00

B. Supplies

1.	Batteries: salinity and oxygen meters	20.00
2.	Oil and gas for the boat	50.00
3.	Niko press fittings	7.89
4.	Niko press tool	16.59
5.	Postage	1.75
6.	Maxell 5¼ inch floppy discs	50.00
	TOTAL	$546.23

SUMMARY

Preliminary results indicate that Hilo Bay has a complex structure in regard to all parameters measured. Lowest oxygen values were found in waters adjacent to the commercial pier. An extremely well developed salt wedge was observed to penetrate the bay as far as the Wailoa Estuary, maintaining a well defined stratification. This stratification is apparently tidally controlled under conditions of low fresh water input.

The Marine Option Program will continue to monitor these parameters throughout the summer of 1983, in addition to studying arsenic distribution in the sediments and biota of Hilo Bay. These studies will provide additional baseline data on the physical and chemical parameters of Hilo Bay and the Wailoa Estuary. This data will enable us to isolate present and past sources of pollution in Hilo Bay.

END NOTES

[1]Hilo Bay: A Chronological History, March 1981, pg. 11

[2]Ibid., pg. 14

[3]Ibid., pg. 81

[4]Ibid., pg. 147

[5]Ibid., pg. 141

[6]Ibid., pg. 245

[7]Ibid., pg. 245

[8]Ibid., pg. 246

[9]Ibid., pg. 141

[10]M & E Pacific, Inc. 1980. Geological, Biological and Water Quality Investigations of Hilo Bay. Prepared for U.S. Army Engineer District, Honolulu by M & E Pacific, Inc., Environmental Engineers, 190 South King Street, Honolulu, Hawaii.

[11]Hawaii Tribune Herald, page 1, November 3, 1982

BIBLIOGRAPHY

Chan, John, G., Faculty Project Advisor. Hilo Bay Pollution Study. National Science Foundation, Hilo College, University of Hawaii: Summer, 1971.

Flemming, N.C., Editor. Undersea. New York: McMillian Publishing Co., 1967.

George, Milton, C. The Deveolopment of Hilo, Hawaii TH: A Modern Tropical Sugar Port or a Slice Through Time at a Place Called Hilo. Printed by Author, 1948.

"Hilo Bay Oil Spill." Hawaii Tribune Herald, November 3, 1982.

Kelly, Marion, Barry Nakamura, Dorothy B. Barrere. Hilo Bay: A Chronological History: Land and Water Use in the Bay Area, Island of Hawaii. Department of Athropology, Bernice P. Bishop Museum, Prepared for the U.S. Army Engineers, Honolulu District, March, 1981.

Leithead, Scott. "Hilo, Hawaii: Its Origins and the Pattern of its Growth, 1878-1900." Thesis, University of Hawaii, 1974.

M.& Pacific, Inc. Geological, Biological, and Water Quality Investigations of Hilo Bay. Prepared for the U.S. Army Engineers, Honolulu District, 1980.

Neighbor Island Consultants. Baseline Environmental Investigations of Hilo Harbor. Prepared for the Department of the Army, Honolulu District, Corps of Engineers. March, 1973.

Sunn, Low, Tom, and Hara, Inc. Final Report: First Spring Season Environmental Studies, Hilo Bay, Hawaii. Prepared for the U.S. Army Engineers, Honolulu District. August, 1977.

APPENDIX

PROJECT PERSONNEL

Dr. Walter C. Dudley, Jr., Assistant Professor
Marine Geology and Oceanography
Natural Science Division
University of Hawaii at Hilo

Dr. Leon E. Hallacher, Assistant Professor Zoology
Natural Science Division
University of Hawaii at Hilo

Dr. Ernest B. S. Kho, Jr., Assistant Professor Chemistry
Natural Science Division
University of Hawaii at Hilo

Thomas M. Hammond, Instructor
Physical Science
Hawaii Community College

Nancy D. Bernard, Student
Marine Option Program
University of Hawaii at Hilo

Anne M. Orcutt, Student
Marine Option Program
University of Hawaii at Hilo

SIGMA XI
The Scientific Research Society

Proceedings of The Big Island Science Conference
Seventh Meeting

ABSTRACT

34. DYNAMIC PROCESSES OF HILO BAY. N. D. Bernard, D. Clements, W. C. Dudley, Jr., L. E. Hallacher, T. Hammond, E. Kho, A. Orcutt, University of Hawaii at Hilo, Hilo, HI 96720.

As part of a long term study on the dynamics of Hilo Bay, temperature, salinity, and oxygen were measured from the surface to the bottom at 16 selected sites in the bay. Depth resolution of the sampling intervals varied from 0.25M at shallow stations, to 2M in deep water at the mouth of the bay. Turbidity of the water was measured at each station. Measurements were made twice monthly from September, 1982 through March 1983. Preliminary results indicate that Hilo Bay has a complex structure in regard to all parameters measured. Lowest oxygen values were found in waters adjacent to the commercial pier. An extremely well developed salt wedge was observed to penetrate the bay as far as the Wailoa Estuary, maintaining a well defined stratification. This stratification is apparently tidally controlled under conditions of low fresh water imput.

APRIL, 1983