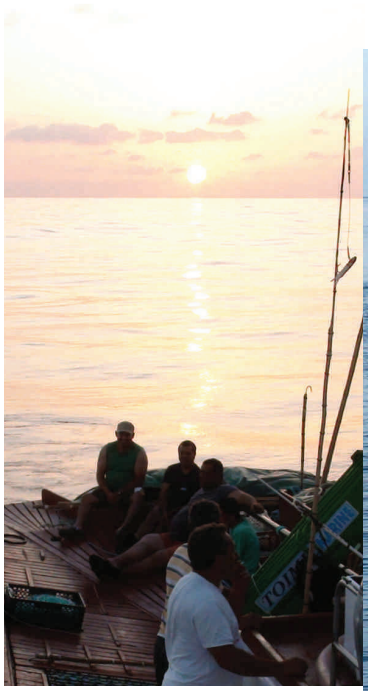
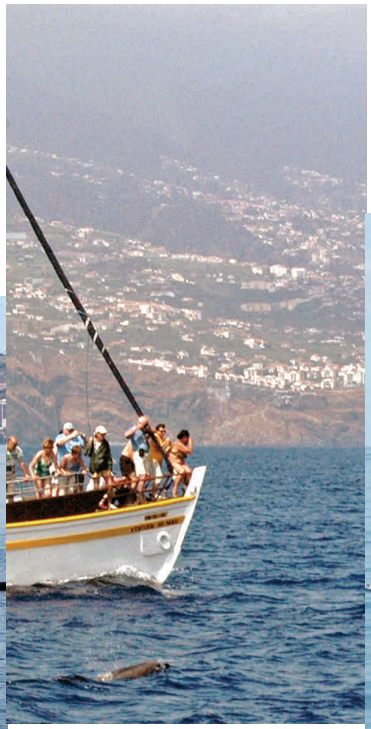
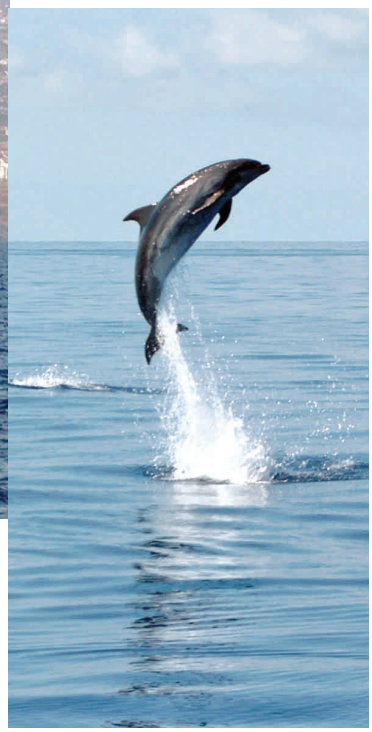
the sea of madeira an oasis to conserve

Whales and dolphins of Madeira







Identify
Study
Manage
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CETACEOSMADEIRA II PROJECT (2009 - 2013)
LIFE07 NAT/P/000646

cetáceos MADEIRA II

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MACHICO

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INDEX

ACKNOWLEDGMENTS

The project CETÁCEOSMADEIRA II (CMII) team acknowledges the collaboration of many volunteers who participated in some of the project actions, including:

Adalberto Carvalho
Ana Higueras
Alexandra Pisareva
Carlos Silva
Catarina Henriques
Cláudia Gomes
Daniel Martins
Filipe Henriques
Jonatan Svensson
José Tosta
José Roberto
Luís Dias
Maria Ovando Rodriguez
Nuno Marques
Mafalda Ferro
Marianne Bohm-Beck
Pedro Neves
Raquel Marques
Rita Ferreira
Rodrigo Freitas
Jose Antonio Bonales
Virginie Wyss

Acknowledgments to the following martitime-touristic vessels, the owners and respective crews:

Bonita da Madeira
Gavião
H2O Madeira
Ribeira Brava
Rota dos Cetáceos
Sea Born I e II
Sea Pleasure
Sea the Best
Ventura do Mar

Acknowledgments to the following vessels of the regional tuna fleet, vessel owners, masters and crews:

Amanhecer
Autonomia
Azimute
Baía do Funchal
Cabo do Mar
Cabo da Praia
Condor
Falcão do Mar
Flor do Pico
Gavina
Mal-Amanhado
Mestre Sacadura
Mestre Soares
Pesca Atum
Progresso Futuro
Pérola de Santa Cruz
Pepe Cumbrera
Ponta do Espartel
Rei dos Açores

WHAT

The project CETACEOSMADEIRA II (CMII) intends to answer the following questions related to the conservation of cetaceans in the Madeira archipelago:

A goal 1 – Are there important areas for the bottlenose dolphin? Should these areas be designated as Site(s) of Community Importance and be part of Natura 2000 Network?

B goal 2 - What are the current areas of operation for whale-watching vessels? Should areas and operation limits be established for the activity in order to contribute to its sustainability and for the conservation of cetaceans?

C goal 3 - Are cetacean species on the high seas exposed to threats due to human activities? If so, which ones and with what impact? Are tuna fishing vessels the most appropriate and/or efficient means for collecting biological information to assess the conservation status of cetaceans at high seas?

> The waters of Madeira are inhabited by 28 species of whales and dolphins, approximately 33% of all known species of cetaceans in the world.

Bottlenose dolphin
Tursiops truncatus

Its distribution covers the coastal and oceanic waters of all the seas of the planet, with the exception of the polar seas. Adults measure 2 to 3,5 meters long and weigh 150 to 650 kg. Males are larger and heavier than females. Its colour is lead grey with faded shadows on the flanks. The belly is white, sometimes pinkish. It feeds on small fish, squid, octopus and crustaceans and its feeding mode varies widely, from individual feeding to group feeding. The more coastal animals form smaller groups than oceanic animals. This species has a complex and cohesive social organization.

Short-finned pilot whale
Globicephala macrorhynchus

Occurs globally in tropical and warm temperate waters. The male pilot whales have an average length of 6m whilst females is 5m. They are dark-grey to black, with a light spot behind the dorsal fin. Its diet consists mainly of fish and cephalopods (squid, octopus and cuttlefish). They are quite gregarious and form groups of a few dozen to a few hundred animals. The social structure of the pilot whales groups is complex, but there seems to be no age or sex segregation. Sometimes they form mixed groups with bottlenose dolphins.

WHY

The high diversity of species in our sea is an ecological, cultural, socioeconomic asset that is important to maintain.

Throughout the last 12 years, the Madeira Whale Museum (MWM) took on several projects to learn about the cetacean species that frequently inhabit the waters of the Madeira archipelago. Based on acquired knowledge, several themes were considered worthy of further studies and attention:

1. the bottlenose dolphin;

2. whale-watching activity;

3. human activities at high seas and their impact on cetaceans;

(for more information: http://museudabaleia.org/index.php?option=com_content&view=article&id=20)

1. *Bottlenose dolphin*

The bottlenose dolphin has been identified as one of the species of cetaceans that is potentially more vulnerable to human activities in the Madeira archipelago. Until recently it was known that:

• They are sighted throughout the year in the coastal waters of Madeira where they develop vital activities, namely, feeding, socializing, resting and reproduction;

• The distribution coincides with the area of increased human activity at sea, especially maritime traffic of recreational crafts, maritime-touristic vessels and fishing activity;

• The bottlenose dolphin is one of the main target species of the whale-watching activity;

• Calves are regularly seen, indicating that these waters are used to give birth and breeding;

However some doubts about the existence of resident bottlenose dolphins and if they prefered particular areas still remained.

The bottlenose dolphin is a priority species under the European Habitats Directive and the responsibility for identifying and proposing Sites of Community Importance (SCI) to integrate the Natura 2000 Network for this species, lies with the Member States.

2. *Whale-watching*

The commercial activity of whale and dolphin watching - whale-watching - began on the south coast of Madeira in the 1990s. Over the years, this activity has been increasing in the number of companies and operating platforms. In order to minimize the stress caused by whale-watching vessels on the observed cetaceans, the MWM proposed a voluntary code of conduct in 2003 stipulating a set of rules for observation.

Though voluntary, the code was adopted by the majority of the companies in the sector and was the basis of legislation created by the Regional Government (Decreto Legislativo Regional n.º 15/2013/M - Regulamento da Atividade de Observação de Vertebrados Marinhos na Região Autónoma da Madeira).

The fore mentioned legislation contemplates the definition of areas of operation and its carrying capacity, justifying the questions (B) considered in this project.

3. *Human activities at high seas and their impact on cetaceans*

The conservation status of cetaceans in the Madeira archipelago has been evaluated based on scientific information collected in coastal waters. Hence there is a lack of information regarding the presence and distribution of cetaceans on the high seas, as well as human activities that take place there. On the other hand, the Habitats Directive mentions in its article no. 11 the responsibility of States to ensure the monitoring of the status of conservation for priority species.

“The high diversity of species in our sea is an ecological, cultural, socioeconomic asset that is important to maintain.”

WHO

The **Madeira Whale Museum** is a department of the Municipality of Machico, whose mission is:

To maintain the heritage and historical knowledge about whaling in Madeira, create and disseminate knowledge on cetaceans and the marine environment through an integrated and environmentally responsible policy, based on museology, education and scientific research, contributing to bring people closer to the sea.

The MWM has developed several scientific studies throughout the years, including the project CETACEOSMADEIRAII, co-financed by the LIFE + project (European Union) and the Municipality of Machico. Several entities have collaborated and contributed to this project, such as whale-watching operators, tuna fishing fleet owners and crews, the *Secretaria Regional da Educação e Recursos Humanos* (the Madeira Regional Goverment Department for Education and Human Resources) and the *Secretaria Regional do Ambiente e dos Recursos Naturais* (the Madeira Regional Government Department of Environment and Natural Resources).

Project Team

Eleven people were part of the project CMII team, including biologists, crew, management and administrative staff, GIS technician and a teacher. Additionally 2 external offshore observers were contracted for boarding in tuna fishing vessels and several volunteers were also involved, participating mainly in the sea campaigns. The project had the technical-scientific consultancy support of four internationally renowned researchers.

Fig. 1 – The MWM team involved in the project CMII.

HABITATS DIRECTIVE AND NATURA 2000 NETWORK

The European Union Habitats Directive main aim is to promote the maintenance of biodiversity by taking into account economic, cultural and regional requirements, thus contributing to the overall objective of sustainable development. The Directive was an European Union response to the continued deterioration of natural habitats and the increasing number of threatened species in Europe. One of the instruments created under the Directive was the Natura 2000 network. It is a coherent European ecological network comprised of Special Areas of Conservation, on land and at sea, to ensure the restoration or maintenance of the natural habitat sites and the species of community interest (annex II) into a favourable conservation status.

The bottlenose dolphin is one of the species classified of community interest under the Habitats Directive (annex II). It is up to the Member States to identify and propose, in its territory, important areas for the species of community interest such as the bottlenose dolphin, to be designated as Sites of Community Importance to integrate the Natura 2000 network, which can at the end of 6 years become Special Areas of Conservation. It is therefore in this context that the first objective of the project CMII is integrated.

One of the important aspects considered in this Directive is the surveillance of conservation status of species of community interest. Such surveillance includes the scientific monitoring of biological and population parameters that are indicators of the condition and viability of populations in the medium and long term. This way it may be possible implement management measures in case human activities are having a negative impact on the monitored species, in order to restore their favourable conservation status. It is in this perspective that the goal 3 of the project CMII was considered, constituting a first approach to collect biological/populational data from platforms of opportunity and evaluate the impacts of human activities on cetaceans in the offshore waters of Madeira.

Fig. 2 – Map indicating the marine areas that are currently part of the natura 2000 network (source: EEA 2012).

WHEN AND WHERE

The Madeira archipelago lies in the North-east Atlantic (geographical position 32.46N - 16.46 W), west of the NW coast of Africa, and inserted in the Macaronesian biogeographic region.

The Madeira archipelago is of volcanic origin and is comprised by the islands of Madeira and Porto Santo, and two sub - archipelagos, Desertas islands and Selvagens islands (both natural reserves).

Fig. 3 – Map of Madeira archipelago location in the context of the north-east Atlantic and the identification of its main islands, where the CMII project took place.

The project CMII took place between June 2009 and June 2013, having the exclusive economic zone (EEZ) of the Madeira archipelago as the study area. To answer the questions A and B sea surveys were conducted in coastal waters of Madeira, Porto Santo and the Desertas and for question C throughout Madeira EEZ.

The archipelago's waters are warm temperate and underwater topography is characterized by the lack of a continental shelf with a rapid increase in depth from the coast. Thus typically oceanic cetaceans, which normally inhabit deep waters, come very close to shore and are easily observed. The Madeira marine environment is characterized by oligotrophic ocean waters (generally with low levels of nutrients), influenced by the arms of the Gulf Stream that heads south, including the Azores current and the Canary current.

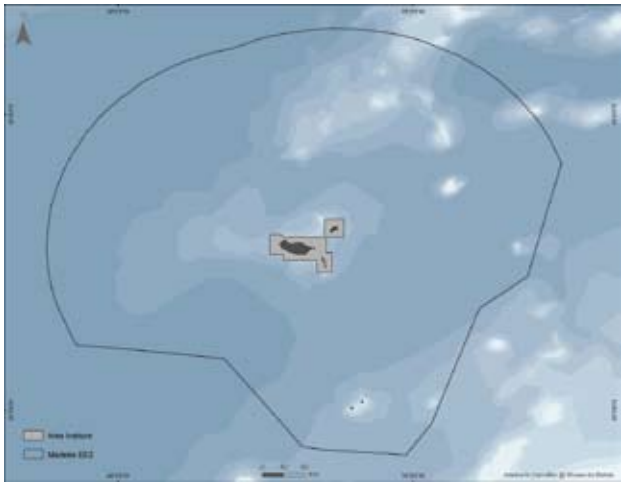


Fig. 4 – Map illustrating the Madeira exclusive economic zone (Madeira EEZ) - the area where the sea surveys for the project CMII took place. The Madeira EEZ has an approximate area of 446 thousand km2, 500 times bigger than the land surface of the archipelago, and includes all the sea within 200 nautical miles (370 km) from the coast. .

Cetaceans in the Atlantic

This archipelago, like other oceanic archipelagos, is an important site for highly mobile marine species such as cetaceans. Oceanographic and ecological characteristics are the basis for this preference and are usually related to food availability (higher productivity in archipelagic sea's compared to high seas), together with the conditions that these archipelagos provide for activities such as reproduction, birth and calves survival in early life, socialization, rest, among others.

The species observed in the waters of Madeira such as the bottlenose dolphin, short-finned pilot whale, the common dolphin and the Atlantic spotted dolphin are part of pelagic populations that have vast distribution areas in the Atlantic Ocean. The bottlenose dolphins and the short-finned pilot whale have groups that regularly use the waters of the archipelago (Island associaded groups) and possibly the same occurs with other species such as the Blainville's beaked whale, as the Cuvier's beaked whale and the pygmy sperm whale, species for which there is still lack of knowledge in Madeira waters.

HOW

At the beginning of the project protocols were prepared for data collection at sea, in order to define the appropriate scientific methodologies, as well as the appropriate data analysis. To answer the questions A and B systematic sea surveys (SSS), random sea surveys (RSS) and opportunistic trips on board whale-watching boats were carried out, and for question C opportunistic trips took place on board tuna fishing vessels (see section WHAT).

Figure 5 and 6 - Scientific research sailboat "Ziphius" navigating along a SSS route / Observers in the two lookout positions (bow and stern) on board "Ziphius".

Systematic Sea Surveys (SSS)

Consists in visual detection and observation of cetaceans at sea along predefined routes, by applying the method of Distance Sampling (see box). The research sailboat "Ziphius" from MWM was used as the observation platform, with a crew of at least 5 people to do this work. The researchers rotated among the various positions on board, 3 lookout positions in effort, 1 annotator position and a helmsman position.

During the route all relevant information is recorded, including sightings of cetaceans (distance and angle of the animals to vessel, species, number of individuals, behaviour, etc..), sampling effort and environmental conditions, as well as other additional tasks such as photo-identification (see box) and the collection of skin samples for genetic studies.

The SSS were carried out in 8 sectors, in the area of sea between the coast and the 12 nautical miles around the islands (Figure 7).

DISTANCE SAMPLING AND SPATIAL MODELLING

As it is usually impossible to count all individuals of a population in nature, the abundance of cetacean population in a study area is based usually on estimates. The chosen method for sampling the populations of interest was "distance sampling". It is one of the most reliable, efficient and widely used methodologies to estimate the density/abundance of cetacean populations worldwide. In this method, the data collected are the distances of the objects that are being sampled (in this case cetaceans) from lines (transects) distributed randomly over the study area. The method has a set of assumptions that should be followed, one of the most important is that all cetaceans on the transect central line be detected.

Using data collected during the distance sampling transects, which includes sightings of cetaceans (e.g. species, geographic location, group size) and sampling effort (the transects kilometres navigated in active search for animals), it is possible to model the distribution of the species observed in the study area. In order to do so, it used one or more co-variables (depth, distance from shore, etc.) that better "explain" the distribution of sightings taking in consideration the sampling effort. Usually, the more effort and more sightings are used in the analysis the more robust will be the results. With this analytic tool it is possible to calculate abundance estimates as well as generate maps of the spatial distribution of cetacean species for the study area.

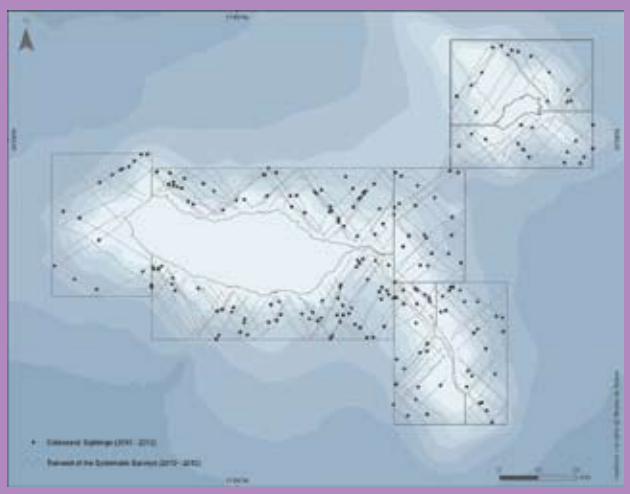


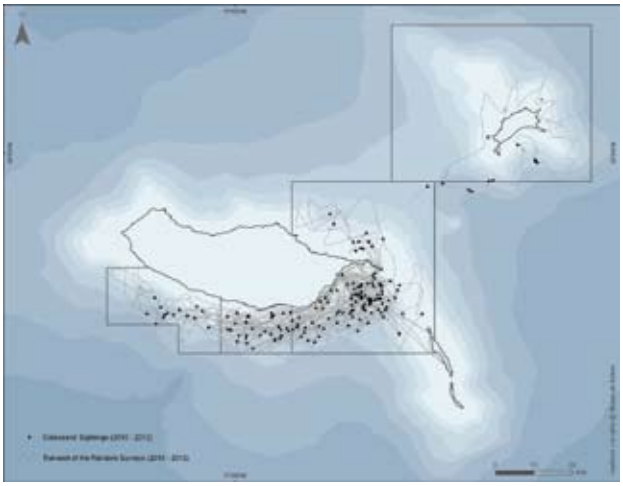
Fig. 7 – Study area and the respective sectors sampled. The lines correspond to transects made in zigzag and the points to sightings of cetaceans.

Random Sea surveys (RSS)

Unlike what happens with systematic sea surveys, in the random surveys there is no predetermined route. Through random sea surveys the area of sea between the coast and the 6 nautical miles was covered, especially in the south coast of Madeira Island. These surveys allowed doing additional tasks, such as photo-identification and tagging. The study area was divided into 4 sectors (East, South, Southwest and Porto Santo) covered in transects made mainly by RIB "Roaz".

For the definition of the sampling areas the target species sightings rate obtained in previous projects and sea conditions were taken into account, given the prevailing winds in the archipelago.

a)



b)

Fig. 8 - a) RIB "Roaz"; b) map of the RSS sampling areas.

PHOTO-IDENTIFICATION

Individual identification is used to understand some parameters such as population size, migration routes, residence, habitat preferences, longevity (life expectancy) and population structure. Most cetaceans show individual colouration patterns or unique dorsal fin or tail edge contours as well as scars accumulated over the years. These are the marks that allow researchers to distinguish one individual from another. The technique of photo - identification means photographing the body part that is considered unique to the animal, for later comparison. The body parts used for identification are variable depending on the species studied, being used usually for dolphins the dorsal fin and for sperm whale the fluke. The photo-identification is a technique widely used to study cetacean populations in the wild as it is a minimally invasive and easy to apply technique.

a)

b)

Fig.9 – Photo-identification photographs of a bottlenose dolphin dorsal fin, identified as the individual Tt237 in the MWM bottlenose dolphin catalogue for Madeira. The photograph a) was taken on July 14, 2010 and b) on August 22, 2011. It is possible to recognize that it is the same animal by comparing the dorsal fin posterior edge contour.

Opportunistic trips in whale-watching boats

Protocols of collaboration with maritime-tourism operators were established, which allowed the MWM to have observers on whale-watching trips. Project team members and volunteers (with specific training) conducted trips from August 2010 to June 2012 with the aim of covering all types of whale-watching boats and every month of the year.

Each observer gathered information concerning the sightings of cetaceans and information on the other whale-watching boats present in those sightings. This collaboration with the whale-watching companies allowed the record of the vessels' routes in order to evaluate the distribution patterns of the fleet (Figure 10). Finally, it was carried out a cetaceans' availability assessment versus the vessels pressure/presence in the main whale-watching area - Funchal. For this purpose, simultaneously with the presence of observers on board whale-watching boats, two lookout posts on land were activated, one in "Garajau" and another one in "Pico da Cruz", using long-range binoculars.

With the aim of assessing the pressure caused by the whale-watching activity on the animals, it was recorded the number of sightings per boat journey, the observed species, the number of boats present per encounter, and how long did the encounters last. The relationship between the number of cetaceans groups available per trip (all groups in the area detected by the boats and the lookouts) with the number of groups detected by the boats was also studied, a map with the route of vessels was created, and finally, all photos with identifying marks were compared with the photo-identification catalogue of each species, in order to know if it were the same animals exposed to the presence of the boats.

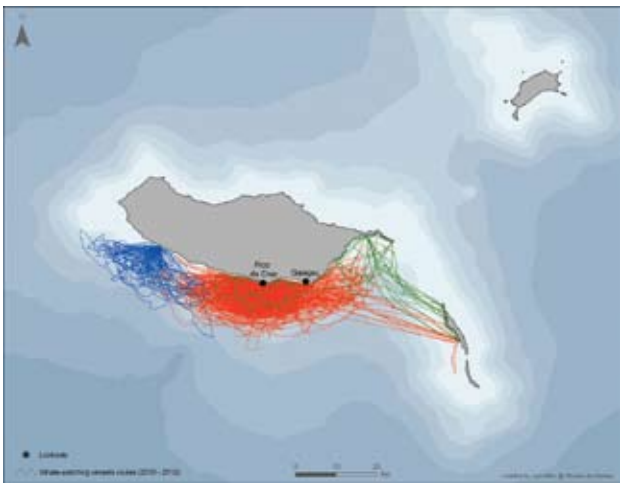


Fig. 10 - Location of the main area of whale-watching activity and the two lookout posts used - "Garajau" and "Pico da Cruz". The routes that define the standard operation of vessels recorded during the study are also presented.

WHALE-WATCHING

The analysis of data obtained from whale-watching vessels and the lookout posts had the aim of answering the following questions: (a) encounters rate (and species) of cetaceans during whale watching trips, (b) how many groups of cetaceans are available for detection during each trip in the area of operation of the activity, (c) how many of these groups are detected by boats, (d) how many boats are present per encounter with cetaceans, (e) how long do these encounters last, and (f) are the observed animals always the same ones?

a)

b)

Fig. 11 - a) Lookout post at "Pico da Cruz", used to locate cetaceans at sea and follow the whale-watching vessels' operation; b) view from the lookout post of whale-watching vessels observing cetaceans.

Opportunistic trips on tuna fishing vessels

To carry out the surveillance of the conservation status of cetaceans in offshore waters of Madeira EEZ, 4 observers working for MWM, made several trips on the Madeiran tuna fishing vessels between June 2010 and September 2012 (20 days a year per observer).

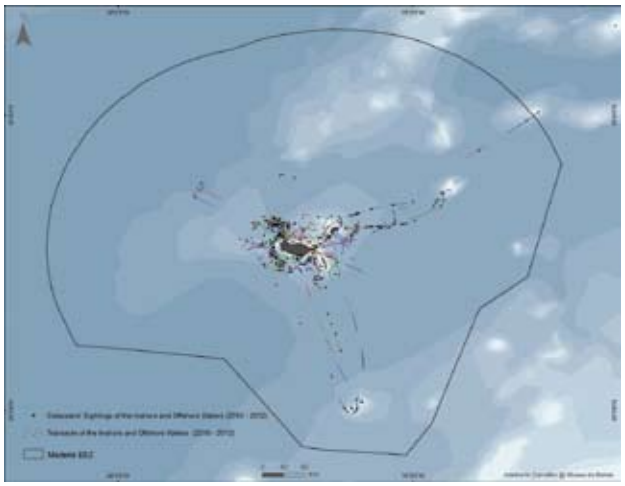


Fig. 12- Study area – Madeira archipelago EEZ; recorded routes of tuna fishing vessels with observers on board.

The tuna fishing vessels were used as platforms of opportunity for data collection, as the operation area of this fleet covers Madeira EEZ offshore waters.

Fig. 13- Madeiran tuna fishing vessel used as observation platform.

The data collected during the trips in the tuna fishing vessels refers to:

• Cetacean species sighted, behaviour, composition and group size, frequency and relative abundance;

• Impact of human activities on cetaceans and the marine environment: maritime traffic, litter and interaction between cetaceans and fisheries (tuna and live bait).

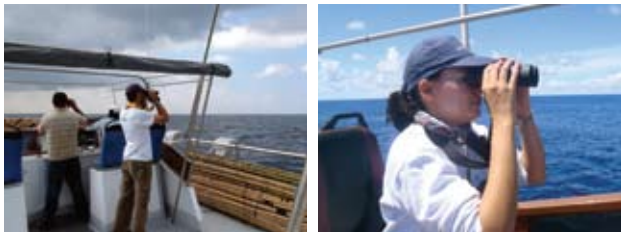


Fig. 14 - Observers in search mode – scanning the horizon for cetaceans.

The routes of the vessels were recorded with GPS and all cetacean sightings were recorded into a database.

Fig. 15 – Tuna fishing event using "pole and line" technique.

> "The tuna fishing vessels were used as platforms of opportunity for data collection, as the operation area of this fleet covers the Madeira EEZ offshore waters."

RESULTS

Site of Community Importance for the Bottlenose dolphin

(Question A – WHAT section)

After 12 years of studies and various projects, much more is known about the life of bottlenose dolphins in Madeiran waters. From the sea surveys' and photo-identification data analysis, we know that on average about 500 bottlenose dolphins use the coastal waters of Madeira. Around 25% of those animals use these waters regularly, they can be considered as resident or animals associated with the islands. There are, however, variations throughout the year, with a larger number of sightings occurring in summer and autumn.

Most bottlenose dolphins are passing by, making major migrations in the Atlantic Ocean, possibly moving between the Azores, Madeira, Canary Islands, offshore waters of mainland Portugal and other locations. All these bottlenose dolphins, residents and transients, are part of a large population that uses the pelagic waters of the North Atlantic Ocean.

The bottlenose dolphins were observed in all coastal waters around the islands of the archipelago up to 2000m deep. However, the results of the data analysis showed a greater preference for certain areas, namely the sea at north of Ponta de São Lourenço, the canal between Madeira and the Desert Islands, the southeast of Madeira as well as the south of Porto Santo (Figure 16). All these areas have in common a depth of less than 1000m, which is the preferred habitat of the species for feeding. The bottlenose dolphins use these waters for socializing, resting, feeding and breeding.

The bottlenose dolphin is one of the cetacean species potentially most vulnerable to human activity in the Madeira archipelago due to its very coastal distribution, especially the resident animals that depend heavily on the waters of Madeira and the quality of its habitat to live.

The MWM previous projects identified whale-watching, the behaviour of recreational crafts with cetaceans, navy sonars and litter at sea, especially plastics, as the human factors with greater impact on cetaceans in the Madeira archipelago.

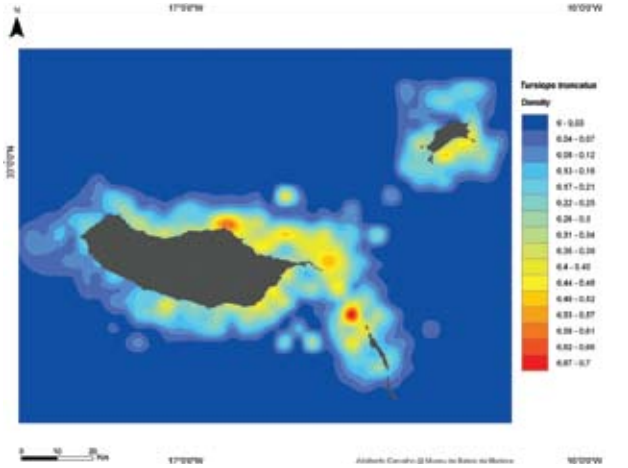


Fig. 16 – Density distribution map of bottlenose dolphin. The red spots represent the areas where it is predicted the higher density of dolphins for the sampled period (2007-2012), taking into account the observation effort.

The distribution of the bottlenose dolphin partially overlaps with the south and southeast of Madeira, the area of higher human activity at sea, including maritime traffic, mainly from recreational crafts. This is also one of the most sought after and observed species by whale-watching boats, not only because it is able to be seen throughout the year, but also for being one of the most common species.

The results of the CMII project and previous projects revealed that fishing activity, an activity traditionally with a big impact on cetaceans, does not have a relevant impact on bottlenose dolphins in Madeira, thanks to the artisanal characteristics and small-scale of the coastal fishing fleet and to the selective fishing gear used. The two most influential fleets in the Region, scabbard fish and tuna fishing fleets, also use selective fishing gears, with a marginal amount of by catch, and carry out part of their activity in deep waters or further offshore where the possibilities of interaction with the bottlenose dolphins are smaller.

The results of the bottlenose dolphin studies in the Madeira archipelago clearly indicate the importance of these waters for the species, shown by the abundance and the activities carry out by the animals, being choosen by at least 125 animals as their home. Additionally, the waters of Madeira are the crossing, stop and feeding point for thousands of migrating bottlenose dolphins in the waters of the North Atlantic, thus acknowledging the geographical importance of these habitats in the wider context of the ocean basin.

The creation of a SCI for bottlenose dolphin in Madeira is completely justifiable, considering the present knowledge of the species in these waters.

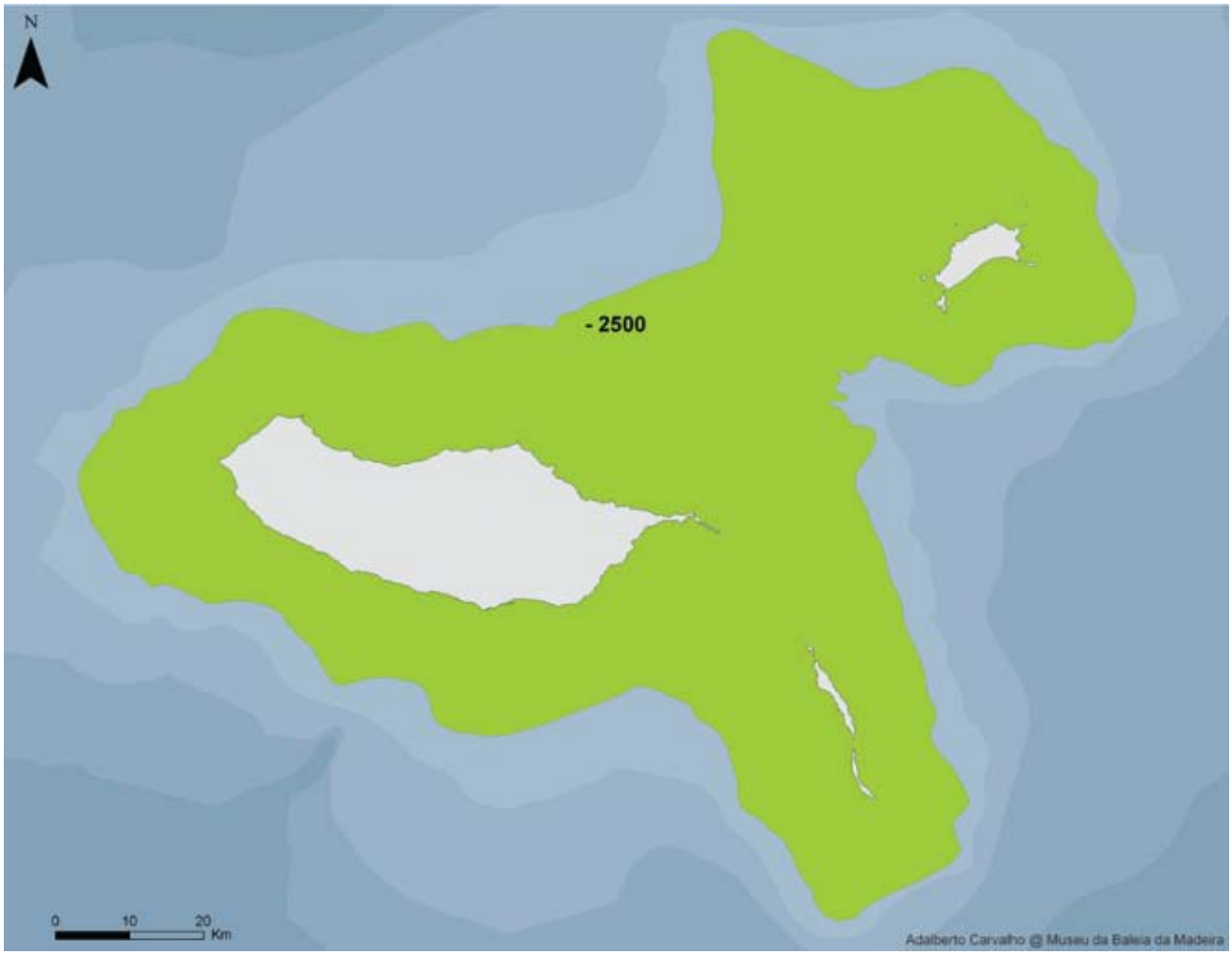
The proposed area for the SCI comprises all coastal waters around the island of Madeira, Desertas islands and Porto Santo between the coast and the 2500m bathymetry, with a total area of 5560 km2 (Figure 17).

This area comprises all important habitats for bottlenose dolphin in the archipelago where the species develops critical activities, including feeding, resting, socializing and reproduction. The experience of other SCIs, namely in the United Kingdom, created for highly mobile species such as the bottlenose dolphin have demonstrated that these areas should be broad enough not only to comprise the critical habitats identified at the time of its creation, but also to accommodate natural fluctuations in their area of distribution.

The designation of a SCI for bottlenose dolphins in Madeira will largely contribute to the inter-connectivity and ecological coherence of natura 2000 network in what concerns marine areas for the bottlenose dolphin in the Northeast Atlantic, thus bridging the gap between the Azores, the Canaries and the Iberian Peninsula where SCI for this species already exist or are proposed.

Fig. 18 – Bottlenose dolphin, one of the main target species of whale-watching activity.

Fig. 17 - Map of the marine area proposed for Site of Community Importance (SCI) for the bottlenose dolphin in the coastal waters of Madeira.



One of the most important aspects of creating a SCI is monitoring the population parameters of the target species and their habitat, in order to assess their favourable conservation status and monitoring any changes in those parameters. This way it is expected that impacts of human activities, at the population level, can be detected and management measures taken to minimize them.

The creation of a SCI does not imply the end or the limitation of human activities in the area. Particularly in Madeira where a number of legislative and management procedures have been implemented out over the past decades, which have contributed decisively to the favourable conservation status of cetaceans in the Madeira archipelago. It should be noted the publication in 1986 of legislation to end the capture, handling and slaughter of cetaceans in this waters, the non-licensing of gillnets together with the promotion of more selective fishing gears and the publication of legislation for the regulation and management of the whale-watching activity.

Nonetheless it is important to monitor the bottlenose dolphin and its habitats, in order to identify any changes in their abundance, distribution, and interference with their critical activities, so that measures can be taken into action in order to achieve a balance between human activities and the conservation objectives for which the SCI was created.

The goal of maintaining the current state of conservation of the bottlenose dolphin in Madeira, brings environmental and ecological benefits, contributing to a balanced marine ecosystem, and provides cultural and socio-economic benefits as well, including the contribution to the sustainability and add-value of whale-watching activities.

500 bottlenose dolphins use the coastal waters of Madeira.

Around 25% of those animals use these waters regularly, they can be considered as resident or animals associated with the islands.

Areas of operation for whale-watching and its carrying capacity

(Questions B - WHAT section)

On a daily basis more than a dozen boats leave the Funchal harbour and other locations on the island for a boat trip off, aiming to observe cetaceans.

Fig. 19 - Some of the different types of whale-watching vessels operating in Madeira.

In 2013 this activity was covered by specific legislation (see section WHY - whale-watching), which includes the definition of operation areas, and its carrying capacity, in order to achieve a balance between the touristic and socio-economic interests related to the activity and the conservation of cetacean species in the archipelago of Madeira as well as the welfare of the animals observed.

The CMII project focused on this issue in order to better understand how cetaceans use the waters of Madeira, how do they interact with the whale-watching boats and the possibility of achieving a balance between the activity growth and conservation, welfare of the animals and quality of the observations.

Fig. 20– Whale-watching vessels observing a group of dolphins in the bay of Funchal.

Eighty six percent of the cetaceans observed by the whale-watching vessels are of 5 species. These are the most abundant species and most likely to be observed, from the 28 known species for Madeira waters. The remaining species, due to its occasional or rare presence, avoiding behavior or difficulty to be observed at sea represent a very small percentage of the observations or are not observed at all.

The bottlenose dolphin and the short-finned pilot whale are 2 of the most frequently observed species. They have an annual presence in the waters of Madeira and both have groups associated with the islands, making them particularly vulnerable to human activities.

The remaining three species are the common dolphin (*Delphinus delphis*), the Atlantic spotted dolphin (*Stenella frontalis*), and the Bryde's whale (*Balaenoptera edeni*). These three species have a seasonal presence, with the common dolphin present especially in winter and spring and the other two species in summer and autumn.

As mentioned above, all of these cetaceans rely on the waters of Madeira to perform various activities crucial to their survival, such as: feeding, resting, socializing, reproduction and breeding. However, the distribution and use of these waters varies from species to species, reflecting their biology and ecology.

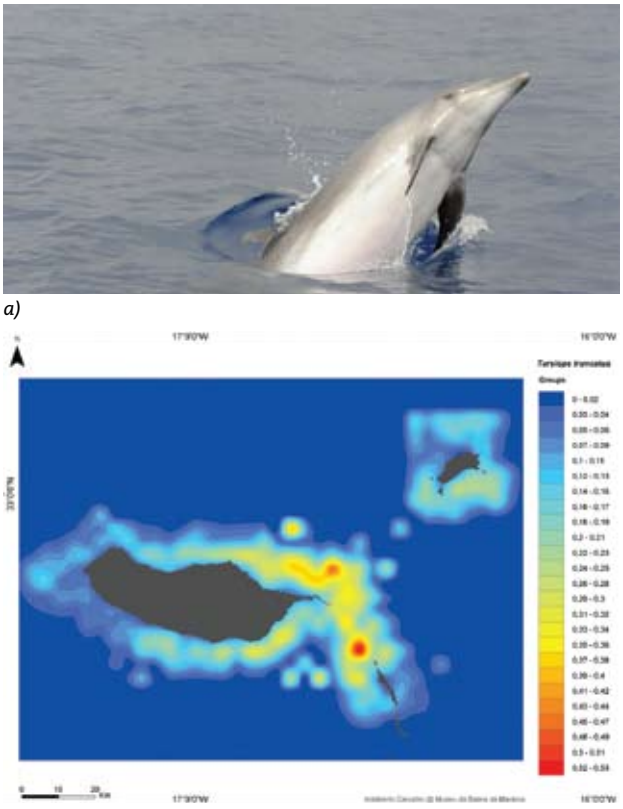
Bottlenose dolphin

The bottlenose dolphin, as seen before, has a preference for shallower waters, with a larger presence in the east of Madeira and south of Porto Santo (see Figure 21).

Pilot whale-tropical

The tropical pilot whale, occurs preferentially in the southeast area of Madeira, in deeper waters, where it feeds, socializes and rests (see figure 22).

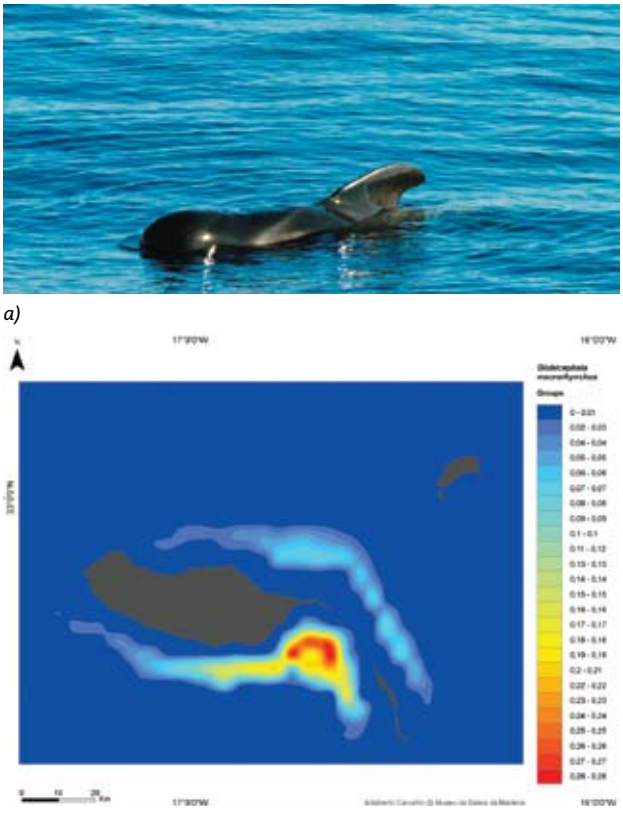
> **86%** of the cetaceans observed by the whale-watching vessels are of 5 species.
> The bottlenose dolphin, the tropical pilot whal, the common dolphin, the Atlantic spotted dolphin and the Bryde's whale.



a)

b)

Fig. 21– Image of a bottlenose dolphin and its group density distribution map. The red spots represent areas where it is estimated a higher density of dolphins groups for the sampled period (2007-2012), taking into account the observation effort.



a)

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Fig. 22 - Image of a short-finned pilot whale dolphin and its group density distribution map.

Common dolphins

The common dolphins and the Atlantic spotted dolphins have a presence across the sea of the archipelago, even though the first one prefers the extremes of the island of Madeira, the waters East of Desertas islands and Porto Santo (see Fig. 23) and the second one the south coast of Madeira island (see Fig. 24).

These five most common species are therefore more vulnerable to pressure caused by the whale-watching activities, especially the local groups, which may suffer serious consequences if the activity is not conducted within certain limits.

One way of minimizing the activity impact on cetaceans is through a proper conduct in the observation of the animals. Another one, also very important, is the definition of areas of operation which take into consideration the distribution of the different target species and the establishment of maximum limits on the activity - carrying capacity - within those areas.

Areas of operation and carrying capacity

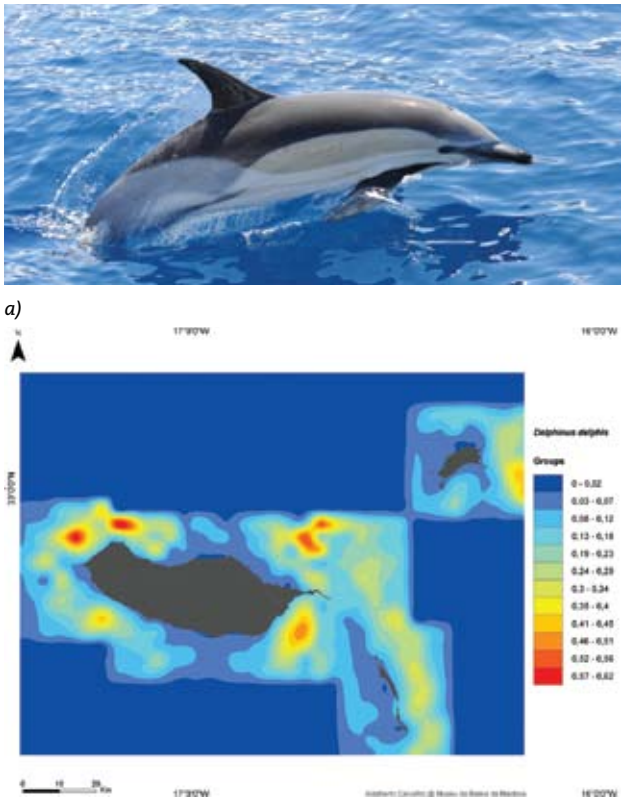
One of the results of project CMII is the proposal of 5 areas of operation for the whale-watching vessels with different carrying capacities.

The definition of these areas considered the present pattern of operation of whale-watching boats, the location of the harbours of the boats and the spatial distribution of the activity's main target species.

The carrying capacity for each area was established taking into account the estimated number of cetaceans groups present in each of the operation areas and the importance of those areas for the species' crucial activities. The carrying capacity is defined by two parameters: maximum number of vessels authorized to operate in an area and maximum number of daily trips to be made by each boat.

The area associated with Funchal harbour, designated as Madeira South (SM, see figure 25), the better studied area and with the largest number of whale-watching boats operating, was considered the reference area, with the underlying assumption: the current level of operation in this area is sustainable, within limits compatible with the conservation objectives, animals welfare and quality of observation of the animals, as considered in the regional legislation for the activity.

Using the calculated reference values for Funchal, namely the number of vessels operating by the estimated groups' density of the four main activity target species, was calculated the maximum number of vessels for the remaining areas of operation.



a)

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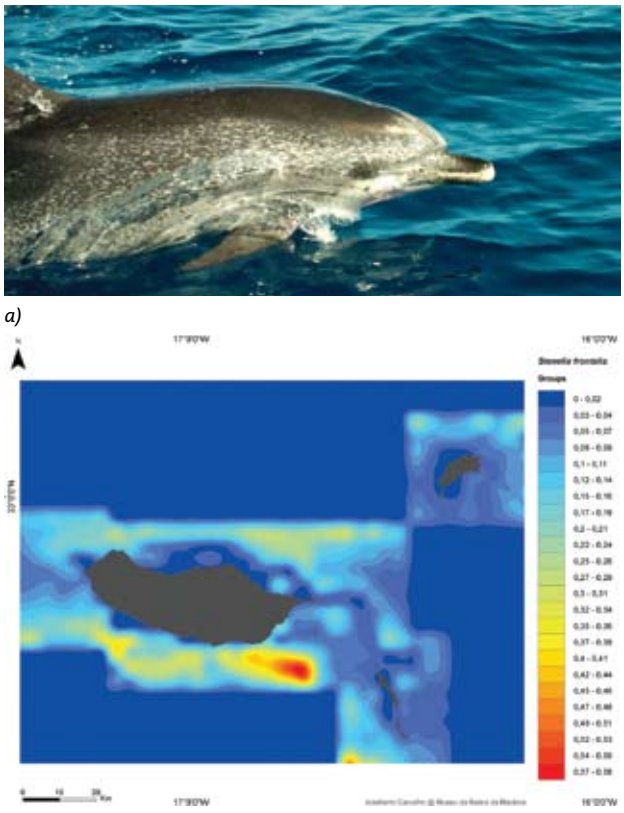
Fig. 23 - Image of a common dolphin and its group density distribution map.



a)

b)

Fig. 24- Image of an Atlantic spotted dolphin and its group density distribution map.

For the South-eastern Madeira area (SEM) a weighting factor was considered in order to lower the pressure, given the particular importance of this area for one or more of the activity target species and the North-eastern area of Madeira (NOM) was considered an exclusion zone since it is one of the important areas for the bottlenose dolphin.

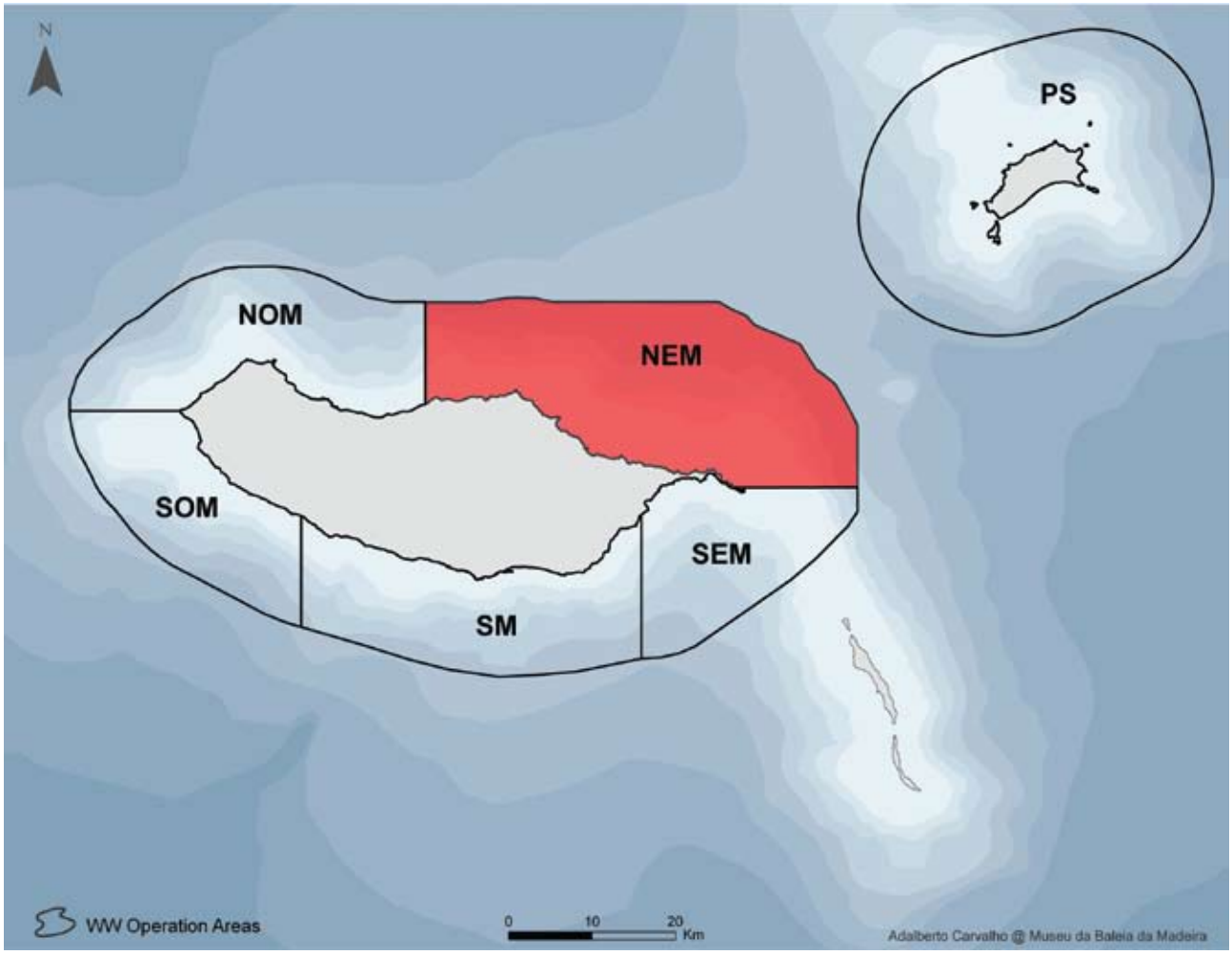
The activity growth can happen through the better use of the capacity already established in Funchal, particularly with the increase in the number of boats daily trips and the increase on the occupancy percentage, which is now on average 51% of the maximum capacity. On the other hand, new whale-watching operations can start in other areas until its maximum capacity is reached.

Over the years the whale-watching operators became aware that the quality of the observation events is more important than the quantity of encounters. Therefore it is essential to let the cetaceans approach the vessels voluntarily, offering this way cetacean's observation events with quality to the tourists.

With this set of measures the conservation of cetaceans and the quality and sustainable growth of whale-watching in Madeira archipelago is better achieved. The definition of areas of operation, and its carrying capacity, will help to keep the pressure on cetaceans within acceptable limits while enabling the activity growth, if there is a demand for it.

Fig. 2 – A Bryde's whale and an Atlantic spotted dolphin feeding on the south-east coast of Madeira.

Fig. 25- The five areas of operation (SM –South Madeira; SOM – South-west Madeira; SEM – South-east Madeira; NOM – North-west Madeira, PS - Porto Santo) proposed by the project CMII for whale-watching and a sixth area of exclusion (NEM – North-east Madeira), as it is one of the important areas for the bottlenose dolphin.



Conservation status of cetaceans in offshore waters

(Questions C – WHAT section)

The monitoring of the conservation status of cetaceans in recent years was restricted to the coastal waters of Madeira Archipelago, due to logistical and financial constraints. For the offshore waters, there was a lack of knowledge about the cetacean species occurring there and about the impact of human activities on those species. The project CMII provided an opportunity to develop and implement surveillance in the offshore waters, with the monitoring of some of the human activities in these remote waters.

Over the last three years 161 days of observation effort were carried out at sea, which resulted in about 7000 km navigated in the Madeira EEZ, of which 5200 km were exclusively in offshore waters. Two hundred and three cetaceans groups were sighted and 364 fishing events (tuna and live bait) on board fishing tuna vessels were registered. The tuna fishing season was covered between March and September (2010-2012).

Cetaceans

The 203 groups of cetaceans sighted corresponded to 11 different species. The common dolphin was the most frequently observed species (29% of all sightings), with the highest rate of sightings (1.23 sightings per 100 km of navigation effort) and also the most abundant (17.71 individuals/100km). For the bottlenose dolphin only one sighting was recorded in offshore waters, which corroborates the more coastal distribution already confirmed in previous studies and also referred in the literature.

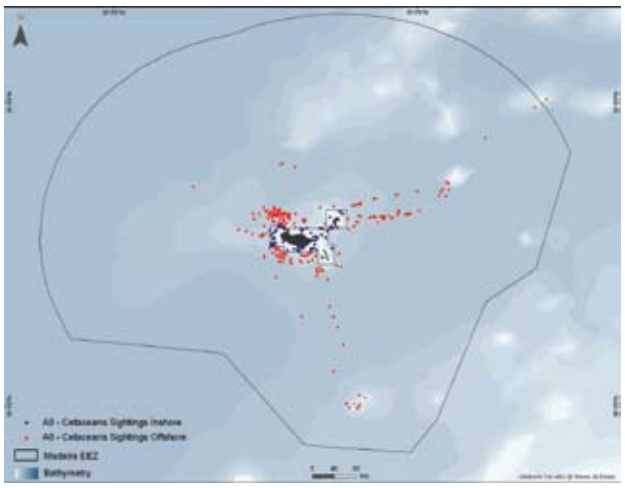


Fig. 27 – Map of cetaceans sightings in the Madeira EEZ- the red dots refer to groups of cetaceans sighted in the offshore waters, the remaining dots (blue) are related to sightings of cetaceans in coastal waters, carried on board tuna fishing vessels.

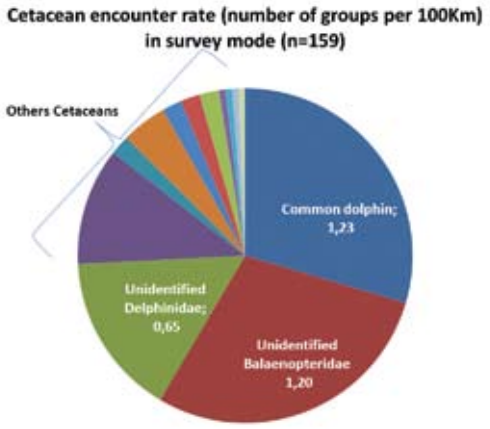


Fig. 28 – Relative frequency of occurence chart of cetacean species sighted in offshore waters of Madeira EEZ. Species with the lowest number of sightings were grouped into "other cetaceans" (28% of sightings) and correspond, in descending order of frequency of occurence, to the following categories/species: unidentified cetaceans; Atlantic spotted dolphin; sperm whale; fin whale; dolphins of the genus Stenella; tropical pilot whale; striped dolphin; beaked whales; bottlenose dolphin; false killer whale; risso's dolphin; killer whale.

The use of platforms of opportunity (tuna fishing vessels), brought some limitations in data collection. In 43% of reported sightings it was not possible to identify the observed cetaceans down to the species level, as the vessels were engaged in fishing activities, which did not allow the approach to the groups observed at greater distances in order to confirm the species.

Fig. 29 – Fin whale - one of the species observed in the offshore waters. These animals use Madeiran waters for feeding and also for migration purposes.

> The 203 groups of cetaceans sighted corresponded to 11 different species.
>
> The common dolphin was the most frequently observed species.

Human activities

Litter

A total of 31 litter aggregations were registered at the surface on the high seas, which included plastics, cables and nets, floating devices and polystyrene (persistent litter). The plastics were the most common type of litter, representing about 65% of total litter found! Given the large size of the study area and the low rate of litter found at sea (No. of aggregations /100km navigation effort), it is expected a low impact of litter on cetaceans. However, over the years there have been several examples of cetaceans and other marine animals stranded on the coast of the Madeira archipelago or were observed in difficulties due to interactions with persistent litter, especially plastics and similar. This is more evident in the waters near the coast where more aggregations of litter are observed, some of them of local origin. It is important to remind that persistent litter takes years, decades, even centuries to degrade, and their cumulative effect is a risk to marine life, especially for marine mammals, turtles, sharks, etc. Many animals end up dying asphyxiated due to plastic ingestion, drowning due to the inability to swim or mutilated, as illustrated by the images in Figure 30.

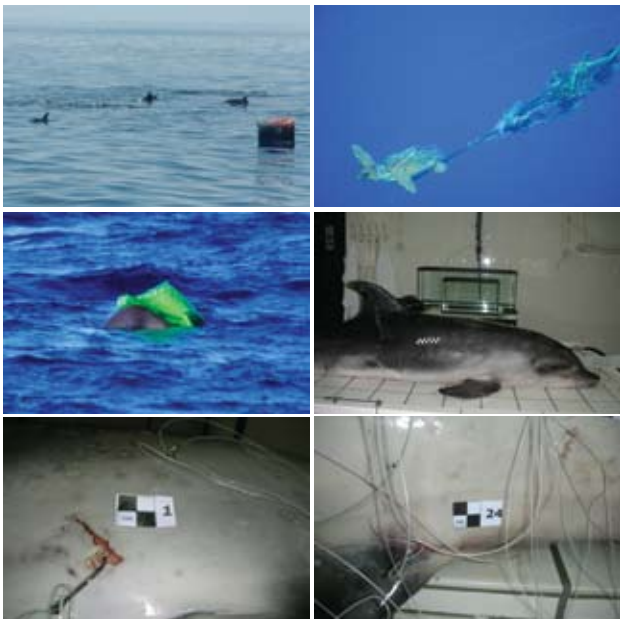


Fig. 30 – Examples of interactions between marine animals and persistent litter at sea, and some of its impacts on these animals.

Maritime traffic

Various types of vessels navigating in the offshore waters of Madeira EEZ were registered, namely: tuna fishing vessels, scabbard fish fishing vessels, cruise ships, freighters, sailboats and yachts. In the study the tuna fishing vessels were the most observed, with 55% of cases followed by freighters with 17%. On average 2,6 ships were observed per day, which represents a very low rate considering in mind the covered area by the observers and the extension of the Madeira EEZ. The risk of collision with cetaceans is reduced either due to low traffic or relatively low speed (<25 knots) of vessels navigating in these waters.

Fig. 31 – Dolphins on the bow of a freighter in the offshore waters of Madeira.

> **65% of total litter found is plastic.**
> It's the most common type of litter.

Interactions with fisheries

Of the 364 registered fishing events during the study period, 9% of events (31) had cetaceans present, and only in 3% of events (11) there was a disturbance in fisheries caused by cetaceans. During fishing events there were no cetaceans by caught. The low rate of interactions and the absence of by catch are quite positive and demonstrates the selectiveness of the fishing gear used by the Madeira tuna fishing fleet and the very low impact on cetaceans.

Traditionally, fishermen fishing for tuna regarded the short-finned pilot whale, or *boca-de-panela* as it is known in Madeira, as an enemy. At the beginning of the project CMII fishermen reported that this species was sinking the tuna and harmed the fishing activity. However, the analysis of data collected during the course of the project indicates that from all cetaceans present in fisheries, the common dolphin was the one with greater presence and interference with the fisheries, followed by other dolphin species. The common dolphin either ate live bait (thrown to tuna for capture) or made tuna sink, thus harming tuna fishing (bigeye tuna). However, the low level of global interactions (3% of the fishing events) between cetaceans and fishing activities does not indicate a significant impact on livelihood and viability of tuna fisheries in the Region. The short-finned pilot whale was not present in fishing events registered by observers, and the species was observed only 3 times in the offshore waters of Madeira EEZ.

Fig. 32 – Common dolphin, the most observed species of cetaceans in offshore waters of Madeira EEZ

Fig. 33 – Short-finned pilot whale

Conservation status

The collection of data regarding biological parameters, important for assessing the conservation status of cetacean species, was limited by the use of platforms of opportunity.

The information collected during the project CMII indicates a low impact on cetaceans of the human activities monitored on offshore waters of the Madeira archipelago (litter, maritime traffic and fisheries). However, it is important to bear in mind that not all of the activities developed in this area were monitored, namely the fishing activities carried out by fishing vessels from outside Madeira, operating between 100 and 200nm off the coast of the archipelago.

The acquired knowledge on the offshore waters of Madeira during the course of the project does not contradicts or points out any problems regarding the assessment carried out in 2004 of the conservation status of cetaceans in the Madeira archipelago. However, it is important to continue monitoring these waters.

The experience acquired during the project will be used to improve field methodologies in order to obtain relevant quantitative data regarding the biological parameters of the most important species.

Fig. 34 – During the sampling period the cetaceans only disturbed 3% of the fishing events and there were no accidental captures.

IMPORTANT FINAL REMARKS

Site of Community Importance for the bottlenose dolphin

• The sea of Madeira is important for the species, shown by the abundance and the activities carried out by the animals in these waters;

• At least 125 animals are islands associated and the waters of Madeira are a crossing, stopping and feeding point for thousands of bottlenose dolphins migrating in the waters of the North Atlantic;

• The proposed area for the SCI comprises all important habitats for bottlenose dolphin in the archipelago and covers the coastal waters of Madeira, Desertas islands and Porto Santo between the coast and the 2500m depth (area of 5560 km2);

• The SCI for bottlenose dolphins in Madeira will largely contribute to the inter-connectivity and ecological coherence of Natura 2000 Network in what concerns marine areas for the bottlenose dolphin in the North-east Atlantic;

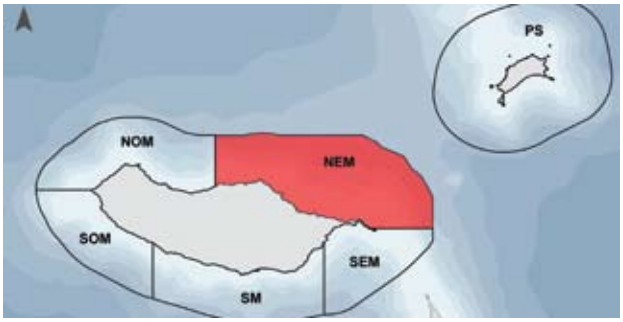
Areas of operation for the whale-watching activity and its carrying capacity

• 86% of cetaceans observed by whale-watching vessels are of 5 species namely bottlenose dolphin, short-finned pilot whale, common dolphin, Atlantic spotted dolphin, and Bryde's whale. The first two species have island associated groups while the remainders have a seasonal presence in waters of Madeira;

• 5 areas of operation for the whale-watching activity with different carrying capacities are proposed;

• The definition of these areas took into consideration the present pattern of operation of whale-watching boats, the location of the harbours of the boats and the spatial distribution of the activity's main target species;

• The carrying capacity for each area was established taking into account the estimated number of cetaceans groups present in each of the operation areas and the importance of those areas for the species' crucial activities. The carrying capacity is defined by two parameters: maximum number of vessels authorized to operate in an area and maximum number of daily trips to be made by each vessel;



Conservation status for cetaceans in offshore waters

• 11 species of cetaceans were identified in offshore waters, with the common dolphin being the most abundant species;

• The anthropogenic activities (litter, maritime traffic and fisheries) developed in these waters have a reduced impact on cetaceans;

• The acquired experience during the course of project CMII allowed the identification of some limitations that should be considered with the aim of improving the methodologies used in monitoring offshore waters using platforms of opportunity. Despite the limitations is important to ensure future monitoring of these waters.

PARTNERS

The partners are an important part of the project CMII. The cooperation and the awareness of all sea users and general population is essential for the conservation of cetaceans, in aspects such as the reduction of persistent litter at sea or proper conduct in whale-watching.

The project CMII had several partners who collaborated in data collection and dissemination/ awareness of the project and its themes, namely:

- Whale-watching operators;
- The owners and crews of tuna fishing vessels;

The whale-watching operators collaborated under objective 2 (Questions B - WHAT section) by providing information regarding routes, schedules and type of whale-watching trips, sightings and by allowing project observers to come on board their vessels for data collection (see opportunistic trips in whale-watching boats - HOW section)

The owners and fishermen of the Madeira tuna fishing fleet allowed the project observers to board their vessels and collaborated in collecting data regarding the fishing fleet, namely: routes, sighted species and interactions of cetaceans with fishing events, among others. (see opportunistic trips in tuna fishing vessels - HOW Section)

Fig. 35– Volunteers carried out an important role in the project by cooperating, for example, as observers on board whale-watching vessels.

Fig. 36 - The cooperation of whale-watching operators and fishermen was important for the achievement of the project's objectives.

WORKSHOP LIFE +

In October 2012, with the final phase of data collection approaching, a workshop took place in Madeira Whale Museum in order to discuss the preliminary results of the project, to discuss the methodology used in the data analysis with the aim of ensuring reliable results and exchange experiences with other LIFE + projects. The workshop was attended by numerous participants such as technical experts (biologists and consultants) internationally renowned, representatives of other LIFE+ projects, government officials and local whale-watching operators. The results from the workshop have exceeded the expectations, providing an added value to the data analysis, and therefore a step forward in the conservation of cetaceans in RAM (Autonomous Region of Madeira).

Fig. 37 -Presentation of preliminary results of the project during the workshop held in October 2012 in MWM.

DIVULGATION

The project CMII divulgation and its outcome to the general population are essential. In order to do so several initiatives were carried out, namely:

Web page - information was made available, during the course of the project in Portuguese and English, the web page was accessed by more than 7,200 visitors; http://www.cetaceos-madeira.com/

Facebook page - Exceeded 500 likes during the course of the project; https://www.facebook.com/pages/Projecto-Cet%C3%A1ceos-Madeira-II/149539561749507

Notice boards - displayed in Machico, Caniçal and Porto Santo;

Publicising material - leaflets, t-shirts, caps, calendars, windcheaters, posters, notepads and sweatshirts, freely distributed to the general population of Madeira;

Temporary exhibit to divulge Natura 2000 Network (RN2000) - Designed to raise awareness for the importance of Cetaceans and RN2000. The exhibition was presented in all Counties of RAM (Autonomous Region of Madeira) (May 2011 - December 2013), having been visited by over 147 000 people;

Conferences in fishing communities to sensitise fishermen for the conservation of cetaceans and RN2000 - the conferences were held in Machico, Caniçal, Porto Santo and Câmara de Lobos;

Fig. 38 – Conferences in fishing communities to sensitise fishermen for the conservation of cetaceans and Natura 2000 Network.

MWM Educational Services held several initiatives aimed at the regional student community, under the project CMII.

The children's book "Pintarolas e o futuro do mar-O contributo da Rede Natura 2000" was elaborated and printed in partnership with the Elementary School 1/PE Machico, for the authors of the texts are the students of the previously mentioned school;

Implementation of educational activities complementary to RN2000 exhibit involving over 1000 students;

Fig. 39 – Didactic activities of the MWM Educational Services under the temporary exhibition carried out for divulgation of Natura 2000 network.

> "147 000 people have visited the temporary exhibit to divulge Natura 2000 Network (RN2000) and the project CMII."

GLOSSARY

BaleiArte contest and exhibition involved more than 800 students, and combined arts, science and environmental awareness. The contest had the collaboration of the artist Patricia Madeira Sumares that was a jury for baleiArte and developed the sculpture: "... as baleias que cruzavam os oceanos." Helena Berenguer, Luís Freitas and Vânia Fernandes also collaborated as members of the jury. The exhibition toured many public spaces, including the Madeira Whale Museum, the Museum of Electricity, a shopping centre (MadeiraShopping), several hotels in the region (Pestana Carlton and Quinta do Lorde Resort Hotel Marina) and the Madeira Airport. It is estimated that the exhibition was visited by around 80 000 people.

Fig. 40 – BaleiArte: models of bottlenose dolphins and short-finned pilot whale, decorated by students from various schools and Occupational Activity Centres in Madeira, on display in a shopping centre in Funchal.

In order to publicize the project and its technical aspects in a simple manner, namely the methodologies used and the results achieved, a Layman's Report (this document) and a DVD were produced, both of free distribution.

The project team also participated in scientific conferences and workshops in order to disseminate the project's results to the scientific community. 2 articles were published in scientific journals, 2 were submitted and others are in preparation for publication after the end of the project (4).

Priority species - species that are endangered in the European territory where the treaty is applicable (except those species whose natural range is marginal in that territory and which are not endangered or vulnerable in the western palearctic region), for which the European Union has particular responsibility for its conservation due to the large dimension of the natural range of this species located on European territory and that are marked with an asterisk (*) in Annex II of the Habitats Directive;

Favourable conservation status – According to the definition of the Habitats Directive, the conservation status is considered "favourable" when:

• Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and

• The natural range of the species is neither being reduced nor in danger of being reduced for the foreseeable future, and

• There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis;

Natura 2000 Network - Coherent European ecological network comprised of special areas of conservation. This network, composed of sites hosting the natural habitats in Annex I and habitats of the species listed in Annex II of the Habitats Directive, shall maintain or, if necessary, restore the natural habitat sites and the species concerned a favourable conservation status in their natural range. Each Member State shall contribute to the creation of Natura 2000 in proportion to the representation within its territory of the natural habitat types and the habitats of species referred to in paragraph 1. Each Member State shall designate, sites as special areas of conservation taking the conservation status set out for Natura 2000 network into account. Where they consider it necessary, Member States shall endeavour to improve the ecological coherence of Natura 2000 network;.

Site of Community Importance - means a site which, in the biogeographical region or regions to which is belongs, contributes significantly to the maintenance or restoration at a favourable conservation status of a natural habitat type in Annex I or of a species in Annex II and may also contribute significantly to the coherence of Natura 2000 referred to in Article 3, and/or contributes significantly to the maintenance of biological diversity within the biogeographic region or regions concerned. For animal species ranging over wide areas, sites of Community importance shall correspond to the places within the natural range of such species which present the physical or biological factors essential to their life and reproduction;

Special area of Conservation – a site of Community importance designated by the Member States through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration, at a favourable conservation status, of the natural habitats and/or the populations of the species for which the site is designated.

factsheet

Title:
Mar da Madeira um oásis a conservar - baleias e golfinhos da Madeira

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Printed by
Meio/EcoFunchal

Impression
500 copies

Design:
Alexandre Caires

Legal Deposit
363804/13

ISBN:
978-989-8110-35-0

Photography credits:
Ana Alves, Ana Dinis, Ana Higueras, Carla Freitas, Cátia Nicolau, Claudia Gomes, Cláudia Ribeiro, Filipe Alves,
Luis Dias, José Ricardo Félix, Ricardo Antunes, Rita Ferreira e Rodrigo Freitas

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Funchal 2013