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# Presence of Southern right whales on the Patagonian Shelf off Argentina during summer from opportunistic sightings

Reyes Reyes, M. Vanesa<sup>1,2,\*</sup>, Hevia, Marta<sup>1,2</sup>, Marino, Alexander<sup>1</sup>, Iñíguez Bessega, Miguel A.<sup>1</sup>

<sup>1</sup> Fundación Cethus, Monteverde 3695, (B1636AEM), Olivos, Argentina

<sup>2</sup> Whale and Dolphin Conservation, Brookfield House 38 St. Paul Street, Chippenham, Wiltshire. SN15 1LJ. UK.

\*Contact e-mail: [vanesa.reyes@cethus.org](mailto:vanesa.reyes@cethus.org)

## ABSTRACT

Península Valdés (PV) is one of the two calving and nursing grounds of southern right whales in the Southwest Atlantic Ocean (SWAO), where the highest concentration of individuals in the SWAO is found. Little information is available about the precise locations of the main feeding grounds and migratory routes for this whale population. Mean encounter rates (ER) calculated from ship-based visual observations from platforms of opportunity during austral summer months are reported along with telemetry satellite information from whales tagged in PV. The highest ER was estimated for the northern area of the Patagonian Shelf (PS) in January, being one order of magnitude higher than those estimated for February and December in PS and the shelf break. Overall, ERs in the PS below 46°S had significantly lower ERs than between 42°-46°S, which is in concordance with lower records from satellite data south of 46°S. Both visual and telemetry satellite data showed low presence of the species in the shelf break during summer months. Satellite telemetry data suggests a feeding ground in the PS between 43° and 47°S and the 100m and the 200m isobaths, which is supported by opportunistic visual observations from ship-based surveys. Dedicated efforts of research within the PS should be increased in order to assess habitat use of SRWs and estimate availability and seasonality of food, and exposure to biotoxins, pollution and infectious agents along the migratory and feeding grounds of the population of SRWs breeding in PV.

**KEYWORDS:** SOUTHERN RIGHT WHALES; FEEDING GROUNDS; SOUTHWEST ATLANTIC OCEAN; SURVEY – VESSEL

## INTRODUCTION

Two winter calving and nursing grounds of southern right whales (SRWs), *Eubalaena australis* (Desmoulins, 1822), have been identified in the Southwest Atlantic Ocean (SWAO): one in Argentina around Península Valdés (PV) (42°S), and one in Brazil between 8°S and 32°S (IWC, 2001). Although whaling activities almost depleted SRWs to near extinction by the end of 1800s (IWC, 2001; 2013), the species is currently protected and PV hosts the highest concentration of individuals in the SWAO with an estimated mean total population of  $4,245 \pm 245$  and an average annual growth rate of  $6.2 \pm 0.3\%$  estimated for the period 2000-2010 in that area (Cooke, 2013; IWC, 2013). However, during the last decade SRWs have experienced high mortality rates of their calves at PV (Rowntree *et al.*, 2013), with significant variation among years (Sironi *et al.*, 2016). There is concern that the high calf mortality could slow population growth rates and affect recovery of the species (Marón *et al.*, 2015). Several hypotheses have been proposed as causes of death, some of them related to poor nutritional state of the mothers due to decreased availability of food, and exposure of biotoxins in feeding and calving grounds (IWC 2011, 2016).

Little information is available about the precise locations of the main feeding grounds and migratory routes for this whale population. There is an urgency to identify such areas and routes and increase knowledge on resources availability and habitat pollution (i.e. harmful algal blooms, infectious agents). The Patagonian Shelf (PS) has been indicated as a probable feeding ground for the species in the SWAO based on historical catch records (Townsend, 1935; Tormosov *et al.*, 1998), stable isotope analysis

(Valenzuela *et al.*, 2009) and satellite telemetry tracking (Zerbini *et al.*, 2015; 2016). Last year Reyes Reyes *et al.* (2016) presented data on the presence of SRW in the PS of Argentina during summer 2016, collected from line transect visual surveys from platforms of opportunity. Most of the sightings were made on the PS, southeast of PV. The Committee recommended future surveys in the area and reporting of the results in conjunction with satellite imagery (IWC, 2017).

This paper aims to update information on new sightings of SRW in the Patagonian Shelf and relate them to available satellite telemetry information of SRW tagged in PV.

## MATERIALS AND METHODS

Line-transect visual observations were made by dedicated observers on the Argentinean Shelf (including the Patagonian Shelf) and shelf break during four surveys from two Argentinean Coast Guard's vessels used as platforms of opportunity: *SB-15 Tango*, *GC-24 Mantilla*, and *GC-189 Prefecto García*. Two surveys were made from Buenos Aires port (34°35.95'S, 58°22.28'W) to Ushuaia port (54°48.52'S, 68°18.17'W), Argentina, one from 16 to 23 January 2016 and the other from 22 to 30 December 2016; while the other two surveys were conducted from Ushuaia to Buenos Aires, one between 8 and 13 February 2016 and the other from 11 to 19 February 2016 (Fig. 1).

Observations were conducted from the bridge when the ship was underway during daylight hours using 7x50 reticuled Fujinon binoculars and the unaided eye. Data were collected by two experienced observers on species identity, group size, GPS position, vessel speed and heading, and number of reticles and animal bearing from the ship for all sightings. Each observer covered one side of the vessel's trackline forward of the beam (90° quadrant).

On-effort transects surveyed during a day were divided into equal segments of 10 nm whenever possible to reduce intra-variability. Analysis was circumscribed within an area from 42° to 48°S, since no SRWs were observed outside that area. Mean encounter rates (ER) (number of sighted individuals per nautical mile surveyed) of SRWs were calculated, considering only data obtained during search effort. For the ER calculations this area was further divided into two zonal bands to reduce variability: 1) 42°-46°S, and 2) 46°-48°S. We also considered separately shelf waters (between the 100m and 200m isobaths) from waters over the break shelf (between the 200m and 1,000m isobaths). Kruskal Wallis and multiple comparisons were used to test for significant differences in ER.

Satellite telemetry data was obtained from Zerbini *et al.* (2015, 2016).

## RESULTS AND DISCUSSION

A total of 34 groups of SRW were observed in the PS, totalizing 58 individuals (48 in January, 4 in February and 6 in December) and 4 groups in the shelf break, totalizing 5 individuals (1 in February and 4 in December) up to a depth of 970m. Whale sightings occurred within an area circumscribed to 42° 22.530'S, 58° 15.356'W in the north and 47° 45.188'S, 61° 9.655'W in the south (Fig.1, Table I). Group size ranged from 1 to 5 individuals ( $\bar{x}$ =2, SD=1), including two pairs mother/calf.

Significant differences were found among the ERs of the PS and shelf break, and among different months ( $H=14.08$ ,  $p<0.0001$ ). The highest ER was estimated for the northern area of the PS in January, being one order of magnitude higher than those estimated for February and December. Overall, ERs in the PS below 46°S had significantly lower ERs than between 42°-46°S, which is in concordance with lower records from satellite data south of 46°S. However, these differences are explained by the ER estimated for January.

Satellite telemetry data shows that SRW tagged in PV concentrated within the Patagonian shelf between 43°S and 47°S during the austral summer months (Fig. 1). The higher amount of records in December might be related to the fact that the animals were tagged in September/October and the average tag duration was 90 days (Zerbini *et al.*, 2016).

The estimated mean ER for the shelf break in February and December are not significantly different, but they are significantly lower than that from January in the northern area of the Patagonian Shelf. These findings are consistent with the low presence of satellite data in the shelf break during summer months.

This study was intended to increase our understanding on summer feeding ground locations in the SWAO, as well as the migratory routes that connect them to the calving and nursing grounds, in order to further assess possible causes of high calf mortality in PV. Satellite telemetry data indicates a feeding

ground in the Patagonian Shelf between 43° and 47°S and the 100m and the 200m isobaths, which is supported by opportunistic visual observations from ship-based surveys presented in this paper.

The presence of SRWs in the Patagonian Shelf has been recorded also during austral fall from telemetry satellite data (Fig. 1). Dedicated efforts of research within the Patagonian Shelf should be made covering a wider area than already surveyed opportunistically including during different months of the year. Future research may include collecting behavioral data from SRWs in the area, as well as zooplankton tows and water samples in order to estimate availability and seasonality of nutritional resources in feeding grounds, and exposure to biotoxins, pollution and infectious agents along the migratory and feeding habitats of the population of SRWs breeding in PV.

Table II: Mean encounter rates (ER)  $\pm$  standard deviation (SD) for the four opportunistic surveys conducted in 2016 along the Patagonian Shelf and shelf break.

|           | Patagonian Shelf |                 |                 |                   | Shelf break     |                 |                   |
|-----------|------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-------------------|
|           | January          | February        | December        | Total effort (nm) | February        | December        | Total effort (nm) |
| 42°-46° S | $0.47 \pm 0.58$  | $0.02 \pm 0.09$ | $0.08 \pm 0.15$ | 283               | $0.04 \pm 0.06$ | $0.03 \pm 0.05$ | 285               |
| 46°-48° S | 0                | $0.01 \pm 0.03$ | $0.06 \pm 0.14$ | 404               | ----            | ----            | 0                 |

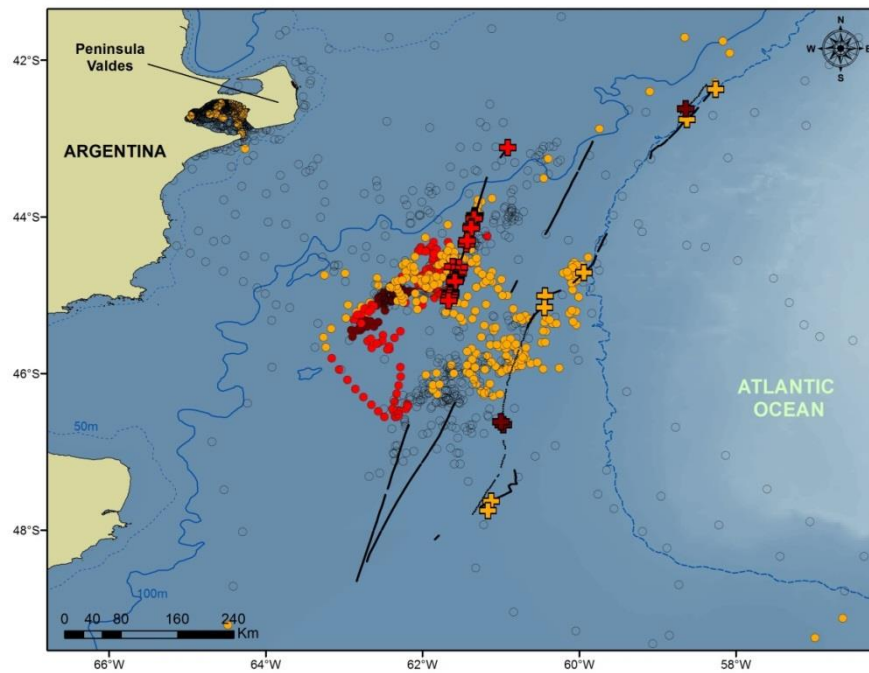


Figure 1: On effort survey tracks (black lines) and distribution of sightings (crosses) observed during Southern right whales off Argentina. For comparison satellite tag locations of whales tagged in PV in 2015 and 2016 (Zerbini *et al.* 2015, 2016) are plotted (circles). Color represents months as follows: orange = December, bright red = January and brown = February. Hollow circles correspond to tag locations from other months.

Table I: Sightings of southern right whales, *Eubalaena australis*, in waters above the Patagonian Shelf (PS) and shelf break (SB) collected during four opportunistic ship surveys. Groups of mother/calf are indicated as M/C.

| Date        | Latitude     | Longitude    | Group size | Area |
|-------------|--------------|--------------|------------|------|
| 19/JAN/2016 | 42° 07.141'S | 60° 54.567'W | 2          | PS   |
| 19/JAN/2016 | 44° 20.876'S | 61° 26.200'W | 2          | PS   |
| 19/JAN/2016 | 44° 21.043'S | 61° 26.242'W | 1          | PS   |
| 19/JAN/2016 | 44° 38.340'S | 61° 36.800'W | 1          | PS   |
| 19/JAN/2016 | 44° 38.886'S | 61° 31.654'W | 5          | PS   |
| 19/JAN/2016 | 44° 43.374'S | 61° 32.696'W | 2          | PS   |
| 19/JAN/2016 | 44° 46.740'S | 61° 34.051'W | 3          | PS   |
| 19/JAN/2016 | 44° 48.173'S | 61° 34.624'W | 2          | PS   |
| 19/JAN/2016 | 44° 49.101'S | 61° 34.999'W | 2          | PS   |
| 19/JAN/2016 | 44° 49.609'S | 61° 35.208'W | 2          | PS   |
| 19/JAN/2016 | 44° 58.482'S | 61° 38.128'W | 3          | PS   |
| 19/JAN/2016 | 43° 59.475'S | 61° 19.691'W | 2          | PS   |
| 19/JAN/2016 | 44° 59.327'S | 61° 38.416'W | 4          | PS   |
| 19/JAN/2016 | 44° 59.911'S | 61° 38.616'W | 2          | PS   |
| 19/JAN/2016 | 45° 00.200'S | 61° 38.720'W | 1          | PS   |
| 19/JAN/2016 | 45° 02.132'S | 61° 39.272'W | 1          | PS   |
| 19/JAN/2016 | 45° 04.523'S | 61° 39.997'W | 1          | PS   |
| 19/JAN/2016 | 44° 00.180'S | 61° 19.910'W | 3          | PS   |
| 19/JAN/2016 | 44° 00.420'S | 61° 19.980'W | 3          | PS   |
| 19/JAN/2016 | 44° 01.690'S | 61° 20.360'W | 1          | PS   |
| 19/JAN/2016 | 44° 01.690'S | 61° 20.360'W | 2          | PS   |
| 19/JAN/2016 | 44° 07.532'S | 61° 22.140'W | 1          | PS   |
| 19/JAN/2016 | 44° 08.870'S | 61° 22.550'W | 1          | PS   |
| 19/JAN/2016 | 44° 18.370'S | 61° 25.520'W | 1          | PS   |
| 16/FEB/2016 | 46° 39.460'S | 60° 58.027'W | 3          | PS   |
| 16/FEB/2016 | 46° 37.072'S | 60° 59.668'W | 1          | PS   |
| 17/FEB/2016 | 42° 37.624'S | 58° 38.253'W | 1          | SB   |
| 25/DEC/2016 | 42° 22.530'S | 58° 15.356'W | 1          | SB   |
| 25/DEC/2016 | 42° 45.692'S | 58° 37.473'W | 1          | SB   |
| 26/DEC/2016 | 44° 42.864'S | 59° 56.243'W | 2 (M/C)    | SB   |
| 26/DEC/2016 | 45° 00.860'S | 60° 26.077'W | 2 (M/C)    | PS   |
| 26/DEC/2016 | 45° 09.629'S | 60° 26.496'W | 1          | PS   |
| 27/DEC/2016 | 47° 37.966'S | 61° 07.250'W | 1          | PS   |
| 27/DEC/2016 | 47° 45.188'S | 61° 09.655'W | 2          | PS   |

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