

Short communication:

New records of sperm whale social units in the Pelagos Sanctuary, Mediterranean Sea

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In the Ligurian Sea, the northern part of the Western Mediterranean Sea, sperm whales (*Physeter macrocephalus* Linnaeus, 1758) are historically sighted as solitary individuals or loose aggregations of males, while social units are extremely occasional. On 21 August 2020, two different social units were recorded in this area with an estimate of 21 individuals in total (12 in the first and nine in the second). The Mediterranean sperm whale subpopulation is considered Endangered under the IUCN Red List and an understanding of its movements and social structure is lacking. These observations increase our knowledge on its conservation biology and possible threats.

Sperm whales exhibit sexual segregation. Adult males usually occur in the higher latitudes, generally solitary or in loose aggregations, while groups of immature males and females with calves are found at latitudes lower than 40° (except 50°N in the North Pacific; Whitehead, 2018), forming long-term social units (Whitehead and Weilgart, 2000; Whitehead, 2003; Rendell and Frantzis, 2016). In most of the Mediterranean Sea, which supports an Endangered subpopulation of sperm whales (Pirota *et al.*, 2021), it appears that sex/age segregation does not occur for the species, probably due to the limited latitudinal range (Rendell and Frantzis, 2016). A seasonal co-occurrence of all the major types of groupings (i.e. solitary males, loose male aggregations, bachelor groups and social units of females and calves) has been regularly observed in Greece (Hellenic Trench: Frantzis *et al.*, 2014), Italy (Naples Bay: Pace *et al.*, 2014) and Spain (Balearic Archipelago: Pirota *et al.*, 2011). However, based on the distribution of recorded sightings, Drouot *et al.* (2004), hypothesized the presence of a general oceanic segregation during the summer months within the northern part of the Western Mediterranean Sea, with males found at higher latitudes and females at lower latitudes, with the 41° parallel as the north/south boundary. Despite previous studies on the species, understanding of the movements and population structure of sperm whales in the Mediterranean Sea is still lacking (Carpinelli *et al.*, 2014; Rendell and Frantzis, 2016).

The Pelagos Sanctuary, a marine protected area located in the Northwest Mediterranean Sea covering 87,500km² (Notarbartolo di Sciara *et al.*, 2008) is characterized by a regular presence of sperm whales, as demonstrated by numerous visual boat surveys and acoustic detection studies since the 1980s (Notarbartolo di Sciara *et al.*, 1993; Gordon *et al.*, 2000; Frantzis *et al.*, 2011; Azzellino *et al.*, 2012; Tepsich *et al.*, 2014). From more than 30 years of research effort, it was generally understood that these waters are predominantly used as a foraging area by solitary individuals or loose aggregations of males (Drouot *et al.*, 2004; Drouot-Dulau and Gannier, 2007; Azzellino *et al.*, 2008). In the past 20 years, observations of females and calves, either alive or dead, were rare in the Pelagos Sanctuary (Table 1). Between June and September 2020, 17 sightings of sperm whales were collected onboard a 26m long whale watching boat, *Motonave Corsara* (Compagnia Golfo Paradiso SRL) in the northern part of the Pelagos Sanctuary. Of these, 13 were individual whales, two were loose aggregations of two and four individuals and two were social units. This study focuses on these two new records of females with calves observed the 21 August 2020 which, to our best knowledge, appear to be the most northward sightings of social units in the Mediterranean Sea reported to date (Fig. 1A).

The first group was sighted at 13:44 (local time), 14.6km from shore, at a depth of 700m, with a best estimate of 12 individuals (minimum 12, maximum 15) observed at the surface at the same time, although it is possible that more animals were not visible underwater. Eight animals, including two calves, were photo-identified by pictures of the dorsal fin and body flanks: (i) two animals were assumed to be females based on the observed presence of a callus on the dorsal fins (Kasuya and Ohsumi, 1966) and their close association with calves during the sighting (Fig. 1D); (ii) three other individuals were also most likely females, as they had calluses and were estimated to be between 10–12 meters in length, comparing them with the observation boat (Arnbom and Whitehead, 1989); (iii) one individual was classified as juvenile, due to an estimated size smaller than the females, both in the field and after reviewing the photos (Fig. 1B). The remaining animals were not approached and only observed at a distance. The animals were divided into a compact group (six individuals), that stayed for most of the time in close association displaying typical surface social behaviour such as surface rolls, lobtails and spyhops, with an additional loose aggregation of six whales further from the boat.

The second group was detected at 15:15 (local time), 16.2km west of the first group, at 18.5km from the shore and at a depth of 1,061m, with a best estimate of nine whales observed at the surface simultaneously (minimum 8, maximum 12). Six individuals were photo-identified during this second encounter: (i) two females were confirmed due to their association with calves and the presence of a callus on the dorsal fin; (ii) one was probably a female considering its length and the presence of the callus but had no associated calf; (iii) the rest were considered juveniles due to their body length in comparison to nearby adults during analysis of photographs. Whales were less compact during this second encounter than during the first but were similarly observed displaying socialising behaviour at the surface, with several surface rolls and side flukes towards the

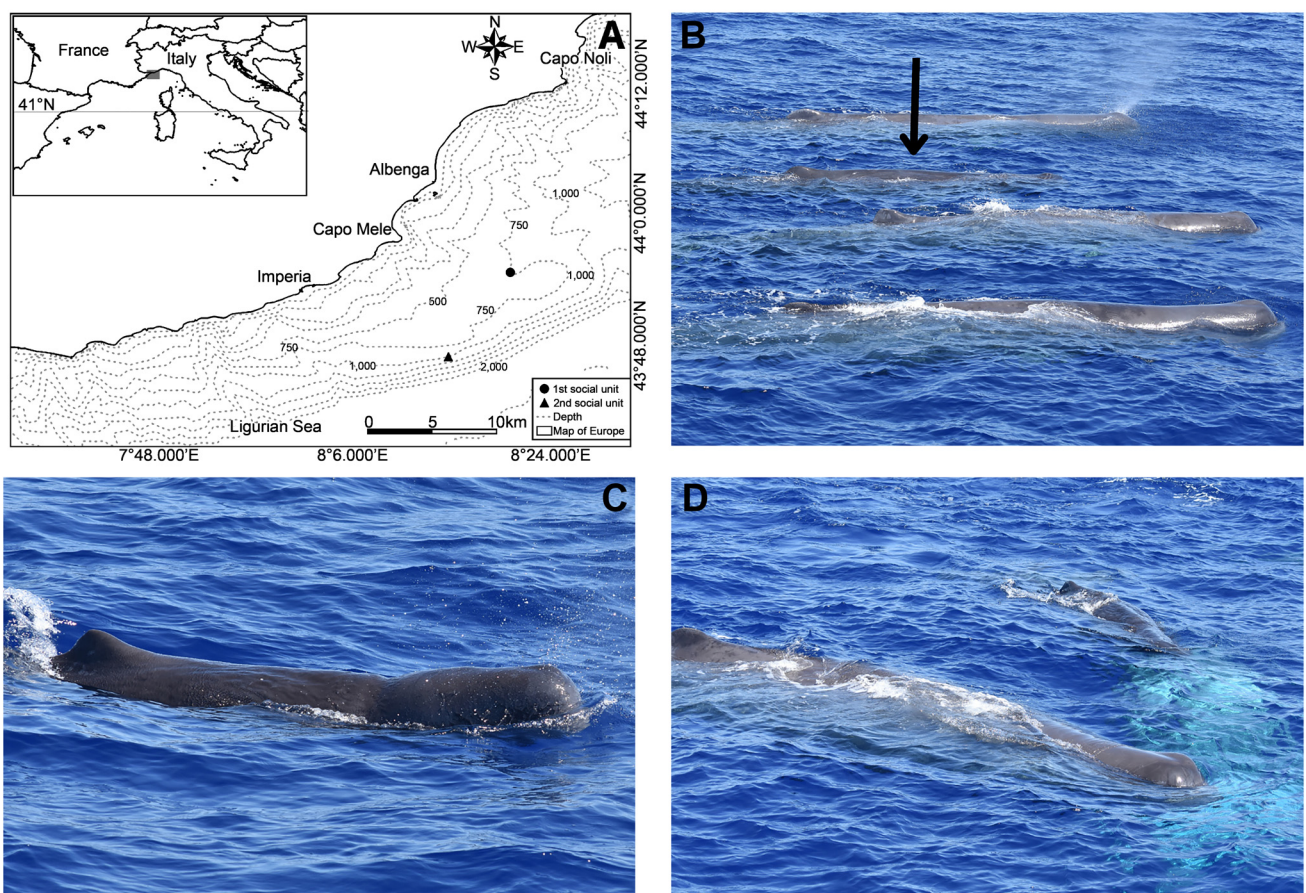


Fig. 1. (A) Map of the area where the two social units were observed. The black circle represents the 1st group encountered while the black triangle represents the 2nd group. (B) Compact group of four animals (three adults plus one juvenile indicated by the black arrow). (C) One of the four calves observed during a typical surface behaviour with the head emerging from the water for every breath. (D) Mother plus calf. (Photos: © Davide Ascheri).

boat. At the start of this sighting, when two adult females plus one calf were approached, the adults performed a fluke out dive, while the calf remained at the surface and approached the boat, where it stayed close by for 15 mins (Fig. 1C). After 25 mins the same two adults (confirmed by photo-ID) resurfaced and the calf moved towards them.

All four calves observed displayed the typical surfacing behaviour with their heads emerging from the water for every breath (Fig. 1C) (Moulins and Würtz, 2005). Moreover, two of the calves were observed several times swimming under the females' bellies in a possible peduncle dive, a type of dive typically associated with suckling behaviour, consisting of repeated short dives underneath the peduncle of a female (Gero and Whitehead, 2007; Gero *et al.*, 2009). However, no milk transfer was noticed. The four observed calves were estimated to be shorter than six meters and, due to their behaviour of not fluking when diving, were considered about 1–2 years old (Frantzis *et al.*, 2014).

It is not possible to determine the long-term association of these individuals, nor the absence of sperm whale visitors potentially only temporally associated with the unit, since the two groups were only encountered on this occasion and photo exchanges with other Italian Research Institutes operating in the Western Mediterranean Sea did not provide any positive matches. On the other hand, the presence of four calves (two for each sighting) and the typical socialising behaviour at the surface confirm the presence of two social units (Frantzis *et al.*, 2014), whose core units and their cohesion across time and space will further need to be investigated.

These new observations inside the Pelagos Sanctuary add to the few already present in literature and increase our understanding of the use of this area by sperm whales. Previous studies have highlighted the Ligurian Sea as an important summer feeding ground for male sperm whales (Drouot *et al.*, 2004; Azzellino *et al.*, 2008), but evidence for different uses of the area by the species is emerging.

Previous records have revealed that the basin can also be used occasionally for socialising behaviours (Pierantonio *et al.*, 2008) and for nursing calves, as observed by Calogero *et al.* (2019). Moreover, sightings of social units appear to have increased since 2007 in the French waters of the Mediterranean Sea north of 41° latitude, inside and especially outside the Pelagos Sanctuary (Tardy *et al.*, 2016). These discoveries may be related to an increased research effort or testify to a change in the area. However, these sightings demonstrate a co-occurrence between solitary males and units of females and calves in the northern Pelagos Sanctuary, even if, currently, to a smaller extent than in the southern and eastern part of the Mediterranean Sea.

The presence of females with calves inside the Pelagos Sanctuary raises concerns regarding the conservation of these fragile groups. The international Marine Protected Area is a high-density maritime traffic area and a high-risk area for cetacean collision with large ships, especially during the summer months, despite its ecological importance for several cetacean species (Di-Méglio *et al.*, 2018; Grossi *et al.*, 2021). Notwithstanding their peculiar ecology, with a prolonged time at depth for foraging and an estimate of only 16% of time spent at the surface (Di-Méglio *et al.*, 2018), sperm whales are still subject to these threats. In particular, it has been estimated that 15.8% of the total strandings of sperm whales along the Western Mediterranean Sea between 2005 and 2017 were caused by ship-strikes (Peltier *et al.*, 2019). This could be even worse for animals that are involved in

Table 1

Sightings of females and calves reported in Northwest Mediterranean Sea (inside the Pelagos Sanctuary). Records of stranded individuals are in italics.

Year	Month	Group Composition	Area	Source
2001	December	Herd of females and calves, > 10 animals	Off Monaco (France)	Moulins and Würtz (2005)
2002	February	<i>1 calf, 5.1 m long</i>	<i>Varazze (Italy)</i>	<i>BDS (2021)</i>
2003	September	3 animals including 1 calf	North of Corsica Island (France)	Laran and Gannier (2005)
2003	December	9 animals including 2 calves	North of Corsica Island (France)	Laran and Gannier (2005)
2004	January	<i>1 calf, 6 m long</i>	<i>Lerici (Italy)</i>	<i>BDS (2021)</i>
2008	October	7 animals with 1 calf	Off Saint-Tropez (France)	Tardy <i>et al.</i> (2016)
2011	October	15 animals with calves and newborn	Off Nice (France)	Tardy <i>et al.</i> (2016)
2012	July	<i>1 calf, 5 m long</i>	<i>Albissola (Italy)</i>	<i>BDS (2021)</i>
2012	September	10 animals with newborn and calves	Off Hyères (France)	Tardy <i>et al.</i> (2016)
2018	October	3 animals including 1 calf	Off Savona (Italy)	Calogero <i>et al.</i> (2019)
2020	August	12 animals with 2 calves and juveniles	Off Albenga (Italy)	This work
2020	August	9 animals with 2 calves and juveniles	Off Andora (Italy)	This work

socialising, feeding or in other activities taking place at the surface, which might result in decreased awareness of upcoming threats (David, 2002). As observed in the Canary Islands, females and young are the most affected by ship-strikes among sperm whales (Carrillo and Ritter, 2010), with possible negative implications on population conservation (Fais *et al.*, 2016). Reporting these currently unusual observations is therefore necessary to increase our understanding of the threats affecting sperm whales in the area, and to include these more vulnerable stages of the sperm whale life cycle in any mitigation measures adopted.

New year-round surveys are required to better understand the spatial and temporal distribution of these sperm whale social units in the Pelagos Sanctuary, and the movements of this endangered species across the Mediterranean Sea.

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