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Southern right whale (Eubalaena australis) surveys in the Falkland Islands during winter 2019 and 2020: preliminary results

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ABSTRACT

A winter occurrence of southern right whales (SRW; *Eubalaena australis*) was first documented along the north-east coast of the Falkland Islands (south-west Atlantic) in 2017. Targeted boat surveys were carried out throughout the winters of 2019 and 2020, incorporating data collection on SRW distribution, photo-identification and tissue sampling. Additionally, a two-year baleen whale acoustic monitoring programme was carried out. A total of 2,742.3 km of boat survey effort was completed, recording 160 on-effort sightings of SRWs, and an additional 35 off-effort sightings. The encounter rate (sightings/km effort) was highest between June and August, peaking during July. Sightings comprised 1–17 animals, and included adults and juveniles; no calves were observed. The proportion of sightings where surface active and social behaviour dominated, comprised 22% of sightings of single animals, 39.5% for pairs, and 78.8% for groups of ≥3 animals. Over 36,000 images were taken during the boat surveys. Analysis of ~10,300 images resulted in 67 individuals being catalogued. The partially-analysed dataset includes one recapture from 2017, and one within-year recapture in 2019. A total of 95 tissue samples (including some duplicates) were acquired via biopsy sampling, and an additional sample from a stranding; the samples are undergoing genetic and isotope analysis. SRW calls, including upsweeps, variable tonal calls, and series of gunshot sounds, were evident in the acoustic recordings; full analysis of the dataset should better clarify SRW temporal occurrence. The extensive work in 2019 and 2020 supports a significant and persistent SRW occurrence along the north-east coast of the Falklands during winter. The region appears to be used both as an area for social interactions among juveniles and adults, and for courtship and mating. The importance of the Falkland Islands as a south-west Atlantic wintering ground merits recognition in regional conservation management plans for the species.

KEYWORDS: FALKLANDS; SOUTH ATLANTIC; SOUTHERN HEMISPHERE; SOUTHERN RIGHT WHALES; PHOTO-IDENTIFICATION; BIOPSY; ACOUSTIC

INTRODUCTION

The southern right whale (SRW; *Eubalaena australis*) is distributed across temperate and polar waters of the Southern Hemisphere, including well-documented winter mating and calving areas located along the coasts of South America (particularly in Argentina and Brazil), South Africa, southern Australia and New Zealand (Cooke and Zerbini, 2018). The pelagic foraging grounds occupied by SRWs during the austral summer are far less well known, but are thought to be concentrated at latitudes of 40–50°S. In many regions, SRWs are steadily recovering from centuries of severe exploitation during the early whaling era (<1920s), although the global population remains well below the estimated pre-exploitation size of 55,000 to 75,000 animals (IWC, 2001).

In the south-west Atlantic, a globally-important SRW breeding ground is located at Península Valdés (and surrounding areas) in Argentina, with smaller numbers calving off Santa Catarina in Brazil. In recent decades, significant calf mortalities have been recorded at Península Valdés, raising concerns that recovery of this important population may have slowed (Crespo et al., 2019). The factors causing the calf mortalities have not been unequivocally identified; however, changes in the foraging behaviour and resulting body condition of their mothers is one potential causal factor (Rowntree et al., 2013). Since 2014, satellite-tracking work has been carried out in the Argentinean breeding areas to document the movements, distribution and foraging behaviour of SRWs in the south-west Atlantic, in an effort to clarify linkage between breeding and feeding areas (Zerbini et al., 2016, 2018).

The International Whaling Commission (IWC) has adopted a Conservation Management Plan (CMP) for SRWs in the south-west Atlantic (Iñíguez Bessega et al., 2012). The CMP aims to protect SRW habitat, minimise anthropogenic impacts, and ensure that the recovery of the species continues to pre-exploitation levels. Although the CMP considered that the identification of migratory routes and feeding areas for SRWs was a top priority for informing their management, it only included passing mention of two confirmed range states that support foraging SRWs in the south-west Atlantic: the Falkland Islands and South Georgia. Both the CMP and the 1998 Comprehensive Assessment of right whales (IWC, 2001) mentioned the Falklands solely in the context of the "Brazil/False Banks/Falkland Islands" summer feeding ground, an offshore area extending between latitudes 30° and 55°S where a large number of SRWs were captured during the whaling era (Townsend, 1935; Richards, 1993).

Since 2017, with the onset of research on sei whales (*Balaenoptera borealis*) in the Falkland Islands (Weir, 2017; Weir et al., 2021), the occurrence of baleen whale species in the region has become better documented. Weir and Stanworth (2019) reviewed whaling data and other available records of SRWs in the Falklands, and described a number of SRW sightings recorded during systematic boat, aerial, and shore-based surveys in 2017. In addition to the historical and ongoing use of pelagic areas around the Falklands during the summer and early autumn (presumably for both foraging and migration), a contemporary occurrence of SRWs was discovered using the coastal waters along the north-east coast of the Falklands during the winter (Weir and Stanworth, 2019). Consequently, a targeted study of SRWs was carried out during the winters of 2019 and 2020 which aimed to establish whether occurrence was persistent across years, provide insight into the numbers and composition (i.e. age, sex) of the animals involved, and assess the underlying drivers for their winter presence in coastal areas. The study has also collected tissue samples to investigate foraging behaviour via stable isotope analysis, and for genetic work to establish population linkage and diversity. This paper provides an update on those activities and some preliminary results.

METHODS

Study area

The study area comprised shallow (water depths of ≤60 m), nearshore (<10 km from the coast) waters located along the coast of the north-east Falkland Islands in the south-west Atlantic (Figure 1). It extended from Wolf Rocks and Cape Pembroke in the south, northwards to Cape Carysfort, including the inlets of Port William and Berkeley Sound (Figure 1).

Visual surveys

During 2019 and 2020, visual surveys for cetaceans (focussing on sei whales and southern right whales) were carried out in the study area during the austral summer (Jan–Feb), autumn (Mar–May), and winter (Jun–Aug). Additionally, two surveys occurred in September 2020, during the austral spring. No SRWs were sighted between January and April, and consequently the remainder of this paper concentrates on surveys in the May to September period spanning the entirety of the austral winter.

The survey platform comprised a 6.5 m rigid-hulled inflatable boat with twin 125-hp engines, providing an observer eye height of ~2 m and an average survey speed of 21 km h^{-1}. The total number of surveys achieved was strongly limited by local weather conditions in the Falklands, and only commenced in favourable conditions for detecting whales, defined as Beaufort sea states ≤4, swell heights ≤2 m, and good visibility (>5 km). Positional data were logged at 1 min intervals, and weather conditions were recorded throughout the surveys.

The survey track typically followed one of three survey routes: (1) a localised survey in sheltered areas around Port William, Cape Pembroke and Kidney Island; (2) as (1) but including a loop of Berkeley Sound; or (3) a survey northwards along the coast to Volunteer Point and, when time/weather permitted, onwards to Cape Carysfort. However, the exact routes varied according to weather conditions, logistical constraints and cetacean encounters.

Effort status was logged as active search, cetacean encounter (when working with a particular group of animals), or off effort. During active search effort, two observers located on the port and starboard sides of the vessel searched continuously for cetaceans by naked eye, each focussed on a 90° area from the bow to their beam. A closing approach was adopted, during which the platform was deviated to approach SRWs for group size estimation, photo-identification and biopsy sampling. When cetaceans were sighted, the time, position, species, group size (best estimate), and behaviour were recorded. An estimate of the age of animals (adult, juvenile or calf) was made when possible.

Photo-identification

Images of SRWs were taken with 100–400 mm zoom lenses during closing mode, with the boat manoeuvred carefully to position the photographers parallel with the animal(s) and to travel slowly alongside. Since the data were collected from a small boat, SRW photo-identification was predominantly limited to acquiring the left and right sides of the heads to document the callosity pattern[1]. However, other markings, such as white patches on the dorsal surface were also photographed. Photo-identification continued until it was deemed likely that all of the left and right sides of individuals within groups had been acquired, or until the encounter was terminated by animals moving away or by logistical constraints. Separate catalogues were produced by the author for left- and right-sides, including some images collected during surveys in 2017 (Weir and Stanworth, 2019). Animals for which images were of insufficient quality (angled, blurred or mostly submerged) were omitted. Each encounter was assessed consecutively, and individuals were either matched to a catalogued animal or added to the catalogue as new entries. The same identification number was used in both catalogues whenever left and right sides could be confidently matched to the same individual.

Genetic sampling

Tissue samples were collected from SRWs using a Barnett crossbow fitted with Finn Larsen (Ceta-Dart, Copenhagen, Denmark) darts, each comprising an Easton aluminium shaft bolt fitted with a M8/40 mm aluminium sampling tip and a stop. All samples were collected by the author, during scenarios where whales were sufficiently close and behaving in a manner that allowed the procedure to be carried out safely and effectively. Whenever possible, photo-identification images were simultaneously captured of biopsied animals, in an effort to both match samples with known animals and avoid repeated sampling of the same individuals.

Acoustic monitoring

An acoustic deployment comprising three SoundTrap ST500 STD recorders (Ocean Instruments, New Zealand) was carried out in Berkeley Sound over a two-year period from December 2018 to December 2020. The deployment was primarily designed to assess sei whale temporal occurrence across Berkeley Sound. The ST500s recorded continuously at the minimum available sample rate of 24 kHz, allowing capture of the lower frequencies used by baleen whales while maximising temporal recording endurance. As an initial investigation of whether SRWs had been recorded on the ST500s, data from three dates on which boat surveys were carried out inside Berkeley Sound and encountered only SRWs (1st and 14th August 2019, and 12 August 2020) were visually inspected in Raven Pro 1.5 (Cornell Bioacoustics Research Program). Files from an ST500 deployed at a central location in Berkeley Sound (Figure 1) were used, to maximise the likelihood of detected whale calls originating from animals inside the inlet rather than further out to sea, thus further increasing confidence about species identification.

RESULTS

Visual surveys

[1] Some dorsal view images of head callosity patterns were also acquired from the boat during spy-hopping behaviour and from limited flights with an unmanned aerial vehicle (UAV); these may facilitate future matching with aerial imagery from other regions.

Thirty-five boat surveys were carried out in the study area during the May to September period, comprising 18 in 2019 and 16 in 2020. A total of 2,742.3 km of survey effort was collected, including 2,460.9 km of active search effort and 281.3 km of SRW encounter effort (Table 1). There were 160 on-effort sightings of SRWs, and an additional 35 sightings were recorded outside of the search effort (Table 1). The 195 sightings included a minimum visual estimate of 433 animals.

The majority of surveys extended northwards along the coast as far as Volunteer Point (n=7) and Cape Carysfort (n=16). Spatial survey coverage differed between months. Coverage of Berkeley Sound was highest during May and early June, during the final period of the sei whale season (Figure 2a,b). The survey focus shifted to the coast between Volunteer Point and Cape Carysfort from July to September, due to the high success with encountering SRWs in that area. Some search effort was carried out in Berkeley Sound during August associated with acoustic deployments, during which SRWs were encountered particularly along the south coast (Figure 2d). In general, sightings of SRWs were most frequent in the more exposed parts of the study area, including off Cape Pembroke and Mengeary Point, and along the coast between Volunteer Point and Cape Carysfort (Figure 2).

Both the search effort and the encounter effort were highest during June and July (Table 1). When corrected for survey effort, the encounter rate of SRWs in the study area during 2019 and 2020 was highest between June and August, and showed a strong winter peak in July (Figure 3). There was a marked reduction in encounter rate during September, although only two surveys were conducted in that month.

Visual estimates of group size indicated that 48% of the 195 SRW sightings were of single animals. However, some of those individuals were encountered between surface active groups (SAGs[2]) and clearly moving purposefully between them; animals were logged as single animals if they arrived separately, even if they subsequently joined groups. A further 31 sightings were logged as a minimum group size of one without being closed upon; those sightings were often at greater distant and could have included more than one animal. Pairs comprised 26% of sightings. Groups of three to five animals accounted for a further 21% of sightings, and the remaining 6% of sightings were seen in the largest groups of six to 17 animals. Groups often changed in size during encounters, with individuals arriving or departing. It proved challenging to assess the ages of animals based on body size; the sightings comprised both adults and juveniles, but the relative proportions of each were undetermined. However, no calves were observed in the study area in either 2019 or 2020.

The behaviour of SRWs was often complex and variable. For the 154 sightings where it was possible to allocate a dominant overall behaviour, surface active and social behaviour (variously comprising SAGs, breaching, flipper slapping, courtship, spy-hopping etc.) was recorded for 71 sightings. Although some surface behaviours (e.g. brief amounts of socialising or flipper slaps) were observed in the 79 other sightings, they primarily comprised travel (n=44), milling/resting (n=26), and animals on repeated long dives (for which behaviour was difficult to determine, as animals were primarily subsurface; n=13). The proportion of sightings where travel, milling or long dives comprised the dominant behaviours was 78% for single animals, 60.5% for pairs, and 21.2% for groups of ≥3 animals. Contrastingly, the proportion of sightings where surface active and social behaviours were dominant was 22% for single animals, 39.5% for pairs, and 78.8% for groups of ≥3 animals. Surface active behaviour in single animals included repeated bouts of breaching or flipper-slapping, and on one occasion a solitary male that was spy-hopping, interacting with Peale's dolphins (*Lagenorhynchus australis*) and laying belly-up at the surface with its penis exposed (Figure 4a). Clear mating attempts were observed in several SAGs (Figure 4b).

Photo-identification

[2] A SAG was defined as two or more whales interacting at the surface with frequent physical contact (Parks and Tyack, 2005).

Over 36,000 images were taken during the boat surveys, including ~17,000 in 2019 and ~19,000 in 2020. Cataloguing and analysis is underway. To date, ~10,300 images have been analysed from SRWs photographed during nine surveys between 12 June and 21 July 2019, resulting in 67 individuals being catalogued. Of those, 54 animals were photographed on both sides, while 7 and 6 animals respectively were photographed on their left or right sides only.

One whale (FEA10) was matched to a small photo-identification dataset from surveys in 2017. The animal was photographed off Cape Pembroke on 31 May 2017, and recaptured off Cape Carysfort on 9 July 2019. A single recapture was also found within the partially-analysed 2019 dataset; FEA30 was recorded on 29 June and on 17 July.

Genetic sampling

A total of 95 tissue samples were acquired via biopsy sampling in 2019 and 2020, spanning all months between May and August (Table 2). However, there are known to be duplicate samples from the same individuals within the dataset, and the total number of unique individuals sampled has not yet been established. An additional tissue sample was collected from a dead animal that stranded on Sea Lion Island in March 2019. Animal sexing, and genetic and isotope analysis of the samples, are underway.

Acoustic monitoring

Visual examination of spectrograms from the ST500 in Berkeley Sound revealed series of whale calls on all three survey dates. The data from 1 August 2019 were masked by significant vessel noise. However, the data on 14 August 2019 and 12 August 2020 were relatively quiet and contained whale calls of good signal-to-noise ratio. The calls were consistent with the sounds documented for SRWs in other geographic regions, including upsweep calls, variable tonal calls, and series of gunshot sounds (Figure 5). A full analysis of the acoustic dataset is underway.

DISCUSSION

Persistent winter occurrence

Weir and Stanworth (2019) reported a newly-documented and significant occurrence of SRWs along the north-east coast of the Falkland Islands during 2017, noting that ongoing monitoring was needed to establish whether 2017 marked the onset of a regular wintering occurrence of SRWs in the Falklands or was an anomalous year. The targeted surveys carried out for SRWs during 2019 and 2020, confirm that the occurrence recorded during 2017 was not anomalous. Rather, a significant wintering aggregation of SRWs has now been documented within the study area across several years, with a strong peak in relative abundance during July. Consequently, it can be concluded that the coastal waters along the north-east coast of the Falkland Islands represent a persistent, and potentially novel, wintering ground for SRWs. It remains unclear whether these wintering aggregations occur throughout the Falklands or whether the north-east region is of particular importance. However, anecdotal observations reported from aircraft operating in the region indicate that SRW groups also occur extensively along the north coast of the Falklands westwards to (at least) the Foul Bay/Cape Dolphin region throughout the winter. Island-wide aerial surveys during the winter may be the only logistically-viable method of assessing occurrence elsewhere.

Region-wide significance

The surveys during 2019 and 2020 were limited to a relatively small spatial study area (north-south linear extent of ~40 km of coast), and were strongly restricted by weather (small boat work was limited to wind speeds of ≤10 knots). Consequently, in the 2019 season (1 May to 15 August) only 16.8% of potential survey days were realised, while in the 2020 season (1 May to 10 September) only 12.0% of potential survey days were realised. Given those limitations, the datasets will clearly under-estimate the true number of animals using the Falklands over those periods. Nevertheless, high numbers of SRWs were recorded during the surveys. The photo-identification analysis is at an early stage. However, the partially-analysed dataset has not evidenced high numbers of recaptures, suggesting that there may be

a steady movement of SRWs through the study area rather than the same individuals remaining for successive weeks/months. Together, these combined data suggest that a significant proportion of the south-west Atlantic SRW population may use the coastal waters around the FI during winter, either as a migratory stop-off or as a wintering destination. The recapture of one SRW between 2017 and 2019 (matching is still in progress), supports the FI being an established and consistent destination for at least some individuals.

Arrival time for wintering aggregations

Considering only data collected in the Berkeley Sound-Port William-Cape Pembroke area (to account for inconsistencies in the spatial distribution of effort), there is some indication of inter-annual variation in the arrival time of SRW wintering aggregations. In 2017, no SRWs were recorded during five boat surveys in the first half of May, but multiple sightings of the species occurred on three surveys in the latter part of May (Weir and Stanworth, 2019), supporting a sudden influx of animals into the study area in mid-May. The 2019 dataset suggests a later arrival time, with five boat surveys carried out during May and early June 2019 not observing SRWs, but all surveys from 12 June onwards encountering them. In 2020, no sightings occurred during a survey on 14 May, but the species was present during all surveys from 28 May to the end of August. These data suggest that the onset time for a consistent presence of SRWs in the study area varies by a few weeks each year. Although boat surveys carried out for sei whales throughout March and April in the Berkeley Sound-Port William-Cape Pembroke area in 2017, 2019 and 2020 did not detect any SRWs (Weir and Stanworth, 2019; Falklands Conservation, unpublished data), infrequent sightings, including socialising groups, were reported anecdotally during March in both 2019 and 2020, which also suggests a movement of some individuals through coastal waters earlier in the year during the autumn[3]. It is expected that analysis of the two-year acoustic dataset will provide better temporal information on SRW occurrence within the study area in due course.

Use of Falklands' waters in winter

Weir and Stanworth (2019) noted that the potential uses of the Falklands study area by SRWs during winter could include: (1) a short-term resting and socialising stop-off for animals migrating from foraging grounds located further east or south, before they continue northwards to established calving areas; (2) a wintering destination used for courtship and mating; (3) a winter gathering area for sub-adult and non-breeding adult SRWs, primarily for social interaction; and (4) a historical winter calving ground. The data collected on SRWs throughout the austral winter of 2019 and 2020 cannot discount any of those possibilities, with the exception that no calves were observed. At the Península Valdés calving ground in Argentina, most new calves appear in August, and the final ones as late as October (Rowntree et al., 2013). While the surveys carried out in the Falklands during 2019 and 2020 had ended by early September, it would be expected that at least some new calves would have been apparent during August. It therefore seems unlikely that the study area currently comprises a calving ground, although that remains a future possibility. The SRW behaviour observed in the Falklands over both winters is strongly supportive of the study area being used as an area for social interactions among juveniles and adults, and as an area where courtship and mating occur. Consistent with those observations is the prevalence of upsweeps and gunshots in the acoustic data assessed for three dates during August. SRW upsweeps are thought to function as a means for individual SRWs to announce their presence to others and for contact maintenance, and in North Atlantic right whale (*E. glacialis*) SAGs they are produced especially when males are approaching a group or when the focal female is diving or leaving (Parks and Tyack, 2005). Right whale gunshots are hypothesized to function as male sexual advertisement directed at females, and as agonistic signals directed at other males (Parks et al., 2005; Crance et al., 2019). The presence of those vocalisation types in the Falklands supports the use of the area for socialising and mating purposes, and the regularity of the vocal behaviour also likely drives the highly aggregative SRW distribution in the region with animals calling frequently to establish contact with other individuals.

[3] Several sightings of SRWs have also been reported in the study area during March 2021, including during one boat survey.

Conclusion

Two years of winter surveys in the Falklands have demonstrated the importance of the region as a wintering destination for SRWs, presumed to be a subset of the south-west Atlantic population. Genetic work should clarify the population affinity of these animals, and isotope analysis may shed light on where animals were foraging in the weeks and months prior to sampling. These data directly address priority data gaps highlighted in the IWC CMP for south-west Atlantic right whales (Iñíguez Bessega et al., 2012). Although the CMP does not currently recognise the Falklands as a significant range state for SRWs, these data highlight the importance of the region as a novel wintering area in addition to its better-established use as a summer foraging ground (Townsend, 1935; Tormosov et al., 1998; Zerbini et al., 2016, 2018).

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Table 1. Southern right whale survey effort and associated sightings between May and September, 2019–2020.

Month	Effort (km)			SRW sightings		
	Total	Search	Encounter	Total	On-effort	Off-effort
May	441.8	428.6	13.2	9	9	0
Jun	793.7	709.7	84.0	49	36	13
Jul	725.9	611.8	114.1	92	76	16
Aug	589.2	522.1	67.1	44	38	6
Sep	191.6	188.7	2.9	1	1	0
Total	2742.3	2461.0	281.3	195	160	35

Table 2. Southern right whale tissue samples collected between May and September, 2019–2020.

Month	Biopsies taken*	Stranding sampling
March	0	1
May	8	0
Jun	25	0
Jul	41	0
Aug	21	0
Total	95	1

*These values are the total number of biopsies, rather than of unique individuals. There are known to be duplicate samples from the same individuals within the dataset.

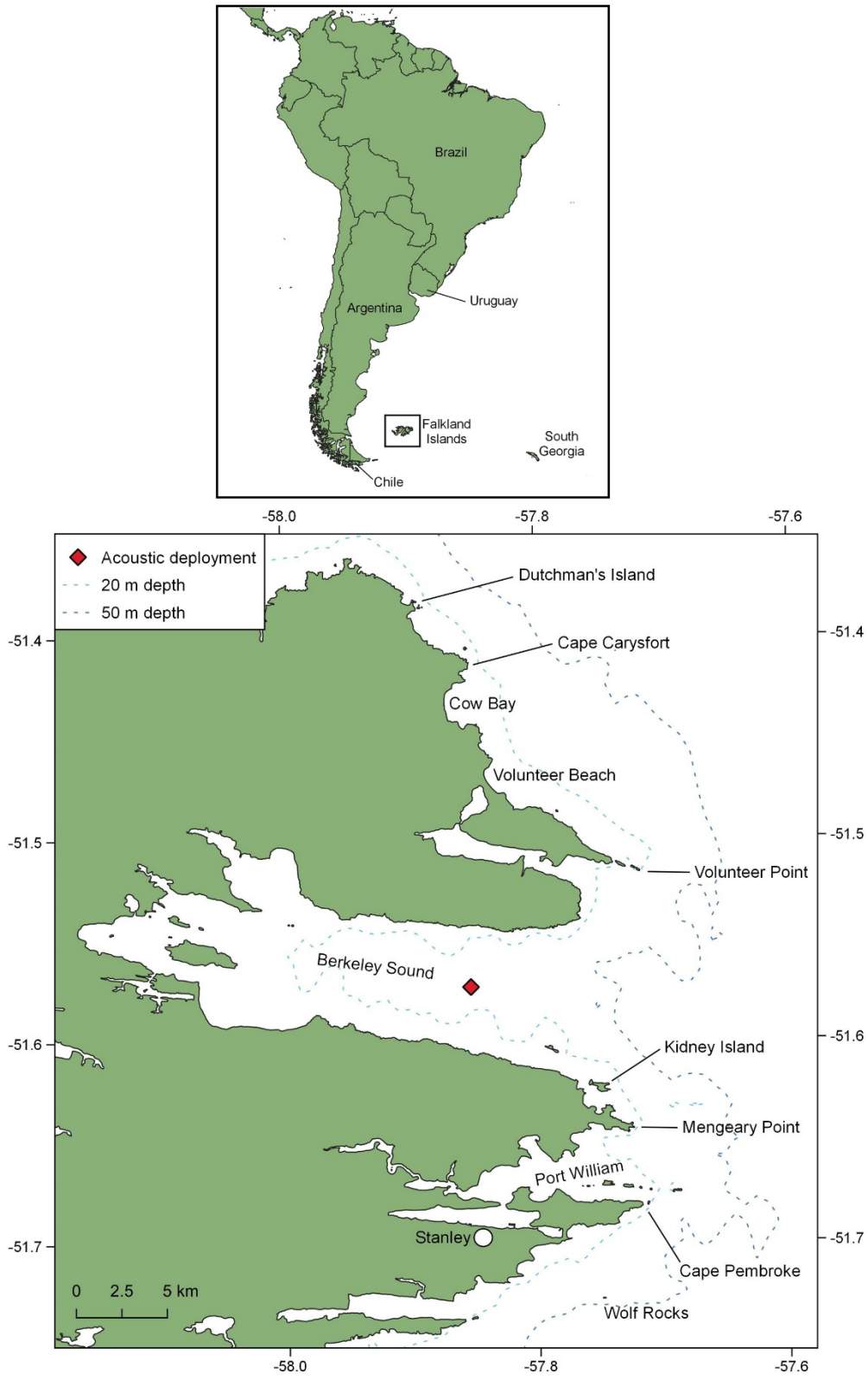
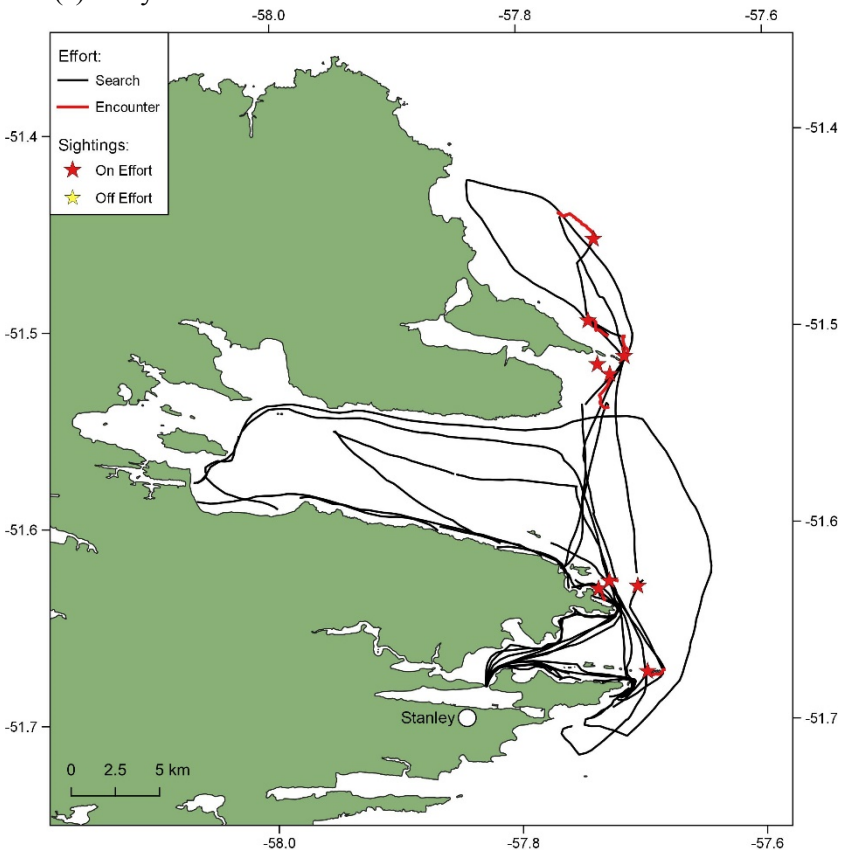
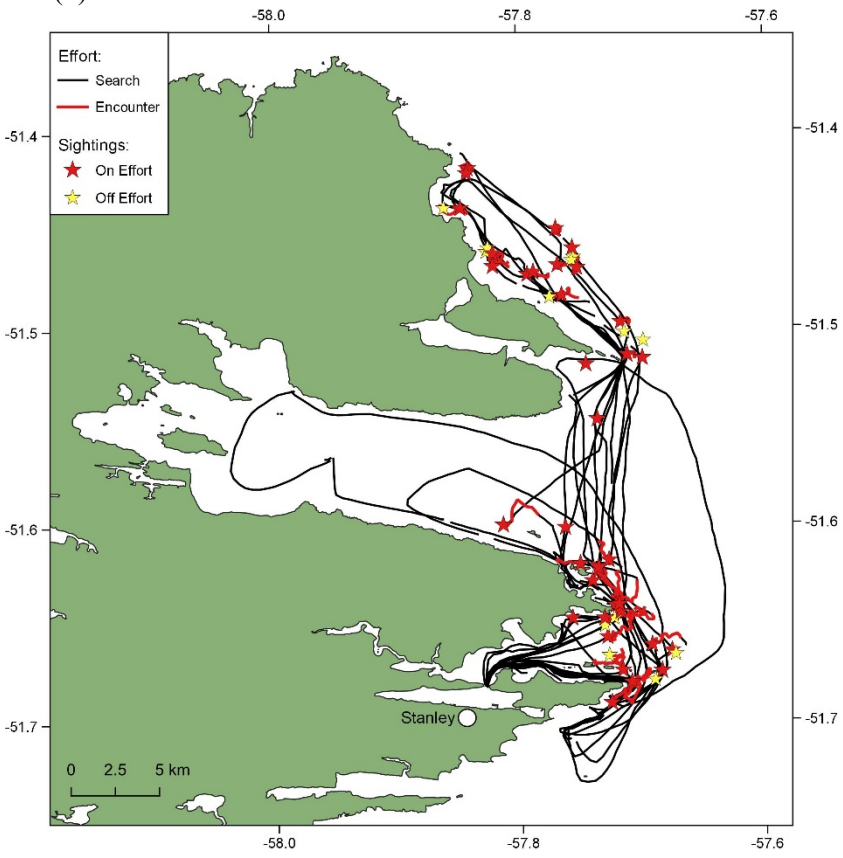


Figure 1. The study area, located on the north-east coast of the Falkland Islands.

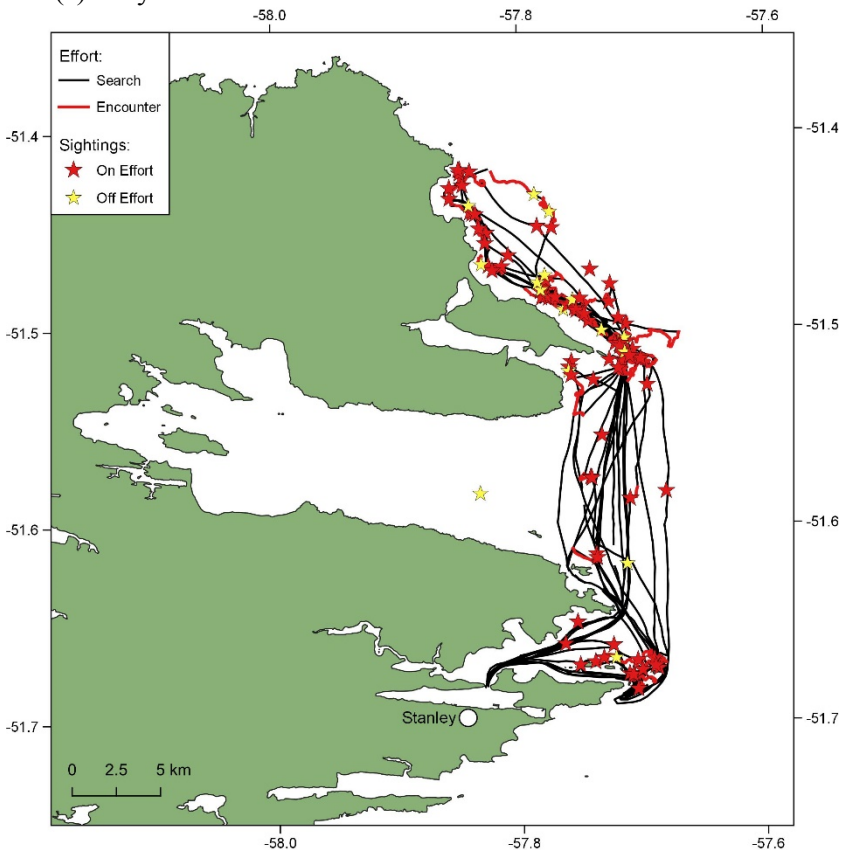
(a) May


-58.0
-57.8
-57.6
-51.4
-51.5
-51.6
-51.7
Effort:
Search
Encounter
Sightings:
On Effort
Off Effort
Stanley
0 2.5 5 km

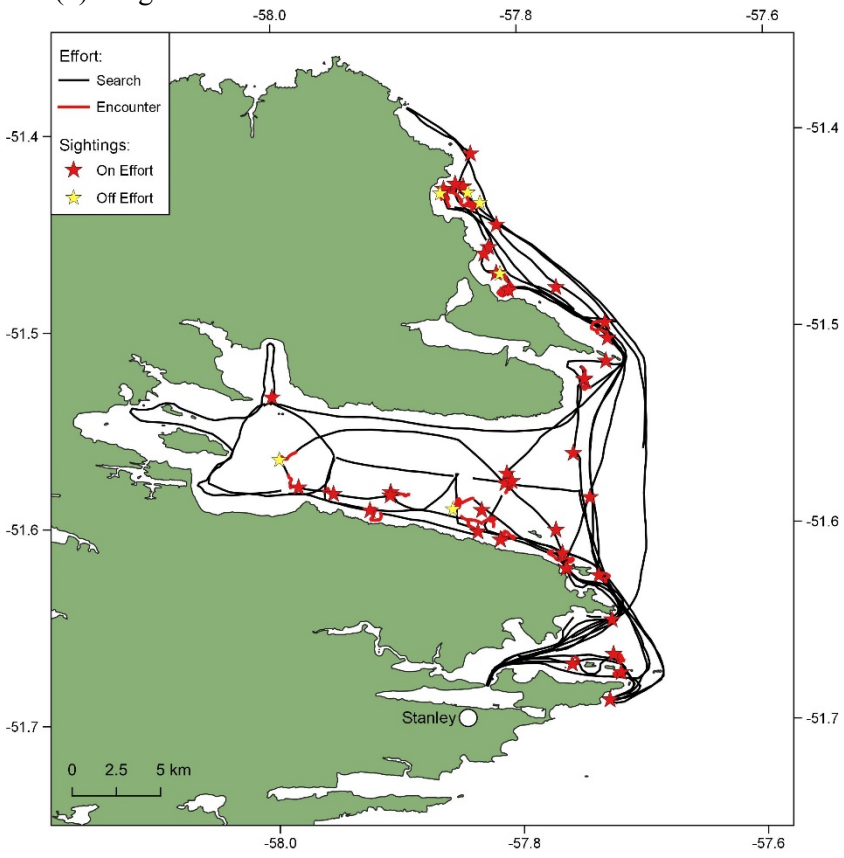
(b) June


-58.0
-57.8
-57.6
-51.4
-51.5
-51.6
-51.7
Effort:
Search
Encounter
Sightings:
On Effort
Off Effort
Stanley
0 2.5 5 km

(c) July



(d) August



(e) September

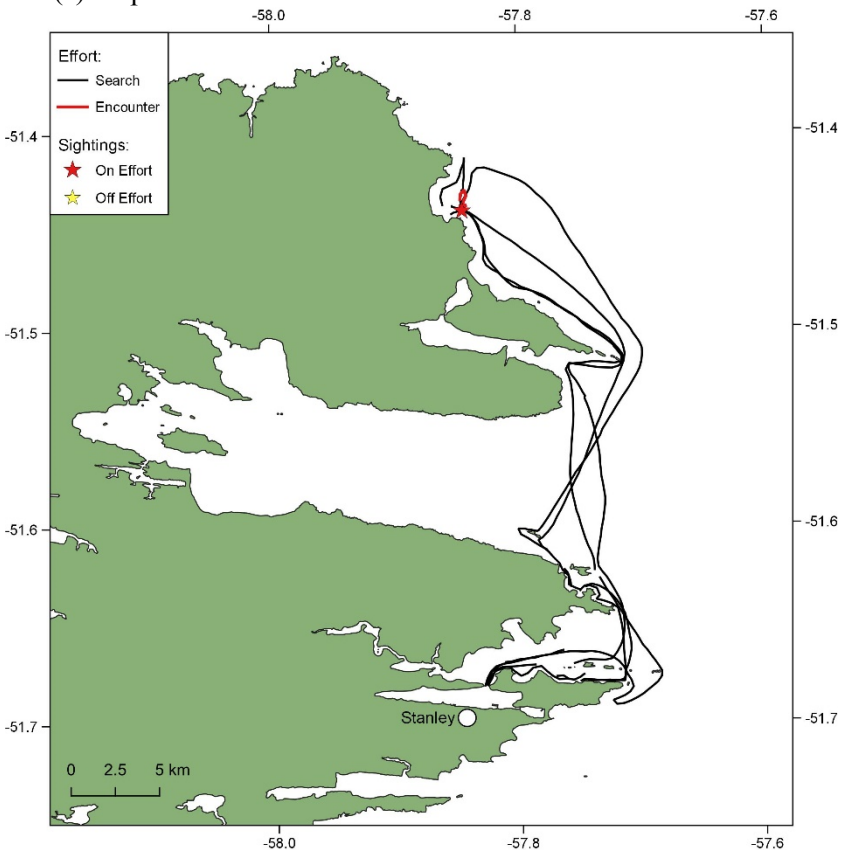


Figure 2. Survey effort and sighting locations during winter surveys for southern right whales in the Falkland Islands, 2019-2020: (a) May; (b) June; (c) July; (d) August; and (e) September.

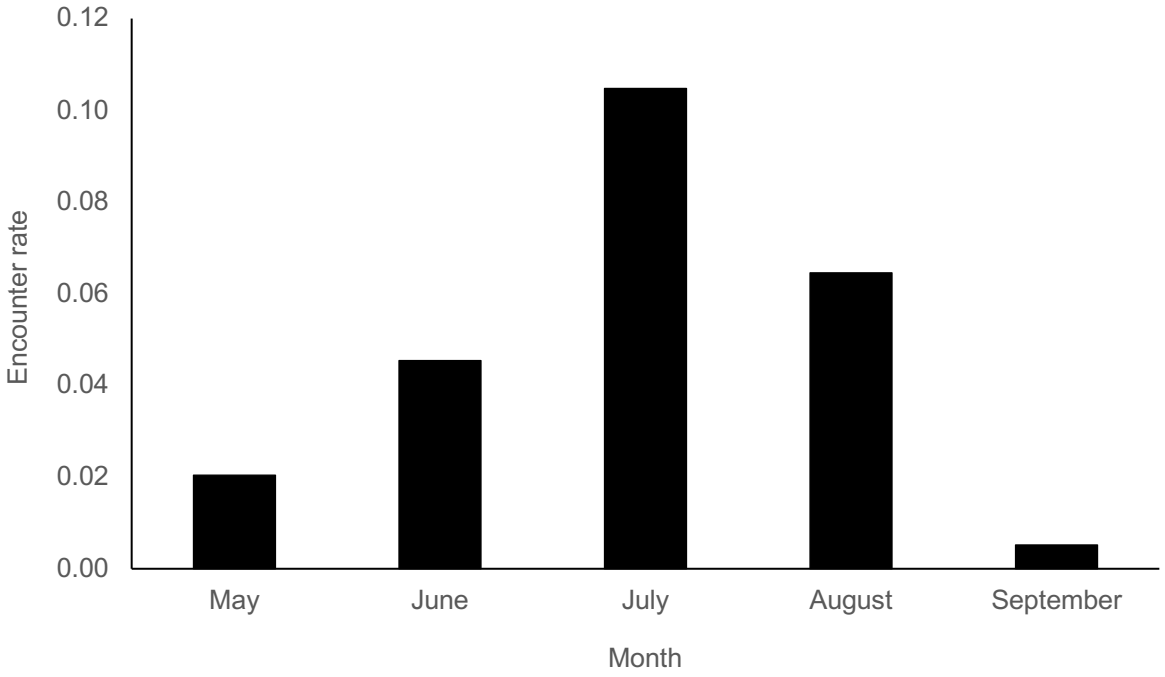


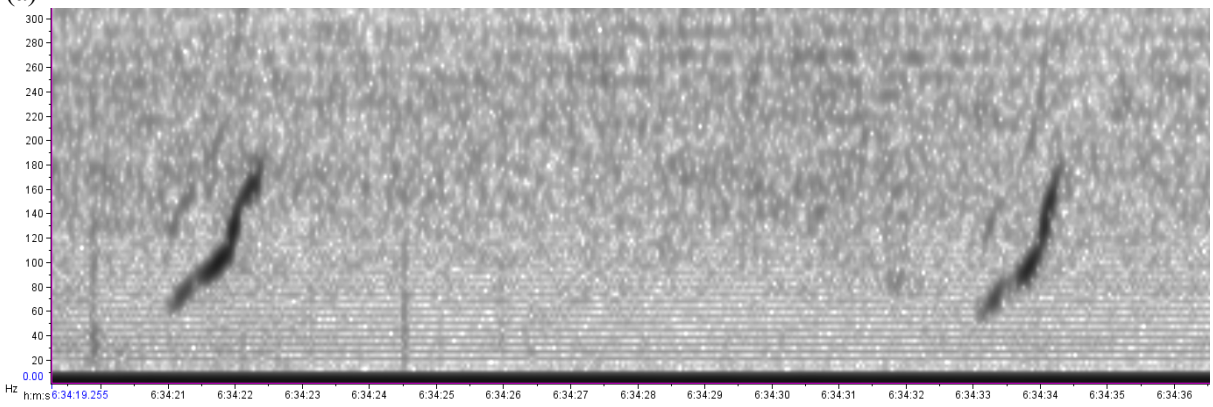
Figure 3. Monthly encounter rate (sightings per km of search effort) of southern right whales in the Falkland Islands.

(a)

(b)

Figure 4. Sexual behaviour of southern right whales in the Falklands: (a) solitary male SRW laying belly-up at the surface with its penis exposed on 12 June 2019; and (b) mating attempts within a SAG on 28 May 2020.

(a)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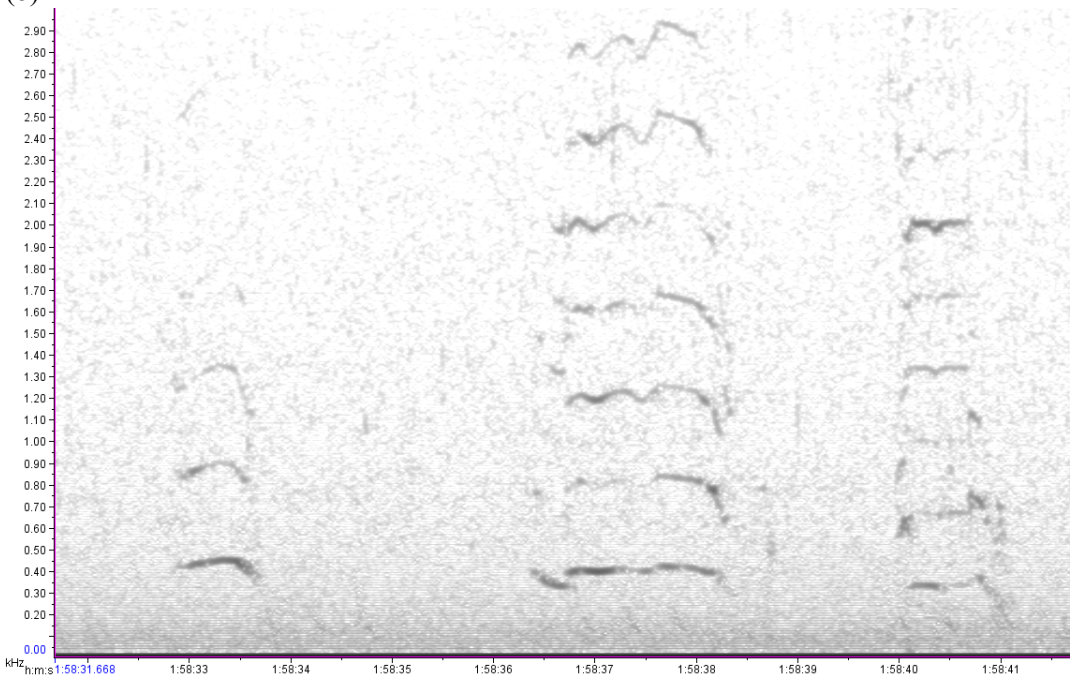
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0.00
Hz
h:m:s
6:34:19.255
6:34:21
6:34:22
6:34:23
6:34:24
6:34:25
6:34:26
6:34:27
6:34:28
6:34:29
6:34:30
6:34:31
6:34:32
6:34:33
6:34:34
6:34:35
6:34:36

(b)


2.90
2.80
2.70
2.60
2.50
2.40
2.30
2.20
2.10
2.00
1.90
1.80
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1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.00
kHz
h:m:s
1:58:31.668
1:58:33
1:58:34
1:58:35
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1:58:37
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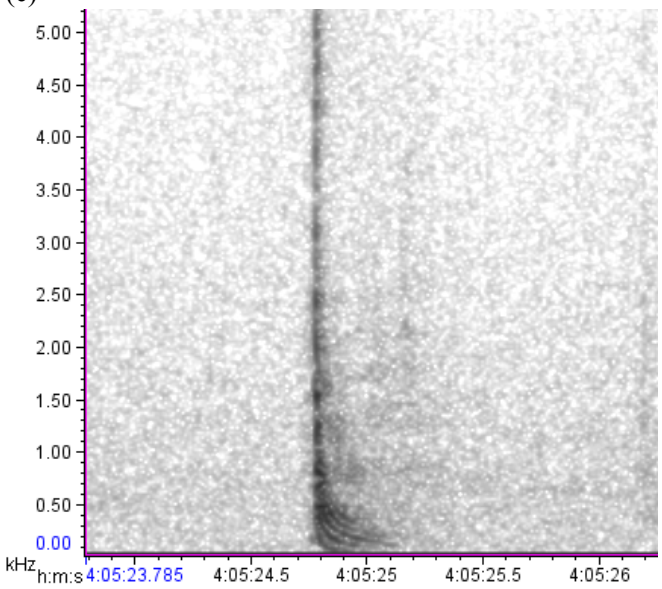
1:58:39
1:58:40
1:58:41

(c)


5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
kHz
h:m:s
4:05:23.785
4:05:24.5
4:05:25
4:05:25.5
4:05:26

(d)

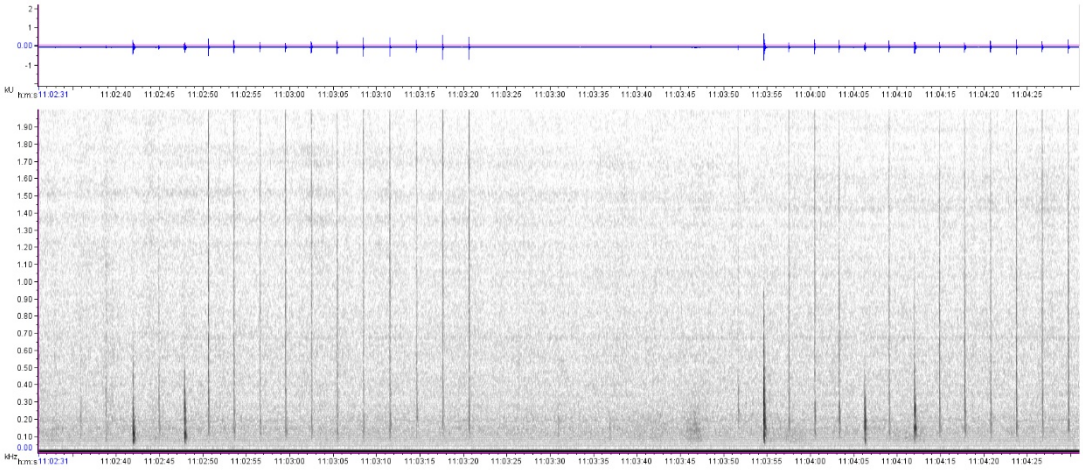


Figure 5. Spectrograms (the x axes are time and the y axes are frequency) of southern right whale calls: (a) upsweeps (Hamming window with 4096 fast Fourier transform, FFT, and 75% overlap); (b) variable tonal calls with harmonics (Hamming window with 2048 FFT and 75% overlap); (c) a single gunshot (Hamming window with 1024 FFT and 75% overlap); (d) 2-min gunshot sequence (Hamming window with 2048 FFT and 75% overlap).