

LONG-RANGE DISPERSAL POSSIBILITIES VIA SEA TURTLE - A CASE FOR *CLUNIO* AND *PONTOMYIA* (DIPTERA: CHIRONOMIDAE) IN PUERTO RICO¹

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ABSTRACT: Larvae of the marine midges *Clunio* and *Pontomyia* are reported as epibionts on the carapace of sea turtles. Turtle transportation may be an important factor in the dispersal of flightless marine midges.

KEY WORDS: long range dispersal, *Clunio*, *Pontomyia*, Diptera, Chironomidae, turtles, Puerto Rico

Pontomyia Edwards (Diptera: Chironomidae) is considered the only truly marine midge (Pinder 1995), occurring at depths down to 30 meters in Belize (Bretschko 1982) as well as in shallow coastal waters (Hashimoto 1976; Epler 2001). Larval *Pontomyia* and *Clunio* Haliday have been found associated with algae and are commonly collected in benthic samples and plankton tows (Tokunaga 1932; Hashimoto 1959). Most reports of *Pontomyia* species are from Indo-Pacific locations (Soong et al., 1999), but a single report exists from the Caribbean (Bretschko 1982), and Hudson et al. (1990) and Epler (1992, 1995, 2001) have reported the genus from Florida. *Clunio* has a worldwide distribution along temperate and tropical sea coasts. This note describes the presence of *Pontomyia* sp. and *Clunio* sp. as Hawksbill sea turtle [*Eretmochelys imbricata* (L.)] epibiota in Puerto Rico.

Previous studies of marine turtle epibiota have reported diverse assemblages of marine organisms (Caine 1986; Frick et al., 1998; Schärer 2003). Special reports have been generated for epibiotic groups such as barnacles (Bugoni et al., 2001; Gramentz 1988; Matsuura and Nakamura 1993; Monroe and Limpus 1979), mollusks (Frazier et al., 1985), crabs (Davenport 1994; Dellinger et al., 1997; Frick et al., 2000), tunicates (Frazier et al., 1991), Bryozoa (Frazier et al., 1992), and algae (Senties et al., 1999). Although midge larvae have been reported as commensals or parasites on a wide variety of invertebrates and vertebrates (Tokeshi 1993, 1995; Epler 2001), chironomids have not previously been reported as epibionts on marine turtles. This research theme may provide knowledge about the dispersal of epibionts as well as insight into habitat use and migrations by their hosts. Marine turtles inhabit coastal areas where intertidal organisms are present, and surfacing through the water column increases the likelihood for acquiring planktonic and benthic larval organisms. Results of epibiotic community studies on *E. imbricata* have identified groups previously unrecorded, such as the only known submarine Chironomidae.

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Mona Island and satellite Monito Island are located in the Mona Passage, between Puerto Rico and the Dominican Republic, approximately 75 km west of Puerto Rico, between 18° 00' N and 18° 13' N and between 67° 01' W and 67° 48' W. The islands' coasts are surrounded by limestone vertical walls, seagrass lagoons, reefs, and sandy beaches, which are nesting habitat for marine turtles. The water temperatures around Mona fluctuated between 25.5° and 30.5°C throughout the year. The islands' coasts provide foraging habitat for endangered species of sea turtles [*E. imbricata* and *Chelonia mydas* (L.)].

The epibiota were identified from 105 turtles collected in July and August of 1999. *Pontomyia* and *Clunio* larvae were present on 19 turtles (18%) which were also covered with patches of filamentous turf algae. This turtle-chironomid association was more frequent in coral reef (17 of 39) vs. cliff wall areas (2 of 66). Percent occurrence of chironomids was ten times higher on turtles of coral reef habitat (35.8%) than in cliff walls (3.0%); the difference is significant at $p < 0.001$ in Chi^2 , 2x2 contingency tables ($X^2 = 22.7$).

Individual *Pontomyia* and *Clunio* larvae were observed in the samples collected, swimming and crawling within algae and unconsolidated substrate composed of calcareous sediment, with foraminiferan tests, small shells, and other unidentified fragments. Chironomids were also observed within tubes of sand particles probably constructed by the larvae. The turtle project was not designed as a midge study; thus the numbers of larvae on each turtle were not recorded, only their frequency of occurrence was noted. The more frequent occurrence of larvae on turtles from coral reef habitat compared to those from cliff wall habitat may be related to the accumulation of sand and turf algae on the carapace of coral reef turtles; in cliff wall habitats this accumulation was less common.

Because only larvae were collected from the turtles, it was not possible to identify specimens of either genus to species. Only one species of *Clunio*, *C. marshalli* Stone and Wirth, has been described from the northwestern Atlantic, with a northernmost record from North Carolina (Epler 2001). The identity of the south Florida/Caribbean species of *Pontomyia* is unknown, because adult males, necessary for species identification, have not been collected. Bretschko (1982) suggested the most likely species would be *P. natans* Edwards, but the insects collected in the Caribbean and Florida could represent an undescribed species. Because Bretschko collected only larvae, pupae and females, he postulated that the Belize population may be parthenogenetic.

According to Soong et al., (1999), *P. oceana* Tokunaga larvae hatch and molt through 4 instars in a generation time of 30 days. Larvae lived up to 45 days under laboratory conditions; adult life stages lasted one to two hours. Soong et al. (1999) stated that the presence of males appears to be necessary for eclosion of females, but offered no explanation. In another marine midge, *Clunio marinus* Haliday, males must strip the pupal exuviae from females before mating (several papers summarized by Armitage 1995). Cheng and Collins (1980) hypothesized that such behavior may occur in *Pontomyia*, but it has never, to our knowledge, been observed.

In some parthenogenetic chironomid taxa, such as *Paratanytarsus grimmii* (Schneider), at least some eggs may be deposited within the pupal exuviae before eclosion (Langton et al., 1988) or all eggs may be laid within the pupal exuviae by unclosed females (P. S. Cranston, pers. comm.). Thus eclosion, whether aided by males or not, may not be necessary for successful reproduction. Bretschko (1982) did not report any eggs within pupal exuviae.

Clunio males are fully winged and have been collected in light traps in the Florida Keys (Hribar and Epler 2007), but females of *Clunio* and *Pontomyia* are wingless (and essentially legless). *Pontomyia* males possess shortened wings, useless for flight, which are used as oars as the midges skate across the water's surface. Males of *Clunio* may be able to disperse by flight over great distances, but *Clunio* females and both sexes of *Pontomyia* would be unable to do so. Thus, sea turtles may provide a significant means for long range dispersal for members of these two genera. It could also be hypothesized that *Thalassomyia*, another coastal marine genus that can occur with *Clunio* (Epler 2001), may eventually be found on the carapace of sea turtles. However, in *Thalassomyia bureni* Wirth, along with the other known coastal marine species in the Gulf of Mexico, *Telmatogeton japonicus* Tokunaga, both sexes are fully winged.

Much has been written about the life history of marine midges and the influence of tidal, lunar and diel effects (see Armitage 1995 for summary), but little has been observed or hypothesized concerning the dispersal abilities of marine flightless midges. Cheng and Hashimoto (1978) offered two hypotheses: males dragging their mates *in copula* would be attracted to fishing vessels, with some egg masses adhering to the algae growing on the sides of the vessels; or eggs could be embedded in floating algal mats which are then dispersed by currents, etc. There appear to be no fossil records of flightless marine midges and we do not know the extent of distribution of these taxa before humans began plying the seas. The fishing vessel hypothesis may partially explain "modern" distribution and dispersal, but it cannot be tested without a fossil record.

Growth of the epibiotic community on a turtle may be enhanced by increased water flow over the carapace, increased exposure to light (when the turtle is surfacing to breathe), and protection from predation or escape from unfavorable conditions. The distribution of marine chironomids and *E. imbricata* overlap in Pacific and Caribbean tropical regions. Trans-Caribbean migrations of adult sea turtles (Van Dam and Diez, unpublished data) may provide for distribution of chironomid species with limited dispersal capabilities, such as *Clunio* and *Pontomyia*. With the recent report (Green and Sánchez 2006) of live midge larvae being transported in the feces of Black-tailed Godwits [Aves: Charadriiformes: Scolopacidae: *Limosa limosa* (L.)], biogeographical hypotheses for marine invertebrates with limited dispersion capabilities should also be reviewed in light of this new observation of turtle transportation. Or, in other words, testudine transportation of tiny tenacious "tendipedids" may partially account for their distribution.

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