

Occurrence and relative abundance of common dolphins in three sites of the Portuguese shore

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ABSTRACT

Throughout the years some researchers have dedicated their efforts to the study of cetaceans' occurrence off Portugal mainland. However, it is still missing a systemic scientific methodology for studying the presence of coastal small cetaceans. This work is a recent approach to the occurrence and relative abundance estimative of cetaceans and especially common dolphins off the west central coast of Portugal. Boat-based visual surveys were conducted in three different geographic locations, resulting in the sighting of several species. In Nazaré we have only observed *Delphinus delphis* while in Peniche and Sesimbra a great diversity of species was recorded, including *Tursiops truncatus*, *Stenella coeruleoalba*, *Phocoena phocoena* and *Balaenoptera acutorostrata*. Most frequently sighted was common dolphin (62%). Occurrence of large groups of this species seems to take place along main ocean topographic features, like the Portuguese submarine canyons and we consider that great depths near shore are suitable habitats for more pelagic species of dolphins such as common dolphins. Total index of common dolphin abundance was of 2.198 individuals per surveyed hour. A much smaller APUE was found for Peniche than for the other two regions, where common dolphins show a similar relative abundance. Future studies using linear transects and continuous long-term approaches will give further insight to small cetaceans' occurrence along Portugal mainland and its relation with different oceanographic features, particularly depths and distances to shore. On-going efforts in coming years added to this first approach will be required to obtain knowledge for the conservation of cetaceans.

KEYWORDS

Population assessment; Relative abundance; Conservation; Portugal

INTRODUCTION

Cetacean distribution and abundance along Atlantic shores of Iberia is still poorly described and limited to a few recent sources (Certain, 2008; Stephanis, 2008). This is particularly true for Portugal, where the study of coastal and oceanic cetaceans along the mainland shore has never been a continuous and long term project. The first scientific and more concise work on this matter in the 20th century was conducted by Teixeira (1979). He compiled and analysed information about the occurrence of cetaceans between 1976 and 1978 using information from museums, old bibliography, strandings, captures by fisherman and observations at the sea. The results were that common dolphins (*Delphinus delphis*) were the most observed species, followed by striped dolphin (*Stenella coeruleoalba*). Later on a couple of other studies were conducted (e.g. Sequeira, 1988) and the results were similar.

From the beginning of the 1980's is the first study about the bottlenose dolphins (*Tursiops truncatus*) resident population of the Sado Estuary which has been monitored since

then (e.g. dos Santos, 1998; dos Santos *et al.*, 2007). In the last few years we are assisting to a growing in the number of studies published and presented in conferences (e.g. Ferreira *et al.*, 2008; Sá *et al.*, 2008; Vieira *et al.*, 2009) that again corroborates the above mentioned occurrences of common dolphins; results of other species occurrence are different according to the local of the coast.

Our objectives are to provide new and continuous information on the occurrence, distribution and abundance of cetaceans along the central Portuguese shore, especially of common dolphins.

METHODS

Study Area

The study area includes three different regions of the central western coast of Portugal mainland, namely Nazaré, Peniche and Sesimbra (Fig. 1). These locations were mainly chosen by their relevant oceanographic features such as the submarine canyons, because great depths near shore are suitable habitats for more pelagic species of dolphins. In Nazaré there is a submarine valley which is the largest canyon in Europe and one of the largest in the world, and more to the south, in Sesimbra, there are two other submarine canyons, Lisboa and Setúbal, as well as two of the major estuaries from Portugal, Tejo and Sado estuary (Mougenot, 1989). In our study area are also included two marine protected areas: the Natural Reserve of Berlengas (Peniche) and the Marine Reserve Prof. Luiz Saldanha (Sesimbra).

Cetacean sightings

A total of 102 boat based surveys were conducted from 2003 to 2009 (Table I). A survey route was selected without pre-determined fixed waypoints. Surveys normally ran perpendicular to the coastline to a maximum of 10 nautical miles off the coast with some variations depending upon prevailing weather and encounter with cetaceans. All surveys were conducted under a Beaufort sea-state inferior to 4. During the surveys one observer was stationed at each side of the boat, at least, scanning an area right ahead the vessel to approximately 135° from its bow. Recordings included species identification, date, time, geographic coordinates, size of the group, predominant behavior, sea state, bathymetry in the position of the sighting and sea surface temperature. The software ArcGis was used to map the sightings.

Analysis

We calculated SPUE (sighting per unit of effort) as the number of sighted cetaceans groups per time at sea for all detected species in each area: $n^{\circ} \text{ sightings} / \text{survey effort} \times 60 \text{ min}$. Relative abundance of common dolphins was estimated by calculating APUE (abundance per unit of effort), as the number of individuals (mean estimate of group size classes) per time at sea in each area: $n^{\circ} \text{ dolphins} / \text{survey effort} \times 60 \text{ min}$. For this analysis we only used sightings with complete information, such as time at sea and group size.

RESULTS

Cetacean occurrence

As a result of boat based surveys an effort of 25086 minutes at sea was accomplished for the three regions (Table I). A total of 79 sightings of 5 different cetacean species were recorded, in the three locations (Fig. 2, 3 and 4). From these, 49 (62%) were of common dolphins.

In Nazaré we have only observed *Delphinus delphis* while in Peniche and Sesimbra a great diversity of species was recorded, including *Tursiops truncatus*, *Stenella coeruleoalba*, *Phocoena phocoena* and *Balaenoptera acutorostrata*. Harbour porpoises were only registered off Peniche. Mixed groups of common and striped dolphins were found in Sesimbra as well as an occurrence of common dolphins close to a minke whale.

A total SPUE of 0.158 cetacean sightings per surveyed hour was obtained ($n=66$); a smaller SPUE for Peniche than for the other two regions was also obtained (Table II).

Common dolphin index of abundance

Groups of common dolphins varied between few individuals to several hundred in the three locations. No significant relation was found between group size and topographic or oceanographic features of the surveyed areas.

A total index of common dolphin abundance of 2.198 individuals per surveyed hour was obtained (n=66). A much smaller APUE was found for Peniche than for the other two regions, where common dolphins show a similar relative abundance (Table III).

DISCUSSION

The small delphinid community (common, bottlenose and striped dolphins) along the central coast of Portugal is similar to what can be found in the Bay of Biscay, Spain (Certain *et al.*, 2008). As referred in other studies about cetaceans' occurrence along the Portuguese mainland (e.g. Teixeira, 1979; Ferreira *et al.*, 2008; Sá *et al.*, 2008, Vieira *et al.*, 2009) and adjacent waters (e.g. Kiszka *et al.*, 2007), the common dolphin was the more frequent specie sighted. Information about its presence in Portuguese waters has also been consolidate along the years from opportunistic captures (Teixeira, 1979), data from stranding (Sequeira *et al.*, 1992; Sequeira *et al.*, 1996), interactions with fisheries (Wise *et al.*, 2007) and observations of opportunity (Vieira *et al.*, 2008). Group sizes of common dolphins are similar to what can be found, for instance, in the Strait of Gibraltar (Stephanis *et al.*, 2008).

Relative abundance of common dolphins off Nazaré was higher, but this refers to the total of cetaceans sighted in the region. Sesimbra followed, but a much greater diversity of species is found in this area. Peniche showed a much lower index of abundance; this is the region where the greatest diversity occurred. Diversity of species and abundance of individuals may reflect oceanographic and topographic characteristics of the studied areas. Depth and slope can be an important factor in the tree locations, considering that these areas are quite different in respect to great depths and its distance to the shore. Generally, it is known that areas adjacent to submarine canyons are extremely rich in nutrients sponsored by significant upwelling (Guerreiro *et al.*, 2006), feeding the trophic chain and composing preferential habitats for pelagic species such as common dolphins (e.g. Ballance *et al.*, 2006; Stockin *et al.*, 2008). The studied areas encompass three major submarine canyons, as well as two important estuaries, and occurrence and diversity of cetaceans must be related with these coastal features.

We also believe that species diversity found in Peniche and Sesimbra may result from some restrictions imposed to fisheries at the respective marine protected areas that, consequently, promoted an increasing availability of food resources to top predators as well as less anthropogenic impacts.

It is absolutely necessary to continue the study also considering interactions between cetaceans and fisheries and for that it is obligatory to monitor the coastal populations of cetaceans in such a poorly known area. Future studies using linear transects surveys to estimate abundance and continuous long-term approaches will give further insight to small cetaceans' occurrence along Portugal mainland and its relation to different oceanographic features, particularly depths and distances to shore. On-going efforts in coming years will be required to obtain knowledge for the conservation of cetaceans.

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Figure 1 – Localization of Portugal mainland indicating the three submarine canyons systems through bathymetric lines and geographical locations of boat based surveys.

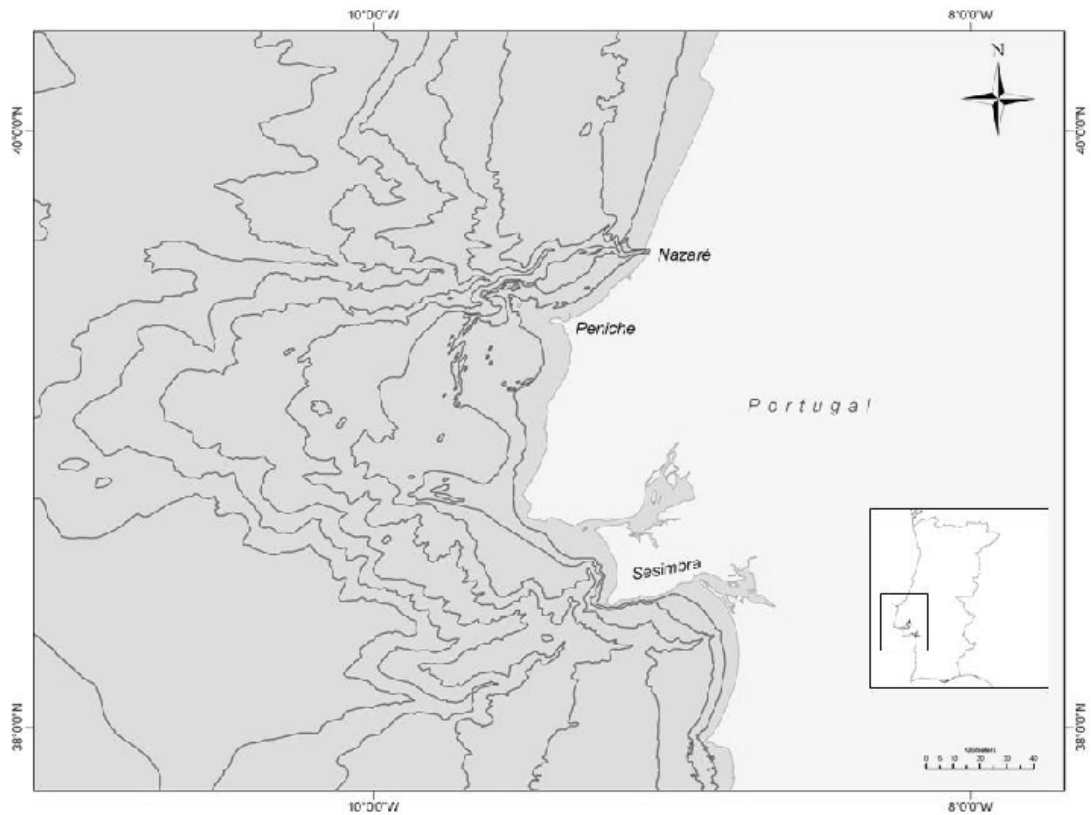


Table I – Number of sea surveys in each location and survey effort (min).

	Period	Surveys	Minutes
Nazaré	2007-2008	13	1564
Peniche	2003-2009	41	17400
Sesimbra	2007-2009	48	6122
TOTAL	2003-2009	102	25086

Figure 2 – Cetaceans sighted in Nazaré during 2007 and 2008 surveys (n=13): ▲ - common dolphin.

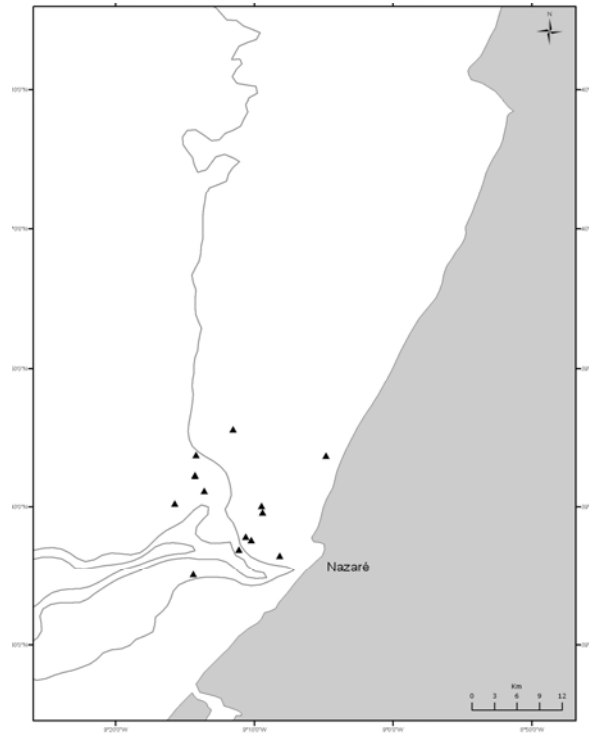


Figure 3 – Cetaceans sighted in Peniche during 2003 to 2009 surveys (n=38): ▲ - common dolphin; ★ - bottlenose dolphin; * - striped dolphin; ● - harbour porpoise; + - minke whale.

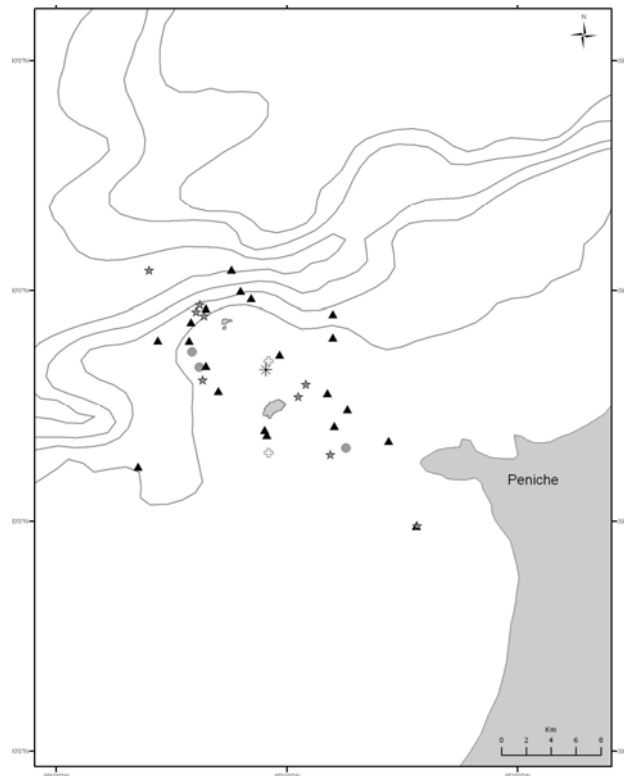


Figure 4 – Cetaceans sighted in Sesimbra during 2007 to 2009 surveys (n=28): ▲ - common dolphin; ★ - bottlenose dolphin; * - striped dolphin; + - minke whale.

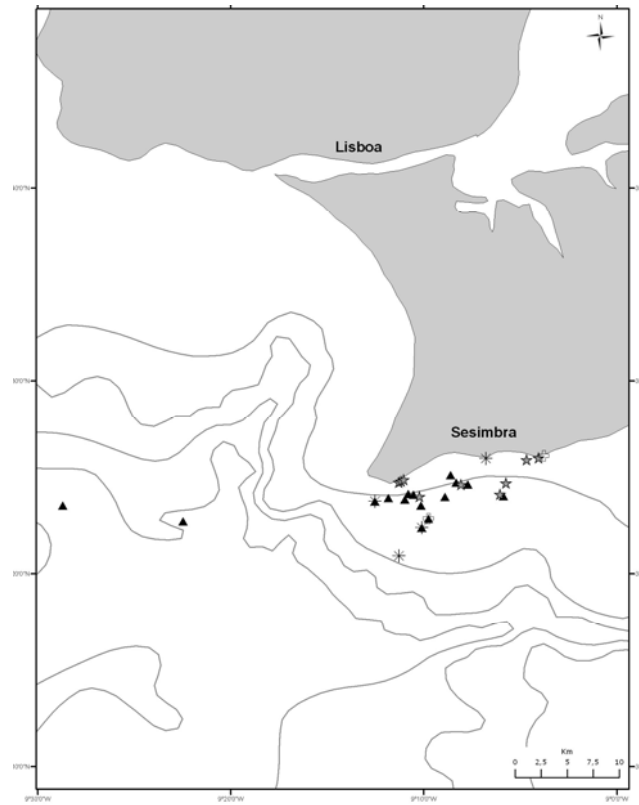


Table II – Species sightings in each location: survey effort (min), number of different species, number of sightings, and SPUE as number of sightings per hour surveyed.

	Survey effort	N. species	N. sightings	SPUE
Nazaré	1564	1	11	0.422
Peniche	17400	5	24	0.083
Sesimbra	6122	4	31	0.304
TOTAL	25086	5	66	1.158

Table III – Common dolphin APUE for each location: survey effort (min), number of individuals (mean of each detected group size class), and APUE as the number of individuals per hour surveyed.

	Survey effort	N. dolphins	APUE
Nazaré	1564	140	5.371
Peniche	17400	279	0.962
Sesimbra	6122	500	4.900
TOTAL	25086	919	2.198