Kona Coast

KONA COAST - WEST HAWAII

G.H. BALAZS FILE

SEA TURTLE TAGGING FORM

LOGGED

ID numbers of new tags attached and any old tags already present[1]		Species[2] and sex (if known)	Date and time	Place-name location (or latitude and longtitude)	Activity of the turtle[3]	Curved carapace length[4]
Left front flipper	Right front flipper					
N-478 "Sam"	N-479	CM Male	12:40 pm 5/19/91	Project Keiki Honu Joe and Peggy Forgues Kapoho-Vacationland Island of Hawaii	Pre-act captured turtles being held in private pond.	ST-60.9 CM C-28.5 in = 72.4cm
N-481 "Charley"	N-48D	CM Male	12:50 pm	Cooperation w/ Greenpeace via Denver Lehman		ST-60.5 CM C-26.7 in = 67.8 cm
N-484 "Kim"	N-482	CM Female	1:00 pm			ST-60.5 CM C-27.0 in = 68.6 cm

DEPT. OF LAND & NATURAL RESOURCES
DIVISION OF FORESTRY & WILDLIFE
P.O. BOX 4849
HILO, HAWAII 96720

[1] *If old tags are present, please carefully record the ID number and the complete address inscription. Indicate if the tag is made of metal or plastic. Use the back of this form if more space is needed to provide details on each turtle handled. Two tags should be applied to all turtles handled.*

[2] *CM = Chelonia mydas (green turtle), EI = Eretmochelys imbricata (hawksbill), CC = Caretta caretta (loggerhead), LO = Lepidochelys olivacea (olive ridley), DC = Dermochelys coriacea (leatherback), ND = Natator depressa (Australian flatback).*

[3] *Activities include (for example) nesting on the beach, swimming or resting in the sea, injured or found sick, etc.*

[4] *Measured with a flexible tape along the curvature of the midline of the upper shell (carapace).*

RETURN TO: G. BALAZS

HONOLULU LABORATORY
Southwest Fisheries Center
2570 Dole Street
Honolulu, HI 96822-2396

Name and address of person filling out this form:

Ronald Bachman
Div. of Forestry & Wildlife
P.O. Box 4849
Hilo, HI 96720

Bachman - 933-4221
Forgues - 965-8341
Greenpeace - 935-0770

RESOURCE MANAGEMENT PLAN

EXCERPT

Kaloko-Honokohau
National Historical Park

HAWAII

February 1991

NATIONAL PARK SERVICE/DEPARTMENT OF THE INTERIOR

RESOURCE MANAGEMENT PLAN

KALOKO-HONOKŌHAU
NATIONAL HISTORICAL PARK

HAWAI'I

73-4786 KANAIANI STREET #14
KAILUA-KONA, HAWAII 96740

FRANCIS KUAILANI SE.

Recommended: _____ 2-12-91
Superintendent, Kaloko-Honokōhau National Historical Park — Date

Concurred: _____ 2-13-91
Director, Pacific Area — Date

Approved: _____ 3/11/91
Regional Director, Western Region — Date

PROJECT STATEMENT

1. Project Number: KAHO-N-018

2. Project Title: Assess and Monitor Threatened and Endangered Marine Turtles and Their Habitats

3. Servicewide Issue: N02 - Impacts on Threatened, Endangered, and Other Sensitive Animals

4. Problem Statement: Green turtles (*Chelonia mydas)* and hawksbills (*Eretmochelys imbricata*) are respectively threatened and endangered, under the U. S. Endangered Species Act. A significant aggregation of immature green turtles is known to occur in nearshore waters of the park (Parrish, 1990). However, little information exists on their ecology at this site, especially food sources, individual growth rates, health status, daily movements, and other factors relevant to effect protection and management as required under the Act. The hawksbill also occurs in small numbers in nearshore waters. Additional surveys are needed to determine how this species utilizes marine habitat of the park. The recently completed Hawaiian Sea Turtle Recovery Plan provides the outline for cooperation between federal and state agencies to undertake research and management actions necessary to recover Hawaiian sea turtles. The National Park Service has been identified as one of the principal agencies in this plan.

5. Description of the Recommended Project: A series of in-water and shoreline sighting surveys would be undertaken to census and observe sea turtles in the area. Capture, tagging, morphometrics, and stomach sampling for food contents would also be undertaken as done at other high density green turtle habitats described in Balazs, Forsyth and Kam (1987). This project could be in part modeled after work in progress at Kiholo Bay (North Kona). At this site, NOAA Sea Turtle Biologists supervise volunteer students from the Hawai'i Preparatory Academy and students of native Hawaiian ancestry from UH Hilo and UH Manoa Hawaiian Leadership Program (UHH) Project Kua'ana (UH-M).

   This project will enable Kaloko-Honokōhau to manage the threatened and endangered species of turtles within the park's authorized boundaries. It is particularly important at this stage of the park's development when so many different plans are being drawn up.

   Duration of Project: At minimum, four 4-day study visits the first year (every three months). Thereafter, two 3-day monitoring visits per year (continuing).

6. Compliance: Cooperative Agreement with NOAA under Section 7 of the Endangered Species Act.

7. Funding Requirements:

   Staffing: (Minimum) 2 National Marine Fisheries Service Biologists (possibly no cost to NPS, cooperative basis)

   3+ volunteers or paid technicians (GS-4)

   Travel, Supplies:

First year	$3,000
Yearly thereafter	1,500

PROJECT STATEMENT

1. Project Number: KAHO-N-019

2. Project Title: Manage Endangered Turtles

3. Servicewide Issue: N02 - Impacts on Threatened Endangered and Other Sensitive Animals

4. Problem Statement: A significant population of juvenile federally listed threatened Hawaiian green turtles is resident within the authorized marine boundary of the park. The endangered hawksbill turtle has also been observed occasionally. Either species may nest along the beaches since tracks have been observed in the sand. Park management is obliged to preserve the habitat of these organisms. Nest sites could be robbed or disturbed by resident fishermen or the small community that uses the beach for recreational purposes. High-powered fishing vessels and scuba divers are an increasing concern. The construction of the proposed marina less than one hundred yards north of the park boundary and subsequent boat activity could have a serious impact on the turtles and their habitat.

5. Description of the Recommended Project:

   a. Establish a cooperative agreement with NOAA Fisheries to provide a monitoring program for nesting, foraging, and other activities within the park that we can cooperatively implement.

   b. Record all oral history on turtles within the park boundaries.

   c. Discuss boat traffic control so that "turtle city" is not disturbed by high speed boats and boat maintenance activities (paint scraping, bilge and gray manure discharge, gas pumping, etc.) that could impact the turtles or their habitat with Honokōhau harbor master to minimize or eliminate these activities.

   d. Educate commercial operators of potential of diving activities and boat anchorage on the turtles in order to prevent any harassment.

   e. Restrict use of beach as recreation area during nesting season.

   The project is very important for park planning purposes, viz. the use of the beaches, the long-term occupation of the fishing village, and the park's response to the proposed development along the northern boundary of the Kaloko section of the park.

6. Compliance: Cooperative Agreement with NOAA under Section 7 of the Endangered Species Act.

7. Funding Requirements:

   Resource Manager/Ranger (0.25 FTE), $7,250 each year

PROJECT STATEMENT

1. Project Number: KAHO-N-006

2. Project Title: Conduct Shoreline Monitoring Program

3. Servicewide Issue: N20 - Lack of Basic Data

4. Problem Statement: Documentation of shoreline features and shoreline activities is required to determine management options. Scope, seasonal variations and intensity of activities is poorly known.

5. Description of the Recommended Project:

   a. Inventory shoreline and large tidepool resources which are major scenic interest (e.g., slate pencil urchin).

   b. Repeatedly monitor shoreline use by birds, turtles, and other wildlife.

   c. Monitor park user activities along shoreline by interview and observation of park visitors.

      (1) collecting "ornamental" invertebrates (corals, cowries, etc.)

      (2) Collecting invertebrates and algae for food (*limu* picking, *'opihi* picking, *a'ama* (black crabs) and *wana* collecting)

      (3) shore pole fishing, spear fishing (entry/exit), and throw net fishing

      (4) recreational swimming and sunbathing

      (5) overnight special use permits

      (6) casual use -- picnic, etc.

   d. Develop a handbook for consistent monitoring of shoreline resources and train park staff in the implementation of program.

   Duration of Project:

   Establishing monitoring program - 1 year
   Monitoring - continuous

6. Compliance: Consultation with U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act and the Migratory Bird Act.

7. Funding Requirements:

	Year 1	Year 2	Year 3	Year 4
Management	$3,000			
Fieldwork	3,000	3,000	3,000	3,000
Total	$6,000	$3,000	$3,000	$3,000

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Science Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396
(808)983-5733 • Fax: (808)983-2902

August 9, 1999

Mr. Francis Kuailani
Superintendent
Koloko-Honokohau National Historical Park
73-4786 Kanalani Street #14
Kailua-Kona, HI 96740

Dear Francis:

I greatly appreciated being able to meet with you on July 28, 1999 to discuss possible research and visitor information projects relating to green turtles basking ashore and foraging at Koloko-Honokohau Historical National Park. Clearly there is the need for additional emphasis to be given to this area by my program and, hopefully, the collaborative efforts of the Hawaii Preparatory Academy directed by Mr. Marc Rice. As mentioned, in the past we have captured, tagged and health-screened turtles during scuba diving surveys off Koloko-Honokohau. My observations with you on July 28th, and again later that same day, vividly illustrated what you, your staff and others have been communicating to me - that is, the turtles are numerous, occur close to shore to forage on limu, and are very tolerant of people visiting the National Park for recreation and sightseeing. This is an impressive phenomenon highlighting the population renewal underway for Hawaiian honu, and the outstanding opportunities for visitors to view sea turtles at this site.

As promised, I am sending you the text in both English and Japanese of the educational sign produced by Marc Rice and his students. This attractive, informative and durable sign has been posted at Kiholo Bay, Punaluu in Kau and several beach right-of-ways at Puako. All of these sites have turtles basking out of the water and foraging close to shore, such as occurs at Koloko-Honokohau. Please contact Marc at 881-4004 to obtain one of these signs for trial use. I believe their construction cost is under $100 each.

I propose that we meet in person in the near future to plan our cooperative work. Please suggest some dates that are possible for you and your staff.

Sincerely,

George H. Balazs
Zoologist and Leader
Marine Turtle Research Program

cc Marc Rice - HPA

Diving with a Difference - We Care

DIVE MAKAI CHARTERS

POST OFFICE BOX 2955
KAILUA-KONA, HAWAII 96745
PHONE & FAX: (808) 329-2025

Copy to MARC + Bebus

Capt. Tom Shockley

Capt. Lisa Choquette

9/25/96

Hi; George:

"Turtles" was "T.I.A." (Turtle International Airport) today, a.k.a. "Duck-flying turtles". Non-interfering observation doth have it's (pleasant) hazards!! They do run into us!! Porter (guide) was watching 1 turtle, oblivious 2 the 1 coming down that ~~was to~~ whacked him in the head!! I'm sure they know we're there!! It roared!!"

2 w/ tags were there, 1 left early on! The other's tags were so algae covered couldn't read, But - RR tag was missing. Approx. 26" shell - F-B (meas. rock alongside)!"

(over)

Finding her now would be the problem!!

Piggy - dear, dear Piggy! A character!!

Her history as I have it:

(I confess to measuring her the other day!!)

1st interaction - 7/2/87

She's a "Happy Wanderer"!!

Wow!! Squid Diet??

10/3/88 - 20" x 17 1/4"

5/17/89 - 20 3/4" x 18 1/4" - Tagged!!

9/13/90 - 23"

9/21/96 - 24"

Quit feeding her sometime in 90-91...!!!

We have only we haven't fed in over 5 years - still come looking for loving!! One - Wacky - will lie on his back to have his belly rubbed!! Unreal!! He comes & finds us!!!

Thanx for hookues!

Come on over!!

Lisa

P.S. You may get a call from my daughter, Becky - the ZOOKEEPER @ Hon. Zoo - Rep. & Angel, asking you to speak to their Herpetological Club - she's President!! Good luck...

Diving with a Difference - We Care

DIVE MAKAI CHARTERS

POST OFFICE BOX 2955
KAILUA-KONA, HAWAII 96745
PHONE & FAX: (808) 329-2025

Att: George Balazs

Capt. Tom Shockley

Capt. Lisa Choquette

11/7/96

Hi, George -

LF - J 431 @ Turtles today (it was incredible - wear helmets - watch for low flying turtles!!) Shell approx. 27"! Looked fine & healthy. Will be in Hon. Mon & Tues. Will holler if I have a chance.

'All well here -

Lisa

Diving with a Difference - We Care

DIVE MAKAI CHARTERS

POST OFFICE BOX 2955
KAILUA-KONA, HAWAII 96745
PHONE & FAX: (808) 329-2025

Att: George Balazs

Capt. Tom Shockley

Capt. Lisa Choquette

9/22/96

Hi, George -

Ran into "Piggy" again yesterday - frisky & well!! Have seen lots of ~~tagged~~ turtles @ T.T., but no tags recently!

All is Well -

Lisa

P.S. Hauled out Piggy's record - 1st made contact over 9 yrs. ago - 7/2/87!!

MARC
FYI. GEO

KAHALU'U BEACH BITES & SNORKEL RENTAL
KAHALU'U BEACH PARK

"THE TURTLE LADY"
CINDY DURAND FOSTER

75-411 NANI KAILUA DR.
KAILUA-KONA, HI 96740
(808) 326-2612

Sent

September 13, 1996

George H. Balazs
NMFS
Honolulu Laboratory
2570 Dole Street
Honolulu, HI 96822-2396
FAX--(808) 943-1290

Dear George,

Do you have a 1 page document that you could FAX to me, which explain the overall & specific objectives of the HONU PROJECT? I thought I had an information sheet like that, but I can't seem to find it.

Also, any other information about the Green Sea Turtles that is avalible would be greatly appreciated. You can send that to: "The Turtle Lady"--Cindy Foster, 75-329 Aloha Kona Drive, Kailua-Kona, HI 96740.

On a personal note, I'm sorry that I missed seeing you when last you came to Kahalu'u Beach Park. I look forward to seeing you the next time your here.

Have a terrific day.

With warm regards,

Cindy Foster

"THE TURTLE LADY"
Cindy Foster

FAX #: (808) 326-5652

Statement For Management

Kaloko-Honokohau

Kaloko-Honokohau National Historical Park/Hawai'i

June 1988

U.S. Department of the Interior/National Park Service

STATEMENT FOR MANAGEMENT

KALOKO-HONOKOHAU
NATIONAL HISTORICAL PARK
HAWAI'I

National Park Service/U. S. Department of the Interior

KALOKO-HONOKOHAU
NATIONAL HISTORICAL PARK

STATEMENT FOR MANAGEMENT

Prepared:	Chief, Interpretation and Resource Management, Kaloko-Honokōhau NHP	JUN 6 1988 Date
Recommended:	Superintendent, Kaloko-Honokōhau NHP	JUN 6 1988 Date
Concurred:	Director, Pacific Area	JUN 9 1988 Date
Approved:	ACTING Regional Director, Western Region	6/20/88 Date

'Ai'makapā is used as a nesting area by the *'alae ke'oke'o* and *ae'o*. The *koloa* occasionally use 'Ai'makapā for wintering.

The black-crowned night-heron, a native resident frequents 'Ai'makapā. Several species of migratory waterfowl often winter at the pond; including, northern pintail, northern shoveler, American wigeon, and blue-winged teal. The latter species produced young at 'Ai'makapā in 1982 and 1983 for the first breeding records of migrant waterfowl in the Hawaiian Islands. Pied-billed grebes are seen regularly and a few now nest at the pond.

A wide variety of accidental or rare stragglers have been recorded at the ponds and park coastline. This list includes: snowy egret, white-fronted goose, brant, green-winged teal, mallard, cinnamon teal, Eurasian wigeon, canvasback, ring-necked duck, hooded merganser, semipalmated plover, lesser yellowlegs, bar-tailed godwit, several species of sandpipers, dunlin, long-billed dowitcher, red-necked phalarope, franklin's gull, ring-billed gull, caspian tern, and black tern.

Other birds frequently seen in the park are wandering tattler, golden plover, chukar partridge, grey francolin, cardinal, ricebird, mynah, and the *pueo* (Hawaiian short-eared owl).

The Island of Hawai'i has very few wetlands suitable for native birds. Thus, key areas such as 'Ai'makapā and Kaloko (when cleared of mangrove) become especially important areas for protecting rare and endangered bird species. The only other comparable area on the Island is 'Opaeula, a small brackish water pond a few miles north of Kaloko. 'Ai'makapā and Opaeula are the only areas on the Island of Hawaii listed as "essential" waterbird habitats in the Hawaiian Waterbird Recovery Plan.

The most noticeable mammal is the mongoose, an unwise introduction to the islands which played a part in upsetting the fragile terrestrial ecosystem of Hawai'i. In addition to the mongoose, rats and feral cats prey on the eggs and young of ground nesting birds.

Feral goats and pigs which cause major problems throughout the island's ecosystems are uncommon in the park and there is little evidence of damage by these aliens.

Marine Resources

Marine life, both offshore and within the fishponds, is particularly abundant because of the presence of a shallow inshore area -- an unusual situation in west Hawai'i. Moreover, this resource was, and still is, used as an important food source.

Low tide exposes part of the coral reef and the inter-tidal zone, both of which contain numerous life forms. *Limu* (seaweed) was present in large amounts but is less abundant now, due to frequent food-gathering use by local citizens. *'Opihi* (a species of limpet) clings to rocks on the inter-tidal zone and the splash zone. This delicacy is becoming scarce throughout Hawai'i, as demands increase for its use. *Pipipi* (periwinkle) has a delicate flavor when boiled and is found in the reef areas. *Wana*, *hawa'e*, *ina*, and *ha'uke'uke* (sea urchins) were caught at various depths (usually in shallow water and tidepools) and served as an important food supplement to Hawaiians, although they are little used today. *A'ama* and *papa'i* (crab) are usually eaten raw and often caught by torchlight.

The brackish water pools are also food sources. *Hihiwae* (similar to periwinkle) was used extensively by ancient Hawaiians for food. *'Opae* (shrimp) are also common and are eaten raw or dried. They are also used today as bait. Still observed within Kaloko are schools of *'ama'ama* (mullet). Also reported to be in the pond are *awa* (milk fish), *manini* (Acanthurus sandvicensis), *aholehole* (Kuhlia sandvicensis), *pao'o* (goby fish), and *'opae* (shrimp). Large *awa* have been observed occasionally breaking the surface at 'Ai'makapā and Kaloko. *Palolo* (fireworms) live in the coral, dead clams, and silt in the bottom of both fishponds and constitute a hazard to anyone venturing into these waters.

An offshore snorkeling survey at Kaloko showed a number of species of fish. Spotted in the surge zone were *paku'iku'i* (Acanthurus achilleo), *manini kole* (Ctenochaetus stigosus), yellow tang, *maiko* (young palani) and *na'ena'e* (surgeon fish). Farther out, as the shelf drops to a depth of 30 to 40 feet, several large

uhu (Scarus perspicillatus) and schools of *kala* (Teuthidae), *palani* (Acanthurus dussumieri), *weke* (Millidae), and *kumu* (Upeneus porphreus) were spotted.

Most of the coral growth is located at Honokōhau Bay and 'Ala'ula Bay, although there is some live coral offshore at Kaloko. The reefs and shallows furnished the nutritional values of sea vegetables, protein, and minerals, which historically supplemented inland agricultural produce (carbohydrates) and established a balanced diet for ancient Hawaiians. This natural food source is an integral part of the land-sea philosophy of resource use that permeated all aspects of traditional Hawaiian lifestyle.

Cultural Resources

Hawaiian civilization has been described as autocratic, feudal, religious, traditional and agrarian; and to some extent all of these labels are correct. None of them, however, is entirely true. To define Hawaiian society solely by these terms would be torturing it into compliance with foreign concepts. Isolated on the mid-Pacific islands, Hawaiians evolved a culture with its own essence.

Archeological evidence of that culture is abundant in the park. The most impressive of the sites are the Kaloko, 'Ai'makapa fishponds and 'Ai'ōpio fish trap and the several *heiau* located between Wawahi wa'a Point in Kohanaiki and the 'Ala'ula Bay area in Kealakehe. The two most prominent of these *heiau* were probably Makaopio *heiau* in 'Ala'ula Bay and the Pu'u'oina *heiau* south of the 'Ai'ōpio fish pond.

'Ai'makapā, the largest of the ponds, is approximately 15 acres in size. 'Aimakapa is a *loko pu'uone* type pond, that is, a large natural pond formed behind a barrier beach. The pond is still intact, although some parts have become overgrown. The pond is still inhabited by awa fish (milk fish, chanos) and native and migratory birds. The variety of sites around the pond include a *hōlua* (slide), *heiau*, bathing pool and a very large platform.

The *hōlua* is one of six which have survived in Kona. It is the only *hōlua* besides the one at Keauhou which would allow two contestants to compete at the same time. The takeoff and runway as far as the brow of the flow are well preserved.

Another interesting site is a large stone located on a high point behind 'Ai'makapā. This stone is called *Kanaka Leo Nui*, which means "man with a loud voice". Local tradition says that in ancient times, a chief by that name stood on the stone and directed fishing fleets off the coast.

The number and type of sites located around 'Ai'makapā indicate that this area was used by the *ali'i* for recreational and ceremonial purposes.

The 'Ai'ōpio pond is 1.7 acres in size and is of the *loko kuapa* type, a pond whose backbone consists of a stone or coral wall. 'Ai'ōpio is also referred to as a fishtrap because it has no *makaha* (sluice gate) and there are four rectangular walled enclosures which were probably used as holding pens for netted fish.

At the south side of the 'Ai'ōpio fishtrap is the Pu'u'oina, probably the finest example of a platform type of *heiau* in Kona. The *heiau* measures 50 feet by 145 feet and varies from three feet to eight feet in height. Its original divisions are almost intact. The simple beauty and durability of the *heiau* are indications of the resourcefulness of the ancient Hawaiians who constructed it.

To the west of the Pu'u'oina Heiau at Alula cove is a fisherman's heiau known as Makaopio. The striking feature of this *heiau* are two great upright stone slabs which measure about 1 foot by 4 feet by 7 feet high. The stones may have served as *ku'ula* (fish gods), but local Hawaiians also believe they were used to measure the heights of warriors who passed through the area.

North of 'Ai'makapā pond is the Kaloko fishpond, also of the *loko kuapa* type. Kaloko is a natural embayment separated from the sea by a man-made sea wall. It is approximately 11 acres in size, with secondary walls within the pond forming three separated areas where fingerlings were raised or where different species of fish were kept.

Kaloko is an excellent example of the engineering skills of the ancient Hawaiians. It has the largest and thickest man-made sea wall, and is the most impressive example of a *loko kuapa* type pond on the island of Hawaii.

The park is marked with numerous grave sites. The grave sites are often overlooked in terms of their overall significance. Their importance to Hawaiians in the area, and throughout the State for that matter cannot be discounted. The grave sites were especially sacred ground, for in Hawaiian religious beliefs deceased ancestors returned in the form of an *Aumakua* (family god) to guide and protect family members still living.

In addition, Kaloko is said to be the burial place of several members of the Kamehameha family. The possibility of Kamehameha the Great being buried at Kaloko has tremendous significance for people of Hawaiian ancestry. Because of this, many local people fear that through careless or thoughtless development the possible burial site of Hawaii's founding father might be destroyed.

The park contains numerous other sites of significance. These sites include the *mauka-makai* trails, *kahua hale* (house platforms), *ko'a* (fishing shrine), *ahu* (stone mounds) a concentration of more than 50 stone enclosures (believed to be agricultural planters), lava tube shelters, canoe landings and shelters, salt pans, petroglyphs, and *papamū* (*kōnane* board).

To date 205 archeological sites have been recorded and another 200 or so have been noted in the park. There may be more, both on land and submerged. All of these sites substantiate prehistoric and historic occupation by many people who utilized the sea and adjacent lands. It was an area used not only by *maka'ainana* (common people), but also by *ali'i* (chiefs) until close to the twentieth century.

Taken individually, the sites may not have great impact for some. But seen in its total perspective, the area is archeologically valuable as a place for studying the activities of pre and early contact Hawaiians, and the changes which occurred in subsistence patterns and land ownership upon the arrival of a different culture.

More importantly for Hawaiians, it represents a place where their ancestors lived, died, and are buried and is therefore invaluable in terms of their heritage.

The fact that many Hawaiians settled in this area substantiates that there were sufficient resources to sustain such populations. Calm seas and shallow landings made it ideal for the Hawaiian canoes. Its shoreline and offshore fishing were very productive, and the shallow bays were ideal for the construction of fish ponds.

The fish ponds of the area were of much importance to the ancient Hawaiians, and reflect their ingenuity in adapting themselves to their environment. Historically, the fish ponds of Kaloko and 'Ai'makapā were larger than they are today. 'Ai'makapā is believed to have encompassed approximately 30 acres.

A great deal of care was taken to maintain the ponds in good working conditions. The ponds caretakers were responsible for keeping the ponds clean of overgrowth, repairing the sea walls and *makaha* in the event of wave damage, and keeping the ponds well stocked with fish. Such great care was taken because the ponds are believed to have been the reserved property of Kamehameha the Great and other high ranking *ali'i* of historical times.

Another physical resource with much historical significance is the Mamalahoa Trail, also known as the King's Highway. The trail extends around the island of Hawaii and was reportedly built for Kamehameha the Great, who often moved his court from one district to another. It is said that Kamehameha, while traveling to a district that was under invasion by an enemy chief, would pick up his soldiers who lived in different settlements along the trail.

There is also a system of *mauka-makai* trails in Honokōhau used by the residents to travel and communicate with *'ohana* (extended family) within the *ahupua'a*. The importance of these *mauka-makai* trails to the subsistence of the ancient Hawaiians cannot be disregarded. These trails should be looked at as lifelines, for it was the common practice of Hawaiians living makai to take fish, salt, *limu* (seaweed) and other items accessible to them up to their *'ohana* living *mauka*. In return, they were given food products such as taro and other items unavailable to them *makai*.

This form of exchange was the basis of the Hawaiian economy, and the system of trails provided the physical means to make it possible.

C. Land and Water Use Trends

Adjacent Land Character and Use

Immediately south of the park is the State-owned and operated Honokōhau small boat harbor. The harbor is not natural, having been blasted out of the lava rock. Presently, there are about 180 berths for craft ranging up to 80 feet in length. Facilities include ramps for launching and retrieving boats, auto parking and boat storage, a boat repair yard, a fuel dock, and a small administrative building. Access to the boat harbor is via a paved public road from the highway. The State has not yet completed its development plans for the harbor. Additional blasting will take place at the southern end to enlarge the harbor to accommodate about 80 more berths for craft up to 100 feet in length. More parking has recently been added, as well as buildings to house a restaurant and commercial area for boat sales, rentals, and supplies. These services are provided by concessioner. As mentioned, the boundary shared by the park and the boat harbor has been officially changed to recognize existing uses by the State and to protect important archeological features and park viewsheds.

The eastern boundary of the park coincides with the Queen Kaahumanu Highway. Both the Kaloko and Honokōhau *ahupua'a* extend to the east of the park boundary. The Lanihau Corporation is also the owner of this *mauka* portion of the Honokōhau *ahupua'a* and is leasing it to a company that operates as a quarry and concrete batching plant. Immediately to the south in the Honokōhau *ahupua'a* is another quarry and a construction yard. Since these operations exist within the boundaries of a State conservation district, they operate under a special use permit. On the *mauka* portion of the Kaloko *ahupua'a*, owned by TSK Associates, a large light industrial and warehouse subdivision is being developed. Upslope from the park and the industrial area are residential developments. Effluent from these developments seems to be reaching the park through underground lava tubes and having an adverse effect on the water quality and biota of the anchialine and fish ponds. Immediately north of and adjacent to the park, a large resort complex is in the

final stages of planning. This development would include two hotels, 800 condominium units, an 18-hole golf course and clubhouse, a 150-slip marina, 200 single-family and 150 multi-family residences. Access to the marina would require blasting through the coral reef and shoreline and destruction of a *heiau* all of which are within the park boundary.

Kailua, a major resort complex, tourist destination area, and retail shopping center on the island of Hawaii, is located about three miles to the south. During the past decade, this area has grown at a rapid rate, going from a population of about 5,000 in 1970 to nearly 15,000 at the present time and tourism is still increasing in the area.

The Keahole Airport is located about two miles north of the park. The area in between is barren lava, except for an ocean thermal energy plant at Keahole Point. The airport is a modern facility utilized for both interisland and mainland service. Just south of the park on the *mauka* side of the highway, the Kealakehe Sports Complex is being proposed to service the Kailua area. The county has located its rubbish dump south of the proposed complex. As previously mentioned, this facility is a source of air pollution which adversely affects the park.

It is obvious that in a very short time, Kaloko-Honokōhau NHP will be virtually surrounded by developments and constitute the only open space/natural area for miles along this shoreline of the Big Island.

Within Park Influences

Within the authorized boundary, two tracts of private land comprising about 255 acres have yet to be acquired despite continuing efforts by the National Park Service. In addition, about 15 acres of land and 510 acres of offshore waters (submerged land) are owned by the State. Although both private and state lands have remained undeveloped for many years, there is no doubt that intensive development will eventually occur on these parcels unless they are acquired by the federal government. By law, the State lands can only be acquired by donation which is unacceptable to the State of Hawaii.

Several residences occupied by family groups totalling about 15-20 people are located on the recently acquired parcel adjacent to the 'Ai'ōpio fishtrap. While the occupants neither own, leased, or rented the property, occupancy was with the full knowledge and consent of the previous landowners. Most of these people have lived here for many years and their life style and subsistence fishing methods represent a scene which has all but disappeared in Hawaii. Further, the Honokōhau Study Advisory Commission Report recommended that these families be allowed to remain for a period of time to be determined by negotiation.

Following meetings with the heads of each of these family groups, Special Use Permits have been drafted, allowing them to continue to reside within the park for a period of five years. These draft permits contain strict provisions against any expansion of existing facilities and use and conditions relating to protection of resources, sanitation, and safety. As of this writing (May 12, 1988), completed Special Use Permits have not been issued.

The private lands within the park contain one of the few and probably the largest sandy beach on the Big Island. It receives unofficial and unstructured public use, mostly by "sunbathers".

Climatic conditions at the park are largely determined by its location at the base of the leeward slopes of Hualālai volcano. The leeward coastal position contributes to the hot, dry climate. Wind patterns feature afternoon onshore breezes caused by the Hualalai updraft. These alternate with light trade winds at night. Since precipitation occurs as a result of the convectional updraft, rainfall is highest during the summer, a pattern unique to the Kona coast within the State.

The temperature is quite constant, with an average annual maximum of 83 degrees F and minimum of 67 degree F recorded at the former Kona Airport, 2 miles southeast of the area. In January the temperature averages 72 degrees F and in July 76 degrees F.

Rainfall is quite low, averaging 25 inches annually. Conditions at the park are even drier than these data from the airport gauge would indicate. Precipitation is lowest between October and May. Several summer months each average twice the monthly

precipitation between October and May; the rainfall pattern is thus truly Kona. Relative humidity is fairly high and stable, averaging 71-77% throughout the year.

Winter storms, high surf, hurricane and tsunami can and have impacted the exposed coast. Historically, tsunami waves have reached about ten feet in height along the Kona coast.

While feral animals do not appear to pose a major threat at present, a number of alien plant species pose a direct and immediate threat to park resources.

D. Visitor Use

The park is not yet fully operational and visitor use will not be encouraged until adequate resource protection and safety programs are in place. However, the Kaloko portion is open to the public with a Park Ranger on duty from 7:30 a.m. to 4:00 p.m., seven days of the week.

No records have been kept on past uses of the property by the public. In accordance with the authorizing study, the park will be managed primarily for day-use. Currently, guided tours are conducted by appointment. During January 1988, the first month the area was open, there were 118 visitors including three group tours. Other visitors were mostly local fishermen.

E. Facilities and Equipment

Buildings*/Structures/Sites	205 recorded archeological sites (probably many more)
Roads/Streets	unpaved - 1 mile
Trails	3 miles
Water/Electric Systems	None on site - Water/Power lines run along highway on east boundary.
Sewage	Portable Toilets
Communication	Radio

Vehicles and Equipment	1 - 2x4 Pick-up -leased from GSA 1 - 4x4 Pick-up w/Crew Cab - leased from GSA 1 - 13 ft. Boston Whaler Work Boat 1 - 4 H. P. Outboard Motor 1 - Boat Trailer

*Office and garage space leased in industrial area east of park.

Old house trailer/temporary shelter near Kaloko fishpond. Permanent facilities, generally in accordance with the Study Commission Report, are dependent upon acquisition of additional lands.

F. Status of Planning

Name of Plan/Study	Preparer	Date	Comments
Honokōhau National Historic Landmark	John Waihee	1973	Data Report to Study Advisory Commission
The Spirit of Kaloko-Honokōhau	Study Commission	5-74	Pre-Authorization Study
Oral Tradition of Honokōhau-Kaloko	Aalaonano and Nahale	1975	Report to NPS
Ancient Hawaiian Shore-Zone Fishponds	Apple and Kikuchi	1975	Includes KAHO ponds
Environmental Statement - Proposed KAHO NHP	WR-NPS	3-75	Draft
Resource Protection Case Study - KAHO	NPS Team	3-82	
Land Protection Plan	Gary Barbano	9-83	
Position Management Plan	Bryan Harry	10-86	Contingency Plan
Plant Communities of KAHO	Joan Canfield	7-87	U of H - CPSU
Natural/Cultural Resource Management Plan	PAAR/Park Staff	3-88	In Preparation
Aquatic Resources Study	CPSU	3-88	In Progress

G. Management Zoning (see maps on following page)

Current Ownership	Acres
Federal (NPS)	380.8
State of Hawaii	525.0*
Private	255.0 ±
TOTAL	1,160.8

*Mostly submerged lands

Historic Zone 621 Acres

The entire area is a National Historic Landmark and virtually all lands and waters were occupied/used by prehistoric and/or later peoples. Therefore, the entire park is in the historic zone with the minor exceptions and qualification noted below.

Natural Zone 535 Acres

In the unlikely event that management of the fishponds and the ocean for historic values conflicts with management for natural values, especially as related to rare and endangered species, management for natural resources will tae precedence.

Development Zone 5 Acres

Small areas will be developed for orientation, cultural education/demonstration, visitor services, etc. Precise locations are unknown at this time.

V. Major Issues

1. Within the authorized boundary, two tracts of private land comprising about 255 acres have yet to be acquired. In addition, about 525 acres of land and offshore waters (submerged land) are owned by the State. There is no doubt that intensive development will occur on all lands unless they are acquired by the federal government. By law, the State lands can only be acquired by donation which is unacceptable to the State of Hawaii.

KAHO PARK DRAFT 3/89 J. Parrish

(Hemitaurichthys polylepis), a plankton feeder seen in a large mid- water school. A sand tilefish (makaa--Malacanthus hoedtii) was the only obligate sand dwelling species observed.

Sea Turtle Observations

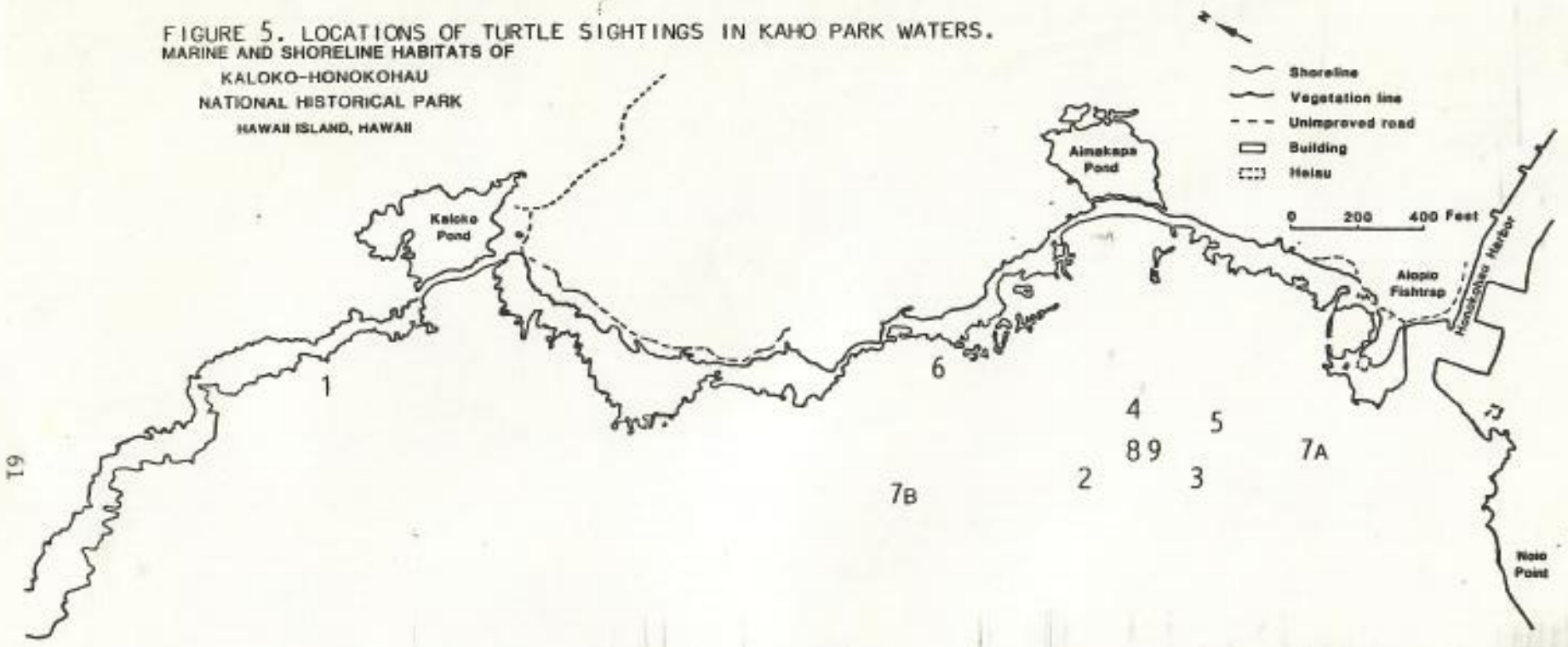
Green sea turtles (Chelonia mydas) were common throughout the park waters. Observations were made both in the water and from the surface (Table 3). Visual estimates of carapace length were made along with information about the appearance of the animals. There were no observations of tagged or unhealthy individuals. Of the 48 turtles observed, 16 had carapace lengths of approximatly 50 cm, and twelve had carapace lengths of approximately 60 cm These two size classes accounted for 58% of the observations. Ten smaller individuals were observed, while only four observations of larger animals were made. The size distribution of sea turtles is heavily skewed towards size classes less that 60 cm (79% of the observations).

Although turtles were regularly seen over a wide area, the majority of observations were made in a relativly small locality offshore from Honokohau beach -- the "turtle grounds" (Fig. 5). This area includes site locations 2, 3, 4, 5, 7, 8 and 9. (The six observations of location 7 were made while traveling by boat from site 7a to 7b.) Only the surveys at sites 8 and 9 were made specifically to observe turtles. Other observations were made in conjuction with other field work, hence observation effort varied and the surveys are not directly comparable. Site locations 4 and 5 are in the Shallow Cliff habitat; locations 2, 3, 8, and 9 are in the deeper offshore edge of the Boulder and Deep Pavement

Table 3. Size distribution of turtles obvserved in KAHO park

		Carapace length (cm)								
Location	Date	30	40	50	60	70	80	90	No est.	Total
1	16 Oct			1						1
2	31 Oct		1	2	2		1			6
3			3	4	2	1				10
4	11 Nov			3	1	1				6
5			1	1	2				1	5
6	12 Nov	2								2
7	25 Nov		1		1				4	6
8	3 Dec		1	2	2			1		6
9			1	3	2					6
		2	8	16	12	2	1	1	5	48

FIGURE 5. LOCATIONS OF TURTLE SIGHTINGS IN KAHO PARK WATERS.



habitat.

Turtles were usually found on the bottom in depresions or in small crevices and holes in areas of higher relief. Most appeared to be sleeping or resting and were flushed as divers approached. The Shallow Pavement zone inside Honokohau Bay had a high biomass of algae, and it is presumed that turtles move into the shallow areas to feed. This short migration is probably nocturnal.

Extant Beach habitats as done at V.N.P.

History of turtles in ponds?

ocean temp?
pond temp?

Enforcement

Feed Turtles

Jack's Piggy/high tides

Species Algae

pollutants from harbor?

depths -

Daily activities -

Food Sources

Education/INF.

Other Species - ie E.i. at Kealakekua

Reduced Solare Radiation/Algae

Cooperative Monitoring w/HPA

Eg - transitory vs. resident?

Growth rate to reflect quality of habitat

Protection of Sea Turtles

Sea turtles are an important and sensitive element of the park marine biota. Because of their important role in traditional Hawaiian culture, their continued presence in park waters represent a significant cultural resource of the park. Because of their official status as threatened species on State and Federal lists, protection is legally required in any Federal activity potentially affecting them.

The "no management" option would simply comply with minimum requirements of the law by taking no action that would further jeopardize turtles. This may be a viable option. If park development does not result in a significant increase in human activity in the water, particularly in the resting area (turtle grounds) described above, the local turtle population will probably be little affected.

Another option would encourage and facilitate maximum and uncontrolled access to the turtles by park visitors for viewing, photography, etc. While such an approach might be popular with some users, it carries a real potential for harassment or injury that may negatively affect turtle populations. At present, the turtles can be easily approached (and harassed) by small open boats (including rental boats) from Honokohau public harbor, less than 5 minutes away.

The recommended option combines active protection of turtles and habitat, interpretation and education for park users, and data gathering to monitor the status of the population. The NPS should pursue with appropriate state authorities the legality and feasibility of routing routine coastwise boat traffic

slightly farther offshore so as to minimize traffic over the heavily used resting habitat. The rerouting involved would create negligible inconvenience for boat traffic, but would greatly reduce the potential for deaths or injuries from boat strikes. Restriction of more localized boat traffic would reduce the hazard of strikes somewhat further, but it would be hard to specify and enforce, short of a total ban on power boats in park waters. The level of risk does not seem to justify such a ban. It is not known whether the present considerable SCUBA diving activity within park waters results in much interaction with turtles. Discussions with the major dive operators would be desirable; depending on the findings, it may be appropriate to restrict or regulate diving operations in the major turtle resting areas.

Park informational material could acquaint visitors with the ecology, traditional uses and cultural importance of turtles, their current biological and legal status and ecological vulnerability, and appropriate behavior for their protection (e.g., avoiding harassment, using care in boat operation, reporting stranded turtles, turtles with tumors, etc.) Should the NPS or a concessionaire ever become involved in conducting boat tours of park waters, an occasional sighting of turtles at the surface may enhance the experience for some visitors, but care in boat operation will be required.

NPS personnel can gather data on turtles that may be of value in protecting the local population and may contribute to the knowledge of turtle biology and management of the larger

population. Such data as records of all sightings, with date, time, location, length of time exposed, and any visible marks such as tags, scars or tumors can be taken incidentally to other duties, from shore or boat. When used with a record of the length of time available for observation useful information on frequency of incidence may be derived; e.g., incidence of total sightings or sightings of tumors may be useful as indices of local population size and health respectively. NPS personnel should consult with Mr. George Balazs of the National Marine Fisheries Service for further (more expert) advice on management and monitoring of turtles. For both enforcement and monitoring purposes (and for a variety of reasons unrelated to turtles) the park should maintain a small boat capability and staff qualified in boat operation.

Cooperative National Parks Resources Studies Unit

University of Hawaii at Manoa

Botany Department

3190 Maile Way, HONOLULU HI 96822
(808) 948-8218
FTS 551-1247

M E M O R A N D U M March 28, 1989

TO: All Participants

FROM: Clifford Smith
Director, CPSU/UH

RE: Kaloko-Honokahau NHP Scoping Session

We would appreciate your participation in a meeting to evaluate the natural resource management and research issues at Kaloko-Honokahau National Historical Park (KAHO) on Wednesday - Friday, April 5 - 7, 1989. The objective of the scoping session is to identify natural resource management and research needs, prepare resource management project statements and rank them in priority. NPS guidelines for resource management project statements are attached.

On Wednesday afternoon, the acting superintendent, Francis Kuailani will lead a walk through the park. If you wish to participate please meet at the park office 73-4786 Kanalani St. (329-6881) in the Kaloko Industrial Park at 1:00 p.m. On Thursday, we will meet at 8:00 a.m. at the old Kona airport to discuss issues and problems related to anchialine ponds, fish ponds and marine resources. On Friday, we will return to the Liliuokalani Center at 8:00 a.m. and discuss the terrestrial issues, e.g. alien plant problems, mongoose management, endangered bird issues, etc. Some of you may want participate both days others just for one day.

A number of management issues have been identified at KAHO (see attached Statement for Management):

Endangered Birds
Endangered Turtles
General Marine Resources
Anchialine Resources
Fish Pond Resources
Alien Plant Problems
Alien Animal Problems
Water Pollution Problems
Air Pollution Problems
External Threats

Some overlap to a certain extent. However, these management issues can be a useful focus for our deliberations.

For further information call Cliff Smith, 948-8218 or Francis Kuailani, 329-6881.

Cliff

Participants:

Director, PAAR
Archaeologist, PAAR
Kolopinski, WRO
Jackson (or substitute), Water Resources Division
USFWS endangered species coordinator
USFWS aquatic specialist
Parrish, USFWS Cooperative Unit
Chai, Anchialine resources
Stone, HAVO, predators
Tunison, HAVO, weeds
Kuailani, Acting Superintendent, KAHO
Smith, CPSU/UH, facilitator
Canfield, TNCH, flora
Gon, TNCH, Anchialine resources

• GPO 1994 – 301-201/80000

Puukohola Heiau

NATIONAL HISTORIC SITE • HAWAII

ADMINISTRATION

Puukohola Heiau National Historic Site, a unit of the National Park Service, U.S. Department of the Interior, is administered by the superintendent of Pu'uhonau o Hōnaunau National Historical Park. Address all inquiries to Honaunau, Kona, HI 96726.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

National Park Service
U.S. DEPARTMENT OF THE INTERIOR

High on a hill above the Pacific Ocean, near the village of Kawaihae on the island of Hawaii, sits Pu'ukoholā Heiau—the last major religious structure of the ancient Hawaiian culture built in the islands.

An artist's conception of Pu'ukoholā Heiau as it probably appeared at the beginning of the 19th century.
Courtesy of Bernice P. Bishop Museum

This heiau, or temple, was built by Kamehameha I in 1790-91 on Pu'ukoholā, the "hill of the whale," and was dedicated to his family war god Kū-kā'ili-moku.

Hawaiians constructed the massive temple platform by carefully setting waterworn lava rocks and boulders together, without using mortar. It measures 68 by 30 meters (224 by 100 feet) with walls on the landward side and on the ends. Three long narrow terraced steps cross the side that faces the sea, thus opening the interior to view from canoes floating offshore.

Over the years, the platform has withstood major earthquakes on this volcanic island, but recent earthquakes have begun to collapse the outer layers of rock. The National Park Service is now planning how best to repair the damages and to do maintenance work stemming from 150 years of abandonment.

When the temple was in use from 1791 to 1819, there were thatched houses and an altar for the ruling chief and his priests. Wooden images of Hawaiian gods stood on the platform and terraces. The houses, images, prayer tower, altar, and other temple furnishings were either destroyed or left to disintegrate, and only the massive stone structure remains today—a reminder of the role played by Pu'ukoholā Heiau in the founding of the Kingdom of Hawaii in 1795 by Kamehameha the Great.

THE CHIEF BUILDS A TEMPLE

In 1782, Kamehameha became ruler of the northwest half of the island of Hawaii, and for about a decade he fought unsuccessfully against his rival chiefs for control of the entire island. Without securing the remainder of the island chiefdoms, he invaded and conquered the islands of Maui, Lanai, and Molokai. Meanwhile, his rivals on Hawaii battled each other until eventually Kamehameha had only one remaining rival—his cousin Keoua Kū'ahu'ula on his home island of Hawaii.

While on Molokai, Kamehameha heard that Keoua Kū'ahu'ula was attacking his property. He sent his aunt to the island of Kauai to seek direction from a famous prophet, Kāpoūkahi, who told her that Kamehameha would conquer all the islands if he built a large temple to his family war god Kū-kā'ili-moku atop Pu'ukoholā hill at Kawaihae. Kamehameha returned to Hawaii to defend his land from Keoua Kū'ahu'ula, who retreated but still held his half of the island.

In 1790, Kamehameha began to build the temple. The prophet Kāpoūkahi joined Kamehameha's staff as the royal architect of the temple, and thousands of workers, camping on the nearby hills, labored to carry the stones to form the massive structure. Even Kamehameha labored with the others. Only one person, his younger brother, was excused because one high chief had to remain ceremonially clean to preside at the religious services. To please the war god, this temple had to be ritually perfect.

When news that Kamehameha was building a major Hawaiian temple reached his rival ruling chiefs, they decided that they must attack him at Kawaihae while he and his subjects were thus occupied. At best, the invasion would eliminate Kamehameha and stop completion of this culturally significant temple. At worst, the interruption would interfere with the construction process and its prescribed series of ceremonies. If they could keep the temple from being ritually perfect, perhaps Kamehameha's war god would be displeased. An invasion therefore had the potential of eliminating or reducing the spiritual power Pu'ukoholā Heiau could supply Kamehameha. The chiefs of Maui, Lanai, and Molokai reconquered their islands and joined by the chiefs of Kauai and Oahu sailed to attack Kamehameha. Kamehameha counterattacked, was successful, and resumed building his temple.

It was a long and arduous task, but finally, in the summer of 1791, the temple was finished. Kamehameha invited his rival Keoua Kū'ahu'ula to the dedication to make peace. Perhaps acceptance of the completed temple and its significance—a fatalistic resignation to his doom—was among the reasons Keoua Kū'ahu'ula came willingly. As he stepped ashore from his canoe on the beach below Pu'ukoholā Heiau, there was a scuffle and he and his close companions were slain. His body was carried up to the temple and offered as the principal sacrifice to Kamehameha's war god.

Keoua Kū'ahu'ula's death ended all opposition on the island of Hawaii, and the prophecy began to be fulfilled. About 1794, Kamehameha reconquered the islands of Maui, Lanai, and Molokai. By 1795 the island of Oahu was added, and Kamehameha

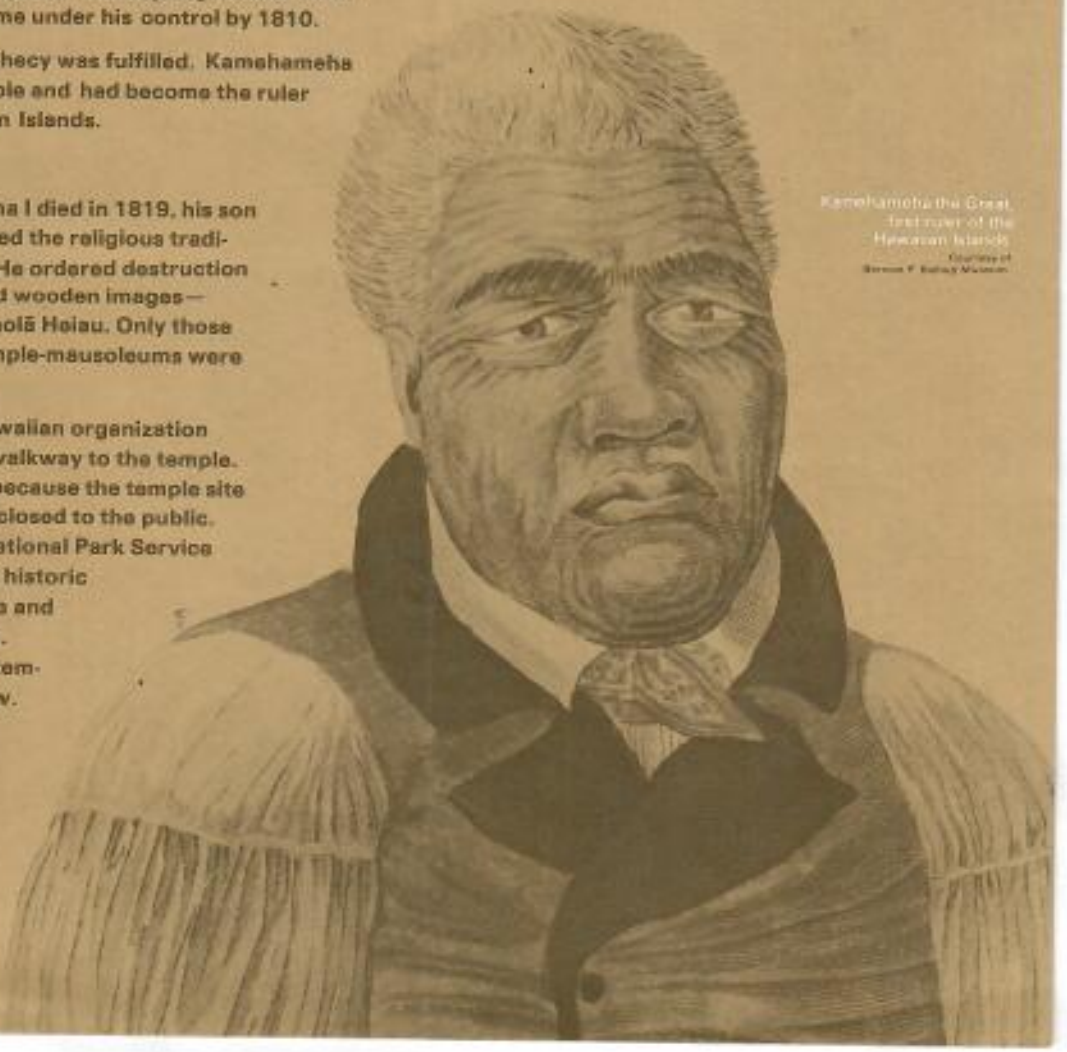
established his kingdom. Through agreement with its king, Kauai came under his control by 1810.

Kāpoūkahi's prophecy was fulfilled. Kamehameha had built the temple and had become the ruler of all the Hawaiian Islands.

EPILOGUE

After Kamehameha I died in 1819, his son Liholiho abandoned the religious traditions of the past. He ordered destruction of the temples and wooden images—including Pu'ukoholā Heiau. Only those that served as temple-mausoleums were not destroyed.

About 1928, a Hawaiian organization built steps and a walkway to the temple. Today, however, because the temple site is crumbling, it is closed to the public. The goal of the National Park Service is to preserve the historic religious structure and to protect visitors. You can view the temple site from below.



Kamehameha the Great, first ruler of the Hawaiian Islands
Courtesy of Bernice P. Bishop Museum

5 PELEKĀNE

Along the coast, below Mailekini Heiau, is the site of the king's residence at Kawaihae—the royal courtyard. King Kamehameha II returned here after the death of his father to prepare for his role as king of the Hawaiian Islands.

Kū-kā'ili-moku, war god of Kamehameha.

Courtesy of Bernice P. Bishop Museum

6 SITE OF JOHN YOUNG'S HOUSE

John Young was a British sailor stranded on Hawaii in 1790. Young became a trusted adviser of Kamehameha the Great and more closely associated with him than any other foreigner. Kamehameha, who called him Olohana, made him a Hawaiian chief. Olohana served as governor of the island of Hawaii from 1802 to 1812, and as business agent for the king. He often made trips to Honolulu and elsewhere and supervised trade with ships at Kawaihae. He also administered the lands Kamehameha had given him—lands which were later inherited by his granddaughter, Queen Emma, wife of King Kamehameha IV.

Little is left of Olohana's home, a compound of several buildings reflecting both European and Hawaiian architectural styles. The house Olohana lived in was made of stone and mortar—probably the first western-type house on the islands. His wife (who was Kamehameha's niece), children, and servants probably lived in other houses of native Hawaiian style. The site of Young's house is north of Pu'ukoholā Heiau across State Route 27.

SAFETY TIPS

To help you have a safe and pleasant visit with us and to preserve this historical area for everyone to enjoy, please observe the following:

- Do not climb on the walls of the temple.
- Stay on designated trails.
- The trail from the information center to the major features in the park is long, hot, and rugged. If you are not physically fit and attired in proper clothing or footwear, do not attempt the hike. You may view the area from the Spencer Beach Park road.
- To prevent grass fires, please do not smoke; this area is very dry and sometimes windy.
- The beach fronting Pu'ukoholā is unsuitable for swimming because the silt from the stream and coral stockpile have collected there. Swimming and picnicking are permitted at nearby Spencer Beach Park, a facility of the County of Hawaii.
- Use caution while getting off and onto the road if you park in front of Pu'ukoholā Heiau on the Spencer Beach Park road. Traffic is heavy.

Have fun—safely!

TRANSPORTATION AND SERVICES

Airlines make scheduled flights several times daily from Honolulu to airports at Hilo, Keahole, and Waimea-Kohala—which is about 19 kilometers (12 miles) from the park. *Taxis* and *car rentals* are available at all airports.

The *Hawaii Visitors Bureau*, a nonprofit organization with offices in Honolulu, Hilo, Kona, Wailuku, Lihue, and 209 Post St., San Francisco, CA 94108, will supply information about trips to and through the Hawaiian Islands.

Camping and picnicking are not permitted within the park. Information on nearby camping at Samuel Spencer County Park may be obtained from Hawaii Visitors Bureau or State or county offices.

Gasoline and oil and a *general store* for supplies are 1.5 kilometers (1 mile) away in Kawaihae. The closest *hospital* is 46.5 kilometers (29 miles) away in Honokaa.

VISITING THE PARK

All points of interest in the park, which is open all year, can be visited on foot. The sites are identified for you on the map of the park area—an area covering 31 hectares (77 acres).

Before 1819, heiau, or temples, played an important role in the cultural and religious life of the islands. Three temple sites are found in the vicinity: the ruins of Pu'ukoholā Heiau—the most famous—and Mailekini Heiau and the traditional site of the Hale-ō-ka-puni Heiau.

This park was authorized by Congress August 17, 1972. Archeological work will continue here to study the ruins and to search for structural remains of other sites and artifacts. Archeological survey will be done on Queen Emma's home, John Young's housesite, and Hale-ō-ka-puni Heiau in the waters of the bay.

Please help us protect and preserve the park.

Leave all plants, animals, rocks, shells, and other natural and manmade features undisturbed. Under the Federal Antiquities Act, it is unlawful to disturb "any historic or prehistoric ruin or monument or any object of antiquity" on Federal lands.

1 PU'UKOHOLĀ HEIAU

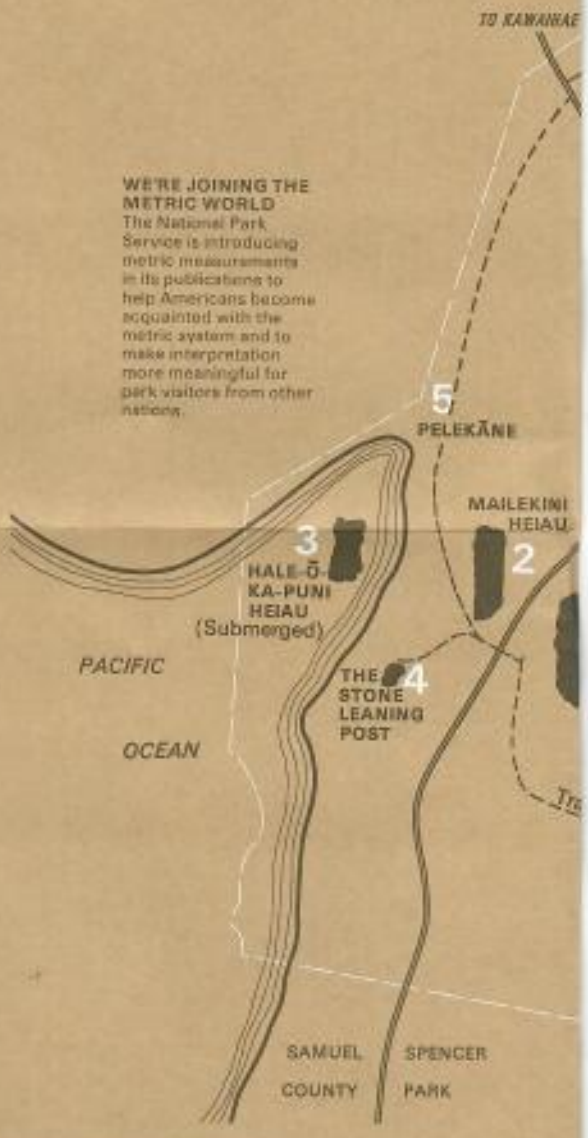
Kamehameha built this temple because a prophet had told him that if he did so, he could fulfill his goal of conquering the Hawaiian Islands. The temple was completed in 1791, and Kamehameha dedicated it to his war god Kū-kā'ili-moku with a sacrifice of the body of his principal rival on Hawaii. The island soon fell to him, and about 4 years later the Hawaiian Kingdom was founded—and Kamehameha was ruler of all.

The great platform of Pu'ukoholā Heiau as seen from the shore of Kawaihae Bay.

2 MAILEKINI HEIAU

On the hillside between Pu'ukoholā Heiau and the sea are the ruins of Mailekini Heiau, a temple used by Kamehameha's ancestors.

An early English missionary said this temple was nearly equal in its dimensions to that on the summit of the hill (Pu'ukoholā), but inferior in every other respect. It appeared to have been literally crowded with idols, but no human sacrifices were offered to any of its gods. During Kamehameha's time this temple was converted by John Young into a fort to protect Kawaihae.



3 HALE-Ō-KA-PUNI HEIAU

The Hale-ō-ka-puni Heiau is believed to be submerged just offshore of Pu'ukoholā. Archeological work needs to be done to determine the location and extent of the ruins of the temple, which was dedicated to the shark gods.

4 THE STONE LEANING POST

On the beach nearby is the rock that the high chief Alapa'ī-kupalupalu-manō leaned against as he watched the sharks circle about the Hale-ō-ka-puni Heiau before devouring the offerings he had placed there.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396

January 30, 1995 F/SWC2:ghb

Mr. Leon Thevenin
104 Puako Beach Drive
H.C.R. #1
Kamuela, Hawaii 96743

Dear Mr. Thevenin:

I am writing to you once again to respond to your inquiry and concern for the health of sea turtles residing in the coastal waters of Puako, South Kohala, Island of Hawaii.

On January 18, 1995, working with personnel from the Hawaii Preparatory Academy, I conducted one of our agency's quarterly surveys and assessments of sea turtles inhabiting the Puako region. Our defined long-term study area, to scuba dive and hand-capture turtles, includes the nearshore waters immediately fronting your residence. Our work on January 18 resulted in the capture and shipboard examination of 30 green turtles (honu), Chelonia mydas. Eleven of these animals had been tagged during our previous visits over the past 4 years at this same location. The remaining 19 turtles were captured and tagged for the first time on January 18.

All 30 turtles inspected on January 18 were in good condition with no evidence of fibropapillomatosis (tumor disease) or other health problems. Puako is one of several sites throughout all of Hawaii where tumored turtles have never been encountered. The 11 previously tagged and recaptured turtles displayed acceptable growth rates consistent with what has been seen in the past at this site and at others where we work.

A single turtle that we captured was found to have a moderate amount of the alga, Sphacelaria tribuloides, growing on its shell and skin. However, occasional encounters with such turtles is not unusual and constitutes no cause for alarm. The alga Sphacelaria (along with several other genera) commonly occurs in patches on many Hawaiian sea turtles. A method sometimes used by turtles in Hawaii to remove algal growth is to periodically visit underwater "cleaning stations" where fish graze on their body. In recent years, the occurrence of such stations has visibly increased. We are aware of one such site at Puako that is regularly frequented by resident turtles. I have enclosed one of our recent publications from the scientific journal, Copeia, that describes some aspects of sea turtle cleaning stations in Hawaii.

If I can be of any additional assistance, please do not hesitate to contact me again.

Sincerely,

George H. Balazs
Zoologist and Leader,
Marine Turtle Research Program

cc Mr. M. Rice, HPA
Dr. E. Reese, HIMB

Copeia reprint enclosure

12-22-94

LEON A. THEVENIN
104 Puako Beach Drive
H.C.R. #1
Kamuela, HI 96743
(808) 882-7969

George Balazs.
2570 Dole St.
Hon. Hi 96822-2396

Turtles in Ponds (Puako)

In answer to your enquiry relative to Turtles in Ponds I can only offer this:

(1) Many are long cultivated on Ponds at Kalahaupaa - (Mauna Lani Resort) under curator Don Akaka -- some are released annually.

(2) At Puako, also Paiva formerly at 105 tried one in their pond without success and then released it into the ocean. This was prior to it being designated as a protected endangered species. Mr. Paiva believed the turtle could reduce the heavy foul smelling lime & algae without success. I planted Tilapia in his Pond which solved the problem.

(3) I shall keep my eyes and ears open for any turtles recently captured in Ponds. So far nothing appears out of the ordinary except the excessive pollution of our coastal waters -- which continues.

I trust the newly elected officials will do something. Sometimes they try to make a good first impression. You and Eanie Reese could help by rendering scientific opinions. I know who should do it.

Leon A Thevenin

■ Man held in downtown beating death A-4
■ Park officials want Kaupo land on Maui A-5

Ohana can't remain on park land

■ A federal judge rules against the Pai family on the Big Island

Star-Bulletin staff

A federal judge today rejected a Hawaiian family's request to continue occupying five acres of Big Island land that has become part of a national park.

U.S. District Judge David Ezra said the Pai Ohana does not have the right to use and live on the land exclusively because its predecessors did not acquire a claim to the property when land was distributed during the Great Mahele of 1848.

In a 50-page ruling that traces the history of native Hawaiian land rights, Ezra said the family essentially is asking for fee-simple rights to the land, which was bought by the government in 1988 to be part of the Kaloko-Honokohau National Historic Park.

Mahealani Pai

"They cannot have the right of permanent occupancy to the exclusion of others without having the equivalent of fee-simple title," the judge wrote.

"In the more than 147 years since the Great Mahele, an absolute and exclusive use and occupancy as alleged by (the family) has never been accepted by any court of the Hawaiian Kingdom, Republic, Territory or State."

He granted the government's request to dismiss the lawsuit, and denied the family's request to have the Hawaii Supreme Court consider the question.

Attorney Arnold Lum of the Native Hawaiian Legal Corp., which brought the suit, reserved comment until reading the judge's decision.

William K. Pai Jr. and his son, William D. Mahealani Pai, were among the family members who asserted a claim to land near the Aiopio fish trap, saying their ancestors had cared for the property since before Western contact.

Some 10 families, most of whom were members of the Pai Ohana, lived there when the National Park Service bought the land. They were given the choice of accepting relocation benefits of up to $5,000 for each household or signing a permit allowing them to remain on the land for five years, with renewals subject to agreement.

Both of the Pais initially signed the special use permits, but stayed on the land after the permits expired in 1993. Shortly before the expiration, they began erecting wooden barricades to deny park personnel and visitors access to the area, and confronted people who tried to enter.

They argued that they had aboriginal rights to stay on the land, and that their constitutional rights were being violated because the government was

HAWAII
Tuesday, January 17, 1995 ■ Star-Bulletin

Hawaii

Bigger than all the other islands in the chain combined, "The Big Island" of Hawaii offers visitors an impressive variety of landscapes and climates. With over 214 miles of scenic coastline and massive mountains rising more than 13,000 ft. above sea level, our conditions range from snow to lush, tropical coastal areas.

Just 30 minutes from Honolulu our relaxed, friendly lifestyle is legendary. Yet the active vacationer will find a full array of sports and pleasures on land, in the air and at sea.

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Celebrate great moments with us!

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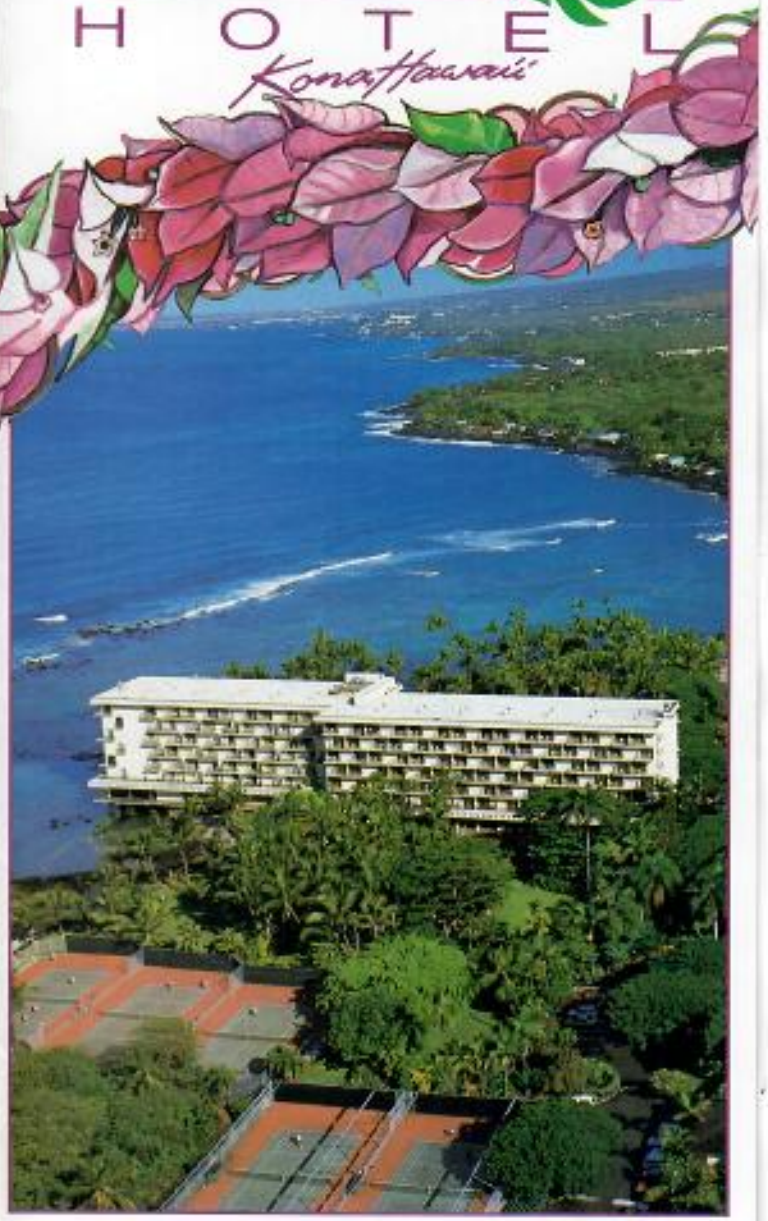
Owned and Operated by AZABU U.S.A. Corp.

Printed in New Zealand

Keauhou Beach HOTEL

Kona Hawaii



Amenities

This is Kona's traditional recreation area, where you experience the true spirit of Aloha. Stroll across to our Kahalu'u Bay for fascinating snorkelling. Enjoy beautifully landscaped tennis courts in our tropical gardens. Meander along oceanside trails among the archeological sites surrounding the hotel. Take a free shuttle to the Keauhou Shopping Village [3 mins.] or Kona Country Club for 27 holes of championship golf. Consult our activities desk for anything from hiking to sailing to air tours.


Tennis from dawn into the tropical night


Snorkel in our own Bay


Relaxing on Kuakini Terrace


Sumptuous Seafood Buffet


Comfort and Calm


Oceanside & Mountain Golf

Accommodations

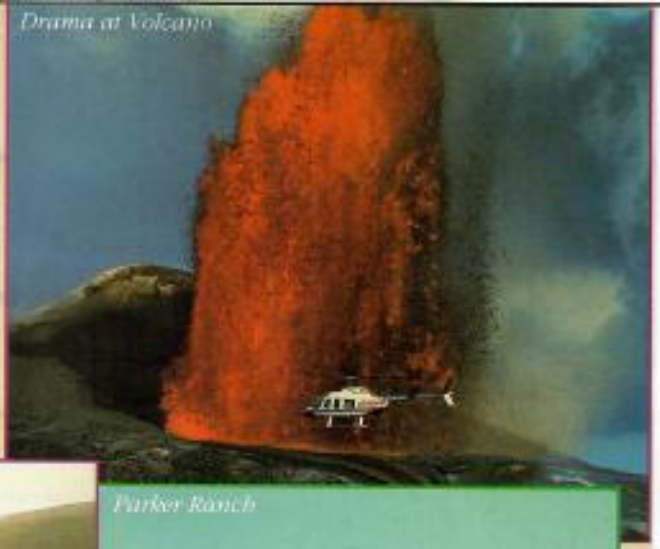
Comfort and a touch of luxury in our recently renovated, spacious guestrooms. Each overlooks our peaceful coast and tropical gardens. Room service is available.

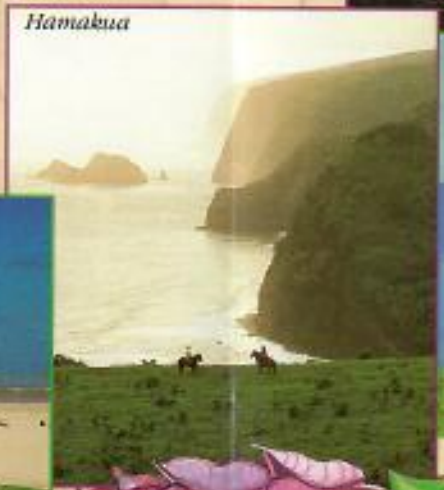
Dining in our new signature restaurant, the Kuakini Terrace, is casual in a tropical plantation atmosphere and popular nightly buffets feature local seafood or oriental delicacies, plus prime rib. Sundays we offer a champagne brunch and our a la carte menu is available daily.

Makai Bar, a local favorite, presents Hawaiian entertainment nightly. Pool side guests enjoy a refreshing snack service.

Attractions

Keauhou Beach Hotel is an ideal base for exploring the rest of the Big Island. *Drive north* for the best white sand beach at Hapuna then up to Waimea, where Parker Ranch welcomes visitors to the largest privately owned ranch in the USA. Or, *drive south* for a black sand beach and witness our active Kilauea Volcano, and then up to the rain forests and waterfalls of our Hamakua coast, where agriculture and floriculture thrive.


Drama at Volcano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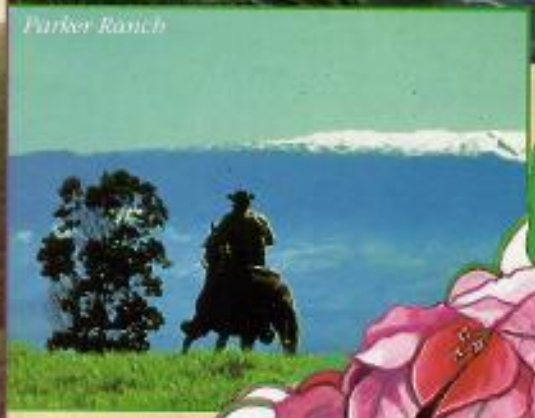
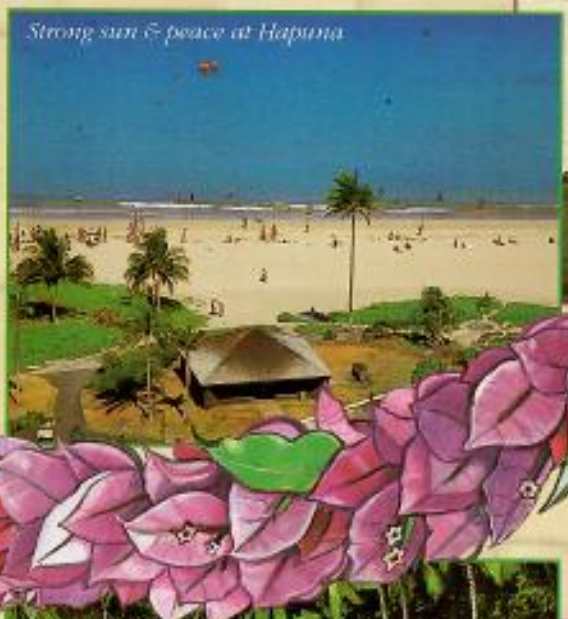
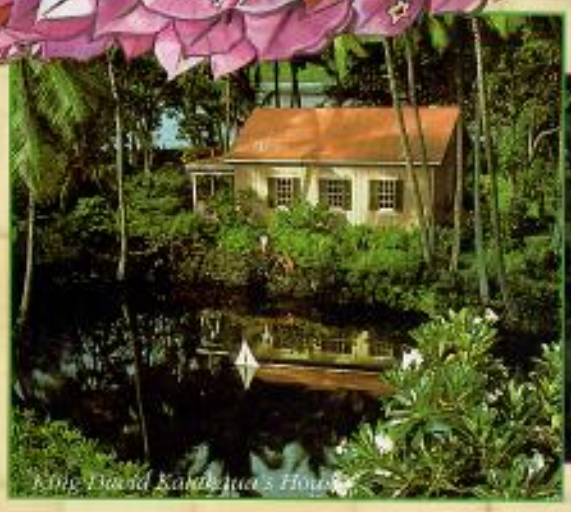

Parker Ranch


Strong sun & peace at Hapuna


King David Kalakaua's House


Petroglyphs on lava rock

History

Ambience here is inherited from our Royal past, when King David Kalakaua retreated from the summer court at Kailua to our grounds. You will also discover historic remains of ancient heiau [temples] and petroglyphs made by the earliest Hawaiian settlers of this beautiful coast.

World renowned orchids and anthuriums will be constant companions on your visit.

Mauna Lani will scrap waterway

☐ The resort plan drew opposition

A3 HSB 6/16/93

By Rod Thompson
Big Island correspondent

KEAUHOU, Hawaii — Mauna Lani Resort this morning permanently withdrew its proposal for a waterway connecting its controversial cove project with the ocean.

Mauna Lani attorney Jeffrey Watanabe made the announcement at a meeting of the Hawaii County Planning Commission.

Watanabe said the company was taking the action following the recommendations of hearing officer Michael Matsukawa, who came out against the project as proposed following a contested case hearing.

The permanent withdrawal applies only to the waterway linking the project to the sea, Watanabe emphasized.

However, Mauna Lani will also rethink its inland waterway proposal known as "The Cove," and may also eliminate that, Watanabe added.

Watanabe gave no time limit for how long the company will need to reconsider the project.

Opponents had feared that blasting the entrance channel would damage a coral reef in the area. Mauna Lani maintained that the channel would have gone through a shelf of lava that was only about 10 percent coral.

Critics also maintained that the inland waterway would have been, in reality, a marina for new homes and condominiums that were planned for the project.

Mauna Lanai's original proposal called for a 30-acre inland waterway connected to the ocean by a 200-foot wide entrance channel.

Within the waterway would have been two islands, which would have been the site for a "Global Capital Village."

Fifty-five single family residences and 300 multi-family residences were also planned for the project.

Four groups formally opposed Mauna Lani's plans. They are the Surfrider Foundation, the Sierra Club, the West Hawaii Surfing Association and Laguardo Brothers Surfing Team. All were represented by attorney Kevin Seiter.

Seiter said he would recommend that his clients work with Mauna Lani to ensure an environmentally-sensitive project.

House backs Mauna Lani's cove project

A1 4/21/93 HSB

☐ But foes say the OK puts the blasting plans on a fast track

By Peter Wagner
Star-Bulletin

Controversial plans to blast a channel and shoreline cove at the Mauna Lani Resort on the Big Island took a step forward at the state Legislature this week when lawmakers approved a needed resolution.

But opponents are crying foul, saying Monday's 30-16 vote by the House amounts to "fast-track" skulduggery.

"Obviously, any developer would like to fast-track their project," said Rep. Jim Shon, who voted against the resolution. "It seems this House has been willing to accommodate lots of special interests this year."

The resolution, now on its way to the Senate for final vote, allows the state Department of Land and Natural Resources to lease submerged land to the Manua Lani for its $147 million project. The Tokyo-based resort wants to dig a 30-acre cove and a 10-acre channel, work that would dredge more than 4 million cubic yards of material.

But some legislators say the resolution shouldn't have been considered until numerous county, state

See **MAUNA LANI**, Page A-8

MAUNA LANI: House backs plans to develop cove project

Continued from Page A-1

and federal permits are cleared.

"Once the developer has satisfied all the conditions to obtain land-use permits, then they should bring all that information to the state Legislature so we can make an informed decision," said Rep. Cynthia Thielen, who voted against the resolution. "In this case, we just issued a blank check."

Rep. Dwight Takamine, who supports the resolution, disagrees. "I don't think we need to be familiar with all the particulars of this project," he said.

"That's why we have all these various permits and authorizations that need to be approved.

"The agencies involved have the technical background necessary to protect public interests," he said.

Takamine, who sees the cove project as a badly needed job source on the Big Island, points out that the Legislature approved a nearly identical resolution last year for the planned Ewa Marina project on Oahu.

That measure also was approved before permits were acquired and similarly stipulates that submerged land can't be leased out until all permit conditions are met, a process likely to draw heavy public scrutiny.

Environmentalists are up in arms over the project, which they say would damage the reef, pollute pristine waters and wipe out several surf spots.

"This is the first private project on the Big Island which proposes the blasting and excavating of coral reef," said Bill Graham of Life of the Land, among numerous environmental groups against the project.

Sierra Club lobbyist David Frankel said the blasting would destroy valuable reef, a sandy beach and surf sites.

"Haven't we learned anything from the muddied waters off Kaneohe and East Honolulu?" he asked.

Fishermen say the 200-foot-wide, 600-foot-long channel would harm a squid breeding ground. Surfers say it would obliterate "Peaks," one of three surf spots in the area, and threaten the others, "Java Lefts" and "Suicide."

But Mauna Lani spokeswoman Leilani Hino said the channel would be well away from surf spots. And the "reef" fronting the hotel is a sparse collection of coral on what is mostly a basaltic shelf.

"The area has about 5 to 9 percent coral cover," she said.

"That's not what I'd call terrific," Hino added.

Moreover, Monday's legislative action is just one of many steps that lie ahead in a long obstacle course, she said.

A total of 14 land-use permits and authorizations are needed.

The Mauna Lani Cove would include two man-made islands with up to 300 condominiums, 50 houses, a health spa and a "think tank" to draw experts from around the world.

The resort earlier scrapped plans for a 250-boat marina in the face of public opposition.

The new project is much the same, minus the boats, which were opposed as a potential source of pollution.

Shon said the resolution was put on a fast track that skipped environmental committees and went straight to the House Finance Committee.

Sent to the House floor Monday along with scores of routine-looking resolutions, the measure could easily have been overlooked had it not been for environmental watchdogs.

"It could have slipped through because it was a resolution, but fortunately the Sierra Club and other environmental groups were watching this one and flagged it," Shon said. "The Finance Committee did not go out of its way to let us know this was a resolution of a different character."

Big Island Reps. Virginia Isbell and Mike O'Keiffe voted against the resolution, saying it will set a bad precedent for shoreline developers.

SATURDAY, Sept. 18, 1993
The Honolulu Advertiser

Money

MONEY SECTION EDITOR:
Ilene Aleshire, 525-8062

Advertiser file photo

With trams, boats and 32 acres of landscaping, the Hyatt Regency Waikoloa was billed as a "fantasy resort" by its developers, but the amenities are expensive to maintain.

Waikoloa finds a buyer led by L.A. firm, Hilton

By Greg Wiles
Advertiser Business Writer

Months of uncertainty regarding the Hyatt Regency Waikoloa ended yesterday when a partnership led by a Los Angeles investment firm and Hilton Hotels Corp. said it will buy the state's fourth-largest hotel and spend millions upgrading it.

Global Resort Partners yesterday said they will assume ownership the first week of November. They said they are taking a long-term approach to the 1,241-room property and want to position it as one of the best beach resorts in the world.

Hilton is considering a number of changes for the resort, including a $20 million upgrading. Dieter Huckestein, Hilton Hotels senior vice president, said all rooms will be renovated and that a hotel within a hotel could be created along the lines of the Alii Tower, an oceanfront tower at the Hilton Hawaiian Village that offers five-star services.

"Basically we are focused on maintaining and enhancing the facilities and the reputation that Hyatt already has gained," Huckestein said.

Hilton is also considering upgrades of the landscaping and recreational facilities along with institution of Hawaiiana programs that have been successful at the Hilton Hawaiian Village, the state's largest hotel.

The hotel had been the subject of much speculation given its reported $40 million annual losses and periodic employee layoffs. The hotel had closed one of its towers during a low occupancy period, and last year there had been rumors that the entire resort might close down.

The hotel is said to be the largest private employer on the Big Island.

Big Island Council Chairman Kalani Schutte yesterday said he was pleased another company has stepped forward.

"I hope Hilton can make it happen. I am glad somebody took over," said the councilman who has represented the South Kohala district for nearly 10 years.

See Waikoloa, Page C4

HYATT REGENCY WAIKOLOA

- **Rooms:** 1,241 rooms and suites in three towers.
- **Facilities:** Eight restaurants, 13 cocktail lounges, luau area. 87,000 square feet of meeting space.
- **Opened:** Sept. 2, 1988 at Waialea Bay, Big Island.
- **Cost:** $360 million.
- **Workers:** 2,000 at peak occupancy. Currently, about 800.
- **Amenities:** Eight tennis courts, health spa; three swimming pools, monorail, motor launches, mile-long museum walk, dolphin lagoon.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region • Western Pacific Program Office
2570 Dole St. • Honolulu, Hawaii 96822-2396

11/13

November 13, 1987 F/SWR1:ETN

MEMORANDUM FOR: F/SWC2 - Richard S. Shomura

FROM: F/SWR1 - John J. Naughton

SUBJECT: Hawaiian Green Sea Turtle "Head Start" Program

This is to request that George Balazs review the attached proposal from Charles Daxboeck and provide any comments he may have to Gene Nitta.

Attachment

MAUNA LANI RESORT

October 16, 1987

Mr. E. Charles Fullerton
Regional Director
SOUTHWEST REGION, NMFS
300 South Ferry Street
Terminal Island, California 90731

RE: HAWAIIAN GREEN SEA TURTLE "HEAD START" PROGRAM

Dear Mr. Fullerton:

Pursuant to our recent brief conversation at the last WESPAC meeting in Honolulu, enclosed is a draft project proposal for the initiation of a Hawaiian Green Sea Turtle "Head Start" program by the Mauna Lani Resort, Inc. Also enclosed are informational publications about the Resort and its parent corporation, The Tokyu Group.

Over the past year or so I have contacted most of the appropriate Federal, State and private agencies' personnel to discuss the matter of turtle "headstarting" and its ramifications. There is certainly guarded optimism and enthusiasm for such a project initiated by the private sector and the Mauna Lani Resort stands ready to commit funds and manpower to see it happen. However, supplemental financial assistance still is necessary. I believe a cooperative Federal - Private sector turtle population restoration program would be a win-win proposition for all concerned, especially the threatened species in question, the Hawaiian green sea turtle, Chelonia mydas.

As you indicated, such a "head start" program could be better served if the proposal were routed through funding provisions under the Endangered Species Act (16 U.S.C. 1531 et seq. - 50 CFR), rather than seeking funding from the S-K pool. Your kind attention and assistance in this matter is very much appreciated.

/ . . .

P.O. Box 4959 • Kohala Coast • Island of Hawaii 96743-4959
Telephone: (808) 885-6677 • TELEX: 752449 • FAX: (808) 885-6375

We look forward to a favorable response to our proposal. Please do not hesitate to contact me if there are further questions or if we can do anything more to make the proposal complete and in a proper form for review.

Again, thank you for your interest in our project.

Sincerely yours,

MAUNA LANI RESORT, INC.

Dr. Charles Daxboeck
Aquatic Resources Manager

CD/lo

cc: T. H. Yamamoto

P. S. Would it be possible to obtain a draft of the recently completed Turtle Recovery Plan from you? Thank you.

HAWAIIAN GREEN SEA TURTLE
(Chelonia mydas)
"HEADSTART" PROGRAM

at

KALAHUIPUA'A FISHPOND

MAUNA LANI RESORT, INC.

Anticipated Starting Date: November 30, 1987

Federal Funds Requested:

1987 - 1988	Year 1	$ 39,450
1988 - 1989	Year 2	31,400
1989 - 1990	Year 3	29,850
	Total	$100,700

INTRODUCTION

The green turtle, Chelonia mydas, is the major marine turtle species throughout the 2,450 km-long Hawaiian archipelago (see Balazs, 1980). Since September,1978, the Hawaiian green sea turtle has been listed in the threatened category under the U. S. Endangered Species Act. Therefore, the entire population from the main Hawaiian Islands, to the Northwestern Hawaiian Islands (NWHI), receives full protection through Federal regulations jointly enforced by the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (USFWS).

/ . . .

Unfortunately, at the present time there are no proven techniques for replenishing the diminished numbers of marine turtles through either stocking or other artificial methods. Where high egg or hatchling predation seems to play a significant role in curbing population growth, the use of some experimental intervention, such as protected incubation, hatching and release under guarded conditions is a valid alternative. Turtle hatchling "headstarting" is another experimental technique, which has had considerable success but very limited application in Hawaii (see Balazs, 1980). This technique is being proposed for initiation by the Mauna Lani Resort, Inc. "Headstarting" involves raising hatchlings in captivity to a juvenile size (up to one year old), where it is assumed that upon release into their native habitat, the probability of natural predation is much reduced and hence, chances of survival to sexual maturity enhanced. The ultimate goal of "headstarting" obviously would be to replenish the diminished wild stock to a level that would eventually allow these Hawaiian green sea turtles to be delisted as threatened. Analyses have demonstrated the benefits of preserving endangered species (see Mendelsohn, 1985).

RATIONALE

The North Kohala District of the Island of Hawaii, site of the Mauna Lani Resort property, is an important resident area where adult Hawaiian green turtles feed and rest. Therefore, a "headstarting" program at our location would be in keeping with a "natural" situation. However, it is realized that it would be overly optimistic to assume that the Mauna Lani Resort project, by itself, could make a sizeable impact on overall stock enhancement in a short period of time. Any impacts must necessarily be measured in terms of decades, given the biology and growth rates of Chelonia mydas. Nonetheless, Mauna Lani Resort, Inc. is prepared to commit to a serious long-term program for research and development of turtle "headstarting" at Kalahuipua'a.

/ . . .

SOURCES OF TURTLES

Hawaiian green turtles, Chelonia mydas, initially will be made available through Sea Life Park, Waimanalo, Oahu. Hatchlings are the progeny of a captive breeding stock of "pre-Act" animals and therefore, formal Federal/State permits for their handling under controlled conditions for educational/rearing purposes are not required at this time.

After an appropriate period of project assessment and evaluation, the Mauna Lani Resort, Inc. may seek a Federal/State permit to collect and transport wild Hawaiian green sea turtles from natural habitats to its "headstarting" facilities. Assuming we will meet all the criteria so that we are designated a proper scientific and educational facility under provisions set out by the as yet unpublished NMFS "Turtle Recovery Plan" (1987), we would work in cooperation with the Recovery Team. We would seek to retrieve individual hatchlings which did not emerge naturally (after 3 - 5 days) from their nests, by excavating the sand and salvaging the turtles. It is assumed that these hatchlings may have been too weak to dig out by themselves and therefore would be less likely to survive, without the assistance afforded by placement into a "headstarting" program.

PROPOSED ACTIVITIES AND DATA COLLECTION

Turtle hatchlings will be reared in round, above-ground tanks supplied with continuous flow through sea water (salinity to be monitored to remain above 21ppt). They will be fed daily on a special diet (menu supplied by Sea Life Park) and their health assessed. Any animals with fin nips will be treated immediately (alcohol and methylene blue). Length - weight relationships of all tagged hatchlings will be recorded on a regular basis.

Care and maintenance of captive Chelonia mydas at Mauna Lani Resort facilities shall be in compliance with standards set by NMFS, USFWS and other appropriate agencies, with guidance and consultations from "headstarting" personnel at Sea Life Park, Oahu.

/ . . .

It is proposed that a public educational display area highlighting the turtle program be built near the holding tanks. An existing sand beach in the natural existing fishpond will be rehabilitated, to a depth of approximately one meter, so that larger animals may haul out to bask in the sun, and may eventually use this area as a nesting site. In addition, a moderate on-site laboratory facility for water quality analyses and other appropriate scientific activities will be constructed in conjunction with the initiation of the turtle "headstart" program.

We firmly believe that public education, both passive display and active lectures/tours as planned by the Mauna Lani Resort, Inc. around the "headstarting" program will assist in generating further awareness of the biology and conservation of the threatened Hawaiian green sea turtle, Chelonia mydas.

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JHL

MAUNA LANI RESORT

October 16, 1987

Mr. E. Charles Fullerton
Regional Director
SOUTHWEST REGION, NMFS
300 South Ferry Street
Terminal Island, California 90731

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/ . . .

P.O. Box 4959 • Kohala Coast • Island of Hawaii 96743-4959
Telephone: (808) 885-6677 • TELEX: 752449 • FAX: (808) 885-6375

We look forward to a favorable response to our proposal. Please do not hesitate to contact me if there are further questions or if we can do anything more to make the proposal complete and in a proper form for review.

Again, thank you for your interest in our project.

Sincerely yours,

MAUNA LANI RESORT, INC.

Dr. Charles Daxboeck
Aquatic Resources Manager

CD/lo

cc: T. H. Yamamoto

P. S. Would it be possible to obtain a draft of the recently completed Turtle Recovery Plan from you? Thank you.

HAWAIIAN GREEN SEA TURTLE
(Chelonia mydas)
"HEADSTART" PROGRAM

at

KALAHUIPUA'A FISHPOND

MAUNA LANI RESORT, INC.

Anticipated Starting Date: November 30, 1987

Federal Funds Requested:

1987 - 1988	Year 1	$ 39,450
1988 - 1989	Year 2	31,400
1989 - 1990	Year 3	29,850
	Total	$100,700

INTRODUCTION

The green turtle, Chelonia mydas, is the major marine turtle species throughout the 2,450 km-long Hawaiian archipelago (see Balazs, 1980). Since September,1978, the Hawaiian green sea turtle has been listed in the threatened category under the U. S. Endangered Species Act. Therefore, the entire population from the main Hawaiian Islands, to the Northwestern Hawaiian Islands (NWHI), receives full protection through Federal regulations jointly enforced by the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (USFWS).

Unfortunately, at the present time there are no proven techniques for replenishing the diminished numbers of marine turtles through either stocking or other artificial methods. Where high egg or hatchling predation seems to play a significant role in curbing population growth, the use of some experimental intervention, such as protected incubation, hatching and release under guarded conditions is a valid alternative. Turtle hatchling "headstarting" is another experimental technique, which has had considerable success but very limited application in Hawaii (see Balazs, 1980). This technique is being proposed for initiation by the Mauna Lani Resort, Inc. "Headstarting" involves raising hatchlings in captivity to a juvenile size (up to one year old), where it is assumed that upon release into their native habitat, the probability of natural predation is much reduced and hence, chances of survival to sexual maturity enhanced. The ultimate goal of "headstarting" obviously would be to replenish the diminished wild stock to a level that would eventually allow these Hawaiian green sea turtles to be delisted as threatened. Analyses have demonstrated the benefits of preserving endangered species (see Mendelsohn, 1985).

RATIONALE

The North Kohala District of the Island of Hawaii, site of the Mauna Lani Resort property, is an important resident area where adult Hawaiian green turtles feed and rest. Therefore, a "headstarting" program at our location would be in keeping with a "natural" situation. However, it is realized that it would be overly optimistic to assume that the Mauna Lani Resort project, by itself, could make a sizeable impact on overall stock enhancement in a short period of time. Any impacts must necessarily be measured in terms of decades, given the biology and growth rates of Chelonia mydas. Nonetheless, Mauna Lani Resort, Inc. is prepared to commit to a serious long-term program for research and development of turtle "headstarting" at Kalahuipua'a.

/ . . .

SOURCES OF TURTLES

Hawaiian green turtles, Chelonia mydas, initially will be made available through Sea Life Park, Waimanalo, Oahu. Hatchlings are the progeny of a captive breeding stock of "pre-Act" animals and therefore, formal Federal/State permits for their handling under controlled conditions for educational/rearing purposes are not required at this time.

After an appropriate period of project assessment and evaluation, the Mauna Lani Resort, Inc. may seek a Federal/State permit to collect and transport wild Hawaiian green sea turtles from natural habitats to its "headstarting" facilities. Assuming we will meet all the criteria so that we are designated a proper scientific and educational facility under provisions set out by the as yet unpublished NMFS "Turtle Recovery Plan" (1987), we would work in cooperation with the Recovery Team. We would seek to retrieve individual hatchlings which did not emerge naturally (after 3 - 5 days) from their nests, by excavating the sand and salvaging the turtles. It is assumed that these hatchlings may have been too weak to dig out by themselves and therefore would be less likely to survive, without the assistance afforded by placement into a "headstarting" program.

PROPOSED ACTIVITIES AND DATA COLLECTION

Turtle hatchlings will be reared in round, above-ground tanks supplied with continuous flow through sea water (salinity to be monitored to remain above 21ppt). They will be fed daily on a special diet (menu supplied by Sea Life Park) and their health assessed. Any animals with fin nips will be treated immediately (alcohol and methylene blue). Length - weight relationships of all tagged hatchlings will be recorded on a regular basis.

Care and maintenance of captive Chelonia mydas at Mauna Lani Resort facilities shall be in compliance with standards set by NMFS, USFWS and other appropriate agencies, with guidance and consultations from "headstarting" personnel at Sea Life Park, Oahu.

/ . . .

It is proposed that a public educational display area highlighting the turtle program be built near the holding tanks. An existing sand beach in the natural existing fishpond will be rehabilitated, to a depth of approximately one meter, so that larger animals may haul out to bask in the sun, and may eventually use this area as a nesting site. In addition, a moderate on-site laboratory facility for water quality analyses and other appropriate scientific activities will be constructed in conjunction with the initiation of the turtle "headstart" program.

We firmly believe that public education, both passive display and active lectures/tours as planned by the Mauna Lani Resort, Inc. around the "headstarting" program will assist in generating further awareness of the biology and conservation of the threatened Hawaiian green sea turtle, Chelonia mydas.

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6. Whittow, G. C. and G. H. Balazs. 1982. Basking behavior of the Hawaiian green turtle (Chelonia mydas). Pacific Sci. 36: 129-139.

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396

November 18, 1987 F/SWC2:GHB

MEMORANDUM FOR: F/SWR1 - Eugene Nitta

THROUGH: F/SWC2 - William G. Gilmartin
F/SWC2 - Richard S. Shomura
F/SWR1 - Doyle E. Gates

FROM: F/SWC2 - George H. Balazs

SUBJECT: Response to your request of 11/13/87 to provide comments on the Charles Daxboeck (Mauna Lani Resort Inc.) green turtle headstart proposal

Dr. Daxboeck contacted me by telephone about a year ago to discuss the concept of headstarting in relation to facilities at the Mauna Lani Resort. At that time he was apparently not under contract to, nor employed by, the facility. I talked with him for quite some time and subsequently mailed him an assortment of our publications on Hawaiian sea turtles. I also laid the groundwork for him to meet in person with Steve Kaiser, Reef Tank Curator at Sea Life Park. Sea Life Park is presently the only source of captive-bred Hawaiian green turtles, and the only private-sector facility with the capabilities and experience to successfully rear hatchlings in numbers to a juvenile size ("headstarting"). I do know that Dr. Daxboeck met with Steve, but I have heard nothing specific about the project idea until receiving a copy of this proposal. A telephone call I recently made to Steve Kaiser indicated that Sea Life Park had also heard nothing further from Dr. Daxboeck, and had not received a copy of the proposal. To be in concordance with our draft Recovery Plan, any headstart program with green turtles would at present be solely dependent upon Sea Life Park. For this reason, I have requested review comments from Steve Kaiser (see attached letter of 11/16/87), which will likely be received subsequent to this memo. Steve's response to me will be relayed at a later date, following my return from our forthcoming two-week field study at Johnston Atoll (11/23-12/7/87).

The following review represents the combined comments of myself and Bill Gilmartin.

1) The proposal is far too brief and lacking in any scientific detail that can be evaluated for chances of success.

2) Based on priorities decided upon in the draft Recovery Plan, there is no justification for committing $100K or any other amount of agency funds to green turtle headstarting prior to addressing funding needs of the other

much higher priority items. Headstarting is a worthy experimental project that is best tried solely by the private-sector under agency guidance (such as presently done by Sea Life Park).

3) Hatchlings have never before been raised at Mauna Lani facilities, nor to my knowledge are there any staff members with experience in raising hatchlings. Does Dr. Daxboeck have such experience? Raising hatchlings is not an easy task. Disease and high mortality can quickly result if environmental conditions and captive care are inadequate. Direct involvement or very close contact with experienced personnel who can devote substantial time to the project will be needed.

4) Two of three juvenile/subadult green turtles being reared under a special research loan agreement by our agency to Mauna Lani have died over the past year. The exact cause of death was not identified, but nevertheless suggested that improvements in facilities and captive management were (are) warranted.

5) Based on several of the above comments, a headstart program at Mauna Lani (or anywhere else in Hawaii) should start out on a <u>small-scale</u> for the first year or two until solid experience is gained in all aspects of the work.

6) Serious consideration should be given by Mauna Lani to rearing 3-4 month old juveniles to about a year of age for release, rather than starting out with hatchlings. The hatchling-rearing part could be done solely at Sea Life Park where years of experience already exist.

7) Any plan for headstarting needs to include strategies for properly acclimating the turtles for release into the wild (e.g. introduction of natural algae food sources, reducing habituation to humans).

8) Security aspects for headstart turtles at Mauna Lani need to be addressed. For example, in recent years the butchered carcass of a turtle was found on the Mauna Lani beach, and a speared turtle was found offshore. (In the latter case, resort concession personnel shipped the injured turtle to us and it was cared-for and later released in good condition).

9) Educational aspects of the project need to be fully and carefully addressed. Headstarting is strictly an experimental restocking action. This point needs to be emphasized.

10) Contrary to the statement made in the proposal, green turtle hatchlings produced at Sea Life Park have been judged to come under the permit jurisdiction of the State of Hawaii. They are also likely to be subject to federal jurisdiction under the ESA, since Sea Life Park's parent stock of turtles was held in captivity in the course of a commercial activity prior to designation as a threatened species (Sea Life Park is a commercial concern). Nevertheless, this should not present any problems for a properly planned and professionally implemented experimental headstart project at Mauna Lani.

11) The draft Recovery Plan does not endorse excavating trapped hatchlings from nests at French Frigate Shoals to transport to the main islands for headstart purposes. The draft plan endorses (advocates) the excavation and release of trapped hatchlings.

12) The Mauna Lani proposal, preferably in revised and expanded form, should be sent to the recovery team members for their comment.

A copy of this memo is being sent to Jim Lecky, since he recently telephoned to ask for my comments on the Mauna Lani proposal.

Attachment

cc: Jim Lecky

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396

DO
C: MMES
C: GHB 11/9

November 19, 1987 F/SWC2

MEMORANDUM FOR: F/SWR1 - Doyle E. Gates
Attn: - Eugene T. Nitta

FROM: F/SWC2 - Richard S. Shomura

SUBJECT: Hawaiian green sea turtle "head start" program

Although the original request was specifically to have George Balazs review the "head start" program proposed by Mauna Lani Resort, I have had additional staff members also review this proposal. I feel that the possible precedent-setting nature of this proposal requires that we (NMFS) evaluate this proposal very carefully. The following are comments provided by three staff members:

Reviewer #1:

(1) The proposal is far too brief and lacking in any scientific detail that can be evaluated for chances of success.

(2) Based on priorities decided upon in the draft Recovery Plan, there is no justification for committing $100K or any other amount of agency funds to green turtle head-starting prior to addressing funding needs of the other much higher priority items. Headstarting is a worthy experimental project that is best tried solely by the private-sector under agency guidance (such as presently done by Sea Life Park).

(3) Hatchlings have never before been raised at Mauna Lani facilities, nor to my knowledge are there any staff members with experience in raising hatchlings. Raising hatchlings is not an easy task. Disease and high mortality can quickly result if environmental conditions and captive care are inadequate. Direct involvement or very close contact with experienced personnel who can devote substantial time to the project will be needed.

(4) Two of three juvenile/subadult green turtles being reared under a special research loan agreement by our agency to Mauna Lani have died over the past year. The exact cause of death was not identified, but nevertheless captive management were (are) warranted.

(5) Based on several of the above comments, a headstart program at Mauna Lani (or anywhere else in Hawaii) should start out on a <u>small scale</u> for the first year or two until solid experience is gained in all aspects of the work.

(6) Serious consideration should be given by Mauna Lani to rearing 3-4 month old juveniles to about a year of age for release, rather than starting out with hatchlings. The hatchling-rearing part could be done solely at Sea Life Park where years of experience already exist.

(7) Any plan for headstarting needs to include strategies for properly acclimating the turtles for release into the wild (e.g., introduction of natural algae food sources, reducing habituation to humans).

(8) Security aspects for headstart turtles at Mauna Lani need to be addressed. For example, in recent years the butchered carcass of a turtle was found on the Mauna Lani beach, and a speared turtle was found offshore. (In the latter case, resort concessional personnel shipped the injured turtle to us and it was cared for and later released in good condition.)

(9) Educational aspects of the project need to be fully and carefully addressed. Headstarting is strictly an experimental restocking action. This point needs to be emphasized.

(10) Contrary to the statement made in the proposal, green turtle hatchlings produced at Sea Life Park have been judged to come under the permit jurisdiction of the State of Hawaii. They are also likely to be subject to federal jurisdiction under the ESA, since Sea Life Park's parent stock of turtles was held in captivity in the course of a commercial activity prior to designation as a threatened species (Sea Life Park is a commercial concern). Nevertheless, this should not present any problems for a properly planned and professionally implemented experimental headstart project at Mauna Lani.

(11) The draft Recovery Plan does not endorse excavating trapped hatchlings from nests at French Frigate Shoals to transport to the main islands for headstart purposes. The draft plan endorses (advocates) the excavation and release of trapped hatchlings.

(12) The Mauna Lani proposal, preferably in revised and expanded form, should be sent to the recovery team members for their comment.

(13) Federal funding, if available, should be spent on the much higher priority items in the Recovery Plan.

Reviewer #2.

(1) I have several problems with this project. The requested private/ government funding of such a proposal could set a bad precedent, leading to a rather haphazard approach to headstarting. The amounts and plans for the funding are poorly spelled out and the proposal is too brief to really evaluate their capabilities. What, for example, will be the Mauna Lani share? What is their commitment to some longevity for the program, and will there be continued requests at the end of the first three years? What kinds of employees will they hire to run the program? There are several such obvious questions.

(2) I have questions about several other things in the proposal. I disagree with the idea that headstarting at their location would be a "natural" situation. Were there historically nesting beaches in the Kohala area? That adults forage there seems somewhat irrelevant to the rearing/release of yearlings. I also have doubts about the benefits such a

program would confer upon the "public." The security at places such as Mauna Lani Resort makes it unlikely that their public would extend far beyond their guests, who are an extremely limited cross section of the U.S. public.

Reviewer #3.

(1) "Headstarting" is among the recovery actions recommended by the Hawaiian Sea Turtle Recovery Team for green sea turtles. Specifically, artificial rearing of hatchlings born to turtles presently in captivity "to a size appropriate for release into coastal foraging pastures" is encouraged in the Plan, provided that any turtles released into the wild are certified to be free of disease. However, headstarting is seen strictly as an experimental activity, applicable only to "a portion of the captive-bred hatchlings"; the optimum disposition of captive-bred hatchlings is by release at known nesting beaches on the night following their emergence. There is no support in the Plan for headstarting of green turtle hatchlings recovered from nests in the wild.

(2) The recovery objective, as stated in the Plan, is to restore the average population of nesting females on each currently used nesting beach to the beach's biological carrying capacity, and to maintain it at that level. Mauna Lani Resort is not among the sites currently used by nesting green turtles, and, strictly speaking, actions aimed specifically at establishing a nesting population at the resort could not be justified as "recovery" actions. However, other concerns notwithstanding, the Plan would presumably support headstarting at the site and release of juveniles in appropriate habitats. Mauna Lani Resort itself might not be an appropriate habitat.

(3) Incredibly, the proposal does not mention how many hatchlings would be involved in the headstart program, but the Plan seems to limit this number to a fraction of those available from captive nesters. Let's say this is 100 hatchlings every year. The total Statewide hatchling production from wild stock is roughly 200,000 turtles annually. Would protection of 5/100 of 1% of the annual hatchling production during their first year of life have a measurable impact on stock recovery? (Actually, the pelagic stage is considered to be 2 yrs.) How many years would it take for such a program to pan out in the long run? How much would it cost? Who would pay for it? What are the carrying capacities of the State's nesting beaches? How large are the present nesting populations? How long will it be until carrying capacities are reached given current population trends? To what degree would recovery be accelerated by headstarting? In the event that survival probabilities of headstarted turtles greatly surpass those of wild ones, what would be the implications for stock fitness of increasing the relative frequency of genes of a little clique of captive brood stock in the wild population? What concrete results have been achieved by other green sea turtle headstarting programs around the world? The proposal touches on none of these important questions. Dozens more could be listed.

(4) Even if headstarting were a crackerjack idea, the appropriate place for planning and implementing the program would be in the government, not the private sector. This is not catfish farming; we're talking about rehabilitation of a threatened species. A serious long-term commitment would be required, with the Federal government carrying the financial burden. I don't question the valuable role the Mauna Lani Resort plays currently in public conservation education regarding green turtles, but I can't help thinking that they would reap lots of PR from such a project, at little cost to them. Meantime, the taxpayer would be sucked into a costly long term deal, and the door would be opened to similar proposals.

(5) The proposal gives no details as to how the money would be spent, no justification for the stated amounts, etc. In any event, if funds of such magnitude were available to enhance green sea turtle recovery, the money would be better spent on other activities proposed in the recovery plan, e.g., more comprehensive surveys of nesting populations, improvement of monitoring capability, marking and release of wild hatchlings, etc.

(6) If experiments with headstarting are ever undertaken, it should only be after the important preliminary questions, e.g., natural mortality of wild stock during the 2-yr pelagic stage, are systematically studied.

(7) Karen Bjorndal (University of Florida), a corresponding consultant to the Hawaiian Sea Turtle Recovery Team, has stated that her only concern with the draft Recovery Plan was the inclusion of captive breeding and experimental headstarting for hawksbills and green turtles. Even though such actions are given low priority in the plan and their experimental nature is emphasized, she thinks it is hazardous to experiment with such small populations.

I concur with the general evaluation of Honolulu Laboratory scientists that the funding request be denied.

cc: I. Barrett
E. Fullerton

SEA LIFE PARK

November 20, 1987

Mr. George Balazs
National Marine Fisheries Service
Southwest Fisheries Center Honolulu Laboratory
Honolulu, Hawaii 96822-2396

Dear George:

I'm writing this letter for two reasons, the first one is in response to the proposal from Maunalani Resort to start a Headstart Program for Green Sea Turtles at their facilities. I have a problem understanding their statement that they will initially be obtaining turtles from Sea Life Park. At this time no agreement of any kind is even under consideration to loan any turtles to them. Quite a while ago I had met with Mr. Daxbeck and he discussed with me the possibility of obtaining turtles from us. He was told at that time that many problems would need to be worked out before Sea Life Park would consider loaning any turtles to Maunalani Resort. Since that meeting I have not been contacted by Mr. Daxbeck and therefore none of the problems have been solved. At this point it seems unlikely they will be able to obtain turtles from Sea Life Park.

If any monies are available for turtle headstarting I would like to apply for upgrading our facilities and an additional nesting beach.

The second reason for this letter is that I understand that NMFS has in it's possession a turtle shell that was recovered from the stomach of a shark and it has a large semi-circle bite mark on it. Would it be possible to obtain this shell on loan for display in our Hawaiian Shark Gallery? I will be more than willing to credit NMFS for this artifact. It would be a terrific addition to our exhibit.

Sincerely,

Steve Kaiser
Curator of Fishes

SEA LIFE, INCORPORATED:
PARK: Makapuu Point • Waimanalo, Hawaii 96795 • Phone 259-7933
SALES OFFICE: 2222 Kalakaua Avenue • Suite 1300 • Honolulu, Hawaii 96815 • Phone 923-1531

(5) END

SEA TURTLE TAGGING FORM

CAPTURE DATE, LOCATION AND METHOD: HAND SNORKEL

CAPTURE TURTLE. 3-18-92 Kalahui puaa pond

PERSON RECORDING DATA: Kathy Hannada — Marina Lani Hotel

OLD TAGS: RFL 10551 / LFL 10552 / L3-4 10553

NEW TAGS: RFL / LFL

TUMOR SCORE: 0

OTHER NEW TAGS: RH #-163

STRAIGHT CARAPACE-LENGTH: 66.9 WIDTH: 51.8

NOTCH LENGTH: 66.7

CURVED CARAPACE LENGTH: 71.0 WIDTH: 65.0

HEAD WIDTH: 9.5

SEX: MALE, FEMALE OR UNDETERMINED: maturing M

TAIL LENGTH: T 27.5 C 18.0

RIGHT FRONT FLIPPER WIDTH: 11.5

SAMPLES COLLECTED:

PLASTRON LENGTH: 55.2

WEIGHT: 100 lbs

DESCRIPTIVE REMARKS: Skinny tail. OSCAR, POND CARETAKER, SAYS 3 TURTLES KEEP PONDS CLEAN OF ALGAE

6/30/88 MAUNA CANI POND

TAG 10551, 10552, 10553

STRAIGHT CARAPACE LENGTH = 66.6 cm

CURVED CARAPACE LENGTH = 71.0 cm

WEIGHT = 104 lbs

CONCLUSION -

ESSENTIALLY NO GROWTH AFTER 3 YEARS 9 MONTHS

PACIFIC BUSINESS NEWS

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PETERS — 4
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Feds score state high on accuracy — 9

HONOLULU, HAWAII • MONDAY, JULY 13, 1992

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gy would be different from the existing plant, he said. He declined to elaborate.

Hawaiian Electric also plans to build a $284 million plant. It has applied to the state Public Utilities Commission for permission to build an oil-fired plant.

"We need peak-hour capacity, and that is generally provided by oil-fired plants," said Hawaiian Electric president Harwood "Dan" Williamson.

But two new Oahu power plants would produce an oversupply, he said, adding that a coal facility could not be completed in time to meet a projected increase in consumer demand for 1994.

An oil-powered generation plant could be built in about two years, Williamson said.

If the planned 180-megawatt plant is built, the utility's Downtown Honolulu plant near Aloha Tower will be retired, he said.

Otherwise, the aging facility will be required to undergo extensive and expensive refurbishments.

shock spurs Kauai Electric

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"Our equipment into their grid is very important; it's a safety net," said plantation general manager, Michael Furukawa.

Kauai Electric needs the plant to meet future power demands and avoid rolling blackouts like those on the Big Island, he said.

As a result of the deal, the firm avoids building a new power plant, said assistant vice president of planning and regulatory affairs for Kauai Electric Denny Polosky.

Under the agreement, Kauai Electric also gets the right to buy a 13-acre site in Lihue for a future power plant for $5 million and a three-acre parcel for a Lihue office building for $1.2 million.

Under a previous contract, Lihue Plantation supplied Kauai Electric with bagasse-generated electricity. However, it has been scaling down sugar operations and had to burn oil to meet the contract.

The agreement reduces the plantation's production from 55.6 million to 40 million kilowatt-hours annually.

SHELL GAME

MAX YUKI, president of Mauna Lani Resort Inc., liberates a green sea turtle. See story page 7.

PBN Photo by Chuck Davis

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ing rates between June 3, 1992, and Dec. 31, 1993; and

• require insurers on Jan. 1, 1993, to slash 15 percent from what they charged on policies that were in effect as of March 1, 1992.

Liberty alleged the new laws deny the company a fair rate of return and will irreparably injure Liberty, other

HFDC will move to affordable housing

By Christine Rodrigo

The state Housing Finance & Development Corp. next month will pack up and move to the Pohulani

Okubo said. HFDC's $33,000 monthly rent at Pohulani will be used to subsidize the rent of elderly residents.

Also, a government agency is

Mauna Lani celebrates 'Turtle Independence Day'

Mauna Lani Bay Hotel and Bungalows general manager Charles Park, left, and Steve Kaiser, director of facilities development at Sea Life Park Hawaii. *Photo by Bob Fewell*

By Chuck Davis

Hawaii's visitor industry and its environmental movement joined forces July 4 when 10 green sea turtles celebrated Independence Day by being reintroduced to the ocean in waters fronting the Mauna Lani Bay Hotel and Bungalows.

The Big Island resort, in cooperation with Sea Life Park Hawaii, reared the turtles to adolescence in its saltwater atrium ponds.

The third annual event brought to 24 the number of turtles released at the Kohala Coast hotel. Each turtle has been tagged for research as part of Sea Life Park's experimental species-restoration program.

"It seems like the Big Island is a good place to get our turtles going," said Steve Kaiser, facilities director at Sea Life Park.

"The National Marine Fisheries Service has captured a couple of the Mauna Lani juveniles we released there, so apparently they're sticking around," he said.

Daniel "Kaniela" Akaka Jr., Mauna Lani's Hawaiian specialist and historian, and son of the U.S. senator, said the program not only helps the turtles' survival chances but is an attraction for hotel guests and an educational tool for school children.

Sen. Daniel Akaka participated in this year's release, along with Mauna Lani Resort president Max Yuki and general manager Charles Park.

The release program at Mauna Lani is designed to nurture a small number of the young to adolescence so they can be safely released into the ocean. As larger animals, juveniles are less likely prey than hatchlings.

The turtles are 12 to 24 months old when they arrive at Mauna Lani's ponds, and are nurtured for about a year before release. Caring for the turtles costs about $6,000 per year plus approximately 4,000 man-hours.

Sun Press
WEEK OF JULY 16-22, 1

Sea Life program hopes to save turtles

Green sea turtles are set free near Mauna Lani resort

By JAMES GONSER
Managing Editor

MAKAPUU — About 500 people were on hand July 4 to watch as 12 Hawaii green sea turtles left captivity for the first time and swam away into the open ocean.

Steve Kaiser, director of facilities development at Sea Life Park, hopes the young turtles and others raised by the park will become living ambassadors for their species, educating people not to hunt, kill or buy turtle products so the reptile will not become extinct.

"We are trying to do a similar thing to what has been done in the ivory trade, educate people that if you buy ivory, there won't be a lot of elephants around," Kaiser said. "We want to use the little turtles to educate people. You would be surprised how many people don't know that it is illegal to bring those products into the United States. We want to get rid of the market for turtle products."

This was the third annual release of endangered green sea turtles that so far has placed 26 two-year-old turtles into the waters off the Mauna Lani Resort on the Kohala coast of the Big Island.

Sea Life Park has a breeding herd of pre-endangered species act turtles (Chelonia mydas) in the turtle lagoon at its Makapuu facility. The turtles, called hono by the Hawaiians, are grandfathered in as exempt from the U.S. Endangered Species Act, which prohibits keeping a threatened species in captivity.

"We are not taking them out of the wild, they are being produced in captivity and then sent out," Kaiser said. "They are cute and cuddly and have the sweetest little faces. By sending them to aquariums and to the Mauna Lani, we hope to educate people about the protection of their species."

Each summer, hatchlings born at Sea Life Park are released into the wild within 24 hours of hatching, but the attrition rate is very high because the tiny turtles are easy prey for birds and fish as they make their way toward deep water. The

See TURTLES on A-6

TURTLE TAG: Steve Kaiser of Sea Life Park (left) and Daniel Akaka Jr. of the Mauna Lani Bay Hotel measure and tag a young green sea turtle before releasing it into the ocean.

Education key to turtles' survival

TURTLES from A-1

turtles spend their first year of life floating along with the ocean currents, Kaiser said.

Sea Life Park's experimental program gives some of the hatchlings a better chance at survival. A portion of each season's hatchlings are sent to the Vancouver Aquarium when 2 to 3 months old to be raised for about a year. The turtles are flown back to the park and then on to the Mauna Lani Bay Hotel and Bungalows to be raised and released.

"The turtles we released are about 2 years old and at the age where they would return to the near-shore water as part of their natural cycle," Kaiser said. "We are not trying to confuse them.

"We don't claim to head start the turtles. The program has not really been shown to increase the numbers of turtles in the wild. It may be too early to have had an impact, or we may just not be putting enough out. What we are trying to do with our turtles is an education thing. We want our turtles to get out to as many different oceanariums and aquariums and zoos as possible."

Green sea turtles are primarily vegetarians and can weigh up to 400 pounds. They eat algae or limu that grows underwater on coral reefs and on rocks close to shore. Green turtles prefer to live near "pastures" of limu that are in near-shore waters around the Hawaiian Islands. The area fronting the Mauna Lani is one of the grazing areas for the hono.

Kaiser said the National Marine Fisheries Service gets 20 to 60 reported cases of turtle poaching a year in Hawaii.

"That's too many," Kaiser said. "Enforcement won't solve the problem; education is the answer."

Kaiser said he recently sent five more turtles to the Mauna Lani and the hotel now has 13 turtles living in its lagoons.

"It is a lot of work for them to feed and check on the turtles," he said "But they do a really good job. They have an extensive array of ponds with fish and algae in the ponds. They really care about and for the turtles.

"It is not just hotel guests that watch the release, a lot of local people come down. Hopefully it will make a big imprint on those younger kids and when they grow up they will say 'I'm not going to poach a turtle or kill a turtle.' "

There's a changing of guard at the Mauna Lani

☐ Yuki is promoted to a post in Canada

11-5-91
B1

By Russ Lynch
Star-Bulletin

Makoto "Max" Yuki, president of **Mauna Lani Resort Inc.** since early 1987, has been promoted to a position in Vancouver, Canada, with **Tokyu Corp.**, which owns about 89 percent of the Big Island resort company.

Yuki will leave after the New Year's holiday, following a transition period with his successor, Morikuni Sasakura, who was general manager of Tokyu's overseas development division.

As chairman and president of Tokyu Canada Corp., Yuki will be headquartered in Vancouver, B.C.

Yuki arrived at Mauna Lani after its first hotel, the 342-room Mauna Lani Bay Hotel and Bungalows, opened in 1983 and with a single golf course.

Makoto "Max" Yuki

Since he became president, the resort has added another luxury hotel, the 543-room Ritz-Carlton, Mauna Lani, a second golf course and several major real estate developments of luxury homes and condominiums. The resort is also completing a $3 million visitor arrival center.

In his move to Canada, Yuki is following in the footsteps of his predecessor at Mauna Lani, Nobuo Kitsuda, who came from Tokyu at the beginning of the resort development, 20 years ago, when Tokyu was a pioneer among Japanese investors in Hawaii real estate developments. After 14 years turning barren lava fields into a lush resort, Kitsuda became head of Tokyu Canada.

The new Mauna Lani president, Sasakura, has been with Tokyu for 28 years. He was involved in development of overseas hotels including the Pan Pacific Hotel in Singapore and the Pan Pacific Wuxi Grand Hotel in China.

The 3,200-acre resort is on the Kohala Coast, north of Kona's Keahole Airport. The resort's minority owner is **Mitsubishi Corp.**

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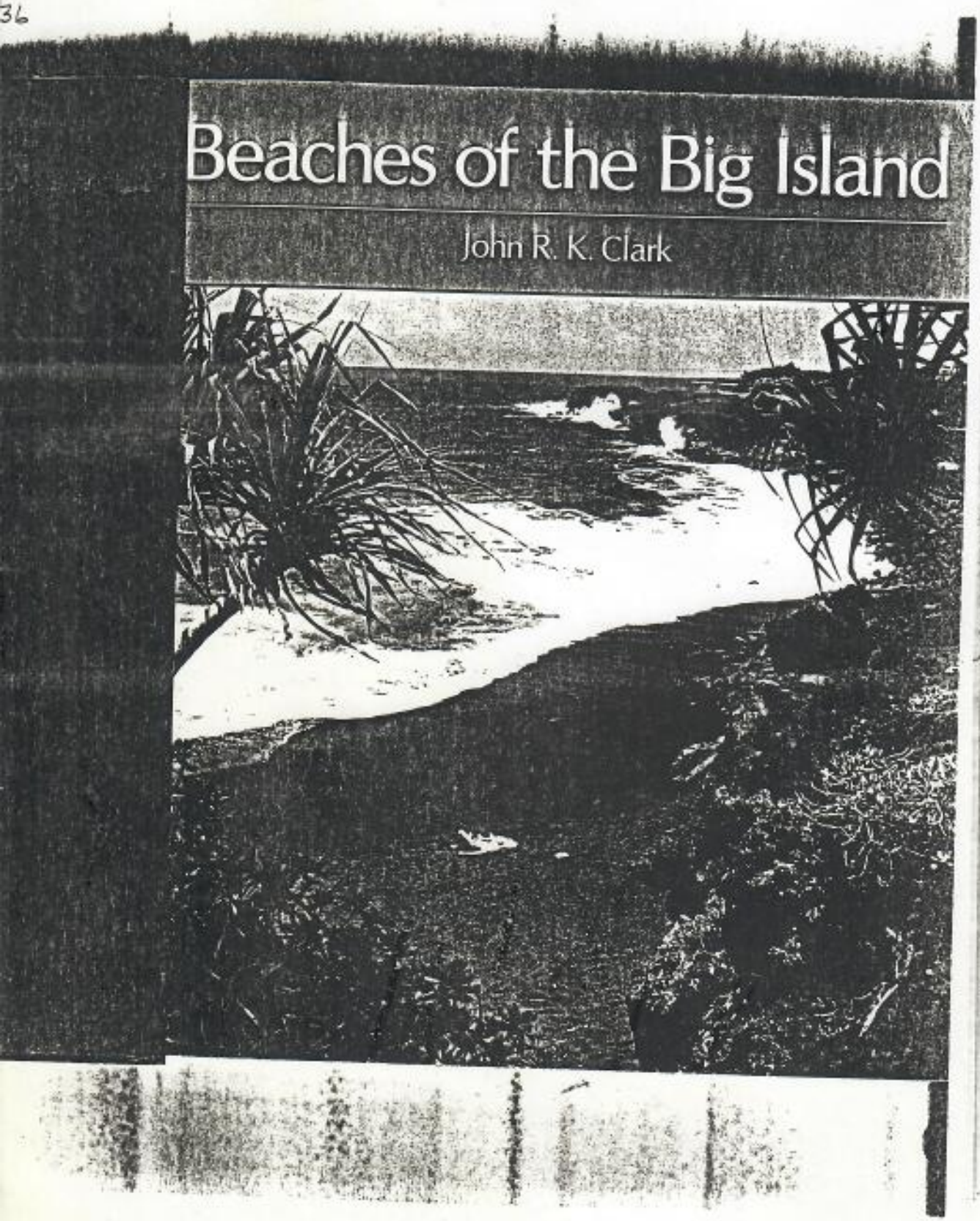
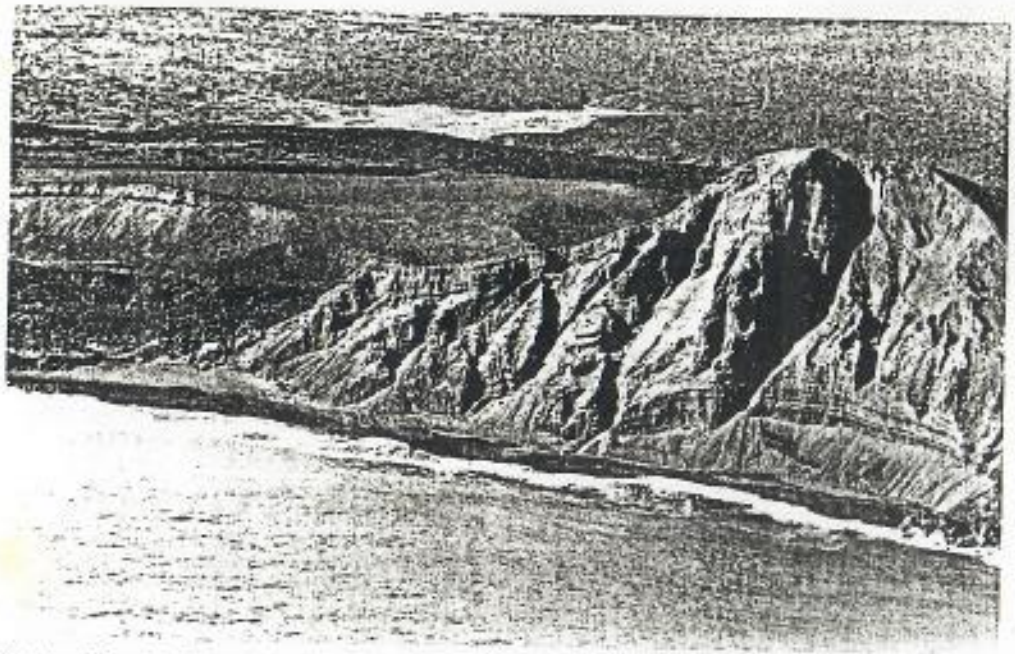
Beaches of the Big Island

John R. K. Clark





Pu'u Hou. When *'a'ā* flows enter the sea, steam explosions occur as the water penetrates the hot central part of the flow. These littoral explosions, so called because they occur at the shoreline, eject tremendous amounts of debris. When massive quantities of the debris pile up at the edge of the flow, they form a littoral cone. Pu'u Hou, created by the lava flow of 1868, stands 240 feet above sea level, the highest littoral cone on the Big Island.

The other two long green sand beaches which front the westernmost end of Pu'u Hou, do not contain any red sand. They also appear green from a distance because of the high olivine content. Like the first, they are unsafe for swimming, and for the same reasons. In one protected spot only can swimmers and snorkelers find a place to get wet during calm seas: at the eastern end of the third beach, a rocky point offers enough of a lee to block the prevailing wind and current.

The barren countryside surrounding the littoral cone is just as uncongenial as the shoreline, providing no protection from the elements. Shade, shelter, and fresh water are nonexistent. Hikers walking over Pu'u Hou should exercise extreme caution near the edges because the material comprising the cone is very loosely compacted and slides very easily underfoot.

Low sea cliffs line the shoreline from Pu'u Hou to Kahakahaken, but several storm beaches of white sand cover the rocks below Pu'u Waimānalo and Pu'u Kaimu'uala. Another pocket of white sand farther west, at Kākio, occupies a small *kīpuka*, the only low-lying area in the *makai* edge of the January 16, 1887, lava flow. The contrast of white sand against the dark masses of surrounding *'a'ā* is startling and easily pinpoints Kākio's location from a distance. This rugged reach of shoreline is frequented primarily by *'opihi* pickers and pole fishermen. There is no convenient public access.

The moderately long white sand storm beach at Kahakahakea is liberally strewn with lava fragments, giving it a salt-and-pepper appearance. Boulders and broken lava front the entire length of the beach, which lacks safe entry and exit points. Waves breaking continually over the rocks preclude almost all in-water activities in the deep, current-ridden waters offshore. A number of natural brackish water wells, in addition to a brackish water pond, occupy various cracks and depressions to the rear of the beach. The ruins of a large number of habitation sites are evidence that this was once a thriving Hawaiian fishing outpost. Fishermen are the most numerous visitors to this remote, desolate area.

(43)

Pōhue

Yesterday the lava reached the sea. It appears that in its course that stream of fire has done much damage to the Kahuku Ranch, that vast tract owned by Col. Samuel Norris. The flow is described as having split into three rivers of fire and to have gone over the flows of 1887 and 1868.

Hawaii Tribune Herald
January 15, 1907

Pōhue, "gourd," is a beautiful little pocket of white sand bordering a small sand-bottomed inlet in Pōhue Bay. During periods of calm seas this picturesque beach is one of the safest swimming areas in the district of Ka'ū and offers excellent snorkeling opportunities along the otherwise rocky shoreline. Pōhue Bay's recessed position in the shoreline protects it from dangerous currents under normal weather conditions and for boaters it is known as the best refuge from the wind between South Point and Kaunā Point. However, hazardous conditions occur occasionally when high surf, particularly during *kona* storms, sweeps across the entire bay and funnels unchecked directly into the beach. The moderately steep slope of the sand is a good indication that dangerous water conditions are sometimes encountered. High surf and storm waves create a powerful shorebreak, backwash, undertows, and rip currents.

Along the eastern margin of the bay, a large, rounded littoral cone, Pu'u Ki, dominates the shoreline and slopes gently down to Pōhue Beach. A number of habitation sites of a former Hawaiian fishing community are located on this rocky slope, which offers a magnificent view of the bay and all points along the coast and inland. Here too is the beginning of a vast petroglyph field that stretches beyond Pu'u Ki toward Kahakahakea.

Tucked into the inside corner of the eastern point of Pōhue Bay is a small beach of black sand with a sprinkling of olivines and white sand. Rocks border the sand at the water's edge and boulders cover the bottom offshore, making it a poor swimming beach. Farther east of the bay, fronting the summit of Pu'u Ki, low, flat-topped sea cliffs overlook one of the most productive *ulua* fishing grounds in the district. Local fishermen throughout the Hawaiian Islands know this area as Hosaka Point or simply as Eddie Hosaka. Edward Y. Hosaka was born and raised in Hawai'i and attended the University of Hawai'i at Manoa in the early 1930s. After earning a master's degree in 1934 he became an agronomist with the University's Extension Services, specializing in pasture management. In time he became recognized throughout the Pacific as an authority on pasture grasses for cattle. His work took him often to the Big Island and into the remotest areas of many of the island's large ranches. In these areas, when his work was completed, he often went shoreline fishing, one of his greatest pleasures. Hosaka, regarded as one of the finest *ulua* fishermen of his day, often fished at Pu'u Ki, located on the shoreline of Kahuku Ranch, and it was there at the age of 55 while doing what he loved best, that he suffered a stroke. Taken immediately by his companions to Hilo Hospital, he died on July 23, 1961. Since that date the point has been known as Eddie Hosaka.

In addition to his work for the University, Hosaka was for many years an honorary associate in Botany at the Bishop Museum—and also an author. Probably his best known and most widely circulated work is *Sport Fishing in Hawaii*, first published in 1944 and still considered one of the standard works on fish and fishing in the Hawaiian Islands.

To the west of Pōhue Beach, a storm beach of white sand, lava fragments, coral rubble, and water-rounded

pebbles borders a larger inlet of Pōhue Bay. The bottom immediately offshore is a very wide, shallow, and rocky shelf that precludes swimming. Just inland of the beach is a large rectangular brackish-water pond, Kanōnone Waterhole, that is encircled by coconut and *hala* trees. This little oasis in the surrounding desert of barren *'a'ā* stands out very clearly and constitutes Pōhue's most visible landmark.

The Pōhue shoreline is known to some local residents as Glover's Beach, for James W. Glover, a former owner of Kahuku Ranch, who founded the general construction firm James W. Glover, Ltd. The company continues to operate from offices in Honolulu and Hilo and has been acknowledged for many years as one of the major local contracting firms in the Hawaiian Islands. After Glover's death, the ranch was sold under court order by the Hawaiian Trust Company, the executor of his estate, to pay estate debts including inheritance taxes amounting to almost a million dollars. The trustees of the Samuel M. Damon Estate, with an offer of $1,363,630, were the successful bidders in 1958 for the 158,000-acre ranch. Because Kahuku Ranch has controlled access to Pōhue for so many years, some Ka'ū residents also know the area as Kahuku Beach. There is no convenient public access to this shoreline.

(44)

Road to the Sea

> After leaving Kapua, we had sailed along close to the shore, till the wind becoming too strong for us to proceed we availed ourselves of the opening [in the rocky shoreline] which Keawaiti afforded, to run the canoe ashore, and wait till the wind should abate, though in so doing we were completely wet with the surf, and spoiled the few provisions we had on board.
>
> A number of conical hills, from 150 to 200 feet high, rose immediately in our rear, much resembling sand-hills in their appearance. On examination, however, we found them composed of volcanic ashes and cinders; but could not discover any mark of their ever having been craters.
>
> *Journal of William Ellis*, 1823

On the shoreline of Ka'ū, between South Point and Kaunā Point, lava flows from the southwest rift zone of Mauna Loa entering the ocean have formed a series of littoral cones. The largest concentrated group of these cones is situated at the end of Road to the Sea, a cinder road that leads from the Hawai'i Belt Road to the shoreline. The highest of the cones are the two known as Nā Pu'u a Pele ("The Hills of Pele") at Keawaiki. According to Hawaiian legend, these hills were once two young men, chiefs of Kahuku, who excelled in all sports, especially *hōlua* ("sled")-riding. Pele also loved this sport. One day she appeared as a beautiful young chiefess to join in the competition. The chiefs, however, suspected her identity and refused to race with her. Angered, Pele came after them with a lava flow that devastated the once fertile lands of Kahuku as she chased them toward the beach. She overtook the chiefs just inland of Keawaiki and turned them into the hills that bear her name, Nā Pu'u a Pele.

On January 9, 1908, another flow from Mauna Loa reached the sea in the same area, surrounding Nā Pu'u a Pele and creating several smaller littoral cones on either side of the older hills. The ocean has eroded the cone to the south of Humuhumu Point and the one to the south of 'Āwili Point, creating two green sand beaches.

The small pocket of black sand at Humuhumu is liberally sprinkled with olivines, giving it a definite green tint in the sunlight. Swimming is safe under normal weather conditions, but the rocky offshore bottom drops abruptly to overhead depths. Snorkeling and nearshore scuba diving are good around the rocky points. High surf, particularly during *kona* storms, sweeps across the entire beach onto the face of the littoral cone and creates a strong shorebreak, undertows, and rip currents.

The larger and longer pocket of black sand at 'Āwili also is tinted green from the high concentration of olivines. The beach is narrow and steep at its eastern end, but flattens and widens at its western end, where a pocket of shoreline vegetation, mostly *pōhuehue* and *naupaka*, occupies the backshore. Swimming is safe under normal weather conditions, but the rocky offshore bottom drops abruptly to overhead depths. Like the neighboring beach at Humuhumu, high surf and *kona* storm waves make swimming very hazardous.

The beach at Humuhumu Point and the beach at 'Āwili Point are collectively known to most area residents as Road to the Sea. Road to the Sea, a 7-mile-long cinder road, begins at the western edge of Hawaiian Ocean View Estates and ends on the shoreline at Humuhumu Point. It is one of the few *mauka-makai* access routes in Ka'ū to the ocean. Ordinary passenger cars traveling slowly can negotiate the road except for the last rugged downhill slope to sea level; so most drivers park above this last section, which requires a vehicle with four-wheel drive, and walk to the shore. Visitors to the area include swimmers and sunbathers during periods of calm seas, and shoreline fishermen who camp and fish throughout the year.

'Āwili. The district of Ka'ū is noted for its eroding littoral cones and the volcanic sand beaches that form at their bases. Located inshore of 'Āwili Point, this cone is one of a large concentration of littoral cones at the bottom of Road to the Sea. The two most famous in the area are called Nā Pu'u a Pele, "The Hills of Pele," after the goddess of the volcano.

'Āwili Point is said to be one of the better *ulua* grounds when these fish are running in Ka'ū—primarily during the spring and summer months. In 1977, Roy Ogata, a professional photographer from Hilo who is acknowledged as one of Hawai'i's finest *ulua* fishermen, in one night caught twenty-three *ulua* at 'Āwili, most of them ranging in size from 20 to 40 pounds. This is now the Hilo Casting Club record for the most *ulua* caught by one person in one night of fishing. Ogata was born and raised on the Hilo bayfront near the Wailuku Stream bridge and spent much of his youth fishing and diving in and around Hilo Bay. In later years, as he fished in different areas on the Big Island, he heard stories of a warm current that periodically flowed past 'Āwili Point and apparently caused the fish to bite with abandon. On the night that he made his record catch, the ocean was rough, the wind was cold, but the water was warm.

Mauna Lani 'think tank' proposed

☐ Big Islanders fear it's a marina homes project all over again

■ Opposition to lagoon is stiff A-4

By Gwenda L. Iyechad
Star-Bulletin

SOUTH KOHALA, Hawaii — Imagine a world-class economist pondering global warming with a religious leader like the Dalai Lama.

Or a respected Asia scholar discussing Third World development with a virtuoso violinist.

These seemingly incongruous collaborations would not take place at a traditional think tank or prestigious university, but could occur here, at a Kohala coast resort.

That is how Kenneth F. Brown, Mauna Lani Resort Inc.'s board chairman, envisions the centerpiece of a proposed $147 million development.

The project, called Mauna Lani Cove, would feature a man-made cove, pricey houses and condominiums, a commercial area, spa, Hawaiian learning center and public parks on 100 acres between the Ritz Carlton Mauna Lani Hotel and the Mauna Lani Bay Hotel. The development's financial viability would depend on its real estate sales.

For Brown, the development's soul would rest on its international think tank that would bring together world-caliber experts.

Star-Bulletin

"A lot of people think it's flaky, but it ain't," quipped Brown.

To become a reality, the project must fight more than skepticism about the think-tank concept.

Big Island environmentalists, recreational organizations and others are mounting campaigns against the project, largely because of plans to carve a 30-acre lagoon out of lava land and to dredge a channel through the reef.

For opponents, it seems a new version of Mauna Lani's 1989 proposal to build a 110-slip marina and residential complex around a man-

See MAUNA LANI, Page A-4

Star-Bulletin

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MAUNA LANI: The resort hopes to dredge out a 30-acre lagoon

Continued from Page A-1

made cove. That proposal was withdrawn after a fire storm of opposition.

Brown and other officials from Mauna Lani, owned by Tokyu Corp. of Japan, say this project is different. No marina is planned, and the international policy center and an adjacent marine-science center would provide educational opportunities not just for scholars and tourists, but for Big Island residents as well.

The tentative name, Five-Mountain Village, represents the five mountains that can be seen from Mauna Lani — Haleakala on Maui, and Kohala, Mauna Kea, Mauna Loa and Hualalai on the Big Island.

For Brown, those mountains are symbolic not only of Hawaiian imagery and mythology, but of the interactive relationship among Pacific Rim nations.

Hawaii, he believes, is at the center of the Pacific Rim, just as the proposed think tank would be at the center of the mountains.

The multi-disciplinary focus of Five-Mountain Village would make the center different from other international think tanks, Brown said.

"Cross fertilization is missing in our society," he said. "For example, it may well be that the outstanding Chinese calligrapher may have an idea about global warming and may be able to explain it in a way that would grab others."

Victor Li, former East-West Center president, is one such believer. Two weeks ago, he brought together Hawaii and mainland scholars — a scientist, economist, philosopher, journalist, strategic arms specialist, Hawaiian expert — to brainstorm about the think tank.

"The people . . . were first-rate, world-class people, and what attracted them was the idea of being able to reach across these lines that have been limiting us," Li said.

The opportunity to come to an ocean-front setting, talk with first-rate intellects and wind down at the spa and other amenities will attract such distinguished visitors, the developers say.

The topics for discussion would be wide open, Li said. They could tackle old issues, such as economic development in Third World countries, but in new ways — by considering Eastern as well as Western approaches, he said.

They also could consider much newer issues, such as the perceived end of the Cold War. Or they could provide fresh ideas for what Hawaii's role in the region should be, Li added.

Barry C. Raleigh, dean of the University of Hawaii's School of Ocean and Earth Science and Technology, was among the scholars at Li's recent meeting.

He is a key force behind a proposal to build a research laboratory for renewable energy and ocean technology at the Big Island's Keahole Point. He believes the lab's scientists would benefit from the type of multi-disciplinary talks that could occur at The Cove.

So "to help scientists along the way to a better, somewhat sharper focus on what will be ultimately most valuable for humanity, this kind of dialogue is essential," he said.

"We are trying to invent something new," Li said. "How all this comes together . . . is what we're trying to discover and invent as we go along."

Brown said the developer would finance the think tank, but he expects grant and corporate support to follow.

What gets him most excited, though, is envisioning the personalities who would meet there.

"I think of the Dalai Lama walking around there and running into George Bush," Brown said. And he laughed with satisfaction.

About the Mauna Lani Cove

- **Developer:** Mauna Lani Resort Inc., owned by Japan's Tokyu Corp.
- **Location:** On 100 acres between the Ritz Carlton Mauna Lani Hotel and the Mauna Lani Bay Hotel, on the Big Island's South Kohala Coast.
- **Cost:** $147 million.
- **Features:** A cove carved out of lava; two artificial islands; ocean access via a channel cut through the reef; 250-300 condo units and 50-55 homes; a village with an international think tank, marine science center, health spa, commercial center; shoreline park; Hawaiian learning center and canoeing center.
- **Jobs expected to be created:** 100-300.
- **Target for completion:** Late 1995.
- **What next?** A public hearing will be held on the project before the Hawaii County Planning Commission, 1:30 p.m. tomorrow at Waimea Elementary and Intermediate School cafeteria.

Ecological concerns are sparking fierce opposition to building a lagoon

By Gwenda L. Iyechad
Star-Bulletin

If the Mauna Lani Cove proposal were limited to an international think tank, the project might clear the bureaucratic hurdles that begin tomorrow relatively easily.

But because the project depends on dredging from two to four million cubic yards of lava land to create a lagoon, and removing about 17,000 cubic yards of lava reef to create a channel, the proposal faces a battle.

The Hawaii County Planning Commission will begin the permit process for the Mauna Lani Resort Inc. proposal tomorrow with a 1:30 p.m. public hearing at Waimea Elementary and Intermediate School.

Representatives of the West Hawaii Sierra Club, Puako Community Association and other community groups that oppose the project say they will attend.

Their concerns center on the project's environmental effects.

"The global village (think tank) element is a great element," said environmentalist Toni Withington, a North Kohala businesswoman. "But the blasting of this huge channel they're talking about is not something that is necessary to the creation of the global village."

Real estate appraiser Peter Young is among those who praise Mauna Lani's track record on the Big Island but acknowledge the concerns.

Young is president of the Big Island Business Council — an umbrella organization of 12 major business groups that has yet to take a stand on the Mauna Lani Cove project.

"Mauna Lani has been an excellent neighbor on the Kohala Coast . . . " Young said. "But any time you deal with a coastline, you're going to have people raising questions and concerns."

The project seems similar to a controversial Mauna Lani proposal in 1989 to build a marina along a similar man-made cove, and that worries some Big Islanders.

"It still looks like a marina, it smells like a marina, it has the same problems," said attorney Rick Schulze, president of Puako Community Association, which opposes the project.

"There are a lot of people who feel it is a deception."

Gordon Chapman, Mauna Lani's environmental affairs manager, said the developer has "absolutely no intention of ever putting a marina component within the cove."

He added: "By the permits we are seeking, they will not allow a marina component. Should anyone in the future desire to put a marina within the cove, they would have to go through the entire permitting process again."

He also said the portion of the reef to be removed is primarily a lava rock terrace. About 5 percent to 9 percent is coral.

Developers would use siltation curtains and suction dredges during construction to make sure silt does not harm existing coral colonies, he said.

Big Island Mayor Lorraine Inouye said she wants to be cautious and flexible as the project goes through the public hearing process, but generally supports the proposal.

She said she would like Mauna Lani to provide a sewage-system hookup for Puako residents and provide land for an expansion of the Puako fire station, which is on the developer's land.

She also wants to make sure the public has access to the development's facilities. She said she believes the developer has made those guarantees.

"I would not support a project like this if the public was going to be barred from participating in making use of the area," she said.

"But I'm still cautious — I'm really concerned about impacts on the surrounding region," Mayor Inouye said.

Opponents say that Mauna Lani must prove that there is overriding public need for the project to get the necessary state approvals.

Builder Edward Lapenas, who is spearheading West Hawaii Sierra Club's opposition to the project, said that will be difficult to prove.

"The fact is that the only people who are going to benefit by this are the 350 shoreline residential property owners on this cove, and Mauna Lani Resort, with the increased property sales," he said.

Chapman disagreed, saying the cove is necessary to make the project viable. And a viable project means not only increased value for the developer, but increased tax revenues, jobs and other community benefits, he said.

"We share their concerns, and probably have greater concerns than they do . . . we're not going to do anything that will harm what we have at the present," Chapman said.

1952

The Kona Earthquake of August 21, 1951, and Its Aftershocks[1]

GORDON A. MACDONALD and CHESTER K. WENTWORTH[2]

INTRODUCTION

AT THREE MINUTES before one o'clock on the morning of August 21, 1951, the southwestern part of the island of Hawaii was shaken by the strongest earthquake recorded there since 1868. The earthquake of August 21 was felt strongly all over the island of Hawaii, weakly on the island of Maui, and in Honolulu, 180 miles away from its origin. Extensive damage resulted in the central Kona district, and lesser damage extended all the way to Naalehu, about 38 miles from the epicenter. The major earthquake was followed by a large number of aftershocks which, although they did little damage, kept the populace of Kona uneasy for several weeks.

A detailed study of the earthquake was immediately undertaken by the staff of the Hawaiian Volcano Observatory. No sharp division of labors existed, but for the most part Macdonald was responsible for the general and instrumental phases of the investigation and Wentworth for the detailed studies of damage, such as that affecting water tanks, stone walls, and gravestones.

Acknowledgements: It is impossible to mention by name all the persons who aided the investigation by contributing observations on the earthquake itself and data on resulting damage. To all these we extend our sincere thanks. Special thanks are due Howard M. Tatsuno, seismograph operator at Konawaena High School near the epicentral area; Sister Mary Thecla, seismograph operator at St. Joseph's School in Hilo; Mrs. Alfred E. Hansen at Naalehu, Allan P. Johnston of Kapapala, and Nancy R. Wallace of Kealakekua, who contributed descriptive reports of many of the aftershocks. Roland E. White, of the Honolulu Magnetic Observatory, U. S. Coast and Geodetic Survey, kindly sent copies of the seismograms of the major earthquake as recorded at Barbers Point, on Oahu. Commander C. A. George, of the Coast and Geodetic Survey, supplied copies of the tide gauge records from Honolulu and Hilo harbors, showing the small tsunami that followed the earthquake. Many persons supplied information on damaged water tanks. Among these Mark Sutherland, Principal of Konawaena School, John Iwane, Extension Service, University of Hawaii, and Masuoka Nagai, of Captain Cook Coffee Company, were especially helpful.

NARRATIVE

Most residents of the island of Hawaii were in bed when the earthquake struck. Nearly everyone in the Kona and Kau districts was awakened, and most people rushed outdoors. Persons in the area near the epicenter reported that the initial movement was largely up and down, with some swaying in an east-west direction, increasing in intensity and giving way to what appeared to be a vortical motion. Noise during the earthquake was intense as doors and windows rattled,

[1] Publication authorized by the Director, U. S. Geological Survey. Manuscript received May 7, 1952.

[2] Director and Geologist, respectively, Hawaiian Volcano Observatory, Hawaii National Park, Hawaii.

dishes and furniture toppled to the floor, water tanks collapsed, and rocks rolled down from stone walls and banks. A few persons who were awake at the time the earthquake occurred reported that the quake was immediately preceded by a dull roar seeming to come from the ground. Shaking is reported to have been nearly continuous for an hour or more after the major shock.

Macdonald was driving through Naalehu, 36 miles from the epicenter, when the earthquake occurred. The car swerved violently, as though it had struck a mudhole. Immediately afterward branches started to snap from trees overhead and fall on the pavement.

Within a matter of moments several houses, churches, and a school building were badly damaged, many other houses slightly damaged, about 200 water tanks destroyed, many miles of stone wall thrown down, roads partly blocked by rock slides, road pavement and shoulders badly cracked, cemeteries damaged, telephone communication and electric power supplies disrupted. Fortunately, only two persons were injured, and they not seriously.

Damage extended for more than 50 miles along the highway that encircles the island, from Holualoa on the north to Honuapo on the southeast. Damage was greatest along the 10-mile stretch from the village of Captain Cook to Hookena (Fig. 1), but as far away as Naalehu many dishes were thrown to the floor in homes, groceries and liquor bottles thrown from shelves in stores, and one house was shifted several inches on its foundations. A few objects were toppled from shelves, pavements were cracked, and numerous landslides started in the vicinity of Kilauea Caldera, 45 miles from the epicenter.

At Napoopoo the ocean was observed withdrawing from shore, and most of the inhabitants of the village were hurriedly evacuated to higher ground until the possibility of a destructive tsunami was past.

Two small fires broke out. One was at Kaimalino, 0.3 mile south of Kealia, where kerosene, spilled in a kerosene-powered refrigerator, caught fire. The other was in Naalehu, where the earthquake upset a kerosene lamp. Both fires were quickly extinguished.

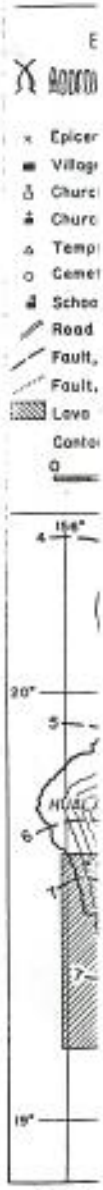
Bright flashes of white light at the time of the major earthquake were reported by persons at Naalehu and Pahala. These persons believe the flashes were not the result of electrical short circuits. Peculiar lights have occasionally been reported during other strong earthquakes.

During the night of August 21–22 persons in the central Kona area reported a distinct odor of hydrogen sulfide, apparently occurring in intermittent waves. The source of this odor is not known. No increase of fuming was observed at the vents of the 1950 eruption on the southwest rift of Mauna Loa.

Aftershocks in great number followed the major earthquake. The seismograph at Konawaena School was badly damaged by the first quake, so the total number of aftershocks will never be known. However, Mrs. H. Masuhara, at Keei, counted 109 felt earthquakes between the principal shock and nine o'clock the next morning. The Konawaena seismograph was repaired and restored to operation at 15:15 on August 23. It recorded 90 earthquakes during the next 24 hours and 494 earthquakes up to midnight on August 31. Most of these, of course, were too small to be felt, even close to the epicenter. Strong aftershocks occurred at 01:28, 09:56, 10:12, 18:32, and 22:48 (Hawaiian Standard time) on August 21, and at 17:15 on August 22. Only slightly less strong were those at 02:14 and 06:28 on August 22. Because of continued earthquakes, graduation ceremonies at Konawaena School on August 22 were held outdoors instead of in the auditorium.

INSTRUMENTAL DATA

The major earthquake dismantled all seismographs on the island of Hawaii. All but the Bosch-Omori seismograph in the Whitney Laboratory on the northeast rim of Kilauea



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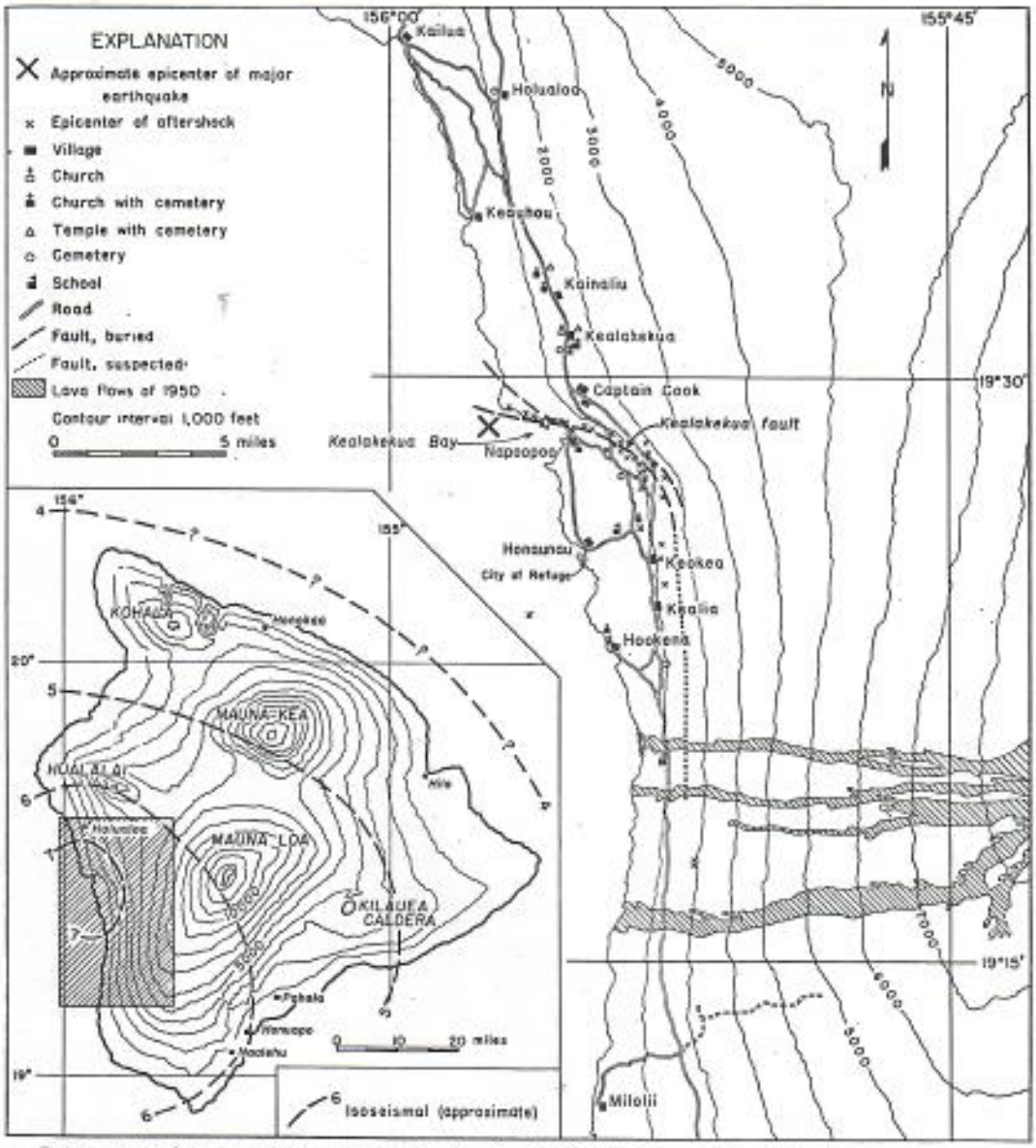

FIG. 1. Map of the central Kona district showing the location of places mentioned in the text and the approximate locations of the epicenters of the major earthquake of August 21, 1951, and of the aftershocks for which reasonably good locations were obtained. The inset map of the island of Hawaii shows the location of the area (shaded) covered by the other map and the approximate position of the isoseismal lines for the major earthquake.

Caldera were dismantled by the preliminary waves. Precise time control and, consequently, the precise time of arrival of the first waves are lacking on the Kona and Hilo instruments. As a result, instrumental data are inadequate for the close location of the focus of the earthquake. The duration of the preliminary waves on the north-south component of the Bosch-Omori instrument was 9.5 seconds, corresponding with a distance of approximately 47 miles from the Whitney Laboratory to the origin of the quake.

John C. Forbes, instrument maker at the Volcano Observatory, repaired the minor

damage to the Bosch-Omori seismograph and put it back in operation at 01:24, 27 minutes after the first earthquake started. At that time the instrument was recording the long waves of a large earthquake. The period of these waves ranged from about 6 to 8 seconds and averaged approximately 6.7 seconds. Their maximum double amplitude was 67 millimeters, corresponding to a theoretical ground displacement of approximately 0.5 millimeter.. These waves continued with gradually decreasing amplitude until 03:20. Because no other earthquake at an appropriate time was observed by more distant stations, it is believed that these long-period waves were the surface waves of the major Kona earthquake.

The time of origin of the major earthquake is given in the notice of preliminary determination of epicenter issued by the U. S. Coast and Geodetic Survey as $00^h56^m57.5^s$ Hawaiian Standard time ($10^h56^m57.5^s$ Greenwich Civil time). The time of beginning of registration of the preliminary waves at the Whitney Laboratory at Kilauea was $00^h57^m09.5^s$ Hawaiian Standard time.

The direction of the first ground movement at Kilauea Caldera was east-southeast and up, that at the Mauna Loa station was east-northeast, and that at the Kealakekua station was east-northeast. At the Kealakekua station the north-south component was only slightly damaged, but on the east-west component the suspensions were broken and the weight dropped on the floor 2 feet west of the pier.

The Kona seismograph, at Konawaena School (Fig. 1), was restored to operation at 15:15 on August 23. Previous to that time, location of the points of origin of the aftershocks on an instrumental basis was uncertain because of the very short base of the triangle formed by the intersection of lines from the earthquake foci to the other stations. Earthquakes after that time are fairly well located because of the control given by the Kealakekua seismograph. Most of these were located by means of data from four stations: Kealakekua, Mauna Loa, Hilo, and Whitney (Kilauea).

Locations of the epicenters of aftershocks which occurred after 15:15 on August 23 with serial number greater than 190 are shown in Figure 1. Thirty-three such aftershocks have been located with small probable error. Most of them fall on or close to a fault that runs out to sea in a west-northwesterly direction along the northern edge of Kealakekua Bay. The existence of this fault, partly buried by later lava flows, has been recognized for many years (Dana, 1890: 30; Stearns and Macdonald, 1946: 37, pl. 1). At its eastern end it bends southward, and the writers have suspected that the abnormally steep lower western slope of Mauna Loa inland from the highway for 15 miles or more south of Captain Cook is a fault scarp deeply buried by later lava flows. An interesting partial confirmation of this theory is furnished by the location of the epicenters of several aftershocks along this line (Fig. 1).

The frequency of aftershocks decreased rapidly from August 23 to September 4. As is shown in Figure 2, the average frequency then decreased very slowly until the end of September. No figure is available for September 7 because of mechanical failure in the recorder at the Kealakekua station. The apparent depth of origin of the aftershocks ranged from 3 to 12 miles, most being about 6 or 7 miles. No progressive change of depth with passage of time is apparent.

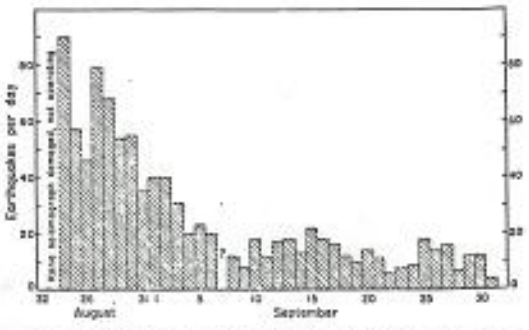

FIG. 2. Graph showing frequency of aftershocks to the end of September, 1951.

Altogether, from the time it was put back in operation until the end of August, the Kealakekua seismograph recorded 494 earthquakes, and until the end of September 965 earthquakes. Nearly all of these are regarded as aftershocks of the big earthquake of August 21. Most were too small and shallow-seated to be recorded at the other stations, hence their foci could not be closely located. It appears certain, however, that most originated along the Kealakekua fault at the northern edge of the Kealakekua embayment.

EFFECTS OF THE EARTHQUAKE

Description of Terrane

The epicentral area lies on the western slope of Mauna Loa, a few miles south of the surficial boundary between Mauna Loa and Hualalai Volcanoes. It is transversed from north to south at altitudes of 1,000 to 1,300 feet above sea level by the main highway, from which roads lead to the shore at Napoopoo, Honaunau, Hookena, and Milolii (Fig. 1). In the vicinity of the highway the average slope of the land surface is about 10 degrees, which is several degrees steeper than the average for Mauna Loa slopes in general. Above an altitude of 5,000 feet the average slope decreases to about 7 degrees. The steepness of the lower part of the slope is believed to result from an ancient fault scarp deeply buried by more recent lava flows.

In the area within 6 miles south of Napoopoo the steep zone is narrower and more sharply defined than farther south, and west of it the slope again flattens toward the sea. Three miles east-southeast of Napoopoo the steep zone turns sharply northwestward and becomes even steeper, taking on the unmistakable characteristics of a fault scarp mantled by more recent lava flows. This scarp forms the northern boundary of Kealakekua Bay, and there the older lava beds in the scarp are not mantled by later flows.

The steep seaward slope results in a distinct asymmetry of the terrane, which asymmetry of necessity extends to nearly all structures on the terrane. Buildings rest on foundations that are high on one side and low on the other. Roads in many places rest on a cut on one side and fill on the other, or on a fill which is shallow on one side and deep on the other. Stone walls parallel to the coast have one sloping side shorter than the other. All of this results in a lesser degree of stability than in structures built on level terranes, and in a favored direction of unstability. Partly because of the higher foundations and deeper fills on the seaward side and partly because of the continuous effect of gravity, structures tended to move downhill during the earthquake regardless of the direction of the actual shaking. This effect must be considered in using the direction of displacement of objects as a means of locating the epicenter.

Rock Slides

Many small rock slides in highway cuts were caused by the earthquake. Most of them came from cuts on the inland side of the highway, probably largely because the cuts were higher on that side. Most of the slides were small, bringing down blocks less than 2 feet across. These caused little damage and were easily removed. A few larger slides brought down large blocks weighing several tons, the removal of which required the use of bulldozers or other heavy equipment. The large slide farthest from the epicenter occurred at a high roadcut just west of Honuapo, 40 miles from the epicenter. Small slides and rock falls in road cuts extended all the way to Kilauea Caldera, 44 miles from the epicenter. Many small rock avalanches took place in Halemaumau Crater during and for several days after the earthquake.

A large part of the damage to road cuts did not, strictly speaking, result from sliding of the materials. Most of it was merely a fraying of the banks by the rolling down of loose or semiloose material. Few of the highway cuts exceeded 5 feet in height, and few

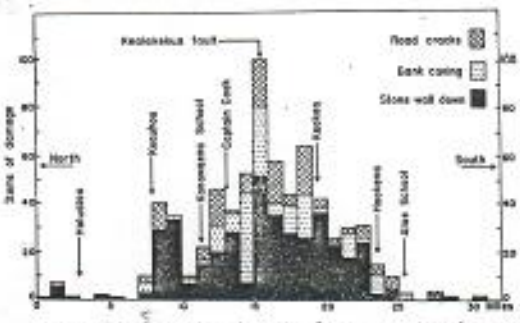

FIG. 3. Diagram showing the frequency distribution of three of the principal types of earthquake damage along the main highway. The arrows indicate the position on the highway of some villages and other features. Note the centering of damage close to the Kealakekua fault.

were dressed back to any approximation to an equilibrium slope. The earthquake of August 21 greatly exceeded in size any previous quake in the affected area since the road cuts were made, and shaking during the earthquake merely dislodged much of the loose material and allowed it to roll down onto the road.

The distribution of abundance of rock slides in road cuts is shown in Figure 3, in which it is represented by the portion of the columns labeled "bank caving." Like the other damage shown in the graph, it was greatest in the immediate vicinity of the Kealakekua fault, inland from and a little south of Kealakekua Bay.

Many large slides took place on the fault scarp at the northern edge of Kealakekua Bay. The slides caused a disturbance of the water of the bay just after the earthquake, and many residents of the coastal village of Napoopoo fled inland, fearing a big tsunami. Slides continued on the Kealakekua cliff for several days after the earthquake, sending up clouds of yellowish-brown dust, leaving fresh scars on the cliff face, and building talus fans at the foot of the cliff.

Less numerous and smaller slides also occurred along the cliff just inland from the village of Hookena Beach. The cliff at Hookena is believed to be an ancient fault scarp, mantled by lava flows from the upper slopes of Mauna Loa during prehistoric times. Many fragments of the lava veneer were shaken down during the earthquake.

Tsunami

Despite early reports to the contrary, there is no doubt that the earthquake was accompanied by a small tsunami, or "tidal wave." At Napoopoo wharf the water was observed to withdraw from shore. The tide was low at the time. Withdrawal of the water lowered the level to about 4 feet below normal low-tide level. Immediately afterward the water returned shoreward, and the level rose about 2 feet above low-tide level.

At Milolii, Eugene Kaupiko reported that a few minutes after the earthquake, which he felt while in a canoe anchored offshore, the water receded from shore, revealing the sea bottom as far out as the edge of the wharf. This represents a lowering of the water level of about 3 feet. After the withdrawal the water returned shoreward, causing a rise of the water level 3 or 4 feet above normal low water and floating away a canoe that had been drawn up on the beach about 2.5 feet above high-tide level. One large fall and rise of the water level appears to have been followed by many small oscillations.

At Honaunau, between Napoopoo and Milolii, Eli Cooper, caretaker of the City of Refuge, went down to the water's edge a few minutes after the earthquake. At that time he could see no signs of disturbance of the water, but a small tsunami could have occurred between the time of the earthquake and his arrival at the strand. At Hookena no tsunami was observed, and there was none large enough to flood the floor of the dock, about 4 feet above normal water level. However, it cannot be said definitely that no small tsunami occurred there.

The Honolulu tide gauge record shows a distinct oscillatory disturbance of the water starting at approximately 01:35, about 38 minutes after the earthquake. Seven or more oscillations are detectable, with an average

period of about 14 minutes, reaching an amplitude from crest to trough of 3.6 inches. This undoubtedly is the record of a seiche set up in Honolulu harbor by the tsunami. Using the time of beginning of the disturbance at Honolulu as that of arrival of the tsunami, the average speed of travel of the tsunami from the epicenter to Honolulu was approximately 284 miles an hour. The time of beginning of the disturbance at Honolulu corresponds well with the calculated theoretical arrival time of a tsunami caused by the Kona earthquake, so there can be little doubt the disturbance was of that origin. A similar disturbance is shown on the record of the Hilo tide gauge. The time of beginning of the disturbance at Hilo is less definite, but appears to have been about 02:38. This corresponds with a much slower average speed of travel of the tsunami, of about 78 miles an hour, as the waves were refracted around the island in comparatively shallow water.

Damage to Buildings

Shortly after the earthquake the Kona police estimated that about 200 houses in the area had suffered some degree of damage. Most houses in the area near the epicenter are of frame construction, set on knee-braced timber underpinning. Such supports proved capable of undergoing the shaking and distortion caused by the earthquake without serious damage. Most of the damage was minor and quickly repaired. Some houses shifted from a fraction of an inch to 3 or 4 inches on their foundations. Many were sufficiently twisted out of line to make it difficult or impossible to close windows and doors. In nearly all houses dishes and other objects were thrown from shelves. Only the more seriously damaged structures are enumerated here.

At Kaimalino, 0.3 mile south of Kealia (Fig. 1), a shop building collapsed. This building was placed on timber supports level with the highway in front but 6 feet above ground level in back, without adequate cross bracing.

FIG. 4. Overthrown shop building at Kaimalino, from the south.

Failure of the underpinning allowed the building to tilt backward and slump to the ground (Fig. 4). A similar situation was found at Keokea, 1.2 miles north of Kealia, where a service station building slumped downhill away from the highway and partly collapsed.

In the Kahauloa area, about 1.7 miles east of Napoopoo village, the walls of a store partly collapsed as a result of distortion of the building caused by shifting on its foundation. The warehouse of another store was badly damaged.

At Hookena Beach two old frame houses were destroyed. One, which had been occupied briefly in 1889 by Robert Louis Stevenson, fell when its timber underpinning failed, and collapsed. The other also was dropped onto the ground by collapse of its underpinning. It appears to have fallen almost straight downward. The building was somewhat twisted, but not otherwise seriously damaged. At Kealia and at Kiilae, about 0.4 mile south of Kealia, two other frame houses were badly damaged by collapse of their timber underpinning. All of these cases of collapse of frame houses appear to have been caused by inadequate bracing or poor materials in the underpinning, in some instances probably aggravated by insecure footings.

The cases of structural damage most distant from the epicenter occurred at Naalehu, 36 miles southeast of Napoopoo, where wallboard in a restaurant was cracked, and one

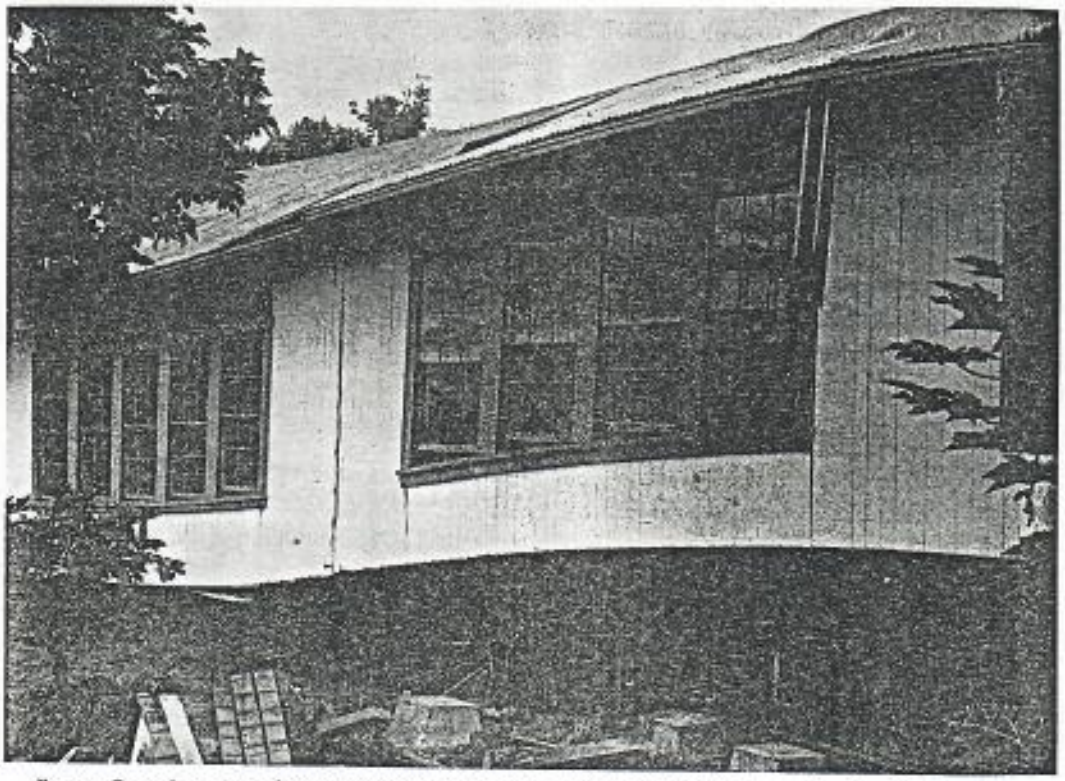

FIG. 5. Central portion of Honaunau School, from the southwest. All but the south end of this building was let down and moved westward owing to inadequate bracing of the underpinning in an east-west direction transverse to the longer dimension of the building.

house was moved several inches on its foundation.

A striking example of the effect of poorly designed underpinning is furnished by the Honaunau School. This was a long, narrow frame building placed with its length parallel to the contour of the ground surface. The front of the building was about 3 feet and the back about 10 feet above ground level. It was supported on timber posts. The posts and knee bracing parallel to the length of the building were entirely adequate, but there was comparatively little bracing parallel to the shorter direction of the building, and some of this was fastened not to joists but to floor boards. As a result, the underpinning was deficient in stiffness in the direction parallel to the ground slope. The direction of shaking during the earthquake was nearly parallel to this direction of weakness in the structure, and the swaying of the structure caused the underpinning to fail in part and to allow the building to slump downhill onto the ground (Fig. 5). The building is considered a total loss.

There were several church buildings with masonry walls in the area near the epicenter. Most of these suffered some damage, and some were very seriously damaged. The masonry consists of fragments of lava rock laid with a mortar made by calcining coral limestone. In some there was very little mortar in the inside parts of the wall. Most of the buildings were more than 95 years old.

The Central Kona Church at Kealakekua suffered cracking of the interior plaster on the east and west walls, but the masonry showed little or no cracking. At the back of the church is a small lean-to addition, the roof of which is supported by beams with

one end set into niches in the wall of the main building. During the earthquake there was enough differential movement of the two portions of the building to pull the beams out of their supporting niches and allow the roof of the addition to drop a few inches. At the front of the church is a tower covered with exterior plaster. The tower and main church building are essentially separate structures and appear to have moved independently during the earthquake. The plaster of the tower was badly cracked.

St. Paul's Church at Honalo, 1.9 miles north of Kealakekua, suffered severe cracking of the masonry in both the main building and the rectory. Kahikolu Church, at Napoopoo, suffered surprisingly little damage. The lintels and interior plaster showed some cracking, but the masonry was unharmed.

The Protestant church at Hookena Beach was badly damaged. The building consisted of masonry walls and a sheet-iron roof, supported on heavy handhewn beams which in turn were supported by east-west beams resting in niches on the upper edge of the front and back walls. During the earthquake nearly the whole front (west) wall was thrown out, some debris being as much as 25 feet from the building (Fig. 6). The other walls were not appreciably damaged, even the interior plaster being almost uncracked. It appears possible that during the quake the roof may have tended to move as a separate unit from the rest of the structure and, by its tendency to lag behind during the initial violent eastward movement of the ground, may have pushed out the front wall.

FIG. 6. West end of Pukaana Church at Hookena Beach showing complete demolition of masonry wall of this 100-year-old structure. Much of the debris was cleared away soon after the earthquake. No nearly comparable damage to this building is known to have taken place during the century since it was built.

FIG. 7. Catholic Church 0.6 mile north of Hookena Beach, from the northwest. The east end of this church was similarly thrown down and outward, to the east. The near corner and the corresponding corner of the small building, already without a roof, suggest displacement most markedly to the northwest, in the general direction of the epicenter.

Similarly, a small stone building nearby, which had long been without a roof as is shown by trees growing within the walls, had both its end walls thrown outward, to west and east, while the side walls remain standing though somewhat cracked.

The Catholic church 0.6 mile north of Hookena Beach was very heavily damaged. The upper portions of both the east and west walls were thrown down (Fig. 7), and the interior plaster on all walls was badly cracked. However, the walls were built merely of loose stones laid together without mortar between them except close to the faces, where the interior and exterior plaster had penetrated a short distance. Considering the type of

construction, probably the most surprising feature is that the building had not collapsed previously in one of the strong earthquakes which occur in Kona every few years.

The lessons to be learned from the structural damage caused by the earthquake are those which have been taught by many strong earthquakes elsewhere. A large proportion of the damage results from poor construction or from poor or inappropriate materials. Unreinforced masonry structures are inadvisable in any area subject to strong earthquakes. Footings should be firm, and construction materials, particularly the underpinning, should be sound. Cross bracing, particularly of underpinning, should be adequate in all directions. The best insurance against earthquake damage is good construction.

Damage to Water Tanks

Practically all dwellings in the Kona area are equipped with water tanks for storage of rain caught on the roof. Nearly all these tanks were of wooden stave construction. A large number of these round, tub-type tanks were destroyed or damaged by the earthquake.

The few metal and masonry tanks were undamaged. Because of their importance, not only in Kona but in many Hawaiian communities, a special study of damage to these tanks has been undertaken. The results will be published elsewhere. Only a brief summary is given here.

Altogether, approximately 200 tanks of a total of more than 1,000 in the heavily shaken area were damaged or destroyed by the earthquake. Tank damage extended from Keauhou on the north to Milolii on the south and was most severe in the area from Captain Cook to Hookena. Tanks showed all degrees of failure, from the development of slight leaks to complete collapse. A few tanks may, at least in part, have been pushed over by neighboring structures. Thus, the tank at the southern end of the Honaunau School building (Fig. 8) may have been partly pushed westward by the collapse of the adjacent

FIG. 8. Demolished tank west of the south end of Honaunau School, footings on which the tank formerly stood, and part of the school building, from the southwest.

building, to which it was connected by a rigid wooden down-spout. However, most of the damaged tanks appear to have failed because of their own behavior during the earthquake. The commonest features contributing to tank failure appear to have been poor footings and inadequate cross bracing of the underpinning.

Damage to Stone Walls

The loose stone walls characteristic of the Kona area were extensively damaged by the earthquake. The principal damage was in the area between Keauhou, 3.5 miles north of Kealakekua, and Pahoehoe, 3 miles south of Hookena (Fig. 1). However, isolated instances of wall derangement were observed as far north as Honokahau, 16 miles north of the epicentral area, and Naalehu, 36 miles southeast. The distribution of damage to walls is shown graphically in Figure 3. Many miles of wall required rebuilding. Since the cost of contract rebuilding is approximately a dollar a yard, the total monetary loss from the destruction of walls is considerable.

Most of the stone walls in the area consist of irregular fragments of clinkery aa lava less than a foot across. A few walls have bases of blocks a foot or more long reaching half-

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way or more through the wall, and, especially in the older walls, occasional slabs are laid partly or entirely through the wall to help tie it together. Because of the rough, irregular surfaces of the fragments it is possible to build them into a nearly vertical wall 3 or 4 feet high and only about 30 inches thick at the base. Such walls stand well under ordinary conditions, but, because of the shortness of the bonding surfaces of adjacent blocks, they are rather unstable under any joggling, such as by earthquakes. The earthquake of August 21 caused extensive shaking down of the walls. The commonest type of damage was a slumping of the upper part of the downslope face of the wall, the fragments rolling down and out a short distance from the base of the wall. Such damage was especially common on the north-south trending walls and at high places on the walls. In a few instances, walls on nearly level ground were dislodged almost equally in both directions, but the failure was preponderantly on the west side of the walls, and the material from the walls was displaced westward.

Some of the westward displacement of material probably resulted from the tendency of the loose material composing the wall to lag behind during the initial strong eastward movement of the ground. However, a large proportion, perhaps most, of the failures of the walls on their west side undoubtedly resulted from the fact that, because of the general westward slope of the ground, the west side of the wall was higher and usually steeper than the east side, and there was a tendency for materials to shift downslope under the influence of gravity.

Well-built walls were surprisingly resistant to earthquake damage. Thus, the wall along the landward side of the highway from Honaunau to Napoopoo, built of carefully placed rectangular blocks of lava, was almost wholly undamaged despite its location very close to the epicenter. Likewise, in other parts of the epicentral area, older walls in which slabs extending through a large portion of the wall had been used to tie the wall together showed comparatively little damage.

At the ancient City of Refuge at Honaunau, about 20 feet of the seaward side of the main outer wall of the enclosure collapsed. It is interesting to note that damage was restricted to a reconstructed portion of the wall, whereas the remaining portions of the original enclosure wall and the walls of the heiau platforms were undamaged. Homer Hayes, a close student of the City of Refuge, has made the highly plausible suggestion that the peculiar construction of the ancient walls, in which occasional broad slabs extend entirely or largely through the wall and sometimes bridge open spaces beneath, is responsible for the greater resistance to earthquakes of the old portions of the wall.

Damage to Roads

Damage to paved roads was of three general sorts: (1) cracking of pavement, (2) cracking and slumping of shoulders and separation of shoulders from pavement, and (3) collapse of road cuts, causing partial obstruction of the road. The latter has already been discussed under the heading "Rock Slides." Minor cracking of shoulders occurred over an area extending about 10 miles north and 12 miles south of the approximate epicenter, and a few cracks were formed as far away as the northeast side of Kilauea Caldera, 47 miles from the epicenter. However, extensive pavement cracking and slumping were restricted to the area between Captain Cook and Hookena. The distribution of cracks in the road is shown in Figure 3.

Observed cracking or slumping of the pavement or shoulders was entirely restricted to portions of the road on fills. In building the road, some gullies were crossed by laying in a rock fill having a batter, or departure from vertical, of less than 1 in 4, filling with fine material, and laying asphalt pavement across the top. Such fills were insufficiently stable to withstand the shaking of a strong earthquake, and in several places the down-

FIG. 9. Crack along roadside south of Kealakekua, from the south, showing separation of embankment from edge of pavement due to slumping.

slope face of the fill was dislodged, allowing the material of the road bed to settle, cracking the pavement. In other places the fill appears to have settled a little merely by compaction during the jostling by the earthquake, causing cracks in the pavement.

A common occurrence was the formation of a crack parallel to the edge of the pavement on its downslope side, either within the pavement a few inches from its edge or between it and the shoulder (Fig. 9). Some of these were as much as 75 feet long and 8 inches wide. This appears to have resulted from a downslope lurching of the shoulder, moving as a separate unit from the portion of the fill beneath the pavement. The independence of movement of the shoulder and pavement was interestingly shown along the highway about 2 miles southeast of Captain Cook, where soil and sod on the shoulder were overthrust as much as an inch onto the pavement.

Damage in Cemeteries

Many headstones in cemeteries in the area near the epicenter were deranged by the earthquake. As a part of the general earthquake investigation, these cemeteries were examined, and a rough statistical study of the damage was made. Unfortunately, owing to shortage of personnel and pressure of other duties, we were delayed several days in making the cemetery examinations, and some restoration of headstones had already taken place in some cemeteries before we visited them. However, in most cemeteries little restoration had been done, and the damage remaining was probably a representative sample of the original damage. It is believed that practically all stones which had been dislodged could be detected, even after they had been replaced, by breaks or scratches on the stone or disturbance of the cement bond at the base of the stone.

There are more than 50 cemeteries in the area, but most are small family or church plots with few graves and have not been used in recent times. In some places burial was in vaults without headstones or with headstones or markers firmly cemented in place and not readily susceptible to damage by an earthquake of the intensity of the one under study. Most of the valuable information came from a few of the larger cemeteries. Damage at these is summarized in the accompanying table, and their locations are shown in Figure 1.

Derangement of headstones included overturning of stones and shifting of stones on their bases with or without rotation. In addition many grave caps were broken, some by falling or disturbance of headstones and some by lurching or slumping of the adjacent subsoil. The latter type of damage was particularly prevalent on steep slopes, where the subsoil is thick and loose. Damage of all sorts was restricted to the area between Honalo and Honokua, 5 miles northeast and 10.5 miles south-southeast, respectively, of the probable position of the epicenter.

In cemeteries north of Keauhou no damage or derangement was noted. Two miles south of Keauhou, at Lanakila cemetery in Lehuula, 4 of the 15 headstones were dislodged to the west. Inland and slightly northward, at the Daifukuji Mission in Honalo, about 5 miles

FIG. 10. Gravestone rotated counterclockwise, in Daifukuji cemetery, Kainaliu, looking approximately northwest.

north of Napoopoo, of an estimated total of 150 grave markers, 6 toppled west, 7 north, 2 east, and none south. Six had been shifted north, 16 were twisted counterclockwise, and 2 clockwise; 8 grave caps were broken (Fig. 10). It was reported that many more had been disturbed but had been restored.

At Hongwanji Mission, Kealakekua, with more than 600 graves, 12 headstones were overthrown to the west, 9 to the east, and none to the north or south. Thirty-four were twisted clockwise, 11 counterclockwise, one each shifted north, west, and south; 22 grave caps were broken.

At the Central Kona Church cemetery at Kealakekua, 12 headstones and one large memorial monument were overturned westward and one stone eastward. Another stone was rotated counterclockwise. In the Episcopal cemetery, just across the highway, five headstones were overturned westward, one was rotated counterclockwise, and one clockwise.

At Kahikolu Church, about 0.5 mile south of the Kealakekua fault line, of a total of 10 headstones, 2 were overturned to the west and one was twisted clockwise. Two miles farther inland but only about 0.6 mile south of the fault line is another cemetery of the Hongwanji Mission. Here, of more than 200 headstones, 29 were still down on September 7, the majority having been dislodged to the west, and 10 or more had been replaced. Thirteen had been twisted clockwise and 4 counterclockwise; 24 grave caps were broken. There was much damage to caps and markers in the lower section of the cemetery where the ground is composed of rocky talus.

At St. Benedict Church, 1.5 miles farther south, there is a cemetery with approximately 100 markers. Nearly half of these are wooden crosses, which were not deranged. Several others are light concrete crosses with wire reinforcing. Some of these were broken at the shank so as to expose the wires one or two of which were the sole remaining support. Of about 20 vertical headstones, 11 were displaced or broken.

The most complete derangement of gravestones was found in the Kalahiki Japanese cemetery, a small hillside cemetery 3.8 miles south of Kealia, where only 2 of 30 markers were found in position 5 days after the earthquake (Fig. 11). The dislodgement was chiefly to the southwest and, to a lesser extent, to the northeast. Ten were shifted to the north without being thrown down. Seven, including some of these 10, were rotated clockwise and one counterclockwise. Here, on loose, steeply sloping ground, a large proportion of the grave caps were broken, owing to poor design and to construction on the newly heaped grave mound. This cemetery is about 11 miles south of the probable epicenter. South of this point no cemeteries with headstones susceptible to overturning or rotation were found.

The prevailing east-west azimuth of fall of gravestones throughout the area is probably largely the result of the prevailing westward slope. The orientation of most cemeteries is governed by the general north-south alignment of the principal roads, and, in turn, most gravestones face the west or east and have

TABLE 1
SUMMARY OF DAMAGE IN CEMETERIES IN AREA EXAMINED

NAME	LOCATION	DISTANCE AND DIRECTION FROM NAPOOPOO	APPROXIMATE NUMBER OF HEADSTONES	HEADSTONES OVERTURNED						HEADSTONES ROTATED	
				NUMBER	PER CENT	APPROXIMATE DIRECTION				CLOCKWISE	COUNTER-CLOCKWISE
						N	E	S	W		
		miles									
Holualoa Japanese	Holualoa	10 N	300	0	0	0	0	0	0	0	0
Daifukuji	Honalo	5 N	150	15	10	7	2	0	6	2	16
Lanakila Church	Kainaliu	4.5 N	12	4	33	0	0	0	4	0	0
Hongwanji Mission	Kealakekua	3 N	600	21	3.5	0	9	0	12	33	10
Central Kona Church	Kealakekua	2.5 N	30	12	40	1	0	0	11	0	1
Christ Church	Kealakekua	2.5 N	60	8	13	0	3	0	5	1	1
Kahikolu Church	Napoopoo	0.5 S	10	2	20	0	1	0	1	1	0
Hongwanji Mission	Keei	1.5 SE	200	40	20	3	22	1	14	13	4
St. Benedict Church	Honaunau	3.5 SE	100	11	11	0	0	0	11	0	0
Japanese	Kalahiki	7.5 S	31	20	64	1	6	1	12	14	1

FIG. 11. Broken bases, displaced base stones, and overturned headstones in Kalahiki Japanese cemetery, south of Kealia, looking southeast. Partly because of unstable hillside ground and partly because of proximity to the epicenter, damage in this cemetery was widespread and severe; scarcely a grave escaped marked derangement.

HEADSTONES ROTATED	
CLOCKWISE	COUNTER-CLOCKWISE
0	0
2	16
0	0
33	10
0	1
1	1
1	0
13	4
0	0
14	1

nese cemetery,
se of proximity
d derangement.

the long dimension of their base oriented north-south. Therefore, the stones rock in an east-west direction much more easily than in any other, and, consequently, the most likely azimuth of fall is east-west. Furthermore, under sustained shaking, there is a tendency for all loose objects, including the soil cover, to work downslope to the west under the influence of gravity.

Rotation of Columns

Imamura (1937: 96) has shown that the direction of rotation of short rectangular columns, such as many headstones are, can be useful in determining the direction of motion during an earthquake and, consequently, the approximate azimuth of the line toward the epicenter. If the earthquake motion is parallel to the sides or to the diagonal (A—B, inset, Fig. 12) of the column, rotation probably will not occur. However, if the earthquake motion is in some intermediate direction, such as E—E′ in Figure 12, a rocking of the column will be accompanied by a rotational tendency. A ground motion in the direction E′ will cause the column to rock on the corner B. At the same time, the resultant of the force E′ in the direction CD will tend to rotate the column about the corner B in a counterclockwise direction. Similarly, a motion in the direction E will tend to cause a counterclockwise rotation about corner A. Directions of earthquake motion lying in the unshaded octants of the diagram tend to cause counterclockwise rotation of the column, and directions of motion in the shaded octants tend to cause clockwise rotation.

However, this law of rotation can be, and commonly is, upset by other conditions. Inhomogeneity of the terrane may cause the principal motion to be, locally, in a direction other than the azimuth pointing directly to the epicenter. Also, excentric irregularities in the bottom of the monument or its underlying base, or in the adhesion between the monument and its base, may result in rotation around those irregularities independent of the rotation described above.

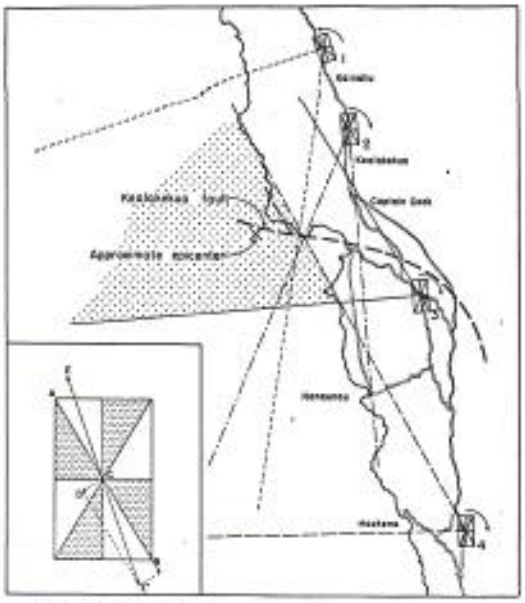

FIG. 12. Map of the central Kona area, showing the prevalent direction of rotation of monuments in cemeteries. The cemeteries are: 1, Daifukuji, Honalo; 2, Hongwanji Mission, Kealakekua; 3, Hongwanji Mission, Keei; 4, Kalahiki Japanese. At each cemetery the arrow indicates the prevalent direction of rotation. The boundaries of the octants containing the direction toward the epicenter are prolonged. The stippled area west of Captain Cook is that in which three or more of the octants overlap. The inset in the lower left is a diagram (after Imamura, 1937) of a horizontal cross section of a rectangular column, indicating the manner in which horizontal earthquake motion E—E′ causes rotation of the column.

During this study it soon became evident that, to be of value, the direction of rotation must be considered on a statistical basis. Thus, two columns only 10 feet apart in the Christ Church cemetery at Kealakekua were rotated approximately equal amounts in opposite directions. However, by using the prevailing direction of rotation of a number of columns in a single area, more useful results were obtained. The average direction of rotation of monuments in each of six cemetery areas from 5 miles north to 10 miles south of Napoopoo were all consistent with an origin of the earthquake on or near the Kealakekua fault from 2.5 to 5 miles west of Napoopoo.

Cemeteries close to the epicenter showed less consistency in the direction of rotation than did those farther away.

In Figure 12 the prevalent directions of rotation of monuments in four cemeteries are shown. Four other cemeteries were omitted because no monuments were rotated in them, or because the number of rotated monuments was too small to yield a reliable statistical result. At each of the four cemeteries plotted, the boundaries of the octants containing the direction toward the epicenter are prolonged. In an area largely west of the shoreline, from 2 miles south to 2 miles north of the approximate trace of the Kealakekua fault, three or more of the four significant octants overlap, and it is within this area of overlap that the epicenter should be situated.

LOCATION OF THE EPICENTER

Because of the dismantling of all but one of the seismographs on the island of Hawaii during the preliminary phase of the earthquake, it is not possible to locate the origin or epicenter instrumentally. The only instrumental datum available is the S—P interval of 9.5 seconds given by the Bosch-Omori seismograph at the northeast rim of Kilauea Caldera (Fig. 13). Using the travel times given by Byerly (1942: 210), this gives a distance of origin of the earthquake of approximately 47 miles from the Bosch-Omori instrument. These curves were derived for sedimentary and granitic rocks but, over a period of several years of use at the Volcano Observatory, have yielded more satisfactory and reasonable earthquake locations than any others. The use of Jones's (1935: 50) curve for duration of the preliminary waves (T*) increases the distance to only 49 miles. Taking into consideration the area of greatest intensity of the earthquake, these distances place the origin of the quake 3 to 5 miles west of the coastline in the vicinity of Napoopoo. The depth of origin appears probably to have been between 5 and 10 miles.

Some information bearing on the location of the epicenter can be derived from the study of damage by the earthquake. The general distribution of damage to roads, stone walls, and road cuts along the main highway is shown in Figure 3. This is based on a count checked against odometer mileage, assigning one unit of damage for each 1 to 15 feet of collapsed wall or road cut. Despite irregularities, the graph shows a distinctly symmetrical, bell-shaped distribution curve, with its peak about 2.5 miles by road southeast of Captain Cook. An average of more than 60 items of damage per mile in the central 5 miles decreases to only one or two per mile more than 9 miles from the center. This point of maximum damage coincides closely with the position of the buried inland extension of the Kealakekua fault. Other types of damage also were most abundant in the same general area. Together with the fact that most of the aftershocks, located by instrumental means, originated on the Kealakekua fault, it leaves little question that the origin of the major earthquake lay on or close to this fault, and that the earthquake almost certainly resulted from movement on it.

The greatest structural damage was farther south, at Hookena, where the destruction of the east and west walls of the two stone churches suggests an epicenter somewhat farther south. The possibility of a twin earthquake with one epicenter lying offshore nearly west of Hookena has been considered, but no other evidence suggests it, and no signs of a second earthquake could be detected from the seismograms either from the island of Hawaii stations or from that of the Coast and Geodetic Survey at Barbers Point on Oahu.

Throughout the Kona area, the prevalent direction of fall of rock slides, stone walls, and tombstones was westward, and the next commonest direction was eastward. The seismograms indicate that the first movement of the ground was eastward, and it is probable that some of the westward fall of objects was

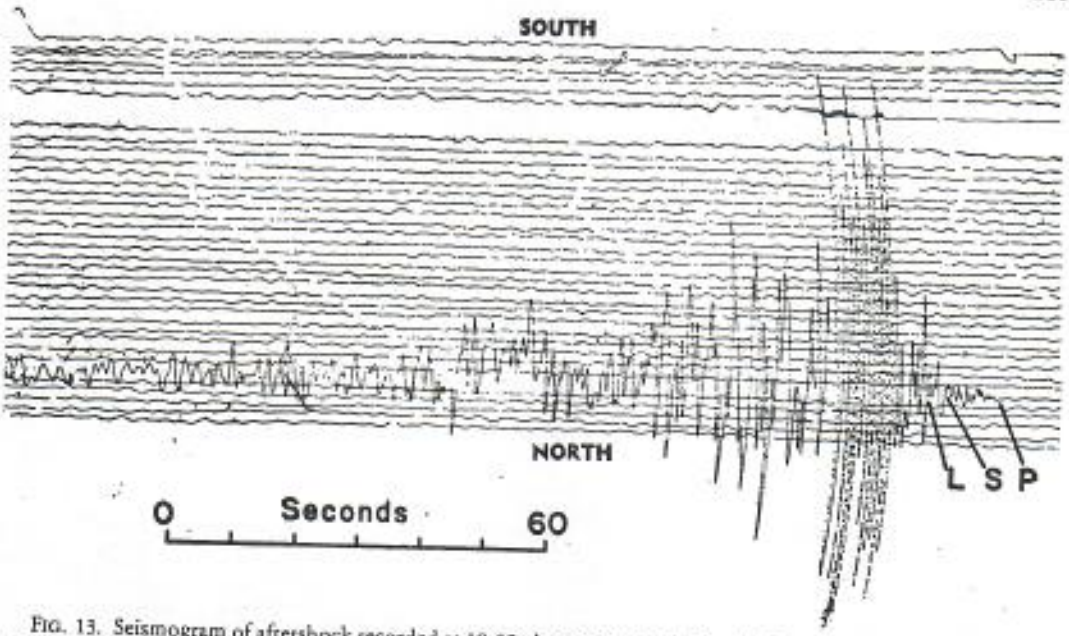

FIG. 13. Seismogram of aftershock recorded at 18:32, August 21, on the Bosch-Omori seismograph at Kilauea. Letters indicate the points of arrival of primary (P), secondary (S), and long (L) waves. The amplitude of 80 mm. on the seismogram corresponds to approximately 0.7 mm. of ground motion at Kilauea, 47 miles from the epicenter.

the result of lagging behind as the ground moved eastward under them. To some extent also, the general east-west azimuth of fall undoubtedly reflects the direction of the epicenter. However, the prevailing east-west slope appears to have been still more important in determining the direction of fall of objects. Its effects on various types of damage have already been indicated.

It has already been pointed out that the prevalent direction of rotation of columns in cemeteries indicates a location of the epicenter within the shaded offshore area in Figure 12. This area contains the seaward extension of the Kealakekua fault.

As a result of the consideration of all lines of evidence, the probable epicenter of the earthquake is placed approximately 3 miles west of Napoopoo, at latitude 19°29′ N, longitude 155°58′ W.

INTENSITY OF THE EARTHQUAKE

There are in common use two different methods of determining and expressing the strength of an earthquake. The older method is based on the observed effects of the earthquake on structures and various other objects. Based on these effects, a numerical value is assigned which is termed the intensity of the earthquake at any one point. Obviously, since the effects are less at greater distances from the origin of the quake, the intensity decreases away from the epicenter. Various scales of intensity have been proposed. That used in the present study is the modified Mercalli intensity scale of 1931 (Wood and Neumann, 1931), in which values range from 1, at which the earthquake is not felt except by a very few persons under especially favorable conditions, to 12, at which damage is total. The second method assigns a value called magnitude to the earthquake, based on the effect on standard seismographs at known distances from the origin of the quake (Richter, 1935). The magnitude is a measure of the amount of energy in the earthquake at its point of origin and, consequently, should be essentially the same at all measuring stations.

The notice of preliminary determination of

epicenter issued by the Coast and Geodetic Survey lists the magnitude of the earthquake of August 21 as 6.75 as determined at Pasadena and 7.0 as determined at Berkeley, in California.

Field studies of the effects of the earthquake indicate an intensity of 7 on the modified Mercalli scale in the area near the epicenter, decreasing to 6 at Waiohinu and Naalehu, 5 in the vicinity of Kilauea Caldera and in Hilo, and 4 at Honokaa and in the Kohala district at the north end of the island. At Honolulu, 180 miles (288 km.) from the epicenter, the intensity was 2. Populated areas of the island of Hawaii are largely restricted to the periphery of the island. The interior portions of the island are almost wholly unpopulated, making it impossible to draw accurate isoseismal lines. Approximate isoseismals are shown in Figure 1.

Given a single impulse, the minimum horizontal acceleration that can cause the sliding of a short stone column on a stone base is 71 per cent of the value of gravity, decreasing to 57 per cent at an angle of emergence of 35° to the horizontal (Imamura, 1937: 105). Because the sliding of headstones and, especially, base plates was common in cemeteries during the August 21 earthquake, it might be concluded that the acceleration during the earthquake was at least six tenths that of gravity. However, Imamura (1937: 106) also has shown that small, short-period vibrations in the epicentral areas of strong earthquakes, although they do not themselves cause the displacement of objects, may so lower the normal values of the coefficients of friction that sliding can be caused by longer period vibrations with accelerations much less than six tenths that of gravity. The presence of such vibrations in the Kona area is suggested by local vagaries of displacement and by other behavior. The acceleration which caused the lateral displacement of objects during the Kona earthquake is not known but probably was much less than six tenths that of gravity.

CONCLUSION

The earthquake of August 21, 1951, like most of its aftershocks, probably was caused by movement on the Kealakekua fault. This is one of a number of similar faults along which the lower slopes of Mauna Loa and Kilauea Volcanoes have moved relatively downward and outward toward the deep ocean. In this sense the earthquake was tectonic in origin.

In one sense, of course, all earthquakes in Hawaii are volcanic in origin. However, the August 21 earthquake cannot be directly related to any specific volcanic episode. It is possible that it is related in some way to the great extravasation of lava during the 1950 eruption of Mauna Loa, but there is no evidence to demonstrate such a relationship. On September 16 a series of smaller earthquakes originated on the Kaoiki fault system, a series of fractures corresponding to the Kealakekua fault, on the southeast slope of Mauna Loa. From mid-May until early July abnormally rapid eastward tilting at Kilauea Caldera indicated a tumescence of Mauna Loa Volcano. There is a possibility that both the August 21 earthquake and its aftershocks and the September 16 earthquakes were caused by a slight upward movement of the central portion of Mauna Loa in relation to the lower slopes. The August 21 earthquake has no known connection with any coming volcanic activity, though such a relationship may yet appear.

The southern part of the island of Hawaii is subject to frequent earthquakes, but few are as intense as that of August 21, 1951. The great earthquake of April 2, 1868, judging from the descriptions of damage, was much more severe. Wood (1914) assigned to it an intensity of 10. Its epicenter was farther south, near Waiohinu in Kau, where extensive surface faulting took place. The earthquakes of March 28 and April 3, 1868, also were probably at least as severe as that of August, 1951. The earthquake of October 6, 1929, centered beneath Hualalai Volcano, had a magnitude

of 6.5 (Gutenberg and Richter, 1949: 207), and caused damage as far south as Captain Cook. The Maui earthquake on January 23, 1938, had a magnitude of 6.75, about the same as that assigned by the California Institute of Technology Seismological Laboratory in Pasadena for the earthquake of August 21, 1951. During the years from 1929 to 1945, Gutenberg and Richter (1949, table 17) list eight earthquakes of magnitude 5 and over which originated in the general Hawaiian area. During the same interval they list 58 earthquakes in California with magnitude of 5 or more and 127 in Japan and Kamchatka. Thus, during those years, California had about seven times as many large earthquakes as the Hawaiian area, and the Japan-Kamchatka area had about 16 times as many. However, there are some areas, such as the northeastern United States, which have far fewer earthquakes than the Hawaiian area.

Based solely on the 1929–1945 interval, the Hawaiian area can expect an average of about one earthquake of magnitude 5 or more every 2 years. However, during the past century, there have been only six earthquakes of intensity comparable to that of August 21, and no other appears to have been quite as severe in central Kona. There is, of course, no assurance that another equally or even more severe earthquake might not occur in that area in much less time than a century. It might occur within the next few months, but, judging from the past, that is quite unlikely.

Well-built structures, with footings of better quality than many of those now found in Kona, will minimize or even eliminate the damage resulting from the lesser earthquakes which the Kona area experiences frequently in common with all the island of Hawaii except the northernmost part. However, it may not be economically feasible to build in such a way as to eliminate damage from the infrequent large earthquakes.

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MARINE ENVIRONMENTAL MONITORING PROGRAM,

MAUNA LANI RESORT

SEA TURTLE POPULATION SURVEY

REPORT I

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August 7, 1992

EXECUTIVE SUMMARY

As part of the comprehensive Mauna Lani marine monitoring program, surveys were conducted to assess populations of resident sea turtle (*Chelonia mydas*). Surveys were conducted over three days (Oct. 15, Nov. 4 and Dec. 30, 1991) from the southernmost boundary of the Mauna Lani property to the southern edge of Puako Beach Lots. In total, forty-eight turtles were observed; 25% were classed as juveniles, 60% were sub-adults, and 15% were large adults. These observations are consistent with previous studies which report that the majority of turtles in the area consists of juveniles and sub-adults. The predominant behaviors of observed turtles was swimming and resting on the bottom or under ledges. No tumors were observed on any individuals, and four turtles were noted to be tagged.

Surveys indicate that turtle abundance is greatest in the area between Makaiwa Bay and Nunuku Inlet (dive site known as "Turtles"), and off of Puako. Future surveys (conducted on a quarterly schedule) will include repetitive intensive investigations of these areas in order to develop a data base that will indicate any seasonal trends in usage. While the procedures required to excavate the channel for the Mauna Lani Cove may temporarily create conditions that are disruptive to turtles, the end result of channel construction will likely provide a region of increased usage for resting and shelter.

INTRODUCTION AND PURPOSE

Mauna Lani Resort, Inc. is currently planning a large project (Mauna Lani Cove), located between the Mauna Lani Bay Hotel and Bungalows and the Ritz-Carlton, Mauna Lani Hotel, in South Kohala, Hawaii. While the detailed design concept of the project is yet to be finalized, it is likely that the plan will include a water feature that will require excavation of dry lands behind the shoreline to depths of 6 to 18 feet below sea level. The excavated basin will be connected to the open ocean by an entrance channel that bisects a fringing reef platform.

The proposed project will involve the alteration of some physical and biological components of the marine environment, and may induce changes to some physical-chemical parameters. As a result, an integral part of the planning process is to identify, and mitigate to the highest degree possible, any potential for environmental degradation of the nearshore ocean. Of particular importance is the potential for impacts from construction of the water feature and entrance channel, as well as the effects from runoff of soil, fertilizers, and other chemicals from land that can cause alterations of water quality and marine life.

In the interest of addressing these issues, and assuring maximal maintenance of environmental quality, it has been deemed appropriate to conduct a long-term comprehensive marine and anchialine pool monitoring program for the Mauna Lani Cove project. Components of the comprehensive monitoring program include water chemistry, and biotic community structure of coral reefs, anchialine pools, sea turtles, and cetaceans. The present report constitutes the first increment in the sea turtle monitoring program.

Green sea turtles (*Chelonia mydas*) are known to frequent the reefs off of the Mauna Lani Resort, as well as along reefs at Puako to the north and the Kapalaoa area to the south (Brock 1989). Indeed, one green turtle resting site offshore of Mauna Lani known as "Turtles" is a popular dive tour destination.

Because of declining population sizes the green sea turtle was granted protection under the federally mandated Endangered Species Act in 1977-78. Green turtles as adults forage and rest in nearshore areas of the main Hawaiian Islands, while reproduction primarily occurs during the summer months in the Northwest Hawaiian Islands. It appears that adults migrate during the summer months to the isolated atolls to the northwest, and return to the high islands in the late summer or early fall.

In the main Hawaiian Islands, green turtles rest along ledges or in caves usually within the 40 to 80 foot depth range during daylight. Under cover of darkness, turtles travel inshore to shallow subtidal and intertidal habitats to forage on benthic algae (Balasz et al. 1987). The normal range of these daily movements between resting and foraging areas is about one kilometer (Balazs 1980, Balasz et al. 1987). Thus, from the present state of knowledge, an ideal green turtle habitat would have a variety of suitable offshore resting habitat (undercut ledges, caves) located within a kilometer or less of shallow nearshore habitat populated with forage algal species. Selectivity of algal species consumed by Hawaiian green turtles appears to vary with the locality of sampling, but stomach content data show *Acanthophora specifera* and *Amansia glomerata* to be quantitatively the most important (Balasz et al 1987).

Program Objectives

The turtle monitoring program for the Mauna Lani Cove project has the following objectives:

- collect data regarding the number of turtles present during daylight hours in nearshore waters (i.e. resting habitat) between Honokaope Bay and Puako;
- determine characteristics of the turtles that are sighted (species, size, sex, distinguishing marks, and behavior);
- correlate sightings with environmental factors (i.e. foraging habitat) that might explain their presence and behavior; and
- reach preliminary conclusions about the extent to which the turtles sighted might be affected by the proposed Mauna Lani Cove project.

Methodology

The surveys are presently being conducted by community members in conjunction with Monitoring Program Scientists. Several methods were employed in assessing green turtle populations at Mauna Lani. To determine the location of various green turtle resting sites, discussions were held with local residents who were able to specify areas of major concentrations. Initially underwater surveys were also conducted of the entire area in order gain an overall picture of the habitat. Initial survey methods included observations from shore, snorkeling in shallow nearshore areas, SCUBA surveys of deeper offshore areas, and offshore sightings from boats.

For purposes of identifying the geographical distribution of abundance, the shoreline was partitioned into five areas (see Figure 1). Area 1 consisted of the region between Honokaope Bay and WaaWaa Point; Area 2 extends from WaaWaa Point to the northern edge of Nunuku Inlet; Area 3 extends from Nunuku Inlet to the north edge of Pauoa Bay; Area 4 extends from Pauoa Bay to Kapuniau Point; and Area 5 extends from Kupuniau Point to the southern edge of Puako Beach Lots.

For subsequent monitoring surveys, intensive, rather than extensive turtle censusing will be carried out using SCUBA at the two sites deemed to be the most popular resting habitats. These sites correspond to Areas 2 and 5 described above. These areas were also the locales of previous turtle surveys (Brock 1989), therefore allowing for a historical comparison in population parameters. Future repetitive intensive surveys at the same sites will also provide a long-term record of population dynamics. Dominant species of forage algae in observed areas of grazing will also be recorded.

With all methods of investigation, upon sighting a turtle the diver attempts to observe the following:

- its species;
- its approximate carapace length (an indicator of size and age);
- the turtle's sex;
- the presence of any distinguishing marks (such as tumors or coloration) that would facilitate reidentification of the animal on subsequent surveys; and

- the activity that the turtle is engaged in at the time of the sighting.

RESULTS

Observations were conducted on October 15, November 4, and December 30, 1991. Results of the surveys are summarized in Table 1. In total, forty-eight individuals were sighted during all surveys. The regions of most turtle observations were Area 4 (22 total sightings) and Area 5 (17 total sightings). Such rankings may be somewhat misleading, however, owing to the greater degree of effort expended in these areas relative to those further to the south. In most observations, it was not possible to determine sex of individuals owing to their small size.

Estimates of carapace (shell) length were divided into three classes; small (less than 15"), medium (15"-30") and large (greater than 30"). Of the 48 individuals sighted, 13 were classed as small, 28 were classed as medium, and 7 were classed as large. Thus, only about 15% of the turtles sighted can be considered to be large adults, while about 85% can be considered juveniles or sub-adults.

The predominant behavior of observed turtles was swimming (14 individuals) and resting on the surface of the reef, under ledges, or in caves (28 individuals). Four observations in Area 5 reported turtles feeding on benthic algae. No tumors were observed on any individuals. Tags were noted on 6 turtles.

Structure of the physical and biotic components of the nearshore marine environment is described in detail in other sections of the monitoring program. In brief, the majority of the Mauna Lani coastal area is characterized by a basaltic shoreline with pocket beaches of white sand. Extension of the basalts below the intertidal region forms a nearshore bench that drops sharply to a water depth of about 25-30 feet. Seaward of the bench drop, the bottom slopes gently seaward, forming the zone of extensive coral growth which extends to depths of 60-80 feet. Turtle resting habitat includes the vertical face of the basaltic bench which is often undercut with caves. Turtles are also observed resting on the surface of the deep beds of finger coral *Porites compressa*.

An exception to the general pattern of nearshore marine environmental structure occurs in the area between Makaiwa Bay and Nunuku Inlet (Area 3) which encompasses the dive site known as "Turtles". In this area the basalt bench terminates in a series of

elongate mounds and ridges that extend upwards as much as 15 feet from a sandy bottom. Tops and sides of the mounds are covered with living coral. The mounds provide a primary resting area for turtles, especially in areas with undercuts that afford shelter.

DISCUSSION

The results of the present survey reconfirm the findings of previous surveys (Brock 1989) that indicate that there is a resident population of green turtles offshore of the Mauna Lani Resort and Puako. A one day census conducted in October 1989 encountered 22 individuals, compared to the 48 individuals counted during three survey dates in the October-December quarter on 1991.

The estimation of turtle size in the field is obviously somewhat subjective. However, an idea of the size distribution is important for characterizing the observed populations in the area of interest. Balazs (1980) defined green turtle growth with the following groupings: juvenile - up to 28 inches in shell length; subadult - 28 to 35 inches in length; and adult (reproductively active) as greater than 35 inches in length.

A consistent observation concerning the resident population off Mauna Lani is the relative distribution among size classes. In the present survey 13 individuals (27%) were classified as "small (less than 15"), 28 individuals (58%) were "medium" (15-30") in size, while only 7 out of 49 turtles (15%) were "large" (greater than 30"). Similarly, in a previous survey of turtles in the same areas off Mauna Lani, Brock (1989) reported 77% of the individuals to be below 25" in shell length, with a mean shell length of about 25 inches. In comparison, green turtles censused off of West Beach in leeward Oahu had an estimated mean length of 34 inches (Brock 1988b). An ongoing survey of turtles off of the site for the proposed Ewa Marina reports most individuals observed in a region of dense aggregations are large individuals with shell lengths greater than 30"; small turtles are exceedingly rare in this region (Marine Research Consultants 1992). Off of Hawaii Kai, Oahu mean shell size was estimated at 25 inches, nearly identical to the Mauna Lani estimates.

One reason for the possible skewing of size distribution of turtles toward smaller individuals may relate to the ongoing turtle release program carried out by Mauna Lani Resort in conjunction with Sea Life Park. Juvenile turtles are released in the nearshore ocean annually after being reared within the Mauna Lani salt-water pond complex. It is

possible that these turtles remain in the vicinity and are observed during subsequent surveys. As six of the turtles observed in the present survey were tagged, it is possible that some of the individuals were hatchlings from Sea Life Park. Anecdotal observations by R. Brock and S. Dollar also suggest that dominant size class of turtles along the coast of West Hawaii is that of juveniles or subabults. As noted above, other areas of Hawaii, notably the leeward coast of Oahu are characterized by populations dominated by larger adults.

Perhaps coincident with the observations of size distribution skewed toward younger individuals are the incidences of visible tumors. During the present survey no tumors were observed on any individuals. It appears that such a pattern is consistent along the entire west coast of Hawaii which does not exhibit high incidences of tumors (Balazs personal communication).

As the present survey is the first in a program that will be ongoing through the pre- and post-construction, it is not yet possible to draw conclusions regarding the seasonality of turtle populations in the Mauna Lani area. Results of similar monitoring programs in other locations in Hawaii point toward a distinct pattern of seasonal abundance. A two-year survey off of Ewa, Oahu shows two distinct levels of abundance. The results of surveys from November to June of 1991 and 1992 were very similar, with green sea turtles present in relatively large aggregations ($\approx$ 10-20 individuals) in the region having the vertical relief sufficient for providing shelter space for protection during daylight resting behavior. Repetitive sightings of identifiable individuals also suggested that the same turtles had been inhabiting the area during the course of the survey program. Results of surveys from June to October were also similar to each other, but differed rather substantially from the surveys described above in that only 4-6 turtles were observed in the area of high relief. The reduction of underwater sightings in August 1991 was attributed in part to decreased visibility owing to turbid conditions associated with wave turbulence. During the September and October 1991 and June 1992 surveys, however, visibility was not substantially limited by resuspended material, and the number of sightings was consistently low.

The cyclical pattern of abundance may represent a seasonal pattern of higher usage of the Ewa area in the winter and spring months, and movement to other regions during the summer. Reduced abundance in the late summer off Ewa may represent seasonal migration to breeding grounds in the Northwest Hawaiian Islands. Alternatively, the data may reflect a pattern of "local" activity of changing resting habitat by the resident

population. Results of repetitive surveys of turtle abundance in the vicinity of West Beach suggest similar patterns of movement of "resident" populations that do not appear to be breeding migrations (Brock 1988b). The continued time-course monitoring on a regular basis off Mauna Lani will provide data to determine the patterns of occurrence on West Hawaii, and how these patterns coincide with other locales in the Hawaiian Islands.

With regard to the potential effects to turtle populations from the proposed Mauna Lani Cove, several preliminary observations can be made. Presently, areas of highest turtle abundance are not in the region that will be physically altered by channel construction. However, the planned configuration of the channel walls involves a stepped design of alternating vertical and horizontal surfaces. Such structure will increase the vertical relief of the substratum compared to the present situation. Thus, it is likely that the post-construction scenario will provide a more suitable resting habitat for turtles than the present flat basaltic bench.

Brock (1989) discusses in detail the potential effects to turtles from blasting activities involved with construction on the west coast of Oahu. A requirement of the blasting permit will undoubtedly entail sweeps of the area prior to setting of charges to ensure that turtles are not present in the immediate area. As no apparent negative impacts were observed in turtle populations as a result of the construction activities off Oahu, it is not expected that such negative impacts will occur at Mauna Lani.

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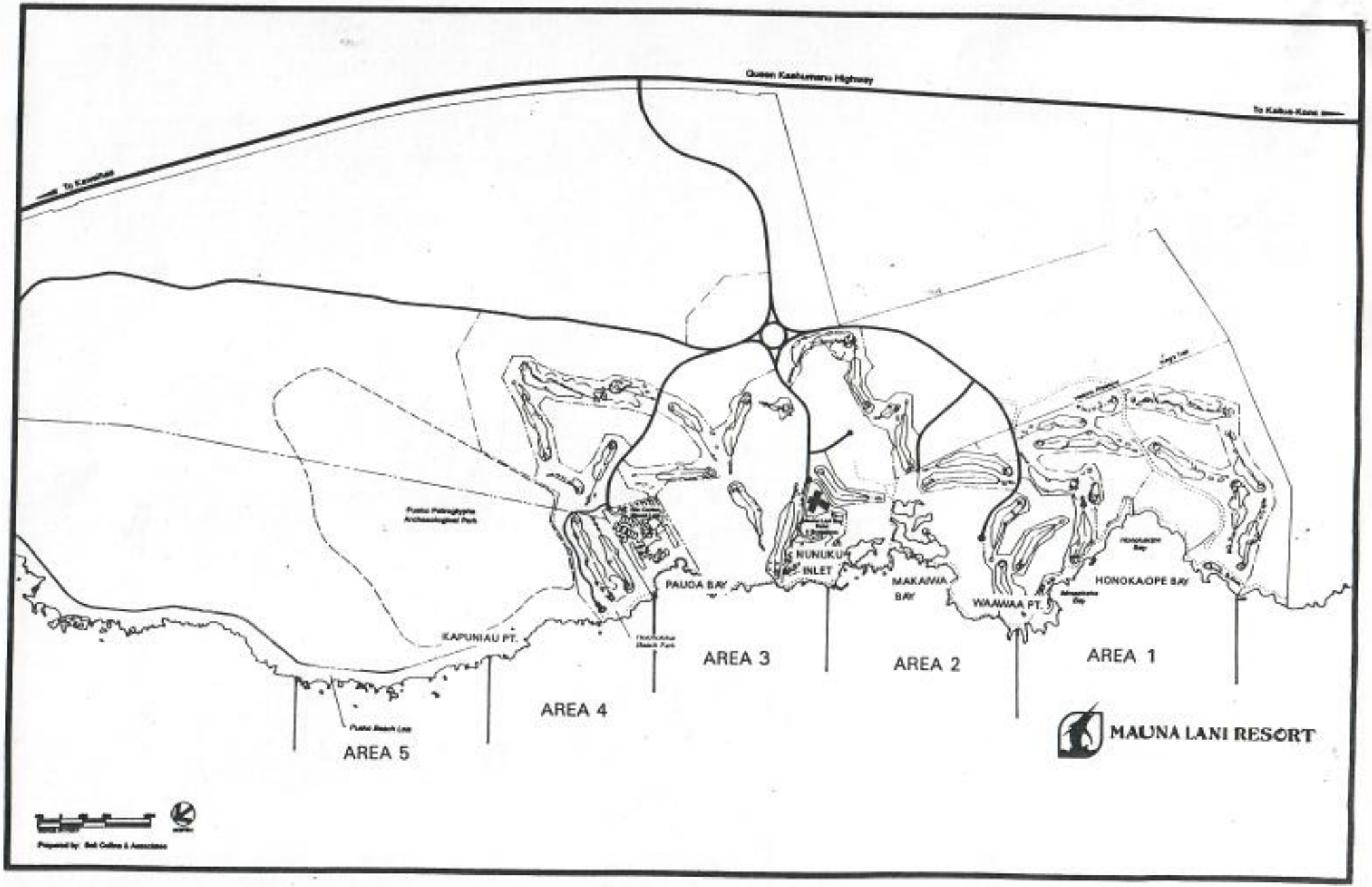


FIGURE 1. Map showing locations and boundaries of five areas off the Mauna Lani Resort that were surveyed for green turtle abundance.

Dion R. DeBois Jr.
P.O.Box 5650
Kailua-Kona, HI. 96745

April 24, 1992

Mr. George Balazs
Zoologist-National Marine Fisheries
2570 Dole St.
Honolulu, HI. 96822-2396

Dear Mr. Balazs:

I am writing to comment on some observations I made while swimming in the bay at Kahalu'u Beach Park here on the Big Island. I am concerned for the sea life living in Kahalu'u bay, specifically Sea Turtles.

Since I moved to the Island of Hawaii a few years ago, I have been enjoying the fact that we have a beautiful reef like the one at Kahalu'u Beach Park. Just minutes from our homes in Kailua and Keahou, you can snorkel and see many of God's wonderful sea creatures that live in Kahalu'u up close and personal. Just as I enjoy Kahalu'u, many others, both residents and tourists, also enjoy exploring the reef at Kahalu'u Beach Park, which brings me to my concerns.

My first concern is for the Sea Turtles who use Kahalu'u to feed. I have come to realize that when the tide is high, there are some young Sea Turtles that frequently visit Kahalu'u. This information I learned from one of the life guards at Kahalu'u who is also concerned for the Sea Turtles. I also understand that some Sea Turtles are on the endangered species list (namely Hawksbill Sea Turtles), and any Sea Turtle, Hawksbill or Green, is not to be chased, handled, or molested in any way. This information I learned from Steve Kaiser of Sea Life Park.

Not long ago, while I was at Kahalu'u, I noticed a young Sea Turtle being handled by some unsupervised children, and this made me wonder, why isn't the government doing more to inform people about the fact that Sea Turtles are protected animals? I would like to see some informational signs posted regarding Sea Turtles.

Another concern I have is for the other sea life living in Kahalu'u bay. People are not paying attention to what they stand on when they put their feet down. As a result, by observing the coral formations, you can see that the tops of some of them are worn down flat, with ulcerations reminiscent of wounds. One of these coral formations that has damage like this was created some years ago when tires were placed in

Kahalu'u specifically for creating these living coral formations. This particular coral formation was being stood on by a tourist who obviously did not know what he was doing. I wish that person realized that he was standing on a living organism. I feel more can be done to educate and inform the many residents and tourists who use Kahalu'u everyday. They need to know that this reef is a very fragile ecosystem and they need to take great care when exploring the reef, in order not to damage any of the sea life in Kahalu'u.

I feel it's important to the preservation of Kahalu'u that the National Marine Fisheries include information about the importance of sea life preservation at Kahalu'u Beach Park. There already is a large information board at Kahalu'u that was presented by the Friends of Kahalu'u some time ago, but it does not contain any information about the fact that Sea Turtles are endangered and should not be molested, nor does it contain any information about how delicate the environment in the bay is. Sometimes it seems like Hawaii has some disposable ecosystems for a disposable society, and as a result, Kahalu'u may be headed in the same direction as Hanama Bay on O'ahu. As we all know, Hanama Bay has sustained major ecological damage from the many years of human intervention. It would be ashame to let such a beautiful reef at Kahalu'u suffer this fate.

I have some simple suggestions that could get Kahalu'u on the road to being cared for, and by, the people who use the bay. Why can't we have some signs located right where people enter the water,(simular to the signs I saw at Punalu'u regarding Hawksbill Sea Turtles) and educate people. Also, more information could be added to the information board in the pavilion that everyone can read. Kahalu'u is a wonderful place, and it's time to get the attention of the people, so everyone can be apart of preserving Kahalu'u, and so Kahalu'u can be enjoyed now and in the future. I would like to hear your opinion on this subject. Thank you for your attention.

Sincerely,

Dion R. DeBois

Dion R. DeBois, Jr.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Area Office - Southwest Region
2570 Dole St. Honolulu, HI 96822-2396
PH: (808)955-8831 FAX: (808)949-7400

May 13, 1992 F/SW033:ETN

Dion R. DeBois, Jr.
P.O. Box 5650
Kailua-Kona, HI 96745

Dear Mr. DeBois:

I am writing in response to your letter to Mr. George Balazs at our Honolulu Laboratory concerning sea turtles at Kahalu'u Beach Park.

We have been working with The Ocean Recreation Council of Hawaii (TORCH) and the University of Hawaii-Sea Grant to develop and place signage at Kahalu'u Beach Park to inform visitors and residents about the green turtles found there and the need to leave them alone. Besides the legal prohibitions regarding harassment of a threatened species there is the potential to drive these turtles away if they are disturbed enough.

I have recently learned that the Friends of Kahalu'u Beach Park are also interested in possibly refurbishing or revising the information board at the Park. This may be a good opportunity to include corals in the signage.

Ms. Karen Klein of TORCH (324-0447) is coordinating the sea turtle sign project and would be receptive to any ideas you might have regarding this subject. Thank you for your interest in protecting listed sea turtles.

Sincerely,

Eugene T. Nitta

Eugene T. Nitta
Protected Species Program Manager

cc: Karen Klein - TORCH
G. Balazs - F/SWC2

Here in the Hyatt Regency Waikoloa saltwater lagoon, you may encounter a remarkable native: The Green Sea Turtle. These animals are fully protected under State Law and the Federal Endangered Species Act, which prohibits harassing or harming them in any way. Please be aware that any handling or chasing turtles is illegal and puts these animals under stress.

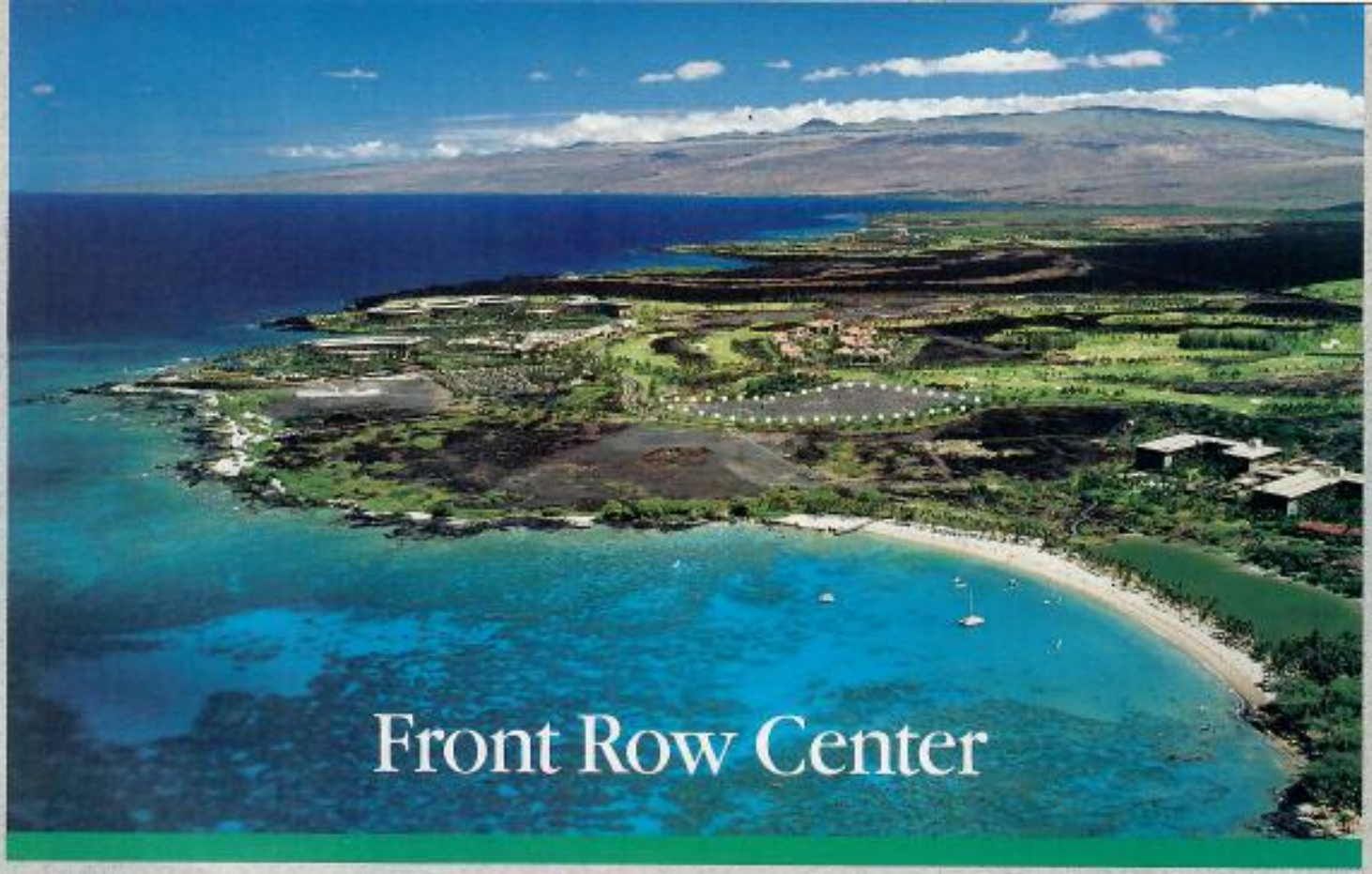
Once tens of millions of green sea turtles inhabited the ocean. Now, due to excessive hunting, incidental drift net kills, pollution and loss of nesting beaches, fewer than 350 females nest in the Hawaiian Islands. They grow very slowly and may take 40-50 years to mature. These graceful saltwater reptiles feed almost entirely on seaweed and algae, making them a vital link in the marine ecosystem. Turtles migrate from the feeding areas in the main Hawaiian Islands to the nesting areas at French Frigate Shoals from May to August. Females lay about 100 eggs in a nest, but very few of the hatchlings will reach adulthood.

お願い

ウミガメに手を触れないようにお願い致します。

ご協力ありがとうございます。

Please do not touch the turtles.



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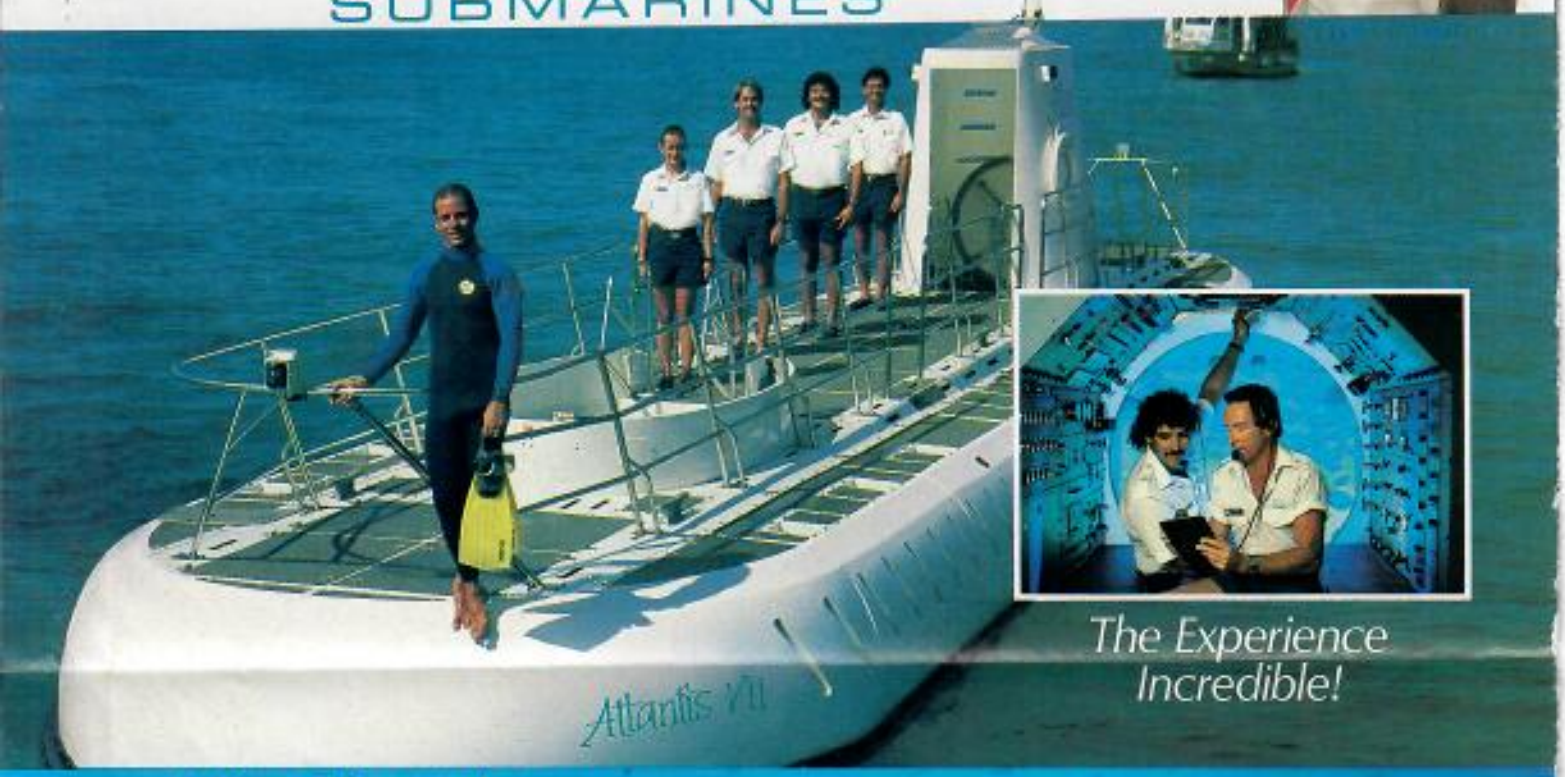

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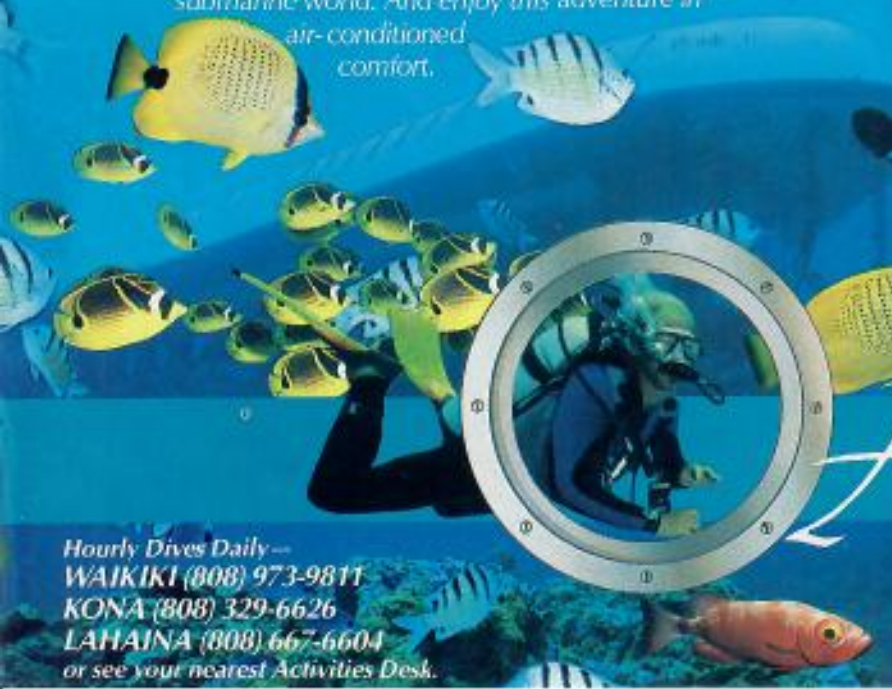

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Jason Woerner Grade 7

Kona waena Int.

- Summary Tables
- Several Thermometer
- Camera
- Time of observation effort

Turtle Log

December 7[1991] - January 18, 1992

Jason Woerner
PO Box 2204
Kealakekua, Hi 96750

TEL. =

2493 Linda Elliot

- find sleeping area
- feed time when turtles are most active, name turtles, number of turtles record injury, favorite feeding areas

10:28 Sat. 7-Dec
spotted smaller turtle by restaurant, seems to be feeding seemed

10:40
- Surface for air and took 4 breaths before submerging
11:10 turtles must be sleeping

Seemed to be disturbed by my presence. Stopped eating stayed in one place. Looked at me.

11:46 spotted another turtle - reddish-brown slightly bigger than last one. Maybe turtles are up!

11:58 going to lunch

1:20 spotted a large turtle about 5 minutes ago. lost track of it while getting this booklet.

1:31 spotted yet another small turtle (may have been the same one) swimming towards the waterfall. this back was covered with green-brown algea

1:35 spotted same turtle ~~coming~~
coming up for air
1:57 followed a medium sized
3:10 -

Dec. 24 2:05 Huge and dead huge turtle with clean shell to the north of the waterfall.
2:50 - Medium sized turtle (about 2ft long and 1ft in wide) feeding near the restaurant.
3:30 The turtle near the restaurant seems to have left.
3:35 Big turtle by waterfall has left yet.
4:50 No turtles spotted in tower. ?

MON - 12/9/91 · BILL 4:45 P

10 M SE of RESTAURANT - SMALL - 50 CM SHELL

WATER DEPTH 1 M AFTERNOON SUN

445 SURFACED SEVERAL TIMES FEEDING

449 BOAT FLOATED NEXT - DID NOT DISTURB

4:40 20 m SE of Restaurant followed large (70cm shell) algae covered turtle to steps south of waterfall.

SMALLER ONE CONTINUED TO GRAZE (APPARENTLY) UNTIL 503 PM, ROSE TO SURFACE TOOK 5 BREATHS, MOVED FURTHER SE

500 - 530 PM NONE SIGHTED AT THE BRIDGES.

January 11, 1997

9:03 AM – No turtles spotted yet, high tide, 15 foot waves

9:20 Been everywhere except the tower, warm water, No turtles ?

9:? Medium sized (12-16 in.) turtle seems to have emerged from previously recorded sleeping hole near waterfall.

9:30 going swimming

9:50 Turtle spotted - Observing from paddle boat. Location: Close to the shore just west of waterfall traveling toward restaurant pier

10:20 – Man and woman in paddleboat molesting turtle, man lifted turtle from water

11:15 – 4 turtles at the same time under the waterfall (big one, 2 medium, 1 small w/ white algea

11:40 swam with 3 turtles

Jan. 12, 1997

11:15 2 turtles (the huge one I saw on the 24th and the large one I saw yesterday).

12:15 - followed 3 turtles around under waterfall. John found a turtle shell.
12:45 - saw 1 large, 1 huge turtle feeding under the waterfall
1:45 - family of 6 picking turtle out of water, petting it, ~~petting~~ feeding it too.

12:20 - saw huge and large turtles "playing" near waterfall

12:26 - 3 turtles out near huge turtle - short tail - female?

huge turtle & large turtle (with dirty back) appear to be playing - swimming together, touching

At waterfall tower:

3 turtles: huge
large w/ dirty back
small (not white)

All 3 swimming under waterfall - saw huge turtle swim after & eat what looked like large, black, lettuce-like plant near surface.

Total turtles seen to date: huge 1
large 1 (dirty algae green white)
medium 2 look identical
small 2 1 reg

6 total

* had to ask 2 kids not to chase & touch turtles. Endang Small.

12:36 Small turtle w/ white algae spotted swimming toward waterfall from direction of restaurant/patio area (waimea side)

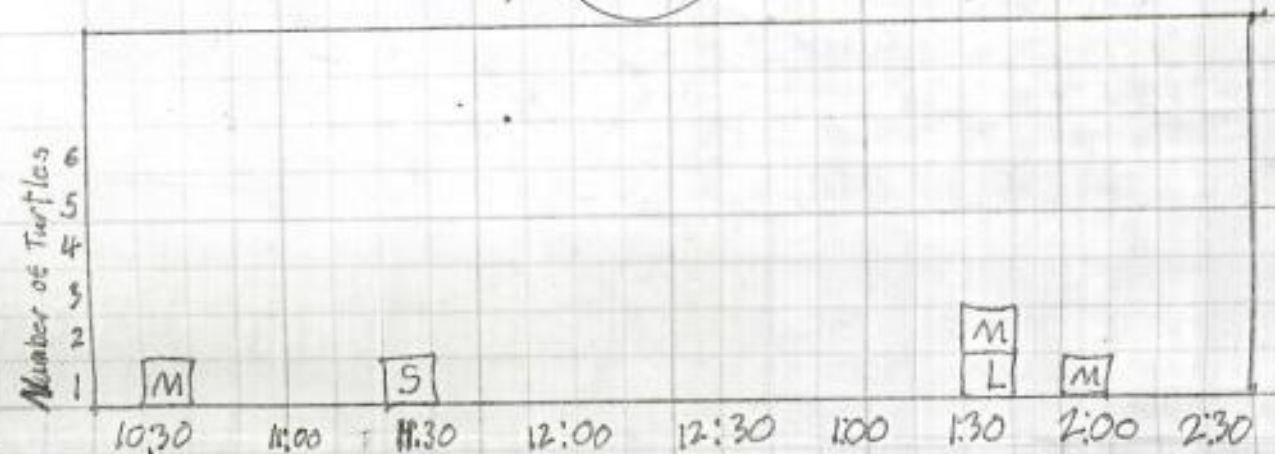
Waterfall 12:40 large
small w/ white
huge
small
} 4

2 smalls swam to meet each other - gently touched. Turned and swam together (wht) sm. White following small - turning, surfacing together played follow the leader for over 3 min. dove down deep together, surfaced together me follow the leader (wht) (sm.). Played together 5 min then seperated.

- Tails: can see tail on huge + - appears short. Can't see tail on large

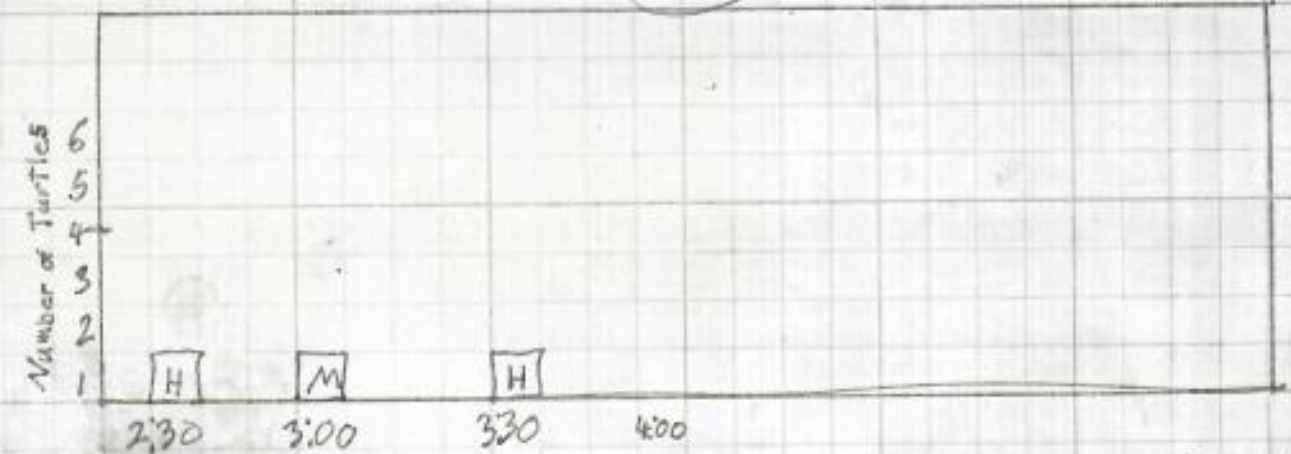
1:41 - from tower over waterfall spotted huge turtle eating floating algae and saw large turtle swimming around

Saturday (Dec. 7, 1991)



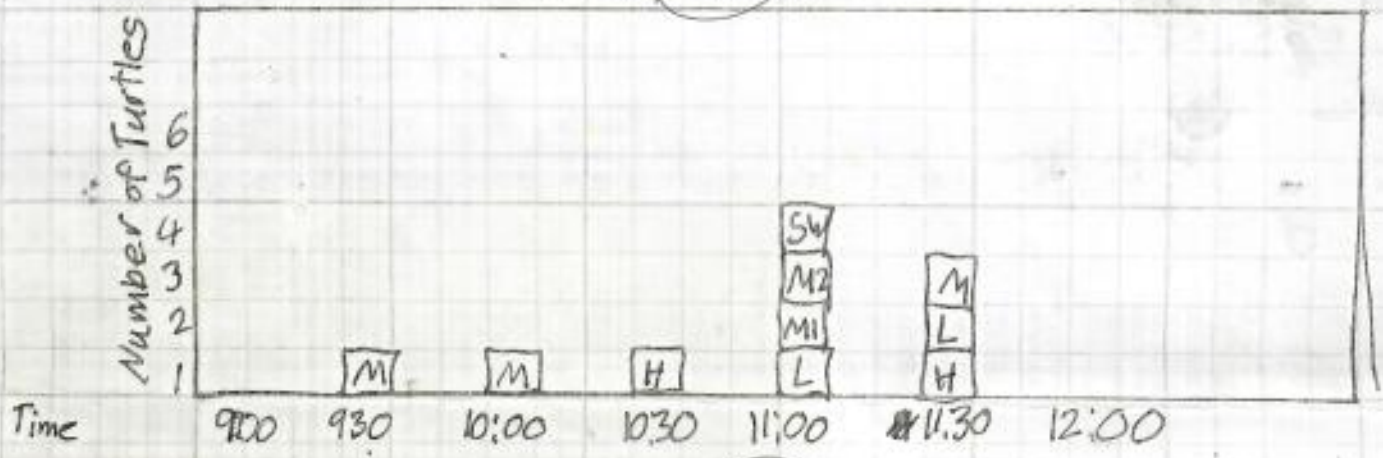
Monday (Dec. 9, 1991)

Tuesday (Dec 24, 1991)



Key: M = unknown m
H = Huge
L = Large
M1 = Medium
M2 = Medium
S = Small
S W = Small wh

January 11, 1992



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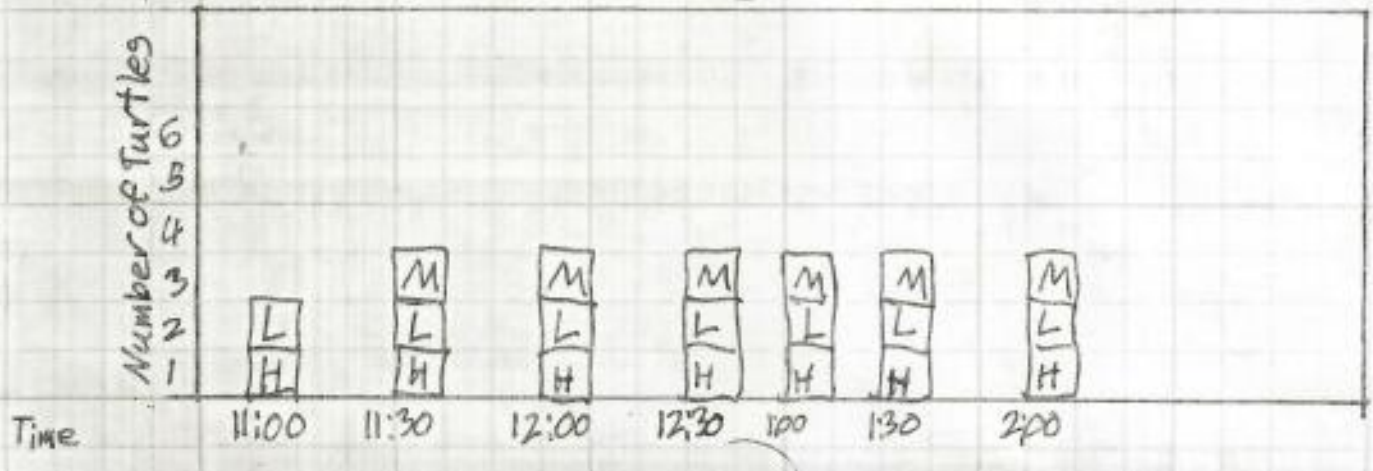
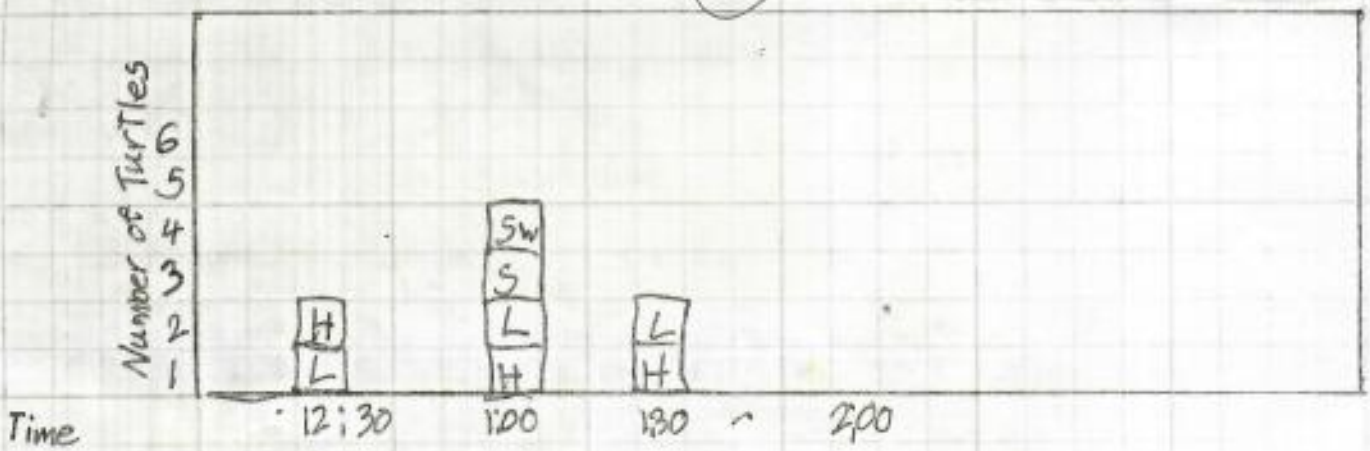


January 18, 1992



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(808) 885-1234 EXT 2866

FOR IMMEDIATE RELEASE

NATIONAL MARINE FISHERIES SERVICE TAG THREATENED GREEN SEA TURTLES AT THE HYATT REGENCY WAIKOLOA

KOHALA COAST, HI -- February 12, 1992 -- With the efficiency of movement that comes from long practice, George Balazs of the National Marine Fisheries Service caught, removed and tagged Thursday four of the green sea turtles that have taken up residency in the Hyatt Regency Waikoloa's lagoon.

The turtles, which are a members of a threatened species, were removed from the lagoon, weighed, measured and examined for any physical defects or abnormalities before being re-released. Balazs explained that the examination and tagging "...allows the National Marine Fisheries Service an increased knowledge of this threatened species and the ability to record each individual's progress for years to come."

Seeking food and protection, the turtles can be seen around the base of the waterfall feeding constantly on the clumps of algae that come over the falls and grow on the rocks and ledges of the lagoon. With estimated ages of between three and fifteen years, the smallest of the four weighed in at 22 pounds and the largest topped the 110 pound capacity of the scale.

(more)

Linda Elliott, Hyatt Regency Waikoloa's Wildlife Director, estimates that there are a total of six turtles in the resort's lagoon. "It is difficult to know exactly why these turtles decided to make our lagoon their home" she stated Thursday. "We can only assume that the lagoon naturally affords them adequate protection from potential predators and plenty of food. We are very pleased to have these wonderful animals as our guests and consider the responsibility of ensuring their continued health and safety a privilege. I am delighted to report that George Balazs initial findings show that each of the four he examined is thriving."

The National Marine Fisheries Service will continue to monitor the turtles on an on-going basis. For more information, contact George Balazs at the National Marine Fisheries Service at (808) 943-1240 or Linda Elliott at the Hyatt Regency Waikoloa at (808) 885-1234 Ext. 1290.

# # #