Sighting history and observations of southern right whales following satellite tagging off South Africa

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ABSTRACT

In September 2001, satellite tags were deployed on 21 southern right whales (*Eubalaena australis*) in South African coastal waters, including eight cows accompanied by newborn calves. To date there have been 26 re-sightings of 11 of these individuals (or their calves) at intervals of 27-1,502 days. So far, 85.7% of the females with calves have been re-sighted with a second calf, at intervals comparable to those that the same individuals showed before tagging. All tags seem to have been shed between 27 and 36 months of tagging. Superficial and remote examination of wound sites indicated the frequent formation of divots with accompanying scarring and cyamids, but little sign of localised (and none of regional) swelling.

KEYWORDS: AFRICA; SOUTHERN RIGHT WHALE; SATELLITE TAGGING; REPRODUCTION; SURVIVORSHIP; SOUTHERN HEMISPHERE

INTRODUCTION

Efforts to attach radio or satellite tags to large whales have been ongoing since 1962 (Watkins, 1978) and 1983 (Montgomery, 1987) respectively. Initially, most of these deployments were on very small numbers of individuals that represented negligible proportions of the populations concerned. As the technology and associated results improved, however, there has been increasing realisation of the potential value of the technique for addressing questions of considerable importance to the conservation of small and endangered populations. At the same time, concerns have arisen that if the technique itself should cause problems (injury, disease) to the tagged individual that may compromise its survival or reproductive rates, then this might be an inappropriate technology to use under such circumstances. In reaction to a proposal to tag individuals from the small and endangered Western North Pacific stock of gray whales (*Eschrichtius robustus*), the Scientific Committee of the International Whaling Commission agreed to review the general issue of the use of telemetry and its potential effects on whales at its 2008 meeting (IWC, In press), when the report of a Marine Mammal Commission Workshop on the subject will be available.

Unfortunately, in most cases once the transmitter of a satellite-tagged animal ceases to function it becomes just another member of its population. In the cases of most large populations of whales, this means that the chances of re-locating it to examine its physical well-being or reproductive status are slim indeed. Furthermore, while a physical examination might suffice to test for obvious injury or disease, testing for impaired survival or reproduction demands that the future history of that individual be monitored over at least one reproductive cycle, and the result compared either with the pre-tagging history of the same individual, or with the post-tagging history of other, untagged individuals from the same population. Such opportunities only really exist in relatively small, well-studied populations (Kraus *et al*., 2000).

Since 1979, annual aerial photographic surveys of southern right whales (*Eubalaena australis*) have been carried out off South Africa, and a catalogue of some 1,000 known individuals has been compiled, mostly mature females with reproductive histories. This paper examines the sighting histories both pre- and post-tagging (where known) and observations of tag sites for 21 southern right whales on which satellite tags were deployed off South Africa in 2001.

MATERIAL AND METHODS

In September 2001, satellite transmitters were deployed on 21 southern right whales in South African waters. These were intended principally as trials of a modified tag before its deployment on North Atlantic right whales.

The tags were stainless steel cylinders 1.8cm in diameter and 24cm long, deployed from a crossbow and designed to be almost completely subdermal (with a stopper preventing the tag from becoming completely embedded). The outer end of the tag carried a 15cm aerial and a 4cm saltwater switch, while two sets of spring tines radiating from the body of the tag increased tag retention. The tag was coated with a long-lasting antibiotic prior to deployment (Mate *et al*., 2007).

Sixteen of the tags were deployed in St. Sebastian Bay on the south coast of South Africa between 8 and 13 September, and five outside Saldanha Bay on the west coast between 21 and 26 September (Fig. 1). Eight tags were placed on cows with calves, all in St. Sebastian Bay, while the remaining 13 were placed on animals without calves (Table 1).

Annual photographic surveys for right whales have been carried out on the South African coast since 1979. The principal targets of these surveys have been cow-calf pairs, and only rarely (i.e. where a second adult was present with a cow-calf pair) have other animals been photographed. Nevertheless, for adult females these potentially provide both pre- and post-tagging information on calving intervals, and for younger animals might provide a year of birth and

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Table 1

Details of satellite tag deployments on southern right whales in South African waters, 2001.

Tag no.	Date deployed	Sex	Grouping	Prior sighting history	Age (yr)[1]	Days with locations
827	8 Sep.	F	With calf	Calved 1997	>10	27
839	8 Sep.	-	1 of 2 subadults	None	-	119
843	8 Sep.	F	With calf	Calved 1992	>15	39
1385	8 Sep.	F	With calf	Calved 1998	>9	1
826	8 Sep.	F	Single	Calved 1983, 1998	>24	36
825	8 Sep.	-	Adult with subadult	Seen 1991 with cow-calf	>10	38
824	8 Sep.	-	Single juvenile near SAG	None	-	0
848	8 Sep.	M	Juvenile from SAG	None	-	123
823	8 Sep.	F	With calf	[Photos too poor to match]	-	25
23034	12 Sep.	-	1 of 3 juveniles	None	-	69
838	12 Sep.	M	1 of 2 juveniles	None	-	66
837	12 Sep.	F	1 of 2 adults	None	-	<1
847	12 Sep.	F	With calf	First observed calving	>6	57
834	12 Sep.	F	With calf	Calved 1998	>9	0
835	13 Sep.	F	With calf	Calved 1987, 1992, 1995, 1998	>20	0
10826	13 Sep.	F	With calf	Seen as calf in 1979, calved 1989, 1992, 1996	22	<1
836	21 Sep.	F	1 of 3 adults	[Photos too poor to match]	-	81
23037	22 Sep.	M	1 of 3 adults	None	-	65
23031	22 Sep.	M	1 of 5	Seen as calf in 1996	5	161
831	22 Sep.	-	1 of 3	None	-	35
4172	26 Sep.	M	Single juvenile	None	-	137

[1] Unless seen as calf, age estimated for females assuming animal was at least 6 years old when seen with first calf.

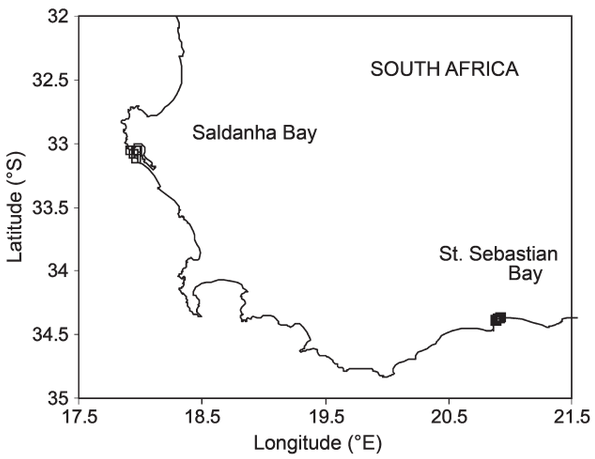

Fig. 1. Coast of Western Cape, South Africa, showing locations of satellite tagging of southern right whales, September 2001.

therefore age at tagging. Photographs of all animals on which satellite tags were deployed have been compared with this catalogue (up to and including the 2005 survey).

Periodic boat-based surveys have been carried out for right (and other) whales on the South African coast, notably from 1995 to 1997 as part of a genetic sampling project, from 1999 to 2001 as part of a humpback whale migration study on the west coast and from 2003 to date as part of a study of a right whale feeding ground on the west coast. Photo-identification has been a major component of all these studies, and where such pictures have been sorted and catalogued, they have been matched with the satellite-tagged animals.

Finally, commercial whalewatching operators were alerted to the presence of satellite-tagged right whales shortly after the tags were deployed, and opportunistic photographs of right whales believed to be tagged, or with wounds possibly caused by tags, were received from some operators. These have been matched with the satellite-tagged animals.

In assessing the status of the wound associated with the tag site, the criteria used by Kraus *et al*. (2000) were adopted, namely, for occurrence of scars: none, white scar, a scar and divot, and a divot and cyamids; and for occurrence of swelling: none, localised, and regional. A divot was defined as an indentation of varying size, localised swelling as a bulge less than 30cm in diameter and regional swelling as a bulge estimated at 30-90cm in diameter.

If no part of the tag could be seen, it was considered to have been shed. This assumption was based on the observation that whales with protruding tags were re-sighted subsequently without any visible sign of the tag.

RESULTS

Two individuals (tags 823 and 836) were insufficiently photo-identified at the time of tagging, so for these individuals there is no available post-tagging information. Of the remaining 19 individuals, 10 (or their calves) have been re-sighted to date, and 26 re-sightings (including of one unidentified individual) have occurred at intervals of 27 to 1,502 days after tagging (Table 2).

Of the seven cows with calves that were tagged and photo-identified adequately, six have been re-sighted with a second calf, five after three years and one after four years, for an average of 3.2 ± 0.4 years. The preceding calving intervals for these seven individuals were 0, 3, 3, 3, 4, 5 and 9 years, for an average (excluding the 0) of 4.5 ± 2.1 years. The calf of the tagged cow with a subsequent 4-year interval was itself seen alone 12.5 and 17 months later, suggesting that its mother had completed its reproductive cycle successfully.

Although it is difficult to make exact determinations from the photographs taken on aerial surveys, part or all of the tag seemed to be present at all sightings up to 836 days after tagging, whereas all re-sightings after 1,098 days indicated that the tag had been shed. ‘Protruding’ tags were recorded as early as 75 days post-tagging, however, so it is possible that some were lost well before 836 days.

Table 2

Details of re-sightings of satellite-tagged right whales on the South African coast.

Tag no.	Date seen	Days post-tagging	Notes on sighting	Tag seen	Scar[1]	Swelling[2]
827	11 Oct. 01	33	From air, with calf	Yes	1	1
827	12 Oct. 04	1,130	From air, with calf	No	4	1
843	14 Oct. 01	36	From air, with calf	Yes	1	1
843	13 Oct. 04	1,131	From air, with calf	No	1	1
1385	10 Oct. 01	32	From air, with calf	Yes	1	1
1385	11 Oct. 01	33	From air, with calf	Yes	1	1
1385	12 Oct. 04	1,130	From air, with calf	[No view]	-	-
826	14 Oct. 01	36	Aerial survey, single	Yes	1	1
837	14 Sep. 04	1,098	Whale watching	No	4	1
847	11 Oct. 01	29	From air, with calf	Yes	1	1
847	5 Dec. 02	420	From boat, in pair	Yes	4	1
847	11 Oct. 04	1,125	From air, with calf	No	2	1
834	10 Oct. 01	28	From air, with calf	Yes	1	1
834	26 Nov. 01	75	Video, with calf	Yes[3]		
834	13 Oct. 04	1,127	From air, with calf	No	3	1
10826	10 Oct. 01	27	From air, with calf	Yes	1	1
10826	30 Sep. 02	382	From boat, calf alone	-	-	-
10826	13 Feb. 03	518	From boat, calf alone	-	-	-
10826	10 Oct. 05	1,461	From air, with calf			
10826	20 Nov. 05	1,502	Whalewatching	No	4	1
23031	20 Oct. 03	758	Aerial survey, 1 of 5	[Too far]	-	-
23031	8 Nov. 03	777	From boat, 1 of 4	Yes[3]	3	1
23031	6 Jan. 04	836	From boat, 1 of 5	Yes[3]	3	1
23031	8 Oct. 04	1,112	From boat, 1 of 4	No	2	1
23034	2 Oct. 02	385	From boat, 1 of 5	Yes[3]	4	1
Unid.	6 Dec. 02	~ 430	From boat, 1 of 5	Yes	4	2

[1]1 = none, 2 = white, 3 = scar + divot, 4 = divot + cyamids. [2]1 = none, 2 = localised, 3 = regional. [3]Tag protruding.

No divot was noticeable at the tag site before 385 days after tagging (although there were no observations between days 36 and 385). After that date scars were recorded as none (1), white scar (2), scar + divot (3) and divot + cyamids (6). Localised swelling was recorded in a single case; otherwise the wound sites were remarkable for their lack of swelling.

DISCUSSION

The satellite-tagging experiment was not designed with a specific follow-up monitoring phase, so these observations are largely opportunistic and take advantage of ongoing research programmes and other activities. The sample of animals is also small so that the power to detect any but major effects is low. Nevertheless, the finding that six out of seven (85.7%) of the cows tagged with calves gave birth to a subsequent calf within intervals comparable to those prior to tagging suggests that the procedure had no major impact on reproductive output (or short-term survival). The efficiency of detecting cows with calves on these surveys has been estimated as 74-82% (Best *et al*., 2001), so the seventh female may have given birth subsequently and gone undetected, or it may still give birth (post-tagging monitoring has only persisted for four years to date). While the survival rate of the dependent calves cannot be evaluated directly from these data, none of the females subsequently gave birth after two years, an interval normally associated with the peri-natal loss of the first calf (Elwen and Best, 2004), while the calf from the sole 4-year calving interval clearly survived to nutritional independence.

Since monitoring efforts were largely directed towards adult females, it is no surprise that the re-sighting rate of known males (1/5) was lower than that of known females (8/11). Furthermore, the mean residence time of unaccompanied southern right whales (including males) in coastal waters is much shorter (20.4 days) than that of cows with calves (70.9 days), providing less opportunity for re-sighting them (Burnell and Bryden, 1997). Consequently it should not be concluded from the lower re-sighting rate of males that their survival was adversely affected by tagging.

Available evidence suggests that all instruments were shed between 27 and 36 months (and possibly sooner) of tagging. There was a noticeable lack of swelling at all but one of the wound sites examined, although divots (both with and without cyamids) were a common feature for all re-sightings after one year or more. Furthermore, because re-sightings tended to occur at annual intervals (when right whales were present in coastal waters) it is possible that swellings occurred but were resolved in the intervening periods.

In summary, the deployment of satellite tags in southern right whales off South Africa appeared to have no major effect on the reproductive success of adult females or (by inference) the survival of their calves. Although divots plus scars and accompanying cyamids were a common feature of wound sites, even after the tags themselves were shed, there was little sign of the localised (and none of the regional) swelling seen in North Atlantic right whales. These conclusions are, of course, based on a very small sample size (with correspondingly low statistical power) and are unable to address any possible longer term effects.

Additionally, it is unclear how applicable these results might be to other large whale populations. North Atlantic right whales, for instance, have a thinner and more variable blubber layer than southern right whales (Angell, 2006), and seem to carry a higher incidence of skin lesions of unknown aetiology (Pettis *et al*., 2004), so it is conceivable that the impacts of the tags could be different in this species (although the extreme inter-annual variability in reproductive success in this population (Kraus *et al*., 2001) might make it difficult to conclusively establish effects).

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