Assessment of the effects of satellite-linked telemetry tags on southern right whales over two decades

Els Vermeulen[1], Christopher Wilkinson[1], Peter B. Best[1,*] and Alexandre N. Zerbini[2,3,4]

Contact email: els.vermeulen@up.ac.za

ABSTRACT

The study of animal movement is critical in biological and ecological sciences. However, such studies are often challenging due to the difficulty of continuously observing wild animals. This is especially true for large baleen whales which can travel across vast distances in the open ocean. The use of animal-borne telemetry tags, which allow for real-time data collection of geographical positions of an individual, has therefore significantly advanced our knowledge on baleen whale movement patterns and currently forms an essential component of cetacean research. However, as satellite tags are invasive, there is concern about their potential effects on an individual's health and wellbeing, and possible implications at the population level. Southern right whales (n = 21) were instrumented with Telonics ST-15 consolidated satellite tags in 2001 in coastal South Africa. Fourteen of these individuals (13 females and one male) were photo-identified either at the time of tagging or subsequently. Given the long-term photo-identification-based monitoring of this population, 13 of these individuals could be resighted up to 21 years post-tagging. This study builds on previous assessments of tag effects by providing an extra decade of information on sighting history and calving rates of the tagged individuals. Results showed no decadal tag effects when tagged whales were compared with untagged individuals. Visual assessment showed full healing of the tag site, with only small divots present in the last 10 years. Given the impact of environmental variability on the maternal body condition and reproductive success of this population, this study suggests no increased vulnerability to such stressors due to tagging. With 21 years of post-tagging data, this is the longest follow-up study on southern right whales to date. Considering the overall concern of the effect of tagging on the health and wellbeing of individuals, studies like these are critically important to ensure quality data collection with the least possible impact on tagged individuals.

KEYWORDS: HEALTH; PHYSIOLOGY; DEMOGRAPHY; SATELLITE TAGGING; TELEMETRY

INTRODUCTION

Animal movement is a fundamental aspect of biology and ecology (Hooten *et al*., 2017). The study of animal movement is therefore deemed critical in biological and ecological sciences, as it relates to our understanding of individual and population-level processes, such as reproduction, foraging and survival, as well as ecological

* Posthumous contribution.

[1] Mammal Research Institute Whale Unit, Faculty of Natural and Agricultural Sciences, University of Pretoria, Pretoria, South Africa.
[2] Cooperative Institute for Climate, Ocean and Ecosystem Studies, University of Washington, Seattle, WA, USA.
[3] Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Seattle, WA, USA.
[4] Marine Ecology and Telemetry Research, Seabeck, WA, USA.

processes, such as food availability, foraging efforts and predation pressure (Nathan *et al.*, 2008). Comprehensive data on animal movement are essential for effective conservation management, as knowledge on the spatio-temporal occurrence of individuals and/or populations allows for efforts to preserve critical habitat (Cagnacci *et al.*, 2010). Long-term studies of animal movement are also key to improving our understanding of changes in biological and ecological processes, such as behavioural responses to environmental change (Trathan *et al*., 2007; Nathan *et al*., 2008). However, studying animal movement can be challenging, as they may be elusive and/or inhabit areas where they are difficult to observe directly. The development of technologies like animal-borne telemetry devices which indicate the near real-time geographical position of individual animals has therefore significantly transformed our ability to study animal movement (Cagnacci *et al*., 2010).

Cetaceans are one such group of animals where movement studies are challenging due to the difficulty of observing them at sea. Many baleen whale species show large-scale seasonal movement patterns from low latitude calving and breeding grounds to productive, usually higher latitude feeding grounds. Most of the initial knowledge on baleen whale movement was derived from historical whaling data (e.g., Townsend, 1935; Tormosov *et al*., 1998), Discovery marks (Brown, 1968; Joyce, 1984) and photographic mark-recapture (e.g., Best *et al*., 1993; Constantine *et al*., 2007). However, technological developments in passive acoustic monitoring (e.g., Davis *et al*., 2020), artificial intelligence-assisted photo-identification (e.g., Cheeseman *et al*., 2022) and satellite telemetry (Heide-Jørgensen *et al*., 2003; Mate *et al*., 2007) have revolutionised our knowledge of baleen whale movement patterns on a global scale. Of these, satellite-linked telemetry tags provide the most detailed information on individual movement patterns.

The first tag ever deployed on a cetacean dates back to the 1930s (Scholander, 1940). There have been significant technological advances since then (e.g., Zerbini *et al*., in press). Today, satellite tags form a critical component of cetacean research (Andrews *et al*., 2019). Depending on the tag type, these instruments can provide data not only on the geographical position of the animal, but also on the animal's physiology, behaviour and the surrounding environment (Andrews *et al*., 2019). They have enabled the collection of information on movement patterns (Zerbini *et al*., 2015a; Lagerquist *et al*., 2019), migratory routes and destinations (Zerbini *et al*., 2006; Andrews-Goff *et al*., 2018; Horton *et al*., 2022; Vermeulen *et al*., 2024, population and stock structure (Heide-Jørgensen *et al*., 2006), identification of critical habitats and biologically important areas (Citta *et al*., 2018; Zerbini *et al*., 2015b; Sahri *et al*., 2022; Kratofil *et al*., 2023), spatial and temporal overlap with anthropogenic activities (Quakenbush *et al*., 2010; Irvine *et al*., 2014; Bedriñana-Romano *et al*., 2021). Considering continuous tag development and improvement, increased commercial availability and the growing need to improve management and conservation of whale populations, it is envisioned that their use will only increase in the future, further expanding our knowledge of cetacean ecology and biology. However, satellite tags, especially those that penetrate in deeper layers of tissue (e.g., consolidated or type C tags, Andrews *et al*., 2019), may present a risk to the tagged individual (Weller, 2008; ONR, 2009; Andrews *et al*., 2019; IWC, 2020). Follow-up studies are therefore essential to assess the individual and population-level impacts of satellite tagging on targeted species (e.g., Best & Mate, 2007; Walker *et al*., 2012; Best *et al.*, 2015; Norman *et al*., 2018; Gulland *et al*., 2024).

Since 1969, the South African southern right whale (SRW, *Eubalaena australis*) population has been monitored through annual aerial surveys flown each year in October between Nature's Valley and Muizenberg (Best, 1970; 1990a; Best *et al*., 2001). Since 1979, these annual surveys have incorportated photography to allow for the individual identification of whales through the unique callosity pattern on their head (Best, 1981; 1990b). These annual surveys create sighting histories from which population parameters are estimated, including population size, survival and population growth rates (Best *et al*., 2001; Brandão *et al*., 2023). Although the primary focus of the survey is photographing the callosity patterns of individuals encountered (with increased effort for calving females), body images are obtained as much as possible to allow for assessment of dorsal pigmentation patterns and scarring rates.

Tagging of SRWs in 2001 in South African waters (Mate *et al*., 2011) provided the first description of the migratory behaviour of this population. Tag duration lasted up to 161 days, with traveling distances up to 8,200 km recorded (Mate *et al*., 2011). Based on long-term monitoring data of this population, Best & Mate

(2007) and Best *et al*. (2015) provided information on demographic and physical/physiological tag effects on tagged individuals though opportunistic follow-up studies up to 11 years after tagging. Here, we extend these analyses with another 10 years of photo-identification data, providing follow-up information on calving rates, sighting histories and wound healing up to 21 years post-tagging.

MATERIALS & METHODS

Tag deployment

Consolidated satellite tags (Type C as defined in Andrews *et al*., 2019), equipped with Telonics ST-15 UHF Argos transmitters, were deployed on 21 southern right whales in 2001 in coastal South Africa (Mate *et al.*, 2011). These tags were stainless steel cylinders of 26.7 cm long and 1.9 cm in diameter, designed to embed in the dorsal surface of the whale and to anchor at or below the blubber-muscle interface. Only the antenna and conductivity sensor located at the posterior end of the tag remain exposed near the surface of the skin (Mate *et al*., 2007). A detailed description of the tags can be found in Best *et al*. (2015). Tags were deployed with a crossbow from a 6 m rigid-hull inflatable boat Saint Sebastian Bay between 8 and 13 September 2001, and outside Saldanha Bay between 21 and 26 September 2001 (Best & Mate, 2007; Mate *et al*., 2011; Best *et al*., 2015). Tag placement was approximately midway the distance between the blowhole and peduncle (on average 0.52 proportional distance from the blowhole) and on average 14.3 cm from the dorsal midline of the body (Table 1 in Best *et al*., 2015).

Sighting histories

Photographs from SRW photo-identification surveys conducted by the Whale Unit of the University of Pretoria Mammal Research Institute off South Africa between 2001 and 2022 were used to assess resighting rates of individuals tagged in 2001. These were compared with the resighting rates of non-tagged whales from that year's cohort (i.e., whales present in the calving grounds in the year tagging occurred). Opportunistic photographs (e.g., from whale-watching boats) of tagged individuals were used whenever available. Because only one tagged male was photo-identified and due to the difficulty of determining sex of solitary animals seen in the aerial surveys, only females that calved in 2001 were considered in this assessment.

Within the available sighting histories of female SRWs, survival of tagged and untagged whales was inferred by estimating the proportion of individuals documented in 2001 off the coast of South Africa that were not seen again (and thus presumed dead) for the following periods:

1. 2002 to 2022;
2. 2002 to 2012 (approximately the first decade after tagging);
3. 2013 to 2022 (approximately the second decade after tagging).

Fisher exact tests (Zar, 1996) were used to evaluate statistical differences in the proportion of whales resighted within these three periods.

Where the year of birth was not known, the age of a tagged female was estimated based on the year when first sighted with a calf, assuming a minimum age of six years at that time (based on the minimum estimated age of first parturition provided in Best *et al*., 2001).

Calving rates

To assess the possible effect of tagging on calving frequency of female SRWs, calving rates were calculated as the number of observed calves divided by the number of years between year of first calving and 2022. This was done for all identified tagged and untagged females as follows:

1. Overall calving rates of tagged and untagged females;
2. Pre-2001 calving rate of tagged and untagged females which had a calf in 2001;

3. Post-2001 calving rate of tagged and untagged females which had a calf in 2001 (including those who calved in 2001 for the first time) for the following periods:
    a. 2002–2022
    b. 2002–2012
    c. 2013–2022
4. Calving rate of tagged versus untagged females who calved for the first time after 2001.

A Shapiro-Wilk test was performed to assess if data were normally distributed. Mann-Whitney U tests were used to assess for differences in calving rate among tagged and untagged females.

One identified female associated with a calf at the time of tagging was found dead in 2004 (PTT835, Table 2). Because this mortality was caused by a ship strike, as described in Best *et al*. (2015), this individual was excluded from the dataset used in the calculation of calving rates.

Descriptive assessment of tag site

The long-term photographic dataset of SRWs was queried for images of the tag site. Opportunistic images were also used where available. A descriptive assessment of the tag site was conducted by two reviewers, and a third one where consensus was not reached, using criteria from Kraus *et al*. (2000) as done in Best & Mate (2007) (Table 1). To ensure data comparability of the scoring results across decades, the tag sites already scored by Best & Mate (2007) were rescored. If the image quality was too poor to accurately assign a score, the highest likely score was given. Although Best & Mate (2007) and more comprehensive methods, such as those used by Gulland *et al*. (2024), also assessed the presence and severity of swelling, this approach was not used here because accurately evaluating swelling from aerial images proved challenging.

Table 1

Criteria used for scoring of the tag site from Kraus *et al*. (2000) as used in Best & Mate (2007)

Score	Tag site condition
1	None
2	White scar
3	Divot* + scar
4	Divot + scar + cyamids

* Divot = an indentation of varying size as defined by Kraus *et al*. (2000)

RESULTS

Sighting histories

Table 2 provides a summary of sighting histories of SRWs tagged in 2001 along the South African coast. Of the 21 individuals tagged in 2001, 14 could be identified as females due to association with a calf either at the time of tagging (n = 8) or at some other stage in their sighting history (n = 6). Mate *et al.* (2011) report on five individuals classified as males either through sexing of a skin biopsy sample taken at the time of tagging or inspection of genital area. The sex of two individuals remain unknown. A total of 14 individuals were photo-identified either during the annual aerial survey flown two weeks after tagging efforts (n = 7) or in subsequent years (n = 7). Such identification was based on matching aerial photo-identification images from the aerial surveys with lateral images of the callosity pattern and tag placement obtained at the time of tagging. Of these 14 identified individuals, 13 were confirmed females and one was a male. Of these, 12 were resighted alive up to 21 years post-tagging (Fig. 1). Additionally, one unidentified male (PTT 23037) had a confirmed opportunistic resighting in 2005 based on the placement and position of the tag (Best *et al*., 2015).

Table 2

Summary of 21 southern right whales tagged in 2001 along the South African coast, including PTT number, photo-ID catalogue number, sex, years of sightings, estimated age at time of tagging and at the last sighting, and number of years and associated calves seen prior and post-tagging.

#	PTT ID	Catalogue number	With calf at time of tagging (Y/N)	Sex	Year of first sighting as non-calf	Year of first observed calving	Year last resighted	Estimated age at time of tagging	Estimated age at last sighting	# of years in which (re)sighted prior to tagging	# of calves observed prior to tagging	# of years in which resighted post-tagging	# of calves observed post-tagging
1	823	NA	Y	F	–	–	–	–	–	–	–	–	–
2	824	NA	N	–	–	–	–	–	–	–	–	–	–
3	825	R9155A	N	F	1991	2013	2018	≥ 10	≥ 27	1	0	4	2
4	826	R8359A	N	F	1983	1983	2001	≥ 24	≥ 24	2	2	0	0
5	827	R9732A	Y	F	1997	1997	2020	≥ 10	≥ 29	1	1	4	4
6	831	R04143A	N	F	2001	2004	2018	≥ 3	≥ 20	0	0	5	5
7	834	R9820A	Y	F	1998	1998	2022	≥ 9	≥ 30	1	1	2	2
8	835	R8754A	Y	F	1987	1987	2004	≥ 20	≥ 23	4	4	1	0
9	836	R02151A	N	F	2001	2002	2015	≥ 5	≥ 19	0	0	2	2
10	837	R06217A	N	F	2001	2006	2018	5 (born 1996)	22	0	0	3	3
11	838	NA	–	M	–	–	–	–	–	–	–	–	–
12	839	NA	N	–	–	–	–	–	–	–	–	–	–
13	843	R9283A	Y	F	1992	1992	2012	≥ 15	≥ 26	1	1	1	1
14	847	R01105A	Y	F	2001	2001	2010	≥ 6	≥ 15	0	0	2	2
15	848	NA	–	M	–	–	–	–	–	–	–	–	–
16	1385	R9854A	Y	F	1998	1998	2018	≥ 9	≥ 26	1	1	3	3
17	4172	NA	–	M	–	–	–	–	–	–	–	–	–
18	10826	R8915A	Y	F	1989	1989	2022	22 (born 1979)	43	3	3	4	3
19	23031	R03155A	–	M	2001	–	2007	5 (born 1996)	11	–	–	2	–
20	23034	R05120A	N	F	2001	2005	2008	≥ 2	≥ 9	0	0	2	2
21	23037	NA	–	M	–	–	2005*	–	–	–	–	1	–

*Indicates a whale for which photo-ID was not available but was assumed to be a tagged whale based on a photograph of the tag site taken by a whale watching operator.

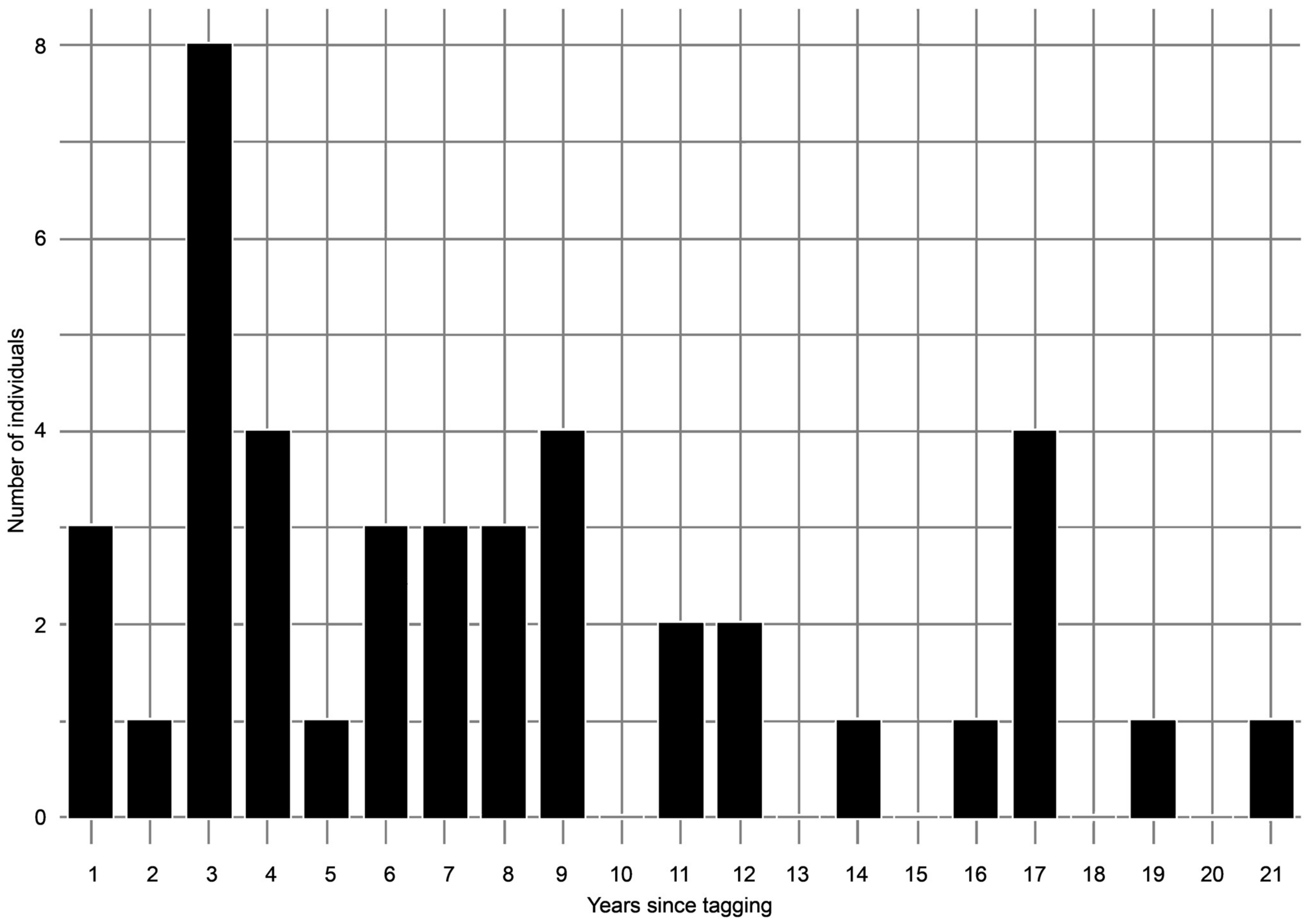

Figure 1. Frequency of resightings of southern right whales satellite-tagged in 2001 in South Africa.

Table 3
Number of individuals sighted and proportion of tagged and untagged female southern right whales resighted off South Africa in three periods since deployment of consolidated satellite tags in 2001.

Period	Tagged	Untagged	Fisher's exact test
Seen (tagging year, 2001)	13	171	–
Seen (2002–2022)	11	151	–
Proportion (2002–2022)	0.846	0.883	No significant difference between tagged and untagged whales (p = 0.657)
Seen (2002–2012)	11	147	–
Proportion (2002–2012)	0.847	0.860	No significant difference between tagged and untagged whales (p = 1)
Seen (2013–2022)	7	99	–
Proportion (2013–2022)	0.539	0.579	No significant difference between tagged and untagged whales (p = 0.779)

Tagged whales were estimated to be between two and > 24 years old at the time of tagging, and anywhere between 11 and 43 years old at their last sighting (Table 2). The proportion of tagged and untagged individuals resighted subsequent to 2001 did not differ significantly across three periods (21 years since tagging [2002–2022], first 11 years after tagging [2002–2012, period chosen for consistency with Best *et al*., 2015] and the subsequent period between 2013 and 2022) (Table 3).

Calving rates

Average calving rate of tagged females did not differ significantly from the average calving rate of all untagged females in the catalogue up to 2022 (Table 4; Fig. 2). Calving rates pre and post-2001 did not vary among tagged and untagged whales. Calving rates reduced between 2002–2012 and 2013–2022 for tagged and untagged females alike (Table 4).

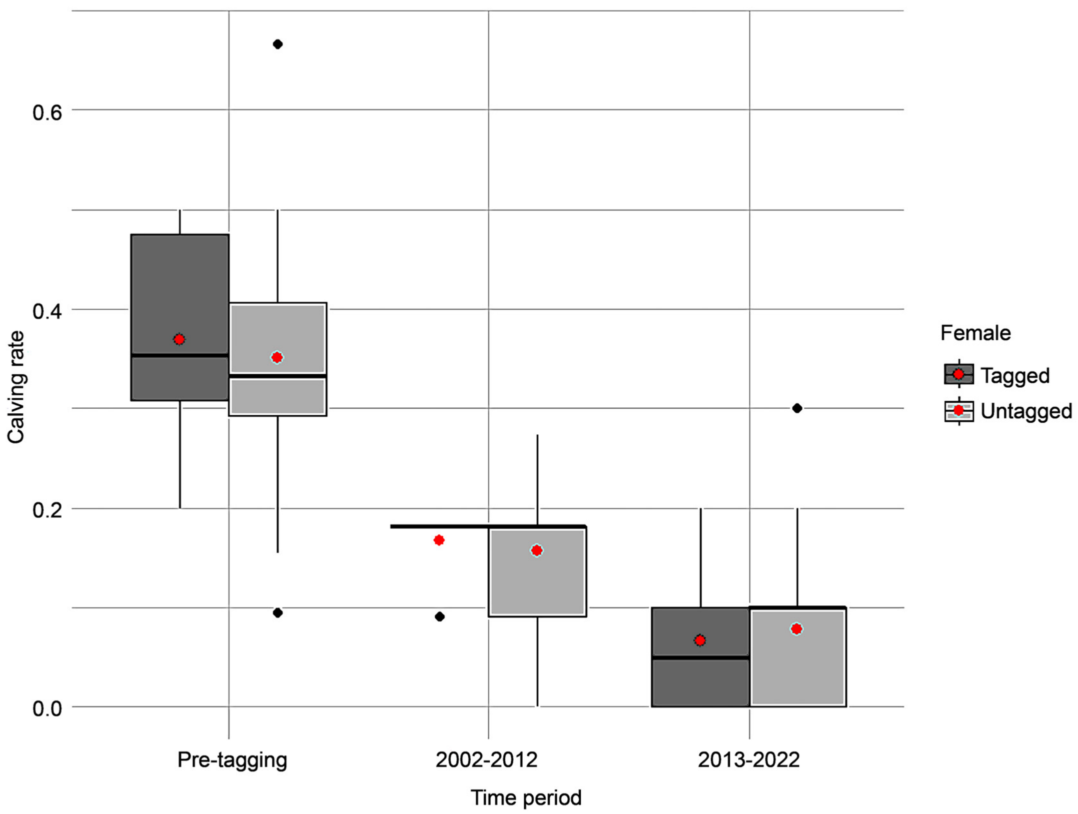

Figure 2. Boxplot representing the calving rate (number of calves/year) of tagged and untagged adult female southern right whales which had a calf in 2001 for the period up to 2001 (pre-tagging), 2002-2012 and 2013-2022. Horizontal lines represent the median. Red dots represent the mean calving rate. Black dots represent outliers. For sample sizes, see Table 4.

Table 4

Mean calving rate (number of calves/year) and standard deviation (SD) of identified adult female southern right whales tagged in 2001, and those untagged individuals in the catalogue.

	Calving Rate		
	Tagged	Untagged	Statistical test results
Overall	0.20 (SD = 0.09; n = 12)	0.25 (SD = 0.23; n = 2,108)	W = 13198, *p* = 0.795
Pre-2001 (with a calf in 2001)	0.38 (SD = 0.13; n = 5)	0.37 (SD = 0.18; n = 115)	W = 331, *p* = 0.57
Post-2001 (with a calf in 2001)			
Period 2002–2022	0.12 (SD = 0.05; n = 6)	0.11 (SD = 0.07; n = 164)	W = 481.5, *p* = 0.93
Period 2002–2012	0.17 (SD = 0.04)	0.16 (SD = 0.09)	W = 512.5, *p* = 0.86
Period 2013–2022	0.07 (SD = 0.08)	0.08 (SD = 0.08)	W = 450.5, *p* = 0.71
Calved after 2001 for first time	0.19 (SD = 0.06; n = 5)	0.19 (SD = 0.11; n = 1,268)	W = 3585, *p* = 0.61

Tag wound assessment

Photographs of tag sites were available for all but one of the resightings. Tag site score decreased slightly in the last decade (2013–2022, average score = 2.9 ± 0.49) compared to the first decade (2002–2012, average score = 3.48 ± 0.32) (Table 5), with either only divots or no visible scar present in the most recent years (see Fig. 3 for example photos).

DISCUSSION

This study builds on the work of Best *et al*. (2015) by providing an extra decade of data on sighting histories, calving rates and wound healing of SRWs tagged in South African coastal waters in 2001. Although the sample size is relatively limited and resighting efforts of tagged whales was not conducted in a systematic manner, with

Table 5

Details of 15 southern right whales tagged in South African coastal waters in 2001, for which photographs were available to assess tag site subsequent to tagging, including sex, PTT number, catalogue ID, details of tag placement (from Best & Mate, 2007), as well as temporal scores of tag site.

Sex	PTT ID	Whale ID	Tag placement			Year (period 2002–2022)																				
			Proportional distance from the head*	Distance from midline (cm)*	Protruding (cm)*	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22
F	825	R9155	0.55	10.0	2.5						3		3				3					3				
F	826	R8359	0.5	5.0	0.0																					
F	827	R9732	0.5	20.0	4.0			4				4									3			3		
F	831	R04143	0.5	15.0	3.0			3			4			3			3					3				
F	834	R9820	0.5	5.0	5.0			3						3												
F	835	R8754	0.4	7.5	5.0			3																		
F	836	R02151	0.67	15.0	2.0	4			4										4							
F	837	R06217	0.5	7.5	6.5			4		3			4			3						3				
F	843	R9283	0.5	40.5	4.5											4*										
F	847	R01105	0.67	5.0	5.0	4		3						4												
F	1385	R9854	0.5	15.0	5.0									3								1				
F	10826	R8915	0.6	15.0	5.5				4			3	3													3
M	23031	R03155	0.33	25.5	5.0		3	4			4															
F	23034	R05120	0.5	12.5	1.0	4			3			3														
M	23037	NA	0.4	10.0	4.0				4																	

* Broken tag still attached as reported in Best *et al*. (2015)

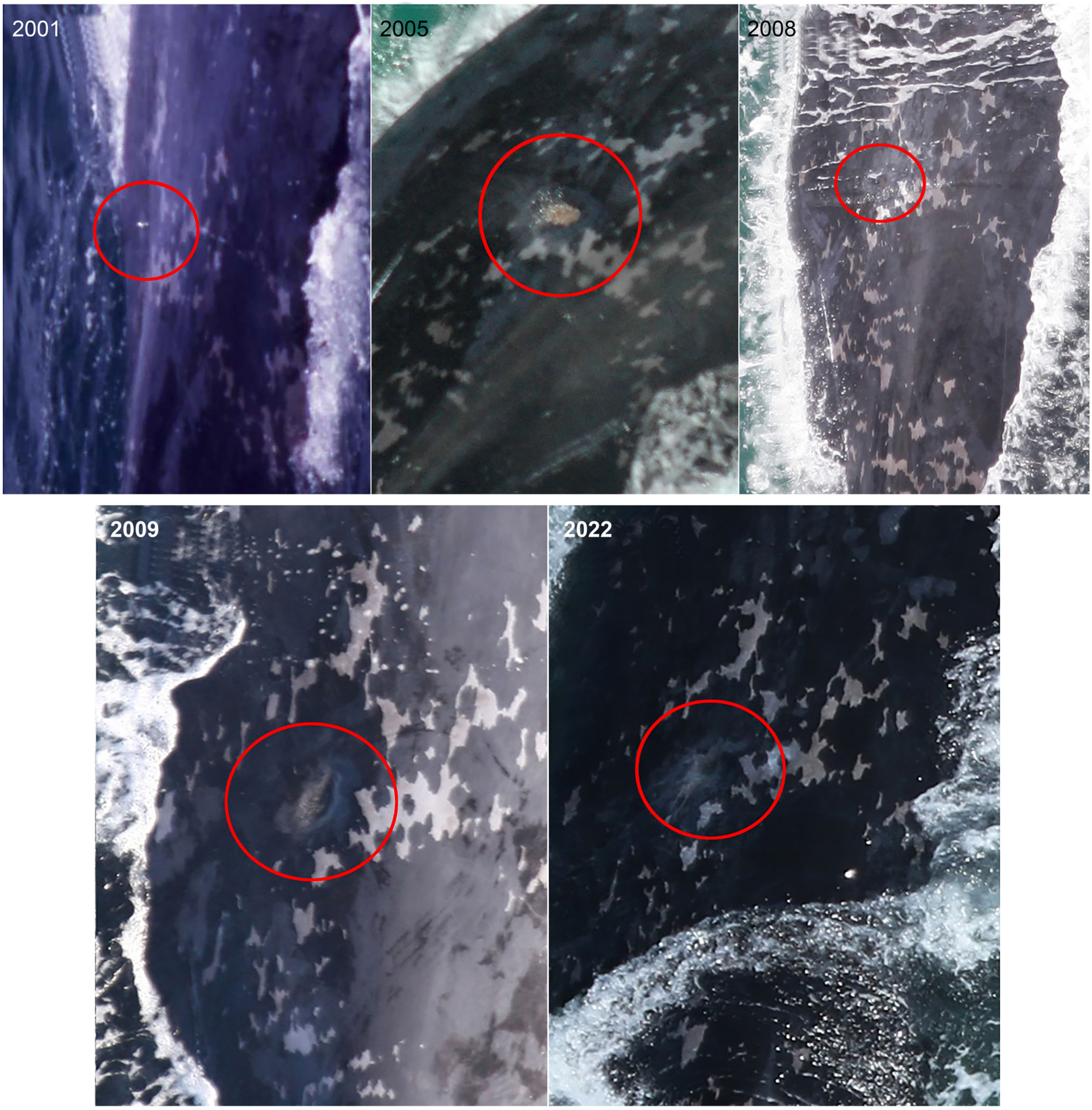

Figure 3. Photographs of PTT 10826 (R8915A) providing examples of progression of tag site over time. Photo of 2001 shows the presence of the tag.

a total of 21 years, this analysis represents the longest follow-up study on any cetacean species post-tagging to date. Results show no difference in the observed sighting history or calving rates of tagged versus untagged individuals over the decades. Although visual assessment of the tag site was limited to aerial photography, images showed all tag sites healed well (i.e., lesions closed and skin tissue repaired), with only small divots visible in the last decade. This suggests that divots may be permanent in some cases (Best *et al.*, 2015), possibly due to localised damage to the underlying tissue.

The proportion of tagged and untagged whales resighted in three periods after the year of tagging (2001) was used here as a proxy to infer potential differences in survival of these two groups. This is a relatively basic comparison because the proportion of animals seen corresponds to a mixture of survival, immigration/emigration and resighting probabilities. However, if the resighting rates and immigration/emigration rates of tagged and untagged whales are similar (and there is no reason to believe they aren't), the results presented here indicate no evidence that tagging resulted in increased long-term mortality probabilities for SRWs off South Africa. The proportion of whales seen or tagged in 2001 is similar across a 21-year period (2002–2022) and within two separate decadal periods (2002–2012 and 2013–2022). These results are consistent with studies designed to assess survival probability of whales tagged with consolidated satellite tags on other species using more sophisticated statistical analysis (e.g., mark-recapture methods), including humpback whales (*Megaptera novaeangliae*, Robbins *et al*., in prep), North Atlantic right whales (*E. glacialis,* Kraus *et al*., 2000) and gray whales (*Eschrichtius robustus*, Calambokidis *et al*., 2015).

Results presented here also provide evidence that tags had no long-term effect on SRW calving rates, confirming the results obtained by Best *et al*. (2015). The estimated average calving rates for two decadal periods (2002–2012 and 2013–2022) were identical between tagged and untagged females. The South African SRW population has undergone important demographic changes in the last 10 years. Long-term monitoring of this population has shown a decreased maternal body condition (Vermeulen *et al*., 2023) and a shift in foraging strategy (van den Berg *et al*., 2021) in the past decade. It is believed these changes have resulted in the decreased reproductive success of the population since 2009 (Brandão *et al*., 2023), in turn linked to reduced food availability in Southern Ocean foraging grounds due to drastic sea-ice declines (Germishuizen *et al*., 2024). The present study clearly showed that a reduction in reproductive success between 2002–2012 and 2013–2022 were nearly identical in tagged and untagged whales (Table 4, Fig. 2), indicating that tagged female right whales were not more vulnerable or susceptible to the environmental changes affecting the population, while also providing further evidence of a lack of adverse effects of the tags on these females.

The tags deployed in South Africa in 2001 were invasive consolidated type (Type C as defined in Andrews *et al*., 2019). Tag design at the time was such that the transmitter and anchor elements were produced as separated parts, connected to each other by an interface that often included threated screws through which the electronics housing and retention elements were attached. A recent detailed follow up study on Gulf of Maine humpback whales showed that interfaced tag designs resulted in a large number of tag failures (Zerbini *et al*., in press) with consequential negative health effects (Robbins *et al.*, 2013; Gulland *et al.*, 2024) and demographic effects (Robbins *et al*., in prep) to tagged individuals. Even though the tags deployed on SRWs in South Africa in 2001 was slightly different than those used initially with Gulf of Maine humpback whales, they presented features, including interfaces, that resulted in breakages on multiple cetacean species. For example, at least two of the satellite tags deployed on SRWs in South Africa were damaged (loss of the antenna and/or the conductivity sensor, with at least one remaining attached for a period of at least 11 years [Best *et al*., 2015]). Goley *et al*. (2024) documented the broken tip of a consolidated tag in the blubber of a gray whale tagged in the eastern North Pacific in 2012 and found stranded in California, USA, in 2019. The retention elements and interface by which these elements were attached to the tag housing were identical to those used with SRWs in South Africa (see a description of the tag and attachment elements in Mate *et al.*, 2007). Even with documented breakages of the tag design used with SRWs in 2001, this study was unable to detect any significant effect in demographic parameters or unusual wound healing on SRWs tagged off South Africa. Lack of noticeable effects could be related to the relatively small sample size and consequent low statistical power to detect a small effect. Effects on survival and calving rates would have to be large (e.g., a reduction of 40–75% in survival and of 62–77% in the calving interval of tagged whales) for an effect to be detected with the sample sizes obtained in this study assuming power to detect an effect is 0.8. They could also mean that SRWs may better tolerate breakages in tag elements when compared to other species, such as humpback whales.

In recent years, substantial effort has gone into increasing the robustness of consolidated satellite tags for whales with the aim to improve tag performance and to minimize health impact on tagged individuals (Zerbini *et al*., in press). New generation transdermal tags are now fully integrated: i.e., they are built as a single unit without interfaces that are prone to failure. These new designs have been used with SRWs since the mid-2010s (e.g., Zerbini *et al*., 2018; Sprogis *et al*., 2023; Kennedy *et al*., 2024 Weir *et al*., 2024), including in South Africa where consolidated tag deployments have occurred yearly since 2022 (Vermeulen *et al*., 2024). The combination of new tag deployments with long-term photo-identification studies in this region will be important to continue assessing the potential effects of invasive telemetry devices on this species, particularly in periods where populations are going through demographic changes due to, in large part, climate effects on their foraging grounds (Brandão *et al*., 2023; Germitshuizen *et al*., 2024).

Considering the concern about the effects of tagging on individual health (IWC, 2020; ONR, 2009; Weller, 2008), follow-up studies are of paramount importance to assess individual and population-level impacts of tagging. Acknowledging the relatively small sample size, this study shows there was no measurable effect of the tags on the sighting history and calving rate of the tagged South African right whales, and that tag sites have healed with only small divots visible to date. It is recommended that future follow-up studies aim to maximise sample size at all times to increase statistical power to assess effects across decadal time spans.

ACKNOWLEDGEMENTS

We thank the anonymous reviewers for their contributions to improve this manuscript. The scientific results and conclusions, as well as any views or opinions expressed here, are those of the authors and do not necessarily reflect those of NOAA or the US Department of Commerce.

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