Marine Mammal Science

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NOTE OPEN ACCESS

Regular Presence of Harbor Porpoises in the Northern Alborán Sea

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ABSTRACT

The harbor porpoise (*Phocoena phocoena*) in the Atlantic waters of Spain and Portugal are a genetically differentiated population from the rest of the North Atlantic. They are rarely seen on the southern Atlantic coast of Spain and are thought to be extinct in the Mediterranean Sea, with scattered sightings and strandings recorded along the Spanish Mediterranean coast. Here, we present 35 live sightings of harbor porpoises along a ~15 km coastline between Los Boliches (Fuengirola) and Benalmádena in Andalucia. The data were collected from whale watching vessels in two distinct periods: 2011–2013 and 2015–2019. The sightings included single individuals (20%) and groups of to up to 6 animals, including calves (especially in 2019). In one encounter, the animals were harassed by people on jet skis. The presence of porpoises and threats they face in this relatively narrow area highlight the need to implement conservation efforts and increase protection.

The Alborán Sea, in the westernmost section of the Mediterranean basin, is considered a transition area between Atlantic and Mediterranean waters. Delimited by the Strait of Gibraltar to the West and the Almería–Oran front to the East (Parrilla and Kinder 1987; Sánchez-Garrido and Nadal 2022), it plays a crucial role in the water circulation of the Mediterranean Sea. Its geophysical features and oceanographic peculiarity, characterized by the presence of Atlantic waters, Levantine Intermediate Waters, Western Mediterranean Deep Water, and two large-scale anticyclonic gyres, support one of the highest productivity levels of the Mediterranean basin (Sánchez-Garrido et al. 2015). Furthermore, several marine species show a limited gene flow through the Alborán Sea, with genetic isolation appearing due to ecological characteristics (Cañadas and Hammond 2006, 2008; Natoli et al. 2005; Natoli et al. 2008).

The area is considered a hotspot for cetacean species (Cañadas et al. 2002; Cañadas et al. 2005). Since the early 90s, several cetacean surveys have been carried out throughout the Alborán Sea (Cañadas and Sagarminaga 2000; Cañadas and Vázquez 2014; Carpinelli et al. 2011; De Stephanis et al. 2008; Giménez et al. 2017, 2018; Mannocci et al. 2018; Panigada et al. 2024). The regular occurrence of nine species has been documented in the area: the common dolphin (*Delphinus delphis*), the common bottlenose dolphin (*Tursiops truncatus*), the fin whale (*Balaenoptera physalus*), the long-finned pilot whale (*Globicephala melas*), the killer whale (*Orcinus orca*), the Risso's dolphin (*Grampus griseus*), the sperm whale (*Physeter macrocephalus*), the Cuvier's beaked whale (*Ziphius cavirostris*), and the striped dolphin (*Stenella coeruleoalba*). As a result, in 2017, the Alborán Sea was selected as an Important Marine Mammal Area (IMMA) by the Marine Mammal Protected Areas Task Force of the International Union for Conservation of Nature (IUCN-MMPATF 2017). However, none of the previously mentioned studies have included the harbor porpoise (*Phocoena phocoena*).

The harbor porpoise occurs in the Atlantic waters of Spain and Portugal (Díaz López and Methion 2024; Lens 1997;

Sequeira 1996) and represents a genetically differentiated population from the rest of the North Atlantic (Fontaine et al. 2007, 2014; Pierce et al. 2024). Fontaine et al. (2014) recommended the Iberian-African population be treated as a different evolutionary significant unit, proposing a subspecies named *P.p.meridionalis*. *P.p.meridionalis* individuals are currently found on the African coast as far North as Agadir, Morocco (Smeenk et al. 1992; Waerebeek and Perrin 2007) and on the Iberian coast as far South as the Gulf of Cádiz (Gnone et al. 2023; Hammond et al. 2002; Hammond et al. 2013). However, live sightings of harbor porpoises on the southern Atlantic coast of Spain are rare (Hammond et al. 2013).

In the Mediterranean Sea, this species is widely accepted to be extinct, with the exception of the Aegean Sea where strandings and live sightings have been documented (Frantzis et al. 2001; Rosel et al. 2003; Ryan et al. 2014; Tonay and Dede 2013). The individuals sighted in the Aegean Sea have been proven to be migrants from the Black Sea and Sea of Azov, as they belong to the subspecies *Phocoena phocoena relicta* (Rosel et al. 2003). This subspecies is genetically distinct from the Atlantic population; no exchange of genes has occurred for centuries and has been classified as "Endangered" (Birkun and Frantzis 2008; Rosel et al. 1995). However, during the recent large-scale Mediterranean cetacean survey (Panigada et al. 2024) no sightings were recorded.

Along the Spanish Mediterranean coast, scattered sightings and strandings have been recorded throughout the years. Lens (1997) reported a stranding event along the Málaga coast (Rey and Cendrero 1982) and a sighting in the Strait of Gibraltar in 1981. Cabezón et al. (2004) reported the presence of the species on the Mediterranean Spanish coast. Furthermore, in spring and summer of 2006, two sightings were listed near Málaga (Monitoring plan for the harbor porpoise in Andalucía),[1] and a stranding was reported by Bellido et al. (2006). The latter was reported as an adult male seen swimming with difficulties off Benalmádena (Málaga province), where it later stranded and died in July 2006. They suggested this was an animal from the Atlantic that had entered the Alborán Sea alone (Bellido et al. 2006).

Finally, in 2009, six strandings on the Atlantic coast (five in Huelva and one in Cádiz) and one on the Mediterranean coast (Estepona, Málaga province) in November were mentioned by the Review of the Marine Environment[2] by the Regional Government of Andalucía (Junta de Andalucía). Basic information about these animals, such as sex or age class, could not be determined due to the high degree of decomposition.

Here, we report 35 live sightings of harbor porpoises in the waters off Málaga province between 2011 and 2019. The sightings were recorded during two distinct periods: between 2011 and 2013 and between 2015 and 2019 (Table 1). Data for the first period were collected from a whale-watching vessel that conducted several trips per day (weather permitted) during daylight hours from June to September. The vessels departed from Benalmádena harbor and ran southward approximately 5 nm from the coast towards Faro de Calaburras (Mijas). Researchers on board searched for animals from the upper deck, located at 3 m above sea level, using binoculars. For each cetacean encounter, the following data were collected: date, time (UTC), species, number of animals, and coordinates.

During the second period, between November 2015 and October 2019, the same data were collected from two different types of tourist vessels departing from Benalmádena harbor: a ferry and a whale-watching platform. Together, they covered the area within 3 nm of the coast between Faro de Calaburras (Mijas) and the Guadalhorce river mouth (Málaga). Trips were conducted daily (weather-dependent) between May and October, and on days with good weather conditions between November and April. Between 2015 and 2017, the positions of the encounters were estimated using coastal reference points, which were converted to coordinates using the software OpenCPN (version 4.8.2). In most of 2018 and all of 2019, the positions were logged using a GPS device. Harbor porpoise sightings with collected or estimated coordinates are reported in Figure 1. For all porpoise sightings with coordinates, seafloor depths were extracted using the function getDepth[3] in Matlab (Mathworks, MA) version 2023a (Table 1).

Fifteen harbor porpoise sightings were recorded between 2011 and 2013, and 20 between 2015 and 2019. The encounters consisted of harbor porpoise groups of between one and six individuals (mean = 2.83, SD = 1.46), with only 20% ($n = 7$) of sightings being of a single animal. Calves were present in six sightings, five of which were in 2019 (Table 1).

Additionally, opportunistic sightings were reported through citizen science between 2006 and 2008 (AS, NV personal communications); however, no dates or locations were recorded. Lastly, through personal communication with local tourist operators, another three sightings have been reported since 2019, two of which occurred in 2023 (supported by videos). One of the porpoise sightings reported by local operators is worth highlighting here. It took place in July 2023 off the coast of Fuengirola, and the report was accompanied by videos and photographs. A group of at least three porpoises, including one younger individual, was targeted by personal watercraft (Jet skis), which is clearly visible in Figure 2 (top right corner).

Furthermore, a stranding event was recorded on April 23, 2023, on the beach of Los Boliches (Fuengirola). Unfortunately, no data were collected on this animal. Based on photographs (e.g., Figure 3), the porpoise was likely an adult female based on the characteristics of the underside. The stranding location was approximately between 36.5508°N 4.6133°W and 36.5498°N 4.6142°W.

During trips, other marine megafauna were sighted, in particular common (*D. delphis*), bottlenose (*T. truncatus*), and striped dolphins (*S. coeruleoalba*), fin whales (*B. physalus*), loggerhead turtles (*Caretta caretta*), and mako sharks (*Isurus oxyrinchus*), but no interactions with harbor porpoises were recorded.

The harbor porpoises were sighted from April to September (Table 1), with the most sightings occurring in 2019. However, this may be linked to vessel trips being more frequent during the tourist season and that in 2019 effort was increased in the area where porpoises had previously been sighted.

All harbor porpoise sightings reported here, including the stranding in 2023, were located along a ~15 km coastline between Los Boliches (Fuengirola) and Benalmádena (Figure 1). The water

TABLE 1 | Sightings of harbor porpoises in the Alborán Sea between 2011 and 2019, together with one sighting and the stranding that occurred in 2023.

Date	Time (UTC)	Lat. (deg)	Long. (deg)	Positional uncertainty	Water depth	#Individuals	#Calves	Comments
July 31, 2011	12:03	36.5608	−4.5878	*M*	−10	2	0	
July 23, 2012	12:05	36.5653	−4.5256	*M*	−48	4	0	
July 31, 2012	17:55	36.5442	−4.5767	*M*	−50	4	0	
September 07, 2012	13:10	36.5608	−4.5878	*M*	−10	4	0	
September 17, 2012	17:10	36.5353	−4.5669	*M*	−64	1	0	
August 05, 2013	11:45	36.5708	−4.5003	*M*	−73	6	1	
August 11, 2013	16:00	36.5722	−4.5353	*M*	−12	3	0	
August 14, 2013	12:00	36.5628	−4.5531	*M*	−26	1	0	
August 15, 2013	18:25	36.5728	−4.5797	*M*	−11	4	0	
August 16, 2013	15:10	36.5750	−4.5694	*M*	−6	6	0	
August, 16, 2013	17:35	36.5764	−4.5500	*M*	−8	6	0	
September 07, 2013	12:30	36.5739	−4.5383	*M*	−10	4	0	
September 10, 2013	16:10	36.5753	−4.5125	*M*	−34	2	0	
September 13, 2013	15:00	36.5822	−4.5303	*M*	−6	1	0	
September 23, 2013	13:10	36.5706	−4.5292	*M*	−21	4	0	
April 26, 2016	14:00	N/A	N/A	N/A	N/A	1	0	Position between Playa Bonita and Torrequebrada. Unknown distance to coast.
June 08, 2016	09:30	36.5757	−4.5268	Est.	−12	4	0	
July 11, 2016	08:45	36.5911	−4.5003	Est.	−18	4	0	
June 12, 2017	10:08	N/A	N/A	N/A	N/A	2	0	Position near Puerto Marina, Benalmádena. Unknown distance to coast.
July 30, 2018	12:00	36.5691	−4.5544	*M*	−11	2	0	
August 03, 2018	08:59	36.5663	−4.5461	*M*	−18	1	0	
August 03, 2018	12:11	36.5711	−4.5458	*M*	−10	1	0	
August 04, 2018	11:30	36.5708	−4.5332	*M*	−16	2	0	

(Continues)

TABLE 1 | (Continued)

Date	Time (UTC)	Lat. (deg)	Long. (deg)	Positional uncertainty	Water depth	#Individuals	#Calves	Comments
August 11, 2018	12:06	36.5695	−4.535	*M*	−18	3	0	
April 27, 2019	N/A	36.5576	−4.5238	*M*	−66	2	0	
May 07, 2019	11:30	36.5594	−4.5352	*M*	−53	3	1	
May 22, 2019	10:14	36.5883	−4.4783	*M*	−74	2	0	
May 26, 2019	10:49	36.5776	−4.5145	*M*	−24	4	1	
May 31, 2019	12:02	36.5558	−4.5533	*M*	−47	1	0	
June 12, 2019	12:17	36.5727	−4.5293	*M*	−15	2	0	
June 12, 2019	14:18	36.5711	−4.5375	*M*	−13	2	0	
June 13, 2019	N/A	36.5677	−4.5486	*M*	−14	3	1	
July 15, 2019	13:41	36.5750	−4.5303	*M*	−11	3	1	
July 21, 2019	12:09	36.5633	−4.5528	*M*	−25	2	0	
August 15, 2019	09:58	36.5697	−4.5425	*M*	−13	3	1	
April 23, 2023	N/A	36.5508 36.5498	−4.6133 −4.6142	Est.	N/A	1	0	Stranded animal in Los Boliches (Fuengirola). Estimated coordinates based on social media images.
July 18, 2023	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Video and images only. Group number unknown. Personal watercrafts (Jet skis) close to the animals.

Abbreviations: deg = decimal degrees, Est. = estimated, Lat. = latitude, Long. = longitude, *M* = measured by GPS, N/A = not available, UTC = coordinated universal time.

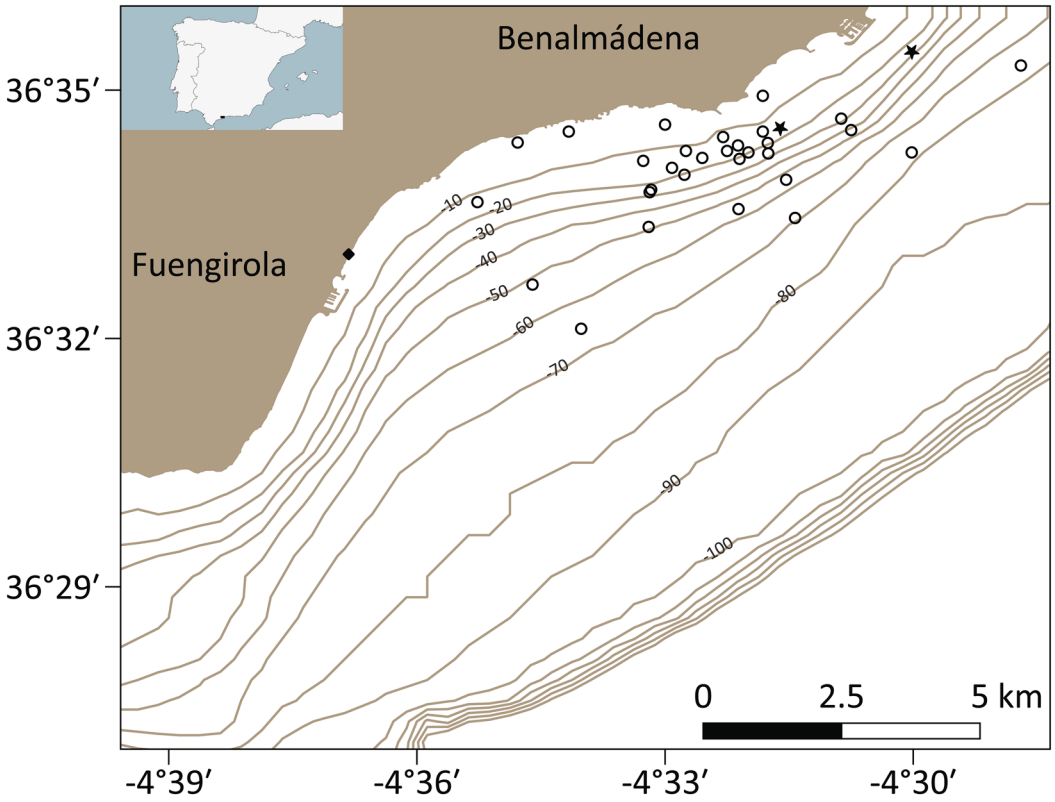

FIGURE 1 | Map of all recorded harbor porpoise sighting locations ($n = 33$). Inserted figure: position of the study area in Spain; stars: estimated positions; white dots: GPS logged positions; diamond: estimated location of 2023 stranding.

FIGURE 2 | Harbor porpoise group encounters in the Alborán Sea.

depth in the sighting locations varied between 6 and 74 m, with an average of 25.7 m (SD = 20.9 m). The area over which the individuals were sighted coincides with the stranding reported in 2006 (Bellido et al. 2006).

The results of this report as the combination of live observations, strandings data, and third-party reports, lead to a compelling case of there being a regular presence of harbor porpoises in Málaga. Model predictions (Fontaine 2016) suggest that the

FIGURE 3 | Adult harbor porpoise stranded on April 23, 2023, in Fuengirola, Spain.

coastal waters of the northern Alborán Sea from the Strait of Gibraltar to the coast of Málaga are a suitable habitat for the species. In addition, the species in Iberian waters has shown a preference for high-production areas, with coastal upwelling (Díaz López and Methion 2024). In the northern Alborán Sea, upwelling is deemed to be quasi-permanent, maintained by cool nutrient-rich waters brought in by the Atlantic Jet during upwelling occurrences in the Strait of Gibraltar (Sánchez-Garrido and Nadal 2022).

Upwelling could be seasonal on the Iberian Atlantic coast, and individuals may be migrating to areas with more continuous upwelling conditions in search of a more stable food source (Fontaine 2016). Indeed, the Iberian population has demonstrated signs of decrease, the species in Spanish waters is classified as "in danger of extinction",[4] and migration towards other areas, such as the Bay of Biscay and Mauritania (Fontaine et al. 2014). Therefore, one hypothesis that should be explored is that the individuals in Málaga are part of this migration and they belong to the endangered subpopulation *P. p. meridionalis*. However, without genetic confirmation, the possibility of these individuals being a local, isolated, and geographically discrete population is equally important and cannot be ruled out. Movements from the Strait of Gibraltar cannot be defined with certainty; the area is heavily surveyed year-round by several whale-watching companies and research groups, but no sightings of the species have been reported (Gnone et al. 2023).

Regardless of the origins and seasonality in Málaga, the presence of the species and threats it faces in this relatively narrow area highlight the need to implement conservation efforts and increase protection. In particular, limiting overlap with intense marine traffic, as well as reducing the risk of fishery bycatch and habitat alteration should be of paramount importance. Furthermore, implementing simultaneous monitoring projects could be crucial for understanding the spatiotemporal distribution and density of individuals, and for carrying out effective conservation strategies including temporal limitations for anthropogenic activities. For such studies, regular aerial and boat surveys and passive acoustic methods could be ideal to estimate the porpoise density and determine the seasonality or residency of the individuals in the northern Alborán Sea (Macaulay et al. 2017; Sveegaard et al. 2011).

Author Contributions

Samantha Blakeman: conceptualization, data curation, investigation, methodology, writing – original draft, writing – review and editing. **Juan Manuel Salazar:** conceptualization, investigation, methodology, writing – review and editing. **Antonio Segura:** conceptualization, investigation, methodology, writing – original draft, writing – review and editing. **Noelia Villalba:** conceptualization, investigation, methodology, writing – original draft, writing – review and editing. **Elena Papale:** writing – review and editing. **Mel Cosentino:** formal analysis, investigation, visualization, writing – original draft, writing – review and editing.

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The data that support the findings of this study will soon be made openly available. They are undergoing curation following MEDIN metadata guidelines and will be archived and published in Zenodo when curation is complete.

Conflicts of Interest

The authors declare no conflicts of interest.

Endnotes

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