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APPENDIX XII

REPORT ON HAWAIIAN MARINE TURTLE POPULATIONS

by John R. Hendrickson *

1. Present Status

a) General

The only species occurring commonly in Hawaiian waters is the Green Sea turtle, Chelonia mydas L. Leathery turtles (Dermochelys coriacea) and Hawksbills (Eretmochelys imbricata) are encountered sporadically, but no nesting is known to occur. The Loggerhead (Caretta caretta) and the Ridley (Lepidochelys olivacea) have been recorded, but there is some doubt as to the accuracy of the reports.

It is difficult to speak with any confidence concerning the subspecific identity of Hawaiian Chelonia mydas; as in many other areas, work needs to be done on their systematic relationships.

Green turtles occur commonly in the waters all along the Hawaiian chain, which extends for approximately 1,500 miles on an ESE-WNW axis in the central Pacific. While nesting undoubtedly occurred on suitable beaches throughout the archipelago during primitive times, it is now confined to small, largely uninhabited islands toward the western end of the chain. The early Hawaiians formed a relatively heavy population on the larger islands and had a culture strongly directed toward heavy exploitation of the sea; apparently most of the nesting aggregations on the larger islands had already been exploited to near-oblivion by the time of the coming of the white man. Hawaiian lore points to nesting on some of the more isolated beaches and there are still occasional reports of single nestings, but there is no longer any significant pattern of nesting on any of the inhabited islands (Hawaii, Maui, Molokai, Oahu, Lanai, Kauai, and Niihau).

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In the absence of long-term data from the nesting sites on the leeward (western) islands, it is not possible to speak with much confidence about trends of turtle abundance in Hawaiian waters. There is widespread agreement among fishermen and professional biologists that there are far fewer Green turtles now than there were 20 years ago, but there is no good objective evidence in the form of censuses, etc. Such data as are available from government records of commercial fishing are described in the following section. I have personal knowledge of four professional fishermen who, in times past, made a speciality of netting turtles; two have stopped this effort as insufficiently productive to support a reasonable living, only one is still seriously in the business and not doing well.

Unpublished work done in the present decade by the Hawaii State Division of Fish and Game, the U.S. Fish and Wildlife Service, the Smithsonian Institution, and the present writer indicates that the major portion of nesting by Hawaiian sea turtles takes place on a few islands in French Frigate shoals, an atoll located approximately at the mid-point of the island chain about 480 miles from Honolulu. Beaches at Kure, Laysan, Lisianski, Midway, and Pearl and Hermes Reef are also used regularly for nesting, but the present impression is that the hatchling production from French Frigate Shoals exceeds that of all other sites combined.

Field workers from the Smithsonian Institution have offered a highly tentative estimate of between 650 and 1300 turtles (both sexes) using French Frigate Shoals during the month of August. It is almost meaningless to manipulate this figure, but, for lack of anything better, I suggest that one might assume twice the August number to represent the month of July and take the same increment for the early part of the season. One would then obtain a figure of between 2,600 and 5,200 turtles as the Hawaiian breeding population (1 + 2 + 1 times 650 - 1,300, and ignoring all other island nestings). While it is very important to state flatly that this estimate has little basis and is not to be trusted, one can at least say that it does not appear to conflict violently with any other available quantitative information.

b) Exploitation

Sea turtle products have no significant monetary relation to the national economy of Hawaii, but one might make the argument that living turtles in the sea do have definable value to the area's tourist-oriented economy. They constitute one of the esthetic attractions of an area where skin- and SCUBA-diving play an increasingly important role and where the total man-hours in the water are reaching very high levels. It would pay Hawaii well (and most informed people recognize this) to promote a situation where every neophyte skin-diver from Iowa or the Bronx had a gambler's chance of being able to go home with a tale of encountering a sea turtle while skin-diving near the reef in Hawaii.

The other side of the coin is that the tourist industry produces a demand for exotic luxury foods such as turtle steaks and turtle soup. Certain restaurants and hotels will now pay \$2.35 and more per pound for the fresh-butchered flesh from the pectoral girdle of a Green turtle; the mark-up by the time it reaches the diner can be imagined, but wealthy tourists will pay, and the supply never equals the demand. Thus, while Green turtles are no longer considered common enough to support full-time, professional net fishermen, every Tom, Dick and Harry who happens upon one has a strong incentive to capture it. A 200 lb. turtle represents perhaps \$50 plus a good meal for family and friends, in addition to a shell to keep or sell.

The special market for the red meat is the principal feature of turtle exploitation in Hawaii. The market for polished shells is a casual one; calipee is not prepared, fat is discarded, and the hide is not saved for leather.

For the past 20 years, the Hawaii Division of Fish and Game has required licenced commercial fishermen to include sea turtles in their periodic reports. The compiled data show annual catches ranging from 17,000 pounds live weight during 1948 (the first year) down to a few hundred pounds in some years. The Division itself is the first to stipulate that the data are imperfect, fluctuating widely and uncheckable.

Particularly in the more recent years after statehood, when income taxes became an important fact of life in Hawaii, there is excellent reason to suspect non-reporting or under-reporting. Further, as the Director of Hawaii Fish and Game says (personal communication): "... I have little doubt that the sport fishery take plus possible unlicenced commercial take far exceeds the legitimate commercial take."

Each year, the Division has been able to obtain a sample of data in which the total poundage of at least one batch of turtles is accompanied by information on the number of animals making up that poundage, allowing a rough indication of "average weight". This figure ranges all the way down to 31 pounds, although it is more commonly close to 100 pounds.

The reported income from sale of turtles has varied somewhat randomly during the past two decades between \$.10 and \$.39 per pound of live weight. Again there is a possibility of under-reporting. It is probably worth noting that the highest reported price of \$.39 per pound live weight is for 1967, the last year represented in the available records, and that the 1966 and 1967 reported harvests are from 3 to 12 times higher than any year since 1956. The enormously strengthened demand for turtle steaks implied in this price rise corresponds with the boom in luxury hotel construction during the last few years.

Almost the entire reported commercial "take" of sea turtles in Hawaii appears to come from inshore waters of a few limited areas on the leeward coasts of Maui, Molokai, and Hawaii. There, long nets (up to $\frac{1}{2}$ mile or more) with stretched mesh of about 18" are laid over the reef in from 5 to 15 feet of water.

From the above, it will be clear that it is impossible at the present time to more than a wild guess at the rate of human predation upon Green turtles in Hawaii. A parallel depletion factor which is demonstrably significant, but equally impossible to estimate in exact fashion, is the rate of predation by large sharks. Appendix I gives a sample calculation of annual loss due to these two factors, using what fragments of information and intuition we have. It arrives at a "guesstimate" of 1,500 turtles of 50 lbs. or more body weight taken out of the Hawaiian population annually by men and sharks. Any Green turtle weighing 50 pounds is probably at least two years old; it is an alert, strong-swimming animal which has survived the worst predation levels in the life history and stands a good chance of becoming a breeder (many weigh 200 - 300 pounds and are already breeders). This is an impossible figure in the light of the earlier estimate of a breeding population of between 2,600 and 5,200 animals, but it does at least conform with the subjective impression that the Hawaiian turtle populations are over-exploited, under-protected, and declining at a significant rate.

c) Conservation

At the present time, Hawaii has no law governing the taking of sea turtles. The appropriate authorities are alert to the need for a suitable code, but they presently lack any objective basis for formulating legislation. They must have this; the local citizenry includes a large proportion of people who are closely tied to the sea by culture, custom, and emotion... they are notably jealous of restrictive legislation in this regard. Hawaii Fish and Game must offer convincing evidence of necessity before it can legitimately expect to obtain legal controls on the taking of sea turtles.

To date, the Division of Fish and Game has not been able to obtain funds for meaningful investigations on sea turtles. They will cooperate enthusiastically with any legitimate projects which can be started, and the writer is confident that they would draft and present for approval suitable legislation as soon as the necessary factual evidence was available.

Aside from Hawaii Fish and Game, the principal operative conservation agency in the Hawaiian area is the U.S. Federal Fish and Wildlife Service, which controls French Frigate Shoals and other nesting grounds in the leeward islands as total sanctuaries. Complete protection is the rule within these sanctuaries (although legitimate research programs are encouraged if they show promise of contributing toward improved protection through increased knowledge). However, the sheer isolation of the islands concerned remains their most real protection at the present time.

The patrol and enforcement capability of the Hawaiian office of the U.S. Fish and Wildlife Service is severely limited. A single, dedicated officer comprises the entire staff, so far as the writer is aware. This man must depend upon the courtesy of State and other Federal agencies (especially the military) to even visit the sanctuaries for which he is responsible. Nothing in the way of propagation and little in the way of other programs may be expected under these circumstances.

d) Research

Since 1961, approximately 350 adult and semi-adult Green turtles have been marked with numbered monel tags by, or on behalf of, the U.S. Fish and Wildlife Officer. More than half were marked at French Frigate Shoals, the rest in other parts of the leeward group. Four good returns were in hand at last communication: two turtles tagged at French Frigate Shoals were taken in the main islands about 500 miles ESE, and two turtles tagged at Pearl and Hermes Reef have been recorded (not killed) in French Frigate Shoals - again a movement of about 500 miles ESE.

The writer has, as marginal time permitted, carried on a few small projects. A few young Green turtles are being maintained in captivity for further information on growth rates and dietary requirements. These same animals are also being used by psychologists from Reed College for work on learning behaviour (they learn quite readily to tap a lever three times for a bit of food, etc.). Hatchling Dermochelys coriacea imported from Malaya were maintained in captivity for an extended period and reached weights exceeding 20 pounds. A small survey of the stomach contents of commercially caught Green turtles has been completed and is now in draft manuscript form. Some work has been done on dissection of the middle and internal ear, preliminary to a study of the animals' ability to use high amplitude, low frequency sound as part of a possible guidance system. A beginning has been made on immunological studies of the Hawaiian green turtles as part of a search for a "living tag" by means of which animals marked as hatchlings might hopefully be recognized as adults through their immune reactions to special antigenic substances.

2. Requirements for the Area

a) Research

There should be set up as soon as possible a tag-recovery program to determine the size and the range of the Hawaiian population, its patterns of migration, and the dynamics of population recruitment and attrition.

This should include a beach program at French Frigate Shoals including both marking and hatchery work, a net-capture program in the larger, windward islands, and (if possible) a program to tag basking turtles at the extreme western end of the chain (Kure, Pearl and Hermes Reef). This should have a minimum duration of 8 years. Because of the great distances involved and necessity of using chartered vessels for transport, costs will probably run above \$30,000 per year.

There should be a program of instrumentation and telemetry of migrating adult turtles to determine migration routes and to seek answers to a number of basic questions concerning navigational mechanics. It is suggested that Hawaii may prove to be an especially good locale for this work for a number of reasons: There is a strong probability that a double population nests at French Frigate Shoals, one group migrating eastward to feeding grounds around the inhabited islands, the other group moving westward an equal distance for the same purpose. The island chain is close to being linear, encompassing distances which are ample for demonstration of migratory characteristics, yet not too great for logistic handling. Military logistic flights now routinely cover the entire linear chain on a bi-weekly basis, enabling good monitoring of instrumented animals or tele-buoys at low cost. The current patterns of the ocean waters concerned are perhaps as well known as any in the Pacific world, because of a long history of detailed work by tuna researchers and general oceanographers.

A culture "farm" should be set up in a suitable bay or lagoon situation to develop standard techniques for efficient rearing of young turtles to a size suitable for efficient marketing, with early assistance sought from the management of luxury hotels where there will be a continuing demand for turtle flesh and where there should be acceptance of the idea of rearing their own animals.

Appendix I

Trial Calculation of Depletion Rate in Hawaiian Green Turtle Populations

Officially reported commercial catch in 1967 5,000 lbs. (live weight)

Assume actual commercial take was twice this10,000 lbs.

Assume average weight of 100 lbs. per turtle (sample average for 1967 was 99 lbs.)100 individuals

Assume the 1967 harvest by sport divers and recreational net fishermen was 4 times the commercial take, or 40,000 pounds, and that the average weight per turtle was 50 pounds800 individuals

From data on stomach contents of some 400 Tiger sharks examined during 1967-1969 (cooperative program of University of Hawaii, Oceanic Institute, and State of Hawaii Fish and Game), assume a predation rate of no less than 100, possibly 1,000 turtles per year of live weight 50 lbs. and aboveSay, 600 individuals.

Say, 1,500 turtles per year of body weight 50 lbs. and up, lost to human and shark predation.

N.B. These estimates are almost totally "blue-sky" guesses, with virtually no solid basis in established fact. The only excuse for making them at all is the total absence of any other information.