Determining survival, migration, and diving patterns of sea turtles released from longline fishing gear using pop-up satellite archival transmitters

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The main objective of this project is to provide reliable estimates of delayed mortality and morbidity in sea turtles following their interactions with longline fishing gear. To do this, we have deployed pop-up satellite archival tags (PSATs) on incidentally-caught turtles. The tags have a fail-safe/mortality sensor, whereby the tag can be set to jettison if the turtle is stationary for a specified period of time or exceeds a specified depth. Rates of post-hooking mortality and morbidity can be correlated with a standardized set of scored observations, such as manner and location of hooking, severity of injury, and a general assessment of the turtles’ health.

As PSATs have never before been deployed on sea turtles, our first goal was to create an attachment system meeting the following criteria: 1) be easily accomplished by inexperienced fishery observers at sea aboard commercial fishing vessels, 2) be safe for both the observer and the turtle, and 3) be an effective technique. We found that by using a syntactic foam manufactured by Syntech Materials, Inc. we could easily fabricate a suitable “base plate” for attachment of the PSAT to the turtle’s carapace. Using captive green turtles maintained at the NMFS Honolulu Laboratory's Kewalo Research Facility (KRF) we also found that a readily available marine epoxy (Marine Fix Fast) would adhere the foam base plate to the carapace for up to 10 months.

After demonstrating the efficacy and safety of our PSAT attachment method, we applied for and obtained approval from both the NMFS Regional Office and NMFS Office of Protected Resources to proceed with the next phase of the project: having at-sea observers attach PSATs to hard shelled turtles incidentally caught in commercial fishing operations by the Hawaii-based longline fleet. We have also developed and had approved an instruction manual that is given to observers as part of their tagging kit. We have subsequently participated in 4 NMFS Regional Office-sponsored workshops to train observers in PSAT attachment procedures, and have trained approximately 80 observers in these techniques. Since March 2001, PSATs have been taken to sea on approximately 264 longline fishing trips by Hawaii-based longline vessels, resulting in approximately 3,100 observed longline sets. Unfortunately, due to current NMFS fishing regulations designed specifically to minimize turtle-longline interactions, only two turtles were

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1 A working document submitted to the 15th Meeting of the Standing Committee on Tuna and Billfish, Honolulu, Hawaii, 22-27 July 2002.
caught during these observed trips. Observers attached PSATs to both turtles. On one turtle, the PSAT remained attached for 4.5 months and provided excellent data on horizontal and vertical movements. These data have also been reported in PFRP Newsletter (Volume 7, No. 2, “Quantifying sea turtle mortality with PSATs”, by Swimmer, Brill and Musyl, April-June 2002). On the second turtle, the PSAT was jettisoned, came to the surface, and began downloading data after only 4 days of attachment. The detachment of the tag may well have been due to a mortality event (i.e., the turtle died and sank almost immediately after release). The longline hook was removed from this turtle before release even though it was embedded relatively deeply in the turtle’s throat. We are awaiting dive depth results before we determine a definitive cause of the early detachment and data transmission.

In order to circumvent the problem of getting too few tags out with the Hawaiian longline fishery, last November we traveled to Pacific coastal waters of Costa Rica where there is a longline fishery (targeting primarily mahi mahi) that has a relatively high rate of interactions with olive ridley turtles. Working with Randall Arauz (Central American Coordinator for Sea Turtle Restoration Project), we caught seven olive ridley turtles, four by longline and three while free swimming (by hand) and equipped them with PSATs. The later individuals served as a set of controls to which the behaviors of longline captured turtles could be compared. Of the seven PSATs deployed, five have detached after periods of approximately 6-8 weeks, a considerably shorter period than expected based on the results from base plate adhesion tests conducted on green turtles at the KRF. The PSATs are apparently still attached to the remaining two turtles and are expected to jettison and report later in 2002. From the vertical movement data obtained so far, there were no apparent mortalities among the olive ridleys.

Because of the seeming failure of the Marine Fix Fast adhesive to maintain attachment of the PSATs for as long as expected with the Costa Rican turtles, a new base plate epoxy adhesive (West Marine System) is currently being tested, again using green turtles maintained at the Kewalo Research Facility. To date, the adhesive appears to be fully functional after 5 months.

We have also been involved in several other related turtle tagging projects. In association with colleagues on the U.S. mainland (Drs. Molly Lutcavage, Anders Rodin, Sam Sadove, and Russ Andrews), a method for attaching PSATs to leatherback turtles released from longline gear is also now being tested. The method involves a subdermal attachment of the PSAT’s tether using a medical-grade titanium bone anchor. The device is manufactured by Mitek Inc. (a division of Ethicon Inc.) and was originally intended for use by orthopedic surgeons for reattaching torn rotator cuff tendons. When tested on the carapace of a freshly dead Atlantic leatherback, the device appeared suitable. Subsequently, field trials of the attachment device were conducted on nesting Atlantic leatherbacks in Puerto Rico last July with mixed results. A redesigned tag head has been manufactured and a second round of tests on nesting Atlantic leatherbacks was recently completed (June 2002), whereby five turtles were tagged using the most modern technique. The PSATs were set to detach after 8 months (January 2003).

We will continue working with experienced NMFS at-sea observers and to train any new ones in methods to attach PSATs to hard-shelled turtles. For the immediate future, observers will continue to be given PSAT tagging kits suitable for use with hard-shelled turtles for each
fishing voyage. If the attachment methods for leatherbacks currently being tested prove suitable, and if the requisite permits/permissions can be obtained, we will begin issuing tagging kits also containing PSATs suitable for attachment to leatherbacks.

We have no way to predict how many sea turtles will be captured by the Hawaii longline fleet on trips monitored by NMFS observers. However, based on experience, we do not expect this number to be large. To once again circumvent the situation of very low rates of turtle interactions in the Hawaii longline fleet, we will be sending six additional PSATs to Randall Arauz in Costa Rica to be deployed in their longline fishery this month. These tagging kits will contain the newer Marine Systems epoxy. We will, therefore, not only gain insight into the survival of released turtles, but also test the long-term adhesive properties of the new epoxy.