STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
STATE PARKS
WATER RESOURCE MANAGEMENT

Ref.PB:EAH

APR 23 2001

CDUA File No.: OA-3004B

MEMORANDUM

TO: Ms. Genevieve Salmonson, Director
Office of Environmental Quality Control

FROM: Dean Y. Uchida, Administrator

SUBJECT: Environmental Assessment (EA) Notice of Determination: Finding of No Significant Impact (FONSI) by Black Pearls, Inc. for a Peal Oyster Farm at the Reef Runway Borrow Pit Adjacent to the Honolulu International Airport Reef Runway, Keehi Lagoon, Oahu

The Department of Land and Natural Resources, Land Division, has reviewed the comments received during the 30 day public comment period, which began on January 8, 2001 and the subject EA. We have determined that the subject project will not have significant environmental impacts and hereby issue a Finding of No Significant Impact (FONSI) for the subject project's EA. Please publish this determination in the May 8, 2001 OEQC Environmental Notice.

We have enclosed four copies of the final EA. My staff will e-mail a completed publication form to your office shortly. Should you have any questions, please contact Eric Hill of our planning staff at 587-0380.

c. Black Pearls, Inc. P.O. Box 525, Holualoa, HI 96725

53

2001-05-08-OA-FEA-Keehi Lagoon

FINAL

ENVIRONMENTAL ASSESSMENT

A PEARL FARM AND
PEARL OYSTER REEF RESEEDING PROJECT

IN

THE REEF RUNWAY BORROW PIT IN KEEHI LAGOON, HONOLULU, OAHU, HAWAII

PREPARED FOR :

Land Division,

Department of Land and Natural Resources

PREPARED BY :

Black Pearls, Inc.
P.O. Box 525, Holualoa, HI 96725

April 12, 2001

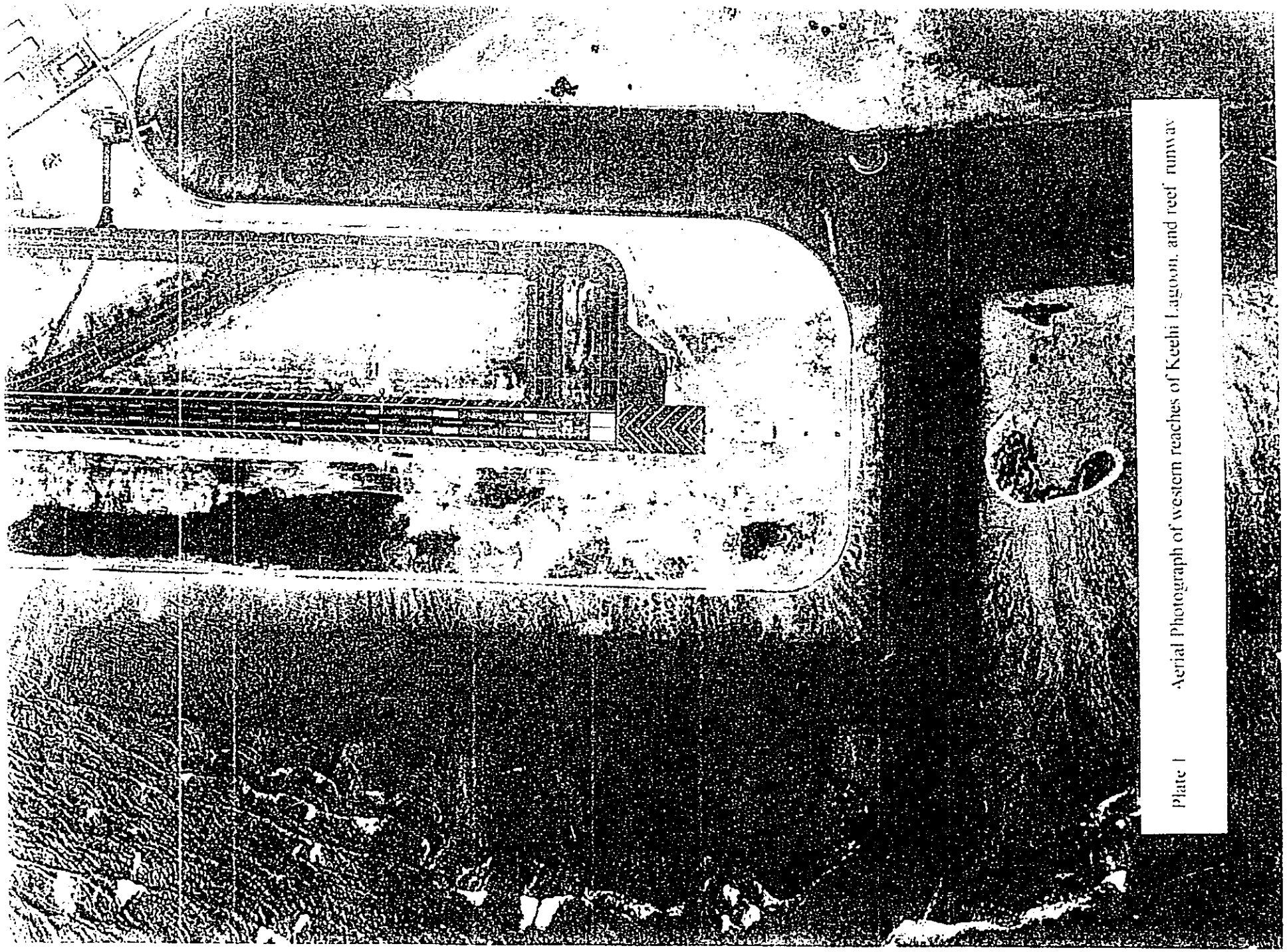


Plate 1 Aerial Photograph of western reaches of Keehi Lagoon, and reef runway

Plate 1. **Aerial photograph of western reaches of Keehi Lagoon, and reef runway, showing beach and reef areas adjacent to the site.**

The proposed project area is the deeper, dark blue water on the ocean side of the reef runway. The project area averages around 45 feet deep, with a bottom substrate of fine mud or silt.

The surrounding reef area runs along the seaward edge (where waves are visibly breaking), and the inner edge (adjacent to the reef runway). This shallow reef flat area is used extensively for recreational fishing. The project would not restrict access to this reef flat area, and would provide an easement along the inner edge of the project area to permit access by small boats to the western (upper) portion of the reef flat.

Some aquarium-fish collecting reportedly occurs along the seaward edge of the project area. Some seaweed collecting is also reported to occur along the inner edge of the project area. As the aquarium-fish collecting is conducted by SCUBA divers, this use is considered incompatible with the project. However, access would be permitted under restricted conditions for collection of seaweed along the inner edge of the project area, within the easement.

Also visible along the seaward edge of the reef runway are several narrow strips of accumulated sand. These are used occasionally by beach-goers, and access to these areas would not be restricted by the project. The most popular beach in the area is on the seaward side of the islet at the end of the reef runway. The draft Environmental Assessment proposed to site a land-base on this islet, to support the project activities, but this component has been deleted from the final project proposal because of the public objections to the impacts on this recreational beach.

The aerial photograph is dated 1/31/95

TABLE OF CONTENTS

List of Figures and Plates

List of Tables

List of Appendices

APPENDIX I : WATER QUALITY EVALUATION FOR PEARL OYSTER FARM DEVELOPMENT IN KE'EHI LAGOON, O'AHU
Prepared by : Miles Anderson, Analytical Laboratories of Hawaii

APPENDIX II : BIOLOGICAL COMMUNITY EVALUATION FOR PEARL FARM DEVELOPMENT IN KE'EHI LAGOON, O'AHU
Prepared by : Ku'ulei Rodgers, Coral Reef Ecologist

APPENDIX III : RECREATIONAL FISHING AND OTHER USES OF THE KE'EHI LAGOON AREA
Prepared by : Heather Reed and Neil Anthony Sims, BPI

APPENDIX IV : FISH SURVEYS OF KE'EHI REEF DREDGED BASIN AREA
Prepared by : Darby Irons, Coral Reef Fisheries Biologist, and Neil Anthony Sims, BPI

APPENDIX V : EVALUATION OF ALTERNATIVE PEARL FARM SITES
Prepared by : Black Pearls, Inc.

SUMMARY

Black Pearls, Inc. is applying for an ocean lease of a portion of the Reef Runway borrow pit area in Keehi lagoon under Chapter 190 D, Hawaii Revised Statutes, as amended. This EA assesses the present environment and current human activities in the proposed pearl farm area. It reviews alternative actions, and recommends the project proceed because of the relatively minor impacts of the project, and the significant economic, environmental and cultural benefits to be gained.

The EA outlines the likely impacts of the pearl farm, and describes means for reducing or mitigating these impacts. With the management practices proposed, the pearl farm will result in little detriment to water quality or benthic ecosystems. An exclusive lease is required for farm security reasons. An area of 75 acres is sought, to enable a commercially viable farm to be supported, and to optimize the health of the reared animals. Animals in better condition will produce better pearls, and will have greater fecundity, maximizing the native pearl oyster stock re-establishment benefits.

The issuance of an exclusive lease will have little impact on current usage of the dredged area; almost all present fishing activities are confined to the surrounding reef flat, and the lease will not exclude the public from these areas. Current rules designate the area for use by recreational thrill craft. This use is not compatible with the pearl farm, and we are working with the jet-ski community and the Division of Boating and Ocean Recreation, Department of Land and Natural Resources (DLNR) to effect a change in the boundaries of this area.

There will be beneficial impacts for the imperiled native species of black-lip pearl oyster, Pinctada margaritifera, from the reef reseeding capacity of the farm. The large, densely-aggregated, well-tended stock of mature adults will represent the largest known reproductive population of oysters in the State. Over time this will result in an increased recruitment of juvenile pearl oysters to the surrounding reef areas, and to the other main Hawaiian Islands. Potential beneficial impacts may also include a reduction in turbidity and an improvement in water clarity in the waters around the farm. The provision of three-dimensional hard-substrate suitable for grazing and browsing may result in an increase in recruitment of juvenile fishes to the surrounding reef and lagoon areas. The facility will be an important precedent for ocean leasing in the state, and would act as a training and education center for pearl farming, and for traditional Hawaiian carving using the native shell material.

The project would also provide revenues to the DLNR's special land and development fund for use in planning, research and development of the aquaculture industry.

---

0. DETERMINATION

0.1 PROJECT DESCRIPTION

The applicant requests an exclusive lease to allow deployment and maintenance of lines, baskets and net-panels in the Reef Runway borrow pit, in Keehi lagoon, for the purposes of commercial culture of the native Hawaiian pearl oyster.

0.2 CONSULTATION WITH AGENCIES AND THE COMMUNITY

Federal Agencies

National Marine Fisheries Service

U.S. Coast Guard

U.S. Department of the Interior, Fish and Wildlife Service

U.S. Department of the Army, Army Corps of Engineers

State Agencies

Office of the Governor

University of Hawaii
- Hawaii Institute of Marine Biology
- Environmental Center

Department of Agriculture
- Office of the Chairperson
- Aquaculture Development Program

Department of Business, Economic Development and Tourism, Hawaii Coastal Zone Management Program

Department of Land and Natural Resources
- Office of the Chairperson
- Division of Land
- Division of Boating and Ocean Recreation
- Division of Aquatic Resources
- Division of Forestry and Wildlife

Department of Transportation
Office of the Director
Airports Division
Harbors Division

Department of Health
Office of the Director
Clean Water Branch
Environmental Health Administration

Office of Hawaiian Affairs

City and County Agencies

Department of Planning and Permitting

Community

Kalihi Neighborhood Board

Hawaii Jewelers Association

Mokauea Fishermen's Association

ATLAPAC Fishing Club

Accepting Authority : State of Hawaii, Department of Land and Natural Resources

Land Use Designation : Conservation District, Submerged Lands, Subzone (R) Resource

Water Classification : Department of Health Class A

Tax Map Key : N/A

Area of Proposed Use : The dredged borrow pit area of land, roughly rectangular, in the reef to the South of the Honolulu Airport Reef Runway, encompassing a total land area of around 75 acres.

Anticipated Time Frame : Commence deployment of oysters on approval of all applicable permits, and signed ocean lease agreement, anticipated to be July, 2001. Expiration date proposed : July, 2021.

Anticipated Determination : The proposed project will not have any significant effect in the context of HRS Chapter 343 and HAR 11-200-12. Therefore a finding of no significant impact (FONSI) is anticipated.

Applicant : Black Pearls, Inc., a private corporation, P.O. Box 525, Kailua-Kona, HI 96725

Funding Source : Private principal investment and commercial loans.

Required permits : Permitting procedures follow Chapter 190 D, HRS, as amended. Permits required include :

U.S. Department of the Army Permit (DA), from U.S. Army Corps of Engineers;
Conservation District Use Permit (CDUP), from Department of Land and Natural Resources;
Coastal Zone Management (CZM) Compliance Certification, from Office of State Planning
Aquaculture License (AL), from Department of Land and Natural Resources, Aquatic Resources

Current Status : Environmental Assessment required. DA, CDUP and CZM permits pending approval of Environmental Assessment. AL will be applied for once the lease is granted.

Distribution list :
U.S. Department of the Army, Army Corps of Engineers
Office of the Governor
Department of Agriculture: Aquaculture Development Program
Department of Land and Natural Resources : Office of the Chairperson
Department of Land and Natural Resources : Division of Land (5 copies)
Department of Land and Natural Resources : Division of Boating and Ocean Recreation
Department of Land and Natural Resources : Division of Aquatic Resources
Department of Health : Clean Water Branch, Office of Environmental Quality Control

Significance Criteria : Chapter 11-200, HAR, establishes "Significance Criteria" to be used as a basis for identifying whether significant environmental impacts will occur. These criteria are addressed below. Significant environmental impacts will occur if any of the following hold :

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource.

There will not be an irrevocable commitment to loss or destruction of any natural or cultural resource. The borrow pit to be used has been previously dredged, so the natural resources have been highly disturbed (see Appendices I, II and III). Subsurface archaeological resources are unlikely to be present in the effected area. In any case, these would not be disturbed by the mid-water farming activity.

(2) Curtails the range of beneficial uses of the environment.

Surveys indicate that the proposed action will not curtail the range of beneficial uses of the environment (see Appendices I, II, III and IV). There is little existing recreational use of the

borrow pit area. The project will only limit use of the surrounding reef flat area under the immediate footprint of the work platforms.

(3) Conflicts with the State's long-term environmental policies or goals and guidelines.
The project is one of the first tests of the amended ocean leasing laws (Chapter 190 D), which were specifically crafted to allow an ocean-based aquaculture industry to develop in the State. The proposed project is consistent with the environmental policies established under HRS 344.

(4) Substantially affects adversely affect the economic welfare, social welfare, or cultural practices of the community and State.
The project will not substantially affect the economic welfare, social welfare, or cultural practices of the community or State. Private investment will be used to finance the project. There will be economic benefits from increased employment and increased jewelry sales. Cultural practices will not be adversely impacted. The project will seek to foster the revitalization of traditional Hawaiian pearl shell carving.

(5) Substantially affects public health.
The project will not substantially affect public health. The water quality immediately around the project site may actually be improved, by removal of particulate and dissolved organics from the water column by the oysters.

(6) Involves substantial secondary impacts such as population changes or effects on public facilities.
No substantial secondary impacts will be involved.

(7) Involves a substantial degradation of environmental quality.
There will be no degradation of environmental quality associated with the project. Indeed, the potential for stock re-establishment benefits, increased water clarity, and greater fish recruitment to the farm area all suggest that there will be susbtantial improvements in environmental quality from the project.

(8) Cumulatively has a considerable effect on the environment or involves a commitment for larger actions.
Implementation of the proposed project will not cause any significant cumulative effects, and does not involve any commitment for larger actions.

(9) Substantially affects a rare, threatened or endangered species or its habitat.
The proposed project will not cause any substantially detriment to a rare, threatened or endangered species or its habitat. Green sea turtles are presumed to occur in the farm area, but will not be adversely affected by the taut-line system for suspending the oysters.

(10) Detrimentally affects air or water quality or ambient noise levels.
None of the emissions from the farm vessels or equipment, or the construction equipment are anticipated to have a substantial effect on air or water quality. Any noise generated by the project, even during construction phase, will be insignificant compared with the noise from the adjacent Reef Runway.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive area.

The borrow pit area, which was dredged to create the Reef Runway, is a highly disturbed environment. Its designation as a Recreational Thrill Craft Area (jet-ski area), and its proximity to the Reef Runway and the State Soil Management Facility all suggest that the area requested for use is not environmentally sensitive.

(12) Substantially affects scenic viewplanes or vistas.

The project will result in few structures above the water (the two small work platforms). Boats and divers will also be regularly working around the oysters in the borrow pit waters. There will be little change in existing viewplanes or vistas by the project and its activities.

(13) Requires substantial energy consumption.

There will be insubstantial amounts of energy used to power the boats and equipment.

Meetings :

January 28, 2000 : "Agency Scoping Meeting", organized by ADP, included representatives from NMFS, ACOE, Coast Guard, Department of Health (DOH), DLNR-DBOR, and DLNR Land Division.

February 8, 2000 : Subsequent follow-up meetings were held with ADP and DLNR Aquatic Resources officials.

March 1, 2000, and July 24th, 2000 : Subsequent follow-up meetings were held with ADP and DLNR-DBOR.

April 19, 2000 : A public informational meeting was held to obtain community input into the plan, and to address potential conflicts with existing user groups in the Keehi lagoon area. The meeting included representatives of ADP, U.S. Coast Guard, DLNR-BOR Keehi Marina management, DLNR Land Board, Boats/Hawaii, Hawaii Jet-ski Boat Association, Mokauea Fisherman's Association, Keehi Marina boater owners, fishermen and residents.

July 24, 2000 : BPI and ADP also met with officials from OHA, to make them aware of the project details, and to assess the potential for OHA's involvement in the education and training components of the project.

January 17, 2001 : A presentation was made to the Kalihi Neighborhood Board.

January 25, 2001 : The DLNR Public Hearing was held to obtain comment on the Environmental Assessment.

1. INTRODUCTION

1.1 PROJECT OUTLINE

Black Pearls, Inc, is proposing to establish the first Hawaiian pearl farm and pearl oyster reef reseeding project in the Reef Runway borrow pit in Keehi Lagoon, Oahu. This project represents one of the first applications for a lease under the amended ocean leasing law, Chapter 190 D, HRS, as amended.

The proposed pearl farm site lies in the South-western most sector of Keehi Lagoon, Oahu, and is directly abutted on the inshore boundary by the Honolulu Airport Reef Runway (Figures 1 and 2). The total area of inshore waters covered by the proposed Farm Lease Area is approximately 35 hectares, or 75 acres (340,000 m^2), which could support a farm standing stock of 50,000 adult oysters. The area was formerly used as the borrow pit for providing fill for the Reef Runway, and thus represents a highly disturbed environment.

The farm array will consist of sub-surface head-lines stretched taut from one side of the borrow pit to the other. These lines will be buoyed to sit just beneath the water surface at low tide, to prevent excessive abrasion on lines and jostling of oysters from wave action, and to ensure ease of working without the need for SCUBA-diving. The polypropylene lines (around ¾" in diameter) will be anchored into the soft substrate at each end using sand-screws or Danforth anchors and concrete block weights. Large (55 gallon) floats at each end will maintain tension on the lines. Oysters will be suspended from the headlines in panels or mesh pouch arrays, with dropper lines keeping the oysters around a depth of about 5 m (15 feet). Smaller floats will support the weight of the oysters along the line. These floats will be anchored with vertical anchor lines weighted by small concrete blocks, to ensure that the lines remain at the precise desired depth (Figure 3).

There will be two farm buildings, two work platforms built or moored at either end of the farm area. which would preferably be permanent post-and-pier structures. If necessary, these buildings may be set on floating pontoons. The work platforms will preferably be built over the soft substrate patches on the inshore side of the farm area, to minimize impacts on the benthic environment (Figure 4). The platforms will be raised above the reach of high waves on spring tides, and will have gangways to moored floating pontoons in deep water for ready access by small boats (Figures 5 and 6). The pontoons will be moored in the same manner as the farm array. The platforms will include semi-enclosed work areas, of a maximum height of 12 feet, to afford workers some protection from the elements while working on farm equipment and oysters, together with a seeding shed for performing the pearl implantation operations, and areas for basing guards and security equipment. With the pontoons and dock areas, boats will be able to move readily between the lines, the staging/storage area and the work platforms. This will mean that there will be no physical damage or other impacts on the corals or other benthos surrounding the farm area.

A single large staging area building on the islet at the end of the Reef Runway was proposed as part of the draft EA. There was some public opposition to private use of the beach area of the

islet, however, and the proposal now does not include this building. The storage area, workshop, restrooms and office facilities will now be located at an alternative land base site, probably in the commercial area of Keehi Marina.

The farm security network may include passive submarine hydrophones, active sonar and other tracking devices, and radar for monitoring nearby surface boat traffic. We will provide FAA and the State Airports Authority with details on all security equipment, to ensure that there is no incompatibility between the farm system and airport operations.

Farm work vessels will be powered by commercially-available jet- or propeller-driven units. Boat designs will provide maximum utility combined with good safety. Fuel will usually not be stored on the site, except in small containers for immediate use. Most fuel and other supplies will be purchased from the commercial fuel dock at Keehi Marina, to eliminate the risks of a major spillage in the farm area due to farm activities.

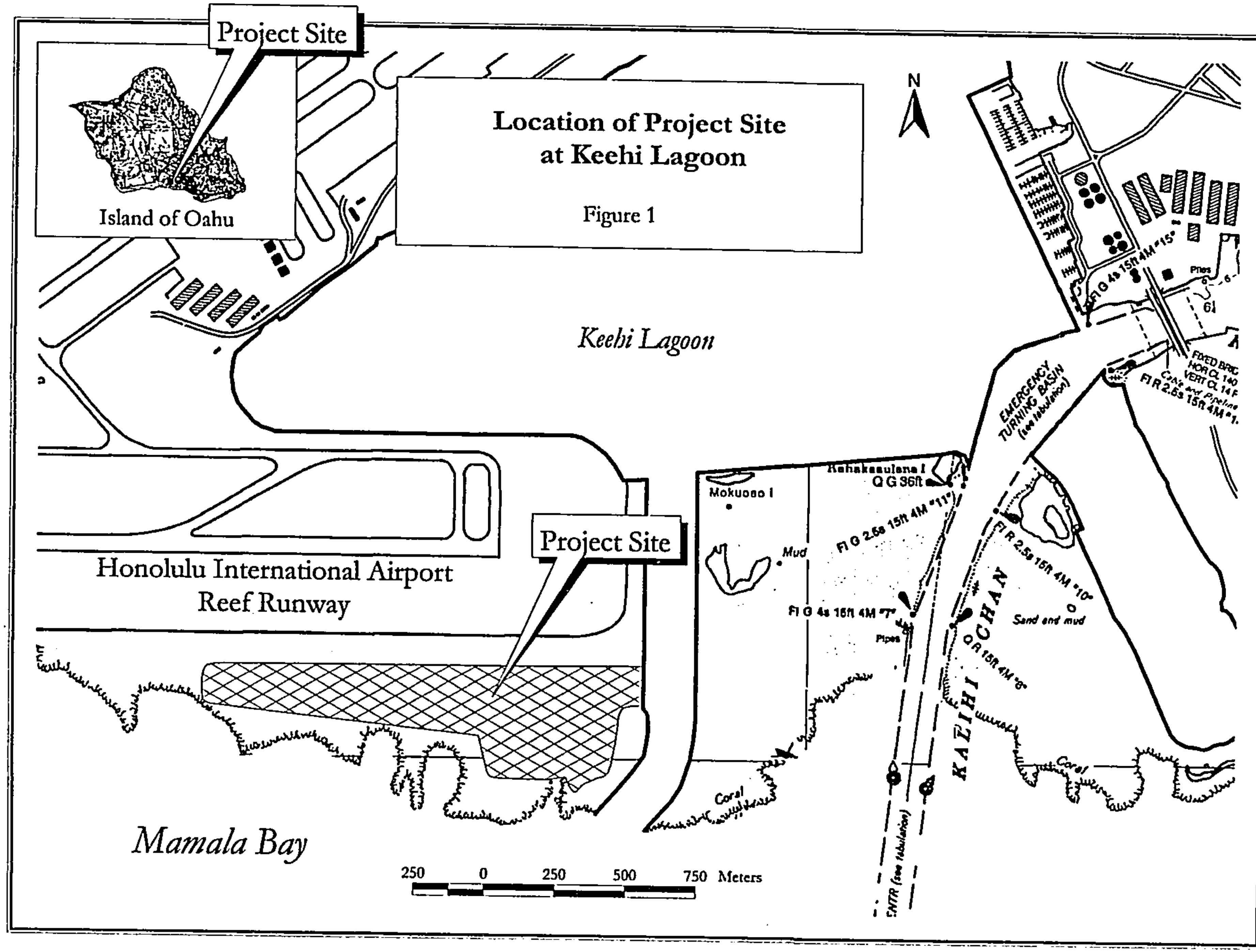
The main farm activities will be maintaining and grading juvenile oysters in the nursery grow-out, cleaning adult oysters in panels or on droplines, and moving oysters to and from the seeding shed when performing the pearl implantation operation and pearl harvest. Nursery grow-out will produce moderate volumes of solid waste – used mesh bags, mesh tubes, and mesh pouches, which will include varying amounts of marine fouling organisms. These would include, primarily, macroalgae, sponges, bryozoans and tunicates. This waste will be disposed of through a contract with a commercial waste management company, and deposited offsite into a county land-fill. Similarly, fouling organisms which accumulate from the cleaning of adult shells will be transferred to a commercial waste disposal company for composting or inclusion into county landfill. Cleaning will occur by lifting the panels from the water, and brushing and spraying them with high-pressure sea-water sprayer in a cradle aboard the pontoons. The cradle drain will be covered with a fine-mesh bag to prevent return of solids to the water. The pearl implantation operation will also result in some solid waste from used mesh bags, and organic waste from oyster tissues. These will be disposed of similarly.

1.2 POTENTIAL BENEFITS

1.2.1 Economic benefits

As with the Tahitian variety, the Hawaiian pearl oyster is capable of producing high quality pearls and pearlshell. Black Pearls, Inc. has had the local shell evaluated by three expert seeding technicians, who considered it very suitable for pearl production (Toshi Fuji, John Lyons, and Ray Marks, pers. comm.). Genuine "Hawaiian black pearls™" would provide a distinctive line for local jewelers, and assist the visitor industry by adding to the romantic allure of the islands. Native Hawaiian artisans would once again be able to work with their local material, preserving cultural traditions and providing opportunities for innovative craftsmanship.

BPI has recently secured a Federal grant to train Hawaiians and Marshallese in pearl seeding techniques, and applied to other State and Federal agencies to expand this program to include

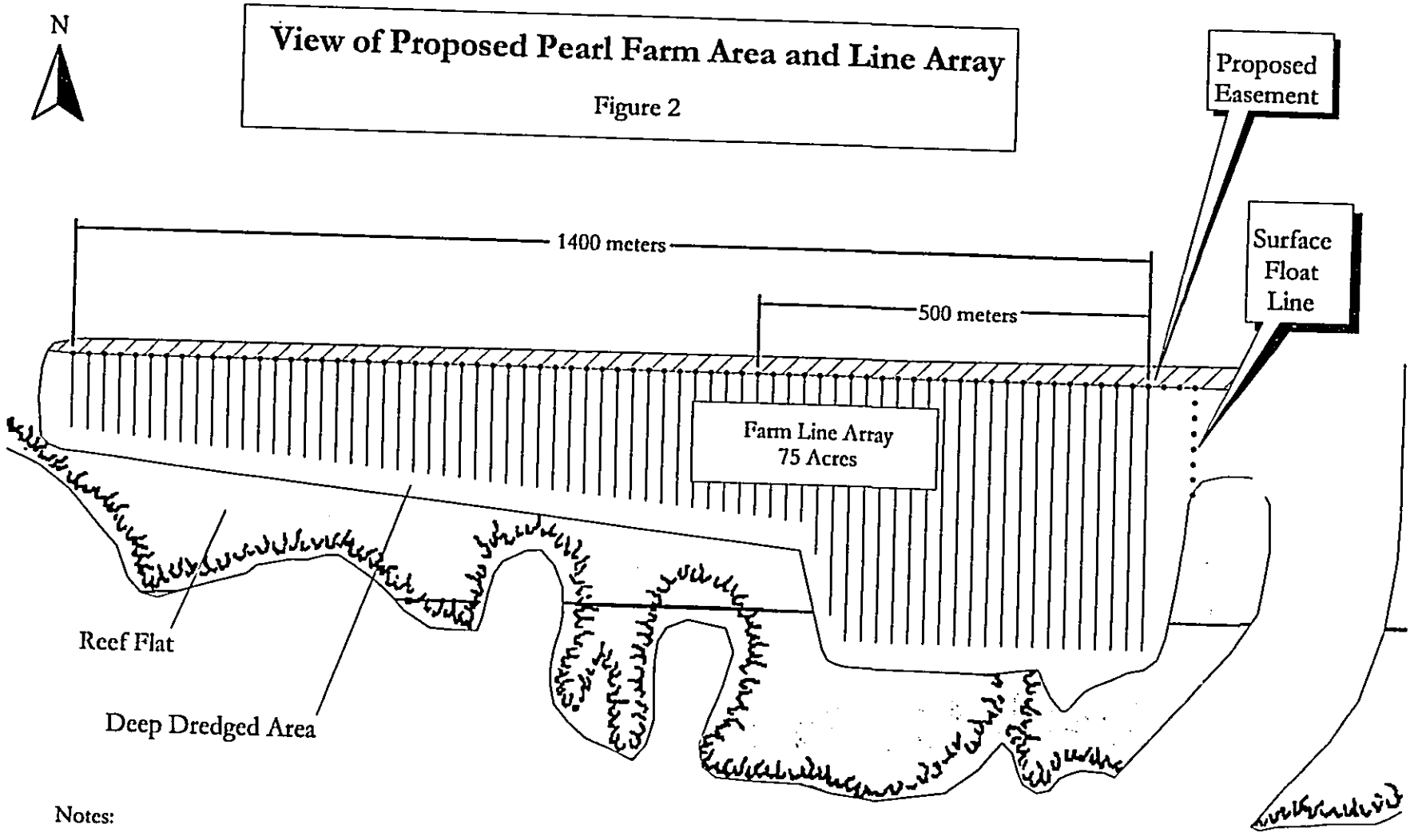


Location of Project Site at Keehi Lagoon

Figure 1

View of Proposed Pearl Farm Area and Line Array

Figure 2



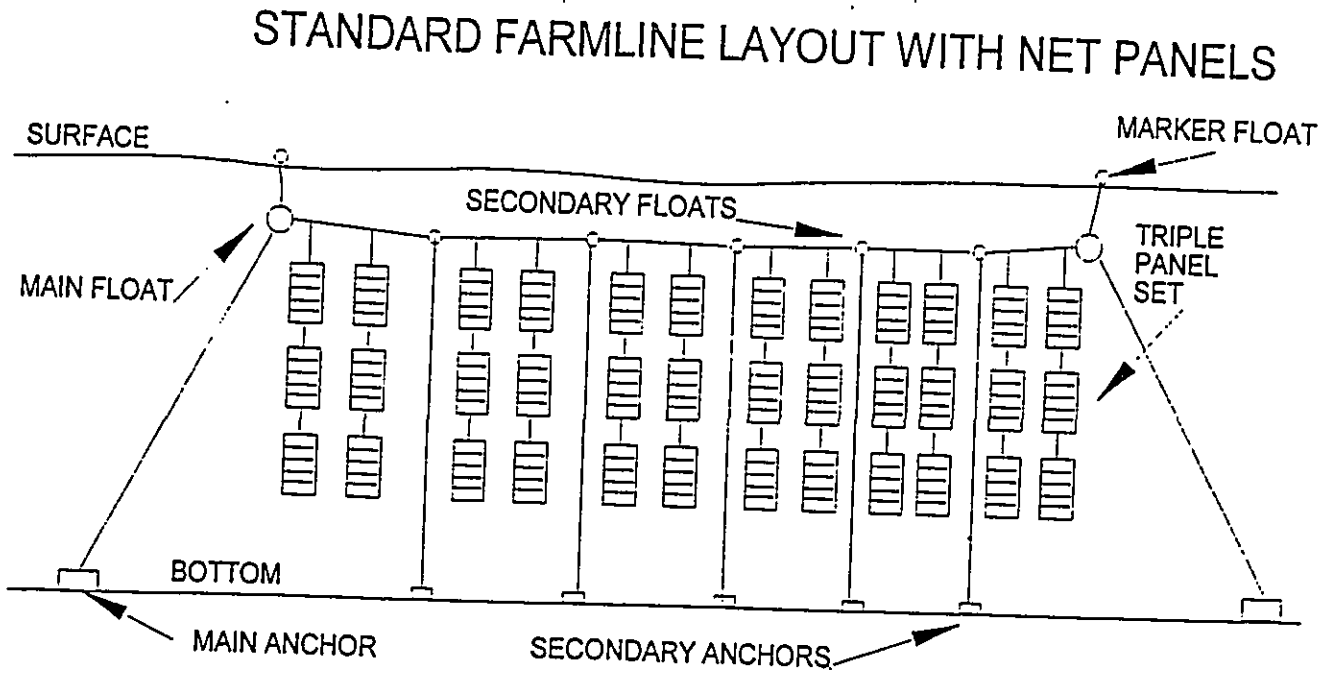
Notes:

1) Distance between farm lines is approximately 20 meters

2) A well-marked surface float line will mark farm area and easement

3) Two post and pier working platforms will be located on the shallow side of the site along the runway and function as workstations and security points

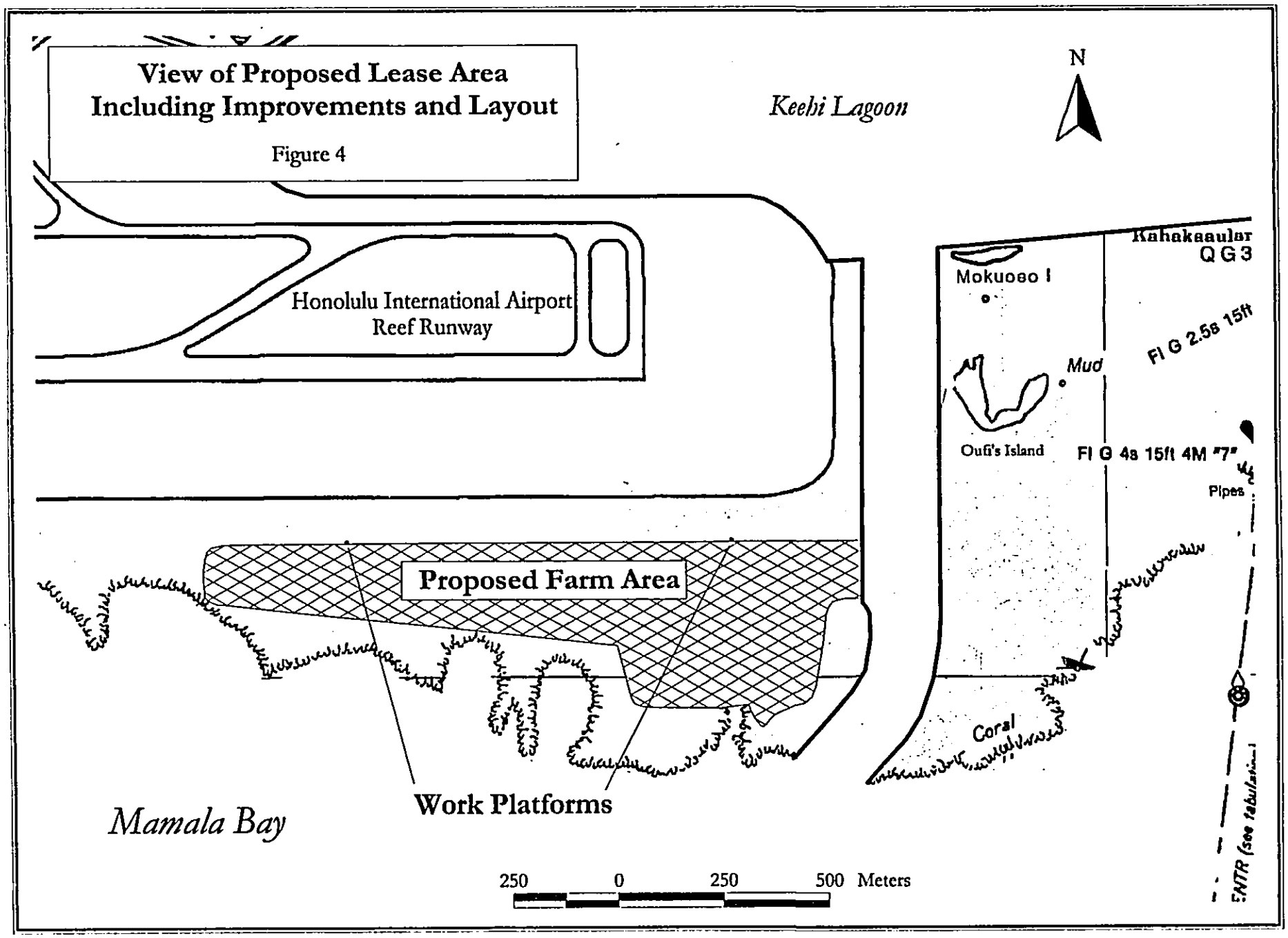
Figure 3. Elevation view of pearl farm line and panel array

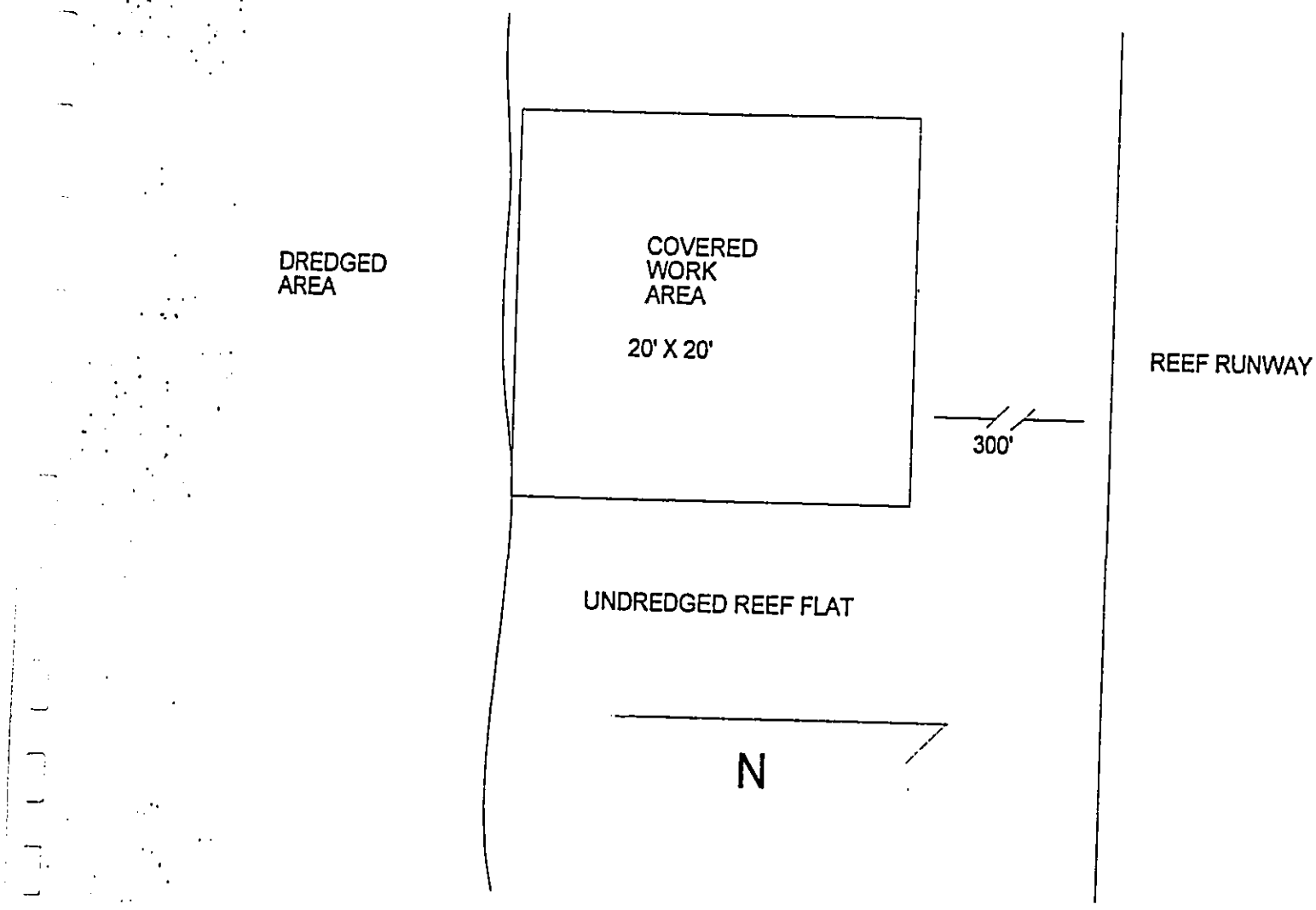


NOTES:
1) WATER DEPTH IN THE AREA IS APPROXIMATELY 40', MAIN FLOATS 12' BELOW SURFACE. SECONDARY FLOATS ARE 12-15' BELOW SURFACE.
2) MAIN ANCHORS ARE CONCRETE BLOCKS ABOUT 200 LBS EACH. SECONDARY ANCHORS ARE 50-75 LBS EACH.
3) A TYPICAL FARMLINE IS ABOUT 600', (THE LENGTH OF A COIL OF ROPE).
4) ALL ROPES ARE POLYPROPYLENE AND RANGE FROM 1/2 TO 3/4'"THICK.
5) FLOATS ARE ROUND PLASTIC FROM 10 - 16" IN DIAMETER.
6) THERE WILL BE A SMALL 6" SURFACE FLOAT TIED TO THE MAIN FLOATS TO MARK THE LOCATION OF EACH FARMLINE IN THE FARM,
7) EACH PANEL WILL CONTAIN FROM 20 - 60 OYSTERS DEPENDING ON THEIR SIZE.

View of Proposed Lease Area Including Improvements and Layout

Figure 4





LAYOUT OF WORKING PLATFORM. THE PLATFORM WILL BE MADE FROM LUMBER PLANKING AND PLYWOOD. IT WILL BE SUPPORTED BY 9 UPRIGHT POSTS IMBEDDED IN 2' X 2' CONCRETE PIERS RESTING ON THE BOTTOM. THERE WILL BE A ROOF BUT NO WALLS.

FIGURE 5

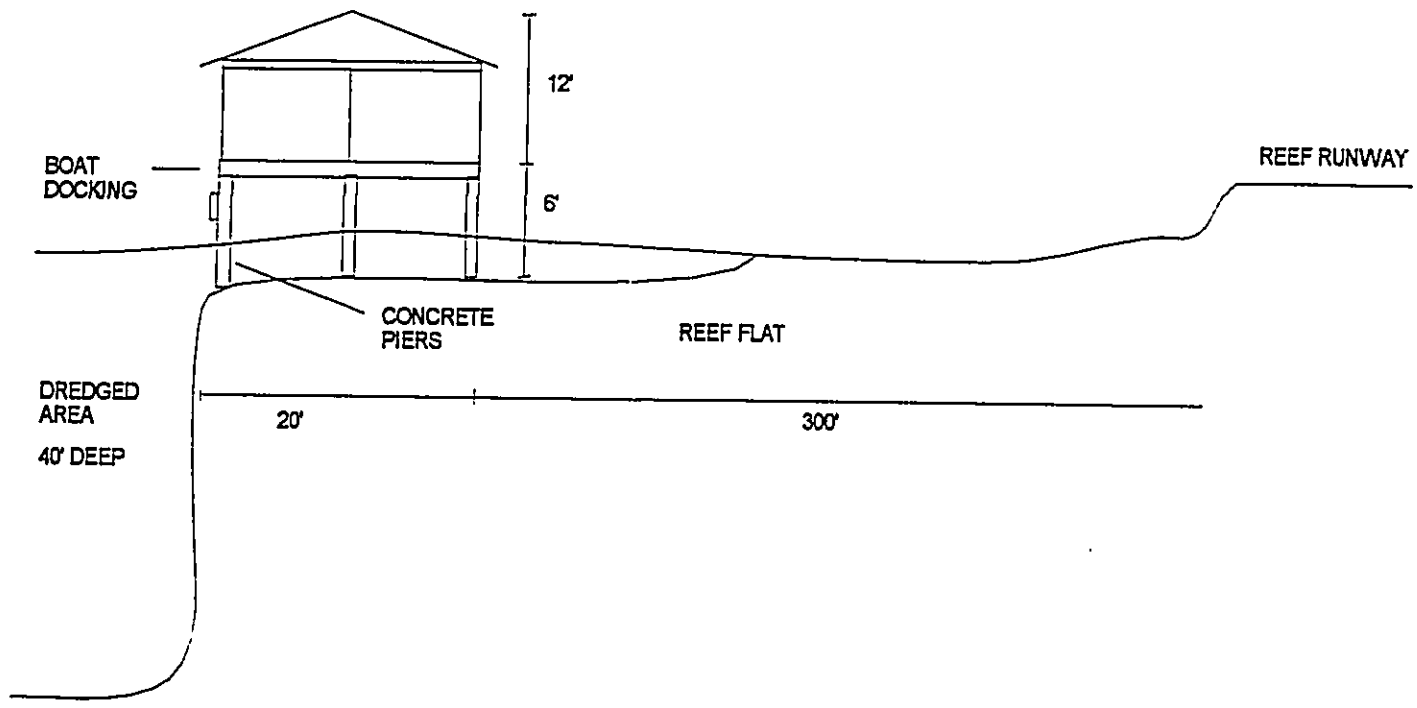


FIGURE 6 WORKING PLATFORM. SIDE VIEW LOOKING WEST.

pearl shell carving and jewelry manufacture. These artisans will form the basis for the expanding integrated pearl industry envisaged for Hawaii.

There are significant economic gains to be derived from this project. Both direct and indirect benefits accrue from the establishment of the first pearl farm, and further benefits occur from other activities. The first commercial pearl farm in Hawaii offers the potential for healthy returns to the investors over the long term. The Federal and State governments will gain increased revenues from direct lease payments, and taxes on wages, purchases of materials and supplies, sale of product and corporate profits.

More than just a single farm, however, this project has the capacity to foster a broad-based industry, with wider long-term economic benefits. As oyster stocks recover, and oysters become more common, techniques will be developed to allow pearl farming along the more protected rural coastlines (Kona, the southern shore of Molokai) and other open coastal areas of the Hawaiian Islands (such as Maalaea Bay, in Maui, and Kawaihae Bay, on the Big Island). A pearl culture industry in Hawaii could help revitalize rural island economies, especially in the economically-depressed areas suffering from the decline of large-scale plantation agriculture. The industry offers lucrative returns and stable employment, as well as wider socio-economic benefits: reversing rural-urban drift and increasing demand for support industries.

On a macro-economic scale, a Hawaiian-based black pearl industry could also reduce imports of Japanese and Tahitian pearls (currently running at around US$400 million per year). "Hawaiian Black Pearls"(TM) would provide a new, highly valuable export, add to the attractions offered to Hawaii's visitors, and enhance the allure that draws them here.

1.2.2 Ecological benefits

The native Hawaiian black-lip pearl oyster, Pinctada margaritifera (galtsoffi), is a distinct, endemic variety of the oyster that produces the fabled Tahitian black pearls. The local pearl oyster was once common, and was traditionally used by Hawaiians in making fishing hooks and lures, other tools (Buck, 1964; Summers, 1990) and ornaments.

The oyster has become increasingly rare since Western contact, due primarily to commercial fishing. The last significant stocks of P. margaritifera (galtsoffi) were fished out at Pearl and Hermes Reef in the 1920's, when over 100 tons of pearl shell were taken from this shallow, open lagoon (Galtsoff, 1933). Recent surveys by N.M.F.S. divers found only 30 adult shells in over 18 diver-hours (R. Moffat, pers. comm.). All of these oysters were above 20 cm shell diameter, suggesting that recruitment is negligible.

Stocks remain uncommon around the main Hawaiian islands (Kay, 1979), despite legal protection. The pearl oyster is often taken by divers for curio value, or for food. They are also preyed on heavily by fish and octopi. Only relict stocks remain in a few areas (Kay, 1979; Sims, 1989; Rogers, et al., in press).

BPI's research has shown that it is simply not practical to conduct an intensive effort to directly reseed Hawaii's reefs and lagoons with hatchery-produced oysters. Fish, crabs and octopi quickly attack any unprotected oysters that are broadcast on the reef. Protective cages would be subject to fouling, and would still leave the oysters vulnerable to snails and other predators.

A more effective stock re-establishment plan would therefore be to set up reproductive reserves of large, densely-aggregated, older adult oysters. These closely-packed, highly fecund animals would be able to synchronize spawning and achieve high fertilization rates, resulting in large numbers of competent larvae. These larvae would then be dispersed by currents, eventually settling out naturally onto the reefs and lagoons throughout the island chain.

1.2.3 Demonstration of pearl farming and ocean aquaculture

Open ocean and nearshore aquaculture offers great potential for this Ocean State. Only recently has the legal pathway opened for development of such water-based aquaculture ventures, with the passage of Act 176 SLH 1999, which amended Chapter 190 D, HRS to allow commercial ocean leases. A pearl farm represents a test of the new ocean leasing law. This application centers on farming of an imperiled, native filter-feeding bivalve.

During the 1999 legislative hearings, this project was identified as an excellent vehicle to test the potential benefits of ocean leasing. Act 176 allows lease applications to be accepted for a five year period; after which the legislature will decide if the amendments will be continued or not. This project offers a unique opportunity for testing a basic technology, using the most benign of species. It also offers a great opportunity to demonstrate to the State government, and the people of Hawaii, the potential benefits of pearl farming.

1.2.4 Cultural and broader benefits

This project will also incorporate a pearlshell workshop area, where traditional pearlshell carvers are given the opportunity of working with natural, native materials, and sharing their skills and knowledge with each other, and with the public. The pearlshell workshop could act as a resource and training center for these artisans, preserving cultural traditions while promoting commercial opportunities for native Hawaiian crafts.

The pearl farm may also be able to offer public tours and other educational opportunities, including information on the oyster species, its history in Hawaii, and the stock re-establishment effort. Eventually an ancillary facility might include a retail outlet for educational materials such as videos and books, and pearl shell and pearl jewelry sales. BPI is currently assisting the Maui Ocean Center to develop pearl oyster displays and written and video educational materials for the public, and is working with the University of Hawaii at Hilo, and UH Seagrant to develop educational videos and displays. The farm would provide further impetus to this kind of work.

1.3 SITE SELECTION

Despite its allure, development of pearl farming in Hawaii presents considerable technical and financial challenges. There are insufficient wild pearl oysters in Hawaiian waters, and there is low natural spatfall. All oysters must therefore be produced in a hatchery. There are also few areas available which both offer protection from high-energy winter waves, and present limited conflicts with existing user groups. Security of the farm is also a major concern, with such a valuable crop. Finally, pearl farming is a very labor-intensive industry, with labor comprising the single greatest component of farm operating costs. Agricultural labor costs in Hawaii are very high – amongst the highest in the nation.

Other countries throughout the Pacific offer more sites, with inexpensive local labor, and an abundance of wild oysters. Regular natural spatfalls can often be gathered on artificial spat collectors. However, one major competitive advantage that Hawaii enjoys is the proximity to the local tourist market, and the potential for the added marketing allure of an Hawaiian pearl.

1.3.1 A preferable pearl farm site

This section of Keehi lagoon was selected for the following reasons :

1. Oysters demonstrate good growth and condition (compared to other sites tested within Keehi Lagoon and Honolulu Harbor)
2. there is good protection from extreme weather and surf conditions
3. there is little existing use of the area
4. potential land-base sites are close to the farm area

Oyster growth and survival rates at Keehi lagoon are compared with other sites and discussed below (see Section 4.1.2 and Appendix V).

The major North and North-west ocean swells of winter have little impact on the South shore of Oahu. The fringing reef in the ocean side of the proposed area affords good protection from South swells, yet still allows continuous swell-driven water circulation through the area. The reef and broad offshore shelf at Keehi manage to dissipate most of the energy of these large ocean swells. The site is also protected from strong trade-wind driven swells, and is not exposed to any long fetch for wind-driven chop, which might limit the number of working days on the site.

1.3.2 An existing environment already severely impacted

The physical and biological attributes of the existing environment of the Reef Runway borrow pit in Keehi lagoon is described below. The area's topography and oceanography are distinguished by the soft, deep silt at the pit bottom, its single deep passage for drainage, and its high rate of flushing by ocean water driven over the reef through wave action. The existing uses of the area are dominated by the proximity of the airport Reef Runway and the airplane traffic. The area is depauperate of fish and bird life, and the benthos is barren.

Wild pearl oysters have been found in the area, during the course of our grow-out trials. This indicates that water quality is sufficiently stable to allow the oysters to thrive in the area.

No endangered species are known to occur in the Keehi Lagoon area. Leatherback and Green Sea Turtles and Monk Seals may occasionally stray into these areas, but the farm does not represent any detrimental impact on these animals. The taut-line mooring system and stiff-mesh panels used to suspend the oysters will mean that these animals could not become entangled in the sub-surface lines. The National Marine Fisheries Service has stated that "the application by BPI is not likely to adversely effect (Endangered Fish Habitat) or any of the (endangered) listed species, which includes the threatened green turtle (*Chelonia mydas*) (letter from Charles Karnella, dated 1/24/01: see Correspondence Attachments).

1.3.3 Minimal potential conflict with existing user groups

The highly disturbed nature of the dredged site means that there is little traditional or customary use of the area. Fishing activities (primarily spearfishing and net fishing) are almost exclusively confined to the shallow reef flat surrounding the farm area. The farm lease will not markedly affect public access to this area, nor restrict fishing activities on the reef flat. Dive surveys of the deep dredged area have shown that there are very limited fish stocks, and almost no benthic organisms which will be negatively impacted by the farm.

There are no historical sites that would be impacted by the pearl farm plans. The only notable recreational use of the deeper borrow pit water is the designation by DLNR-BOR as a recreational thrill craft area. This use is not compatible with the pearl farm, a change in the boundaries of this area will be required before the lease can be issued (refer to letter from Howard Gehring, dated 11/20/00: see Correspondence Attachments). The Kalihi Neighborhood Board has expressed unanimous support for the proposal (letter from Bernadette Young, dated 2/12/01: see Correspondence Attachments).

1.3.4 Practical and economic limitations of the lease area

Based on the available farm area, and extrapolation from ecological modeling of sustainable carrying capacities of the Keehi lagoon waters by our consultants, the number of farmed oysters in the proposed lease area should not exceed 50,000 adult animals (see Appendix I). This would represent approximately 20,000 pearls harvested each year. Assuming these pearls attain the same wholesale prices as Tahitian pearls, a farm of this size could generate gross annual revenues, at steady state (after Year 8) of approximately $0.8 million. This would provide an acceptable return on the $2.2 million initial investment in the farm.

Economies of scale dictate that a farm standing stock of 50,000 adult oysters is the minimum viable farm size for this area. If the farm area is any smaller, the oysters become too crowded, or the farm must hold fewer oysters. Greater crowding negatively impacts oyster health, which may result in poorer pearl quality, or a reduction in oyster fecundity and the reef reseeding benefits from the farm. Greater crowding may also negatively impact the benthos or water quality (Appendix I). Fewer oysters on the farm would reduce the operation's gross revenues, resulting in an unacceptably low rate of financial return on the initial investment.

2. PURPOSES AND JUSTIFICATIONS

2.1 PURPOSES

The proposed operation of the first Hawaiian pearl farm in the Reef Runway borrow pit at Keehi Lagoon has two primary purposes. The first is to set up a commercially-viable for-profit aquaculture entity that will produce Hawaiian black pearls and black-lip pearl shell for use in the local jewelry and artisan industries. The second is to use this farm as a privately-funded, economically self-sustaining stock re-establishment program for the native Hawaiian black-lip pearl oyster, P. margaritifera (galtsoffi). These two primary purposes are briefly outlined in Section 1.2 ("Potential Benefits"). These primary purposes are expanded upon below (Sections 2.2.1, and 2.2.2, respectively).

As the first commercial pearl farm in Hawaii, and one of the first uses of the amended ocean leasing law, this project can serve as an excellent demonstration of pearl farming and ocean aquaculture in Hawaii. The farm will also offer opportunities for training of prospective pearl farmers for expansion of the industry to other, more rural areas of the state, and training of Hawaiians and other Pacific Islanders in the technically-demanding pearl seeding operation.

The availability of native Hawaiian pearl shell and the catalyst of the farm presence could also help foster a revitalization of traditional Hawaiian shell carving. The farm could provide a venue for artisans to work and share skills with apprentices or the public, as well as possibly providing a related retail outlet for such artifacts. BPI has been working with both traditional and modern pearl shell carvers, and all have expressed interest in using the farm as a vehicle for greater exposure and training opportunities.

There is also envisioned a significant public education component of the project – either on-site, or through affiliated institutions such as Seagrant, Hawaii Institute of Marine Biology (HIMB), the Natural Energy Laboratory of Hawaii Authority (NELHA), Maui Ocean Center and Waikiki Aquarium. This project represents an ideal marriage of commercial development and ecological preservation, and could be seen as a model public-private partnership.

2.2 JUSTIFICATIONS

2.2.1 Meeting the demands of the Hawaiian pearl market

The Hawaiian jewelry trade suffers from an almost complete lack of locally-produced gems. Hawaii's jewelers have expressed enthusiasm for developing a source of local pearls. Jewelers report that they receive regular inquiries from customers who show interest in purchasing local product. The jewelers can only refer wistfully to the fishery in Pearl Harbor in the early 19th Century, and the rare natural pearls found amongst the oysters collected from Pearl and Hermes Reef in the late 1920's. Members of the Hawaii Jeweler's Association and the Hawaiian Chapter of the Geological Institute of America have all expressed interest in assisting with the development and marketing of "Hawaiian black pearls(TM)". A seminar presented to GIA (Hawaii

Chapter) by one of BPI's principals was considered by the organizers to be one of the best attended and best received presentations in the Chapter's history (Edward Cook, in litt., March, 1999).

The U.S. pearl market has been growing dramatically throughout the last decade. The total value of all pearl imports increased from US$ 108 million in 1990 to over US$ 407 million for 1999. Black pearl production volumes in French Polynesia have similarly increased from around one tonne in 1990 to a current level of over four tonnes. This increase in production has largely been absorbed by the burgeoning U.S. demand. Pearls – particularly black pearls – are now known and recognized throughout most regions of the U.S. Hawaiian black pearls(TM) could similarly provide a distinctive product for local jewelers. This could result in increased sales volume from the pearls themselves, but also increased sales from greater traffic through jewelry stores.

The experience from Tahiti suggests that sales of native Hawaiian pearls and pearl crafts could increase the profile of Hawaii. Every ring, necklace, earring or carving sold out-of-state becomes a perpetual promotional tool. Astute marketing of Hawaiian black pearls(TM) would associate the product with the exclusive, expensive South Sea Pearls, rather than the more common Akoya pearls from Japan, or freshwater pearls from China.

A Hawaiian-based black pearl industry could also offer some benefits from improving the national balance of payments through import substitution. Hawaiian black pearls could reduce the current level of pearl and pearl product imports, primarily from Japan and Tahiti, valued at over US$400 million per year. "Hawaiian Black Pearls"(TM) would provide a new, highly valuable export, add to the attractions offered to Hawaii's visitors.

2.2.2 Hawaii's black-lip pearl oyster in peril

a. The taxonomic status of P. margaritifera (galtsoffi)

The native Hawaiian black-lip pearl oyster, Pinctada margaritifera (galtsoffi), is a distinct, endemic variety of the oyster that produces Tahiti's famous black pearls. P. margaritifera is widespread throughout the Indo-Pacific, ranging from East Africa and the Red Sea, to Hawaii and the southeastern-most isles of Polynesia (Gervis and Sims, 1992).

Bartsch (1931) described the Hawaiian pearl oyster as a separate species, P. galtsoffi, but Kay (1979) considered it indistinguishable from Ranson's description of P. margaritifera. The precise taxonomic status of the Hawaiian oyster will probably need to be clarified by genetic studies, but it is certainly an invaluable, discrete gene pool. The breadth of genetic diversity will become even more important as controlled breeding programs seek to produce strains that may grow faster, be more disease resistant, or produce larger, or better quality pearls.

b. The status of stocks in Hawaii

The Hawaiian pearl oyster was once common around the main Hawaiian Islands, and was traditionally used by Hawaiians in making fishing hooks and lures, other tools (Summers, 1990)

and ornaments. The oyster has become increasingly rare since Western contact, due primarily to increased fishing pressure.

The last significant stocks of P. margaritifera (galtsoffi) were fished out at Pearl and Hermes Reef in the 1920's, when over 100 tons of pearl shell were taken from this shallow, open lagoon (Galtsoff, 1933). Recent surveys by N.M.F.S. divers found only 30 adult shells in over 18 diver-hours (R. Moffat, pers. comm.). All of these oysters were above 20 cm shell diameter, suggesting that recruitment is negligible.

Stocks remain uncommon around the main Hawaiian islands (Kay, 1979), despite legal protection. The pearl oyster is often taken by divers for curio value, or for food. They are also preyed on heavily by fish and octopi. Only relict stocks remain in a few areas (Kay, 1979; Sims, 1989, Rogers, et al., in press).

Kaneohe Bay holds one of the few remaining refuges of pearl oysters around the main Hawaiian Islands. BPI personnel have undertaken surveys of the stocks in Kaneohe Bay with assistance from National Marine Fisheries Service and H.IM.B. staff. Permanent transects were used to track changes in oyster abundance from the original survey in 1989, to the most recent survey in 1996 (Sims, 1989, Rogers, et al., in press). Even in its best known refuge, the stocks are showing only just being maintained, and are still under heavy fishing pressure.

Extensive surveys of reefs and lagoons elsewhere throughout the main Hawaiian islands found very few oysters (Sims and Sarver, 1998). Most were widely scattered, with fewer than one oyster found per hour of diving. Several small discrete clumps of oysters have been found by BPI divers over the years.

c. Stock re-establishment : The reproductive reserve concept

The Hawaiian pearl oyster has suffered from severe and ongoing overfishing, where the population has been reduced to the point at, or just below the level of self-sustainability. Sedentary animals in exposed reef environments such as Hawaii's coastlines are highly susceptible to overfishing. There is similar evidence of virtual extirpation of P. margaritifera in Kiritimati Island (Christmas Island) in Kiribati, and Suwarrow Atoll, in the Cook Islands. Together with Pearl and Hermes Reef and Kaneohe Bay, these lagoons are all characterized by low lagoon water retention times. Once fishing has depleted the population density, fewer viable embryos are produced, and fewer larvae successfully recruit.

P. margaritifera is a protandrous hermaphrodite, maturing first as males, with some proportion of the population later converting to females. By five years of age, a normal population will have around a 1:1 ratio of males : females. Fecundity of oysters also increases with age. The greatest reproductive potential of an individual is probably somewhere beyond 8 or 10 years old.

Spawning occurs as irregular epidemic incidents; males spawn first, which subsequently stimulates females to spawn. When oysters are thinly scattered on an exposed reef or open

lagoon, there is a reduced likelihood of a successful synchronized spawning. At low densities, dilution factors also greatly reduce the proportion of eggs that are successfully fertilized.

In earlier research (see Section 4.1.1), BPI tried to develop the means for directly re-establishing juvenile or adult oysters onto Hawaii's reefs. However, the heavy predation problems, and fouling of any protective cages, precluded this as a viable means of introducing hatchery-bred animals into the wild. This research concluded that "reproductive nodes" would be the most effective means of stock re-establishment; aggregations of large, fecund oysters cultured at selected locations throughout the islands. These would overcome the problems of poor spawning synchronization and low fertilization rates by placing the oysters in close proximity to each other. With these "reproductive nodes" located in bodies of water with some reasonable retention time, subsequent chances of recruitment would be optimized.

A considerable commitment of funds would be required over the long term to set up, protect, and maintain these nodes. Besides hatchery and nursery operating costs, the oysters must also be cleaned regularly, to ensure that they remain in good condition. Security must also prevent theft or predation. The maximum reproductive potential for a hatchery-generated node is not attained before 10 years, and so measurable benefits of increased recruitment to nearby reefs may not be discernable until 15 years or more. There is no way that public funds would be able to support such a strategy. The only economically viable option is to seek support from the private sector, and to extract some economic returns from the reproductive nodes.

A commercial pearl farm is, in essence, an ideal reproductive node. In a farm, large numbers of older oysters are held in close proximity, well tended and regularly cleaned. The synchronized spawning epidemics would result in high fertilization rates and large numbers of larvae released into the plankton. The larvae would be dispersed by currents, eventually settling out naturally both onto the reefs and lagoons in the immediate area, or throughout the group.

This pattern of farm development resulting in increased recruitment of P. margaritifera to the wild – and to artificial spat collectors - has been reported from French Polynesia and the Cook Islands (Ray Newnham, Ray Marks, pers. comm.). A similar increased abundance of Mexican winged pearl oysters (Pteria sterna) has also been reported from Guayamas, Mexico, in conjunction with farm development there (Oscar Blanco, pers. comm.).

2.2.3 Demonstration of nearshore ocean aquaculture

a. A test case for the new ocean leasing law

Amending the ocean leasing law during the 1999 State legislative session engendered much comment from agencies and the public. Both legislative committee members and many of those who testified at the hearings recognized that the future for ocean aquaculture in Hawaii required a "user friendly" permit/lease regime, to test the feasibility and impacts of such leases.

Interest in ocean aquaculture is rising among policy-makers and private aquaculture entrepreneurs. However, the general public has little perception of the issues, impacts and

benefits from ocean farming in the nearshore or offshore environments. The amended ocean leasing law was specifically crafted to provide for a finite testing period. During this five year period, the legislators envisaged that two or more private companies might apply for, and be issued with, ocean leases for aquaculture purposes. Reports to the legislature each year on progress under this revised law are required. There is therefore a clear mandate from the legislature for trial ocean leases to assess the impacts on the environment and public reaction.

This project offers a great opportunity to demonstrate to the State government, and the people of Hawaii, the potential benefits which pearl farming – and other nearshore aquaculture ventures - could bring. This will then enable informed decision-making when the law is reviewed at the end of the five year trial period.

b. Training and extension opportunities

This venture will also provide training for prospective pearl farmers, farm workers and pearl seeding technicians. Black Pearls, Inc. has a demonstrated capacity for training and for fostering a broad industry growth, as evidenced by the efforts of our subsidiary farm in the Marshall Islands. Black Pearls of Micronesia, Inc. currently employs over 40 locals on our one farm site and hatchery in Majuro. Partner-farm joint venture arrangements are also helping to foster locally-owned and operated farms in other islands beyond Majuro.

Over the last eight years we have received support for training programs from US Department of Agriculture (USDA), National Marine Fisheries Service (NMFS), University of Hawaii Seagrant (UHSG) and Land Grant, in both Hawaii and the Marshall Islands. We have also established close links with the newly-established Pacific Pearl Culture Training and Extension program based at the University of Hawaii-Hilo. We would also welcome involvement from other State, Federal and private agencies to increase our capacity and effectiveness in accomplishing these training and extension goals.

By increasing the level of pearl culture and offshore aquaculture expertise among Hawaii's workers, this project will support the possible future growth of this industry in the State. It will also enable Hawaii to leverage a greater role in the growing Pacific pearl culture industry.

2.2.4 Rekindling artisanal carving with Hawaiian pearl shell

It has become increasingly difficult to find artisans who can demonstrate an expertise – or even a working competence - in traditional Hawaiian carving skills. There appear to be several constraints that inhibit perpetuation of these skills: the artisans usually work alone, and are largely self-taught; there is little natural local material available; and there is little to distinguish traditional Hawaiian artifacts from other imported imitations in the marketplace. There is therefore a need to bring together artisans who have an interest in reviving and perpetuating the traditional Hawaiian carving skills, to enable sharing of ideas, instruction of novices and training of apprentices. There is a need to focus these activities around a source of natural local materials, such as Hawaiian pearlshell, and there is a need to provide for retail outlets under a co-operative

or other designation that would ensure that these traditional pieces achieve recognition and appropriate value in the marketplace.

We envisage that, at some stage, our project will be able to address these needs by fostering the set-up of a Hawaiian pearlshell workshop area. At this facility (which may or may not be located near the farm), traditional pearlshell carvers will be given opportunity for working together with natural, native materials, as well as having opportunity for sharing their skills and knowledge with each other, and with the public. The pearlshell workshop could act as a resource and training center for these artisans, preserving cultural traditions while promoting commercial opportunities for native Hawaiian crafts.

2.2.5 The broader need for environmental awareness: a model

The native Hawaiian pearl oyster has been largely left to languish by the public agencies for reef conservation and restoration. This may be due to lack of awareness of the oyster and its plight, and the possible steps that could be taken to begin restoration. Black Pearls, Inc., working under federal and state research grants, has led the development of hatchery techniques, nursery and grow-out culture and stock re-establishment methods for this species. USDA, NMFS, National Science Foundation (NSF), UH SeaGrant, and Hawaii's High Technology Development Corporation have provided research and development funds. This public-private approach could be a model for other co-operative conservation efforts, such as coral reef restoration.

There is also a broader history to the native Hawaiian pearl oyster, and a greater ecological message in this project that could be used to increase environmental awareness among both policy-makers and the public. This project could be used as an exemplary case study for explaining the fragility of the reef ecosystems, the difficulties of recovery after abuse, and the advantages of co-operative efforts. The consequences of the earlier overfishing of stocks present a powerful lesson. The role of P. margaritifera in Hawaii's coral reef community offers opportunity for deeper understanding of biodiversity and ecological balance. This component could also highlight the collaboration in developing this project between the private sector and Hawaii's State government.

3. PROJECT DESCRIPTION

3.1 TECHNICAL CHARACTERISTICS

3.1.1 Pearl farm operations

The proposed pearl farm will use hatchery-reared native Hawaiian pearl oysters to produce Hawaiian black pearls™ and Hawaiian pearl shell jewelry. A separate hatchery facility, currently based at NELHA, in Kona, will supply juvenile oysters to the farm. The broodstock will be selected from various islands throughout the state to ensure genetic diversity. The juvenile oysters will be raised in net bags, and eventually transferred to net panels, which will be suspended from the sub-surface headlines (see Figure 3).

The oysters will be cleaned regularly, to ensure they remain in good condition. The main farm activities will be maintaining and grading juvenile oysters in the nursery grow-out, cleaning adult oysters in panels or on droplines, and moving oysters to and from the seeding shed, when performing the pearl implantation operation and pearl harvest.

Some mortalities are expected due to predatory snails, crabs and flatworms in the net bags. Once the animals reach the net panel stage these mortalities should abate. The animals will be seeded with round pearl nuclei at around 2 - 3 years age. The first pearls will be harvested 2 years later. When the first pearls are harvested, those oysters that produce a marketable pearl will be reseeded with another nucleus. Up to three or four pearls can be produced from a single oyster over six or eight years. Oysters that are not reseeded will be either seeded with half-pearl or mabe-pearl seeds, used for shell carving, or retired to stud. Stud oysters will be placed either on the substrate beneath the farm, or may later be moved to protected aggregations in MLCDs or FMAs around the islands (if the oysters are large enough to withstand fish, octopus or crab predation).

3.1.2 Farm location and layout

The proposed pearl farm site lies in the deeper waters of the Reef Runway borrow pit. This site offers good protection from offshore swells, reasonable protection from wind-driven chop, deep water for suspending the hanging net panels from headlines, and good water quality and circulation patterns. The area directly abuts the inshore boundary by the Honolulu Airport Reef Runway. The lease will comprise solely the deep water areas of the borrow pit, and three small footprints for buildings from which to support operations.

The farm will be almost invisible from above the water. Sub-surface head-lines stretched taut across the borrow pit will be buoyed to sit just beneath the water surface. This ensures that there is little movement of the lines due to wave action, and minimal need for SCUBA-diving. These lines will be anchored into the soft substrate at each end using sand-screws or Danforth anchors and concrete block weights. Large (55 gallon) floats at each end will maintain tension on the lines. Oysters will be suspended from the headlines in panels or mesh pouch arrays, with dropper

lines keeping the oysters around a depth of about 5 m (15 feet). Smaller floats will support the weight of the oysters along the line. These floats will be anchored with vertical anchor lines weighted by small concrete blocks, to ensure that the lines remain at the precise desired depth (See Figure 3).

The farm buildings will consist of two work platforms on the inshore side of the borrow pit, at either end of the farm area. These would preferably be on post-and-pier structures, but floating pontoons may also be a viable alternative with less impact directly on the substrate. The layout and design of these buildings is shown in Figures 5 and 6. A staging area dock and building was formerly proposed to be built on the islet at the end of the Reef Runway, but because of the public objections to use of this location, the staging area and storage facilities will now be located in another area, away from the site (probably the commercial Keehi marina).

The farm will have a security network, which may include watchmen, passive submarine hydrophones, active sonar and other tracking devices, and radar for monitoring nearby surface boat traffic. Apart from the passive hydrophones, the surveillance system would not be that much different from the electronic equipment found on a cargo ship or fishing boat. Federal Aviation Authority (FAA) and the Honolulu Airports Division will be provided with details on all security equipment, to ensure that there is no incompatibility between the farm system and airport operations.

Farm work vessels will be powered by commercially-available jet- or propeller-driven outboard engines.

3.2 ECONOMIC CHARACTERISTICS

Ecological modeling of sustainable oyster carrying capacities of the Keehi lagoon waters by our consultant (see Appendix I) indicate that the maximum number of farmed oysters in the proposed lease area should not exceed 50,000 adult animals. This represents approximately 20,000 pearls harvested each year.

Assuming these pearls receive the same wholesale prices as Tahitian pearls (an optimistic assumption) a farm of 75 acres could generate steady state annual revenues by Year 8. The initial investment required to build the farm and maintain operation until profitability would be of the order of $2 million.

A major deterrent to investment is the five year wait from beginning operations on the site until the first harvest and sales. The farm does not break even for many years. Pearl farming therefore will need investors with a long-term perspective.

Labor and salaries are the most significant component of pearl farm operations, comprising nearly 40% of the recurrent steady state costs (five full-time jobs). Other labor, such as project management, administration, and seeding technicians comprise a further 37% of costs (equivalent to one full time, one half time and two seasonal positions). Hatchery operations are billed on a per oyster basis, but contribute a further 7% to overall project costs. Again, these

consist largely of labor costs (equivalent to one full time job). Total value of all employment for the pearl farm is then almost 80% of total recurrent farm operating costs, with the equivalent of seven full time and three part time positions.

Economies of scale dictate a minimum farm size of 75 acres. If the farm area is any smaller, the oysters are either more crowded, or the farm must hold fewer oysters. Greater crowding results in poorer oyster health (and possibly poorer pearl quality, and reduction in the reef reseeding capacity, because of lower fecundity of oysters), and some greater impact on the benthos or water quality. Fewer oysters would result in lower revenues and an unattractive rate of return.

3.3 SOCIAL CHARACTERISTICS

As outlined above, this project makes a significant contribution to employment, with seven full time and three part time positions. Over 80% of all recurrent farm expenditure is committed to the workforce, for farm labor, administration and management, seeding technician services and hatchery operations. The major social impact of the farm is the loss of public access to most of the deep water area of the borrow pit. As discussed above, however, surveys indicate that the deeper waters of the borrow pit are not greatly utilized by fishermen, jet skiers or recreational boating enthusiasts.

Security of the farm is a major concern with such a valuable crop. The lease must provide exclusive use of the area. Swimming, snorkeling or SCUBA-diving activities in the farm area by the public would compromise the security of the farm stocks. Similarly, passage of surface craft through the area would create concerns for both security, and the safety of farm workers. Much of the farm work will entail surface swimming or snorkeling to deploy or retrieve ropes and net materials. It is difficult under such circumstances for workers to always ensure that they have a boat or dive flag nearby to alert transiting boats of the diver's presence. Any non-exclusive lease would therefore not be tenable because of liability concerns.

The proposed farm area lies in a dead-end channel, and there is little reason for boats to transit the area unless they are seeking access to the reef flat area surrounding the farm. The requested farm lease area will include an easement or designated right-of-way for vessels to transit from the circulation channel to the western end of the area. The public response to date has been overwhelming in favor of locating this easement on the reef runway side of the farm (see Figure 4).

The entire area, including the farm site, is currently zoned for use by recreational thrill craft (RTC). However, surveys of activity over the summer of 1999 (see Appendix IV), and incidental observations made during the course of research and survey work over the past five years, indicate that the protected waters inside the reef are not heavily used by jet-skiers. In only one instance were jet skis observed in the borrow pit area, and these were apparently traversing the area to reach the waves over the shallow reef area on the western end of the reef runway.

Discussions with the responsible agency (Division of Boating and Ocean Recreation), RTC users and the community are currently under way to resolve the siting of the pearl farm in the RTC area (refer to letter from Howard Gehring, dated 11/20/00: see Correspondence Attachments).

3.4 ENVIRONMNENTAL CHARACTERISTICS

The major environmental characteristics of the project should be beneficial, with increased recruitment of the imperiled native Hawaiian pearl oyster to the nearby reefs and lagoons (see Section 2.2.2 a., above).

The presence of buildings and workers on the site will not represent a major degradation of the visual integrity of the area. There will be a minor impact on water quality in the area. Removal of particulate organic matter from the water column by the oysters should be considered a benefit, as it would improve water clarity in the area. The increased detrital loading onto the substrate may result in greater biological activity there; the soft substrate is presently devoid of holothurians or other detrital feeders. There will also be some increased levels of dissolved organic nitrogen from the respiratory functions of the animals suspended in the water column.

Pearl oysters are highly sensitive to deteriorating water quality, and quickly succumb to infections from opportunistic bacteria if they are excessively stressed. Minor stresses may also result in poor quality nacre, and therefore lower value for the pearl crop. Pearl farm managers are therefore always very concerned that any reduction in water quality or oyster condition might compromise pearl retention rate or nacre quality. With so much of a farm's viability contingent on maintaining optimum conditions for the animals, farm management is focussed on never allowing stocking densities or other farm practices to stress the oysters. In summary, a pearl farm tends to be self-regulating to maintain high standards of water quality, so that the farm is economically successful.

4. ALTERNATIVES

4.1 ALTERNATIVES EVALUATED

4.1.1 Research and development

As outlined above, Black Pearls, Inc. first developed and began to test the concept of a Hawaiian pearl farm in 1993. Grow-out trials in Hawaii were conducted under four separate research grants: one from NMFS, two from USDA, and a matching grant from the Hawaii High Technology Development Center. There were two broad goals for this research. Firstly, to devise suitable methods for a stock re-establishment program for the Hawaiian black-lip pearl oyster; secondly, and simultaneously, to determine the feasibility of commercial pearl farming in Hawaii. The work encompassed the full gamut of methods for collecting spat, reproducing the animals and growing out the oysters in the wild.

a. Oyster surveys

Stock surveys were initially conducted to determine the abundance of the animal in the wild. There were only two instances of prior survey work for this species. Galtsoff (1933) documented the remnants of the stock at Pearl and Hermes Reef, after the fishing there had virtually extirpated the local population. A survey of Kaneohe Bay stocks was in 1989 provided an estimate of around 200 oysters in the Bay (Sims, unpublished report). The size-class distribution showed that there was little recruitment occurring. The stock was also still apparently subject to fishing pressure, despite legal protection.

As part of BPI's research program, the population in Kaneohe Bay was resurveyed in 1997, along the same transect lines as those used by Sims (ibid). There was little change in the population over the intervening eight years (Rogers, et al, in press). The 1997 data were also heavily skewed by one highly aggregated group of adult oysters found at a single site, that might have been evidence of someone illegally stockpiling the animals. If this one aggregation is eliminated, the Kaneohe Bay population actually showed a significant decline over the eight year period. The seven transects from 1989 which were re-surveyed in 1996 showed an overall decrease in the oyster population of almost 60% (Sims and Sarver, 1998).

Extensive timed-swim surveys were also conducted in 1997 at two other sites on Hawaii, one site on Molokai, and four sites around the Keehi lagoon area. No oysters were found at any of these sites. Some oysters have subsequently been found in the vicinity of several of these survey transects, indicating that these biotopes are suitable for this species. An extensive search was also undertaken in Midway Atoll lagoon. No oysters were found during this survey. Anecdotal evidence suggests that the animals are present in Midway, but very rare (ibid).

b. Spat collector trials

In other pearl farming areas (such as French Polynesia and the Cook Islands), the farms rely on spat (young oysters) gathered on special 'spat collector' lines. The animals settle out of the

plankton onto the artificial substrates of these collectors. Spat collector trials were therefore used to evaluate the feasibility of collection of juvenile oysters at three sites in Hawaii.

Spat collector trials were conducted at three sites: Hawaii Institute of Marine Biology, Snug Harbor, and Kawaihae Harbor. Only one spat was found over the course of these trials, indicating that natural recruitment was very low. Spat collectors – as practiced in other lagoons in the South Pacific – are therefore impractical in Hawaii. Any pearl farm will therefore need to rely on hatchery-produced spat as the source of farm stocks.

c. Stock re-establishment trials

Initial trials to test placement of animals directly onto the reef were very disappointing. Within a matter of weeks, even thick-shelled adult oysters were killed when placed on the reef without protective cages. From the shells recovered, it was inferred that these mortalities were from either fish (such as *mu*, Monotaxis grandoculis), crabs, or octopii. Oysters in protective mesh cages were also subject to predation from smaller crabs and snails (such as Cymatium spp.). The mesh cages also were heavily fouled, reducing the growth rates and overall condition of the oysters inside.

The most successful means of ocean grow-out of animals was in buoyed sub-surface lines – either single anchor lines, or taut headlines stretched between buoys 25 – 40 feet below the surface. Predation from snails was still heavy at the juvenile stage, but survival improved with the development of an innovative juvenile grow-out system. This system was subsequently modified to also reduce fish predation on juveniles.

Extensive land-based grow-out trials were also conducted by Black Pearls, Inc. at both the NELHA, in Kona, as well as in the Kawaihae Harbor area, and at HIMB in Kaneohe Bay. The NELHA trials ran for over three years, using a variety of water sources and a range of food sources. The other trials in Kawaihae and Kaneohe used "green water" systems, with no supplemental feeding. In all instances, the land-based tank arrays performed poorly over the long term, with slower growth and higher rates of mortality than in corresponding ocean grow-out. Land-based tank grow-out of pearl oysters also requires massive capital investment for tanks, pumps, pipelines, back-up systems and - most critically – the labor required to grow the algal food. Given the higher risk involved in land-based culture, these added costs render land-based pearl culture uneconomical at present.

4.1.2 Identifying potential farm sites

By 1996 we had concluded the bulk of this research. We used growth in shell diameter (DVM) and survival rates as the criteria for identifying preferable areas for reproductive nodes and farm sites. We presumed that the parameter of shell growth was the best indicator of potential nacre deposition rates and overall oyster condition – which is related to fecundity. This single factor of shell growth was then the strongest criteria for site selection.

The von Bertalanffy growth parameters for each of the sites tested are given in Table 1. These parameters were then converted to growth curves, which were used to calculate $T_{(120)}$, or the time it takes, in years, for the animals to grow from spat to seedable size (arbitrarily established at a shell diameter of 120 mm). The sites in Table 1 are ranked according to the growth performance in these trials. The best four sites were Kealakekua Bay on the Big Island, Haleolono Harbor in Molokai, the Inner Harbor in Midway Atoll, and Kaneohe Bay on Oahu. The growth in Keehi lagoon was amongst the slowest, with a $T_{(120)}$ of 3.9 years.

TABLE 1 : GROWTH PARAMETERS FOR HAWAIIAN BLACK-LIP PEARL OYSTERS AT SEVEN SITES AROUND THE HAWAIIAN ARCHIPELAGO

SITE	LOCATION / SYSTEM	K	L_∞	$r_{(1)}$	ϕ'	$T_{(120)(2)}$
			(mm)			(years)
KEALAKEKUA BAY	Sub-surface line	0.21	338	0.17	4.38	2.75
HALEOLONO HARBOR	Sub-surface line	0.64	184	0.27	4.34	2.8
MIDWAY ATOLL	Harbor, Finger Pier	0.19	326	0.17	4.30	3.3
KANEOHE BAY	HIMB, Sub-surface line	0.11	485	0.08	4.41	3.7
KEEHI LAGOON	Reef Runway, Borrow pit	0.09	658	0.04	4.59	3.9
KAWAIHAE HARBOR	Inner Basin, Sub-surface line	1.75	128	0.45	4.46	4.0
KAWAIHAE HARBOR	Offshore, Sub-surface line	-	95	0.46		4.0*

(1) Correlation coefficient from Ford-Walford plot
(2) Estimated graphically from growth curves
* = Extrapolation from growth curve

(from Table 8, in Sims and Sarver, 1998).

As early as 1994, BPI had entered into discussions with the State to analyze the existing ocean leasing law, and explore the potential for a commercial pearl farm in Hawaii. A number of sites were not considered feasible simply because of the heavy recreational use. Most of the sites that might have been suitable on purely biological and oceanographic criteria had other legal or

administrative constraints. These considerations are briefly reviewed in more detail on a site-by-site basis in Appendix V, and are summarized in Tables 2 and 3.

The Keehi site therefore represents the best available site that could be accessed without presenting major conflicts with current users.

4.1.2 NO ACTION ALTERNATIVE

The option of No Action is not recommended, given the long-term benefit for reef reseeding of this native species, and the potential economic benefits which could accrue to the State, and to associated industries such as the pearl shell carving, tourist and jewelry industries.

TABLE 2 : BIOLOGICAL AND OCEANOGRAPHIC CRITERIA FOR POTENTIAL PEARL FARM SITES

Site	Snail Predation	Fish Predation	Wild Stocks in Area?	Degree of Exposure to High Surf	Extent of Potential Farm Area (of suitable depth)	Overall Considerations
KEALAKEKUA BAY	Heavy	Heavy	None	Very exposed	Extensive area inside Bay	Excellent growth, But exposed, and poor nursery area
HALEOLONO HARBOR	Negligible	None	Scarce	Somewhat protected	Very limited area	Limited scale; Good potential nursery
MIDWAY HARBOR	None	Variable	Very scarce; extirpated	Somewhat protected	Very limited area	Limited scale; Good potential nursery
KANEOHE BAY	Negligible	None	Present	Well protected	Extensive area inside Bay	Excellent site; Good potential nursery
KEEHI LAGOON	Variable	Variable	Present	Well protected	Limited area in Borrow Pit	Slower growth, Fair potential nursery
KAWAIHAE - INSIDE HARBOR	Heavy	Variable	Present	Well protected	Moderate area inside harbor	Slow growth, poor nursery
KAWAIHAE - OFFSHORE	Heavy	Variable	Present	Exposed	Extensive area, but deep (> 120 ft)	Exposed, slow growth, And poor nursery

TABLE 3 : LEGAL, SOCIAL AND CULTURAL FACTORS CONSIDERED FOR POTENTIAL PEARL FARM SITES

Site	Legal Regime	Logistics	Current Management	Recreational Use	Cultural value	Intangible Value	Possibility of exclusive lease
KEALAKEKUA BAY	Ceded Lands, under DLNR jurisdiction	No ramp	FMA in half of Bay	Heavy	Historic site	Strong value placed on natural beauty	None
HALEOLONO HARBOR	Privately-leased harbor	Remote	Molokai Ranch controls access	Increasing use by residents	Used for canoe races	Strong value placed on community access	Possible if project gathers community support
MIDWAY HARBOR	National Wildlife Refuge	Very remote	USFWS restrict access	Harbor intended for use as yacht mooring area	Atoll has historic value, but not harbor	Negligible; a dredged harbor	USFWS have already denied use of harbor
KANEOHE BAY	Ceded Lands, under DLNR jurisdiction	Convenient, but difficult access	Community management committee	Very heavy resident and tourist use	Strong	Community user groups compete for access	None; Marines have denied use of exclusion zone
REEF RUNWAY, KEEHI LAGOON	Ceded Lands, under DOT jurisdiction	Convenient, with easy access	BOR-designated jet-ski area	Limited jet-ski use	Dredged borrow pit	Negligible, adjacent to toxic waste dump and jet-ski area	Very attractive; subject of this EA, and pending application for lease
KAWAIHAE - INSIDE HARBOR	Ceded Lands, under DOT jurisdiction	Convenient, with easy access	Under DOT control, but lightly used	Regularly used by paddlers and others	Negligible	Negligible	DOT policy excludes aquaculture from commercial harbors
KAWAIHAE - OFFSHORE	Ceded Lands, under DLNR jurisdiction	Convenient, with easy access	None	Some offshore fishing	Negligible	Negligible	Possible, if fishing interests accept loss of access offshore

5. ENVIRONMENTAL SETTING

The Reef Runway Borrow Pit in Keehi lagoon is a highly disturbed ecosystem, because of the previous dredging of the area and its proximity to the runway. It therefore represents an almost insignificant environmental and social asset.

5.1 WATER QUALITY

Analytical Laboratories of Hawaii, Inc., has conducted a study of the water quality in and around the farm site (Figure 7), and compared these results with data from pearl farming lagoons in the Cook Islands (Appendix I). The water in Keehi lagoon was found to be highly turbid, with a high level of particulate organic matter. General water movement patterns are governed by tide and wave action driving water over the outer reef edge, and draining to the east, directly out through the circulation channel.

5.2 BIOTA

For the purposes of this discussion, the biota is divided into three types: Terrestrial flora, terrestrial fauna, and marine biota. The effects of the proposed project on rare, threatened or endangered species or their habitats are considered independently, in light of the regulatory requirements of the Migratory Bird Treaty Act and the Endangered Species Act.

The original biota in the borrow pit area of the Reef Runway has been severely disturbed. The deeper waters of the borrow pit support a very depauperate benthic, fish and bird fauna.

5.2.1 Terrestrial flora

With the removal of the proposed staging area from the project plan, the proposed project is completely water-based, and therefore would not impact the terrestrial flora in any way.

5.2.2 Terrestrial fauna

The Division of Forestry and Wildlife (DFW), DLNR, provided bird survey data for the Keehi area. Dr Carol Terry of DFW concluded that "this area is used only infrequently as a foraging area by native Hawaiian waterbirds and periodically by winter migrants (and) does not appear to be (a) significant (bird) habitat" (Dr Carol Terry, in litt, 9/25/97).

5.2.3 Marine biota

An extensive survey of the benthic biotic of the proposed project area was conducted (Figure 8, Appendix II). There was a relatively high coverage and diversity of live corals along the reef flat on the ocean side of the borrow pit, but only a low coverage on the inner reef flat. Abundance

and diversity of corals decreased rapidly with increasing depth on the walls of the borrow pit. There was no macroflora or macrofauna found on the soft sediments of the borrow pit floor.

A survey of fishes using a visual census technique (Appendix III). The fishes showed a similar pattern of abundance and diversity to the corals: high abundance and diversity on the ocean side of the reef flat, low along the inside reef flat, and decreasing dramatically with greater depth. Only one individual fish was found among the soft substrates of the deeper area of the borrow pit: a "nightmare weke" (Upeneus arge).

5.2.4 Rare, threatened or endangered species

Four species of marine animals that occur in Hawaiian waters have been declared threatened or endangered and are under Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) is common in the nearshore waters of the main Hawaiian Islands. The endangered hawksbill turtle (*Eretmochelys imbricata*) is infrequently found in Hawaiian waters. The principal nesting site for the green turtle is in the Northwest Hawaiian Islands, on French Frigate Shoals (Balazs, 1980). No turtles were observed in the area during the survey work or over the course of the grow-out trials at the site.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) are known to winter in the Hawaiian Islands, but are not found in inshore waters. There is a designated Hawaiian Islands Humpback Whale National Marine Sanctuary that includes waters along the south coast of Oahu from Magic Island to Makapuu Point.

The Hawaiian Monk Seal (*Monachus schauinslandi*) occurs rarely in the main Hawaiian Islands, but has not been observed in or near the site of the proposed project.

5.3 RECREATION

A ramp survey was conducted of boaters, fishermen and other recreational users at the Keehi boat ramps from March to August, 1999 (Appendix IV). The survey covered the summer months, when recreational use was expected to be greatest. This survey was designed by BPI staff, in consultation with Dr Jim Parrish of UH Zoology, and implemented with the assistance of undergraduate student help.

Most of the recreational activity in the area is confined to fishing on the adjacent reef flats. The only activity in the deep portion of the borrow pit was the occasional fishermen using casting rods and spinning lures, presumably targeting carangids (omilu, papio, etc, or trevallies and jacks, Family Carangidae).

Although the area is designated for use of recreational thrill craft (jet skis), there was only one instance in the past four years of research at the site when jet skis were present.

5.4 NOISE AND AIR QUALITY

Current noise levels and air quality are severely impacted by the site's proximity to the Reef Runway of Honolulu International Airport.

5.5 AESTHETICS

There is little of intrinsic aesthetic value presently at the project site because of the highly disturbed environment, and the degraded aesthetics associated with the proximity of the runway. The aesthetic value of the site is probably best reflected in the present land usages condoned by the State in the area, or adjacent areas : for recreational thrill craft on the borrow pit waters, for a major airport runway, and for a dump on the ocean-side of the adjacent Reef Runway.

5.6 CULTURAL RESOURCES AND PRACTICES

5.6.1 Customary collecting

There are presently no existing traditional gathering rights or cultural practices in the project site itself, in the borrow pit. Customary collection of marine organisms, such as fishing and collecting of octopii, occurs primarily on the adjacent reef flat. Some collection of seaweed (limu, ogo) and aquarium-fish has been reported in the area of the lease. The seaweed collection is conducted by free-divers along the inland (northern) edge of the borrow pit; the aquarium-fish collection is conducted by SCUBA divers along the seaward (southern) edge of the borrow pit.

5.6.2 Pearl shell carving

There is a present paucity of natural, native carving materials available to artisans working in Hawaii. Most of the pearl shell presently used by the few local artisans is imported from Fiji or Tahiti. Although some black coral and other precious coral carving has been established, this is non-traditional, and also relies on imports of raw materials and finished products.

5.7 LAND USE COMPATIBILITY AND ENVIRONMENTAL JUSTICE

5.7.1 Current usage

The majority of the project area is currently designated by Executive Order as the jurisdiction of the Department of Transportation (DOT) for airport use (Figure 9). The seaward portion of the area, beyond the DOT boundary, is under DLNR jurisdiction, and is designated as the Resource Sub-zone (per HAR Section 13 – 5).

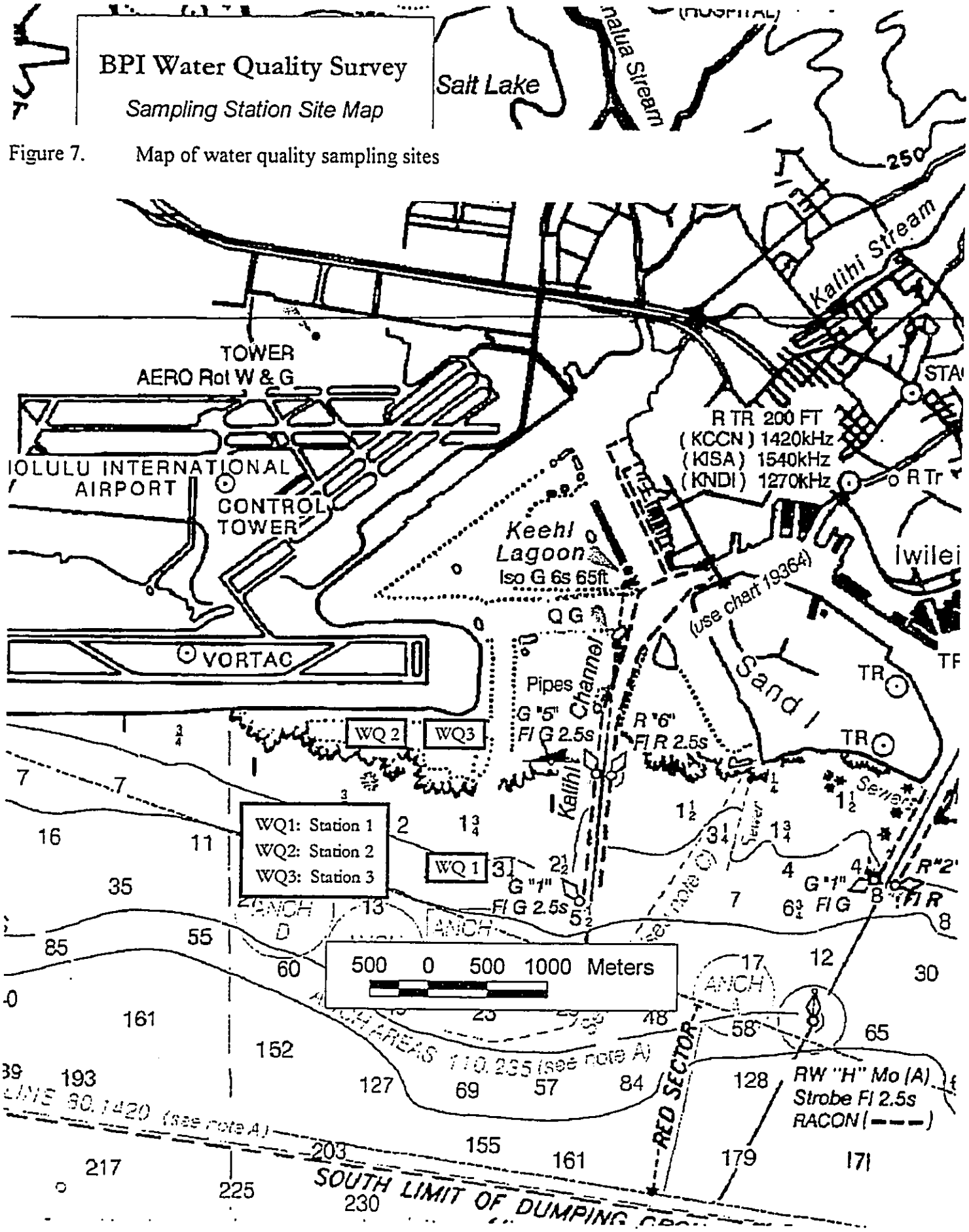


Figure 7. Map of water quality sampling sites

The proposed site presently offers no significant environmental or public benefits, beyond the rare instance of use by recreational thrill craft.

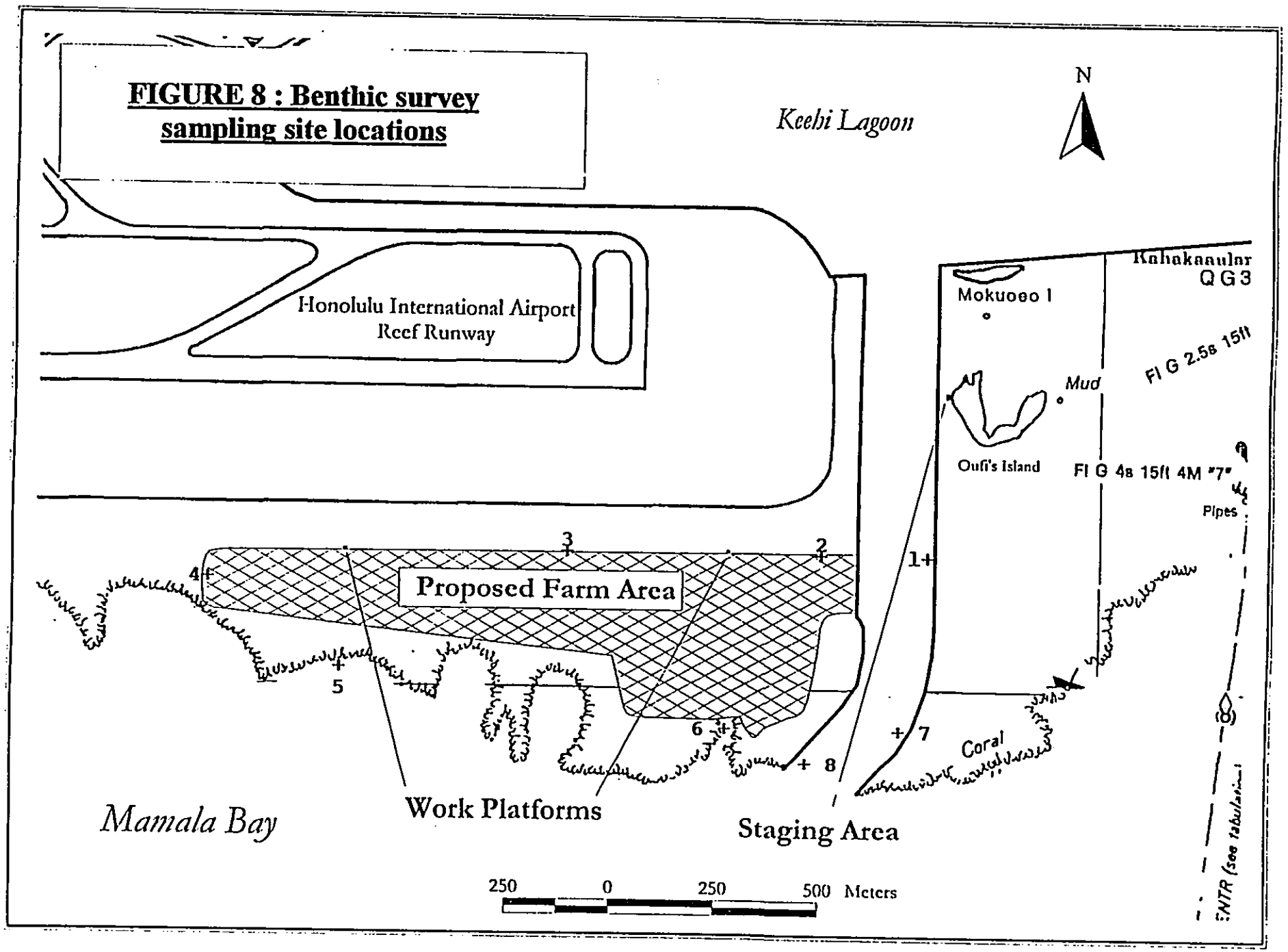
5.7.2 Submerged lands issues and the public trust

As submerged lands, the proposed pearl farm site constitutes part of the ceded lands trust. The 1999 amendments to the Ocean Leasing law directly addressed the issue of Office of Hawaiian Affairs' share of the lease revenues, by stipulating that the designated 20% of lease payments should be due to OHA.

5.7.3 Public perceptions of ocean use

The public perceptions of ocean access and ownership in Hawaii are largely based on the ancient western concept of Mares Librum – Freedom of the Seas. The 1999 amendments to the ocean leasing law (Chapter 190 D) were the first major step to view the oceans as a resource that could be occupied and sustainably developed, rather than simply exploited. This represents a sea change in the legislative thinking that reflects two positions : the first is that open-access fisheries, and unrestricted access to the ocean does not allow for effective management of ocean resources. The second recalls the ancient Hawaiian land-use and ocean-ownership practices related to the principles of the ahu-pua'a, fishponds, and the konohiki fisheries. This provided for ownership of ocean resources, and was recognized as a sustainable, efficient means of managing the ocean, and reducing conflicts.

FIGURE 8 : Benthic survey sampling site locations



6. POTENTIAL IMPACTS AND MITIGATION

6.1 IMPACTS DURING CONSTRUCTION

Primary impacts during farm construction are confined to the proposed areas where permanent fixtures are to be located: the post-and-pier work platforms, and the anchoring of the oyster lines. If floating pontoons are used for the work platforms, then there will be some increased impact from anchoring, but a much reduced impact from the footprint of the buildings and construction activity.

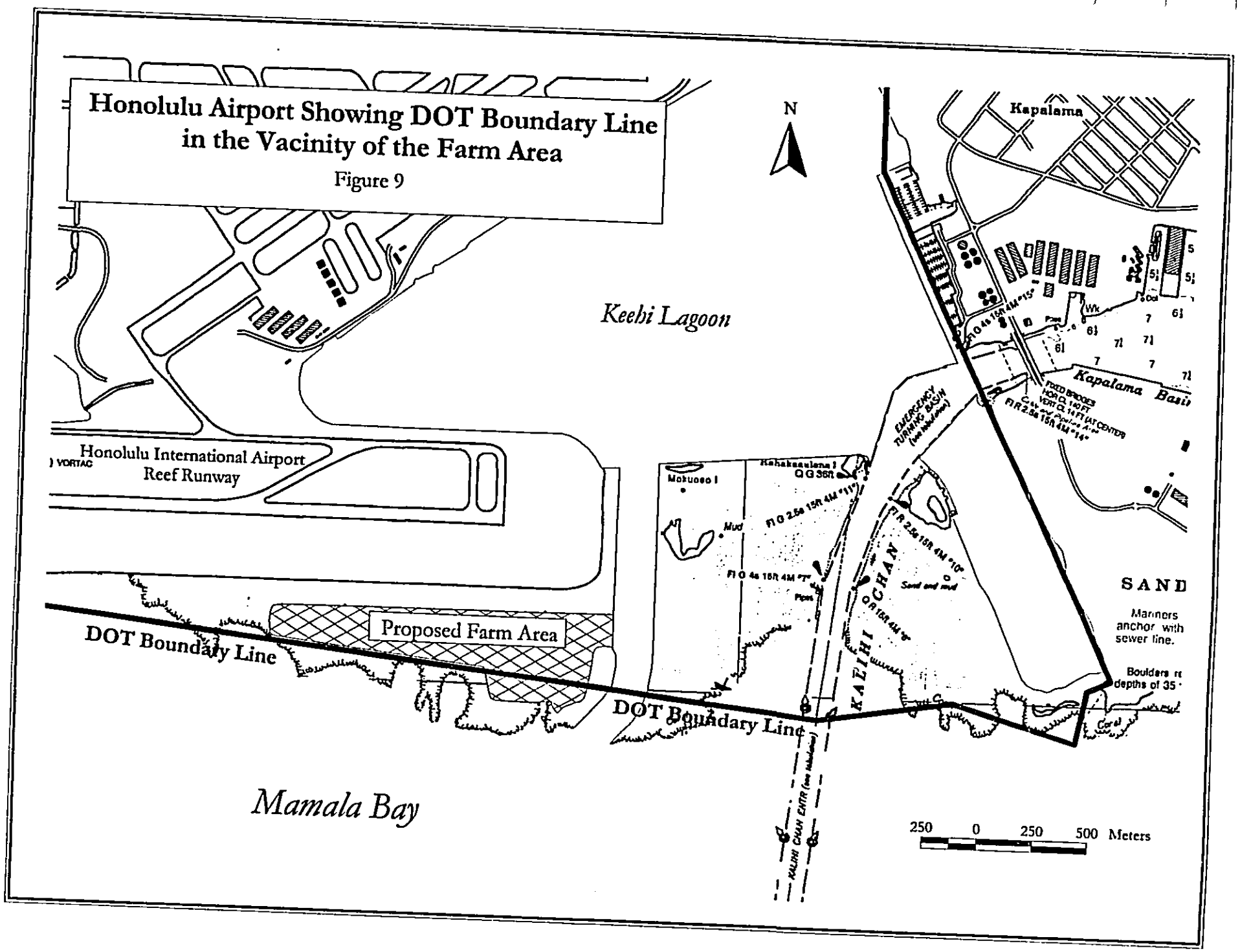
The two work platforms will be located in the water on the inner (mauka) edge of the borrow pit, in the two areas which have sand build-up (Plate 1 and Figure 4). These platforms are specifically sited on these sand areas to minimize any detrimental impacts to the benthic flora and fauna during construction and ongoing operation of the facility. The work platforms will each be of around 25' by 25' dimension, and will include small shed-like structures of a maximum 12' height. The work platforms will be built on pilings made of concrete or other suitable material, which will be buried into the soft substrate. There will be a short-term increase in sedimentation from the sinking of the pilings into the soft substrate, and drilling of the rock for anchoring of steel reinforcing bars. The construction company will be instructed to use best management practices to limit sediment suspension, e.g. using silt curtains or other containment measures deemed necessary by responsible agencies. The impacts of these activities will be minimal, and short term, and should have no lasting measurable effects on the surrounding biota.

Up to four additional pontoon rafts and up to twenty boat mooring buoys will be located throughout the farm lease area, for ease of working on the oysters. The pontoons may be moved from one location to another, or may be towed out of the lease area entirely during periods of impending bad weather or surf. Alternative mooring sites in the more protected parts of Keehi lagoon will be determined in consultation with the Keehi Lagoon Harbor Master. All boat and pontoon moorings will be anchored either by sand-screws or Danforth anchors, directly into the soft sediment. There will be some slight re-suspension of sediments when burying these anchors in place, but this will not result in measurable impacts on the surrounding biota.

The oyster lines will be anchored into either the bare limestone rock on the vertical sides of the borrow pit, or into the soft substrate at the bottom. Anchor lines will be attached to the rock face of the borrow pit by stainless steel eyebolts embedded in epoxy glue. These bolts will be sited so as not to come in contact with corals or any other benthic fauna. The only primary impacts will then be the minimal sediment generated by drilling into the rock face to anchor the bolts. These bolt-holes will be about 1" in diameter, and about 12" deep, and the fine sediment generated from drilling will quickly dissipate. Anchor lines in the soft substrate will be secured by either sand-screws, sand bags or concrete anchor blocks. Sand-screws will be used where permanent, taut lines are required, such as at the end of each line. Sand bags or concrete blocks will be used where the anchor lines need to merely hold the line beneath the surface, or may need to be lifted for occasional cleaning work, such as in the middle sections of each line. In all instances, the

Honolulu Airport Showing DOT Boundary Line in the Vacinity of the Farm Area

Figure 9



anchors will result in only minimal re-suspension of soft sediments, which will have no measurable impacts on the biota of the area.

Minimal and transient pollution will occur during construction. There will be a very slight risk of pollution from spills of fuel, oil, or hydraulic fluids from the machinery used in the construction. The construction company will be required to use best management practices for its machinery. The small scale of construction activities ensures that any spills that may occur will also be small, and easily handled.

Increased levels of noise will be associated with construction of the buildings and ancillary structures required for the pearl farm. This noise will be at that level normally associated with small building construction, and will be insignificant compared with the runway noise.

6.2 LONG TERM IMPACTS

6.2.1 Water quality

The broad conclusion drawn by the consultant was that the pearl farm would improve water clarity (Appendix I). The principal impact on water quality will be from removal of particulate matter from the water column by the filter feeding action of the oysters. Given the heavy load of particulate organic matter, this could be considered a beneficial impact, rather than a detriment.

There will be increased sedimentation from oyster faeces and pseudofaeces. Provided that oysters were maintained at a reasonable density, however, natural processes would readily absorb such an increase in the sediment loading beneath the farm, or an increase in dissolved organic nitrogen from the animals' respiration.

A long term water quality monitoring program will be instigated, at the farming company's expense, to track these impacts from the farm. Because of the long-term nature of the impacts on water quality, sampling will begin with a base-line survey in the first year of the lease, and then will consist of follow-up surveys every five years, as the farm grows to full capacity. These surveys will measure turbidity and sedimentation rates, and biological oxygen demand of the substrate beneath the farm. (see Management Plan, attached to the CDUA Permit Application).

6.2.2 Biota

a. Terrestrial flora

As noted above, the project no longer includes any land-based structures, and no impacts would effect the terrestrial flora of the surrounding areas.

b. Terrestrial fauna

The project would not impact terrestrial fauna, beyond a minimal increase in noise and activity, which may temporarily disturb birdlife in the area. As this area is not considered important for birdlife, these impacts will be insignificant.

c. Marine biota

As the project plan calls for siting of the oysters on sub-surface lines within the deeper water of the borrow pit, there is no expected impacts from the oysters themselves on the benthic biota. There may be some ongoing disturbance of the surrounding reef flat from the increased human traffic in the area, but most of the farm work will involve movement of workers between the submerged lines, the pontoons, the work platforms, and the main building. There will be very little need for farm workers to go onto the reef area.

The existing environment in the borrow pit (open water) provides little opportunity for settlement of fishes or invertebrates out of the plankton. The submerged oyster lines will therefore provide ample habitat and opportunity for settlement of both fishes and benthic organisms. Sedentary benthic organisms will be periodically removed by the routine cleaning outlined in the farm management operating procedures (See *Section 3.1.1*). Demersal invertebrates, such as crustaceans, nudibranchs, gastropods and echinoderms may be either removed during the cleaning, or may be dislodged and fall to the bottom of the borrow pit, where they would likely be either consumed by predatory fish, or buried in the silt.

The provision of three-dimensional hard-substrate suitable for grazing and browsing may result in an increase in recruitment of juvenile fishes to the surrounding reef and lagoon areas. These fish may migrate from the farm to the adjacent reef areas. This ongoing influx of juveniles to the surrounding reef area should result in improved diversity and biomass of the fish fauna, and better catch rates and average size of fishes harvested by recreational fishermen.

d. Rare, threatened or endangered species

The project will not unduly impact any of the threatened or endangered species. Green turtles may occur in the area, but there is no risk of entanglement in the taut line system used for suspending the oysters, and there are no other potential impacts.

There will be beneficial impacts for the rare, native black-lip pearl oyster, Pinctada margaritifera (galtsoffi). The large, densely-aggregated, well-tended stock of mature adults will result in a significant increase in the reproductive capacity of the population. There will be an increased recruitment of juvenile pearl oysters to the surrounding reef areas, and to the other main Hawaiian Islands, which should result in a gradual increase in abundance of this imperiled species (see Section 2.2.2).

6.2.3 Recreation

The primary impact from farm operations will result from the exclusion of the public from the lease area. This loss of access to the majority of the deep area of the borrow pit area is not

considered significant, as our survey work indicates that there is minimal fishing or other recreational use of the deepwater area. Recreational use of the area by swimmers, divers or fisherfolk would be incompatible with the farming activities, because of the potential security problems, the possible interference with farm activities, and the liability issues with public access to a company-controlled area.

Access to the reef flat will not be constrained by the project, except where the lease area provides for the two small work platforms on the reef flat (Figure 4). Fishing activities on the reef flat will not be affected. Cast fishing into the deeper waters of the project area in the borrow pit would need to be limited, because of the risk of entanglement of the fishing lines with the oyster lines or with free-divers working with the oysters. Fishing catch rates in adjacent areas would not be negatively affected by the project, and may actually increase because of the 'spillover' effect of juvenile fish which recruit into the project area (see above, 6.2.2 (c) Marine Biota).

A designated easement will be provided along one side of the farm lease area to permit boat access along the full length of the reef flat. The location and extent of this easement will be as indicated in Figure 2. Discussions with DOT Airports Division, DLNR, and the community indicated a strong preference for the easement to be provided along the inshore (mauka) side of the lease area, rather than along the seaward (makai) boundary. The proposed width of the easement would be 60 feet, which should be sufficient to allow two small boats to pass each other under inclement conditions, at no-wake speed, and would also allow access by the Airports Division Crash-Fire safety vessel in an emergency situation. If the Board considered it appropriate, the company would be willing to provide a small number of permanent moorings at the end of the easement, for use by recreational fishermen or beachgoers.

During the public hearing for the project, one individual objected to the exclusive lease conditions, on the basis of a past history of collecting limu (ogo) and aquarium fish (primarily one species, the raccoon butterflyfish, Chaetodon lunula) in the area. In subsequent discussions between the applicant and the individual, it was agreed that the lease should contain some provision for individuals or small groups of free-divers requesting access on an occasional and restricted basis for the purposes of collecting limu within the easement area. As the aquarium fish collection involves use of SCUBA, this would represent an unacceptable security risk for the project, and the individual accepted this compromise.

The Director of Transportation (letter from Jerry Matsuda, dated 1/12/01: see Correspondence Attachments) requested that "access easements be provided for boats on both sides of the proposed lease area". Again, this was primarily to permit aquarium-fish collection on the ocean-side of the borrow pit, which would require SCUBA diving. No other groups or individuals have requested access to both sides, and the applicant strongly prefers the easement be limited to one side, the inland side.

The use of recreational thrill craft (jet skis) in the project area would not be acceptable because of the security risk and safety issues. The designated jet ski area is approximately 867 acres. The proposed pearl farm therefore represents only 8.6% of the total area of the jet ski zone (Figure 10). As noted above, DNLR-BOR is facilitating discussions with the Keehi community,

including recreational thrill craft representatives, to reach a mutually agreeable solution. Such a solution might involve re-designation of the recreational thrill craft zone boundaries to exclude the proposed pearl farm site, and adding to the zone's boundaries to ensure no net loss of area. Other nearby areas may provide a better jet-ski zone, with greater wave action.

There was considerable interest in the draft Environmental Assessment from the thrill-craft community. The numerous comments at the public hearing are perhaps best exemplified by excerpts from Russell Kaupu's testimony : "I have nothing in opposition to the application .... (the existing jet-ski area is) a considerable distance between where you launch your watercraft and where you ride (your) watercraft ... (the distance is a) safety concern for my family .... there is a much better area for personal watercraft which fronts the shoreline area near the small boat harbor ramp" (from DLNR's official transcript of the meeting, 1/25/01, pp 56 - 9).

In subsequent discussions, DLNR-BOR representatives have indicated that they are prepared to begin the rule-change process, and have no problems with the lease being issued contingent on the completion of the rule change to exclude jet skis from the project area.

6.2.4 Noise and air quality

The pearl farm will not contribute measurably to current noise levels. Boat engines and high-pressure washers used by the farm will generate ongoing noise during farm operation, but this will be insignificant compared with the noise from the airport. The exhaust from boat engines and pressure washers will be an insignificant effect on air quality.

6.2.5 Aesthetics

The pearl farm project will primarily impact the aesthetics of the site from the addition of the work platforms and other buildings that comprise the land bases. Similar buildings are found throughout the Keehi lagoon. There will be visual impacts of mooring buoys, work pontoons, and boats in the lease area, and some increase in noise associated with the use of these boats. Given the overall environmental and economic benefits to be derived from the project, the presence of the buildings and activity in the farm area is considered a minor impact.

6.2.6 Cultural resources and practices

a. Customary collecting

Access to, or practice of any customary activities on the reef flat will not be constrained by the project. As the deep area of the borrow pit represents a highly disturbed site, the issue of customary practices does not affect the area impacted by the lease. The possible existence of some traditional or customary Native Hawaiian practices in the borrow pit area unknown to the applicant was addressed in discussions with OHA officials, prior to submitting the draft Environmental Assessment. OHA was fully aware of the application, and indicated that they

would undertake their own enquiries. Apparently OHA found no reason to comment further on the application.

b. Pearl shell carving

The pearl farm would provide a source of pearl shell and a focus for Hawaiian shell artisans to work together. An outreach program working through the farm project would provide opportunities for traditional artisans to share their skills and knowledge with each other, and with the public. The pearlshell carving facility could act as a resource and training center for these artisans, preserving cultural traditions while promoting commercial opportunities for native Hawaiian crafts.

6.7 Land use compatibility and environmental justice

a. Current usage

The dedication of the Reef Runway borrow pit to an exclusive ocean lease is not incompatible with the other industrial uses of the airport and harbor area.

b. Submerged lands issues and the public trust

The revised legislation directly addresses the issue of distribution of lease payments, as it relates to the State's obligations to the Office of Hawaiian Affairs (OHA). BPI has proposed a program for training of native Hawaiians in pearl farm operations and management, and for setting up satellite pearl farms in other areas of the state. BPI's subsidiary in the Marshall Islands, Black Pearls of Micronesia, Inc., is helping the industry there develop along these lines. BPI also has Federal funding in hand from NMFS, for re-training of Hawaiian fishermen in pearl seeding skills. BPI would welcome OHA's involvement in implementing these programs, and has expressed such interest to OHA.

c. Public perceptions of ocean use

There may be some initial objections to lease of the ocean space for private gain. However, in this instance, the broader public benefits would appear to far outweigh these concerns. This therefore represents an ideal test case by which legislators, the public, and the responsible agencies can assess the actual impacts of an exclusive ocean lease, and better evaluate future applications.

6.8 Cumulative impacts

The major potential long-term cumulative impact will be the increased abundance of the imperiled native Hawaiian pearl oyster on the surrounding reefs and lagoons of the main Hawaiian islands.

If this proves successful as a demonstration project, further ocean leases may be applied for. If other pearl farm sites can be identified, or if suitable technology can be developed for offshore pearl farming, then pearl farming may be expanded to these other sites. This farm would then be used as a training and demonstration center.

The only negative cumulative impacts from this action would be those associated with the redrawing of the boundaries of the Recreational Thrill Craft Zone from its current site to an area further to seaward. These issues are still being discussed with concerned parties.

6.9 Irreversible and irretrievable commitment of resources

The proposed project requires the commitment of a long-term exclusive lease of submerged lands, the water column and the surface, for the establishment of the pearl farm. This is neither irreversible nor irretrievable. Chapter 190 D, as amended, specifically addresses the requirement for any lessee vacating an ocean lease to remove all equipment and to restore the site to its original condition.

6.10 Summary of operating constraints

Operating constraints discussed in the above sections are summarized in Table 4, below.

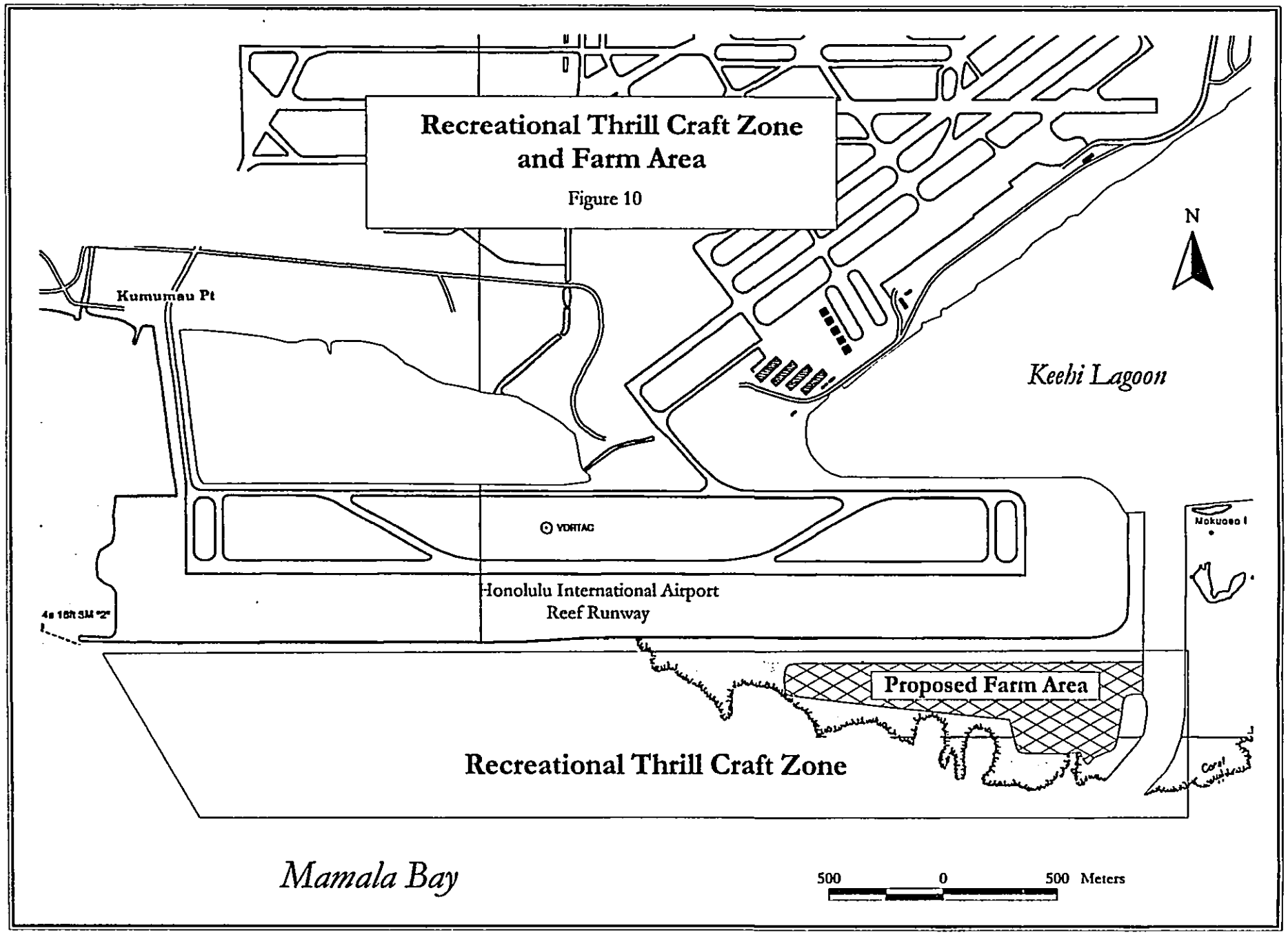

Recreational Thrill Craft Zone
and Farm Area
Figure 10
N
Kumumau Pt
Keehi Lagoon
VORTAC
Honolulu International Airport
Reef Runway
Mokuoloe I
Proposed Farm Area
Recreational Thrill Craft Zone
Mamala Bay
500 0 500 Meters

TABLE 4 : SUMMARY OF OPERATING CONSTRAINTS

TOPIC	ISSUE OR IMPACT	OPERATING CONSTRAINT OR MITIGATING CIRCUMSTANCE
Water quality	Filter feeding by the oysters may result in removal of particulate and dissolved organic materials, and hence a decrease in turbidity.	Improvements in nearshore water clarity are usually considered beneficial. Oyster density must be restricted. Prudent farm management strategies ensure that numbers or density of oysters do not result in reduction of organic loading to the point that oysters downcurrent do not obtain sufficient food. Water quality monitoring to include turbidity.
	Respiratory activity by oysters may result in elevated levels of metabolic wastes.	Oyster density must be restricted. Prudent farm management strategies must ensure that numbers or density of oysters do not result in any elevation in nitrogenous wastes or other factors which could reduce the animals' condition and the quality of the pearls. Water quality monitoring to include sedimentation rates and BOD of soft substrate.
Terrestrial Flora	None. The proposed staging area building has been eliminated from the plan.	None. An alternative storage/staging area will be located elsewhere – probably in the Keehi commercial marina.
Terrestrial Fauna	Short term noise and activity nuisance on migratory and other birds during construction.	None. No significant bird use of the area. Any effects are insignificant compared with other disturbances in the area.
	Ongoing noise and activity from farm operations.	As above.
Marine Biota	Short-term impacts on benthic community from construction activity for work platforms.	Work platforms will be post-and-pier construction, and, where practical, will be sited on the two areas of soft substrate on the inner (mauka) edge of farm area.
	Ongoing impacts on benthic community from increased human activity in the farm area.	Staging area and work platforms will enable workers to transfer personnel and equipment from storage areas to boats and to oyster lines without coming into contact with coral reef flat.

Marine Biota (continued)	Increased recruitment of imperiled Hawaiian black-lip pearl oyster to surrounding reefs.	None. This is considered a significant and highly desirable benefit, and is one of the main justifications for the project.
	Increased settlement of demersal fish and invertebrates on and around the oysters and oyster lines.	This recruitment will not result in any measurable decrease in recruitment to the adjacent reef flat. On cleaning of lines and oysters, demersal fish and invertebrates will either fall to the bottom or swim to the nearby reef flat.
	Increased settlement of sedentary invertebrates on and around the oysters and oyster lines.	This recruitment will not result in any measurable decrease in recruitment to the adjacent reef flat. Fouling material from oysters and lines will be collected and disposed of in an approved commercial land-fill.
	Sedentary corals and other invertebrates will be impacted by placement of anchors and sand screws into substrate.	Sand bags, sand screws or concrete anchors will only be used on soft bottoms. Fixed anchors will be drilled into bare rock substrate, and sited so as to cause minimal damage to benthos.
	Any fuel accidentally spilt during construction or operation of the farm could impact the surrounding area.	The farm area is usually well flushed through the Circulation Channel. Even so, contractors for construction will be bound to use best management practices. Farm operations will only use small volumes of fuel.
Rare, threatened or endangered species	Potential to disturb threatened green sea turtles or endangered hawksbill turtles.	None. Taut line moorings will eliminate risk of entanglement. Laws protecting threatened species will be adhered to.
	Potential to disrupt endangered humpback whales in the Hawaiian Islands National Marine Sanctuary.	Humpback whales do not frequent inshore waters.
	Potential to disturb endangered Hawaiian Monk Seals.	None. Monk seals are rare around the main Hawaiian Islands. Taut line moorings will eliminate risk of entanglement. Laws protecting threatened species will be adhered to.
Recreation	Lease will exclude recreational fishermen from borrow pit area.	Unrestricted access to surrounding reef flat will still be permitted. Collection of seaweed (limu, ogo) within the lease's easement area will be permitted under certain conditions.
	Lease will exclude recreational thrill craft (RTC) from borrow pit area.	RTC zone boundaries may be redrawn to exclude borrow pit area. A preferable area for jet-ski use may be made available.
	Lease will restrict movement of boats and access to reef flat area surrounding the borrow pit.	Easement along inshore (mauka) side of lease area will allow unrestricted boat movement to reef flat and western end of borrow pit area.

Noise and Air Quality	Noise and air emissions during construction or operation of the farm may impact the surrounding environment.	Noise and air emissions during construction will only be over the short term. Farm operation impacts will be insignificant, compared with the nearby Reef Runway.
Aesthetics	Addition of buildings and farm activity will degrade aesthetic environment.	Project impacts will be insignificant, compared with the nearby Reef Runway and Keehi Lagoon.
Cultural Resources and Practices	Exclusive lease over area will preclude customary and traditional marine collection practices.	Boat easement corridor and assured access to reef flat will allow existing practices to continue unhindered. Dredged deep water area not used for traditional collecting. Collection of seaweed (limu, ogo) within the lease's easement area will be permitted under certain conditions.
	Increased availability of traditional Hawaiian pearl shell materials will foster a rebirth of interest in carving.	None. This is considered a desirable benefit, and is one of the secondary justifications for the project.
Land Use Compatibility and Environmental Justice	Impacts from exclusive use of lease area may include changes in public perceptions of the use of ocean space.	The project will require exclusive use of the lease area. This may be the first exclusive aquaculture lease for State submerged lands. The legislature allowed for such consideration in the 1999 amendments of 190 D.
	Hawaiian groups or individuals may object to ceded lands being used for private projects.	The amended 190 D directly addresses the issue of revenue sharing with the Office of Hawaiian Affairs, and expressly designates that 20% of lease revenues be diverted to OHA. There is also considerable public good to be gained from this project in improved environment and employment opportunities for Hawaiians in rural areas of the State.
	There is a constitutional requirement for legislative oversight of any disposition of the public lands trust.	The amended 190 D addresses this issue by requiring an annual report to the legislature by the implementing agency (Aquaculture Development Program, in DOA).
Cumulative	Increased abundance of Hawaiian pearl oyster on reefs and lagoons.	A desirable benefit from the project.
	Relocation of jet-ski zone, or redrawing of zone boundaries	A rule change will be required of DLNR-DBOR. This may result in further impacts on any newly-designated jet-ski zone.

7. CONSULTATIONS AND STATUS OF PERMITS

The purpose of this section is to outline the regulatory issues and coordination associated with the proposed pearl farm project in the Reef Runway borrow pit of Keehi Lagoon. Regulatory issues include permits and concurrence with a number of Federal, State and County regulations. Consultation has included scoping meetings with a range of state and federal agencies, and the public.

7.1 PERMITS AND APPROVALS

Permitting procedures follow Chapter 190 D, HRS, as amended.

7.1.1 Federal

a. U.S. Department of the Army Permit

The Rivers and Harbors Act, Section 10, requires that a Department of the Army (DA) permit be issued for any activity that obstructs or alters navigable waters of the U.S. This project will require the construction of the work platforms, deployment of permanent moorings for boats and for the sub-surface oyster lines. As such, a Section 10 authorization will be required as part of a DA permit application.

The U.S. Army Corps of Engineers (ACOE) is responsible for administering and granting DA permits. The criteria for issuance of a DA permit are similar to those for issuance of an EA. At the discretion of the ACOE, the DA permit can be processed and issued concurrently with other permits.

7.1.2 State

a. Conservation District Use Application

Chapter 183-C HRS and HAR 13-5 pertain to any use of lands in the Conservation District. The Conservation District Use Application (CDUA) process is managed by the Land Division of DLNR. A CDUA permit is required before a lease can be considered by the BLNR.

Conservation Lands that may be impacted include all of the proposed lease area in the borrow pit, and the footprints of the two work platforms. DBOR may also need to issue approval or other written permission for placement of permanent mooring buoys for boats and pontoons, and anchor lines for the oyster lines.

b. National Pollutant Discharge Elimination System Permit

The State Department of Health has stated that a National Pollutant Discharge Elimination System (NPDES) general permit is required only if there is (a) stormwater runoff (b) hydrotesting water (c) construction dewatering effluent, or if "the facility is considered to be either a concentrated aquatic animal production facility or an aquaculture project, as defined in 40 Code of Federal Regulations Sections 122.24 and 122.25. Aquaculture projects that grow less than 100,000 lbs of product per year are exempted from the NPDES permit requirement, and as such, an NPDES permit is not required.

c. DOH Solid Waste Permit

The DOH Office of Solid Waste Management (OSWM) and City and County of Honolulu may require regulation of the disposal of the organic fouling material from the cleaned oysters and lines. Solid waste regulations are detailed in HAR 11-58.1, Separate discussions will be held with DOH-OSWM to determine the applicability of these regulations to the disposal of fouling material. Permit applications, where necessary, will occur after the EA process is completed.

d. Special Management Areas and Shoreline Setback

As the land-based staging and storage facility has been removed from the project plan, the project is no longer be subject to Special Management Area (SMA) permit requirements. A letter from the City and County of Honolulu Department of Planning and Permitting has been received which states that the project "is not within the SMA ... (an) is not subject to the permit requirements of Chapter 25, Revised Ordinances of Honolulu.

e. Aquaculture License

An Aquaculture License is required for commercial culture of a State protected species under Chapter 187A-3.5 HRS and Sections 13-74-43 and 13-74-44 HAR. DLNR-Division of Aquatic Resources and DOA-ADP are the co-ordinating agencies. An umbrella license and consolidated permit will be issued before the farm becomes operational.

7.2 AGENCIES, CITIZEN GROUPS AND INDIVIDUALS CONSULTED

The State Aquaculture Development Program (ADP: under the Department of Agriculture) has acted as liaison and principal contact for BPI during review of the legislation, consideration of the project concept, initial meetings and drafting of the EA. BPI and ADP have had regular contact on numerous issues and questions over the last five years, and these contacts are therefore not itemized below.

There have been a series of meetings presenting the project proposal to the State DOT and DOT Airports Division officials on 12/10/97, 3/2/98, and 4/25/00. A formal written request for guidance has been submitted to Brain Minaii, Deputy Director of DOT, addressing the salient issues. These include clarification of the leasing procedure for a non-conforming use, the roles of the Departments of Transportation and Land and Natural Resources in issuance of the lease, and specific concerns of the Federal Aviation Administration. ADP and/or BPI have also met with officials from DLNR Land Division to discuss the lease issues for the site on 11/20/97, 4/23/98, 6/1/98, and 8/4/98.

A series of meetings were held during the development of the project proposal process, with ADP acting in a facilitatory role. A meeting was held with officials from ADP, NMFS, ACOE, Coast Guard, Department of Health (DOH), DLNR-DBOR, and DLNR Land Division on 1/28/00. Subsequent follow-up meetings were held with DLNR Aquatic Resources officials on 2/8/00, and with DLNR-DBOR on 3/1/00 and 7/24/00.

A public informational meeting was held during the development of the EA. The first meeting, held on 4/19/00, sought community input into the plan, and addressed potential conflicts with existing user groups in the Keehi lagoon area. The meeting included representatives of U.S. Coast Guard, DLNR-BOR Keehi Marina management, DLNR Land Board, Boats/Hawaii, Hawaii Jet-ski Boat Association, Mokauea Fisherman's Association, Keehi Marina boater owners, fishermen and residents.

An informational package outlining the project was also provided to Chuck Johnson, of Hawaii Fishing News, to present to a meeting of ATLAPAC, an Oahu fishing club. BPI and ADP also met with officials from OHA on 7/24/00, to make them aware of the project details, and to assess the potential for OHA's involvement in the education and training components of the project.

On January 17, 2001, a presentation outlining the project was made to the Kalihi Neighborhood Board, and a motion to support the proposal passed unanimously.

Table 5 presents a listing of agencies and organizations consulted during development of the project concept and the EA.

TABLE 5 : AGENCIES AND ORGANIZATIONS CONSULTED

Agencies Consulted	Date
Federal Agencies	
National Marine Fisheries Service	1/28/00
Army Corps of Engineers	1/28/00
Coast Guard	1/28/00
State Agencies	
DLNR, Land Division	11/20/97, 4/23/98, 6/1/98, 8/4/98
DLNR, Boating and Ocean Recreation	1/28/00, 3/1/00, 7/24/00
DLNR, Forestry and Wildlife	1/28/00
DBEDT Coastal Zone Management Program	1/28/00
DOT, Airports Division	12/10/97, 3/2/98, 4/25/00
DOH	1/28/00
Office of Hawaiian Affairs	7/24/00
City and County Agencies	
Department of Planning and Permitting	2/5/01
Kalihi Neighborhood Board	1/17/01

REFERENCES

Bartsch, P. 1931. A new pearl oyster from the Hawaiian Islands. Proc. U.S. Nat. Mus. Washington 79 (2): 1 - 2.

Buck, Peter 1964 Arts and Crafts of Hawaii 14 vols. Bishop Museum Press, Honolulu.

Galtsoff, P.S. 1933. Pearl and Hermes Reef, Hawaii, hydrological and biological observations. Bull. Bishop Mus., Honolulu. **107**: 49 pp.

Gervis, M. T., and Sims, N. A. 1992. "A review of the biology and ecology of pearl oysters, (Pteriidae, Bivalvia)". ICLARM Studies and Reviews, International Center for Living Aquatic Resources Management, Manilla, Philippines. 42 pp.

Jameson, H.L. 1901. On the identity and distribution of the mother of pearl oysters with a revision of the subgenus Margaritifera. Proc. Zool. Soc. London,(1): 372 - 394.

Kay, E.A. 1979. Hawaiian Marine Shells. Reef and Shore Fauna of Hawaii, Section 4: Mollusca. Bernice P. Bishop Museum Special Publication 64 (4). Bishop Museum Press, Honolulu, Hawaii.

Ranson, G. 1961. Les especes d'huitres perlieres du genre Pinctada (Biologie de quelqes unes d'etre elles). Mem. Inst. Roy. Sci. Nat. Belgique. 2e'me serie : 67 - 95.

Sims, N.A. and Sarver, D.J. 1998. The Hawaiian Black-lip Pearl Oyster : Restoring the Stocks, Re-establishing the Pearlshell Fishery and Evaluating the Potential for Reef Ranching. A Report by Black Pearls, Inc., pursuant to National Oceanographic and Atmospheric Administration Award No. NA56FD0083. August 13, 1998.

Summers, Catherine C. 1990. Hawaiian cordage. Pacific anthropological records; 39. Bishop Museum Press, Honolulu : 129 p

CORRESPONDENCE ATTACHMENTS

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

March 22, 2001

Regulatory Branch

Mr. Neil A. Sims, Vice President
Black Pearls, Inc.
P.O. Box 525
Holualoa, Hawaii 96725

Dear Mr. Sims:

This letter replies to your Application for a Department of the Army (DA) Permit, dated August 8, 2000. Your request for a (DA) permit to deploy subsurface oyster lines in the Reef Runway borrow pit is hereby approved. Your project has been coordinated with the interested agencies and I have determined that the deployment can be authorized by a Letter of Permission under Section 10 of the Rivers and Harbors Act of 1899.

The following conditions apply to this permit.

a. The project will be constructed substantially as stated in the draft Environmental Assessment for the project dated August 21, 2000, except that the staging area adjacent to Oufi's Island is no longer included in the proposed project.

b. The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure of work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

c. The project shall be in compliance with State water quality standards and requirements of the Department of Health.

d. Pre-installation in-water surveys to note the presence of sea turtles or humpback whales should be conducted. Installation should be postponed until turtles or whales have departed the site.

e. The moorings lines should be examined each day that personnel are present at the site for any entanglements or injuries of listed species. Through unlikely, in the event that a turtle or humpback whale is entangled or injured by the moorings the Pacific Islands Protected Species Program Coordinator must be notified immediately at (808) 973-2987).

f. Any interactions or sightings of protected species should be recorded on a copy of the enclosed sheet and submitted on an annual basis to the National Marine Fisheries Service, Protected Species Program, 1601 Kapiolani Boulevard, Suite 1110, Honolulu, Hawaii 96814-0047. Reports should include species name, date, time of interaction and the activity of the animal.

g. During construction of the working platforms and deployment of the mooring lines silt containment devices shall be installed to contain construction generated turbidity within the construction area.

h. Your construction and operations activities must be in compliance with State of Hawaii Water Quality Standards and water pollution control requirements specified in Hawaii Administrative Rules Chapters 11-54 and 11-55.

If you have any questions please contact Mr. William Lennan of my staff at 438-6986 or FAX 438-4060. Please refer to File Number 200000085 in any future correspondence with our office.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

22 March 2001

GEORGE P. YOUNG, P.E.
Chief, Regulatory Branch
For and in behalf of District Engineer
Ronald N. Light, Lieutenant Colonel, EN
U.S. Army Corps of Engineers

DATE

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Mr. Coloma-Agaran
Chairperson
Department of Land and Natural Resources
Kalanimoku Bldg Room 220,
1151 Punchbowl St.,
Honolulu, HI 96809

January 24, 2001

RECEIVED
2001 JAN 26 A 11:10

Re: Permit application: OA 3004

Dear Mr. Coloma-Agaran:

The Southwest Region of the National Marine Fisheries Service (NMFS) has historically supported the sustainable development of marine resources in the central and western Pacific. To this end, NMFS has, and continues to support the responsible development of black lipped pearl oyster (*Pinctada magaritifera*) mariculture in the region and would like to offer the State of Hawaii Board of Land and Natural Resources (BLNR) background information in support of application # OA 3004 by Black Pearls Inc. (BPI).

For over twelve years, the NMFS has provided fiscal resources and other support for activities including black lipped pearl oyster resource surveys and assessments to determine the presence of indigenous populations in the Hawaiian Archipelago and at various sites in Micronesia (i.e. the Republic of Marshall Islands and the Federated States of Micronesia). These studies were completed by NOAA/NMFS personnel, partners at local marine resource agencies, as well as by a variety of individuals and firms in the private sector. The majority of the work was performed by Black Pearls Inc. (BPI) with the support of the Saltonstall-Kennedy (S-K) competitive grant program.

In 1997, BPI completed black lipped pearl oyster resource surveys throughout the Hawaii Archipelago - from Midway to the Big Island. BPI also investigated the viability of establishing a black lipped pearl oyster demonstration farm in the State. Site selection criteria were established and several areas within the State identified as potentially viable commercial sites. The applicant's proposed site at Keehi lagoon was, after weighing all the biological, logistical, regulatory, and political parameters, determined to be the most viable. The NMFS also supported more detailed investigation by the applicant of a variety of parameters specific to this Keehi site; the results of which have been documented in an environmental assessment provided to the BLNR by the applicant. While it is not the agency's intention to assess the adequacy of the NEPA document, we would like to clarify our role in the process and address some concerns raised by other stakeholders.

The NMFS, in its capacity as the agency responsible for a variety of marine protected species was requested by the applicant, as well as the U.S. Army Corps of Engineers (Corps), to provide a list of protected species which might be found in the waters near the proposed project site. Additionally, the Corps sought NMFS review of the installation(s) and operation of the proposed pearl oyster farm's impacts on essential fish habitat (EFH) and endangered/threatened species. The NMFS determined that the application by BPI is not likely to adversely affect EFH or any of the listed species, which includes the threatened green turtle (*Chelonia mydas*).

In closing NMFS would like to express our continued support for the activities as proposed by BPI. If successful, these activities could lead to the development of a viable black pearl industry in the State of Hawaii and provide a demonstration for a much wider audience in Micronesia and beyond.

Sincerely,

Charles Kamella, Ph.D.
Administrator, Pacific Islands Area Office

cc: Black Pearls Inc.
M. Dupree
A. Everson

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
STATE PARKS
WATER RESOURCE MANAGEMENT

REF.:PB:EAH

DEC 12 1999

CDUA File No.:OA-3004B
Acceptance Date: 12/8/2000
180-Day Exp. Date: 6/6/2001

Mr. Neil Anthony Sims, Vice President
Black Pearls, Inc.
P. O. Box 525
Holualoa, HI 96725

Dear Mr. Sims,

NOTICE OF ACCEPTANCE AND PRELIMINARY ENVIRONMENTAL DETERMINATION:
CONSERVATION DISTRICT USE APPLICATION OA-3004, BOARD PERMIT AND
REQUEST FOR A LEASE FOR MARINE ACTIVITIES

This acknowledges the acceptance for processing of your application for a pearl oyster farm at the Reef Runway Borrow Pit adjacent to the Honolulu International Airport Reef Runway, Keehi Lagoon, Oahu. Your dual permit and lease application is being processed pursuant to Chapter 190D, Hawaii Revised Statutes (HRS).

According to the information in the application, we understand that you intend to grow hatchery raised *Pinctada margaritifera (galtsoffi)*, an endemic variety of the black lipped pearl oyster, on suspended net panels in a 75 acre state marine water exclusive shellfish farm use area at the reef runway borrow pit for pearl production. The wild broodstock will be selected from various islands throughout the state to ensure genetic diversity.

We understand that the borrow pit area has an average depth of 40 feet below mean low tide. The farm will be secured to the bottom or sides of the borrow pit by moorings. Floats and lines connecting the farm will be submerged between three and 15 feet below the level of the ocean at mean low tide. Two or three small farm maintenance structures of post and pier construction are proposed to be built within the conservation district. A maximum of four pontoon rafts would be moored within the farm area, would be moved within the farm or adjacent areas as needed and would be used to operate the farm.

We understand that the farm will be submerged and that marker buoys, only, will mark the site. On the contrary, we also understand that a surface float line will mark the airport runway side of the farm.

We also understand that an "easement" is proposed on the airport runway side of the farm to allow the transit of boat traffic along the outside of the farm area. We understand that no such "right of way" is currently proposed on the reef facing side of the farm.

While the proposed farm area is encumbered by Governor's Executive Order 3202 to the Department of Transportation, Harbors and Airports Divisions, most of the area of the proposed peal oyster farm is designated a recreational thrill craft operating area pursuant to Section 13-256-94, HAR. We understand that our Division of Boating and Ocean Recreation may initiate an amendment to the administrative rules at some time in the future and that, as your application states, farm implementation would be contingent upon successful amendment to the administrative rules which removes the proposed farm area from the recreational thrill craft operating area.

After reviewing the application, we find that:

1. The proposed use is an identified marine activity, mariculture, as defined by Chapter 190D, Hawaii Revised Statutes, for which a lease of state marine waters may be applied for;

2. The proposed use is considered an identified use within the Resource Subzone of the Conservation District pursuant to Section 13-5-24 (R-1) AQUACULTURE (D-1) of the Hawaii Administrative Rules (HAR);

3. A public hearing will be required since the proposed use is of a commercial nature; and

4. In conformance with Title 11, Chapter 200, of the Administrative Rules, a draft environmental assessment and anticipated finding of no significant impact (FONSI) to the environment will be published in the Environmental Notice.

As the applicant, please be advised that it will be your responsibility to comply with the provisions of Section 205A, Hawaii Revised Statutes, relating to Coastal Zone Management (Special Management Area) requirements.

Negative action on your application, as required by law, by the Board of Land and Natural Resources can be expected should you fail to obtain from the County thirty (30) days prior to the 180-day expiration date, as noted on the first page of this notice, one of the following:

1. A determination that the proposed development is outside the Special Management Area (SMA);

2. A determination that the proposed development is exempt from the provisions of the county ordinance and/or regulation specific to Section 205A-29(b), HRS; or

3. A Special Management Area (SMA) permit for the proposed development.

As part of the Board of Land and Natural Resources's evaluation of your application, we request statements related to the two criteria listed in Section 190D-11(e), HRS, specifically: (1) that the applicant has the capacity to carry out the entire project; and (2) that the proposed project is clearly in the public interest upon consideration of the overall economic, social, and environmental impacts.

In regards to marine life, please confirm and clarify what measures will be taken to quantify the present stock of marine life, including oyster health, which occur at and near the site and what measures will be taken to monitor and quantify the stock of marine life, including oyster health, which occur at and near the farm area in the future after farm implementation.

In addition, we request further information and clarification, including a preliminary site plan, related to how the site will be marked on the ocean surface. We also request further information and clarification regarding on site security and potential interactions at the farm site with the public. In addition to issues regarding security, due to the fact that the farm will act as a fish aggregation device please also confirm your intentions regarding any management of fishing by pole from the shore or any fishing around the farm. Please inform the department how government and you, as lessee, would respond to unauthorized intrusion into the exclusive lease area as detected by your security personnel or other means. Please also indicate how you will respond to theft, vandalism, shellfish disease and severe ocean condition or other emergency.

In regards to the rights of tenants, please provide statements related to:

1. The identity and scope of "valued cultural, historical and natural resources" in the area, including the extent to which traditional and customary native Hawaiian rights are exercised in the area;

2. The extent to which those resources, including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action; and

3. The feasible action, if any, to be taken by the Board of Land and Natural Resources in regards to your application and lease request to reasonably protect native Hawaiian rights if they exist.

We have no record of application fees being submitted for your application. Please submit $2350 to cover your application's application and public hearing fees. Pursuant to Chapter 190D-11(b), the Department must issue three public notices stating that the application for a lease for marine activities in state marine waters, has been received. Please be advised that in addition to the

application and public hearing fees, you will be required to remit additional monies for the cost of the public notices which are required under Section 190D-11(b), HRS.

Please submit your CUDA's application and public hearing fees by January 10, 2001. Please submit the information requested herein by February 7, 2001. Please also incorporate the information requested herein in your final environmental assessment.

Pending action on your application by the Board of Land and Natural Resources in the near future, your cooperation and early response to the matters presented herein will be appreciated. Should you have any questions, please contact Eric Hill of our Land Division's Planning Branch at 587-0380.

Aloha,

TIMOTHY E. JOHNS
Chairperson

c: Board Members
DOCARE/DAR/DOBOR/LD(ODLO/EB)
DOT(Harbors/Airports)/DOH/OHA/OEQC/DBEDT/DOA
City and County of Honolulu, Department of Planning and Permitting
US Coast Guard/US Army Corps of Engineers
USFWS – Pacific Islands Ecoregion/NMFS – Honolulu Laboratory
Kalihi-Palama Neighborhood Board

Black Pearls, Inc.
Kona, Hawaii
Producers of Hawaiian Black Pearls ™

P.O. Box 525 Holualoa, HI 96725 U.S.A. Phone (808) 325-6516 Fax (808) 325-3425

E-mail Address : nasims@aloha.net

Our ref : Johns1.doc/Keehi/words/Konalab
Your ref : CDUA File No: OA-3004B
January 10, 2001

Chairperson
DLNR
PO Box 621
Honolulu, HI 96809

RE : Your 12/12/00 (dated 12/12/99) letter of acceptance of our CDUA Application

Dear Chairperson,

Thank you for the above referenced letter (please note the date correction), which correctly restates much of the broad intent of our lease application.

There are a few clarifying comments that we wish to make to your outline of the project. The first reflects changes to our proposal in response to public input that we have received since submittal of the EA. The Keehi community has expressed increasing concern about the use of "Oufi's Island" as our land base, because of the effects this would have on public recreation in the area. We will therefore amend our proposal to not include the land base on Oufi's Island. We will find an alternative site for our land base within an already appropriately-zoned area, such as in the Keehi Marina facilities. We still would like to be able to install the two post-and-pier work platforms on the inner (southern) edge of the farm area.

The second clarification concerns two misperceptions in the description in your letter of the "public easement". Firstly, we would provide the public easement on the inside perimeter of the farm lease area, not "along the outside". We would want the easement to be part of the lease area, so that we could use the waters beneath the easement for underwater anchors or mooring lines, and for our own boat movements. Secondly, we are not particularly concerned whether the easement is on the inshore (runway side) or offshore (reef side) of the farm area. We are willing to permit easement over either area, and in the public meeting with the Keehi lagoon community, we asked for their preference. The response was overwhelmingly in favor of the inshore side, but we would be amenable to changing this, if you or others so requested.

In response to your question on the criteria in 190D-11(e) HRS :

(1) "the capacity to carry out the project" : Black Pearls, Inc. has the capacity, and certainly the qualifications, to carry out this project. Our company has been developing this concept for the last eight years, since we first began operations. We have pioneered development of the hatchery culture techniques, nursery systems and adult grow-out for this species in Hawaii. We have conducted stock surveys and reef reseeding trials throughout the Hawaiian chain, and have set up and monitored growth trials at over 20 sites.

Over the last eight years, while we have been nurturing the concept of Hawaiian pearl farming, we have had to derive our income from sources outside of Hawaii. Our company is therefore very experienced in planning, managing and financing pearl farm projects in other parts of the world. We are the founders, part-owners and managers for a commercial pearl farm and hatchery in Majuro lagoon, in the Marshall Islands. This operation is supporting the growth of the industry in Micronesia through training of Marshallese, sharing of farm technology and supply of spat to local farmers. In 1998 this company received an investment commitment of over $2.1 million from a U.S. mainland investment group. We have provided consulting services to a Philippines pearl farm for design, construction supervision, management and training for a commercial scale hatchery for the silver-lip pearl oyster, Pinctada maxima. We are partners in a silver-lip pearl farm in Australia, and we are project partners with an established operation in Thailand. We have provided consulting services in pearl farm development and management to the governments of the Cook Islands, Kiribati, the South Pacific Commission and the South Pacific Forum Secretariat. We have also conducted a feasibility study and business plan for the Cook Islands government for a hatchery-based pearl farm project on a remote atoll under National Park jurisdiction. We are pleased to provide you with reference contacts for any of these projects, if you wish.

(2) "the project is clearly in the pubic interest" : In our opinion, this project is very clearly in the public interest, upon consideration of the overall economic, social and environmental impacts. Section 2.2 Justifications, of our EA is comprehensive in its detailing of the benefits to be derived from this project. These primarily hinge on the critical status of this endemic Hawaiian coral reef species. The Hawaiian pearl oyster, P. margaritifera (galtsoffi), has been severely overfished in the past, and DAR officials are currently considering having it listed as a candidate species under the Endangered Species Act. This project provides the only feasible avenue for a long-term stock re-establishment effort for this species, and it offers a means for private funds to pay for this program. Economically, the availability of Hawaiian pearls would fill a strong demand for local jewelry products. The farm itself would provide local employment, and the site could also be used for training and extension to support expansion of pearl farming or other forms of shellfish culture in Hawaii or the South Pacific. Simultaneously, the project will also provide pearl shell materials for use by Hawaiian artisans, which we hope would increase the level of interest in traditional shell crafts and modern pearl shell art. The project would also provide a test case of the ocean leasing law, and a barometer for assessing the impact of such

operations, as well as being an excellent example of public-private initiatives working for the public good.

There are some costs in the loss of public access to the borrow pit, but in the EA (refer to Sections 5, Environmental Setting, and 6, Potential Impacts and Mitigation), we point out that this area is highly disturbed, biologically depauperate, and little utilized by the public. In the balance, we believe that this is very much in the public good.

Addressing the other concerns in your letter, regarding marine life, the site plan, and site security:

We recognize the need for ongoing monitoring of the marine life in the area. Any changes that might occur will be gradual, as we build up our farm stocks, and we would therefore propose that every five years we will repeat surveys of water quality, benthic community health and fish abundance identical to those which were conducted to support the EA. Measures of oyster health are more difficult to obtain. Unless there is an obvious disease outbreak (refer to comments below), there are no criteria by which to adequately evaluate oyster health. There are always some losses on a farm associated with seeding operations and handling stress, and these will be reported in the annual report required under the State Aquaculture License legislation.

The site will be marked with surface floats around the perimeter. The number, size and markings on these floats will be determined in consultation with officials in your department (Boating, DAR, DOCARE), DOT (Harbors and Airports) and the Coast Guard. We will not inhibit the actions of shore fishermen, so long as they do not physically enter the farm area. We would like to ask them not to cast their lures and baits in around the farm lines, because of the risk of entanglement with the lines and oyster net baskets, and the personal injury risk this would impose on our workers. However, this would be negotiable, and we would not insist on this being a condition of the lease.

If there is an unauthorized intrusion into the farm area, we would at first attempt to notify the parties involved that they are intruding on an exclusive aquaculture area. If they ignored the directions or instructions from our farm workers, we would then notify the police and/or the Coast Guard. Similarly, in any instance of theft or vandalism, our first response would be to notify the police and/or Coast Guard. Once the lease is granted, we plan to meet with these enforcement officials (and DOCARE officials, if they are interested in involvement) and outline a plan for responding to such situations.

As the lines are all submerged, and well-anchored, there is no problem for oysters in severe ocean conditions. In extreme conditions, we would move personnel and moveable equipment such as pontoons to a better-protected area, which would be determined beforehand in consultation with the Keehi Marina harbormaster. In case of evidence of a shellfish disease, we would immediately notify the State's Aquaculture Veterinarian (under the Aquaculture Development Program), and seek his recommendations on how to respond. We are unable to pre-ordain our response to such situations because so little is known of bivalve diseases, and we must meet any new situation as it arises. The policies that we adopt for responses to these security, weather and disease situations would then become part of the farm management plan.

Regarding the rights of tenants, we need to reiterate that, at this stage, we are unaware of any "valued cultural, historical or natural resources" in the farm area. We are not impeding access to the reef flat, and therefore we are not impinging on any traditional and customary native Hawaiian rights in the area surrounding the farm. The borrow pit itself – the actual area of the farm – has only been in existence since the construction of the reef runway, and we presently do not know of any traditional or customary uses which are exercised there. In the event that there may indeed be such rights or uses, we would address these on a case-by-case basis. We will hopefully be able to respond to these issues with some greater confidence after the public meeting.

We are keenly aware of the innovative nature of this application, and we recognize that the public may have concerns. We are hopeful that all such concerns can be resolved in an atmosphere of mutual good will and conciliation, with the interests of the public, the environment and the oysters all given due consideration.

Please note that we are enclosing here a check for $2,350, being the application and public hearing fees required, as per your letter.

Yours sincerely,

Neil Anthony Sims
V.P. / Research Dir.

P.S. We do not have mailing addresses for all those you copied your letter to, but we would like to have this similarly disseminated. Could you please copy this letter to all the same recipients you list? i.e. :

Board Members
DOCARE/DAR/DOBOR/LD(ODLO/EB)
DOT (Harbors/Airports)/DOH/OHA/OEQC/DBEDT/DOA
City and County of Honolulu, Department of Planning and Permitting
US Coast Guard/US Army Corps of Engineers
USFWS – Pacific Islands Ecoregion/NMFS – Honolulu Laboratory
Kalihi-Palama Neighborhood Board

BENJAMIN J. CAYETANO
GOVERNOR

GENEVIEVE SALMONSON
DIRECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

February 7, 2001

Mr. Gilbert Agaran, Chair
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Agaran:

Subject: Draft Environmental Assessment for the Ke'ehi Lagoon Pearl Oyster Farm, O'ahu

Thank you for the opportunity to review the subject document. We have the following questions and comments.

1. Please provide a map or maps that show the following:
   a. The shoreline and date the shoreline was surveyed.
   b. Locations of any beaches within the affected area.
   c. Areas where fishing and recreational activities are occurring.
   d. Locations of all fuel storage facilities.
   e. Locations of coral reefs
   f. Sites where the reef will be removed and replaced.

2. Please provide the date of aerial photograph of the western reaches of Ke'ehi Lagoon and reef runway (plate 1).

3. Please consult with the Department of Health concerning the potential impacts of the proposed sewage septic tank and its associated leach field.

4. Please describe all the mitigation measures that will be taken to minimize spills from the proposed fuel storage facilities.

5. What is the basis for determining that there are no traditional gathering rights or cultural practices in the project site? Please consult with the Office of Hawaiian Affairs concerning this issue.

6. Please consult with the Kalihi Neighborhood Board concerning this project and in particular regarding the need to restrict access to the site.

7. Please describe the potential impact of the active sonar on the animals that live or visit the project site.

8. How does this project fit with the State DOT's 2020 O'ahu master plan.

9. Please consult with pleasure craft users and include their comments in the final environmental assessment.

10. How would the aircraft noise affect the employees of this operation? Please consult with the State Department of Labor, OSHA program and include their comments in the final environmental assessment.

Should you have any questions, please call Jeyan Thirugnanam at 586-4185.

Sincerely,

Genevieve Salmonson
Director

c: Black Pearls, Inc.

Black Pearls, Inc.
Kona, Hawaii
Producers of Hawaiian Black Pearls ™

P.O. Box 525 Holualoa, HI 96725 U.S.A. Phone (808) 325-6516 Fax (808) 325-3425

E-mail Address : nasims@aloha.net

04/09/01
Salmonson1

G. Salmonson
Director
Office of Environmental Quality Control
235 Sth Beretania St, Suite 702
Honolulu, HI, 96813

Dear Ms Salmonson,

Thank you for your comments on the draft Environmental Assessment for the Ke'ehi Lagoon Pearl Oyster Farm (letter to DLNR, dated 2/7/01). I will endeavor to address each of your concerns in turn.

1. a. We are unable to locate any detailed maps of the shoreline, and we do not know the date that the shoreline was surveyed. DLNR Lands Division is also unaware of such survey information. A survey of the area will be conducted prior to the issuance of the lease.

b. There are no beaches within the proposed lease area. In Plate 1, three small areas where sand has accumulated against the reef runway revetment are clearly visible in the aerial photograph. These will be indicated more clearly in Plate 1 in the final Environmental Assessment, and an accompanying legend will indicate their use for recreation.

c. Fishing and recreational activities occasionally occur throughout the surrounding reef flat area – i.e. all the areas outside of the cross-hatched farm area shown in Fig. 1 and Fig. 4. There is negligible fishing or other recreational activity in the cross-hatched area that is proposed as the farm site.

d. In the face of public concerns, we have deleted the staging and storage area which was originally proposed for the islet at the end of the runway. We will find an alternative storage and office area elsewhere within the lagoon environs – probably in the Keehi commercial marina. There will therefore be no fuel stored on the site, beyond the small containers usually used for small boats, or for powering small generators or other petrol-driven equipment.

e. The coral reef is shown in Fig. 1, as the irregular line to the south of the project site. There is a legend of "Coral" in two places on this figure. The same symbol for coral is used in Fig.s 2 and 4. In the latter, it is again indicated as "Coral". If you feel that this is still insufficient, could you please suggest how we should display the locations of coral reefs on our maps.

f. As we are no longer intending to site the staging/storage area on the islet, there will be no coral removal or replacement associated with this structure. The two work platforms on the inside edge of the farm area will be sited in the sand, and will not impact the coral in any way.

2. This photograph is dated 1/31/95. There has been little change in the area since this photograph was taken.

3. As indicated above, in 1.c., we have deleted the staging and storage area from our request. There will therefore be no septic tank or leach field in the area of the islet.

4. Again (refer to 1.d., above) there will be no fuel stored on the site, beyond the hand-carried containers usually used for small boats or small engines. There may be accidental spillages from these containers. Some of our boats may have built-in fuel tanks, but these would not leak unless there was an accident which ruptured one of these tanks. In any such event of a fuel spillage, we will immediately notify both the Coast Guard and the Harbormaster's office, and we will take whatever remedial action is prudent and appropriate. We will develop and maintain a "Fuel Spill Response Procedure" in conjunction with the Coast Guard and the Harbormaster's office, and will train our staff in these procedures. We will endeavor to maintain a supply of oil absorbent pads on site, and staff will be trained in their correct use. Our primary concern will always be for the safety of our employees.

5. We have consulted with the local community of users and with OHA in making the determination that there are no traditional gathering rights or customary practices in the area. The possible existence of some traditional or customary Native Hawaiian practices in the borrow pit area unknown to the applicant was addressed in discussions with OHA officials, prior to submitting the draft Environmental Assessment. OHA indicated at the time that they would conduct their own individual assessment to determine if such impacts might occur. We have since received a letter from OHA on the project. They express general support, have no specific objections, and do not mention any conflict with traditional gathering rights or customary practices.

During the public hearing process reviewing the draft EA document, one individual – familiar with Hawaiian fishing and collecting practices - objected to the exclusive lease conditions, on the basis of a past history of collecting limu (ogo) and aquarium fish (primarily one species, the raccoon butterflyfish, Chaetodon lunula) in the area. In subsequent discussions between the applicant and the individual, it was mutually agreed that the lease should contain some provision for individuals or small groups of free-divers requesting access on a restricted basis for the purposes of collecting limu within the easement area. As the aquarium fish collection involves use of SCUBA, this would represent an unacceptable security risk for the project, and the individual accepted this compromise.

6. We met with the Kalihi Neighborhood Board on January 17th, 2001, and outlined the project. The Board voted unanimously to support the project. We attach here a copy of their letter, dated 2/12/01, outlining their support.

7. As we state in the draft Environmental Assessment, the sonar equipment would not be substantively different from the electronic equipment found on a cargo ship or fishing boat. Based on this information, the National Marine Fisheries Service has determined that "the application by BPI is not likely to adversely effect (Endangered Fish Habitat) or any of the (endangered) listed species, which includes the threatened green turtle (*Chelonia mydas*)" (letter from Charles Karnella, dated 1/24/01).

8. The State Department of Transportation Harbors Administrator, has reviewed the project in the context of the 2020 Master Plan, identified four projects "that could potentially impact the pearl farm ..." and that the applicant "... should be aware of potential negative impacts ... from silt/debris" (letter from Thomas Fujikawa, 1/9/01). There was no mention of any possible inconsistency of the proposed pearl farm with the 2020 Master plan projects.

9. As indicated in our draft Environmental Assessment, we have already consulted extensively with the recreational users of the area, including thrill craft and pleasure craft users, through public meetings, the creel survey process at boat ramps, and one-on-one follow-up discussions. The following paragraph will be inserted into the final Environmental Assessment document.

"There was considerable interest in the draft Environmental Assessment from the thrill-craft community. The comments at the public hearing are perhaps best exemplified by excerpts from Russell Kaupu's testimony : "I have nothing in opposition to the application .... (the existing jet-ski area is) a considerable distance between where you launch your watercraft and where you ride (your) watercraft ... (the distance is a) safety concern for my family .... there is a much better area for personal watercraft which fronts the shoreline area near the small boat harbor ramp" (from DLNR's official transcript of the meeting, 1/25/01, pp 56 - 9)."

10. We are concerned about the potential for aircraft noise to have a negative impact on our employees. We want to provide a quality environment for our workers, so that they are healthy and productive. We note that there is already some recreational use of the area, but we recognize that there may still be some possibility that chronic exposure could effect workers' hearing or welfare. We will consult with State Department of Labor and OSHA program officials, and take whatever preventative action they recommend, be it limiting the duration during which employees are exposed to the noise, or use of ear-muffs or some other mitigating measure. We believe that these discussions are more appropriately held when we are beginning to plan for staffing of the farm.

Thank you for your comment letter and for your concerns. Please feel free to contact us if you wish to discuss any of these matters further.

Yours sincerely,

Neil Anthony Sims
V.P. / Research Dir.

c.c. DLNR, Dean Uchida
ADP, John Corbin

BENJAMIN J. CAYETANO
Governor

JAMES J. NAKATANI
Chairperson, Board of Agriculture

LETITIA M. UYEHARA
Deputy to the Chairperson

State of Hawaii
DEPARTMENT OF AGRICULTURE
Aquaculture Development Program
1177 Alakea Street, #400
Honolulu, Hawaii 96813
E-mail Address: aquacult@aloha.com
Website: http://www.aloha.com/~aquacult
Tel: (808) 587-0000
Fax: (808) 587-0033

January 23, 2001

Mr. Dean Y. Uchida
Administrator
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Uchida:

Thank you for the opportunity to comment on the Conservation District Use Application (CDUA) OA-3004 and Environmental Assessment from Black Pearls Inc. (BPI). The Company is requesting to lease State marine waters at the Reef Runway Borrow Pit adjacent to the Honolulu International Airport Reef Runway, Keehi Lagoon, Oahu. We have the following comments based on our familiarity with the Company and its plans.

- As you are aware, this project is one of two initial test cases for the newly amended ocean leasing law, Chapter 190D. The legislature amended Chapter 190D to allow the issuance of long-term commercial leases for a period of five years, at which it will examine the situation and consider extending the law.

- The BPI project, after substantial statewide site testing, has identified a site, the Reef Runway Borrow Pit, that is biologically suited to pearl oyster farming, while having minimal multiple use issues. The site has been carefully studied and baselines established, as evidenced by the Environmental Assessment and the appended comprehensive studies of site flora, fauna and existing recreational and other uses.

  Full utilization of the site requires a rule change excluding the 75-acre farm from the existing 700-acre plus recreational thrill craft zone and the collaborative identification with jet ski enthusiasts of another 75 acres contiguous with the existing zone. Initial discussions between the applicant, thrill craft representatives, other site users and your Department's Division of Boating and Ocean Recreation (DBOR) indicate this negotiation for redrawing of boundaries is possible, once it appears the subject lease may be approved.

- The use for commercial black pearl farming is economically beneficial to Hawaii, while being environmentally benign and perhaps even beneficial to nearshore water quality by cleaning up turbid waters through the natural filter feeding of the oyster stocks. Economic impacts include the direct farm investment and farm jobs generated and indirect economic impacts through spin off businesses such as jewelry making. Local people will be trained in valuable, exportable skills, such as pearl grafting techniques, as another side benefit.

Remarkably, a large oyster farm allows for natural production of oyster larvae that will reseed the natural population of indigenous Hawaiian black pearl oysters, which has been severely depleted statewide. This extremely valuable resource management tool is provided to State marine resource managers at no taxpayer expense. In addition, the pearl farm should improve fishing in the general area with its anticipated positive impacts on stock recruitment.

- The project also provides a cultured source, and in a decade or two wild sources, of black pearl oyster shells. Availability of these unique shells will allow the re-emergence of the significance of this species in Hawaiian culture, particularly through Hawaiian shell carving. Hawaiian artisans appear very interested in working with this project toward this mutually beneficial end.

- BPI is internationally known in the pearl industry, as a cutting-edge, technology company that is environmentally responsible. The principals have worked all over the world in advancing the pearl farming industry in a sustainable manner. Now, with this project they wish to apply their accumulated knowledge and skills to benefit Hawaii, their home, and its natural environment.

In conclusion, the project would utilize an underused portion of Hawaii's nearshore ocean space to demonstrate commercial ocean leasing for pearl farming. The project is unobtrusive in terms of appearance and low impact in terms of management approach. BPI needs management control over 75 acres of the borrow pit for the reef runway and the Aquaculture Development Program supports the issuance of this lease. Further, we believe that it is in the public interest to do so because of the significant economic, environmental, natural resource management and Hawaiian cultural benefits the farm with foster.

We would be pleased to answer any questions you might have on these statements. Thank you for the opportunity to comment.

Sincerely,

John S. Corbin
Manager

c: DOA Chairperson

bc: Neil Sims

BENJAMIN J. CAYETANO
GOVERNOR

RECEIVED
LAND DIVISION
2001 JAN 26 A 11: 13

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
AIRPORTS DIVISION
400 RODGERS BOULEVARD, SUITE 700
HONOLULU, HAWAII 96819-1880

LEADING HAWAII INTO THE NEW MILLENNIUM
1959 2000+

BRIAN K. MINAAI
DIRECTOR

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

January 12, 2001

IN REPLY REFER TO:

AIR-P
01.0021

TO: DEAN Y. UCHIDA, ADMINISTRATOR
LAND DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: JERRY M. MATSUDA, P.E.
AIRPORTS ADMINISTRATOR

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT, CONSERVATION DISTRICT USE APPLICATION OA-3004 (BOARD PERMIT) AND REQUEST TO LEASE STATE MARINE WATERS FOR A PEARL OYSTER FARM AT THE REEF RUNWAY BORROW PIT ADJACENT TO THE HONOLULU INTERNATIONAL AIRPORT REEF RUNWAY, KEEHI LAGOON, HONOLULU, OAHU

We have received the Draft Environmental Assessment, Conservation District Use Application No. OA-3004, and Request to lease State Marine Waters by Black Pearls, Inc. at the Reef Runway Borrow Pit adjacent to the Honolulu International Airport Reef Runway, which location is within submerged land under Executive Order (EO) No. 3202, which places control and management under both the Airports Division and Harbors Division.

Having reviewed both documents, we have no objection to the use by Black Pearl, Inc. of the submerged area within EO No. 3202. Subject to concurrence by the Harbors Division, you may process a lease for ocean lease under Chapter 190D-21, HRS.

Should you have any questions, please contact Ben Schlapak of our Planning Office at 838-8821 or David Shimokawa of our Property Management Staff at 838-8676.

Hana Like No Ke Ala Aloha
Working Together to Provide Gateways of Aloha

BENJAMIN J. CAYETANO
GOVERNOR

RECEIVED
2001 JAN 11 A 11:22
STATE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION
79-20 KAMITZ HWY. • HONOLULU HAWAII 96813-4898

LEADING HAWAII INTO THE NEW MILLENNIUM
1959 2000+

BRIAN K. MINAMI
DIRECTOR

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

January 9, 2001

IN REPLY REFER TO:
HAR-EP
1546.01

TO: DEAN Y. UCHIDA, ADMINISTRATOR
LAND DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: THOMAS T. FUJIKAWA
HARBORS ADMINISTRATOR

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT, CONSERVATION DISTRICT USE APPLICATION OA-3004 (BOARD PERMIT) AND REQUEST TO LEASE STATE MARINE WATERS FOR A PEARL OYSTER FARM AT THE REEF RUNWAY BORROW PIT ADJACENT TO THE HONOLULU INTERNATIONAL AIRPORT REEF RUNWAY, KEEHI LAGOON, OAHU

Thank you for your letter of December 12, 2000 requesting that we review and comment on the subject matter.

We have reviewed the subject documents and have the following comments to offer:

A. Regarding Draft Environmental Assessment and Conservation District Use Application OA-3004

Based on our 2020 Oahu Commercial Harbors Master Plan, there are four future projects that could potentially impact the pearl farm (see Attachment 1):

- Keehi Lagoon Channel improvements project will create access to new lay berths along Lagoon Drive;
- Dredging to a depth of –25 feet in mauka area of proposed oyster farm location;
- Dredging of the Kalihi Channel; and
- Future tunnel that will cross the Kalihi Channel.

Construction-related activities for these projects will produce silt/debris, subsequently becoming waterborne and possibly impacting the proposed pearl farm. Whether or not the silt/debris reach the pearl farm via variable ocean currents, the pearl farm owner/operator should be aware of potential negative impacts to its pearl farm. Furthermore, it should be clearly communicated to the pearl farm owner/operator that the STATE or any entity involved with said projects shall not be held liable for such impacts.

Should the pearl farm owner/operator's equipment/materials for its business (e.g., oyster lines, pontoons, etc.) detach from their anchorage points, what is its emergency response plan? How can they ensure neighboring ocean users that such an incident will not be a detriment to them?

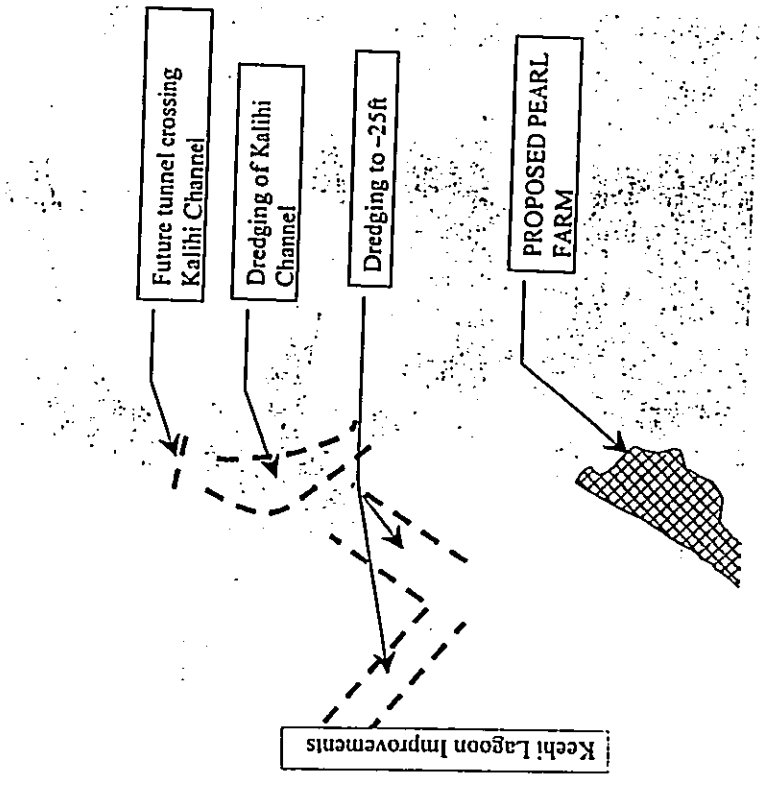
B. Regarding Request to Lease State Marine Waters

Please refer to our November 22, 2000 memo (see Attachment 2) where we state no objections toward the proposal to lease.

Attachments:

Attachment-1 Photograph of areas of concern
Attachment-2 November 22, 2000 letter to DLNR

2020 Oahu Commercial Harbors Master Plan Projects that may impact the proposed Pearl Farm



ATTACHMENT-1

R/S 01.0488
HAR-PM
0525.01

November 22, 2000

TO: TIMOTHY E. JOHNS, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

FROM: KAZU HAYASHIDA K.H.
DIRECTOR OF TRANSPORTATION

SUBJECT: PROCESSING OF A CONSERVATION DISTRICT USE APPLICATION (CDUA), TOGETHER WITH A PROPOSED LAND USE OF STATE LAND AT THE REEF RUNWAY BORROW PIT SITUATED AT KEEHI LAGOON, MAMALA BAY, HONOLULU, OAHU

Thank you for your memorandum of September 25, 2000 requesting our review and comment concerning the processing of a CDUA for Black Pearls, Inc., together with a proposed lease of the use of approximately 75 acres of the borrow pit adjacent to the Reef Runway of the Honolulu International Airport.

We have no objections to the proposal for processing of the CDUA and the proposed lease for the pearl farm as submitted by the applicant, Black Pearls, Inc. We understand that the Division of Boating and Ocean Recreation is willing to consider modifying the boundaries of the Recreational Thrill Craft Zone that overlaps the proposed project area.

We do request that, as proposed by the Harbors Division at a meeting involving all concerned parties on October 31, 2000, access easements be provided for boats on both sides of the proposed lease area.

Should your staff have any questions, they may contact John Dooling, Property Manager, at 587-1943.

JD:mg

ATTACHMENT-2

Black Pearls, Inc.
Kona, Hawaii
Producers of Hawaiian Black Pearls ™

P.O. Box 525 Holualoa, HI 96725 U.S.A. Phone (808) 325-6516 Fax (808) 325-3425

E-mail Address : nasims@aloha.net

04/13/01

Thomas Fujikawa
Harbors Administrator
Department of Transportation
79 So. Nimitz Hwy,
Honolulu, HI 96813-4898

Dear Mr Fujikawa,

I am in receipt of your comments dated January 9th, 2001 (which includes the letter from Kazu Hayashida, dated 11/22/00) on our draft Environmental Assessment and CDUA application for a lease for pearl farming in the reef runway borrow pit, Keehi lagoon.

We appreciate your concurrence with the project proposal for the use of the borrow pit, and we are grateful for the details on the potential impacts to the farm which might arise from implementation of the 2020 Harbors Master Plan. We understand your concerns on liability, and we agree that the State should not be held liable for any negative impacts from silt/debris affecting the pearl farm during this construction.

We wish to make the following further clarifications and comments :

Safety concerns : We intend to work closely with both the Keehi Harbormaster, the Coast Guard and the airport and harbor authorities to develop an Emergency Response Plan for dealing with any possible crisis situation, such as high surf, storm or surge conditions; spillage of oil, fuel or other chemicals; security breaches at the farm; and other accidents or emergencies which pose a threat to life or property. We would be pleased to include your office in the discussions to develop this plan, so that you may offer your advice and guidance.

Easement location : We note the request by the Harbors Division for considering providing easements for boats on both sides of the proposed lease area. However, it would be extremely difficult for the farm to operate successfully if there were easements completely surrounding the farm. The purpose of the easement is to provide access to the surrounding reef flat area. The vast majority of the public (indeed, all others consulted) strongly preferred that the easement be along the inland (mauka or northern) side of the lease area. While this may preclude direct access to the reef front, this area is accessible from the seaward side, by diving, and from both the eastern (Diamond Head) and Western (Ewa) ends of the lease area, by wading.

At the meeting with Harbors Division (10/31/00), the rationale that was provided for suggesting two easements was – to my understanding - primarily to allow continued aquarium-fish collecting along the ocean (makai, or southern) side of the lease area. During the public hearing process, one other member of the public requested continued access to the ocean-side of the lease area for aquarium-fish collecting, and to the inland-side for collecting limu (ogo). We are willing to accommodate the need for individuals who wish to collect limu on the inland side of the lease area, under some company-controlled access arrangement, as this would be by snorkeling, and would not unduly compromise farm security. However, aquarium-fish collecting requires the use of SCUBA, and it would be a considerable imposition on the security of the pearl farm to have people SCUBA-diving within an easement area, directly adjacent to the pearl oysters. The risk to farm security is readily apparent, and the other individual concurred with this compromise: only controlled collecting by snorkeling in the easement along the inland edge of the lease. We would ask that your agency support this compromise position.

If your concerns are also a question of access to the seaward reef for dealing with crises such as recovery or salvage of vessels aground or in distress, we can address this in the emergency response plan, which we have offered to develop in conjunction with appropriate agencies and individuals. We have always recognized the need for rescue vessels to have access to the reef front in emergency situations, and we will ensure that the farm line array provides room for this.

We therefore propose to include the following two paragraphs in the Final Environmental Assessment :

"During the public hearing for the project, one individual objected to the exclusive lease conditions, on the basis of a past history of collecting limu (ogo) and aquarium fish (primarily one species, the raccoon butterflyfish, Chaetodon lunula) in the area. In subsequent discussions between the applicant and the individual, it was agreed that the lease should contain some provision for individuals or small groups of free-divers requesting access on an occasional and restricted basis for the purposes of collecting limu within the easement area. As the aquarium fish collection involves use of SCUBA, this would represent an unacceptable security risk for the project, and the individual accepted this compromise."

"The Director of Transportation requested that "access easements be provided for boats on both sides of the proposed lease area". Again, this was primarily to permit aquarium-fish collection on the ocean-side of the borrow pit, which would require SCUBA diving. No other groups or individuals have requested access to both sides, and the applicant strongly prefers the easement be limited to one side, the inland side."

Please feel free to contact us if you wish to discuss any of these matters further. Thank you for your comment letter and for your concerns.

Yours sincerely,

Neil Anthony Sims
V.P. / Research Dir.

FAX (808) 594-1865

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS
711 KAPIOLANI BOULEVARD, SUITE 500
HONOLULU, HAWAII 96813

January 4, 2001

Mr. Dean Y. Uchida
Administrator
Land Division
Department of Land and Natural
Resources
P.O. Box 621
Honolulu, HI 96809

SUBJECT: DRAFT Environmental Assessment – A Pearl Farm And Pearl Oyster Reef Reseeding Project In The Reef Runway Borrow Pit In Keehi Lagoon, Honolulu, Oahu, Hawaii

Dear Mr. Uchida:

Thank you for the opportunity to comment on the above referenced project. Black Pearls, Inc. (BPI) is applying for an ocean lease of a portion of the Reef Runway borrow pit area in Keehi lagoon under Chapter 190D.

We are in general support of the proposed project but have some concerns.

CULTURAL RESOURCES AND PRACTICES

First and foremost we agree with the comments in Chairperson Timothy E. Johns in his letter of December 12 to BPI. He requests statements related to:

1. *The identity and scope of "valued cultural, historical and natural resources" in the area, including the extent to which traditional and customary native Hawaiian rights are exercised in the area;*

2. *The extent to which those resources, including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action; and*

3. *The feasible action, if any, to be taken by the Board of Land and Natural Resources in regards to your application and lease request to reasonable protect native Hawaiian rights if they exist.*

OHA urges that access to the beaches and shoreline waters at the proposed project site be available for public use. Access to the shoreline and beaches are an important part of the Hawaiian culture for fishing, cultural and recreational activities. With regards to access there appears to be a conflict in the Environmental Assessment (EA). On page 7 BPI states "...and the lease will not exclude the public from these areas." On page 23 the EA reports "Security of the farm is a major concern with such a valuable crop. The lease must provide exclusive use of the area." The chart on page 43 states "Exclusive lease over area will preclude customary and traditional marine collection practices."

We have taken note of BPI's concerns about security and liability. We would therefore encourage BPI to develop a "buffer zone" extending 50 to 75 yards from the shoreline to allow for access for Hawaiian fishing, cultural and recreational activities.

In several places within the EA reference is made to the fact that there "are no historical sites that would be impacted by the pearl farm" and that "There are *presently* no existing traditional gathering rights or cultural practices in the project site itself, in the borrow pit" (*emphasis added*). There are no references to reports, studies, or discussions with native Hawaiians nor is there any information as to how these conclusions were reached.

CEDED LANDS

We are in agreement with your conclusion that these lands are ceded lands for which 20% of the revenue is owed to OHA on behalf of Native Hawaiians. We seek the opportunity of discussing the method to determine the revenue with Black Pearls, Inc. prior to the negotiations for the lease.

TRAINING FOR NATIVE HAWAIIANS

The proposals for providing training for native Hawaiians in pearl farm operations and management, pearl shell carving and sales are excellent ideas and OHA would like to be involved in implementing these programs. OHA would also hope that should funding become available for additional pearl farms, BPI and OHA could discuss possible joint ventures.

We anticipate the Final Environmental Assessment and will further comment following our thorough review. If you have any questions, please contact Jerry B. Norris at 594-1966.

Sincerely,

Colin C. Kippen, Jr.
Deputy Administrator

cc: OHA Board of Trustees

Black Pearls, Inc.
Kona, Hawaii
Producers of Hawaiian Black Pearls ™

P.O. Box 525 Holualoa, HI 96725 U.S.A. Phone (808) 325-6516 Fax (808) 325-3425

E-mail Address : nasims@aloha.net

04/10/01 3:32 PM
Kippen reply 1

Colin Kippen
Deputy Administrator, Office Of Hawaiian Affairs
711 Kapiolani Blvd, Suite 500
Honolulu, HI 96813

Dear Mr Kippen,

Thank you for your comments on the draft Environmental Assessment for the Ke'ehi Lagoon Pearl Oyster Farm (dated January 4th, 2001). I apologize for the delay in reply, but Lands Division only received your letter on March 21st.

We appreciate your expression of general support for the project, and we believe that most of your concerns are based on a misunderstanding of the project as laid out in the draft Environmental Assessment (EA). I would like to address each of your concerns in turn.

Cultural Resources and Practices

We have reiterated in both letters and public meetings that we will not exclude the public from the surrounding beach and reef area. The perceived conflict between statements on page 7, page 23 and page 43 of the EA is a misreading. Page 7 refers to the fact that we will not exclude the public from the surrounding beach and reef areas. Statements on pages 23 and 43 refer to our need for exclusive use of the deep water area in the borrow pit itself.

One member of the public has come forward and claimed that they do engage in seaweed collection in the requested project area. This collection occurs by free-divers, in the area designated as an easement, and we have therefore been able to reach an acceptable compromise to allow continuing restricted access for these activities. This individual and one other also stated that some aquarium fish collection occurs in the seaward edge of the area, by SCUBA divers. For security reasons, continuation of this activity would be incompatible with the farm use.

We based the statements on the presence of historical sites or traditional gathering practices on the fact that the borrow pit is highly disturbed, having been created by the dredging in the 1970's that created the reef runway.

Ceded Lands

We would welcome the opportunity to discuss with you the methods for determining revenues, as related to ceded lands payments. However, this is a complex issue, and one for the Land Division, DLNR, to work out with you according to the guidelines in Chapter 190 D, HRS.

Training for Native Hawaiians

We welcome OHA's expression of interest in involvement in training for pearl shell carving and farm operations, and possible joint ventures for expansion of pearl farming to other areas. It has long been our hope that OHA and other Hawaiian organizations would work with us in this vein. We would like to initiate further discussions on these opportunities, and how we may further our mutual goals. Could you identify the appropriate OHA officer for us to contact for this, please?

Please contact us if you have any more questions or concerns. We thank you again for your interest and support.

Yours sincerely,

Neil Anthony Sims
V.P. / Research Dir.

c.c. DLNR, Eric Hill
ADP, John Corbin

State of Hawaii
Department of Land and Natural Resources
DIVISION OF AQUATIC RESOURCES

October 20, 2000

TO: Michael M. Fujimoto, Acting Administrator

FROM: Francis G. Oishi, Aquatic Biologist

SUBJECT: Comments on authorization request to process a CDUA

Comment Requested by: Dean Uchida, Land Division	Date of:	Request undated	Receipt 9/22/00	Referral 10/10/00

Note: This was received late due to participation on HURL cruise; extension requested and granted by E. Hill on 10/12.

Summary of Proposed Project

Title: Pearl Oyster Farm
Project by: Black Pearls, Inc.
Location: Reef Runway, Keehi Lagoon, Oahu

Brief Description: There is an application before the Department that requests a permit to allow for the development of a black pearl aquaculture farm on 75 acres of nearshore marine environment adjacent to the seaward Diamond Head end of the Honolulu International Airport's Reef Runway. The applicant proposes to culture the endemic pearl oyster, Pinctada margaritifera (which is protected from take by Hawaii Administrative Rules Chapter 13-83), to produce black pearls. The proposed farm operation would involve culturing the oysters by holding them in cages/net bags and suspending them on lines below the water's surface. The applicant claims no environmental damage would result, and that the subject area (referred to as the borrow pit) does not see much use. This area was once reef flat, and was dredged to elevate the adjacent area to form the present reef runway. It is presently characterized as a rectangular submerged pit with a soft sediment bottom. The application states that fishermen who use the area would not be restricted from accessing the shallow reef flat areas just west of the intended operation.

Comments: This proposal involves the use of State lands that are currently regulated for use as a recreational jet ski area (attachment). The applicant maintains that they are working with the Department to have these rules modified so that their application can proceed. Provided they are successful, I suggest the following as conditions under which a lease of State lands and the Conservation District Use Permit could be granted:

The applicant proposes to work with a regulated species, one that is already uncommon; therefore, the applicant should be held to higher standard. There should be no collecting of local oysters (from around the subject area), that the applicant be required to do a baseline of existing stocks, and monitor for change (including the assertion that the project will enhance recruitment to the area).

Disease introduction may decimate the resident stock nearby. Subsequent documentation should include details on how the farm operation would miligate disease spread to wild stocks.

This area is used by public to fish, dive, hand harvest, and boat. The use of shoreline and reef flat areas by fishermen cannot be restricted. Some thought must be given to the proposed anchoring of suspension lines into the borrow pit's vertical walls (to hold the lines taut). This will inhibit divers' present use and will prohibit shore casters or trollers, too. This is considered restricting access to public resources.

The addition of vertical structures to the subject area will attract finfishes of various species. Whether to forage or find shelter, various fish species will find the raft culture facility attractive. No additional for-profit activity should be allowed, specifically by capitalizing on an opportunity to fish (and sell) these fishes (for food or aquarium purposes). Allowing such would grant an unfair advantage (exclusivity to other resources that are otherwise available to the public).

Two claims (p. 37) are made that the proposed project will benefit resources: that the vertical structure of the farm will provide habitat for fishes, that will in turn improve diversity and biomass (of fishes) to the surrounding area, and that by operating a pearl oyster farm, that surrounding areas would benefit from increased settling of oyster spat, increasing the population of pearl oysters. If there is information to support these claims by citing research or reports from existing South Pacific aquaculture operations (or to condition the permit to provide such information from monitoring), we would ask the application to provide this.

On page 48, a claim is made that there will be no irrevocable commitment of a natural resource because the subject area is anthropogenically degraded and does not have any significant resource. But the water column can hold and sustain fishery resources and the surface area is a space/access resource. Both of these will be (if the permit is granted) leased for the exclusive use of the applicant and will subsequently become unavailable to the public.

Attachment

Black Pearls, Inc.
Kona, Hawaii
Producers of Hawaiian Black Pearls ™

P.O. Box 525 Holualoa, HI 96725 U.S.A. Phone (808) 325-6516 Fax (808) 325-3425

E-mail Address : nasims@aloha.net

04/10/01

Oishi 1

Francis Oishi
DLNR, Division of Aquatic Resources
1151 Punchbowl St, Room 330
Honolulu, HI 96813

Dear Francis,

I am in receipt of your comments on our CDUA application for the pearl farm lease in Keehi lagoon, dated 10/20/00. Please note that I have already addressed many of these concerns in an earlier letter to DLNR (dated 1/10/01 – copy enclosed here). However, I will address the outstanding issues raised.

Regulated species : We appreciate the sensitive nature of working with a regulated species. If there is any need for us to obtain further batches of wild broodstock, we will only do so under the terms of our Scientific Collecting Permit, issued by your office. We have sufficient broodstock at the moment, however some ongoing collecting may be necessary to maintain genetic diversity among our farm stocks, and therefore the resulting wild progeny.

We have already conducted extensive baseline surveys elsewhere around the State, including surveys in around the Keehi area. The survey methods and the results are detailed in a project report document held by NMFS. Your office should also have copies of this report.

These surveys showed that the resident stock in the area is negligible. Nevertheless, in the event of any evidence of a disease introduction to the farm, we will notify the appropriate authorities – primarily the State Aquaculture Disease Specialist - and seek their guidance.

Stock Re-establishment : Regarding oyster stock re-establishment, please note that the following has been inserted into the Final Environmental Assessment, to address your questions :

"This pattern of farm development resulting in increased recruitment of P. margaritifera to the wild – and to artificial spat collectors - has been reported from French Polynesia and the Cook Islands (Ray Newnham, Ray Marks, pers. comm.). A similar increased abundance of Mexican winged pearl oysters (Pteria sterna) has also been reported from Guayamas, Mexico, in conjunction with farm development there (Oscar Blanco, pers. comm.)."

Regarding fisheries enhancement, the literature on tropical fisheries management is replete with examples where protected areas, such as those in exclusive aquaculture lease areas, resulted in increased catches in adjacent open areas. The work by Russ and Alcala in the Philippines fishery reserves is probably the best example ("Do marine reserves export adult fish biomass? Evidence from Apo Island, Central Philippines.: Mar. Ecol. Prog. Ser. 132: 1-9, 1996.).

We address the issue of exclusivity, loss of access and the overall public interest in the attached letter. We also include the following paragraphs in the Final Environmental Assessment, on fishery resources and recreational access, respectively :

"During the public hearing for the CDUA and EA, one individual objected to the exclusive lease conditions, on the basis of a past history of collecting limu (ogo) and aquarium fish (primarily one species, the raccoon butterflyfish, Chaetodon lunula) in the area. In subsequent discussions between the applicant and the individual, it was agreed that the lease should contain some provision for individuals or small groups of free-divers requesting access on a restricted basis for the purposes of collecting limu within the easement area. As the aquarium fish collection involves use of SCUBA, this would represent an unacceptable security risk for the project, and the individual accepted this compromise."

"There was considerable interest in the draft Environmental Assessment from the thrill-craft community. The comments at the public hearing are perhaps best exemplified by excerpts from Russell Kaupu's testimony : "I have nothing in opposition to the application .... (the existing jet-ski area is) a considerable distance between where you launch your watercraft and where you ride (your) watercraft ... (the distance is a) safety concern for my family .... there is a much better area for personal watercraft which fronts the shoreline area near the small boat harbor ramp" (from DLNR's official transcript of the meeting, 1/25/01, pp 56 - 9)."

There appeared to be no other major concerns from the public regarding exclusion from the borrow pit area.

Please feel free to contact us if you wish to discuss any of these matters further. Thank you for your comment letter and for your concerns.

Yours sincerely,

Neil Anthony Sims
V.P. / Research Dir.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

RECEIVED
LAND DIVISION
2001 FEB -5 A 11: 14

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

In reply, please refer to:
File:

00-253/cpo

February 2, 2001

TO: Dean Y. Uchida, Administrator
Land Division
Department of Land and Natural Resources

FROM: Gary Gill
Deputy Director
Environmental Health Administration

SUBJECT: CONSERVATION DISTRICT USE APPLICATION

Applicant:	Black Pearls, Inc.
File No.:	OA-3004
Request:	Pearl Oyster Farm at the Reef Runway Borrow Pit
Location:	Keehi Lagoon, Oahu
TMK:	N/A

Thank you for allowing us to review and comment on the subject request. We have the following comments to offer:

Water Pollution

1. The Army Corps of Engineers should be contacted to identify whether a Federal permit (including a Department of Army permit) is required for this project. If it is determined that a Federal permit is required for the subject project, then a Section 401 Water Quality Certification would also be required from the Department of Health's Clean Water Branch.

2. If the project involves any of the following discharges into State waters, a National Pollutant Discharge Elimination System (NPDES) general permit is required for each activity:

a. Storm water runoff associated with construction activities, including clearing, grading, and excavation, that result in the disturbance of equal to or greater than five (5) acres of total land area;

b. If construction begins or continues after March 10, 2003, storm water runoff associated with construction activities, including clearing, grading, and excavation, that result in the disturbance of equal to or greater than one (1) acre;

c. Hydrotesting water; and

d. Construction dewatering effluent.

3. If the facility is considered to be either a *concentrated aquatic animal production facility* or an aquaculture project, as defined in 40 Code of Federal Regulations Sections 122.24 and 122.25, then an NPDES individual permit would be required for the operation of the facility.

4. The Department of Health requires that Notices of Intent (NOI) for NPDES general permits be submitted thirty days before the discharge is to occur. NPDES individual permit applications should be submitted 180 days before the facility begins operations. NOI and NPDES individual permit applications can be picked up at the Clean Water Branch or downloaded from our website at

http://www.state.hi.us/doh/eh/cwb/forms/index.html.

Should you have any questions, please contact Ms. Kris Poentis, Engineering Section of the Clean Water Branch at 586-4309.

c: CWB

Black Pearls, Inc.
Kona, Hawaii
Producers of Hawaiian Black Pearls ™

P.O. Box 525 Holualoa, HI 96725 U.S.A. Phone (808) 325-6516 Fax (808) 325-3425

E-mail Address : nasims@aloha.net

04/09/01
Gill 1

Gary Gill
Deputy Director, Environmental Health Administration
Department of Health, P.O. Box 3378
Honolulu, HI 96801

Dear Mr Gill,

I am in receipt of your comments on our CDUA application for the pearl farm lease in Keehi lagoon, dated 2/2/01. We would like to respond to your comments pointwise :

1.We have submitted an application to the Army Corps of Engineers for a Department of the Army Permit.

2.The project will not involve any stormwater run-off, construction resulting in disturbance of greater than one acre, hydrotesting, or construction dewatering effluent. As such an NPDES general permit will not be required for those activities.

3. The facility is considered to be neither a concentrated aquatic animal production facility producing discharges nor an aquaculture project receiving discharges, and as such an NPDES individual permit will not be required. As a rule (e.g. Washington State), states do not require an NPDES permit for shellfish farming in nearshore waters.

4. As no NPDES permit is required, a Notice of Intent is not required.

Please feel free to contact us if you wish to discuss any of these matters further. Thank you for your comment letter and for your concerns.

Yours sincerely,

Neil Anthony Sims
V.P. / Research Dir.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

TIMOTHY E. JOHNS
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY DIRECTOR
JAMET E. KAWELO

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF BOATING AND OCEAN RECREATION
333 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813

Date: November 20, 2000

To: Dean Uchida, Administrator, Land Division

From: Howard Gehring, Acting Administrator

Subject: Request for Authorization from the Department to Process a Conservation District Use Application Including a Land Use of State Land
Applicant: Black Pearls, Inc.
File No.: OA-3004
Request: Pearl Farm and Pearl Oyster Reef Reseeding Project
Location: State Marine Water at the Reef runway borrow Pit, Keehi Lagoon, Honolulu, Hawaii

This memo is in response to your request to review the above application and our comments follow.

The location of the proposed pearl farm would violate Section 13-256-94, Hawaii Administrative Rules which designates the site as a recreational thrill craft operating area. Our concerns are summarized in a letter dated July 8, 2000 to Mr. John Corbin of the Dept. of Agriculture's Division of Aquaculture, we state in part, "our administrative rules, which have the force and effect of law, designate Reef Runway Zone F for recreational thrill craft operations and as a result, a change in our rules would be necessary before Black Pearls, Inc. could be permitted to utilize this area. When at such a time we overcome the obstacles and concerns, the rules may be proposed to be amended to reconfigure the recreational thrill craft operating area resulting in vacating the area Black Pearls wishes to operate, keeping in mind the safety of all concerned. We must also consider any conflict in use, undue hardships, and any significant imposition of those presently authorized to use this area."

It is our understanding that this would become the first near shore or shoreline area leased for farming purposes. The action of leasing shoreline and near shore waters for farming introduces another interest group into the many competing for use of our limited shoreline and near shore waters. The pearl farm is different in that it wants exclusive use and would deprive fishermen, divers, and boaters of access to an area customarily accessed by these groups.

We hosted an informal informational meeting on April 19, 2000 at the Keehi Small Boat Harbor conference room on Black Pearls, Inc.'s proposal. Attached is our meeting notice and the list of comments and concerns generated by the those in attendance at the meeting.

Should you desire any additional information please feel free to contact Mr. Steve Thompson at 587-1973.

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING
235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

BENJAMIN J. CAYETANO
GOVERNOR
SELJI F. NAYA, Ph.D.
DIRECTOR
SHARON S. NARIMATSU
DEPUTY DIRECTOR
DAVID W. BLANE
DIRECTOR, OFFICE OF PLANNING

Telephone: (808) 587-2846
Fax: (808) 587-2824

Ref. No. P-8858

October 13, 2000

Mr. George P. Young, P.E.
Chief, Regulatory Branch
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858-5440

Dear Mr. Young:

Subject: Hawaii Coastal Zone Management (CZM) Program Federal Consistency Review for a Pearl Farm and Reseeding Project in Keehi Lagoon, Oahu, (Army Permit #20000085)

We have reviewed the proposal for a pearl farm and pearl oyster reef reseeding project in the reef runway borrow pit in Keehi Lagoon. We concur with your CZM consistency determination based on the following:

1. A silt containment device shall be installed prior to construction and properly maintained throughout the duration of construction. Removal of the silt containment device shall not cause turbidity that violates State water quality standards.

2. Runoff from construction activities and parking areas shall be appropriately mitigated and comply with applicable State of Hawaii water quality standards as specified in the Hawaii Administrative Rules (HAR), Chapter 11-54 and water pollution control requirements as specified in Chapter 11-55. These Administrative Rules are administered by the Department of Health and are federally approved enforceable policies of the Hawaii CZM Program.

3. Water quality from maintenance and operation activities shall be appropriately mitigated and comply with applicable State of Hawaii water quality standards as specified in the HAR, Chapter 11-54 and water pollution control requirements as specified in Chapter 11-55.

4. The project shall be in compliance with regulations for the Shoreline Setback Area and Special Management Area, if applicable, which are administered by the City and County of Honolulu Department of Planning and Permitting.

5. The project shall be in compliance with regulations for the Conservation district, if applicable, which are administered by the State Department of Land and Natural Resources (DLNR).

6. The project shall be in compliance with regulations for fishing, collecting aquatic life, and other activities relating to aquatic resources, if applicable, which are administered by the DLNR, Division of Aquatic Resources and Department of Agriculture, Aquaculture Development Program.

CZM consistency concurrence is not an endorsement of the project nor does it convey approval with any other regulations administered by any State or county agency. Thank you for your continued cooperation in complying with Hawaii's CZM Program. If you have any questions, please call Debra Tom of our CZM Program at 587-2840.

Sincerely,

David W. Blane, AICP
Director
Office of Planning

c: U.S. Army Corps of Engineers, Regulatory Branch
U.S. National Marine Fisheries Service, Pacific Area Office
U.S. Fish and Wild life Service, Pacific Islands Ecoregion
Department of Health, Clean Water Branch
Department of Land & Natural Resources,
Division of Aquatic Resources
✓Planning & Technical Services Branch
John S. Corbin, Department of Agriculture

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET • HONOLULU, HAWAII 96813
TELEPHONE (808) 523-4414 • FAX (808) 527-6743 • INTERNET www.co.honolulu.hi.us

JEREMY HARRIS
MAYOR

RANDALL K. FUJIKI, AIA
ACTING DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

February 5, 2001

2001/CLOG-416(ASK)

Mr. Neil Anthony Sims
Vice President/Research Director
Black Pearls, Inc.
P. O. Box 525
Holualoa, Hawaii 96725

Dear Mr. Sims:

Special Management Area Review
Pearl Farm and Oyster Reef Reseeding Project
Reef Runway Borrow Pit in Keehi Lagoon, Oahu

This responds to your January 25, 2001 inquiry, requesting a project review and determination of Special Management Area Use Permit requirements for the proposed pearl farm in Keehi Lagoon.

We have reviewed the submitted information. Based on the supplemental information provided in your transmittal letter and January 25, 2001 press release, we have determined that the project for which you are seeking a Conservation District Use Permit is not within the Special Management Area. As such, the project is not subject to the permit requirements of Chapter 25, Revised Ordinances of Honolulu.

Should you have any questions, please contact Ardis Shaw-Kim of our staff at 527-5349.

Sincerely yours,

for RANDALL K. FUJIKI, AIA
Acting Director of Planning
and Permitting

RKF:am

cc: Eric Hill, Department of Land and Natural Resources
John S. Corbin, Department of Agriculture

posse doc no. 74557

FROM : _____ FAX NO. : _____ Jan. 26 2001 01:33PM P1

EXCELLENT
Gems & Diamonds
Established Since 1972

January 25, 2001

Dear Committee Members:

My name is Mabel Lau and I am the current president of the Hawaii Jewelers Association. I have been designing and manufacturing fine jewelry in Hawaii for over 28 years. Today I write to you as a concerned citizen totally supporting the Black Pearl Inc. plan to cultivate black pearls in Hawaii. The State of Hawaii will benefit tremendously from this company in various environmental and economic ways.

First and foremost, the cultivation of black pearls does not pollute the waters of Hawaii. Because oysters do not require feeding as they live on plankton, the oysters actually clean the waters instead of polluting it. In fact, these oysters flourish in clean waters and do not do well in polluted waters. Cleaner Hawaiian waters is obviously a tremendous benefit for the people of Hawaii, however that is not the only positive as Hawaiian black pearls could potentially become an industry that could be a major tourist attraction.

The Hawaii Visitor Convention Bureau could possibly promote Hawaiian black pearls as another attraction to come to the islands. As the Tahitian black pearls have become a world-renowned commodity, this could be in the same for Hawaiian black pearls. The potential for increased business and tourist dollars are endless. This product will be truly unique to the islands of Hawaii.

I have nothing but praise for this company and for the business that they are trying to bring to Hawaii. I would humbly ask that the committee members support this very viable business option and approve Black Pearl Inc.'s application for the oyster farm lease. Thank you for your time and consideration in this matter.

Sincerely yours,

Mabel Lau
President, Hawaii Jewelers Association
Vice President, Excellent Gems Corp.

100 North Beretania Street #134, Honolulu, Hawaii 96817 Phone: (808) 531-8666 Fax: (808) 523-8012

University of Hawai'i at Mānoa

Environmental Center
A Unit of Water Resources Research Center
2550 Campus Road • Crawford 317 • Honolulu, Hawai'i 96822
Telephone: (808) 956-7361 • Facsimile: (808) 956-3980

February 7, 2001
EA:0254

Mr. Neil Simms
Black Pearls Inc.
P.O. Box 525
Holualoa, Hawaii 96725

Dear Mr. Simms:

Draft Environmental Assessment
Ke'ehi Lagoon Pearl Oyster Farm
Honolulu, Oahu

Black Pearls Inc. is requesting a Board Permit to lease 75 acres of ocean for aquaculture purposes. The site is located in the Reef Runway borrow pit inside Keehi Lagoon, approximately 100m south of the eastern end of the Reef Runway of the Honolulu Airport. The proposed area ranges from 45-50 feet in depth. The applicant proposes to rear a local variety of black-lip pearl oyster, *Pintada margaritifera*. The construction of permanent structures include two work platforms, and a storage area. The oysters will be suspended with lines and pouches at a depth of 5m. The farm will contain a standing stock of 50,000 oysters.

This review was conducted with the assistance of Jaw-Kai Wang Biosystems Engineering; Alison Kay, Zoology; and Renee Thompson, Environmental Center.

General Comments

The organization of this EA is quite confusing. It would be helpful if the final EA were to be sequentially paginated, the figures and maps inserted where they are cited, and the various Appendices titled and paginated as appendices and not given joint titles as individual EA's.

Introduction

There is an inconsistency between the Introduction page 8 and Appendix I. regarding the number of oysters that will be raised. Page 8 section 1.1 states that the proposed site will support a standing stock of 50,000 oysters. While Appendix I. Water Quality Evaluation states on pages 7, and 12, that the proposed farm will have a standing stock of 30,000 oysters. The Water Quality Assessment calculations were made with the stock of 30,000 and not 50,000. The final EA should be revised and the Water Quality Evaluation calculations (Appendix I) should be corrected to reflect the conditions predicted from the proposed 50,000 population. For example, what effect will the additional 20,000 oysters have on the amount of biofouling and nutrients to the sea floor?

We note on page 8 that 55 gallon floats will be used to maintain tension on the lines supporting the panels or mesh pouches containing the oysters. Will these floats be 55 gallon steel drums? If so, periodic maintenance and a replacement schedule should be adopted to insure that leaking drums are removed and properly disposed so they do not become a litter problem.

What are the wave or surge climate design parameters for the farm array and the accompanying staging area, office and restrooms? This information should be provided in the final EA. The proposed sea water plumbing system may be fine, but bathrooms also require fresh water for sinks. How will fresh water be provided to the office and restrooms? The use of a septic tank with a leach field on the island may pose a water quality. What is the elevation of Oufi's island and the depth to the water table? A qualified engineer should assess the proposed waste disposal plan to insure that wastewater will not either surface on the island or drain immediately to the coastal waters. Perhaps the use of dry toilets would be a viable option?

Biofouling

Several places within the document, for example, page 9 , indicate that fouling organisms such as "macroalgae, sponges, bryozoans, and tunicates" will be periodically removed and disposed of in a landfill. We suggest that Black Pearls Inc. seek out alternate means to dispose of this "waste". Live animals such as sea cucumbers, brittle stars, starfish, sponges, etc. Should be returned to a suitable marine habitat rather than destroyed and added to solid waste landfills. Perhaps they can be added to the artificial reefs created for the Atlantis or Voyager Submarines. Non-viable materials removed from the oysters could be used at local organic composting facilities around the island, in the same way that land greenwaste is recycled. This would save space in the local landfill and provide a useful product, not a costly waste.

Stock Re-establishment

From the information provided it appears that populations of Hawaiian black-lip pearls were present in very localized areas. They were found at Pearl and Hermes reef and Pearl Harbor. Today as indicated by the EA there is a small remaining stock in Kaneohe Bay. We are skeptical of the assertion that the proposed action will in fact be re-establishing stocks in Hawaii. As indicated on page 26 section 4c, previous stock re-establishment trials have been largely unsuccessful due to predation and fishing. What is the basis for the assumption that putting larvae in the water will actually lead to adult oysters in the wild? What is the evidence that Hawaiian black-lip pearl oysters were ever well-established and common in Hawaii, as indicated on page 16?

Appendix I.

Appendix I, in section 2.0 p.5, Oyster Physiology Related to Water Quality states "Clearance rates, pseudofeces production, absorption efficiency, respiration rate and excretion rate have been determined at a high degree of confidence".

We assume that the "high degree of confidence" statement applies to the results of studies of clearance rates in varying concentrations of particulates or turbidity since a subsequent statement (Section 2.1) suggests a wide variation in clearance rates, "...clearance rates range from 10 to 100 liters per hour with nominal values averaging around 25 liters per hour". It would be helpful if the final EA provided the experimental data on which the clearance rates relative to particulates or turbidity are based.

We note in Appendix I. page 25 that an oyster density of 1.0 oyster per square meter is sufficient to keep water quality at an optimum level. Given that recommendation, it would appear that only 15 to 20 acres of farm area would be more than adequate to grow 50,000 oysters. Are there plans to significantly expand the farm in the future? The rationale for requesting the 75 acres should be provided in the final EA.

Conclusion

As a matter of policy, we note that if this project is successful it will likely provide a major empetus or incentive for other entrepreneurs to enter the nearshore aquaculture field. It is important for the state to be aware of this potential and to develop policy and long range plans for similar ocean leasing activities. Piece meal consideration of permit applications should be avoided if at all possible.

Sincerely,

Jaquelin Miller Ph.D,
Associate Coordinator, Environmental Center

cc: OEQC
James Moncur, WRRC
Alison Kay
Jaw-Kai Wang
Renee Thompson

Black Pearls, Inc.
Kona, Hawaii
Producers of Hawaiian Black Pearls ™

P.O. Box 525 Holualoa, HI 96725 U.S.A. Phone (808) 325-6516 Fax (808) 325-3425

E-mail Address : nasims@aloha.net

03/22/01 10:00 AM
Miller reply 1ci

Dr J. Miller
UH Environmental Center
2550 Campus Rd, Crawford 317
Honolulu, HI 96822

Dear Dr Miller,

Thank you for your comments on the draft Environmental Assessment for the Ke'ehi Lagoon Pearl Oyster Farm (dated 2/7/01). I would like to address each of your concerns in turn.

General Comments

We understand you found the layout confusing, and we will attempt to make the Final Environmental Assessment more readily accessible.

Introduction

Regarding water quality :

Thank you for picking up this inconsistency in farm numbers between the Environmental Assessment text and Appendix 1. As stated in the text, our intention is to build the farm up to a density of 50,000 seeded adult pearl oysters. The Final Environmental Assessment will reflect the following changes in the water quality calculations. These changes will be :

P 7., Section 2.4 :

Draft read : "...total amount of ammonia-nitrogen excreted is ...10 g of ammonia per hour"
Final should read as "16.7 g of ammonia per hour".

Draft read : "...over a 24 hr period, approximately 240 g of ammonia-nitrogen excreted ... results in an input of only 0.0066 ug/L."
Final should read as "400 g of ammonia-nitrogen excreted ... an input of only 0.011 ug/L."

P 12., Section 6.2 :

Draft read : "...30,000 oysters ... in (an) area of 350,000 square meters. Thus the threshold of one oyster per meter squared has been conservatively retained by a factor of greater than 1:10"
Final should read as "50,000 oysters ... in (an) area of 350,000 square meters. Thus the threshold of one oyster per meter squared has been conservatively retained by a factor of greater than 1:7".

P 24., Section 9.1 :

Draft read : "...an input of 0.0066 ug/L (ammonia) ... is equivalent to less than the 0.5% of the most stringent standards for the "dry" criteria."
Final should read as "...an input of 0.011 ug/L (ammonia) ... is equivalent to 0.55% of the most stringent standards for the "dry" criteria ".

The overall conclusions of the water quality study remain the same. As we state in the text of the draft Environmental Assessment, we have built in considerable confidence levels in determining our stocking densities, because of the sensitivity of the animals, their susceptibility to stressors, and the resultant detrimental impacts this may have on pearl quality and oyster fecundity.

Regarding your other concerns :

The 55 gallon drums will be plastic.

Please note that the staging/storage area and buildings are now no longer part of the project proposal, and your concerns about the leach field no longer apply. We will find alternative storage and office areas elsewhere within the lagoon area – probably in the Keehi commercial marina. The exposure of the farm to wave or surge events is therefore greatly minimized. The only structures above the waterline will then be the two work platforms on the inside edge of the borrow pit. These will be designed in accord with the best engineering practices, taking into account the potential wave or surge exposure.

Biofouling

Our concern with returning live invertebrates to a discrete area such as an artificial reef is that the animals may accumulate and cause anoxic conditions, or build up of pathogenic bacteria. It is always considered best management practice in pearl culture to dispose of the organisms on dry land. We know of no composting system that can absorb any quantities of animal matter and salt. Please let us know if you can suggest a viable alternative. The materials do not represent a significant volume of matter, and the loss of space in the landfill will not be significant.

Stock Re-establishment

Please note that the following has been inserted into the Final Environmental Assessment, to address your questions :

"This pattern of farm development resulting in increased recruitment of P. margaritifera to the wild – and to artificial spat collectors - has been reported from French Polynesia and the Cook Islands (Ray Newnham, Ray Marks, pers. comm.). A similar increased abundance of Mexican winged pearl oysters (Pteria sterna) has also been reported from Guayamas, Mexico, in conjunction with farm development there (Oscar Blanco, pers. comm.)."

To our knowledge, there is no alternative cost-effective means for stock enhancement in the main Hawaiian Islands. The evidence on past abundance is tenuous: traditional use of pearl shell lures and fishooks, traditional Hawaiian folklore, the records of Kamehameha's use of a dredge in Pearl Harbor, and Jameson's 1901 reference to the Hawaiian oyster as a component of the worldwide pearl shell trade. Galtsoff's paper (1933) is the most comprehensive source, but is at least a century after the first regular shipping contacts were initiated. Elsewhere across the Pacific, the history of pearl shell exploitation has been similar – the first traders to make contact with an island sought pearl shell and beche-de-mer (sea cucumbers) as the most valuable marine commodities available. There are rarely any written records of such brief fisheries.

Appendix I

Much of this work on oyster physiology and water quality is based on ecological studies of pearl farming in the Cook Islands. This work is not formally published, and most of the raw data remains the property of the Cook Islands government. Nevertheless, Mr Anderson will try to address any specific questions you may have, if you wish to contact him directly.

To our knowledge there are no other such studies on P. margaritifera physiology, beyond those referenced in Anderson's water quality study.

Thank you for your comment letter and for your concerns. Please feel free to contact us if you wish to discuss any of these matters further.

Yours sincerely,

Neil Anthony Sims
V.P. / Research Dir.

c.c. OEQC, Genevieve Salmonson
DLNR, Eric Hill
ADP, John Corbin
ALH, Miles Anderson

KALIHI-PALAMA NEIGHBORHOOD BOARD NO. 15

c/o NEIGHBORHOOD COMMISSION • CITY HALL, ROOM 400 • HONOLULU, HAWAII 96813

February 12, 2001

Mr. Gil Coloma-Agaran
Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Subject: Pearl Farm at the Reef Runway

Dear Sir:

On January 17, 2001, the Kalihi-Palama Neighborhood Board No. 15 voted unanimously in support of a formation of a pearl farm at the Reef Runway. Dr. Dale Sarver and Mr. Neil Sims of Black Pearls, Inc gave the presentation. Mr. John Corbin from the Department of Agriculture was also present.

The Board strongly believes that this proposed pearl farm would generate a new and exciting industry for our State and economy. This is the best proposal ever for the Reef Runway. Pearl cultivation also improves the water quality and will save the rare black Hawaiian oyster from extinction. Members believe that eventually this site could become a tourist attraction.

Therefore, on behalf of the Kalihi-Palama Neighborhood Board, I am requesting your support and approval of permits necessary for this most worthwhile and exciting industry.

Sincerely,

Bernadette Young

Bernadette Young
Chair

cc: Senator Rod Tam
Senator Suzanne Chun Oakland
Senator Donna Mercado Kim
Representative Denis Arakaki
Representative Jun Abinsay
Representative Lei Ahu Isa
Council Chair Jon Yoshimura
Councilmember Romy Cachola
Mr. John Corbin, Department of Agriculture
Mr. Neil Sims, Black Pearls, Inc.
Dr. Dale Sarver

APPENDIX I :

WATER QUALITY EVALUATION FOR PEARL OYSTER FARM DEVELOPMENT IN KE'EHI LAGOON, OAHU

By : Miles Anderson

Environmental Impact Assessment
Water Quality Evaluation

For

Pearl Oyster Farm Development

In

Ke'ehi Lagoon
O'ahu, Hawaii

Prepared for:

Black Pearls, Inc.
P.O. Box 525, Holualoa, Hawaii 96725

Prepared by:

Miles Anderson
Analytical Laboratories of Hawaii
1320 Aalapapa Dr.
Kailua, Oahu, Hawaii 96734

August 8, 1999

Table of Contents

Figures

Tables

References

Books, Technical Reports and Environmental Impact Surveys

Standard Methods for the Examination of Water and Wastewater, Seventeenth Edition Franson, Mary Ann. 1995, American Public Health Association.

Lagoon Circulation Studies in Manihiki, Cook Islands. Circulation Report. SOPAC, March 5, 1997.

Lagoon Ecology Monitoring and Management Project, Manihiki Lagoon, Cook Islands, RDA International, Inc. July, 1997.

Cook Islands Black Pearl Oyster Project, Pearl Oyster Biology, Lagoon Water Quality and Ecological Conditions. June 1992 to March 1994 observations on Tongereva Atoll. RDA International, Inc. 1994.

Final Environmental Assessment Environmental Impact Statement Preparation Notice. Voyager Submarines Hawaii Artificial Reef Installation. Sea Engineering, Inc. 1997.

Final Environmental Impact Statement. The Operation of Submersibles as a Public Attraction on the Waters off Waikiki, Oahu, Hawaii. Aecos, Inc. 1987.

Final Environmental Impact Statement for Honolulu International Airport. 1971.

Environmental Impact Statement for the Proposed Disposal of Solid Waste Bales in Keehi Lagoon and the Coastal Waters of Oahu. 1976.

Journal Publications

Anderson S. Miles, 1998. The ecological sustainability of pearl farming in Manihiki Lagoon, Northern Cook Islands. Pearl Oyster Information Bulletin Number 11: 7-11.

Yukihira, H., D. W. Klumpp, and J. S. Lucas. 1999. Feeding adaptations of the pearl oysters, *Pinctada margaritifera* and *P. maxima* to variations in natural particulates. Marine Ecology Progress Series.

Yukihira, H., D. W. Klumpp, and J. S. Lucas. 1998. Comparative effects of the microalgal species and food concentration on suspension feeding and energy budgets of the pearl oysters, *Pinctada margaritifera* and *P. maxima.* Marine Ecology Progress Series Vol. 171: 71-84.

Yukihira, H., D. W. Klumpp, and J. S. Lucas. 1998. Effects of body size on suspension feeding and energy budgets for the pearl oysters *Pinctada margaritifera* and *P. maxima* Marine Ecology Progress Series 170: 119-130.

Pouvreau et al. 1999. Filtration by the pearl oyster, *Pinctada margaritifera,* under conditions of low seston load and small particle size in a tropical lagoon habitat. Aquaculture 176 (3-4): 295-314.

Thesis

Feeding Models and Chlorophyll Levels at Black Pearl Farms in the Cook Islands. Implications for Management. Ponia, Benjamin Ellis. A dissertation submitted in partial fulfillment of the requirements for the Degree of Master of Science of Tropical Environmental Management in the Department of Tropical Environment Science and Geography at the James Cook University of North Queensland. January 1997.

1.0 Introduction

Maintenance of quality marine environments, in concert with sensible coastal development, has been challenging over the last few decades. Marine water quality has been one of the areas of concern when development is being proposed and has been implemented as a routine component in the permitting process.

Black Pearls Inc. is proposing to establish a black pearl oyster farm in the vicinity of Reef Runway near the mouth of Keehi Lagoon (Figure 1). This report addresses the concern regarding degradation of water quality resulting from the proposed activity. It draws on published biological data regarding oyster biology and biofouling, hydrodynamic surveys and long term environmental water quality monitoring data that have been conducted in the area of interest during the last two decades. It includes an independent survey conducted by BPI to establish a snapshot of the present marine water quality in the area of the proposed activity. The majority of field data that is available, referencing pearl oyster farming activities, is from atoll lagoons of the tropical Central Pacific. However, specific attention has been given to understanding the similarities and dissimilarities between those environments and the nearshore marine environment of Hawaii.

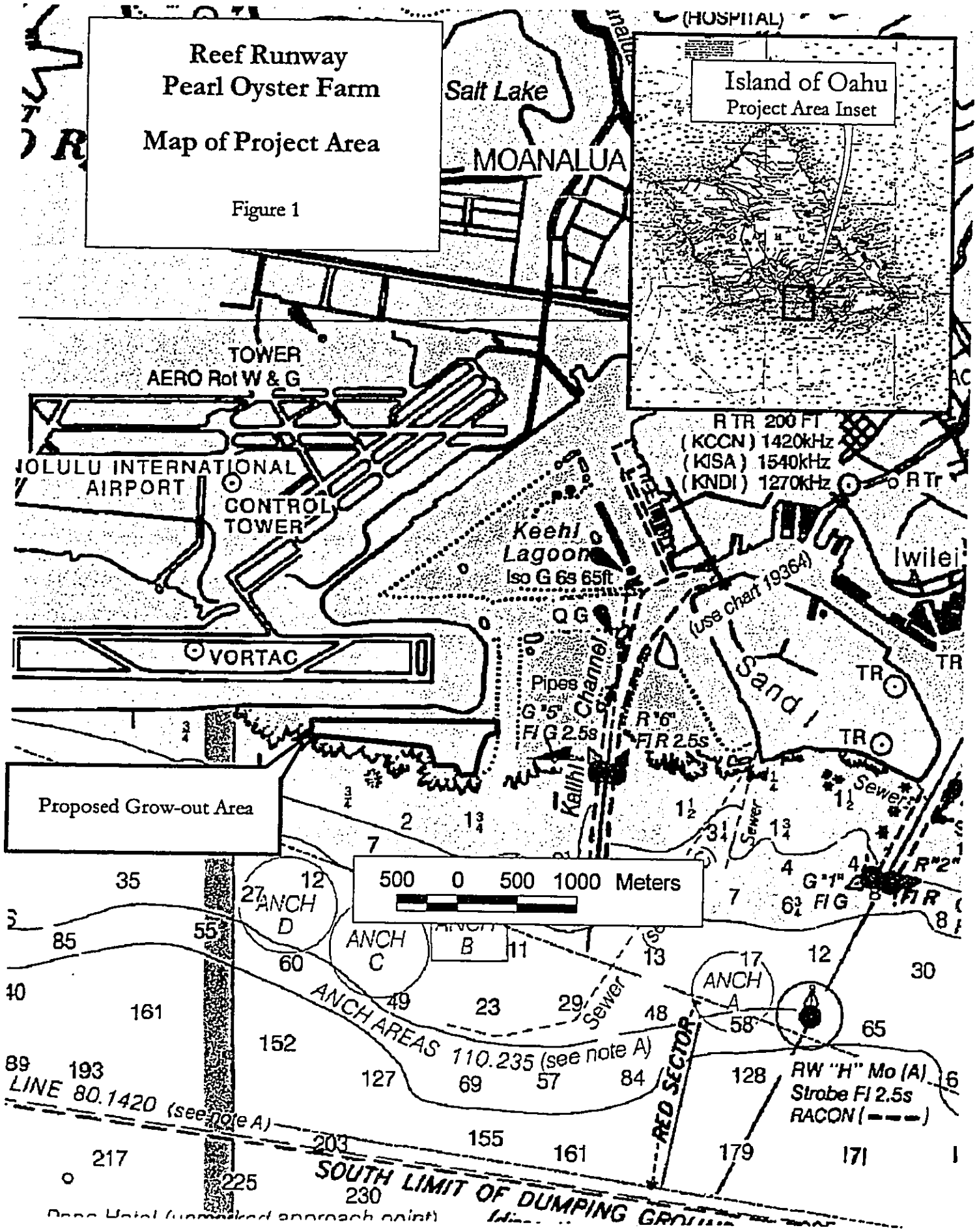
Estimation of the risk of potential environmental impact to water quality from aquaculture activities is made with particular consideration given to oyster farming for the production of black pearls. The data that has been collected and the research that has been conducted lends itself to considerable reliability in anticipating the extent of alteration of water quality from proposed pearl oyster farming activity.

2.0 Oysters Physiology Related to Water Quality

Black lipped pearl oysters pass water over their gills where particulate material above 1 um nominal diameter is captured. The particles are either ingested or packaged as pseudofeces where they are released and fall to the seafloor. Detailed studies have been conducted yielding important information about black lipped pearl oyster feeding and physiology (Yukihira et all 1998, 1999). Clearance rates, pseudofeces production, absorption efficiency, respiration rate and excretion rate have been determined at a high degree of confidence.

2.1 Filter Feeding

Particles are removed from the water column by filter feeding of pearl oysters. The clearance rate (volume of water that is passed over the oyster's gills during a discrete amount of time) varies depending on particle size and concentration (Yukihira et al. 1998). In high seston load conditions, clearance rates are lower than during low seston load. Clearance rates range from 10 to 100 liters per hour with nominal values averaging around 25 liters per hour. If excessive amounts of suspended material are present in the ambient seawater or if the material, which is suspended, is exceptionally large, filter feeding slows and may stop.



2.2 Particle Sizes

Black lipped pearl oysters remove suspended particles as small as 1 um in diameter from the surrounding seawater (Pouvreau et al. 1999). Nearly all material above 3 um diameter is removed and above 5 um, the concentration of residual suspended particulate is below the limits of detection.

2.3 Pseudofeces Production

As the available food in the ambient water increases, a greater proportion that is trapped by the filter feeding process bypasses the digestive system and is converted to psuedofeces and ejected at the labial palps. The psuedofeces sink to the seafloor where they are assimilated by microbes and other benthic feeding organisms. Conversely, the absorption efficiency of food decreases as the concentration of suspended material increases (Yukihira et al. 1998). *Pinctada margaritifera* is highly adapted to balance the efficiency of filtration, ingestion and assimilation of suspended particulate material in oligotrophic tropical seawater conditions such as those that exist in atoll lagoons and near shore waters of Hawaii. As a result, the presence of black lipped pearl oysters can have a beneficial impact on water as suspended material is removed.

2.4 Feces Production and Excretion

The ingested particulate material is digested as it passes through the digestive tract of the oyster. The byproduct of digestion is fecal material production and excretion of soluble inorganic nitrogen, primarily in the form of ammonia. Fecal material falls to the seafloor and is remineralized with the psuedofeces. Ammonia is dissipated by water current and is absorbed as the primary nutrient for the growth of phytoplankton. Studies have shown that an average sized oyster of 50 grams (g) tissue dry weight excretes 3 to 4 hundred micrograms (ug) ammonia-nitrogen per hour. For a farm with a standing stock of 50,000 oysters it is expected that the total amount of ammonia-nitrogen excreted is of the order of 16.7 g of ammonia per hour. The boundary of the borrow pit has been digitized from geo-referenced NOAA navigational chart # 19357 and the total area determined to be 350,000 square meters. Using an average depth of 30 feet (10m) the total water volume is approximately 3.5 million cubic meters. Therefore, over a 24 hr period, approximately 400 g of ammonia-nitrogen excreted into the water within the borrow pit results in an input of only 0.011 ug/L. At this rate, only during very long periods of extremely low water exchange would it be expected that measurable amounts of ammonia-nitrogen will be detected. Specific in-situ studies have been conducted of the impact of these byproducts on water quality and are detailed below (Anderson, 1998).

3.0 Water Motion and Current Regimes

The exchange of water over a pearl oyster farm provides the mechanism by which oyster food is brought into the area being used for pearl oyster farming and soluble byproducts are removed. As a result, the exchange of water that has been exposed to aquaculture activities with the surrounding water mass dictates the rate at which potential impact is dissipated. Information on water motion and current regimes in Keehi Lagoon area have been acquired and reviewed for this report.

3.1 Voyager Submarines Survey

A water current study was conducted during the preparation of the EIS for permitting the operation of Voyager Submarines in the near-shore waters adjacent to that proposed farm area (Sea Engineering, Inc. 1997). The results of the survey show that circulation in the area adjacent to the Keehi Lagoon proposed pearl farm area is complex.

The project area is almost completely protected from episodes of high surf, which are generated from North Pacific winter storms. While the area is occasionally severely impacted by Kona and cyclonic storms, these events are extremely uncommon.

South swells that directly impact the area are generated from storms in the Southern Hemisphere and are common during summer months. These waves are typically long and low with periods of 12 to 20 seconds having deep-water heights of 1.5 to 6.5 feet. Most of the energy of these waves is dissipated as they pass across the extensive shelf offshore of the project area. As a result, the wave action across the reef flat fringing the borrow pit is dramatically reduced and these episodes, therefore, have a minimal impact on the project area.

The major components of the circulation in the project area are the North Pacific Equatorial Current, which flows in a general westerly direction through the Hawaiian Islands and semidiurnal and diurnal tide waves. Under these prevailing conditions small surf passes over the reef causing a gradual flow of water from the farm area out the deep channel on the south end of the project area. The water is ultimately transported off shore where it dissipates in the complex current patterns that are driven by the North Pacific Equatorial Current and tidal patterns.

3.2 Manihiki Survey

Studies of water current in atoll lagoons of the tropical Pacific where the preponderance of black pearl farming is underway have provided important information about the potential impacts of water quality degradation from this activity. One such study was conducted at Manihiki Atoll in the Cook Islands where the South Pacific Applied Geoscience Commission (SOPAC) carried out a one-month study of hydrodynamic patterns in Manihiki Lagoon which is heavily farmed for black pearl production (SOPAC 1997). Three vane-type current meters, a conductivity-temperature-depth probe and a boat mounted Acoustic Doppler Current Profiler (ADCP) were deployed. A global positioning system was used to establish base station positions, position bathymetery and to navigate to ADPC sites.

In prevailing trade wind conditions, the upper 90 feet of water in Manihiki Lagoon (the area used for farming black-lipped pearl oysters) exchanges with the open ocean approximately every 60 days and water currents rarely exceed 8 cm per second. This slow exchange and low current velocity is characteristic of closed or semi-closed lagoons. Closed and semi-closed lagoons, open lagoons, bays and estuaries, sheltered coast and open coast progressively experience more water exchange.

Though the project area is small compared to a typical atoll, the hydrodynamic regime is more typical of an atoll than of a sheltered or open coastal area. As in an atoll, the water enters over the reef and exits through a channel. Thus, the water motion is dominated by

Down Current Edge of Farm			
Shell Density	2M	6M	20M
0.13	7.87%	-0.83%	5.57%
0.19	8.33%	-1.52%	19.05%
0.48	16.67%	-42.67%	33.33%
0.7	9.26%	-40.67%	77.52%
Average	10.53%	-21.42%	33.87%

Table 1. Impact on water quality from farmed pearl oysters at the down current edge of a farm as a result of oyster feeding showing the change of chlorophyll-a in water which has passed through and under the farm

100 M Down Current of Farm			
Shell Density	2M	6M	20M
0.13	-7.92%	0.65%	6.80%
0.19	2.73%	1.67%	0%
0.48	9.50%	-4.67%	14%
0.7	-33.33%	-33.30%	10%
Average	-7.26%	-8.91%	7.70%

Table 2. Impact on water quality from farmed pearl oysters 100 meters down current of a farm as a result of oyster feeding showing the reduced change of chlorophyll-a in water which has passed through and under the farm

200 M Down Current of Farm			
Shell Density	2M	6M	20M
0.13	-8.47%	-4.76%	-3.84%
0.19	2.77%	2.73%	-0.20%
0.48	-4.11%	-4.68%	-5.88%
0.7	-7.41%	0.00%	7.04%
Average	-4.31%	-1.68%	-0.72%

Table 3. Impact on water quality from farmed pearl oysters 200 meters down current of a farm as a result of oyster feeding showing the ameliorated change of chlorophyll-a in water which has passed through and under the farm

a unidirectional motion typical of an atoll as compared to reversing tidal flows encountered in Malama Bay, a sheltered or semi-open coastal area.

4.0 Particulate Reduction in Water Impacted by a Pearl Oyster Farm

One of the most authoritative studies available in this area involved examination of impact to ambient water resulting from its passage over a pearl oyster farm in Manihiki Lagoon in the Northern Group of the Cook Islands (Anderson 1997, RDA Int. 1997). In this study, the extent of removal of phytoplankton is effectively measured by analysis of the change of chlorophyll-a. Since most suspended material is removed from the water as a result of filter feeding, the relative reduction of chlorophyll-a reflects the relative reduction of most of the particulate material in the water column.

The oyster density on four farms used in this survey was determined to be 0.13, 0.19, 0.48 and 0.70 oysters per square meter of surface area using GIS spatial data management technology. A single up-current site was selected as a reference station and three other stations were established on the down-current edge of the farm. Three more sites were established 100 meters and another three 200 meters down current of the farm. Three control stations were established in an area which was unaffected by farming activity. Water samples were collected at three depths (2, 6 and 20 meters) from each sample station. Current velocities of the water passing across the farms was estimated to be 1 to 5 centimeters per second using diver observation of the distance suspended particles move during a specific amount of time.

The reduction of chlorophyll-a was compared to farmed oyster density. A relative change in phytoplankton concentration after the water passed over the farm was calculated by assigning the up-current station a value of 100% and comparing the down-current stations at each depth.

Several patterns emerged. At the down current edge of the farm the water that passed above the farm but not through it showed little change (Table 1, Figure 2). The water that passed through the farm showed an approximate 40% decrease in phytoplankton at densities above 0.4 oysters per square meter. However, the water that passed under the farm showed an increase in phytoplankton. At a farmed oyster density of 0.7 oysters per square meter, the increase in phytoplankton at the down current edge was as high as 77% at the deep site. This increase is attributed to increased nutrient levels in the water as a result of metabolic byproducts of oyster metabolism and that of other fouling organisms on the farm.

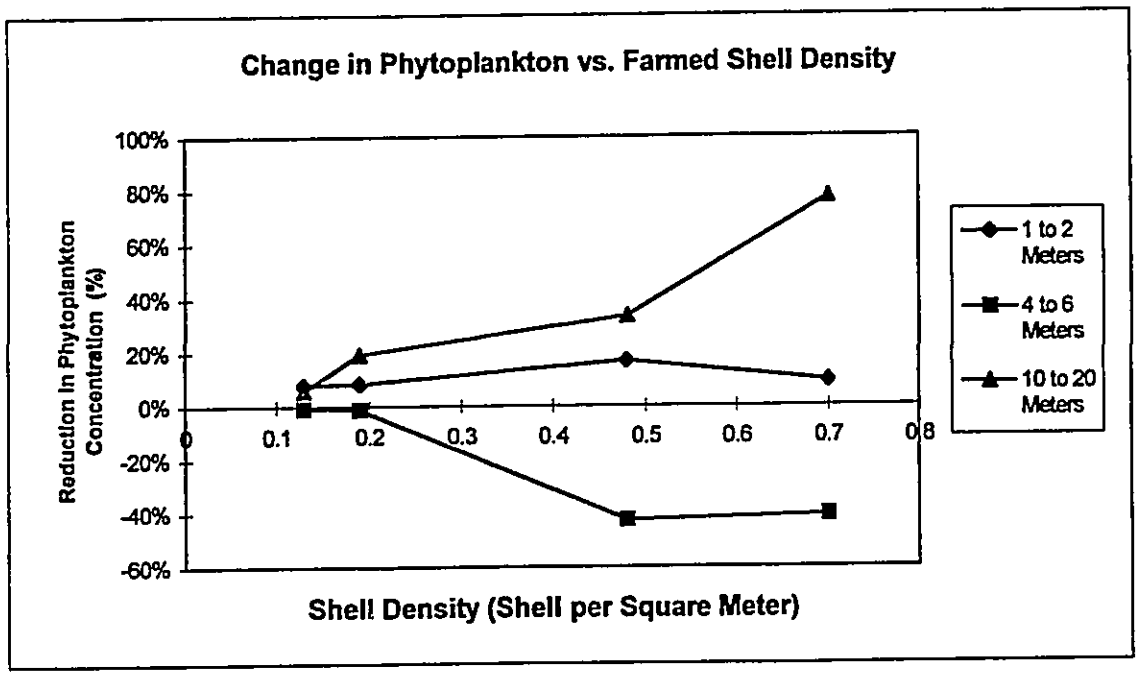


Figure 2. Change in phytoplankton as lagoon water passes over pearl oyster farms of four densities at three depths at the down current edge of the farms

Dissolved inorganic nutrient analysis was not available to this project so this assumption was not tested.

100 meters down current of the farms, the impact had decreased significantly (Table 2) and 200 meters down current of the farm the impact was ameliorated (Table 3, Figure 3).

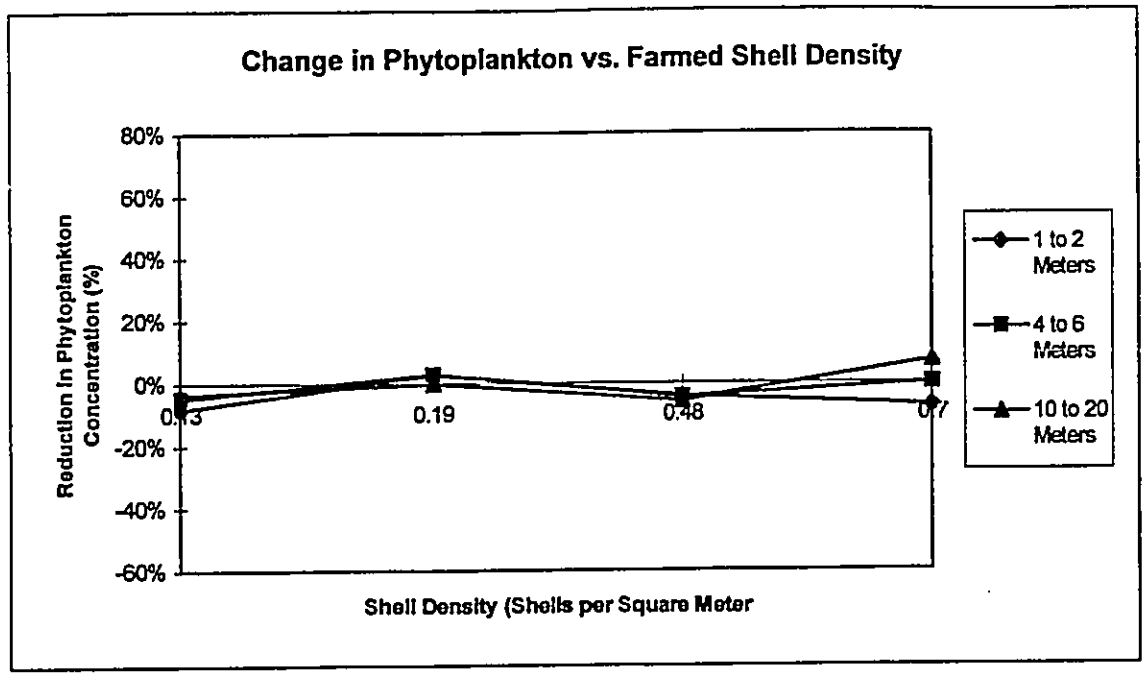


Figure 3. Change in phytoplankton as lagoon water passes over pearl oyster farms of four densities at three depths 200 meters down current of the farms

5.0 Sediment Oxygen Demand and Water Quality

Organic material such as feces and debris from farmed organisms and biofouling on farm lines, buoys and other farm structures falls to the sea floor where it decomposes. As the intensity of farming increases, the amount of organic material, which rains to the sea floor also, increases. There may be some risk of nutrient enrichment in aerobic conditions, or production of noxious compounds in anaerobic conditions. The extent of this impact was assessed in Manihiki Lagoon by measuring the sediment oxygen demand (SOD), the net amount of oxygen which is exchanged as a result of the biological activity associated with the sediment. A survey was established to evaluate the extent to which SOD is altered in areas used for farming black-lipped pearl oysters.

A sample of sediment was collected from an area, which was not used for oyster farming and this sample was used as a control. Experimental samples were collected directly under long line farms of varying oyster density ranging from 0.13 to 1.0 oysters per square meter of surface area. The experiment was again conducted using sediment collected under a rack culture area where oyster farming is far more intense. In areas used for rack culture, farmed oyster densities reach 25 oysters per square meter.

Sediment collected under the farm which supports an oyster density of 1.0 oyster per square meter or less, produced no significant change in dissolved oxygen when inoculating a standard BOD bottle with as much as 50 grams of sediment. A 40% reduction in dissolved oxygen was measured when ten grams of sediment collected from under the rack culture area was used as an inoculant. This data suggests that the benthic community readily assimilates the feces and other detritus (such as dislodged epibionts) from oysters under long-line farms. Therefore the risk of impact on water quality from

decomposition of organic material, which rains to the sea floor from pearl oyster farms, is minimal at oyster densities that are typical of long-line culture.

6.0 Pearl Oyster Farming Activity Related to Impacts on Water Quality

6.1 Wild vs. Farmed Oyster Population

A quantitative comparison of the impact of a wild oyster in its natural habitat and a farmed oyster on a long line is difficult to make, but similarities and dissimilarities can be identified. An oyster in its natural habitat filter-feeds, excretes byproducts and feces, at the same rate as an oyster on a farm line. In general, physiological processes are similar. Furthermore, the oyster density in an undisturbed wild oyster population typically exceeds the density of a moderately populated farm by many fold. Thus the impact of the presence of the oysters on the long lines has very little risk of causing deterioration of the environment.

6.2 Biofouling

The primary difference between the potential of impact to water quality as a result of farmed vs. wild oyster populations is the biofouling associated with the lines, buoys and anchors that constitute the farm structure. Artificial substrates such as farm structures that have been studied on the Polynesian and Micronesian Archipelagoes demonstrate significantly heavier biofouling than those in waters of the Hawaiian Islands (Personal *observation and communication – Cheney, 1995, Sims 1998).* Measurements of biofouling on pearl oyster farm lines in the Northern Group of the Cook Islands have yielded values of 0.5 kg wet weight of organisms attached and growing on farm substrates per meter of line. These organisms have the potential to contribute to the degradation of water quality by feeding, excretion and deposition of organic material on the sea floor.

Two important factors must be identified when assessing this risk. First, the studies on particulate reduction and sediment oxygen demand discussed above were conducted on moderately well maintained pearl oyster farms with a stable population of fouling organisms. Thus, at the low levels of farming intensity of 1 oyster per meter squared of sea surface, the impact of biofouling has been factored into the estimate of risk of alteration of water quality. Exercising prudence in farm maintenance by keeping oysters at low densities and minimizing the amounts of bio-fouling can further mitigate the risk of impact to water quality.

Second, The proposed farm of 50,000 oysters will take place in a physical area of 350,000 square meters. Thus the threshold of one oyster per meter squared has been conservatively retained by a factor of greater than 1:7.

7.0 Review of Existing Water Quality Data Collected in the Keehi Lagoon Area

Specific criteria for open coastal waters have been established based on Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54 (HRS 54), Water Quality Standards which apply to Receiving Water Limitations (Table 4). These criteria are based on the extent of natural runoff and seepage that occurs in an area. The "wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile. The "dry" criteria apply when the open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile. Since the project site is dominated by influx of open coastal seawater and thus receives very little fresh water runoff or seepage, the more stringent "dry" criteria is applied in this EIA. The "wet" criteria is applied to the water quality data from surveys conducted within Keehi Lagoon as this water body is significantly influenced by freshwater runoff from Maunalua Stream and ground water intrusion.

7.1 Previous Environmental Impact Studies at Keehi Lagoon

Four environmental assessments have been conducted in the Keehi Lagoon area during the last two decades (Honolulu Airport 1971, Solid Waste Bales 1976, Aecos 1987, Sea Engineering 1997). Of these, only the Voyager Submarines Hawaii (VSH) included specific field surveys where water samples were collected and analyzed. The Environmental Impact Statement published in October 1997 includes the data and conclusions from those surveys. In that study, twelve water quality parameters were surveyed of which 10 are designated in HAR 54 Water Quality Standards. Water samples were collected at the surface, mid-water and near the bottom at six sample sites (Figure 4) and is summarized (Table 5). The data was examined based on both the wet and dry criteria for the State of Hawaii water quality standards. The survey concludes that there is little vertical stratification of the water column at any of the sample locations and little indication of variation between sample sites. When the data are compared with State of Hawaii Water Quality Criteria, they do not exceed the given value more the 10% or 2% of the time for either wet or dry criteria. This survey examined water offshore of the survey area conducted by BPI described in section 7.3. The water quality closer to shore is influenced by both land-based activities as well as biological phenomenon associated with the reef and shoreline. Therefore, the inshore survey conducted by BPI complements the VSH data.

Environmental Impact Statements were also conducted during the permitting for construction of the Honolulu International Airport, Atlantis Submarines and proposed Disposal of Solid Waste Bales in Keehi Lagoon and Coastal Waters of Oahu. However, these projects did not include specific surveys of water quality in the area.

7.2 Routine monitoring programs at Keehi Lagoon

The State of Hawaii Department of Health Clean Water Branch has conducted regular water quality surveys at three sites in Keehi Lagoon between 1973 and 1995 (Figure 5). The data was downloaded from STORET, the USEPA environmental data archive. A descriptive summary of water chemistry for each site is presented here (Table 6, 7 and 8).

Table 4. State of Hawaii Open Coastal Water Quality Criteria

Parameter	Geometric mean not to exceed the given value	Not to exceed the given Value more than 10% of the time	Not to exceed the given value more than 2% of the time
Total Notrogen (ug N/L)	150.00* 110.00**	250.00* 180.00**	350.00* 250.00**
Ammonia Nitrogen (ug N/L)	3.50* 2.00**	8.50* 5.00**	15.00* 9.00**
Nitrate+Nitrite Nitrogen (ug [NO3+NO2}-N/L)	5.00* 3.50**	14.00* 10.00**	25.00* 20.00**
Total Phosphorus (ug P/L)	20.00* 16.00**	40.00* 30.00**	60.00* 45.00**
Chlorophyll a (ug/L)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00**
Turbidity (NTU)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**
pH Units	shall not deviate more than 0.5 units from a value of 8.1		
Temperature	shall not vary more than 1 deg. C from "ambient conditions" considering input and oceanographic factors		
Dissolved Oxygen	not less than 75% saturation		

* "wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shorline mile

** "dry" criteria apply when the open coastal waters receive less than three million gallons per day of fresh water discharge per shorline mile

Voyager Submarines
Water Quality Survey Map

Estimated Positions of
Water Quality Sampling Sites

Figure 4

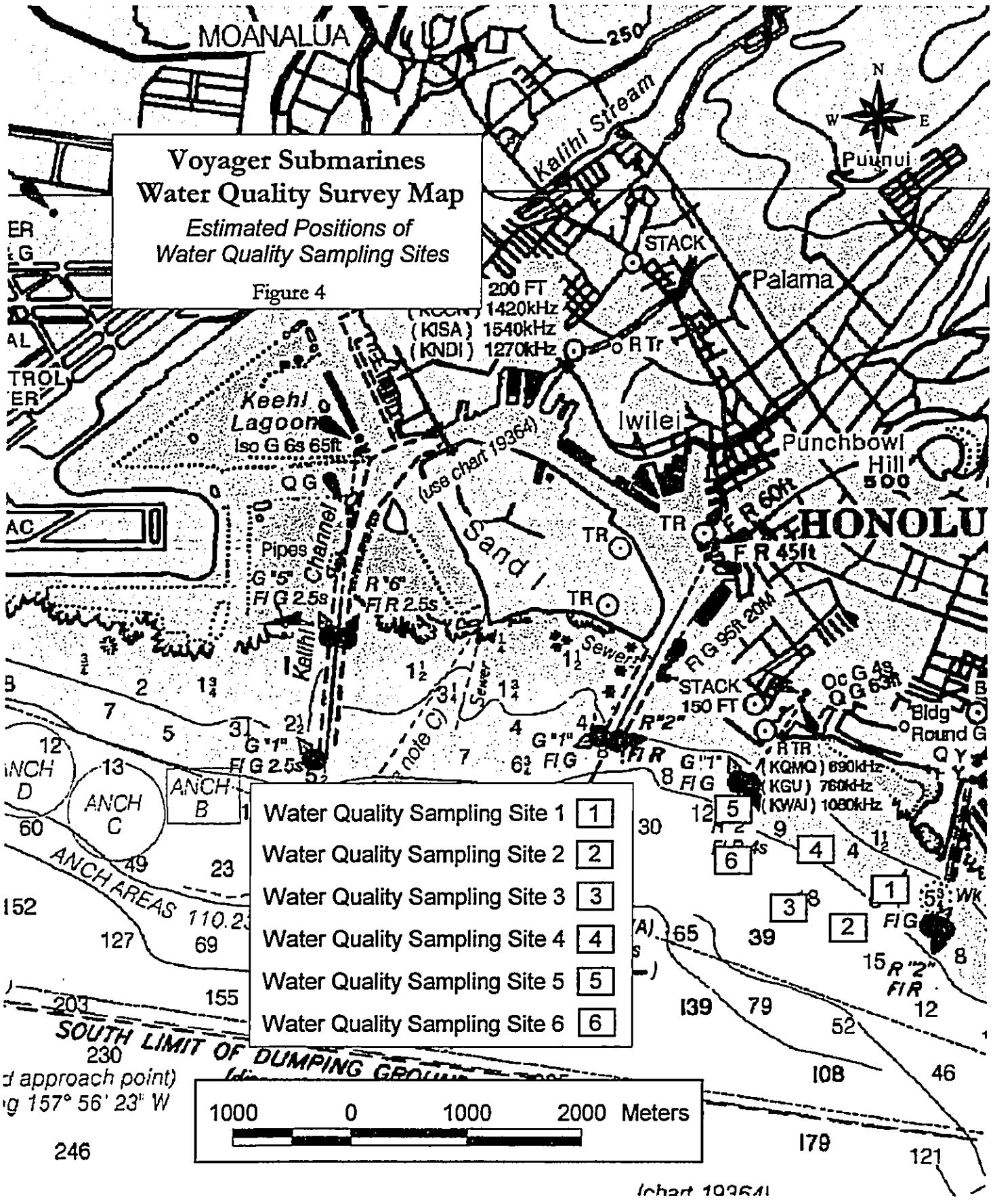


Table 5. Summary of water quality data from Voyager Submarine EIS Survey

Sample Station	PO4 (ug/L)	NO3 (ug/L)	NH4 (ug/L)	Si (ug/L)	DOP (ug/L)	DON (ug/L)	TP (ug/L)	TN (ug/L)	TURB (ntu)	SALT (0/00)	pH (rel)	Chl-a (ug/L)
1-S	4.96	0.28	1.40	65.52	11.78	11.86	16.74	113.54	0.22	34.757	8.14	0.211
1-M	4.96	0.14	1.40	64.40	11.78	107.24	16.74	108.78	0.14	34.751	8.16	0.223
1-B	4.96	0.42	1.12	65.24	10.85	112.28	15.50	113.82	0.20	34.768	8.17	0.235
2-S	4.34	0.42	0.42	61.32	11.47	121.52	15.81	122.36	0.14	34.773	8.17	0.230
2-M	4.03	0.42	0.84	61.32	9.92	82.18	13.95	83.44	0.11	34.757	8.17	0.216
2-B	4.03	0.42	0.84	61.32	11.47	106.82	15.50	108.08	0.19	34.76	8.17	0.238
3-S	4.03	0.28	0.84	63.00	11.16	89.74	15.19	90.86	0.11	34.758	8.17	0.240
3-M	3.72	0.28	0.84	59.08	11.16	69.88	14.88	98.00	0.09	34.771	8.17	0.233
3-B	4.34	0.14	1.26	57.96	9.61	83.58	13.95	84.98	0.11	34.761	8.16	0.238
4-S	3.72	0.28	0.56	76.44	10.54	106.82	14.26	107.66	0.11	34.698	8.17	0.218
4-M	3.72	0.28	0.84	70.00	10.23	86.38	13.95	87.50	0.11	34.723	8.17	0.233
4-B	3.72	0.14	1.54	66.36	11.47	100.66	15.19	102.34	0.11	34.725	8.17	0.211
5-S	3.72	0.42	0.56	60.76	10.54	114.38	14.26	115.36	0.11	34.758	8.17	0.225
5-M	3.72	0.56	1.54	58.80	10.85	103.60	14.57	105.70	0.10	34.751	8.17	0.228
5-B	3.72	0.84	0.70	56.56	10.85	123.76	14.57	125.30	0.20	34.744	8.17	0.228
6-S	3.72	0.84	0.56	61.32	10.23	118.02	13.95	119.42	0.12	34.726	8.17	0.208
6-M	3.72	0.70	1.96	61.88	10.23	117.60	13.95	120.26	0.11	34.757	8.17	0.235
6-B	4.03	0.98	1.26	60.20	12.40	186.20	16.43	188.44	0.11	34.741	8.17	0.235

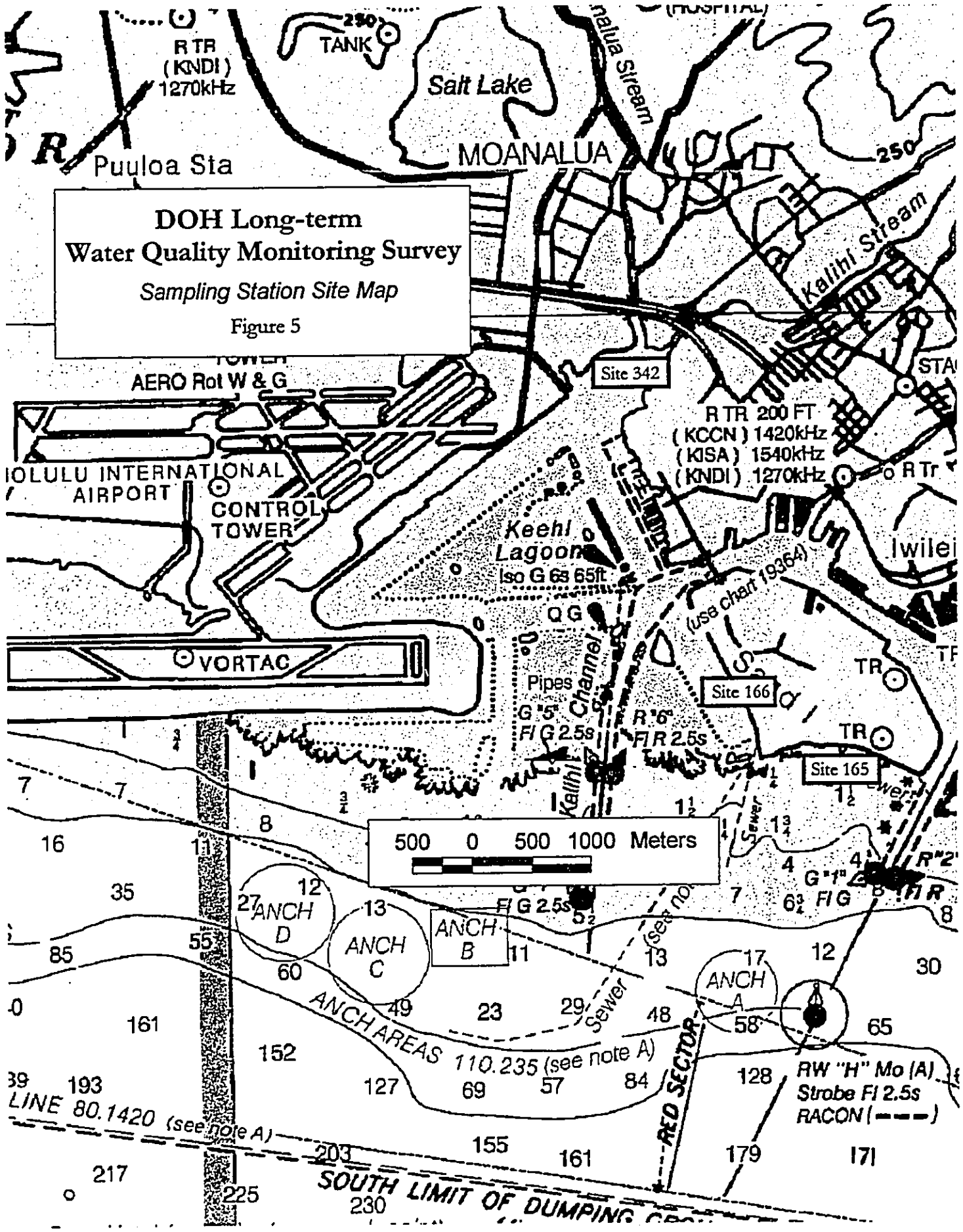


Table 6. Water Quality Data Summary for State of Hawaii Deparment of Health Clean Water Branch Site No. 165

Statistic	*Temp*	*Turbidity*	*DO*	*pH*	*TSS*	*Total N*	*NH4 N*	*NO3+NO2 N*	*Total P*	*Ortho P*	*Chl-a*	*Salinity*
	Deg C	NTU	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	PPT
Mean	25.09	1.22	6.90	8.16	23.30	0.15	0.06	0.02	0.01	0.01	5.60	33.34
Standard Deviatior	1.73	0.96	0.38	0.11	11.02	0.09	0.02	0.03	0.01	0.01	7.85	3.16
Range	6.50	5.10	1.80	0.50	58.00	0.35	0.09	0.24	0.04	0.03	50.50	26.10
Minimum	21.50	0.20	6.20	7.90	1.00	0.10	0.05	0.01	0.01	0.01	2.50	10.50
Maximum	28.00	5.30	8.00	8.40	59.00	0.45	0.14	0.25	0.05	0.04	53.00	36.60
Count	56	55	56	53	54	53	56	56	56	56	54	56

Table 7. Water Quality Data Summary for State of Hawaii Deparment of Health Clean Water Branch Site No. 166

Statistic	*Temp*	*Turbidity*	*DO*	*pH*	*TSS*	*Total N*	*NH4 N*	*NO3+NO2 N*	*Total P*	*Ortho P*	*Chl-a*	*Salinity*
	Deg C	NTU	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	PPT
Mean	25.84	12.93	6.53	8.12	64.81	0.18	0.10	0.06	0.04	0.02	13.82	34.07
Standard Deviatior	1.41	56.61	0.64	0.16	59.92	0.10	0.04	0.05	0.05	0.02	24.72	1.36
Range	7.50	499.90	3.30	1.00	212.00	0.44	0.21	0.17	0.34	0.09	124.50	9.80
Minimum	22.50	0.10	5.00	7.60	11.00	0.01	0.05	0.00	0.01	0.01	2.50	25.40
Maximum	30.00	500.00	8.30	8.60	223.00	0.45	0.26	0.17	0.34	0.09	127.00	35.20
Count	84	83	82	79	36	84	35	84	84	35	27	51

Table 8. Water Quality Data Summary for State of Hawaii Deparment of Health Clean Water Branch Site No. 342

Statistic	*Temp*	*Turbidity*	*DO*	*pH*	*TSS*	*Total N*	*NH4 N*	*NO3+NO2 N*	*Total P*	*Ortho P*	*Chl-a*	*Salinity*
	Deg C	NTU	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	PPT
Mean	25.69	8.33	6.01	8.08	32.19	0.24	0.07	0.06	0.04	0.02	152.83	32.51
Standard Deviatior	1.64	7.36	0.88	0.14	29.11	0.18	0.04	0.06	0.03	0.02	235.43	4.73
Range	9.50	35.90	4.90	0.90	250.00	0.86	0.23	0.36	0.17	0.15	1366.50	33.00
Minimum	20.50	0.10	3.90	7.80	7.00	0.01	0.05	0.01	0.01	0.01	1.50	2.00
Maximum	30.00	36.00	8.80	8.70	257.00	0.87	0.28	0.37	0.18	0.15	1368.00	35.00
Count	126	128	127	123	81	127	80	128	128	79	73	93

7.3 Water Quality Survey for Existing Work

BPI conducted a survey of the existing water quality in the project area to determine the potential risk of degradation to water quality resulting from the proposed activity. The survey was designed to include water quality constituents inclusive in the specific criteria for open coastal waters based on HRS 54. Sample collection and analysis methods were employed that comply with the rigorous standards that have been developed to establish legal validity of water quality analysis (American Water Works Association, 1997).

Methods

Water samples were collected at three locations (Figure 6). One sampling site was established on each end of the proposed grow-out area and a third site was established in water of similar depth outside of the reef. At each sampling site, a shallow water sample was collected three feet below the surface and a deep sample was collected three feet off the bottom.

Data was recorded on custom-made data sheets that were printed on waterproof paper. Chain of custody records were kept for the entire sample collection and analysis procedure. Geographic positions of the sampling sites were obtained on NAD 83 datum and projected to Universe Transverse Mercator Zone 4 North in units of meters. These were overlaid on NOAA navigational maps that were transformed to the same datum and projection.

Basic water quality parameters that are amenable to analysis by hand held field instruments were measured on site. Temperature and dissolved oxygen were measured using a YSI dissolved oxygen meter. Salinity was measured using a hand held refractometer. pH was measured using a pH meter that was calibrated using certified buffer solutions of pH 7.00 and 10.00 less than one hour prior to collection and analysis of samples. The buffer solutions were rechecked after the fieldwork was complete to determine the amount of signal drift.

Two samples collected at each station were delivered to a certified water quality laboratory for analysis. A 1-liter sample was collected in an amber Nalgene container to be analyzed for chlorophyll-a content. The second was collected in a chemically cleaned 125-ml container that was sub-sampled and analyzed for inorganic nutrients and total nitrogen and phosphorus.

The sample collection process began at 9:30 AM and was completed by 11:00 AM on February 26, 1999. All samples and chain of custody records were returned to the laboratory by noon on the same day. Laboratory sample analysis was completed within 10 working days of sample collection.

Results and discussion

The water quality for each analyte at each site has been summarized (Table 9). In all samples, total nitrogen and total phosphorus are within the DOH criteria. While the inorganic nutrient data exceed the most stringent criteria in some samples, the data show that they fall well within the criteria that may not be exceeded more than 10% of the time. Nitrate+Nitrite concentrations exceed the standards in the offshore control sample and the surface sample at Site 2 exceeds the standard for ammonia.

Salinity, dissolved oxygen, temperature and pH at Sites 2 and 3 are all indistinguishable from the offshore control sample. The standardization of the pH meter after the measurement of the samples showed no measurable drift.

The turbidity in the control samples exceeds the most stringent criteria but meets the standard that is not to be exceeded more than 10% of the time. The turbidity in the samples collected in the proposed grow-out area exceed the criteria that is not to be exceeded 10% of the time and the bottom sample from Site 3 exceeds the most relaxed criteria which is not to be exceeded 2% of the time.

Chlorophyll-a concentrations from the offshore control station are close to the most stringent standard. The chlorophyll-a concentration of the samples collected in the proposed grow-out all exceed the criteria that is not to be exceeded 10% of the time and the bottom sample from Site 3 exceeds the most relaxed criteria which is not to be exceeded 2% of the time. These results are interpreted in section 8 below.

Table 9. Survey Water Quality Data

Parameter												
Station	Water Depth (feet)	Sample Depth (feet)	TN (ug N/L)	NH3 (ug N/L)	NO3+NO2 (ug N/L)	TP (ug P/L)	Chl a (ug/L)	Turbity (NTU)	pH pH Units	Temp. Deg. C	Salinity PPT	DO % Sat.
1-S	40	3	96	1	6	10	0.24	0.45	8.1	25.0	35.0	96
1-B	40	37	98	2	4	12	0.14	0.45	8.2	25.1	35.0	98
2-S	50	3	108	4	2	11	0.92	1.00	8.2	25.1	36.0	108
2-B	50	47	97	<1	1	12	0.63	1.72	8.1	25.1	35.5	106
3-S	47	3	97	1	1	13	0.72	1.70	8.1	25.1	36.0	102
3-B	47	44	108	1	1	15	1.35	3.12	8.1	25.1	35.5	100

8.0 Existing Marine Water Quality Environment

When examining the potential for impact to water quality from the proposed activity, the existing water quality environment must be characterized. The data collected in the three surveys described above represent three separate regimes which, when combined, provide a water quality description from the inner shoreline of the lagoon to the offshore open coastal Water. The DOH sampling stations are located in the inner area of the lagoon and were selected as representative of water quality in that area. The Voyager Submarines sampling sites were established offshore and the data reflects the character of open ocean conditions near the Island of Oahu. The BPI survey sites were established to examine the water quality in the proposed survey area, which lies as an intermediate between the water quality in the lagoon and that offshore.

8.1 Data from Samples Collected Offshore

Data from samples collected offshore indicate that near shore coastal water appears to be well mixed and bears little evidence of impact from land-based activities.

8.2 Data from Samples Collected within Keehi Lagoon

The water quality within the lagoon is extensively impacted due to groundwater intrusion and freshwater inflow from land based runoff and the ongoing sediment disturbances in and around Honolulu Harbor. During heavy rainfall events, highly turbid discharge from Maunalua Stream can occur for several days. This discharge can be high in pollutants and inorganic nutrients and heavily impact the water within Keehi Lagoon. Even when the discharge from the canal is not excessive, the water from the canal and groundwater seeping from the shoreline provides a consistent source of inorganic nutrients, which supports a robust phytoplankton community within the lagoon. The data suggest that the water quality within the lagoon is highly variable in both time and space and occasionally exceeds the least stringent "wet" criteria for all parameters with mean values ranging from above the 10% value to well past the 2% value. Furthermore, episodes of discharge of sewage and industrial waste have checkered the history of the lagoon. Keehi Lagoon is one of several locations around the country where coastal pollution is still a major problem according to a report in the Honolulu Star Bulletin on January 21, 1997. Sewage spills and high concentrations of heavy metals and carcinogenic organic compounds have labeled Keehi Lagoon as one of the several locations around the country where coastal pollution is still a major problem.

8.3 Data from Samples Collected within the Project Area

Within the project area the data show that in the conditions at the time of the survey, the offshore water quality either marginally meets the DOH criteria for turbidity, chlorophyll-a and inorganic and total nutrients or slightly exceeds them. The water in the proposed grow-out area illustrates a very different quality. Nutrients are extremely low in this water while chlorophyll-a and turbidity exceed even the most relaxed criteria.

In general, a low level of nutrients in water that supports high chlorophyll-a concentrations is common. Phytoplankton that are responsible for the presence of chlorophyll-a take up the nutrients for growth resulting in the observed low levels.

The high levels of turbidity in this water are most likely a result of extremely fine sediment that becomes suspended in the water column. Reports from divers that conduct coral reef surveys in the area support this conclusion (Ku'ulei Rogers, Pers. Com). The sediment is residual from the excavation and dredging of the area during construction of the Reef Runway.

These data suggest that the water quality within the proposed grow-out area is a mix of water within the lagoon and that which flows over the reef from wave and tidal action. It is apparent that the water in the grow-out area is dominated by the in flow open coastal water as it's quality is far more similar to that water mass that of the lagoon.

9.0 Expected Impact to Water Quality Resulting from a Pearl Oyster Farm

Water quality impacts that are expected to result from the proposed pearl oyster farming activity have been organized into "localized" and "regional" regimes. Localized impacts include the alteration of water quality within the farm boundaries to a distance of 500 meters downstream of the farm. Regional impacts include the alteration of water quality beyond this 500 meter buffer including the nearshore open coastal water.

9.1 Localized Impact on Water Quality

Based on the data collected in this survey it is concluded that the water quality in the *proposed farming area* meets most of the criteria established by the State of Hawaii for coastal waters with the exception of chlorophyll-a and turbidity. Due to filter feeding by the farmed oysters, it is expected that the phytoplankton levels in the ambient water will be reduced and will contribute to reducing the level of chlorophyll-a. Turbidity may also be reduced as it is also removed by filter feeding. However, based of filtration rates and the volume of the farm area, only 0.5% of the water mass will be filtered in 24 hour period. Thus, if impact to the water mass from farming activity is detectable, it will be very small even within the 500 meter buffer zone that designates the localized area.

The estimate of impact to water quality from oyster excretion is based on a rate of 350 ug ammonia-nitrogen per hour per oyster. Over a 24-hr period, the dilution of all ammonia excreted into the volume of the lagoon results in an input of 0.011 ug/L. This is equivalent to 0.55% of the most stringent standards for the "dry" criteria. At this rate, even during very long periods of extremely low water exchange it is expected that measurable amounts of ammonia-nitrogen will only be marginally detectable and will remain significantly within the limits of HRS 54 criteria.

It is recognized that the impact to water quality will not be diluted throughout the entire lagoon but will result in a plume down stream of the farm. Using an extremely conservative dilution rate of 1:10 the most stringent standards for the "dry" criteria of ammonia-nitrogen dictated by HRS 54 would not be exceeded. The risk of impact to water quality as a result of ammonia contamination is further reduced by the uptake of ammonia by phytoplankton in the water column. Therefore the risk of impact resulting from oyster feeding and excretion is very low leaving a considerable conservative margin.

9.2 Regional Impact on Water Quality

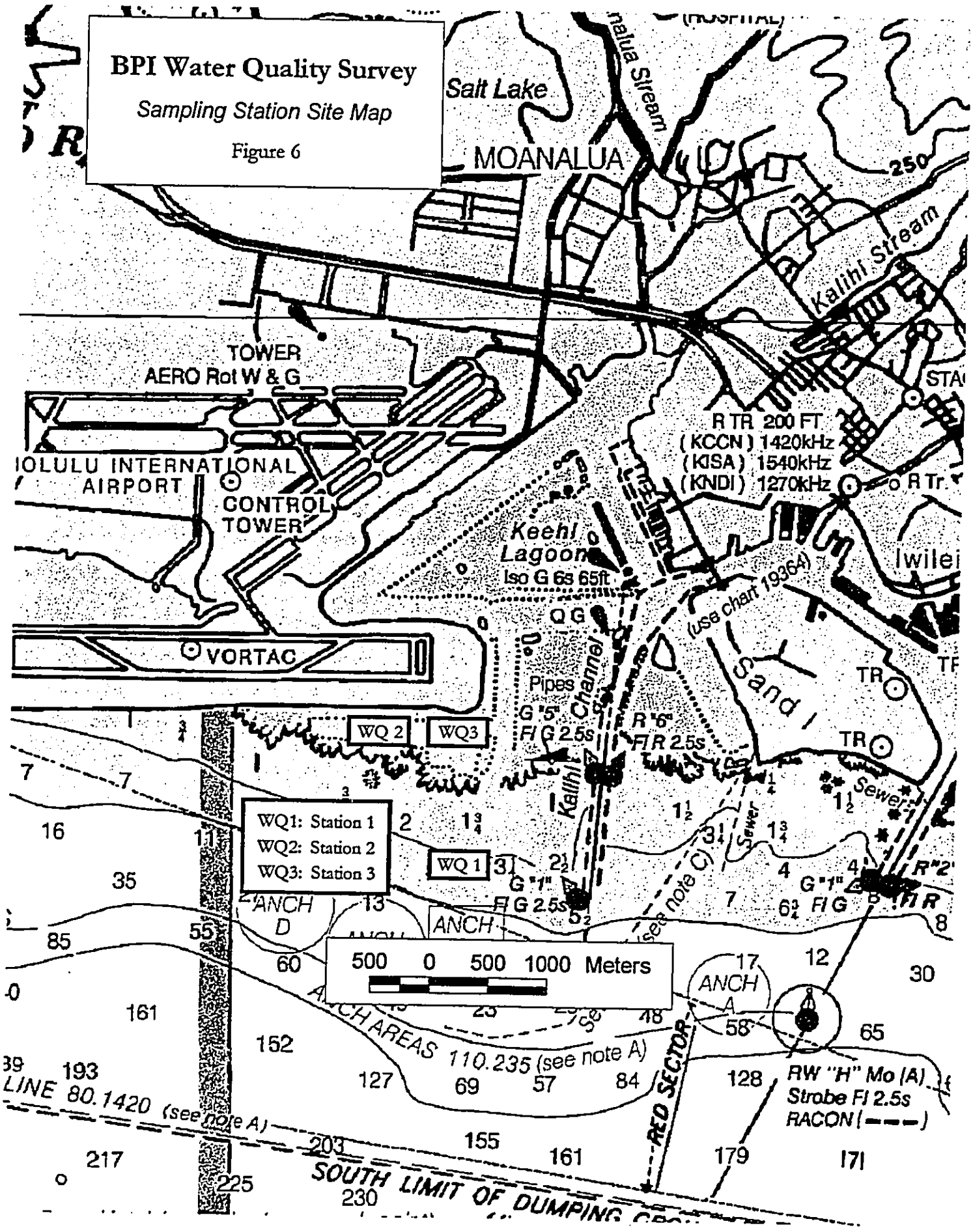
Extensive Research has shown that pearl oyster farming, when conducted at low density and when ecologically sound farming practices are implemented, pose low risk of

degradation to the ambient water quality (Anderson, 1997). It has been demonstrated that where pearl oyster farms are maintained using ecologically sound farming methods and farmed pearl oyster density is kept below 1.0 oysters per square meter, the impacts to water quality associated with oyster feeding and metabolism are ameliorated a short distance from the farm. It has also been shown that no discernible impacts exist in the oxygen demand associated with the sediment under a pearl oyster farm in which farming methods meet these standards. Given the hydrodynamic regime and existing water quality of the lagoon, proposed project area and offshore water it is expected that the regional impact of the proposed activity will not be significant.

BPI Water Quality Survey

Sampling Station Site Map

Figure 6



APPENDIX II :

BIOLOGICAL COMMUNITY EVALUATION FOR PEARL FARM DEVELOPMENT IN KE'EHI LAGOON, OAHU

By : Ku'ulei Rodgers

Environmental Impact Assessment
Biological Community Evaluation

For

Pearl Farming Development
In

Ke'ehi Lagoon
O'ahu, Hawai'i

prepared for:
Black Pearls Inc.
P.O. Box 525, Holualoa, Hawai'i 96725

prepared by:
Ku'ulei Rodgers
Independent Consultant
Coral Reef Ecologist
Hawai'i Institute of Marine Biology
P.O. Box 1346 Coconut Island, Kāne'ohe Hawai'i

May 1999

1) Physical Description of Sites

a) General Description of Habitats

1) Historical

Ke'ehi Lagoon is a fringing coral reef that has been significantly altered by dredging and landfill operations since the 1930's. Prior to excavations and shoreline extensions for the Honolulu International Airport and Hickam Air Force Base Golf Course, Ke'ehi Lagoon was comprised of extensive mud flats behind the fringing reef with some benthic exposure during low tides. Shallow waters provided sparse navigable area. Following the construction of three seaplane runways during World War II, navigable channels and a triangular reef remnant were created.

2) Borrow Area

A borrow area was dredged for fill material. The depth in this area ranges from 7 to 13 meters. It is almost devoid of hard substrate, consisting of fine silt.

3) Reef Flat and Slope

Subsequent dredging also substantially altered the physical environment of the reef in the lagoon. Large rock outcrops dominate the reef edge on the margins of the borrow area. The slope is more pronounced on the southern margin of the reef, descending rapidly at a steep angle. The northern and eastern margins incline gradually. Calcareous rock and rubble and course grained sand are found in the reef flat and slope areas between 0 and 5 meters, particularly on the southern margin of the reef, due to relative increased wave action. Three perennial streams provide freshwater influence to Ke'ehi Lagoon, Moanalua, Kalihi and the Nu'uanu Streams.

4) Outer Fringing Reef

The seaward outer reef flat is a large shallow area composed of consolidated limestone, rubble and sand. A spur and groove environment fronts the reef. A circulation channel and the Kalihi Ship Channel bisect the reef at opposite ends of the lagoon. This continuous reef margin is less than 1 to 2 meters in depth. Moving landward, the substrate changes from solid limestone to rubble, limestone outcrops and patchy sand pockets.

5) Islets

Numerous calcareous islets are found within the lagoon on the reef flat, creating a habitat for mangrove establishment. These mounds of coral, sand and rubble are mostly altered at various locales near the margins of the reef flat. Some of these islets are occupied permanently by residents, and others by transient squatters and fishermen or serve as a base for recreational activities.

6) Circulation

The circulation of the lagoon is dependent on tidal current influent and effluent and typical tradewind patterns. The residence time of the water within the lagoon was greatly improved with the addition of the Circulation Channel which provides a counter-clockwise circulation pattern around the triangular area. Flood tide currents enter through the Kalihi Channel and to a lesser degree over the reef flat. Seaward flow exits primarily through the Circulation Channel at the end of the reef runway. During ebb tide, waters from Honolulu Harbor drain into Ke'ehi Lagoon and out the Kalihi Channel and to a lesser degree out the Circulation Channel. Thus, the Circulation Channel serves as an exit for seaward flows regardless of the tidal phase due to tidal and tradewind driven circulation.

2) Description of Sites and Stations

a) Site Selection

Eight sites were selected as representative of the area proposed for oyster cultivation (figure 1). Criteria for site selection included the proximity to the proposed cultivation area and their thorough representation of the surrounding borrow area. The water circulation pattern was a consideration in site selection. Flood tide currents enter through the Kalihi Channel and also over the outer fringing reef. Exit of water occurs primarily through the Circulation Channel.

Site 1

This site is located near the islet closest to the borrow area. This islet is the proposed land base for oyster operations and security. Anthropogenic impacts from oyster habitation of the islet was a consideration in site selection.

Site 2 &3

Inner fringing reef sites 2&3 are areas most susceptible to any impacts generated by the proposed pearl farm operations. Water flow is directed over the inner fringing reef from the borrow area. Sedimentation deposits are heaviest in this area relative to other sites.

Site 4

This site is located at the end of the borrow area making it more susceptible than other sites to any changes in water quality due to its high water retention rate.

Site 5 & 6

Outer fringing reef sites 5&6 are located seaward of the borrow area. These sites represent areas of high water circulation and exchange, least affected by proposed operations due to their up current position.

Site 7

Effluent flows out the Circulation Channel from both the borrow area and the inner harbor of Ke'ehi Lagoon contacting Site 7 on both the incoming and outgoing tides.

Site 8

This site is located on the west, Ewa side of the dredged channel. This is the least protected of the sites representing an area where oceanic conditions prevail.

b) Location

Global positioning system coordinates were recorded for verification and future reference. Exact locations will assure return for resurvey should future monitoring of sites be proposed subsequent to proposed aquaculture operations.

Site number	North GPS coordinate	West GPS coordinate	Location
1	21° 18' 23.9"	157° 54' 26.3"	Inner circulation channel-near islet
2	21° 18' 21.4"	157° 54' 35.2"	Inner fringing reef
3	21° 18' 22.6"	157° 55' 57.0"	Inner fringing reef
4	21° 18' 19.3"	157° 55' 24.0"	West end of borrow area
5	21° 18' 11.2"	157° 55' 11.4"	Outer fringing reef

Site number	North GPS coordinate	West GPS coordinate	Location
6	21° 18' 18.2"	157° 54' 11.4"	Outer fringing reef
7	21° 18' 10.2"	157° 54' 42.7"	Outer fringing reef
8	21° 18' 05.2"	157° 54' 26.5"	West side of circulation channel

c) Station Selection

At each site, 3 stations were selected. Stations at 1, 3, and 10 meters address the stratification of organisms by depth providing overall representation of the sites. In Ke'ehi Lagoon, hard substratum declines in deeper waters. Habitat diversity, and diversity and abundance of organisms are also highly influenced and stratified by depth. Spatial variability within each station was addressed with replicate transects. Seasonal variability was reduced by surveying sites within the same temporal frame. All data were collected between February and April 1999. The 1m station surveys the reef flat environment with relatively high algal diversity and abundance. The 3m station includes the reef slope with higher coral cover than other depths. The 10m station reaches the bottom edge of the slope and at many sites the bottom of the lagoon. The average depth of the borrow area is 12m. This environment is characterized by low biotic diversity and considerable silt accumulation. No stations were selected below 10m since it was determined by prior observations that silt totally dominates these depths.

3) Methods of Benthic Community Evaluation

A total of 72 transects encompassed 8 sites and 3 depths. At each station, three 25m transect lines were placed on the bottom along the 1m, 3m, and 10m isobaths. A $1m^2$ quadrat was placed at 15 randomly selected points along each line. Data was recorded *in situ* using visual estimates of percent cover of all

macroscopic species and substratum occupying each quadrat. Field observations were made to qualitatively record additional species not occurring on the transects in order to compile a more complete species list and more representative estimates of abundance and distribution of coral species. Virtually all corals recorded from field observations were represented on the transects.

a) Macroalgae

Seaweeds were divided into functional form groups based on internal anatomy and external morphology. The major algal assemblages consisted of:

- Macroalgae which is defined here as large, more rigid and morphologically complex algal forms with canopy heights of > 10 mm.
- Coralline algae consists of calcareous, crustose corallines.
- Algal turfs are described here as a complex mixture of species that is widespread with heights of < 10mm. Algal turfs at Ke'ehi stations are synonymous with the data sheet category dead coral and rubble, which they cover with fine, filamentous assemblages. Exclusion of this category in statistical analyses was due to difficulty in species identification and risk of exclusion of hard, non-biological substrate.

Macroalgae was identified in the field to species level. Algal turfs and coralline algae encrusting rubble and dead coral were not identified to species level.

b) Substratum

Non-biological substrate was separated into the following benthic types:

- Silt is defined as fine, particulate sediment generally <64 μm of terrigenous and calcareous origin.

- Sand are grains coarser than silt of calcareous origin ranging between 64 μm and 2 mm.
- Rubble consists of unattached calcareous material ranging in size from 2 mm to 10 cm.
- Dead coral is defined here as calcareous coral skeleton lacking live tissue with surfaces dominated by filamentous algal turf < 10 mm.

The biological benthic community was subdivided into coral, seaweeds and macro-invertebrates.

c) Invertebrates

- Coral was identified to species level *in situ*. Verification and taxonomic identification of less common species or species of unusual morphology were established by biologists at the Coral Reef Ecology Laboratory at the Hawai'i Institute of Marine Biology, University of Hawai'i.

- Macro-invertebrates were identified to species level whenever possible. Species in the Phyla Porifera were identified to Phylum only.

4) Results and Observations

Overall Observations

Ke'ehi Lagoon is a very poor area biologically relative to most Hawaiian coastlines and bays. This can be expected from the high turbidity and organic loading. Reef-building corals are important indicators of coastal conditions. At Ke'ehi, habitat complexity is relatively low. Topographical relief is also low due to planar, shallow reef flats and a linear mud bottom. Differences in community structure consist primarily of differences in species organization. The primary mechanism for controlling abundance and diversity of corals is disturbance. In more protected areas like Ke'ehi Lagoon, temperature, light, salinity, turbidity, predation and bioerosion are of equal or greater importance. There are 42

species of corals belonging to 16 genera found in the Hawaiian Islands. Twelve species belonging to 8 genera were documented at Ke'ehi Lagoon (Table 1).

Coral Distribution and Abundance

Distribution and abundance patterns in Ke'ehi Lagoon are typical of a disturbed environment. Coral colony size within the lagoon is small. Although all depths surveyed are in the euphotic zone, corals below 10m are nearly absent. Turbid conditions may impede feeding and limit light used by zooxanthellae for photosynthesis. The thick layer of silt at this depth inhibits recruitment due to lack of suitable settlement substrate. A total average percent cover of 0.06 at 10m substantiates this claim (figure 2). Diversity was lowest at this depth (figure 3). Station 8, exposed to cleaner, more oceanic conditions, is the anomaly with the highest average percent coral cover, 0.3.

The 3m depth has the highest average percent coral cover, 1.7 (figure 2). This may be due to less disturbance from wave energy and sufficient suitable substrate available for recruitment: Coral diversity was also highest at this depth, recording 10 species (figure 3). Dead coral and rubble dominate at this depth. Station 8 was again the outlier showing significantly higher coral cover and diversity than the other stations. The oceanographic differences of this station reflect the biological differences. *Porites lobata* and *Pocillopora meandrina*, characteristic of high wave energy environments, are found here in greater abundance than other stations.

The reef flat at 1m depth has low coral cover (0.5) with colonies of very small size due to high wave energy conditions (figure 5).

Macroalgal Diversity and Abundance

A strong correlation between algal abundance and diversity and depth occurs (figure 3). Forty-one species of algae are found at stations above 1m, declining to only 14 species at the 3m depth, with a further sharp decline to 4 species at

10m (table 2). Algal species found at 10m either grew unattached or were found attached loosely to the fine silt dominating this depth. Algal diversity was relatively constant across stations at each depth. Algal abundance at the 10m depth (2.4%) was similar to the 3m depth (2.3%) due to the wide coverage of *Halophila hawaiiensis*, an endemic seagrass (figure 5). Algae showed a 26.8% coverage at the shallow depths as expected, significantly higher than the other two depths surveyed. A total of 43 macroalgae were recorded from transects during this survey (table 3). The outer fringing reef stations showed higher average percent cover of both algae and coral although they were not significantly different due to high standard deviations (figure 4).
Species like *Acanthophora spicifera* and *Spyridia filamentosa* are highly tolerant of stagnant water. The high percent of these species reflects the poor water circulation in some areas. Many algal species have high numbers of epiphytes, another indication of polluted conditions. Pollution tolerant forms such as blue-green Cyanophytes like *Lygbya* and *Symploca* are also present in significant abundance. *Acanthophora* and *Ulva* also tolerate low circulation environments. These algae compete with coralline algae, limiting recruitment surface for coral larvae. Most of the common macroalgae found in Ke'ehi Lagoon require or tolerate high levels of inorganic nutrients indicating high organic loading in the area. At the cleaner stations 7 & 8, percent algal cover was low and coral cover high compared to stations receiving less water circulation (figure 6).

Invertebrates

Rock boring urchins characteristic of a high energy environment were common on the reef flat (table 3). Species living in mud and dead coral (e.g. feather dusters and Christmas tree worms) were present in significant quantities. Hydroids, sponges and tunicates, typical of harbors and lagoons were also found in abundance.

5) Description and Evaluation of Environmental Impact on Benthic Substrate and Organisms

a) Primary Impacts- habitat modification and loss

1) Rare or endangered species

No impacts on the biota are expected from proposed oyster cultivation. No rare or endangered species of coral or algae were found within Ke'ehi Lagoon during this survey. All recorded species are found elsewhere along the south shore of O'ahu.

Halophila hawaiiensis was found in some abundance along the reef slope edge and bottom of the silted dredged portions of the borrow area. Little is known of the distribution and abundance of this endemic seagrass. It serves as an important food resource for the endangered green sea turtle, *Chelonia mydas*. It also serves as an important substrate for other native epiphytic species of algae. The proposed pearl farm is located away from the reef slope and is thus unlikely to disturb seagrass beds. *Halophila hawaiiensis* is found in soft substrate unsuitable for permanent anchorage.

2) Anchor Damage

Setting of anchors from small boats associated with the pearl farm will not affect the coral reef environment since they will be restricted to the dredged borrow area. Deployment of anchors from the sub-surface long-line system and working platforms placed at depths below 5m would have little impact. Few corals are located at these depths.

b) Introductions

Concerns of introduced alien epiphytic species or disease that may be transferred to native populations from farm oysters are unfounded. Spat from aquacultured oysters will be from animals native to Hawai'i and spawned under laboratory conditions.

c) Positive Impacts

1) Water Quality

Oysters improve water quality by filtering and removing particulate organic material from the water.

2) Benefits to the Native Oyster Population

Pearl farming operations can have positive effects on the environment and the biota. Pearl farming can be an activity benign to the environment. *Pinctada margaritifera* , the black lip pearl oyster is native to Hawai'i. They are uncommon in the main Hawaiian Islands, found in patchy distributions throughout the archipelago. The farm may serve to reestablish and enhance the natural populations. Scattered individuals were recorded near the proposed area on the reef slope. The Ke'ehi oyster population should benefit from the reproductive capacity of the farm. Stock from a pearl farm can also prevent possible founder effects from small population size. Low density and patchy distribution may increase susceptibility to environmental stresses, catastrophic events or anthropogenic activities. Pearl farming provides conditions favorable to the increase of the native population. Low reproductive rates due to small population size can limit populations. Depleted populations can be enhanced by larval recruitment from farm oysters.

Pinctada margaritifera is a protected marine fisheries resource. It is illegal to take, kill, possess, remove or sell this species in Hawai'i without a permit. The black lip pearl oyster was a vital part of the native culture and must be retained, protected and managed for the survival of cultural practices and spiritual values.

Conclusions

Pinctada margaritifera is a filter feeding organism that obtains its resources from the seawater. No added nutrients that may affect species composition in the surrounding area are needed to culture farm raised oysters. Platforms, lines and

buoys will provide added substrate for recruitment of organisms naturally occurring in the vicinity. As no short or long term negative impacts to the biotic community are foreseen, no environmental protection plan or mitigating measures are necessary.

References

Devaney and Eldredge. 1977. Reef and Shore Fauna of Hawaii. Section 1: Protozoa through Ctenophora. B.P. Bishop Museum Special Publication. 64(1). Bishop Museum Press. Honolulu, Hawaii. 278 pp.

Fielding, Ann. 1985. Hawaiian reefs and tidepools. 3rd edition. China color printing company, Inc. Taipei, Taiwan, Republic of China. 103 pp.

Harvey, George. W. 1970. Final Report. Keehi Lagoon Ecological Survey. Oceanic Institute.

Kay, E.A. 1979. Hawaiian Marine Shells. Reef and Shore Fauna of Hawai'i, Section 4: Mollusca. Bernice P. Bishop Museum Special Publication 64 (4). Bishop Museum Press, Honolulu, Hawai'i.

Magruder and Hunt. 1979. Seaweeds of Hawaii. 1st edition. The Oriental publishing company. Honolulu, Hawaii. 116 pp.

State of Hawaii. Dept. of Transportation, Harbors Division. 1989. Keehi Lagoon Recreational Plan and Draft Environmental Statement. Honolulu, Hawaii.

Family	Species	Common Name	Hawaiian Name	Location	Depth
Invertebrates **Coral**		'ako'ako'a, ko'a, puna kea			
Acroporidae	*Montipora patula*			2,4,5,6,8	1m, 3m
Acroporidae	*Montipora verrucosa*	Rice coral		2,5,6,8	3m, 10m
Faviidae	*Cyphastrea ocellina*			3,5,6	1m, 3m
Faviidae	*Leptastrea purpurea*			All sites	All depths
Pocilloporidae	*Pocillopora damicornis*			All sites	1m, 3m
Pocilloporidae	*Pocillopora meandrina*	Cauliflower or Rose coral		All sites	1m, 3m
Poritidae	*Porites compressa*	Finger coral	pohaku puna	3	3m, 10m
Poritidae	*Porites lobata*	Lobe coral	pohaku puna	2,3,4,5,6,8	All depths
Thamasteidae	*Psammocaora nierstraszi*			4,5,6,7	All depths
Thamasteidae	*Psammocora stellata*			4,5	1m
Zoanthidae	*Palythoa tuberculosa*	zoanthid soft coral	Limu-make-o-Hana	7,8	1m, 10m
Xeniidae	*Anthelia edmonsoni*	octocoral		8	1m, 10m

Table 1: Coral Species, Depth and Abundance recorded from Transects at Ke'ehi Lagoon

Invertebrates					
Phylum	Species	Common Name	Hawaiian Name	Location	Abundance
Porifera	Porifera spp	Sponges	hu'akai, 'upi	All sites	Common
Cnidaria	Aiptasia spp.	Anemones	'okole	1,3	
Cnidaria	Bryozoans	Bryozoans		1,7	
Cnidaria	Hydroids	Hydroids		All sites	Common
Platyhelminthes	*P. cellatus*	Solar slug		1,2	
Platyhelminthes	*Sabellastarte sanctijosephi*	Featherduster worm		1,2,3,4,5,6,7	Common
Platyhelminthes	*Lanice conchilega*	Spaghetti worm	kauna'oa	1,3	
Platyhelminthes	*Spirobranchus giganteus*	Christmas tree worm	kio	1,2,3,4,5,7	Common
Mollusca	*Stylocheilus*	Sea hare	kualakai	2,3	
Mollusca	Nudibranch spp.	Nudibranch		3	
Mollusca		Rock oyster		All sites	Common
Echinodermata	*Echinometra mathaei*	Rock boring urchin	'ina kea	2,3,4,5,6,7,8	Common
Echinodermata	*Echinometra oblonga*	Oblong urchin	'ina	4,5,8	
Echinodermata	*Echinothrix diadema*	Long-spined urchin		2	
Echinodermata	*Pseudobolentia indiana*	Purple urchin	hawa'e po'ohina	2	
Echinodermata	*Tripneustes gratilla*	Collector urchin	Hawa'e maoli	2	
Echinodermata	*Ophiocoma erinaceus*	Brittlestar		4	
Echinodermata	*Holothuria atra*	Black Sea cucumber	loli okuhi kuhi	6,8	
Echinodermata	*Actinopyga mauritiana*	Speckled sea cucumber		6,8	
Arthropoda		Mantis shrimp	aloalo	1	
Arthropoda	*E. identalis*	Hawaiian lobster	ula	1,2,5	
Arthropoda	*Paguridae spp.*	Hermit crab	unauna	5,7	
Arthropoda	*Stenopus hispidus*	Barber pole shrimp	'opae	6	
Chordata		Tunicates		All sites	common

Table 2: Invertebrate Species, Location and Abundance recorded from Transects at Ke'ehi Lagoon

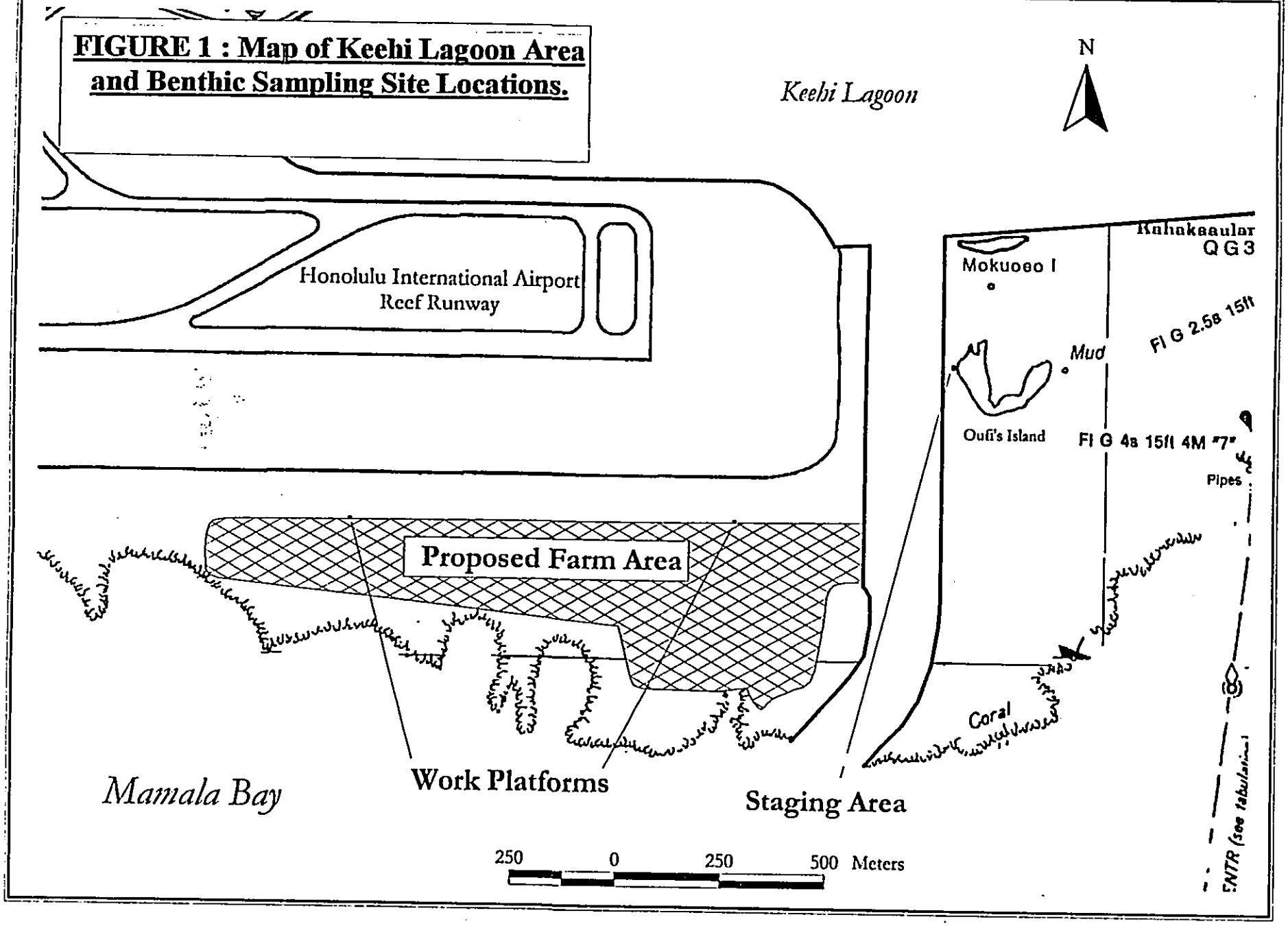
Algae						
Division/Order	Species	Common Name	Hawaiian Name	Location	Depth	Abundance
Cyanophyta	*Lyngbya majuscula*			1,2,3,4,5,6	1m, 3m	common
Cyanophyta	*Symploca hydnoides*			3,4,5,6,7,8	1m, 3m	
Chlorophyta Uvales	*Ulva reticulata*	Sea lettuce		2	1m	
Siphonocladales	*Dictyosphaeria cavernosa*	Bubble algae		1,2,3,4,5,6	All depths	Common
	Dictyosphaeria verslusyii	Bubble algae		2,3,4,5,7,8	1m, 3m	Common
	Microdictyon spp.			8	1m	
	Valonia aegagropila			8	1m	
Caulerpales	*Caulerpa racemosa*			4	1m	
	Caulerpa serrulata			1	1m	
	Codium arabicum			2,3	1m	
	Codium edule		'a'ala'ula	4	1m	
	Codium reediae		wawae'iole	1,2,3,4,5,6	1m, 3m	
	Halimeda discoidea			All sites	1m, 3m	common
Dasycladales	*Bornetella sphaerica*			2,3	1m	
	Dasyopsis spp.			3,5,6,8	1m	
Seagrasses	*Halophila hawaiiensis*			2,4,6,8	10m	Common
Phaeophyta Dictyotales	*Dictyopteris plagiogramma*		lipoa	6	1m	
	Dictyota acutiloba		alani	1	1m	
	Dictyota friabilis			4,6,8	1m	Common
	Dictyota sandvicensis		alani	2,4,5,6,7	1m, 3m	Common

Table 3: Macroalgal Species, Location and Abundance

Algae Division/Order	Species	Common Name	Hawaiian Name	Location	Depth	Abundance
	Padina japonica	Elephant ears		1,3,4,5,6,7,8	1m	Common
	Stypopodium hawaiiensis			7	1m	
Fucales	*Turbinaria ornata*			5	1m	
Scytosiphonales	*Colpomenia sinuosa*		puha	4,5	1m	
	Hydroclathrus clathratus			1	1m	
Rhodophyta Bonnemaisoniales	*Asparagopsis taxiformis*		kohu	6,7,8	1m	
Ceramiales	*Acanthophora spicifera*			All sites	1m, 3m	Common
	Laurensia succisa		lipe'epe'e	1,3,4	1m, 3m	
	Melanamansia glomerata			2,5	1m, 3m	
	Spyridia filamentosa			1,2,3,5,6	All depths	Common
	Wrangelia pencillata			3,6	1m	
Gelidiales	*Pterocladia caerulescens*			2,4,6,8	1m, 10m	
	Martensia fragilis					
Gigartinales	*Gracilaria salicornia*			2,4,5,7,8	1m, 3m	
	Hypnea cervicornis			3	1m	
	Gracilaria bursapastoris	ogo		3	1m	
	Plocamium sandvicense			1,3	1m	
Nemaliales	*Galaxaura fastigiata*			6	1m	
	Gelidella acerosa			2,3,4,5,6,7	1m, 3m	Common
Coralline algae	*Porolithon spp.*			8	1m	
	Hydrolithon spp.			All sites	1m, 3m	common
				All sites	1m, 3m	common

Table 3: Macroalgal Species, Location and Abundance

FIGURE 1 : Map of Keehi Lagoon Area and Benthic Sampling Site Locations.



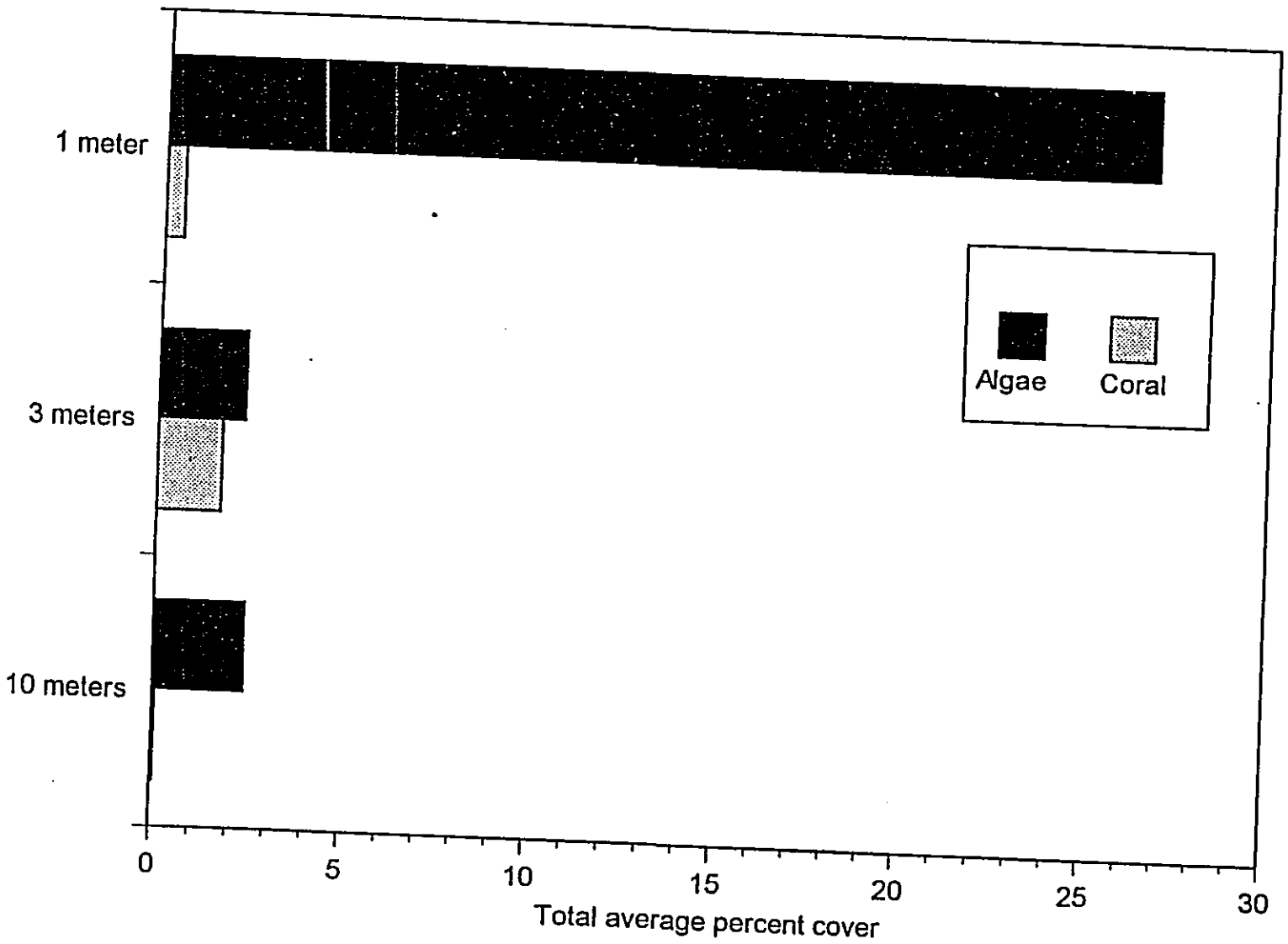


Figure 1: Total average percent cover of algae and coral in Ke'ehi Lagoon

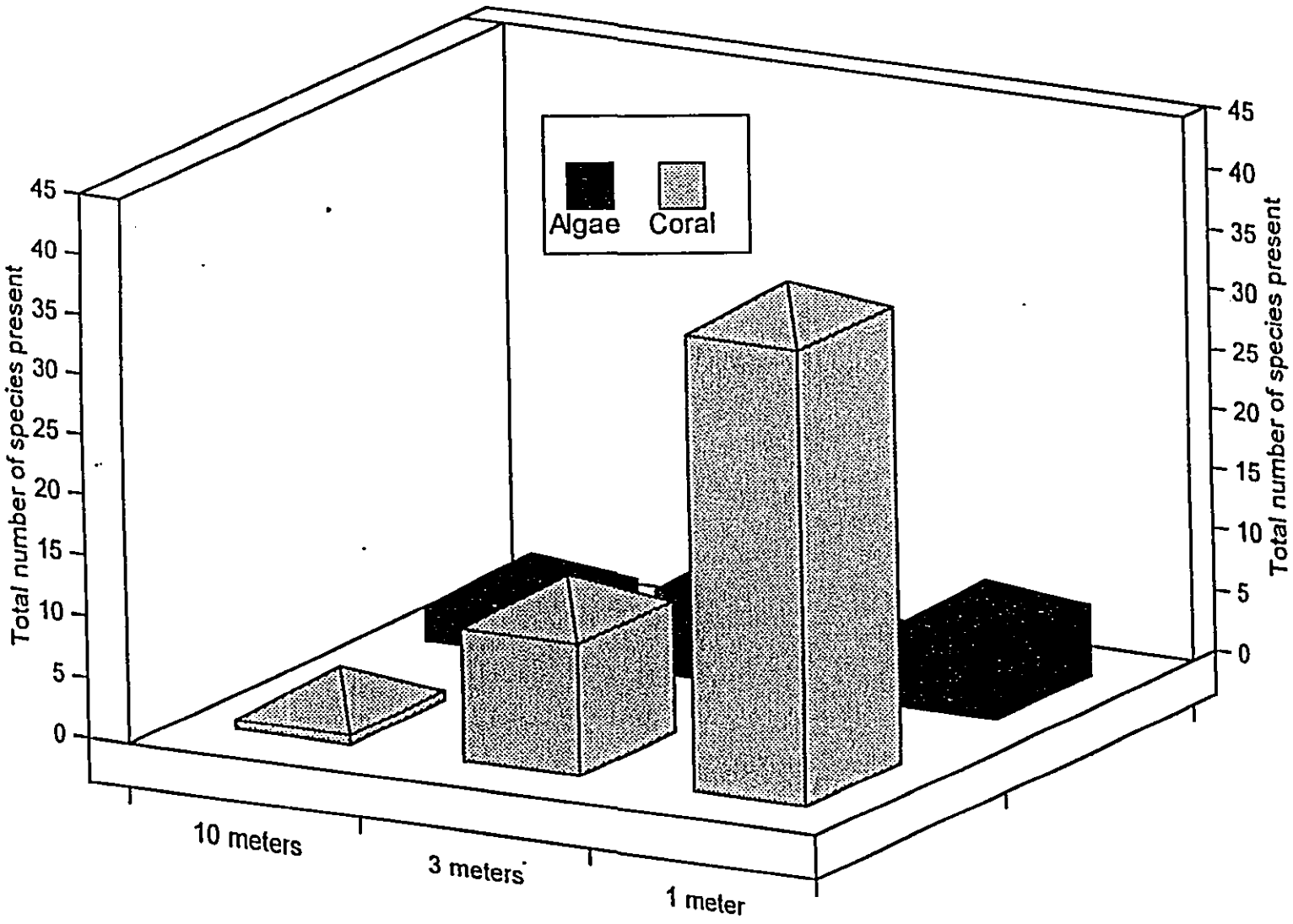


Figure 2: Ke'ehi Lagoon-Coral and Algal Diversity by Depth

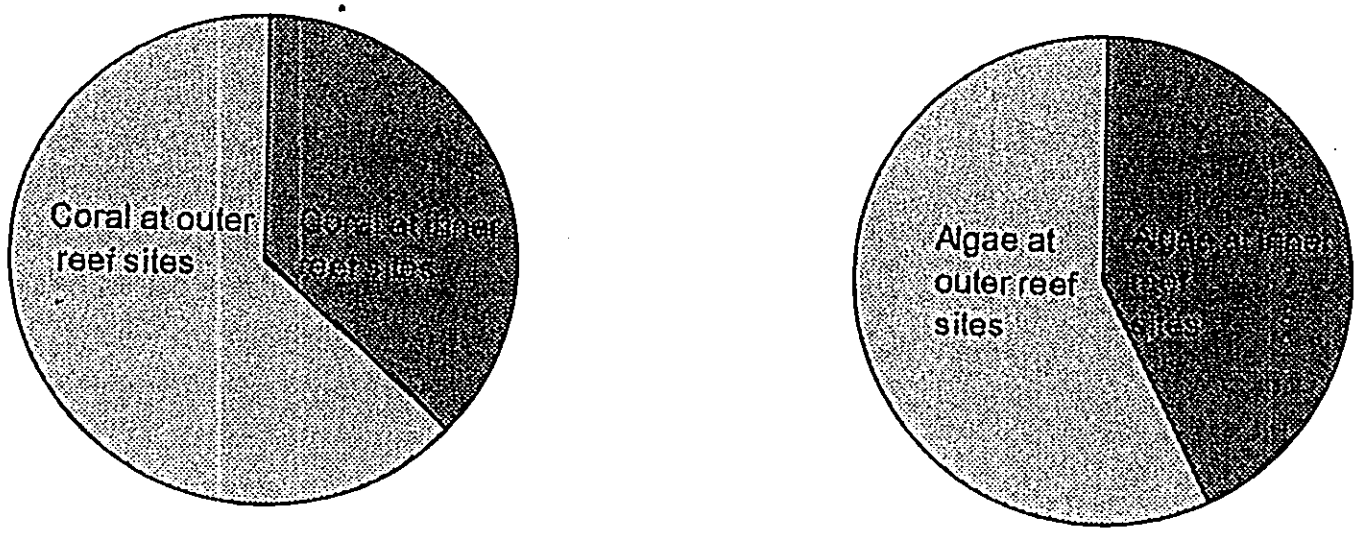


Figure 3: Ke'ehi Lagoon-Abundance of Coral and Algae at Outer vs. Inner Reef sites

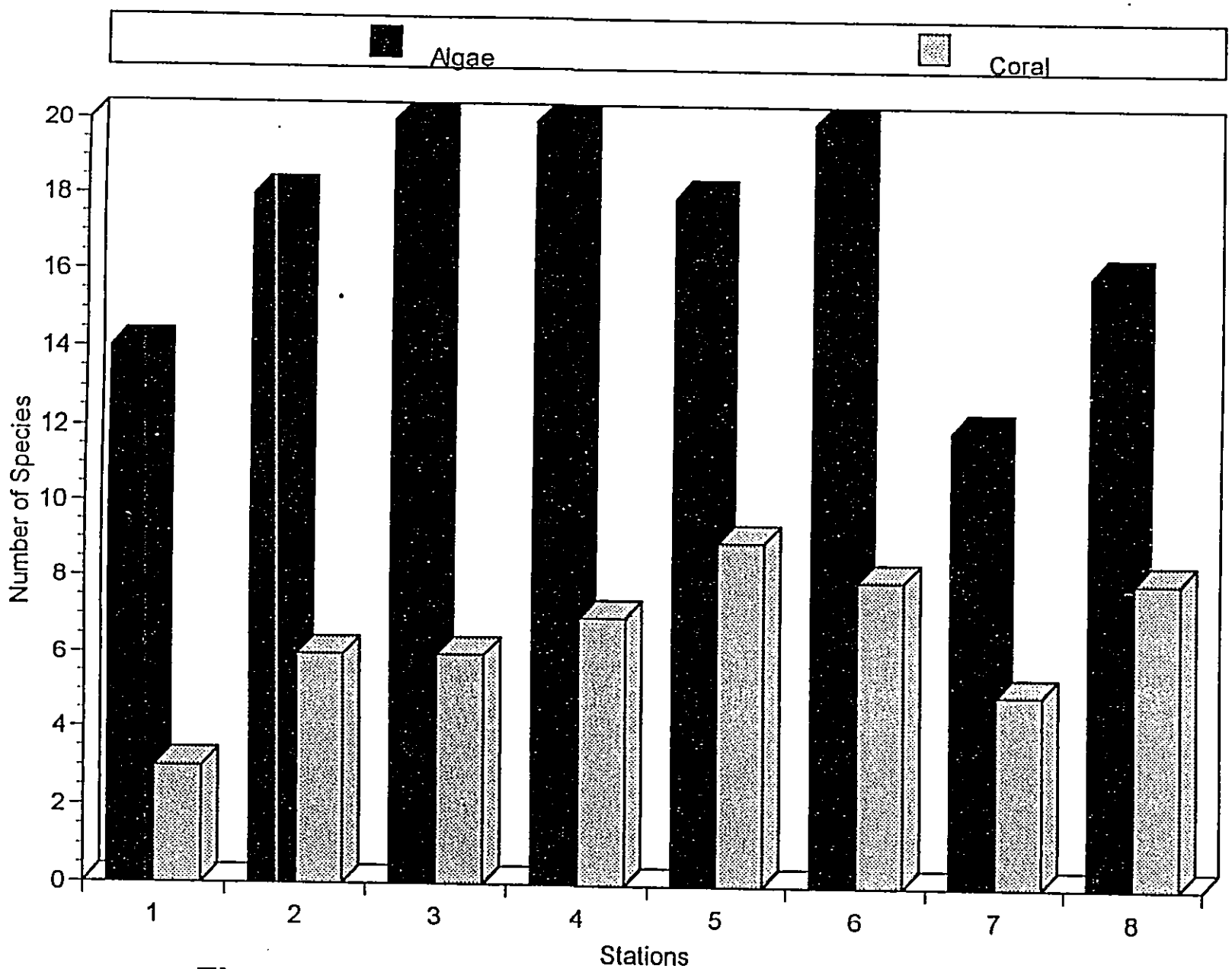


Figure 4: Algal and Coral Diversity by Station in Ke'ehi Lagoon

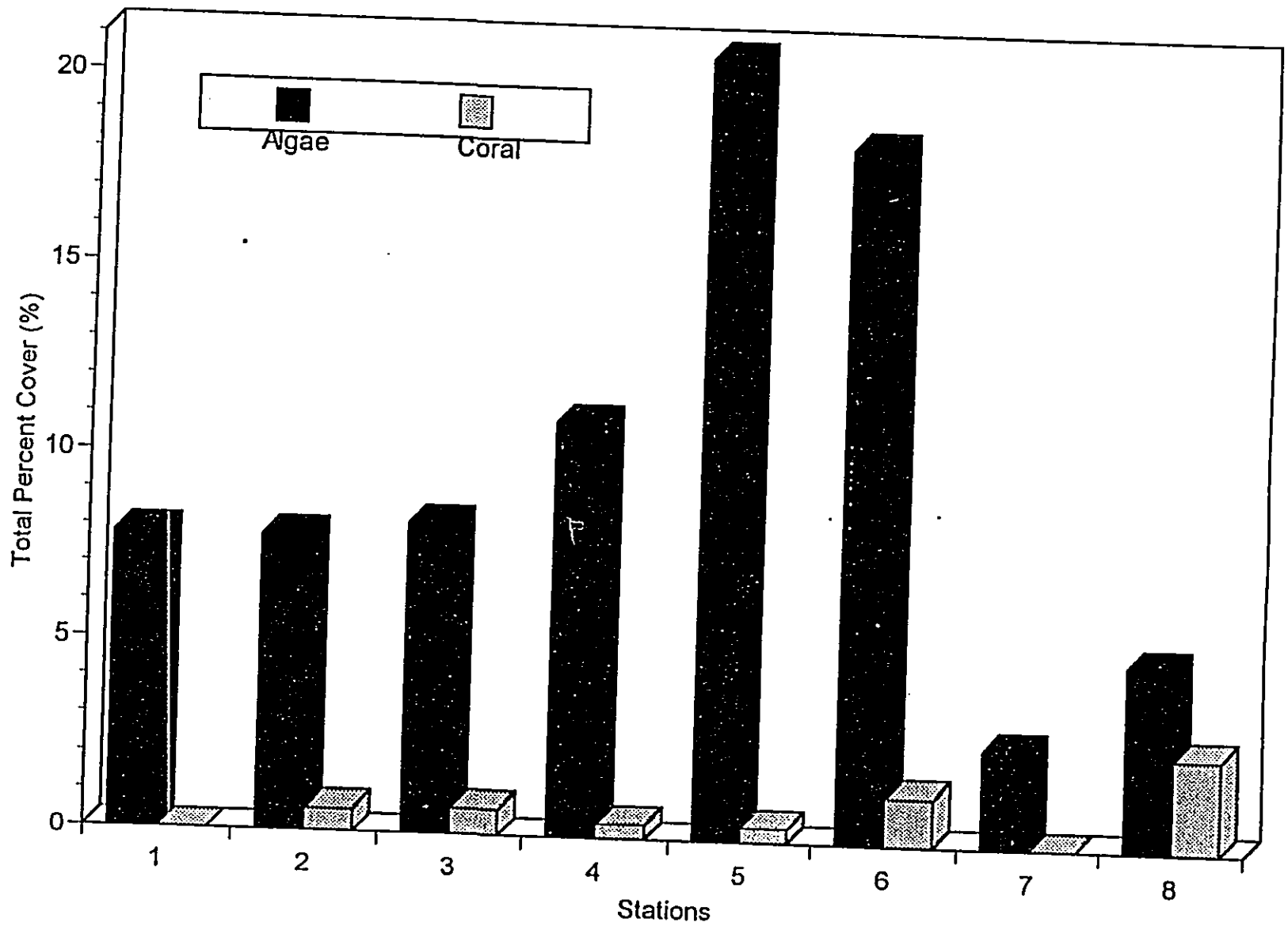


Figure 5: Total Percent Coral and Algal Cover by Station in Ke'ehi Lagoon

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

September 25, 1997

Mr. Dale Sarber
Black Pearls, Inc.
P. O. Box 525
Holualoa, HI 96725

Dear Mr. Sarber,

Enclosed are the data that you requested for the Reef Runway. The data indicate that this area is used only infrequently as a foraging area by native Hawaiian waterbirds and periodically by winter migrants. Therefore does not appear to be significant habitat for either native Hawaiian or migratory birds.

Sincerely,

Carol J. Terry, Ph. D.
Wildlife Biologist

Day-Mo	Year	Season	Island	Wetland	Status	HAWD	HACO	NACO	HAMO	HAST	BCNH	CAEG	FRGB	EUWD	MALL	MaDuM	Duck	Rescue	AMWI	CANV
14-Jan	1980	WINTER	OAHU	Reef Runway	NB															
12-Jan	1981	WINTER	OAHU	Reef Runway	NB															
6-Jan	1982	WINTER	OAHU	Reef Runway																
11-Jan	1983	WINTER	OAHU	Reef Runway																
10-Jan	1984	WINTER	OAHU	Reef Runway	NB															
17-Jan	1985	WINTER	OAHU	Reef Runway	NC															
16-Jan	1986	WINTER	OAHU	Reef Runway	NC															
14-Jan	1987	WINTER	OAHU	Reef Runway																
25-Jan	1988	WINTER	OAHU	Reef Runway						2										
27-Jan	1989	WINTER	OAHU	Reef Runway				1		2	1									
17-Jan	1990	WINTER	OAHU	Reef Runway						4	3									
10-Jan	1991	WINTER	OAHU	Reef Runway						2										
29-Jan	1992	WINTER	OAHU	Reef Runway																
30-Jan	1993	WINTER	OAHU	Reef Runway																
25-Jan	1995	WINTER	OAHU	Reef Runway	NC															
23-Jan	1996	WINTER	OAHU	Reef Runway																

Day-Mo	Year	CACO	Duck	GTBH	LESA	LEGP	LESC	NOPI	NSHO	RUTU	SAND	SCAUP	SEPL	WATA	UASB	Unidentified	WL	TC	WI	SC	CC	RF	WR
14-Jan	1980																*				*		
12-Jan	1981																*	*	*	*	*	*	*
6-Jan	1982																*	*	*	*	*	*	*
11-Jan	1983																*	*	*	*	*	*	*
10-Jan	1984																*	*	*	*	*	*	*
17-Jan	1985																						
16-Jan	1986																						
14-Jan	1987					4											*				*		
25-Jan	1988					25				35	19			2			*				*		
27-Jan	1989																[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17-Jan	1990									6				3			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10-Jan	1991					25								1			*	*	*	*	*	*	*
29-Jan	1992					300				50							*	*	*	*	*	*	*
30-Jan	1993					11				13	18						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25-Jan	1995																*	*	*	*	*	*	*
23-Jan	1996					3					2						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

These data are NOT population estimates. They should only be used as indications of trends and the presence of a species at a particular site.

Information from State of Hawaii Division of Forestry and Wildlife
1151 Punchbowl St.
Honolulu, HI. 96813

*No data on habitat or weather conditions

Day-Mo	Year	Season	Island	Wetland	Status	HAWD	HACO	HACO	HAMO	HAST	BCNH	CAEG	PECR	FUWD	MALL	Mallard	Black	Ducks	AMWI	CANV	CAGO	Duck	GTBN	LESA	LEGP	LESC	NOPI	BSHO	RUTU	SAND	SCAUP	SEPL	WATA	Unid	Teal	RL	SC	HI	SC	CC	EF	WD
2-Aug	1974	SUMMER	OAHU	Reef Runway	NB																															*	*	*	*	*	*	*	
1-Aug	1975	SUMMER	OAHU	Reef Runway	NC																															*				*			
4,5-Aug	1976	SUMMER	OAHU	Reef Runway	NC																															*				*			
2[illegible]-Jul	1977	SUMMER	OAHU	Reef Runway	NC																															*				*			
2[illegible]-Jul	1978	SUMMER	OAHU	Reef Runway	NC																															*				*			
1,2-Aug	1979	SUMMER	OAHU	Reef Runway	NC																															*				*			
31-Jul	1980	SUMMER	OAHU	Reef Runway	NC																															*	*	*	*	*	*	*	
10-Aug	1981	SUMMER	OAHU	Reef Runway	NB																															*	*	*	*	*	*	*	
4-Aug	1982	SUMMER	OAHU	Reef Runway																																*	*	*	*	*	*	*	
27-Jul	1983	SUMMER	OAHU	Reef Runway																																*	*	*	*	*	*	*	
1-Aug	1984	SUMMER	OAHU	Reef Runway	NB																															*	*	*	*	*	*	*	
30-Jul	1985	SUMMER	OAHU	Reef Runway	NC																															*				*			
1-Aug	1986	SUMMER	OAHU	Reef Runway	NC																																						
24-Jul	1987	SUMMER	OAHU	Reef Runway						3	2														60				60	60			60										
2-Aug	1988	SUMMER	OAHU	Reef Runway							3																									*				*			
7-Aug	1989	SUMMER	OAHU	Reef Runway							3														3											[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
31-Aug	1990	SUMMER	OAHU	Reef Runway	NC																															[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
2[illegible]-Aug	1991	SUMMER	OAHU	Reef Runway								110													33				3														
5-Aug	1992	SUMMER	OAHU	Reef Runway						2	1																									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
23-Aug	1993	SUMMER	OAHU	Reef Runway																					47								12			[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
24-Aug	1994	SUMMER	OAHU	Reef Runway																									3							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
22-Aug	1995	SUMMER	OAHU	Reef Runway																					20														[illegible]	[illegible]	[illegible]	[illegible]	
14-Jan	1974	WINTER	OAHU	Reef Runway	NC																															*	*	*		*	*	*	
23-Jan	1975	WINTER	OAHU	Reef Runway	NB																															*	*	*	*	*	*	*	
15-Jan	1976	WINTER	OAHU	Reef Runway	NC																															*	*	*	*	*	*	*	
13-Jan	1977	WINTER	OAHU	Reef Runway	NC																															*				*			
12-Jan	1978	WINTER	OAHU	Reef Runway	NC																															*				*			
13,14-Jan	1979	WINTER	OAHU	Reef Runway	NC																															*				*			

These data are NOT population estimates. They should only be used as indications of trends and the presence of a species at a particular site.

Information from State of Hawaii Division of Forestry and Wildlife
1151 Punchbowl St.
Honolulu, HI. 96813

**No data on habitat or weather conditions*

APPENDIX III :

A SURVEY OF FISHING AND OTHER RECREATIONAL ACTIVITY IN THE KE'EHI LAGOON AREA, ON THE SOUTH SHORE OF THE ISLAND OF OAHU

By : Heather Reed and Neil Anthony Sims

A survey of fishing and other recreational activity

in the Keehi Lagoon area,

on the south shore of the island of Oahu.

By : Heather Reed and Neil Anthony Sims

Black Pearls, Inc.
P.O. Box 525, Holualoa, HI 96725
Hawaii, U.S.A.

Date : November 15th, 1999

Abstract

A survey of fishing and other recreational activities was conducted over six months from March to August, 1999. The goal was to assess the possible effects of a proposed Hawaiian black pearl farm in the Reef Runway borrow pit on the existing recreational and subsistence use of the area.

An initial scoping survey of the proposed farm area found two main user groups: those who walked in around the Reef Runway, and those who came in on boats. Those using shore access were fishing exclusively on the reef flat area surrounding the borrow pit. The intensive survey therefore targeted boaters, by using questionnaires at the main ramps in the Keehi Marina/Sand Island area.

Of all boaters interviewed, only 13% frequented the Reef Runway area, and only 2% reported fishing in the borrow pit. These were spearfishermen who presumably work along the edge of the pit. Only one fish was reportedly caught within the borrow pit: a moana (banded goatfish).

These results suggest that use of the deep water area of the borrow pit will not unduly impact recreational activities in the area. Access to the surrounding reef flat should not be constrained, and so an easement for movement of boats and other watercraft should be provided to allow passage from one end of the borrow pit to the other. This could be either along the inside or outside edge of the borrow pit.

.....

Introduction

A survey of fishing activity was conducted at Keehi Lagoon, on the south shore of the island of Oahu, to determine the level of activity in the area, and the potential conflicts between fishing and a proposed pearl farm in the Reef Runway borrow pit area.

The survey consisted of two parts. An initial scoping survey was conducted to determine which types of fishing and other recreational activities were occurring in the borrow pit area, and to allow framing of the more comprehensive survey methodology. This ran over a two month period, from March to April, 1999, and involved observations by individuals using boats and binoculars.

The more comprehensive survey was then run over the summer, from June to August, 1999. This survey addressed the recreational activities in the whole Keehi lagoon area, including identifying the precise locations fished, and activities undertaken by fisherfolk, the usual timing and motivations for fishing, and the interviewees disposition towards more proactive management of recreational activities.

Simultaneously, surveys were conducted of the benthic environment and of fishes in the area. These generally indicated that the Reef Runway borrow pit represents a highly disturbed site, with a depauperate coral and fish fauna on the sides and bottom of the pit. The surrounding reef flat areas contain reasonable abundance and diversity of both corals and fishes, but these would not be impacted by the proposed pearl farm activities in the deep water of the borrow pit.

Materials and methods

The preliminary evaluation of activity at the Reef Runway reef flat and borrow pit areas was conducted by boat, with observers using binoculars to observe and record all activity in the area. The survey was conducted over a three week period, including holidays, weekends and mid-week days. The surveyor used binoculars to observe and record the water activity in the Reef runway area, including number of boats and individuals, and their activity (boating, sunbathing, SCUBA-diving, snorkeling, and fishing – recreational or commercial).

The results from this preliminary survey indicated that the best assessment of fishing activity in the deeper waters of the borrow pit could be obtained by conducting a ramp survey of boats and other watercraft, at the Keehi marina and Sand Island boat ramps. A copy of the initial questionnaire form is provided as Appendix _. The questionnaire was spread over five sections: Effort, Sites, Gear, Catch and Management.

Ramp survey respondents were asked to describe their normal fishing activities, and the range of areas that they covered, rather than to report the gear, activities, or areas fished on that specific day. This was done in an attempt to increase the breadth of coverage by the survey. We recognized that this question format would reduce the accuracy of the results in terms of catch and effort data. Nevertheless, the overpowering concern for this survey, was to measure potential perceived impacts. A survey of actual impacts would have required time and financial resources

far beyond the scope of this effort. Besides, given the nature of fisherfolk's memories, the recollections or perceptions often far exceed the reality. It was considered preferable to err on the side of overestimating impacts, rather than underestimating impacts.

From June 18 to August 1, 1999, fisherfolk and other boaters were surveyed on the ramps on randomly assigned days (including weekends, holidays and weekdays), as they were either launching or returning, or if they were fishing from shore. The ramp and shore were patrolled at both Keehi Marina and Sand Island, from around 8 am to 6 pm on designated days, providing a total of 234 man-hours coverage. Complete coverage on any one day, or any specified number of days was not considered essential, as the interviews were simply intended to provide an indication of the representative types and sites for activities, rather than a measure of total fishing effort. For the same reason, extension of the survey effort beyond the allotted time period was also not considered essential.

Interviewees were told that the survey was not related to any State agency, but was being conducted independently to assess the impacts of changes to the existing fishing access and management regime. This was because of a strong disinclination among interviewees to respond to interviewers until there was emphatic denial that they were State employees. The reasons given for such disinclination centered around a general distrust of government regulation.

Results

The preliminary survey showed that activity in the Reef Runway area usually began around 9:00 am and ended around 2:30 or 3:00 pm. A total of 11 boats were recorded over the five days: four at the inner (northern) reef flat, and seven at the outer (southern) reef flat. All were associated with activities on the reef flat or fishing from the reef edge into the surge channels on the seaward side. No boats were anchored in the deep water. Fourteen people were pole fishing on the reef flat, without using boats. Four of those same people were also collecting limu. Three people were netting on the reef flat, and two divers were fishing for octopus. Two SCUBA divers were observed. These were diving on the inner edge of the borrow pit. In one instance, four jetskis were seen parked on the beach. Eight people were observed walking the beach.

Based on these results, we concluded that most of the use of the area based on shoreline access was confined to the beach or the reef flat. Use of the deeper borrow pit area – the actual site of the pearl farm – was, by necessity, restricted primarily to boats or other watercraft. The ramp survey was therefore designed to assess the extent of boat and watercraft use of the borrow pit area, relative to other areas in Keehi Lagoon.

A total of 160 responses to the ramp survey questionnaire were obtained. Of these, only 21 (13%) reported fishing in the Reef Runway reef flat or reef crest area. Only 3 individuals (2%) reported that they sometimes fished inside the borrow pit. All of the respondents that used the Reef Runway area fished both seasons, summer and winter. 38% fished on weekends at an average of about 6 hours a day. 76% reportedly fished only for recreation, whereas the rest fished for food or money. 23% fished by themselves and the rest fished with two to four other people.

Smaller boats, of around 17ft length were the dominant vessels in use in the Reef Runway area.

Fishing gear used and techniques employed were diverse, with casting rods, gill net, surround net and scoop nets used (Fig. 9). These are typical shallow water and reef fishing gear. The principal target species of fish in the Runway Reef area by rod and reel were palani, (surgeonfish, *Acanthurus dussermerii*), moana (goatfish, *Mulloidichthys* spp), papio (trevally, *Caranx melampygus*, *C. ferdau* and *C. orthogrammus*), and kaku (barracuda, *Sphyraena sphyraena*) (see Fig 4; Table 3). The reported number of fish caught ranged from two to twelve per day.

Moana and papio were reportedly sometimes targeted in the area by bottomfishing, with an average of twelve fish reportedly taken per trip.

Surround-nets and hand nets were used to target aquarium fish including, saddle wrasse (*Halichoeres* spp) moorish idol (*Zanclus cornutus*) bluebox fish (25) and yellow tang (*Zebrasoma flavescens*). Reported catch rates for each species were in the order of 15 – 25 individuals of each per trip, with a total reported around 75 fish per trip.

48% of the reported effort on the reef flat area near the Reef Runway was from gillnets and drive nets, which were used to target weke (striped goatfish, *Parupeneus samoaensis*) and manini, (convict tang, *Acanthurus triostegis*) papio, and mullet (probably *Mugil cephalus)*. Hand spears and Hawaiian slings were used on the reef flat to catch manini, palani, and octopus.

The three individuals who reported occasionally fishing in the borrow pit used slings and hand spears. However, reef fish are only found in any numbers on the rock and coral sides of the borrow pit. As there are almost no reef fish found in the silty-bottom, deeper part of the borrow pit, it is unlikely that these fishermen were diving in the deeper water.

Only one fish was reported as being caught in the borrow pit area: a moana (banded goatfish, *Mulloidichthys* spp).

Outside of the Reef Runway reef, area, the principal gear type used was trolling rods, targeting offshore species (Tables 2 and 4, Fig. 2). Reports indicated average catches of two skipjack tuna (aku, *Katsuwonus pelamis*) per trip.

In answer to questions on the management of the fishery and the area, most respondents identified their major complaint as being simply not enough fish. Other complaints expressed by respondents were inadequate enforcement of fishing regulations, overfishing of baitfish resources by aku boats, excessive collection of limu (seaweed) near the Reef Runway, pollution from Honolulu Harbor and sewage outfalls, and excessive noise from planes, jetskis and boats. A number of respondents identified exclusion from areas as being a problem, but these were almost universally shore fishermen who resented not being allowed to fish from the Keehi pier.

None of the management strategies proposed by the interviewers were well received. The idea of establishing permanent reserve areas was supported by 41% of respondents. Only the notion of size-limits was supported by a majority of respondents (59%). Although the shortage of fish was considered the major problem, only a bare majority (51%) approved the proposition of fishing

licenses being used to support fish restocking programs. Most respondents expressed distrust of government licensing programs, and stated that they thought the funds would not be used properly.

Discussion and conclusions

Although there is heavy recreational and subsistence fishing activity on the reef flat area on the south side (oceanward) of the Reef Runway there is negligible fishing activity in the deeper waters of the borrow pit. If a pearl farm were to be located in the area, it should not restrict access to the surrounding reef flat. Excluding access to the deeper areas, with silty bottom, would not seem to have a great impact on fishing and other recreational pursuits.

Shoreline access, around the rim of the Reef Runway, should not be constrained by the pearl farm. Some means of boat access to the reef flat area should also be provided, to allow fisherfolk to bring boats in to the reef area. Unrestricted boat movement through a pearl farm area is highly dangerous for both the vessel itself (which may hit floating lines or buoys) or for the farm workers (who may be snorkelling around the lines). However, given the heavy use of the reef flat area, some form of easement should be provided to allow boats and jet skis to move the full length of the borrow pit. This could be along the length of either the inner (northern) rim, or the outer (southern) rim of the borrow pit.

.....

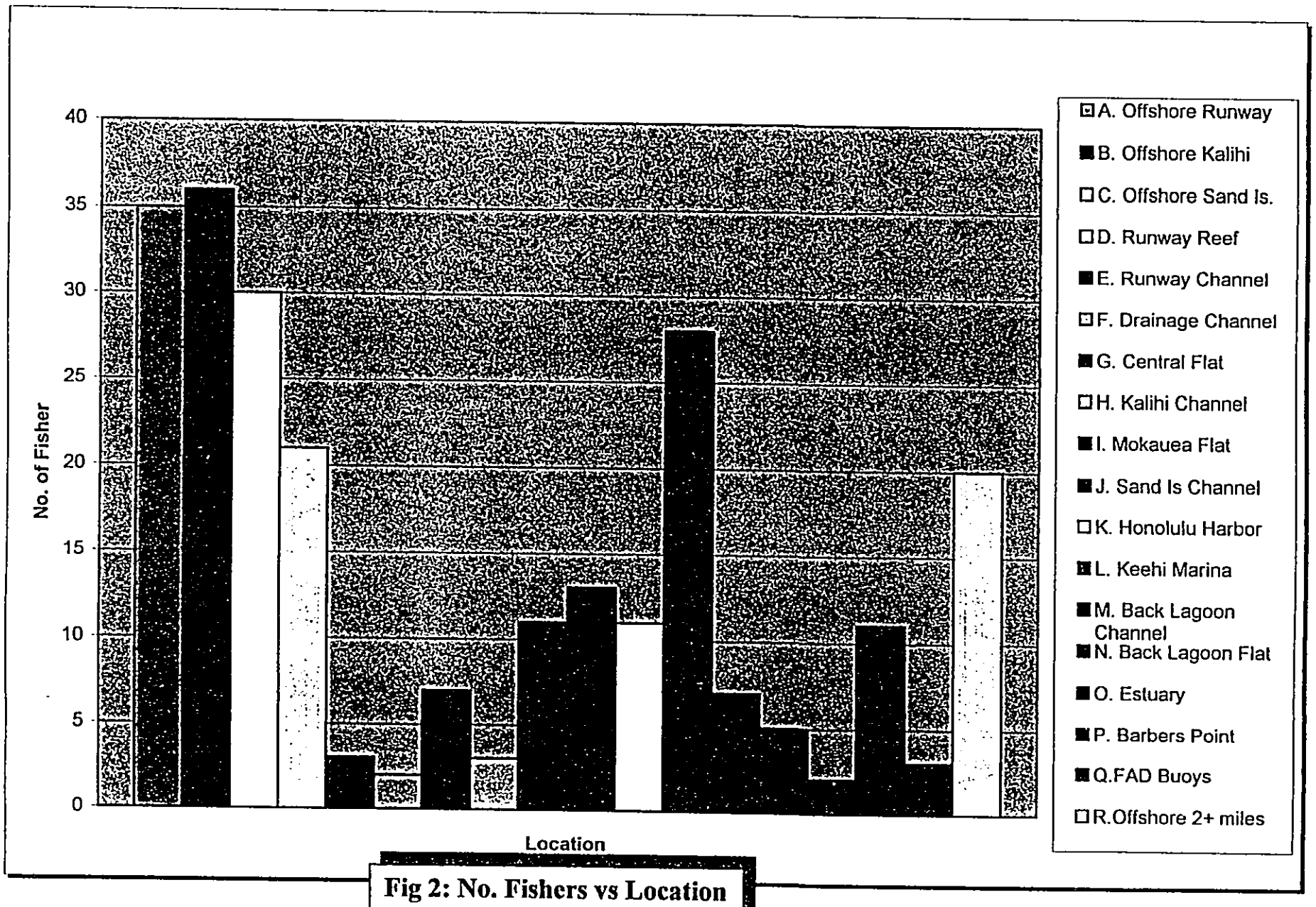


Fig 2: No. Fishers vs Location

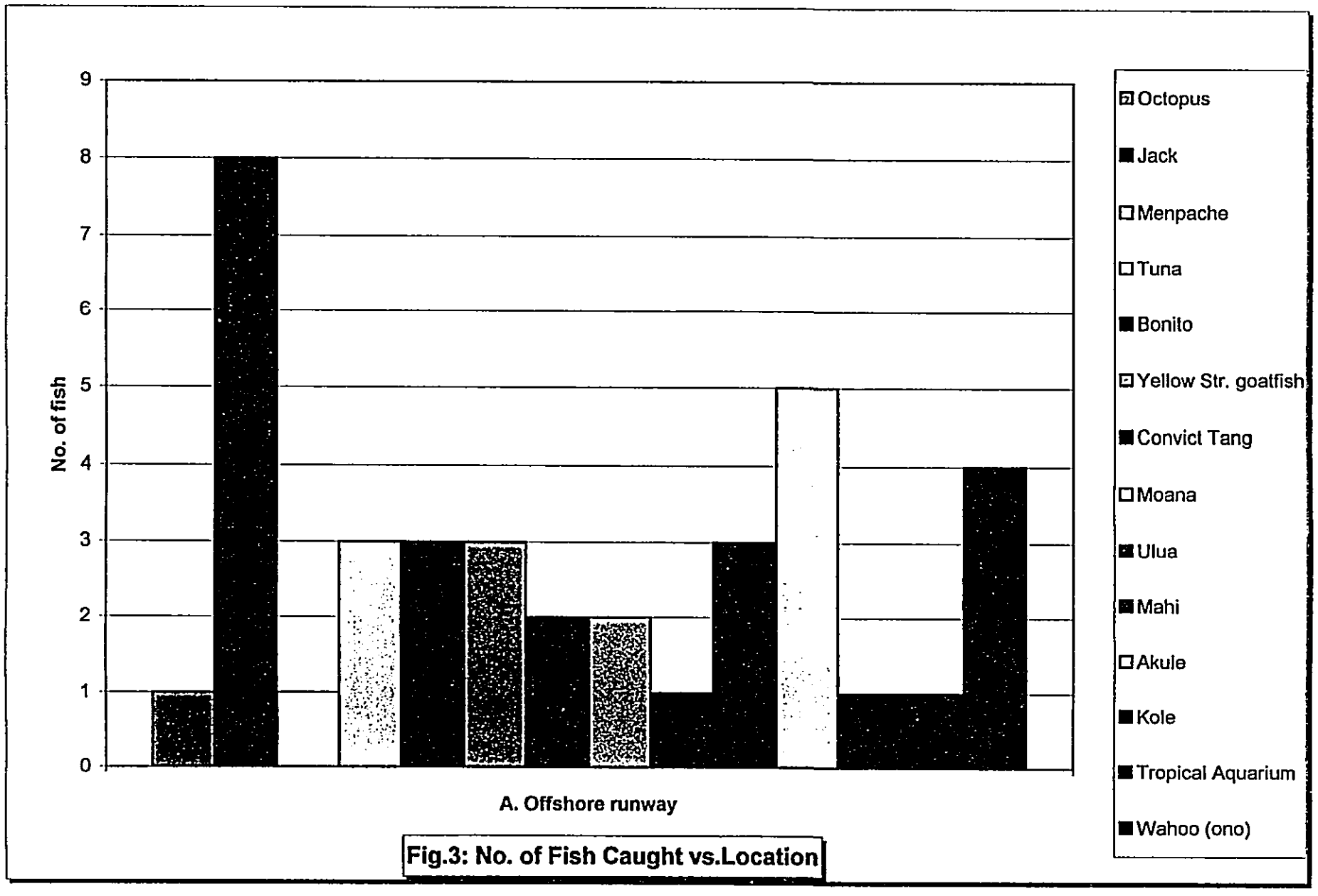
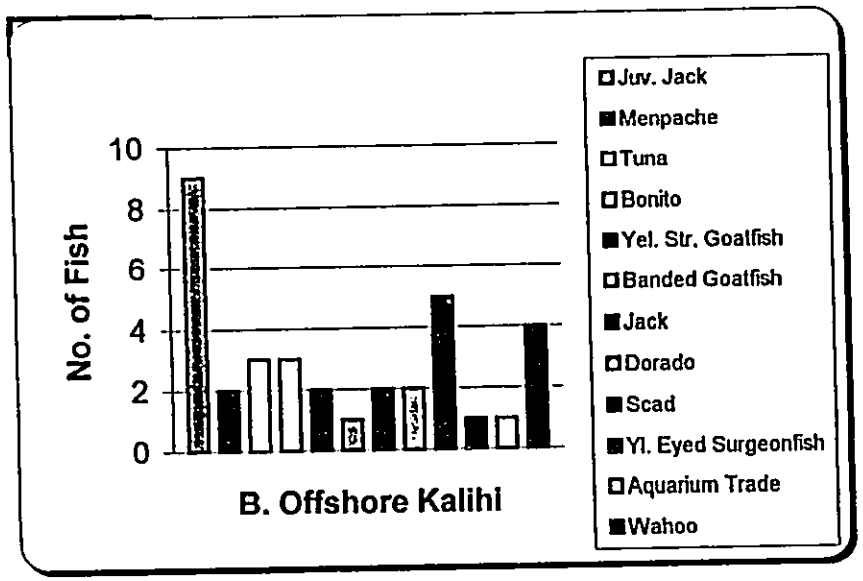
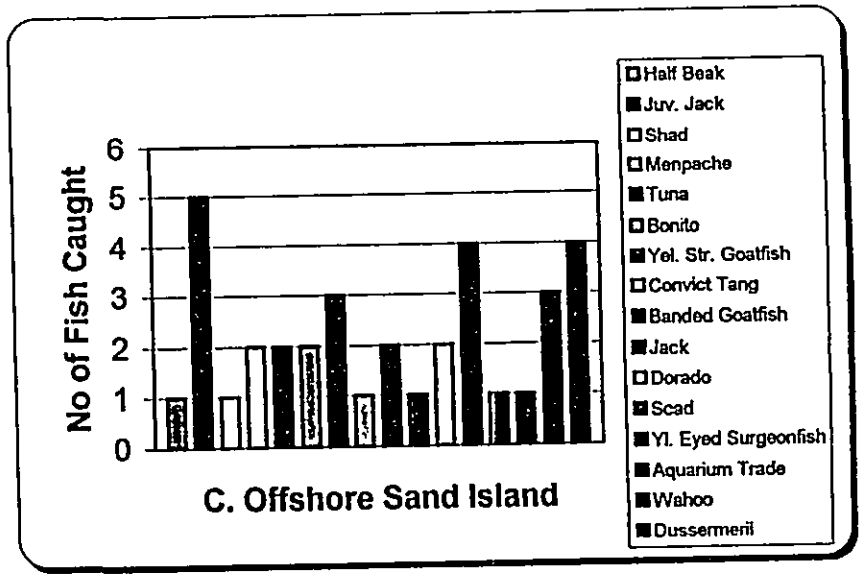
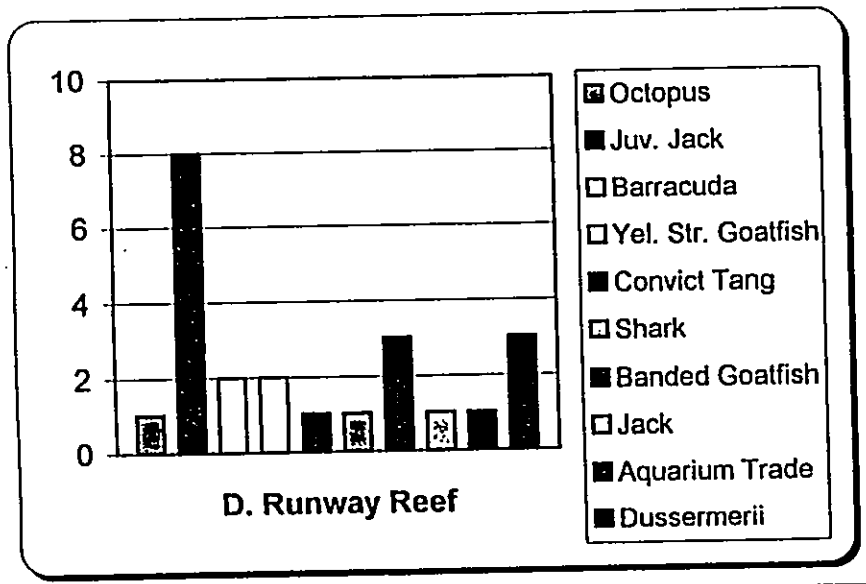


Fig.3: No. of Fish Caught vs.Location







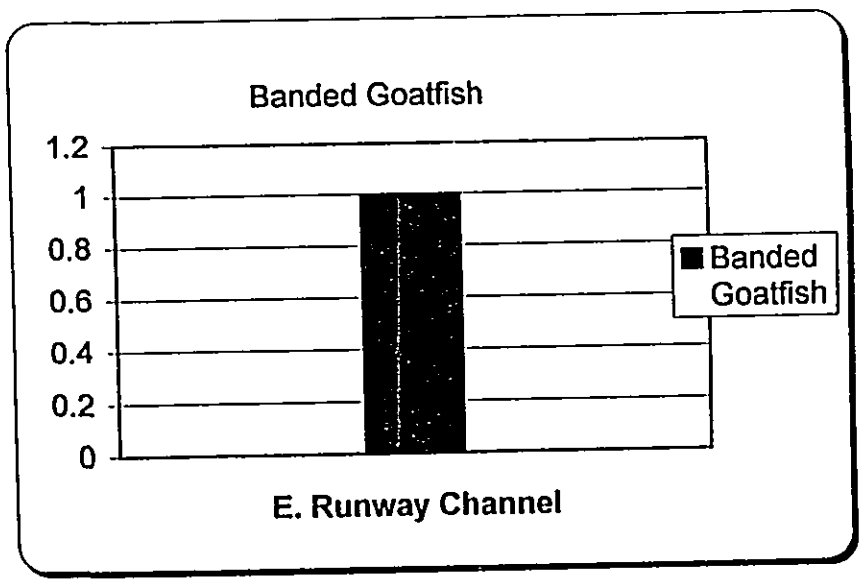
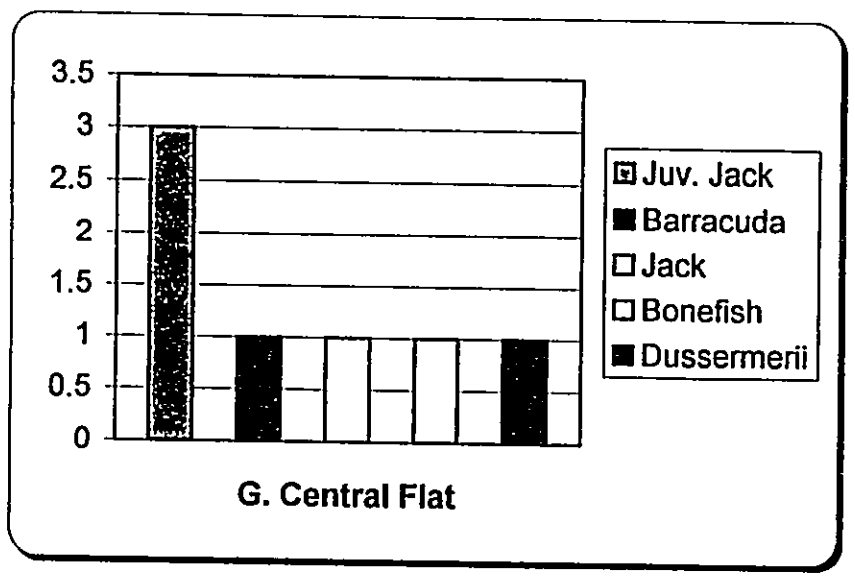
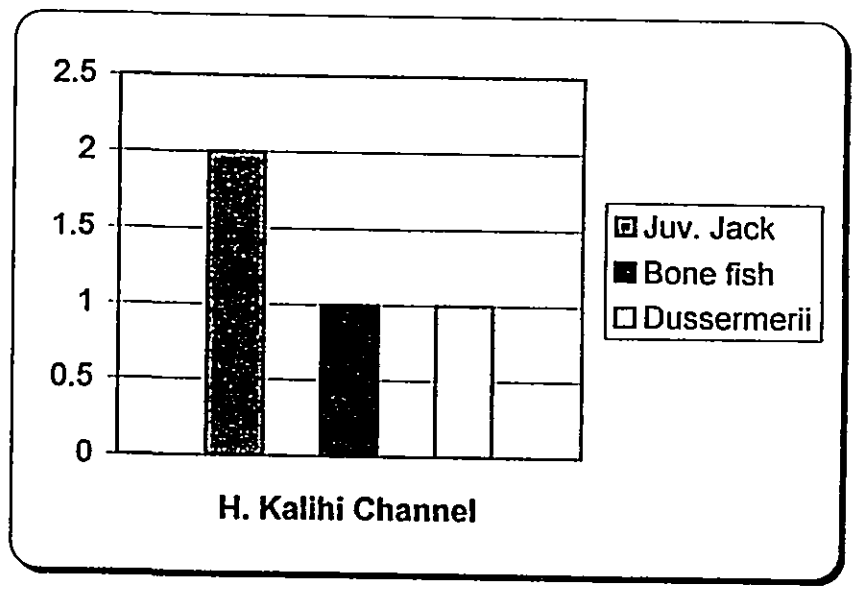


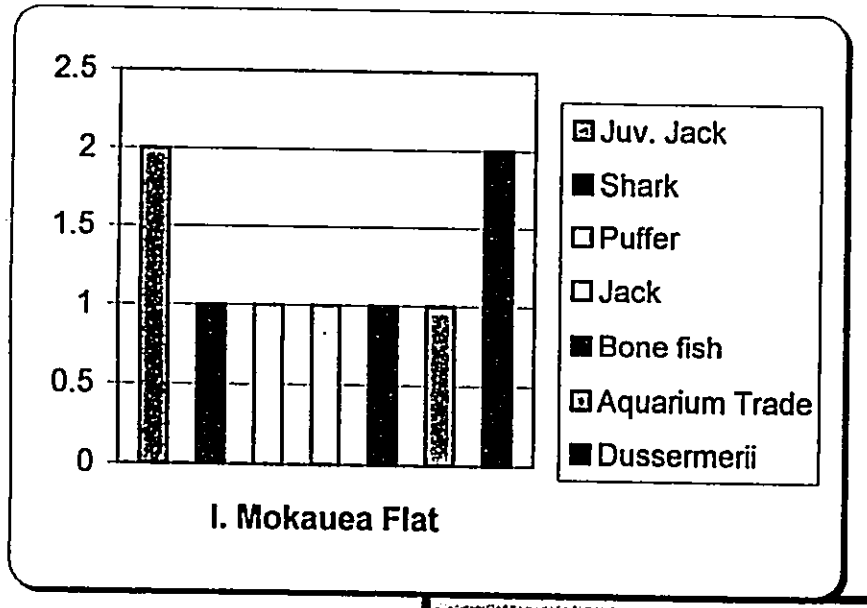
Fig 4: No of Fish Caught vs Location



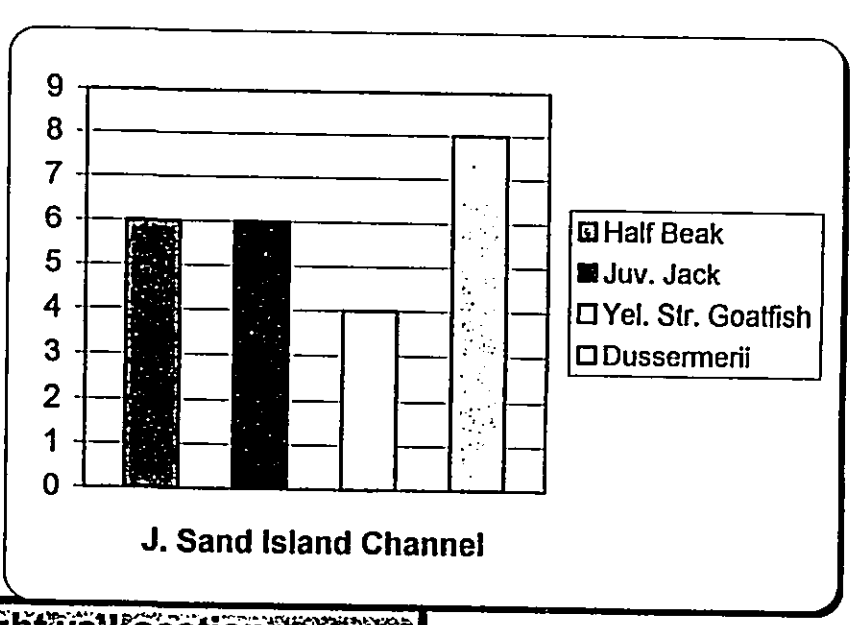
G. Central Flat



H. Kalihi Channel

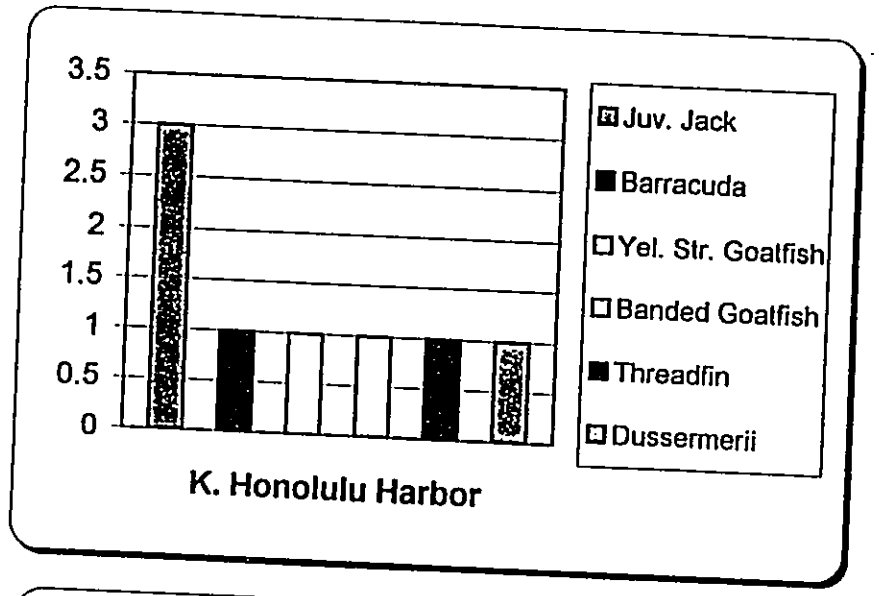


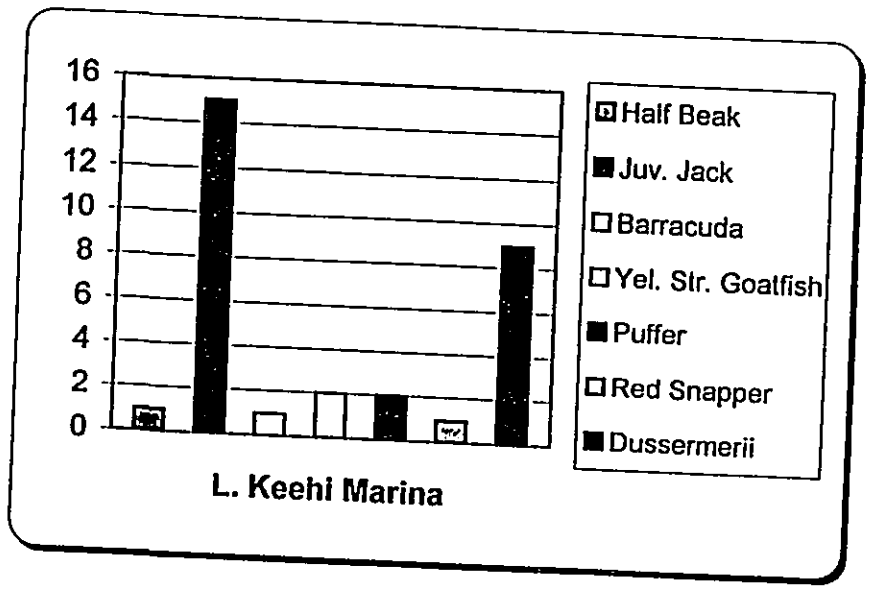
I. Mokauea Flat

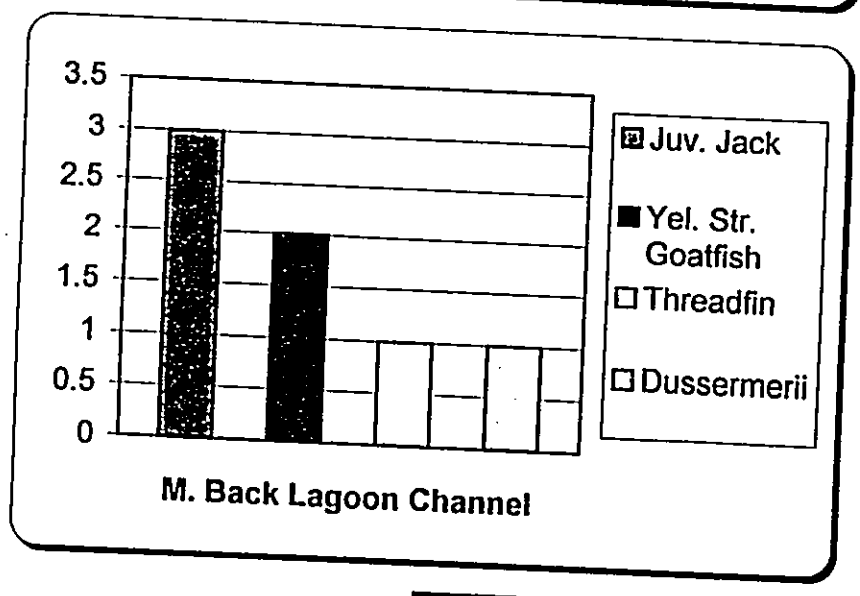


J. Sand Island Channel

Fig 5: No of Fish Caught vs Location







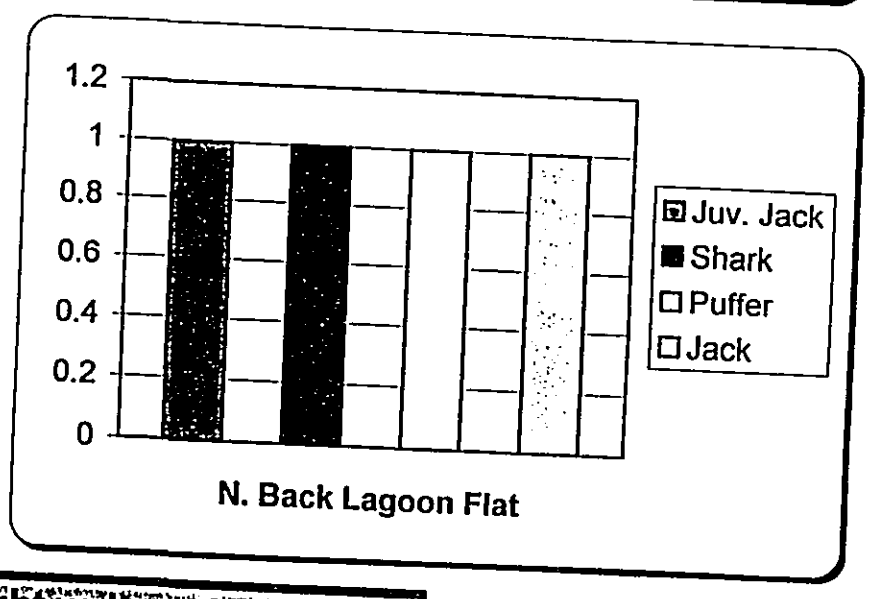
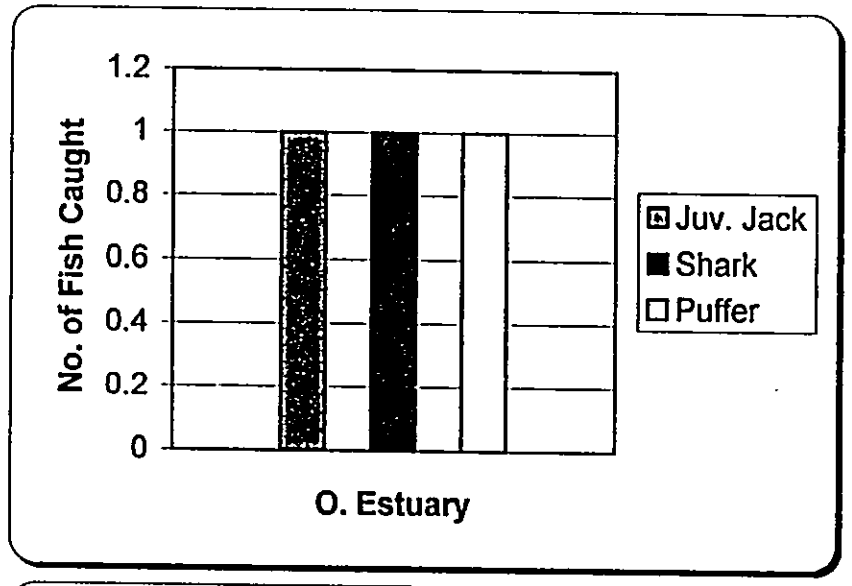
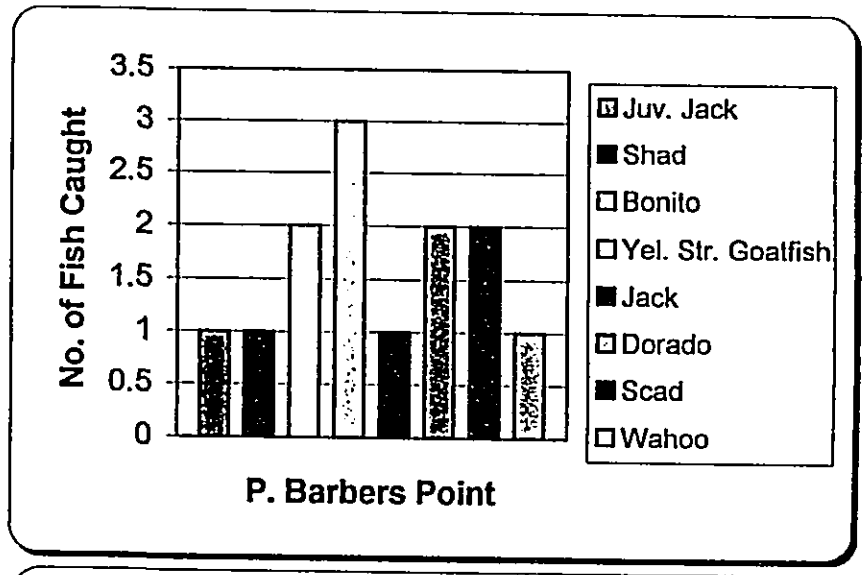
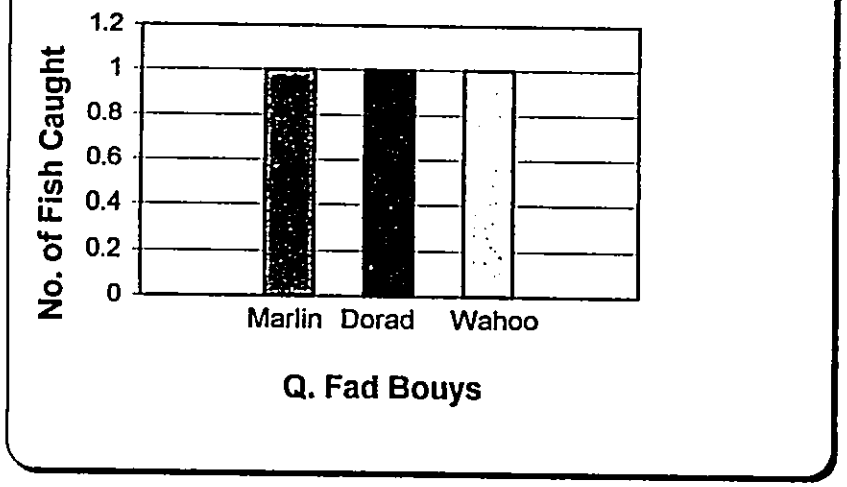


Fig 6: No of Fish Caught vs Location







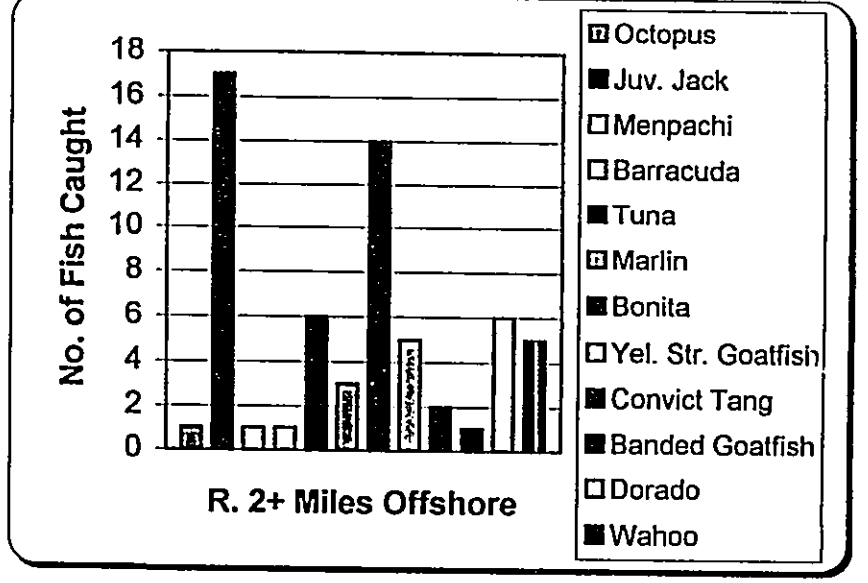


Fig 7: No of Fish Caught vs Location

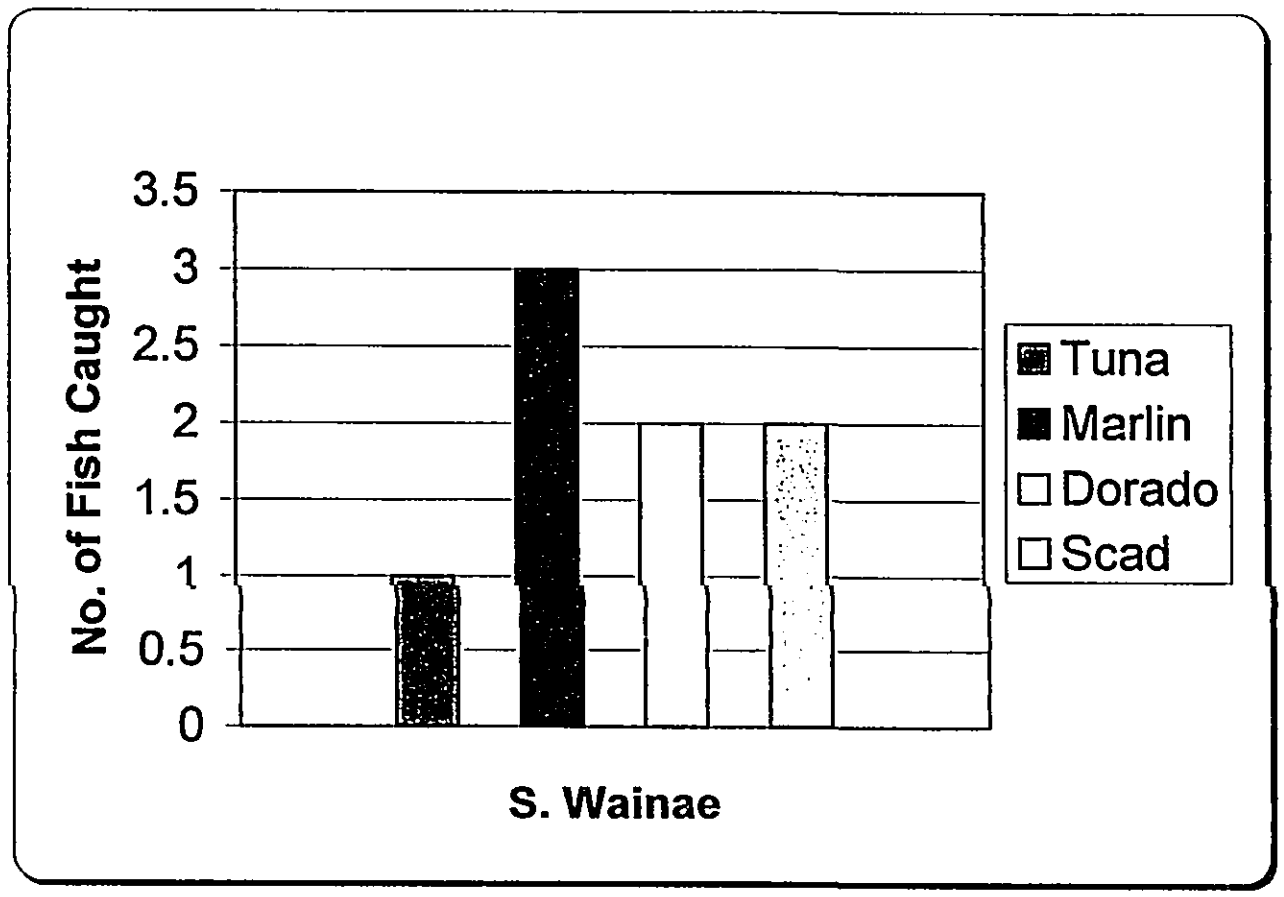


Fig 8: No of Fish Caught vs Location

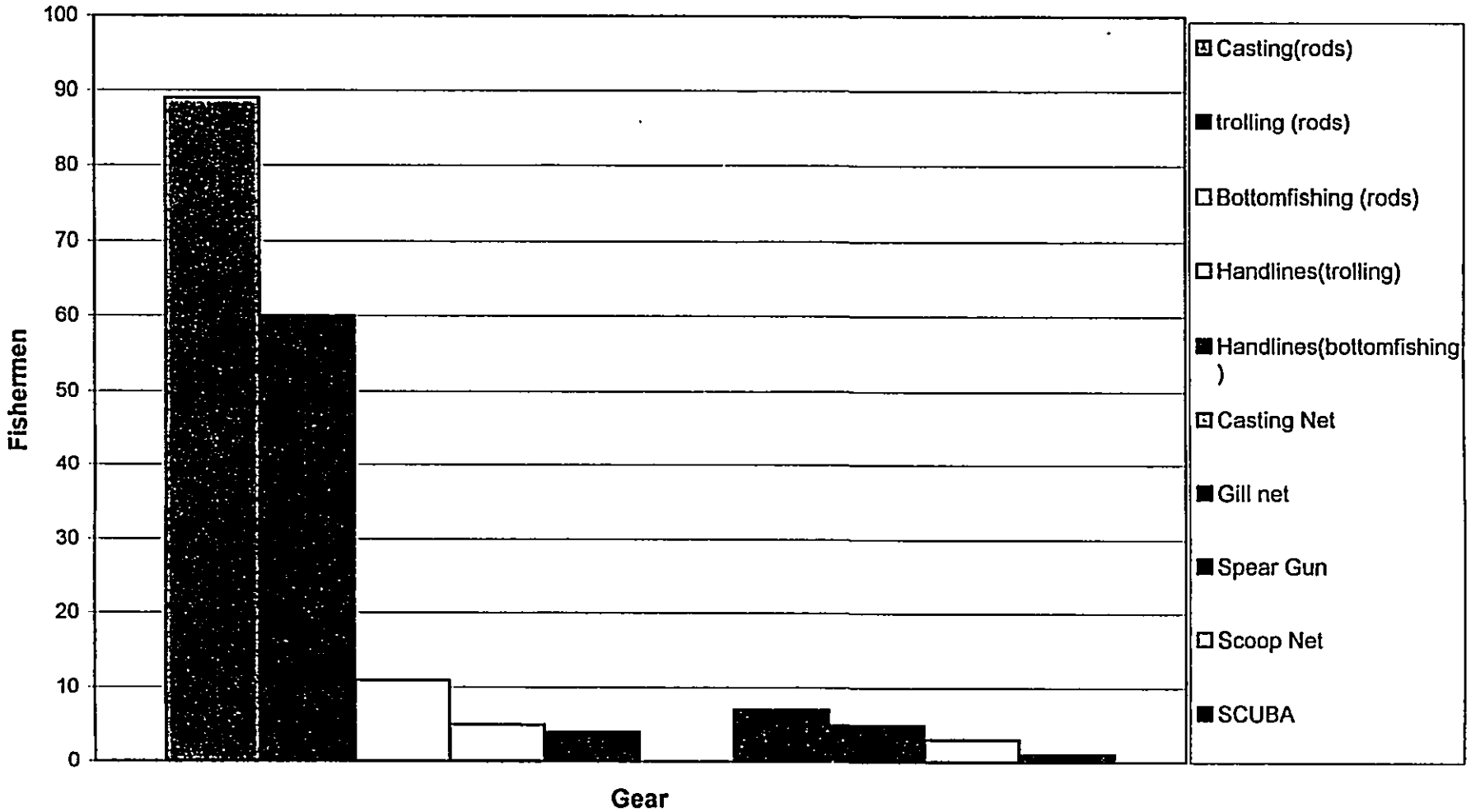


Fig. 9: Gear Used

Table 1 Section Data

1.0 Effort

	Total	Average
Boater Departing	45	28
Boater Returning	51	32
Fisher at Marina or Beach	64	40
Summer	46	29
Winter	2	1
Both Sum/Win	112	70
Everyday	6	4
few days	24	15
week	41	26
monthly	36	23
less than each month	33	21
Weekdays	33	21
weekends	58	36
both	51	32
Hrs	838	524

5.0 Management Section

In favor of:	Total No.	Average%
Sizelimits	95	59
Baglimits	76	48
Closed Seasons	71	44
Reserve areas	66	41
Fishing License for Restocking		
Yes	81	51
No	39	24
Depends	40	25

3.2 Gear

Type of Gear	Total No.
Rods(casting)	89
Rods(trolling)	60
Rods(bottom)	11
Handlines(trolling)	5
Handlines(bottom)	4
Casting net	0
Surround Net	7
Gill net(set)	7
Spear gun	5
Scoop nets	3
Traps	1
Hand spear/sling	14
Fence net	1
SCUBA	1

Calculations:

Total sum of column. =sum(x1:x160)

The Average was based on sixty surveys. =(x1/160)*100

2.1 Survey Locations

Table 2. Sites Surveyed

Site Surveyed	Total no. of Fishers	Percentage of Fishers
A. Offshore Runway	35	22
B. Offshore Kahili	36	23
C. Offshore Sand Island	30	19
D. Runway Reef	21	13
E. Runway Reef Channel	3	2
F. Drainage Channel	2	1
G. Central Flat	7	4
H. Kalihi Channel	3	2
I. Mokauea Flat	11	7
J. Sand Is Channel	13	8
K. Honolulu Harbor	11	7
L. Keehi Marina	28	18
M. Back Lagoon Channel	7	4
N. Back Lagoon Flat	5	3
O. Estuary	2	1
P. Barbers Point	11	7
Q. FAD Buoys	3	2
R. 2+ Miles Offshore	20	13
S. Wainae	3	2

Table 3: Type of Fish Caught

Common Name	Hawaiian	Total	Average
Half Beak	Iheihe	3	2
Octopus	Tako	6	4
Jack	Papio	63	39
Shad	Opelu	2	1
Soldier Fish	Menpache	6	4
Barracuda	Kaku	7	4
Tuna	Ahi	10	6
Marlin	Au	7	4
Bonito	Aku	18	11
Yel. Str. Goatfish	Weke	20	13
Convict Tang	Manini	5	3
Shark	Mano	3	2
Puffer	Pu'u-ola'I	4	3
BandedGoatfish	Moana	10	6
Jack	Ulua	4	3
Dolphin	Mahi	15	9
Scad	Akule	8	5
Red Snapper	Opakapaka	1	1
Yl. Eyed Surgeonfish	Kole	2	1
Bone fish	Oieo	6	4
Aquarium Fish	Tropical	2	1
Wahoo	Ono	14	9
Threadfin	Moi	2	1
Dussermerii	Palani	24	15

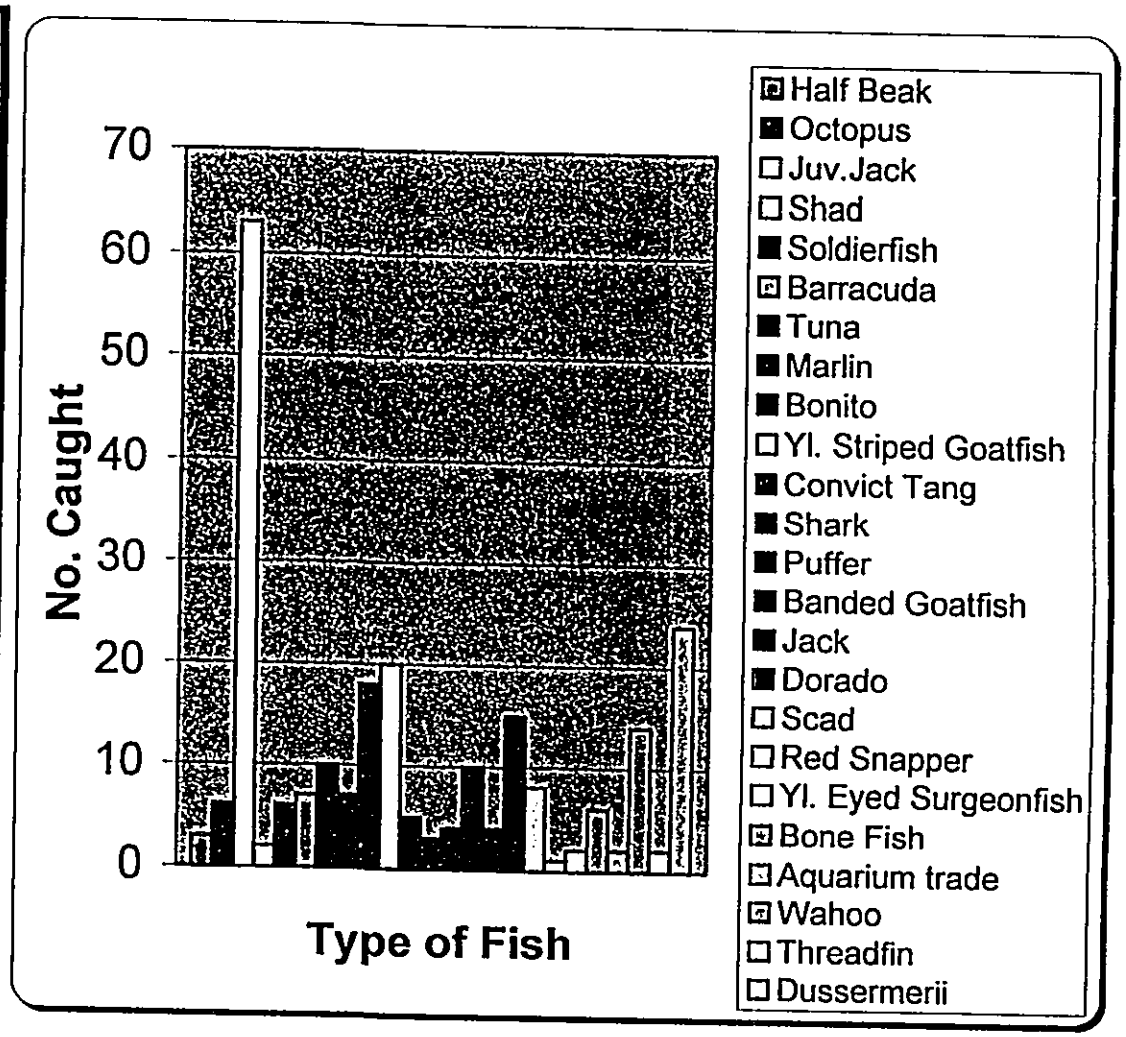


Table 4: Catch vs Location

Common Name	Hawaiian Name	A.	B.	C.	D.	E.	F.	G	H.	I.	J.	K.	L.	M.	N.	O.	P.	Q.	R.	S.
Half Beak				1							1		1							
Octopus	Tako	1			1														1	
Jack	Papio	8	9	5	8			3	2	2	6	3	15	3	1	1	1		17	
Shad	Opelu			1													1			
Solidier Fish	Menpache	1	2	2															1	
Barracuda	Kaku				2			1				1	1						1	
Tuna	Ahi	3	3	2															6	1
Marlin	Au																	1	3	3
Bonito	Aku	3	3	2													2		14	
Yel. Str. Goatfish	Weke	3	2	3	2						4	1	2	2			3		5	
Convict Tang	Manini	2		1	1														2	
Shark	Mano				1					1					1	1				
Puffer	Pu'u-ola'I									1			2		1	1				
BandedGoatfish	Moana	2	1	2	3	1						1							1	
Jack	Ulua	1	2	1	1			1		1					1		1			
Dolphin	Mahi	3	2	2													2	1	6	2
Scad	Akule	5	5	4													2	0	0	2
Red Snapper	Opakapaka												1							
Yl. Eyed Surgeonfish	Kole	1	1	1																
Bone fish	Oieo							1	1	1										
Aquarium Trade	Tropical	1	1	1	1					1										
Wahoo	Ono	4	4	3													1	1	5	3
Threadfin	Moi											1		1						
Dussermerii	Palani			4	3			1	1	2	8	1	9	1					7	

Appendix I: Preliminary Survey

Location:
Reef Name:
Time:
Depth:
Collector

Date:
Reef zone:
Wind speed:
% Cloud cover:
Lattitude/Longitude

Type of Observation	# of Observations		Notes
Aquarium Fish Collecting			
Boating Activity: Anchoring, anchor damage ____	# boats		
Kayaks ____	#boats		
Canoes ____	# boat		
Thrillcraft Activity ____	# boats		
Fishing Activity:	# groups	# individuals	
Pole and line ____	____	____	
Trolling ____	____	____	
Gillnetting ____	____	____	
Trapping			
Marine debris: Type:	amount		
SCUBA activity:	# groups	# individuals	
Recreational ____	____	____	
Commercial tours ____	____	____	
Spearfishing ____	____	____	
Snorkeling activity:	# groups	# individuals	
Recreational ____	____	____	
Commercial tours ____	____	____	
Spearfishing ____	____	____	

Appendix II-1999 Survey

KEEHI LAGOON / SAND ISLAND FISHING SURVEY QUESTIONNAIRE

Interviewer : _____ Date : ___ / ___ / 99 Time: _____am/pm
Age: _____
BOAT AT RAMP – departing / returning OR FISHERPERSON ON WHARF/BEACH

1. EFFORT

1.1 How often do you come fishing in the Keehi/Sand Island area?
SUMMER every day / few days / week / month or so / less than each month
WINTER every day / few days / week / month or so / less than each month

1.2 Which days do you usually fish? Weekdays / Weekend / Both?

1.3 How long is your average fishing trip, in hours? _____ hours

1.4 What's the main goal for you when you go fishing : (Rank : 1, 2, 3)
a. Food _____
b. Recreation _____
c. Money _____

1.5 How many people usually go fishing with you? Yourself + _____

2. SITES

2.1 Where do you like to go fishing? (Refer to map).
Rank from 0 = Never go fishing there, 1 = sometimes, 2 = often, 3 = Always go to this spot.
Draw on map to clarify, if necessary :

A. Offshore Runway _____
B. Offshore Kalihi _____
C. Offshore Sand Is. _____
D. Runway Reef _____
E. Runway Channel _____
F. Drainage Channel _____
G. Central Flat _____
H. Kalihi Channel _____
I. Mokauea Flat _____
J. Sand Is Channel _____
K. Honolulu Harbor _____
L. Keehi Marina _____
M. Back-lagoon Channel _____
N. Back-lagoon Flat _____
O. Estuary _____

3. GEAR

3.1 If you fish from a boat, please describe : Hull type/make _____
Size (ft) _____ Motor (hp) _____ Trailer/cartop/moored

If you fish from shore, how do you get there : Drive/walk/bicycle/public transport? (circle one)

3.2 What kinds of gear, and numbers, for present trip? (Interviewer fill out)

GEAR TYPE	NUMBER		
Rods (casting)		Handlines (bottom-fishing)	
Rods (trolling)		Casting net	
Rods (bottom-fishing)		Surround net	
Handlines (trolling)		Gill net (set net)	
		Spear gun	
		Hand spear / sling	

Is this what you usually use? More / Less / Same : _____

4. CATCH

4.1 List types of fish that you usually catch on a fishing trip
(indicate approximate numbers, averaged out over your last three fishing trips)

FISH NAME(S)	AVG NUMBER
_____	_____
_____	_____
_____	_____

4.2 Do you ever sell your catch? _____

5. MANAGEMENT

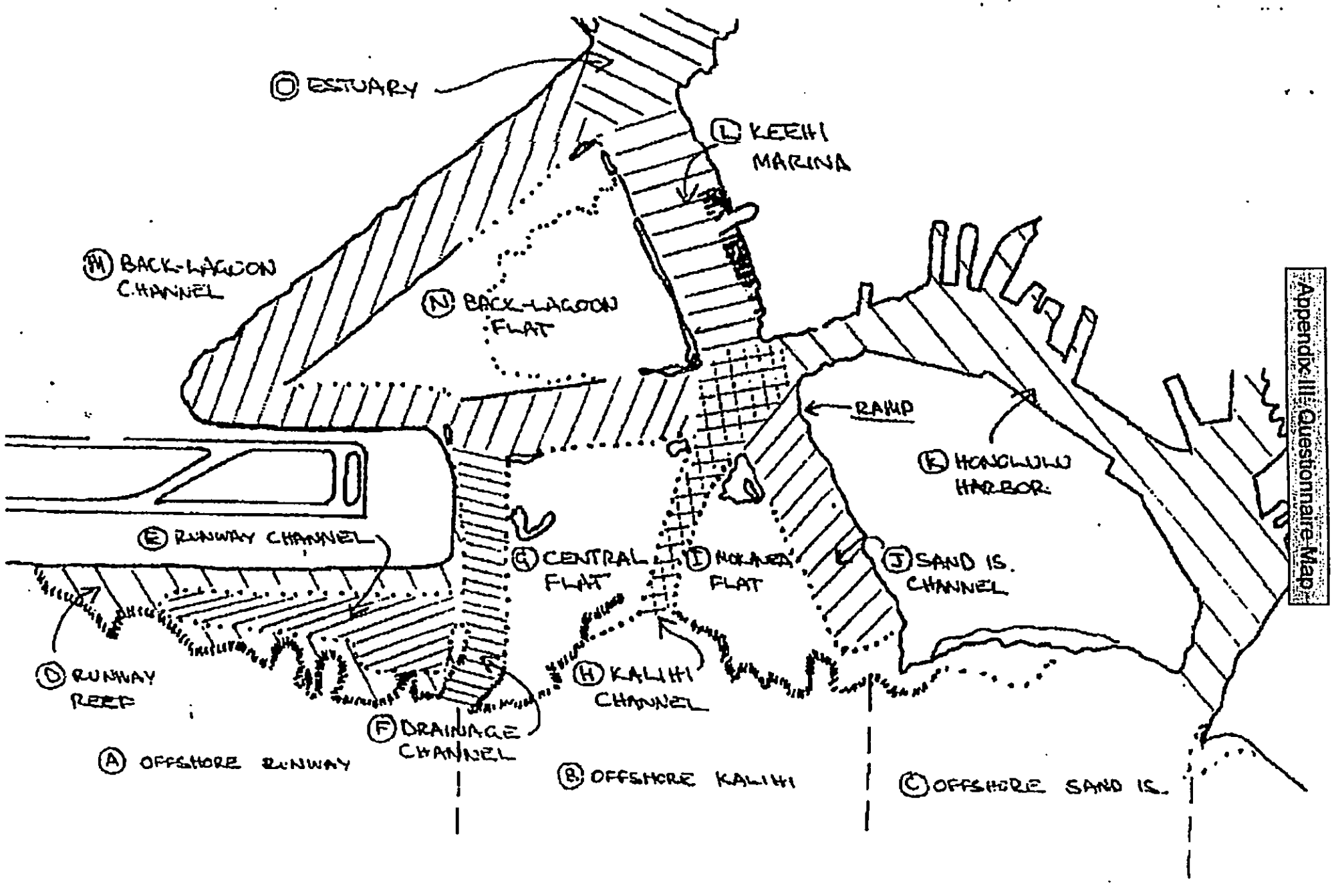
5.1 Do you think that something needs to be done to improve fishing in the Keehi/Sand Island area? Circle which ones :

Size limits (minimum size limits for each species)
Bag limits (limited number per person per day)
Closed seasons (periodic closure of some or all of the area to fishing)
Reserve areas (some areas set aside for no fishing)

5.2 Scientists can now use hatcheries to stock fishing areas with young papio, mullet, moi, etc, like they do for trout in the mainland. Would you be happy to pay for a fishing license if the money was used for this purpose? Y = Yes, N = No _____

5.3 What other problems do you see in the use of the Keehi lagoon area ? Circle which ones :

Too many boats
Too many jet skis and other recreational water craft
Too many tour operators or other commercial users
People living on boats and islets
Pollution from harbor
Pollution from sewage
Noise from airplanes
Too many people fishing
Not enough area available for fishing
Bans on fishing in some areas
Not enough fish
Other _____



APPENDIX IV :

A VISUAL CENSUS OF FISHES FOUND IN THE REEF RUNWAY BORROW PIT, AND SURROUNDING AREAS OF KEEHI LAGOON AREA

By : Darby Irons and Neil Anthony Sims

A visual census of fishes found in

the Reef Runway Borrow Pit,

and surrounding areas of Keehi Lagoon area,

By : Darby Irons[(1)] and Neil Anthony Sims[(2)]

(1) : C/- University of Hawaii, Zoology Department
P.O. Box 6898 Kamuela, HI 96743

(2) : Black Pearls, Inc., P.O. Box 525, Holualoa, HI 96725, Hawaii, U.S.A.

Date : December 1st, 1999

Abstract

Visual census transects were used to assess the abundance and diversity of fishes in the Reef Runway borrow pit of Keehi Lagoon. Generally the fish fauna of the area is depauperate, reflecting both the disturbed nature of the site and the fishing pressure in the Keehi lagoon area.

Fish were both most common and most abundant on the seaward areas, along the reef flat and on the slope of the borrow pit. Fish were less abundant on the inshore reef flat and slope. Only one fish was found in the three transects located in the deep, silt-covered bottom of the borrow pit.

A pearl farm has been proposed for the deep water areas of the borrow pit. This would probably have benefits for the fish fauna on the adjacent reef flats. The three-dimensional structure of the pearl farm would increase recruitment to the area. As these fish mature, they would then migrate onto the nearby reef flat.

.....

Introduction

A series of visual census transects were set out for surveying the resident fish population of the Reef Runway borrow pit and surrounding areas. These surveys were intended to assess the impacts of a proposed pearl farm in the deeper waters of the borrow pit.

Given the limited resources available, a single "snapshot" survey was considered valid. No attempt was made at assessing the transient fish population or other fish movement through the area, which would have required extensive surveys over several years, using extractive sampling techniques.

The survey was conducted in August, 1999, and complemented the ramp survey of fishing boats and other recreational water craft in Keehi Lagoon.

Materials and methods

An initial reconnaissance of the area indicated that the fish stocks were highly stratified with depth. The visual census transects were therefore laid out within three depth strata, that corresponded to the three main topographical features :

- the reef flat surrounding the borrow pit, with an average depth of around 1 m, and primarily consisting of hard substrate
- the reef slope, along the dredged sides of the borrow pit, with an average transect depth of around 6 m, consisting of hard substrate with some patches of fine silt, and
- the basin bottom, around 15 m deep, consisting entirely of fine silt.

A total of eleven transects were surveyed; four each on the reef flat and the reef slope, and three in the basin bottom (Figure 1). Standard visual census techniques were employed. A 100 foot long (30 m) transect line was laid in an East-West direction, and a diver worked along the line counting all fish visible within 3 m (10 feet) of each side of the line, including the water column.

Visibility varied with depth. In the basin bottom, visibility was limited to only around 1 m (3 ft), because of the heavy silt loading in the water. On the reef slope, visibility improved to around 3 m (10 ft), with visibility over 6 m (20 ft) on the reef flat. All dives were conducted by Darby Irons.

Results

The species list of fish encountered during the survey (Table 1) is typical of disturbed reef sites in Hawaiian waters.

Only one individual fish, a *Upeneus arge*, or Bandtail goatfish, was observed in the three transects along the basin bottom. This correlates with the lack of any hard substrate in the area. There were no algae or invertebrates available in the fine silt on the basin bottom to provide any food or cover for any fish.

There was an obvious pattern of greatest abundance and diversity of fish fauna on the seaward reef flat and reef slope (T4, T5, T10 and T11) along the south side of the borrow pit. A total count of 104 fish occurred in these transects, representing 93% of the total of 112 fish encountered during the survey. This is also the area with the greatest wave-driven water movement (Miles Anderson, pers. comm.), and the highest cover and abundance of corals (Ku'ulei Rogers, pers. comm.).

The inshore transects (T6, T7, T8 and T9) along the northern rim of the borrow pit had both the lowest abundance and diversity, with a total of only five different species, and seven individuals found in the four transects in this area.

Discussion and conclusions

The fish fauna in this area is typical of a highly disturbed inshore Hawaiian reef area. The fish abundance and diversity are affected by the past history of disturbance by dredging, the scarcity of coral fauna, the soft substrate on the bottom of the borrow pit, and the pattern of water movement over the reef crest.

The scarcity of fish in the deep water of the borrow pit implies that the occupation of this water by a commercial pearl farm would not greatly impact present fishing activities. This corroborates other work assessing the patterns of fishing activity in the area, which showed that almost all fishing effort is directed at the reef flat area.

The lack of three-dimensional substrate in the area probably means that there is little recruitment to the reef flat and slopes surrounding the borrow pit. The presence of the oyster lines suspended in the water column would therefore have potential to increase fish recruitment to the area. Larval fish coming over the reef into the borrow pit would remain in around the pearl farm, feeding off the algae and invertebrates which grow on the oysters. As these fish grow, they would begin to move out onto the adjacent reef flat, where they would become available to fishermen.

.....

TABLE 1 : VISUAL CENSUS SURVEY RESULTS FROM TRANSECTS T1 - T11

		TRANSECT	T5	T11	T7	T9	T4	T10	T6	T8	T1	T2	T3
		DEPTH ZONE	Reef		Flat		Reef		Slope		Basin Bottom		
		INSHORE / SEAWARD	SEAWARD		INSHORE		SEAWARD		INSHORE				
		DEPTH (m)	1	1	1	1	6	6	6	6	15	15	15
Family	**Species Name**	**Common Name**											
ACANTHURIDAE	Acanthurus blochii	Ringtail surgeonfish		2			5	6					
(Surgeonfishes)	Acanthurus dussumieri	Eyestrip surgeonfish			1			1					
	Acanthurus leucopareius	Whitebar surgeonfish					2						
	Acanthurus olivaceus	Orangeband surgeonfish					1						
	Acanthurus triostegus	Convict surgeonfish	2	1			3						
	Ctenochaetus strigosis	Goldring surgeonfish	4				6						
	Zanclus cornutus	Moorish idol					26						
	Zebrasoma flavescens	Yellow tang					6						
LABRIDAE	Stethojulis balteata	Belted wrasse	2	3									
(Wrasses)	Thalassoma purpureum	Surge wrasse			2								
	Thalossoma duperrey	Saddle wrasse	2										
MULLIDAE	Parupeneus multifasciatus	Manybar goatfish					3						1
(Goatfishes)	Upeneus arge	Bandtail goatfish											
POMACENTRIDAE	Dascyllus albisella	Hawaiian dascyllus							1				
(Damselfishes)	Plectroglyphidodon johnstonianus	Blue-eye damselfish	1										
	Plectroglyphidodon sindonis	Rock damselfish	1										
OTHERS	Canthigaster jactator	Hawaiian whitespotted toby			1			1		1			
	Chaetodon miliaris	Milletseed butterflyfish					2						
	Diodon hystrix	Porcupinefish					1			1			
	Enchelynassa canina	Viper moray					1						
	Scarus psittacus	Palenose parrotfish	12	10									
NUMBER OF SPECIES (Diversity)			7	4	3	0	11	3	1	2	0	0	1
TOTAL ALL INDIVIDUALS (Abundance)			24	16	4	0	56	8	1	2	0	0	1

Fish census 99.123

APPENDIX V :

EVALUATION OF ALTERNATIVE PEARL FARM SITES

By : Black Pearls, Inc.

APPENDIX V : EVALUATION OF ALTERNATIVE PEARL FARM SITES

1. Kealakekua Bay, Hawaii Island

Although excellent growth and survival of adults, the juveniles are subject to heavy snail infestations and fish predation. There is an extensive area available in the 90 – 150 ft depth range inside the Bay, but a large proportion of the more protected area is part of the MLCD. The remainder of the Bay is exposed to winter ocean swells. The area has great recreational, historical and cultural significance. Any exclusive lease would face considerable opposition from current user-groups.

2. Haleolono Harbor, Molokai

Good stock abundance is reported from Molokai's south reef, but this was not confirmed by our survey work. Both oysters and spat showed excellent growth and survival. The Harbor is reasonably well protected from winter swells, but is exposed to south swells in summer.

Although the site is remote, road access through the Molokai Ranch land is possible. The Ranch management was approached, but was not interested in involvement in a commercial venture. There is presently a privately-held non-exclusive lease over the harbor area. The Harbor is increasingly used for recreational purposes by residents, and is the site for the start of the annual Molokai Channel canoe race.

Without Ranch support, this site was considered unworkable.

3. Midway Atoll National Wildlife Refuge

Oysters held in the harbor at Midway showed very good growth and survival. The water in this sheltered area is quite turbid. Waters outside the harbor are less turbid, and are exposed to heavy scouring by the winter swells. In spite of its remoteness, the area would have presented some advantages: security concerns would be greatly reduced, and its proximity to Pearl and Hermes Reef meant that stock replenishment efforts might have significant benefits there.

In early visits to the site (beginning in 1994), BPI initiated informal discussions with Fish and Wildlife staff, who seemed receptive to the idea of using a section of the boat harbor for a stock enhancement and commercial pearl farming project. USFWS discouraged any consideration of siting a farm in the outer lagoon, due to navigation hazards and potential for disturbance of endangered species (Monk seals and turtles).

Fish and Wildlife officers indicated verbally that they had no objections to the type of pearl farm development that we were proposing in the harbor, but deferred decision-making to Midway Phoenix Corporation, the then holders of rights to run flights and tourist operations within the Refuge. FWS insisted that any use rights we might obtain would have to be carried out under the present lease arrangements through MPC.

Initial discussions with Midway Phoenix indicated that they might be interested in such a project if the financial returns were sufficient. After further discussions, however, Midway Phoenix decided that they would prefer to use the harbor waters for mooring pleasure craft. They indicated that there would not be sufficient area available within the harbor for the planned farm use, unless FWS specifically requested that they make such provision.

BPI then sent a formal request to Fish and Wildlife Refuge Manager, Rick Shallenberger, requesting use of part of the harbor at Midway for the pearl farm, and emphasizing the obligation on the part of USFWS to restore the Refuge to its pristine condition. Shallenberger denied permission, and this site was then dropped from further consideration.

4. Kaneohe Bay, Oahu

Kaneohe Bay contains what is believed to be the largest remaining stock of oysters in the Hawaiian Islands. In the past, the Bay has been subject to heavy pollution, but this situation appears to have improved over the last two decades. Grow-out trials using hatchery-produced oysters showed good growth of spat and adults, with almost no predation problems.

The Bay is subjected to very heavy recreational and commercial tourist use. There are almost no underutilized areas, and any further commercial activities would therefore have to displace existing activities. The process of obtaining a lease would face strong opposition. There are also no commercial land base sites available on the water.

The only possibility for obtaining access to the Bay without impacting existing public recreation was then to site the pearl farm within the Kaneohe Marine Air Corps Base Exclusion Zone. This is a 500 m wide area, of ideal depth and well protected from ocean swells. It also offers the advantage of good security. Since access by the public was already restricted, there were also no other conflicting public uses. The only potential use conflict was with the Marines themselves, and it was never apparent precisely what activities the Marines carry out in this area.

While there was no data on growth and survival from inside the restricted area, it was close to the site where oysters were reared near Coconut Island (Hawaii Institute of Marine Biology). It could be expected that oysters would fare at least as well within the Marine's Exclusion Zone, and probably better, due to more current and circulation. In addition, some of the researchers working on the dolphin program on the Marine Base had collected pearl oysters from the mesh on the dolphin pens (Arthur Wong-duk, pers. comm). The oysters were thriving in these conditions.

John Corbin of ADP made the initial approach to the Marines via a phone conversation with Lt. Col. Torric. Mr Corbin then write to Commanding General Bice requesting a meeting. A meeting occurred on the Base, attended by John Corbin, and several Marine representatives. BPI principals were not invited to this meeting. John explained the project and answered questions. There appeared to be no obvious objections from the Marines to the concept, suggesting that there was no gross incompatibility with existing use of the area. A map showing our choices for sites was subsequently forwarded to the Marines.

On September 18, 1997, Commanding General Bice wrote to ADP to formally deny our request to locate the project within their security buffer zone. Given the current status of military bases being altered and closed, it was impossible for them to grant a 5 to 10 year access. In addition they chose to invoke the policy of not allowing any intrusion into their security buffer zone that would have any effect on military readiness.

No further action was therefore taken on this site.

5. Kawaihae Harbor, Hawaii Island

A number of oysters were found within Kawaihae Harbor, although none were encountered in the randomly-sited stock survey areas. The Harbor produces fair growth of adults, although the heavy silt load makes juvenile and spat grow-out difficult. The Harbor is well protected from ocean swells, and there are numerous possible land base sites on adjacent fill areas.

In addition, Kawaihae Harbor has been largely idle for many years, since the demise of the Hamakua Sugar Co., and the decommissioning of the sugar bulk storage and loading facility. The Harbor is currently only used by inter-island barges, military links to Pohakuloa Training Camp, and recreational paddlers and fishermen.

However, the Harbor still lies under Department of Transport jurisdiction. DOT has designated all harbors for exclusive use by commercial shipping and recreation. Aquaculture is not considered compatible with these uses.

6. Pearl Harbor, Oahu

An additional, obvious site for potential culture of pearl oysters in Hawaii is Pearl Harbor. The historical record suggests that both P. margaritifera (galtsoffi) and the smaller P. radiata grew prolifically in the harbor. Although the wild stocks have been wiped out by both overfishing and environmental perturbance (initially run-off from the ranching and agriculture on Ewa plain, later from the US Naval presence), there is some anecdotal evidence that the waters now support good growth of oysters. Pearl Harbor would offer one of the most secure pearl farm sites imaginable, with good protection from ocean swells.

Unfortunately, the U.S. Navy rebuffed all approaches by BPI and ADP to consider such a project. BPI was not even given permission to conduct grow-out trials by hanging oyster panels underneath the dock of the Ford Island Yacht Club. Without Naval approval even for trial studies, this site was no longer considered.

7. Keehi Lagoon, Oahu

Initial trials inside the University of Hawaii's facility in Snug Harbor yielded poor growth and survivorship. Oysters were then moved to the old seaplane landing area, adjacent to Sand Island. Some were also suspended beneath the dock of one of the residents of Mokauea Islet, in the

middle of Keehi lagoon. These trials also showed poor growth and survival. We concluded that the run-off and other pollutants from Honolulu Harbor must have been adversely affecting the oysters.

The oysters were then moved further afield, across the Kalihi Channel and Circulation Channel to the borrow pit adjacent to the Reef Runway. Initial trials in the mauka corner of the borrow pit directly abutting the circulation channel showed good growth and survival among the adults, but poor early nursery results, due to the heavy silt load. Subsequent trials at two other areas further to the west and towards the makai edge of the borrow pit showed much improved nursery growth and survival.

Some oysters were also found in the wild along the makai rim of the borrow pit. The site offers reasonable protection from ocean swells, as most of the wave energy is absorbed on the reef before it reaches the site. There are no conflicting recreational uses, apart from some fishing on the adjacent reef flat, and its designation as a recreational thrill craft area. The site appears to be little used by thrill craft.

The Department of Transport controls most of the area, under an Executive Order, through the Airports Division. In preliminary meetings with Airports personnel (Barry Fukunaga), the response was encouraging, with no specific objections to the proposal. Since almost all of the materials would be underwater there will be nothing to attract birds – the primary concern of FAA with such activities. There was already a precedent in that DOT rented space to a commercial water skiing company near that area.

A pearl farm would be viewed as a non-conforming use of the land. This would probably prevent Airports from issuing a long-term lease. DLNR would have to grant the lease with concurrence from DOT.

MANAGEMENT PLAN

FOR A PEARL FARM AND
PEARL OYSTER REEF RESEEDING PROJECT

IN

THE REEF RUNWAY BORROW PIT IN KEEHI LAGOON, HONOLULU, OAHU, HAWAII

PREPARED FOR :

Board of Land and Natural Resources,
pursuant to Section 13-5-24 R-1 HAR

PREPARED BY :

Black Pearls, Inc.
P.O. Box 525, Holualoa, HI 96725

August 1, 2000

1. GENERAL DESCRIPTION

Pursuant to Section 13-5-34 HAR, Black Pearls, Inc. requests a Board Permit to allow an ocean lease for aquaculture, specifically a Hawaiian black pearl™ farm, in the Reef Runway borrow pit inside Keehi Lagoon (see Figure 1). Sub-surface oyster lines will be laid across the borrow pit, at a depth of around 3 m, and net panels and juvenile culture baskets will be suspended from these headlines. Headlines will be taut, anchored with sandscrews or eyebolts at each end, and with sandbag anchors in between (see attached Environmental Assessment, Figure 3).

The oysters will be exclusively the local variety of black-lip pearl oyster, Pinctada margaritifera, produced in BPI's hatchery at the Natural Energy Laboratory of Hawaii Authority, in Kona, Hawaii. The oysters will be implanted with nuclei, and the pearls will be removed after time. The aggregation of oysters on the farm should result in a dramatic increase in recruitment of this imperiled species to neighboring reefs and lagoons.

The oysters and lines will be tended from small boats and moored pontoons. Post-and-pier work platforms and a storage/staging area may be built on soft substrate areas bordering the lease. An exclusive lease is requested, for both security and safety reasons. At the termination of the lease, all subsurface lines and other structures will be removed.

The pearl farm will occupy the surface, seafloor and water column of the State marine waters and submerged lands classified in the Resource Subzone per section 13-5-13 (5) HAR. This use is consistent with the Conservation District, and the Resource Subzone, as identified in section 13-5-24 R-1 i.e. AQUACULTURE.

2. EXISTING CONDITIONS ON PARCEL

Ownership : The borrow pit waters are owned by the State of Hawaii. A large portion of the area is under DOT Airports Division jurisdiction. The remainder is administered by the Department of Land and Natural Resources (see attached EA, Figure 9).

Resources : The borrow pit itself supports very little flora or fauna. A fish census survey showed only on individual fish in the deep, silt bottom area (see Appendices to the attached EA). The area is not a significant habitat for birds. There is no historical significance to the site.

Presence of Threatened or Endangered Species : Green sea turtles occur in the area, but no adverse interactions are expected because of the taut line moorings. Other endangered species do not frequent the area.

Constraints : None. The area is part of State Marine Waters, but is protected from heavy surf action by the outer reef. All oyster lines, etc will be below the water surface, and will not be impacted by heavy surf or storm surges.

Existing land uses : There are no existing structures in the proposed lease area. The area is currently designated as part of a Recreational Thrill Craft Zone, but DBOR has proposed that the Zone boundaries could be redrawn by a simple rule change. The change in Zone boundaries, to the satisfaction of all concerned, would be a condition of the Board permit. Oufi's Island – the proposed site of the staging/storage area is used by beachgoers. Although there is little fishing or other recreational use of the deeper waters of the borrow pit, the surrounding reef flat is heavily used by fisherfolk. BPI has proposed that the lease includes provision for an easement along either the seaward or inshore edge of the borrow pit, to allow continued access to the reef flat area by boats.

Existing Conservation District Use Permits : None.

Access : The borrow pit can be reached by foot via a trail that follows the eastern perimeter of the Reef Runway, from Lagoon Drive. The only other access is by boat or other watercraft.

Soils : The entire area of the proposed lease is around 45 – 50 feet deep. The lagoon bottom is covered with a thick layer of fine white silt.

3. PROPOSED LAND USES ON PARCEL

Description of proposed Land Use : The pearl farm will occupy the surface, seafloor and water column of the State marine waters and submerged lands classified in the Resource Subzone per section 13-5-13 (5), and section 13-5-24 R-1 AQUACULTURE.

Site Plan : See Figure 1, attached.

Justification : Pearl farming is aquaculture, and therefore complies with the requirements for the resource subzone, as detailed in section 13-5-24 R-1 AQUACULTURE.

Relationship to other land uses : The area is currently designated as part of a Recreational Thrill Craft Zone, but DBOR has proposed that the Zone boundaries could be redrawn by a simple rule change. The change in Zone boundaries, to the satisfaction of all concerned, would be a condition of the Board permit. Oufi's Island – the proposed site of the staging/storage area is used by beachgoers. Although there is little fishing or other recreational use of the deeper waters of the borrow pit, the surrounding reef flat is heavily used by fisherfolk. BPI has proposed that the lease includes provision for an easement along either the seaward or inshore edge of the borrow pit, to allow continued access to the reef flat area by boats.

The loss of public access will be balanced by the significant public good derived from this project. Benefits include the stock re-establishment of this imperiled native species, the demonstration of ocean leasing laws for the legislature and the public to gauge the impacts, and the increased availability of native Hawaiian pearl shell for use by local artisans.

Expected timing : The project could expect to obtain the lease by January 1st, 2001. Operations would commence as soon as possible thereafter. A 20 year lease is requested.

Monitoring strategies : A long term water quality monitoring program will be instigated, at the farming company's expense, to track impacts from the farm on water quality. Because of the long-term nature of the impacts on water quality, sampling will begin with a base-line survey in the first year of the lease, and then will consist of follow-up surveys every five years, as the farm grows to full capacity. These surveys will measure turbidity and sedimentation rates, and biological oxygen demand of the substrate beneath the farm.

Environmental Assessment : A draft Environmental Assessment is included in the package.

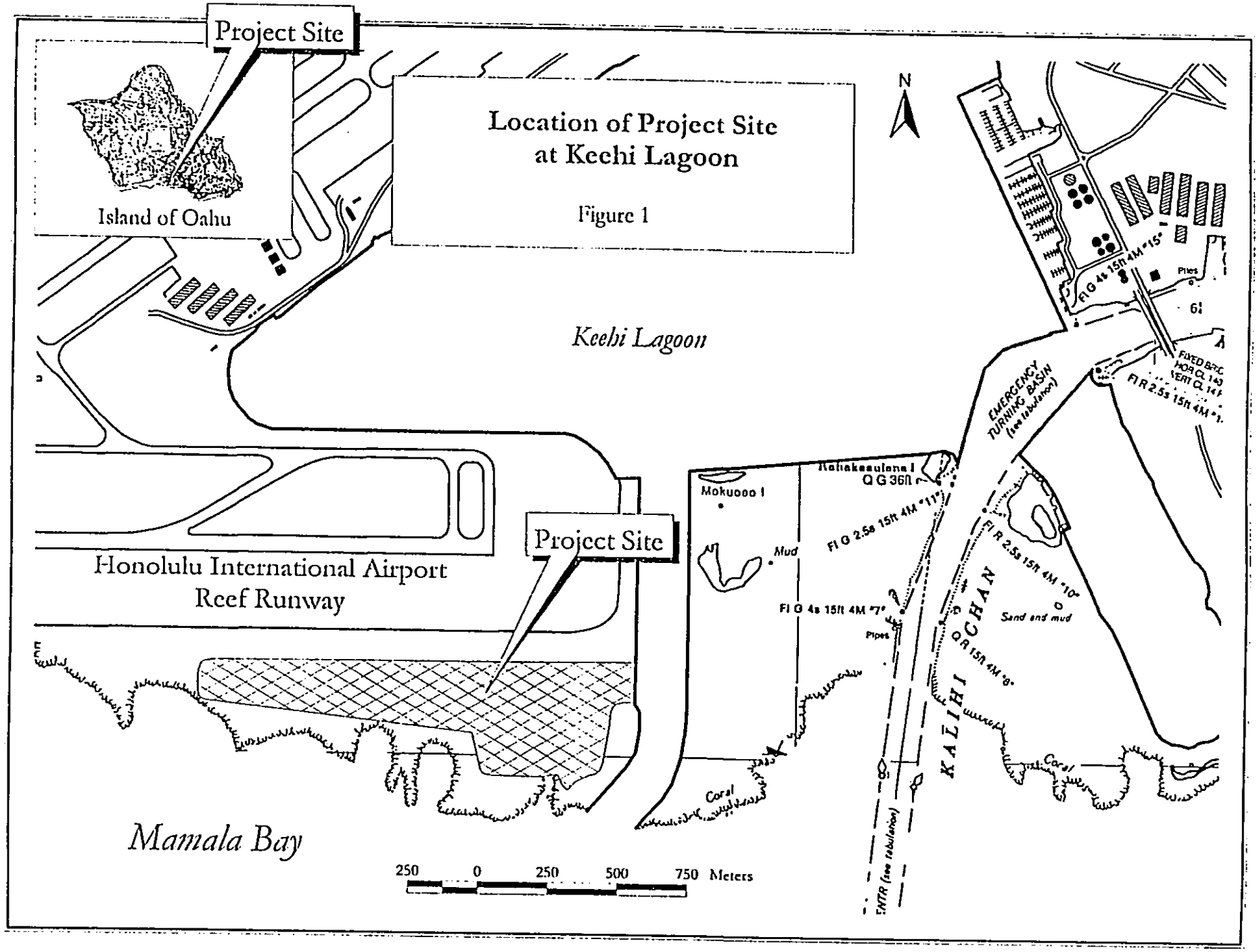
Historic Preservation concerns : There are no such concerns for the area, as described in the EA.

4. REPORTING SCHEDULE

Time duration of management plan : The management plan shall remain in effect for the full duration of the lease. A 20 year renewable lease is requested, based on the long lead time until the pearl farm reaches commercial production, and the long-term nature of the stock re-establishment effort.

Annual reporting schedule : The pearl farm will be subject to annual reporting requirements under the Aquaculture License law. A copy of this annual report will be provided to DLNR, along with the reports from the water quality monitoring program, as appropriate.

Annual reporting requirements : The Aquaculture License law requires details on number of protected animals held on the farm. The water quality monitoring program will provide raw data, analysis and interpretation of the turbidity and sedimentation rates, and biological oxygen demand of the substrate beneath the farm


Project Site
Island of Oahu
Location of Project Site
at Keehi Lagoon
Figure 1
N
Keehi Lagoon
Honolulu International Airport
Reef Runway
Project Site
Mamala Bay
250 0 250 500 750 Meters
Mokuoloe I
Mud
Coral
Pipes
Sand and mud
KALIHI CHAN
Coral
EMERGENCY TURNING BASIN
(see tabulation)
ENTR (see tabulation)
Fl G 4s 15ft 4M "15°
Fl G 2.5s 15ft 4M "11°
Fl G 4s 15ft 4M "7°
Fl R 2.5s 15ft 4M "10°
QR 15ft 4M "8°
Fl R 2.5s 15ft 4M "1
Q G 36ft