# EUROPEAN RESEARCH ON CETACEANS - 22

**PROCEEDINGS OF THE TWENTY-SECOND ANNUAL CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY, EGMOND AAN ZEE, THE NETHERLANDS 10-12 MARCH 2008**

**EDITORS: G.J. PIERCE, E. PHILIPS & R. LICK**

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# Monitoring cetacean populations over 15 years in Central Tyrrhenian Sea using a non-dedicated ferry as a observation platform.

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## INTRODUCTION

Italy has taken several commitments in terms of monitoring Cetacean populations, in accordance with international Conventions, Agreements, European Directives, Regulations and Strategies including the CBD, ACCOBAMS, the Pèlagos Sanctuary, the Habitats Directive and the Regulation (EC) 812/2004. Moreover, monitoring cetacean presence, distribution and migration timing is an effective indicator to detect environmental changes and habitat degradation and to recommend appropriate conservation planning.

Types of observation platforms and cost of research have been the main problems on the development of an effective and cost efficient protocol to survey cetacean population over time. Given the low cost, the standard route, speed and height of the observer, ferries are an efficient and cost-effective platform of opportunity for long-term monitoring programmes of cetaceans (Wall *et al*., 2006; Kiszka *et al*., 2007). Ferries provide the opportunity to undertake repetitive surveys along a fixed line transect which can be conducted regularly throughout different years, providing, consequently, information on long-term populations pattern (MacLeod *et al*., 2007) .

The geographical and ecological characteristics of the Central Tyrrhenian Sea makes it strategic for collecting data and monitoring the presence of animals, also because intercepts perpendicularly the marine corridor that connects the Northern-Pelagos Sanctuary to the Southern-Mediterranean Sea where a new protection zone for the protection and conservation of marine biodiversity has been proposed.

## METHODS

From 1989 to 1991 weekly observations on cetacean were undertaken (Marini *et al*., 1997), in "passing mode", using ferries as platform of opportunity for dedicated sightings (*sensu* Donovan, 2005) along the "fixed line transect" (Fig. 1) from Civitavecchia (Rome district-Latium) to Golfo Aranci (Sardinia). The route included different habitats such as shelf, shelf edge and deep sea and is perpendicular to the direction of whales migration.

In 2007 research restarted with same protocol and under supervision of same investigators. In this study we describe results from summer, from May to September, 2007 (31 runs-160 hours of time spent in observations) and we compare them with the pattern of occurrence of three years of summer surveys conducted in the 1990s (89 ferry runs-598 hours of observations).

Mean cruising speed was approximately 18-19 knots. Average time of the run was approximately 6-7 hours. However, due to variation in visibility clearness during the survey (for changes in wind strength, wave height, rain or fog), the actual observations were not continuous and differed according to the run. For this reason and due to the fact that along the transect sighting could be considered an event and not a state, relative abundance was measured as number of sightings for unit of time spent in observation -encounter rate- (Reid *et al*., 2003; Evans and Hammond, 2004; Wall *et al*., 2006) ).

Each transect was considered as an independent statistical unit. We primarily analysed presence, relative abundance calculated as encounter rate (number of sightings per hour of observation -e.r.-), mean group size (g.s.) and distribution; observations were undertaken in fine weather condition (Beaufort sea-state 3 or less and good visibility). Sightings of cetacean species were associated to ferry position and group size. Moreover, possible episodes of "ferry-whale" collisions were recorded. Two observers, of which at least one expert, were located on the bridge of the boat. Each observer focused primarily on a 90° arc ahead of the ship and continuously scanned the area by naked eye with occasional scan with binoculars, which were used mainly to confirm sightings and assess species and group size. Even if data on radial distance and angle between the detected group

and the trackline have been recorded, in order to apply the line transect sampling methods (Distance), these have not been used in this preliminary analysis.
We used identification at genera level for *Balaenoptera* spp. as it was not always possible to distinguish between the species present in the Mediterranean. For all the species, when not possible to identify the species, the sighting was placed in the non identified category (NI).
As there was no or just mild violation of data distribution, ANOVA was used to test variation of relative abundance between different years and between months within the same year.


**Fig. 1 -** Study area. Source google earth

## RESULTS

### Presence, relative abundance, group size

Of the seven species of cetaceans sighted in the 90s (with a total of 393 sightings) only six were recorded (with a total of 110 sightings) in 2007 (Table 1). In the 90's 18% of sightings were recorded in the NI category, while in 2007 only 5% of sightings were NI.

**Table 1 -** Species of cetaceans in the Mediterranean Sea and species sighted in Central Tyrrhenian Sea in Summer in the 90s and 2007 survey.

| Species | Presence in Mediterranean sea | Sighted in Central Tyrrhenian Sea during summer '90 and 2007 (in bold) | |
|---|---|---|---|
| | | Frequent | Between 1 and 4 sightings |
| *Balaenoptera physalus* (Lacépède, 1804) | Regular | X **X** | |
| *Globicephala melas* (Traill, 1809) | | | |
| *Physeter macrocephalus* (Linnaeus, 1758) | | - | X **X** |
| *Stenella coeruleoalba* (Meyen, 1833) | | X **X** | |
| *Tursiops truncatus* (Montagu, 1821) | | X **X** | |
| *Ziphius cavirostris* (Couvier, 1823) | | | X **X** |
| *Delphinus delphis* (Linnaeus, 1758) | | - | - |
| *Grampus griseus* (Cuvier, 1812) | | X | - |
| *Balaenoptera acutorostrata* (Lacépède, 1804) | Occasional | X | **X?** |
| *Pseudorca crassidens* (Owen, 1846) | | - | |
| *Steno bredanensis* (Cuvier in Lesson, 1828) | | - | |
| *Orcinus orca* (Linnaeus, 1758) | | - | |
| *Megaptera novaeangliae* (Borowski, 1781) | | - | |
| *Eubalena glacialis* (Müller, 1776) | Accidental | - | |
| *Balaenoptera borealis* (Lesson, 1828) | | - | |
| *Kogia sima* (Owen, 1866) | | - | |
| *Mesoplodon densirostris* (Blainville, 1817) | | - | |
| *Mesoplodon europaeus* (Gervais, 1855) | | - | |
| *Sousa chinensis* (Osbeck, 1765) | | - | |

In 2007, encounter rate of *Balaenoptera* sp. was 0,18h$^{-1}$±0,06 with group size of 1,3±0,11 while, for *Stenella coeruleoalba*, e.r. was 0,51h$^{-1}$±0,08 with 5,4±0,57 g.s. There was a significant difference of monthly e.r. of *Balaenoptera* sp. (P<0.05), with higher values at the beginning of summer, strengthening the migratory behaviour trend recorded for the first time in the 90's. Monthly e.r. of *S. coeruleoalba*, instead, was similar during the summer period in 2007 (P=0.36) as it was in the 1990 study (Fig.2).

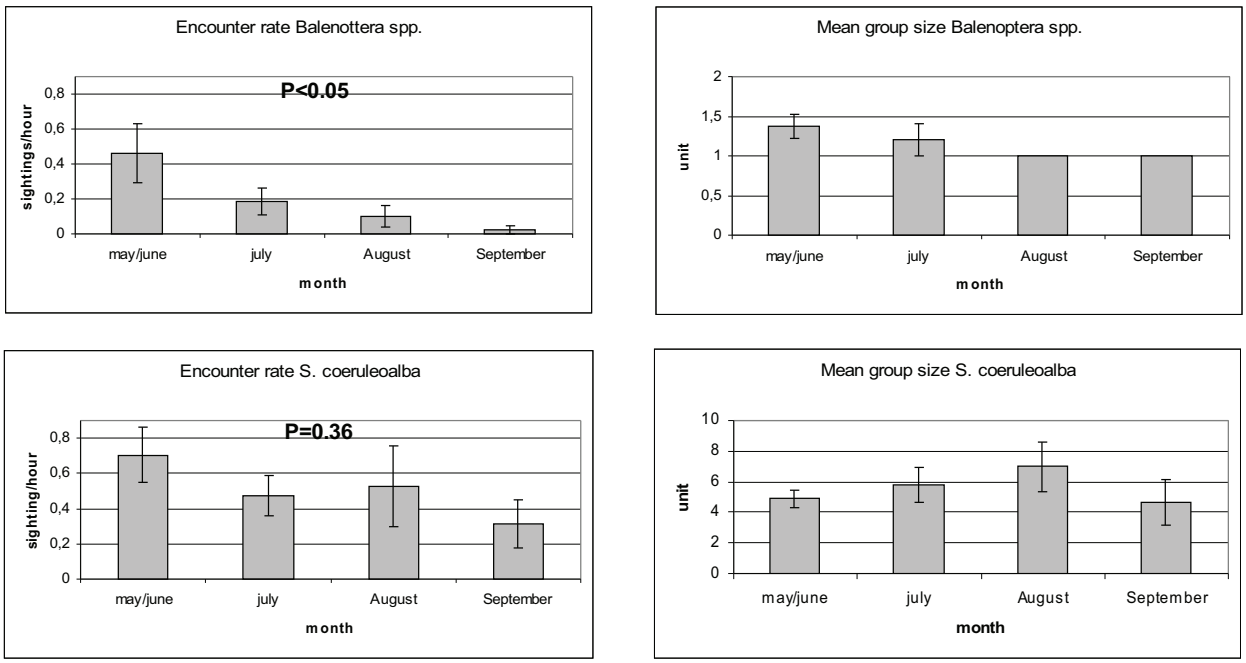


**Fig. 2**- Encounter rate and group size during summer 2007 of *Balenoptera* spp. and *Stenella coeruleoalba*; figures represent mean values (±1 S.E.) per ferry run; P-value: probability that the monthly encounter rate have the same mean.

Compared with the 90s there was an increase of e.r. of *Balaenoptera* spp. (78%) and of *S. coeruleoalba* (29%), for the latter g.s. decreased (18%).
*Tursiops truncatus* e.r. in 2007 was 0,050h$^{-1}$±0,01 and g.s. was 2,55±0,6. Compared with the 1990s there was a 30% increase of e.r. and a 39% decrease in group size (Fig. 3).

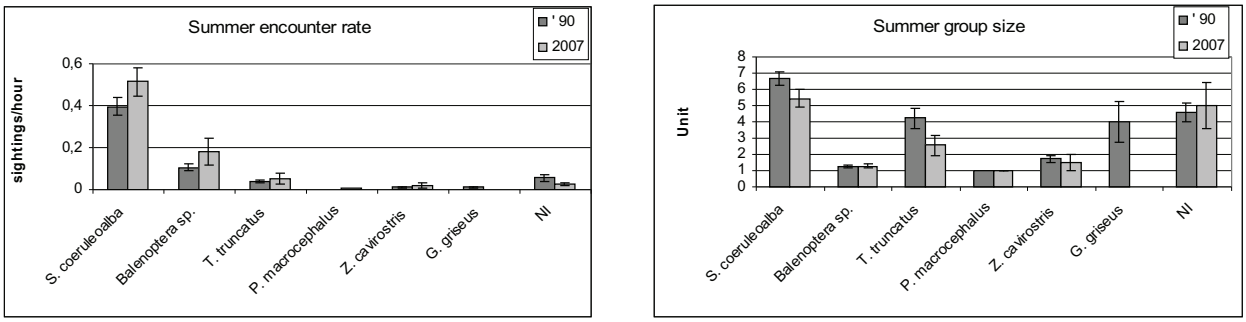


**Fig. 3**- Comparison between summer 90s and 2007 of encounter rate and group size; figures represent mean values (±1 S.E.) per ferry run.

## Distribution

In both the investigated periods, distribution pattern of *Balaenoptera* sp. was aggregated with a large number of sightings occurring between 50 and 90 NM from the Latium coastline and within the bathymetry of 1.000 m and 1.500 m.
*S. coeruleoalba* had a casual distribution pattern with most of the sightings occurring between 40 and 110 NM from the Lazio coastline within the deep sea bottom.

Most of the sightings of *Tursiops truncatus* occurred towards the Sardinian coastline, within the continental shelf. However, some sightings occurred also within the deep sea bottom and towards the Civitavecchia coastline (Fig. 4, Table 2).

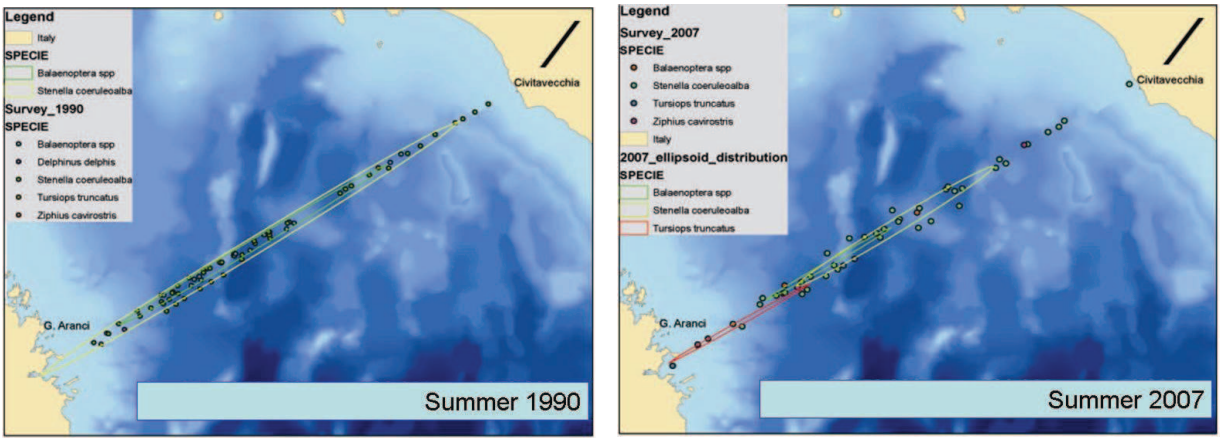


**Fig. 4**· Ellipsoid distribution of the main sighted species, both in Summer 90s and in 2007

**Table 2**. Summary of main results for relative abundance, group size and distribution; comparisons between the 90s and 2007 survey.

| | Encounter rate (number of sightings per hour of observation) | | Group size | | Distribution > 75% of sightings | |
|---|---|---|---|---|---|---|
| | 2007 | difference with the 90s | 2007 | difference with the 90s | 2007 | 90s |
| ***Balaenoptera sp*** | $0{,}18h^{-1}\pm0{,}06$ | > 75% | 1,3±0,11 | > 5% | 50-90 MN from the Lazio coastline. Bathymetry 1000-1500 | 50-90 MN from the Lazio coastline. Bathymetry 1000-1500 |
| ***S. coeruleoalba*** | $0{,}51h^{-1}\pm0{,}08$ | >25% | 5,4±0,57 | <20% | 40 -100 MN from the Lazio coastline. Bathymetry > 400 | 40 -110 MN from the Lazio coastline. Bathymetry > 400 |
| ***T. truncatus*** | $0{,}050h^{-1}\pm0{,}01$ | >30% | 2,55±0,6 | <40% | 10-20 MN from the Sardinian coastline. Bathymetry 0-200 | 0-20 MN from the Sardinian coastline. Bathymetry 0-200 |

## Ferry-whale collision

No Ferry-whale collisions were recorded in the investigated periods, for a total of 141 ferry runs, which included also runs carry out in poor visibility (n=21).

## CONCLUSION

Preliminary results of comparisons over 15 years showed some differences with an increase of relative abundance of whole sighted species. *Grampus griseus* was not re-sighted in 2007 and *Balaenoptera* spp. confirmed the migratory behaviour with sighting peaking in June before decreasing by September. Geographical distribution of the sighted species was similar over time. General comparisons, however, need to take into account the different observation effort and different values of not identified species.

While no ferry-whale collisions were recorded, the results back up the need of a "voluntary code of conduct" for the shipping industry to reduce cruise speed, especially at night, during *Balenoptera* spp. peak migration period (e.g June for the summer period in the Central Tyrrhenian sea) in areas were encounter rates are high (e.g. in the stretch between the 50 and 90 MN from the Lazio coast) .

Re-surveying confirmed how effective and cost-efficient are regular ferry based surveys for monitoring relative abundance, distribution of cetacean and, consequently, environment quality. More research, however, is required to:

1. increase knowledge on cetaceans presence, distribution and migration pattern to control the effectiveness of conservation actions already undertaken, such as the Pèlagos Sanctuary, and to support the require of further new conservation effort such as the proposed new Sanctuary in the Southern-Mediterranean;
2. assess if data collected from the line transect are consistent with data from other sources.

From spring 2008 other research organizations, such as University of Genoa, University of Pisa and Ketos NGO in Sicily, agreed to undertake a similar monitoring programme in other areas of the Tyrrhenian sea, allowing the development of a wider survey, from the Ligurian basin to the Sicilian channel, using the same established research protocol. ISPRA-the Italian Institute for Environmental Protection and Research of the Italian Ministry of Environment of the Land and the Sea is part of this network. The analysis of data collected in 2008 campaign are in progress. Aim of the Institute is to validate and standardise recording methods and assess the efficacy of a 'long-term' monitoring programme in term of early sign of potential decline in cetacean population. Monitoring cetacean presence, relative abundance, distribution and migration timing, in fact, is an effective indicator to detect environmental changes and habitat degradation as cetacean, being at the top of the food chain and living in a wide range of habitats, are good indicators of marine and coastal health and can provide information to improve conservation and adaptive management.

**ACKNOWLEDGEMENTS**

This research was made possible thanks to the contribution of the **Corsica-Sardinia Ferry**, the Town of Civitavecchia and the RP Optix. We especially would like to thank Annalisa Baldacci, Cristina Pizzutti, Matteo Germinario and all the crew of the Sardinia Vera. Many thanks also to Federica Gelosa, Laura Grippia, Germana Villetti, Gianni Prontu, Stefania Carcassi, B&B de Rosas (G. Aranci) and Bruno Diaz Lopez.

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