

Epibionts of Hawksbill Turtles in a Caribbean Nesting Ground: A Potentially Unique Association with Snapping Shrimp (Crustacea: Alpheidae)

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Much of the information available on sea turtle epibionts concerns the organisms associated with loggerhead sea turtles (*Caretta caretta*). Thus, it is typically believed that loggerheads support larger and more diverse epibiotic communities than any other sea turtle species (Frick *et al.* 2000). A quick foray through the literature on loggerhead epibionts reveals that loggerhead turtles host more than 125 epibiotic species worldwide (Bugoni *et al.* 2001; Dodd 1988; Frick *et al.* 1998; Frick *et al.* 2000; Senties *et al.* 1999; Williams & Frick 2001). Yet, a recent survey of the epibionts associated with hawksbill turtles (*Eretmochelys imbricata*) on Puerto Rican foraging grounds (primarily subadult turtles) reveals that hawksbill epibiotic communities often rival those of loggerheads in load, abundance and diversity (Scharer 2001). Currently, over 100 epibiotic organisms are hosted by hawksbills worldwide (Frazier *et al.* 1985; Scharer 2001; Witzell 1983). As more material becomes available there is no doubt that new species will be found as epibiotic associates of both hawksbills and loggerheads.

Despite over three decades of flipper tagging in some areas, it is surprising that there is little information available on the epibionts of nesting hawksbill turtles in the Caribbean. Carr *et al.* (1966) note the occurrence of heavily fouled nesters at Tortuguero, Costa Rica and point out large white barnacles (apparently *Chelonibia* sp.) on the carapace and plastron. Much of the remaining literature available on the epibionts of hawksbill turtles in the Caribbean concerns foraging turtles and immature specimens (Scharer 2001; Witzell 1983). There are no published studies that have monitored the epibiont community composition of a population of hawksbill turtles continuously throughout the course of a nesting season.

Inspired by the hawksbill turtle's propensity for epibiont growth, we initiated a study of the epibionts associated with nesting hawksbill turtles from Pasture Bay Beach, Jumby Bay, Long Island, Antigua, in the West Indies from June – November 2001. We sampled 28 individual hawksbill turtles (curved carapace length (CCL), 79.0 – 96.6 cm average = 89.2 cm) following

methods outlined in Frick *et al.* (1998). A number of epibiont types were encountered (Table 1), usually attached to or living amongst sessile epibiota located on the posterior 1/3 of the carapace region. Several epibiont forms were also found living amongst epibiota accumulated beneath overlapping vertebral scutes, particularly the third and fourth vertebral scutes from the nuchal region.

The occurrence of some epibiont species identified during this study are noteworthy because they represent the first observations of these particular species as hawksbill epibionts and, in some cases, first reports as sea turtle epibionts (see Table 1). With the exception of obligate commensals like *Chelonibia* barnacles and *Podocerus chelonophilus* amphipods, all of the epibionts collected from Jumby Bay nesters are also commonly found as free-living forms, usually associated with live bottom habitats throughout the greater Caribbean. Thus, the occurrence or density of any of the aforementioned epibionts is most likely an artifact of the seasonal or even cyclical recruitment of these forms into the marine habitats utilized by female hawksbills during interesting periods. In the present case, coastal live bottom habitats appear to be the interesting habitats used by hawksbills observed nesting in Antigua. A study by Starbird *et al.* (1999) reported similar interesting habitat use by nesting hawksbills from Buck Island, St. Croix, U.S. Virgin Islands. Nesting loggerheads in the southeastern U.S. commonly host epibiont taxa analogous in composition, density and abundance to the fouling communities found on submerged structures adjacent to interesting habitats and Puerto Rican hawksbill turtles at coral reef and cliff wall foraging habitats commonly host epibionts similar to the fouling communities associated with their surrounding environment (Caretta Research Project unpublished data; Scharer 2001).

Given the wide-ranging migration events documented for adult hawksbill turtles in the Caribbean, sometimes 1900+ km, and the hawksbill turtle's affinity for coastal live bottom and reef habitats, it is not surprising that the epibionts documented in this study are similar to

epibiotic taxa found on hawksbill turtles throughout the Caribbean (Meylan 1999; Scharer 2001; Witzell 1983). It is possible that 'reef-hopping macrofauna', like hawksbill turtles, may aid in the introduction and emigration of certain plants and animals from one reef system to another, a point worthy of consideration to any student of biodiversity.

Although it was previously mentioned that we were not surprised to find the aforementioned epibiota from Antigua nesters given the commonality of many of these species within coral reef and other live bottom habitats throughout the greater Caribbean, the occurrence of alpheid shrimp (*Synalpheus fritzmuelleri*) as epibionts of hawksbill turtles is, however, possibly a unique association amongst sea turtles. Alpheid shrimp are easily recognized by their single, large, modified claw or chela that is used to make distinct snapping or popping sounds. Laboratory studies indicate that the concussion wave generated by the snapping shrimp's chela, which has been observed to shatter the glass of an aquarium, serves to stun small animals (Williams 1984). A remarkable adaptation evoked for territorial disputes, protection and prey acquisition.

Known colloquially as the speckled snapping shrimp, *S. fritzmuelleri* is a relatively small shrimp (up to ~2 cm in length) that can be found in temperate to tropical waters from Beaufort, North Carolina, USA to Santa Catarina, Brazil; Gulf of Mexico; Bermuda; St. Helena Island, South Atlantic and Baja California (Chace 1966). In temperate and subtropical climates, *S. fritzmuelleri* breeds during the warmer months of year and year-round in tropical regions. Members of the genus *Synalpheus* are commonly known as 'sponge shrimps', well-noted denizens of the external and internal surfaces of large sponges associated with nearshore, reef habitats; *S. fritzmuelleri* is no exception (Chace 1972). However, *S. fritzmuelleri* is also known to inhabit a variety of gaps and sinuses associated with other reef inhabitants. In southeastern Florida, USA *S. fritzmuelleri* is commonly found on sabellariid worm (*Phragmatopoma lapidosa*) reefs (Gore & Wilson 1978; Gore *et al.* 1976; 1978). Aside from *S. fritzmuelleri*'s breeding periodicity and its affinity for reef habitats and reef associated sessile organisms, very little is known of the speckled snapping shrimp's life history (Williams 1984). Thus, it is difficult to speculate the nature of the relationship that exists between *S. fritzmuelleri* and the hawksbill turtle.

We found *S. fritzmuelleri* present amongst samples that were collected from the overlapping scutes of three Jumby Bay nesters (n=3 shrimp: 1 adult male and two ovigerous females). Additionally, we found a single alpheid (an ovigerous female) living amongst epibiota within a gap formed by a carapace injury or deformation on the center of the third, right-hand costal scute of a fourth turtle. Only one other study reports the occurrence of alpheid shrimps as epibionts of sea turtles (Scharer 2001). Scharer (2001) found alpheids (identity not specified) to occur under the overlapping scutes of 3.8 % of the immature hawksbill turtles she surveyed from Puerto Rican coral reef foraging grounds near Mona Island. She also noted that epibionts situated beneath overlapping scutes were most common on immature hawksbills as the scutes of adults are typically more juxtaposed rather than imbricated - although, relatively young nesters will occasionally bear a few overlapping scutes and harbor epibionts within the associated crevices (Witzell 1983; present study). Nonetheless, it is the occurrence of *S. fritzmuelleri* from a carapace injury or deformation (as mentioned above) that provides reason for highlighting the association between alpheid shrimp and hawksbill turtles.

Epibiont	Frequency (%)
Annelida: ²	
<i>Hydroides</i> sp. ²	20 (71)
<i>Loimia</i> sp. ²	1 (4)
Arthropoda:	
<i>Chelonibia caretta</i>	27 (96)
<i>Chelonibia testudinaria</i>	2 (7)
<i>Micropanope nuttingi</i> ²	1 (4)
<i>Podocerus chelonophilus</i>	2 (7)
<i>Synalpheus fritzmuelleri</i> ²	4 (14)
Chordata:	
<i>Microcosmus</i> sp.	3 (11)
Cnidaria: ²	
<i>Podocoryne carnea</i> ²	2 (7)
Foraminifera:	
<i>Amphistegina</i> sp.	11 (39)
<i>Homotrema rubrum</i> ²	21 (75)
Porifera: ²	
<i>Lissodendoryx isodictyalis</i> ²	6 (21)
Sipunculida:	
<i>Phascolosoma</i> sp.	10 (36)
Algae:	
<i>Ceramium</i> sp.	13 (46)
<i>Chaetomorpha</i> sp. ¹	9 (32)
<i>Codium</i> sp. ²	2 (7)

Table 1. Epibionts from nesting hawksbill turtles (*Eretmochelys imbricata*) from Jumby Bay, Antigua, West Indies (n = 28 turtles).¹First report as a hawksbill epibiont, ²First report as a sea turtle epibiont.

Literally hundreds of loggerhead turtles - that are known to occupy reef habitats within the range stated for *S. fritzmuelleri* - have been surveyed for epibiota and not once have alpheid shrimp been observed (Dodd 1988; Frick *et al.* 1998, 2000). A logical assumption on the matter might contend that the overlapping scutes of the hawksbill turtle, which are absent in other species of marine turtles, could influence particular epibiont associations to occur, including the occurrence of *S. fritzmuelleri*. Yet, we found an alpheid also inhabiting a carapace abnormality on a hawksbill turtle. In the southeastern US, another haunt of the speckled snapping shrimp, we see many loggerhead turtles (immature and adult turtles alike) with carapace injuries and deformations similar to the one observed housing *S. fritzmuelleri*. Such abnormalities usually appear to be as a result of interactions with boat propellers and/or caused by barnacle colonization. Nonetheless, loggerhead turtles from the southeastern US, which have been the subjects of more intensive surveys, have failed to yield any alpheid shrimp - despite the residency of some loggerheads in reef habitats and the presence of shell abnormalities that form crevices analogous to those on hawksbills.

It is possible that behavioral differences in *S. fritzmuelleri* from widely separated localities may exist and epibiosis on turtles does not factor into the life history plan of some populations. Or, behavioral differences between hawksbill and loggerhead turtles may account for the occurrence of alpheid shrimp on the former and not the latter. It is also possible that the spongivorous feeding habit of hawksbills (Bjorndal 1997; Meylan 1988) prompts the occurrence of alpheid colonization. Perhaps alpheids emigrate onto hawksbills as the turtles consume sponges hosting snapping shrimp; after all it would be better to live atop the predator rather than the prey. Until more investigations of this topic are initiated and other turtle species with carapace abnormalities suitable for alpheid colonization are surveyed, the relationship between alpheid shrimp and hawksbills will remain potentially unique among sea turtles.

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Predation on Loggerhead and Leatherback Post-Hatchlings by Gray Snapper

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Sharks and fin-fishes have been documented as a significant source of mortality for hatchling sea turtles entering the ocean from rookery beaches and during the swim-frenzy period en route to nursery habitats (Carr 1986; Gyuris 1994; Stancyk 1982; Witham 1974; Witherington & Salmon 1992; Witzell 1981; Woodard 1980a; 1980b; 1980c; Wyneken & Salmon 1994). The aforementioned studies report snappers (*Lutjanus* sp.), tarpon (*Megalops atlanticus*), sea bass (*Centropristis striata*), grouper (*Epinephelus* spp., *Promicrops* sp.), moray eels (Muraenidae), barracuda (Sphyraenidae), jacks (*Caranx* spp.), wrasses (Labridae), parrotfish (Scaridae), dolphin (*Coryphaena hippurus*) and catfish (*Arius* sp.) as predators of loggerhead (*Caretta caretta*), green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempi*) and hawksbill (*Eretmochelys imbricata*) turtles. Unfortunately, these studies provide little or no qualitative or quantitative data regarding the predatory fishes involved, and predominately studied predation occurring directly adjacent to the nesting beaches. Fish predation on post-hatchlings (hereafter defined as neonates no longer in frenzied-swimming mode; Wyneken & Salmon 1992) in the western Atlantic has had limited study, particularly in continental-shelf waters away from nesting beaches. Here we present data on the frequency of occurrence of loggerhead and leatherback (*Dermochelys coriacea*) post-hatchlings

in the stomach contents of gray snappers (*Lutjanus griseus*) collected over offshore reef areas well to the east (2.5-11.5km) of high-density nesting beaches in southeastern Florida (study area bounded by 27° 05'N, 79° 59'W; 27° 05'N, 80° 08'W; 26° 51'N, 79° 59'W; 26°51'N, 80° 03'W). Additionally, we provide data on the physical characteristics of predatory snappers in relation to the size and condition of the post-hatchling turtles consumed.

Fish were collected as part of a study that is examining the feeding ecology of gray, lane (*L. synagris*), mutton (*L. analis*), and yellowtail (*Ocyurus chrysurus*) snappers, which focuses on identifying the principal prey that snappers consume just prior to and during their spawning season. We collected fish specimens from June-November 2000, a period spanning the sea turtle hatching season in our study area. The sampling area is a coastal section of southeast Florida extending from navigable, near shore waters out to a depth of 60 m. Sampling sites were randomly drawn from a pool of one-minute cartographic grids, and sampling locations within grids were selected using a sampling protocol for identifying reef structure within each grid (approximately 1 square nautical mile). At each sampling site we collected fish with wire fish traps containing bait and with bottom-rigged hook-and-line gear. We sampled two sites per week, setting three traps