

Increasing numbers of green turtles afflicted with debilitating fibropapillomas (fibrous epithelial growths) have been recorded during recent years in the Hawaiian Islands (Balazs 1986; Dailey and Balazs 1987). A concomitant increase in parasitization by *Ozobranchus* has also been seen, especially on the turtles diseased with tumors. Fibropapillomas are highly vascularized, thereby affording ideal sites for leeches to attach. The relationship between *Ozobranchus* and fibropapillomas was first described by Nigrelli and Smith (1943).

Experimental prophylaxes on captive sea turtles parasitized by *Ozobranchus* have included the use of various toxic agents. Schwartz (1974) immersed captive loggerheads, *Caretta caretta*, and green turtles in copper sulfate solution; this treatment proved effective in eliminating *O. margoi* adults and their egg cases but induced increased swimming activity in the turtles. Concentrated topical iodine used by Schwartz (1974) was only temporarily effective. Davies and Chapman (1974) reported that 3 of 85 captive sea turtles heavily parasitized by *O. branchiatus* and *O. margoi* died several months after treatment with copper sulfate, but cause of death was not determined. They also applied 10% formalin directly to the leeches and their eggs, after which the turtles were left out of the water for 3 hours. This treatment, however, was not highly effective (Davies and Chapman 1974). At Sea Life Park in Hawaii, several topical treatments with isopropyl alcohol successfully eradicated *O. margoi* in a massive outbreak on captive green turtles, loggerheads and hawksbills, *Eretmochelys imbricata* (Sea Life Park unpublished data, 1978).

As with any toxic chemical treatment for parasites, there is the possibility of undesirable, acute or chronic side effects to the host. Consequently, the use of a benign therapy would be preferable, if such a treatment were available. On 9 August 1987, a lethargic juvenile green turtle, afflicted with tumors and measuring 55 cm in carapace length, was found stranded at Kailua Beach on the Island of Oahu, Hawaii. Numerous *O. branchiatus* were present on the turtle, especially on the ulcerated tumors protruding from the neck and eyes. Egg cases also were present in abundance. The turtle was subsequently held in a shaded seawater tank measuring 2.4 m in diameter and filled to a depth of 0.5 m. The turtle continued to survive in this holding facility, where it was fed chopped fish and squid on a daily basis. Incidental observations made during routine tank cleaning over the following weeks revealed that the leeches seemed to be negatively affected by rinsing with fresh water from a hose. As a result, systematic treatment and observations were conducted. Treatment consisted of draining the turtle's tank completely and filling it with fresh water. When treatment began on 23 September 1987, 120 leeches were attached to the turtle. The leeches reacted immediately to immersion in fresh water by rapidly crawling over the surface of the turtle. Within 30 minutes of soaking in fresh water, leeches began to fall off and were found dead on the tank bottom. After 90 minutes, 80 leeches remained on the turtle. The tank was then drained and refilled with seawater. The number of leeches on the turtle decreased

progressively after the freshwater immersion. On the following day, only 35 of the initial 120 leeches remained. Only four leeches remained after 4 days; no leeches were present on Day 6.

Two weeks after treatment, leeches began to reappear, and the egg cases had changed from a dark to a light color. Close examination revealed that the lighter color represented newly hatched eggs. Consequently, it was concluded that the freshwater treatment had little or no effect on the egg cases and that additional treatments would be needed to completely rid the turtle of leeches as new ones hatched. Subsequent immersions were conducted on this turtle and on a second one also found stranded with a heavy infestation of *O. branchiatus*. Eventually, both turtles were completely freed of leeches, and no negative effects were seen.

The relative scarcity of *Ozobranchus* on healthy green turtles in Hawaii suggests that some natural mechanism exists to deter or eliminate these parasites. Hawaiian green turtles commonly use algal and sea grass foraging habitats, where freshwater discharges into the sea. Reduced salinities at these locations may aid in the control of *Ozobranchus* through hypotonic shock. According to Sawyer et al. (1975), both *O. branchiatus* and *O. margoi* occur exclusively in salinities over 30‰. Another possibility in controlling leeches is that healthy turtles subject themselves to more frequent grooming by certain fishes at discrete underwater cleaning stations known to exist in Hawaii (Balazs 1980; Balazs et al. 1987). The special circumstance of adult green turtles sometimes basking ashore in Hawaii may also facilitate leech control through heating and desiccation (Whittow and Balazs 1982).

Future research should examine different levels of salinity and duration of immersion needed to effect mortality in leeches on captive turtles. These data may then be used to help explain, or predict, the natural means of parasite control by sea turtles in the wild and to refine a practical nonchemical treatment against leeches in captive turtles.

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## TECHNIQUES

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### A NEW THERAPY FOR MARINE TURTLES PARASITIZED BY THE PISCICOLID LEECH, *Ozobranchus branchiatus*

Marine leeches, *Ozobranchus* spp., are prominent ectoparasites on the green turtle, *Chelonia mydas*, in the Hawaiian Islands and on certain other sea turtle populations worldwide (Hirth 1971; Balazs 1980). Both *O. branchiatus* and *O. margoi* have been documented on green turtles in Hawaii, but the former species is believed to be more prevalent (Balazs 1980). A quantitative survey on this subject is currently in progress by the authors.

The two species of leeches are easily distinguished in that *O. branchiatus* has seven pairs of branchiae and *O. margoi* has only five. The former species ranges in length from 3.5 to 11 mm, and the latter is 4 to 30 mm (Sawyer et al. 1975; Davies 1978; Lauckner 1985). Both species attach to soft skin surfaces of the axial and inguinal regions, as well as the neck, eyes and cloaca. In heavily parasitized turtles, yellowish mats of leech egg cases are commonly found cemented to the plastron and ventral surfaces of the neck and flippers.

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