FATTY ACIDS IN DEPOT FAT OF JUVENILE GREEN TURTLES FEEDING AT DIFFERENT LOCATIONS IN THE HAWAIIAN ISLANDS

M. Katherine Moore[1], Gloria T. Seaborn[1], George H. Balazs[2]

[1]National Marine Fisheries Service, Southeast Fisheries Science Center, Charleston Laboratory, P.O. Box 12607, Charleston, SC 29422-2607

[2]National Marine Fisheries Service, Southwest Fisheries Science Center, Honolulu Laboratory, 2570 Dole Street, Honolulu HI 96822-2396

Locations of feeding grounds and types of food available to marine turtles are important conservation considerations. The green turtle, Chelonia mydas, is unique among marine turtles in that as an adult in the wild, it is preferentially an herbivore, feeding on sea grasses and algae (Ross 1985, Bjorndal 1981, Mortimer 1981, Balazs, 1980).

Dietary fatty acids may be incorporated directly into depot fat, in addition to the fatty acids biosynthesized by the animal. Joseph et al. (1985) described the effects of diet on the depot fatty acid composition of the green turtle. Differences were noted between the fatty acid composition of depot fat of a Caribbean green turtle, feeding primarily on sea grass, and that of a green turtle captured in the Hawaiian Islands. The authors suggested that the inclusion of algae, and possibly jellyfish, in the diet of the Hawaiian green may account for this difference.

Hawaiian green turtles spend most of their lives residing in coastal areas of the large volcanic islands at the southeastern end of the archipelago. Research at numerous sites in these nearshore waters is ongoing to gather baseline data on growth rates, food sources, movements, health status, habitat characteristics, and population trends (Russell and Balazs 1994, Balazs et al. 1994, Balazs 1991, Balazs et al. 1987, Balazs 1980). The habitat characteristics of these foraging pastures differ considerably and cause variations in feeding strategy and behavior. We undertook a study to determine if depot fatty acid composition could be used to identify feeding locations for Hawaiian green turtles. We collected depot fat samples from juvenile turtles from two distinct feeding populations. The initial phase of the study, described in this report, is a comparison of the depot fatty acid composition of 22 turtles captured at Ahu-O-Laka in Kaneohe Bay, Oahu with those of 24 animals from Kiholo Bay, Island of Hawaii. Though both turtles with and without fibropapillomatosis were caught and sampled, only apparently healthy animals are addressed in this phase of the study.

STUDY SITES

Kiholo Bay is a small bay on the Kona Coast of the Island of Hawaii. The turtles sleep under the rocky outcrops of the shore of the bay at night and feed on the red alga Gelidium pusilium from nearby lava rock substrate during the day. Ahu-O-Laka is a submerged sandbar in the middle of Kaneohe Bay on Oahu. Resident turtles are thought to feed primarily on Halophila hawaiiensis, a sea grass which grows abundantly in the sandy substrate. Turtles also have the opportunity in Kaneohe Bay to feed on Hypnea, Acanthophora, Codium, and Ulva, but these algae have not been found in significant amounts in stomach flushings or in the mouths of turtles caught at Ahu-O-Laka (Balazs et al. 1993). Many of the turtles captured at Ahu-O-Laka still had blades of Halophila in their mouths when apprehended. There is no overlap between Kiholo Bay and Ahu-O-Laka in availability of plant food items.

MATERIALS AND METHODS

Turtles were caught at Kiholo Bay on Hawaii and at Kaneohe Bay on Oahu. Kiholo animals were caught by hand while snorkeling along the rocky shore of the bay at night. Kaneohe Bay animals were caught by hand by diving from the bow of a small boat while motoring slowly along the sandbar-grazing area known as Ahu-O-Laka. Tissue biopsies were taken from the fat pocket located just dorsal to the insertion of the right hind flipper. The area was deadened with lidocaine and rinsed with betadine before a small incision was made with a scalpel, and 1-5 g fat was teased out using a scalpel and hemostat. The incision was closed with 1-2 stitches, and the turtle was returned to the water (Balazs 1985, Balazs and Morris unpublished data). Halophila hawaiiensis was collected at Ahu-O-Laka, and Gelidium pusilium was collected at Kiholo.

Fat and dietary samples were frozen on dry ice immediately after collection and stored at -20°C until analyzed. Lipids were extracted from samples with chloroform/methanol (Folch, 1957) and fatty acid methyl esters were prepared as described by Christopherson and Glass (1969). The resulting fatty acid methyl esters (FAME) were analyzed on an HP5890 gas chromatograph fitted with a 30 m DB225 capillary column and a flame ionization detector. Peaks were identified by comparison of their retention times with those of primary and secondary standards, argentation TLC, and GC/MS.

RESULTS AND DISCUSSION

Though the habitats, and therefore the dietary items, were distinctly different at Kiholo and Ahu-O-Laka, these differences were not reflected in the composition of the depot fat of the animals feeding in these two locations. A correlation was observed between depot fatty acid profile and the size of the turtle (SCL), regardless of feeding location. The Type 2 profile (Fig. 1), typical of the larger animals, had marked similarities to those found for depot fat of an adult Caribbean green turtle (Joseph et al, 1985) and both Hawaiian and Caribbean green turtle egg lipids (Seaborn and Moore, unpublished data). The typical profile found for the smaller turtles may indicate differences in lipid metabolism or, to some extent, their diet in the pelagic stage. If site-dependant differences exist in the depot fatty acid composition of the turtles feeding at the two sites, they were masked by the striking differences associated with turtle size (Fig. 2). Although this study did not show a definitive relationship between diet and depot fatty acid composition, it does suggest opportunities for studies in predator/prey relationships and lipid metabolism.

ACKNOWLEDGEMENTS

The authors would like to gratefully acknowledge the help of Shawn K. Koga, Connie Sears, Marc Rice, George Watson, and students of the Hawaiian Preparatory Academy.

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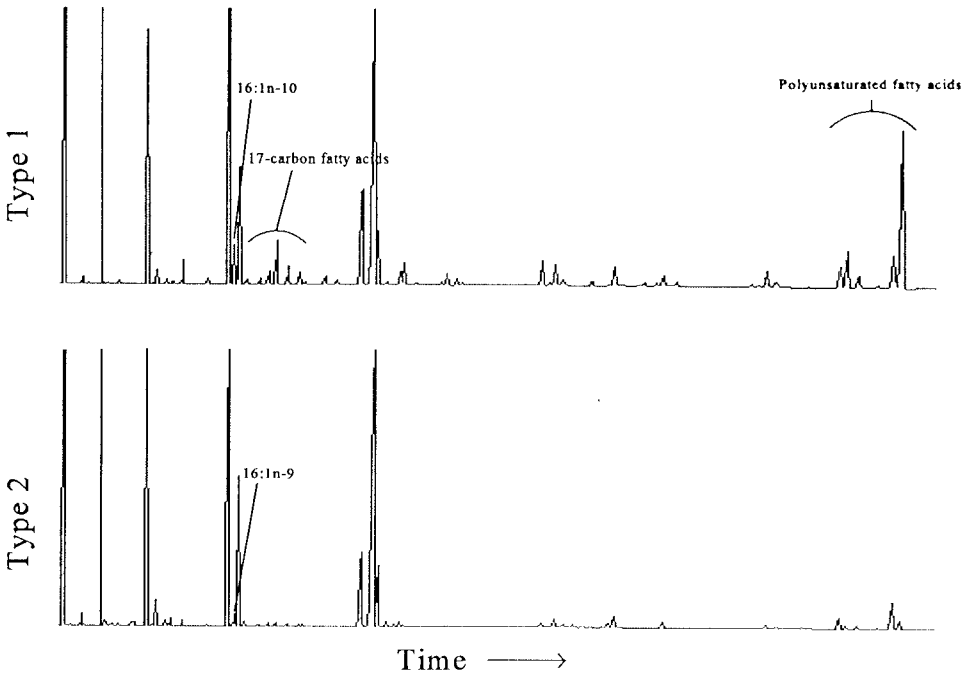

Figure 1. Typical chromatographic profiles from analysis of turtle depot fat. Elution time is directly related to the identity of each component; peak size is directly proportional to the amount of each componenet in the sample. Although considerable variations were found in the fatty acid profiles of turtles from both locations, most of the animals could be categorized as having one of two profile types. We arbitrarily designated these as Type 1 and Type 2. 20 Kaneohe Bay turtles and 11 Kiholo turtles were classified as Type 1. 9 of the Kiholo Turtles were classified as Type 2, with 3 Kiholo and 2 Kaneohe Bay animals classified as intermediate between the two profiles. Major differences between the two profile types were exhibited in the 16-carbon monoenes, the 17-carbon fatty acids, and the polyunsaturated fatty acids.

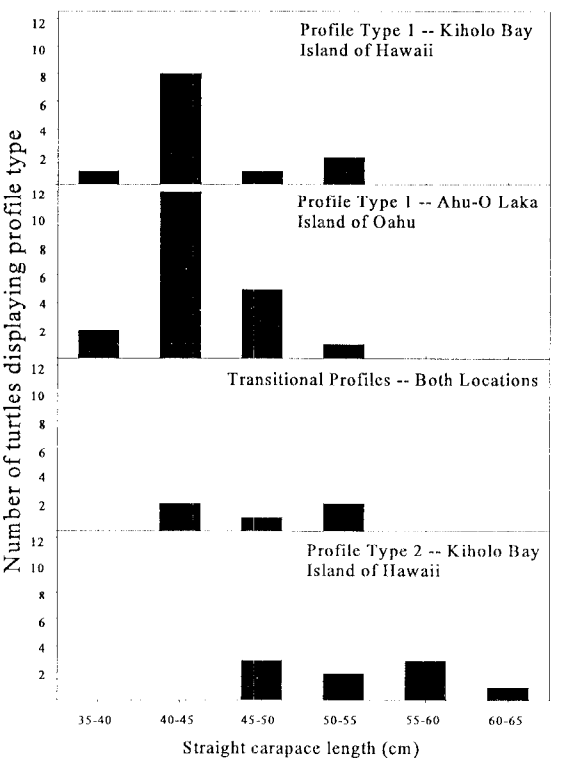

Figure 2. Size distribution based on straight carapace length (SCL) for each type of turtle and each location. Turtles classified as Type 1 were predominantly those with SCL of 40-45 cm, while those classified as Type 2 had SCL>45 cm. Turtles with a fatty acid profile intermediate between the two were also of intermediate size.

NOAA Technical Memorandum NMFS-SEFSC-387

PROCEEDINGS OF THE FIFTEENTH ANNUAL SYMPOSIUM ON SEA TURTLE BIOLOGY AND CONSERVATION

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Hilton Head, South Carolina

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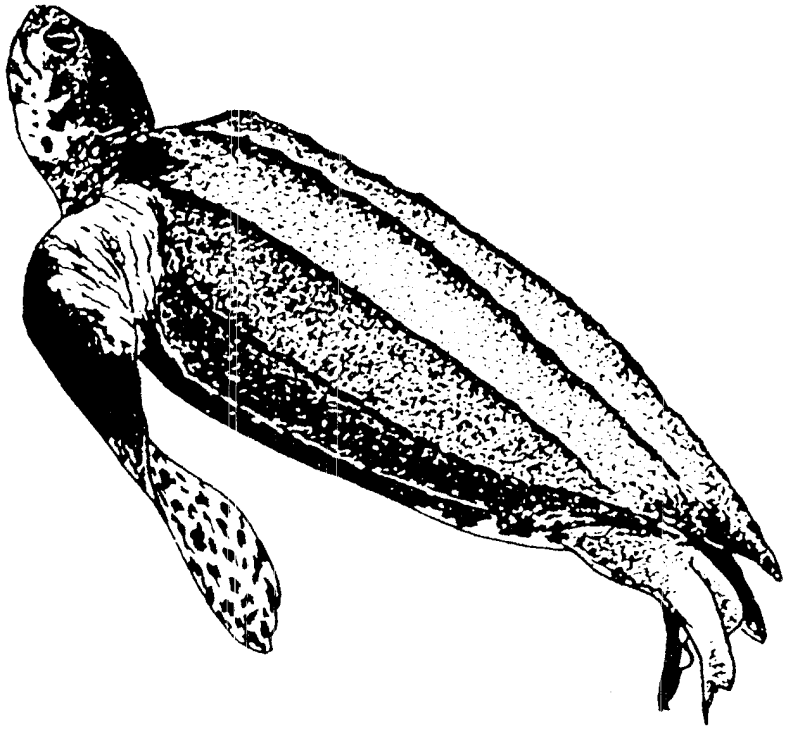

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149

June 1996