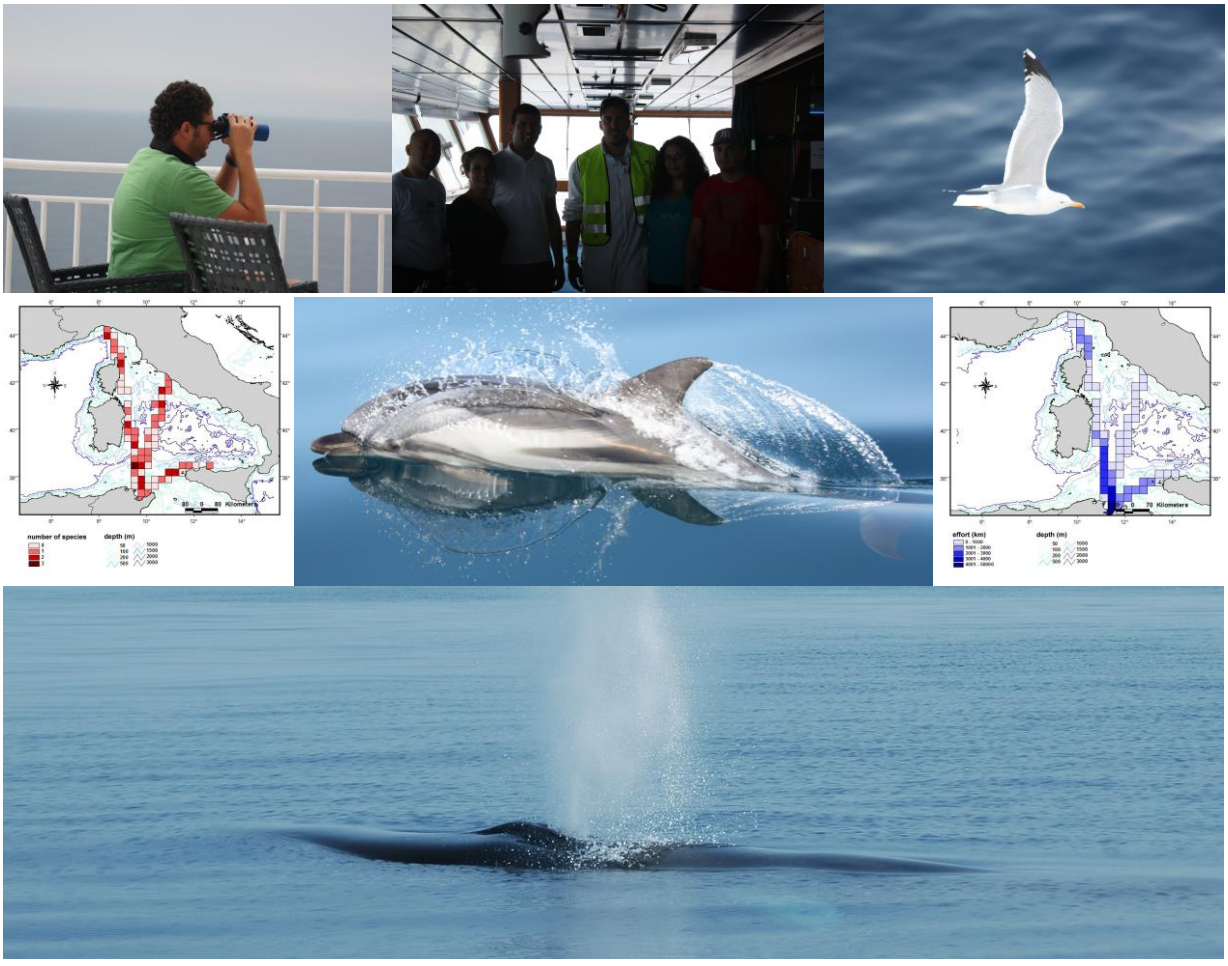
Accord sur la Conservation des Cétacés de la Mer Noire, de la Méditerranée et de la zone Atlantique adjacente

ACCOBAMS

Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area

Cetacean coordinated transborder monitoring using ferries as platform of observation off Tunisia



ATUTAX

PARTENAIRE ACCOBAMS

Aïssi et al.

October 2015

Title of the report
Cetacean coordinated transborder monitoring using ferries as platform of observation off Tunisia

Study required and financed by
ACCOBAMS Secrétariat Permanent
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Reference of the study

Memorandum of Understanding N° 002/2013

With the participation of

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1. Context of the study

The Strait of Sicily is a topographically complex region of the central Mediterranean Sea connecting the western and eastern Mediterranean sub-basins. Its special topography allows the occurrence of significant biological processes and phenomena, and circulation scheme makes this area a highly productive and a biodiversity hotspot within the Mediterranean, since various retention areas for phytoplankton and nurseries for small pelagic fishes has been identified.

This Mediterranean sub-region is classified as poorly studied within the ACCOBAMS area and requires further studies to determine cetacean critical habitats (Hereafter CCH) and threats related to them. Indeed, data on the occurrence and distribution of cetacean species in the Mediterranean is non-homogenous. Being extremely mobile and migratory top predators, these species are able to travel rapidly from one area to another depending on trophic richness of a given area. The strait of Sicily is suspected to play a crucial role in the life cycle of cetacean species allowing the inter-basin movements.

Taking into consideration efforts deployed by different researchers, government bodies operating in this areas and ACCOBAMS partners, various strategies were developed to fill the gap of information. This study comes in this context covering an area characterized by the presence of fin whales (*Balaenoptera physalus*) and other cetacean species, in order to assess new Mediterranean areas that could require protection and conservation measures, as well as for the identification of potential threats and the implementation of mitigation measures. ACCOBAMS (under its Supplementary Conservation grant Funds) financed our proposal to cover this central Mediterranean area with a pioneer cetacean monitoring programme.

The study proposes to regularly monitor the Tunis-Genoa, Tunis-Civitàvecchia and Tunis-Palermo ferry-lines in order to collect data on both pelagic and coastal cetacean species. It involves the presence of ‘‘Marine Mammal Observers’’ on board the ferries. These trained individuals are in charge of sighting cetaceans all along the ferry route. Data collected will help to investigate the seasonal trends in cetacean presence and distribution; estimate abundance and density; set the basis for systematic data collection in order to explore inter-annual variability; investigate fin whale migration patterns.

The fixed line transect in this central Mediterranean area joined the network coordinated by ISPRA since 2007 using passenger's ferries as platform of observation. The network covered a considerable proportion of the Mediterranean basin and involving five countries (Italy, France, Spain, Tunisia and Greece). This common protocol of survey (onboard ferries) allows obtaining data over a large temporal and spatial scale with a cost effective programme.

Expected results are accessible in open-data on the OBIS SEAMAP website to improve the knowledge on large scale ecology of certain cetacean species and overall Mediterranean level to optimize their conservation level.

Indeed, all predicted species to occur in the study area are listed in Annex IV of Directive 92/43/CEE "Directive Habitat" and are recognized as "*Community interest requiring strict protection*". Based on the IUCN Red List for the Mediterranean-subpopulation, three species (striped dolphin, bottlenose dolphin and fin whale) are classified as "vulnerable", both species (Cuvier's beaked whale and Risso's dolphin) are classified as "data deficient" and two species are considered "endangered": the sperm whale and the common dolphin (**Table 1**).

Table 1. Cetacean species likely to occur in the strait of Sicily and their status based on the IUCN Red List.

Common name	**Scientific name**	**Abbreviation**	**Status**
Fin whale	*Balaenoptera physalus*	Bp	vulnerable
Sperm whale	*Physeter macrocephalus*	Pm	endangered
Cuvier's beaked whale	*Ziphius cavirostris*	Zc	data deficient
Bottlenose dolphin	*Tursiops truncatus*	Tt	vulnerable
Striped dolphin	*Stenella coeruleoalba*	Sc	vulnerable
Common dolphin	*Delphinus delphis*	Dd	endangered
Risso's dolphin	*Grampus griseus*	Gg	data deficient

Fixed line transect method is adopted as a sampling protocol already established and proven by the "Mediterranean Network monitoring cetacean in fixed transects on ferries" coordinated by ISPRA. The main objectives of the study are to:

1. assess the distribution and abundance of cetaceans in pelagic habitats;
2. quantify seasonal passages of cetaceans in the Sardinia valley and the strait of Sicily;
3. assess the role of this central Mediterranean area in the life cycle of migratory species as fin whale and sperm whale.

2. Activities carried out during the implementation of the study

Activity 1: Transfer of technology

During 2008 and 2009, we participated actively to the monitoring program elaborated by CIMA Research Foundation onboard the Sardinia-Corsica Ferries cruising entirely in the Pelagos Sanctuary (track line from Savona to Bastia). This expertise makes the task of capacity building easiest than previous. Thus, we were closely supported by CIMA during the kick off to make an inventory about requested materials to be acquired, teams composition and survey program schedule. Then all documents related to the monitoring program and data acquisition were shared using *Google drive* tools. Afterward the selected observers assisted to an online training (using *Skype* conference) on Monitoring protocol and GIS technique (**Figure 1**).

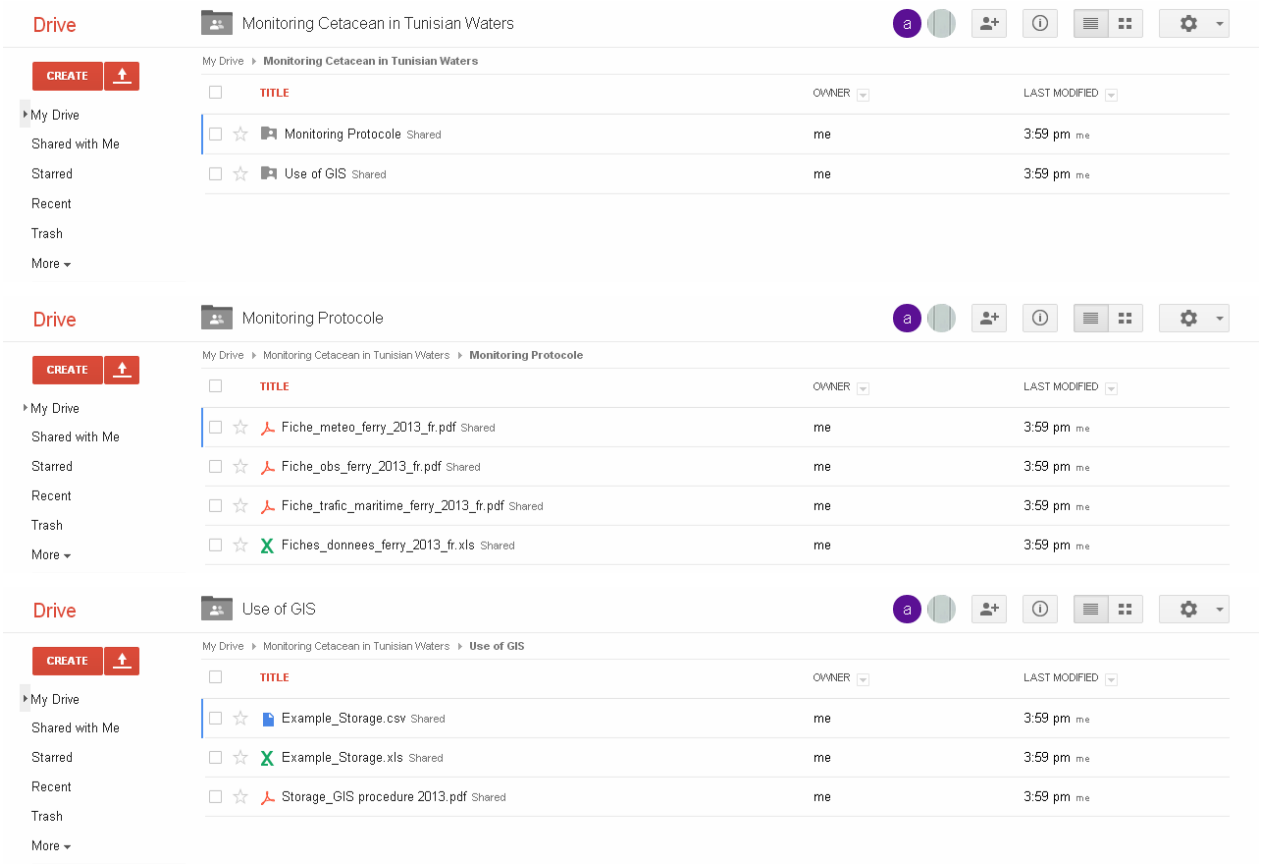


Figure 1: Online CIMA Research Foundation documents shared with ATUTAX observers in the framework of capacity building aspect and transfer of technology.

Activity 2: Training for Marine Mammal Observers

2.1: Training in Tunisia

The ACCOBAMS Permanent Secretariat recently developed in Tunisia a teaching module on the conservation of cetaceans for Master's level students. As the Faculty of Sciences of Bizerte didn't incorporate this module in its teaching curriculum, we organized two training sessions destined to researchers and members of universities (Faculty of Sciences of Bizerte, Faculty of Sciences of Tunis, Tunisian National Institute for Agronomy) and various Tunisian NGOs (**Figure 2**). Three major topics were developed:

- Species of cetaceans and identification technique,
- Threats to cetaceans and Conservation Measures,
- Study Techniques.

In parallel, a dedicated theme on security onboard and high seas legislations as developed to the selected marine mammal observers listed below:

- ✓ Bilel LOUSSAIEF (Master student at the FST) (Email: bilalous_1@hotmail.fr)
- ✓ Zeineb HENTATI (engineer INAT) (Email: zeineb1987@yahoo.fr)
- ✓ Nouha MAKHLOUF (Master student at the FSB) (Email: nouha.m21@live.fr)
- ✓ Kaouther ISHAK (Master student at the FSB) (Email: kaouther.ishak@gmail.com)
- ✓ Amine GABSIA (member of the ATUTAX)
- ✓ Sonia Khadija Maïté GUROUN (PhD Student at the FSB)

Figure 2: Kick off meeting of the study cetacean monitoring using ferries as platform of observation off Tunisia project – Hammamet 26th-28th 2013.

2.2: Training in Sicily

Several university students participated at the training both in workshops and on board; two bachelor degree thesis of the former student: Irene Scannavino and Gaia Cristiana Miria.

The Sicilian and Tunisian team on a conjunct survey

Activity 3: Historical data and bibliographic research

Looking to achieve the conservation objectives established by ACCOBAMS agreement, an understanding of the potential impact of current or future threats to cetaceans seems to be crucial. Thus, it is essential to have detailed knowledge of historical abundance and distribution of each species, their habitat requirements, population structure and ecology..

Despite efforts elaborated to collect data from stranding events and occasional or regular coastal monitoring in this area, knowledge is still insufficient. Further research and monitoring are therefore still necessary to increase current information of the parameters that control the distribution of these marine mammals as well as potential threats to these populations in the region.

Activity 4: Preliminary analysis to adjust the survey program technique

Previous surveys conducted from 2008 to 2010 were partially financed by the Faculty of Sciences of Bizerte (FSB) and the Regional Activity Centre for Aires specially Protected (RAC / SPA). The monitoring programme adopted was to cover the coastal northern Tunisian coasts using opportunistic trips on small fishing boats. Preliminary results recorded, accompanied with data

from stranding events, helps us to orientate our survey and predict cetacean species frequenting the study area like fin whale, sperm whale, bottlenose dolphin and striped dolphin.

Activity 5: Sampling protocol

A.5.1. Survey platforms and study area

Three vessels were used as platform of observation during these surveys, operated by two agencies/companies. These vessels offered a variety of cruising speeds and platform heights. The Tunisian company of navigation (hereafter CTN) covered the area between Tunis to Genoa, and Grimaldi company covered two tracks between Tunis to Palermo and Tunis to Civitavecchia.

The study area is considered among Mediterranean zones with minimum survey effort on cetaceans' distribution. Indeed, the waters of the strait of Sicily are thought to represent one of the most important cetacean critical habitats (hereafter CCH). The unique topography of the strait (through the IUCN initiative to identify biodiversity in submarine canyons and seamounts), suggests potential areas for cetaceans' occurrence to be considered as CCH. In recognition of its importance for cetacean migration, this area is proposed to include marine protected areas including cetacean habitat.

A.5.2. Ferry survey

Teams of four marine mammal observers conducted the survey from the bridge of the vessel. Observers effort focused on a 90° arc ahead of the ship, however sightings located up to 90° to port and starboard were included. The observers scanned the area by eye and using binoculars.
Bearings to sightings were measured using the ships gyrocompass and distances were estimated with the aid of a distance measuring stick. Environmental data were recorded every half an hour. Automated position data were obtained through a laptop computer linked to GPS receiver or from ships instruments.

The survey vessels travelled at an average speed 20-24 knots when on passage and clear of navigation channels. The vessels conducted almost identical transects from month to month, diverging from these routes only when maneuvering to avoid other ship or boat traffic.

Survey effort was conducted during daylight hours in good weather and visibility conditions (calm sea less than 3 on Beaufort scale and visibility greater than 1 nm). Indeed, surveys should generally not be performed in sea states above Beaufort 3 due to the reduction in the detectability

of surfacing cetaceans Sightings were identified to species level where possible, with species identifications being graded as definite, probable or possible. Where species identification could not be confirmed, sightings were downgraded (e.g. unidentified dolphin / unidentified whale).

3. Difficulties encountered and measures taken to overcome problems

i) **Delay in starting of the study related to the selection step**. This delay has slightly modified the schedule of implementation of the various project tasks. Thus some observers (who followed the theoretical training) were not able to participate in the practical phase. Indeed, during this period, students were already engaged at their university courses, and it was almost impossible to get them involved in the cetacean monitoring with a weekly rhythm.

The ATUTAX decided to involve only students having a permission from their scientific supervisors to mess three days a week to overlap their own research and cetacean monitoring.

This delay has also had an impact on the choice of shipping line and weekend shuttle.

ii) **Visa procedure**. As the track line covered an area from the northern Africa (Tunisia) to a European country (Italy), MMO were obliged to acquire a visa. Facilities were obtained from the ACCOBAMS Secretariat and ISPRA (Italy) to introduce the importance of the study to the Italian Cultural Center in Tunis.

All observers received their own visa covering the study period and all of them established the survey without difficulty.

iii) **Equipments and materials onboard**. We confess that the use of basic MMO equipments is a common obstacle in the North African countries. Indeed, the use of binoculars is not allowed without a dedicated permission. We recommend all MMO in those countries to address a request to the police services for the use of binoculars and the boarding of materials during the survey. In our case, we received the agreement from several authorities about the use of these equipments like the custom services, ports authority and boarder police (**Figure 3**).

iv) **Funds transfer**. The ATUTAX wasn't able to transfer funds to various partners outside of Tunisia. The ACCOBAMS Secretariat helped us and an amendment to the Memorandum of Understanding was established to allow partners to receive directly their funds from the ACCOBAMS Secretariat. Thus the budget received by ATUTAX

was limited to the amount of 11 900.00€ and KETOS association received the amount of 3 100.00€.

4. Modifications introduced in the implementation of the study

A slight rectification in the trackline survey was required due to the suspension of the Tunis – Palermo ferry line by the navigation company. We decided to cover largest area in the strait of Sicily and to survey two navigation routes:

i- Tunis-Palermo-Civitavecchia, covered by MMO of the KETOS association

ii- Trackline between Tunis to Genoa, covering the upper side of the strait of Sicily named also the Sardinia valley, surveyed by MMO of the ATUTAX.

Data on marine debris from three specific sources as land-based, ocean-based, and general (marine debris that cannot be distinguished as a land-based or ocean-based source) were collected in the central area of the Mediterranean using a scientifically valid protocol.

5. Achievements and Results

Activity 5: Field work and data collection

Since 27th September 2013 to May 2015, 23 surveys (Table 2) were completed in the central Mediterranean Sea on board ferries navigating between Tunis to various destinations like Genoa, Civitavecchia and Palermo totaling 71609 Kilometers (Figure 3). In all 157 sightings, 6 cetacean species were recorded in good weather conditions (Table 3). The confirmed cetacean species were fin whale, sperm whale, Cuvier's beaked whale, striped dolphin, common dolphin and bottlenose dolphin. 40 sightings of turtles and 12 sun fish were also recorded.

The most frequently observed cetacean species were by far the striped dolphin in schools ranging from 1 to 80 individuals (S=73), then the bottlenose dolphin (pod ranging from 1 to 16, S=39). Fin whales (12 sight.), common dolphins (9 sight.) sperm whale (2 sight.) and Cuvier's beaked whale (2 sight.) were also sighted.

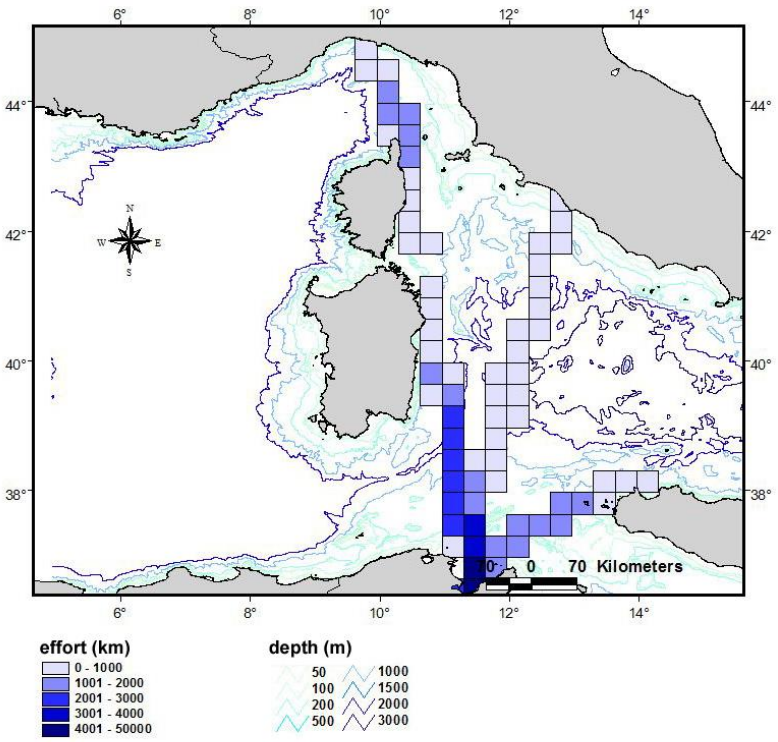


Figure 3: Map of the effort deployed to monitor cetacean distribution onboard ferries in the central Mediterranean Sea during the study period.

Date	Boat name	Observation conditions	Comments	Observation numbers
27 september 2013	TANIT	On effort	-	05
28 september 2013				
29 september 2013				
04 October 2013	CARTHAGE	On effort	-	04
05 october 2013				
06 october 2013				
11 October2013	TANIT	On effort	-	11
12 october 2013				
13 octobr 2013				
18 October 2013	CARTHAGE	On effort	Bad weather conditions	06
19 october 2013				
20 october 2013				
25 October 2013	No effort due to the bad weather conditions (fog)			
26 october 2013				
27 october 2013				
01 November 2013	CARTHAGE	On effort	-	07
02 november 2013				
03 november 2013				
08 November 2013	No effort due to the bad weather conditions			
09 november 2013				
10 november 2013				
15 November 2013	No effort due to the bad weather conditions			
16 november 2013				
17 november 2013				
29 November 2013	CARTHAGE	On effort	No effort due to the bad weather conditions during the last day	04
30 november 2013				
1 december 2013				
06 december2013	CARTHAGE	On effort	No effort due to the bad weather conditions during the first day	07
07 december 2013				
08 december 2013				
17 December 2013	Zeus Palace	On effort		00
18 December 2013	Zeus Palace	On effort		15
19 December 2013	Zeus Palace	On effort		00
21 January 2014	Zeus Palace	On effort		00
22 January 2014	Zeus Palace	On effort	-	02

23 January 2014	Zeus Palace	On effort		02
11 February 2014	Zeus Palace	On effort		00
12 February 2014	Zeus Palace	On effort		03
13 February 2014	Zeus Palace	On effort		00
18 march 2014	Zeus Palace	On effort		02
19 march 2014	Zeus Palace	On effort		00
20 march 2014	Zeus Palace	On effort		03
08 april 2014	Zeus Palace	On effort		03
09 april 2014	Zeus Palace	On effort		01
10 april 2014	Zeus Palace	On effort		03
22 April 2014	Zeus Palace	On effort		10
23 April 2014	Zeus Palace	On effort		10
24 April 2014	Zeus Palace	On effort		01
20 May 2014	Zeus Palace	On effort		01
21 May 2014	Zeus Palace	On effort		06
23 May 2014	Zeus Palace	On effort		04
24 May 2014	Zeus Palace	On effort		04
13 February 2015	Carthage	On effort		02
14 February 2015	Carthage	On effort		10
15 February 2015	Carthage	On effort		01
17 April 2015	Carthage	On effort		03
18 April 2015	Carthage	On effort		01
19 April 2015	Carthage	On effort		03
15 May 2015	Carthage	On effort		01
16 May 2015	Carthage	On effort		04
17 May 2015	Carthage	On effort		01
19 May 2015	Zeus Palace	On effort		01
20 May 2015	Zeus Palace	On effort		09
21 May 2015	Zeus Palace	On effort		02
8 September 2015	Zeus Palace	On effort		03
9 September 2015	Zeus Palace	On effort		02
10 September 2015	Zeus Palace	On effort		02

Table 2: Cumulative list of cruises elaborated by the network of cetacean monitoring network in the central Mediterranean Sea onboard ferries to detect cetacean distribution in the area.

Encoutered species	Observation numbers
Fin whale	12
Sperm whale	02
Cuvier's beaked whale	02
Striped dolphin	73
Bottlenose dolphin	39
Common dolphin	09
Not identified dolphins	20

Table 3: Sighting species recorded during the survey programme developed onboard ferries cruising in the central Mediterranean Sea.

Activity 6: Spatial analysis

To investigate the spatial distribution and relative abundance of cetaceans we overlaid a 20' x 20' grid on the study area (Figure 4). Encounter rates were (ER) calculated for each cell of the grid as

$$ER = \frac{n}{L} \times 100$$

where *n* is the number of encounters, and *L* is the total distance travelled (i.e. survey effort) in nautical miles (subsequently referred to as miles, for brevity). Global values of encounter rates were also calculated for the whole study area.

For each of the three sub-regions we also computed sighting frequencies (SF) for every species observed, computed as:

$$SF_k = \frac{n_{jk}}{n_k}$$

where $\mathbf{n_{jk}}$ is the number of sightings per each species **j** in the region **k** and $\mathbf{n_k}$ is the total number of on-effort sightings in region **k**. Cetacean diversity was then evaluated with the Shannon-Weaver index (H', Frontier and Pichod-Viale, 1995). We used number of sightings rather than number of individuals, because school sizes may be inaccurately estimated from ferries:

$$H' = -\sum (njk / nk) Log2(njk / nk)$$

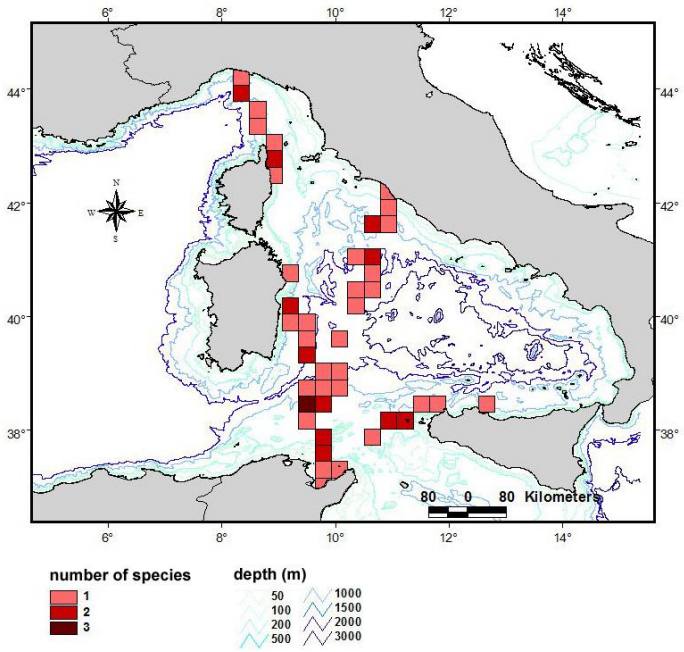
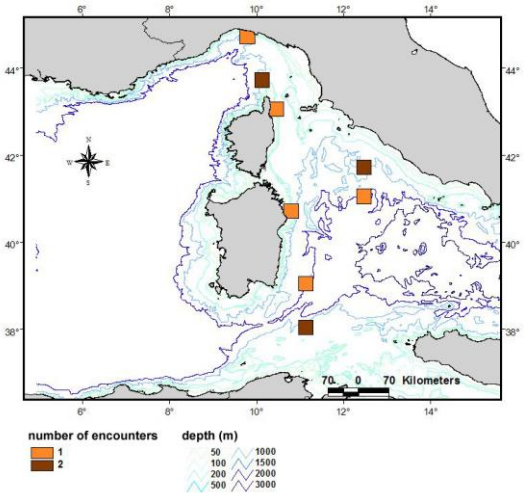
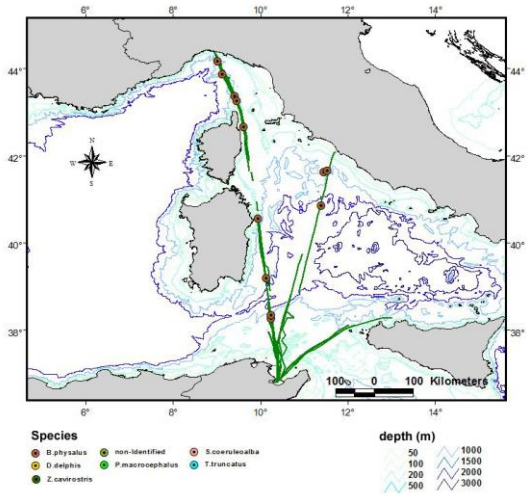
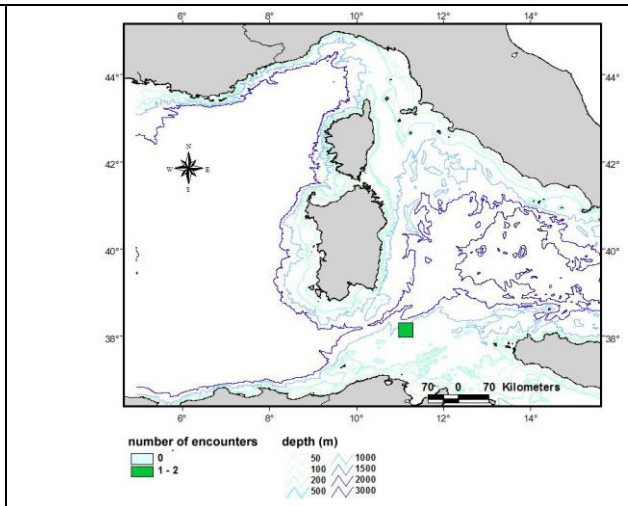
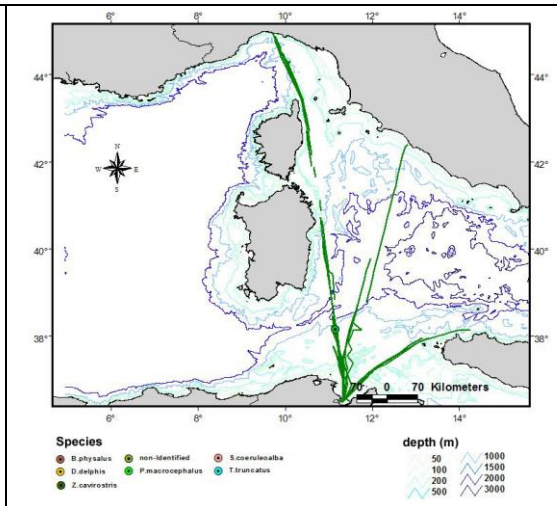
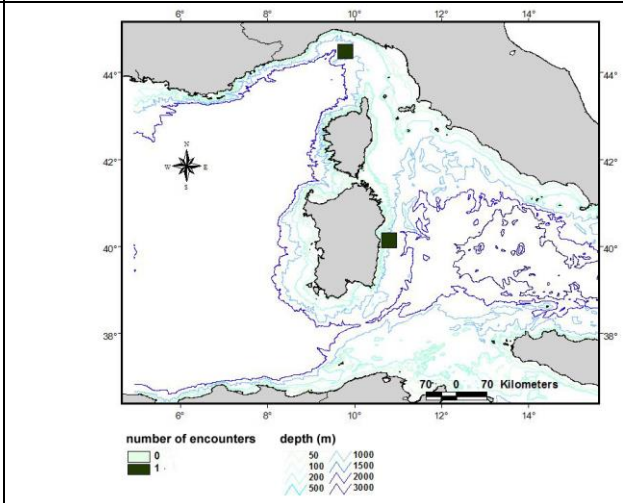
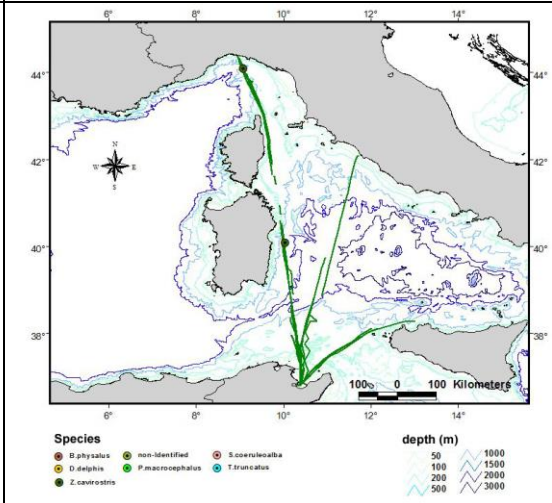
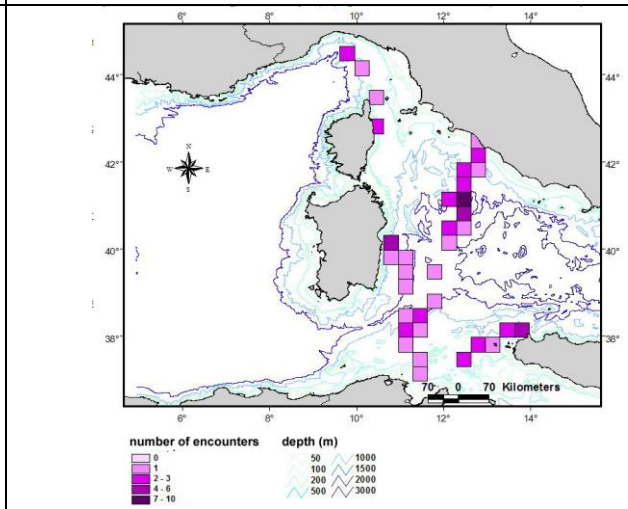
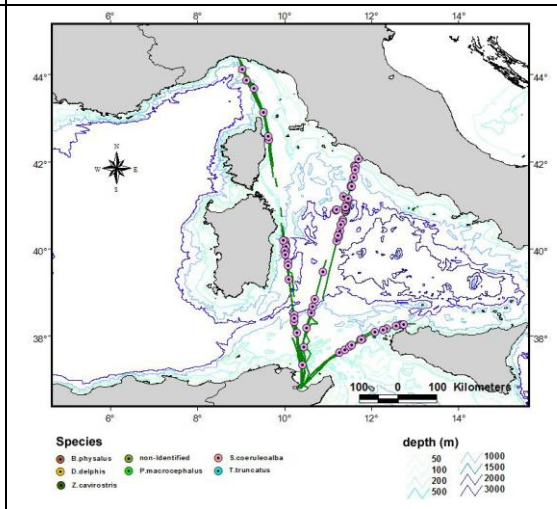


Figure 4: Map of the cetacean encounter rate in the central Mediterranean Sea using ferries as platform of observation.

	Encounter rate	Observations
Fin whale		

Sperm whale		
Cuvier's beaked whale		
Striped dolphin		

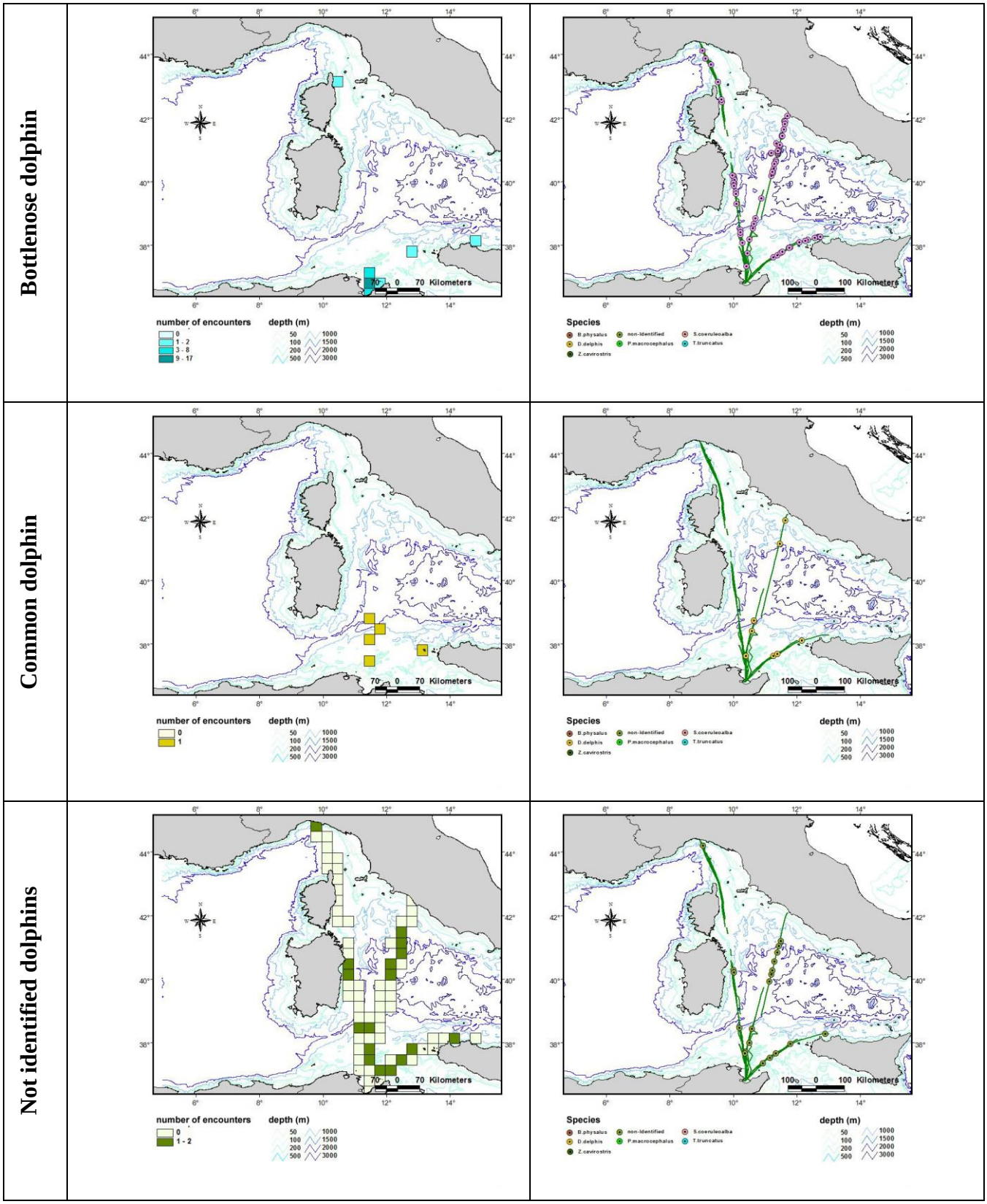


Figure 5: Maps of the spatial distribution of observations and encounter rate along transects between Tunis to various Italian countries (Genoa, Civitavecchia and Palermo).

Several attempts were made to run a model to see if there are any patterns or relations between cetaceans' presence and ecological variables such as depth, slope and aspect. The analysis suggests that a model at this point would not be efficient to show any significant relations and this is mainly attributed to the low effort and small sighting rate (Figure 6). Hence, a recommendation would be to increase the survey effort and conduct the survey in variety of seasons to see if seasonality can be included as a variable in the model.

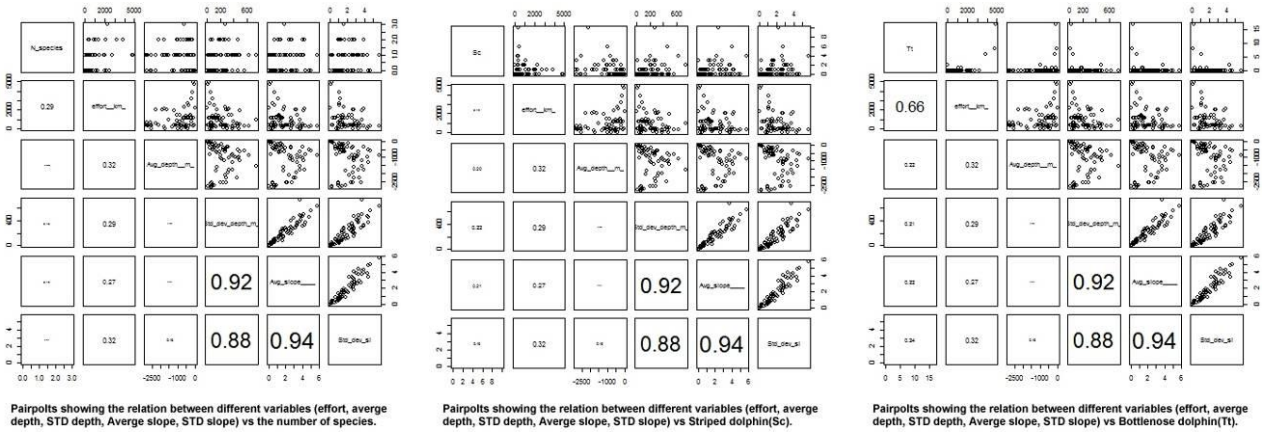


Figure 6: Plots of cetacean distribution correlated to ecological variables.

The macrolitter survey:

Both in the EU Marine Strategy Framework Directive and in the Barcelona Convention Ecosystem Approach (EcAp) there is the requirement to monitor that properties and quantities of marine litter do not cause harm to the coastal and marine environment and specific target have been established to reach the good ecological status of the marine waters. Monitoring methods should be consistent across the marine region and relevant transboundary impacts should be taken into account. For this reason within this project also the abundance, composition and distribution of marine macrolitter (items greater than 20cm) that floats in the waters between Sicily and Tunisia in the Sicilian Channel/Tunisian plateau was undertaken by research bodies of the two countries. Macrolitter, in fact, is a direct indicator of litter that gets into the sea; it can impact marine life as animals can be entangled or can ingest floating plastic. Considering the importance of the region for the fishing industry special care was undertaken for the monitoring of derelict floating fishing gear and drifting/lost FADs. Based on approx. 400 km (5 samples) of effort, results showed that density in nearby port/costal region is 2,5 ± 0,3 items·km^{-2} while values in high sea areas are 5 fold times less. Most of the items are artificial polymers (70%) followed by processed wood (several board/beams larger than 50cm). One floating derelict net was recorded

while no object resembling FADs were detected. The monitoring of the area is just at is early stage, however future systematic surveys will set up an important baseline on the quantity of macrolitter/drifting fishing gear present in the region also allowing to evaluate the capacity of measures enforced to reduce the waste ending up in the sea.

Activity 7: Dissemination

By the end of the first phase of the project implementation, preliminary results of the survey elaborated in the central Mediterranean Sea were presented during international conferences dealing with the interdisciplinarity of the monitoring programme.

Main scientific contributions are as follow:

Aïssi, M., Arcangeli, A., Crosti R., Daly Yahia MN, Loussaief B., Moulins A., Pellegrino G., Rosso M., Ruvolo, A., Tringali LM., Tepsich P. 2015. **Cetacean occurrence and spatial distribution in the central Mediterranean Sea using ferries as platform of observation**. *Russian Journal of Marine Biology*, 41(5):343-350.

Aïssi M., Arcangeli A, Crosti R., Daly Yahia MN., Loussaief B., Moulins A., Pellegrino G., Rosso M., Ruvolo A., Tringali LM., Tepsich P. 2015. **Cetacean monitoring onboard ferries in the central Mediterranean Sea**. In *Proceedings of the 29th European Cetacean Society, 23rd - 25th March 2015, La Valletta, Malta*. (Poster)

Pellegrino G., Monaco C., Arcangeli A., Crosti R., Ruvolo A., Aïssi M., Abate D., Tringali L.M.. 2015. **Interaction between cetacean and maritime traffic in the "Sicilian-Tunisian" channel**. *In Proceedings of the 29th European Cetacean Society, 23rd - 25th March 2015, La Valletta, Malta*. (Poster)

Aïssi, M., Loussaief B, Tringali LM, Arcangeli A, Crosti R, Tepsich P, Moulins D'Inca A, Daly Yahia MN. 2014. **Tunisian and Italian cooperation to monitor cetacean in the central Mediterranean Sea: preliminary results of an ACCOBAMS co-funded project**. *3rd Biennial Conference on Cetacean Conservation in South Mediterranean Countries, Jounieh – Lebanon, 21-23 October 2014*. (Poster)

Aïssi, M., Loussaief B, Tringali LM, Arcangeli A, Crosti R, Tepsich P, Moulins D'Inca A, Daly Yahia MN. 2014. **Efficiency of MPAs on marine mammals conservation: case study of large cetaceans in the central Mediterranean**. *3rd Biennial Conference on Cetacean Conservation in South Mediterranean Countries, Jounieh – Lebanon, 21-23 October 2014*. (Oral communication)

Arcangeli A., Aissi M., Atzori F., Azzolin M., Baccetti N., Campana I., Castelli A., Cerri F., Cinti F., Crosti R., [.....], Frau F., Luperini C., Maffucci F., Marini L., Moulins A., Paraboschi M., Pellegrino G., Ruvolo A., Tepsich P., Tringali M. 2014. **Synoptic data collection on Cetacean, Marine birds, Sea turtle, Marine traffic, Marine litter: a**

multidisciplinary collaboration in Mediterranean sea. *3rd IMCC, Glasgow, Scotland, 14-18 August 2014.*

Pellegrino, G; Aissi, Arcangeli; Kchouk, ME; Moulins, A; Ruvolo, A; Tringali, ML; Crosti, R. 2014. **Transborder cetacean monitoring using ferries as platforms of observation between Tunisia and Italy: winter results of an ACCOBAMS co-funded project**. *IMCC Conference Glasgow*. (Poster)

Results of this study were uploaded (in open access) to the OBIS SEAMAP database. Several similar platforms are available in the web and are also in open access. Looking to focus the effort on cetacean studies elaborated in the Mediterranean Sea and contiguous Atlantic area by different ACCOBAMS partners, we suggest the use of a common platform (database) to have a wider idea about the large scale ecology of these top predators able to migrate hundred of kilometers from their seasonal feeding grounds.

On the other hand, a dedicated blog (http://itucre.blogspot.it/) and Facebook page (www.facebook.com/balenaferries?fref=ts) have been also created to secure the promotion of the study within and outside partners environment.

6. Conclusions

i. This study is the first to investigate cetacean occurrence in the central Mediterranean Sea covering coastal and high seas of the strait of Sicily, Tunisian plateau and the Sardinia valley. Indeed, this area is classified among not studied zone and no data available for all cetacean species known to occur in the Mediterranean Sea. The variety of habitats in this area is supposed to supports many of the toothed Mediterranean cetacean species.

   The spatial distribution of sightings is heterogeneous between different species. Group size of the species observed was also highly variable. Delphinids were characterized by larger group size and the larger species by smaller. Toothed cetaceans were encountered throughout the study area with highest diversity index inside the Pelagos sanctuary, followed by the Sardo-Tunisian channel and then by the eastern Sardinian margin. Conversely, the mean encounter rate, pooling all species together, was higher in the Sardo-Tunisian channel and Eastern Sardinian margin than in the Pelagos Sanctuary.

   The study area is highly heterogeneous, covering shelf, slope and special bottom topographic features (seamounts and submarine canyons). As a result, marine mammal

observers recorded high cetacean diversity with typically shelf species like bottlenose dolphin and open sea / pelagic species, such as striped dolphin, common dolphin, sperm whale and fin whales. Moreover, Cuvier's beaked whale was also recorded twice in the eastern Sardinia margin and inside the International sanctuary for marine mammals: Pelagos.

The highest cetacean species diversity was reported in the Pelagos sanctuary which is supposed to be attributed to the diverse range of their feeding habitats and prey. The depth and seabed topography of this International Sanctuary for marine mammals consists on shelf, shelf edges and deep submarine canyons. The Pelagos Sanctuary is also an area where cold and warm temperate waters mix. Indeed, this productive habitat is considered beyond the extremely important areas for cetacean populations due to the abundance of food and to the diversity of the habitats, with characteristics most favorable for the feeding and reproduction of marine mammals. The present results would tend to support the hypothesis that cetacean species are present in this spatially restricted feeding habitat also outside the summer season.

ii. Focusing on the Sardo-Tunisian channel (named also the Sardinia valley, which is the sea region comprised between Sardinia and Sicily and bordered to the south by the northern Tunisian continental shelf), our results indicate that cetacean diversity was reported specially near the canyon of Bizerte zone.

This area overlaps highest densities of striped dolphins and large cetaceans like sperm whale and fin whale individuals. This unique mysticete is known to undertake very wide migrations from the Pelagos sanctuary to the waters surrounding Lampedusa through straits. A Marine Protected Areas network must take into account this aspect of the species' biology. If a migration route is interrupted by natural events or causes of anthropic origin, the migrating species can change its conservative behavior, leaving the migration routes forever.

For many species moving throughout the entire Mediterranean Sea (i.e. Bluefin tuna, swordfish, turtles, sharks and cetaceans), protection of migratory corridors could be as essential as protecting their feeding and spawning areas.

The recent availability of cetacean observations has led to great interest in characterizing the wide range distribution of mammal distribution. The distribution map can be useful for guiding future research especially over the deep valley of the canyon of Bizerte which

seems to play a key role for large cetacean migrating southward from the Pelagos sanctuary by the end of the summer season. .

iii. The highest encounter rate of bottlenose dolphin was recorded along the Tunisian coast (the Gulf of Tunis). MMO reported a close association of this coastal specie with active trawling; activity that provides a feeding opportunity for dolphins.

This result provides a novel insight into dolphin abundance, population dynamics and size, behavioral ecology and also interaction for a better understanding of how bottlenose dolphins and the fishing industry affect each other. It becomes increasingly more important to assess population parameters for conservation purposes. Anthropogenic activities interfere with the natural regulation processes, which often has detrimental consequences. Thus, an estimation of the population size seems to be crucial in this area if we consider the intensity of fishing activities developed in this northern Tunisian coast.

With this in mind, we evaluated that it is crucial that effective monitoring plan must be developed in this coastal area. Two cooperation agreements were signed by the end of this study;

- ✓ The ATUTAX with the financial support of RAC/SPA started to assess the current population status, the habitat use and the social structure of bottlenose dolphin in the northern Tunisian coasts. Boat-based surveys were conducted by the end of this study in collaboration with Ibrahim BENAMER to photo-identify individuals and collect demographic data from an independent research vessel.

  A total of 17 sightings were recorded during the summer season of 2015. Group size varied from one individual (solitary) to eight individuals. Out of these were at least 38 individuals with distinctive marks which are now under work for a catalogue, and at least 18 described as smooth dorsal fins' individuals (Figure 7).

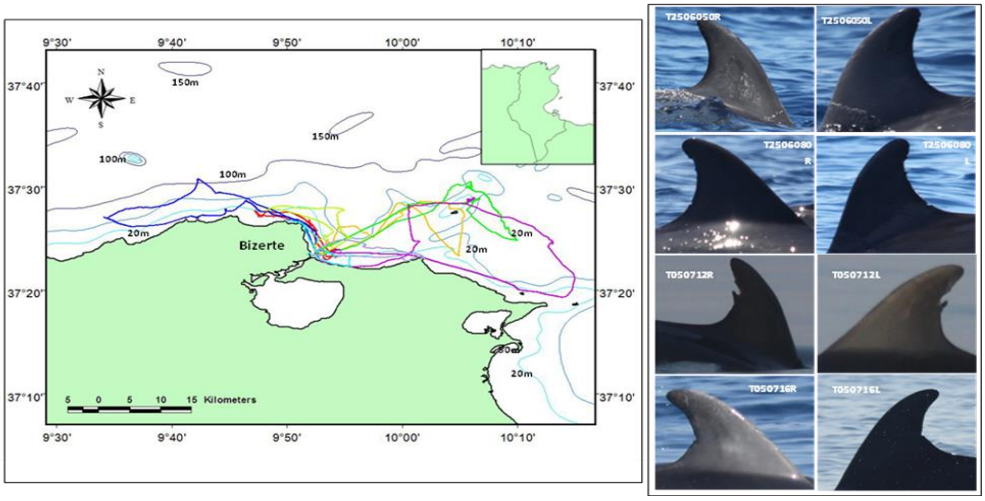


Figure 7: Samples of the effort deployed in the northern Tunisian cast to study bottlenose dolphin population and pictures for some of the marked individuals encountered during the survey (left and Right sides) (Ibrahim BEN AMER)

- ✓ The Faculty of Sciences of Bizerte with the administrative support of Tunisian Agency of protection and coastal development "APAL" (Agence de Protection et d'aménagement du littoral) are developing a long term strategy in order to implement a systematic survey of coastal bottlenose dolphin population inhabiting / frequenting the Tunisian marine protected areas along the five next years. This kind of study may provide a deeper understanding of the abundance and distribution of this top preadtors in La Galite, Cap Negro-Cap Serrat and Zembra MPAs.

7. Recommendations

The recent availability of cetacean observations has led to great interest in characterizing the wide range distribution of mammal distribution. The distribution map can be useful for example for guiding future research especially over the deep valley of the canyon of Bizerte which seems to play a key role for cetacean. Indeed, information gathered from this study could also serve societal needs as the orientation of the dolphin watching companies installation over the northern Tunisian plateau. Several initiatives have already initiated to evaluate this tourism economy activity, but the data missing turned away the focus of investments. In this context, forecasting of cetacean distribution is crucial. Obviously, additional studies are needed to better estimate the seasonal cetacean abundance in this central Mediterranean area. Information on species distribution and density plays a key role in management and conservation.

Cetacean observation from "platforms of opportunity", often commercial vessels, merchant navy vessels or ferries, can provide the basis for large surveys and can run for long periods of time at a relatively low cost. This low-cost way of collecting large quantities of data may be exploitable in different non studied Mediterranean areas.

For a better management of cetacean status in the Mediterranean Sea, we suggest to:

- **Develop a common guideline for Marine Mammal Observers**

Dedicated training for MMO was imperative in the beginning of the study. In order to assure the reliability of data collected from different MMOs, we suggest developing a common protocol of observation method and protocols to be used in the ACCOBAMS area.

- **Enlarge the network to the south Mediterranean areas**

Fewer studies are developed in the pelagic waters of the south Mediterranean Sea. As this technique (use of ferries as platform of observation) is among cheapest protocols adopted covering largest area, we suggest to support additional institutions to integrate the network of surveys on board ferries managed by ISPRA since 2007. Based on new maritime commercial exchanges between Egypt and Algeria, we recommend the ACCOBAMS partners in those countries to check the practical feasibility of this technique with the respective navigation companies. This navigation route covered almost canyons and seamount areas as well as the southern area of the Hellenic Trench.

- **Estimate the bottlenose dolphin population size along the Tunisian coastline**

Bottlenose dolphins are one of the most coastal cetacean species recorded in the Gulf of Tunis. Previous studies conducted in Tunisia have primarily focused on the northern Tunisian area. However this species also occurs in other regions like the eastern and the southern of Tunisia. Little is known about the bottlenose dolphins inhabiting these waters. Thus, it is particularly evident to select as study sites the whole Tunisian coastline area. In addition to the actual results and those of the first continual survey along the coast of Bizerte, the engagement of some Tunisian national institutions to cover partially the boat-based monitoring in the declared Tunisian MPAs encourage us to proceed on the enlargement of the study area. The objectives of a similar study will be: (1) to estimate the seasonal abundance of bottlenose dolphins in different Tunisian sub-areas using photo-identification mark-recapture techniques; (2) to create a photo-identification catalogue of distinctive individuals in the region for long-term monitoring purposes

and share them on the Intercet database; and (3) to characterise dolphin site fidelity patterns in this area.

8. Abstract

Cetaceans are wide-ranging long-lived mobile marine species, living mostly in pelagic waters. Threats can have an impact at individual level as well as on population size and/or distribution. Consistent long-term large-scale population monitoring is therefore needed for defining and monitoring the effectiveness of conservation measures. Nevertheless, monitoring programmes deal with limited resources, affecting repeatability and spatial extent of surveys, and with consistency among data collected. Since 2007, a collaborative programme based on a standard protocol was established in the Mediterranean Sea. This network of cetacean monitoring used ferries as platform of observation.

In this context, trained marine mammal observers of the ATUTAX (Tunisian NGO) and Ketos (Italian NGO) conducted a survey to identify and characterize the abundance and distribution of these top predators in the central Mediterranean Sea. This first major offshore cetacean survey funded by ACCOBAMS covered the routes trajectory along Palermo – Tunis - Civitàvecchia and Tunis - Genoa. Along three consecutive years, 69 days of survey effort were conducted during which 5 identified cetacean species including balaenopteridae, delphinidae, ziphiidae and physeteridae families were recorded; bottlenose dolphin (*Tursiops truncatus*), short-beaked common dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*), fin whale (*Balaenoptera physalus*), Cuvier's beaked whale (*Ziphius cavirostris*) and sperm whale (*Physeter macrocephalus*). As part of the study, visual observations for seabirds, marine turtles and species in association were conducted. Furthermore, maritime traffic and marine litter monitoring protocols were adopted in order to improve the evaluation of the impact of the main human pressures on the conservation status of cetaceans and their development trends.

New insights on the distribution, abundance and threats of cetaceans in this poorly studied area have a valuable impact in the implementation of an effective conservation action. Moreover, this survey is considered of great importance in order to implement the ACCOBAMS survey initiative (ASI) and reach the objectives of the EU Marine Strategy (MSFD) and the Ecosystem Approach (EcAp) strategy for which cetacean are pertinent indicators. Ecological relevance of the region, statistical strength due the strict protocol/magnitude of effort, cost effectiveness are all aspects that evidence the efficiency of this monitoring plan.

Annexes

Main scientific activities issued from the project results

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ECOLOGY

Cetacean Occurrence and Spatial Distribution in the Central Mediterranean Sea Using Ferries as Platform of Observation[1]

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Abstract—While cetacean distribution and habitat is well investigated in some areas in the Mediterranean, only a few studies have been conducted so far in the central part of the Mediterranean basin. In order to fill this gap, a dedicated research program has been developed using ferries operating between Tunis and Genoa as platforms of opportunity to collect data on cetacean presence and distribution. The area was subdivided in three sub-regions: the Sardo-Tunisian channel, the eastern Sardinian margin and the international sanctuary for marine mammals *Pelagos*. During fall 2013, marine mammal observers surveyed 1900 nautical miles and recorded 39 encounters of 5 identified species including balaenopteridae, delphinidae, ziphiidae and physeteridae families. Bottlenose dolphin (*Tursiops truncatus*) and striped dolphin (*Stenella coeruleoalba*) were the most common species followed in decreasing occurrence by fin whale (*Balaenoptera physalus*), Cuvier's beaked whale (*Ziphius cavirostris*) and sperm whale (*Physeter macrocephalus*). The distribution of bottlenose dolphin was restricted to the shallow waters of the Tunisian plateau over the continental shelf. Striped dolphins were sighted in the open sea waters and the eastern Sardinia margin. Large cetaceans as sperm whale and fin whale were mainly recorded over the canyon of Bizerte in the Sardo-Tunisian channel. Highest diversity index was reported in the Pelagos sanctuary even during autumn, confirming the area as a preferred habitat for several cetacean species. Our results also highlight the importance of the Sardo-Tunisian channel, where a relatively important diversity index has been computed, especially over the canyon of Bizerte. This study is the first to investigate cetacean diversity in pelagic central Mediterranean waters and highlights the insistent need to develop regular monitoring in this area.

Keywords: cetacean distribution, central Mediterranean, ferries, platform of observation.

DOI: 10.1134/S1063074015050028

INTRODUCTION

Enormous effort has been deployed into the investigation of cetacean abundance and distribution over the last decades. Despite these efforts, our current knowledge about many species distribution, encounter rate and habitats in the Mediterranean Sea remains very limited [28]. While cetacean abundance, distribution and habitat preferences are well investigated in the north-western basin, little is still known in the central Mediterranean. So far, only a few studies have been dedicated to the distribution and population size of cetaceans in this area, focusing mainly on specific small regions [6, 10, 16, 23, 31]. Moreover, the limited survey effort in mid-Mediterranean Sea has been carried out only during the summer months: the lack of knowledge about cetacean presence and distribution in the area, particularly outside summer months, severely restricts our knowledge of the full geographic range of most cetacean species and consequently inhibits our understanding of their seasonal movements within the entire basin.

Despite sometimes denoted as poorly productive [35], the waters of the central Mediterranean Sea contain a high diversity of cetaceans with the occurrence

[1] The text was submitted by the authors in English.

Aïssi, M., Arcangeli, A., Crosti R., Daly Yahia MN, Loussaief B., Moulins A., Pellegrino G., Rosso M., Ruvolo, A., Tringali LM., Tepsich P. 2015. Cetacean occurrence and spatial distribution in the central Mediterranean Sea using ferries as platform of observation. *Russian Journal of Marine Biology*, 41(5):342-350.

Poster Abstracts – ECS2015 - Malta

DIS-01: Cetacean monitoring onboard ferries in the central Mediterranean Sea

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From September 2013 to July 2014 the marine mammal observers of the ATUTAX (Tunisian NGO) and Ketos (Italian NGO) conducted a survey of top predator (whales, dolphins and sea turtles) distribution and relative abundance (abundance per unit effort) using ferries as platform of observation. This first major offshore cetacean survey was conducted in the central Mediterranean area, being part of the network survey programme coordinated by ISPRA since 2007.

In total, more than 250 h of monitoring spread over 45 working days resulted in hundreds of cetacean sightings. Six common species were identified: fin whale (*Balaenoptera physalus*), sperm whale (*Physeter macrocephalus*), Cuvier's beaked whale (*Ziphius cavirostris*), bottlenose dolphin (*Tursiops truncatus*), striped dolphin (*Stenella coeruleoalba*) and common dolphin (*Delphinus delphis*). The most observed pelagic species were striped dolphin followed by fin whale, Cuvier's beaked whale, common dolphin and sperm whale. Coastal species were almost bottlenose dolphins.

These preliminary results of the first phase of the project co-funded by ACCOBAMS add important information about cetacean species distribution and long-term use of this area characterized by heterogenic topography like seamounts and submarine canyons. Collected data contribute to the large-scale cetacean survey network which monitors one of the potential critical habitats for cetacean species believed likely to be a "migratory" ground for large cetaceans and which is one of the areas in the Mediterranean region with highest maritime traffic density. The data from this survey has begun to highlight major differences in species occurrence and relative abundance between the Pelagos sanctuary and beyond this international MPA itself.

Aïssi M., Arcangeli A, Crosti R., Daly Yahia MN., Loussaief B., Moulins A., Pellegrino G., Rosso M., Ruvolo A., Tringali LM., Tepsich P. 2015. **Cetacean monitoring onboard ferries in the central Mediterranean Sea**. In *Proceedings of the 29th European Cetacean Society, 23rd - 25th March 2015, La Valletta, Malta*. (Poster)

Poster Abstracts – ECS2015 - Malta

HI-09: Interaction between cetacean and maritime traffic in the "Sicilian-Tunisian" channel

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Within the Mediterranean Sea marine region the **"Sicilian Channel"** is the one with higher intensity of maritime traffic, created by ships that from the south-east of the Mediterranean Sea move to the Strait of Gibraltar, the pressure is even greater in the constriction area of the Strait between Sicily and Tunisia were the density increases. The area, due to the presence of high productive values, is considered one of the potential wintering grounds for fin whale. While several Multilateral Environmental Agreements (such as ACCOBAMS, Barcelona Convention SPA/BD) require for States Parties to evaluate and manage the interactions between cetaceans and vessels, there has never being such assessment in the area. For this reason, since winter 2013, using ferries as observation platforms, along a fixed transect line between Palermo and Tunisia, started a study, co-funded by ACCOBAMS, that monitored systematically cetacean distribution and the interaction with maritime traffic. Along the ferry route, dedicated cetacean observers, through seascape scan sampling, computed the number of large vessels detected both during cetacean sightings (n=80) and randomly (n=250). About 260 hours of observation were undertaken in good sea conditions (≤3 of the Douglas scale), covering over 4,000 nautical miles. Differences in percentage, distribution and frequency of the values of the two computations were tested. Overall results showed that during sightings, values of maritime traffic were reduced to about 35% with a significant difference in distribution and frequency (M-W and K-S both $P<0.01$). The reduction was not uniform across the species. In particular *S. coeruleoalba*, and *Balaenoptera* spp. sightings occurred with lower maritime traffic intensity, while *T. truncatus* sightings occurred with an higher numbers of vessels compared to random vessel detection. One near event (<50 m from the bow of the ship) was recorded.

Pellegrino G., Monaco C., Arcangeli A., Crosti R., Ruvolo A., Aïssi M., Abate D., Tringali L.M.. 2015. **Interaction between cetacean and maritime traffic in the "Sicilian-Tunisian" channel**. *In Proceedings of the 29th European Cetacean Society, 23rd - 25th March 2015, La Valletta, Malta*. (Poster)

Monitoring of cetaceans in the central Mediterranean Sea: preliminary results of a Tunisian/ Italian cooperation project financially supported by ACCOBAMS

Aïssi M.[1,2*], Loussaief B.[1], Tringali LM.[3], Arcangeli A.[4], Crosti R.[5], Tepsich P.[6], Moulins A.[6], Daly Yahia MN.[1,2]

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Introduction

Cetacean survey using ferries as paltform of observation was carried out in the central Mediterranean Sea during fall and winter 2013. This ''passive mode'' of monitoring was the first to investigate cetacean occurrence in this ''poor studied'' area. This region enclose the Sardinia and the Sicily channels, beleived to be one of the potential connectivity area in the Mediterranean for the migratory marine mammals.

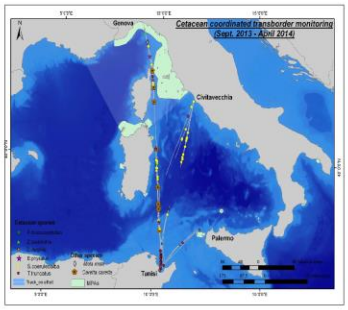
Materials and methods

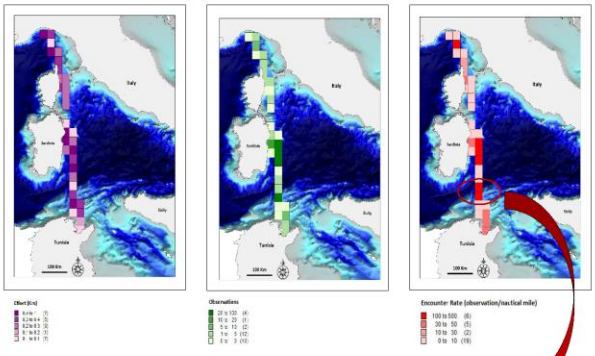
Observations were reported by trained marine mammal observers scanning the horizon by baked eyes and binoculars.

Line transect sampling is a tool for assessing marine mammal populations that is commonly used when the interest lies in evaluating how many individuals of the species of interest occur in a defined study area.

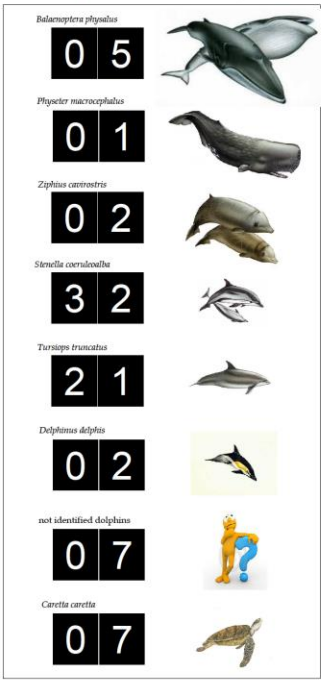
Traditionally, the methods imply that observers based on a ship travel down lines and record the perpendicular distances from the line to each detected school as well as their group sizes.

Results





Group of animals sighted



Conclusions

Encounter rate pointed out a **high distribution** of cetacean species in the **canyon of Bizerte** area.

Large scale monitoring in the central Mediterranean Sea illustrated the **spatial distribution** of at least **three** pelagic **cetacean species beyond the Pelagos Sanctuary**: fin whale, sperm whale and striped dolphin.

Autumn fin whale occurrence in this area support the hypothesis of resident mediterranean subpopulation.

3rd CSMC – Jounieh – Lebanon 21-23 October 2014

Aïssi, M., Loussaief B, Tringali LM, Arcangeli A, Crosti R, Tepsich P, Moulins D'Inca A, Daly Yahia MN. 2014. **Tunisian and Italian cooperation to monitor cetacean in the central Mediterranean Sea: preliminary results of an ACCOBAMS co-funded project**. *3rd Biennial Conference on Cetacean Conservation in South Mediterranean Countries, Jounieh – Lebanon, 21-23 October 2014*. (Poster)

Efficiency of MPAs in marine mammal conservation: case study of large cetaceans in the central Mediterranean

Aïssi M.[1,2*], Loussaief B.[1], Tringali LM.[3], Arcangeli A.[4], Crosti R.[5], Tepsich P.[6], Moulins A.[6], Daly Yahia MN.[1,2]

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The Pelagos Sanctuary was established in 2002 to protect marine mammals from the negative impacts of human activities. It hosts a high concentration of cetaceans like fin whales (*Balaenoptera physalus*) and sperm whales (*Physeter macrocephalus*). Despite the important number of management plans executed and the protection measures implemented by authorities, pressures from human activities threatening cetacean survival in the Mediterranean are still existent.

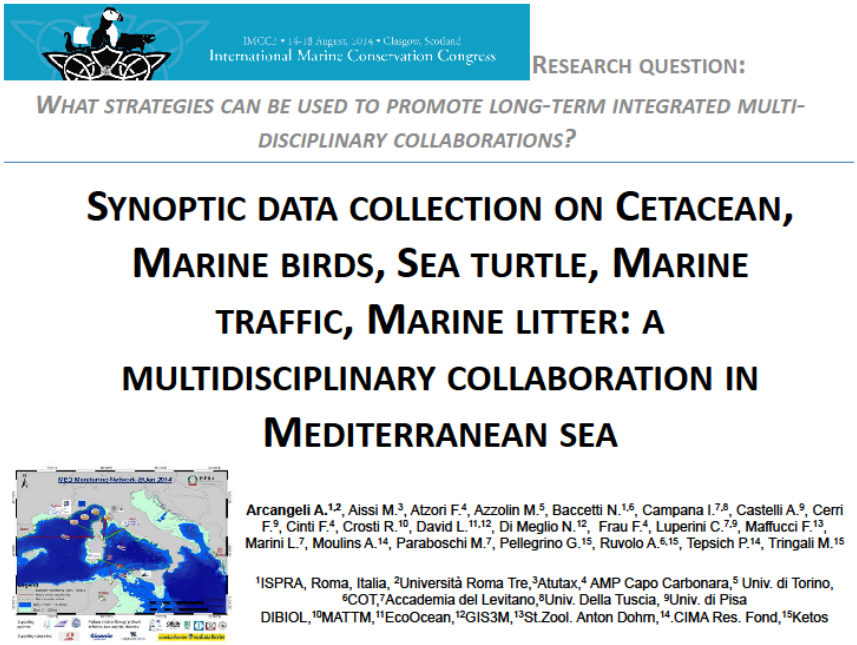
Spatial distribution studies of large cetacean elucidated a strong relationship between preferred habitat and specific physiographic features as seamounts and canyons. Indeed, sperm whales seemed to favour in particular the submarine canyon habitat. However, a certain degree of association is recognizable for fin whales distribution near seamount summit (maximum effect at 15 nautical miles). This tendency has been previously reported in the Mediterranean and was supported by several dedicated observations.

The simulation of sperm whale distribution using Artificial Neural Network Model pointed out a relatively high predictive occurrence of sperm whales beyond the Pelagos Sanctuary. A collaborative program sharing a standard protocol for monitoring cetacean in the central Mediterranean Sea was developed and co-funded by ACCOBAMS to check among others this hypothesis. Results of the extensive visual surveys undertaken in this area through fixed transect lines pointed out a high seasonal biodiversity and a significant encounter rate.

The expansion of MPAs surface in the Mediterranean may be considered as one of the tools to manage and conserve highly mobile species. Moreover, identification and protection of "active structure" attracting these top predators should be considered of prime importance.

Key words: canyon, seamounts, fin whales, sperm whales, MPA

Aïssi, M., Loussaief B, Tringali LM, Arcangeli A, Crosti R, Tepsich P, Moulins D'Inca A, Daly Yahia MN. 2014. **Efficiency of MPAs on marine mammals conservation: case study of large cetaceans in the central Mediterranean**. *3rd Biennial Conference on Cetacean Conservation in South Mediterranean Countries, Jounieh – Lebanon, 21-23 October 2014*. (Oral communication)



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