United Nations Environment Programme

MEDITERRANEAN ACTION PLAN

Regional Activity Centre for Specially Protected Areas

Satellite telemetry applied to fin whales in the Mediterranean Sea

Draft internal report

Draft to be used only to support the preparation of documents for the "*Mediterranean Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas. Malaga, Spain, 7-11 April 2014*"

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Background information

The Tethys Research Institute has conducted, as commissioned by the Direzione Generale Protezione della Natura del Ministero dell'Ambiente e della Tutela del Territorio e del Mare (MATTM), two campaigns of satellite telemetry of fin whale (*Balaenoptera physalus*) in the Mediterranean Sea, with the aim of gaining insights on the species fine scale habitat use as well as migration patterns and routes across the Region.

In fact, although a series of research activities have already produced detailed information on the presence, distribution, abundance, density, habitat use and diving behavior for the species, and despite the previous tagging effort, information on movements and migrations of fin whales within the Basin is still rather limited.

For many populations of large cetaceans, the relationship between the summer feeding and the winter breeding grounds is unknown and mostly the subject of speculation. Gaining knowledge on the geographic range, seasonal distribution, population structure, and migration routes is thus essential to identify the potential detrimental effects of anthropogenic activities within the area where those species occur. The current lack of such knowledge hampers the difficulties to develop and implement effective mitigation measures and long-term conservation efforts of these marine mammals within the Mediterranean Sea.

Furthermore, as strongly emphasized during the joint IWC - ACCOBAMS workshop organized in Beaulieu-sur-Mer in September 2010, there is an urgent need to collect information on the population structure of Mediterranean fin whales, important for the correct interpretation of the estimates of abundance and density and to evaluate possible trends is space and time.

Finally, the activities carried out and the data collected so far are therefore not only particularly relevant in terms of conservation and management of the species, but also central in terms of capacity building and education. In fact, in light of the many collaborations established with established national and international professionals and organisations, and given the high profile of the innovative tools used, this project could contribute to the ongoing discussions within the international scientific community on this approach to cetacean research, and represent a leading example for the Mediterranean Region.

Data collection

Tagging tools

Two different categories of satellite transmitters were used during the first and the ongoing phase of the project:

- Low Impact Minimally Percutaneous External- LIMPET electronic tags (Figure 1a and 1b), originally designed for medium-sized cetaceans (such as killer whales, *Orcinus orca*), applied to the whale with small anchoring systems. These tags are generally applied in the area of the dorsal fin and are characterized by relatively minimally invasive effects, since the instrument is of modest size and weight, and remains outside the body of the whale. Tags are usually applied with a crossbow or air rifle.

Fig. 1a - *LIMPET* tag.

Fig. 1b - *LIMPET* tag with deployment arrow.

- "*Implantable*" tags (Fig. 2a) which penetrates with the whole cylindrical body into the muscle tissue of the animal, with the exception of the antenna. These tags have been used with great success with several species of large whales, including fin whales and sperm whales. The main advantage of implantable tags lies in the larger batteries. The anchoring system may change based on the species and to increase the period of data transmission. They are usually deployed through a specially designed pneumatic gun (gun ARTS; Figure 2b). The plot in Figure 3 shows the average duration recorded for species marked in the last decades using implantable tags.

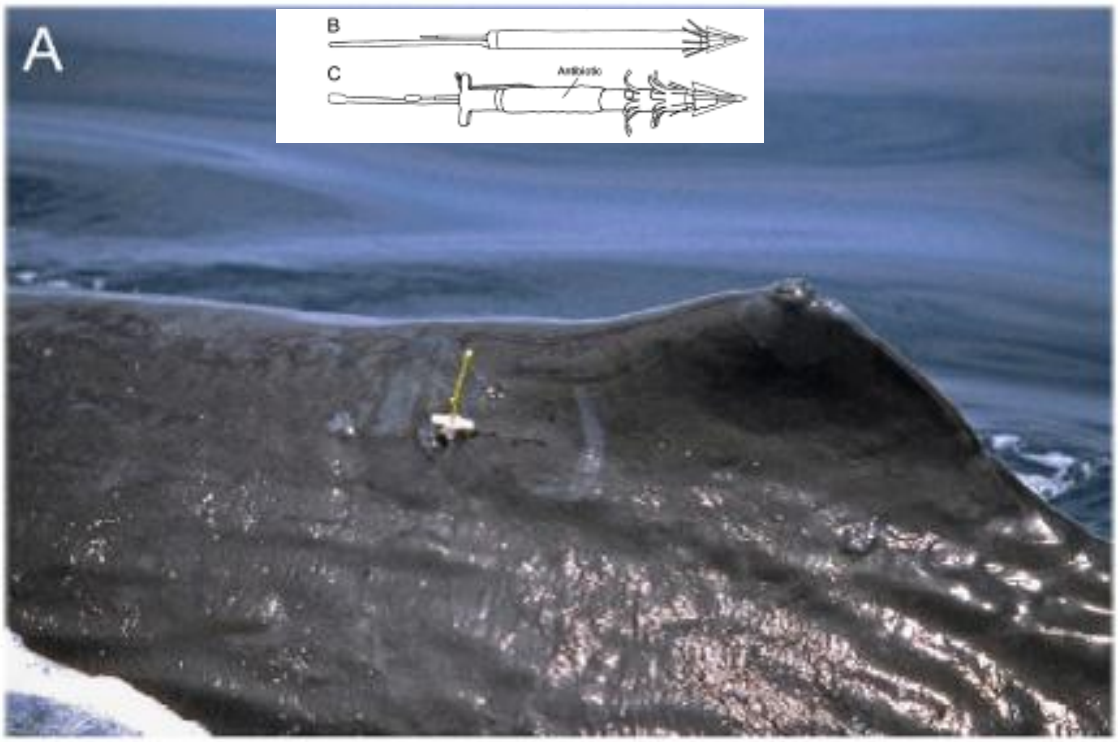

Fig. 2a – *Implantable* tag on a sperm whale.

Fig. 2b – Gun ARTS used to deploy *implantable* tags.

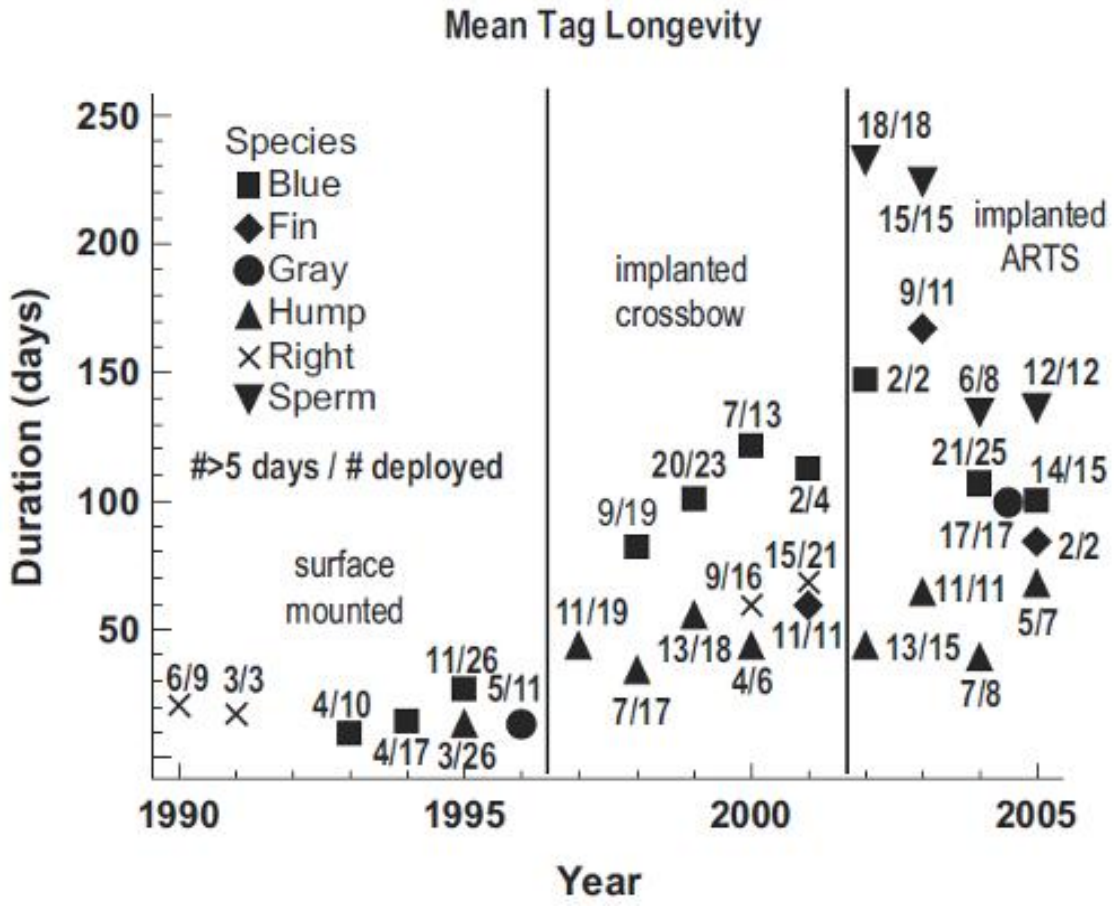

Fig. 3 – Mean tag longevity per species and tag model since 1993, with details on deployment methods (after Mate et al., 2007).

Study areas

The first tagging campaign (first phase) was carried out in the waters of the Ligurian Sea, North-Western Mediterranean Sea, in September 2012. The area (Figure 4) is one of the most productive sectors of the Mediterranean Basin and is a well know summer feeding ground for the fin whale as well as a region with an high occurrence of cetaceans. The whole surveyed area falls within the waters of the Pelagos Sanctuary for Mediterranean Marine Mammals (hereafter “Pelagos Sanctuary”).

Fig. 4 – The study area in the North-Western Ligurian Sea.

The second campaign (second phase; ongoing) was carried out in March 2013 in the waters surrounding the Island of Lampedusa, Sicily Channel, Central Mediterranean Sea (Figure 5). The knowledge on the presence of cetaceans in the area is limited, but it represents one of the few known winter feeding grounds for fin whales in the Mediterranean Sea, so far reported.

Fig. 5 – The study area in the Sicily Channel.

The area contains critical sea bird and cetacean habitats, deep sea corals, seamounts, and highly productive, very shallow offshore banks, and it supports a high productivity and nursery areas for several shark species as well as critical sea bird habitats. Furthermore, the area comprises important spawning sites for charismatic species such as the bluefin tuna and the swordfish. Therefore, the Sicily Channel has been considered and proposed as a high priority area to be included in future conservation plans under the Convention on Biological Diversity (CBD) and the Specially Protected Areas and Biological Diversity Mediterranean (SPA/BD).

Research platforms

For the 2012 survey in the Ligurian Sea a 18 metres sailing boat (Figure 6) was used as the main navigation/observation platform, while a speed-boat (Figure 7) was used as the main tagging platform.

Fig. 6 – Navigation/observation platform used in the Ligurian Sea.

Fig. 7 – Tagging platform used in the Ligurian Sea.

The project carried out in 2013 in the waters surrounding the Island of Lampedusa was a land based project, with daily expeditions at sea by means of a speed boat (Figure 8), as main navigation/observation and tagging platform.

Fig. 8 – Tagging platform used in the Sicily Channel.

Preliminary results

Fin whale tagging

During the first phase of the research project in the waters of the Pelagos Sanctuary a total of 13 non-consecutive days were spent at sea. A total of 1299 km, of which 1102 km (85%), were travelled in positive conditions. An overall number of 53 sightings of cetaceans, belonging to four different species were recorded: striped dolphin (*Stenella coeruleoalba*, n = 26, 49.1%), fin whale (*Balaenoptera physalus*, n = 25, 47.1%), sperm whale (*Physeter macrocephalus*, n = 1, 1.9%) and Cuvier's beaked whale (*Ziphius cavirostris*, n = 1, 1.9%). Figure 9 shows the tracks travelled during the research campaign, while the locations of the sightings are shown in Figure 10.

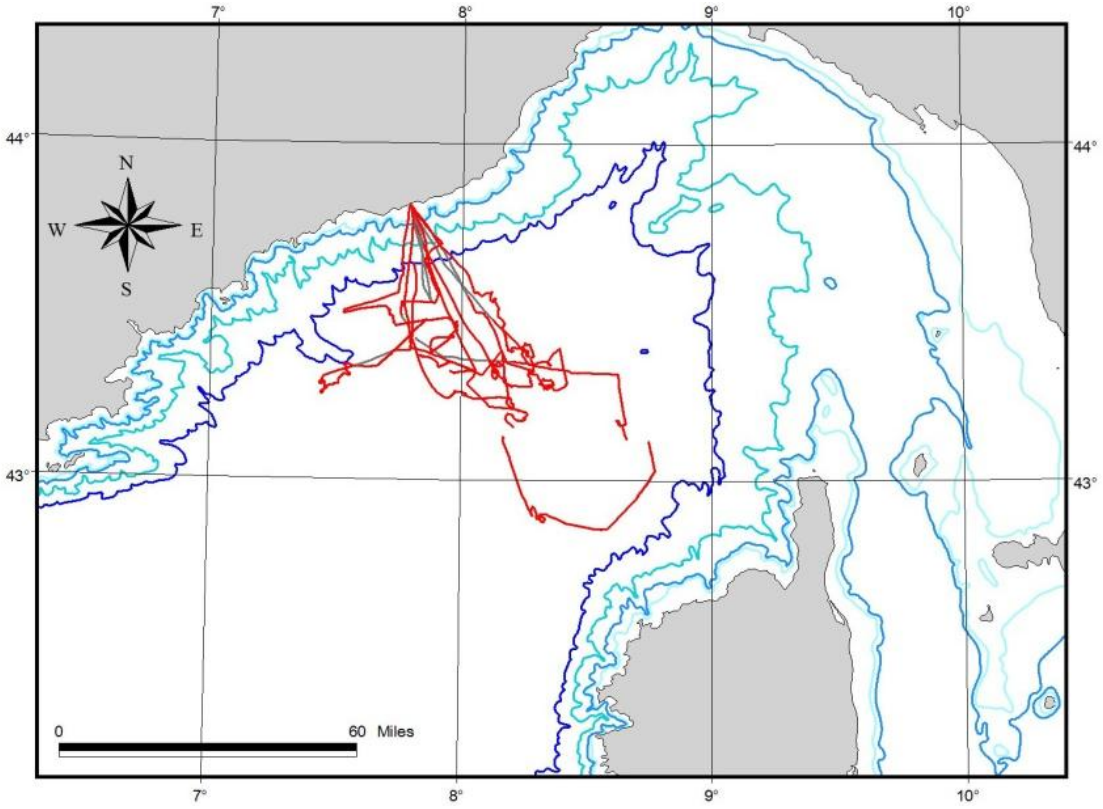

Fig. 9 – Tracks travelled during the research campaign in the Ligurian Sea.

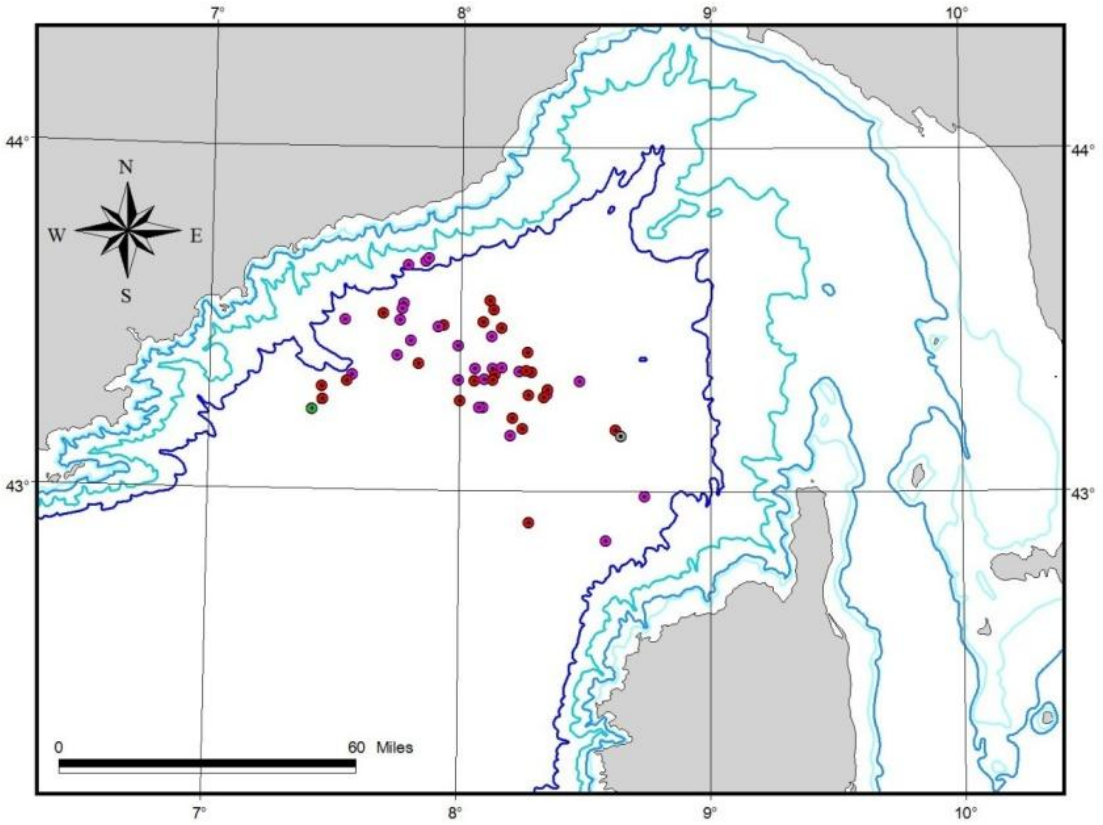

Fig. 10 – Location of the sightings recorded during the 2012 campaign (purple=striped dolphin, red=fin whale, grey=Cuvier's beaked whale e green=sperm whale).

In total, 8 fin whales were tagged (3 “LIMPET” and 5 “Implantable” tags). The instruments remained on the body of the whales for a period ranging between 2 and 142 days (average 52.8 days). The implantable tags performed better than the LIMPET ones, remaining on the body of the whales for about double the time. The tracks of the 8 tagged whales are shown in the Figures 11a – 17a as well as the location of the tags on the body of the animals (Figure 11b – 17b).

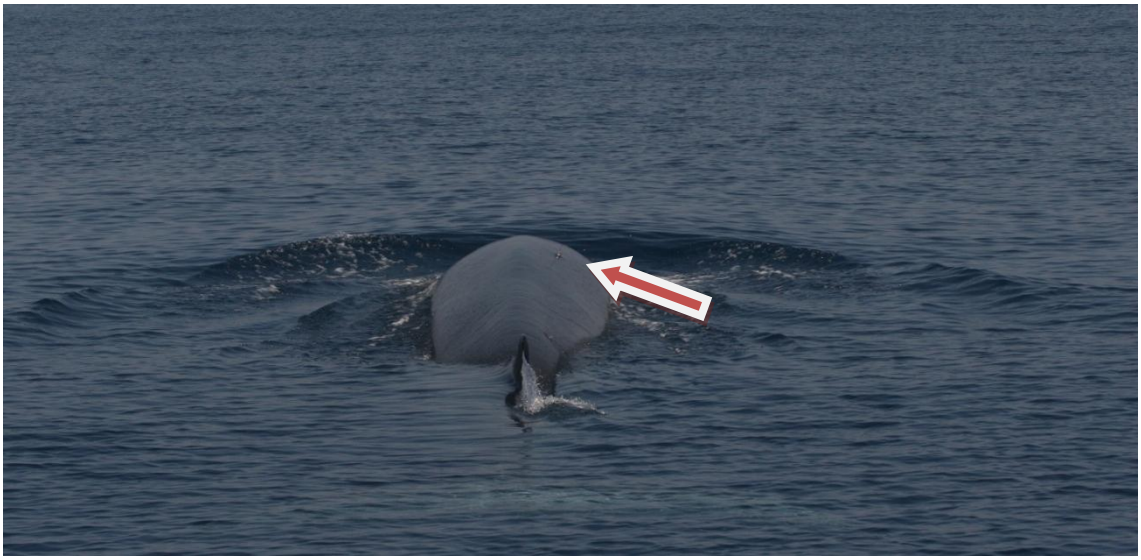

Fig. 11a – The position of the instrument on the animal Bp Tel 04.

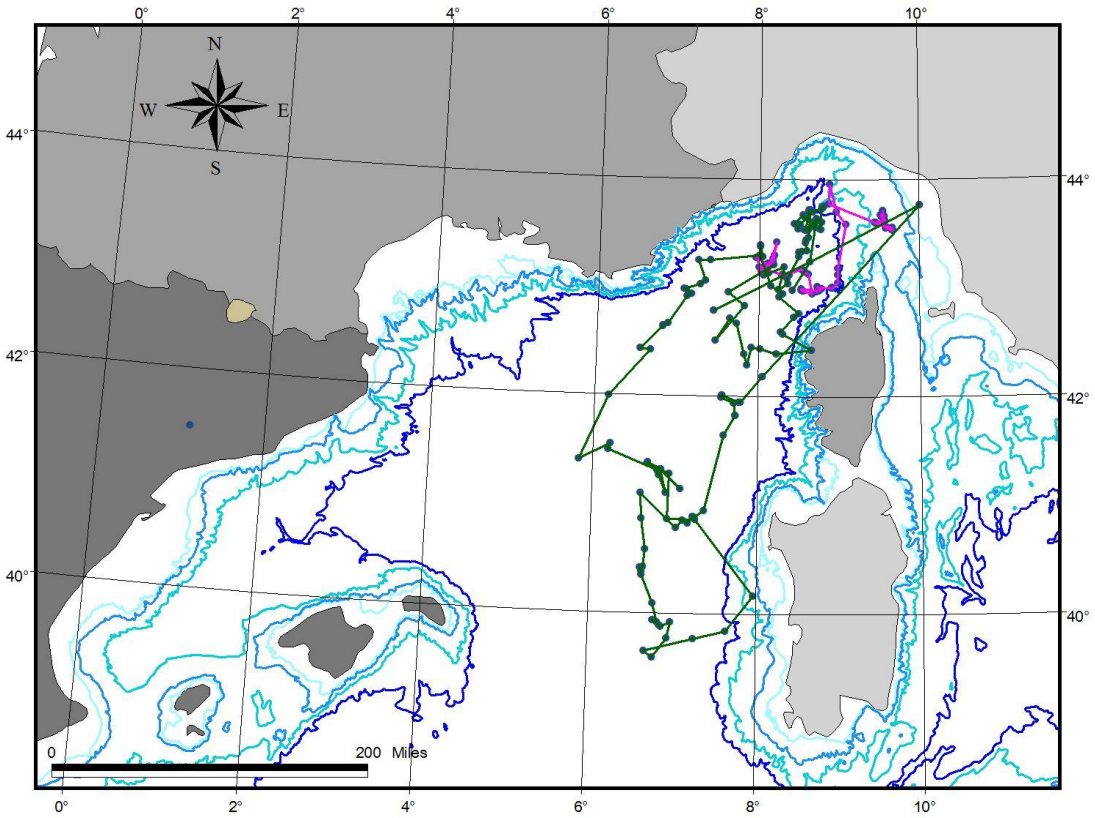

Fig. 11b – The tracks travelled by the animal Bp TEL 04.

Fig. 12a – The position of the instrument on the animal Bp Tel 05.

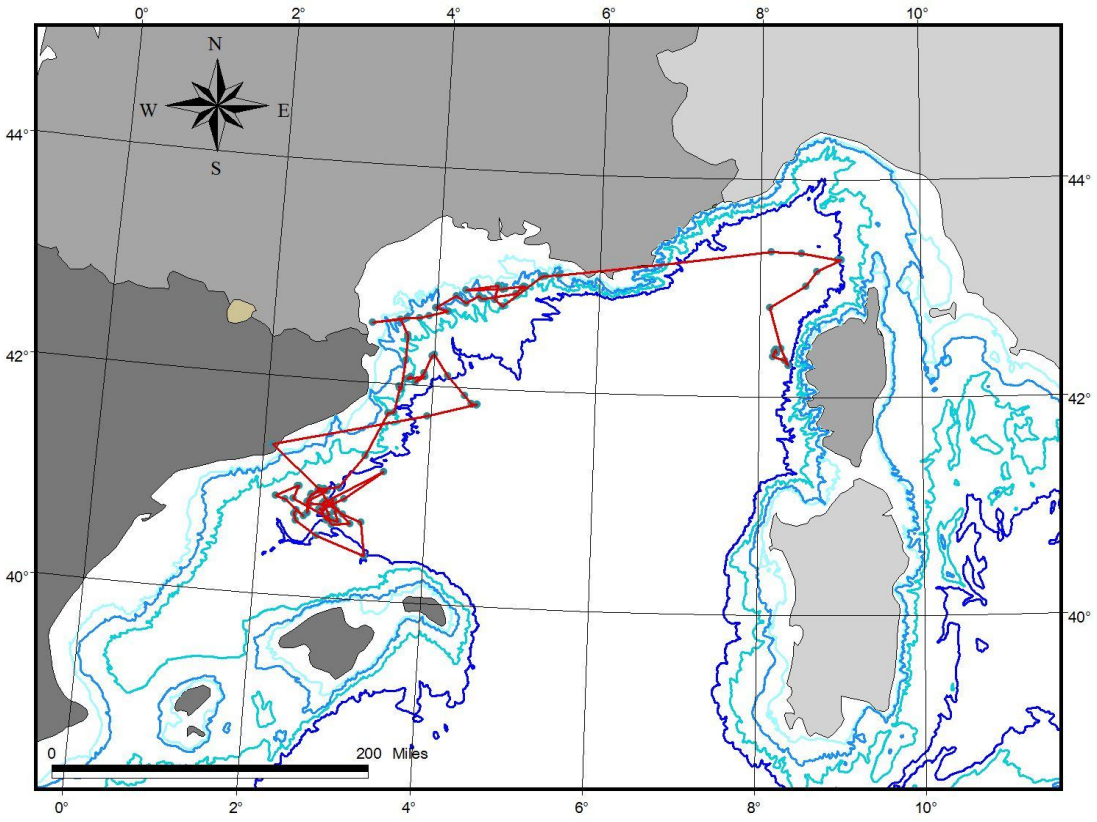

Fig. 12b – The tracks travelled by the animal Bp TEL 05.

Fig. 13a – The position of the instrument on the animal Bp TEL 07.

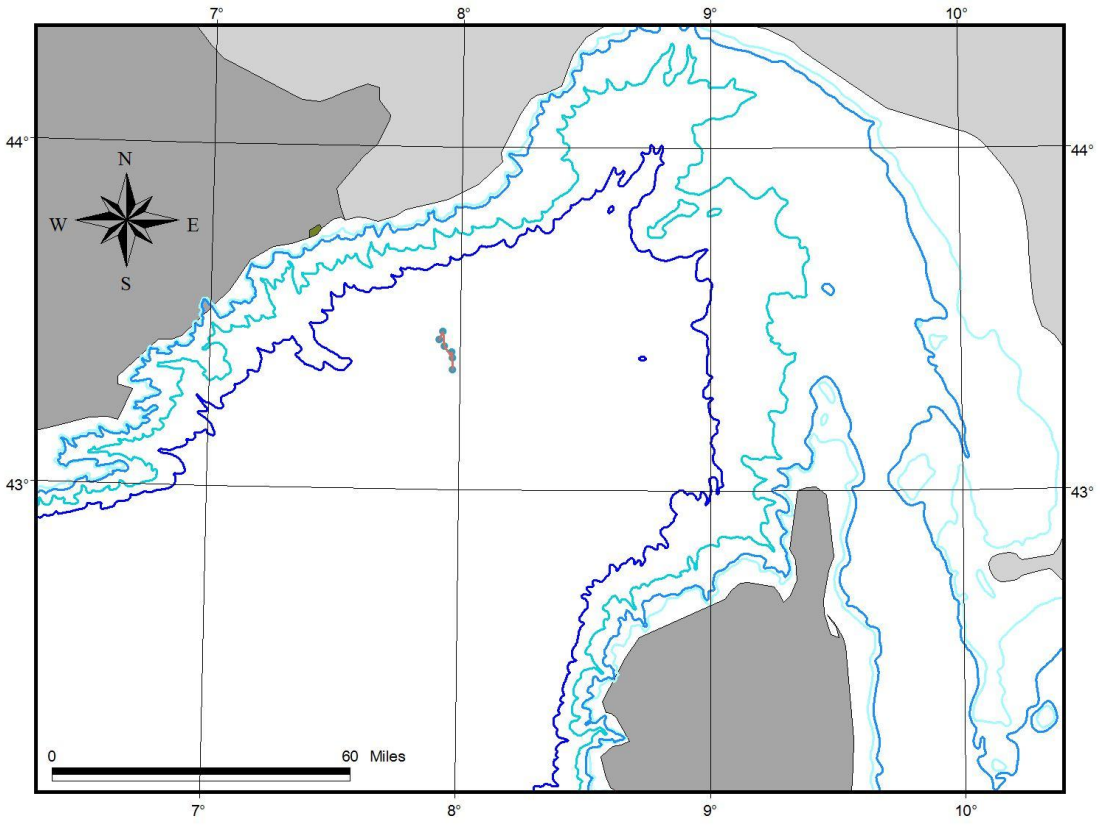

Fig. 13b – The tracks travelled by the animal Bp TEL 07.

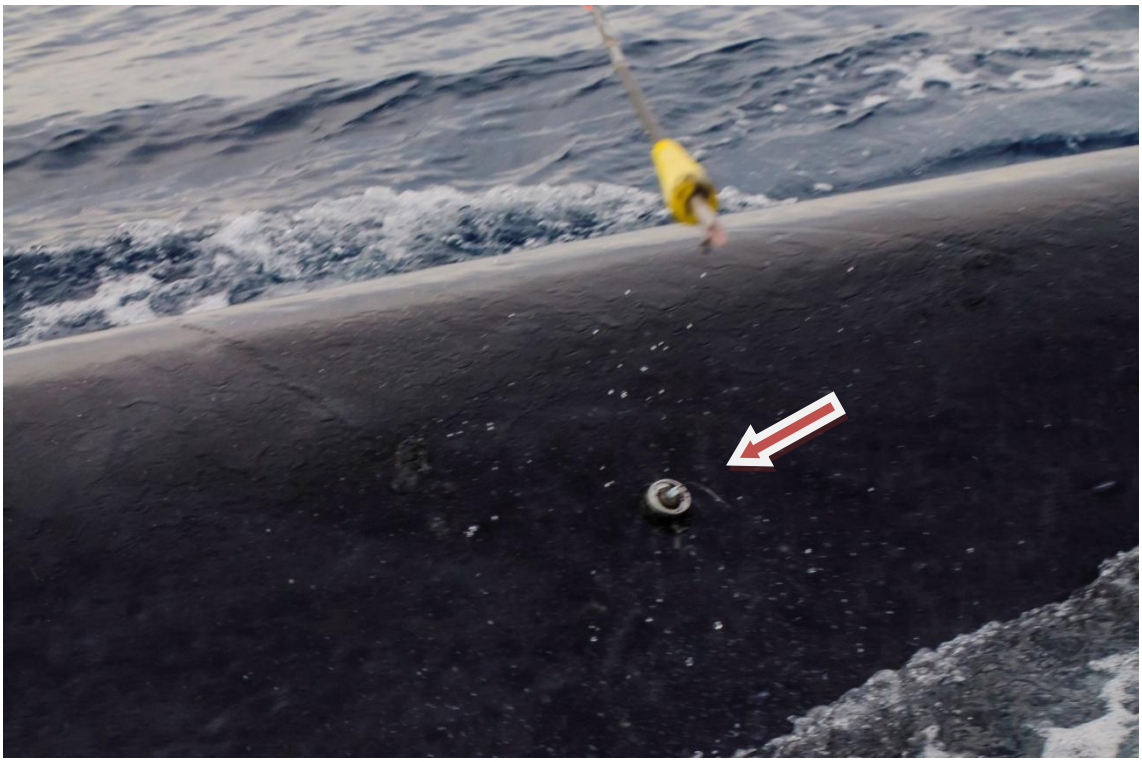

Fig 14a - The position of the instrument on the animal Bp TEL 15.

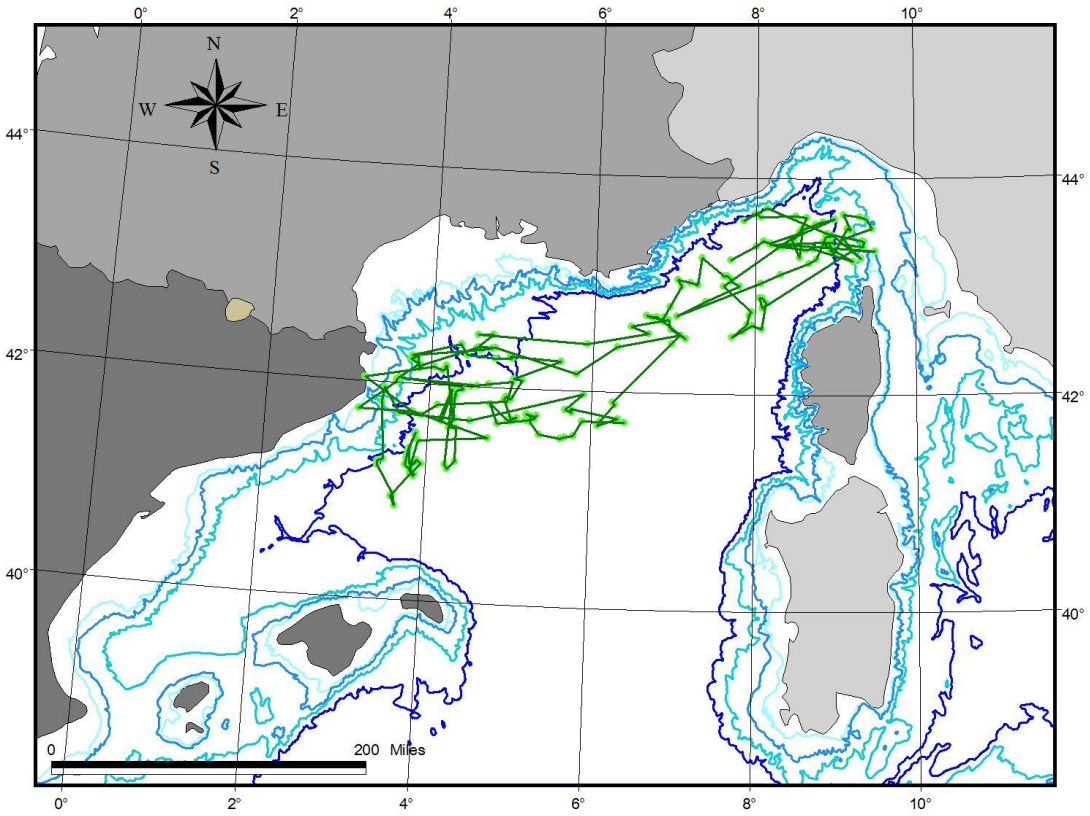

Fig. 14b – The tracks travelled by the animal Bp TEL 15.

Fig. 15a – The position of the instrument on the animal Bp TEL 25.

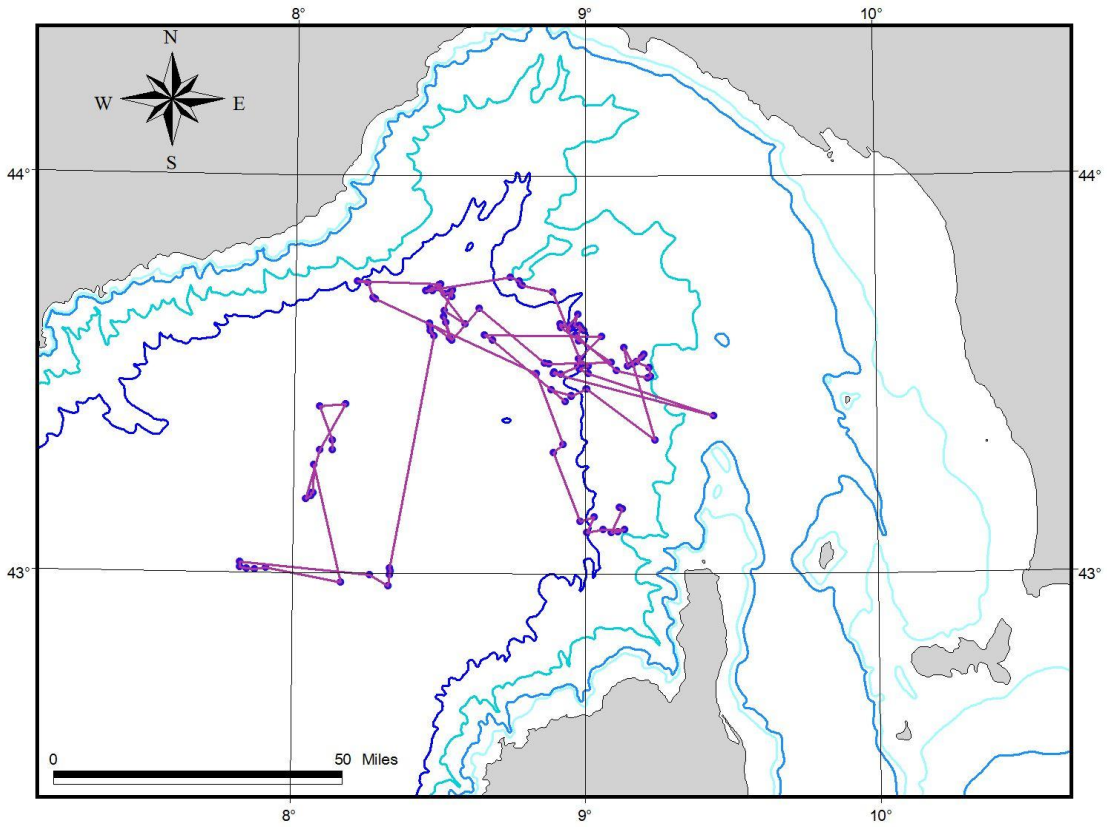

Fig. 15b – The tracks travelled by the animal Bp TEL 25.

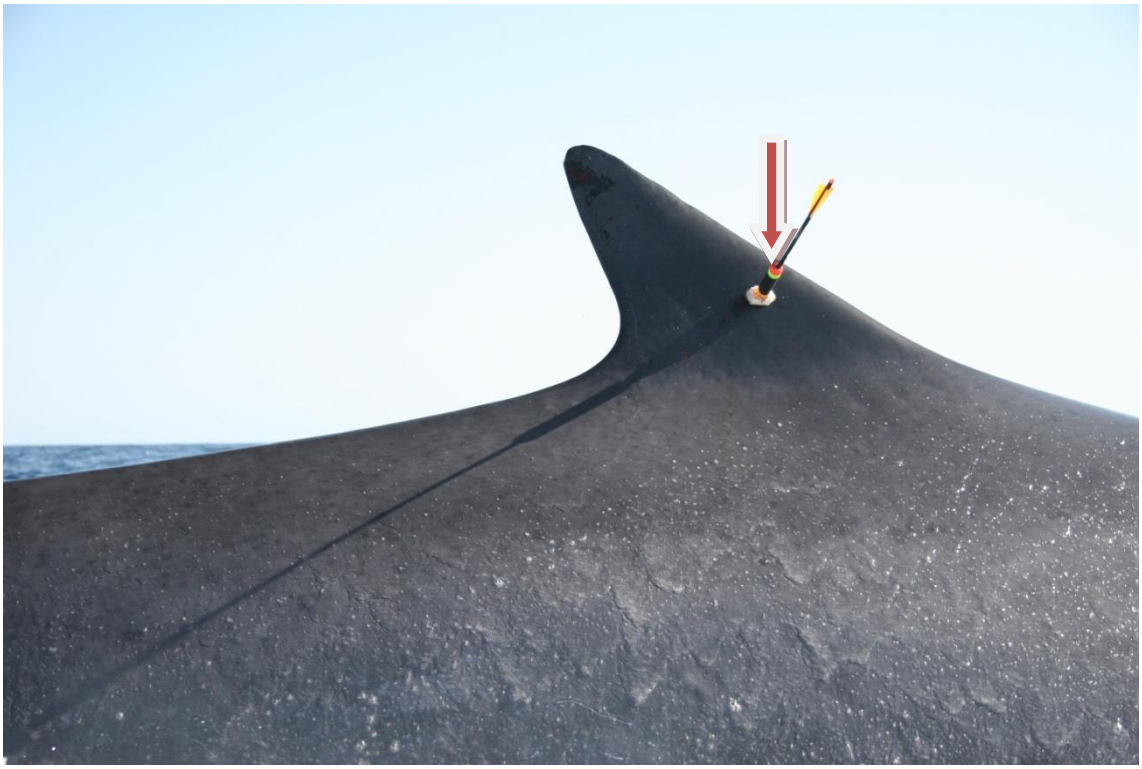

Fig. 16a – The position of the instrument on the animal Bp TEL 26.

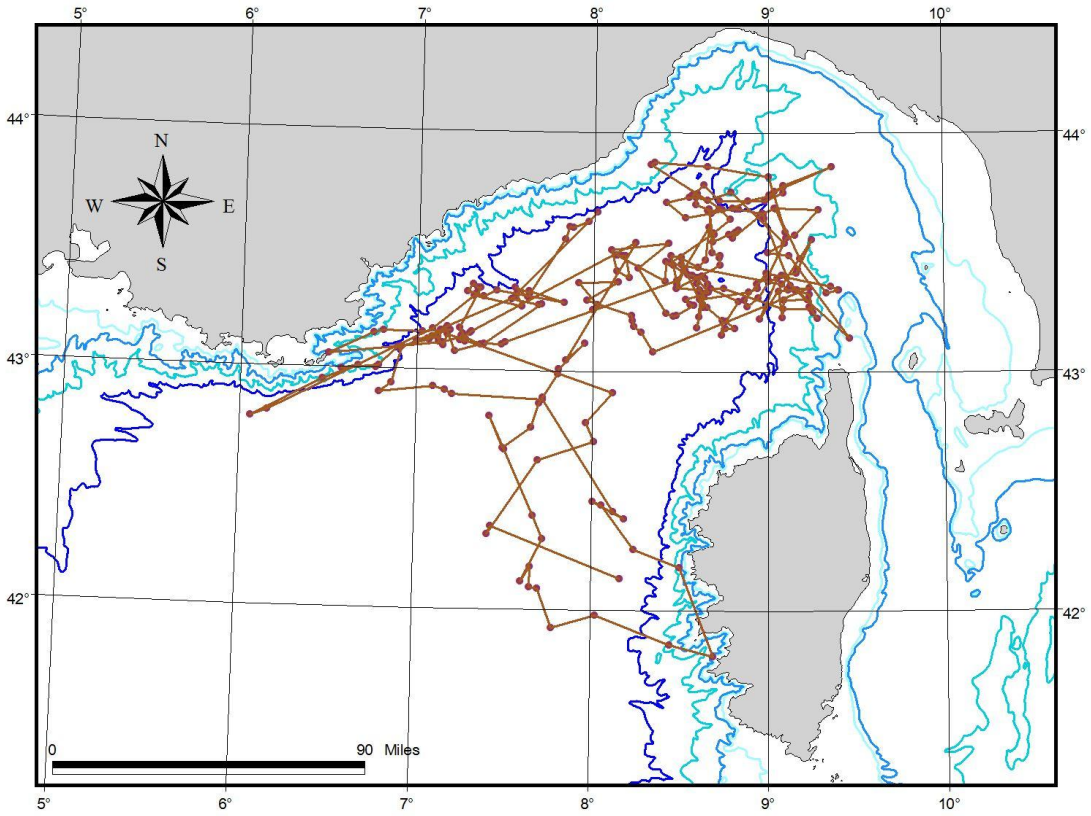

Fig. 16b – The tracks travelled by the animal Bp TEL 26.

Fig. 17a – The position of the instrument on the animal Bp TEL 29.

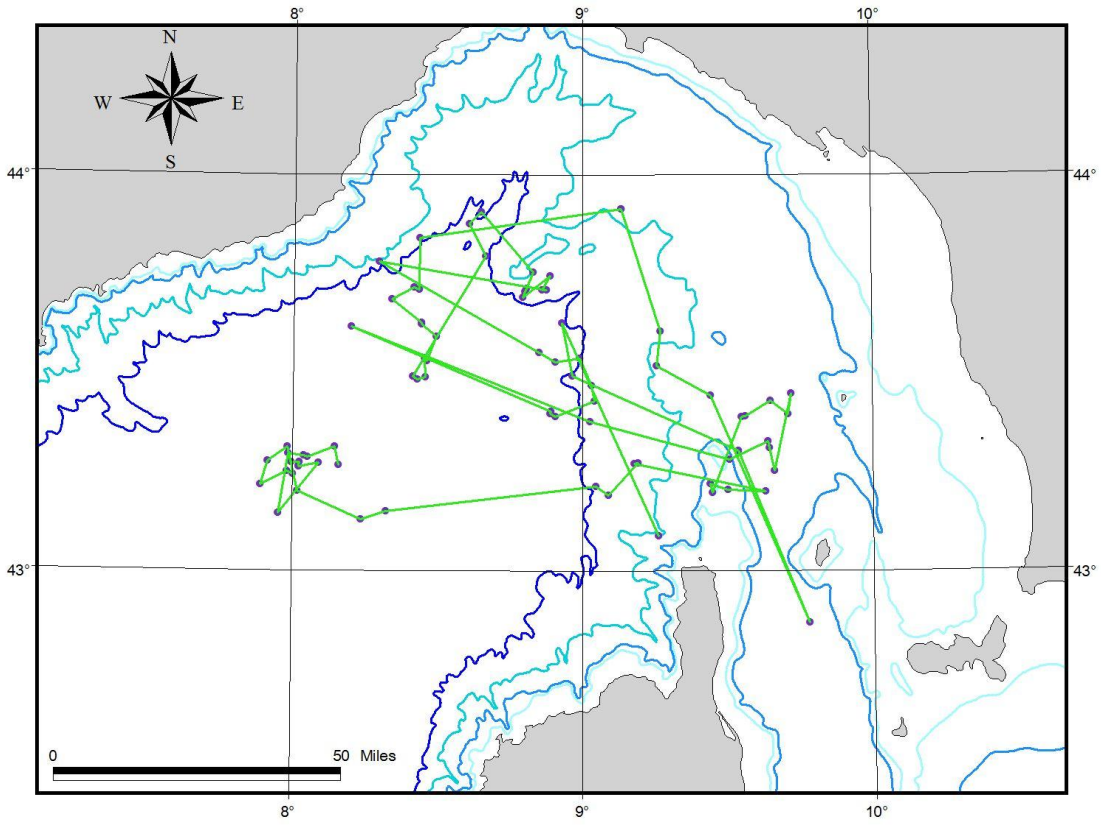

Fig. 17b – The tracks travelled by the animal Bp TEL 29.

During the first campaign of the ongoing second phase of the project in the waters surrounding the Island of Lampedusa, 13 days were spent at sea. Unfortunately, the generally bad weather and sea conditions, as well as the low occurrence of fin whales, only allowed the deployment of 3 satellite transmitters that remained on the body of the whales for a very short time. Figure 18 shows the tracks of the tagged whales.

Satellite transmitters were deployed between 3 and 13 March 2013, during 7 days of research effort at sea. The three whales were marked by the inflatable with implantable tags shorter than the ones used in the Ligurian Sea in 2013. The choice to use transmitters of different lengths was made to evaluate the performances of different anchoring systems and to possibly further reduce the potential impacts of the tag on the whale. The first tag transmitted for 8 days, the second one for 4 days, while the third one remained on the whale for 13 days. Different causes may have led to this rather scarce performances, one of them possibly being the shallow depth of the water around the Island of Lampedusa. It can, in fact, be hypothesised that whales do touch the bottom during dives, therefore scrubbing the tag off the body. Another cause may lay in the interactions between different animals associated with feeding activities; whales may get close to each other and therefore detaching the transmitter off the bodies.

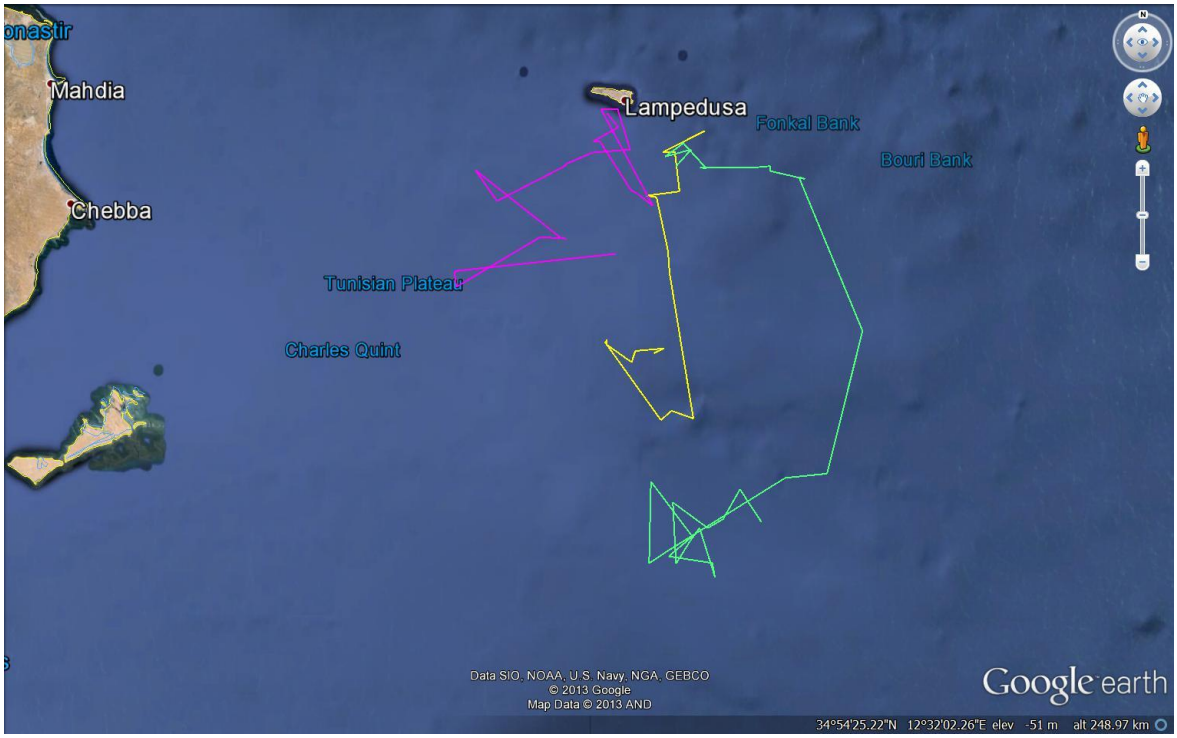

Fig. 18 – Fin whale tracks off Lampedusa Island (different colours represent different whales).

Given the small sample size of the Lampedusa campaign data, it is not possible to present any result on the short- and mid-term movements and migration of whales in the area, therefore the need to replicate the fieldwork in 2014 as well.

We are currently planning the field work for 2014 and in order to avoid similar situations to those experienced in 2013, we plan to deploy LIMPET tags only. Having a higher position on the dorsal fin and a smaller size, we are confident that interactions between the animals and with the bottom of the sea will not cause any detachment from the animals.

On the other hand, the analyses of the movement of the 8 fin whales tagged in the Pelagos Sanctuary highlighted the significance of this area for the species and, at the same time, showed how the animals use a wider area than previously thought, extending their movements in the waters of the Gulf of Lyons and in those adjacent to Spain.

Potential critical feeding areas

While at the moment it is not possible to investigate the presence of critical feeding areas for fin whales in the Sicily Channel due to the small sample size, interesting information have been gained for the waters of the North-Western Mediterranean Sea. Current investigation and ongoing

data analysis show how the tagged whales remained in the NW Mediterranean longer than expected, possibly due to the concomitance of peculiar oceanographic and climatic conditions.

An innovative approach to investigate the potential feeding habitat of fin whales in the western Mediterranean has been developed based on the occurrence of mesoscale productive fronts that have been identified or hypothesized to play a key role on feeding of fin whales and of other large pelagic predators. This new innovative approach is important to fullfill and implements the requirements under the Marine Strategy Framework Directive (MSFD) towards the establishment of monitoring programs (by 2014), the development of conservation measures (by 2016) and the mitigation of human-induced threats on Mediterranean cetacean populations (by 2020).

Figures 19-20 show the movements of the tagged whales overlapped to potential feeding grounds in the NW Mediterranean Sea. Feeding habitats were determined mainly from the simultaneous occurrence of large oceanic fronts of satellite-derived sea-surface chlorophyll content (CHL a) and temperature (SST). Overall, fin whale potential habitat occurs frequently during summer in dynamic areas of the general circulation, and is substantially more spread over the basin in winter.

In the following figures the tracks of some selected whales have been overlapped to areas which can be considered as foraging habitats. In Fig. 19 one whale remains at the boundary of a presumed feeding area in the central Ligurian Sea, between Corsica Island and the mainland; while in Fig. 20 the tagged whale remain in a feeding area between the Balearic Islands and the coast of Spain, at the borders of the Gulf of Lions. Particular oceanographic conditions in the area, such as permanent frontal systems, allow high levels of upwelling events, thus making this area particularly rich in biomass. The selected habitats are predicted over a summary of 15 days, therefore daily specific events may go unnoticed.

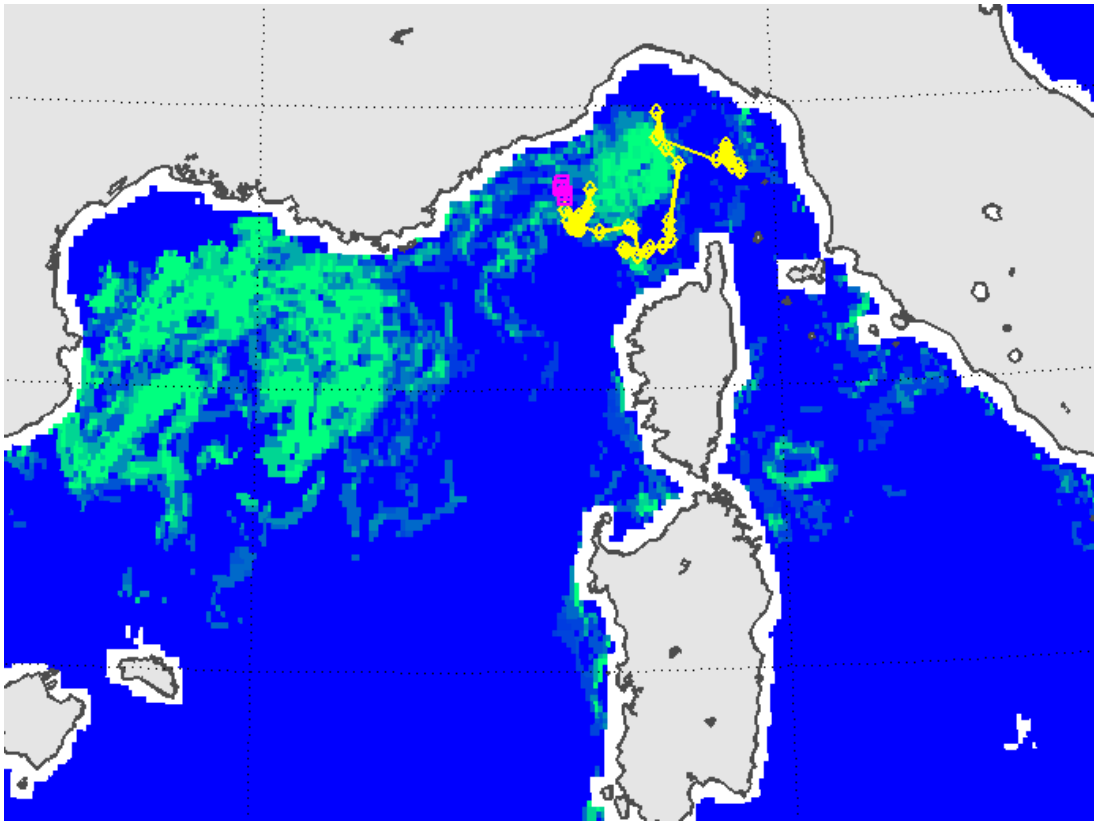

Fig. 19 – Fin whale tracks overlapped to presumed feeding habitats (1-15 September 2012)

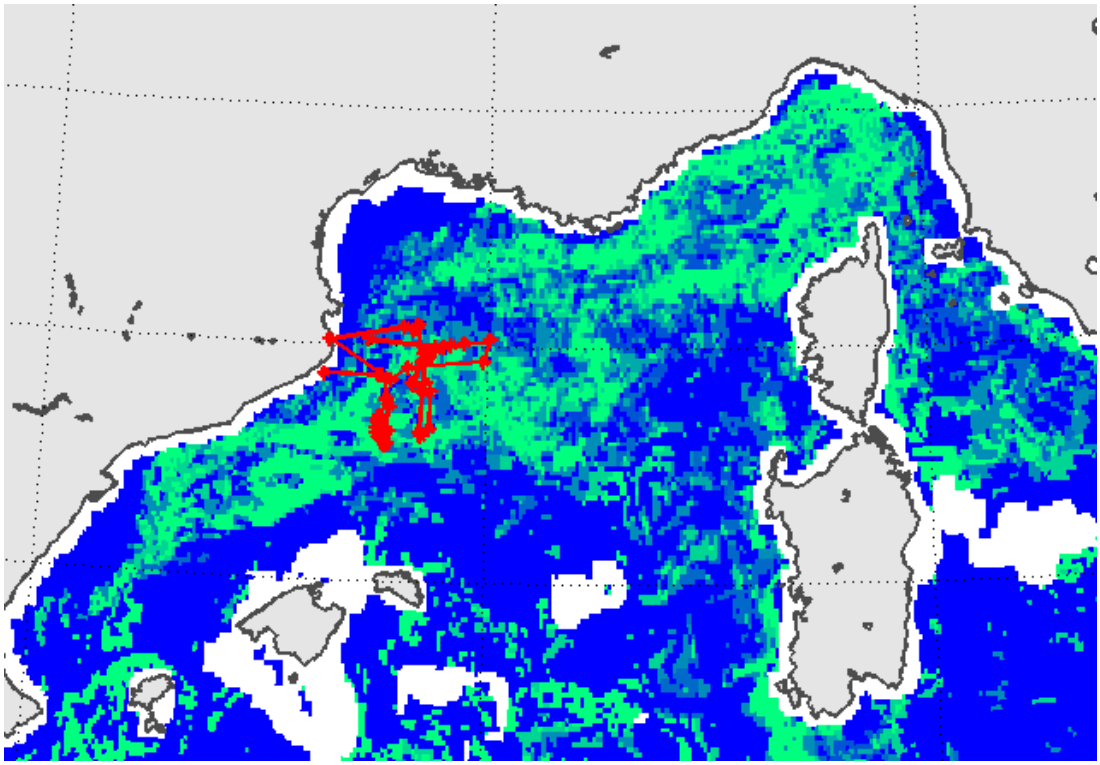

Fig. 20 – Fin whale tracks overlapped to presumed feeding habitats (1-15 November 2012)

Ongoing and future activities

Due to the scarce results obtained during the first research cruise in the Sicily Channel, a second expedition has been planned for the month of February-March 2014 in the same area, with the objective of deploying more satellite transmitters. The main goal is to gain knowledge on the short- and mid-term movements of fin whales in the region and to identify critical feeding habitas for the species, as well as the potential to identify long-term migration routes and pattern between the winter and the summer feeding grounds. Knowledge of these ecological parametres would definitely help to identify, plan and improve protection measures and to implement mitigation actions from anthropogenic threats, such as those represented by ship strikes, for example.

The intended outputs of the planned future filed work effort are:

- reports and presentation at national and international conservation meetings and workshops
- presentations to national and international meetings and conferences
- scientific articles published in intternational journals

Capacity buildings and public awareness

The project carried out so far has been developed, planned and carried out in close collaboration with several national and international organizations and professionals. Researchers from the Institute for Environmental Protection and Research (ISPRA, Italy), The University of Siena (Italy), the Institute Aqualie (Brazil), the International Whaling Commission (IWC) and the U.S. National Oceanic and Atmospheric Administration (NOAA) are involved in all the different phases oof the project, from data collection to data analysis. The project was also attended by French researchers of the group GIS3M - *Groupement d'Intérêt Mammifères Scientifique pour les Marins de Méditerranée et leur environnement*. This wide collaboration is important to deepen the current academic discussion on this approach to cetacean research and helps to take into consideration all the possible issues (legal, technica, ethical) strictly related to satellite telemetry. Furthermore, the inclusion in the project of leading scientists and the use of state of the art tools for data collection has the potential to represent a leading example within the Mediterranean Sea with important outcomes for capacity buildings and public awareness.

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