Attachment Protocol for STRETCH SPOT-S-433 Tiny Turtle Tags

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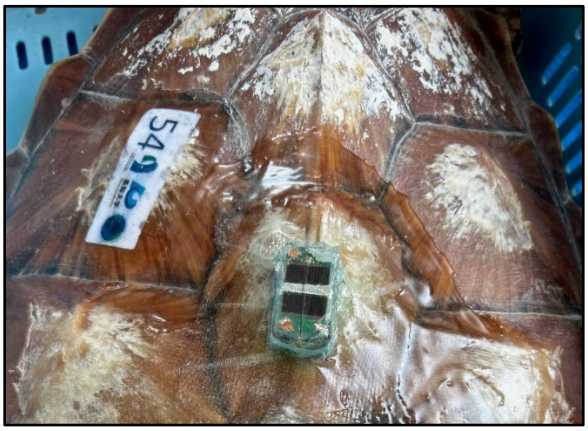
Step-by-step attachment procedure used for prototype testing Tiny Turtle Tags (TTTs) by the STRETCH program on two-year-old captive reared loggerhead sea turtles (Caretta caretta) at the Port of Nagoya Public Aquarium in June 2025.

Five TTTs were supplied by Wildlife Computers Inc. to STRETCH, the first to be field tested on sea turtles after successful deployments of the similar tiny solar tags (Denali) on multiple species of birds globally.

More information on the STRETCH program can be found here.



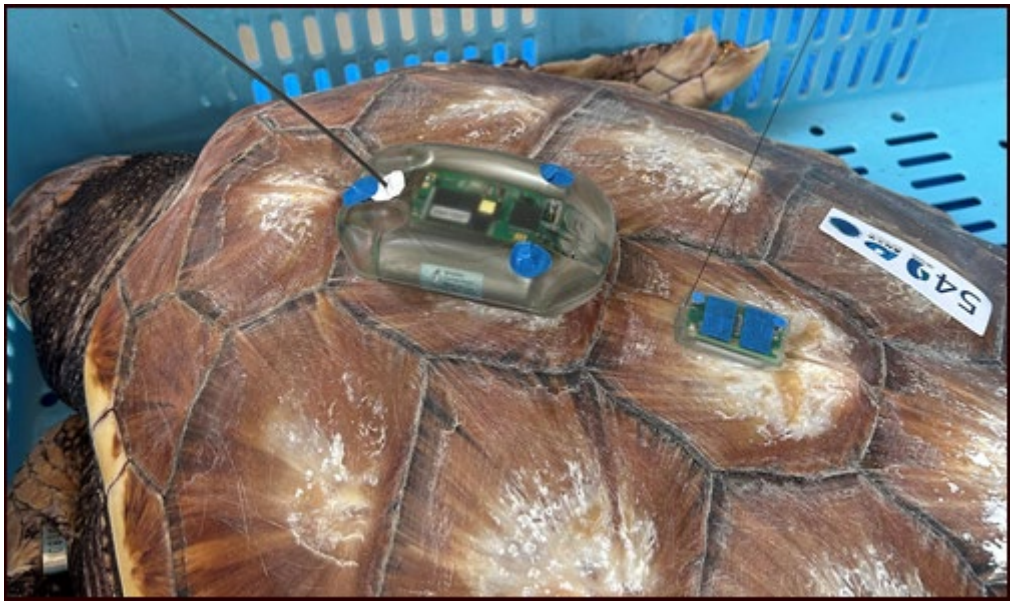
- During three consecutive days from Sat 21st to Mon 23rd June 2025, a total of 33 tags (25 x SPOT, 3 x SPLASH and 5 x TTT) were attached to 28 turtles in batches of 9, 14 and 10 tags respectively.

Size and Mass by Cohort:

Cohort	Year	Avg. SCL (cm)	Range (cm)	Avg. Mass (kg)	Range (kg)
1	2023	36.5	32.2–41.1	7.9	5.4–11.0
2	2024	38.3	34.5–45.3	8.8	6.6–13.9
3	2025	38.7	35.6–44.5	8.3	6.5–13.5

Notes before the protocol:

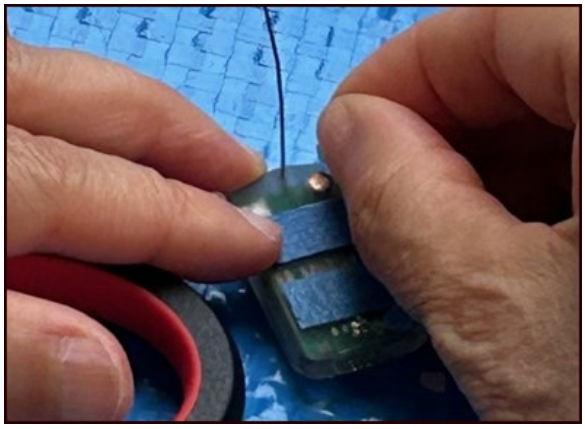
- The TTTs weigh 7.2 g and have a footprint of 34 x 19 x 8 mm (L x W x H). The majority of the upper surface is covered by two solar panels and two copper wet/dry sensors. The procedure described here for the TTTs is based on the standard protocol used by STRETCH (already described) with some modest changes to accommodate for the small size and surface areas involved.
- With only 28 turtles available to be tagged, we opted to double tag all three of the turtles carrying SPLASH tags and two of the largest turtles carrying SPOT tags. This provided a means of validating the TTTs location accuracy.
- Two antenna types were being field trialed. Three of the TTTs had a stiff single stranded stainless-steel antenna which protruded at 90 degrees to the upper surface on the anterior end of the tag and two had a stranded nitinol antenna which was significantly more flexible (floppy).
- Ideally the tags would have been positioned at the highest point on the carapace, the location most likely to break the water surface first or be highest out the water when the turtles are basking on the surface to optimize satellite transmission and solar charging.
- Being double tagged, the SPLASH/SPOT tags took preference and were optimally positioned on the second vertebral scute from the head. The TTTs were attached to the third vertebral scute. The three TTTs paired with SPLASH tags had stiff antenna's and orientated with the anterior of the tag facing forward toward the head of the turtle. The two paired with SPOT tags were orientated in reverse. This was done to minimize/avoid any possibility of interference from the antennas potentially touching each other during deployment.

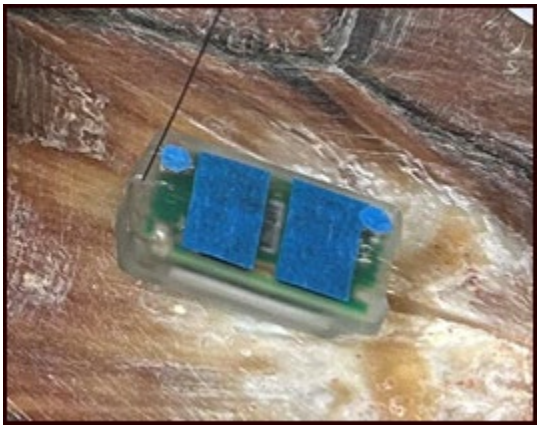


- SPOT and SPLASH tags were attached first as per the standard STRETCH protocol, the TTTs attached afterwards, once the resin was dry, but before any antifoul bottom paint was applied.

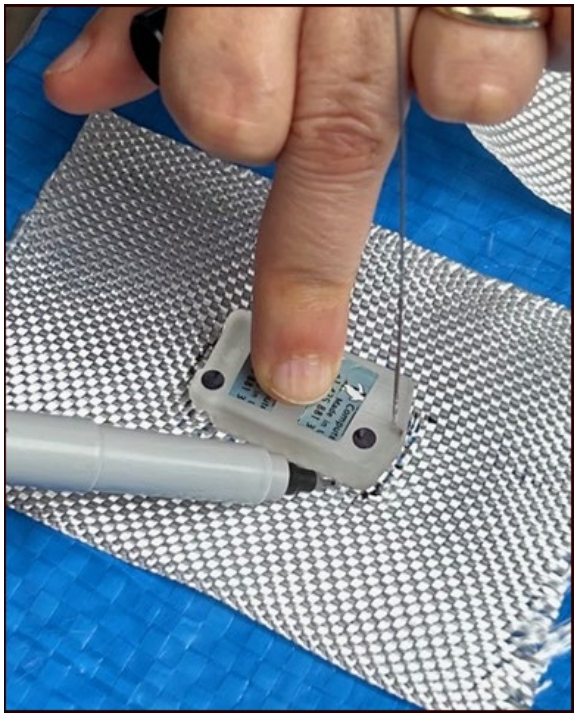
Attachment procedure of the TTTs in detail:

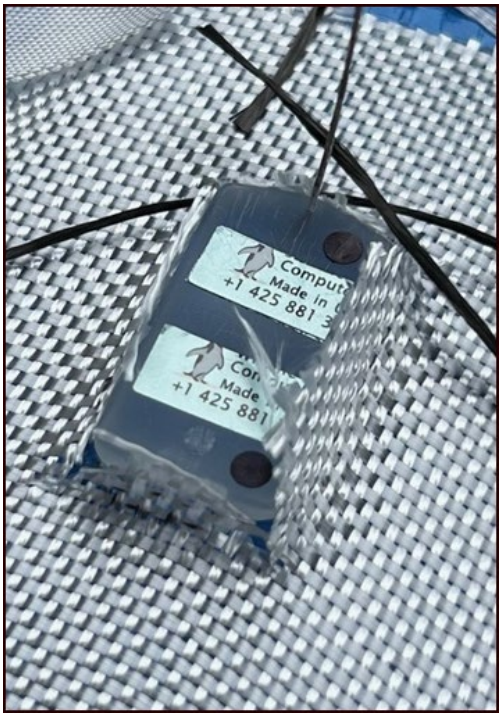
1. Cover the solar panels and wet/dry sensors with masking tape.





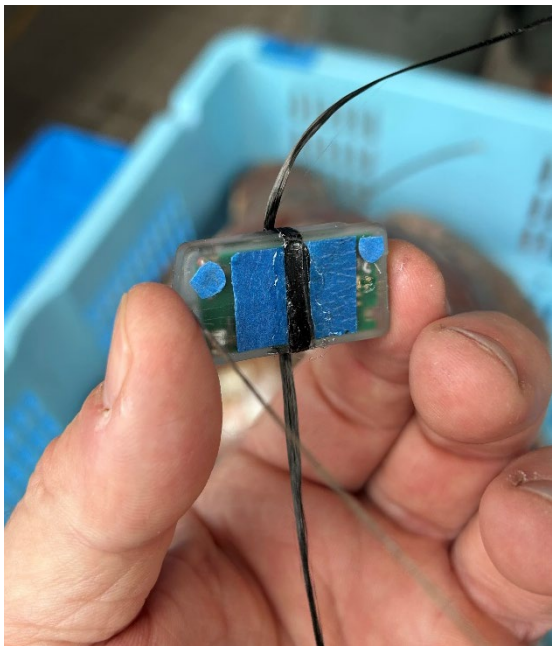
2. Outline the tag footprint on a piece of fiber glass cloth about 100 mm long x 75 mm wide. Create corner notches and a center cut-out inside the outline. Goal is to have a sufficient flap of cloth to ride up the sides and front of the tag that can be resined against the edges of the tag. Set aside until step 6.



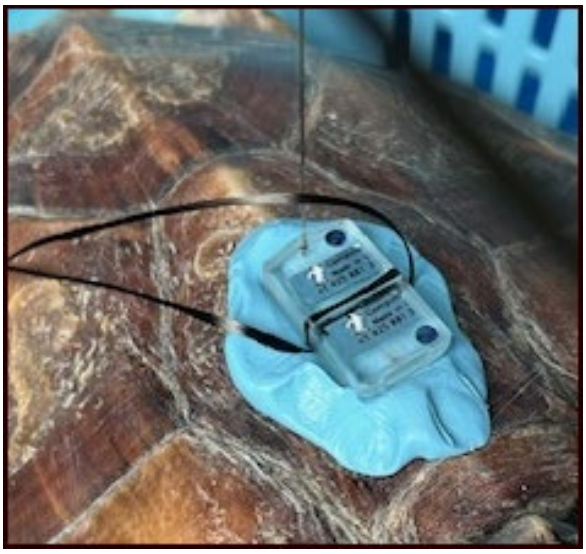


3. Extract a thread of fiber from a piece of carbon braided webbing. Lay the fiber across the width of the tag between the solar panels and with a fine tipped paint brush apply a thin coat of resin

avoiding the masking tape covering the solar panels. Once securely bonded to the upper surface, resin the fiber to each side of the tag, then crisscross the fiber underneath the tag and apply resin. When fully cured the carbon fiber is bonded completely to and around the middle of the tag extending each side from the bottom edge of the tag.



4. When the polyester resin is sufficiently dry, elastomer silicon putty is hand mixed and pressed to the base of the tag. The tag is then positioned and pressed down onto the freshly cured resin on vertebral scute 3, directly behind the attached SPLASH/SPOT tag. When cured (just minutes), excess silicon is trimmed to the footprint of the tag with a craft knife taking care not to damage the carbon fiber extension anchors or do any damage to the carapace.



5. Trim the two extension anchors of carbon fiber to size then resin them directly to the carapace. When cured fiberglass a piece of 25 mm wide cloth over the top of the fiber and running up the side of the tag, level with the top but not extending above it.

6. Carefully place the piece of fiberglass cloth prepared in step 2 over the top of the tag with the antenna and upper surface of the tag exposed through the hole. Apply resin taking great care to get full coverage of the cloth riding up the sides, front and back of the tag. Ensure you do not extend any fiber or resin residue above the top surface of the tag creating a well in which water can sit when deployed. This is imperative because water pooled over the wet/dry sensors will prevent the tag from transmitting when the turtle is on the surface.

7. Once the last polyester resin coat has cured the entire polyester footprint is antifouled with a single coat of red antifoul paint, including the antennas on the TTT.

Final Step:

8. When dry, remove masking tape from the sensors and solar panels and return the turtles to their individual holding pens. The TTTs will automatically turn on once the wet/dry sensors are exposed to salt water.