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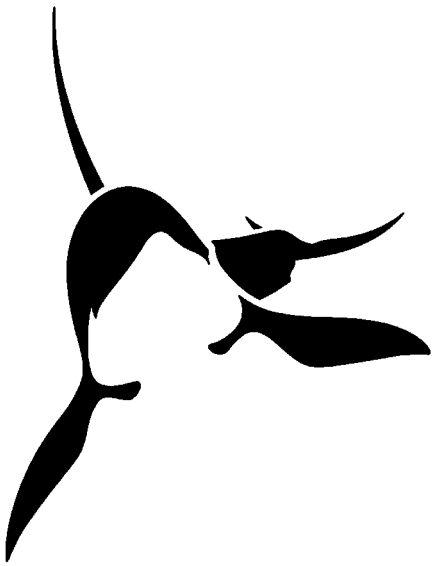

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YEAR-ROUND MONITORING OF CETACEAN POPULATIONS IN THE NORTHERN TYRRHENIAN SEA (PELAGOS SANCTUARY) USING FERRIES AS A RESEARCH PLATFORM

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INTRODUCTION

Year-round continuous cetacean monitoring programs provide information that facilitates conservation of marine mammals and adaptive management of MPAs. This research investigates distribution, relative abundance and seasonality of cetacean along a transect which is at the southern-eastern border of the Pelagos Sanctuary and crosses the Tuscan Archipelago Protected Area. In this paper we present data from weekly observations that were undertaken from February 2008 to February 2009 with dedicated surveys along the fixed transect Livorno-Bastia route (Northern Tyrrhenian Sea), using ferries as a research platform. Repeated surveys along fixed transects reduces spatial heterogeneity; furthermore, the use of scheduled ferry runs does not add a new disturb for the animals. Data collected contribute to the large-scale cetacean survey network which monitors the Ligurian and Tyrrhenian Sea; all records of the network are shared through a common database.

METHODS

From February 2008 to February 2009 weekly dedicated survey were undertaken in "passing mode" (continuous search effort, with schools or animals not being approached), along fixed transect (Table 1), using ferries as a research platform for dedicated surveys along the Livorno-Bastia route (Northern Tyrrhenian Sea). Observations were undertaken only in Beaufort ≤ 3. Each transect was considered as an independent statistical unit. For each species correlation between consecutive transect runs was undertaken to assess independency; in case of "similarity" one of the run was randomly excluded from the data set.

We primarily analyzed presence, encounter rate (ER = number of sightings per hour spent in observation-"on effort"), mean group size and distribution. Sightings were related to boat traffic (vessels>5 metres) and oceanographic parameters (such as chlorophyll concentration or sea surface temperature). Possible ferry-whale collisions were also recorded.

Table 1 Survey route parameters

Route length	Average travel speed	Average journey time
65 NM	18.04 kts	3.05 hrs

RESULTS

During 78 transects (239 hours of survey effort), we sighted 82 cetacean groups that contained 322 individuals. Mean encounter rate was 0.35 sightings /hour. (Table 2).

Table 2 Survey effort from Feb. 27, 2008 to Feb. 28, 2009

# transects	Hrs surveyed	Nautical Miles surveyed	# cetacean sightings	# cetacean sighted	Encounter rate
78	228.20	4117.03	82	322	0.0199 sightings /NM
					0.3502 sightings/hr

Three species were commonly sighted: fin whale (*Balaenoptera physalus)* (26% of sightings, 8% of

sighted animals), striped dolphin (*Stenella coeruleoalba*) (36% of sightings, 71% of sighted animals) and bottlenose dolphin (*Tursiops truncatus*) (32% of sightings, 20% of sighted animals). There were, however, seasonal differences in presence and relative abundance of different species during the year. *Physeter macrocephalus,* instead, was sighted only once.

Species distribution, density spatial distribution and encounter rate

Fin whale: the correlation test showed correlation only between sightings of some consecutive runs during April and May, probably due to a stationary behavior of the species during those months. The species distributed mainly on the continental shelf (Fig.1 and Fig. 2), where nautical traffic were less intense (Agnesi et al., 2007; Arcangeli et al., in press).

The encounter rate of this species showed a bimodal trend of presence with maximum on spring and fall (Fig.3), which agrees with the hypothesis of migratory passage along this transect.

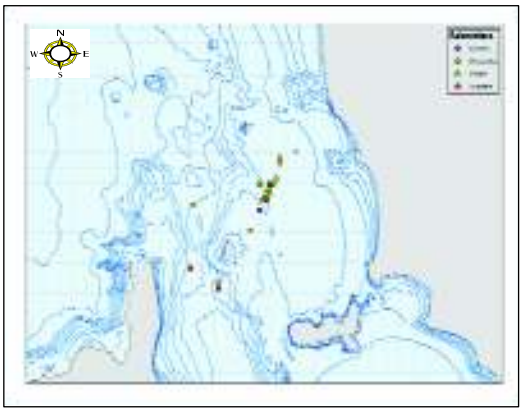

Fig. 1 Fin whale sightings per season

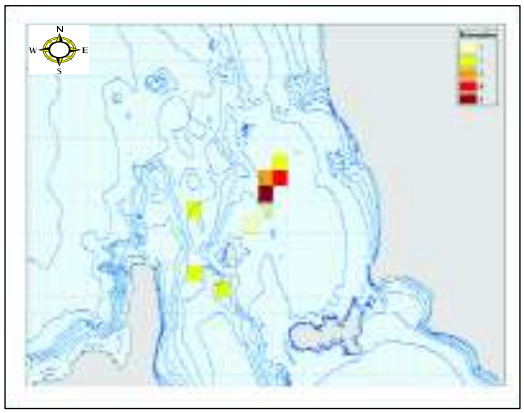

Fig. 2 Fin whale density spatial distribution

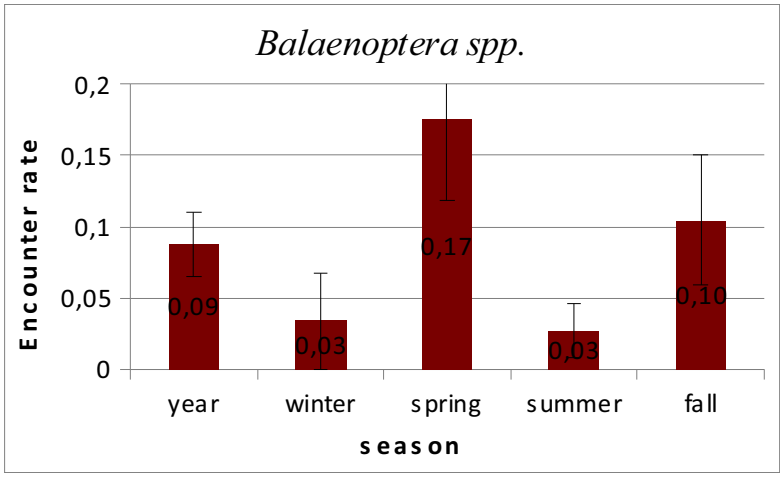

Fig. 3 Fin whale ER by season

Striped dolphin: density values, as well as the encounter rate, for (Fig.4, Fig. 5, Fig. 6) agree with what expected considering the topography of the track line of the route. The species is distributed especially in the western part of the transect, characterized by depths over 400 meters. During the spring, the species moves towards the continental shelf.

Fig. 4 Striped dolphin sightings per season

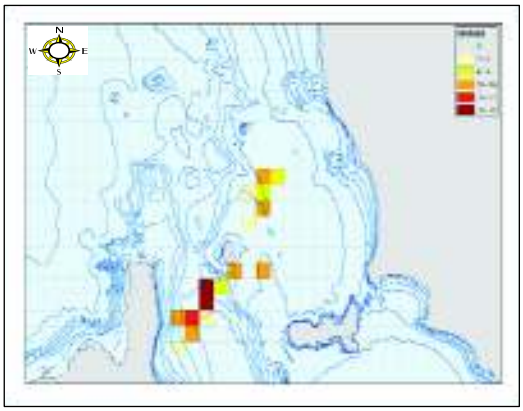

Fig. 5 Striped dolphin density spatial distribution

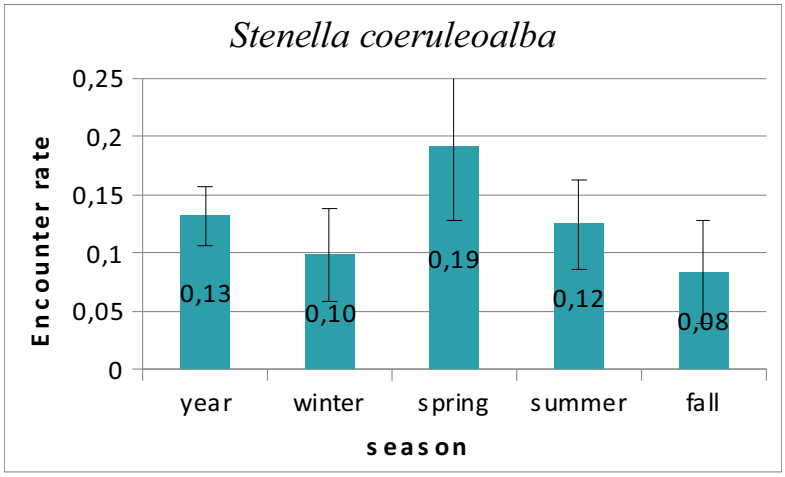

Fig. 6 Striped dolphin ER per season

Bottlenose dolphin: is generally found near the coastal areas during the year, except in spring, when it distributes all along the Livorno-Bastia transect (Fig. 7, Fig. 8): this could be related to males dispersal during the mating period or for food search opportunity. Thus, it appears that the Sardinian-Corsican population and the continental one are not separated.
During fall and winter, the species had a lower encounter rate, compared to spring and summer (Fig. 9).

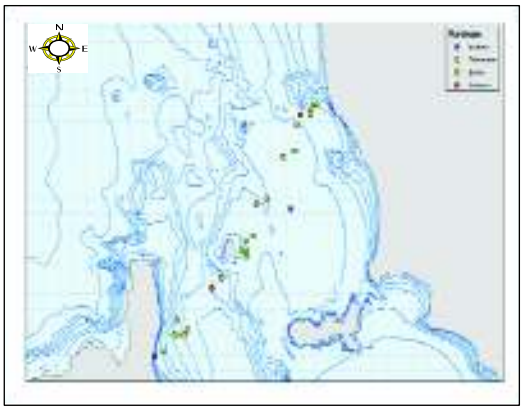

Fig. 7 Bottlenose dolphin sightings per season

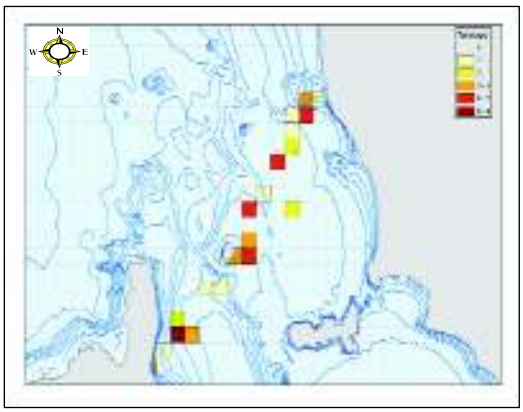

Fig. 8 Bottlenose dolphin density spatial distribution

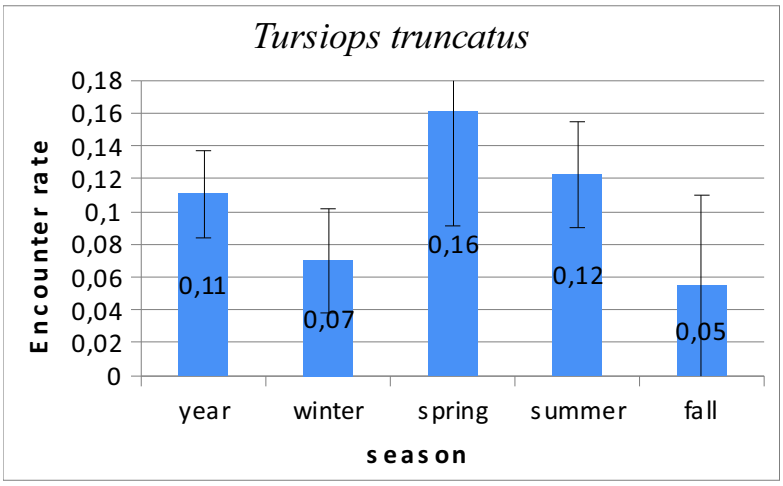

Fig. 9 Bottlenose dolphin ER per season

During cetacean sightings the amount of detected nautical traffic was lower (-180%; $P<0.05$) than in absence of cetacean ("control"). No cetacean ship strikes were recorded over 4300 NM travelled. Finally, no significant correlation was found between encounter rate data and the chlorophyll concentration or between encounter rate data and sea surface temperature.

DISCUSSION

Ferries are an efficient and cost-effective research platform for long-term monitoring program of cetaceans despite some disadvantages such as the fact that it is not possible to change route to follow animals to confirm species identification, group size or behavior (Marini et al., 1997; Arcangeli et al., 2008). Even thought, the study provided important data about year-round cetacean presence in the Northern Tyrrhenian Sea, where two Marine Protected Areas are established (Pelagos Sanctuary and Tuscany Archipelago MPA). Results showed seasonal differences in presence and relative abundance of species, extremely important data to be taken into account in planning species conservation programs. At the moment the research is still ongoing which will provide long term data on species that will be correlated to oceanographic data and human related factors.

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