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Short Note

Observations of Burmeister's Porpoise (*Phocoena spinipinnis*) in the Northern Coast of Peru

Luis Santillán[1, 2]

[1]*Universidad San Ignacio de Loyola, Facultad de Ingeniería, Grupo de Investigación BIOMAS, La Molina, Lima, Perú*
[2]*Peruvian Centre for Cetacean Research (CEPEC), Pucusana, Lima 20, Perú*
E-mail: lsantillan@usil.edu.pe

Burmeister's porpoise (*Phocoena spinipinnis*; Burmeister, 1865) is a common odontocete found along both the Pacific and Atlantic coasts of South America, ranging from Bahía de Paita in northern Peru to Santa Catarina in southern Brazil (Brownell & Praderi, 1984; Aguayo-Lobo et al., 1998; Brownell & Clapham, 1999; Reyes, 2009a). This porpoise is commonly found in Peruvian inshore waters. Previous studies reported morphology and reproductive information based on bycaught animals and strandings (Goodall et al., 1995; Brownell & Clapham, 1999; Bastida et al., 2007; Reyes, 2009a). Other studies presented information about the distribution and ecological aspects in Peru (Majluf & Reyes, 1989; Reyes & van Waerebeek, 1994; García-Godos et al., 2007; Reyes, 2009a, 2009b; Clay et al., 2018) and other countries in South America (Goodall et al., 1995; Tezanos Pinto et al., 2000; Molina-Schiller et al., 2005). Burmeister's porpoises exhibit genetic differentiation among populations from Peru, Chile, and Argentina (Rosa et al., 2005). Such variation is similar for other odontocetes, such as the dusky dolphin (*Lagenorhynchus obscurus*), on the Pacific coast of South America (de Oliveira et al., 2012).

In this short note, observations of Burmeister's porpoise are reported over short periods (between 4 and 7 d) during different time frames (months and years) to provide a preliminary description of its distribution and occurrence in Peruvian waters. Information on sightings and movements in this region are scarce despite the common occurrence of the species (Goodall et al., 1995; Reyes & Oporto, 1995; van Waerebeek et al., 2002; Heinrich et al., 2004). Their inconspicuous appearance, small group travel, and lack of aerial display make them difficult to survey. Thus, increased observations with passive technologies (e.g., Clay et al., 2018) are needed to understand seasonal and spatial characteristics of habitat use near the northern extreme of its Pacific range.

The survey area included Salaverry Port (78° 14' W; 08° 13' S; Figure 1), a location with a high rate of incidental catch of small cetaceans in Peru, especially for Burmeister's porpoise. Bycatch remains high in this area even after the ban on the catch of small cetaceans enacted in the 1990s (van Waerebeek et al., 1988, 1997; Reyes & van Waerebeek, 1994; van Waerebeek & Reyes, 1994; Mangel et al., 2010; Altherr & Hodgins, 2018).

The survey was designed as a marine baseline study for port facilities at Salaverry Port and not specifically for marine mammals. Daily work at sea spanned from 4 to 6 h, roughly from 0600 h to midday. After midday, wind speed often increased, limiting opportunities to observe porpoises. Good weather conditions were necessary to complete the survey; observations recorded with wind speeds below 2 on the Beaufort scale were included in the study. Surveys had average 5-d durations (Table 1). Surveys were performed in June 2005 (referred to hereafter as Jun-05), March 2006 (referred to as Mar-06), January 2009 (referred to as Jan-09), March 2012 (referred to as Mar-12), and July 2012 (referred to as Jul-12). January and March are warm months, and June and July are cold months. The survey followed seven 3-nmi line transects perpendicular to the coastline (Figure 1). The same observer (the author) was in charge of all surveys. The observation platform was a 7-ton artisanal fishing vessel from which the observer visually scanned 180° for any disruptive changes on the water surface. Nikon 10×50 binoculars (Nikon, Minato City, Tokyo, Japan) were used when necessary to support observation efforts. Sightings were geographically referenced in degrees and minutes. Vessel speed ranged between 3 to 6 kts. This study did not consider individual identification, and individual animals might have been counted more than once.

Total survey time was 81.51 h (Table 1). The total number of sightings was 40 and mostly

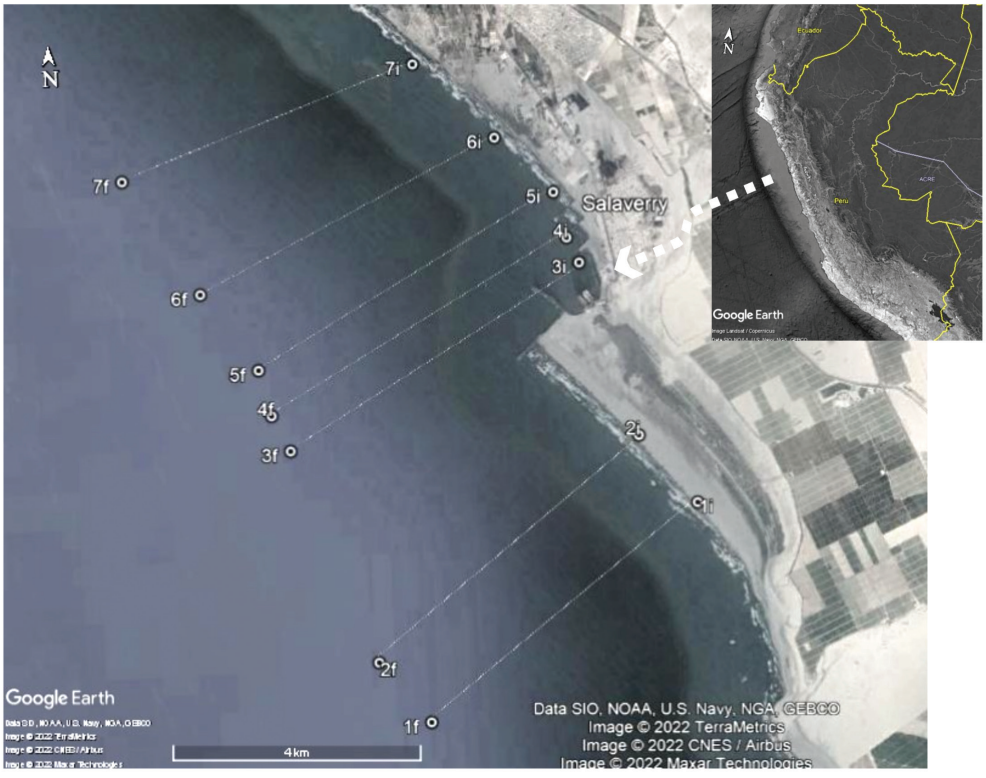

Figure 1. Study area and survey transects (transect 1 to 7; Xi = start, Xf = end)

Table 1. Detailed information of survey effort, number of sightings, and number of individuals

Month	Number of survey days	Effort (h)	Porpoise total sightings	Encounter rate	Porpoise total counts
Jun-05	4	18.25	8	0.44	9
Mar-06	6	25.52	3	0.12	4
Jan-09	7	22.55	13	0.44	20
Mar-12	4	6.57	3	0.46	3
Jul-12	4	8.62	13	1.51	19

involved a single animal (Table 2). The Jul-12 survey recorded the largest number of sightings (n = 13), and both Mar-06 and Mar-12 recorded the lowest numbers (n = 3) (see Figure 2a-2e).

Total count for the five periods was 55 (Table 1). This number is not an abundance estimate since resighting and missed sightings are possible sources of bias. However, the current information provides a valuable description of the occurrence of Burmeister's porpoises in the area. A higher occurrence was found during Jan-09 and Jul-12 with 20 and 19 porpoises, respectively (Table 1; Figure 3). Mean counts and standard deviations (SDs) are similar (Table 2); higher variability was observed for Jan-09 ($\bar{x}$ = 1.54 ± 0.18; SD = 0.66) and Jul-12 ($\bar{x}$ = 1.46 ± 0.22; SD = 0.78) (Table 2). Total encounter rate was 0.45 sightings/hour. Warm months, Mar-06, Jan-09, and Mar-12, showed similar and lower encounter rates, and one of the cold months, Jul-12, showed a higher encounter rate with 1.51 sightings/hour (Table 2; Figure 4).

Despite limitations of the data, the cold month of Jul-12 presented the higher encounter rate. On

Table 2. Summary statistics by month of survey. SE = standard error; SD = standard deviation.

	Jun-05	Mar-06	Jan-09	Mar-12	Jul-12
n (sightings)	8	3	13	3	13
Minimum count	1	1	1	1	1
Maximum count	2	2	3	1	3
Mean count	1.13	1.33	1.54	1	1.46
SE count	0.13	0.33	0.18	0	0.22
SD count	0.35	0.58	0.66	0	0.78

the other hand, warm months, such as Mar-06, Jan-09, and Mar-12, presented lower encounter rates (Figure 4). Notably, in the warm month, Jan-09, and the cold month, Jul-12, higher counts and sightings were associated with remarkably different survey efforts. This information still provides preliminary insight into seasonal differences in the distribution of Burmeister's porpoise in Peru's coastal waters.

Sightings included single animals, pairs, and trios (Table 2). Single animals and pairs were observed in all periods except Mar-12 when only single porpoises were recorded. Sightings of three animals together were rare and only observed in Jan-09 and Jul-12 along with higher numbers of sightings and porpoise abundance (Table 2). Preliminary observations in the Beagle Channel indicated a substantial percentage of pairs (55%) and trios (22.27%), whereas single animals were observed less often (18.18%) (Tezanos Pinto et al., 2000). A remarkable difference in porpoise sightings is found for the Salaverry area, implying noticeable differences between populations.

Information on permanent and high incidental bycatch of Burmeister's porpoise in Salaverry's artisanal fishery is available (van Waerebeek et al., 1988, 2002, 2018; Reyes & van Waerebeek, 1994; Mangel et al., 2010), as is the distribution and habitat use through acoustic click detectors (Clay et al., 2018). Based on this evidence and the information presented herein, Salaverry Port and adjacent waters are likely important habitat for the Burmeister's porpoise; comparative studies in other coastal areas in Peru are necessary to identify additional valuable habitats. Data presented in this short note provide information about occurrence along the coastal area of Salaverry, which may be indicative of a suitable habitat where populations are vulnerable to anthropogenic activities such as coastal fisheries. Although this cetacean is common in Peru, demographic information for the species in Peru and mostly in its entire distribution in South America is lacking. Data presented herein will help to fill this gap in knowledge of the species.

Molina-Schiller et al. (2005) proposed the area between Paita in Peru and the Gulf of Arauco in Chile as a relevant oceanographic area for the distribution of Burmeister's porpoise. Oceanographic conditions and prey distribution and abundance influence the distribution and movements of marine mammals (Benson et al., 2002; Hastie et al., 2005; Schiller, 2006). In northern Peru, upwelling peaks in austral winter (July to September), but biological productivity occurs in response to the force of the wind that makes upwelling favorable (Montecino & Lange, 2009). Warm subtropical surficial waters move closer to the coast in summer and autumn, and coastal upwelling disperses them in winter and spring (Bakun & Weeks, 2008). Anchovy (*Engraulis ringens*), a pelagic fish in the Peruvian marine ecosystem that displays rapid population recruitment (Flores et al., 2008), is important in the diet of Burmeister's porpoise (Reyes & van Waerebeek, 1994; García-Godos et al., 2007). The occurrence of Burmeister's porpoise is influenced by both pelagic fish and oceanographic conditions (Reyes & van Waerebeek, 1994; Molina-Schiller et al., 2005; García-Godos et al., 2007). The observations presented herein are consistent with an increase in the occurrence of the porpoise when cold waters are prevalent during upwelling peaks in austral winter (July to September) and conditions for anchovy are ideal. Water temperatures of 17 to 18°C attract porpoises for longer periods (Clay et al., 2018), concordant with cool waters during cold months like July when sightings and numbers were greatest.

Reproduction may also trigger changes to the distribution of the porpoise (Brownell & Clapham, 1999), suggesting a peak of conception and parturition in summer (February-March). Pregnant females are recorded year-round (Bastida et al., 2007; Reyes, 2009a), and mating may take place in summer (December to March; Reyes, 2009a). The reduction of sightings during March, presented in this short note, is coincident to the time of

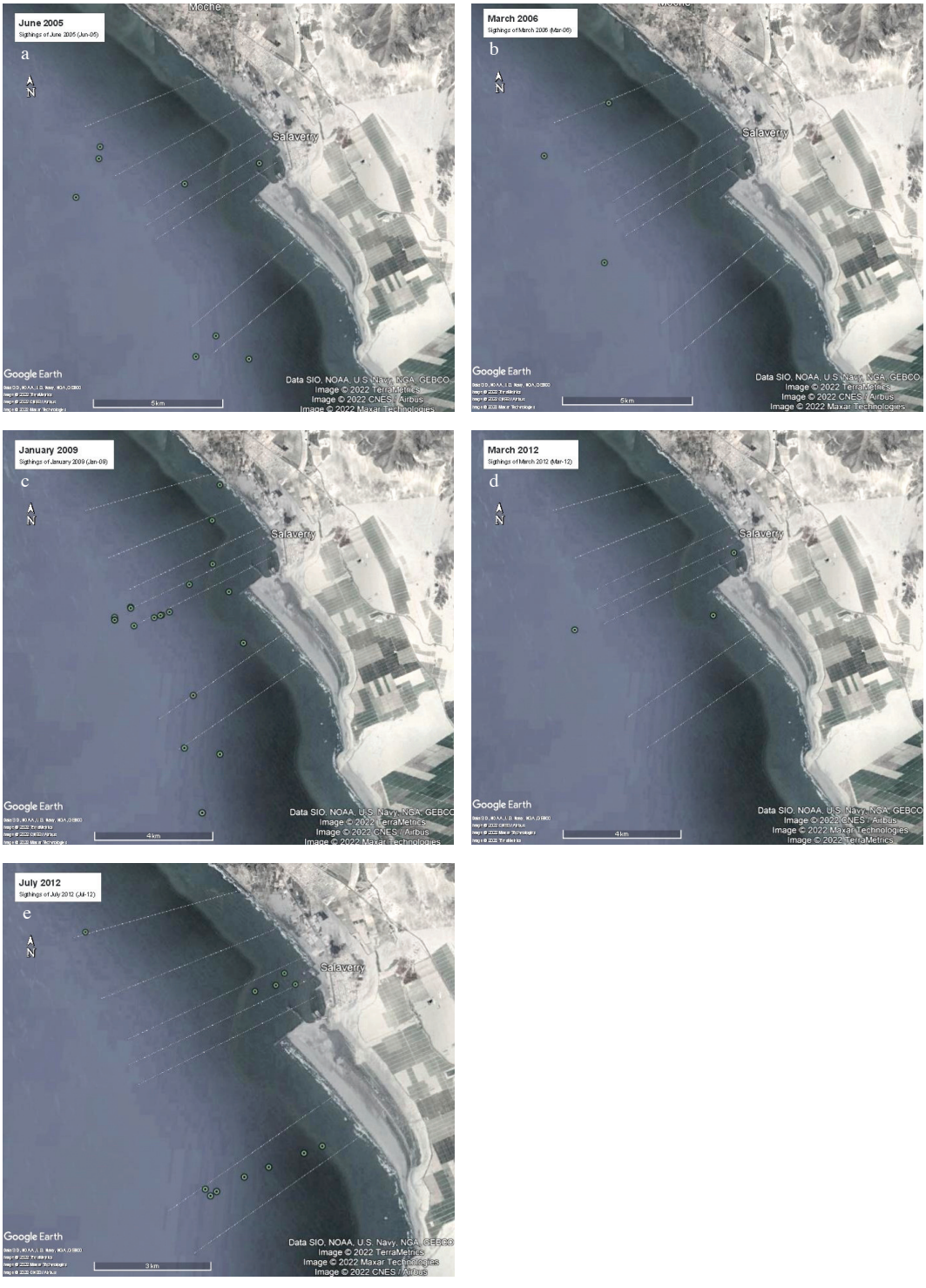

Figure 2. Sightings of Burmeister's porpoise (*Phocoena spinipinnis*) from June 2005 to July 2012; dark dots represent sightings of the porpoise in (a) June 2005 (Jun-05), (b) March 2006 (Mar-06), (c) January 2009 (Jan-09); (d) March 2012 (Mar-12), and (e) July 2012 (Jul-12).

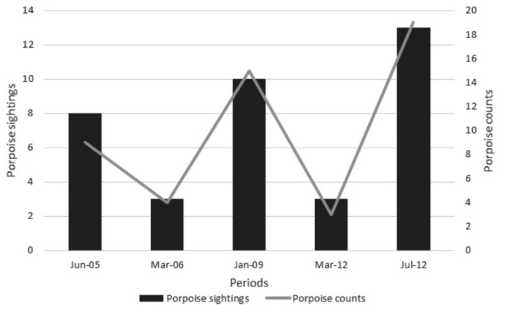

Figure 3. Comparison of Burmeister's porpoise sightings and counts

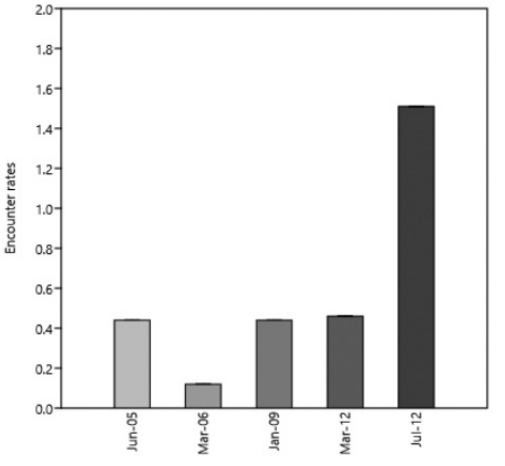

Figure 4. Encounter rate of Burmeister's porpoise from June 2005 to July 2012 in the Salaverry Port study area

conception, parturition, and mating as suggested by previous studies.

Similar phocoenids, such as the harbor porpoise (*Phocoena phocoena*), aggregate in key habitats with seasonal changes (Fontaine et al., 2007; Sveegaard et al., 2011; Wingfield et al., 2017). The Burmeister's porpoise population might follow a similar trend, with key habitats and high-density areas where most of the population aggregates during certain seasons. The data in this short note provide the first look at demographic fluctuation; however, more data are necessary to evaluate spatio-temporal trends within Peruvian waters.

van Waerebeek et al. (2002) reported the largest aggregations of Burmeister's porpoise in September off Caleta Guañape, south of Salaverry Port, with two large aggregations of 150 and 40 individuals, respectively. Another sighting of a large group was obtained in Paracas (13° S) in March with 22 individuals. Those records did not occur during cold periods but during transition periods between warm to cold months (22 individuals in Paracas) and cold to warm months (190 individuals in Caleta Guañape). Regular observations at sea are necessary to confirm seasonal changes in abundance or frequency of sightings. Caleta Guañape and Salaverry might represent part of the total home range due to their closeness; however, this will only be confirmed with future studies.

The apparent isolation of the Peruvian population (de Oliveira et al., 2012) is a concern because of the high rate of incidental catch in the artisanal fishery. At present, Burmeister's porpoise is classified as "Near Threatened" on the International Union for Conservation of Nature's (IUCN) *Red List* (Félix et al., 2018), and lack of knowledge on population dynamics and biology increases the urgency to examine the species in moderate and high circumstance research.

This study represents a preliminary overview of the occurrence and local movements of the Burmeister's porpoise. More sightings of wild animals at sea are essential, especially for the Peruvian population, which faces high levels of human disturbance (Félix et al., 2018). Incidental catch is the most evident disturbance (van Waerebeek et al., 1988, 1997; Reyes & van Waerebeek, 1994; van Waerebeek & Reyes, 1994; Mangel et al., 2010), but marine pollution, habitat loss, coastal urban and industrial development, and other anthropogenic factors are also a concern, and their impact on the Burmeister's porpoise population is currently unknown. Photo-identification techniques can be applied to porpoise populations (Asplanato et al., 2019) to better understand changes in population and habitat use.

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