Short communication

Reactions of Heaviside's dolphins to tagging attempts using remotely-deployed suction-cup tags

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Tagging attempts of Heaviside's dolphins (*Cephalorhynchus heavisidii*) using a remotely-deployed suction-cup tag were performed in Table Bay and St Helena Bay on the southwest coast of South Africa. The observed reactions of dolphins indicate that this tagging approach has negligible impacts on the dolphin behaviour and Heaviside's dolphins might be tagged with suction cup tags without adverse affects.

Key words: *Cephalorhynchus heavisidii,* Heaviside's dolphin, reactions to tagging, suction-cup tag.

Data loggers and radio telemetry have become powerful tools in studies of diving behaviour, diurnal patterns, physiology, and movement of marine animals along with characteristics of their physical environment (Hooker & Baird 2001; Naito 2004; Hooker *et al.* 2007; Rutz & Hays 2009). In the case of small odontocetes, the deployment and attachment of tags often involves capturing of animals, with tags either pinned (or sewn) to the dorsal fin or dorsal side of the body or attached manually to the skin with suction cups (Hooker & Baird 2001; Akamatsu *et al.* 2005; Dietz *et al.* 2007). Tags with suction cups are also deployed onto free-ranging animals using poles or crossbows (Baird 1994; Stone *et al.* 1994; Hanson & Baird 1998; Hooker *et al.* 2001; Andrews *et al.* 2008). In many cases, remote deployment of tags with suction cups has been successful, causing only moderate or negligible reactions from the animals involved; however, Schneider (1998) reported reactions of bottlenose dolphins (*Tursiops truncatus*) that were far too strong for this tagging technique to be effective.

Heaviside's dolphins (*Cephalorhynchus heavisidii*) are small (maximum length 1.75 m) coastal dolphins that are endemic to the west coast of southern Africa (Best & Abernethy 1994; Best 2007). There have been few studies of their ecology and behaviour and the species is among the least known cetaceans (but see Elwen *et al.* 2006, 2009a,b; Morisaka *et al.* 2011). In the work reported here, we determine whether remote deployment of suction-cup tags can be an effective method for studying the movements and diving behaviour of this species, and we assess the reactions of dolphins to tagging.

Tagging attempts were conducted in Table Bay (33°50′S, 18°22′E) and St Helena Bay (32°40′S, 17°50′E) on the southwest coast of South Africa in January and February 2008. The tags we used were a modified version of those used by Akamatsu *et al.* (2005) for finless porpoises. Each tag consisted of a data logger (PD2GT, diameter: 21 mm, length: 114 mm, weight: 60 g; Little Leonardo, Tokyo, Japan), an integrated very-high-frequency (VHF) transmitter (Advanced Telemetry Systems, Isanti, MN, USA) encased in a float made of synthetic foam, which is a hard, incompressible resin embedded with glass bubbles for floatation that is frequently used in tag design, and an 8-cm-diameter rubber suction cup (Canadian Tire, Toronto, ON, Canada). The inner surface of the suction cup was coated with silicone grease before each tagging attempt.

Tagging was performed from the bow of a boat that traversed the study area at an average speed of 5 knots, under sea-state conditions not exceeding 3 in the Beaufort scale. Two types of boats were used, either a 6-m inflatable with two 50-HP outboard engines or an 8.5-m catamaran with two 115-HP outboard engines; the larger boat was used only twice. The research team included a tagger, a boat skipper, and a videographer who used a HDR-SR1 Sony camcorder to video-record each tagging attempt.

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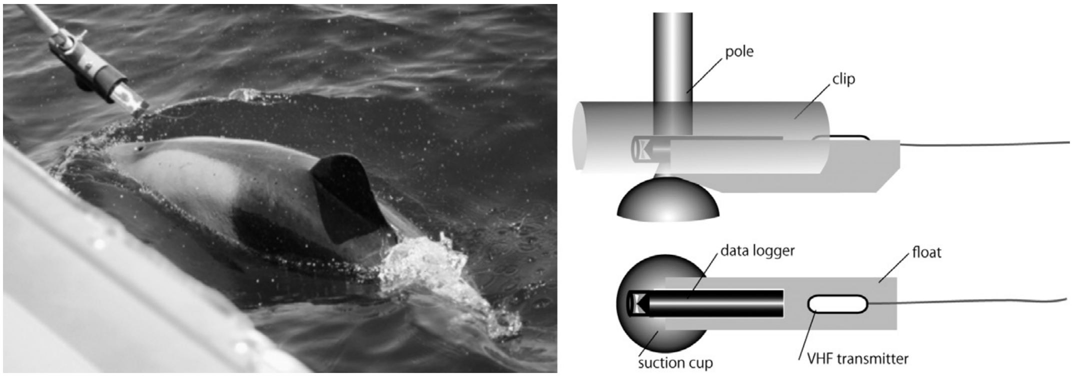

Fig. 1. Attachment of a data logger to a Heaviside's dolphin using a suction-cup tag (Table Bay, Western Cape, South Africa); see text for tag technical specifications (photograph courtesy of Mammal Research Institute, University of Pretoria).

Each tag was attached to an extendable pole (1 m long, extendable to 3 m) with a plastic clip. The suction cup was pressed quickly against the dorsal side of a dolphin when it approached the boat to ride the bow-wave and surfaced in front of, or next to the bow (Fig. 1). Each attempt was recorded as either a *miss* or a *hit*. If the suction cup did not stick to the dolphin the boat was turned around to retrieve it. The reactions of targeted dolphins and the behaviours of other group members before and after tagging were video-recorded for subsequent analyses.

A *group* was defined as a spatial aggregation of animals that were involved in similar (often the same) activities and interacted with each other with no changes in the composition of the aggregation (after Karczmarski *et al.* 2005). Dolphin behaviour was defined as either (a) *socializing* (characterized by various affiliative behaviours, such as flipper rubbing, body contact, sexual behaviour or vigorous activities like synchronous leaps, chasing, and apparently playful behaviours), (b) *milling* (when dolphins moved in no apparent direction and frequently reoriented slowly within a group), (c) *travelling* (when dolphins moved steadily in a particular direction), and (d) *resting* (*i.e.* low-energy activities when dolphins were close together, moved little, but occasionally submerged together for long periods). Dolphin behaviour was assessed before and after each tagging attempts. After an unsuccessful tagging, if the dolphins remained around the boat and conditions were suitable, tagging attempt was repeated with the same protocol of assessment of dolphin behaviour (Table 1).

We distinguished four categories of dolphin reactions to tagging (after Weinrich *et al.* 1991): *no reaction,* when dolphin behaviour after our tagging attempt did not differ from what was observed before the tagging); *low-level,* when the behaviour of dolphins changed slightly, but with no apparent vigorous response to the tagging attempt (*i.e.* dolphin dived or dived and moved away from the boat, but returned to the boat within seconds later); *moderate,* when the animal modified its behaviour in a forceful manner (such as tail slapping, accelerating, or rapid diving), but briefly, and did not move far away from the boat or group; and *strong,* when dolphins changed their behaviour in a succession of forceful movements, such as successive percussive behaviours with breaches and tail slaps, or when the entire group moved rapidly away from the boat).

Dolphins generally approached the boat and rode its bow wave while socializing and milling, seldom when resting. The number of bow-riders ranged from one to seven (Table 1). The dolphins often swam with their lateral sides towards the surface and when the tagger or the tagging pole moved they often swam 3–5 m away from the bow, breathed, and then returned to the bow. They often rode bow waves repeatedly, and when the boat turned to retrieve the floating tag after an unsuccessful tagging attempt, the dolphins frequently remained with the boat, seemingly waiting for the next bow wave. In those cases, several tagging attempts (up to 6) were performed on a single group.

A total of 26 tagging attempts were made (16 *hits* and 10 *misses*) during 10 boat surveys and 26 encounters with dolphin groups (Table 1). Although the tags hit the dolphins and the suction cup made contact with the dolphin's skin during each of the 16 hits none of the tags remained

Table 1. Reactions of Heaviside's dolphins to tagging attempts conducted in Table Bay and St Helena Bay, Western Cape, South Africa, in January and February 2008. 'Group behaviour' refers to the predominant behaviour of the majority of the group members. No tagging attempts were made when dolphins were resting or travelling. For description of dolphin reaction categories, see text.

Group size	Number of bow-riders	Group behaviour before tagging	Hit or miss	Dolphin reaction	Group behaviour after tagging
20	3	Socializing	Hit	No reaction	Socializing
6	2	Socializing	Hit	Low	Bow-riding
6	2	Socializing	Hit	Low	Bow-riding
6	2	Socializing	Hit	Low	Bow-riding
6	3	Socializing	Hit	Low	Bow-riding
6	3	Socializing	Hit	Low	Bow-riding
6	2	Socializing	Hit	Low	Bow-riding
4	2	Socializing	Hit	Low	Bow-riding
25	2	Milling	Hit	Low	Milling
25	4	Milling	Hit	Low	Milling, bow-riding
25	5	Socializing	Hit	Low	Socializing
7	2	Milling, bow-riding	Hit	Low	Milling, bow-riding
7	4	Bow-riding	Hit	Low	Bow-riding
7	2	Bow-riding	Hit	Low	Bow-riding
7	4	Bow-riding	Hit	Low	Bow-riding
6	4	Bow-riding	Hit	Low	Bow-riding
3	1	Socializing	Miss	Low	Bow-riding
6	2	Socializing	Miss	Low	Bow-riding
25	3	Milling	Miss	Low	Milling
25	5	Milling	Miss	Low	?
7	7	Milling, bow-riding	Miss	Low	Milling, bow-riding
7	7	Milling, bow-riding	Miss	Low	Milling, bow-riding
7	2	Milling, bow-riding	Miss	Low	Milling, bow-riding
7	2	Milling, bow-riding	Miss	Low	Milling, bow-riding
7	4	Milling	Miss	Low	Milling
8	1	Bow-riding	Miss	Moderate	?

attached. We think that the small body size and fast movements of Heaviside's dolphins prevented expulsion of all water beneath the suction cups as they were pressed onto the skin which would have reduced the strength of the suction and caused the tag to be quickly shed. During another 15 encounters, the dolphins did not surface close enough to the bow to facilitate tagging.

The mean interval between tagging attempts and the next occurrence of bow-riding was 203 ±

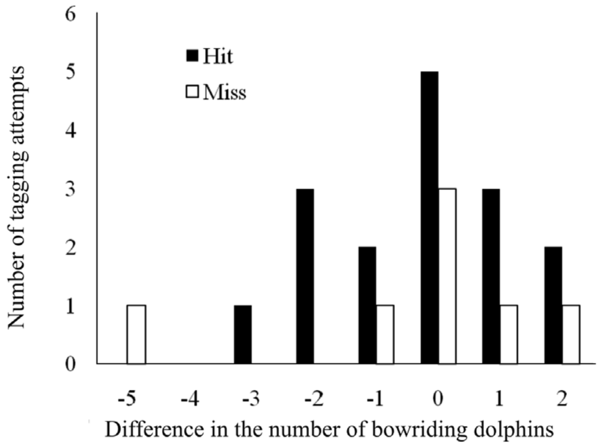

Fig. 2. Frequency distribution of differences in the numbers of bow-riding individuals counted in consecutive tagging attempts on Heaviside's dolphins (Table Bay and St Helena Bay, Western Cape, South Africa). Positive values indicate increasing numbers of bow-riders; negative values indicate decreasing numbers (*e.g.* –1 indicates one less bow-riding dolphin at the next consecutive tagging attempt).

Table 2. Reactions to tagging attempts among six species of odontocetes; categories of reaction follow Weinrich *et al.* (1991). See text for details.

Species	Hector's dolphin (Stone *et al.* 1994)	Dall's porpoise (Hanson & Baird 1998)	Killer whale (Baird 1994)	Northern bottlenose (Hooker *et al.* 2001)	Bottlenose dolphin (Schneider *et al.* 1998)	Heaviside's dolphin (this study)
Deployment method	Pole	Pole	Crossbow	Crossbow	Pole or crossbow	Pole
Misses (no contact)	*n* = unknown	*n* = 2 No reaction	*n* = 19 No reaction (74%), Low-level reaction (26%)	*n* = 55 No reaction (60%), Low-level reaction (38%), Moderate reaction (2%)	*n* = 7 No reaction (29%), Low-level reaction (71%)	*n* = 10 Low-level reaction (90%), Moderate reaction (10%)
Unsuccessful hits	*n* = Unknown No reaction	*n* = 10 No reaction (20%), Low-level reaction (80%)	*n* = 34 No reaction (35%), Low-level reaction (65%)	*n* = 23 No reaction (9%), Low-level reaction (65%), Moderate reaction (26%)	*n* = 5 Low-level reaction (60%), Moderate reaction (40%)	*n* = 16 No reaction (6%), Low-level reaction (94%)
Successful hits	*n* = 3 Low-level reaction (100%)	*n* = 3 Low-level reaction (66%), Moderate reaction (33%)	*n* = 7 No reaction (43%), Low-level reaction (57%)	*n* = 6 Low-level reaction (67%), Moderate reaction (33%)	*n* = 5 Moderate reaction, (60%), Strong reaction (40%)	*n* = 0

169 s (mean ± SD, *n* = 26), with little difference for intervals following a preceding hit (mean = 196 ± 140 s, *n* = 16) and miss (mean = 216 ± 227 s, *n* = 10), (*P* = 0.4, Mann-Whitney *U*-test). Similarly, when several consecutive tagging attempts were performed (*n* = 9 groups), the number of bow-riding dolphins often differed between attempts (Fig. 2), but was not significantly different from the number of dolphins in the group during the prior attempt ($mean_{hit}$ = –0.25 ± 1.48, *n* = 16; $mean_{miss}$ = –0.43 ± 2.22, *n* = 7; *P* = 0.89, Mann-Whitney *U*-test).

Targeted dolphins typically dived after each tagging attempt, regardless of whether the attempt was a hit or a miss, but returned to the bow and resumed bow-riding shortly after. Their reactions were either no reaction (4%; hit: *n* = 1, miss: *n* = 0), low-level reaction (92%; hit: *n* = 15, miss: *n* = 9), or moderate reaction (4%; hit: *n* = 0, miss: *n* = 1). In the single case of no reaction, the dolphin did not dive after the tagging attempt but remained alongside the boat, seemingly looking up at the tagger. The strongest reaction followed one of the misses after which the dolphin dived rapidly creating a splash as the pole struck the water surface and it did not return to the bow.

Our observations suggest that the tagging attempts had negligible impact on Heaviside's dolphins. The animals generally shifted from bow-riding to other types of behaviour at the end of each tagging session, often resuming the behaviour displayed prior to bow-riding and our tagging attempts. Although it was usually not possible to determine whether a targeted dolphin returned to the bow of the boat after a failed tagging attempt, we did not see any obvious differences between the reactions to hits and misses. This suggests that the animals reacted primarily to visual and acoustic cues associated with tagging, and physical contact with the suction cup seemed to add little to the overall reaction. However, as all our tagging attempts failed, we can only speculate about reactions had we successfully deployed the tags.

Several studies have described reactions of cetaceans to tagging (Table 2), and all successfully tagged species had either slight or no reaction during most tagging attempts (both successful tag deployments and misses). The reactions we observed in Heaviside's dolphins place them in a range of tagging-feasible species, for which tags with suction cups have proven effective. No obvious changes in reactions occurred between the first and last days of tagging (*cf.* Baird 1994 for reactions in killer whales) suggesting that long-term effects are likely negligible. We suggest that light striking of Heaviside's dolphins with the attachment pole did not have significant effects on the dolphin behaviour and the species might be tagged with suction cup tags without adverse affects.

The closely related and similarly behaving Hector's dolphins have been successfully tagged with remotely deployed suction-cup tags (Stone *et al.* 1994), while Akamatsu *et al.* (2005) succeeded attaching a tag to finless porpoises using the same type of a suction-cup. Based on our failed tagging attempts, we suggest that modification of suction cup size and perhaps its texture, and reducing tag and float sizes to decrease drag could make this tagging approach more effective. Heaviside's dolphins seem behaviourally well suited for suction-cup tagging and we encourage our fellow researchers to try.

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