

SEA TURTLES OF KAHOO LAWE ISLAND

- A Preliminary Survey -

by

George H. Balazs
Hawaii Institute of Marine Biology
P. O. Box 1346
Kaneohe, Hawaii 96744

November 1978

CONTENTS

	Pages
INTRODUCTION.	1
HISTORICAL PERSPECTIVE.	2
SURVEY ACTIVITIES	4
FINDINGS.	6
Nesting Habitat Considerations	6
Feeding Habitat Considerations	9
SUMMARY	12
ACKNOWLEDGEMENTS.	14
REFERENCES.	15

Figure 1. Kahoolawe Island.

Figure 2. Western coastline of Kahoolawe showing the locations of the eight sand beaches and limits of the 7.6 kilometer study area.

Figure 3. Kahoolawe Island showing the locations of turtle sightings made by Navy personnel, 22-27 September 1978.

Table 1. Algae collected in the nearshore waters of Kahoolawe between Kealaikahiki Point and beach 6.

Table 2. Turtle sightings made by Navy personnel at Kahoolawe, 22-27 September 1978.

The results and interpretations of original research presented in this report should not be quoted in a journal publication without the author's permission.

INTRODUCTION

An important component of the life history study of the Hawaiian green turtle (*Chelonia mydas*) underway since September 1976 involves the delineation of feeding and breeding aggregations associated with the 1200 kilometers of island coastline present throughout the Hawaiian Archipelago (18°55'N, 154°49'W to 28°15'N, 178°20'W). Defining the ecological characteristics of these aggregations is basic to the formulation of sound strategies for management and conservation. An additional motivating factor for the collection of such data is the recent (September 1978) listing of the green turtle as a Threatened species under provisions of the Endangered Species Act of 1973 (Public Law 93-205; 87 Stat. 884). Two other less abundant sea turtles also found in Hawaiian waters, the hawksbill (*Eretmochelys imbricata*) and the leatherback (*Dermochelys coriacea*), have been listed in the Endangered category since 1970. Marine and terrestrial habitats critical for these three species in Hawaii are in need of designation in accordance with Section 7 of the Act and the additions relating to Interagency Cooperation published in the *Federal Register* on 4 January 1978.

Although a number of significant advances have been made in the knowledge of Hawaiian sea turtles and their habitats (Balazs, 1974; 1976; 1977, 1978b; 1978c), insufficient information continues to exist for many remote coastal areas of the archipelago. This is due principally to problems of logistics and the supplemental financial support required to undertake such field research. Kahoolawe (Figure 1), the smallest of the eight major Hawaiian Islands, is one location for which there have been no data published on any

life history aspect of sea turtles. The purpose of this paper is therefore to present the results of a preliminary survey recently made along portions of Kahoolawe's 46 kilometer coastline. In addition, relevant information resulting from personal communications and a review of the available literature has been consolidated for presentation.

HISTORICAL PERSPECTIVE

The history of Kahoolawe has been described as consisting of three general time periods termed 1) Hawaiian; 2) Exploitive; and 3) Bombing (Apple and Apple, 1976). The first period extended from prehistoric times to the 1850's and consisted mainly of traditional Hawaiian usage involving small permanent settlements and visitations by residents of other islands. It is interesting to note that McAllister's (1933) survey of archaeological sites from this period revealed the presence of turtleshell fishhooks (makau 'ea) and fragments of turtle shell at a fishermen's workshop and shrine located at Kamohio Bay on the island's southern coast. Along with bone, teeth and pearl shell, the thick horny plates of the hawksbill turtle were favored by the early Hawaiians for manufacturing fishhooks (Buck, 1964; Emory, 1968). Although it seems likely that the material found at Kahoolawe was obtained from locally captured hawksbills, there is nevertheless the possibility that it was imported from another island.

In the second historic period (1850's - 1940) the predominant activity on the island was livestock ranching. During this era numerous unsuccessful efforts were made to eradicate the feral goats and sheep that were competing

with cattle for food, thereby hastening defoliation and erosion of the island. Mrs. Inez Ashdown, an historian presently living on Maui, formerly resided on Kahoolawe at Kuheeia Bay during the course of her father's (Angus MacPhee) cattle ranching efforts between 1916 and 1941. In recent discussions with Mrs. Ashdown, it was indicated that the bay and sand beach on the island's western coast now called Smuggler Cove was in fact known to the Hawaiians as Honukanaenae. Honukanaenae was also specified as the name of the point of land immediately to the south of the bay. The translation of Honukanaenae is "chant for turtles", referring to the area as one that has been blessed for turtle nesting (Ashdown, 1976). Although Mrs. Ashdown did not personally have the opportunity to observe turtles at this location, she was nevertheless informed by her father's Hawaiian paniolo (cowboys) that nesting took place. No information could be provided on the species, seasonality, or numbers of turtles involved. Some charts of Kahoolawe have listed this site as Hanakanaea, however such a place name appears to be erroneous. Pukui and Elbert (1971) previously expressed uncertainty over the meaning of Hanakanaea as a name for the area. Based on information supplied by Mrs. Ashdown, the Pacific Scientific Information Center at the Bernice P. Bishop Museum has now adopted Honukanaenae for use on charts and listings of Hawaiian place names (L. S. Motteler and E. H. Bryan, Jr., personal communication).

The third and continuing historic period commenced in 1940 and consists of exclusive use of Kahoolawe by the U. S. military services for aerial bombing and other types of ordnance practice. The Navy, which administers the island, has been subjected to various pressures since 1964 to terminate

these activities and return the area to civilian control. This has resulted in part in the increased monitoring of certain environmental aspects of the island along with the renewal of archaeological investigations. During the course of numerous visits to the island in conjunction with these activities, the Navy's Natural Resources Specialist has made no observations of turtles, although attention has not been specifically focused on this aspect (G. E. Swedberg, personal communication). Also, no sightings of turtles were reported during underwater (scuba) fish surveys conducted by the Hawaii State Division of Fish and Game at four distinct sites along the island's southern and northwestern coasts (Ego *et al.*, 1972). In contrast, archaeologists currently working on the island report that turtles in small numbers have been occasionally sighted, particularly in the nearshore waters of the northwestern coast. However, to date no signs of nesting have been noted (M. Morganstein, personal communication).

SURVEY ACTIVITIES

In response to requests submitted to the Navy in May and June of 1977, the author was granted permission to enter Kahoolawe to conduct surveys of sea turtles. Transportation to the island for this purpose was made available by the Navy for one day on 23 June 1978, and again for three days commencing 23 August 1978.

The survey of 23 June consisted of one hour of low level (100 m) aerial reconnaissance of most of the island's coastline utilizing a CH53 Marine Corps helicopter. In addition, 2.5 hours were spent on land examining the beaches and nearshore waters present for a distance of 1.4 kilometers to the

northwest of the helicopter landing pads and small military facility located at Honukanaenae Beach. Mr. John J. Naughton, Fishery Biologist with the National Marine Fisheries Service, also participated as an observer on this one day survey.

The three day survey in August consisted of the following activities:

- 1) 15 minutes of low level aerial reconnaissance of coastal areas adjacent to Kealaikahiki Point utilizing an SH3G Navy helicopter;
- 2) a total of 21.5 daytime hours of direct observations on land of the sand beaches and near-shore waters extending from the lighthouse on the island's southern coast to 1.8 kilometers northeast of Kealaikahiki Point (encompassing 7.6 kilometers of coastline) (Figure 2);
- 3) a total of 4.5 daytime hours of observations conducted underwater with face mask and fins at six selected nearshore areas located from Honukanaenae to 1.8 kilometers northeast of Kealaikahiki Point; and
- 4) collection of algae from the six areas where the underwater observations were conducted.

Underwater observations were not possible at sites between the lighthouse and Honukanaenae, due to the precipitous coastline and hazardous wave conditions. Furthermore, all surveys on land were carried out on foot due to the absence of coastline roads and available vehicles. The few dirt roads that are present on the island provide access principally to the higher elevations of the interior where ordnance practice is carried out. The extent of coastline surveyed was therefore limited by difficulties of access and the amount of available time on the island. Initial plans for the noninjurious use of large mesh nets to sample and tag turtles at Honukanaenea were not carried out due to the possibility of accidentally

entangling spinner porpoise (*Stenella longirostris*) that were regularly seen in the area. Other participants in the August survey included Mr. Alan K. H. Kam, Biological Assistant with the Hawaii Institute of Marine Biology, and HTI Steven Jones, an ordnance disposal specialist assigned by the Navy as a safety precaution.

In addition to the June and August field surveys conducted by the author, cooperation was obtained from Navy personnel in the filing of turtle sighting report forms in conjunction with surveys of unexploded torpedos and other ordnance conducted 22-27 September 1978 in Kahoolawe's northwestern, western and southern coastal waters. This work included the use of scuba and small boats.

FINDINGS

Nesting Habitat Considerations

Aerial observations indicated that Kahoolawe's coastline is mostly rocky with only a limited amount of beach area. All of the beaches in which sand is the predominant component are located at the island's western end within the study area surveyed on foot. Other short segments of beach seen from the air appeared to consist primarily of silt mixed with small quantities of sand or rocks. Such sites are particularly numerous along the northwestern coast at the seaward exits of gulches. A somewhat larger shore area of silt and sand was noted at the southern end of Kanapou Bay on the island's eastern coast. It should be noted that the beach systems of Kahoolawe were the only ones in the major Hawaiian Islands not to be comprehensively

analyzed by Moberly and Chamberlain (1968).

It is unlikely that either of the two species of sea turtles (green and hawksbill) known to breed in the Hawaiian Archipelago would find any of the silt or essentially mud beaches acceptable as nesting habitat. It should be noted, however, that seasonal or yearly fluctuations in waves and currents could at times bring greater quantities of sand ashore, thereby possibly making some of the sites suitable for nest excavation and egg incubation. Although changes of this nature have been documented at other nesting areas (Schulz, 1975), no information presently exists on such an occurrence at Kahoolawe.

Surveys on foot resulted in the close inspection of each of the eight sand beaches identified at the island's western end (Figure 2). Five of these beaches occur to the southeast and three to the northwest of Kealaikahiki Point. Honukanae (designated as beach 1) is the largest expanse covering 500 meters, while the smallest (beach 4) covers less than 100 meters. Green and hawksbill nestings in Hawaii can occur from June through November, but no signs of such activity were detected at any of the locations examined. The question exists whether much of this sand beach habitat is, in fact, suitable for nesting at the present time. A naturally occurring adverse factor which applies to beaches 2, 4 and the northwestern segment of beach 1 is the presence of rocks above the high tide line at the beachtop platform where nesting normally takes place. For the beaches that possess appropriate platforms (1,3,5,6,7,8), underground root systems of the introduced kiawe tree (*Prosopis chilensis*) have to a large extent established obstacles that would probably be discouraging

to nesting attempts. Furthermore, although the wave-washed approaches of these beaches consist of clean calcareous sand, the platforms themselves contain varying levels of fine red soil resulting from the island's severe erosion. The suitability of such substrates for turtle reproduction is unknown. Seasonal or yearly changes in waves and currents could, however, also alter these beach conditions.

From the standpoint of existing human usage, several additional adverse influences were recorded. On beach 8, which is the most distant from the facility at Honukanaenae, the tracks of vehicles were found (apparently gaining access by an unimproved overland route), along with various discarded tin cans. The latter items, as well as footprints, were also noted along the other seven beaches. This would seem to indicate use of the areas for recreational purposes or periodic maneuvers, both of which have potential for discouraging any nesting attempts. At Honukanaenae, recreational swimming and beach usage by large numbers of personnel were seen to take place following a return from artillery practice. Another human activity observed that could have far greater impact, however, was the apparently established practice of removing beach sand from Honukanaenae with heavy equipment for use in road repair.

In many respects, the adverse historic and contemporary factors shaping nesting habitat conditions at Honukanaenae and other sand beaches at Kahoolawe are similar to those affecting Polihua, a well known former nesting beach for green turtles on the north shore of Lanai (Emory, 1969; Balazs, 1975). A major difference, however, is the regular discharge of ordnance (including high intensity flares) on Kahoolawe, the explosions of

which were commonly heard during the course of the survey. Although there is no information on the effects of sound on the behavior of adult turtles during nesting, hatchlings prior to emergence from the underground nest are known to respond to noise stimulus produced by jet aircraft engines (Balazs and Ross, 1974). Artificial light, such as may periodically exist along the coastline from aerial flares, is widely recognized as a deterrent to turtle nesting.

Feeding Habitat Considerations

The results of aerial observations indicated that Kahoolawe's nearshore waters contain areas of high turbidity as well as clear visibility through which relatively rich coral growth could periodically be detected. No turtles were seen floating at the surface or surfacing for respiration, such as have been recorded during similar surveys at other islands using small, fixed-wing aircraft. Strong winds and the resulting rough conditions on the ocean's surface were at least in part responsible for the absence of sightings at Kahoolawe. Periods of light wind or calm are known to stimulate turtles to rest on the surface for extended periods, presumably to take advantage of the warmer layer of water which results from solar radiation (G. C. Whittow, personal communication). During weather conditions that are not conducive to this surface basking behavior, turtles utilize caves, coral ledges and other concealed underwater habitat to carry out periods of quiescence.

A total of four turtles, all *Chelonia*, were observed during the course of the surveys made from land. Two of the turtles, estimated to be 55-65 centimeters in carapace length, were present at the surface for brief

periods approximately 125 meters from shore in the vicinity of beach 3. Breath hold times for these individuals lasted for 15 minutes or more, suggesting that some form of underwater resting behavior was occurring, rather than active feeding which normally requires more frequent respiration. The two other turtles sighted were within 20 meters of shore between Kealaikahiki Point and beach 6. Frequent surfacings (2-4 minute intervals) for respiration suggested that active feeding was taking place. Underwater observations on one of these turtles were successfully carried out for a short time. During this period, the turtle was seen grazing on a thin mat of the red alga *Gelidium* growing on a rock 1.5 meters beneath the surface. The turtle rapidly departed from the area when it became aware of human presence.

No other turtles were seen during the five other observational periods conducted underwater. Benthic algae, the principal food of green turtles in Hawaii, were not found in either great abundance or diversity at any of the sites examined. Based on the results of studies conducted to date at other nearshore areas in the major Hawaiian Islands, significant aggregations of green turtles are usually only found in association with rich pastures of algae, particularly those composed of the genera *Pterocladia*, *Codium*, *Amansia* and *Ulva*. The most abundant area of algal growth observed at Kahoolawe was between Kealaikahiki Point and beach 6. Eleven different kinds of algae were collected along this segment of coastline and subsequently identified (Table 1). No additional species were recovered from any of the other underwater areas examined. It should be noted, however, that algal array and abundance at a particular location can show considerable variation

with the time of the year sampled.

In contrast to the herbivorous feeding habits of the green turtle, hawksbills are known to be primarily carnivorous. Carr and Stancyk (1975), in analyses of stomach contents from 29 specimens, found that hawksbills in the Caribbean feed principally on the sponge, *Geodia*, and the asidean, *Styela*. In the only Hawaiian hawksbill examined to date which was recovered dead from a gill net in Kaneohe Bay (Oahu), the stomach was found to be completely filled with pieces of three kinds of unidentifiable sponges (Balazs, 1978a). During the underwater observations at Kahoolawe, several kinds of rock encrusting sponges were noted, but not in great abundance.

Underwater surveys of unexploded ordnance conducted by Navy personnel in September resulted in the sighting of 13 turtles, all of which were believed to be *Chelonia* (Figure 3, Table 2). Three of the turtles or 23% were estimated to exceed 80 centimeters in carapace length and therefore were sexually mature. It is interesting to note that the two largest turtles (nos. 7 and 8) were observed at the greatest depth (18 m). Four other turtles (31%) were sighted in the vicinity of the unnamed bay before Kii Point, approximately 7 kilometers past the northwestern extremity of the study area covered in August. Five of the 13 turtles (38%), however, were recorded within the study area.

The suitability of portions of Kahoolawe's nearshore waters for green and hawksbill feeding habitat has undoubtedly been adversely impacted by accelerated erosion and sedimentation, as well as certain more direct human activities. Although ordnance practice is not currently being carried out along the island's coastline, torpedos from submarines were previously

fired at the island (Nelson, 1978) and projectiles from ships were directed at shoreline targets. It is possible that this latter activity could be renewed at any time should it be deemed necessary for fleet readiness (G. E. Swedberg, personal communication). In addition to physically altering the bottom, explosions in the water generate shock waves that are capable of rendering turtles unconscious, thereby causing death by drowning. Furthermore, chemical and heavy metal pollutants can be released into the ecosystem (see Young, 1973). Such factors should be taken into consideration in any eventual plans to clear unexploded ordnance from Kahoolawe's coastal waters by controlled detonations.

SUMMARY

The results of this investigation of sea turtles at Kahoolawe represent the most comprehensive information thus far assembled on the subject. Nevertheless, the research must be regarded in its proper perspective as preliminary in nature. Only two study visits comprising four days were carried out on the island, during which time only 7.6 kilometers or 16.5% of the coastline were examined with some degree of intensity. The data gathered can therefore be best utilized as a basis for conducting additional field studies that will ultimately allow for conclusions of a more definitive nature to be reached. With respect to nesting, a series of one day land surveys of the eight sand beaches need to be made at regular intervals of four weeks or less throughout several breeding seasons. At the same time, all of the island's silt beach areas should be examined from the air in order to detect any changes that could

enhance the prospects for nesting. With respect to feeding aggregations, additional observational surveys encompassing the remaining 83.5% of the island's coastal waters need to be conducted from land. At appropriate locations, underwater counts of turtles and collections of algae and sponges should be made using face mask and fins. Areas of particular significance that may be identified should be more thoroughly investigated using a small boat, scuba, and established procedures for capture and tagging.

ACKNOWLEDGEMENTS

This research was conducted in conjunction with grants received from the Office of the Marine Affairs Coordinator (State of Hawaii) and the Sea Grant College Program of the University of Hawaii. I express my appreciation to the Department of the Navy, Pacific Division, Naval Facilities Engineering Command at Pearl Harbor for granting permission to enter Kahoolawe and for making the necessary transportation arrangements. I also gratefully acknowledge the valuable assistance of Mr. Lee S. Motteler, Mr. Edwin H. Bryan, Jr., Mrs. Inez Ashdown, HT1 Steven Jones, Mr. Gerald E. Swedberg, Mr. John J. Naughton, Mr. Alan K. H. Kam, Dr. Dennis Russell (for algae identification), and Navy personnel of the Explosive Ordnance Disposal Mobil Unit One at Barber's Point, Hawaii. Appreciation is also extended to the flight crews of the Marine Corps and Navy helicopters that provided transportation, and to numerous other military personnel met during the course of the survey who expressed interest in sea turtles and were anxious to provide assistance in any way possible.

REFERENCES

- Apple, R. and P. Apple (1976) Kahoolawe: Three periods of history.
Honolulu Star-Bulletin, 7 February, A:11.
- Ashdown, I. (1976) Kahoolawe place names. unpublished manuscript, 3 pp.
- Balazs, G. H. (1974) Survival status of the green turtle nesting and
basking colony at French Frigate Shoals, Northwestern Hawaiian Islands.
American Fisheries Society, 104th Annual Meeting, Honolulu, 8 pp.
- Balazs, G. H. (1975) Green turtles uncertain future. *Defenders*, 50,
6:521-523.
- Balazs, G. H. (1976) Green turtle migrations in the Hawaiian Archipelago.
Biological Conservation (Great Britain), 9:125-140.
- Balazs, G. H. (1977) Ecological aspects of green turtles at Necker Island.
Hawaii Institute of Marine Biology, October, 27 pp.
- Balazs, G. H. (1978a) A hawksbill turtle in Kaneohe Bay, Oahu. *'Elepaio*,
38, 11:128-129.
- Balazs, G. H. (1978b) Terrestrial critical habitat for sea turtles under
U. S. jurisdiction in the Pacific region: An overview of existing
knowledge. *'Elepaio*, 39, 4:37-41.
- Balazs, G. H. (1978c) Investigations of the growth, food sources and
migrations of immature Hawaiian *Chelonia*. *IUCN Marine Turtle
Newsletter*, in press.
- Balazs, G. H. and E. Ross (1974) Observations of the preemergence
behavior of the green turtle. *Copeia*, 4:986-988.

- Buck, P. H. (1964) Arts and crafts of Hawaii: Fishing. Bernice P. Bishop Museum Special Publication 45, 7:285-585.
- Carr, A. and S. Stancyk (1975) Observations on the ecology and survival outlook of the hawksbill turtle. *Biological Conservation*, 8:161-172.
- Ego, K., Sakuda, H., Onizuka, E., Okamoto, H. and D. Shinno (1972) Kahoolawe fish survey: July 30 to August 2, 1972. State of Hawaii, Department of Land and Natural Resources, Division of Fish and Game, 12 pp.
- Emory, K. P. (1968) Fishhooks. Bernice P. Bishop Museum Special Publication 47, 62 pp.
- Emory, K. P. (1969) The Island of Lanai: A survey of native culture. *Bernice P. Bishop Museum Bulletin* 12, 129 pp.
- Moberly, R., Jr. and T. Chamberlain (1968) Hawaiian beach systems. Final report prepared for Harbors Division, Department of Transportation, State of Hawaii. Hawaii Institute of Geophysics, University of Hawaii, HIG-64-2, revision of first issuance in 1964, 95 pp.
- Nelson, L. (1978) Firings date back to World War II: Navy will search out 'dud' torpedoes off Kahoolawe. *Honolulu Star-Bulletin*, 7 September, B:8.
- Schulz, J. P. (1975) Sea turtles nesting in Surinam. *Nederlandsche Commissie voor Internationale Natuurbescherming, Mededelingen No. 23*, Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands, 143 pp.
- Young, G. A. (1973) Guide-lines for evaluating the environmental effects of underwater explosion tests. NOLTR 72-211, Explosions Research Department, Underwater Explosions Division, Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland, 91 pp.

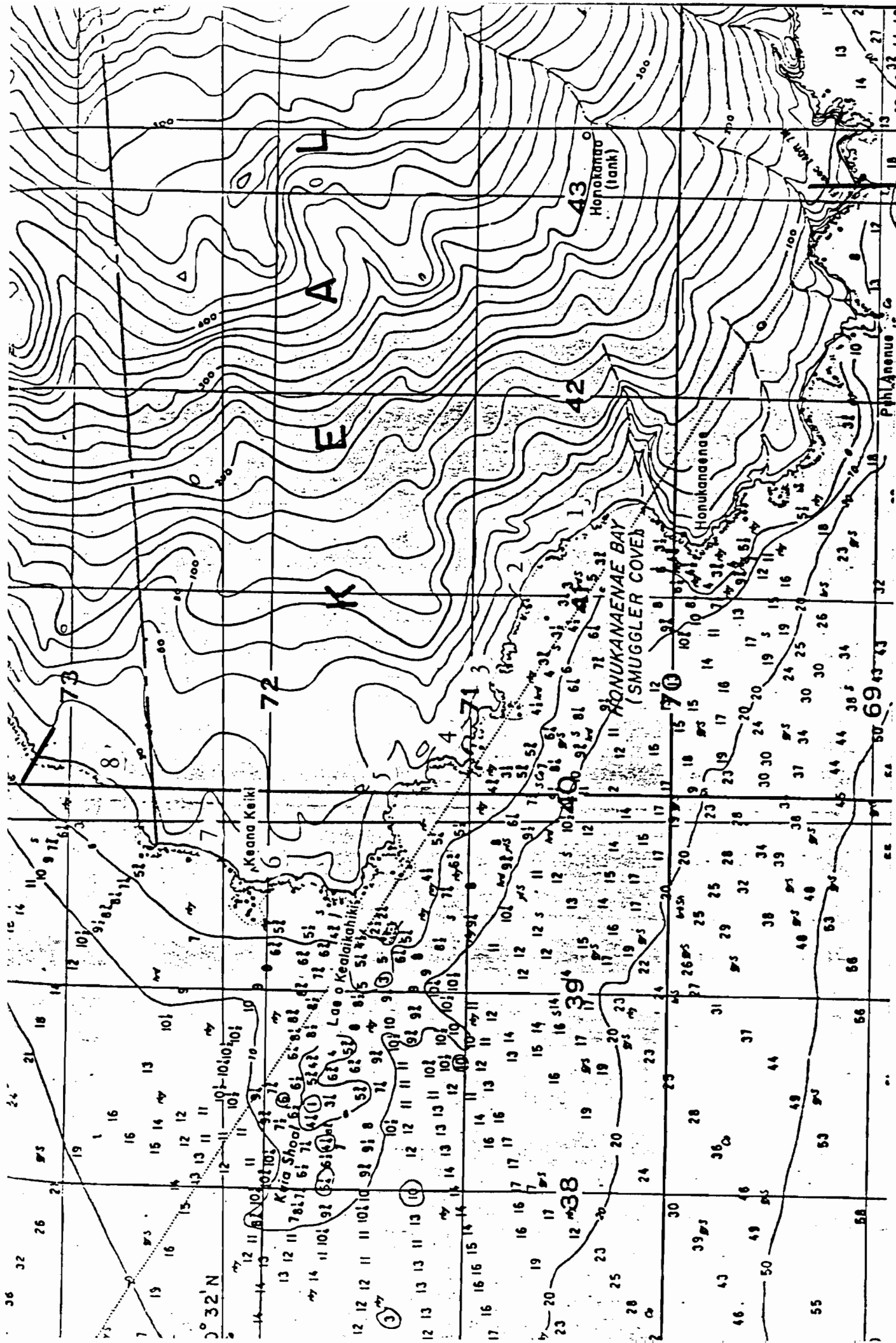


Figure 2. Western coastline of Kahoolawe showing the locations of the eight sand beaches and limits of the 7.6 kilometer study area. (from chart by Naval Facilities Engineering Command, courtesy of Lee S. Morteler)

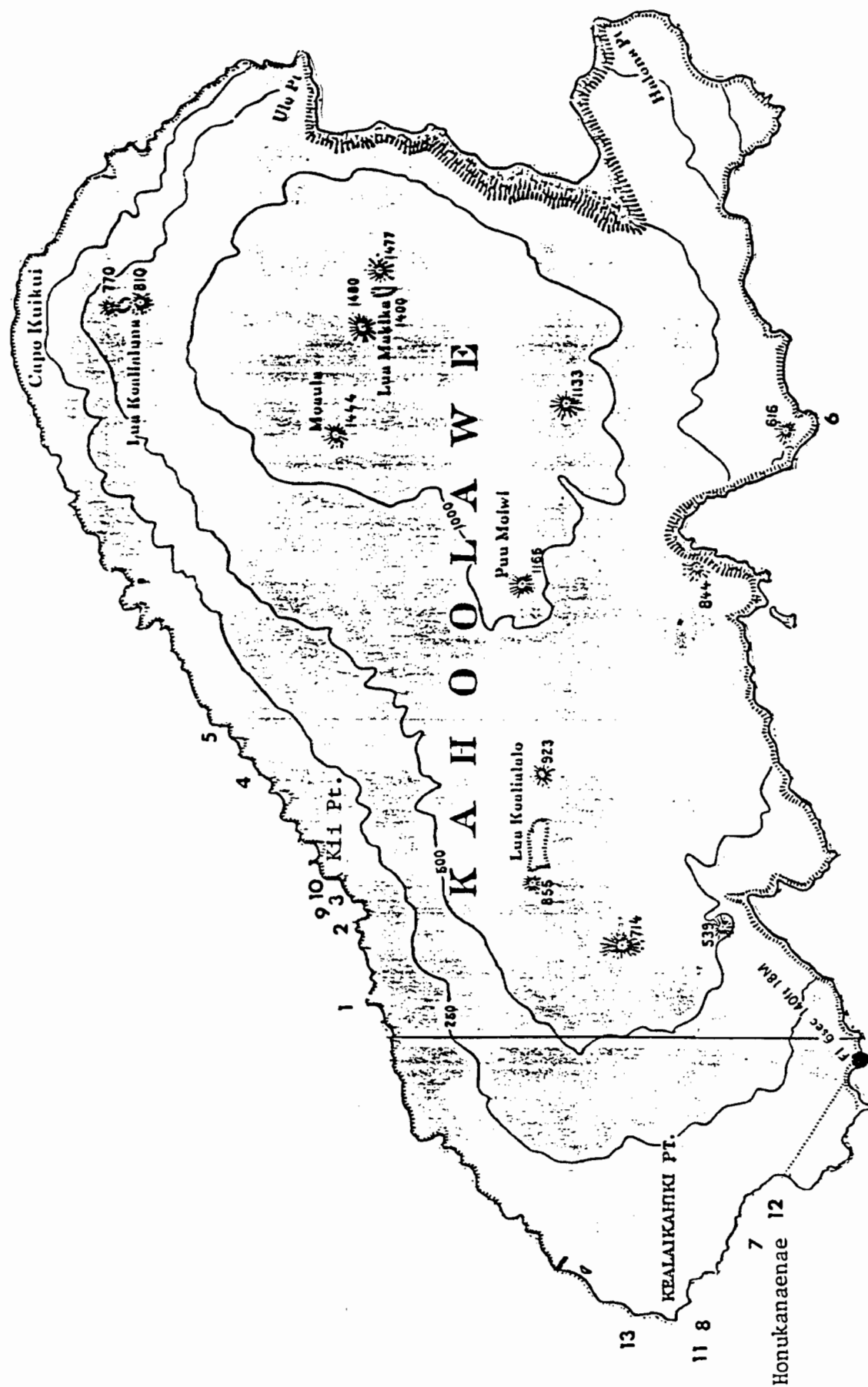


Figure 3. Kahoolawe Island showing the locations of turtle sightings (1-13) made by Navy personnel, 22-27 September 1978. (from C. & G.S. 4130)

Table 1. Algae collected in the nearshore waters of Kahoolawe between
Kealaikahiki Point and beach 6.

1. *Actinotrichia rigida*
2. *Amansia glomerata*
3. *Chondrococcus hornemanni*
4. *Corallina* sp.
5. *Dictyopteris plagiogramma*
6. *Ectocarpus breviarticulatus*
7. *Gelidium* sp.
8. *Jania capillacea*
9. *Larrencia* sp.
10. *Lobophora variegata*
11. *Microdictyon japonicum*

Table 2. Turtle sightings made by Navy personnel at Kahoolawe,
22-27 September 1978.

Turtle sighting no.	Date	Estimated carapace length in centimeters	Approximate depth of sighting in meters
1	22 September	60	6
2	22	45-50	3
3	22	75	7.5
4	23	75	12
5	23	60-70	surface
6	24	90	surface
7	26	100	18
8	26	115	18
9	26	75	1.5
10	26	45	3
11	27	45-50	surface
12	27	45-50	2.5
13	27	60-75	1.5