Polar Biology
https://doi.org/10.1007/s00300-018-2315-4

SHORT NOTE

Occurrence of dusky dolphin *lagenorhynchus obscurus* in Tierra Del Fuego archipelago over five decades

Natalia A. Dellabianca[1,2] · Mónica A. Torres[1,2] · Andrea Raya Rey[1,3]

Received: 21 April 2017 / Revised: 12 March 2018 / Accepted: 16 March 2018

Abstract

Dusky dolphins *Lagenorhynchus obscurus* are distributed in circumpolar temperate and cold temperate waters of the Southern hemisphere. In Tierra del Fuego, their presence had been considered occasional but in the last decade, they became very common along the Beagle Channel. Here, we evaluate the occurrence of dusky dolphins in Tierra del Fuego along 44 years. We also discuss the relationship of this population with their distribution in southern South America. We used three different datasets: sightings hosted in the Ocean Biogeographic Information System OBIS, incidental sightings, and shipboard sighting surveys. A total of 44 sightings of dusky dolphins in Tierra del Fuego were obtained from the three datasets from 1972 to 2016. Most individuals were recorded in the southern area of the Fuegian Archipelago. Between the 1970s and 90s their occurrence in the Beagle Channel was infrequent up to the year 2000. From 2009 to date, they were recorded each year in the Argentinean Beagle Channel waters during austral summer and fall months, suggesting at least, a seasonal resident population. Our results preclude assessing if the observed groups of dolphins in the southern portion of South America came originally from the Atlantic or Pacific Oceans populations. Molecular and spatial ecology studies (e.g., using satellite tags) could help to better understand which lineage they belong to and their spatio-temporal movements in the area.

Keywords *Lagenorhynchus obscurus* · Distribution · Beagle Channel · Southern South America

Introduction

The archipelago of Tierra del Fuego is formed by a group of islands of different sizes, fjords, and inner channels. The largest island, the Isla Grande of Tierra del Fuego, is shared by Argentina and Chile and is delimited by the Strait of Magellan to the north and the Beagle Channel to the south. Both natural boundaries link the Pacific and Atlantic Oceans. Acha et al. (2004) reported the presence of two frontal zones in this region: the Patagonian cold estuarine zone, which extends from Chiloe Island (42°S) in the Pacific ocean to the south of San Jorge Gulf (46° 30′S) in the Atlantic coast, and the Patagonian tidal frontal zone which extends along the Argentine coastline from northern Peninsula Valdés (42°) to Staten Island (55°S). As same authors emphasize, frontal zones have a key role in ecological processes and are characterized by enhanced primary production, offering both suitable habitats for nektonic species and foraging areas for top predators. Indeed, 30 species of cetaceans have been reported through sightings, catches, and stranding records in this region (Aguayo-Lobo et al. 1998; Goodall et al. 2008). The dusky dolphin *Lagenorhynchus obscurus* is one of the smallest dolphins occurring in the subantarctic waters of Tierra del Fuego. This species is distributed in the circumpolar temperate and cold temperate waters of the Southern hemisphere. In South America, they are found from Cape Horn to north-central Peru in the Pacific and from Cape Horn to 36°S in the Atlantic, including the waters off the Malvinas (Falkland) Islands (Van Waerebeek 1992; Van Waerebeek and Würsig 2009). However, it had

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00300-018-2315-4) contains supplementary material, which is available to authorized users.

✉ Natalia A. Dellabianca
ndellabianc@gmail.com

[1] Laboratorio de Ecología y Conservación de Vida Silvestre CADIC-CONICET, Houssay 200, V9410BFD Ushuaia, Tierra del Fuego, Argentina

[2] Museo Acatushún de Aves y Mamíferos Marinos Australes, Ea. Harberton, Tierra del Fuego, Argentina

[3] Instituto de Ciencias Polares, Ambiente y Recursos Naturales, Universidad Nacional de Tierra del Fuego, Ushuaia, Tierra del Fuego, Argentina

Published online: 27 March 2018

been suggested that dusky dolphins are more abundant in the northern range of their distribution off both coasts (Van Waerebeek 1992), being one of most common small cetaceans on the north and central Patagonian shelf (Würsig and Würsig 1980; Crespo et al. 1997; Schiavini et al. 1999) and one of most abundant in the coastal waters of Peru (Van Waerebeek and Würsig 2009). Historically, the presence of dusky dolphins had been considered occasional in Tierra del Fuego. Van Waerebeek (1992) reported only four confirmed sightings in waters of the Magellan Strait and western part of Tierra del Fuego and mentioned one at 150 km east of the Atlantic coast of Tierra del Fuego. In over 20 years of research in the area, RNP Goodall sighted this species for the first time in 1996 in Nassau bay near Cape Horn (Goodall et al. 1997). Later, Gibbons et al. (2002) also suggested that its occurrence is rare for the region since dusky dolphins had only been recorded twice during seven surveys carried out in the Fuegian channels between December 1999 and February 2001. However, in the last decades, dusky dolphins have become very common in the Argentinean Beagle Channel waters where they co-occur with their congener the Peale's dolphin *Lagenorhynchus australis.* The main objective of our study is to evaluate the occurrence of dusky dolphins in Tierra del Fuego over 44 years, updating the information reported by Goodall et al. (1997). Additionally, we report the relationship of this population with their distribution in southern South America and discuss a possible eastern displacement of Peale's dolphin by the presence of dusky dolphins in Beagle Channel waters.

Materials and methods

We used three different datasets: sightings hosted in the Ocean Biogeographic Information System (OBIS), incidental sightings from the R. Natalie P. Goodall program (RNPG), and shipboard sighting surveys conducted by the laboratory of Wildlife Ecology and Conservation (LECOVIS) from the Austral Center for Scientific Research of the National Council for Scientific and Technological Research (CADIC-CONICET). From the OBIS and RNPG databases we only used reliable sightings: those records supported by verifiable evidence such as photographs, videos, or specimens (confirmed records) and those considered as likely reliable which were reported by experienced observers (unsupported records). Confirmed and unsupported records from OBIS and RNPG are shown in Online Resource 1 and 2 for dusky dolphin and Peale's dolphin, respectively. For dusky dolphins we used all reliable sighting records from South America available in each database, whereas for Peale's dolphins we only used the reliable records from waters around Tierra del Fuego archipelago (52.5°S to 56.5°S and 63°W to 73°W).

OBIS database

We used the OBIS (Halpin et al. 2009, http://seamap.env.duke.edu/) open source database, which is known to host a vast majority of marine mammals-related data points. This type of data reflects the public information available for a given region, and it is widely used for modeling or studying distribution worldwide (Tittensor et al. 2010; Best et al. 2012). We only used sightings data from reliable sources (University of Magallanes, Patagonian National Center, among others). In addition, we used those records published in Goodall et al. (1997) and hosted in OBIS which were substantiated by the references or considered as likely reliable by the expertise of observers. Sightings data range from 1972 to 2003 and from 1972 to 1994 for dusky dolphin and Peale's dolphin, respectively. Despite that many records come from dedicated surveys, no effort data were available for this dataset.

Incidental sightings from the RNPG program

The RNPG program was initiated by Dr. Natalie Goodall in the 1970s to study marine mammals in Tierra del Fuego, Argentina. Through this program, incidental sighting reports were collected from crews and captains of research vessels and tourist ships as well as from local residents and scientists traveling in the area (see Goodall et al. 1997 for more details). As mentioned before, we only used reliable RNPG sighting data which were supported by photos/videos or reported by experienced observers. For dusky dolphin we used unpublished records from 1999 to 2009 while for Peale's dolphin we used unpublished data (1997–2006) as well as those published for the first time in Goodall et al. (1997), which were not also hosted in OBIS (1975–1997).

Sightings of dedicated shipboard surveys

Since 2009 dedicated sighting surveys have been conducted by members of LECOVIS along the eastern coast of Tierra del Fuego and the Argentine sector of the Beagle Channel as part of a long-term monitoring program to evaluate climate effects on the community of marine mammals in Subantarctic and Antarctic waters. Occurrence data were collected using the methodology described in Dellabianca et al. (2016). Different vessels including research (*Puerto Deseado*), coast guard *(Tango SB-15* and *Prefecto Garcia*), and pilot vessels (*Nativa and Fueguina*) were used as observation platforms during 16 surveys. We used data obtained from 2009 to 2016 for both species.

In order to investigate temporal occurrence of dusky dolphins in Tierra del Fuego and the possible eastern

displacement of Peale's dolphin along the same timelines, sightings in each database were separated by decades and then the different datasets were pooled for the same periods. Finally, all records were incorporated into a geographic information system (GIS) using Quantum GIS (QGIS, http://www.qgis.org/) to visualize and describe them spatially.

Results

Dusky dolphin in Tierra del Fuego

A total of 44 dusky dolphin sightings in Tierra del Fuego were obtained from the three datasets spanning from 1972 to 2016 (OBIS = 8, RNPG = 13, and LECOVIS = 23). Most of the sightings were recorded in the southern area of the Fuegian Archipelago shown in Fig. 1. Between the early 70s and the late 90s only 11 reliable records of the species were reported in the area. Its occurrence in the Beagle Channel was infrequent, being also sighted in the Atlantic coast, the Chilean channels, and the Cape Horn Archipelago and adjacent waters (Figs. 2a–c). However, after 2002 they were usually observed in the Argentinean waters of the Beagle Channel (Fig. 2d). In addition, from 2009 to date, they were recorded each year in that zone during the austral summer and fall months (Fig. 2e).

Dusky dolphin of Tierra del Fuego and their relation with other populations of South America

In Fig. 1 we summarized the 91 reliable sightings of dusky dolphins in South America (including the 44 records for Tierra del Fuego mentioned above) obtained from the three datasets (OBIS = 49, RNPG = 13, and LECOVIS = 29). Sightings in the South Pacific were mainly coastal, with most records concentrated in the southern range of distribution. On the Atlantic coast, dolphins were observed both close to and far from the shore and relatively continuous from ~ 36°S to south of the San Jorge Gulf (~ 48°S). However, a few offshore sightings (near the Malvinas/Falkland Islands) were observed between ~ 48 and 53°S and only three in Tierra del Fuego.

Co-occurrence of dusky dolphin and Peale's dolphin in the Beagle Channel waters

A total of 231 Peale's dolphin sightings in Tierra del Fuego were obtained from the three datasets between 1972 and 2016 (OBIS = 34, RNPG = 132, and LECOVIS = 65).

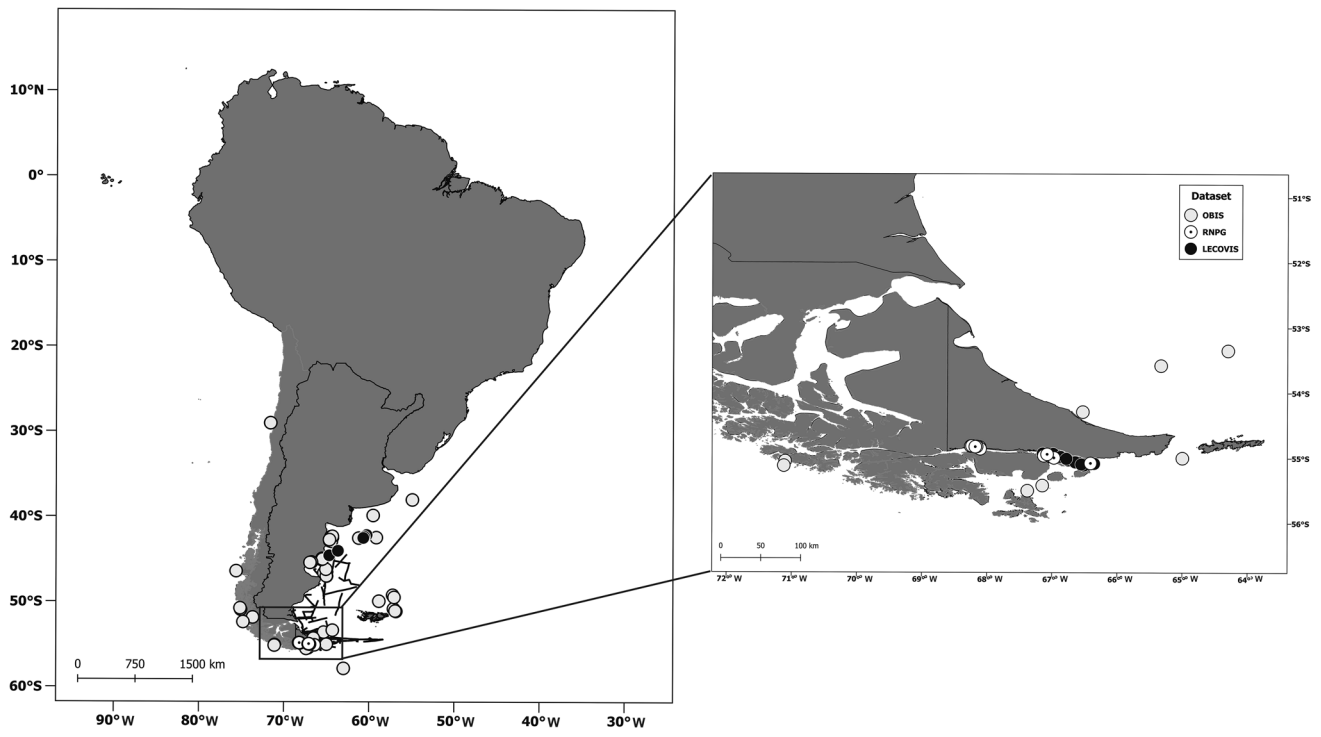

Fig. 1 Spatial distribution of sightings of dusky dolphins *Lagenorhynchus obscurus* in South America (zoomed in Tierra del Fuego Archipelago) from three different datasets and tracks of the different scientific cruises surveys conducted from 2009 to 2016 by the Laboratory of Wildlife Ecology and Conservation (LECOVIS). *OBIS* Ocean Biogeographic Information System, *RNPG* R. Natalie P. Goodall program

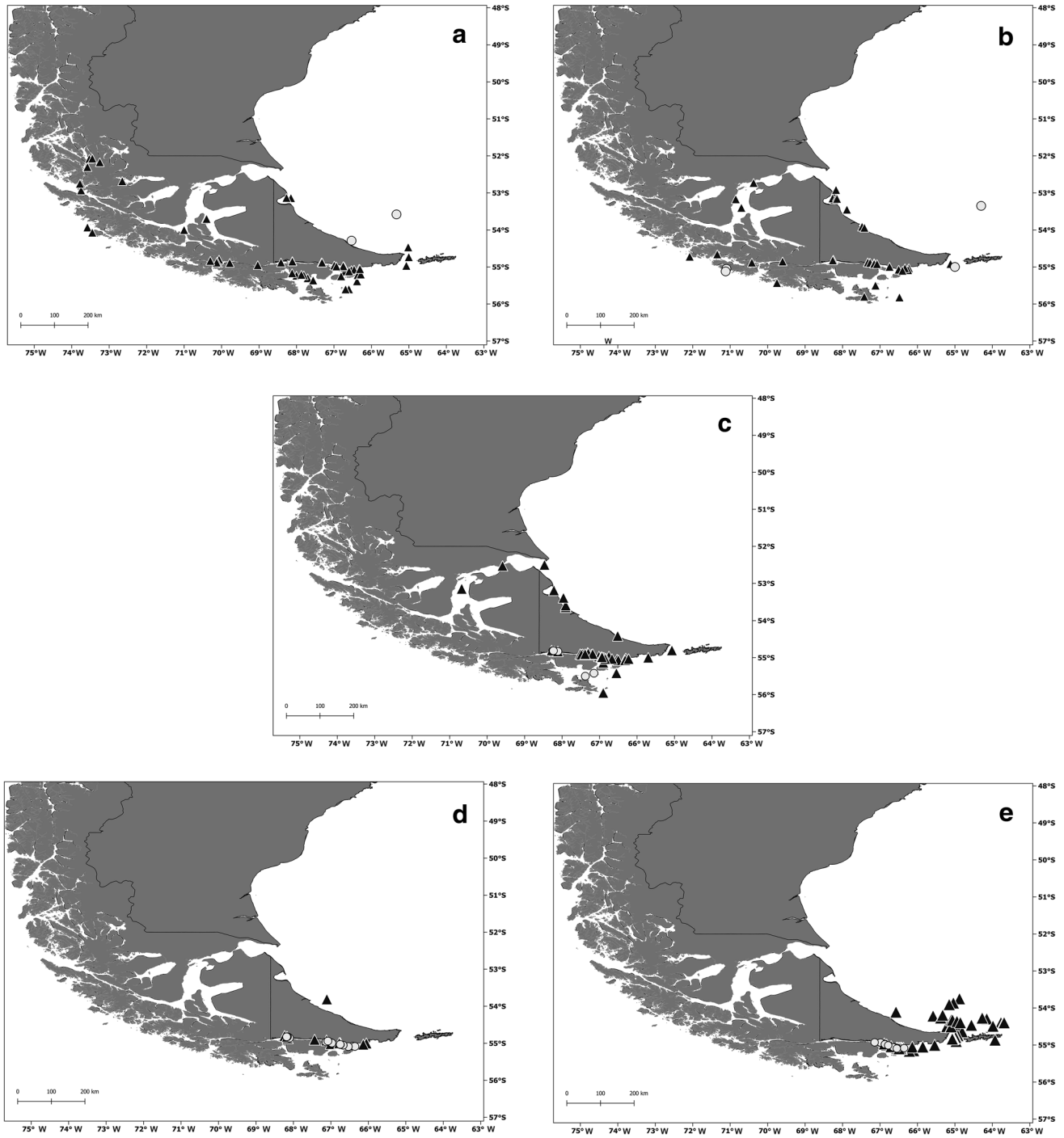

Fig. 2 Spatial distribution of sightings of dusky dolphins *Lagenorhynchus obscurus* (circle) and Peale's dolphins *L. australis* (triangle) in Tierra del Fuego Archipelago during five decades. **a** 1970s. **b** 1980s. **c** 1990s. **d** 2000s. **e** 2010s

Spatial distribution of these sightings from 1970s to 2010s is shown in Fig. 2 (a–e, respectively). Between 1970 and 1989, Peale's dolphins were distributed along most of the extension of the Beagle Channel. From 1990 onward, they were only registered in Ushuaia Bay and to the east.

Discussion

In this study, evaluating the occurrence of dusky dolphins in Tierra del Fuego along five decades was possible using

reliable sighting data from different sources. Despite the fact that search effort could not be assessed for all three datasets; each of them provided valuable and complementary information. Our results showed that, during the last 15 years, dusky dolphins were frequently sighted in areas where they had not been observed before. However, other cetacean species, such as Peale's dolphin, having been regularly recorded in these areas since early 70s by many tourist, commercial, and scientific ships traveling along the Beagle Channel (Fig. 2).

The constant presence of dusky dolphins since 2009 during summer months suggests, at least, a seasonal resident population. Seasonal occurrence patterns were documented for other populations of dusky dolphins in Argentina (Würsig and Würsig1980) and New Zealand (Würsig et al. 1997), but since dedicated surveys of LECOVIS were conducted from September to April and most sighting records from the other two dataset were reported during summer months, there is no evidence so far to determine whether they remain year-round in the Beagle Channel or move to other areas in winter. Ecological studies involving systematic monitoring throughout the year and satellite tag tracking of the dolphins could provide a better understanding of their spatio-temporal movements in the area.

Dusky dolphins of Tierra del Fuego and their relation with other populations in South America

Van Waerebeek (1992) postulated a distribution gap of the species in the South Pacific between 36°30′S and 46°S and suggested that animals recorded in southern Chile could belong to the Atlantic population if this gap was corroborated. Later, the southern limit of the northern population was extended to 39°43′S (Aguayo-Lobo et al. 1998) but no dusky dolphins were observed during 14 surveys from December 2000 to November 2001 between 41° 30′S and 48°S (Viddi et al. 2010). Reliable records in Chilean waters from our study also supported its absence in that region. In the southwestern South Atlantic, the dusky dolphin was frequently observed between 38°S and 47°S, but its occurrence between 47° and 55°S remains uncertain due to a lower systematic monitoring effort in this area (Crespo et al. 1997).

Our results showed a distribution gap between ~ 48 and 53°S. Though we reported a few sightings near Malvinas/Falkland Islands, there was no record of the species during a 3 year study of the distribution of top predators in the area (White et al. 2002) and Otley (2012) suggested considering this species as rare in the cetacean community of these islands. No dusky dolphins were observed between 45 and 54°S during six shipboard surveys conducted along the Patagonian shelf and four from Ushuaia bay (54°47′S, 68°17′W) to Namuncurá (Burdwood) Bank (~ 54°S to 54°30′S, 56°W to 62°W) (Fig. 1) (NAD and MAT, personal observation). In addition, in 36 years of research, only five specimens were found stranded in the Atlantic coastal waters of Tierra del Fuego (Goodall et al. 2008).

In this context, we hypothesize that the group sighted since 2000 in the Argentinean Beagle Channel probably comes from the animals recorded previously in southern Chile. However, from our results we cannot determine if the observed groups of dolphins in the southern portion of South America came originally from the Atlantic or Pacific Ocean populations. Since genetic differences between the dusky dolphins inhabiting the western and eastern coast of South America have been reported (Cassens et al. 2003), comparative DNA studies will allow us to determine which subpopulation stock they belong to.

Co-ocurrence of dusky dolphin and Peale's dolphin in the Beagle Channel

As mentioned above, during the last decades dusky dolphins were frequently observed in the Argentinean Beagle Channel waters, in the same areas where Peale's dolphin had been sighted before (ARR, personal observation). Additionally, during different shipboard sighting surveys the Peale's dolphin was mainly found in the easternmost part of the Beagle Channel, suggesting a possible displacement by the dusky dolphin. Although preliminary, our results did not support the hypotheses of the displacement, since we observed an overlap in their sighting (Fig. 2d–e). In addition, on some occasions we observed mixed groups which are shown in the video records (Online Resource 3 and 4). The first video was recorded in February 2014. That day we sighted a group of dusky dolphins approaching the *R/V Puerto Deseado* and a few minutes later, a group of Peale's dolphins joined them bow riding. Later, all of them left our vessel and swam together towards another boat (the tourist ship *Ushuaia*) where they were recorded by a member of its crew. In November 2016, other members of LECOVIS recorded two dusky dolphins swimming with a small group of Peale's dolphins (Online Resource 4).

The sympatry between both species had been largely suggested (Van Waerebeek 1992; Crespo et al. 1997; Goodall et al. 1997; Garaffo et al. 2011), although the use of habitat would be different (Brownell et al. 1998). Their co-occurrence in Argentinean Beagle Channel waters offers a great opportunity to investigate the possible interactions between these species as well as habitat selection and resource requirements of both the dusky and Peale's dolphin on a small scale.

Although occasionally, groups of dusky dolphins have been sighted in the Tierra del Fuego Archipelago since the 70s. If habitat conditions were favorable, the species could have stayed in the area and the number of animals increased since then. A greater abundance could have resulted in a

wider distribution. It remains unclear whether groups of dolphins sighted in the Cape Horn Area in the 90s moved into the Beagle Channels waters in the 2000s, and whether they migrate from one place to another seasonally or if different groups remain in those areas throughout the season. This could be elucidated through collaborative studies with Chilean colleagues, by designing and conducting systematic sighting surveys in both areas at the same time. The confirmed presence, at least during the summer months, of dusky dolphins in Argentinean Beagle Channel waters could be a starting point for future research goals such as spatio-temporal abundance and distribution patterns, habitat selection, trophic ecology, genetic structure, and behavior, among others.

Acknowledgements This work is dedicated to the memory of R. Natalie. P. Goodall. Thanks Natalie for your dedication in studying marine mammals at the end of the world. We are grateful to Thomas D. Goodall, Anne N. Goodall, Abby J. Goodall, and the R. Natalie P. Goodall Foundation for their permission to use the RNPG sighting data. We especially thank the captains and the crews on board the *R/V Puerto Deseado*, *Tango SB-15*, *Prefecto Garcia*, *Nativa*, and *Fueguina* for all their assistance and cooperation during the surveys. Special thanks are extended to Gabriela Scioscia, Lida Pimper, Natalia Paso Viola, Fernanda Negri, and Natalia Rosciano for participating and collecting data during the cetacean sighting surveys, to Pablo Taraborrelli, Nicolás Lois, and Ulises Balza for the video records of mixed groups of dolphins, to C. Charter and M. Liljesthrom for helping with the English edition, and to G. Hofmeyr and an anonymous reviewer for their helpful comments. This research was possible with the support of the Agencia Nacional de Promoción Científica y Tecnológica (PICT 2012 No. 1832) and the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET).

References

Acha EM, Mianzan HW, Guerrero RA, Favero M, Bava J (2004) Marine fronts at the continental shelves of austral South America: physical and ecological processes. J Mar Syst 44:83–105. https://doi.org/10.1016/j.jmarsys.2003.09.005

Aguayo-Lobo A, Torres D, Acevedo J (1998) Los mamíferos marinos de Chile: i. Cetacea. Serie Científica INACH 48:19–159

Best BD, Halpin PN, Read AJ, Fujioka E, Good CP, LaBrecque EA, Schick RS, Roberts JJ, Hazen LJ, Qian SS, Palka DL, Garrison LP, McLellan WA (2012) Online cetacean habitat modeling system for the US east coast and Gulf of Mexico. Endang Species Res 18:1–15

Brownell RL Jr, Crespo EA, Donahue M (1998) Peale's dolphin, Lagenorhynchus australis. In: Ridgway S, Harrison R (eds) Handbook of marine mammals, vol 6. The second book of dolphins and the porpoises. Academic Press, London, pp 105–120

Cassens I, Van Waerebeek K, Best PB, Crespo EA, Reyes J, Milinkovitch MC (2003) The phylogeography of dusky dolphins (*Lagenorhynchus obscurus)*: a critical examination of network methods and rooting procedures. Mol Ecol 12:1781–1792

Crespo EA, Pedraza SN, Coscarella M, Garcia NA, Dans SL, Iñiguez M, Reyes LM, Koen Alonso M, Schiavini ACM, Gonzalez R (1997) Distribution and school size of dusky dolphins, *Lagenorhynchus obscurus* (Gray, 1828), in the southwestern South Atlantic Ocean. Rep Int Whal Comm 47:693–697

Dellabianca NA, Pierce GJ, Raya Rey A, Scioscia G, Miller DL, Torres MA, Paso Viola MN, Goodall RNP, Schiavini AC (2016) Spatial models of abundance and habitat preferences of Commerson's and Peale's Dolphin in Southern Patagonian Waters. PLoS ONE 11(10):e0163441. https://doi.org/10.1371/journal.pone.0163441

Garaffo GV, Dans SL, Pedraza SN, Degrati M, Schiavini A, González R, Crespo EA (2011) Modeling habitat use for Dusky Dolphin and Commerson's Dolphin in Patagonia. Mar Ecol Prog Ser 421:217–277. https://doi.org/10.3354/meps08912

Gibbons J, Venegas C, Guzmán L, Pizarro G, Boré D, Galvéz P, Harlin A, Capella J, Brageret S (2002) Programa de monitoreo de pequeños cetáceos en áreas selectas de la XII región. Available: http://www.fip.cl/FIP/Archivos/pdf/informes/inffinal%2099-28.pdf. Accessed 20 Oct 2017

Goodall RNP, de Haro JC, Fraga F, Iñiguez MA, Norris KS (1997) Sightings and behaviour of Peale's dolphins, *Lagenorhynchus australis*, with notes on dusky dolphins, *L. obscurus*, off southernmost South America. Rep Int Whal Commn 47:757–775

Goodall RNP, Dellabianca N, Boy CC, Benegas LG, Pimper LE, Riccialdelli L (2008) Review of small cetaceans stranded or incidentally captured on the coasts of Tierra del Fuego, Argentina, over 33 years. Paper SC/60/SM21 presented to the Scientific Committee, Int Whal Comm, Santiago, Chile, May–June 2008, p 14. Available from www.iwcoffice.org

Halpin PN, Read AJ, Fujioka E, Best BD, Donnelly B, Hazen LJ, Kot C, Urian K, LaBrecque E, Dimatteo A, Cleary J, Good C, Crowder LB, Hyrenbach KD (2009) OBIS-SEAMAP: the world data center for marine mammal, sea bird, and sea turtle distributions. Oceanography 22:104–115

de Haro JC, Iñiguez MA (1997) Ecology and Behaviour of Peale's Dolphin, Lagenorhynchus australis (Peale, 1848) at CaboVirgenes (52° 30'S, 68° 28'W), in Patagonia, Argentina. Rep Int Whal Comm 47:723–727

Otley H (2012) The composition of the cetacean community in the Falkland (Malvinas) islands, southwest South Atlantic. Rev Biol Mar Oceanogr 47:537–551

Reyes LM (2006) Cetaceans of central Patagonia, Argentina. Aquat Mamm 32:20–30

Schiavini A, Pedraza SN, Crespo EA, Gonzalez R, Dans SL (1999) Abundance of dusky dolphins (*Lagenorhynchus obscurus*) off north and central Patagonia, Argentina, in spring and a comparison with incidental catch in fisheries. Mar Mamm Sci 15:828–840

Sielfeld W, Venegas C (1978) Observaciones de delfínidos en los canales australes de Chile. An Inst Patagon 9:145–151

Tittensor DP, Mora C, Jetz W, Lotze HK, Ricard D, Berghe EV, Worm B (2010) Global patterns and predictors of marine biodiversity across taxa. Nature 466:1098–1101

Van Waerebeek K (1992) Records of dusky dolphins *Lagenorhynchus obscurus* (Gray, 1828) in the eastern South Pacific. Beaufortia 43:45–61

Van Waerebeek K, Würsig B (2009) Dusky dolphin: *Lagenorhynchus obscurus*. In: Perrin WF, Würsig B, Thewissen JGM (eds) Encyclopedia of marine mammals. Academic Press, San Diego, pp 335–338

Viddi FA, Hucke-Gaete R, Torres-Florez JP, Ribeiro S (2010) Spatial and seasonal variability in cetacean distribution in the fjords of northern Patagonia, Chile. ICES J Mar Sci 67:959–970

White RW, Gillon KW, Black AD, Reid JB (2002) The distribution of seabirds and marine mammals in Falkland Islands waters. Joint Nature Conservation Committee, Peterborough

Würsig B, Würsig M (1980) Behavior and ecology of the dusky dolphin, *Lagenorhynchus obscurus*, in the South Atlantic. Fish Bull 77:871–890

Würsig B, Cipriano F, Slooten E, Constantine R, Barr K, Yin S (1997) Dusky dolphins (*Lagenorhynchus obscurus*) off New Zealand: status of present knowledge. Rep Int Whal Commn 47:715–722