TECHNIQUES

RETENTION OF FLIPPER TAGS ON HATCHLING SEA TURTLES

The inability of researchers to find a tag suitable for hatchling sea turtles has been mentioned repeatedly in the literature (Carr 1967*a*, 1967*b*; Hirth 1971; Hughes 1974; Carr et al. 1978; Mrosovsky 1978*b*, 1982, 1983; Rudloe 1979; Hendrickson and Hendrickson 1980). Body dimensions and weight increase substantially as a hatchling grows from a few centimeters long to an adult of 70 cm or more. This factor has been viewed as a major obstacle to devising a practical tag that will stay in place. Furthermore, an added demand on such a tag is the many years (10-60) that may be required for a turtle to reach adult size (Balazs 1979, 1982*b*; Limpus 1979; Limpus and Walters 1980; Mendonca 1981). A successful tag for hatchlings has considerable potential for answering important questions about survival rates, geographical dispersal, the "lost year" pelagic phase, early growth rates, and nesting site affinities. It would also help in evaluating hatchery and head-start projects attempting to replenish depleted turtle populations.

Existing published information on attempts to tag hatchlings with an external mechanical tag suggests that such a tag is "... soon either overgrown or popped off by the increasing thickness of the tissue it perforates" (Carr 1967*b*; see also Hirth 1971; Hughes 1974; Mrosovsky 1983). However, the details of the experimental evaluation leading to this conclusion have not been reported. Plastic tags have been used on the hind flipper (Carr 1967*b*) and carapace (Uchida 1973; Hughes 1974) of hatchlings released into the wild, but no recoveries have been reported, and shedding rates have apparently not been estimated through captive rearing. There is no specific mention in the literature of the use of metal tags on hatchlings. Metal flipper tags have been regularly used on adult sea turtles at nesting sites since the early 1950s.

Besides external mechanical tags, other marking techniques that have been tried on hatchlings include the internal implantation of small magnets (Carr 1967*b*) and stainless wire (Hughes 1974; Schwartz 1981), branding (Carr 1967*b*), tattooing (Carr 1967*b*; Balazs 1978), injection of europium (Shoop 1978) and autografts (Hendrickson and Hendrickson 1980). Some workers have also marked hatchlings by cutting away or notching marginal scutes (Bustard 1972, 1979; Hughes 1974; Limpus 1978). However, this technique has not resulted in reliable long-term recoveries. Furthermore, a potentially confusing situation has developed because hatchlings have been notched in many different research programs over the years. There are also inherent difficulties in distinguishing a notchmark from a natural injury (Mrosovsky 1978*a*).

An externally applied tag, such as a flipper tag, has substantial advantages over other marking techniques if it remains in place. These tags are far more likely to be recognized as a tag by the person resighting the turtle. They also permit a specific message to be visibly inscribed (i.e., return address, identification number) so that resighting data can be communicated back to the tagger.

A recent study in Hawaii of the shedding rates of metal flipper tags on small sea turtles indicates that this method of marking hatchlings should be seriously reconsidered. This note presents the results of the study, along with a discussion of its implications and requirements for further tag evaluation.

METHODS

In September 1980, hatchling green turtles, *Chelonia mydas*, were collected from French Frigate Shoals in the Northwestern Hawaiian Islands for use in testing a "living-tag" marking system involving autografts of contrasting pigmented tissue (Hendrickson and Hendrickson 1980). The hatchlings ranged from 5 to 6 cm in straight carapace length (SCL). Small Monel* tags (style 4-1005, size 1) from the National Band and Tag Co. of Newport, Kentucky were attached to the last right marginal scute of each hatchling to identify individuals during the study. These tags measure 8 x 2.5 x 2.5 mm when applied. They have been commercially available for many years, being advertised for use on fingerling fish, small mammals, and birds.

At 1 month of age, when the turtles ranged from 7 to 10 cm SCL, the tags had to be removed from the carapace due to distorted growth and necrosis of surrounding tissue. Replacement tags of the same size were then attached by the author to the trailing edge of the right front flipper. At 6 months of age (15-19 cm SCL) the same size tag was also applied to the left front flipper of each turtle.

Captive rearing of most of the turtles used for the living-tag study was completed at 12 months. The results of this work are reported elsewhere (see Hendrickson and Hendrickson 1981, 1983). The 174 surviving turtles averaged 23 cm SCL (range 16-30 cm) and 2.6 kg (range 0.7-5.2 kg). Each turtle was examined for the retention of flipper tags. At the same time, a larger Inconel® tag (size 681) was attached to a front flipper. Shortly thereafter, 169 of the turtles were released into the wild at several locations throughout the Hawaiian Islands.

RESULTS

Of the 174 yearling turtles, 147 (84.5%) still had both small flipper tags. One tag was missing from 26 (14.9%) turtles, and only a single turtle (0.6%) had lost both tags. Some tags were slightly corroded, but nearly all were still securely attached with little evidence of being overgrown or sloughing off (Fig. 1). Many tags had, however, rotated so that the long axis was perpendicular, instead of parallel, to the flipper's trailing edge. Of the 26 that lost 1 tag, 18 were from the right flipper applied at 1 month of age, and 8 from the left flipper applied at 6 months.

Five turtles were retained in captivity for continued rearing; four of these had two tags still in place, and one had a single tag. As of August 1983 when the turtles were 35 months old, three of the turtles that had both tags still attached at 1 year of age had each shed one tag. Of the other two turtles, one still had both tags, and one had the single tag that was present at 1 year of age (Table 1).

Two of the 169 turtles released have been resighted after a sufficient interval to yield further information on tag retention. Five others were reported washed or crawling

Figure 1. Size 1 Monel® and size 681 Inconel® tags on the right front flipper of a yearling Hawaiian green turtle. The size 1 tag was attached at 1 month of age.

*Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

ashore during the first 2 months following release. The two longer-term resightings involved turtles 22 and 32 months of age. Both retained the two small tags present at the time of release. During their time in the wild, the turtles had grown from 29.5 to 33.6 cm, and from 27.2 to 36.0 cm. The 22-month old turtle was found speared just 3 km from its release site on the Island of Oahu. The 32-month old animal was released at the same site but was captured alive in a net 5,600 km away, at Truk, in the western Pacific.

DISCUSSION

Contrary to earlier reports, the external tags used in this study showed impressive retention rates. The success achieved is probably because small metal tags have not been fully tested on the front flipper. Another key factor may be that the tags used in the present study only showed minor corrosion. Corrosion is known to be an important factor in tag loss experienced in some research programs. Although long thought to be one of the better alloys available for turtle tags, Monel® is now known to corrode in a highly variable and sometimes severe fashion, even on turtles within the same population. If Monel® flipper tags were previously used on hatchlings by other workers, the tag shedding they observed may have been mainly due to corrosion. Tag corrosion and various other factors affecting tag retention have been discussed in Balazs (1982*a*).

Since late 1976, size 681 flipper tags made from Inconel®, an alloy far superior to Monel® in corrosion resistance, have been used on adult and immature green turtles in Hawaii. No corrosion has been seen in these tags, although some tags are still shed from tearing and other factors. Placing two or more tags on each turtle has greatly offset this problem (Balazs 1983). Inconel® tags are not currently available due to high production costs. However, a company in Western Australia (Stockbrands Co. Pty. Ltd. of Mt. Hawthorn) has recently offered titanium flipper tags at a reasonable price ($120 per 1,000). Titanium has nearly as high corrosion resistance as Inconel® (LaQue 1975). The author and C. J. Limpus (Queensland National Parks and Wildlife Service, Townsville, Australia) have arranged for the manufacture of titanium tags equivalent to the size 1 Monel® tags tested in the present study. Future evaluations on hatchlings will therefore be possible using a product that is superior to Monel® in corrosion resistance.

Previous workers tagging hatchlings often stressed the need for a tag to persist into adulthood. The protracted time to maturity, and the increasing level of research now being conducted on immature turtles in the sea, now seem to make this goal less critical. Similar information can probably be gathered by catching wild juveniles already tagged as hatchlings, and retagging them with larger tags as needed.

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Table 1. Growth and tag shedding of five green turtles retained in captivity from 12 to 35 months of age.

	Straight carapace length (cm)		Increase in growth (cm)	Size 1 tags	
	12 months	35 months		Right[1]	Left[2]
1.	20.9	41.8	20.9	Shed	On
2.	24.3	46.7	22.4	Shed	On
3.	20.0	40.2	20.2	On	Shed
4.	24.6	40.3	15.7	On	On
5.	22.0	41.4	19.4	On	[3]

[1]Tags initially put on at 1 month of age when the turtles ranged 7-10 cm SCL.

[2]Tags initially put on at 6 months of age when the turtles ranged 15-19 cm SCL.

[3]Tag not present at 12 months of age.

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