DOLPHINS OF THE KELP

REPORT
Cetacean observations between the Falkland Islands and South Georgia conducted on board of the HMS Enterprise from the 21st to the 31st of January 2017

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SUMMARY

An eleven-day cetacean visual survey was conducted during a return journey from the Falkland Islands to South Georgia onboard of the British Royal Navy's *HMS Enterprise* in January 2017, by the cetacean team of the South Atlantic Environmental Research Institute (SAERI). The main objective was to conduct cetacean observations throughout an area where information on cetacean presence, abundance and distribution is scarce or patchy. The survey also represented also an opportunity to further expand the project's community outreach, establishing cooperation with the Government of South Georgia and the South Sandwich Islands (GSGSSI) and the UK Royal Navy.

A total of 673 km was navigated in good conditions for spotting cetaceans and 89 sightings of eight cetacean species were recorded, including four baleen whales (blue whale, *Balaenoptera musculus*; fin whale, *Balaenoptera physalus*; sei whale, *Balaenoptera borealis*; and humpback whale, *Megaptera novaeangliae*), and four delphinids (Commerson's dolphin, *Cephalorhynchus commersonii*; hourglass dolphin, *Lagenorhynchus cruciger*; Peale's dolphin, *Lagenorhynchus australis*; and orca, *Orcinus orca*). Baleen whales sightings represented the vast majority of the records and the sei whale was the species most frequently sighted. The distribution patterns observed showed a high concentration of sei and fin whales over the Polar Front, and almost no overlap between both sei and fin whales, and humpback whales. Humpback whales were observed only in continental waters around South Georgia and Shag Rocks. One blue whale was also encountered. Even though Antarctic minke and southern right whales are among the most commonly sighted baleen whale species around South Georgia in summer, they were not encountered during this survey.

The large number of sightings compared to the limited period of observation highlights the importance of this area for cetaceans, in particular for baleen whales that migrate during austral summer from northern breeding grounds to the highly productive polar waters southeast of the Polar Front to feed.

Due to the remoteness of the area and the hostile weather conditions, vessel surveys can be carried out only using large ships with experienced crews and are therefore very expensive. The use of platforms of opportunity such as the *HMS Enterprise* has proven essential for cetacean monitoring in such areas. After the whaling in the 20th century considerably depleted many stocks of cetaceans, scientific data are needed to support national, regional and international conservation efforts and help

securing a future for this charismatic component of the marine biodiversity facing emerging environmental threats such as overfishing and climate changes.

We recommend that in the future similar opportunities continue to be encouraged and efforts coordinated allowing trained people to join ships travelling to these remote and still poorly understood areas to record cetacean occurrence.

INTRODUCTION

The waters surveyed during this trip encompass the cold temperate and sub-Antarctic zone, and the southern polar Antarctic zone whose boundary is defined by an oceanic frontal feature known as Polar Front (PF) (**Figure 1**). The PF is the most important feature of a system of fronts and currents created by the Antarctic Circumpolar Current (ACC) circulating around Antarctica from west to east. Across the front the temperature can change dramatically, up to 10˚C, over few kilometers affecting marine wildlife distribution including cetacean. When the massive volume of water moved by the ACC funnels through the narrow gap of the Drake Passage and encounters the steep-sided ridge of the Scotia Arc, it forms a complex system of strong currents and eddies that make the region extremely dynamic oceanographically creating areas of exceptionally high productivity (**Figure 2**) (Arhan *et al.* 2002; Agnew, 2004).
Despite a difference of few degrees of latitude, the Falkland Islands (51˚-52˚S) and South Georgia (54˚S) are respectively located north and south to the Polar Front and are consequentially characterized by different climates and ecosystems.

The Falkland Islands are located about 550km off the south-east coast of South America on a projection of the Patagonian Shelf and lie to the northern boundary of the Sub-Antarctic Front (SAF); offshore sea temperatures range from 6 ˚C in the winter to 13 ˚C in the summer (Richards, 1997). Productivity in the Falkland Islands is dictated by the interaction of currents and the topography of the southern Patagonian shelf. A branch of the cold ACC is deflected northward encircling the Falkland Islands and generating the Patagonian Current to the west and the strongest Falkland (Malvinas) (**Figure 1**). The Falkland Current travels north until it turned eastward by the warmer waters of the Brazil Current. Along the Falklands shelf edges, the cold waters of the Falkland Current generate a strong upwelling and therefore and primary production considered amongst the highest in the South Western Atlantic (Sanchez and Ciechomski 1995, Arhan *et al.* 2002, Agnew 2004, Arkhipkin, *et al.* 2013).

South Georgia is located about 1,370 Km east-south-east of the Falkland Islands and 4,800 Km off southwest of South Africa. The island lies south of the PF; offshore sea temperatures ranges from 0 ˚C to 3 ˚C year-round (Whitehouse *et al.* 2008). In South Georgia, productivity is again enhanced by a complex system of currents and fronts further supplied by iron washed from the shore (Burton and Croxall 2012). A branch of the ACC (**Figure 1** the Sub-Antarctic Circumpolar Current Front, SACCF is shown) is deflected south, toward South Georgia where is turned to flow northwards along the south-east end of the island and again westwards along its

north coast. Another part of the ACC also flows directly toward the west coast of South Georgia where it forms a complex mix of currents both east and west of Shag Rocks. The blooms north of South Georgia are amongst the most intense south of the Polar Front (Murphy *et al.* 2013) and support the highest densities of Antarctic krill (*Euphausia superba*) throughout the Southern Ocean (Reid *et al.* 2000, Atkinson *et al.* 2008).

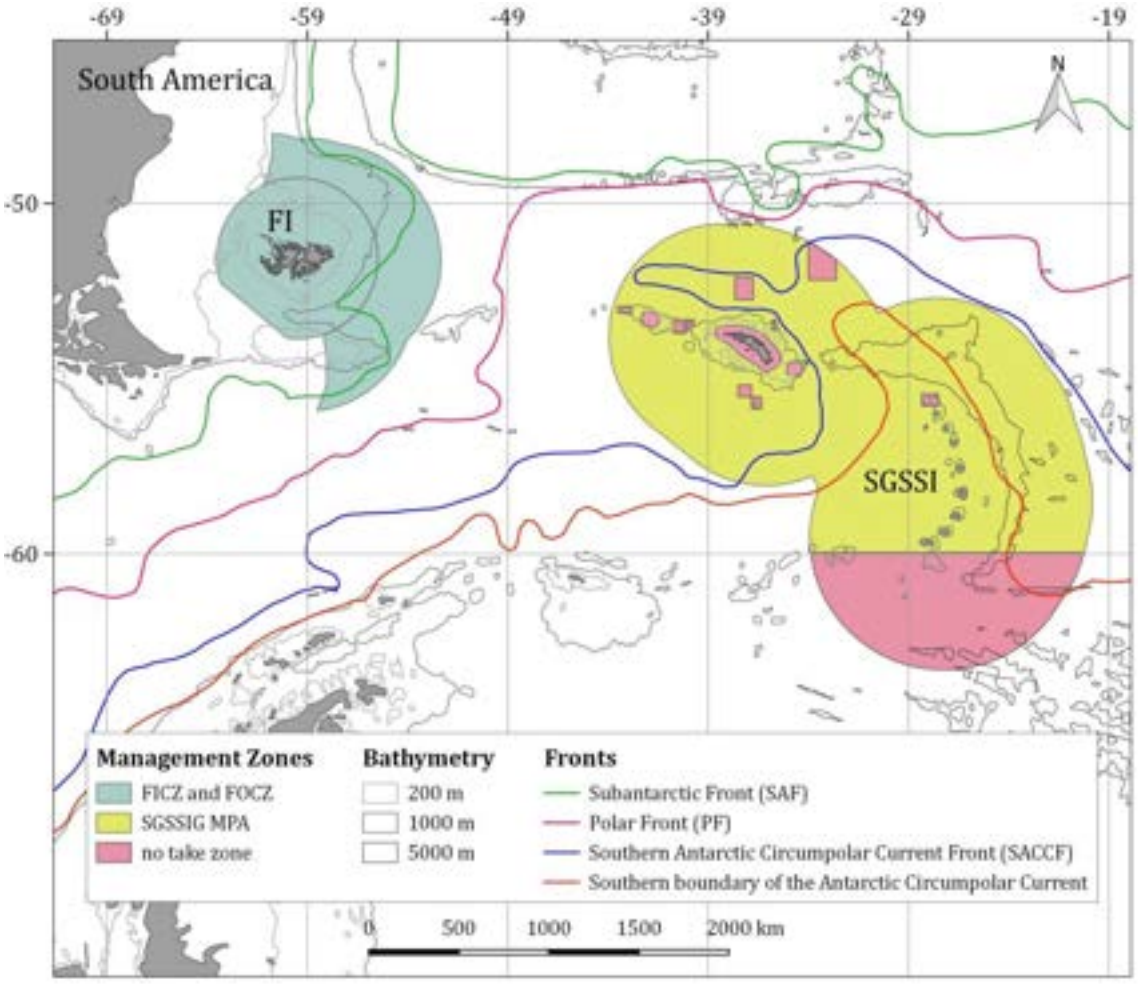

Figure 1 – Map showing the area between the Falkland Islands (FI) and South Georgia and the Sandwich Islands (SGSSI) that was partially covered during the survey. Also shown are the marine management zones around the FI and SGSSI, the bathymetry, and the mean positions of the fronts.

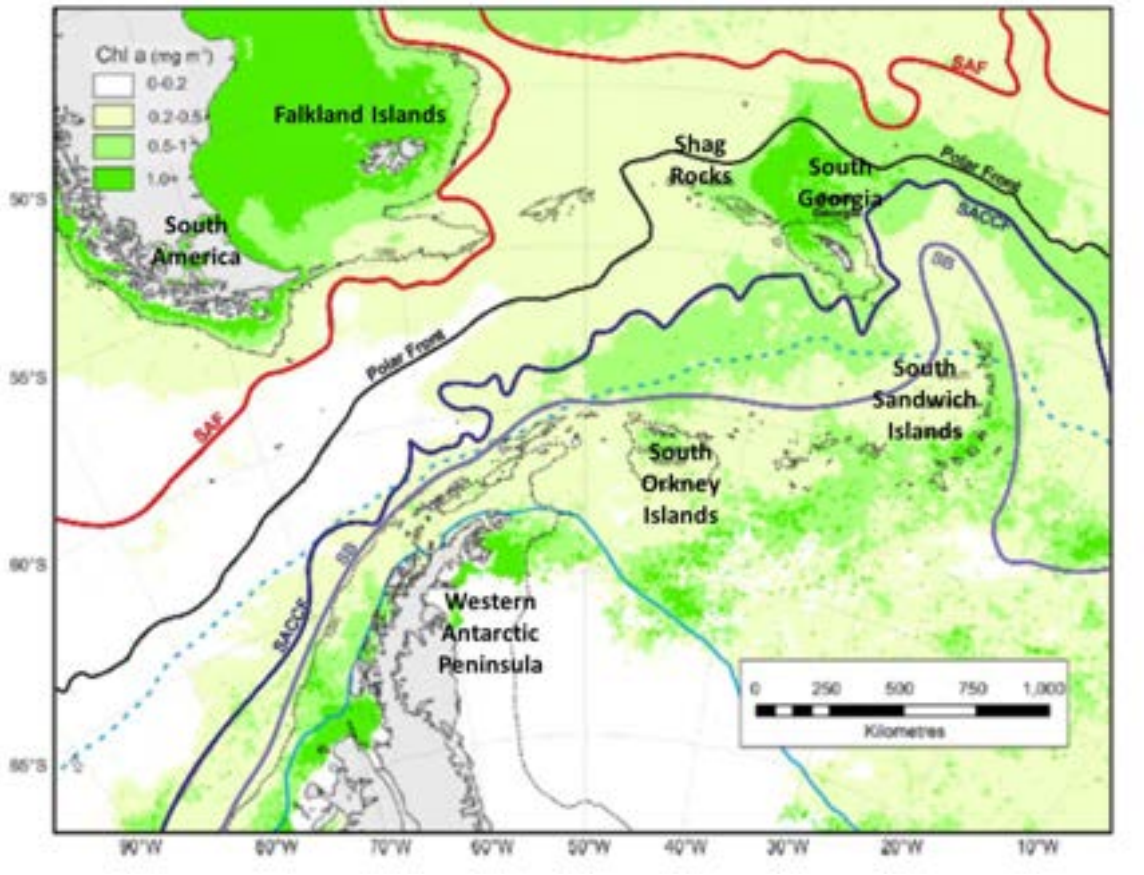

Figure 2 - Image showing the Falkland Islands and South Georgia and the mean position of the oceanographic fronts generated by the Antarctic Circumpolar Current (ACC). SAF = Sub-Antarctic Front; SACCF = Southern Antarctic Circumpolar Current Front; SB = Southern boundary of ACC. Also shown the 1000 m isobaths (black dashed lines), the mean winter (dashed blue line) and summer (solid blue line) sea ice extent (15% concentration), and the mean surface chlorophyll a concentration (mg m−2) between September and March (SeaWiFS derived satellite data, NASA, means calculated only for cells where 10 values were obtained within a year). The white areas include cells where no data are available. Modified from Murphy *et al.* 2013.

Due to this high productivity (**Figure 2**), the waters off South Georgia and the Falkland Islands are key feeding ground for a biodiverse fauna (including large fish, sea birds, pinnipeds and cetaceans) and important areas for the fishing industry (Agnew 2004).

In the Falklands waters a multinational fishery has been active since the mid-1970s without regulations (White *et al.* 2002). After the 1986 a regulation through the sale of licenses was adopted initially (in 1986) with the creation of a Falkland Islands Interim Fishery Conservation and Management Zone (FICZ) and later (in 1990) with the extension of this zone to 200 nautical miles to create the Falklands Outer Conservation Zone (FOCZ) (**Figure 1**). Furthermore, since 2014 the Falkland Islands have been implementing Marine Spatial Planning process for co-ordinated

management of the marine environment (Augé *et al.* 2015, Augé 2016, Golding 2017).

Commercial fishing started around South Georgia in the 1960s in the context of a declining sealing and whaling industry. In particular the Soviet fishing fleet was among the first exploring the Scotia Sea, including waters around South Georgia, as a consequence of a fishing expansion programme started in the late 1950s. Throughout the 1960s and the 1970s the whole Antarctic region was subject to unmanaged exploitative fishing, leading to depletion of several stocks (Agnew 2004). In 1993 the Government of SGSSI Government declared the waters within 200 nautical miles from the coast a SGSSI Maritime Zone introducing a system of regulation through the sale of licenses, similar to that developed by the FIG. To further enhance protection and management for marine life affected by fishing, in 2012 the Government of SGSSI created one of the world's largest (1.07 million km^2), sustainably managed Marine Protected Area (MPA) that encompasses the entire SGSSI Maritime Zone north of 60 °S. Within this area, no-take zones were fixed at 12 nautical miles from the coast of South Georgia, Clerke Rocks, Shag and Black Rocks and the South Sandwich Islands, and a network of benthic no-take-zones was put in place in popular toothfish fishing areas (**Figure 1**). The aim of these initiatives is to promote healthy biodiverse ecosystems where wildlife and cetacean species can thrive, and support the ongoing recovery of baleen whale populations (GSGSSI 2013).

However, like any other natural resource management process, their efficiency depends on the availability of reliable data on species presence, abundance, and distribution in space and time (Croll *et al.* 1998, Kaschner *et al.* 2012). While these data might be accessible for fish (i.e. though analyses of the catches, Hansson and Rudstam 1995, Agnew 2004), pinnipeds, and sea birds (i.e. during breeding on land, Clausen 2000), for cetacean the situation is different as they spend their entire life at sea, moving over large areas, at very low densities (Hammond 2010).

Cetaceans are also particularly vulnerable being long lived animals with slow sexual maturation, low reproductive rates and, for some species, intense nursing for offspring. These life history characteristics reduce the ability of cetacean populations to recover from overexploitation or other persistent anthropogenic mortality (Merrick *et al.* 2009).

Currently, cetacean information in the region between the Falkland Islands and South Georgia is scarce and population's sizes are unknown. Only few surveys have

been carried out since the end of the whaling in the area (Moore *et al.* 1999, Reid *et al.* 2000, Hedley *et al.* 2001, White *et al.* 2002, Reilly *et al.* 2004, Black 2005, Širović *et al.* 2006, Yates and Brickle 2007, Rossi-Santos *et al.* 2007, Dellabianca *et al.* 2012, Richardson *et al.* 2012, Otley 2012, Casoli 2014, Thomsen 2014, Fran and Augé 2016, Tognetti 2016). A total of twenty-five species of cetaceans have been recorded in these waters including eight species of mysticetes or baleen whales (blue whale, *Balaenoptera musculus*; fin whale, *Balaenoptera physalus*; sei whale, *Balaenoptera borealis*; minke whale species, either Antarctic minke whale *Balaenoptera bonaerensis* or dwarf minke whale[1] *Balaenoptera* acutorostrata; humpback whale, *Megaptera novaeangliae*; southern right whale, *Eubalaena australis*; pygmy right whale, *Caperea marginata*), seven species of beaked whales (southern bottlenose whale, *Hyperoodon planifrons*; Andrew's beaked whale, *Mesoplodon bowdoini*; strap-toothed whale, *Mesoplodon layardii*; Gray's beaked whale, *Mesoplodon grayi*; Hector's beaked whale, *Mesoplodon hectori*; Cuvier's beaked whale, *Ziphius cavirostris*; Arnoux's beaked whale, *Berardius arnuxii*), eight species of delphinids (Commerson's dolphin, *Cephalorhynchus commersonii*; Peale's dolphin, *Lagenorhynchus australis*; hourglass dolphin, *Lagenorhynchus cruciger*; dusky dolphin, *Lagenorhynchus obscurus*; orca, *Orcinus orca*; long-finned pilot whale, *Globicephala melas*; southern right whale dolphin, *Lissodelphis peronii*; common bottlenose dolphin, *Tursiops truncatus*), one species of porpoise (spectacled porpoise, *Phocoena dioptrica*) and the sperm whale, *Physeter macrocephalus* (Hamilton 1952, Goodall *et al.* 1997, Moore *et al.* 1999, Hedley *et al.* 2001, White *et al.* 2002, Širović *et al.* 2006, Rossi-Santos *et al.* 2007, Burton and Croxall 2012, Dellabianca *et al.* 2012, Otley 2012, Frans and Augé 2016).

The logistic challenges of harsh remote offshore environments, the high costs of surveying, and the difficulties in funding long-term cetacean monitoring programs, highlight the importance of utilizing platforms of opportunity that venture to remote environments.

Making the most out of an opportunity provided by the Royal Navy and an invitation from the, Commander Philip Harper Commanding Officer of the *HMS Enterprise*, two of SAERI's cetacean ecologists joined the the eleven-day expedition from the Falkland Islands to South Georgia. The main objectives of this survey were:

[1] The Dwarf Minke whale is a form of *B. acutorostrata* that occurs in the southern hemisphere (Reilly *et al.* 2008e). The identification between *B. acutorostrata* and *B. bonaerensis* is ambiguous because the two species are partially sympatric and hard to distinguish. In this document there is no future reference to *B. acutorostrata.*

1. To provide information about cetacean distribution and occurrence in a poorly understood, yet historically important region of whale diversity in order to support the conservation efforts of the SGSSI and Falkland Islands Governments toward a sustainable fishery

2. To strengthen partnerships, facilitated networking, and capacity building in the region (e.g. Falkland Islands, South Georgia and Sandwich Islands, and the Royal Navy).

This report summarizes the results of the cetacean observations carried out from the *HMS Enterprise* during a round-trip from the Falkland Islands to South Georgia in January 2017.

1. CETACEAN OBSERVATIONS

1.1. Materials and methods

The expedition from the Falkland Islands to South Georgia and back was conducted aboard the *HMS Enterprise*, from the 21st to the 31st of January 2017 for a total of 11 days (**Figure 3**and **Figure 4**). The *HMS Enterprise* is a 90.6 m long and 16.8 m large multi-role survey vessel of the Royal Navy (www.royalnavy.mod.uk/enterprise) (**Figure 5**). The vessel is equipped with two 1.7 MW (2,279 hp) azimuth thrusters allowing for a cruising speed of 22 km/h (12 knots) and a continuous cruising range of about 17,200 km (9,300 nm) corresponding to 35 days at sea.

The *HMS Enterprise* left Mare Harbor at East Cove, Falkland Islands, in the morning of the 21st of January and arrived to South Georgia on the early morning on the 24th. The ship then navigated along the eastern coast of South Georgia and stopped at Gold Harbour (**Figure 4**) for several hours, allowing the crew to disembark and admire the local fauna. In the afternoon the vessel proceed to the southern part of the Island and entered in the Drygalski fiord, before spending the night navigating parallel to the coast (**Figure 4**). On the 25th the vessel moved to Grytviken and after maneuvering around an iceberg at the entrance of the bay, anchored in King Edward Cove for the afternoon. In the evening the vessel moved out the bay and spent the night safely navigating offshore, to re-anchor in the bay on the 26th. The ship remained anchored all day long and no visual effort in search for cetacean was

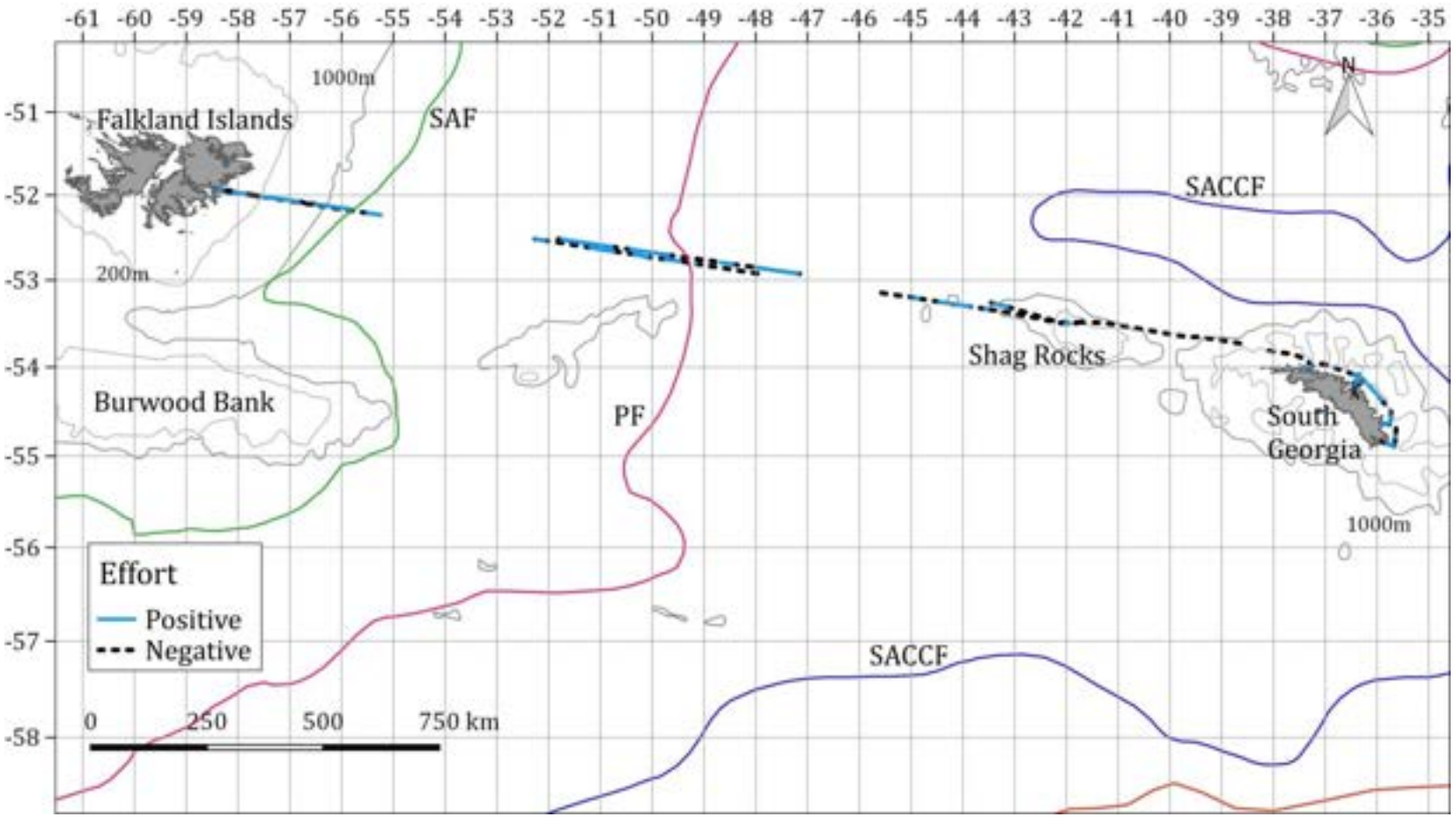

Figure 3 - Visual survey effort from the Falkland Islands to South Georgia. The blue line represents positive effort; the dotted line represents negative effort. Also shown are the mean positions of the Polar Front (PF, red line), Sub-Antarctic Front (SAF, green line), Southern Antarctic Circumpolar Current Front (SACCF, dark blue line), the 200 m isobaths (light grey line) and the 1000 m isobaths (grey line). Gaps in the track along transect reflect night time navigation.

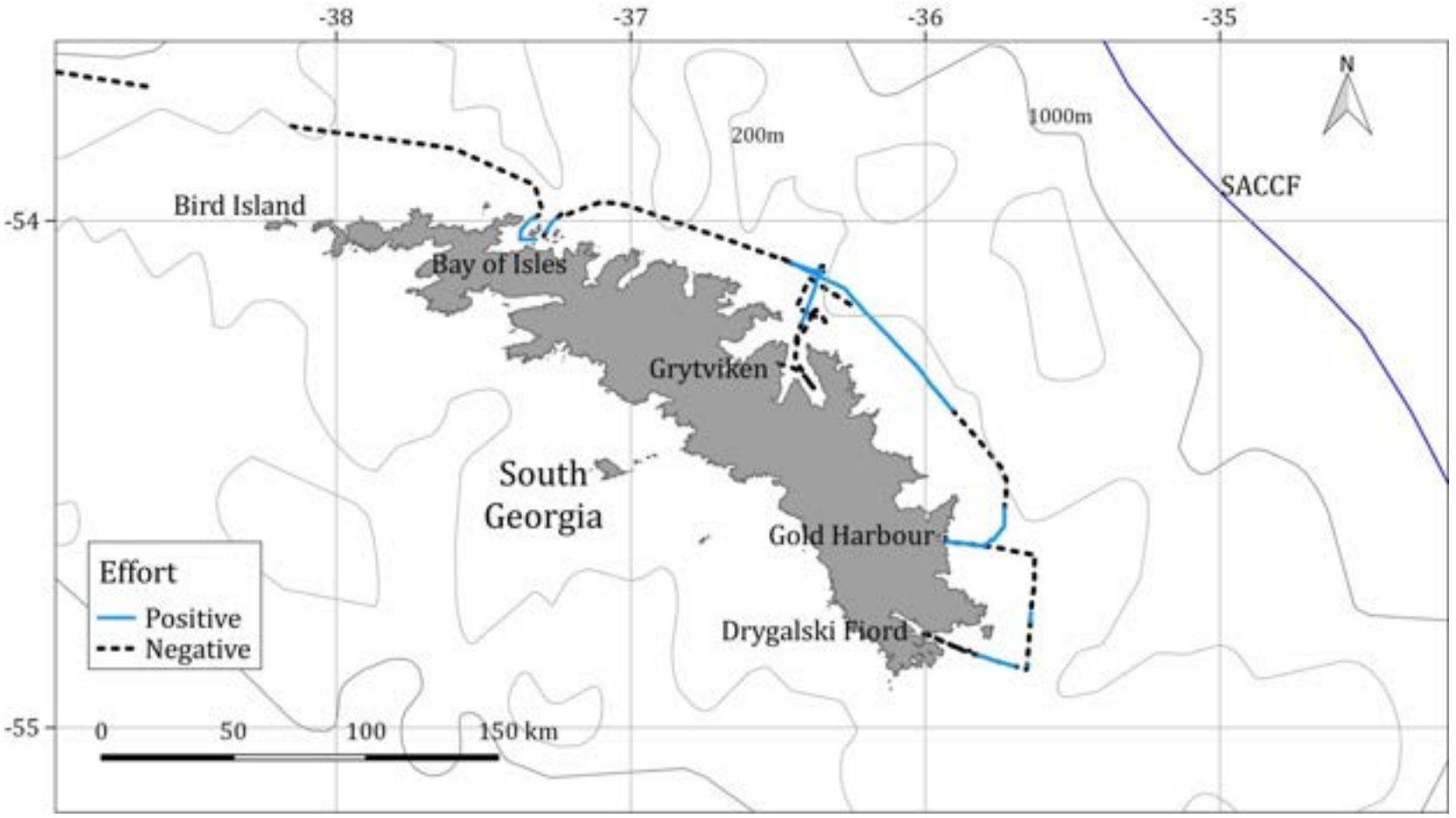

Figure 4 – Detailed of the route along the eastern coast of South Georgia. The blue line represents positive effort; the dotted line represents negative effort. Also shown are the mean position of the Southern Antarctic Circumpolar Current Front (SACCF, dark blue line), the 200 m isobaths (light grey line) and the 1000 m isobaths (grey line). Gaps in the track along transect reflect night time navigation.

Figure 5 – The *HMS Enterprise* anchored off Gold Harbour, South Georgia.

carried out on the 26th. On the 27th the vessel moved north along the eastern coast and commenced the trip back to the Falklands. The trip back lasted 4 days and the ship reached the east coast of the East Falkland of the 30th. The strong wind (> 8 Beaufort) did not allow entering in Mare Harbor until the morning on the 31st of January 2017.

The route followed a straight line between the Falklands and South Georgia and cetaceans were never approached when sighted.

The total distance travelled during the expedition was about 3,780 km of which approximately 3,050 km were the trip from the Falklands to South Georgia and back and 729 km was spent navigating in and around the South Georgia. During the trip the Executive officer Matthew Warren was on command of the *HMS Enterprise*.

1.1.1. Data collection

Cetacean observation was carried out daily by two observers from about 45 minutes after sunrise until 45 minutes before sunset, except in bad weather conditions (wind stronger than 5 Beaufort, strong rain and/or fog, reducing visibility under 1 km). Effort was considered as 'Positive' when the vessel was navigating at a speed ranging from 16 to 28 km/h (9 to 15 knots) and two observers were looking for cetaceans; as 'Negative' otherwise. When cetacean were encountered in negative effort the category 'Cetacean' was filled 'Yes'. The observation platform was located

outside on the upper bridge at 11 meters above sea level (**Figure 6**). Observers alternated their position on the right and left side of the ship about every hour and took breaks after 3 consecutive hours of work and for meals.

Figure 6 - The locations of the two observers (red points) outside on the upper bridge of the *HMS Enterprise* at 11 m above the sea surface.

Observers searched with naked eyes a sector directly ahead of the track-line to 90 degrees abeam on their respective side (**Figure 7**). Waterproof 7x50 binoculars with compass were used to confirm species identification and estimate the true bearing for each sighting.

Time, position (latitude and longitude), and vessel speed and bearing, were recorded automatically every minute with a global positioning system Garmin 72H.

Environmental and effort data were tape recorded at the beginning and at the end of each observer effort block and every time there was a change in weather conditions. Environmental data included time, sea state in Beaufort and Douglas scales, swell high (in meters, plus the category 'confused swell' when direction and high were not clearly identifiable), wind direction (as cardinal points), percentage of cloud cover (from 0 to 100%), presence of glare, precipitation and fog intensity (low, medium, intense, and patchy – for fog was also recorded an estimation of the visibility in meters).

Figure 7 - Observer looking for cetacean from the right side of the upper bridge of the *HMS Enterprise*.

Navigation data included effort ('Positive' or 'Negative'), cetacean spotted/reported during negative navigation ('yes'), and observer location (right or left). When a sighting occurred the following data were recorded:

- species or group code ('like fin whale', 'like blue whale' etc.; 'unidentified cetacean', 'unidentified delphinids, 'unidentified baleen whale', 'unidentified whale' – including baleen whale and sperm whale, and 'unidentified large whales' – including blue and fin whales);
- true bearing of the animal or the group centre;
- distance from the animal or group centre (i.e. visual estimates by observers from experience);
- cue at sighting (blow, body, splash, birds, other);
- spotter name and sector of observation;
- group size (minimum number counted, maximum estimated and best estimate);
- behaviour at sighting (travelling, feeding, milling);
- swimming direction - only for baleen whale;
- Presence of pictures/video and number.

Photographs were taken when possible using a CANON EOS 7D Mark II, equipped with a lens EF 70-200mm f/2.8 L IS II USM, and a Nikon D7200, equipped with a lens

AF-S VR-NIKKOR 70-200mm 1:2.8G (**Figure 8**). Pictures helped to verify species identification. A combination of body features and behaviors were used to identify animals at species level following the guidelines specified in **Appendix 1, 2 and 3**.

The navigation and sighting data collected in this survey (including the pictures) are available at the Information Management System and GIS Data Center (http://www.south-atlantic-research.org/ims-gis).

Figure 8 - Observer during photo-identification.

1.1.2. Data processing and analyses

Times and positions where downloaded every evening from the GPS as text file and copied in a Microsoft Excel spreadsheet. Tape-recorded navigation and sighting data were typed in the same spreadsheet by matching times.

One-minute waypoints were transformed into shapefile segments using MARINElife Ecological Survey Data Analyst V0.3.3.1 (cetamon.codeplex.com). The shapefile was imported into QGIS 2.18.13. and projected using the South Pole Stereographic projection. Lengths (for each one minute segments, for positive and negative effort, and in total) were obtained using the command '$length' found in the tool Geometry.

Cetacean sightings were mapped to visually explore species distributions. The total numbers of delphinids and baleen whale sightings as well as the relative abundance of animals were plotted for 1° longitude bin between 58°W and 35°W. Relative abundance was calculated as the relative percentage of the number of animals sighted in each bin in relation to the total number of animals recorded in the survey.

Percentage effort was calculated as the relative percentage of the distance travelled in each bin out of the total amount of kilometers navigated during the survey.

Encounter rates were estimated using only positive effort for species known to occur through the extent of the waters covered during the survey (including sei, fin, humpback whales and hourglass dolphins), and for all baleen whales. Sightings of the categories 'like sei' (n=3), 'like fin' (n=3), and 'like humpback' (n=1) were included for these calculations to the respective species. Positive effort per bin was used as sample unit to estimate variance. Bins with less than 10 km of positive effort were removed. The only sighting of blue whale was made in one of the two bins removed therefore blue whale encounter rate is not available.

Encounter rates for the same baleen species/group were also estimated for the three following zones: 35˚-41˚W, including South Georgia and Shag Rocks; 42˚-48˚W, including zones between Shag Rocks and the surrounding of the PF; 49˚-51˚W, including the area around the PF.

The maximum distance from the coast was calculated for Commerson's and Peale's dolphins' sightings using QGIS distance tools.

1.2. Results

1.2.1. Visual effort

A total of 2,275 km were navigated during daylight and cetacean observations were conducted throughout 673 km (30%). Rain and thick fog patches (visibility to less than 1 km) and sea state greater than 5 Beaufort Sea greatly limited observations throughout the majority of the daylight navigation (**Figure 9)**.

During the survey several seabird species were observed and photographed, mainly south of the Polar Front around South Georgia. Photographs are available on **Appendix 4.**

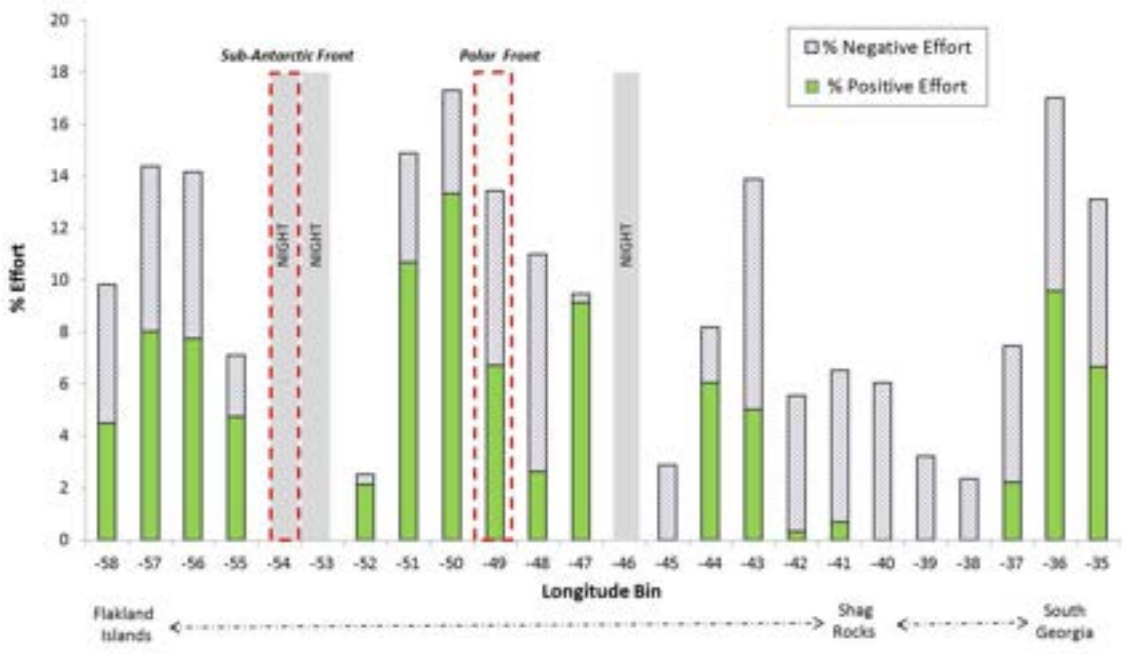

Figure 9 - Percentage of positive and negative effort divided by 1 °longitude bin.

1.2.2. Cetacean sightings

During the survey 89 sightings were made (**Table 1**). Species were identified in 56 occasions (63%) including four species of delphinids (Commerson's dolphin - *Cephalorhynchus commersonii*, hourglass dolphin - *Lagenorhynchus cruciger*, Peale's dolphin - *Lagenorhynchus australis*, and killer whale - *Orcinus orca*) and four species of baleen whales (blue whale - *Balaenoptera musculus,* fin whale - *Balaenoptera physalus*, sei whale - *Balaenoptera borealis*, and humpback whale - Megaptera novaeangliae). Sei whale was the species with more sightings (29), followed by fin whale (10), and humpback whales (7). Only one sighting of one individual of blue whale was made.

Species identification was not possible for 33 sightings of which in 28 occasions (85%) baleen whales were identified in various categories, including 'like fin whale' (3 sightings), 'like sei whale' (3 sightings), 'like humpback whale' (1 sighting), 'unidentified large baleen whale' (6 sightings of either blue or fin whales), and 'unidentified baleen whale' (15 sightings). The remaining 5 sightings were recorded as 'unidentified whale' (either a baleen whale or the sperm whale), 'unidentified delphinids' and 'unidentified cetacean (**Table 1**).

The total number of animals sighted was 192 of which baleen whales were the most sighted (78%), followed by delphinids (20%). Among the 149 baleen whales, the majority was represented by sei whales (57), followed by the fin whales (34), unidentified baleen whales (24), and humpback whales (14) (**Figure 10**).

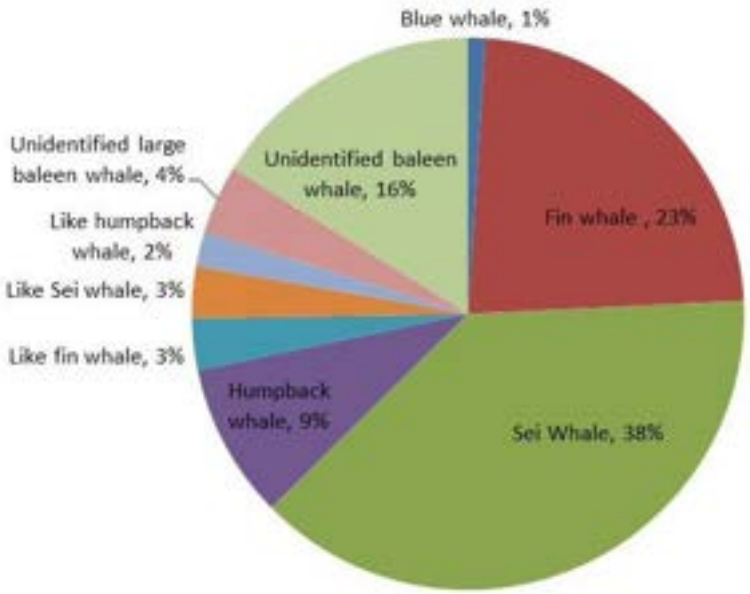

Figure 10 - Percentage of total number of baleen whales individuals divided by species and categories when identification to species level was not possible (n-=149).

Group size for sei and humpback whales varied between one and four individuals with a mean of 2.0 (SD=1.6 and SD=1.2, respectively). Similar values were recorded for 'unidentified baleen whale' (mean=1.6, SD=1.1). Mean group size for fin whale was larger (mean=3.4, SD=1.7) than what recorded for sei and humpback whales, with number of individuals per group ranging from one to six animals (**Table 1**). All cetaceans observed for which species was identified appeared to be adult animals. No distinct large aggregations of baleen whales (e.g. >50 animals) were seen during this survey.

Table 1 - Summary of cetacean sightings made in 'positive' and 'negative' effort for species and for categories. The total number of animals, the mean group size with standard deviation (SD) and range are also shown.

Common name	Species scientific name	No of sightings	No of animals	Mean	SD	Range
Antarctic blue whale	*Balaenoptera musculus*	1	1			
Fin whale	*Balaenoptera physalus*	10	34	3.4	1.7	1-6
Sei Whale	*Balaenoptera borealis*	29	57	2.0	1.6	1-4
Humpback whale	*Megaptera novaeangliae*	7	14	2.0	1.2	1-4
Commerson's dolphin	*Cephalorhynchus commersonii*	1	3			
Hourglass dolphin	*Lagenorhynchus cruciger*	4	21	5.3	3.4	2-10
Peale's dolphin	*Lagenorhynchus australis*	2	5	2.5	0.7	2-3
Killer whale	*Orcinus orca*	2	5	2.5	2.1	1-4
Like fin whale		3	5	1.7	0.6	1-2
Like Sei whale		3	5	1.7	0.6	1-2
Like humpback whale		1	3			
Unidentified large baleen whale		6	6	1.0		
Unidentified baleen whale		15	24	1.6	1.1	1-4
Unidentified whale		2	2	1.0		
Unidentified dolphin		1	5			
Unidentified cetacean		2	2	1.0		
Total		**89**	**192**			
Total delphinids and %		10 (11%)	39 (20%)			
Total baleen whales and %		75 (85%)	149 (78%)			
Total other (whale + cetacean) and %		4 (5%)	4 (2%)			

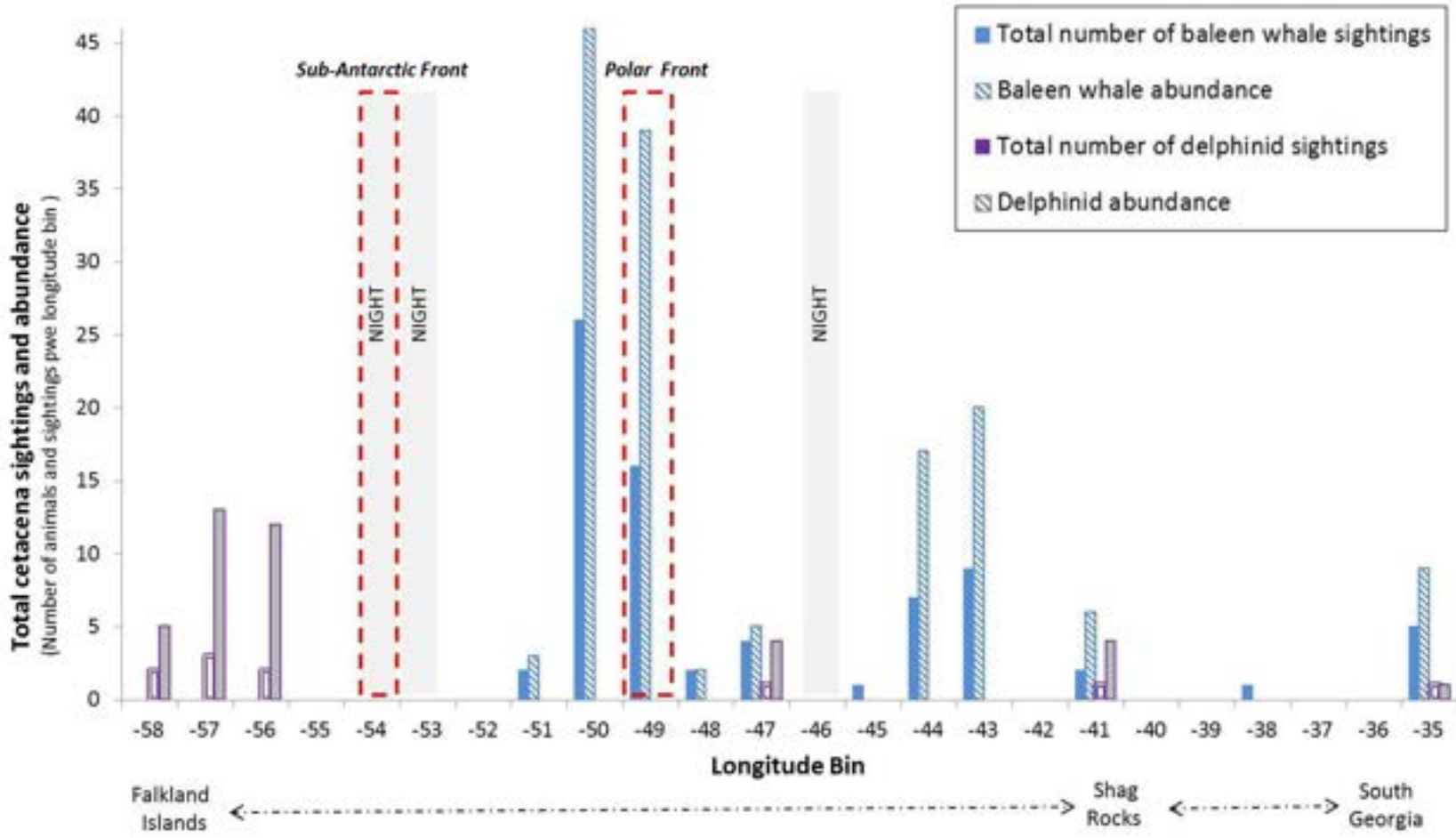

Figure 11 – Total number of cetacean sightings and individuals in each longitudinal 1°bin, divided by delphinids and baleen whales. Areas covered at night are reported (grey boxes). Also shown the mean positions of the Sub Antarctic Front and Polar Front (red dotted boxes).

Three species delphinids including Commerson's, Peale's and hourglass dolphins, were in the survey (Error! Reference source not found.**).** The only sighting of C ommerson's dolphin occurred in East Cove Bay, East Falkland Island where three individuals approach the pilot boat maneuvering around the HMS Enterprise during docking. Dolphins were observed diving repeatedly in the muddy-water generated by the propellers of the pilot boat (**Figure 12**).

Two groups of Peale's dolphins were sighted off East Cove Bay, at about 21 km and 45 km of distance, within the continental platform.

The four sightings of hourglass dolphins occurred way offshore the first two about 100 km west of the SAF and the second two about 140 km east of the PF.

The two sightings of orcas (**Figure 14**) were made at the entrance of the Drygalski fiord (one large male, **Figure 13**) and north Shag Rocks (four individuals of which at least one a female). This group was seen among 4-7 fin whales swimming in different direction. Both sightings occurred with negative effort and therefore, encounter rate was not calculated.

Humpback whales were mostly seen in shallow waters near Shag Rocks and South Georgia, while fin and sei whales were sighted in deepest waters particularly in proximity to the PF. One blue whale was sighted west of Shag Rocks and just outside the SGSSI MPA (**Figure 15**).

Our data showed little overlap between the distribution of both sei and fin whales and humpback whales (**Figure 15**). It is important to underline that a large number of sightings of unidentified baleen whales were also made along the route, and that these sightings refer to whales' sighted at large distances from the ship position and for which species was impossible to be determined (**Figure 16**).

Distinctive feeding behavior was only recorded once on the 29th of January while the *HMS Enterprise* crossed the Polar Front, and a group of four fin whales were rolling on their side indicating surface feeding activity.

Figure 12 - Commerson's dolphins swimming around the pilot boat that was helping the HMS Enterprise during the docking, in East Cover, East Falkland Island.

Figure 13 - Male orca encountered at the entrance of the Drygalski fiord (24th of January 2017).

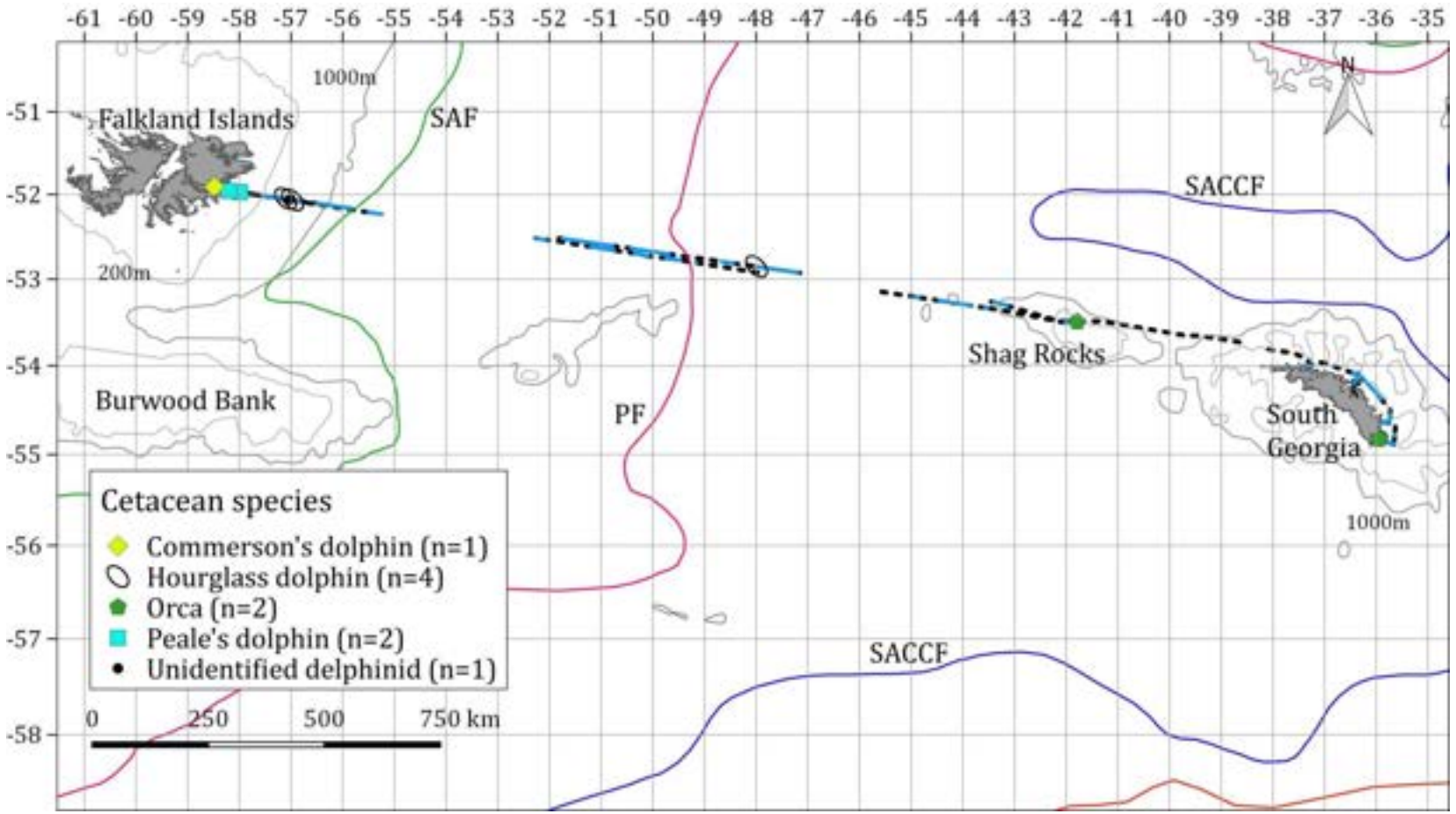

Figure 14 - Sighting distribution of the delphinids species observed during the survey. Two of the four sightings of hourglass dolphins overlap in the map around 48˚W. The blue line represents positive effort; the dotted line represents negative effort. Also shown are the mean positions of the Polar Front (PF, red line), Sub-Antarctic Front (SAF, green line), Southern Antarctic Circumpolar Current Front (SACCF, dark blue line). The 200 m isobaths (light grey line) and the 1000 m isobaths (grey line). Gaps in the track along transect reflect night time navigation.

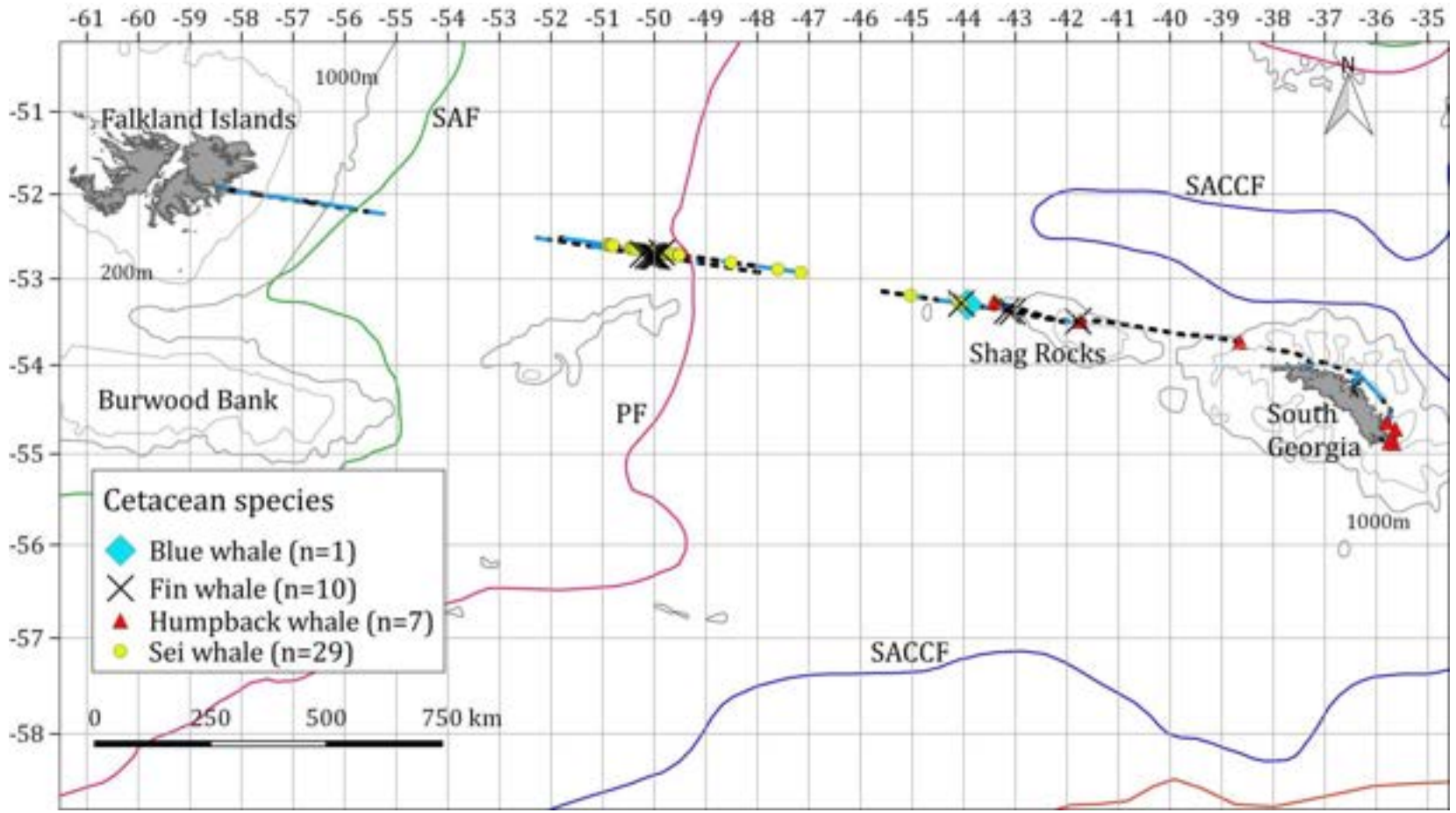

Figure 15 - Sighting distribution of the baleen whale species observed during the survey. The blue line represents positive effort; the dotted line represents negative effort. Also shown are the mean positions of the Polar Front (PF, red line), Sub-Antarctic Front (SAF, green line), Southern Antarctic Circumpolar Current Front (SACCF, dark blue line), the 200 m isobaths (light grey line) and the 1000 m isobaths (grey line). Gaps in the track along transect reflect night time navigation.

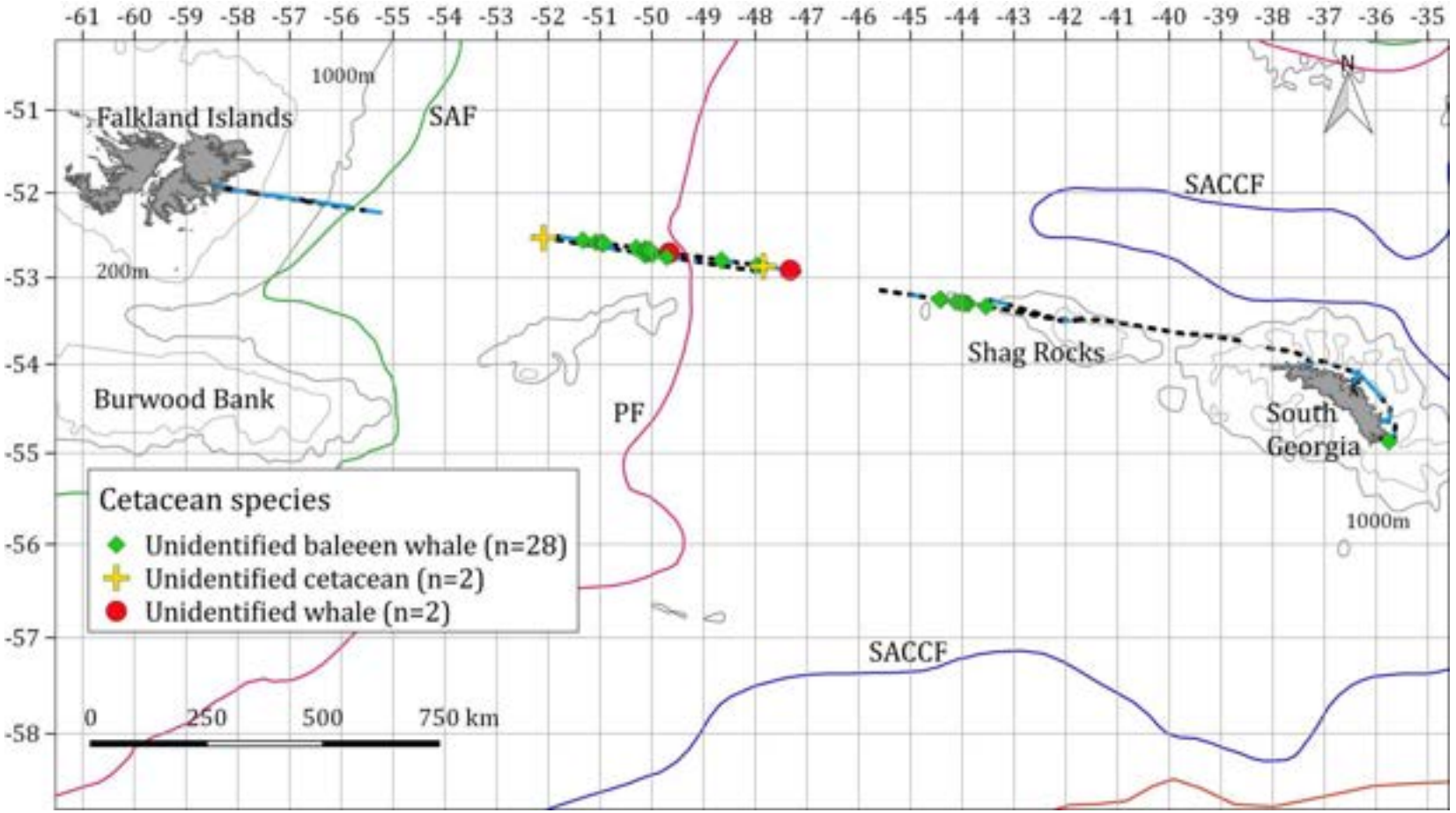

Figure 16 - Sighting distribution of unidentified cetaceans observed during the survey. The blue line represents positive effort; the dotted line represents negative effort. Also shown are the mean positions of the Polar Front (PF, red line), Sub-Antarctic Front (SAF, green line), Southern Antarctic Circumpolar Current Front (SACCF, dark blue line), the 200 m isobaths (light grey line) and the 1000 m isobaths (grey line). Gaps in the track along transect reflect night time navigation.

1.2.3. Encounter rates

Baleen species encounter rates (ERs) divided by 1˚ bin of longitude, are showed in **Error! Reference source not found.**. Two bins were excluded because the positive e ffort was less than 10 km leaving a total of 666 km of positive effort considered in the analyses. The figure shows the high concentration of sei and fin whales around the PF. Of the seven humpback whale sightings only one was made in positive effort off the southeastern coast of South Georgia.

ERs for baleen, sei, fin humpback whales and hourglass dolphins are shown in (**Table 2**). One group of baleen whales was encountered every 17 km (ER=0.058, CV= 1.4), one of sei whales every 35 km (ER=0.029, CV= 1.7), one of fin whales every 130 km (ER=0.008, CV= 1.5), one of humpback whales every 670 km (ER=0.001, CV=3.7), and one of hourglass dolphins every 205 km (ER=0.005, CV= 2.2).

Table 2 – Number of sighting (n), average encounter rate (ER), standard deviation (SD), and coefficient of variation (CV) calculated per cetacean species. ER are based on positive effort per 1° longitude bins, excluding those with less than 10 km of navigation.

Species	n	ER	SD	CV
Baleen Whales	46	0.058	0.084	1.4
Sei whale	20	0.029	0.049	1.7
Fin whale	7	0.008	0.012	1.5
Humpback whale	1	0.001	0.006	3.7
Hourglass dolphin	4	0.005	0.011	2.2

ERs are also shown for the zone over the PF (49° -51°W), the zone between the PF and Shag Rocks (42° -48°W), and the area around Shag Rocks and South Georgia (35° -41°W) to highlighted the high concentration of baleen whales, in particular sei and fin whales, observed over the PF (**Table 3**).

Table 3 - Encounter rates (sightings/km) and coefficient of variation (CV) for all baleen, sei, fin and humpback whales calculated over the PF (49° -51°W), the zone between the PF and Shag Rocks a(42° -48°W) , and the area around Shag Rocks and South Georgia (35° -41°W).

Species	49° - 51°W		42° - 48°W		35° - 41°W	
	E	CV	E	CV	E	CV
All baleen	0.154	0.7	0.093	0.9	0.015	1.7
Sei whale	0.081	0.9	0.047	1.1	na	na
Fin whale	0.023	0.4	0.012	1.2	na	na
Humpback whale	na	na	na	na	0.007	1.7

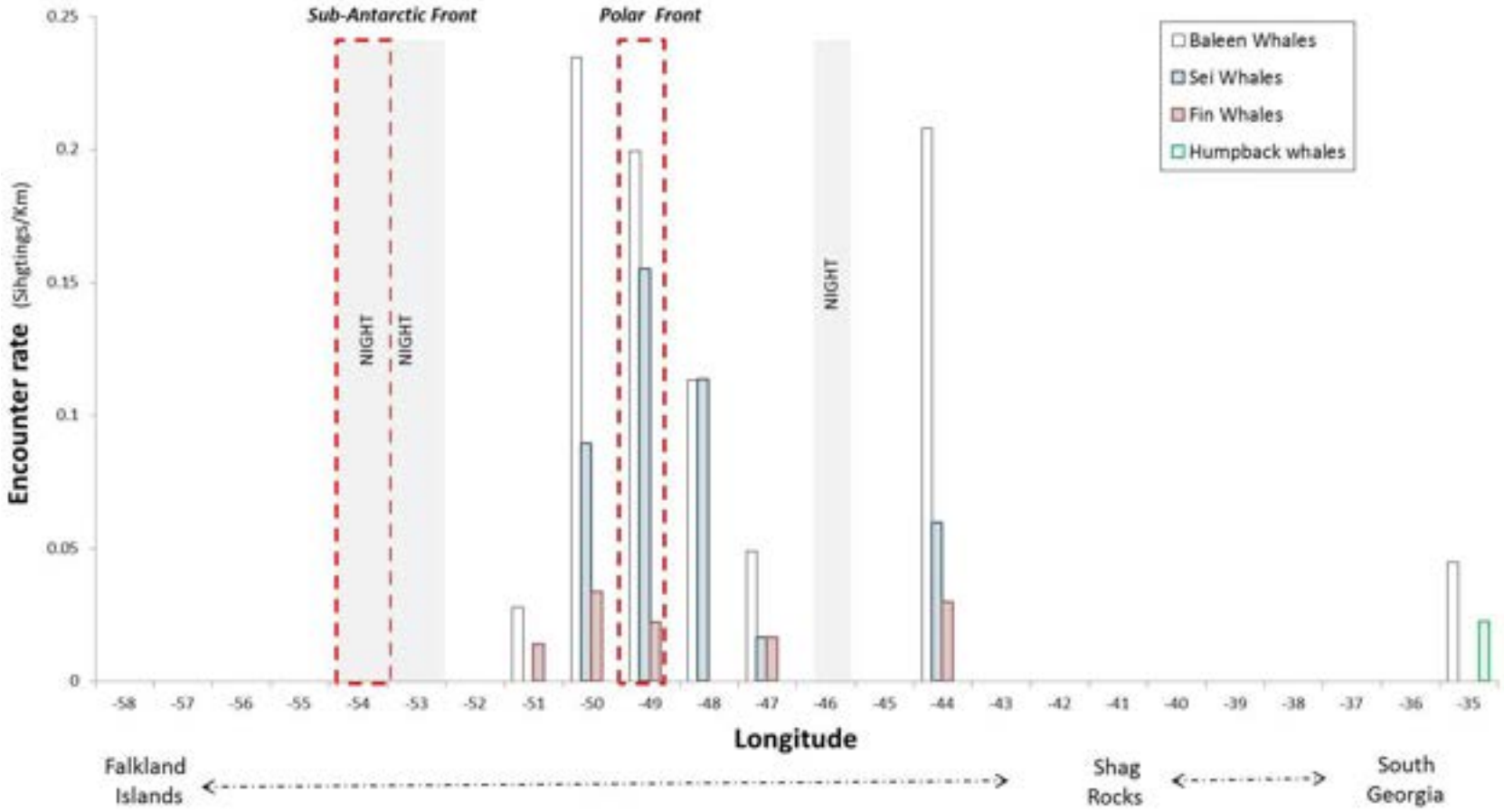

Figure 17 - Encounter rates (sightings/km) of all baleen (white bars), fin (red bars), sei (blue bars) and humpback whales (green bars) per each longitudinal 1°bins. Areas covered at night are reported (grey boxes). Also shown (red dotted boxes) the mean positions of the Sub Antarctic Front and Polar Front.

1.3. Discussion

This opportunistic survey provided new information about the occurrence and distribution of cetaceans inhabiting the waters between the Falklands Islands and South Georgia in January 2017.

1.3.1. Delphinids

Commerson's and Peale's dolphins are coastal species, living in the southern cold-temperate waters of the Patagonian Shelf including the Falkland Islands (**Figure 18**). During our survey, both species were observed near the shoreline of the Falklands where they are known to be abundant and breed locally (Hamilton 1952, Goodall *et al.* 1997, Brownell 1998, Goodall 2002; White *et al.* 2002, Strange 2007, Thomsen 2014).

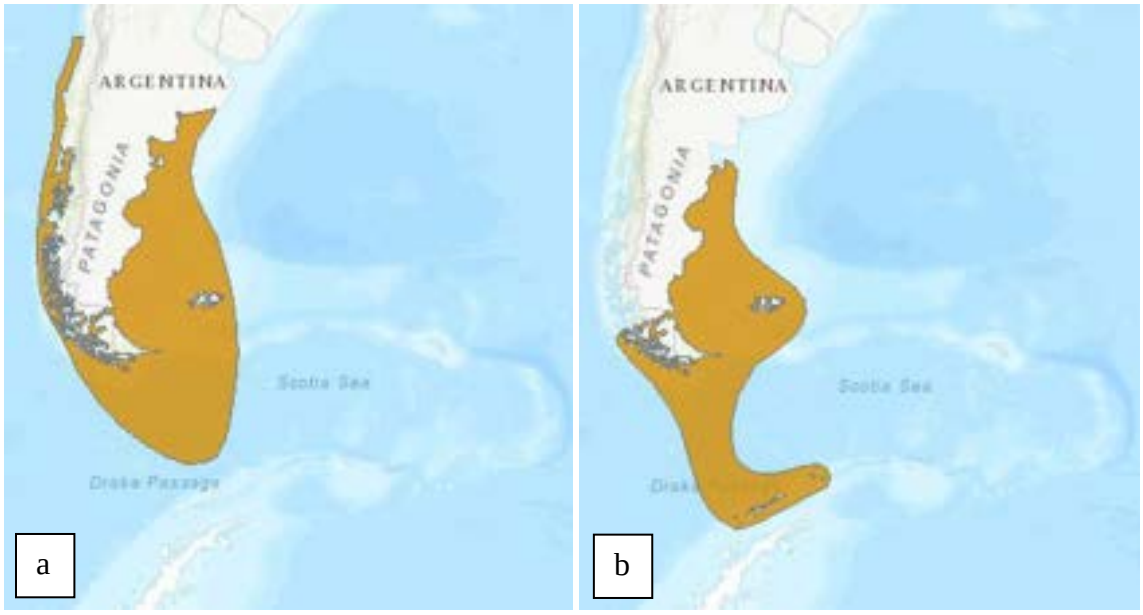

Figure 18 - Peale's (a) and Commerson's (b) dolphin distribution maps obtained by the IUCN Red List website on the 28th of September 2017 (http://maps.iucnredlist.org/map.html?id=11143; http://maps.iucnredlist.org/map.html?id=4159).

The offshore limit of both species is not very clear. Although observed swimming very close to shore and in the kelp forest (White *et al.* 2002, Thomsen 2014), **Commerson's dolphins** have been found more than 200 km offshore (Pedraza 2008) and south of the Antarctic Polar Front into the Drake Passage (Dawson, 2002). Reports of this species presence in the waters of South Georgia (Brown

1988) have been rejected (Reeves *et al.* 2013). A single individual was reported in the South African waters but it is likely that it belongs to the subspecies *C. c. kreguelensis* and that its distribution is extralimital (de Bruyns *et al.* 2006).

Cold temperatures do not seem to be a limit for the distribution of this small dolphin (maximum 146 cm; 45 kg, Dawson, 2009) since it prefers cool waters above the continental shelf with strong tidal current and continental runoff. Around the Falkland Islands groups of Commerson's have been observed in winter swimming in water with surface temperature of 3˚C (M. Costa personal communication).

Prey availability might influence Commerson's offshore distribution. Although known to feed on pelagic schooling fish in open areas, Commerson's appear to prefer benthic animals including fish, cephalopods, crustaceans, and other invertebrates (Reeves *et al.* 2013).

Peale's dolphins are known to inhabit waters above the continental shelf along open and wave-washed coasts and in protected bays and channels (Hammond *et al.* 2008). Around the Falklands they have been commonly observed offshore within the boundary of the FICZ, over the Burdwood Bank (White *et al.* 2002, Black 2005), and during navigation to Punta Arenas, Chile (Gillon *et al.* 2000, Garcia 2016), suggesting that the species might have a continuous distribution between the Falklands and southern South America.

Population size for both species is not known for the Falkland Islands. The abundance estimate is one of the aims of the 'Dolphins of the Kelp' project, funded by the Darwin Initiative and carried out at the South Environmental and Research Institute (SAERI) since October 2016.

Hourglass dolphins, orcas and long-finned pilot whales are the only three species of delphinids regularly inhabiting the cold Antarctic waters (Boyd, 2009). The four sightings of **hourglass dolphin** made during the trip reflect the distribution of the species that is known to prefer offshore areas within the ACC but also wander off the coasts of Antarctica, Patagonia, South Africa, Australia, New Zealand and the southern islands, including Falklands, South Georgia and the South Sandwich, Crozet, Kerguelen, and Marion-Prince Edward (Goodall 1997 and 2002, Black 2005, Hammond *et al.* 2008, Van Warebeek *et al.* 2010, Dellabianca *et al.* 2012).

Around the Falkland Islands hourglass dolphins are known to regularly occur between September and March within the cold, northward flowing waters of the Falkland/Malvinas current (White *et al.* 2002). We did not observed this species in

the waters north Shag Rocks and South Georgia where they have been reported even if in few numbers (Matthews 1977, Moore *et al.* 1999, Black 2005, Richardson *et al.* 2012).

Mean group size for hourglass dolphins observed in this trip (n=4, mean=5.3, SD=3.4) is similar to what described in the literature in the region (mean=5.05, SD=2.99 by Dellabianca *et al.* 2012, mean=5.3 by White *et al.* 2002). Group size observed ranged from 2 to 10 confirming what observed by Dellabianca *et al.* 2012 but below the value of 50 individuals reported by White et al.2002 (and well below the one hundreds individuals described by Kasamatsu *et al.* 1988 and Miyazaki & Kato 1988).

The **orcas** observed during this trip appear belonging to the type A, the form specialized to mainly prey on Antarctic Minke whales, at least in Antarctica. Four morphologically and ecologically distinct forms of orcas (A, B, C and D, **Figure 19**) occur in the Antarctic waters (Pitman & Ensor 2003; Pitman *et al.* 2007, 2011). Of these types A, B and D have been observed around South Georgia (Burton & Croxall 2012).

We did not see orcas in the waters around Falkland Islands. A small group shows high site fidelity in summer in the waters around Sea Lion, Falkland Islands where it has been studied for more than 20 years (Elephant Seals Research Group, 2017). These orcas are morphologically similar to type A, although they are known to prey on southern elephant seals weaned pups (*Mirounga leonina*). However, pinnipeds are not their main source of food and it is not clear what they feed on when they are not at Sea Lion (Casoli *et al.* 2014, Tognetti 2016). Some individuals have been seen following sei whales passing along the coast of the island but it is not known if they were hunting the whales. The hypothesis is that these orcas belong to a largest population with an offshore distribution and regularly visit the coastal area around the Falklands, in particular Sea Lion Island that is known to be a main breeding site of southern elephant seals in the Falklands (F. Galimberti, pers. comm., Elephant Seals Research Group 2017).

Figure 19 – The four types of orcas (*Orcinus orca*) recognized in the southern hemisphere. Credit to NOAA.

The species of delphinids observed during the trip are listed as 'Data Deficient' in the red list of the he International Union for Conservation of Nature[2] (IUCN) with the exception of hourglass dolphin that is listed as 'Least Concern'. The results from this survey, in combination with those we are obtaining within the Dolphins of the Kelp Project, are essential to assess species status not only on locally but also regionally and internationally.

1.3.2. Baleen whales

Six species of baleen whales (blue, fin, sei, humpback, Antarctic minke and southern right whales) can be defined as true Antarctic whales relying on Southern Ocean as habitats for breeding or feeding or both (Boyd 2009). All these whales are known to migrate from winter breeding grounds generally located at low latitudes to summer feeding grounds in the cold sub-Antarctic and Antarctic waters. The baleen whales winter distributions are in general poorly known. In their Antarctic feeding grounds,

[2] Species are classified by the IUCN Red List into the following groups: not evaluated (NE), data deficient (DD), least concern (LC), near threatened (NT), vulnerable (VU), Endangered (EN), critically endangered (CR), Extinct in the wild (EW), and extinct (EX).

baleen whales were heavily depleted during the commercial whaling from the beginning of the 20th century (Leaper and Miller 2011).

During this survey, four out of the six species of Antarctic baleen whales have been observed. The **sei whale** was the most encountered species in terms of both number of sightings (n_s=29) and individuals (n_i=57), followed by the **fin whale** (n_s=10 and n_i=34). The majority of the sightings were made between 49°W and 51°W of longitude and 52°S and 54°S of latitude, in correspondence of the PF (**Figure 11**).

In summer sei whales are known to mainly concentrate in the zone 40–50°S in the South Atlantic (Reilly *et al.* 2008b), at lower latitudes of those observed during our survey. The occurrence of sei whales at latitudes greater than 50°S was reported by White *et al.* (2000) in the FICZ and FOCZ from 1998 to 2000 where the species was the second most sighted baleen whale after the minke whales[3], and by Black (2005) in the SGSSI MPA and between the Falklands and South Georgia from 2002 to 2004. Fin whales were the most sighted species of baleen whales encountered by Black (2005) in oceanic waters during the period of surveys although considerable variation in the sighting numbers was observed.

In the South Atlantic, fin whales are mainly concentrated in the zone 40–60°S although the species is known to penetrate into the high Antarctic, along with blue, Antarctic minke and humpback whales (Reilly *et al.* 2008b). The area where we encountered the fin whales was therefore within their known range.

Several sightings of sei and fin whales were distributed from the PF to Shag Rocks (42˚-48˚W) (**Figure 15**) confirming what previously reported (Black 2005, Širović *et al*. 2006). Hedley *et al.* (2001) also reported few sightings of sei whales but none of fin whales (although in the paper several other baleen whales were reported in the area without species identification).

In the waters around Shag Rocks we made only one sighting of about four individuals of fin whales and four of orcas. The animals were observed within 1 km from the ship; it was not clear if orcas were hunting the whales although animals were moving fast and in different directions. We did not observe sei whales around Shag Rocks but both species are known to be present (Black 2005, Richardson *et al.* (2012). Sei and fin whales were reported in the proximity of Bird Island, north and east off South Georgia although in low numbers (Moore *et al.* 1999, Reid *et al.* 2000, Richardson *et al.* 2012). Rossi-Santos *et al.* (2007) reported only one sighting of fin

[3] Reported as *B. acutorostrata* in White et al.2002.

whale north of South Georgia but none of sei whale. During our survey sei and fin whales were not observed along the eastern side of South Georgia (**Figure 4**) where few sightings have been reported by Richardson *et al.* (2012).

Sei whale is listed as 'endangered' in the IUCN Red List (Reilly *et al.* 2008b) but information about this species is scarce. During commercial whaling over 125,000 individuals have been caught between 1950s and 1960s, and although total catch are smaller than those for others baleen whales, the species' range is known to have declined (Leaper and Miller, 2011). The high number of sei whales observed together with the knowledge than sei whales were present in large numbers in the Falklands waters during summer 2016-2017 (Weir 2017), are important information that will possibly contribute to a better understanding of the species status and distribution.

In the 20th century in the Antarctic waters, fin whales were the most heavily affected by the commercial whaling in term of number of individuals caught (718,000, Leaper and Miller, 2011), and, with an estimated population of less than 60,000 individuals (Branch & Butterworth 2001), are currently listed as 'endangered' in the IUCN Red List (Reilly *et al.* 2013a). Our results show a relatively high number of sightings and individuals in an area where Moore *et al.* (1999), 20 years ago, observed only few, providing interesting new information about a possible species recovery. In the last decade in fact, fin whales have shown an increment in numbers in the Western Antarctic Peninsula and the South Orkney Islands (Joiris & Dochy 2013, Santora *et al.* 2014, Herr *et al.* 2016, Viquerat and Herr 2017).

Humpback whale was the third most sighted baleen whale encountered during our survey and the only species sighted along the southeastern coast of South Georgia (**Figure 4**). During our survey, the humpback whales that have not been sighted along the coast of South Georgia were recorded in the 41˚-43˚W zone, confirming the distribution in the literature. Humpback whales are in fact abundant in the coastal Antarctic waters during summer (Reilly *et al.* 2008d) including the waters around South Georgia and Shag Rocks (Moore *et al.* 1999, Reid *et al.* 2000, Black 2005, Širović *et al.* 2006, Rossi-Santos *et al.* 2007, Richardson *et al.* 2012). Black (2005) suggested that humpback whales are possibly present throughout the whole year although in low numbers. Hedley *et al.* (2001) however, had a very low school density prediction for humpback whales in the waters around South Georgia. The predictive model used included the geographical coordinates that usually do not give relevant biological insights into the drivers of animal distribution (Cañadas and Hammond, 2006).

In the southern hemisphere seven major breeding stocks have been recognized by the International Whaling Commission (IWC) (stocks A to G, **Figure 20**). Although Antarctic summer feeding areas of each stock are not fully understood, data from photo-identification, genetic, tags, and satellite tracking suggest that the stock A feeds in the waters of South Georgia (Zerbini *et al.* 2006a and b, Zerbini *et al.* 2011). Stevick *et al.* (2006) reports that one individual photo-identified over the Brazilian stock (A) has been recaptured near Shag Rock. Currently, there is no information supporting movement between the Antarctic Peninsula and the east coast of South America (Stevick *et al.* 2004). Stock A is the second smallest population in the Southern Hemisphere with 6,500 individual estimated (after the stock G, with 4,000 individuals). Although, population size is still below the level before exploitation (25,000 individuals estimated in 1904), the stock A has recovered well (Reilly *et al.* 2008d). Humpback whale is therefore considered 'least concern' in the IUCN Red List (Reilly *et al.* 2008d) although some populations are still small (Leaper and Miller, 2011).

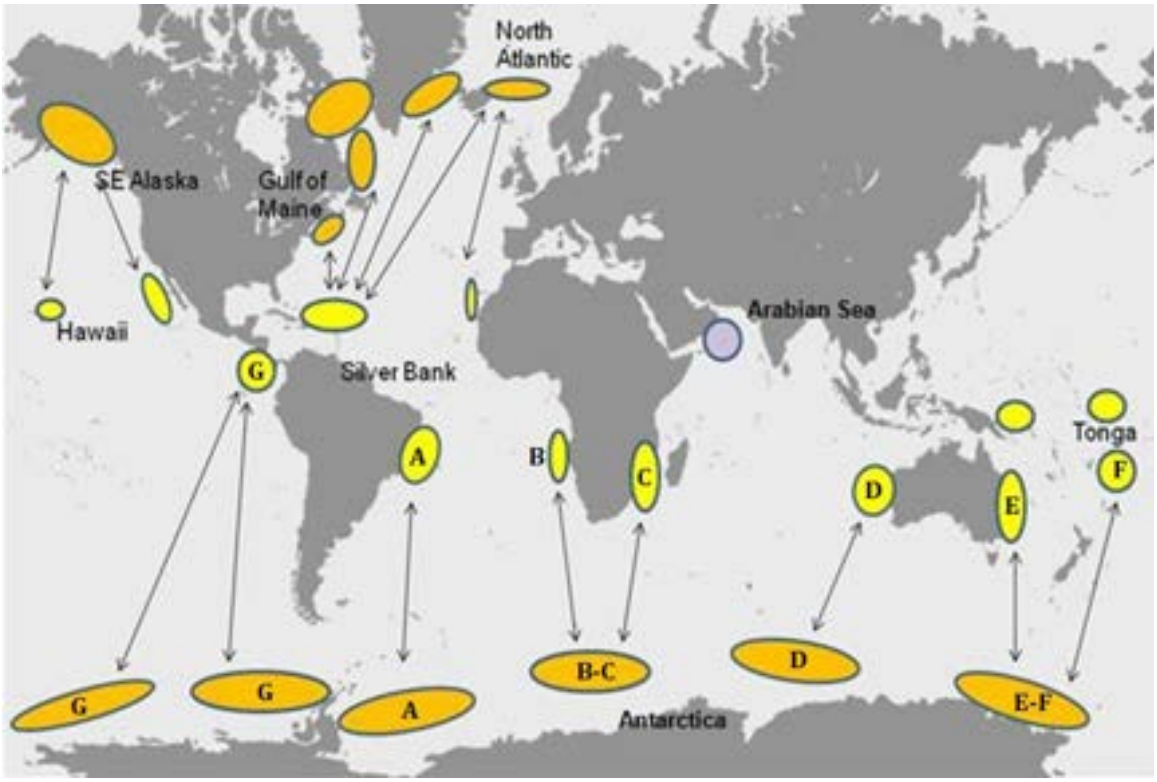

Figure 20 – Distribution of the 14 identified humpback whale winter breeding grounds (yellow polygons) and summer feeding ground (orange polygons); seven stocks (A-G) are populations that migrate during summer in the Antarctic waters (not shown in the figure). Figure modified by Humpback Whale Research Foundation (www.hwrf-uk.org/About-humpback-whales.html), downloaded on the 11th of October 2017 (http://www.hwrf-uk.org/About-humpback-whales.html).

Our data show little overlap between both sei and fin whales, and humpback whales over the 49°-51°W zone over the PF, although the three species were all encountered in the waters around Shag Rocks. In order to coexist and avoid inter-specific competition, sympatric baleen whales species must differ to some degree in their ecological requirements (Friedlaender *et al.* 2009). The life cycle, distribution, behaviour and abundance of the main prey in the Antarctic water, the Antarctic krill (*Euphausia superba*), and physical and bathymetric features (such as ice edge, slope) are known to strongly influence baleen whale distribution (Brierley *et al.* 2002, Friedlaender *et al.* 2009). For example Humpback whales associate with areas of increased prey abundance of small (<35 mm) juvenile krill and close to shore (Friedlaender *et al.* 2009), fin whales associate with large (>45 mm) mature krill located offshore, and minke whales associate with intermediate sized krill (35-44 mm) (Santora *et al.* 2010). The area where we sighted the highest concentration of sei and fin whales is known to be not particularly high in productivity (**Figure 1**, Murphy *et al.* 2013). However, adult and immature krill that migrate or are transported by currents are known to concentrate along fronts, including the PF, proving potential suitable habitats for fin whales (Atkinson *et al.* 2008). No studies have related the distribution of sei whales to prey in the Southern Ocean.

Only one **blue whale** was encountered (about 130 km west of Shag Rocks) during our survey that, compared to the relatively small effort, is good news. At the end of the 1990s Moore *et al.* 1999 reported that only one sighting of blue whale was made in 25 years of sailing in the waters among the Falkland Islands, South Georgia and the Antarctic Peninsula. Black (2005) reported a relative high number of blue whales sightings (8) in the summer of 2002/2003 and one sighting in summer 2003/2004. Blue whale are perhaps the species that most suffered from the commercial whaling in the southern hemisphere and today only 2,000 individuals, less than 1% of the assumed pre-exploitation level, are known to wandering the Antarctic waters (Branch *et al.* 2004). Recently, Branch (2007) estimated a circumpolar recovery rate of 8.2% (Leaper and Miller 2011). The Antarctic subspecies is considered 'critically endangered' in the IUCN Red List (Reilly et al. 2008c)

Antarctic minke whale and **southern right whales** where not encountered during our survey. The former is only present in the southern hemisphere, with a sporadic single record above the equator (Rice 1998). During summer months minke whales are abundant in all the Antarctic waters south of 60°S where they are known primarily feeding on Antarctic krill (Tamura and Konishi 2009). Winter distribution is less well known; based on data from whaling operation and subsequent recovery, Reilly *et al.* (2008a) suggest at least a partial migration to the Antarctic of a

population located in Brazil during winter season. Antarctic minke whale is the most commonly sighted baleen species within the FICZ-FOCZ (White *et al.* 2002), and it is also been reported off South Georgia (Moore *et al.* 1999, Reid 2000, Hedley *et al.* 2001, Black 2005, Richardson *et al.* 2012). Commercial whaling for the species began in the 1970s and although reduced, pelagic catching has continued under scientific permit. Population size estimates are not accepted within the IWC and Antarctic minke whale is currently considered 'data deficient' in the IUCN Red List (Reilly *et al.* 2008a, Leaper and Miller, 2011)

Southern right whale is present in the Southern Hemisphere with circumpolar distribution. The winter breeding population is concentrated near coastlines in the northern part of the range. Atlantic coast of South America (Argentina and Brazil) is one of the main breeding areas at present, together with southern Australia, New Zealand and South Africa (Reilly *et al.* 2013b). In summer months southern right whales are typically found between 40-50°S (Ohsumi and Kasamatsu 1986); however sightings have been recorded as far as 65°S in more recent years (IWC 2007, Bannister *et al.* 1999) and around South Georgia (Rowntree *et al.*2001). South Georgia is considered indeed an important feeding ground for the species and several individuals breeding off the Argentinian coast are known to visit the area during austral summer (Best *et al*. 1993, Rowntree *et al*. 2001). . Diet appears to consist mainly of copepods north of 40°S, and switches to euphausiids when south of 50°S (Tormosov *et al.* 1998). The species is among the commonest baleen whales observed around South Georgia (Moore *et al.* 1999, Reid *et al.* 2000, Black 2005).

Southern right whale is currently considered 'least concern' in the IUCN Red List after a strong recovery in areas such Argentina/Brazil, South Africa, and Australia (Best 1990, Payne *et al*. 1990, Reilly *et al.* 2013b, Leaper and Miller, 2011).

Tens of individuals were observed for the first time near shore the Falkland Islands this winter (May-August 2017); groups of 4-8 individuals were spotted socializing very close (4 m of depth) to the coast along the sandy beaches of Port William and Cape Dolphin suggesting mating behavior and the possible presence of a calf have been observed near Saunders. Whales gradually disappeared at the end of August (M. Costa Pers. Comm.).

During our survey, no baleen whales were observed in the waters near the Falkland Island although all species appear to have returned after years of absence (White *et al.* 2002, Otley 2012, Fran and Augé 2016).

2. PARTNERSHIP AND NETWORKING

The expedition was a great opportunity to further develop the cooperative relationship between SAERI cetacean team, the GSGSSI officer, and the UK Royal Navy.

The UK Royal Navy has been running the UK Royal Navy Marine Mammal Observations program since 1947. The purpose is collecting incidental sightings of cetaceans in remote areas to contribute to a better scientific understanding of cetacean status, including distributions, breeding areas, and migration routes. This data are deposited to the UK Hydrographic Office and made public available (http://seamap.env.duke.edu/search/?dataset_id=64) on the OBIS SEAMAP platform (http://seamap.env.duke.edu/) an online Ocean Biogeographic Information System that provided spatial data of large vertebrates including marine mammal, seabird, sea turtle, rays and sharks.

During the survey the SAERI cetacean team could appreciate the enthusiasm, competence, and dedication that the Navy officers were putting in cetacean observation, together with their military tasks. Several sightings were reported by the Navy observer, in particular during break time for the observers.

Two lectures were provided by the SAERI cetacean team to the *HMS Enterprise* crew. The first focused on physiological adaptations of cetaceans compared to other marine and terrestrial mammals and was delivered by the Project Manager, Dr. Marina Costa, on the 25th of January. The second focused on the Dolphins of the Kelp Project, founded by the Darwin Initiative and aimed to establish baseline data on the abundance, distribution, natural history and genetic diversity of Commerson's and Peale's dolphins of the Falkland Island, and delivered by the Project Officer, Dr. Maria Isabel Garcia Rojas on the 27th of January.

SAERI cetacean team had the opportunity to participate on the onboard naval training including: sea survival, firefighting and evacuation, as well as South Georgia Biodiversity and Biosecurity standards and protocols. The SAERI team attended a presentation about the *HMS Enterprise* eighteen months rescuing mission of the immigrants attempting the cross of the Mediterranean Sea from Libya. Commodore Darren Bone RN, Commander of the British Forces of the Falkland Islands/South Atlantic Islands (2015), delivered a presentation about the rescue operations of the passengers and crew of the cruise ship 'Le Boreal' that suffered a major engine room fire on the 18th of November 2015 near Cape Dolphin, East Falkland. In South

Georgia, Simon Browning, Government Officer of SGSSIG delivered a biosecurity and health and safety briefing to the SAERI cetacean team and the crew.

This collaboration was very valuable from many angles including:

- proving It provided the opportunity to collect invaluable data about cetacean presence, abundance and distribution;
- extending the community outreach capacity of the project;
- improving the skills of both SAERI cetacean team and crew;
- enhancing sharing data collection methodology;
- highlighting the importance of sharing data on public platform;
- underlining the importance of platforms of opportunity for the advancement of our knowledge on species distribution and occurrence patterns throughout all oceans.

CONCLUSIONS AND RECOMMENDATIONS

Cetacean surveys are seldom carried out in these cold, harsh and remote regions due to the extremely high costs and difficult logistic associated. However, the need for knowledge about the cetacean community in these areas is essential to understand the status of conservation of those populations, in particular baleen whales, that were heavily affected by the extirpation of thousands of animals during the whaling era, and in view of emerging environmental threats such as of loss of winter sea-ice and rising water temperatures, and potential anthropogenic pressure caused by the krill fishery.

Platforms of opportunity, like the *HMS Enterprise*, demonstrate how collaborations between different institutions enables increased data collection which can provide and enhance evidence-based development of national, regional and international policy and legislation tools directed to species conservation management systems as required.

We therefore recommend extending the use of platforms of opportunity regularly moving between the Falkland Islands and South Georgia (including tourist ships) to monitor cetacean populations, and continue building baseline data from which decisions can be made. The SAERI cetacean team could develop a program for training observers to continue to collect important data to mitigate anthropogenic impact, yet sustain the local economies.

ACKOWLEDGEMENTS

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APPENDIX

1. Features used for baleen whales identification.

	Size (m)	Blow	Dorsal Fin	Colour	Head/Jaw	Fluke
Blue Whale	20 – 34 m	Tall, powerful, and upright (6 -12 m height). Lingers in the air for a few seconds. 	Miniature and stubby. Set well back. 	Pale greyish mottled. 	Huge head, broad and flattened. Both sides of the mouth uniformly blue-grey. 	Large fluke (up to 1/4 of body length). Concave or atright trailing edges.
Fin Whale	18 – 26 m	Tall, narrow, upright (3-4m height). 	Relatively small compared to the body size. Sits low and slopes backwards. Pointed tip. 	Dark grey / brownish black. Grey chevron behind head. 	Head more pointed than blue whale. Lower jaw colour creamy white on right-side, dark on the left. 	Broad and triangular. Slightly Concave trailing edges. White underside.
Sei Whale	12 – 16 m	Narrow and cloudy. Wider than taller (3m height). 	Tall and erect. Smooth trailing edge. Sits forward on the body. 	Bluish grey, dark grey or black. May appear brown at times. 	V-shaped, slim & streamlined. 	Small in relation to body. Triangular shape.
Humpback Whale	12 – 16 m	Wide and bushy Narrow and cloudy. Wider than taller (2-3m height). 	Distinctive hump in front of the dorsal fin. Low and stubby. 	Blue-black, black or dark. 	Knobs on top of the head. Slender in profile. Jaw rounded near tip. Scars and Barnacles present un the underside.	Dark upper sides with black and white patches on the underside. S-shape irregular trailing edges.

2. Surfacing behavior used for baleen whales identification.

	Overall distinctive features	Surfacing behaviour
Blue Whale	- After the blowhole is no longer visible, the back of the animal is sighted alone for a few seconds before the dorsal fin is visible. - Appears blue underwater thus the name blue whale. - Pale grey or white mottling coloration. - Huge splashguard.	The whale rises at a shallow angle. The tall blow rises and the large splashguard is visible. The head disappears and the long back rolls into view for a few seconds before the small dorsal fin appears. The whale may arch its tail stock before diving or may disappear sinking below the surface. When the fluke is shown (rarely) it slips under water at a shallow angle.
Fin Whale	- Large animal with a tall and thin upright blow. - Small backwards dorsal fin is seen usually in a different frame than the blowhole. - Tail stock usually visible after dorsal fin during a surfacing event.	The top of the flat head emerges first. The whale blows (tall column) while its back stays low in the water, then the long dark back comes into view followed by the dorsal fin and soon after by the anterior of the tail stock. The tail stock arches as the whale dives but the fluke is rarely seen.
Sei Whale	- Both bush blow/blowhole and tall erect dorsal fin are usually seen in the same frame as the whale surfaces. - Head may rise steeply when surfacing so that the tip of the jaw is observed breaking through the water.	The head rise as a shallow angle, then the narrow blow appears. The blowhole and the dorsal fin are visible simultaneously and remain visible for some time. Before dropping under water their back rises a little as the whale drops beneath the surface without arching their tail stock or fluking up.
Humpback Whale	- Pronounced hump before the dorsal fin. - Flukes up when dives.	Blow & fin just visible simultaneously. Arches body and tail stock as it dives. Regularly fluke up dives.

3. Cetaceans encountered during the survey.

Baleen whales

1a - Humpback Whale.

1b - Humpback Whale.

2a - Blue Whale.

2b - Blue Whale.

3a - Sei Whale.

3b - Sei Whale.

4a - Fin Whale.

4b - Fin Whale.

Delphinids

5a - Orca (possibly type 'A').

5b - Orca.

6a - Hourglass Dolphin.

6b - Hourglass Dolphin.

7a - Peale's Dolphin.

7b - Peale's Dolphin.

8a - Commerson's Dolphin.

8b - Commerson's Dolphin.

4. Sea Birds encountered during the survey

Penguins

1 - Gentoo Penguin.

2 - Chinstrap Penguin.

3 - Macaroni Penguin.

4 - King Penguin.

Albatrosses

5a - Wandering Albatross.

5b - Wandering Albatross.

6 - Black-browed Albatross.

7 - Grey-headed Albatross.

8a - Light-mantled Albatross.

8b - Light-mantled Albatross.

Giant petrels

9a - Southern Giant Petrel - white morph.

9b - Southern Giant Petrel - white morph.

10a - Southern Giant Petrel.

10b - Northern Giant Petrel.

Others

11a - Cape Petrel.

11b - Cape Petrel.

12 - Soft-plumaged Petrel (possible).

13 - White-chinned Petrel.

14a - Antarctic Prion (possible).

14b - Antarctic Prion (possible).

15 - South Georgia Pintail.

16 - Snowy Sheathbill.

17a - Brown Skua.

17b - Brown Skua.

18 - Wilson's Storm-petrel.

19 - Antarctic Tern.

20 - Imperial Shag.

21 - Kelp Gull.