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Report of the southern right whale aerial surveys - 2021

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Content

Abstract

Since 1969, annual aerial surveys have been condicted along the South African coast to monitor the recovery of the South African population of southern right whales (*Eubalaena australis*) from extensive whaling. From 1979, these annual surveys incorporated a photo-identification component, resulting in an uninterrupted 42-year survey series of photo-identification history. Although these surveys have revealed a steady population increase since the protection of the species from commercial whaling, recent results have indicated substantial changes including a marked decline in the prevalence of unaccompanied adults since 2010, an increase in the reproductive cycle from the normal 3-year cycle to 4- and 5- year calving intervals since 2010, and an enormous fluctuation in the number of cow-calf pairs along the South African shore since 2015.

The 2021 annual photo-identification aerial survey, covering the area between Nature's Valley to Muizenberg, was flown between 3 and 5 October 2021 in a westward direction, with the aim to count all southern right whales and photograph all females with calves as well as individuals with a brindle or grey blaze colouration. A total of 16 hours and 33 minutes were flown in an Airbus EC120B helicopter, chartered by Silvercross Helicopters, to complete the survey. Of these, 12 hours and 6 minutes were flown as search effort, and 4 hours 27 minutes were flown in transit to and from the survey start and end-points. In total, 191 cow-calf pairs of southern right whales (382 animals) and 32 unaccompanied adults were observed, leading to a total of 414 southern right whales. Although this number is an increase from the low number of cow-calf pairs seen during the 2020 annual aerial survey (n=67), it remains far below the numbers to be expected based on the projected population growth rate. For unaccompanied adults, numbers remain similar to 2020 (n=31) and therefore marks the fifth-lowest count since the commencement of the aerial surveys.

In total, 191 cow-calf pairs and 18 unaccompanied adults were photo-identified during the survey. Subsequent data analysis indicated the presence of 12 duplicates in the dataset, and 2 individuals with a lack of good quality photographs, leading to the identification of 195 unique individual southern right whales, including 177 cows. Of these, 86 could be matched to previously known females giving results on 75 new inter-calving intervals. The observed calving intervals indicated the majority of cows calving in 2021 had a normal 3-year (19%), 6-year (17%) and 7-year (16%) calving interval.

Similar to the 2020 survey, this year's photo-identification analyses showed the low frequency of re-identifications of the older females known in the catalogue. In fact, the vast majority (71%) of females (re-)identified in 2021, had been added to the catalogue only in the past decade, and only 17 cows photographed in 2021 were known to the catalogue since prior the year 2000. Whether or not this is a result of a non-random component of the population being captured on the October survey, remains to be determined.

Prior to the annual helicopter survey, two aerial count surveys were conducted, with the sole purpose of counting cow-calf pairs in the coastal area between Hermanus New Harbour and Witsand (covering the main nursery grounds). This survey was flown in an eastward direction on 3 August 2021 and 15 September 2021 using an autogyro. Results of this survey indicated the presence of 169 cow-calf pairs

and 52 unaccompanied adults, and 211 cow-calf pairs and 35 unaccompanied adults respectively, along this limited stretch of coastline.

These data continue to indicate a peak of cow-calf pair numbers in September rather than October, and is believed to reflect a reduced residency time on the South African coast.

The incessant low number of unaccompanied adults remains a concern in regard to the country's whale-watching industry (legislation prohibits the approach of cow-calf pairs < 300m), as accumulative effects of approaching vessels on cow-calf pairs could have energetic consequences for both cow and calf. Furthermore, the observed demographic fluctuations in the South African southern right whale population reiterates the extreme value of this long-term dataset. An uninterrupted continuation of these survey series is therefore crucial, not only to monitor southern right whales in their breeding ground off South Africa, but also to improve our understanding of the changing state of the larger marine ecosystem these whales inhabit.

Introduction

The South African population, which occupies seasonal calving and nursery grounds in the nearshore and protected waters of the southern Cape coast, has been monitored through annual aerial surveys since 1969, to assess their population increase following the international protection from commercial whaling. From 1979 onwards, these annual aerial surveys have incorporated photo-identification (Best, 1981; Best, 1990; Best et al., 2001; Best 2011), a method by which individual whales are identified through overhead photographs of the callosity pattern on the head and/or skin pigmentation patterns found on the back (brindle colouration, grey blaze and white patches) (Payne et al. 1983). Considering the increasing size of the population, and the therefore increasing length (and cost) of the survey each year, special focus is given to all nursing females and their calves (cow-calf pairs), as well as individuals with a brindle, white blaze or partial grey colouration. This currently 42-year long database serves as a basis for vital demographic parameters of the population to be modelled and estimated (including, for example, calving intervals, female survival rates and age at first parturition) (Best et al., 2001; Best et al., 2005).

In the past decade, results of this long-term database show abrupt changes in the population including: (a) an abrupt decrease in sightings along the South African coast of unaccompanied adults (i.e. adult whales without a calf incl. males and females), (b) extreme fluctuations in the number of cow-calf pairs since 2015 (Findlay et al., 2017), (c) an increase in calving intervals from 3-year calving intervals to 4- and 5-year intervals, suggesting calving failure (Vermeulen et al., 2018; Brandão et al., 2018), (c) an apparent shift in peak presence of cow-calf pairs in the South African breeding ground from early October to late August/early September (Vermeulen et al., 2018), and (d) a slight decrease in the population increase rate from 7.1% per annum in 2001 (Best et al., 2001), to 6.8% in 2011, 6.6% in 2012 and to 6.5% per annum in 2017 (Brandão et al., 2018). Together, these data warrant further in-depth analyses and indicate that the continuation of the long-term monitoring of southern right whales within the calving grounds of the southern Cape is more vital than ever before.

This report provides the results of the 2021 southern right whale aerial surveys.

Methods and Procedures

Annual photo-identification aerial survey

The annual helicopter-based photo-identification survey of southern right whales is conducted along the southern Cape coast of South Africa from Nature's Valley to Muizenberg (for locations see Figure 3) at the end of September - early October, a time when it is believed most calves are present along the coast (i.e. most calves have been born and have not yet left on their annual migration south). Operating procedures have been largely standardised over this 40-year survey-series (although technological advances have been incorporated where necessary). The survey is flown coastwise and generally westwards at an altitude of 330 m and a ground speed of 80-100 kts under adequate sighting and photographic conditions. The survey is generally conducted between 08h00 to 16h00 each day as glare compromises photography earlier and later in the day. The survey continues the following day from the point reached at the end of the previous day. In the past years, the surveys have been flown with an Airbus EC120B helicopter some 500-800 m offshore, with one observer searching inshore from the starboard forward seat, while a second observer searches offshore from the rear port seat (with assistance from the pilot on the port forward seat). If deemed advantageous, the observer in the rear seat could shift over to the starboard side of the helicopter and assist with spotting in a shoreward direction at times. Should glare interfere with sighting conditions, then the flight path would shift temporarily over the shore, with the pilot and rear observer searching seawards so as to increase sightability. The use of the Airbus helicopter has allowed for safer hovering capabilities, and the configuration within the helicopter has allowed for photographing in a southerly and easterly direction (by the observer in the rear port seat) limiting the exposure to glare from midday onwards and thus decreasing hovering times (see Figure 1).

All observed cetacean groups are recorded, including group size and composition, as well as time and position. If photography of southern right whales is required, the helicopter descends to an altitude of 150 m. The callosity patterns and pigmentation features of all cow and calf pairs and animals with a distinct colouration pattern are photographed by the rear observer using a Canon 7D EOS camera with a 100-400 mm lens. Once photography is complete the aircraft returns to an altitude of 330 m and resumes searching or moves directly to the next sighted group at an altitude of 150 m.

Figure 1. Picture of the Airbus EC120B helicopter in Cape Town International Airport, and in flight.

A support vehicle accompanies the aerial survey, allowing for daily provisioning of the survey team, transport of equipment and luggage, and, most importantly, rotation of observers during each day's survey if needed.

Aerial count survey

In order to examine the general increase of cow-calf pairs along the southern Cape coast during whale season (June to December), additional aerial surveys were carried out between Hermanus New Harbour and Witsand (for locations see Figure 3) using a light-weight autogyro (or gyrocopter; Figure 2).

An autogyro is a small type of aircraft that uses an unpowered rotor in autorotation to develop lift, and an engine-powered propeller, similar to that of a fixed-wing aircraft, to provide thrust. It is a very fuel-efficient aircraft which allows for cost-effective monitoring of an extended coastal strip compared to an aeroplane or helicopter. However, an autogyro only allows for two passengers; the pilot who sits in the front and an observer in the rear. Additionally, due to the engine-powered propeller and an unpowered rotor, the autogyro has no hovering capabilities, and is often an open configuration. All these aspects make it difficult to collect photo-identification data while making notes and observations. Therefore, the sole purpose of these surveys is to count southern right whale females associated with calves as accurately as possible.

Figure 2. Image of the autogyro used for the count survey

The extent of coastline between Hermanus New Harbour and Witsand was chosen as it is believed to cover two of the main nursery grounds of the southern Cape coast, i.e. De Hoop Nature Reserve and Walker Bay (Elwen and Best, 2004). Although Saint Sebastian Bay (from Witsand to the East; Figure 3) is also known as a main nursery ground, this bay cannot be covered due to the fuel restrictions of the aircraft and financial limitations.

The survey was flown in an eastward direction between 08h00 and 14h00 at an altitude of approximately 300m, a speed of approximately 60kts and a distance of 500m offshore. During the survey, the pilot would mainly search ahead and coastwise, while the observer in the back would search offshore.

Intercom communication between the pilot and the observer allows for the observer to make notes of the cow-calf pairs counted both inshore and offshore. When whales were too far offshore to determine group composition, they would be approached after which the aircraft would return to a distance of approximately 500m offshore. If the presence of a calf could not be determined with certainty, the observed whale would be recorded as unaccompanied, and the survey would continue. Each survey would take no longer than approximately 3 hours in a continuous flight, limiting the likelihood of duplicates within the count.

Photo-identification analysis

Photographs of the 2021 annual photo-identification aerial surveys were processed as follows: Firstly, the best images of each encounter were selected and those for same-day duplicates amalgamated. Secondly, photographs were visually inspected to eliminate within-year duplicates for the photo-identification matching process. Finally, matching of individuals was conducted using the Hiby-Lovell automated computer-based image recognition (Hiby and Lovell, 2001) and associated database system, which utilises digitised extracts of the callosity patterns (automatically adjusted for tilt and inclination) to make inter-individual comparisons. Automated comparisons of callosity patterns are rated for similarity using digital algorithm indices of similarity from 1.00 to zero, with the most similar candidate presented first. Matching by eye starts with the highest index and continues until a match is made or until the index has fallen to 0.50, although the performance of the system is such that the actual match is found in the first 3 candidates in over 90% of the cases. The dorsal pigmentation features are used in confirmation of a match and can be directly matched by eye with calves from earlier years (even in the absence of suitable photographs showing callosity patterns) to provide known-age individuals. When an individual was matched with a previously known individual, the sighting was recorded in the catalogue. When no match could be found, the individual was assigned a unique identification number and incorporated into the catalogue as a new individual. Once all the matching was complete, capture-recapture histories and associated calving intervals were extracted from the dataset. Further analysis of population parameters and distribution will be conducted according to Best (1990), Best et al. (2001; 2005) and Brandõ et al. (2018) among others.

Results

Annual photo-identification aerial survey

The 2021 annual photo-identification aerials survey was flown along the coast between the 3rd and 5th of October 2021 in a westward direction between Nature's Valley and Muizenberg. The helicopter and survey team were positioned at Witsand on the 2nd of October. The region between Nature's Valley and Infanta Point was surveyed on the 3rd of October. Infanta Point to Arniston was surveyed on the 4th of October and the remaining coast from Arniston to Muizenberg on the 5th of October.

A total of 16 hours and 33 minutes of flight operations were required to complete the survey, of which 12 hours and 6 minutes were flown as search effort, and 4 hours 27 minutes were flown in transit to and from the survey start and endpoints. Table 1 shows the general progress of the survey. Figure 3 shows the flight path including the distribution of the different sightings. Figures 4, 5 and 6 provide additional detail to the sightings.

Table 1: Flight schedule of the 2021 annual southern right whale aerial survey flown between Nature's Valley and Muizenberg.

Flight	Date	Flight Start	Flight End	Total Time	Survey start	Survey end	Search Time	Transit Time	CC SRW	Un Ad SRW
1	2 October 2021	Cape Town International Airport	Witsand	1:10	Transit			1:10		
2	3 October 2021	Witsand	George	0:45	Transit			0:45		
3	3 October 2021	George	George	1:34	Natures Valley	George coast	0:34	1:00	0	0
4	3 October 2021	George	Witsand	2:14	George coast	Infanta Point	2:05	0:09	14	7
5	4 October 2021	Witsand	De Hoop	2:23	Infanta Point	Koppie Alleen	2:12	0:11	45	8
6	4 October 2021	De Hoop	De Hoop	1:39	Koppie Alleen	Arniston	1:21	0:18	26	0
7	5 October 2021	De Hoop	Grootbos	2:44	Arniston	Brandfontein	2:20	0:24	39	3
8	5 October 2021	Grootbos	Grootbos	2:22	Brandfontein	De Kelders	2:03	0:19	49	7
9	5 October 2021	Grootbos	Cape Town International Airport	1:42	De Kelders	Muizenberg	1:31	0:11	18	7
Total				**16:33**			**12:06**	**4:27**	**191**	**32**

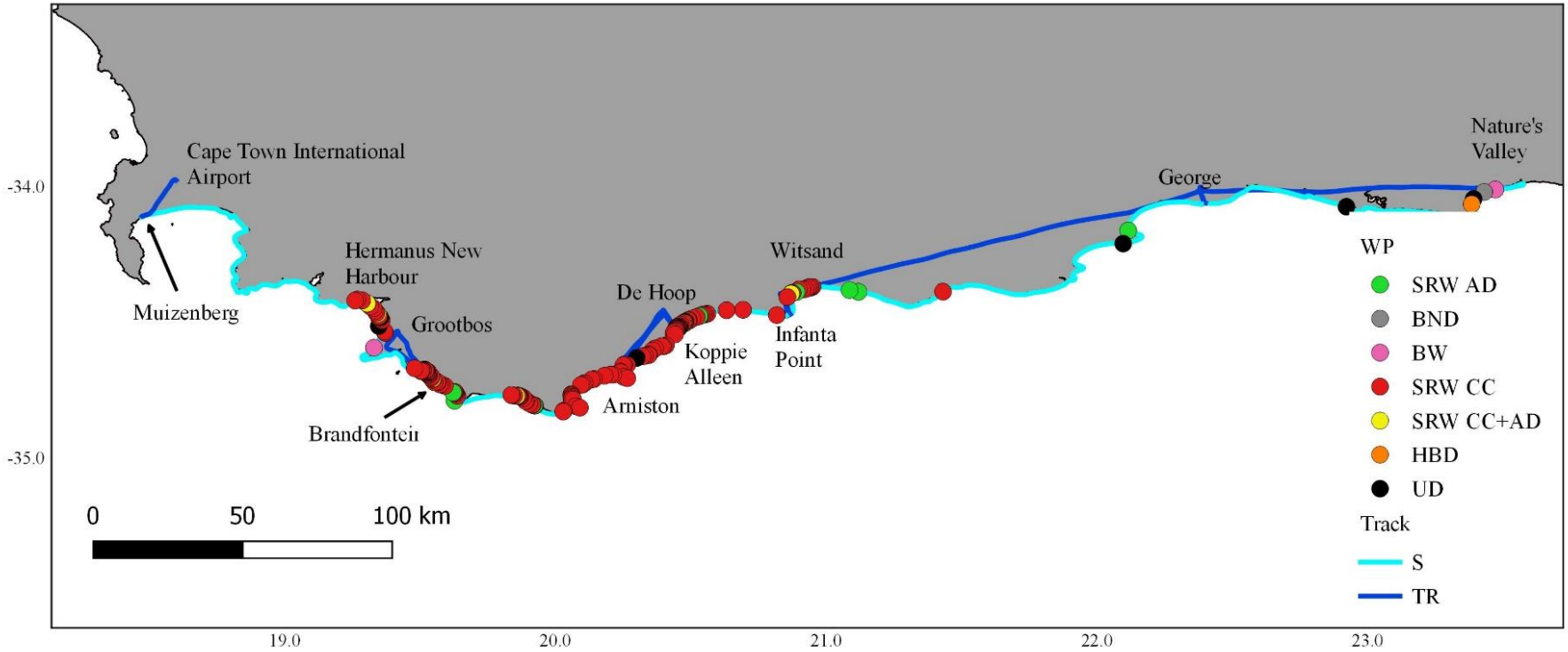

Figure 3. Flight path with search effort (light blue line) and transit (dark blue line), as well as encounters of unaccompanied southern right whales (SRW AD), bottlenose dolphins (BND), Bryde's whales (BW), southern right whale cow and calves (SRW CC), groups including southern right whale cows, calves and unaccompanied adults (SRW CC + AD), humpback dolphins (HBD) and unidentified dolphins (UD) during the 2021 South African southern right whale survey between Nature's Valley and Muizenberg.

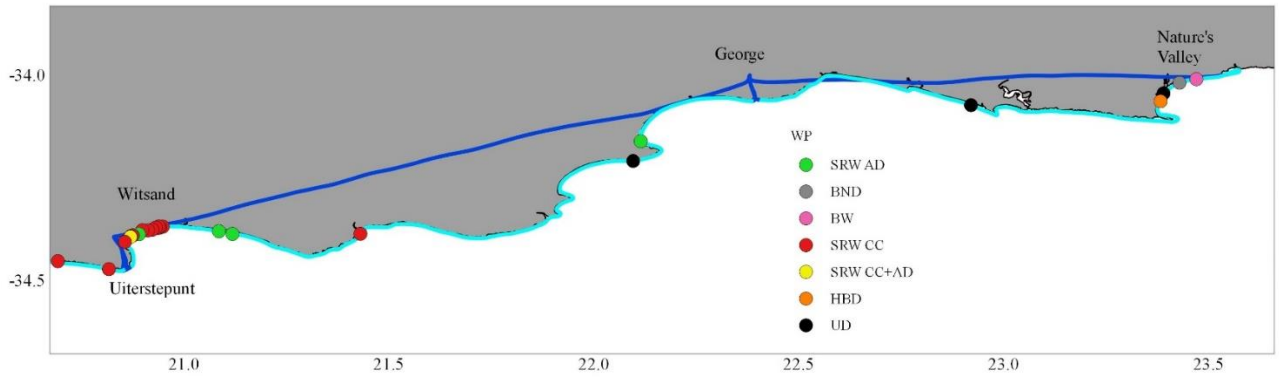

Figure 4. Flight path with search effort (light blue line) and transit (dark blue line), as well as encounters of unaccompanied southern right whales (SRW AD), bottlenose dolphins (BND), Bryde's whales (BW), southern right whale cow and calves (SRW CC), groups including southern right whale cows, calves and unaccompanied adults (SRW CC + AD), humpback dolphins (HBD) and unidentified dolphins (UD) during the 2021 South African southern right whale survey between Nature's Valley and Uiterstepunt.

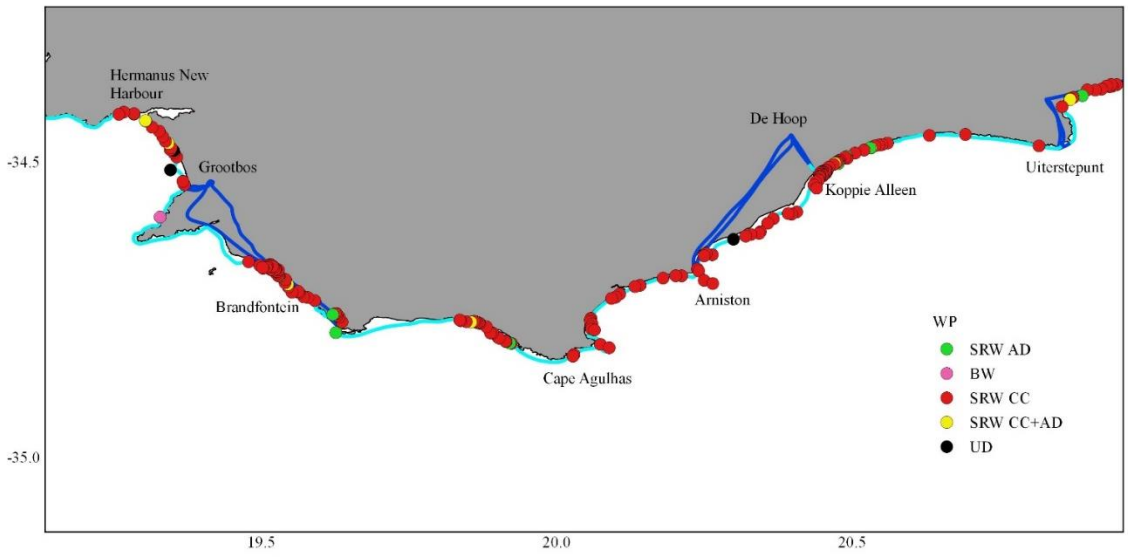

Figure 5. Flight path with search effort (light blue line) and transit (dark blue line), as well as encounters of unaccompanied southern right whales (SRW AD), Bryde's whales (BW), southern right whale cow and calves (SRW CC), groups including southern right whale cows, calves and unaccompanied adults (SRW CC + AD), and unidentified dolphins (UD) during the 2021 South African southern right whale survey between Uiterstepunt and Hermanus New Harbour.

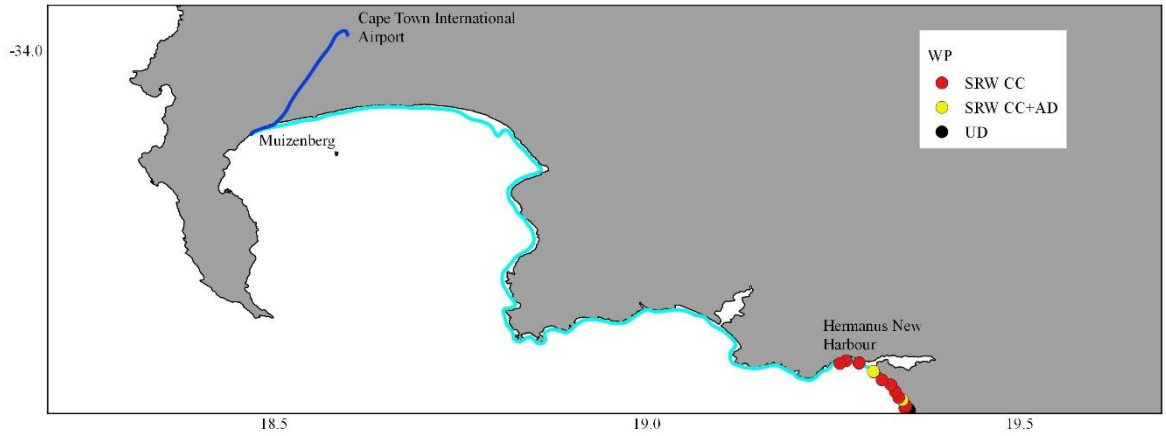

Figure 6. Flight path with search effort (light blue line) and transit (dark blue line), as well as encounters of southern right whale cow and calves (SRW CC), groups including southern right whale cows, calves and unaccompanied adults (SRW CC + AD), and unidentified dolphins (UD) during the 2021 South African southern right whale survey between Hermanus New Harbour and Muizenberg.

Table 2 shows the cetacean groups encountered in adequate sighting conditions across the entire survey region (Nature's Valley to Muizenberg). In total 191 cow and calf pairs of southern right whales (382 animals) in 173 groups, as well as 22 groups equalling 32 unaccompanied adult southern right whales, were encountered during the survey. Over 8,000 photographs of southern right whales were taken during the survey including between-group spacer images. Furthermore, 2 Bryde's whales (*Balaenoptera brydei edeni*) were encountered (Figure 3, 4, 5 and Table 2). Additionally, 1 group of 4 humpback dolphins (*Sousa plumbea*), 2 groups totalling some 40 bottlenose dolphins (probably *Tursiops aduncus*) and 8 groups totalling some 76 unidentified dolphins were encountered (Figure 3, 4, 5, 6 and Table 2).

Table 2. Numbers of groups and individual cetaceans encountered during the 2021 South African southern right whale survey between Nature's Valley and Muizenberg.

	Southern right whales	**Southern right whales**	**Bryde's whales**	**Humpback dolphins**	**Bottlenose dolphins**	**Unidentified dolphins**
	Cow-calf pairs	**Unacc. Adults**				
Groups	173	22	2	1	2	8
Individuals	191	32	2	4	40	76

Field counts of cow-calf pairs and unaccompanied adult southern right whales encountered on the 2021 annual aerial survey are shown in figure 7 in relation to the field counts since 1979.

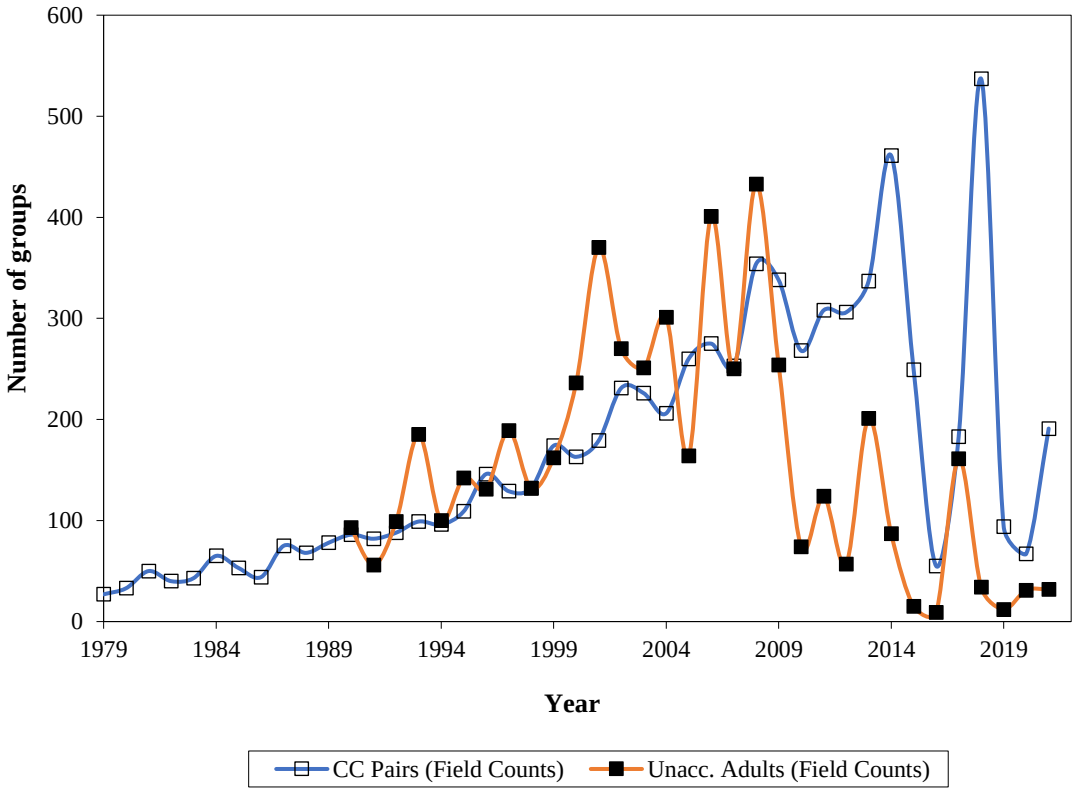

Figure 7. Numbers of southern right whale cow and calf pairs and unaccompanied adults counted on the South African southern right whale survey each year since 1979.

Aerial count survey

Two aerial surveys were conducted between the Hermanus New harbour and Witsand in addition to the annual photo-identification aerial survey, for the sole purpose to count cow-calf pairs. The first survey was flown on the 3rd of August, during which 158 cow-calf pairs and 52 unaccompanied adults were counted (Figure 8, Table 3). The second survey was flown on the 15th of September 2021, during which 211 cow-calf pairs and 35 unaccompanied adults were counted (Figure 9, Table 3). These results continue to be in line with previous data, which suggest an apparent peak presence of cow-calf pairs in September, as opposed to October, when the annual photo-identification aerial survey is conducted. On both count surveys, as well as on the annual photo-identification survey, the largest concentration of cow-calf pairs was observed in the De Hoop Nature Reserve.

Table 3. Number of cow-calf pairs counted during the aerial count surveys flown between Hermanus New Harbour and Witsand.

Date	Number of cow-calf pairs counted	Flight (search) times	Duration
03/08/2021	158	9:27 – 11:28	2h01min
15/09/2021	211	9:44 – 11:58	2h14min

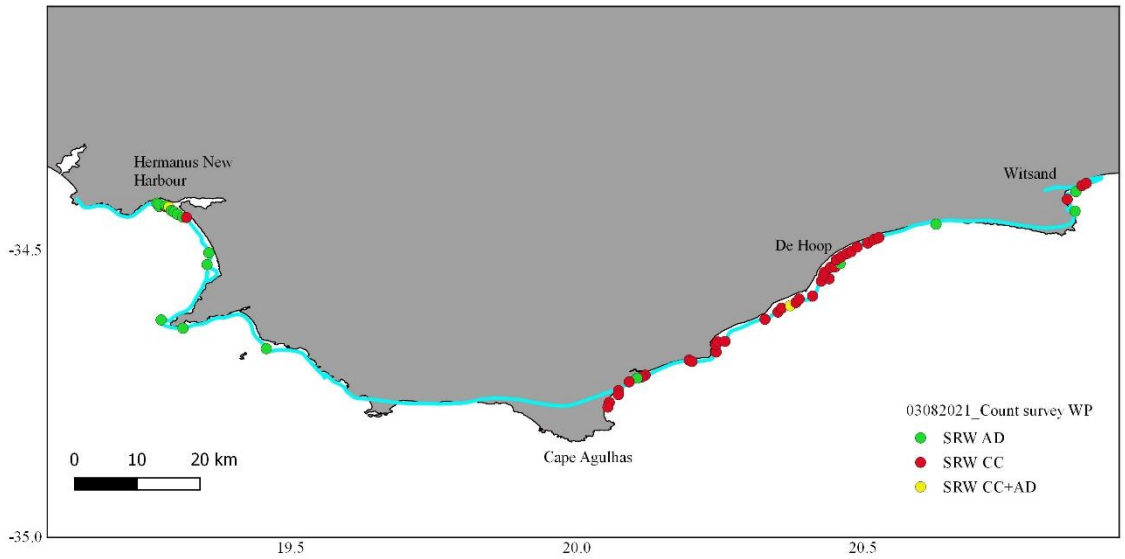

Figure 8. Map indicating the encounters of southern right whale cow-calf pairs along the stretch of coastline between Hermanus New Harbour and Witsand on 3 August 2021, as well as encounters of unaccompanied adult southern right whales (SRW AD), southern right whale cow-calf pairs (SRW CC) and groups including unaccompanied adults and cow-calf pairs (SRW CC+AD). Where the track line goes over land indicates areas of heavy fog that were encountered and avoided for safety reasons, and thus flown off effort.

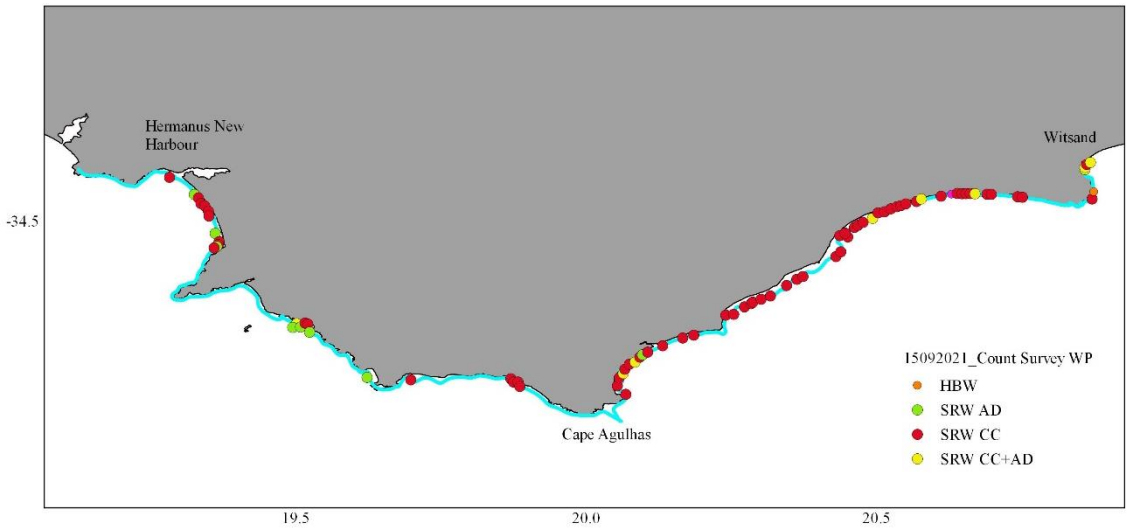

Figure 9. Map indicating the encounters of southern right whale cow-calf pairs along the stretch of coastline between Hermanus New Harbour and Witsand on 15 September 2021, as well as encounters of humpback whales (HBW), unaccompanied adult southern right whales (SRW AD), southern right whale cow-calf pairs (SRW CC) and groups including unaccompanied adults and cow-calf pairs (SRW CC+AD).

Photo-identification analysis

In total, 191 cow-calf pairs and 18 unaccompanied adults (209 individuals) were photo-identified during the survey. Subsequent data analysis indicated the presence of 12 duplicates in the dataset, and 2 individuals with a lack of good quality photographs, leading to the identification of 195 unique individual southern right whales, including 177 cows (Figure 10). Of these, 86 could be matched to previously known females whereas the other 91 were assigned as newly identified cows (Table 4).

Table 4. The number of southern right whale cow-calf pairs counted, number of unique females identified (i.e. duplicates excluded) and the number of identified females matched with previously known individuals, during the 2021 annual aerial survey

	2021
Number of females with calves counted	191
Number of unique females with calves identified	177
Number of females with calves matched to previous known females	86

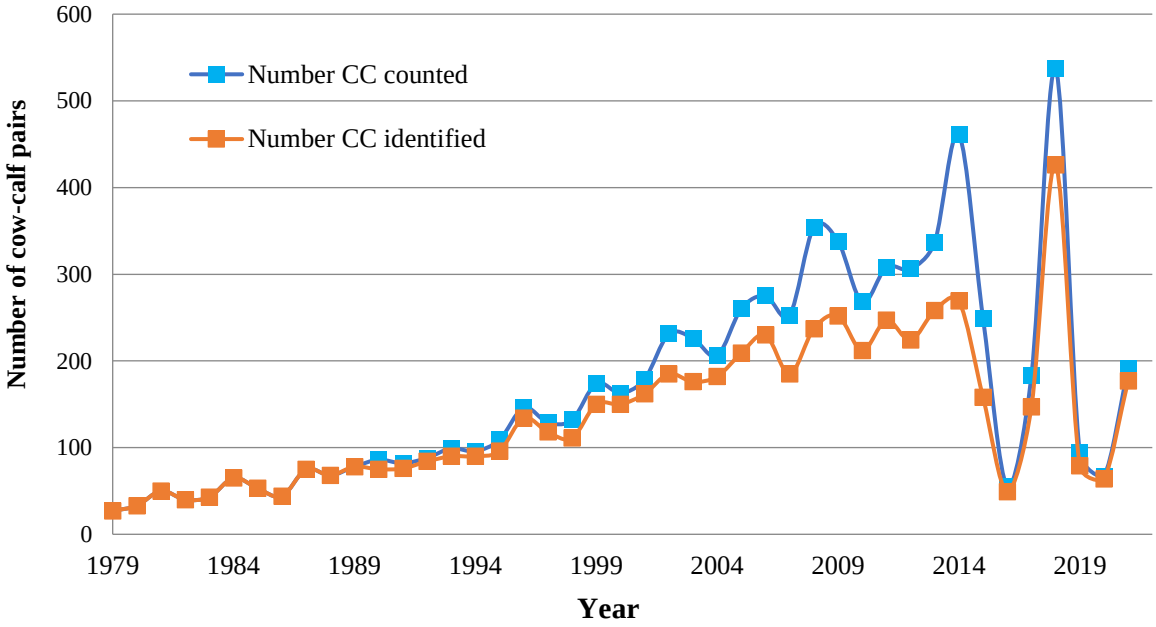

Figure 10. The number of females with calves counted and identified during the annual aerial surveys since 1979. The difference between both graphs indicates the number of within year duplicates (individuals photographed more than once during an aerial survey).

Photo-identification matching gave results on 75 new inter-calving intervals (i.e., 11 reidentified females were previously identified as unaccompanied adults). The majority of cows had a normal 3-year (19%), 6-year (17%) or 7-year (16%) calving interval. Considering a 6-year interval is assumed to be a combination of two normal 3-year calving intervals respectively, this result is slightly different from the recently observed shift to a 4- and 5-year calving cycle and ties in with the increased observation of 3-year and 6-year calving intervals in 2019 and 2020 (Figure 11). Nonetheless, as can be seen in figure 10, the total proportion of females with a 3-, 4- and 5-year calving interval decreases over time indicating there is an increasing number of females with even longer calving intervals.

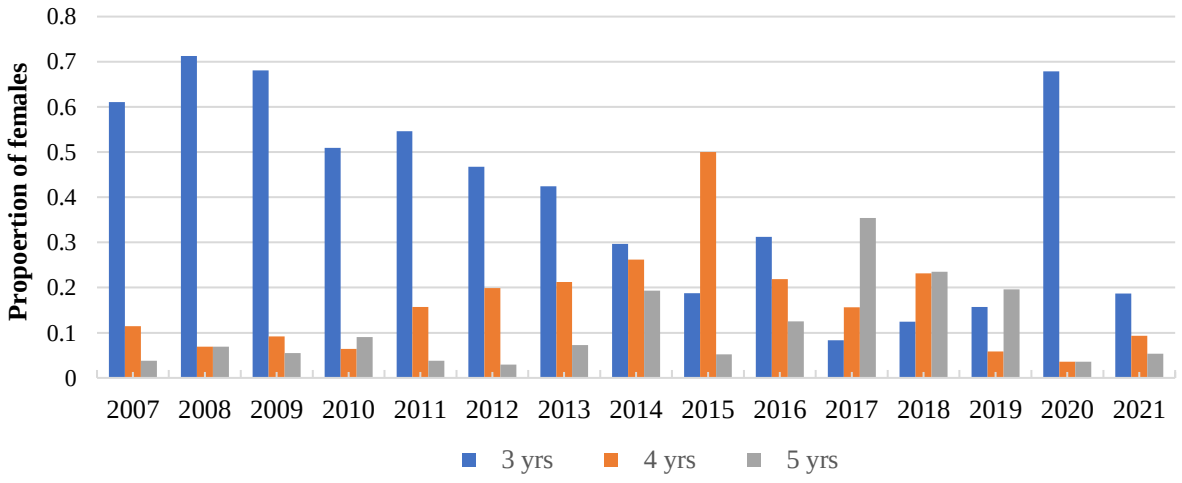

Figure 11. Frequency of 3-, 4- and 5-year calving intervals in female southern right whales identified on the annual aerial surveys since 2007.

Furthermore, as in 2020, it was notable that a relatively large number of identified cows were unknown to the catalogue, and therefore presumably first time (or young) mothers (51% whereas proportions in previous years ranged between 30%-40%). In fact, 71% of all cows identified in the 2021 survey were added to the catalogue post-2010. Only 17 cows photographed in 2021 (9%) were known to the catalogue since prior the year 2000.

Discussion

The 2021 annual aerial survey showed continued low counts of southern right whale cow-calf pairs and unaccompanied adults along the southern Cape coast (Figure 9). As in previous years, these low numbers are not believed to result from any changes to the standardised survey methodology or differences in sightings conditions overt the survey series. Rather, these low counts are believed to reflect an altered migration pattern of the non-calving component of the population as a trade-off to maintain limited energy reserves to ensure survival and maximize reproductive investment (Trathan et al., 2006; Murphy et al., 2007; Braithewait et al., 2015;). Such a hypothesis is further supported by the drastic decrease in body condition of South African southern right whales observed over the past two decades (Thavar et al., 2021; Thavar, 2022). Over the same time period, isotopic data indicated an alteration in the foraging strategy of the South African southern right whales, with a general northward shift in foraging location (van den Berg et al. 2021). These data are further corroborated by preliminary telemetry data, showing 4 female southern right whales with satellite transmitters currently remaining above 50°S (see www.mammalresearchinstitute.science/whale-unit) as opposed to migrating down to 60°S (Mate et al. 2011). Considering the vast oceanic range of southern right whale feeding grounds, all these findings combined may point toward large-scale ecosystem changes in the Southern Ocean. This is perhaps not surprising, given the unprecedented impacts of recent climate change on Southern Ocean physical features, which in turn have driven regional changes on all levels of Antarctic marine food webs (see Rogers et al., 2020). The change in feeding strategy of South Africa's population of southern right whales could represent an attempt to cope with an environmental shift in (some of) their foraging grounds. However, considering their decreased body condition and increase in calving intervals, this change does not seem to be successful.

Although the majority of observed calving intervals in 2021 reflected "normal" 3-year cycle (Figure 10), the total proportion of 2-, 3-, 4- or 5-year intervals combined reflected merely 34% of the observed calving intervals of 2021. In fact, as can be seen in figure 12, the combined proportions of 2-, 3-, 4- and 5-year calving intervals decreases over time, revealing an increase in other, longer calving intervals.

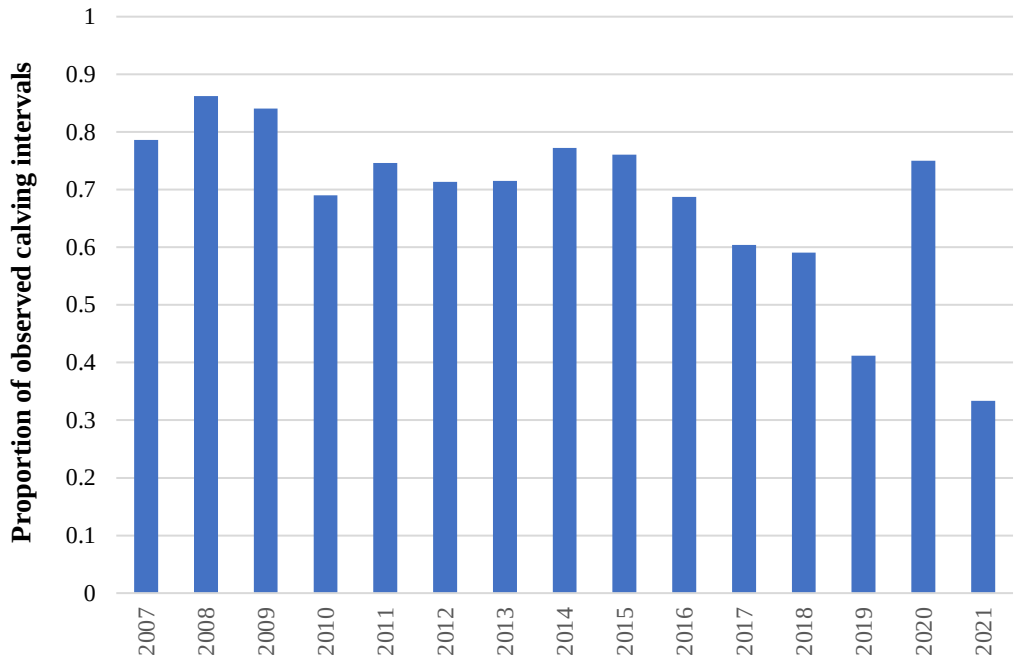

Figure 12. Proportion of 2-, 3-, 4- and 5-year calving intervals combined, between 2007 and 2021.

Unfortunately, no conclusion can be drawn on calving intervals > 6 years due to the uncertainty of possible missed calving (Knowlton et al. 1994). In this regard, the observed trend could be a by-product of a reduced residency time of cow-calf pairs along the South African coast, with an increasing amount of calving being missed on the annual October survey.

Indeed, 2021 was the 5th consecutive year of aerial count surveys which reveal a greater number of cow-calf pairs along the southern Cape coast earlier in the year (Late August/September vs October). As there is still no (scientific nor anecdotal) observational data suggesting an earlier birthing season, these data point towards a reduced residency time of cow-calf pairs on the South African breeding ground. The general west-ward movement (believed to occur immediately prior to the southward movement) of cow-calf pairs visible from August (all cow-calf pairs observed east of Cape Agulhas; Figure 8) to September (few cow-calf pairs west of Cape Agulhas) and then October (many more cow-calf pairs to the west of Cape Agulhas) as seen in previous years (see Vermeulen et al. 2018, 2019, 2020), further strengthens this hypothesis. Whether or not this reduced residency time affects calf survival, and therefore population dynamics, remains to be determined.

Recommendations

The continuation of the survey series and an assessment of the resulting demographic parameters remains of crucial importance to monitor and investigate the observed changes in the South African southern right whale population, and its effects on population dynamics. This will entail not only a continuation of the annual photo-identification aerial surveys, but also the continuation of the additional count surveys to monitor the timing of peak calving along the South African coast and additional photo-

identification effort prior to the annual aerial survey, especially around the main concentration areas of cow-calf pairs (especially De Hoop Nature Reserve), to re-assess, among other things, birthing season, residency time of cow-calf pairs and the portion of the female population captured on the annual photo-identification survey. A continued in-depth assessment on the foraging ecology, migration, reproductive success and body condition of this population is furthermore crucial, to gain a better understanding of the observed changes in the population.

Additionally, considering unaccompanied adult southern right whales form the backbone of the South African Whale-Watching industry (legislation around this industry prohibits the approach of cow-calf pairs at a distance < 300m), the continued low presence of these whales along the South African coast has serious consequences for cow-calf pairs. Without more specific data and in the precautionary approach, it is strongly recommended that the South African permitting authority and the South African Boat based Whale-watching Association engage with researchers in order to properly manage the activities with this valuable natural resource, especially considering the likely low energetic reserves of the nursing cows.

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