KAUAI Fishpond material KAUAI

1980s TURTLE SIGHTINGS
GEORGE BALAZS FILE

JAMES A WAYT
P.O. BOX 58
LAWAI HAWAII
96765

5-4-83

GEORGE

HERE ARE A FEW SLIDES FOR YOU THEY ARE OF TURTLE 3628 THAT I GAVE INFORMATION ON HOPE THEY ARE USEFUL TO YOU.

IF YOU NEED ANY MORE INFO OR HELP FEEL FREE TO CONTACT ME, HOPE TO SEE YOU WHEN YOU COME TO THE MEETING ON KAUAI ON THE 19TH AGAIN IF YOU WISH TO GO TO THE SEPERATION CAGES I AM AVAILABLE ON THE BOTH

ALOHA
JIM WAYT

Kauai 742-9472

2-A MAY 18, 1983 - WEDNESDAY
The GARDEN ISLAND

Meeting tomorrow

Are turtles needed for food?

by Julia Neal

The public meeting tomorrow to discuss whether to allow Hawai'i residents to take green sea turtles for subsistence will be held in the wake of two arrests on Kaua'i for illegally killing the turtles.

State Conservation and Resources enforcement officer Tony Nakamura said an anonymous phone call brought police to the bluff overlooking the waters off Princeville last Saturday. Joined by conservation enforcement officers, they arrested John Klodes, 21, and Grant Olson, 19, of Hanalei for allegedly taking a mature green sea turtle with a shell length of 30 inches.

Nakamura said the pair caught the turtle while free diving from the shore, and butchered it before enforcement officers arrived.

The meeting will begin at 7 p.m. in the Lihu'e Library Conference Room. It is sponsored by the National Marine Fisheries Service, which is reviewing turtle protection laws for Guam, American Samoa, Palau, the Northern Marianas, Micronesia, the Marshall Islands and Hawai'i.

Natives of islands further south have requested permission to take the turtles, and in some cases gained it, claiming they need turtle meat for survival. And individuals in Hawai'i have also made a request, claiming the ban on turtle hunting, intereferes with "native Hawaiian rights."

But the federal government allowed other Polynesians living in U.S. territories to take the turtle because there was little other protein available, federal officials said.

The questions facing the decisionmakers concerning Hawai'i, is whether native Hawaiians have other available sources of protein and whether the sea turtles, which have been protected since 1978, are now plentiful enough to allow limited taking.

20 April '83
Box 1671
Lihue
-96766

Dear George:

Jim Watt's address is P.O. Box 58, Lawai, Kauai 96765. He stated (today) that he has seen the same turtle (tagged) since his first report in the same general area. Further, he stated that in the general "Sheraton Cave" area of Poipu it is common to see at least 4-5 sleeping turtles, on any & given day, year round.

He said he did not see a second tag on the front left flipper, only #3628 on front rt.

Aloha,

Don Hancock

May 5, 1982

Sandy Conrad
Co-Chair, Miloli'i Committee
P. O. Box 576
Waimea, Hawaii 96796

Dear Sandy:

I'm not sure if we met in person, but you may recall that I gave a slide show on sea turtles at a KUA meeting in December. I just received the May newsletter, KUA Kako'o (nice name!), and read about the trip in late June that is being planned for Miloli'i. I would really like to join with you, but during this time I will still be camped-out on an islet at French Frigate Shoals tagging big nesting turtles. What I would like to do, however, is send you a supply of turtle sighting forms that include a map of the Miloli'i coastline. As a part of the trip, perhaps you could ask all participants to keep a special eye out for turtles, and record whatever they are able to see. Please let me know if this will fit in with the planned dives and other activities.

A week or so ago I sent the club a newly printed sea turtle ID poster. Hope it arrived safely. I'll send several more soon when the next supply shipment arrives from the source in Florida.

Best regards. Hope to hear from you soon.

Sincerely,

GEORGE H. BALAZS
Assistant Marine Biologist

GHB:ec

Those Hanalei

By Peter Wagner Star-Bulletin Writer

LIHUE, Kauai—No one is around to describe what Hanalei School was like when it was founded in 1835, but there is a taro farmer out there who remembers how it was in 1902.

In 1902, Kinichi Tasaka was 6 years old and his father would row him back and forth across the Hanalei River to get him to school. Born in 1896, Tasaka may be the oldest living alumnus of the school and he is expected to be among the honored guests at its centennial celebration tomorrow.

According to school historians, the school was started soon after the arrival of the Wilcox missionary family in Hanalei in 1835. The school, however, was not incorporated into Hawaii's public school system until 1881.

Hanalei School's three wooden buildings, surrounded by about three acres of the greenest grass this side of Mt. Waialeale, were built in the late 1920s, replacing earlier structures at the site. These buildings are due to be razed within the next several years and replaced by a larger facility.

School principal Nick Beck says construction on the new facility may begin by 1984. It is needed to accommodate a planned expansion of the student body from the present 140 students—in kindergarten through the seventh grade—to 250 students.

The outward appearance of the tiny school has changed little in the past 100 years. The school still is bordered by a well-tended white picket fence and surrounded by a lush, green landscape and the soaring, often waterfall-lined cliffs of Mt. Waialeale.

"The school was in the same place it is now, but the buildings have changed," Tasaka writes in reminiscences soon to be published by a group of local residents.

In addition to recalling that Francis Deverill was his first teacher, a memory stretching back about 80 years, Tasaka also writes vividly about the strict code of discipline in those days.

"In our days, we used to learn pretty good," he writes. "We were scared, that's why."

The penalty for misspelling a word during a spelling bee was one rap on the palm of the hand for each letter in the misspelled word, Tasaka recalls.

But things have changed, he writes. "Now it's easier for the kids but hard for the teachers. You cannot scold them too much. The kids go home and tell the parents. The parents get after them. Pretty soon the teacher fired."

Tasaka's memoirs, along with those of other alumni, have been gathered by Carol Wilcox and Susan Francis, both members of the Hanalei School Parents Association, into a collection titled "Hau'oli La Hanau." The publication, complete with old photographs, is expected to be available soon.

Tasaka, who still farms taro in Hanalei with his son, remembers the school bag his mother made for him and the home lunch he brought to school in it.

"I used to bring ball-rice with *ume* (a salty plum) inside," he writes. I learned reading, writing, arithmetic, geography, Hawaiian geography and history. We had a school garden and we used to plant beets and lettuce and all those things. The teacher gave everyone a little bit to take home."

Hanalei students this year, top, principal Nick Beck, above, and former student and taro farmer Kinichi Tasaka, who attended the school in 1902, right.

i School Days

Also invited to attend the centennial festivities is 78-year-old Harry Ho, who was born and raised in Hanalei and who graduated from the school's seventh grade in 1918.

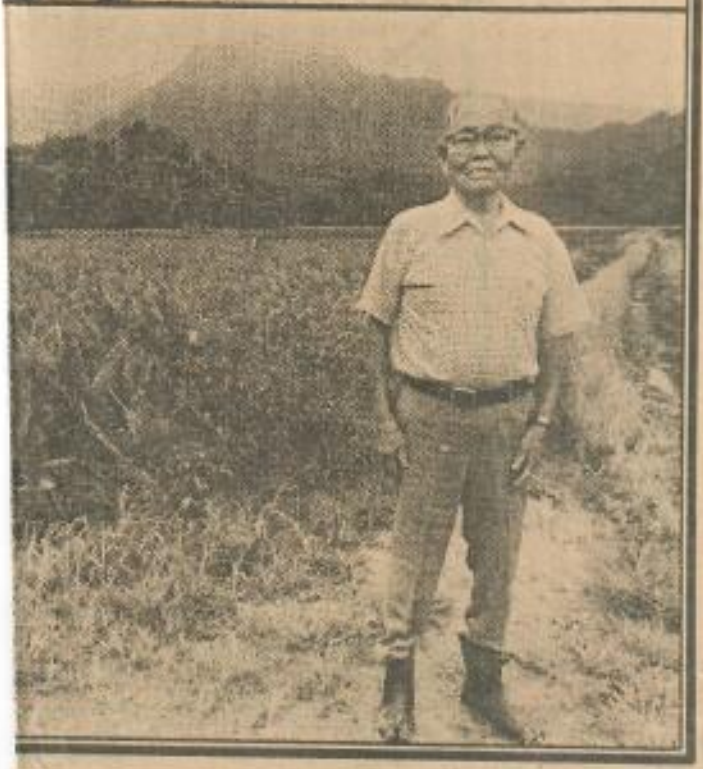
Soon after graduation from Kauai High School in Lihue in 1925, Ho became principal of Hanalei School before being transferred as principal to Haena School, not far from Hanalei. His wife, Rebecca, also taught at Hanalei School.

Clorinda Nakashima, 49, was a 1946 Hanalei graduate, who wrote about wearing a pinafore uniform to school in her reminiscences.

"There were no special classes," Nakashima recalls. "If you were bright enough, they would let you skip that grade and go on to the next one. There was no such thing as kindergarten. We called it 'receiving.' And we didn't have PE (physical education class). Usually recess was our PE."

Nakashima recalls using toothpicks to learn her math lessons. "Our teacher would say, 'Instead of counting your fingers, bring your toothpicks and with that you are going to add or subtract.'"

Today, under the guidance of Beck and 10 teachers, Hanalei School is turning out students using the latest instructional techniques. And Beck believes the school has something going for it not easily found in other schools—a close relationship with the community.



"It's a small school, so we have lots of activities centered around the school. And we know so many of the parents personally that if a student is having a problem, sooner or later we try to solve it together with the parents," he says.

Wilcox says Hanalei is a family school. "There's lots of aloha passed from grandparent to parent to child."

The all-day celebration tomorrow will begin at 11:30 a.m. with a traditional blessing ceremony, followed by a May Day pageant of Hawaiian dance and song by students at the school. A luau and an afternoon of Hawaiian entertainment is scheduled to follow the pageant, beginning at about 1 p.m., headlined by the Hanalei Hawaiian Civic Club, Lovey Apana's dance troup and a number of popular Hawaiian entertainment groups from the Islands. Admission, payable at the door, is $1 without the luau and $5 including the luau.

Star-Bulletin

Today

Features

Entertainment

Honolulu

Friday, April 30, 1982

Section B

28 Dec 81

George,

Thank you so much for taking the time to go over and talk to those kids. Please don't hesitate to drop in the office if you get to Kauai. If there is something like turtle planting that you think it might be of use please let me know.

Lingren – Suite 1-A
4480 Ahukini Rd.
Lihue, HI 96766

KAUA'I UNDERWATER ASSOCIATION

KUA Newsletter HAVE A SAFE AND HAPPY HOLIDAY! December, 1981

UNDERSEA FILMS

World-renown photographer, BILL MACDONALD was here November 1st with a friend and showed some fascinating films and slides. The event took place at Lihu'e United Church Parish Hall and lasted for two hours. Topics viewed were on OTEC I, Fish Aggregation Buoys, Whales and Dolphins, California Kelp, and Boat Ballooning. About 115 people were able to attend even with a notice of less than a week. The event, free to the public, was sponsored by KUA.

LETTER TO K.U.A.

In response to surveys taken by the members, SPIRIT has sent this letter dated October 26, 1981:

Dear Members of KUA,

Mahalo so much for your recent response to Project Interlock, and to Bill Manewal.

I am on O'ahu meeting with Greenpeace staff and my hero--Dexter Cate.

We are planning a journey to Kaua'i by boat with a film crew to document the encounters with wild dolphins and start a documentary film here in our beautiful Hawai'i.

It is a mystery to me who made up the report form I received from Bill. My special thanks to whoever did it. Keep it up.

I'm hoping to see you all soon.

Love, Spirit

Box 248
Hanalei

P.S. I can be reached by phone at the Greenpeace office here at 537-9505.

Diving Safety SIGNS

The long discussed emergency signs that we'll put up at frequented diving sights are now completed. The signs are red-and-white, silk-screened printing on aluminum sheets, 18" x 24". These signs tell hurting divers who to contact if they have the mentioned symptoms, and what first aid actions to do while help is arriving. Volunteers are presently posting these signs around the island in thirteen different locations. Thank you to SEA GRANT for funding this project!

BAD NEWS FOR WANA

October was the beginning of a statewide wana die-off. Hawai'i, the Big Isle, was the first island noticed & the wana deaths have since spread to Moloka'i, O'ahu, and the south shore of Kaua'i. There is no known reason for this phenomenon; research is still being done. Anyone who has noticed this occurrence is urged to contact TERRY O'HALLORAN at 742-6991 or DON HEACOCK at Fish and Game, 245-4444.

RECENT TREATMENT

A bends case was successfully treated this month. The diver had made several deep dives that day, back-to-back. Thanks to all who turned out for the treatment!

KOLOA CLEAN-UP

The last clean-up was so successful and fun, it was discussed a clean-up should be done every three months. BARBIE SUSSEX took it upon herself recently to clean the area herself and managed to fill four bags. Good going, Barb!

New Chamber Logging Procedures

Due to the inconsistency in chamber logging procedures, two stamps have been made to be used before, during and end of treatments in the log book. Stamp #1 is to be used <u>before</u> and <u>after</u> treatments. The checkouts are to be <u>initialed</u> by the responsible persons. Stamp #2 is to be used right after Stamp #1 in the <u>beginning</u> and anytime <u>during</u> the treatment where a shift is changed.

Stamp #1:

Air - #1___	O_2 - #1___	Check list:
#2___	#2___	Oper ____
#3___	#3___	Gas ____
#4___	#4___	Tender____
	#5___	

Stamp #2:

Supervisor(s) Time _____
Operator(s) Time _____
Logkeeper(s) Time _____
Gas Tender(s) Time _____
Inside Tender(s) Time _____
Doctor(s) Time _____
Type of Case _____
Patient _____

We have some real nice letterheads and envelopes with the K U A logo and address printed now. Anyone wanting to write an official KUA letter can get this stationery from the current secretary, PATTY GRANT at 245-2049.

<u>NEXT MEETING! IMPORTANT! GUEST SPEAKER, GEORGE BALAZS, & 1982 ELECTIONS!</u>

Place - Koloa Neighborhood Center
Time - December 3, 1981 at 7:00 p.m.
Agenda - The major topic will be ELECTIONS of K U A officers for 1982. If you can't make it, you may send your ballot it, but you'll have to do it soon. Membership dues will also be voted on.

A special addition to the meeting will be guest speaker, GEORGE BALAZS, a research biologist with the Hawai'i Institute of Marine Biology, UH. George has been conducting field research of Hawaiian green sea turtles, Hawaiian monk seals, crustacean nutrition, and aquaculture. We're honored to have him present the program "A Journey Through the North-Western Hawaiian Islands," including photographs and adventures of his research.

Everyone is encouraged to attend this last meeting of the year. GUESTS are welcome as always. Meeting is open to the public.

The KAUA'I UNDERWATER ASSOCIATION Newsletter is printed and published once a month by various members. This December issue's reporters were PATTY GRANT and LINDA MANN, typist and layouts -CHERYL SHINTANI, printed by JOHN MCFARLAND. Anyone with reports on KUA happenings or other ocean-related communications are urged to send them to any of the above persons or call PATTY GRANT at 245-2049 by the middle of each month.

* * * B A L L O T * * *

If you don't think you'll be attending the December meeting at Koloa Neighborhood Center on December 3, 1981 at 7:00 p.m., you may mail your ballot in to KAUA'I UNDERWATER ASSOCIATION, P. O. BOX 188, KAPA'A, HAWAI'I 96746. If you will be present at the meeting, please bring this ballot with you. (More ballots will be available at the door.)

E L E C T I O N O F O F F I C E R S

(Check only one from each category)

PRESIDENT..... ___ TERRY O'HALLORAN
___ (Write-in)_____

VICE PRESIDENT..... ___
___ (Write-in)_____

SECRETARY..... ___ MICHAEL SHINTANI
___ (Write-in)_____

TREASURER..... ___ (Write-in) T. DONNELLY
___ (Write-in)_____

* *

REPORT FROM MEMBERSHIP CHAIRMAN, LINDA MANN

For the year 1981, there are 111 members on file with 77 members paying their dues for the year. The reamining members will be placed on the inactive list.

I recommend a change in the membership structure for the coming year due to the increased cost of keeping members informed of the events through the monthly newsletter. At the present time, newsletters to members run at about $4.56 per member for the year. I feel that the dues should be adjusted so that these expenses, at the least, can be covered. I suggest the following scale:

INDIVIDUAL MEMBER $5.00

FAMILY MEMBERSHIP $7.00
(Couples and their keiki's - who are of age and living at the same address)

SUPPORTING MEMBER ..... $25.00 or more
(This NEW category would be for persons who wish to support K U A, commercial fishermen, dive stores, tour companies, etc. This SUPPORTING MEMBER will receive a certificate to display.)

other suggestions_____
_____
_____
_____

As the dues are named in the Charter for K U A, it needs to be voted on by the members. (Those with dues paid are the only ones qualified to vote.) Please consider the pro's, con's, and let's vote on a new dues schedule for 1982!

KAUAI UNDERWATER ASSOCIATION
P. O. BOX 168
KAPAA, HI. 96746

George Balazs
U of Hi at Manoa
PO ~~Box~~ 1346
Coconut Island
Kaneohe, Hi
96744

WHERE TIME STANDS STILL—A modest farmhouse on Niihau, the privately held island off Kauai. —Star-Bulletin Photo.

Niihau, Where Living Is Simple

By Wallace Turner

KEKAHA, Kauai—That lumpy form rising out of the sea on the southwest horizon is Niihau, a privately held island as inaccessible to the public as any place in the United States.

About 600 Polynesians with a fraction of Japanese ancestry live on the 18-mile-long Island in 19th-century Hawaiian style, speaking the Hawaiian language in everyday life. They have no electricity, running water, liquor or firearms. There is no jail, nor are there police officers, and the Congregational minister, who is one of them, is the arbiter of disputes.

The owners keep the Island as a ranch where cattle and sheep graze on plants that can survive in an arid climate. Niihau lies directly downwind from the peak on the Island of Kauai and so gets almost no rain from the northeast trade winds.

A commercial honey operation depends on the yellow blossoms of the keawe tree, whose bean-like fruit then becomes fodder and whose wood becomes charcoal.

NIIHAU HAS BEEN owned by one family of cane planters since 1864 when Elizabeth M. Sinclair, a

the life as "simple in the extreme." There is no electricity on Niihau, nor is there a system for piping water into the houses. Kerosene stoves are used for cooking.

Rainfall is caught on roofs and moved into barrels at each home to augment the communal water supply.

The Robinsons' Niihau ranch has 63 jobs. The ranch owns all the buildings, including the three one-room structures where teachers paid by the state are instructing 34 students this year.

All three teachers were born on Niihau. The teacher in charge is Jean Keale, who holds the Island's only teaching certificate. She is one of only two Niihau grade school graduates to earn a college degree. The other is Keale's daughter, Jean Beniamina.

AFTER GRADUATING from the Island grade school, each woman went to Honolulu to Kamehameha School, operated for Hawaiians by the Bishop Estate, Hawaii's largest non-government landowner. There is now but one student from Niihau at Kamehameha School. Both Keale and Beniamina graduated from the University of Hawaii.

Beniamina, who is married to a

New Zealander, moved her family to Kauai, the northwestern island of the Hawaii chain.

Almost as an afterthought when acquiring extensive holdings on Kauai, Sinclair purchased Niihau for $10,000 in gold from the Polynesian monarchy that then ruled Hawaii.

From that day to this, the Island has been a private place for Sinclair's descendants. Today most of what she held is in the Gay & Robinson Co., a sugar cane plantation, on Kauai's south coast opposite Niihau.

Helen Robinson is the present senior family member. Her son, Bruce, is the manager of the family enterprises. Neither would agree to be interviewed about Niihau.

People who have heard the Robinsons speak of Niihau say the mother and son feel that the Island is a family property that the Robinsons may manage as they see fit and with no responsibility to account to the public.

To a remarkable degree, the Robinsons have been able to control story-telling about "the Forbidden Island," as local people refer to it. It is common for a professional man to say, when imparting some lore about Niihau, "Don't use my name."

THE ROBINSONS have refused for decades to permit reporters to ride over to Niihau on the World War II landing barge that carries provisions in.

Officials from public agencies, however, visit there freely as their duties require. Dr. Mitsugi Nakashima, the district superintendent of schools, said he had visited it "a number of times."

He described the Island as very dry, the buildings of sawed planks as "very weathered," and

Robinson cane worker of Japanese descent, now is a teaching aide at Waimea Canyon School, where a dozen or so Niihau students are usually in classes. These are children of Niihau families whose job assignments have been shifted temporarily to Kauai's cane fields.

These students come to the school only partly competent in English, said Jacqueline Carpentier, the principal. In their brief stays, a special federally financed program tries to teach them to broaden their English and such things as how to shop in stores and handle money.

Carpentier said: "I make no effort to stop them from speaking Hawaiian because I see it as important to maintain their culture. So it is common to hear two Niihau students speaking in Hawaiian."

BENIAMINA translates. She will spend Christmas with her mother on Niihau and looks forward "to talking with everybody all the time in Hawaiian." She said she loves the Island, fondly remembers her childhood there and thinks about returning there to live.

"But I've gotten used to turning on the lights," she said. "And I like the refrigerator, too."

The Robinsons strictly enforce rules against liquor and guns. While tobacco is not banned, the ranch owners will not supply it, so residents who smoke must find a way to import tobacco.

There is a Congregational Church on Niihau. A knowledgeable person who asked not to be identified said a Ten Commandants behavior code was what the Robinson family expected its tenants and employees to follow on Niihau.

NIIHAU CLIFFS—Steep cliffs 500 to 600 feet high form a rugged coastline at one end of Niihau, the Forbidden Island. —Star-Bulletin Photo.

New Wildlife Preserve Created on Haleakala

By Harry Whitten
Star-Bulletin Writer

If the songs of birds could be translated into English, there should be joyous notes emanating from the damp northern slopes of Maui's Haleakala as the result of an agreement announced today.

The Nature Conservancy of Hawaii and Haleakala Ranch Co. said the agreement gives the Conservancy an option to acquire a conservation easement to set up a biological preserve on 5,230 acres of ranch property.

This will be the Waikamoi Preserve, to be managed as habitat for endangered species of Hawaii's native forest birds and also for protection of rare and endangered plants. The preserve is habitat for five endangered bird species: Maui 'akepa, crested honeycreeper or 'akohekohe, Maui parrotbill, dark-rumped petrel, and nene (the state bird).

The Conservancy started its Endangered Hawaiian Forest Bird Project in late 1980 to ensure survival of 19 species of native birds that are threatened with extinction. Waikamoi makes the fifth preserve that it is developing.

WAIKAMOI'S NATIVE plant communities range from alpine grasslands near the summit of Hanakauhi Mountain, 8,640-feet high, to koa and ohia forests along the lower boundaries west of Koolau Gap at about 4,400-feet elevation.

The option, signed by Peter Baldwin, president of Haleakala Ranch, and Kelvin Taketa, Conservancy Hawaii field representative, must be exercised by Aug. 25, 1983 if terms of the conservation easement are to become effective. The easement will give the Conservancy management rights to protect the endangered plant and animal species.

Although largely restricted from disturbing the preserve, the ranch, as fee owner, will retain the right to hunt feral animals and game birds and to develop further a water transport system on the property.

Baldwin said, "In my opinion, the Conservancy's management program will enhance both the ecological value and the watershed potential of Waikamoi. Our agreement with the Conservancy will lead to long-term benefits to the people of Hawaii as well as to the ranch."

The Conservancy's management proposals will focus first on curbing destruction caused by wild goats and pigs. The Conservancy hopes to work closely with neighboring landowners, including the National Park Service.

OF THE 58 kinds of birds in Hawaiian forests in 1778 when Capt. James Cook arrived, 20 species are believed to be extinct and 23 are classified as endangered by the U.S. Department of the Interior.

"Most of the native forest ecosystems in which these birds evolved have been altered dramatically by introduced animals, plants, diseases, and land development that accompanied the human settlement of Hawaii," Taketa said.

"What makes the proposed Waikamoi Preserve so outstanding is that much of the natural environment is still relatively intact."

Mike Banfield, vice president of properties for the ranch and one of the principal figures in negotiating the Waikamoi agreement, said that too often in the past business interests and "so-called environmentalists" have confronted each other instead of seeking solutions to common problems.

"At Waikamoi, watershed deterioration and the destruction of the native forest ecosystem really are two sides of the same coin that the Conservancy and the Ranch are addressing with a single solution. I hope this cooperative effort will be duplicated elsewhere in Hawaii, where our water supplies are so vital and where so little remains of our natural heritage."

THE CONSERVANCY'S other preserves are:

— Kamakou, Molokai. An option to purchase a similar conservation easement was signed and recently exercised by the Conservancy and Molokai Ranch, Ltd., to establish the 2,700-acre Kamakou Preserve, part of the only habitat for the endangered Molokai thrush and Molokai creeper.

— Kipahulu, Maui. It was here that the Conservancy first became involved in Hawaii, in the late 1960s, when it joined the state in conveying to the National Park Service approximately 8,000 acres of upper Kipahulu Valley. The Conservancy still owns and manages interests in approximately 1,000 acres in the lower valley as the Kipahulu Valley Preserve.

— Hakalau, Big Island. In 1978 the Conservancy acquired on the Hamakua slopes of Mauna Kea a 3,300-acre portion of a large koa and ohia forest. It hopes to expand its Hakalau Preserve, which provides habitat for seven bird species, of which four are endangered, found only on the Big Island.

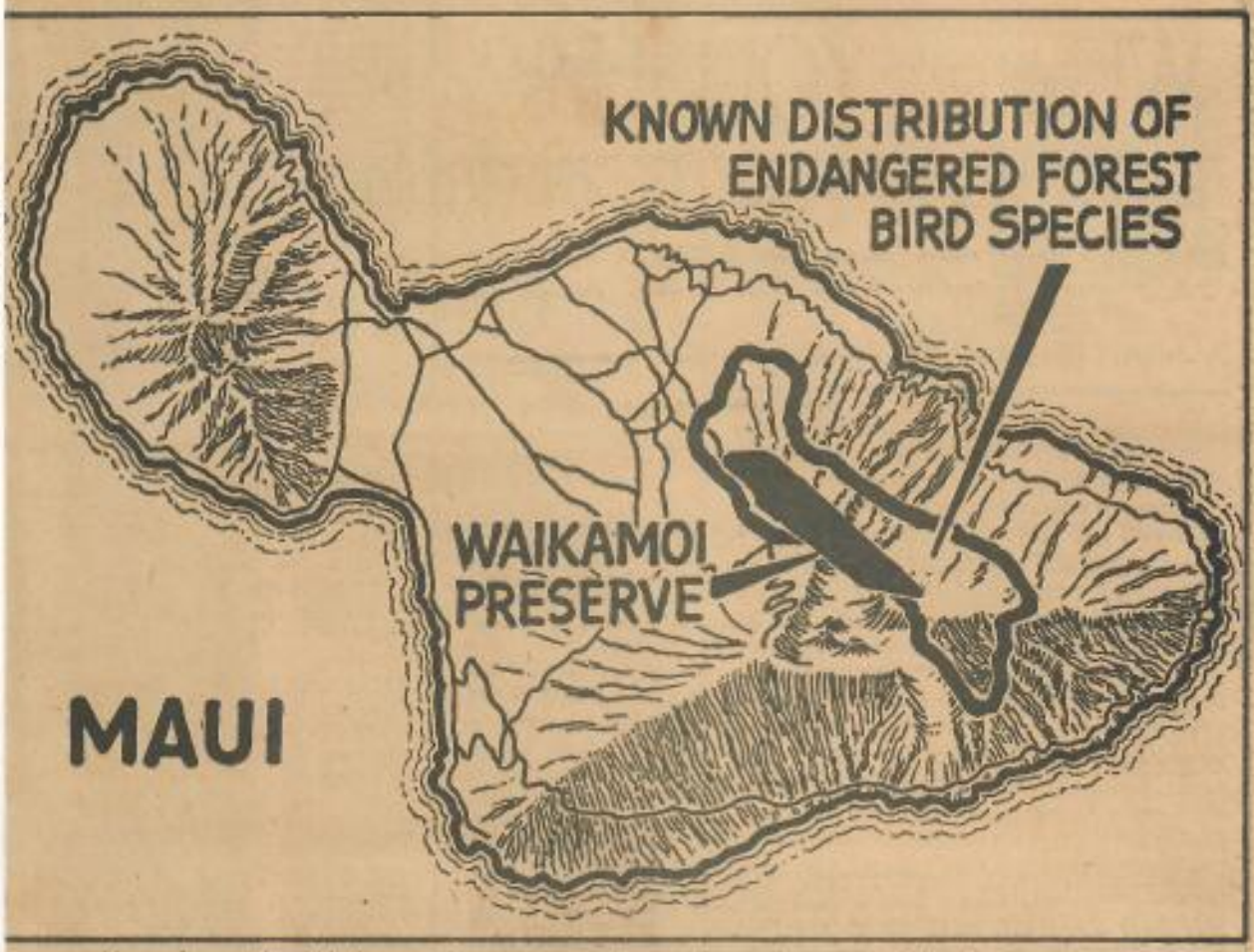
— Kaluahonu, Kauai. This 213-acre area is habitat for seven endangered species.

TO ACHIEVE its goal of establishing and managing the five biological preserves, the Nature Conservancy of Hawaii must complete a $3 million fund-raising campaign by the end of 1983. The Goodhill Foundation of New York awarded the Conservancy a $1 million challenge grant, which means an additional $2 million must be raised from individuals, corporations and foundations in Hawaii and on the Mainland.

Of the $3 million, approximate-

In Hawaii...

● Monday, October 11, 1982
Honolulu Star-Bulletin A-3



Map shows the Waikamoi Preserve on the northern slopes of Haleakala on Maui.

ly $800,000 will be used for preserve acquisition, $1.8 million for management activities, including an endowment fund for each preserve, and the remaining $400,000 for staff operations through 1983.

The Nature Conservancy of Hawaii has an 18-member board of trustees, with Samuel A. Cooke as chairman.

The national organization was founded in 1951 and has been involved in 2,891 projects with more than 1.8 million acres. It is a private, non-profit organization whose resources are devoted to the protection of natural areas and the diversity of life they support. First priority is given to preserving those areas which safeguard rare or endangered species of plants or animals.

It uses a number of techniques such as acquisition of natural areas and also techniques less than ownership, such as conservation easements and dedication of land.

The 'Akohekohe, or crested honeycreeper.

UNIVERSITY OF HAWAII · KAUAI COMMUNITY COLLEGE

August 26 1976

George H. Balazs
University of Hawaii
Hawaii Institute of Marine Biology
Coconut Island, P.O. Box 1346
Kaneohe, Oahu, HI 96744

Dear Mr. Balazs:

Thank you very much for your letter of 18 Aug 1976 and the enclosed materials, especially your article "Green Turtle Migrations in the Hawaiian Archipelago."

I have not come across any other fishpond data to suggest that certain ponds were used specifically for turtles. The Waimanalo pond of Pāhonu is probably not a fishpond but a pen for the keeping of turtles in one area. I have seen penned turtles at the Kiholo ponds on the Island of Hawai'i. The explanation given to me by informants was that frequently, caught turtles are penned for later use as food. One informant mentioned that turtles would walk into the ponds and stay there for some length of time before returning to the sea.

who?

The Advertiser article of 2 Oct 1974 is in error. the name of the temple is Kiha-hōuna; how the author obtained the definition "Temple of the Weeping Turtle" is beyond me. Kiha-hōuna refers to the chief-builder, Kiha, and the act of scooping, or hōuna. Several miles inland at Maha'ulepu and located on a natural tonque of lava was a heiau called Ka-lae-o-ka-honu. which translates the "projecting land of the turtle." This is the only reference to turtles in this area. Perhaps the Advertiser got the temples mixed.

I will mail you a reprint of my Science article as soon as I receive them. Again, thank you for your interest.

Sincerely yours,
William K. Kikuchi
William K. Kikuchi

* KAM, Herbert K.M Kapaa
4739 Kawaihau Rd.
Kapaa, Kauai Telephone number 822-4849

* ~~Mun~~ MUNDON, MIKE H. Anahola # 822-5448
Hanalei Fire Station Hanalei 826-6830

FLEMING, WILLIAM Omao # 742-1043

* KAIPAKA, LAREY ~~Hanalei~~ # 826-6782
SEA SAGE KAPAA, HI # 822-3841
BILL MANEWAL

JOHNNY DUARTE
BARLOW CHO
Phil Yamagata
? * Misao Miyamoto
Andrew Lowell - died (Anahola)

AREAS ON THE ISLAND OF KAUAI OF SEA TURTLE ACTIVITY

1. MILOLII
2. NOALOLO
3. HAENA (END OF THE ROAD)
4. HAENA PARK PAVILION
5. HANALEI BAY (BEACH HOTEL)
6. PRINCEVILLE b) PEKE RD
   a) PONAHELE Rd
7. ANINI (BLUE ROAD)
8. ANINI (OUTSIDE OF PAVILION)
9. PILAA - KEPOHI PT
10. KAAKAANIO
11. MOLOAA BAY
12. KEALIA - (PALIKU PT)
13. KAPAA LOOKOUT
14. WAILUA
15. KOLOA LANDING
16. PORT ALLEN
17. MAKAWELI - PAKALA

HERBERT KAM, MY MAJOR CONTACT ON KAUAI WHO INTRODUCED ME TO ALL OF HIS FRIENDS WHO HE HAD GONE TURTLING WITH, OR HAD ANY KNOWLEDGE OF SEA TURTLE ACTIVITY. BEFORE HE STARTED FARMING IN 1960, HE CAUGHT QUITE A FEW TURTLES, HIS AREAS THAT HE PARTICULARLY VISITED WERE:

1. Milolii
2. Ninalolo
3. Pilaa
4. Moloaa
5. Beach House, Kealia
6. Kapaa
7. Kamakani -
8. Pakala - Makaweli

THE USUAL METHOD OF CAPTURE INVOLVED A LARGE HOOK TIED TO THE END OF A LINE. THE TURTLE WAS GAFFED AND THEN HAULED ABOARD. AT THE BEACH HOUSE (1946-47) IT WAS NOT UNCOMMON TO GO THERE TO RIDE TURTLES, AND LATER DRAG THEM TO SHORE, BUTCHER THEM AND THE TAKE IT HOME TO KAPAA.

USAGE: MEAT FROM THE TURTLE WAS DRIED, JERKED, BAR-B-QUED, SWEET-SOUR, OR MADE INTO STEW. SOMETIMES THE PLASTRON WAS SEPARATED WITH HOT WATER, AND THE CARTILAGE PUT INTO A SLOW OVEN TO LATER "PUFF" UP, TO BE USED FOR SOUP. FAT FROM THE SHELL WAS SUN-DRIED AND THE LIQUID PUT INTO JARS TO BE USED FOR BURN REMEDIES. MANY TIMES TURTLES WERE CAUGHT

TO OBTAIN THEIR BLOOD AS A REMEDY FOR ASTHMA ATTACKS. I DO NOT KNOW IF THIS WAS A HAWAIIAN OR CHINESE MEDICINE. ALSO SAID THAT SOME PEOPLE ATE THE LIVER, BUT YOU HAD TO BE CAREFUL NOT TO CUT ANY GLANDS, THAT MIGHT SPOIL THE FLAVOR. INTESTINES WERE USED BY THE HAWAIIANS, CLAIMED IT HAD A SOAPY TASTE. SHELLS WERE NOT SAVED AND SO WERE BURIED AT THE BEACH OR DUMPED IN THE BACK YARD.

HE PREFERRED TO HUNT TURTLES IN THE MORNING OR EARLY EVENING. ALSO SAID THAT DURING ROUGH WEATHER THE TURTLES WOULD FLOAT ON THE SURFACE, QUITE EASILY VISIBLE. SPECIAL REFERENCE OF THIS ACTIVITY OF FLOATING TURTLES ON THE SURFACE WAS MADE FOR KAPAA AND HANALEI BAY. THE AREA OF MILOLII AND NOALOLO WERE CONSTANTLY BROUGHT UP WHEN TALK OF CAPTURING TURTLES. INDICATED THAT IF YOU USED A NET YOU COULD CATCH QUITE A FEW, YOU NEEDED A BOAT TO GAIN ACCESS AND THERE WAS A BEACH TO CAMP ON. CLAIMED THAT BEFORE IT BECAME ILLEGAL TO USE NETS, WM. FLEMING WAS THE LAST COMMERCIAL FISHERMAN TO LAY NETS IN THIS AREA. PILAA - AND AREA BETWEEN POHAKU MALUMALU AND KEAUHI PT. WAS FOR MR. KAM ANOTHER PLACE TO CATCH SLEEPING TURTLES. THERE WAS A LARGE FLAT REEF SYSTEM THAT WAS CUT BY SANDY CHANNELS. THOUGH I WALKED THIS AREA FOR A DAY, I DID NOT SEE ANY TURTLES. ACCESS IS BY HIKING ALONG THE COAST, OR BOAT, OR BY CONTACTING JOHNSON RANCH WHO LEASE THE LAND FOR CATTLE GRAZING AND THUS LOCK THEIR GATES. MOLOAA BAY IS A SANDY BAY WITH SHALLOW

REEFS ON THE INWARD SIDES OF THE BAY. THOUGH I HAD HIKED IN FROM KAAKAHUIU, THERE IS A PUBLIC ROAD THAT GOES TO THE BEACH AND A PUBLIC-RIGHT OF WAY. THIS BEACH WAS THE ONLY ONE THAT HAD FECAL PELLETS ON IT (FOUND FOOD) SINCE I WAS HIKING, I HAD NOT BROUGHT ANY THING TO PRESERVE SAMPLES.

MIKE MOOOON: A FIREMAN WHO WORKS AT THE HANALEI FIRE STATION, AND LIVES AT ANAHOLA. IN THE PAST HE USED TO CATCH MANY TURTLES, USUALLY ACCOMPANYING WILLIAM FLEMING. HAS DIVED ALL AROUND THE ISLAND OF KAUAI, BUT NOW NOT JUST DIVES FROM HANNA TO ANAHOLA. ON THE WALL OF HIS HOUSE IN ANAHOLA, FACING THE MAIN HIGHWAY IS A POLISHED TURTLE SHELL 36" (CC) AND IN HIS GARAGE WAS A 38" (CC) SHELL. HE ALSO HAD TWO SMALLER ONES MOUNTED, (ABOUT 15" (C)). MY UNCLE INDICATED THAT THE SHELLS WERE OBTAINED IN THE EARLY 1950's (1951) [OBTAINED PICTURES OF THEM.] I VISITED MR. MOOOON AT THE HANALEI FIRE STATION AND SHOWED HIM THE TOPOGRAPHICAL MAPS AND HE POINTED OUT AREAS WHERE HE HAD SEEN TURTLES.

1. Mililii
2. Njalolo
3. Princeville a) Punahele Rd b) Pepe Rd.
4. Kaakaanio
5. Moloaa
6. Kaomakani - Makaweli

HE BELIEVED THERE WAS A RESIDENT POPULATION THAT TRAVELED FROM NJALOLO, MILOLII TO HANALEI, PRINCEVILLE AND THESE TURTLES WENT BACK AND FORTH. GOOD MONTHS FOR TURTLE FISHING: [APRIL, MAY, JUNE] BEST TIME TO CATCH THEM: MORNING AND SUNSET WHILE THE TURTLES WERE FEEDING. HE ALSO REMEMBERED THAT IN 1960 AT MOLOAA, TRACKS, LIKE CATERPILLAR TREADS WERE SEEN ON THE BEACH, BEFORE HE HAD KNOWN ANYTHING ABOUT NESTING ACTIVITY.

LARRY KAIPAKA and BILL MANEGAL

LARRY IS THE OWNER OF "SEA SAGE" A DIVE CENTER LOCATED AT KAPAA AND POIPU. HE REGULARLY CONDUCTS DIVES - SCUBA TO AREAS WHERE DIVERS CAN OBSERVE TURTLES. THEY HAVE A 21' BOSTON WHALER WHICH IS USUALLY USED IN THE HANALEI AREA. WHEN TOURS ARE GOING THEY USUALLY VISIT THE PRINCEVILLE AREA AND HE SAYS THAT THERE ARE SEVERAL TURTLES THERE. I LEFT WITH HIM, SEVERAL TURTLE SITING FORMS THAT HE SAID HE WOULD FILL-IN. I WAS UNABLE TO CONTACT HIM LATER DURING MY VISIT BECAUSE HE BECAME SICK AND WAS NOT AT HIS SHOP.

1. HANALEI
2. PRINCEVILLE
3. KOLOA LANDING

MISAO MIYAMOTO: A RETIRED FIREMAN, FISHERMAN WHO HAS INTENSIVELY USED THE OCEAN FOR FISH OR TURTLES. OWNS HIS OWN BOAT, POLES, AND QUITE A FEW NETS. HE USED NETS OR CAUGHT BY HAND TURTLES THAT HE SAW, AND STILL HAS TWO NETS IN HIS POSSESSION. (a) Cotton 14½" eye about 300' long 10-15' deep? and (b) Nylon 14" eye 20' deep w/ #60 test and 500' long. THE MANNER IN WHICH HE EMPLOYED THE NET WAS TO FIRST LOCATE THE TURTLE AND BY USING A BOAT TO COMPLETELY SURROUND THE ANIMAL. ANOTHER WAY WAS TO BLOCK OFF A CERTAIN AREA, BOUNDED BY THE SHALLOW REEF FLAT AND THEN DRIVE THE TURTLES INTO THE NET. THE NETS WERE NEVER LEFT OVERNIGHT BECAUSE TURTLES, LARGE OR SMALL MIGHT DROWN - AND NO ONE EATS DEAD TURTLE. THE FISHERMAN MUST OBTAIN THE ANIMAL ALIVE AND BUTCHER IT HIMSELF. ALSO HE KNEW THAT SHARKS WOULD DESTROY THE NET IF TURTLES WERE IN THEM. ALSO WHEN TURTLES DROWN THEY BEGIN TO SMELL. AREAS THAT HE VISITED:

1. NUALOLO - MILOLII
2. PRINCEVILLE
3. ANINI - BLUE POND AND PAVILION

WHEN FISHING FOR TURTLES, HE WOULD GO OUT IN THE AFTERNOON (3-4 pm) USUALLY WHEN HE OBSERVED THE TURTLES FEEDING ON RED LIMU. THE BEST SEASON, WAS NOT DURING THE SUMMER TIME, EVEN THOUGH THE WEATHER WAS NICE, BUT DURING THE WINTER MONTHS DURING BREAKS IN THE WEATHER, WHEN BAY AND THE WATER WAS CLEAN AND DRY. TURTLES WOULD THEN

BE FLOATING ON THE SURFACE.

MR. MIYAMOTO PREFERRED TO EAT TURTLE MEAT THAN BEEF STEAK, AND EXPRESSED LOVING THE TENDERNESS AND FLAVOR. TURTLES THAT HAD DROWNED WERE NEVER EATEN BECAUSE OF THE BAD SMELL, AND WHEN BUTCHERING, GREAT CARE WAS MADE NOT TO CUT ANY OF THE GLANDS ALONG THE SIDES OF THE SHELL' ? MARGINALS OR BILE GLANDS. HE HAD TRIED EATING THE INTESTINES, BUT THE FLAVOR REMINDED HIM OF SOAP. THE LIVER ALSO HAD AN ODD TASTE. HAWAIIANS, HE SAID ENJOYED EATING THE LIVER AND INTESTINES, AND LIKED THE GREEN FAT TO COOK WITH. THE TURTLE FAT WAS ALSO A GOOD REMEDY FOR BURNS, BECAUSE IT LEFT NO SCARS, AND WAS USED QUITE EXTENSIVELY BEFORE KNOWLEDGE OF THE CURATIVE POWERS OF THE ALOE PLANT. PROCESSING OF THE FAT INVOLVED LEADING IT IN THE SUN, AND AS IT MELTED, QUICKLY POURED INTO JARS.

HE ALSO HAD MOUNTED SEVERAL SMALL TURTLES, STUFFED AND POLISHED. AS A FAMILY POSSESSION THEY WERE HIGHLY REGARDED WITH NO THOUGHTS OF SELLING THEM. (PICTURES TAKEN)

A VARNISHED SHELL 36" (CC) HUNG IN HIS GARAGE

I TRIED TO COVER AS MANY SPOTS AS I COULD TO SEE IF OBSERVATIONS FROM SHORE COULD AFFORD ME ANY RESULTS OF TURTLE SIGHTINGS. FROM PRINCEVILLE TO MOLOKAA BAY WERE CLIFFS AND HILLSIDES, THAT MADE OCULAR SIGHTINGS POSSIBLE. OF ALL THE AREAS I VISITED, THE ONE THAT CONTINUALLY PROVIDED ME WITH RESULTS WAS A REEF FLAT AT KAAKAANIO

ACCESS TO THIS AREA IS ALONG A DIRT ROAD THROUGH PASTURE LAND. PRESENTLY, THE SPOTS WHERE I SAT TO MAKE MY OBSERVATIONS ARE BEING BUILT ON, TWO HOUSES AND SOON A ROAD WILL WIND DOWN TO THE BEACH. OBSERVATIONS ON THE HILLSIDE ALLOWED ME TO COVER THE ENTIRE REEF AND NOTICE AREAS OF PARTICULAR CONGREGATIONS OF TURTLES. OBSERVATIONS WERE USUALLY TIMED FOR MID MORNING (7-9 am) and EARLY EVENING (4.30-6.30 pm). AT BOTH THESE TIMES, TURTLES WERE OBSERVED IN NUMBERS TOTALING ABOUT FIVE. DIFFERENTIATION IN SIZES I ESTIMATED THAT THERE WERE SOME LARGE HEADED ONES AND SOME MEDIUM SIZED. THE TURTLES APPEARED TO BE STAYING IN THE SAME AREA, THROUGHOUT MY OBSERVATIONS, AND AS WAVES FORMED COULD BE SEEN UPENDED FEEDING ON THE SHALLOW REEF. THE REEF WAS EXTENSIVE, AND DURING LOW TIDES IN THE MORNING AND EVENING THE TURTLES SEEMED AS IF THEY WERE RIGHT IN THE SURF-STRIKE ZONE.

ON AUGUST 19, FRIDAY I NOTICED TWO PEOPLE WITH A HARPOON ON THE REEF FLAT. THEY WERE HOPING TO SPEAR A TURTLE BETWEEN WAVES, AND WHEN THE TURTLE CAME UP FOR A BREATH. THEY WERE SUCCESSFUL FOR SOON A LARGE TURTLE WAS HARPOONED, AND DRAGGED TO SHORE.

Name?

I PROCEEDED TO INVESTIGATE AND FOUND THE TURTLE ON THE BEACH BEING BUTCHERED. I KNEW ONE OF THEM (BUT STILL AM NOT SURE THAT HE HAS A PERMIT) AND SO WAS ABLE OBTAIN A SAMPLE OF THE STOMACH CONTENTS, HEAD, TAIL AND BODY MEASUREMENTS. AND SINCE IT WAS I WHO WOUNDED UPON THEM, I TRIED TO MAKE MY INTRUSION AS PLEASANT AS POSSIBLE. THE TURTLE WAS TAKEN FOR HOME CONSUMPTION AND THE HARPOON WOUND WOUND, THOUGH SERIOUS DID NOT READILY DISPATCH THE TURTLE.

(S) $32\frac{1}{8} \times 25\frac{7}{8}$

(C) $34 \times 31\frac{1}{2}$

P.L. $24\frac{1}{4}$

Male turtle.

STOMACH CONTENTS:

Pterocladia

quite fresh smelling, full packed, when obtaining sample I thought it had two stomachs (each one w/ a constricting muscle)

ALGAE ON REEF

Pterocladia

Asparagopsis t. (Immokalee)

Acanthophora

WAS UNABLE TO DESCEND INTO THE WATER BY MYSELF BECAUSE OF REPORTS OF A STRONG CURRENT AND SAFETY CONSCIOUS

· Amphipod 6/10/78
To Bill Cooke?

Turtle survey of the Island of Kauai between June 6 - June 9, 1978 by Alan K.H. Kam.*

note * accompanied by Mark Scheele, MOP student University of Hawaii

JUNE 6, 1978 TUESDAY

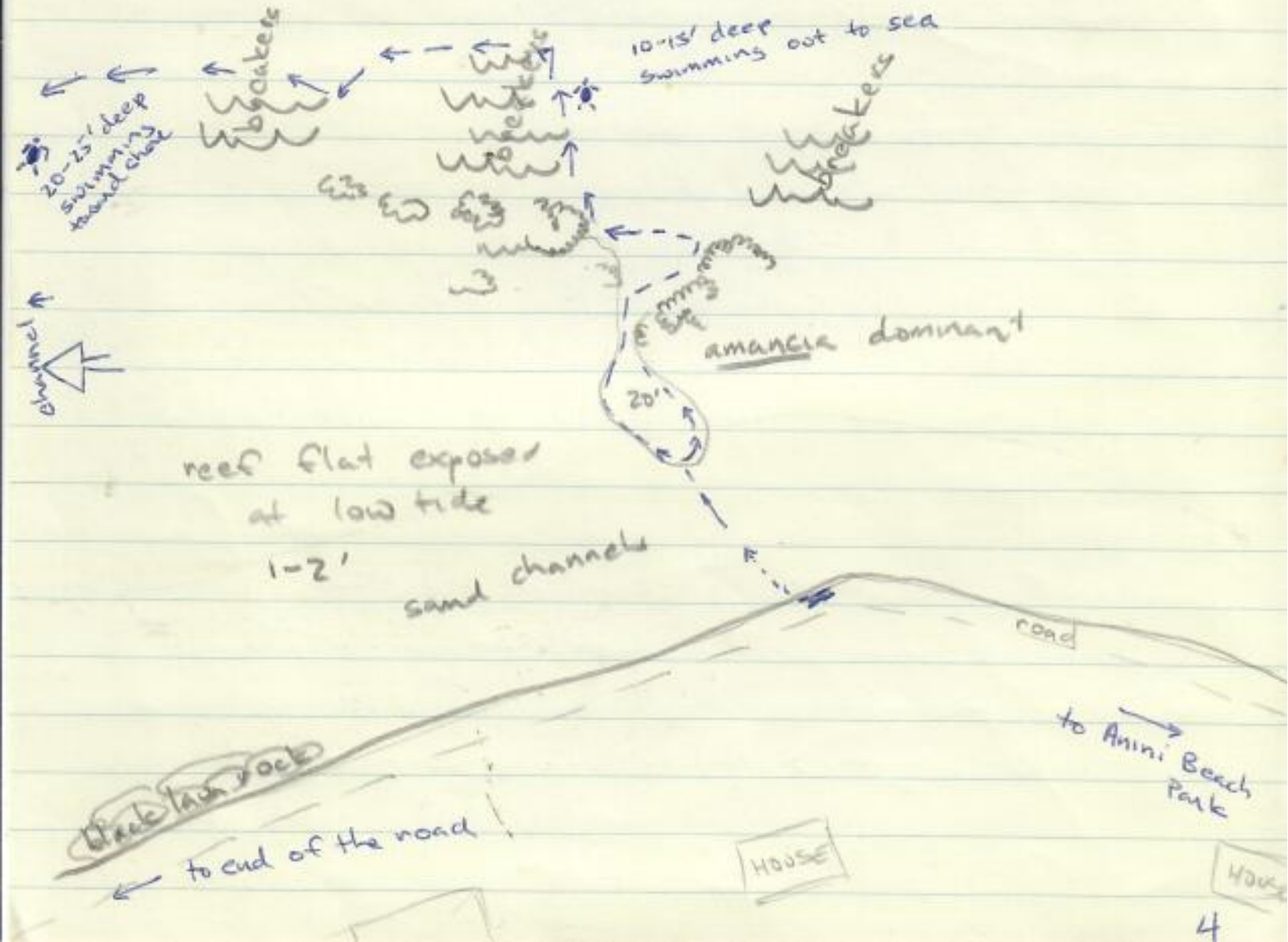
Aloha Airlines to Kauai, leave 0630. Weather over Kauai - cloudy and windy, rain over the mountains. Nawiliwili Hbr. waters brown from runoff and choppy. 90% cloud cover. Pick up car in Lihue from American International (Kauai Sands hotel / car package deal) and head to Kaakaanio and Hanalei to look at water conditions. Attempted to go down dirt road to Kaakaanio, too muddy for car rental. Talked to man in ~~Ford~~ Chev Blazer coming from coast along road, - no houses built and road is very treacherous. Next road down - a cattle road, is unlocked but road is worse. Will go to Hanalei and Haena. After passing Kilauea Bay Lighthoose - closed til 1200 visited an area called Anini, tide rising, a little bit of surf but water looks clean. Checked out small channel where in the past I had caught a turtle. Tomorrow will come here to snorkel and then SCUBA. Proceed to Hanalei, Princeville - Pepe St. and looking from the cliffs try to locate a trail down the cliff. The trail was found, will survey the area with SCUBA, water very clean, looks like an ideal spot for turtles - lots of patches of reefs → therefore ledges, + turtles? Head to Haena,

raing, a few transients on road hitchhiking, locate Dolphin restaurant by side of road near Hanalei river. Reach end of the road, heavy water runoff has cut a 2-3' channel through the sand beach. 1-2 cans of tourist, no Zodiacs, a very peaceful scene, photographs taken. Turn around and visit 'Sea Sage' a dive shop at Hanalei and the go to Kauai Sands, a hotel located on the beach next to 'The Market Place', a trendy Whalers Village-type tourist stop. Weather looks more cloudy, no patches of blue sky so I have decided to go cruising to Poipu - Spouting Horn area.

The water at Poipu was relatively calm, Spouting Horn quite peaceful and looked good for diving. Picked up two aluminum 80's at Sea Sage in Poipu, asked about turtles to the sales man (a black, who surfs and dives). He didn't know of turtles at Spouting Horn and only suggested that a few were seen at Koloa Landing. Went to Brenneckes for some bodysurfing, and then back to the Kauai Sands.

JUNE 7, 1978 WEDNESDAY

Setting up my dive gear I found out I forgot my weight belt (8 lbs) Luckily I had an extra [3 lbs] and Mark S. loaned me another 4lbs along with his SCUBAPRO back buoyancy-compensator (push-button diving). We headed toward Anini at 0700, parked and donned our snorkel gear to first make a survey of the area.



A 1-3 foot breaking swell from the north was creating a current running toward Hanalei. By snorkeling through the surf, a fair amount of area was surveyed. 0745 Mark motioned to me to come to where he was floating. He had seen a turtle on the bottom, siting on the rocks, 10-15 feet below. I could not locate the turtle but finally saw it as it swam out to sea. Carapace covered with calcareous algae, <20" length, not particularly curious of divers. We followed the coast toward Hanalei; the bottom that we surveyed mostly flat, little ledges, lots of manini and surgeonfish. Swam over an area that looks like the channel created by the stream on land (deep enough for boats). Saw a ~~smaller~~ larger turtle, clean shell, >20" length swimming toward shore, unable to follow it. Exited on the shallow reef flat and walked to the beach. Area covered about 2-3000 feet.

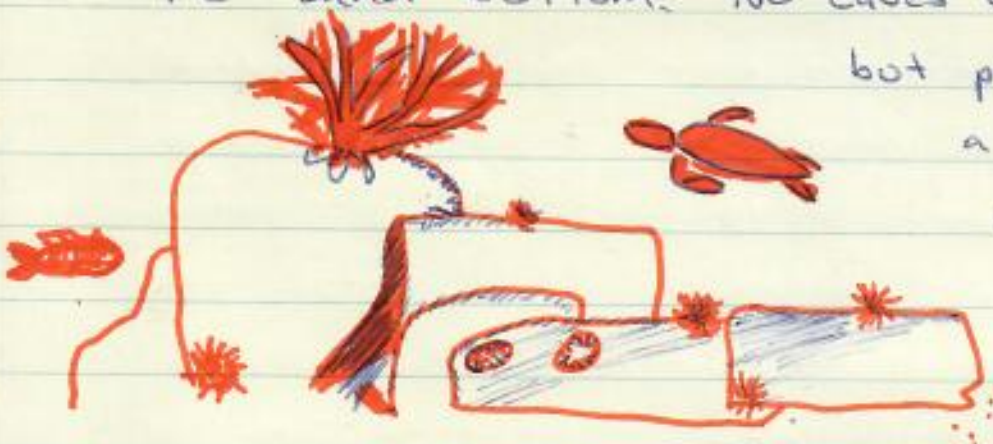
Weather getting a bit more windy, tide rising. A tourist asks us about diving in this area, reply that it is fairly safe and then talk about turtles. Surface interval 45 minutes, don gear - push button diving, air pressure in aluminum 80's = 2800. Enter water in deep channel (15-20') where we snorkeled

previoosly. Silty bottom, deep caves - no fish. This time we followed the channel to the right and as soon as we encountered the breakers made a 180° turn and headed to the first set of breakers on the left. Mark again saw the first turtle and as I tried to head it off, the turtle turned and swam away. It was just too fast for us. (about 20", carapace overgrown with algae. Continued survey, as Mark entered a small cavern and I proceeded above him I spied another turtle leaving the other end of the cave. (about 20", algae covered) Air getting low so rather than exit further up the coast have decided to head straight in, through the rocks and surf. Exit time 1200.

Tide rising, water covering the reef flat and the weather deteriorating I have decided to go to the south shore and perhaps survey Koloa Landing Pick up four aluminum 80's at the Poipo. Sea Sage and gather from the lady salesperson that the water on this side is clean and good for diving.

Enter water at Koloa Landing, easy entry and exit - a boat ramp, no fresh water.

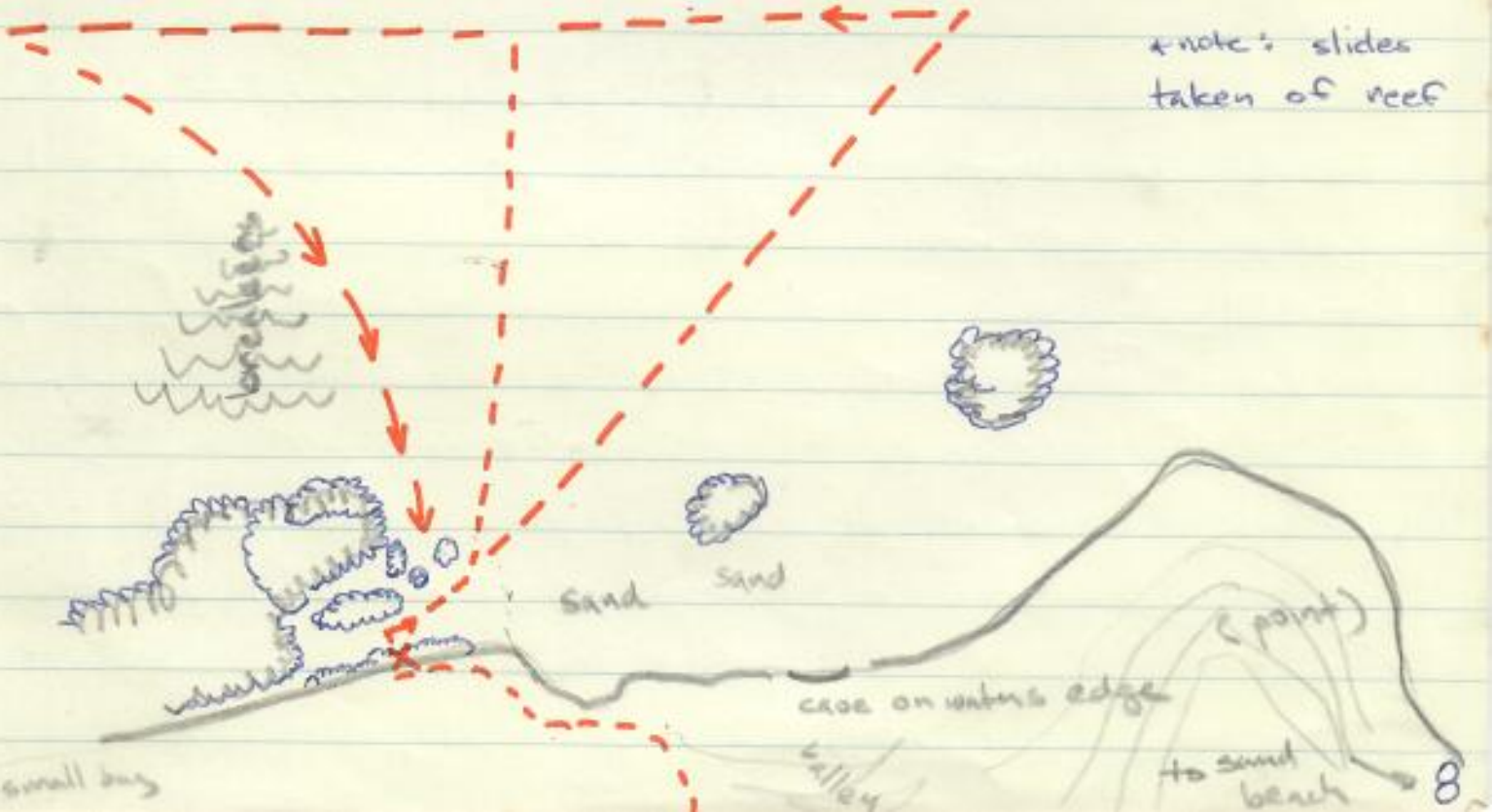
Inflate bacpass and swim-kick out to the dive area. Large boulders immediately off of the Landing, becoming porites lobata heads - very abundant. We have gone to the left, somewhat towards Kauai Sheraton and sank to the bottom in about 30' of seawater. Am following the edge of the reef where it merges with the sand bottom. No caves or large overhangs but perhaps this might be a spot where a turtle might rest. Schools of c. miliaris, and



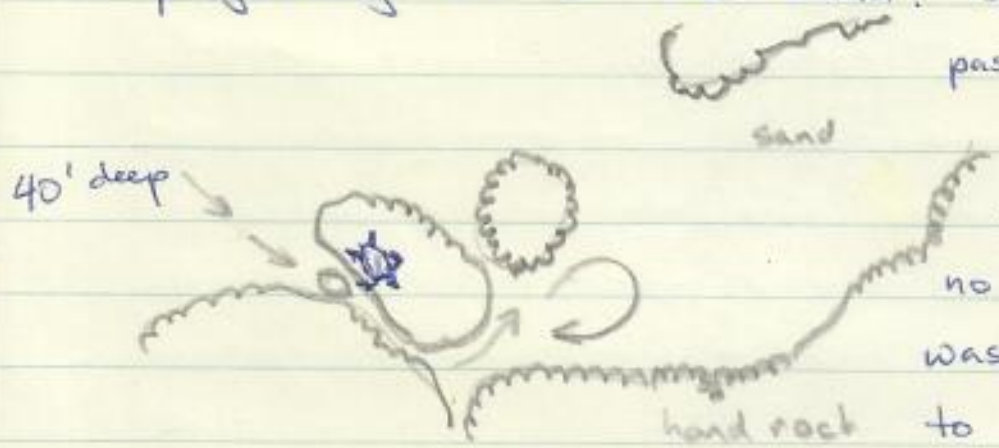
in some of the darker holes, menpachi and aweowea. Did not spot any cowries or lobsters. A few large jacks 3-5lbs. Large coral heads 2½ diameter Pocillipora lingolata, p. meandrina and large heads of porites lobata. Bottom rock is composed of flat volcanic slabs. One turtle seen but too far away to get a good look at it. Exit 1500-1645, drop off empty tanks at Sea Sage with 2 filled ones for tomorrows dive at Hanalei.

June 8, 1978 Thoesday

Wake up at 0600, gather up gear from bathtub and head to Hanalei, Princeville. Drive along main road, turn right at Pepe St; (?) first right will take you to overlook Princeville A.; but follow road to Alii Kai, KAUI to some tennis courts and an empty lot. The trail begins there. Empty lot, down hill, left turn cross stream, up grass knoll and then climb down dirt and then climb down some lava boulders. And when you get to the lava bench, you realize that the water is another 6 feet below you and so an exit point must be found.

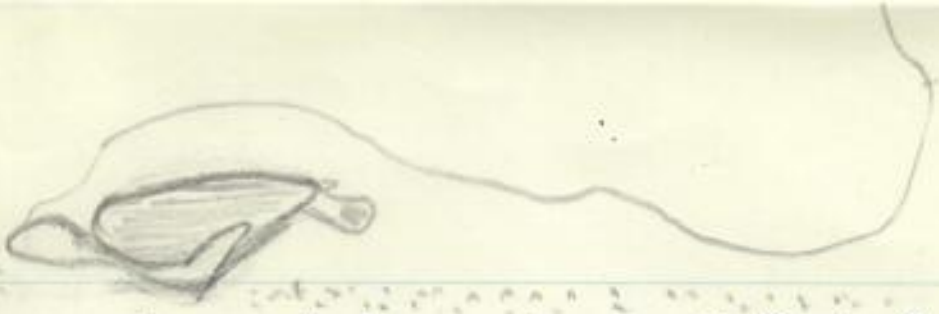


Entered water and inflated backpac B.C. and kicked out on our backs. Very easy tool to use and helpful. Dropped down to a 30' bottom, many caves and overhangs. A hard bottom strata with many deep passages cut through it, sand bottom. Found an area with many rocks projecting out of the sand. I went through a passage exploring the ledge zone between sand and rock. Saw no turtles, but H.S. who was following was able to grab a turtle that was wedged in a recess under the rocks. As we were gaining control of the struggling turtle, I was holding the front flippers when a loud "pop!" was heard. Perhaps the humerus popped out of the acromial process on the radii and ulna junction. But whatever happened, the turtle's left front flipper suffered damage for the turtle was unable to react vigorously in that flipper. We swam to the surface, inflated the b.c.'s and back-kicked to shore. The injured turtle was placed on the lava and we again took to the water in search for a turtle. We dropped down into a roughly circular sandy area and explored the perimeter.



*note: another turtle sighted, no particular information of this sitting

30' deep



Underneath a ledge, about 4 feet from the outside I found a turtle resting upon the sand. Its eyes were open, but was not moving to escape. Because of my gear, it was necessary to use my bang stick to prod the turtle into moving closer to me. My first couple of jabs elicited no response and I had to try to go in deepen to grab the turtle. By knocking the shell a few times the turtle came toward me and I was able to grab it, though it involved the turtle hitting the ceiling and breaking segments of some plates. Exited the water to tag both turtles.

a) first turtle caught by M.S.; injured left front flipper
length (c) 17" width (c) 15" tail: 3 3/8
Tag number # 2501 RFL # 2502 RFL trailing
clean shell, no barnacles, no skin barnacles - when released the turtle swam quickly away.

b) second turtle caught by A.K.
length (c) 18 7/8 width (c) 17 5/8 tail 3 1/8
Tag number # 2503 RFL # 2504 LFL
clean shell, between 4-6 marginal on Right side there is an indentation.

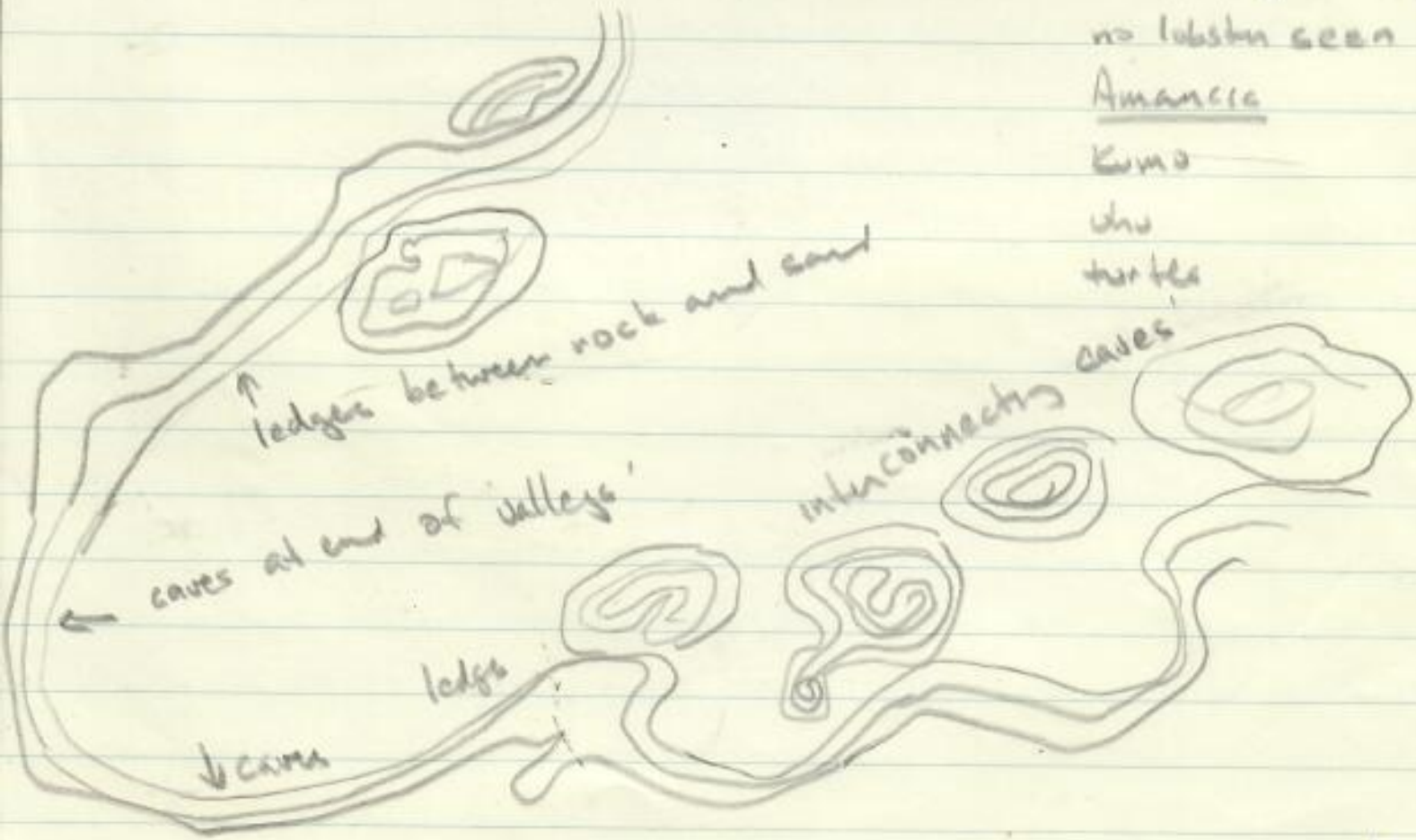
*note: amphipod sample taken from healing wound left hind flipper, delivered to Bill Cooke 6/10

Hiked up the hill, tide rising and water getting more rough. Went to Poipu to dive the right side of Koloa Landing. Picked up four tanks at Poipu, Sea Sage. No turtles sighted. Exit at 4.30 pm. Drop off 2 tanks.

Evening: visit the Hanalei Courthouse for public hearing.

JUNE 9, 1978 FRIDAY

0630 Wake-up, breakfast and then move out of hotel with all gear and baggage. Drive to Hanalei, Princeville A, hike down the cliffs and ready to dive 0900. Lose an o-ring by hitting regulaters first stage against top of cave. Changed in water and survey resumed. Missed a turtle as it came charging at me from a likely looking cave, bounced off the roof of the cave, eluded my grasp and sped past M.S. Another small turtle was seen swimming above me, unable to pursue it, the turtle got away.



no lobster seen
Amancio
Kuma
the
turtles

Due to our flying later that afternoon, I decided to do some visiting, look at Waimea Canyon and Kalalau Lookout. Lv. Kauai 850 pm

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FISH AND GAME
1151 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

20 January 1982

Dr. George Balazs
HIMB

MR. DONALD E. HEACOCK
Division of Aquatic Resources
Dept. of Land & Natural Resources
P.O. Box 1671
Lihue, Kaua'i 96766

Dear George:

Regarding your dossier on green turtle (GT) managemt in Hawaii, my comments are as follows:

First, in Cooper's letter (27 Nov '81) to WPRFMC, he states that "turtles are endangered without sufficient information, we cant catch or eat turtles for our survival, this is our aboriginal right, our working rights... remember, America overthrew our Hawaiian Nation in 1893, and we have never been compensated."

Comments:

1) if turtles are being managed without sufficient information (which Cooper claims) then agencies involved in GT managmt had better collect sufficient informatio as soon as possible! George, you have done, and are doing, an outstanding job on GT biological research - but what additional work can, and should, be done (eg. tagging studies on all high islands for additional growth & migration information).

2) I can sympathize with "Hawaiian Rights". however, regarding biological, socio-economic implications

of species management (any species) the conservation and perpetuation of the species comes above all else! If GT populations are decreasing in Hawaii now, then no one should be able to take them for any reason. Extinction of a species is "no ones" right! Also, Cooper states Hawaiians should be able to participate in a subsistence GT fishery. Let's assume that OHA will set criteria for defining a "Hawaiian" — of this number of people, and, concomitantly, the number of turtles these people would, or possible could, harvest annually is greater than the present annual yield of GT (based on reproduction, growth + natural mortality) then the turtles would be getting "the short end of the stick" of such a Hawaiian subsistence fishery — GT have rights too!

If "proof" could be shown that GT populations are increasing in Hawaii and/or that the GT population size is large enough (based on reprod., growth + nat. mort) to permit a subsistance fishery; then the fishery should be limited to native Hawaiians (criteria set by OHA) only. However, management implications of such a fishery would be complex: "Hawaiians" would have to carry, or have on hand, OHA identification cards while catching turtles, if one saw them catch the turtle they may not verify that it was caught (in other words — as with most "non-commercial" fisheries — no catch reports are legally required, and

it does seem a bit strand or coincidental that Cooper (who represents commercial fishing interests) is asking for a subsistance GT fishery - I can't help but be a little skeptical about his motives.

Finally, I don't think that Alaskans, Hawaiians or most American Indians ever relied on GT! Cooper states that in some areas of the Western Pacific natives are allowed subsistance catch of GT, and that, therefore precedent may be set for a GT subsistance fishery in HI. However, two wrongs don't make a right — if the GT populations are in shabby condition in those areas (of the West. Pacific) then these situations would support not having a similar fishery here. I assume recruitment of GT in Hawaii would be more limited than recruitment in the Western Pacific (with its many islands) therefore, differing management schemes may apply to these areas.

Regarding H. Ego's letter (22 Dec 1981) I am not sure if he is referring to "Hawaiian people" (page 3) "as people who live in Hawaii or Native Hawaiian (an ethnic minority). On page two "Alternative 7- allow subsistance fishing..." of this letter and Arizoshi's comments in the Fed. Register (28 July '75) both refer to all people in HI, not ethnic Hawaiians as Cooper is addressing.

(forgive my chicken scratches!)

What puzzles me is that the State

claims (Fed. Reg. '78) that the regs. on taking GT <36" in legth for home consumption is adequately protecting the GT populations. This implies that the State (HFG) is monitoring GT populations & then recently placed GT under the Wildlife Division!

I could go on but its getting very late (1AM). Hope that I can help you in some way.

Aloha,
Don Hoesch

GT are an important nat. resource (aquatic resr.) in Hawaii and I am anxious to study the populations (route by recording numbers sighted, etc. and hopefully do some tagging here on Kauai) but I don't know what the DOAR official stand will finally be on GT management!

Dear Mr Balaza, April 7, 1982

Recieved your letter on the 6th I wish to give a history about turtle hunting on Kauai. During World War I I became a fisherman, This turtle harvesting started from conservation of meat on Fridays [People invested in boats with no knowledge about fishing so went into turtle hunting.

Here are the areas Waimea Beach 3000 ft. Nights catch 30 to 40 only 150 to 350 lbs Net length 150 yards height 20 ft.

Napali coast Makaha Valley to Awaawa Puhi Valley 3 1/2 miles long. Catch 20-30 the vegetation feed makes a difference. It took only 2 days or 3 days for a boat load. Travel to Honolulu Pier 15 Market Pacific fishing Co. by Mr. Yamashiro Kekaulike St.

Wanini (ANINI?) between Hanalei and Kilauea

Turtle that goes on the beaches Nualolo Kai and Miloli'i. It seems to be a breeding ground I caught so many that we had release many turtle time and again.

If I should write all my feelings toward this helpless industry it going to take days

before I can finish my report to you

Every fisherman who failed to comply with out conservation thinking went out of business. After the World War II is a good example these laws encourage the part time fishermen to destroy our natural resources by greed so what we see today. nothing but problems

I will be in Honolulu in a week or so so I will let these people call you and let you know when I will there.

Mr. Lloyle Gates Mr. Jerry Norris Mr. Paul Bartram Mr. Stanley Swerdloff or Mr. A. L. Symons

Until then

Yours truly

Koichi Masaki

K. Masaki
Waimea, Kauai Box 286
96796

ARCHAEOLOGY ON KAUAI
Kauai Community College
~~RR 1, Box 216~~ 3-1901 Kaumualii Hwy
Lihue, Hawaii 96766

May 17, 1982

Dr. Balazs

Aloha:

Thank you for your letter and newspaper copy of 12 May 1982. I will put both in my files.

I am very familiar with the Kalāhuipua'a fishponds. I did one of the early surveys in the 60's with Dr. John Belshe. Bishop Museum has a report of the archaeological sites found around the ponds. Very good report. The author was Dr. P. V. Kirch.

I am glad someone is taking care of the ponds and putting fry ~~fish~~ to stock the waters. I once knew the Hawaiian caretaker who maintained all 7 ponds. No turtles, all were mullet. I did see a most unusual sight. Traditional references say that a white mullet acted as leader of a school of mullet. I saw 2 white mullet there. I don't know if they were albino but I was most impressed with Hawaiian tradition. The ones I saw were also leading a school of mullet. I hope the new caretakers are keeping the white mullet around. Again much thanks for the clippings!

Sincerely yours
William K. Kikuchi
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Sincerely yours
William K. Kikuchi
William K. Kikuchi

567 South King Street
Suite 200
P.O. Box 3466
Honolulu, Hawaii 96801
Telephone 523-6200

KAMEHAMEHA SCHOOLS / BERNICE PAUAHI BISHOP ESTATE

April 21, 1983

Mr. George H. Balazs
Assistant Marine Biologist
University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P. O. Box 1346
Coconut Island, Kaneohe, Hawaii 96744

Dear Mr. Balazs:

Mr. Malcolm Love is very generous in his opinion on my ability to shed some light on the matter of the green sea turtle. Mr. Love sounds like a member of the M.A.S. (mutual admiration society).

Mr. Love is the only person alive that knows much of anything about the pond at Kalahuipuaa--gathering place of the pigs.

Mr. Love knows about eight years more of the pond's history than anyone else. I doubt that the present keeper knows more than one or two years history of the pond and if he knows anything about the history then I do not believe anyone else would know as much as Mr. Love.

I have never heard of turtles being kept in fishponds to control the growth of limu.

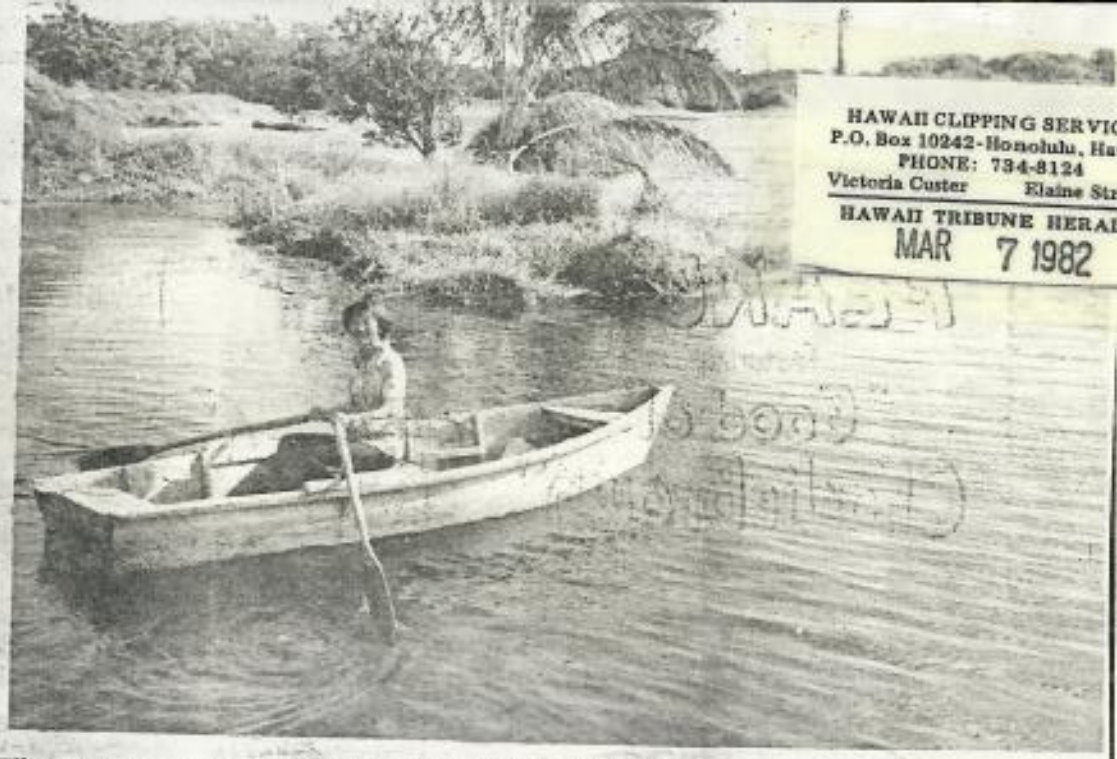
Come to think of it, I wonder how much fresh water a deep water sea turtle can stand. If you have the time I would like to talk to you about this.

Sincerely,

Richard Lyman, Jr.

cc: Mr. Love

With a hand net, Susumu Nakagawa snares a fat mullet from one of the fish holding boxes anchored near the shore. The fish are kept in the boxes for short periods then sold to those who call in orders.



Ellen Nakagawa is accustomed to rowing the small boat into the big pond where her husband sets the crossnets.

—Fourth in an Aquaculture Series—

Tremendous Amount of Work Needed To Rehabilitate Old Fish Ponds

By Maxine Hughes
Orchid Isle editor

"They talk about aquaculture as the coming thing but there are many problems," said Susumu Nakagawa as he looked out over the 30-acre natural fish pond in Keaukaha, adding, "however, we're going to try to make a go of it."

"In our case the problems are mostly with the harvesting methods and establishing a market. And at present the pond is understocked. We've got to rear fingerlings so the pond is filled up and that will take time because it's so big," he said.

Nakagawa, just retired research entomologist with the U.S. Department of Agriculture which included work with the fruit fly, is now spending full time concentrating on mullet, tilapia and aholehole.

The fish farming project is a joint family effort. Nakagawa and his wife

(Continued on Page 23)

T-H Photos by

steamed in ti
her ways and
imous tomato

But the growth rate is slow because the water in the pond, brackish fed by underground springs, is cold.

operation for some years, is knowledgeable in all phases of the project.

"There's a tremendous amount of work to be done," Susumu stated. "Among them, building stone walls to

One method of harvesting the fish is luring them from the big pond, at left, through the trap and into a smaller pond at right, although this is considered inefficient. In stormy weather that is easy. The Nakagawas raise a board on top of the trap to watch the fish pass through.

Upgrading Aquaculture Methods

(From Page 4)

Ellen work every day at the site now that he is retired. They are assisted parttime by his brother Lawrence Nakagawa, principal of Mt. View School, and his wife Harume, who works for Bank of Hawaii.

Even so, progress in upgrading the pond to full capacity moves slowly because of the magnitude of rehabilitation.

The area is a familiar Keaukaha landmark to residents who often remark on a tree in the pond filled to capacity with cattle egrets — that is, when the birds are not promenading on the nearby airport runways.

Also well remembered by kamaainas is a restaurant on the site. It specialized in mullet from the pond steamed in ti leaves and cooked in other ways and what is still called "famous tomato soup."

The fish farming operation and restaurant was established more than 50 years ago by Nakagawa's parents. When the restaurant was demolished by the 1946 tsunami, it was rebuilt at a nearby location and finally the present smaller one was built.

Later an uncle, Shigeru Fukumori, ran the business for a number of years until recently. Now the restaurant is open only on special occasions. But under the current management team, a small snack shop is open on weekends.

In addition, some fish is sold at the pond to those who call and leave an order in advance. This means that only the number of fish ordered are caught the day they are to be picked up.

"This has been only by word of mouth because we don't have enough fish to supply everybody," Susumu Nakagawa remarked. "There is quite a demand for tilapia by the newly arrived Filipinos, who even take it to Honolulu and the mainland."

There are also orders for mullet and aholehole and their is a good potential market for them, according to Susumu.

Developing a market, of course, depends on a number of factors. One is continuously restocking the pond to assure a steady supply of fish to outlets.

"We go out almost every morning to catch baby mullet and aholehole at Wailoa River because they won't hatch in the pond," explained Ellen. "And we're lucky if there's a 50 percent survival rate from each catch."

After the fingerlings are caught they are kept in holding boxes safe from predators until they are two inches long and are then released in the big pond. But the growth rate is slow because the water in the pond, brackish fed by underground springs, is cold.

There are many mullet ponds in the state but they're understocked because of the time consuming chore of collecting the fingerlings, according to Susumu.

However, he says the Oceanic Institute in Honolulu is working on mullet breeding and if successful, they could provide fingerlings for stocking ponds.

"If they can supply baby fish to most of the fish farmers, it would make things easier and it would be a time saver for all of us," he said.

The Nakagawas use crossnets and traps to harvest the fish, methods they recognize must be updated to handle a big scale operation.

"For one thing," explained Ellen, "If you do that often, the fish get wise to what you're doing, they get scared and hide."

Ellen, who has helped with the operation for some years, is knowledgeable in all phases of the project.

"Whether rain or shine, you've got to be here when there's work to be done. And when it's pouring or storming, that's when the fish go into the traps and that's when we catch them and put them in the holding boxes," she said knowingly.

As they contemplate bringing the fish pond to full capacity, Susumu says he is evaluating the potential of tilapia.

"I'm taking a hard look at tilapia. They're hardy, easy to raise and prolific. They grow in any kind of water and eat anything," he observed. "But we don't know what the market is."

Yet with all the unknown factors, some of the basic problems are obvious.

"There's a tremendous amount of work to be done," Susumu stated. "Among them, building stone walls to section off the pond in different compartments. But the biggest chore right now is containing the aquatic grass — it grows rapidly."

And he confirmed another problem shared by other fish farmers — that of poaching.

Nevertheless, the Nakagawa family plans to give fish farming a wholehearted try.

Casimiro Cacho, an employe of Amfac's papaya operation, shows off one of the several tilapia he has ordered. On the scales is a bag of the fish which he says have 'the best taste.'

A SURVEY OF THE NA PALI COAST FAUNA AND ITS HABITAT ON THE ISLAND OF KAUAI - JULY, 1979

Division of Fish and Game
Department of Land and Natural Resources

INTRODUCTION:

In order that the Division of State Parks may fulfill their obligation to develop a management plan for the Na Pali Coast, base line data on the fauna and range conditions of that area was needed. The Division of State Parks, through a memorandum of agreement, requested the Division of Fish and Game to provide the technical staff to conduct a survey during July 1979 to provide this information.

During the period of July 16 through 20, 1979, two wildlife biologists conducted a feral goat census, game mammal range survey and a non-game inventory of the Na Pali Coast between Kalalau and Milolii Valleys. The findings of that survey are presented in this report, along with a discussion of the potential impacts on the wildlife resources resulting from other activities in the area. Specific management recommendations are provided where potential conflicts or needs were identified.

OBJECTIVES:

1. To determine the status, distribution and population trends of feral goats on the Na Pali Coast, Kauai.

2. To determine range conditions and trends on the Na Pali Coast.

3. To determine the status and distribution of wildlife other than game mammals, on the Na Pali Coast.

4. To identify potential conflicts between other recreational uses and the wildlife resources of the Na Pali Coast.

5. To recommend wildlife management measures for the Na Pali Coast.

METHODS:

The wildlife survey work on the Na Pali Coast was accomplished by Ronald L. Walker, Wildlife Branch Chief, and Thomas Telfer, Wildlife Biologist, Kauai Section during the period July 16 through 20, 1979. Access into the area and between survey locations was by commercial helicopter. Four Forestry Division botanists, Ms. Carolyn Corn, et. al., and a contract archaeologist, Ms. Myra Tuggle, made surveys in their fields of interest, and have reported their findings separately. An itinerary of the survey is presented in Table 1.

Feral goat populations were surveyed by walking the same routes used in previous surveys and tabulating goats by sex and age classes. Binoculars were used to aid in making observations when needed. A total goat population estimate for each area was made by using the following formula: Actual number of goats seen/Estimated percent of total area seen, x 100.

Feral goat range conditions were evaluated in three ways: 1. Subjective observations of vegetative conditions and the degree of erosion and amount of vegetation browsed, in comparison to similar observations made during the past ten years in the same areas. 2. Comparisons of current photo station photographs with those taken in previous years, and 3. Analysis of range plants both inside and outside established feral goat range study exclosures (areas fenced to exclude goats). Exclosure analysis consisted of tabulating lists of plant species occurrence, evaluating plant canopy coverage (estimated percentage of horizontal space occupied by each species per unit area), and estimating the degree of plant use (consumption) by goats. Coverage "classes" were used to reduce sampling error or bias. See Table 2 for a description of the coverage and use classes used.

The non-game wildlife and game birds were censused while walking game survey routes and incidentally during other parts of the day. Each species was ranked according to relative abundance. Notes were kept on nesting localities and other pertinent information.

FINDINGS:

Goat Population Status and Trends

Table 3 presents goat census totals for each area surveyed, by sex and age class. Estimated total populations are given in the last column. Table 4 presents goat population survey information collected in a similar manner since 1958 for comparison.

Kalalau Valley was censused on July 16, 1979 between 10:55 a.m. and 5:30 p.m. The feral goat population was considered somewhat below that of ten years ago (1969). A total of 36 goats was seen on the north side of the valley, whereas only 15 were seen on the south side. This type of distribution was typical of previous census findings, possibly because foot access to the southern slopes is easier, and hence has probably been more heavily hunted. Only twenty percent of the total goat range was estimated to have been visible from the transects walks; therefore, the actual goat population of Kalalau Valley, within the accessible area (below 2,000 feet elevation) was estimated at 255 animals. During the heat of the day, the majority of goats occupied the kukui groves and areas forested by yellow guava, and were not easy to census. Some of the goats could be located by their bleating.

Noticeable changes in range conditions from previous visits to these areas revealed the likelihood that the feral goat population had decreased over the past ten years. Some areas previously found heavily grazed by goats, appeared to be nearly unused during this survey. In addition to a possible decreased goat population, there may have been new disturbance factors that have altered goat distribution within Kalalau Valley (helicopters, and increased human activity) and thus affected habitat conditions.

Honopu Valley was censused on July 17, 1979 from 8:55 a.m. to 3:30 p.m. The feral goat population in Honopu was about average when compared with findings of previous years. Forty goats were counted during the survey. An estimated 80 percent of the valley could be visually censused; therefore, the estimated goat population at Honopu was 50. Honopu provides difficult access either by boat or helicopter, and therefore has probably not been as heavily hunted as some of the other areas along the coastline.

Awaawapuhi Valley was reached by crossing over from Nualolo Aina on July 19, 1979 between 7:30 a.m. and 12:40 p.m. Only 4 goats were seen between the valleys while crossing over; none within Awaawapuhi Valley itself, although a moderate amount of goat droppings and trails were noticed. Awaawapuhi appears to support goats intermittently, and there is a definite preference for the makai areas over the deep narrow valley bottom. Two adult goat carcasses were found within the valley bottom and perhaps died three to four weeks prior to our visit there.

Nualolo Aina was surveyed on July 18, 1979 between 8:30 a.m. and 3:45 p.m. The survey party hiked up the valley bottom, then up a pinnacle in the back of the valley, then up a steep side slope to approximately 1,000 feet elevation, down a tributary, and to the head of the valley. A total of 34 goats was seen during the ground survey. Much of the valley floor was hidden by kukui forest, dense lantana and guava thickets: Therefore, only an estimated 65 percent of the total area within the valley was visually covered. The estimated total goat population in Nualolo Aina was 68. A much larger population had been recorded in Nualolo on previous censuses (see Table 4).

Milolii Bench (the makai slope north of Milolii Cabin) was censused early on July 20th, between 5:45 a.m. and 7:45 a.m. A total of 29 goats was tallied in that relatively small area, most of which moved in from the Nualolo cliffs, and a few from the top. Milolii Valley proper, was surveyed between 8:50 a.m. and 11:15 a.m. No goats were seen or heard at all in this area. Very few tracks were seen, though some droppings were observed on the south slope near photo station M-2. Milolii Valley is hunted rather heavily from the top, since it is accessible by a jeep road, and this may explain the lack of goats.

The sex ratio of those goats that could be classified, was 1.31 nannies to each billy. Whether or not this was a valid measure of the overall sex ratio is uncertain. Similar surveys generally favored the nannies slightly to the billies, yet aerial censuses in the mid-1970's revealed a reverse sex ratio, favoring the billies. It was noted in some of the valleys that there were flocks made up chiefly of billies. There were great differences in the sex ratios between the populations of the individual valleys, however the individual valley population samples were too small to provide reliable sex ratio data.

Twenty-one percent of the goats seen (that could be classified) were kids, primarily in the one-half to three-quarter size group. No young kids, in the one-quarter size class were seen. Goat productivity on the Na Pali Coast appeared to be normal.

Feral Goat Range Conditions and Trends

Considerable changes in the vegetation had occurred on the Na Pali Coast goat range from what existed during the last ground survey which was made in 1972. Many of the open areas in Kalalau Valley, formerly grazed by cattle had become further overgrown with shrubs, trees and exotic understory plants. The valley bottom vegetation had matured considerably. Kukui groves and yellow guava thickets had grown and had closed canopies to a greater degree than before. The dominant understory plant, air plant, had become almost a pure stand beneath the guava. Several years ago, air plant was noted as an invading species. There was also noticeable growth and spread of Java plum trees in the valley bottom and behind Kalalau Beach, which was formerly dominated by lantana and koa haole.

On the southern side of Kalalau Valley, an established goat exclosure was analysed on "Cabin Ridge." The results of that analysis are shown in Table 5. Yellow guava had increased its coverage both inside and outside the exclosure. The vegetation in this area was noticeably overgorwn, and hardly used by goats in comparison to what was recorded on previous visits to the area. Alahee (Plectronia odorata), previously heavily browsed by goats in the exclosure vicinity, had become more widespread and had grown considerably. There was only slight grazing of yellow foxtail grass and horseweed (less than 5% of that available) outside the exclosure. All other plant species were untouched. Coverage classes were identical both inside and outside the exclosure, except that molasses grass, an uncommon species in the area, was found outside the exclosure and not inside. Photographs were taken here and further up the ridge and compared to those taken during previous surveys.

The lack of goat browsing in the vicinity of the "Cabin Ridge" exclosure may have been due to the regular use of that immediate site by commercial helicopters for "rest stops." On July 16th, commercial helicopters landed here at least three times (daily visits are probably more frequent than this), and at other times at a point above Kalalau Beach, while we were there.

Further up the south side of Kalalau Valley, there was much less open range land. Goat browsing on air plant, Bryophyllum pinnatum, and West Indian sage, Salvia occ.*, yellow guava, Psidium guajava and Bidens spp. was most prominent in this area.

The Kalalau Valley bottom adjacent to the stream was quite uniformly vegetated with yellow guava, with a dense air plant and fern understory. Goats had browsed chiefly on air plant and elephantopus, E. mollis, in that area.

Vegetation on the northern slope of Kalalau Valley appeared to be in good condition when compared with previous surveys. Goat droppings and trails were common, especially on the lower ridge ends above Kalalau Stream. Air plant and yellow guava had also increased in coverage on the northern side of the Valley.

*tentative identification

Apparently, cattle (one or more) still remain in Kalalau Valley, as droppings and tracks were seen. The State Parks caretaker reported seeing cattle down by the beach earlier in the year. These are apparently remnants of the Gay and Robinson cattle that were grazing in the area until the mid-1960's when most were removed.

Honopu Valley likewise showed considerable differences in vegetation since the last visit made there in 1972. Air plant had spread and become much more dense than formerly. The hau, Hibiscus tiliaceus, patches in the valley bottom, and lantana, Lantana camara, coverage had expanded considerably from what was noted on the previous visits to the area. Goat range conditions were considered "fair" to "good" in Honopu. Well-traveled trails and indications of moderately heavy browse consumption were prevalent on the upper shoulders of the side ridges. One photo station, (H-2) revealed that considerable erosion had taken place since the previous photo had been taken (see Appendix I.0). Though goat trampling and grazing do accelerate and contribute to erosion, it is not likely that these areas would heal even if goats were removed, since the gradient is too steep, and the upper soil horizon has already been lost. Honopu Valley continued to show an increased take-over by exotic noxious plants, primarily lantana, air plant and hau.

Nualolo Aina was also noted to have become increasingly overgrown with exotic plants. Lantana had become more widespread in the upper middle valley; however the kukui and yellow guava had matured and provided a more open understory in the upper valley bottom. Air plant had become well established in Nualolo Aina, whereas ten years ago, it went almost unnoticed. West Indian sage, though existing previously, had become one of the most prominent understory plants, and was one of the most heavily used by goats. Range conditions in the upper slopes, were generally good, despite the prominence of goat trails, and signs of regular goat activity. Air plant and horseweed, Conyza spp. were the most heavily used plants whereas the grasses were only used lightly. It was also noted that the horseweed was not as heavily used in the valley bottom as it was on the upper slopes. It appeared that goats prefer the steep side slopes to the valley bottom for grazing, probably because it affords greater security and a variety of escape routes.

The Nualolo feral goat exclosure was visited on July 19th, and analyzed for vegetative coverage and browse use by goats. The analysis results are shown in Table 6. Horseweed, pili grass and natal red top were heavily used by goats outside the exclosure. Yellow guava, Bidens sp. and narrow leaf plantain, Plantago lanceolata, were not found outside the fence, but did exist within the fence, indicating the likelihood that they had been eradicated by grazing goats in that vicinity. Yellow foxtail grass, Setaria glauca, was noted to have survived as an understory to lantana, whereas pili grass, Heteropogon contortus and natal red-top, Tricholaena repens appeared to be more competitive for open spaces. Yellow foxtail grass is normally one of the more heavily used grasses and probably has survived grazing by goats merely because of the protection afforded by the lantana overstory. Pili grass and red-top did not appear to be favored by goats for grazing. A small grass not able to be positively identified, but appearing to be a brome grass, and swollen finger grass, Chloris inflata were found outside the exclosure but not inside. These are less palatable grasses, and were not

grazed by goats, but had become established where competition had been reduced by goat consumption of the more palatable species. The vegetation at the Nualolo exclosure site did not appear to have changed much since the previous visit, except that pili grass had gained a stronger foothold within the open area of the exclosure. It has been found in the past that severe edaphic conditions on these wind blown cliffs have a great part in determining the condition and make up of range plants, and that the effects of grazing goats may be of secondary importance.

Awaawapuhi Valley had undergone tremendous vegetative changes. Ten years ago, the major ground cover was yellow foxtail grass; lantana was almost non-existent. During this survey, a very dense stand of air plant and West Indian sage covered the valley floor and slopes. Lantana had increased its coverage, but not into the lower mid valley, where it is too shady. The heaviest goat browsing was on horseweed. Air plant, West Indian sage and yellow foxtail grass were used only in moderate amounts. Goat activity in Awaawapuhi was so low that much of the vegetation on the valley bottom was knee deep and used only lightly. The seaward bluffs at Awaawapuhi were dry and eroded as they have always been. The lack of vegetation on these exposed areas is more a result of severe edaphic conditions than heavy grazing by goats.

The Milolii Bench was very dry, choked with lantana, and full of rough broken rock. Very little palatable forage was available in this area. That which existed consisted chiefly of West Indian sage and yellow foxtail grass. Airplant had not yet invaded this area, and possibly may never do so because it is too dry. Milolii Valley proper has undergone remarkable vegetative changes in the past five years. Java plum, koa haole, and yellow guava have matured similarly as in Kalalau Valley, and formed a semi-closed canopy forest and an open understory. Formerly, this area was almost impenetrable, consisting of scrub koa haole, lantana, cat's claw and others. During this visit, forage grasses were waist high, and hardly used at all, owing to the absence of a goat population.

Several photo station photographs taken throughout the Na Pali Coast during this survey trip and previously are presented in the appendix. These can be used for making comparisons with past and future photos at the same locations.

Non-Game Animals and Game Birds

Table 7 shows a list of all non-game and game bird species seen during the week of July 16 through 20, 1979 on the Na Pali Coast. A total of 25 bird species, including the koloa maoli, Anas wyvilliana, an endangered species and the Newell's shearwater, Puffinus puffinus newelli, a threatened species, was encountered on the trip.

One koloa was flushed from the upper Kalalau Stream on July 16th, and four others were observed flying along the coastline at Nualolo Aina early in the morning on July 18th. Use of all of these perennial streams by koloa is probably regular, but intermittent. Several of the streams had abundant opae, prawns, oopu, and aquatic insect larvae which koloa evidently feed upon.

Few Newell's shearwaters have been recorded during previous surveys, and only at great distances, where they were presumably traveling inland to their nesting burrows. This year however, a nesting population of Newell's was discovered behind the Milolii Cabin on the cliff face. The actual nest burrows could not be reached due to the inaccessible sheer rock cliff upon which they were apparently nesting. Characteristic vocalizations of shearwaters were heard just after dusk, and before dawn, that indicated that this was an actual nesting colony. It was judged that these birds were nesting on a shallow ledge approximately 250 feet above the cabin. This nest site is atypical of their normal nesting habitat, which is generally several miles inland, and under dense stands of uluhe fern.

Other sea birds observed during the survey included: brown boobies, Iwa (Great Frigatebird), White-tailed Tropic brids, and Noio (White-capped noddies). The noddies were nesting in two sea caves between Kalalau Beach and Honopu Beach in small numbers, and are not too commonly seen around the main islands. There is another large colony of nesting noddies between Hanakapiai and Hanakoa (an area we were not able to survey) that reputedly is visited by the commercial zodiac boat tours past the area.

A golden eagle, presumably the one first sighted in 1967, was observed above Nualolo Aina on July 18th.

The only game birds encountered during the survey were Chukar partridges, Erckel's francolin partridges, Lace-necked doves, and Barred doves. Ring-necked pheasants, regularly recorded on previous surveys into the area, were heard, but not seen on this trip. Kalalau Valley and Nualolo Valley very likely still support small populations of pheasants. Chukars were very common in Awaawapuhi and at Nualolo Aina. Erckel's francolins were heard in Milolii Valley, but not seen, nor were they heard further to the north.

Green sea turtles were observed between Nualolo Aina and Awaawapuhi and at Milolii Reef. One ± 28" (carapace length) male turtle was encountered resting on the Milolii Reef at low tide. It was checked for tags (none), and was observed to have a large tumor-like growth at the base of its right hind flipper.

Feral cats were seen at Kalalau Valley, along with some semi-domestic cats that frequented the camp sites near the State Parks shed. Feral cats were previously recorded at Awaawapuhi and Nualolo Aina, but not during this survey. Walker noted possible feral cat droppings at Awaawapuhi.

DISCUSSION:

1. Public Hunting

The feral goat population on the Na Pali Coast provides considerable recreation for Kauai's hunters. The hunting season is limited to two months of the year: August and September. It is necessary to permit hunting during the summer months, since many hunters gain access to the area by boat, and can only do so when the ocean is calm. Goat hunting not only provides recreational opportunities, but is a necessity in order that goat numbers do not get out of hand, and cause severe damage

to the range. However, controls on the harvest of goats are also needed so that the recreational value can be maintained. Illegal, out-of-season hunting is suspected to be widespread, since the annual legally reported taken cannot account for the large annual reduction of goats that occurs. Enforcement of the Na Pali Coast against out-of-season and in-excess of bag limit hunting, has been very difficult, due to the lack of manpower, equipment, and access to the area by enforcement personnel. One of the greatest needs on the Na Pali Coast is to increase the effectiveness of the enforcement program. The cooperation of the Parks maintenance staff in the area in reporting suspected illegal hunting activity to the enforcement personnel would be very helpful.

Potential conflicts between hunters and hikers or campers in Kalalau and Pohakuao may exist. Both goats and hikers were seen within the open guava forest in the bottom of Kalalau Valley. The shooting of goats within this densely vegetated area may produce hazards to hikers in the area. Perhaps the upper valley will need to be closed to non-hunters during Saturdays and Sundays in August and September. Signs warning hikers of the hazard need to be thoroughly posted. A year round hazard exists where illegal out-of-season hunting goes on.

2. Helicopter Activity

Commercial helicopter traffic was noted to have some serious potential conflicts with game mammal management on the Na Pali Coast. During the survey, three separate helicopter companies, flying tours along the coast, were observed to produce considerable noise and disturbance. Helicopters passed by in intervals as short as every five minutes in some instances. Low level flights and those up into the narrow valleys were particularly disruptive. Goats have been observed to flee and hide from low flying helicopters; they apparently do not become used to the constant overflights. We have noticed in Waimea Canyon that regular helicopter traffic may be responsible for movement of goats into the forest from the open cliff areas. The regular landing of helicopters near the "Cabin Ridge" goat exclosure in Kalalau Valley may have been the cause of goats vacating that area.

There have been numerous complaints by hunters, who have at great effort gotten into remote areas to hunt goats, only to be frustrated after stalking their game, when helicopters fly by and spoil their hunt. It would be advisable to consider the possibility of regulating aircraft altitudes, and flight paths over the Na Pali Coast, if the area is to be used for wildland recreational purposes. Several members of the survey party were noticeably annoyed by the constant overflights of the helicopters. It destroys the enjoyment of the wilderness aspect of the area. The landing of helicopters any place within the valleys proper should be prohibited. Much of the illegal hunting activity likely obtains access via commercial helicopters, and/or by commercial boats. Strict controls over landings could help to alleviate this problem.

3. Vegetative Changes

Upon assessing vegetation and range conditions on the Na Pali Coast, it was evident that substantial changes have taken place within the past ten years. Many of the invading exotics, such as air plant, Java plum, and yellow guava, have replaced much of what was once grassland. It is more than likely that this trend will continue. Some form of vegetation management may be necessary in some areas if the recreational values of these areas are to be maintained. A forest management plan could be helpful in maintaining suitable areas for recreational purposes, though not much can likely be done to maintain open grasslands that are more suitable for feral goat management and public hunting.

Feral goat grazing and browsing have both positive and negative effects on the existing rangeland. Goats do utilize and help to control some of the exotic plants that are spreading, such as air plant, elephantopus and guava, yet they also consume beneficial grasses, plants and spread seeds. To completely eradicate goats would permit the unchecked growth of many noxious plants. It would eliminate a valuable recreational resource: Hunting. On the other hand, an uncontrolled goat population could cause increased erosion and additonal threat to rare native flora that is already restricted to those sites that are virtually inaccessible to goats. Sustained yield hunting can be justified so long as the goat populations are kept well under control. The most severe damage to the native habitat has occurred in the past when goat numbers were in the tens of thousands.

There are occasionally localized areas overpopulated by goats. Notably, the Pohakuao-Hanakoa area has reached this condition. The reason for these overpopulated sites appears to be related to poor access. Special limited hunting seasons could be declared in these areas if range damage is occurring.

4. Non-Game and Endangered Species Protection

The endangered koloa and threatened Newell's shearwater are relatively safe within the habitats they use on the Na Pali Coast. The only concern is to keep disturbance to a minimum. No immediate threat to either species was apparent under present conditions in the area. The development of higher levels of use further back in Kalalau Valley may be adverse to continued use by koloa, but this is a relatively minor concern.

The Noio (white-capped noddy) that nests in several caves along the sea cliffs should be protected from harassment. The reputed regular passage of commercial zodiac type boats into the sea caves while coming and going from Kalalau should be discouraged, as this disturbance factor could cause the abandonment of these nesting areas by the noio.

Green sea turtles, also an endangered species, are common along the Na Pali Coastline and should be protected against harassment. At one time this species nested at Nualolo Kai and at Milolii. Human disturbance and over-harvest may be the cause of their failing to nest there any more.

Hawaiian monk seals are very rarely seen near Kauai though some day, under protection and management, this endangered species may become more abundant and become a regular visitor along the Na Pali beaches.

Other non-game consist of common native or introduced species of birds and mammals. There are no particular concerns or problems related to them, so long as development does not exceed the wildland management status which the area is to be used for.

RECOMMENDATIONS:

1. Feral goat hunting should be continued as at present (August and September) on a lottery basis to assign weekends to hunters.

2. Special limited goat hunting seasons should be declared for localized over-populated areas by mutual agreement of the Division of State Parks and the Division of Fish and Game, if range damage occurs.

3. Hiker-camper safety should be improved during the goat hunting season by either declaring the upper Kalalau Valley "off limits" to non-hunters during hunting days or by adequately warning the non-hunting public of the hazards, with signs and handouts to be distributed with camping permits.

4. Enforcement of hunting regulations should be greatly increased, not only in Kalalau Valley, but by boat along the entire Na Pali Coast. Adequate funding for necessary equipment, manpower and patrol time must be provided if the area is to be managed properly.

5. The Department should seriously consider a commercial helicopter management policy to limit low level flights and landings to specific corridors, altitudes and sites. No commercial "rest stops" or landings should be permitted in areas that are used for public hunting. Low level flights should be limited to areas not in use by hunters or campers. If campers are permitted access by helicopter, the hours of drop-off should be limited to a specific period of time, so as to avoid constant disturbance in the wildland recreational area.

6. The Division of Forestry should be consulted about means to manage vegetation at specific sites that are to be used for intensive recreational purposes.

7. Commercial and private boat traffic should be discouraged from entering sea caves used for nesting by seabirds.

8. The Division of Fish and Game should be consulted before any large development projects are undertaken that may affect wildlife habitat adversely within the area.

9. Should endangered marine animals (Monk seals or green sea turtles) become regular visitors to the beach areas long the coastline, efforts to educate recreationists on the need to avoid harassment to them is needed.

10. A wildlife survey similar to this one should be conducted every five years to monitor trends and to re-evaluate management concerns.

PREPARED BY:

Thomas C. Telfer by scan
Thomas C. Telfer
District Wildlife Biologist, Kauai

APPROVED BY:

Ronald L. Walker
Ronald L. Walker
Chief, Wildlife Branch
in what Division ?

APPROVED BY:

Libert K. Landgraf
Libert K. Landgraf
State Forester

Date: November 9, 1979

April 19, 1982

Mr. George H. Balazs
Assistant Marine Biologist
University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P. O. Box 1346 Coconut Island
Kaneohe, Hawaii 96744

Dear Mr. Balazs:

In regards to your question on sea turtles - I believe my parents introduced them into the pond merely for people to look at and not for the purpose of controlling limu or for aiding in the culture of mullet and other fish. We do not have any turtles now because of the damage they cause to our fish nets. Our neighbor has a couple of small turtles in his pond and he said they are kept in the pond for looks.

The salinity of our pond is about 2 ppt and the temperatures range around 70 degrees F. ± 5 degrees depending on the time of the year, location and depth of the pond.

Sincerely,

S Nakagawa

Susumu Nakagawa

KAUAI COMMUNITY COLLEGE
University of Hawaii

April 13, 1982

George H. Balazs:

Aloha:

Much thanks for your letter of 6 April 1982. I really appreciate the two post cards of turtles, thank you.

In response to Mr. Alika Cooper's remarks about the use of turtles in fishponds – I have not heard or read anything like he mentions. He may be correct, I have no way of knowing at this time. I do think that turtles were kept in ponds only when they were caught and in numbers that could not justify they being eaten all at once. I do believe the word "occasional" is closer than "often" in reference to turtles being kept in ponds.

It is amazing that no Hawaiian scholar has mentioned the purposeful use of turtles in ponds, therefore, my assumption is that the keeping ~~turtles~~ in ponds was an occasional thing. I have seen turtles in the Kona ponds in the late 60's and believe that they were kept to keep them alive until needed. One fisherman informant mentioned that he did just that. I will go and ask fishermen here exactly what they did with turtles. May be make for an interesting article.

Well, I hope I have been of some help. Please feel free to write me.

Sincerely yours
William Kikuchi
William K. Kikuchi

AN EQUAL OPPORTUNITY EMPLOYER
~~RR 1, Box 216~~, Lihue, Hawaii 96766 / Telephone 245-8311
3-1901 KAUMUALII HIGHWAY

The Honolulu Advertiser

April 29, 1980

Post Office Box 3110 · Honolulu, Hawaii 96802

George Balazs
Assistant Marine Biologist
Hawaii Institute of Marine Biology
P.O. Box 1346
Coconut Island
Kaneohe, HI 96744

Dear George,

I already had a copy of your booklet, but was glad to have another. Thanks.

I've heard from various people over the nine years I've been on Kauai that Sea Green Turtles once laid eggs along the Na Pali Coast. Sadly, I can't remember now the names of most of those informants. Most recently, Duke Wellington, the Kauai manager for Gaspro Inc., 3990C Rice Street, Lihue ~~HI~~ 96766. He recalls being with or talking with old timers who would catch the turtles laying eggs on Polihale beach. They'd flip them over to incapacitate them, he said.

sent 5/6/80

For more information about old timers with possible information, you might get in tough with George Niitani, Kauai State Parks Chief, or with Kauai state wildlife biologist Tom C. Telfer, at the State Building, Lihue.

I hope these fellows can help.

Aloha,

Jan TenBruggencate
Kauai Bureau
The Honolulu Advertiser
P.O. Box 524, Lihue HI 96766

ative Hawaiian Legal Corporation

1164 BISHOP STREET, SUITE 1102, HONOLULU, HAWAII 96813 TELEPHONE (808) 521-2302

September 16, 1982

Alika Cooper & Sons, Inc.
163 Kaiulani Street
Hilo, Hawaii 96720

Dear Alika:

I have reviewed the correspondence you sent me. It appears from examination of said correspondence that the Federal Government in enacting the prohibition of taking sea turtles for any purpose did so without examining all of the information available to determine the true merits of the case. There are 3 areas of use of the sea turtles which must be examined individually:

1. Use of live sea turtles to help aquaculture in commercial fish ponds.

2. Subsistence taking of sea turtles for use in individual Hawaiian diet.

3. Taking of sea turtles for commercial re-sale.

Let us examine each of the 3 areas in sequence.

Area 1: Native Hawaiian Legal Corporation has not had time to investigate the merits of your claim that use of live sea turtles would in fact help aquaculture for the various reasons that you stated. We also have not had time to determine whether or not this was the use which was employed by ancient Hawaiian societies. However, we can definately say that if your assertions prove to be true, then we will support any efforts on your part to attempt to employ live sea turtles for aquaculture purposes.

Area 2: It is clear that sea turtles were in fact captured and eaten as part of the ancient Hawaiian diet. However, in order to establish a position on whether or not Native Hawaiians should be allowed to take sea turtles for their individual diet supplement, NHLC needs additional data. It needs information to substantiate the proposition that if Hawaiian divers and fishermen start taking sea turtles for subsistance use, it will not endanger the existing

sea turtle population in the Hawaiian archipalago. It is necessary that we receive information with respect to this point. Assuming that there is a plentiful population of sea turtles large enough to support a subsistence use for native Hawaiian diets, it still must be established that there are regulatory administrative procedures available that will be able to protect the sea turtle population from an abusive taking by the general population.

Area 3: This area concerns the taking of sea turtles for commercial re-sale. NHLC does not support this type of use of sea turtles for profit. We will support the type of ancient Hawaiian uses of the sea. We do not support the expanding of that type of use for commercial profit.

Therefore, the only area which needs to be explored in depth is Area No. 2 whether or not NHLC will support a subsistence taking of sea turtles for use in the native Hawaiian diet.

If you have any questions concerning the contents of this letter please feel free to call me at my office. I remain,

Me ka'oia'i'o

Gary M. Pakele

GMP/sm

Waimea, Kauai
Sept. 17. 1982

Mr George H. Balazs, Asst Marine Biologist
Hawaii Institute of Marine Biology
P.O Box 1346 Coconut Island.
Kaneohe, Hawaii. 96744

Dear Mr Balazs:-

This is in reply to your letter of Sept. 9. 1982. The Ron Evans you are referring to is Capt Ronald Evans who is in charge of the Pacific Missile Range Facility located at Mana, Kauai.
My experience with green turtles goes back to before World War II and a couple of years after the war. We did not land at Nihoa on account of poor anchorage for Mr Lindsay Tayo's boat but anchored at Necker Kai where Nihoa, safer spot to anchor her boat. I went along as a crew-member but our trip to the Napali coast was not for catching turtles but if while

Torching on the reef we saw across a small turtle we would bring it back with us.

One night while torching before the war we found 25 turtles sleeping on the sandy beach on the far end of Nualolo beach. There is a channel that comes right up to the beach. That was our first experience in seeing turtles on that beach. I would say the turtles weighed in from 100 pounds to 200 pounds. I am not in a position to say whether or not the turtles went up on the beach to lay eggs or simply to sleep on the beach.

In talking to present day fishermen who go to Napili coast to fish when the weather permits they say turtles are very very scarce in Napili coast. Thanks for the identification poster. Hope I have been of some help to you.

Aloha from Kauai

Ed K Robinson

ED K. ROBINSON
P O BOX 515
WAIMEA, HI.
96796

Sunday Travel

The Sunday Star-Bulletin & Advertiser

Kauai: The paradise l

ronn ronck
travel editor

Tell everyone you know. Kauai is back to being beautiful. A recent trip back to Kauai has convinced me that the Garden Isle is once more beginning to take its popular nickname seriously.

Sure, there was heavy damage to Kauai from last year's Hurricane Iwa, but you'd never know it by just driving around the island. Paradise has been found and put back together again. Other than some fallen trees and scores of new roof shingles, the place looks green and growing, a splendid treat for the eyes and spirit.

What? You love Kauai but haven't been back since the hurricane. Do yourself a favor. Get back as soon as you can. If you've never been to Kauai then make plans to go. You'll never find a better time since many of the hotels are now offering special discount plans to re-attract visitors.

From Honolulu International Airport to Lihue Airport on the southeast coast of Kauai it's a 103-mile flight on Hawaiian Airlines, Aloha Airlines or Mid-Pacific. Princeville Airways, a small commuter airline, also lands at Princeville Airport in north Kauai.

The best advice I can give is to pick up a rental car at Lihue Airport. You'll definitely need a car on Kauai for any self-guided sightseeing.

Lihue is the business center of Kauai and the county capital. The most complete shopping facilities are here, including the brand-new Kukui Grove Center, on Kaumualii Highway, with its Liberty House, Sears, Longs, Woolworth, Star Market, Foot Locker and Waldenbooks. Also in the center is the expanded Rainbow Books and Stones Gallery shop, which is the premiere art exhibit space on the island.

From Lihue, sightseers have their choice of two main roads leading to Kauai's attractions. You can take Highway 56 and drive the 40 miles north through Kapaa to Hanalei Bay or you can take Highway 50 and drive south to Waimea and Kekaha. At Waimea most visitors go up into the mountains on Highway 55 to Waimea Canyon and the Kalalau Valley Lookout.

Let's go south today and north tomorrow. Nawiliwili is a mile from Lihue and here you'll find a shopping village and the 11-story Kauai Surf Hotel, the island's only high-rise.

Not far away is the scenic Menehune Fish Pond, an ancient aquaculture project attributed to Hawaii's industri-

Attributed to Hawaii's legendar
off bend of the Huleia Stream.

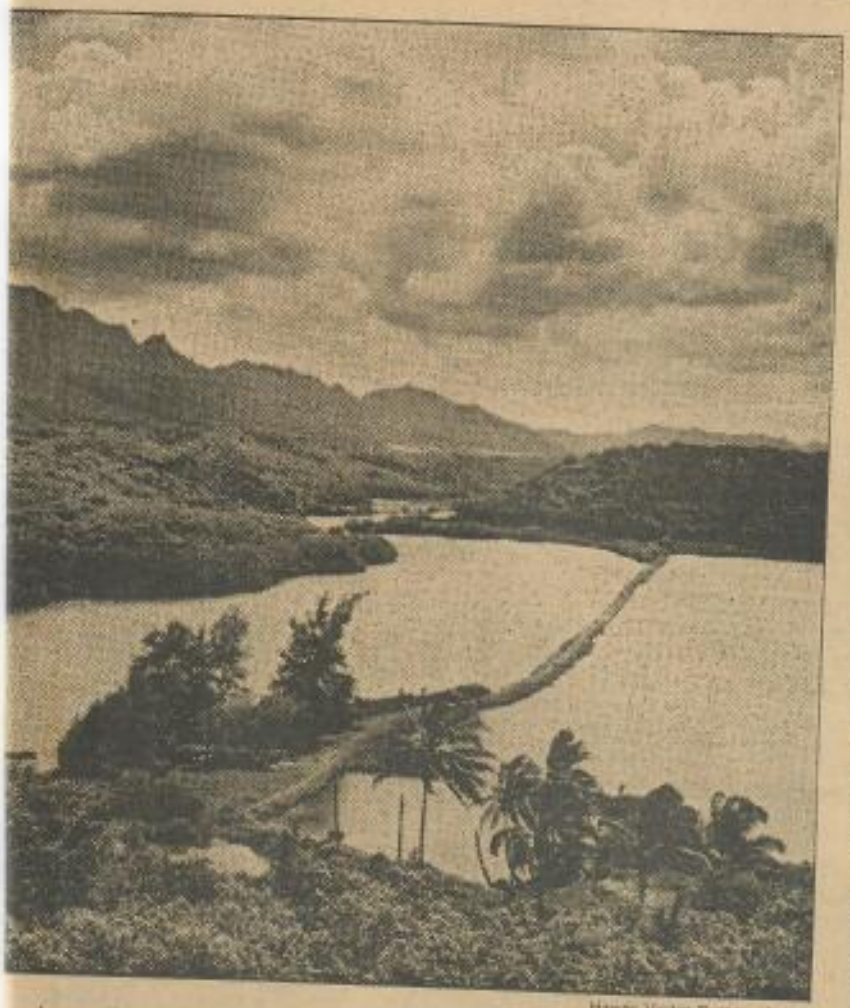
ous "little people," the menehunes. The pond — actually a severed bend in the Huleia Stream — is enclosed by a lava rock wall over 900 feet long. There's an overlook along Niumalu Road that's great for photo-taking.

A little past Kalaheo on Highway 54 you can stop at the Hanapepe Canyon Lookout. I've been told a spectacular waterfall once decorated this valley, but all that's left now is a choice view of red cliffs.

Further down the road is Waimea, once the Polynesian capital of the island. Just before you'll see a sign indicating the location of the old

Prepared by the staff of the Honolulu Advertiser

ost has now been found



Hawaii Visitor Bureau photos

y elves, the Menehune Fishpond, above right, is actually a walled-

shops), the Kauai Sands, Islander on the Beach, the Kauai Beach Boy Hotel, the Sheraton Coconut Beach Hotel, the Plantation Hale, and a few miles away, resort condominiums like the Kapaa Shore which features one, two and three bedroom oceanfront units with full kitchens. There's also a central court area with a 40-foot swimming pool, a large deck and grass area for sunning. Hawaiiana Resorts also operates another resort condiminium, the nearby Kaha Lani which has nine low-rise buildings nestled between a golf course and a park.

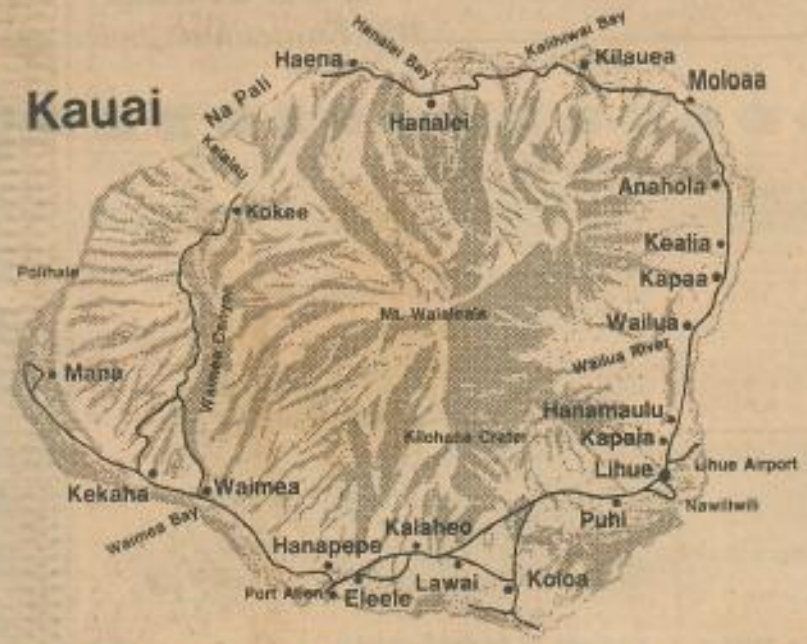
After passing Princeville Airport — where you can take a Papillon helicopter tour above the Na Pali coastline — its 2 miles ahead to Princeville, itself, a self-contained 11,000 acre resort development of individual townhouse communities, restaurants, tennis courts and the famed Princeville Makai Golf Course. Good restaurants, too, like the Princeville Lanai, the Bali Hai and the Beamreach on the upper level at the Pali Ke Kua condiminium.

While at Princeville I took a look at the attractive Pali Ke Kua complex, a set of low-rise one- and two-bedroom condominium units. Though some of the units were hit by Hurricane Iwa, the Pali Ke Kua grouping — like the rest of Princeville — is now back in order and thriving.

After visiting Princeville, stop at the Hanalei Lookout — it's one of Kauai's great vistas — and cross the 1912 steel framework bridge into unspoiled Hanalei. There are several places to stop in Hanalei for food and drink, including the popular Tahiti Nui's Bar.

A little further is Hanalei

Hula dancers attract guests on stage at the Market Place in the Coconut Plantation.



Kauai, the Garden Isle, is the oldest island in the Hawaiian chain.

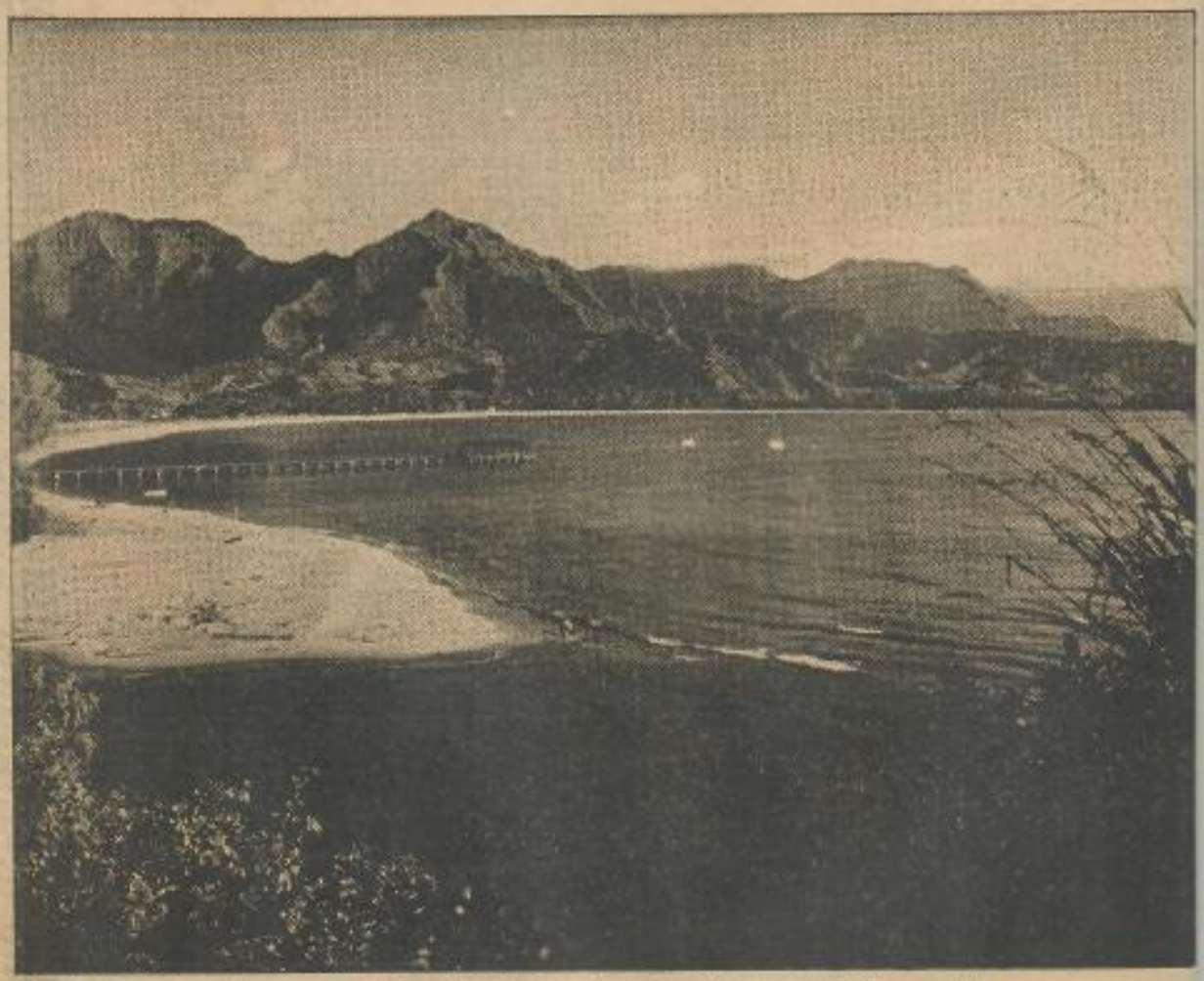
— but don't bother looking for it. The ruins are lost somewhere in the kiawe thicket and the beach is littered with junk.

Some visitors might want to drive on to Mana but it's best to turn up into the mountains from either Waimea or Kekaha. Route 55 is about 12 miles to Waimea Canyon State Park and the 3,400-foot Waimea Canyon Lookout.

If you drive 8 miles farther you'll reach Kokee State Park and the Kalalau Valley Lookout. Some visitors prefer this 4,000-foot view to that of Waimea Canyon. The valley is unpopulated and hiking is not only forbidden but near impossible.

Now it's time to return to your hotel for dinner and relaxation. Don't try to make the trip around to Hanalei the same day. Save this drive for your second day of sightseeing and you'll enjoy it twice as much.

OK, Day Two. On your way north, pull over at Kapaa and don't miss the boat trip up the Wailua River to the Fern Grotto. The Wai-



Hanalei Bay is a favorite spot for picnickers, photographers and visiting yachts.

Visitors can reach the lovely Fern Grotto by taking a short boat ride up the Wailua River.

lua is the only navigable river in the islands and it's associated with a number of menehune legends.

Since 1947 the family-operated Smith Motor Boat Service has been providing daily trips and today there is a fleet of 16 boats with capacities from 15 to 157 people. The trips leave every half hour, from 9 a.m. to 4 p.m.

The island fantasy world at the Coco Palms Resort is worthy of special mention. Located on the opposite side of the Wailua River from Smiths Motor Boat Service, its 416 guest rooms lure repeat visitors back year after year. Honeymooners will find it hard to beat the Kings' and Queens' cottages. These thatched-roof abodes each have a hidden garden with an outdoor lava-rock wall bath for romantic privacy.

The Wailua-Kapaa area features Kauai's largest resort concentration. Besides Coco Palms you'll find the Market Place at the Coconut Plantation (a tourist-oriented shoping center with over 70

Kauai's most photographed beach and the site of filming for the movie "South Pacific."

Haena Point is where the road ends. Ke'e Beach here is popular but unless you've alread got a bathing suit on you'll have to change in your car. There are no changing shelters.

If you're a hardy hiker you can trek and camp out at the various sites along the 11-mile Kalalau Trail, part of the Na Pali Coast State Park. Camping permits are required, and there are other rules, so write to the Department of Land and Natural Resources, Division of State Parks, P.O. Box 1671, Lihue, Kauai 96766.

Since this is the end of our sightseeing trip let me give you two other places to write for information.

- Hawaii Visitors Bureau, 207 Lihue Plaza Building, 3016 Umi St., Lihue, Kauai 96766.
- County of Kauai, Office of Economic Development, 4396 Rice St., Lihue, Kauai 96766. For $1.98 this office will send you its new "Kauai Vacation Guide."

Waimea Canyon was described as the 'Grand Canyon of the Pacific' by Mark Twain.

Sea Trek stalks hidden Kauai

Sea Trek Hawaii, a non-profit outdoor educational outfit based in Kaneohe, is now offering an exciting adventure trek to the Garden Isle for four days and three nights.

The new "Kauai Mini-Trek" provides a "different" way to experience the hidden delights only found off the beaten tourist path. It's ideal for local residents who have always wanted to hike the Na Pali Coast into Hanakapiai Valley, snorkel in Hanalei Bay, and photograph the unique wildlife found in Waimea Canyon.

Each group of trekkers (14 maximum) are led by a knowledgeable staff of trek leaders who are experienced in the out-of-doors and eager to share their knowledge of the Garden Isle's natural and cultural history. All ages can come (children under 18 must be accompanied by an adult) and you do not need to be experienced.

All you need is a good state of health, to be reasonably fit and active, and a desire to participate in an exciting outdoor learning adventure. Travel around Kauai is by 12 passenger mini-bus and lodging each night is in Sea Trek's Eureka four-man tents shared by two.

All meals are included and major camping equipment provided (just bring sleeping bag, pad, and snorkling gear if you want). Come alone, with a friend, or as a family. The sharing of each day's outdoor experiences and outdoor living with a small group of people like yourself is personalized and meaningful to those on their own or with a friend.

Hikers trace an ancient trail leading down to the sea.

The Kauai Mini-Trek operates Thursdays-Sundays beginning at the Lihue Airport at 10:30 a.m. Day 1 and ending at the Lihue Airport at 3 p.m. on Day 4. Reservations can be made by calling Sea Trek's office at 235-6614 or writing for a brochure to P.O. Box 1585 Kaneohe, Hawaii 96744.

The cost of the 4 day/3 night trek is normally $275 per person but for kamaainas who make their reservations for the summer treks before May 9 there will be a 20 percent discount, and reservations made throughout the rest of the year will receive a 10 percent discount.

Sea Trek also offers a 4 day/3 night mini-treks to Maui and 3 day sailing treks aboard a 38-foot sloop to Maui, Lanai, and Molokai. These trips are scheduled in sequence and may be added to the Kauai Mini-Trek for those who are looking for adventure by land and sea.

Meals are prepared by the Sea Trek staff.

Photos by Margy Parker

Heather Harvey walks down Poipu Beach in front of The Waiohai resort hotel.

Gregg Solomon prepares to putt while Marvin Otsuji holds the flag at the recently opened Kiahuna golf course.

Poipu has a golden touch

By Ronn Ronck
Advertiser Travel Editor

During the past two years, the Poipu Beach resort area on Kauai has emerged as a destination in itself. Although there was heavy damage to this side of the island from Hurricane Iwa, the hotels are now back in business as if nothing had ever happened and golfers are pouring in to take their swings at the splendid Kiahuna Championship Golf Course that opened April 15.

Poipu is Kauai's gold coast; long known for its sunny weather, good beaches and fine swimming, it is 15 miles west of Lihue and is a good central location for sightseeing excursions.

On one of the lava promontories in front of The Waiohai Hotel is a partially preserved heiau, one of a series that extended from Poipu Beach to the top pf Mount Waialeale. Hurricane Iwa uncovered a major archaeological site at the original heiau by blowing away the sand to reveal new foundation walls, ancient dike stones, and fishhooks and other small artifacts. New excavations are planned.

Five minutes from Poipu is Koloa, a turn-of-the-century sugar town where the remnants of the sugar mill still exist. The old wooden storefronts contain shopping and dining opportunities in a charmingly rustic setting.

Unless you never plan to leave your hotel, pick up a rental car at Lihue Airport.

At the present time there are about 2,000 hotel rooms and condominium suites in Poipu. Even with this recent development, however, the area seems pretty private — because of Kauai's building limit of four stories.

The major hotels are as follows:

● **The Waiohai.**

It would be hard to top the luxurious Waiohai, with its 460 first-class rooms and suites.

In the basement there's a fully equipped Clark Hatch Physical Fitness center with a glass-enclosed therapy pool. The Amfac hotel has two adult pools, one with a swim-up bar, and a kiddie pool. A heated outdoor jacuzzi is popular with guests.

On the ground floor there are a couple of fine restaurants — beginning with The Waiohoi Terrace, with its open-air seating. It's open for breakfast, lunch and dinner and has a splendid Sunday champagne brunch from 10 a.m. to 2 p.m. that shouldn't be missed.

The Tamarind Room provides an elegant dining experience. Reservations are essential, and coats or long-sleeve shirts are required for gentlemen.

The Waiohai has six tennis courts — four lighted — for play. The Tennis Shop has a complete line of equipment.

● **Poipu Beach Hotel.**

Long a popular family hotel, the Poipu Beach is located adjacent to its more expensive Amfac sister-hotel, The Waiohai, and shares the same beautiful curving beach. It has 142 rooms, all with kitchenette units.

The Poipu Beach has the Hale Ohana Room for dining and the Mahina Lounge for dancing, but guests also like to walk next door to try out out the Waiohai's restaurants.

● **Sheraton—Kauai.**

The Sheraton lost its ocean wing during Hurricane Iwa but it is being restored with new rooms, restaurants, shops and a convention center. The 232-room Garden Wing is in full service, as are its excellent restaurants.

La Coquille provides breakfast, lunch and dinner along with an exciting Polynesian buffet dinner show. Drinks are available at the poolside Lawai Terrace or the oceanside Drum Lounge. The Pareo Pub is ideal for cocktail savoring.

● **Kiahuna Plantation.**

The Kiahuna, managed by Moana/Kauai Corp., has temporarily shut down after Hurricane Iwa but its cottage-style cedar and redwood beach houses will be back in operation by Dec. 1.

Its Plantation Gardens restaurant, located in a former sugar plantation manager's 19th-century home, should be welcomed back warmly.

Meanwhile, the big news is that the first nine holes of the Kiahuna Plantation Golf Course are open, with the clubhouse and second nine scheduled to be ready with the main resort's reopening in December. There is now a temporary pro shop for equipment and rentals.

Poipu has needed a good golf course to attract its maximum number of visitors, but the Kiahuna Plantation course is a lot more than good. It's beautifully designed by Rob-

See Poipu on Page 10

Poipu returns to glory

from page 7

ert Trent Jones Jr. and is able to challenge players at every level. The course also incorporates a number of historical and archaeological remains in its design.

● **Poipu Kai.**

The 240 units of Poipu Kai, managed by Colony Resorts, are set in four different developments, all with their own pools, clustered around the central tennis courts. Now available are one-, two- and three-bedroom units — townhouses and single-level flats — with both garden and ocean views.

The 110-acre Poipu Kai resort also has an excellent restaurant named Kona's.

Other resorts in the beautiful Poipu area, all with rooms available, include the Poipu Kapili, with 60 units; Sunset Kahili, 35 units; Poipu Shores, 40 units; Koloa Landing Cottages, three units; Garden Isle Cottages, three units; Poipu Executive Beach Rentals, six units; Poipu Crater Condominiums, 30 units; and Waikomo Streams Condominiums, 60 units.

For reservations, contact the resorts themselves or your travel agent. Many of the resorts now have special kamaaina rates to attract visitors from neighboring islands back to the Poipu area.

Photo by Margit Parker

Sunset is a romantic experience along Poipu Beach.

Police

by Georgia

Miscellaneous type reports

A call asking police to be alert in case there was trouble at the KCC graduation, from someone who wasn't graduating, but fortunately trouble didn't materialize . . . a report of a man on Kalalau Trail in need of medical assistance (which firemen handled nicely) . . . numerous complaints of barking dogs on Crossley Rd. . . . police were asked to remove "unwanted" from a Po'ipu restaurant . . . a call saying there was a man lying alongside Akahi St. in Lihu'e . . . and a report of a forgery case that required investigation.

A report of a man chasing a woman with a knife at Kapa'a Ball Park turned out to be a case of attempted suicide rather than attempted homicide . . . a request from Honolulu Police Department, asking KPD to investigate a child abuse complaint . . . a report of a teacher harassing a student (and that's a switch) . . . a man called to say his wife had taken an overdose of medication and had just left in the family car . . . a man asked police to help him find his vehicle . . . a report of a vehicle in a ditch by the Wailua Golf Course . . . and a man said he was being harassed by his ex-girlfriend.

A call saying an elderly person had been assaulted by River St. in Kapa'a . . . a request for police to check on an elderly man who seems to be ill and is locked in his room . . . one Lihu'e man claims he was assaulted and another that he was threatened in a terroristic manner . . . gun shots were heard in Kilauea . . . someone heard yelling and screaming near the parking lot at Kuhio Shores . . . police were called to investigate an overdose case at Mahelona Hospital . . . and there was a report of a man yelling by the Shelter (and that's a no-no).

A report of nails on Maluhia Rd. by Koloa . . . police were called to check on a fist fight at Kapa'a Elementary School (and to detain the two assaultees) . . . a call from Kapa'a saying someone had set his car on fire . . . numerous obscene and harassing phone calls . . . reports of pakalolo growing here and there and all around the island . . . a call from Wilcox Hospital saying they were treating a man injured in an Ultra Light plane accident . . . a report of a man throwing rocks at a vehicle with a child in it . . . police checked on dogs chasing children in Kilauea . . . gun shots heard on Powerhouse Rd. on the North Shore . . . Robert Hammond of Kapa'a said a dog killed his chicken . . . and there was a disturbance in the parking lot of a Waipouli hotel.

Several complaints about disturbances outside Vanishing Point in Waipouli . . . an alarmed woman called police to say a man told her he was sick and going to die . . . a report of someone threatening a bartenderess at a Nawiliwili bar . . . police were called when a 14 year old was stranded at the airport . . . domestics (family fights that have gotten out of hand) reported - in a vehicle at Kaikea Lookout, (two) at Po'ipu Kai, and at Kekaha Hawn. Homes . . . a request for assistance from the FBI . . . police were asked to deal with a person at Wilcox Hospital who was presenting problems...a report of two men arguing loudly in a Nawiliwili night club parking lot . . . there was a problem with marijuana at Waimea Canyon (ELEMENTARY) School . . . also, a statue there was damaged . . . reports of drug activities (buying, selling, tending, and possessing) . . . and police were called to investigate four assaults at Kaua'i HS, one at Waimea H S, and two at Hanalei School.

Some people get arrested

William A. Aiken, 21, of Kalaheo is charged with attempting to burglarize a unit at Nihi Kai in Po'ipu . . . George Camarillo, 31, of Koloa was arrested for spouse abuse . . . James Meadows, 48, of Lihu'e was cited for contempt of court . . . John Klodes, 21, and Grant Olson, 19, both of Hanalei, were both cited by a game warden for possession of an endangered species (green turtles) . . . four men from Kapa'a, Daniel Cook, 32, William Stricklen, 18, Dale Swapinski, 29, and Dan Dale, 18, all face felony marijuana charges . . . Mitchell Alapa, 28, of Anahola was served with a summons for contempt of court . . . and Thomas Perreira, 22, of Kalaheo was arrested for assault in the 3rd degree and violation of an order for protection (TRO - temporary restraining order).

Patricio Duarte, 42, was cited for trespassing . . . four students were "arrested" for gambling at Kaua'i HS, two juveniles plus Orlanda Viloria, 18, and Darren Silva, 18 . . . Paul Laporte, 29, of Kapa'a was cited for contempt of court . . . nine year olds at two different schools were detained for truancy . . . James Crawhorn, 25, of Lihu'e was arrested for drunk driving . . . Jonathan Tucker, 18, of Koloa and Duane Patricio, 20, of 'Oma'o, both face charges of theft in the 2nd degree for allegedly stealing gasoline . . . Reginald Kaalehahi, 32, of Kapa'a is charged with trespassing . . . Gino Basconcillo, 19, of Kapa'a, and a juvenile, are charged with burglarizing MacDonald's in Waipouli

News

Mossman

. . . Helen McDonald, 65, of Anahola was cited for contempt of court . . . Frederick Bitterman, 24 of Kekaha is charged with forgery . . . Rock Lacro, 27, of Lihu'e faces two misdemeanor assault charges, terroristic threatening in the 1st degree, and attempted theft . . . and Michael Waterhouse, 30, of Puhi was arrested for drunk driving.

Ferdinand Comisap, 38, of Hanama'ulu is charged with trespassing . . . Daniel Cook, 32, of Waipouli faces a misdemeanor marijuana charge . . . the man taken into custody after a woman passed a note at State Savings saying "call police," then told officers the man had assaulted and threatened her, was released pending further investigation . . . Alan Bird, 36, of Kilauea is charged with promoting deterimental drugs in the 2nd degree . . . there were three incidents where juveniles were detained for shoplifting . . . Marie Moriani, 18, of 'Ele'ele faces a charge of assault in the 3rd degree . . . and Robert Arii of Koloa was arrested for spouse abuse.

Pablo Villanueva, 85, of Hanama'ulu is charged with shoplifting . . . a juvenile was detained for attempting to assault the vice principal at Kaua'i HS . . . Kimberly Cook, 26, of Hanalei was arrested for assault in the 3rd degree . . . Thomas Perreira, 22, of Kalaheo faces (additional) charges of reckless endangering in the 2nd degree and criminal property damage . . . Thomas Huddy, 35, of Kapa'a was arrested for DUI and prohibition (an opened container of liquor in a motor vehicle) . . . Gilbert Garcia, 31, of Kapa'a faces a drunk driving charge also . . . Saturnino Leones, 20, of Koloa was cited for contempt of court (for not showing up on his trial on attempted murder, though he is a guest at KCCC now) . . . and Jeffery Orsatelli, 18, of Kalaheo is charged with assault and harassment.

Bradley Phillips, 20, and Mark Phillips, 26, both of Kilauea, both face a misdemeanor detrimental drug charge and a felony dangerous drug charge . . . Richard Hernandez, 29, of Kilauea was arrested on two assault charges, two terroristic threatening charges (all misdemeanors), on Kaua'i, and on a charge of distributing a controlled substance (heroin) on the basis of a federal warrant from California . . . Robert Gonsalves, Jr., 26, of Anahola was arrested on the charge of theft in the 1st degree . . . Dennis Causing, 32, of Kapa'a, and Charlie Mantaza, both face a misdemeanor detrimental drug charge and a felony dangerous drug charge . . . and John Quellette, 28, of Honolulu was arrested on an assault charge.

Some of the thefts and burglaries

Two reports of theft at Kaua'i HS . . . Vernon Boido reported a theft at Kikiaola Boat Harbor . . . a report from Kai Construction Co. from Honolulu, of a theft from their Anahola Bridge job site . . . someone stole an employee's purse at Waimea Big Save . . . Darrick Callahan of Kalaheo told police his white pick-up truck was stolen . . . Christina Cabangcala of Lihu'e reported the theft of money from her home . . . there was a burglary at Kapa'a HS . . . Stewart Husband of Kalaheo said his wallet was stolen . . . Greg Espina reported theft from a vehicle at Nawiliwili Boat Harbor . . . and David Dambacher of Kapa'a said someone stole his chickens.

A rifle "disappeared" from Woolworth's at Kukui Grove . . . someone broke into Alexander Ruiz's home in Koloa . . . McDonald's at Wailua was burglarized . . . a report of theft from the administration building at Waimea HS . . . a theft at Nawiliwili Marine . . . someone made off with chain link fence from the Water Dept's facility on Kahuna Rd. . . . a refrigerator was stolen from Hanalei Bay Villas . . . JoAnn Carvalho told police a bicycle was taken from Lihu'e Townhouse . . . Young Bros. reported the theft of freight at Nawiliwili . . . and Barbara Watts of 'Oma'o said her purse was stolen from a vehicle at Maha'ulepu.

Someone broke into Palma Kamala's place in Waipouli . . . James Bourdon of Nawiliwili said a vehicle was stolen from the Small Boat Harbor . . . Nicholas Konstantino of Kapahi reported a burglary . . . and there was a break-in at Serra Lumber in Nawiliwili.

A report of theft of jewelry from Kaua'i Gifts at Kukui Grove . . . Pat Naea of Kapahi said her home was burglarized . . . Kyoichi Kanekuni of Kekaha reported a burglary also . . . Beverly Kaiminaauao of Kapa'a told police someone made off with her cable TV box . . . Barbra Boiser of Kapahi said her bicycle was stolen . . . Catherine Benson of Po'ipu filed an auto theft report . . . a battery that belonged in a county vehicle was stolen in Kapa'a . . . there was a burglary at the Lihu'e Plantation herbicide plant . . . and Mary Jane Simao of Kalaheo reported the theft of beer from her garage.

Visitors get ripped-off

Guests from Washington and California had the misfortune to have their rented cars broken into at Polihale . . . visitors from Utah reported theft from their car at Kaua'i Sands . . . there were three burglaries at Kaua'i Beach Villas at Nukoli'i . . . a rental car was broken into at Lumahai . . . and four rental cars were broken into at Huleia Wildlife Refuge in Lihu'e.

We have a lot of honest people too

Beverly Newberry found money near Kapa'a School (and turned it over to police) . . . Elaine Futterer found some traveler's checks at Farrell's . . . Dorothy Kai of Kalaheo found a wallet . . . someone mailed a wallet they found, into KPD, and someone else left a wallet they had found, at the police station . . . Steve Spirik of Po'ipu found a purse . . . Abel Medeiros of Koloa found a wallet . . . Allen Shimizu of Hanapepe said his daughter found a wallet . . . Raymond Fernandes at Otsuka's found a radio and some keys . . . and Ruth Emoto of Lihu'e turned over some wallets found at Tip Top.

KAUAI COMMUNITY COLLEGE
University of Hawaii

August 23, 1984

Dr. George Balazs
National Marine Fisheries Service
Honolulu Laboratory
P.O. Box 3830
Honolulu, HI 96812

Dear Dr. Balazs:

I am returning your 2 color pictures of the petroglyphs. Thank you for letting me see them. I'm just sorry I didn't return them earlier. The next issue of AOK, will be on the petroglyphs of Wailua. There is an unusual turtle petroglyph here. It looks like this:

I dont know but it could be a turtle. Anyway much thanks for your letters and notes.

Sincerely yours
William K. Kikuchi
William K. Kikuchi

CAYMAN TURTLE FARM (1983) LTD.

19 August 1985

Mr. Larry Ogren
National Marine Fisheries Service
SEFC, Panama City Laboratory
3500 Delwood Beach Road
Panama City
Florida
32407 U.S.A.

Dear Larry,

Kind of algae?? salt or fresh?

The turtle could be one of ours. In June 1983 we released a number of yearling turtles in Tarpon Lake in Little Cayman. This pond was becoming overgrown with algae and the local residents asked for some turtles to control growth. All turtles were double tagged with the Dalton tag (blue) of the size shown in the photo you sent. Early this year it was reported to us that all the algae was gone and the turtles in the lake were starving. In February my wife went over and caught and released 12 of these turtles but this particular turtle wasn't one of the tag numbers released. The local residents were going to continue to catch and release the turtles and I would guess that this turtle had been released in that way. Did you notice if it had a notch or a scar of a notch in the 5th marginal scute up from the tail on the right side. All our turtles had a fairly deep "V" cut in this marginal. Tag # 208 weighed 2.6 lbs when released in June '83.

How old then??

Sincerely yours,
CAYMAN TURTLE FARM (1983) LTD.

Jim Wood, Ph.D.
General Manager

>4 lbs in 2 years!

Recap: June 1985 Panama City weight = 6.23 lbs

P.O.BOX 645, GRAND CAYMAN, CAYMAN ISLANDS, BRITISH WEST INDIES
TEL. 809 949-3894 CABLES: TURTLE TELEX: CP4257

Looking at Hawaii through the shifting waters of fishponds

from the sea

mike markrich

There were many things a poor boy could do for fun in Kaneohe Bay during the 1920s. But playing in the neighbor's fishpond was not one of them.

" 'Keiki la'puale,' my grandmother would scold me in Hawaiian. She would call me a little rascal," said Henry Wong, 72, as he watched the rain fall over Kaneohe Bay.

"When I was growing up, people took running fishponds very seriously. The people who had fishponds wanted to keep outsiders away. They knew that other people knew they had fish and crabs in their ponds and they wanted to discourage poaching."

Wong no longer has to worry about getting chased away from fishponds. He has owned one since 1966.

His 10-acre mullet pond, known as Waikalua Loko, is one of the last of the many fishponds that once lined Kaneohe Bay. Most of the ponds he knew as a child have disappeared, replaced by marinas, housing devlopments and concrete.

The Chinese workers in small boats whom Wong knew in his youth no longer can be seen paddling out into the bay to capture the small mullet they cultivated in their ponds.

Most of the large schools of mullet that once frequented the bay are also gone. But Wong's sons still gather the small fish several times a year, and he continues to grow them in his pond.

He is the keeper of an ancient legacy of fishpond management that passed from Hawaiians to Chinese immigrants more than 100 years ago.

There were nearly 350 fishponds in Hawaii when Capt. James Cook first arrived in Hawaii. They were exclusively in the hands of lesser Hawaiian chiefs. But time and the many changes that took place in Hawaiian life after Cook's arrival resulted in a transfer of ownership of these stone enclosures.

The need to keep live fish for royalty lessened after the fall of the monarchy, and many of the Hawaiian families who owned fishponds leased or sold them. Many eventually came to be owned by Chinese immigrants.

The transfer was gradual, said Wong, who is Chinese-Scottish-Hawaiian. "They (the Hawaiians) sold their property for money because they didn't know what to do with it. It was foolish — but it was what they wanted."

Msgr. Charles Kekumano, a longtime student of Hawaiian life, said that in time many of the Chinese immigrants not only took over management responsibility of the fishponds in the countryside but also assumed the role of konohiki — a combination fishpond operator and district magistrate.

He explained that in rural areas the konohiki was often called to settle disputes and act as an intermediary between rural (predominately Hawaiian) residents and people from the royal and, later, territorial government.

Kekumano said that when Chinese immigrants arrived in the Islands in the 1820s, fishponds were of economic importance because they were often the only readily available source of food.

Henry Wong clears

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California-Santa Cruz

Honolulu Advertiser AUG 4, 1985 A3

Advertiser photo by David Yamada

Henry Wong clears debris from the sluice gate. His 10-acre mullet pond is behind him.

He explained that the culture of the southern Chinese who settled in the rural areas of the Islands was similar to those of the Hawaiians. Kekumano said Caucasians could see no value in running a fishpond when a faster financial return could be had fishing in the ocean. The Chinese, however, came from a culture that had stressed raising fish in ponds for thousands of years. He said that peoples from the Hawaiian and Chinese cultures shared many of the same medicines and, as time passed, intermarried.

"This situation was probably unique among Chinese in the U.S.," said Su Cheng Chan, Chinese-American history scholar at the University of California-Santa Cruz.

"I think Chinese immigrants in Hawaii actually moved from being fishpond managers to becoming the most important people in their locality. I don't think that you can find another example of this anywhere in the United States . . . I think the only analogy that can be drawn is with the Chinese in Southeast Asia or certain islands in the Pacific."

Chan, who has recently completed a book on the effects of Chinese immigration on California agriculture, said she studied the fishpond culture in Hawaii while researching her book. She said that the Chinese farmers who settled in Hawaii brought with them a system of fish and rice culture that many of them adapted to their new environment.

Wong loves his pond but admits that it is not what it once was. Leaves, floating cans and other debris get stuck on the makaha or sluice gate and block the free flow of water in and out of the pond. Mangrove trees block some of the stone walls and silt has filled the pond to the point where it is now no more than two feet deep.

Wong said that in times past the Chinese and Hawaiians would clean and scrape the bottom of their ponds constantly. He would clean the makaha three times a day. But nowadays, he said with a smile, his children and grandchildren have other interests. "They just want to go fishing," Wong said.

7/14/87 HSB

No oil washes up on Kauai from spill off Barbers Point

It seems Kauai has been spared any impact from the 4,000-gallon oil spill last week off Oahu, a Coast Guard spokesman said yesterday.

Lt. Cmdr. Ken Keane said there were no reports of oil washing up on Kauai over the weekend or yesterday. He said Pacific Resources Inc. workers patrolling the beaches did not report seeing any pollution.

A Coast Guard plane saw no sign of the oil spill Friday, Keane said.

Keane said it appears the spill did not affect Kauai at all, and the Coast Guard has closed the case.

The oil spilled July 6 off Barbers Point when a feeder hose broke as the Alaska crude was being transferred from an offshore vessel to the Hawaii Independent Refineries plant.

No Mention of turtles

Aquaculture in Ancient Hawaii

Integrated farming systems included massive freshwater and seawater fish ponds

Barry A. Costa-Pierce

A combination of food-producing technologies is required to support a large human population where there is a limited amount of arable land. Today integrated farming systems—combining agriculture, aquaculture, animal husbandry, and waste treatment technologies—are in use in South and Southeast Asia and China, as well as in Eastern Europe and the Middle East.

In Hungary, for example, a ten-year cycle of land and water use is commonly practiced to convert marginal agricultural and waste lands into productive agricultural lands (Brown 1977, Muller 1978). For five years a combination of duck and common carp (*Cyprinus carpio*) farming in ponds produces about 4000 kg/ha/year of ducks and fish. During years six and seven, the ponds are drained and alfalfa is planted in the pond bottoms. Yields of alfalfa are approximately 8000kg/ha in the first year and 6000 kg/ha in the second. During years eight, nine, and ten, rice is planted, and harvests average 3000–3500 kg/ha/year. The ten-year cycle then begins anew with combined duck and fish farming.

Barry A. Costa-Pierce conducted this research for Integrated Aquaculture, Inc., Waimanalo, HI 96795. He is now project leader of the Integrated Aquaculture and Fisheries Development for Indonesian Reservoirs Project and an associate scientist in the Aquaculture Program, International Center for Living Aquatic Resources Management (ICLARM), MC P.O. Box 1501, Makati, Metro Manila, Philippines.

Seawater farming may have originated in Hawaii more than 1500 years ago

In the northern Delta region of Egypt, aquaculture is being used as a first stage of reclaiming over 50,000 ha of highly saline soils for agriculture, and up to 10,000 families are supported by the practice (Cross 1981). In spring, large ponds are constructed in unreclaimed saline soils, which may have salt concentrations as high as 200 parts per thousand (ppt). These ponds are flooded with water of 5–8 ppt for two weeks, then the water is drained. Flooding is then repeated. After the second batch of water is discarded, the ponds are filled to 30 cm depth and stocked with mullet fingerlings (*Lisa ramada, Lisa saliens,* and *Mugil cephalus*) caught from the sea. Farmers regulate the pond salinity by adding water during the season, and no feed or fertilizer is used. Fish are harvested from December to April and yields are 300–500 kg/ha/year.

Low salinity standing water in the ponds forces the higher salinity groundwater downwards through the soil profile, where it is collected in subsurface drains. Each spring the progress of soil desalination is checked by inserting twigs of *Eucalyptus* sp. into the pond soil. If the twigs die, the land is again used for aquaculture; if the twigs live, the farmers know the soil can support a crop of barley. This system reclaims soils over a three- to four-year period and has replaced the costly conventional ten-year reclamation schemes previously used by government engineers in the region.

Similarly, in Thailand, a single large farm may contain several thousand ducks, chickens, and pigs, as well as over a million fish, in a system incorporating anaerobic digestion, waste recycling, and water reuse (Figure 1).

Only recently have scientists begun to understand the fundamental value of integrating food production systems (Bardach 1982, Billard 1986, Ma 1985, Pullin and Shehadeh 1980, Shang and Costa-Pierce 1983). In some cases, however, integrated farming systems techniques have experienced failure due at least in part to socio-economic, cultural, and political factors. Therefore it is useful to consider historical examples of integrated farming systems and their socio-cultural contexts.

Some traditions of ancient aquaculture

Integrated farming systems, which included aquaculture, arose in ancient China, Egypt, and Hawaii, and perhaps also Europe and the southwestern United States. This innovation in food production, which developed in localized regions, may have resulted from extreme population pressure on the production capacities of natural and agricultural ecosystems. There is evidence of both local and widespread famine in ancient China, Eu-

rope, the Middle East, and Oceania. Mallory (1928) reported that China experienced famine in some province nearly every year for over a thousand years. In 1878 Cornelius Walford compiled a chronicle of 350 famines in Europe and the Middle East, going back as far as a famine in Rome in 436 B.C. (Ehrlich and Ehrlich 1972).

Originally, aquaculture seems to have evolved from fishing. Then it developed into integrated agriculture-aquaculture farming systems in the most advanced ancient agricultural societies (Ruddle 1980, 1982). For example, in the upper Mekong River watershed, in southwest China and Laos, ricefield fisheries may have co-evolved with wet rice cultivation and the fermentation of rice and fish surpluses (Ishige and Ruddle 1985). In these systems freshwater aquaculture was integrated into existing agricultural enterprises, creating a new type of agroecosystem.

China is often credited with the development of much of the art and science of modern aquaculture. Chinese fishing methods, fisheries management, and early aquaculture techniques have been documented as far back as 1122 B.C. (Radcliffe 1926). Intensive fishing pressure, due to the great population pressures in the coastal zone of ancient China likely helped initiate the early aquaculture development. Around 2000 B.C. the ruler Yu Wang issued a conservation edict prohibiting fishing during the spawning seasons (Wu 1985). During the Chou Dynasty (1122 to 249 B.C.), Fan Li started breeding and raising common carp in Wuxi, Jiangsu Province, in eastern China. In 473 B.C. he wrote a book entitled *Fish Breeding*, the first known document on aquaculture (Fan Li fifth century B.C.).

Ancient Chinese aquaculture employed only common carp until the Tang Dynasty (618 to 906 A.D.), when the Emperor Li banned the culture, fishing, sale, and consumption of this fish because its Chinese name was the same as that of the Emperor! Over time, aquaculture was begun using five other carp species—grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), mud carp (*Cirrhina molitorella*), and black carp (*Mylopharyngodon piceus*)—whose fingerlings could be easily caught in the Pearl and Yangtze rivers and reared together in ponds. Thus arose the classical Chinese fish polyculture that is widely practiced today (FAO 1983, Ruddle and Zhong 1987).

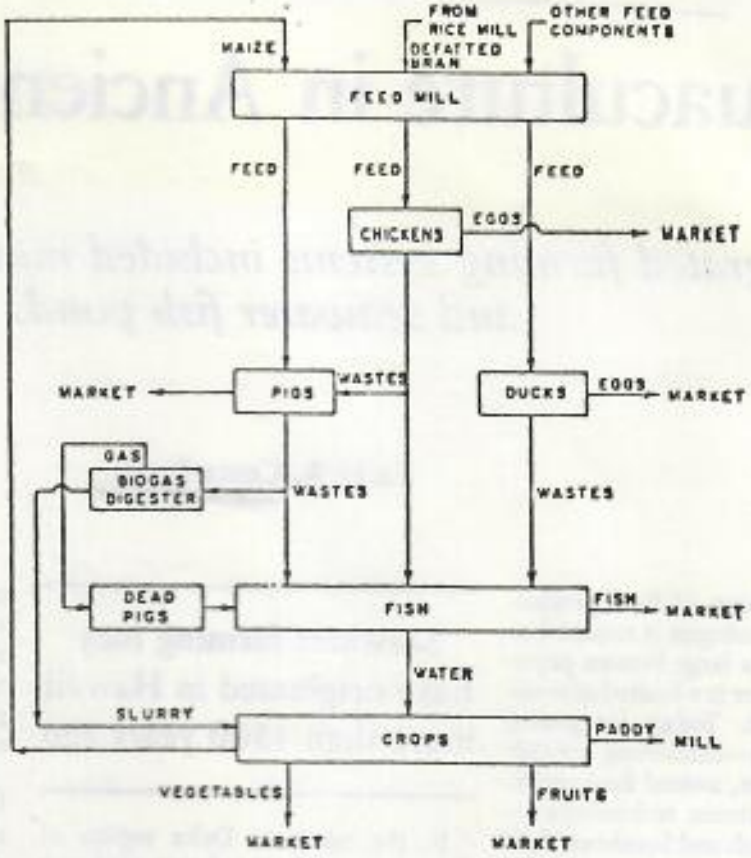

Figure 1. System schematic of Kirikan Farm, Thailand, a large-scale integrated biogas energy-agriculture-aquaculture facility, which illustrates the principles of resource conservation, waste recycling, and symbiotic, high-yielding food production subunits. Modified from Edwards (1980).

It is not clear whether aquaculture originated in China or was introduced from elsewhere before 2000 B.C. Common carp are not native to China but came from the rivers of Central Asia that drain into the Black and Caspian Seas (Schäperclaus 1962). Okada (1960) proposes that the Romans or their predecessors introduced the fish into ancient China and Europe. Thus the origins of aquaculture might lie somewhere in ancient Europe, and aquaculture may have been transplanted into China by ancient trade and migration.

Once established in China, however, fish culture techniques spread rapidly from the Chinese mainland into Japan, but aquaculture in Japan remained unimportant until recently (Drews 1951). Chinese aquaculture techniques also spread into India around 1127 A.D. (Bimacher and Tripathi 1966, Jhingran 1969). More recently (about 1910), Chinese immigrants introduced aquaculture into Thailand (Smith 1925) and integrated farming techniques into Malaysia, Singapore, and Indonesia (Terra 1958).

The sophistication of aquaculture in ancient China has been well documented; however, parallel developments occurred in ancient Egypt. Although no written treatise is known that describes ancient Egyptian aquaculture techniques, well-preserved, magnificently detailed bas reliefs illustrate a highly developed technology of farming the Nile tilapia (*Oreochromis niloticus*) (Chimits 1957).

In a scene on the Tomb of Thebaine (Davis and Gardner 1954), for instance, an Egyptian of importance is sitting in his garden and fishing a drainable, artificial fish tank for Nile tilapia, using a double line with two hooks (Figure 2). His wife is seated

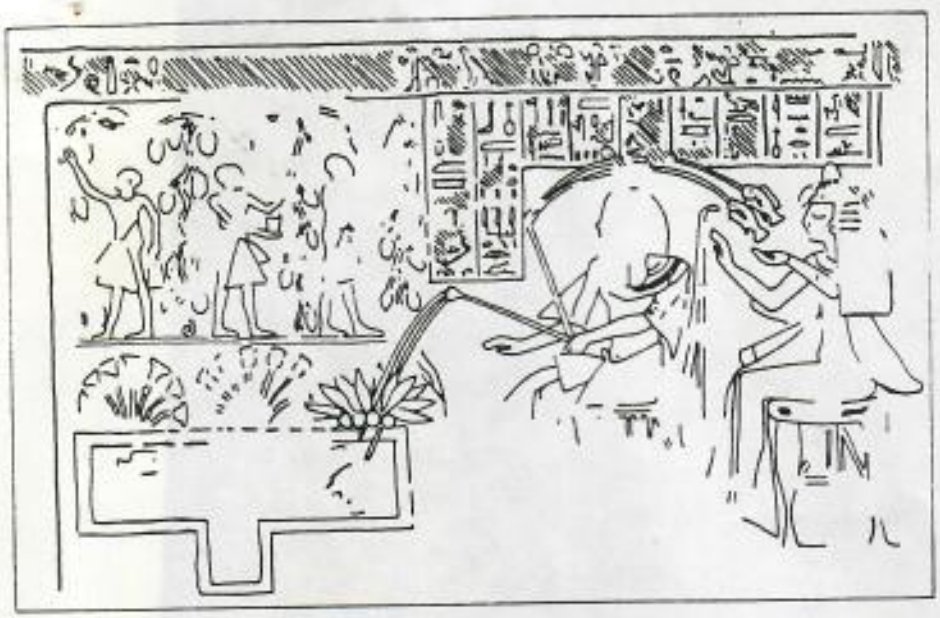

Figure 2. Bas relief on the Tomb of Thebaine, Nile Delta, Egypt, circa 2000 B.C. Note the central drainage canal, floating plants, and juxtaposition of tank to fruit trees. These components are widely used in modern aquaculture to harvest fish, provide shelter for small fish, and reuse wastewaters in agriculture, respectively. Redrawn from author's photographs and Chimits (1957).

just behind him to unhook the catch. The tank has a clearly defined central drainage canal and shallow sides with floating plants as shelter for the fish: In the background are servants picking fruit from trees that are irrigated by water from the fish pond. This illustration indicates that fish culture in artificial ponds was used in conjunction with agriculture before 2000 B.C. in Egypt, and the system provides a remarkable parallel to ancient Chinese integrated farming systems.

With a system of canals and gates, ancient Egyptians managed large inland lakes for fish production. Isaiah's prophesy (19 Is 10) was failure "for all that make sluices or ponds for fish," referring to the ancient Egyptians (Fryer and Iles 1972). These techniques are described further:

> Lake Moeris, which is in a very dry region, is fed by an artificial canal coming from the Nile; the water flows into the lake for six months, and back from the lake into the Nile for another six months. With the water flowing back into the Nile, the lake brought to the Royal Treasury, through its fisheries, one talent [35 kg] a day. While flowing back into the lake, the output was only 20 mines [11 kg].
>
> —*Herodotus*, Book II written circa 450 B.C. (Chimits 1957, p. 214).

In addition to the Chinese and Egyptian examples of ancient aquaculture, fish culture or fish "storage" may have been practiced in ancient Poland (Bogucki and Grygiel 1983) and in the US Southwest (Figure 3) (McCown and McCown 1982). But more careful studies are needed to document true aquaculture at these sites.

The ancient aquaculture and integrated farming systems of Hawaii exhibit a very remarkable sophistication in terms of their diversity, distinctive management, and sheer extent of development, especially given the small size of Hawaii. Although the Hawaiian systems are only 1500–1800 years old (a comparatively recent development by Chinese and Egyptian standards) mariculture—seawater farming—may have originated in Hawaii.

Socio-cultural system of ancient Hawaii

> The whole distance to the village of Whyeete is taken up with innumerable artificial fishponds extending a mile inland from shore, in these the fish taken by nets in the sea are put, and though most of the ponds are fresh water, yet the fish seem to thrive and fatten. . . . The ponds are several hundred in number and are the resort of ducks and other water fowl.
>
> —T. Bloxam, British naturalist on *H. M. S.* Blonde, describing Waikiki in 1825 (Handy and Handy 1972, p. 482).

The ancient Hawaiian fishponds were part of a large, integrated, and complex Hawaiian subsistence and barter economy that included agriculture, aquaculture, and animal rearing. The political aspects of this sociocultural system contributed greatly to the development of the expansive aquaculture-agriculture network.

Hierarchical political control and redistribution of food was essential to the smooth functioning of the ancient integrated farming systems, because construction and management of the huge fishpond complexes required sizeable labor forces. Massive ponds such as the Kaloko pond in Kona, Hawaii, have a 229-m-long wall measuring about 2 m high and 11 m thick at the base. This wall contains an estimated 150,000 m^3 of rock and fill (Apple and Kikuchi 1975). The Kuapa pond at Maunalua, Oahu, was reportedly built over several years by thousands of people who formed long human chains to transport rocks from the Ko'olau Mountains. Efforts of this magnitude obviously required great social organization.

Ancient Hawaii had highly stratified chiefdoms with a well-defined class structure separating chiefs, advisors, stewards, and commoners. This organization was similar to that of the chiefdoms found in Tonga, Samoa, and the Society Islands (Sahlins 1958). Prior to 1848, all Hawaiian land—its resources, fishponds, and communal and spiritual centers—were owned by the kings (*ali'i*). The kings would contract the bulk of the land and fishponds to lesser chiefs (*konohiki*) but keep sacred and special resources, such as fishponds that produced especially tasty fish, under their direct control. Couriers would transport, from these royal ponds to the court, plump fish in water-filled gourds or by hand (Rice 1923) (Figure 4).

Konohiki were granted large, wedge-shaped areas (*ahupua'a*) of the Hawaiian islands that encompassed entire valleys and stretched from the mountains to the sea (Lind 1938)

Figure 3. Aerial view of fish ponds, possibly built by the Palm Springs or Cahuilla Native Americans, along the shore of ancient Lake Le Conte, now west of the Salton Sea in Southern California. Numerous circular and rectangular ponds can be seen along the former lake shoreline. It is not yet known if true aquaculture or simple fish trapping occurred in this region, but growing archeological evidence exists that a highly sophisticated agricultural/fisheries society trapped migrating fish from the ancient lake, cultured them in small ponds, and reproduced them for distribution elsewhere. Photo: Frank Colver with permission from B. H. McCown, Archaeological Survey Association of Southern California, Redlands, CA.

(Figure 5). These *ahupua'a* were generally not demarcated in Hawaii; no evidence of erect stones marking individual land holdings, such as in Tahiti, have been found (Handy and Handy 1972). It appears that the *ahupua'a* were mainly political subdivisions granted by the *ali'i* to *konohiki* to assure subsistence supplies of food, firewood, timber, thatch, and ornamentation.

Handy and Handy (1972) have described a share-cropping arrangement between tenant families and the *konohiki* that was "comprehensive and reciprocal in its benefits." Within an *ahupua'a* were sections of land (*'ili*) granted to individual extended families (*'ohana*) for cultivation. These temporary or permanent land divisions within the *ahupua'a* were clearly marked and carried individual titles. "It was said that in every com-

Figure 4. "Makoa," an illustration of the Hawaiian fish couriers who carried fresh fish over long distances from royal ponds to the travelling court of ancient Hawaiian kings. Print: Dietrich Varez, Volcano, HI.

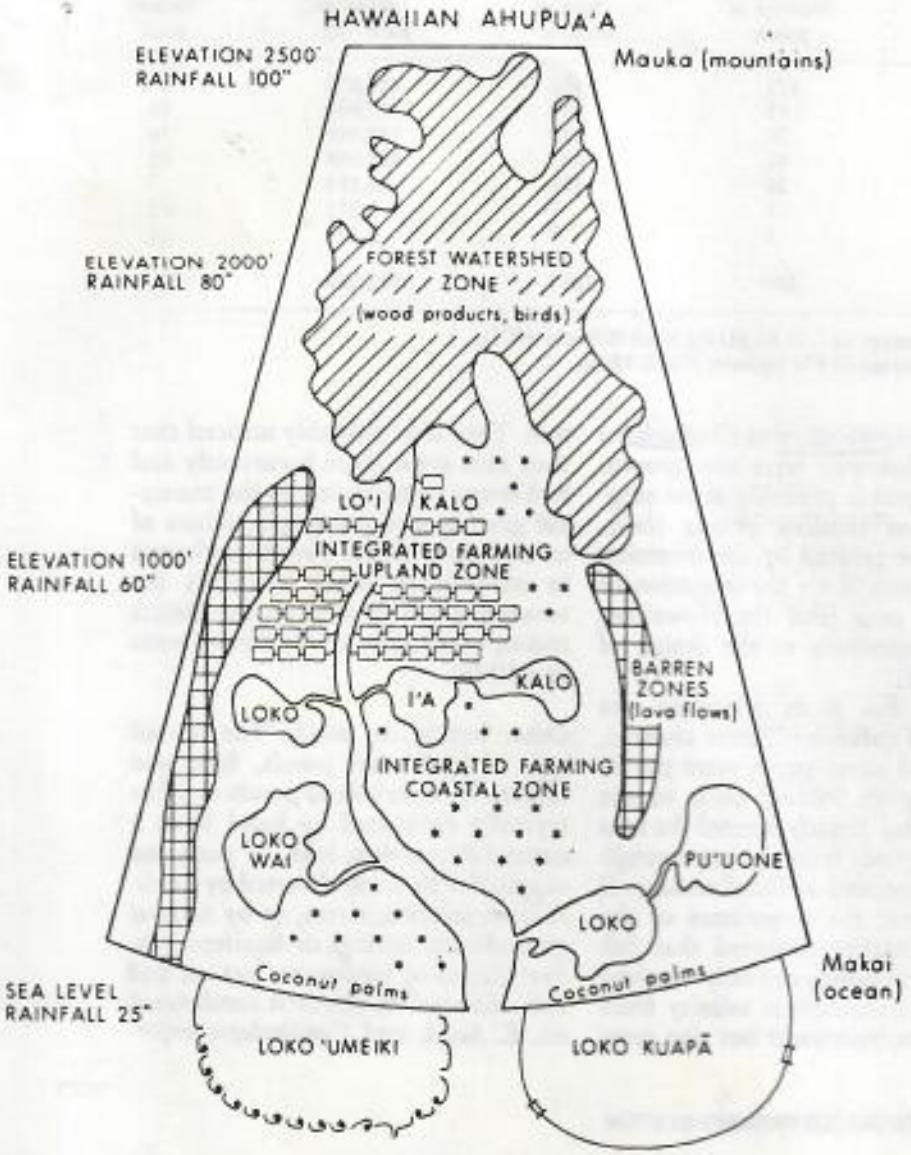

Figure 5. An idealized Hawaiian *ahupua'a* showing topographical placement of freshwater, brackish-water, and oceanic integrated farming systems. Stars indicate placement of settlements. The systems were very diverse and were adapted to the wide range of environments present, but typical valley systems of this type would be approximately 10 km from mountains to ocean and 10–20 km along the shoreline.

munity there were individuals who were well versed in the local lore of land boundaries, rights, and history" (Handy and Handy 1972, p. 49).

All harvests from the fishponds were distributed in a politically institutionalized manner by the *konohiki* to the *'ohana* and pond workers living in the *ahupua'a*. Kikuchi (1976) has suggested that the fishponds were symbols of the chiefly right to conspicuous consumption and the exclusive ownership of the land and its resources, and that the fishponds were the subject of frequent intertribal and intratribal conflict.

Kamakau (1976) argues, however, that the presence of the fishponds did not indicate any contempt on the part of the *konohiki* for the local populace. He stated, "How could they have worked together in unity and made these walls if they had been frequently at war and in opposition one against another? If they did not eat the fruit of their efforts?" Indeed, a native Hawaiian, David Malo, wrote of a Big Island chief who was killed because of his cruel efforts to exploit his people when he ". . . made the people of Ka'u sweat and groan . . .[with] the building of heavy stone walls about several fishponds. . ." (Malo 1951).

Contact with Europeans, which began in 1778, had a variety of dramatic effects on Hawaiian society. It destroyed the ancient religion and the chief's supernatural right to control all the land, its resources, and its people. The economy changed from the traditional barter system to a money economy. Contact with foreigners also brought new diseases, which led to the massive depopulation of Hawaii.

The Hawaiian land decision of 1848 allowed the purchase of land by Hawaiian commoners and by foreigners. In many areas the largest purchase of government lands was by foreigners; some foreigners purchased thousands of acres for $.25–$.50 per acre (Kelly 1980). This land decision (locally known as the Great Mahele) was a pivotal point not only in Hawaiian history but also in the history of the integrated farming systems. Decline of the fishpond complexes and Hawaiian integrated farming systems was rapid after the Great Mahele.

Once the harvests from the lands and fishponds became economic entities with prices, their distribution tended no longer to follow either an institutionalized pattern of sharing (Handy and Handy 1972) or of exploitation of the commoners by the chiefs (Kikuchi 1973), as before the Great Mahele. With the general demise of native Hawaiian society, the majority of Hawaiian integrated farming systems fell into disuse and disrepair.

When Captain James Cook reached Hawaii in 1778, at least 360 fishponds existed. They produced some 900,000 kg fish/yr (Table 1). According to the State of Hawaii only 28 ponds were suitable for fish culture in 1977 (Madden and Paulsen 1977); by 1985 only seven ponds were in commercial or subsistence use. These ponds produced 15,000–20,000 kg/yr, a mere one to two percent of the earlier production.

Integrated farming systems

Four basic types of fishponds and one fish "trap" were known in ancient Hawaii and were integrated to various degrees with taro (*Colocasia esculenta*) agriculture. Ponds were fed with cut grass, mussels, clams, seaweeds, and taro leaf from adjacent

agricultural or natural ecosystems (Titcomb 1952, Wilder 1923). In contrast to modern integrated systems, Hawaiian fishponds did not receive fertilization from animal or human wastes or kitchen refuse; the chiefs prohibited such waste use (Kikuchi 1976).

The diversity, extent, and number of fishponds in Hawaii before contact with Europeans is impressive. The various fishponds (Figure 6) spanned the natural salinity range of water. The four types of fishponds (Figure 7) developed within the *ahupua'a* were:

- freshwater taro fishponds (*loko i'a kalo*)
- other freshwater ponds (*loko wai*)
- brackish water ponds (*loko pu'uone*)
- seawater ponds (*loko kuapa*)

An additional type of pond (really a fish trap) was known as *loko 'umeiki* (Summers 1964).

Freshwater taro fishponds. The taro fishponds (*loko i'a kalo*) were developed in the uplands to cultivate taro and simultaneously grow a limited range of euryhaline and freshwater fish, such as mullet (*Mugil cephalus; ama 'ama*), silver perch (*Kuhlia sandwicensis; aholehole*), and Hawaiian gobies (*Eleotris sandwicensis* and *E. fusca; 'o'opu*). Freshwater prawn (*Macrobrachium* sp.; *opae*) and green algae (*Spirogyra* sp. and *Cladophora* sp.; *limu kalawai*) were also grown. These fishponds probably arose originally from shallow ponds (*lo'i*), which were created by the diversion of stream runoff for the irrigation of taro, and over time the Hawaiians added aquaculture to the design of these ponds.

Table 1. Estimated yields of Hawaiian aquaculture ponds before 1900.

Island	Number of ponds	Area in hectares*	Minimum yield† (kg)	Percent total
Oahu	175	1306	438,816	49
Hawaii	59	440	147,840	16
Molokai	56	418	140,448	16
Kauai	42	313	105,168	12
Maui	26	194	65,184	7
Lanai	1	7	2,352	<1
Niihau	1	7	2,352	<1
Total	360	2685	902,160	100

* Using an average of 7.46 ha per fishpond (Kikuchi 1973).
† Using an average of 336 kg/ha/yr (Cobb 1902).

Surplus fish from abundant sea harvests of milkfish (*Chanos chanos*), mullet, and silver perch were put in shallow ponds located close to the sea. Fish also directly entered the taro patch-fishponds from the sea through the newly created artificial estuary. It is likely that the originators of the stocking practice observed that fish held in these ponds not only survived the harsh transition in salinity from seawater to freshwater but also grew well. They also probably noticed that their taro grew more luxuriantly and had fewer pests, owing to the continual grazing and pruning activities of certain types of fish. Taro was planted in mounds to leave channels for swimming fish to feed on the insects and ripe leaf stems of the taro (Kamakau 1976).

Other freshwater ponds. The second type of freshwater ponds, *loko wai* (Figure 7), were inland ponds or lakes typically excavated by hand from a natural depression, lake, or pool and supplied with water diverted by ditches from streams, rivers, or by natural groundwater springs or aquifers. Native species of freshwater prawn and Hawaiian gobies (*Eleotris sandwicensis, E. fusca*, and *Gnatholepis anjer-*

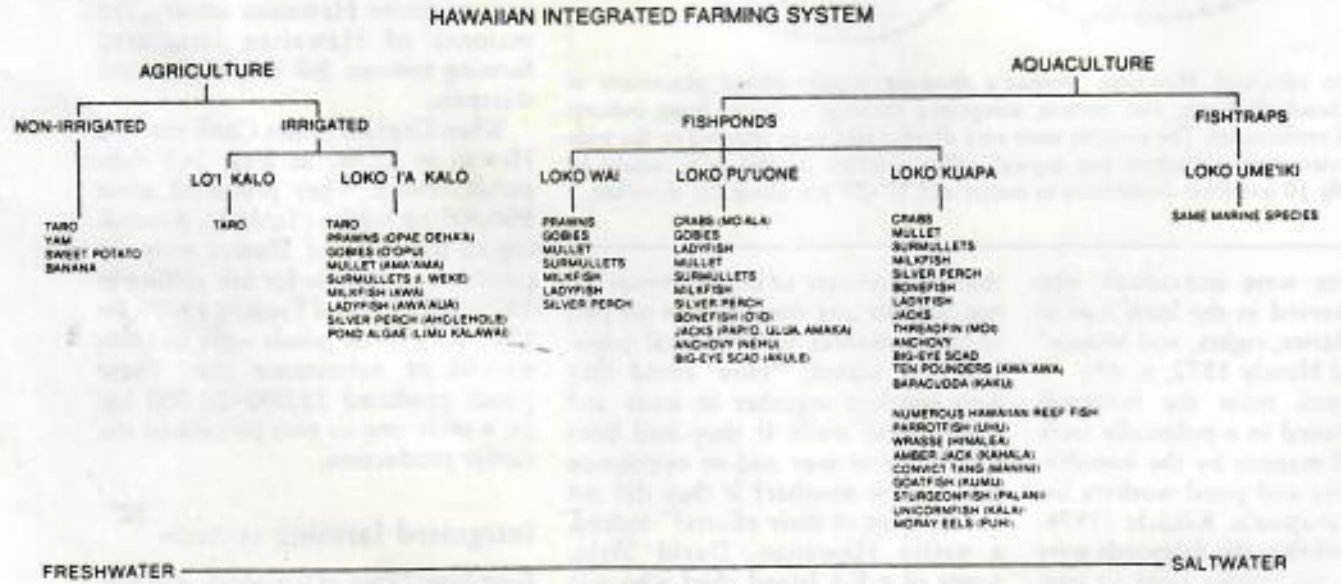

Figure 6. The Hawaiian integrated farming system spanned the normal salinity range of water and comprised a continuum from agriculture to aquaculture. An impressive number of species were harvested from seawater fishponds and traps; the ponds enclosed a reef-flat environment and all its species. Modified from Kikuchi (1976).

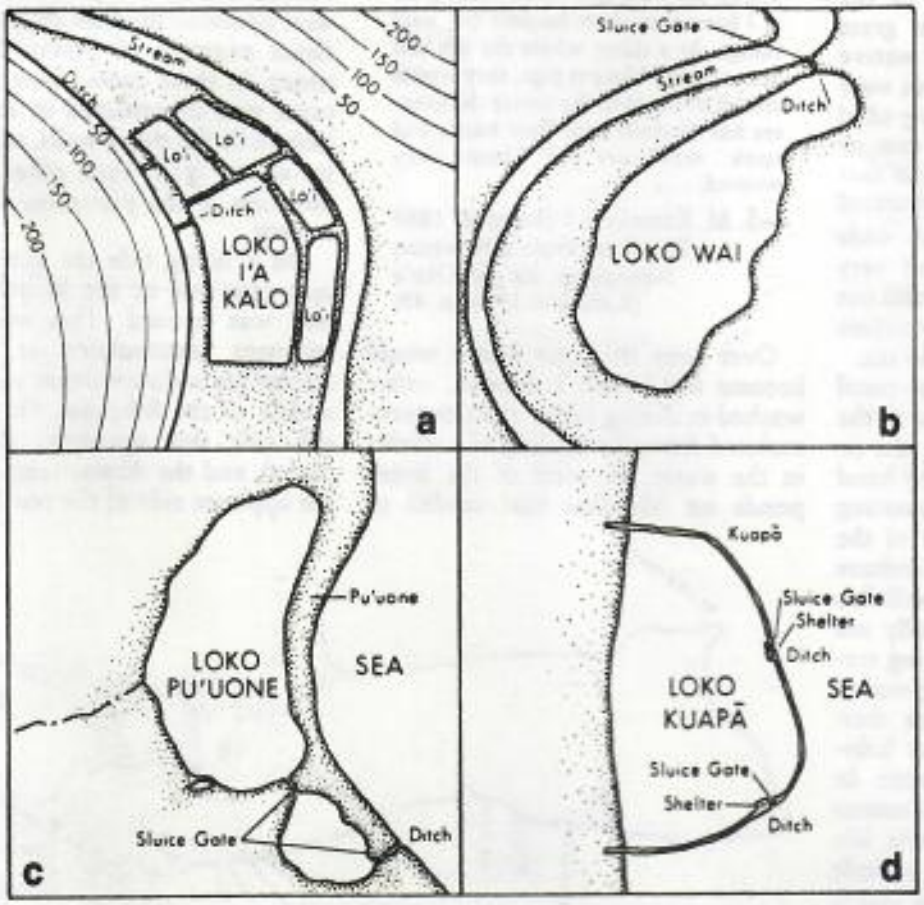

Figure 7. Four main types of ancient Hawaiian integrated farming systems: (a) *lo'i* were for the paddy culture of taro (*Colocasia esculenta*, and *loko i'a kalo* were taro patches modified to include aquaculture; these upland ponds are depicted in a valley with elevation contours indicated; (b) *loko wai* were artificial and natural freshwater lakes excavated for or modified for aquaculture respectively; (c) *loko pu'uone* were brackish-water lakes separated from the sea by a *pu'uone* or spit of land reinforced by mud, silt, and refuse and connected to the sea by a ditch that had grates to trap and hold large fish; (d) *loko kuapa* were ponds built along the shoreline usually on top of a reef flat with volcanic rock and/or coral to form a wall (*kuapa*). Controlled harvests were accomplished using a canal, net, and grate system. Modified from Kikuchi (1976).

nesis) and migrants from the sea that move into fresh water (mullet, milkfish, and silver perch) were stocked, grown, and harvested from these ponds. Milkfish were particularly abundant in these ponds, having been procured in shallow shoreline areas and carried long distances in large gourds filled with water (Beckley 1883). These ponds were harvested by woven reed nets (*hala*) placed across a channel to capture the fish during their seaward spawning migrations, oftentimes during full moons in the spring.

Brackish-water ponds. Brackish-water ponds, the third type of fishpond, were coastal ponds excavated by hand from a natural body of water stranded by eustatic sea-level changes (Kikuchi 1976), or formed by piling mud, sand, and coral to form earth embankments parallel to the coast (Figure 7). A sand bar, coastal reef, or two adjacent edges of land mass isolated these ponds from the open sea. These *loko pu'uone* were connected to the ocean by a canal constructed so that seawater would enter the fishpond on a rising tide. *Loko pu'uone* usually had some freshwater inputs, either from springs, streams entering the pond, submarine groundwater discharges, or water percolating from adjacent aquifers. The combination of fresh and salt water produced a brackish-water environment that was very productive and very diverse in the species that could acclimate from both fresh and salt water. Two types of *loko pu'uone* have been described, a planter's *pu'uone* and an *ali'i pu'uone* (Handy and Handy 1972), classified by their ownership and the effort and elaboration used in their construction.

Seawater ponds. The fourth type of fishpond, the seawater ponds or *loko kuapa* (Figure 7), was the ultimate aquaculture achievement of the native Hawaiians and a valuable contribution to native engineering and subsistence food production. Mariculture, or the farming of euryhaline and marine aquatic animals in seawater, appears to have reached a sophisticated level in ancient Hawaii. Summers (1964) states that *loko kuapa* are found nowhere else in Polynesia.

The main isolating feature of these ponds was a seawall (*kuapa*) constructed of coral or lava rock. Kikuchi (1973) noted that the lengths of 90 fishponds studied ranged from 46–1920 m, with the greatest frequency of lengths between 366–610 m, and containing an average of 955 m^3 of rocks and fill. Some of the stones used in the walls have been estimated to weigh as much as a half a ton.

On the island of Molokai, which has a protected, regular, shoal southern coastline, more *loko kuapa* were constructed per area of land than anywhere else in Hawaii (Figure 8). Large numbers of these ponds were also developed in the Kaneohe Bay, Waikiki, and Pearl Harbor areas of Oahu (Figure 9). In some of the Molokai ponds coralline algae, which secretes a natural cement, was used to strengthen the walls. Women and children gathered these algae from the sea for this purpose (Summers 1964). Ponds on Molokai were built on a reef flat, with the walls extending in a semicircle from the shoreline. The ponds thereby contained all of the marine aquatic biota of the original reef environment. At least 22 species of marine life flourished in these ponds.

Loko kuapa had an additional feature that can only be described as an ancient engineering marvel. Canals (*auwai*) were constructed into the walls of the ponds for the stocking, harvesting, and cleaning of the seawater ponds with minimal human effort. The canals connected the ponds di-

rectly to the sea and had, in the middle, a single, immovable grate (*makaha*) made of dense native woods (Figure 10). These grates were constructed by vertically lashing solid timbers (*'ohi'ia* or *lama*) to two or three cross beams with ferns, so that the individual timbers were separated by approximately 0.5–2.0-cm wide spaces. Thus only water and very small fish could pass freely in and out of the pond. The pond was therefore automatically stocked from the sea.

The grates were fixed in the canal and large fish trying to migrate to the sea were harvested by setting nets on the pond side of the grate or by hand capture (Kamakau 1976). Harvesting was attuned to the behavior of the fish. *Loko kuapa* were used to culture mainly two species of fish—milkfish and mullet. Both are technically sea spawners (catadromous). During certain seasons (frequently spring moons in Hawaii), they return from their freshwater and brackish-water habitats to spawn in coastal seawater. In contrast, salmon, being anadromous fish, have an exactly opposite life cycle. During the migration periods the keepers of the fish pond (*kia'i*) would joyously watch hundreds of fish swim into the canal in a futile attempt to reach the sea. Nets set on the pond side of the *makaha* would close off the migratory route.

Later in Hawaiian history, the canals were modified to have one or two vertically moveable *makaha* substituting for the set net and immovable *makaha* used earlier. With this modification, as the fish entered the canal and tried to migrate to the sea, the seaside *makaha* was lowered (or was permanently fixed) and the pondside *makaha* raised. The pondside *makaha* was then lowered, trapping the fish, which were simply netted out of the canal. The process was then repeated. Thus through the use of keen observational skills and knowledge of fish behavior, a method was devised of allowing the fish to harvest themselves.

> When the keeper of the pond wished to remove some fish, he would go to the makaha (grate) while the tide was coming. . . . The keeper would dip his foot into the water at the makaha and if the sea pressed in like a stream and felt warm, then he knew that the sluice would be full of fish. The fish would scent the fresh sea and long for it. I have seen them become like wild things. At a sluice where the fish had been treated like pet pigs, they would crowd to the makaha where the keepers felt of them with their hands and took whatever of them they wanted. . . .
>
> —S. M. Kamakau, 9 December 1869
> Translated from a Hawaiian Newspaper, *Ke Au 'Oko'a*
> (Kamakau 1976, p. 49)

Over time the *loko kuapa* would become filled with sediments, either washed in during heavy rains or accumulated from the settling of particles in the water. In some of the larger ponds on Molokai that tended to become silted, the grates and canals were operated to clean the ponds, in a clever example of practical maintenance. In these cases, more than one canal was constructed in an orderly pattern in the pond walls, with grates set across from each other into the direction of the prevailing longshore current.

On a rising tide the grate on the upstream end of the longshore current was opened. This washed the sediment accumulated at this upstream grate downstream toward the middle of the fishpond. On the next ebb tide this upstream grate was closed, and the downstream grate on the opposite side of the pond opened.

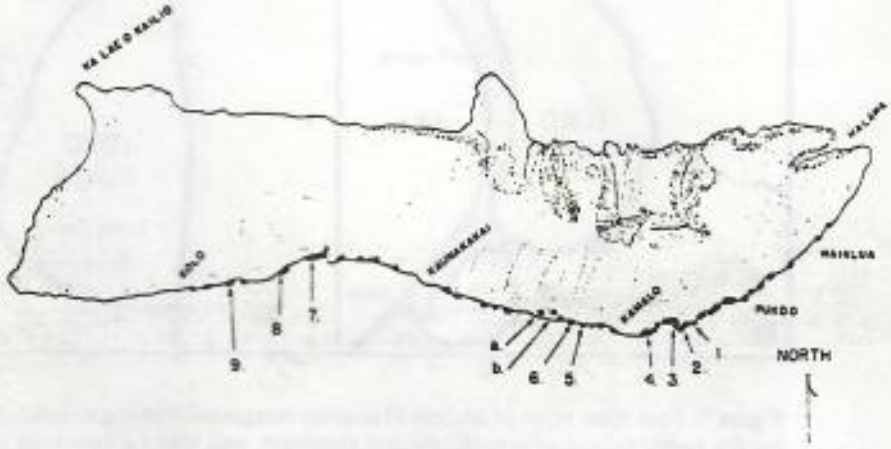

Figure 8. A map of the Hawaiian island of Molokai with its long, shoal southern coastline. Darkened areas indicate the areas of some 28 marine fishponds (*loko kuapa*). Two brackish water ponds (*loko pu'uone*) are indicated by letters. Numbers refer to the location of fish traps (*loko 'umeiki*). Modified from Cobb (1902).

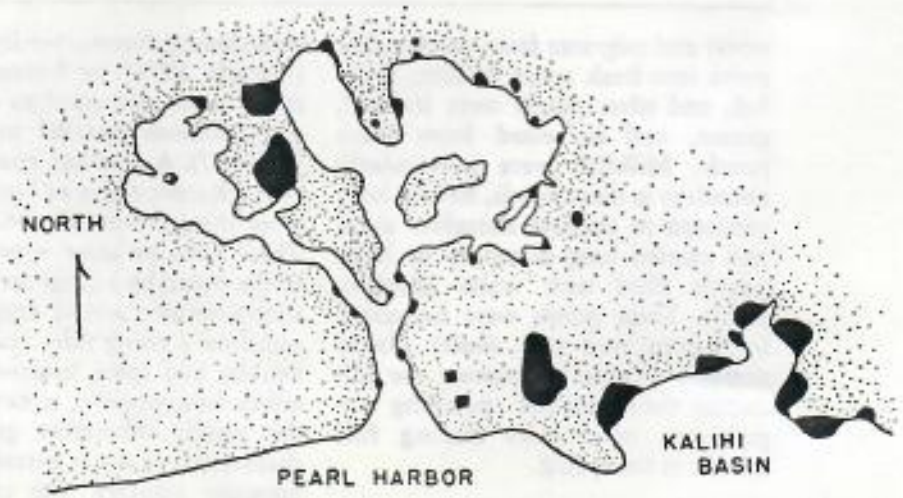

Figure 9. A map of the Pearl Harbor and Kalihi Basin areas of the island of Oahu, Hawaii. Darkened areas depict the locations of more than 30 *loko wai, loko pu'uone,* and *loko kuapa*. Modified from McAllister (1933).

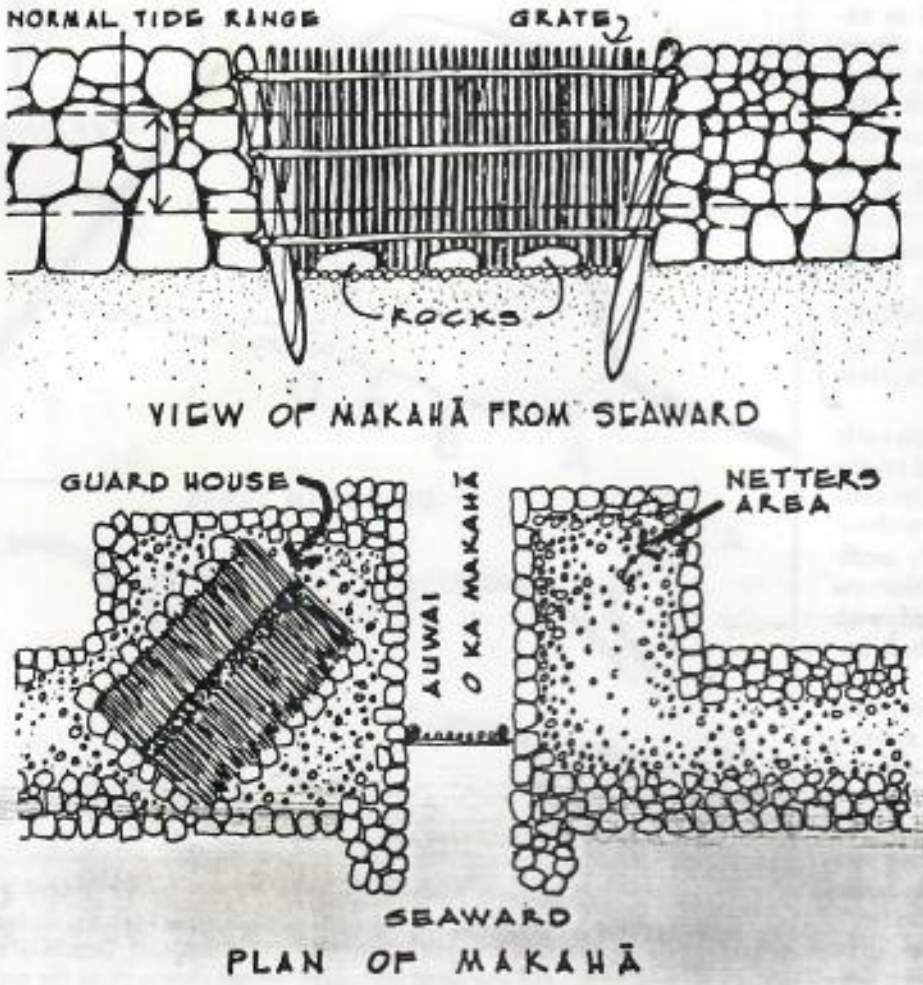

Figure 10. Details of the sluice grate (*makaha*) that was permanently fixed in a canal (*auwai o ka makaha*) connecting the pond to the open sea. Nets were set on the pond side of the canal to capture fish gathering in the canal attempting to migrate to the sea. Note that a single, immovable grate was used in the ancient design. Modified from Apple and Kikuchi (1975).

The ebb tide therefore tended to pull the accumulated sediment from the middle of the pond toward the downstream grate. By a regular program of following the tidal cycle and opening and closing the proper grates the ponds could be effectively cleaned of sediment. In addition, if a pond was silted up after a particularly heavy rain, weighted bamboo rakes (*kope 'ohe*) were towed behind outrigger canoes to facilitate movement of the accumulated sediment out of the fish ponds.

Cordover (1970) has discovered another type of seawater fishpond on Molokai with no grates. These ponds were stocked with fingerling mullet (*Mugil cephalus*) only once, and it was reported by Hawaiians that mullet spawned and grew there successfully. Hamre (1945) reported more of these types of ponds on Molokai prior to the 1946 tsunami. Although modern scientists have had great difficulty in spawning mullet in captivity (this has improved only recently), Phelps was assured by Hawaiian elders that mullet had indeed spawned regularly in these ponds. He states, "The Hawaiian knowledge of the natural history of fishes, in the old days, should not be underestimated" (Phelps 1937, p. 14).

Fish trap. The last type of fishpond used by the Hawaiians, *loko 'umeiki*, was actually a trap rather than a pond (Figure 11). Hawaiian fish traps are very similar to those in much of Oceania. Like *loko kuapa*, these traps were shoreline ponds with low, semicircular pond walls. However, unlike the *loko kuapa*, pond walls were partially or wholly submerged at high tide and contained numerous openings, or lanes, leading into or out of the trap. Most known *loko'umeiki* were located on the island of Molokai, possibly owing to the favorable orientation of the island with regard to longshore currents. However, it is claimed that Pearl Harbor, on Oahu, had three or four of these types of traps and that one fish trap may have existed on land.[1]

These lanes connecting the traps with the ocean were used to catch fish migrating down the coastline, which were attracted to the surge of water at the lane entrances (Figure 11). Fishermen simply laid a net facing the sea across the opening of the lane to capture inflowing fish on an incoming tide. When the tide reversed, fishermen faced their nets toward the traps, capturing fish as they swam out toward the sea. It was reported that the right to fish during different portions of the tidal cycle was divided among family groups.

> Such was the case of Mikiawa Pond at Ka'amola, Molokai. When the tide was coming in, the people of Keawanui could use the lanes. When the sea ebbed, the fish belong to Ka'amola.
>
> —Timoteo Keaweiwi, 1853
> *Foreign Native Testimony Book 16*
> State of Hawaii Archives
> Honolulu, Hawaii
> (Summers 1964, p. 56)

Implications

It is evident that the ancient Hawaiians supported a relatively high population density by managing an ecologically complex integrated farming system that connected agricultural watersheds to oceanic environments. These historical developments are remarkably similar in principle to integrated farming systems developed in ancient China and Egypt. Hawaiian society, like other ancient civilizations, was subject to droughts, climatic disruptions, natural disasters, and famines; it may have developed these integrated farming systems in response.

The limited archeological and

[1] W. Kikuchi, 1985, personal communication. Department of Science, Kauai Community College, Lihue, Kauai, HI.

aquaculture research, as well as exploration in the Pacific Basin, allows no conclusions to be drawn either regarding the uniqueness of the Hawaiian integrated farming systems among the Pacific islands, as some have suggested (Kikuchi 1973, Summers 1964), or their possible relationships to Chinese or other Asian systems. The Hawaiians appear to be one of the originators of mariculture; there is no evidence of another ancient culture using oceanic resources in this manner.

Most of the previous work on early Hawaiian aquaculture focused on the marine fishponds. These studies concluded that the ponds were technologically primitive, ecologically inefficient, and unproductive in biomass per unit area when compared with Asian practices (Hiatt 1947a,b, Kikuchi 1973, 1976). But these earlier interpretations may be inappropriate in light of the total farming system, which spanned an extensive salinity range of water and encompassed entire valleys.

Direct comparison with Asian systems is unjustified, because the aquaculture systems are at opposite ends of the management spectrum. The Asian systems are semi-intensive, sustained by large inputs of labor, feed, and fertilizer supplements; whereas the Hawaiian systems were mostly sustained by natural productivity, and thus are called extensive. For an extensive system, the estimated yields by Cobb (1902) of 336 kg/ha/year would place the Hawaiian fishpond systems operated before contact with European culture on par with most extensive aquaculture systems in the world today. Indeed these yields are comparable to some of the smaller intensively managed modern Chinese lakes and reservoirs (Billard 1986).

Only recently have scientists systematically documented traditional technologies of agricultural and fishing societies. These studies of traditional crops, methods, and systems have produced so many advances in such a short time, many agricultural researchers now first consider traditional knowledge, however primitive it may appear, and use it as a foundation for further research (Richards 1985).

Until the 1970s, however, the poverty and underdeveloped status of fishing and agricultural societies were attributed to their "inefficient," "primitive," and "subsistence" technologies, without any consideration of sociocultural and economic concerns (Ruddle and Grandstaff 1978). Thus, the poverty of traditional fishermen was ascribed to a lack of modern fishing gear and methods. Recent scientific study, however, has shown that traditional fishermen have a wide knowledge of oceanography, fish biology and behavior, and conservation and management practices that preserved the biological integrity of fish stocks for generations before the advent of modern gear or methods (Johannes 1978, Johannes et al. 1983, RaiChoudhury 1980, Roy 1982, Ruddle and Johannes 1985). Perhaps these traditional fishing and agricultural societies should be termed ecologically advanced rather than technologically backward.

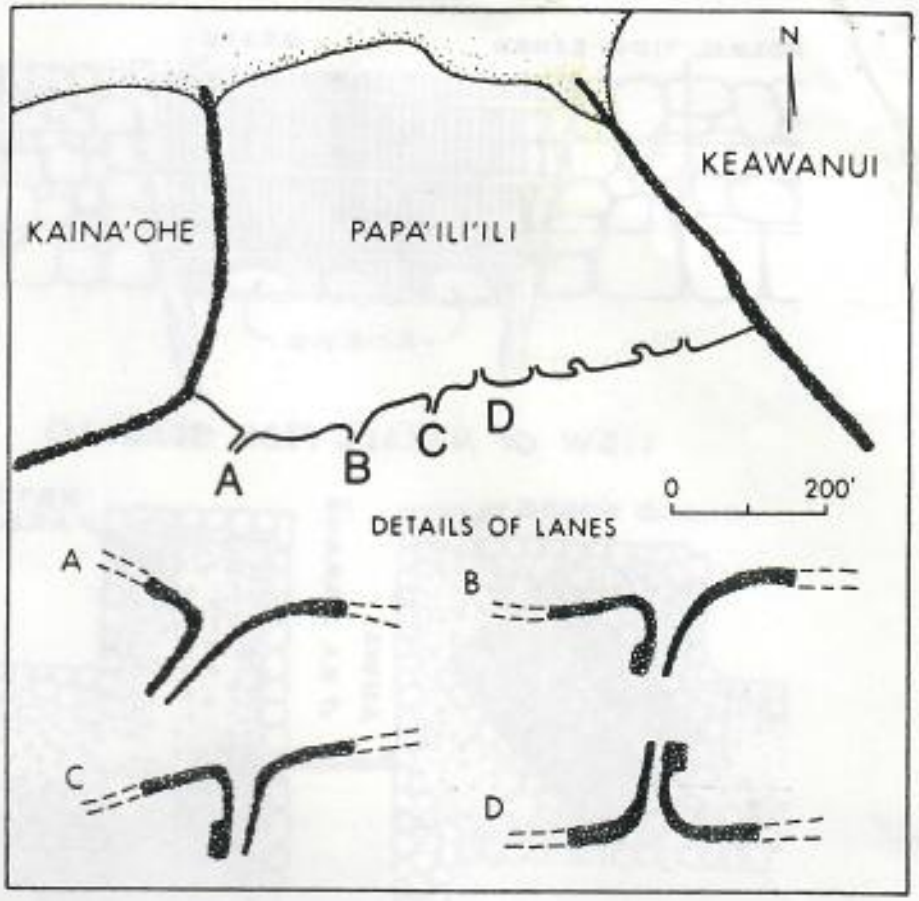

Figure 11. Plan of a fish trap (*loko'umeiki*) (*Papa'ili'ili*), from Molokai wedged between two marine fishponds (*loko kuapa*) (*Kaina'ohe* and *Keawanui*). Details of three pond outlet canals (A, B, C) and one pond inlet canal (D) are shown. Note the enlarged wall sections on canals B, C, and D accommodating fisherman. These areas indicate where nets were set to capture fish on rising (D) and falling (A, B, C) tides. Modified from Stokes (1909).

Extensive aquaculture systems, their sustainability, productivity, and roles in traditional food production networks have received little attention to date. These systems may have a much greater role in integrated rural development schemes worldwide than the high-yielding intensive aquaculture systems because they can be ecologically benign and integrated into fragile natural ecosystems with no pollution impact (Hirata 1983); they have lower capital costs, allowing entry by the poorest farmers in society; they require little management or foreign expertise; and they frequently have higher economic returns than intensive systems (Hirasawa 1985).

The vast majority of aquaculture production today comes from extensive and integrated farming systems in Asia (FAO 1984, Zweig 1985). The principles and management of these

systems are quite similar to the ancient Hawaiian systems. Simple technology transfer from one traditional system to another may dramatically increase productivity and efficiency. For example, the modern version of the Hawaiian canal-grate system may have great potential for the thousands of hectares of extensive marine ponds along the coasts of India and Indonesia.

Transfer and improvement of knowledge in traditional food production systems may have greater value than any "technological fix" applied by modern machines and methods. While we do not know how to stimulate, manage, and sustain a natural food web in an extensive aquaculture system to repeatedly obtain high yields, we do know it is possible. With no supplemental feeds or fertilizers added, and management timed to the abundances of natural foods available, scientists have achieved experimental productivities from 11,000–25,500 kg/ha/year in Laguna de Bay, Philippines (SEAFDEC 1980).

Hawaiian integrated farming systems evolved and proliferated within a unique socio-cultural context. However, the traditional designs, ecosystem development concepts, and integrated aquatic resources management principles may be instructive to some modern societies with burgeoning populations desperate to increase food production and employment opportunities in traditional agricultural sectors.

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Waimea
Leauokale Pt
Camp Seven
M A K A W E L I
Waipao
Waikoloi Gulch
Mahu Gulch
Kaluakoi Papuaa Gulch Valley
Puu Pahu
Puulani
Kahipa
Ahuaaliku
Hahonui Gulch
Poo
Camp Six
Makaweli Landing
Pakala
Mahinauli Gulch
Manienaula
Camp Five
Puu o Papai
Camp Two
Kapahili
Gulch
Papaia Gulch
Nikiula Gulch
HANAPEPE
RIVER
H A N A P E P E
D
Kaumakani
Camp Four
Koki
Hoaka
Kaumakani
Paweo
Camp Three
Hanapepe
Eleele
Port Allen
Hanapepe Bay
Kuunakaiole
Puolo
Paakahi
Wali
Camp Three
Camp Two
McBryde Plantation Mill
W A H I A W A
Kalaheo
Gulch
Koheo Pt
Nahunakueu
35'
65'
180'
P A C I F

Wahiawa
Camp Twelve
Ioleau
Camp Eleven
Camp Ten
Kapaku
Manuhonuhonu
Kumanohanu
Waihohonu
Koloa
Wyllie Reservoir
Kalaakapohu
Natuakeina
Kalapa
Ka Lae o Kihohu
Puu Pihakapu
Kawelikoa
Puu Keke
Ka Lae Pana
Kamala
Kapunakea Pond
Manoloa
Ka Lae o Kaiwa
Lanipuao Rock
Kaulala
Ka Lae Kiki
Kolopa
Nahumaalo
Lae o Kahala
Koloa Landing
Lae o Kamilo
Kihouna
Nukumoi
Makahuena Point
Waikomo Stream
O C E A N
30'

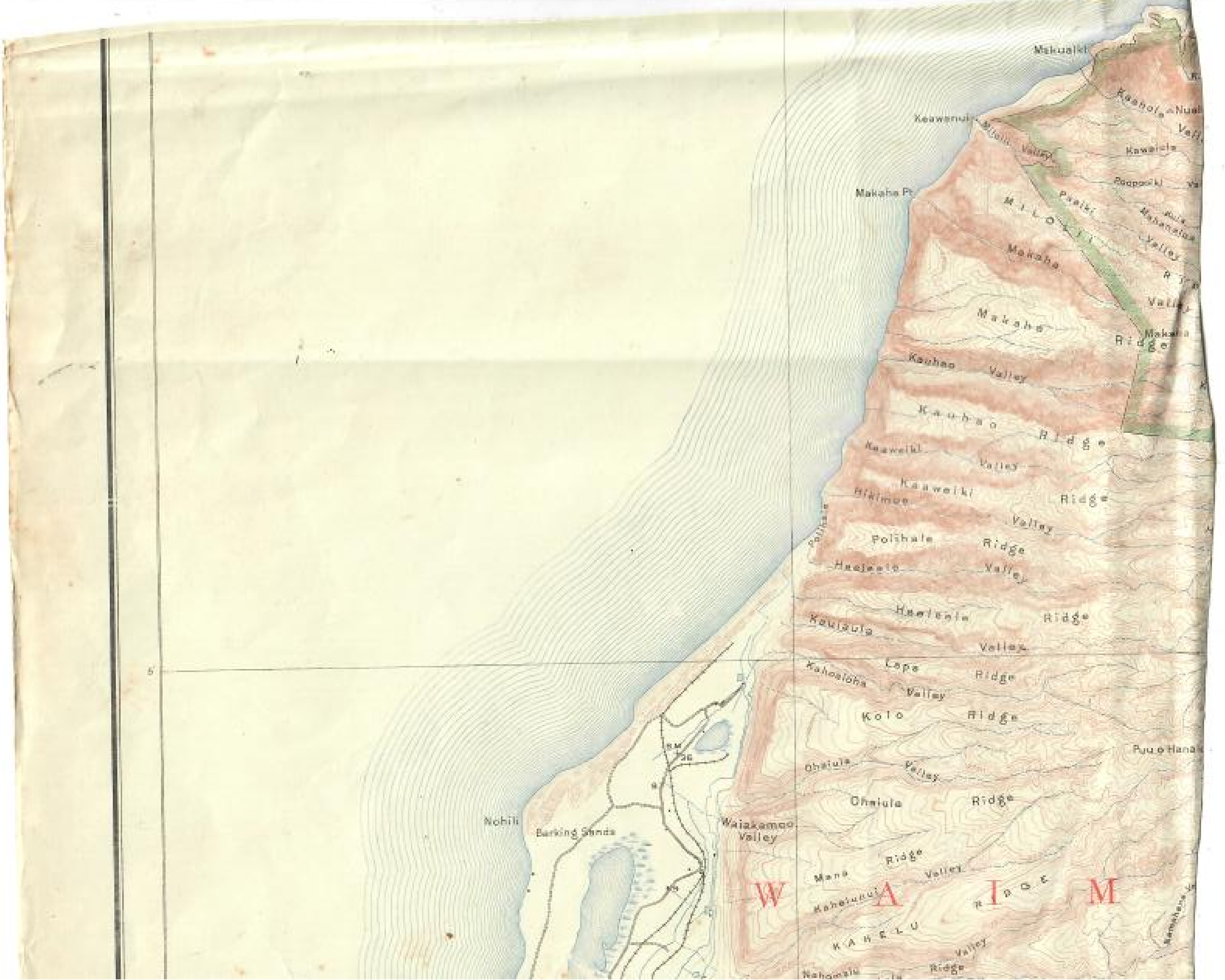

Mauna Kapu
Nailiakaues
Ridge
Kokoma
Kalepa
Waiu
Kawailoa
Kaililiahinale
Kalepa
Hanamaulu
Bay
Stream
Kapaia
Ahukini
Nawiliwili
Kamilo
courthouse
Kukii Pt
Ninini Pt
Nawiliwili
Bay
Carter Point
Kalanipuu
Kapaiwa
Kawai Point
Hokunui
CHANNEL
140'
22°00'

Kuahu Pt
Anahola Bay
Kahala Pt
Lae o Kailiu
Lae Lipoa
Pohakuloa
Anapalau Point
Ahihi Pt
Lae r Paliku
Kealia
KAPAA
Lae Alakukui
Wailua Bay
Wailua
Puu Alanakau
Puu Konanae
Kawalumakua
Kikoo
Kiokala
Anahola
Kanehu
Puu Kinu
Puu Lawi
Valley House
Kapaa School
Kaelnlua
Nonou Mtn
Opaekaa Falls
Keahua
Kealia
Kapaa
Stream
River
Ridge
RESERVE
K A W A I H A U D I S T R I C T


20'
Kepuhi Pt
Pakala
Moloaa Bay
Moloaa
Puu Auau
Papaa Bay
Stream
Kamoku
RESERVE
Amu


Lae o Kolokalo
Makahoa Pt
Hanalei Bay
Puu Poa
Lae o Kawaonui
Ka Lae Honono
Kalihiwai Bay
Pukamoe Point
Mokuaeae
Lae o Kilauea
Makaniti Rock
Kilauea
Kilauea
Kalihiwai
Hanalei
Pooku
Kaupua
Makaihuwaa
Kamoo Koleaka
Waiokihi
Kamoohui
Kaukaopua
Kaapu
Kamani
Kolopua
Kapalikea
Mahina Kahau
Halaula
Puu Ki
Waipuni
Puu o Miki
Kapailu
Hihimanu
Mamalahoa
Puu Manu
Kapaka
Puu Maheu
Poluaili
Puohonui
Waihohonua
Puu Pana
Kamookoa Ridge
KAUAI ELECTRIC POWER LINE
NAMAHANA
DISTRICT
MOLOAA FOR


I C O C E A N
40
35
Haena Pt
Lae o Kaonohi
Kepuhi
Ka Lae o Kailio
Caves
Makana
Maunahou
Pohakakane
Puu Nopili
Maunanuluo
Kulanailiis
Palikea
Puu Ushia
Kealawela
Aikanaka
Poli Eleele
Huno o Na Pali
Pohakea
POHAKUAO
Kanakou
Puu Ki
Aleelau
Waiahuakua
Keanapuka
Moaalele
Pohakuokane
Puu Ilihi
Kalalau Valley
Na Keiki o Na Iie
KALALAU
HANAKOA
HANAKAPIAI
HAENA
HANALEI
Falls


Makuaiki
Keawanui
Milolii Valley
Kaaholo
Nualolo
Valley
Kawaiola
Paopaoiki
Makaha Pt.
Paaiki
MILOLII
Makaha
Valley
Makaha
Makaha
Ridge
Kauhao
Valley
Kauhao
Ridge
Kaaweiki
Valley
Kaaweiki
Ridge
Hikimoe
Valley
Polihale
Polihale
Ridge
Haeleele
Valley
Haeleele
Ridge
Kaulaula
Valley
Kahoaloha
Lapa
Ridge
Valley
Kolo
Ridge
Puu o Hana
Ohaiula
Valley
Ohaiula
Ridge
Nohili
Barking Sands
Waiakamoo
Valley
Mana
Ridge
Valley
Kaheiunui
KAHELU
Valley
Ridge
Nahomalu
W A I M
RIDGE
5'

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TOPOGRAPHIC MAP

ARCHAEOLOGY ON KAUA'I

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Frontispiece
Alekoko Fishpond, circa 1920-30's, Hūleia.
Picture Courtesy of the Kaua'i Museum. Neg PN 1655.1
Picture shows fishpond wall and considerable silting.

KAUA'I COMMUNITY COLLEGE
3-1901 KAUMUALII HWY
LIHUE, HAWAII 96766

Alekoko Fishpond, circa 1930-40's, Hūleia.
Details of secondary ponds, wall, structures and channel dug into the silted pond. Photo courtesy of the Kaua'i Museum, Neg PN 3030.14.

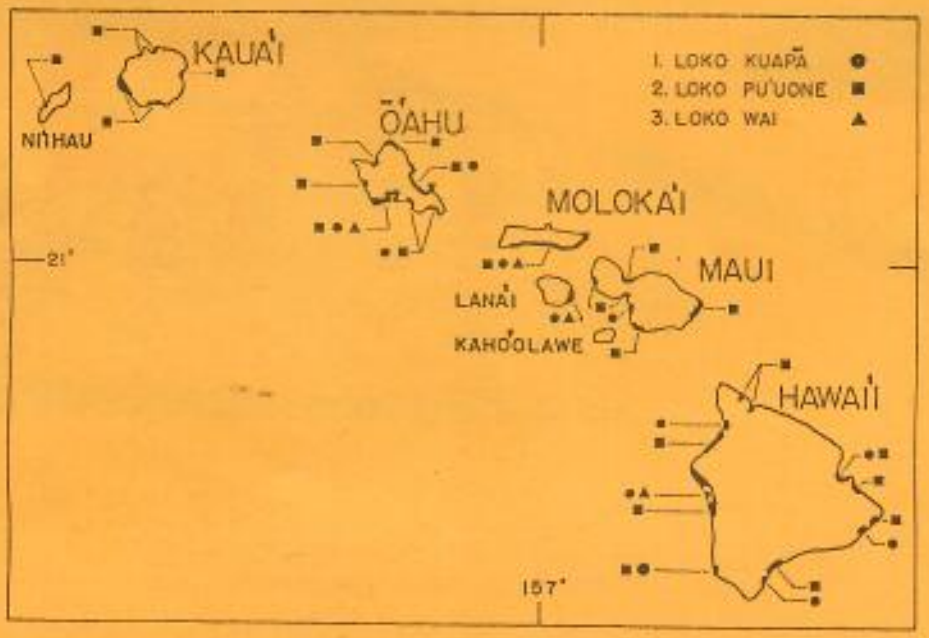

Fig. 1. The four basic Hawaiian fishpond types. (A) The loko i'a kalo, located in an inland area; (B) the loko wai, a natural lake artificially connected to a stream by a ditch; (C) The loko pu'uone, ponds created by coastal barrier beaches, artificially connected to each other, and drained by a ditch; and (D) the loko kuapā, two ditches and a seawall isolating a coastal body of water. No scale.

ARCHAEOLOGY ON KAUA'I

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* *

THE FISHPONDS OF KAUA'I

by

William K. Kikuchi

I. INTRODUCTION

The development of aquaculture in prehistoric Hawai'i was an example of independent invention and innovation. The word innovation is defined as something new that has no predecessor. Aquaculture in ancient Hawaiian society had no known predecessor in the island cultures of Oceania; that is nothing similar to the Hawaiian model has yet been documented by the author for Polynesia, Micronesia and Melanesia (Kikuchi 1973). Similarly, nothing has been found in New Guinea and Australia. Pond aquaculture was found in the islands of Indonesia, the Philippines, China and Japan; however, their physical distance to the Hawaiian Islands and the lack of pond aquaculture in the intermediate island groups preclude any direct influence.

A. HISTORY

Prehistoric Hawaiian society date from around A.D. 500 and lasted until A. D. 1778, a mere 1278 years before western contact made its impact on the culture. Estimates from legendary sources (Kikuchi 1973) place the development of Hawaiian aquaculture at around A.D. 1100, which means that it was only 600 years after the islands were discovered and colonized that aquaculture was "invented". From A.D. 1100 to A. D. 1778, only 678 years lapsed while native fishpond culture progressed from an idea to become an exclusively high status, economic and political food-producing technology. This innovation, the short span of time it took to develop the technology, and its integration into the economic-political realm were truly hallmarks of native ingenuity and adaptation (Fig. 1).

By the year 1900, there were 394 documented fishponds in the Hawaiian Islands. It is probable that many more were to be found so that the figures are, at best only an estimate. The distribution varied based on the type of pond and on the geomorphological characteristics of the land and the sea for each island (Kikuchi 1973:39 Table I).

Table I. Type Distribution of Fishponds

TYPE OF FISHPOND	SITE	SYMBOL	ISLAND						
			NIIHAU	KAUAI	OAHU	MOLOKAI	LANAI	MAUI	HAWAII
Loko Kuapa	Ia	○			13	21	1	5	1
	Ia1				11	9		2	
	Ia2				17	8			
	Ia3				2	1			
	Ib				10			1	12
	Ib1				4				
	Ic				7	1			1
Loko Pu'uone	II	□	1	16	19	13		8	26
	IIa							2	6
	IIa1				3				
	IIb				1				1
Loko Wai	III	△		3	8	1		3	2
	IIIa			4	2			1	4
	IIIb			5	71	2		1	2
	IIIc			1	1				
	IIId								1
Loko I'a Kalo	IV	◒		13	6			3	
Mythical				1					
Unknown				17	2	2		8	4
Total = 394			1	60	177	58	1	34	63

B. ORIGINS

Hawaiian aquaculture probably has its origins in agricultural pondfields. Natural, swampy areas were utilized and evolved into ponded agrucultural taro (Colocasia esculenta) fields. These natural springs, stream spills and runoffs and had no means whereby to prevent fresh and brackish riverine and estuarine fish, shellfish, crustacians and seaweeds from entering into their environment. These agricultural pond fields were used primarily to grow taro, but the added features of aquatic flora and fauna were serendipitous to the farmer. The farmers had a choice; these ponds could easily grow only agricultural or aquacultural foodstuffs or they could provide a combination of both.

The advantages of native Hawaiian aquaculture were: 1) it produced a variety of foods; 2) these foods could be continuously grown irregardless of the seasons and were therefore always fresh; 3) these foods could be harvested at any time of the day or night and throughout the year; and 4) the ponds served as a natural storehouse. Although the initial construction required considerable human energy, maintenance was minimal. These qualities enabled the owner to become wealthier and more powerful, both economically and politically.

Aquacultural pondfields at first required no great effort in construction because most were natural bodies of water or, primarily, taro plots. When these pond fields began to expand into the shore areas where parts of rivers, streams and the sea had to be sectioned off or isolated by stone walls, the resultant fishponds required a powerful centralized authority that could command, supply, and finance massive seawall construction. Probably at this stage the food-making technology was at an intensive level where construction, production, and maintenance were highly integrated into the political system, a system which needed to have the resources of these ponds, but also desired to show others their power to construct the ponds, a form of "conspicuous manifest consumption". Therefore, the development of native aquaculture was not independent invention based on the resources of the sea but an innovation and independent invention based on the extension, elaboration and adaption of agricultural practices. Native aquaculture was one end of a continuum of agriculture.

II. KAUA'I ISLAND

The island of Kaua'i is the fourth largest island of the major inhabited islands in the Hawaiian archipelago. It is the oldest island geologically (5.6 million years old) and therefore shows the greatest amount of fluvial and marine erosion of its surfaces and along its coastal perimeter. The original maximum diameter was estimated to have been 40 by 32 miles (Hinds 1930). Presently the same dimensions are 32 by 22 miles.

The island is divided into 4 geomorphological areas: 1) the summit plateau; 2) the dissected highlands; 3) the elevated wave-cut platform of east Kaua'i; and 4) the constructional plain (Hinds 1930:22; see figure 2). The areas where much of the Kaua'i aquaculture occurred were in the elevated wave-cut platform and in the constructional plain areas. These two areas were much affected by Pleistocene submergence and emergence and by recent Holocene sea level fluctuations. The presence of the marine cliffs of Napali, Hanalei through Anahola, and the Kipukai and Maha'ulepu coastlines attest to the effects of the sea on the submerged margins of the island of Kaua'i. Where the sea has retreated, the shoreline consists of a narrow, sandy strip and, in the case of the Mana plains, a large marshy constructional plain. This land is a coastal rampart of sand dunes nearly 30 feet high fronting the shoreline and isolating the loamy soils and swamps of the flats. These emerged coastal plains formed swamps and marshes that were ideally suited to the construction of loko pu'uone and loko-wai ponds.

Depending on the amount of fresh water available in an area, the same areas could be easily converted to the loko-i'a-kalo ponds. The abundance of swamps and marshy lowland areas at the mouth of numerous gullies and valleys provided a suitable wet alluvial condition for both agriculture and aquacultural use and thus did not necessitate the construction of the large, labor-intensive loko-kuapā type ponds.

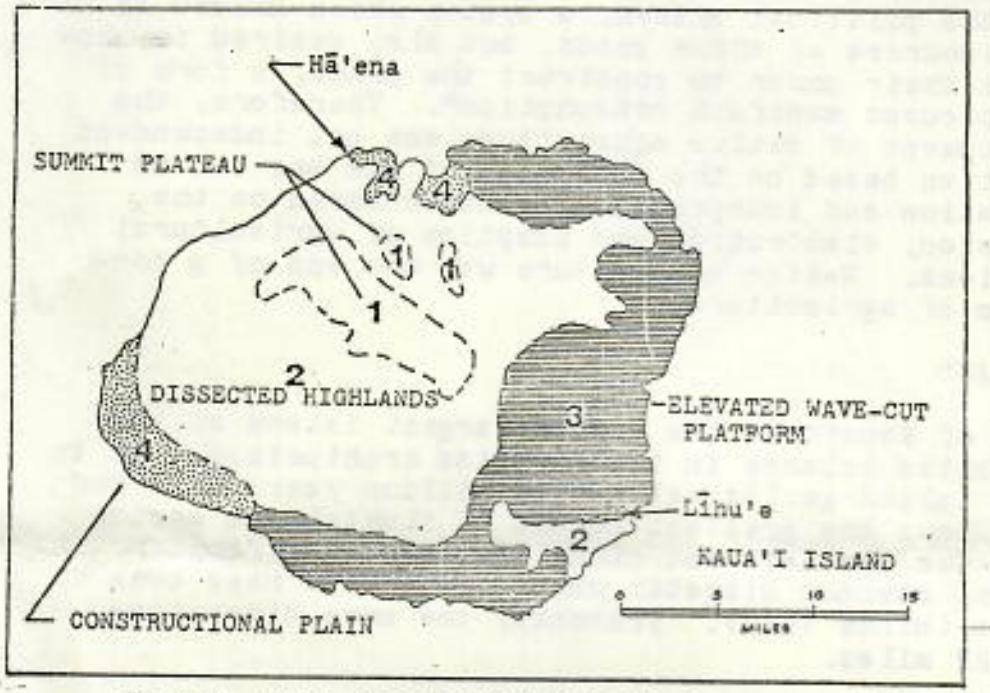

Fig 2 Four Geomorphological Areas.

A. FISHPONDS OF KAUA'I (Fig. 3,4)

There were 394 fishponds recorded for the Hawaiian Islands. Kaua'i Island had 59 ponds, or only 15% of the total count. Of these, only 3 types of ponds out of a possible 4 types were recorded. These were types II, III, and IV. Type I, the loko-kuapā was not present. A loko-kuapā was formed when a rock wall was constructed from the shore into the sea and ringed back to the shore

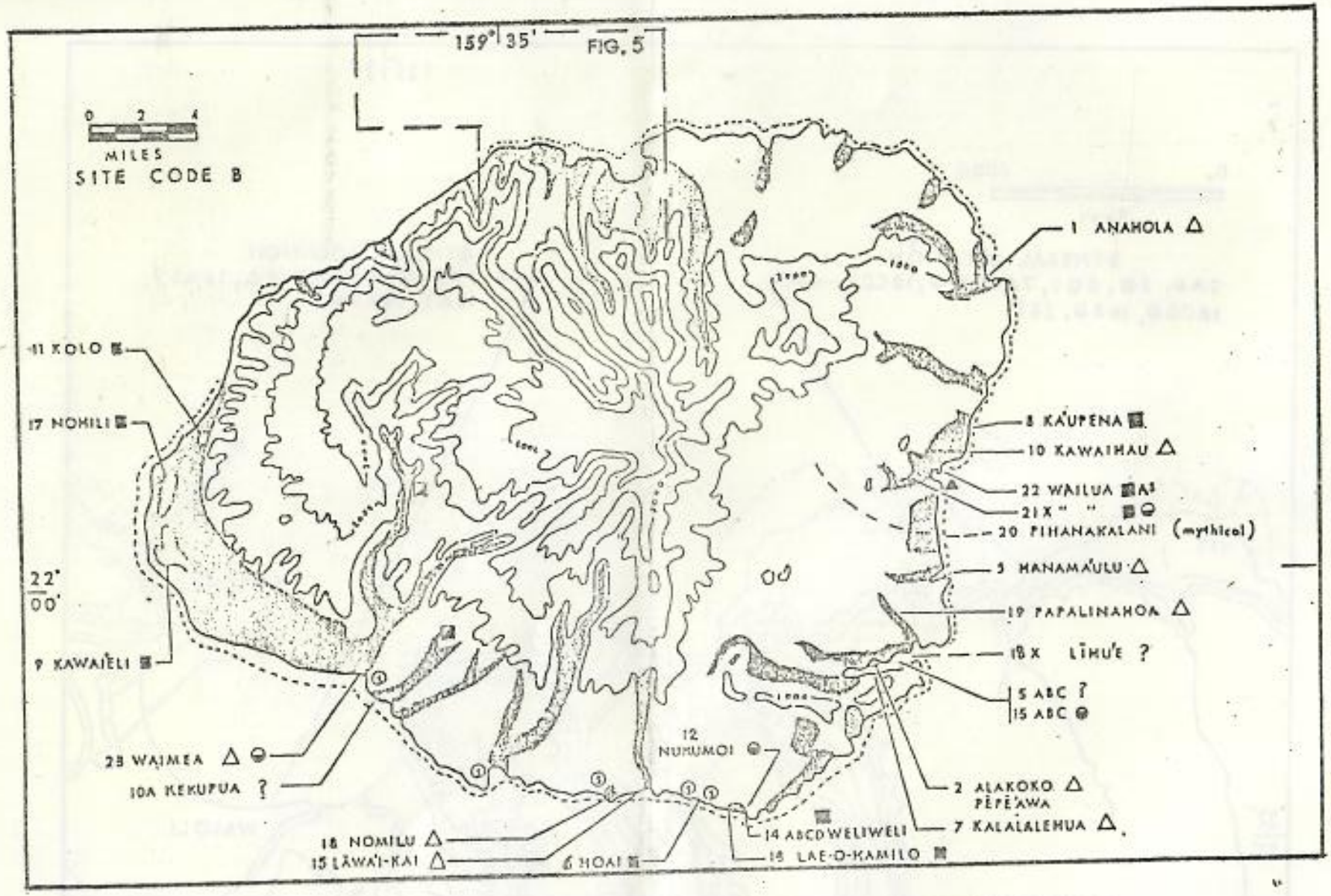

FIG.3 . FISHPOND DISTRIBUTIONS, KAUA'I ISLAND
(after Kikuchi 1973,Fig. 4,p.16).

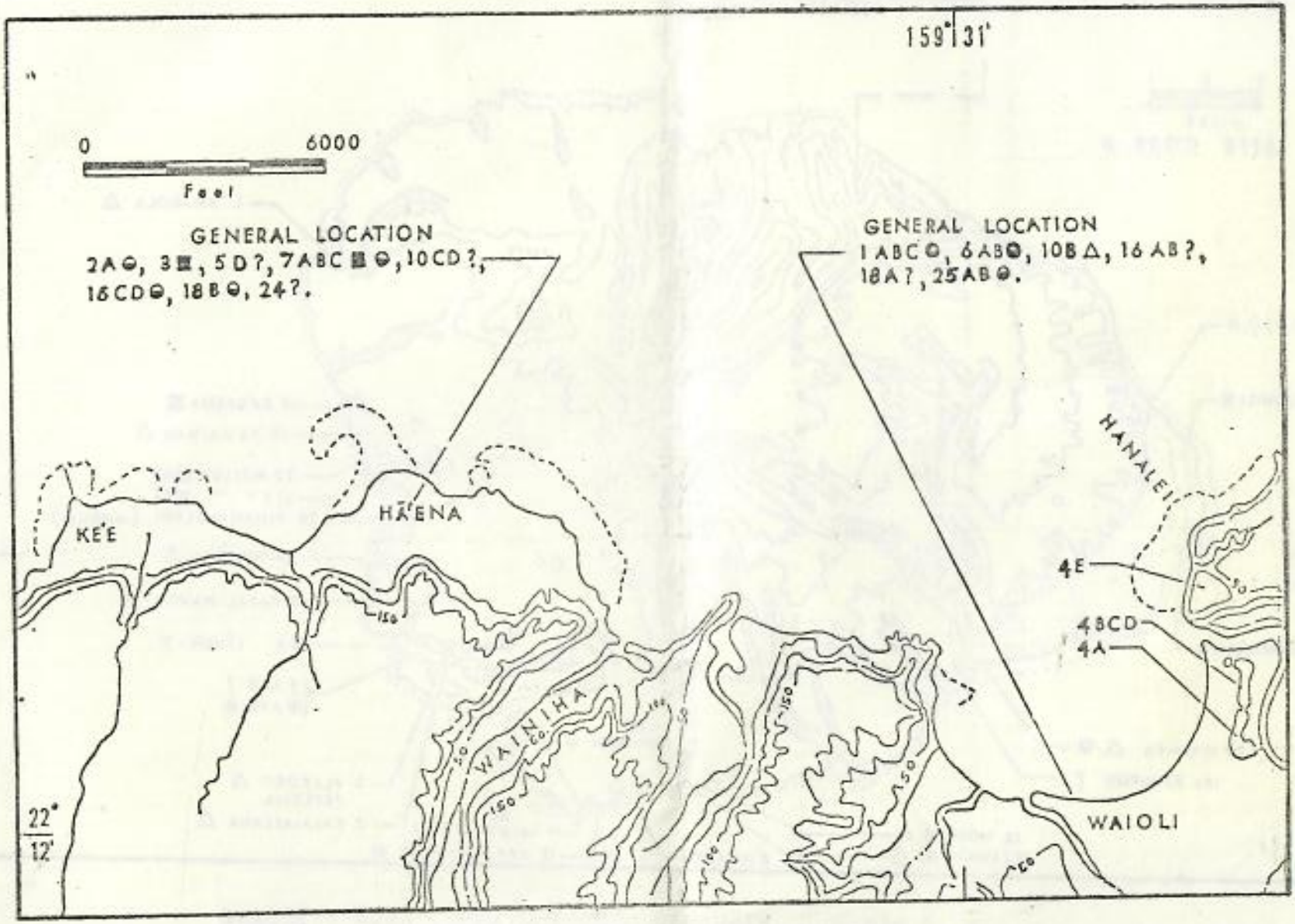

FIG. 4. FISHPONDS OF HANALEI-HA'ENA.
(after Kikuchi 1973, Fig. 5, p.17).

forming a large semicircular arch. The function of the wall was to isolate the pond's water from the sea. The requirement for such a fishpond was the presence of an extensive, shallow underwater shelf protected by an off shore reef line. The shoreline of Hanalei Bay, Wanini Beach and Kapa'a best fit the aforementioned requirements, but, for some reason, the type I ponds were not built along these beaches. A search using aerial photographs along the suspected shoreline areas did not reveal any long sunken or destroyed remnants of type I ponds there. One possible reason for the lack of type I ponds is that the alluvial plains and numerous rivers and streams provided an easier medium to develop other pond types than the very laborious kuapā type. Secondly, the chiefdom which Kaua'i did not seem to have developed until late in its prehistory.

B. TYPE II PONDS

Type II, or the Loko-Pu'uone, was represented by 15 ponds (25.4% of the Kaua'i ponds). These were ponds that were formed by the stranding of a body of water by a natural sand barrier. Some of these ponds were later altered by digging ditches which allowed the sea to enter and exit during times of high tide. On Kaua'i the type II ponds were all found on the alluvial plains. Their one common characteristic was that they were always found at sea level, and therefore, their water level tended to fluctuate with the tides. There were two ponds at Ha'ena, one at Hanalei, one at Kapa'a, three at Wailua, five at Po'ipu and three at Mana (Table 2).

TABLE 2. Type II Loko Pu'uone

Site No.	Location		Acreage
B3	--	Hā'ena	--
B4e	Pu'u Poa	Hanalei	--
B6	--	Hō'ai, Kōloa	0.10 +
B7b	Kamaloko	Hā'ena	--
B8	Ka'upena	Kapa'a	--
B9	Kawaieli	Mānā	77.0
B11	Kolo	Mānā	11.0
B14a	--	Weliweli	--
B14b	--	Weliweli	--
B14c	--	Weliweli	--
B14d	--	Weliweli	--
B17	Nohili	Mānā	179
B21x	--	Wailua	--
B22a	CocoPalms	Wailua	3.84
B22b	--	Wailua	--
			272.44

C. TYPE III PONDS

Type III, or the **Loko Wai** ponds, were represented by 13 sites on Kaua'i, or 22% of the total. The **Loko Wai** were classified as bodies of water ranging from fresh to brackish, that usually were located inland from the shore and usually along streams and rivers.

There were many subtypes under **Loko Wai** ponds. Type III is a naturally ponded body of water such as a lake. Type IIIa is a type III which has been altered so that its plan view contains signs of human changes. Type IIIb is a pond which was formed when a natural body of water, such as a large river, meanders to form an oxbow lake. A rock or earth wall was constructed to create a new pond utilizing the oxbow lake. Type IIIc is a volcanic crater which became filled with water and subsequently used as a fishpond. Type IIId is a pond formed when a stream is walled at two sectors to create a fishpond. With one exception, these pond types were found on or near the streams and rivers of: Hanalei (4); Anahola (1); Kapa'a (1); Hanama'ulu (1); Huleia (2); Nawiliwili (1); Lawa'i (1); and Waimea (1). (Table 3). The exception is the Nomilu fishpond which is a volcanic crater just adjacent to the sea off Kalaheo.

TABLE 3. Type III Loko Wai

Site No.	Name and Location		Subtype					Acreage
			A	B	C	D	X	
B1	--	Anahola				1		--
B2	Alekoko	Huleia		1				32.1
B4a	Kanoa	Hanalei	1					3.84
B4b	--	Hanalei	1					
B4c	--	Hanalei	1					
B4d	--	Hanalei	1					12.78
B5	--	Hanama'ulu		1				--
B7	Kalalalehua	Huleia		1				--
B10	Kawaihau	Kapa'a					1	--
B15	--	Lawa'i-kai		1				1.1
B18	Nomilu	Kalaheo			1			4.3
B19	Papalinahoa	Nawiliwili					1	4.0
B23	--	Waimea					1	--
			4	4	1	1	3	58.12

D. TYPE IV PONDS

The type IV ponds **Loko-i'a-kalo** was, as the name implies, a pond which grew both fish and taro. It was basically an agricultural field whose primary function was the growth of taro. However, the irrigation ditches allowed the inclusion of fresh water crustacean, fresh water fish, shellfish and certain aquatic plants into these pondfields. Thus the native terminology for pond fields were **loko-kalo, loko-i'a** and **loko-i'a-kalo** a clear indication in the native worldview that a pondfield could be used to concentrate on agriculture, aquaculture or a combination of both.

The **loko-i'a-kalo** were difficult to document. The reasons are that the use of the pond field can change from that of a taro field to that of a fishpond in a season's time. Pinpointing the pondfield type as exclusively for fish culture is very difficult. Probably many of the ponds grew fish as well as taro; at what percentage a pond became a fishpond and not a taro pond is debatable. The data for this type of pond will always be suspect. A search of Kaua'i ponds reveal 14 **loko-i'a-kalo.**

These ponds of Kaua'i were found along the alluvial areas of the island, where taro agriculture was common. These areas were: Hanalei (6); Ke'e at Ha'ena (4); Po'ipu (2); and the coastal plain and valley of Nawiliwili (2) (Table 4).

TABLE 4 Type IV Loko-i'a-kalo

Site No	Name	Location	Acreage
B1a	Ahau	Waioli	--
B1b	--	Waioli	--
B1c	--	Waioli	--
B2a	Esetera	Ha'ena	0.438
B6a	Kaiulu	Waioli	--
B7c	Kanaele	Ha'ena	--
B12	--	Koloa	--
B13	--	Koloa	0.10
B15b	--	Nawiliwili	--
B15c	--	Nawiliwili	--
B16d	Naia	Ha'ena	0.58
B18b	Paki	Ha'ena	0.188
B25a	--	Waioli	10.3
B25b	--	Waioli	0.12
			11.726

E. UNKNOWN TYPES

In the study of the Kaua'i fishponds, the types of 17 ponds, or 29% could not be determined. Six of these were in Ha'ena; five in Waioli (Hanalei); three in Huleia; one at Nawiliwili; one in Lihu'e (probably in the Nawiliwili region) and one at Makaweli (Table 5). Although the types are not known, it is most probable that these were Types II and III because of their locations: low alluvial areas where large rivers and streams were found. The latter would apply to the 3 unknown types for Huleia, Nawiliwili and Lihu'e. Further research may reveal their true nature.

TABLE 5. Unknown Fishpond

Site	No Name	Location	Acreage
B5a	--	Haiku,Huleia	--
B5b	--	Haiku,Huleia	--
B5c	--	Haiku,Huleia	--
B5d	Halulu	Waipa,Hā'ena	--
B6b	Kaaikahala	Waioli	1.34
B7a	Kamauaeopilau	Hā'ena	--
B10a	Kekupua	Makaweli	--
B10b	Kuloko	Waioli	1.06
B10c	Keaweloko	Hā'ena	1.61
B10d	Ke'e	Hā'ena	3.85
B15a	Lokoponu	Nāwiliwili	--
B16x	--	Līhu'e	--
B16a	Maikai	Waioli	--
B16b	Momona	Waioli	--
B16c	Malupō	Hā'ena	--
B18a	Opahale	Waioli	0.25
B24	Waikoko	Hā'ena	--
			8.11

F. PONDS WITH LEGENDARY BACKGROUND

Four fishponds had legends or stories associated with them. The first legend concerned the brother and sister shark guardian spirits named Alekoko and Kahalalehue who contracted the construction of the Alekoko and Aalalalehue fishponds by the mythical menehune people. These two ponds, site B2 and B7 respectively, were not completed (Kaiwi 1921). The third fishpond was Nomilu, site B17 (Kikuchi and Stauder 1976:2-10), which was first associated with the legend of Pele seeking a suitable volcanic home. Several stories were recorded (BPBM Tape H41Y5) of the resident

guardian water spirit (mo'o) within fishponds. The last site was the fishpond of Papalinahoa, site B19, which was recorded by the Bishop Museum (BPBM Tape H-62D). Other fishponds most likely had their own legendary material and eventually through research some of these tales will be found. However, at the present time the lack of legendary materials attest to the rapid decline of native aquaculture and the native practioners who were also the storehouse of the legendary resources of their area.

III. SUMMARY

The fishponds of Kaua'i were relatively simple utilizing natural bodies of water as the site locations. The lack of the massive loko-kuapā type ponds suggest the chiefs of the island could not find suitable shoreline conditions and that the political and economic power of the Kaua'i chiefs were not strongly centralized to command such projects. Similarly, the temples of the island are not massive as their counterparts of the other islands which seem to be also related to the strength and power of a centralized political organization.

Of the 59 documented fishponds, only 5 remain in some condition of disrepair. This amounts to only 8% of what once was. These ponds are Alekoko (B2), Nomilu (B17), Papalinahoa (B19), Lawa'i kai (15) and Pu'u-poa (B4e). Of these only Alekoko is really accessible and visible. All of these ponds require maintenance and restoration and has good to excellent interpretative values. These sites should be protected and restored as either a historical site and/or as an operating functional fishpond to ensure it from being destroyed by humans or by nature.

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n.d. BPBM H-41Y5. 18 August 1959. Transcription by Mary Kawena Pukui in Bernice P. Bishop Museum. Honolulu.

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