

Evaluation of Tag Attachments on Small Cetaceans

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LONG-TERM GOALS

Our goal was to produce a safe and reliable, single-pin satellite-linked tagging system for deployment on small cetaceans over periods of months, with minimal risk of harm to the animals.

OBJECTIVES

1. Refine specific hypotheses for laboratory tests of tags and attachments, through review and assessment of previous single-pin tag deployments for which post-deployment observations are available (n = 179 tags, through 15 Dec 2011).
2. Evaluate hydrodynamics of currently available satellite-linked tags and attachments.
3. Determine effectiveness of changes to tags and attachments through hydrodynamic modeling.
4. Perform, under controlled circumstances, field tests of new tag designs resulting from laboratory studies conducted as part of this project, including:
 - a. Deploy (n=10, 3 real and 7 “dummy”) satellite-linked TDR tags with single-pin attachments for comparison with untagged control dolphins, during bottlenose dolphin health assessments of residents in Sarasota Bay, Florida.
 - b. Monitor and photograph conditions of tags and dolphins
 - i. Compare dolphin swimming, respiration, ranging, and social data with previous data for that individual and controls.
 - ii. Document condition of fin relative to pin migration or pressure necrosis.
 - iii. Document the position of tag on the fin, and relate to changes in transmission characteristics (surface time, data message length, and signal quality).
 - iv. Document changes in condition of tags and animals with formation of biogrowth.

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- v. Recapture tagged dolphins (and control dolphins) after about 6-8 weeks to remove tags, closely examine fins, and perform health assessments for comparison with data from initial deployment.
 - vi. Test corrosable attachment pins configurations
5. Publish findings in a series of peer-reviewed manuscripts in a timely manner, including the initial review of previous deployments and results of tests in the proposed project.

APPROACH

We combined the expertise of a non-governmental organization, the Chicago Zoological Society (CZS), and a small, veteran-owned business, BelleQuant Engineering, to develop and test penetrating dorsal fin tag attachment designs for small cetaceans. Our integrative approach, aimed at improving tag attachments, addressed two questions: (1) the causes of tag success and failure, and (2) short- and long-term physical, physiological, and behavioral effects of tags on the animals. We employed a systematic approach including computer modeling and controlled field studies during this project, building on years of development to date. Our collaborative efforts brought decades of relevant experience to these issues, including evaluation of past tag deployments, hydrodynamic modeling, and field tests of promising designs. Dr. Brian Balmer of CZS evaluated previous records of single-point tag attachments for guidance on optimal tag positions on the dorsal fin. Dr. Laurens Howle of BelleQuant Engineering conducted computational flow dynamics modeling to arrive at an optimal tag design for field testing, and identified an appropriate position for attachment of a tag on the dorsal fin trailing edge. Dr. Randall Wells of CZS managed the project and coordinated tag production and field tests. All of these investigators, along with Dr. Michael Scott, participated in the deployment and retrieval of tags for field tests. The staff of the CZS Sarasota Dolphin Research Program engaged in tracking and observations of the experimental tags during field tests.

WORK COMPLETED

All of the proposed computational flow dynamics modeling and field work has been completed. Data analyses and manuscript preparation are underway.

RESULTS

Accomplishments are summarized below for each objective:

1. *Refine specific hypotheses for laboratory tests of tags and attachments, through review and assessment of previous single-pin tag deployments for which post-deployment observations are available ($n = 179$ tags, through 15 Dec 2011).*
Evaluation of previous deployments found, in general, that attachments in the lower third of the trailing edge of the dorsal fin were of longer duration than attachments higher on the fin.
2. *Evaluate hydrodynamics of currently available satellite-linked tags and attachments.*
Computational flow dynamics modeling demonstrated that horizontally oriented tags created significantly less drag than vertically oriented tags. Undesirable turbulence was identified in association with the current horizontal tag designs: 1) immediately behind the tag, 2) at the reinforced base of the antenna, 3) the anterior edge of the tag, and 4) at the lock nuts that secure

the tag to the fin. In addition, modeling demonstrated that flow patterns at some sensor locations on existing tags were conducive to biogrowth that fouled the sensors and interfered with tag function.

3. *Determine effectiveness of changes to tags and attachments through hydrodynamic modeling.* Modifications to the smallest available satellite-linked TDR tag for single-pin attachment to dolphins (Wildlife Computers SPLASH tag) were modeled to: 1) reduce drag by adding faring to the posterior end of the tag, 2) reduce drag by filling the attachment wings as they approach the tag body, 3) reduce drag by removing reinforcement at the base of the antenna, and 4) move the sensors to areas of greater flow. At the suggestion of Wildlife Computers, the lock nuts were replaced with thread-forming flat-head screws, further reducing drag. In combination, these changes reduced drag by about 50% from the previous design. In addition, the top and bottom of the “V” where the wings meet the tag body were rounded to reduce the possibility of cutting into the fin should the tag rotate around the attachment pin and contact the trailing edge of the fin. Wildlife Computers incorporated these suggestions into an experimental design for field tests. They also recommended a silicon-based antifouling coating, “*Propspeed*,” as a means to further reduce drag and improve tag performance. Examples of the experimental tags are shown in Figure 1.

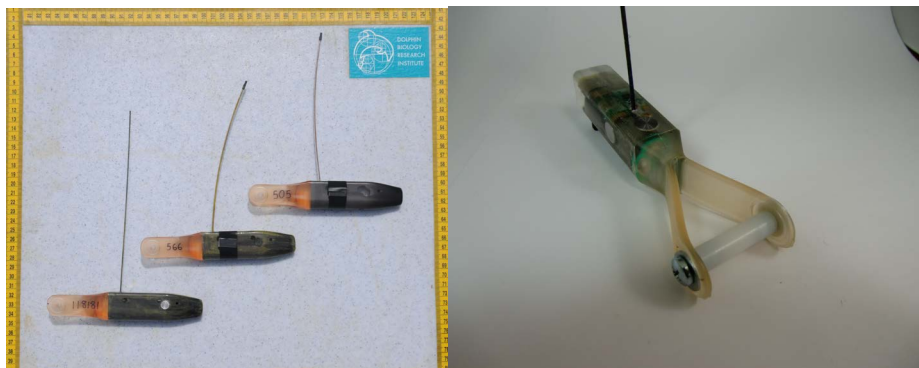


Figure 1. Left: Examples of tags deployed for experiments: a) “118181” = Splash10 satellite-linked TDR tag with PropSpeed coating; b) “566” = VHF “dummy” tag with PropSpeed coating; c) “505” = uncoated VHF “dummy” tag. Right: 5/16” Delrin pin and self-threading flat-head screw attachment (on a slightly earlier tag version).

4. *Perform, under controlled circumstances, field tests of new tag designs resulting from laboratory studies conducted as part of this project, including:*
Field tests of the tag design resulting from evaluation of previous deployments and computational flow dynamics modeling were conducted during May-August 2012. Ten experimental tags were deployed on long-term resident bottlenose dolphin adults or juveniles in Sarasota Bay, Florida, in conjunction with health assessment operations during 7-10 May 2012 (Table 1). Three of these were Wildlife Computers Splash10 satellite-linked time-depth recording (TDR) tags. The other seven were VHF tags in identical configurations as the TDR tags, prepared by Wildlife Computers (Figure 1). Half of these were treated with *Propspeed* antifouling coating, and the other half were left uncoated. In three cases, both members of strongly bonded male pairs were tagged, with one receiving a coated and the other receiving an uncoated tag, to control for potential differences in exposure to biofouling organisms related to differential habitat use. The dolphins were observed, photographed, and video-recorded over

the 69-92 days they carried tags. Eight of the dolphins were recaptured in July 2012, the tags were removed, and health assessments were performed, 69-75 days after deployment. The remaining male pair (F242 and F164) was observed until the tags came off their fins, as designed, sometime between post-deployment day 92 and day 119 (Table 1).

Table 1. Tag deployment and recovery data for Sarasota Bay bottlenose dolphins. “FB” indicates the dolphin’s identification code (based on freeze-brand number).

FB	Sex	Deploy Date	Recover Date	# Days	Tag Type	Coated
F113	F	7-May-12	20-Jul-12	75	SPLASH10	Yes
FB20	M	7-May-12	18-Jul-12	73	SPLASH10	Yes
F258	M	7-May-12	18-Jul-12	73	VHF	No
F242	M	8-May-12	na	92-119	SPLASH10	Yes
F164	M	8-May-12	na	92-119	VHF	No
F159	F	8-May-12	19-Jul-12	73	VHF	No
F142	M	9-May-12	16-Jul-12	69	VHF	No
F276	M	9-May-12	16-Jul-12	69	VHF	Yes
F221	F	10-May-12	20-Jul-12	72	VHF	Yes
F252	M	10-May-12	20-Jul-12	72	VHF	No

The new tag design worked very well. There was little or no migration of the attachment pin through the fin (Figure 2). Observations of the tagged dolphins found no behavioral differences associated with the tags, in terms of respiration patterns, ranging, or social patterns. Both tagged adult females became pregnant while carrying tags and successfully calved in 2013. Follow-up assessments in July found no indication of health problems associated with the tags. The anti-fouling coating worked very well. Minimal growth occurred on coated tags as compared to the heavy growth on uncoated tags (Figure 3).

5. *Publish findings in a series of peer-reviewed manuscripts in a timely manner, including the initial review of previous deployments and results of tests in the proposed project.*

Publications have been prepared or are in preparation. In addition, a project summary was presented at IAAAM in April 2013, and another has been accepted for presentation at the Society for Marine Mammalogy’s biennial conference in December 2013.

Balmer, B.C., R. S. Wells, L. E. Howle, A. A. Barleycorn, W. A. McLellan, D. A. Pabst, T. K. Rowles, L. H. Schwacke, F. I. Townsend, A. J. Westgate, and E. S. Zolman. Accepted. Advances in cetacean telemetry: a review of single-pin transmitter attachment techniques on small cetaceans. *Marine Mammal Science*. – *This is the initial review of previous deployments.*

Wells, R.S., K.A. McHugh, D.C. Douglas, S. Shippee, E.J. Berens McCabe, N.B. Barros and G.T. Phillips. In review. Feeding and activity patterns of a free-ranging, long-term resident community of bottlenose dolphins in Sarasota Bay, Florida. *Frontiers in Diabetes*. – *This manuscript makes use of the tracking data from the 3 dolphins tagged with experimental satellite-linked tags for this ONR project during 2012.*

Wells, R. S., B. C. Balmer, L. E. Howle, M. D. Scott, D. A. Fauquier, A. A. Barleycorn, K. A. McHugh, J. B. Allen, A. B. Irvine, F. I. Townsend, J. C. Sweeney, and S. Wilton. In prep. Experimental tests of small electronic tags for dolphins. To be submitted to *Marine Mammal Science*. – *This manuscript summarizes the field tests performed for this ONR project. Analyses are nearing completion.*

IMPACT/APPLICATIONS

The tag design, attachment, and coating combination developed during this project are significant improvements over previous designs, in terms of performance and reduction of risk of injury to the animal. The results of this project suggest that researchers or cetacean rehabilitation facility managers may now have a small cetacean satellite-linked tag (and potentially other electronic tags) option that can be applied with a high level of confidence for optimal data collection over periods of months and minimal concern about impacts of the tag on bottlenose dolphins. The new design is currently being used in the field, with great success. A tag deployed on a franciscana in Brazil in April 2013 is still transmitting 134 days post-deployment (as of 21 August 2013). Franciscanas, as the smallest of dolphins, should be considered the worst-case scenario for potential tag impacts related to size/drag. All 27 tags deployed on bottlenose dolphins in Barataria Bay, LA and Mississippi Sound in June-August 2013 during NOAA health assessment projects are still transmitting, as of 21 August 2013.

RELATED PROJECTS

None



Figure 2. The dorsal fin of adult male F242, 119 days post-deployment. The tag was attached for at least 92 days before coming off the dorsal fin, as designed. The only remaining evidence of tagging is a small hole near the bottom of the fin, with no indication of necrosis. Photo by Sarasota Dolphin Research Program, taken under NMFS Scientific Research Permit No. 15543.



Figure 3. Adult males F164 (left) and F242 (right) 92 days post-deployment, showing heavy biofouling on F164's uncoated tag, and no growth on F242's coated tag. Photo by Sarasota Dolphin Research Program, taken under NMFS Scientific Research Permit No. 15543.