

# ENVIRONMENTAL FACTORS DRIVING CETACEAN DISTRIBUTION OFF THE CENTRAL CATALAN COAST

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## INTRODUCTION

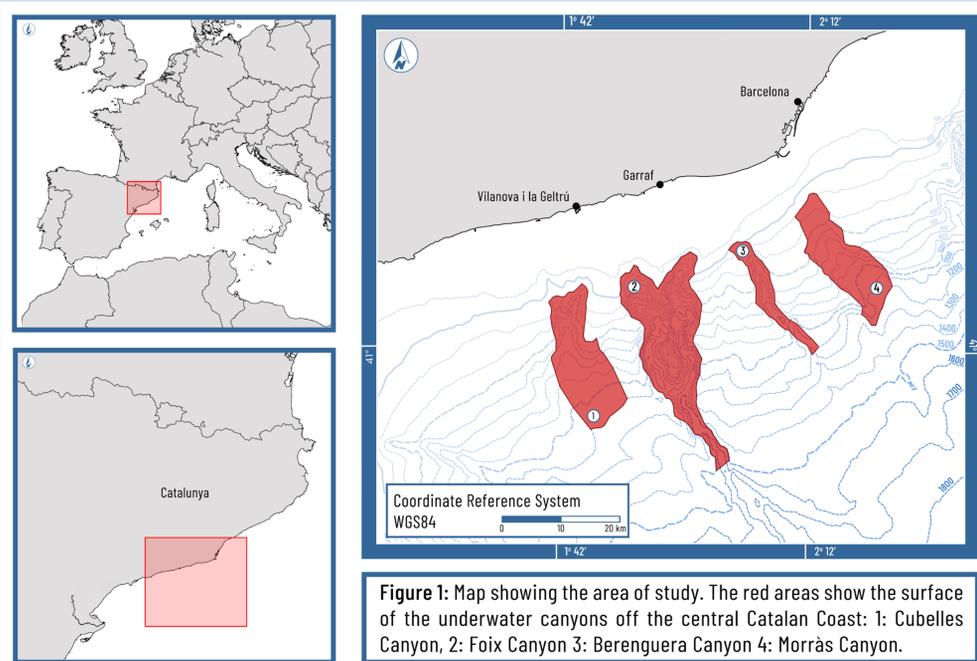
Several species of cetaceans have been recorded off the Catalan coast. Previous studies and stranding records carried out since the 1970s suggest that cetaceans are present year round in the Northwestern Mediterranean Sea (Gozalbes Aparicio *et al.*, 2012), however, there is a lack of information on cetacean distribution of the central Catalan coast.

Local seafloor physiography (depth, slope, and the presence of geographical accidents such as submarine canyons) can play a significant role in cetacean distribution. Cetacean associations with submarine canyons have been anecdotally described or documented in scientific literature. However, while studies on cetacean distribution and abundance within and around submarine canyons exist, the amount of data available is limited and biased towards a few well-studied canyons known for high cetacean abundance (Moors-Murphy, 2014).

In this context, the present work aims to assess the importance of submarine canyons and other physical environmental factors, such as depth and slope gradient of the seafloor (slope), in cetacean distribution.

## METHODS

The study area is located off the central Catalan coast (NE Iberian Peninsula), covering approximately 1100 km<sup>2</sup> between the coastline and 15 miles offshore. The area is located on the continental shelf and slope and it is characterised by the presence of four submarine canyons, as occurs in other areas of the Mediterranean (Figure 1).



(Figure 1)

Dedicated boat surveys were carried out from Vilanova i la Geltrú, Sitges and Segur de Calafell harbours between 2013 and 2016 and from Garraf harbour since September 2016.

A handheld GPS was used to record the coordinates of the sightings and the track of each surveys. The GPS tracks were used to extract the position of the vessel every 20 minutes. Information about the group size, composition and general behaviour was recorded for each sighting. QGIS 3.8 was used to extract the depth, the slope and the distance to the nearest submarine canyon for each sighting.

Hexagonal tessellation (cells  $r=1\text{ nm}$ ) was used to generate searching effort and species distribution maps. Effort maps were obtained by counting the observation points in effort (active search for cetaceans) in each cell (Díaz López and Shirai, 2007).

The softwares R and Past3 were used to carry out the statistical analysis.

## RESULTS

Data were collected year round in two periods (march 2013 – June 2014 and April 2016 – December 2018) during 79 days at sea, covering a total distance of 5473 km.

In total, 122 sightings of 6 different species, including fin whales (*Balaenoptera physalus*), bottlenose dolphins (*Tursiops truncatus*), striped dolphins (*Stenella coeruleoalba*), Risso's dolphins (*Grampus griseus*), sperm whales (*Physeter macrocephalus*) and common dolphins (*Delphinus delphis*) were recorded.

The distribution of species (sightings per unit of effort) is shown in Figure 2.

Box-plot analysis and One-Way Anova was used to compare the depth, distance to the canyon and slope in which the most sighted species were found (Figure 3).

Results showed that there were significant differences between species at the  $p < 0.05$  level in depth [ $F(4,114) = 14.92, p = 0.000$ ], slope [ $F(4,109) = 3.92, p = 0.005$ ], and distance to the canyons [ $F(4,114) = 11.11, p = 0.000$ ].

Bottlenose dolphins found in continental shelf waters, relatively shallow, away from canyons and with low slope.

Fin whales found in slope waters of moderate depth, near underwater canyons.

Risso's dolphins found in slope deep waters above underwater canyons.

Striped dolphins found in a wider range of slope deep waters close to underwater canyons.

Sperm whales found in slope deep waters, relatively close to underwater canyons.

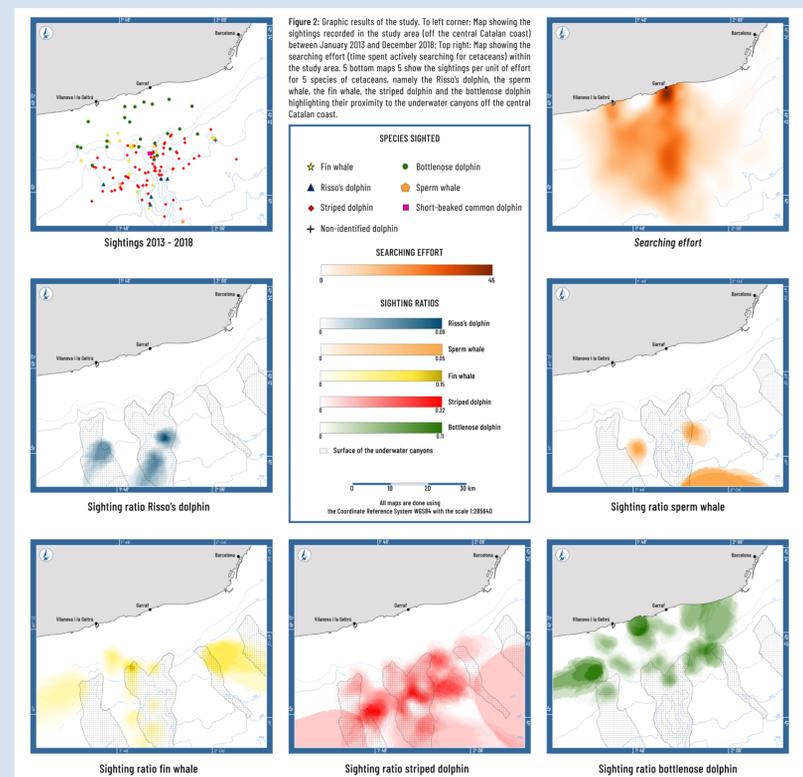


## CONCLUSIONS

The study showed that species distribution might be highly influenced by the characteristics of the seafloor, namely depth, slope, and the presence of geographical accidents such as submarine canyons.

The study provides valuable baseline information on the physical environmental factors that influence cetacean distribution.

Future works combining environmental and geophysical variables are needed to have a global understanding of the factors driving cetacean distribution off the central Catalan coast.



(Figure 2)

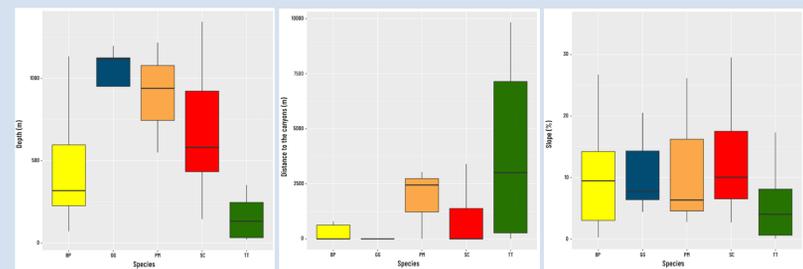


Figure 3. Box Plot displaying data distribution of physical environmental factors (depth, distance to the canyon and slope) and species. BP Fin whales (n=18), GG Risso's dolphins (n=5), PP, Sperm whales (n=3), SC Striped dolphins (n=70), TT Bottlenose dolphins (n=26).

## ACKNOWLEDGEMENTS

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