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Agenda Item 5.1.1: **High speed ferries**

Reports on the impacts produced by the maritime traffic on cetacean populations in the Strait of Gibraltar (Spain). Current situation and future previsions.

Submitted by: **Observer (Information Document)**

NOTE:
IN THE INTERESTS OF ECONOMY, DELEGATES ARE KINDLY REMINDED TO BRING THEIR OWN COPIES OF THESE DOCUMENTS TO THE MEETING

Secretariat's Note

The following document was submitted by the Ministry of the Environment of Spain.

MINISTERIO
DE MEDIO AMBIENTE

SECRETARIA GENERAL
PARA EL TERRITORIO Y
LA BIODIVERSIDAD

DIRECCION GENERAL
PARA LA BIODIVERSIDAD

REPORTS ON THE IMPACTS PRODUCED BY THE MARITIME TRAFFIC ON CETACEAN POPULATIONS IN THE STRAIT OF GIBRALTAR (SPAIN). CURRENT SITUATION AND FUTURE PREVISIONS.

Coordinator of the project

Renaud de Stephanis

CIRCE
CONSERVACIÓN INFORMACIÓN & ESTUDIO SOBRE LOS CETÁCEOS

December 2005

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REPORTS ON THE IMPACTS PRODUCED BY THE MARITIME TRAFFIC ON CETACEAN POPULATIONS IN THE STRAIT OF GIBRALTAR (SPAIN). CURRENT SITUATION AND FUTURE PREVISIONS.

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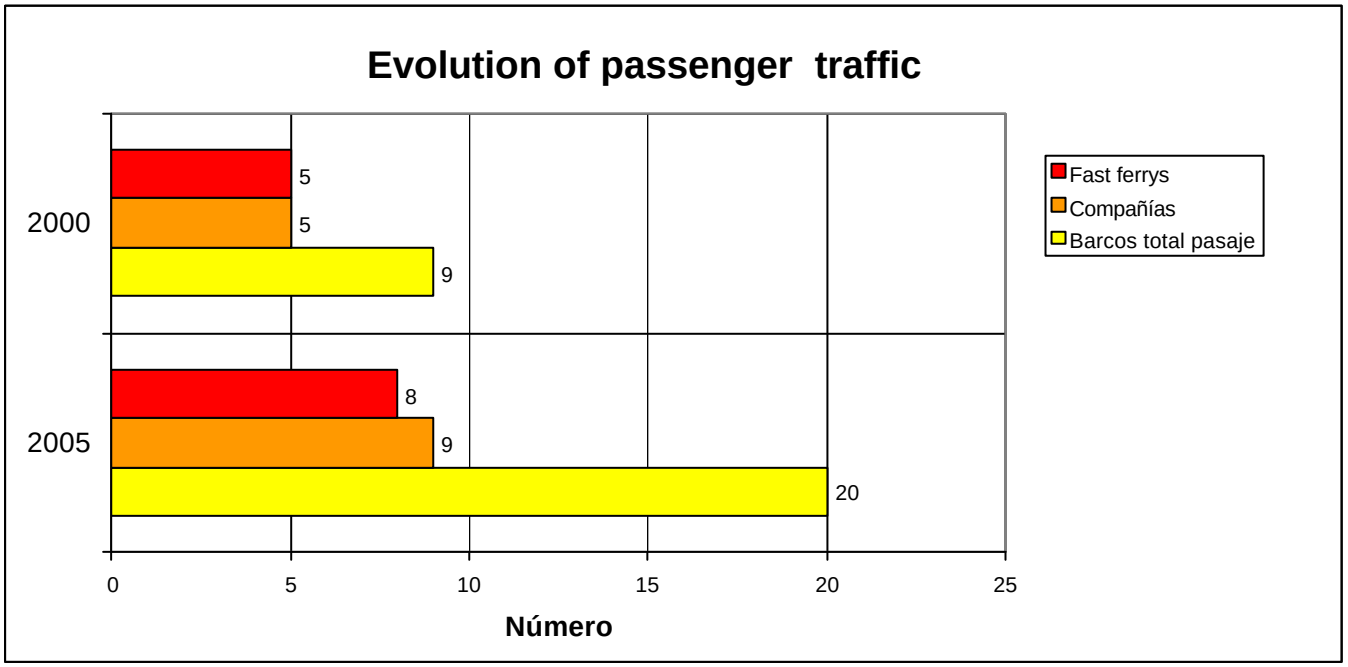
1. JUSTIFICATION

The Strait of Gibraltar is a place transited by a large number of ferries and fast ferries on the North-South axe, and cargos on the East-West axe with a traffic estimated at 91 009 vessels in 2004 according to the data of the Maritime Rescue Records of Tarifa (Spain). These data makes the Strait of Gibraltar the second natural navigation channel most transited in the world after the English Channel. The evolution between 2000 and 2005 has been important with new passenger lines opening between Tangier and Algeciras and Tangier and Tarifa. The number of companies almost doubled, passing from 5 to 9 and the total number of passenger boat has also increased from 9 to 20 boats.

	1999	2004
Cargos (E-W)	**53336**	**61184**
Ferries (N- S)	**13473**	
Fast ferries (N- S)	**17047**	
Ferries & Fast ferries (N- S)	**30520**	**29825**
Total number of boats identified	**83856**	**91009**

Records of boats passing through the Strait of Gibraltar in 1999 and 2004 (source: Dirección General de la Marina Mercante. Seguridad Marítima y Contaminación: Sociedad de Salvamento y Seguridad Marítima de Tarifa).



Evolution of Passenger Traffic, comparison between 2000 and 2005

The fact that the Strait of Gibraltar is a place highly transited by passenger and commercial boats, as shown before, on the North-South and East-West axes, is an important factor to take into consideration for the conservation of the cetacean communities of the Strait of Gibraltar. A new harbour under construction on the North of Morocco is predicted to absorb all of the passenger traffic that currently exists between the North of Africa and South of the Iberian Peninsula, which is presently from Algeciras and Tarifa. It is also highly probable that it will absorb part of the traffic that currently exist between Ceuta and Algeciras, which will produce a high increase in terms of ferries and fast ferries in the centre of the Strait of Gibraltar.

Therefore the new harbour is expected to have an important increase of number of commercial boats that currently arrived in Tangier.

2. OBJECTIVES

The main objective of this document is to identify the current problem that exists between cetaceans and the maritime traffic in the Strait of Gibraltar and provide information to appreciate the impacts and suggest correction measures in front of the construction of the new harbour Oued Rmel for the cetacean communities. To attain these objectives, the project was divided in primary and secondary objectives, using the last ones to answer the first ones.

Primary objectives:

- To identify what are the current impacts produced by the maritime traffic on the cetacean populations of the Strait of Gibraltar.
- To evaluate the possible impacts that the new Tangier harbour could have on the cetacean populations of the Strait of Gibraltar, considering the new maritime routes that will be created between the Iberian Peninsula and Morocco.

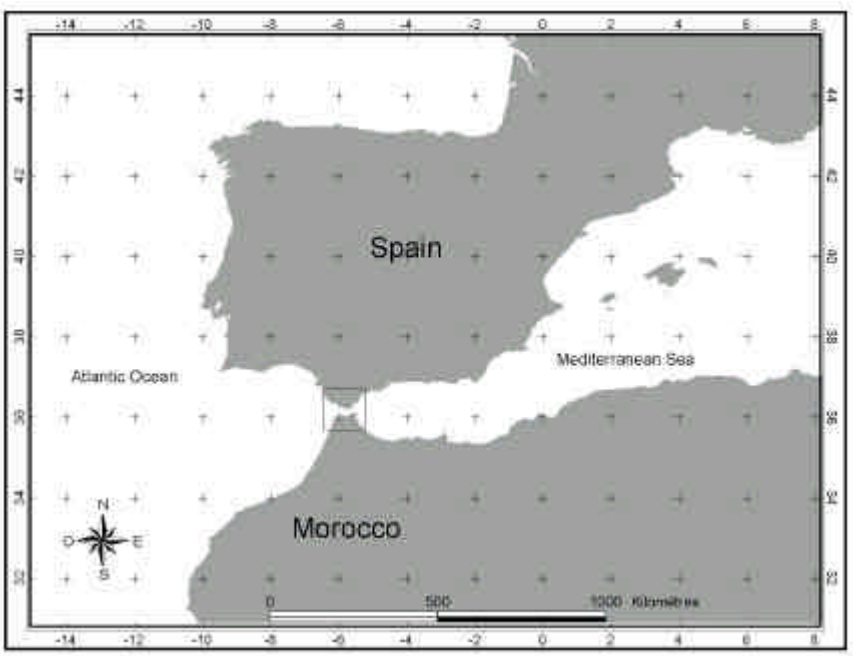
Secondary objectives:

- To identify the spatial distribution of cetaceans in the Strait of Gibraltar through the year.
- To identify the temporal distribution of cetaceans in the Strait of Gibraltar between 1998 and 2004.
- To identify the level of residence of the different cetacean species present in the Strait of Gibraltar.
- To identify the absolute abundance of bottlenose dolphin, long-finned pilot whales, sperm whales and killer whales in the Strait of Gibraltar.

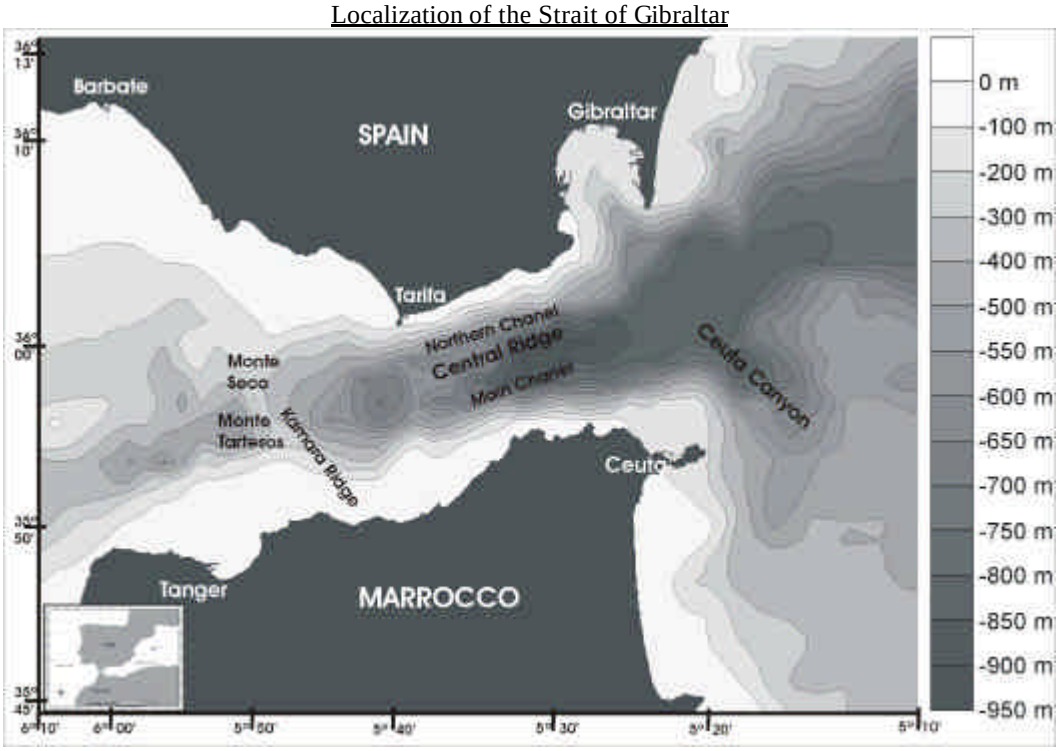
3. METHODS

3.1. STUDY AREA

The study area includes Barbate Bay and waters of Conil de la Frontera to the Strait of Gibraltar including the waters of Algeciras Bay and of the Autonomous City of Ceuta.



Localization of the Strait of Gibraltar

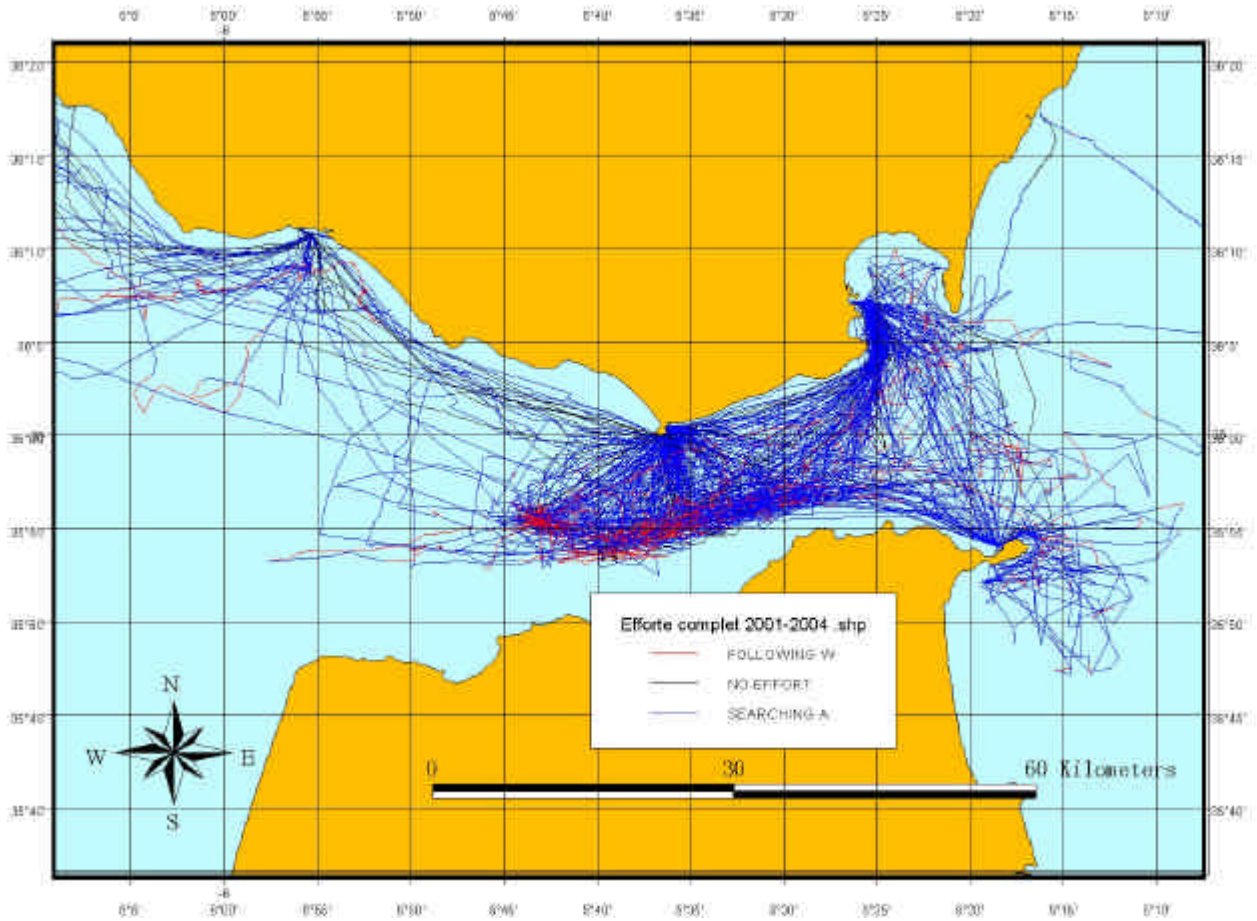


Predicted study area

3.2. DATA AVAILABLE FOR THE ANALYSES:

CIRCE has carried out aleatoric transects in the Strait of Gibraltar since 2001. The researchers making up CIRCE were collaborating with whale watching companies between 1998 and 2000 creating a database which is available to CIRCE for this project. In total, 22 648km were sailed realizing a total of 2 284 sightings of 10 species of marine mammals.

The study area was divided in squares of 2 minutes of latitude per 2 minutes of longitude of resolution. The distance in kilometres of searching in each square was then calculated using a Geographical Information System: Arc-View 3.2 of ESRI. Only the squares covered by at least 3km of transects with searching effort were used for the analyses.



Transects carried out between 2001 and 2004

Especies	1999	2000	2001	2002	2003	2004	Total
Balaenoptera acutorostrata	0	2	0	0	0	0	2
Balaenoptera musculus	0	1	0	0	0	0	1
Balaenoptera physalus	5	12	1	5	2	1	26
Cistophora cristata	2	0	0	0	0	0	2
Delphinus delphis	88	132	129	57	18	27	451
Globicephala melas	172	179	47	59	54	61	572
Orcinus orca	6	6	5	18	11	4	50
Physeter macrocephalus	33	22	158	56	77	2	348
Stenella coeruleoalba	94	112	100	79	17	33	435
Tursiops truncatus	107	110	58	47	35	40	397
Total	507	576	498	321	214	168	2284

Marine mammal sightings made between 1998 and 2004

4. RESULTS

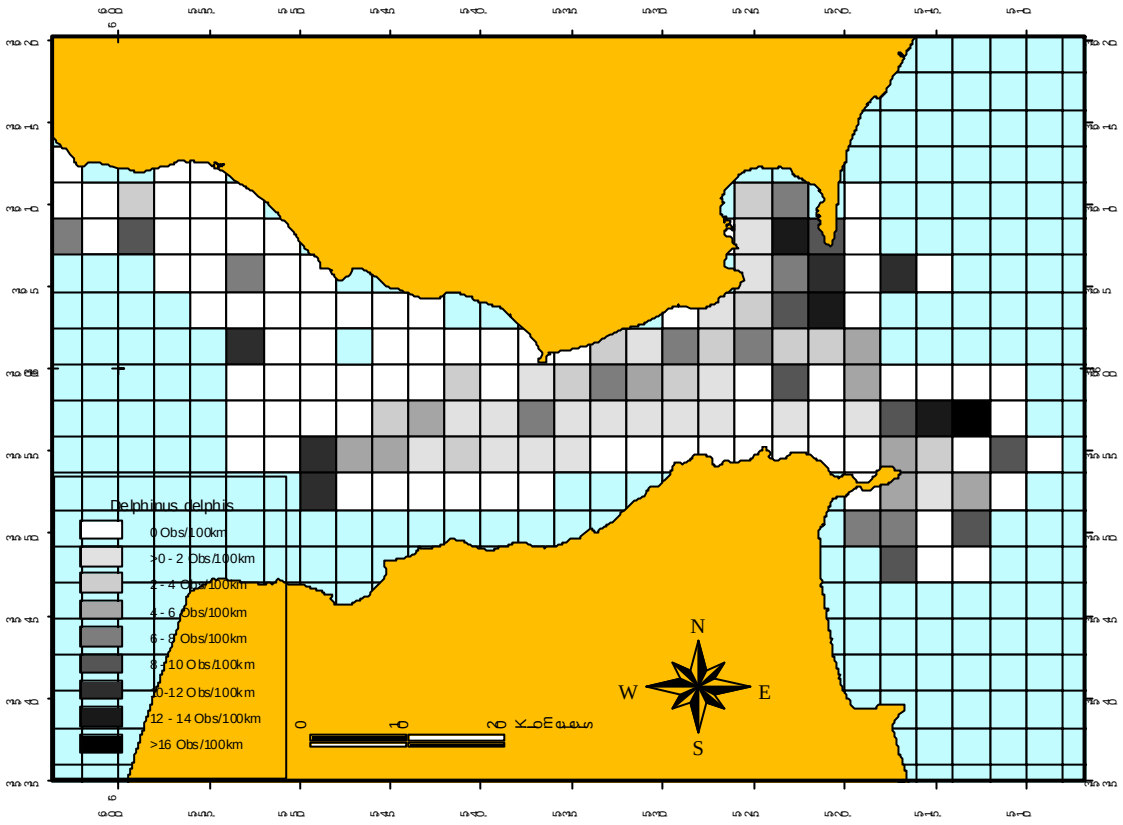
4.1. CETACEANS SPATIAL DISTRIBUTION ANALYSIS:

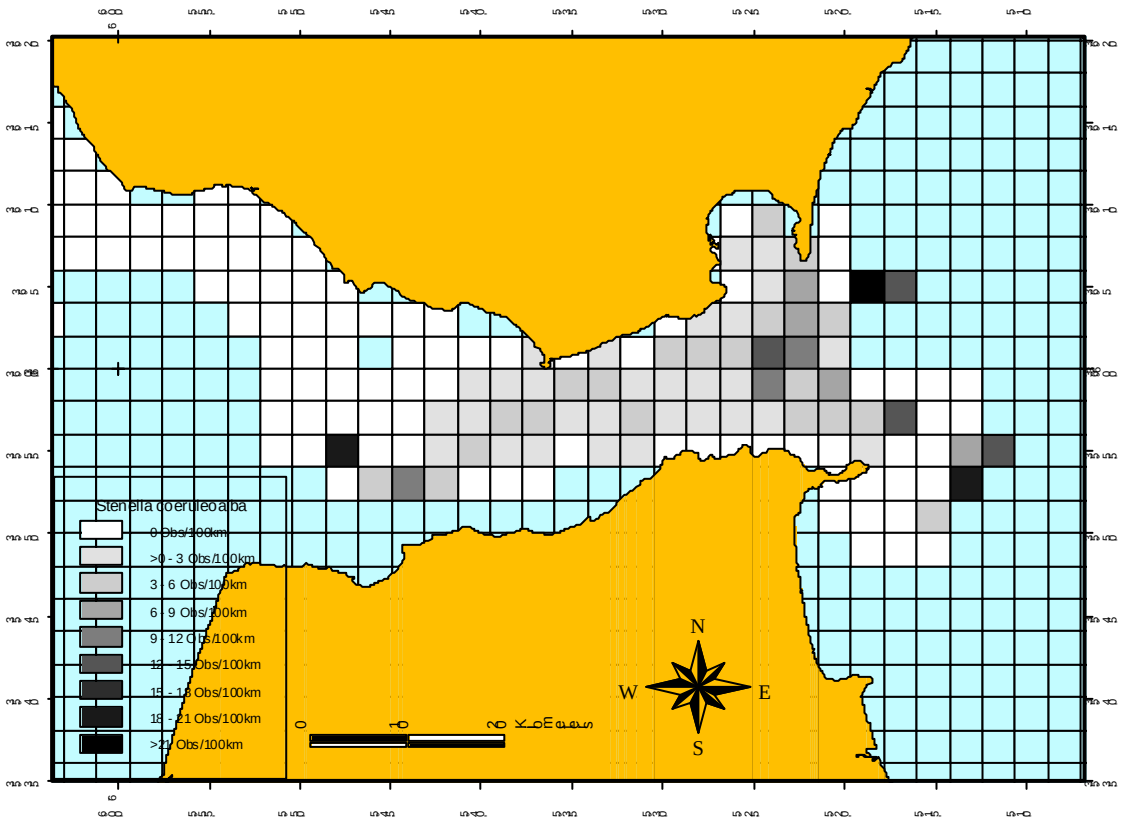
4.1.1. Presence of cetaceans and relative abundance

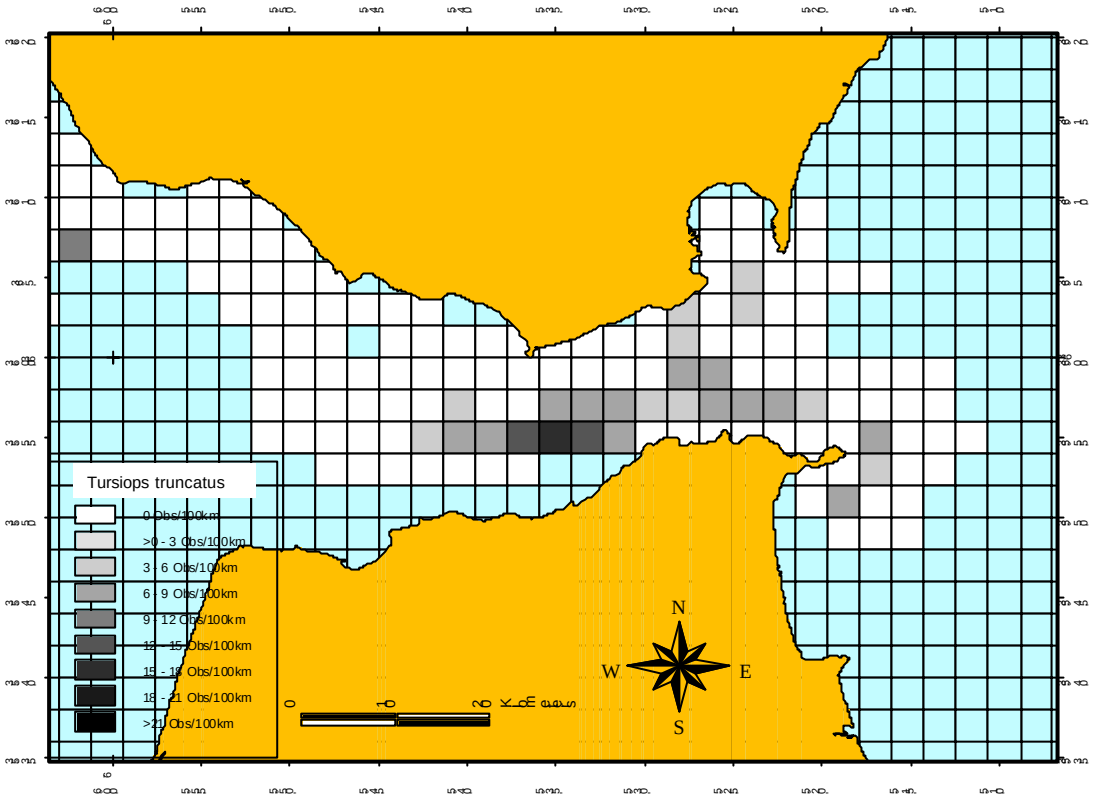
A total of 10 marine mammal species were observed in the Strait. The minke whales, blue whale and hooded seal were only observed a few times which we consider as exceptional species and are not commonly observed in the Strait. The other 7 cetacean species were present regularly in the Strait. In terms of sighting the most commonly observed species were the common dolphin and the long-finned pilot whale. The less frequently observed species were the fin whale and the killer whale. If the average number of individual in a group is taken into account, the more abundant species were the striped dolphin and the common dolphin while the less observed species were the fin whale and the sperm whale.

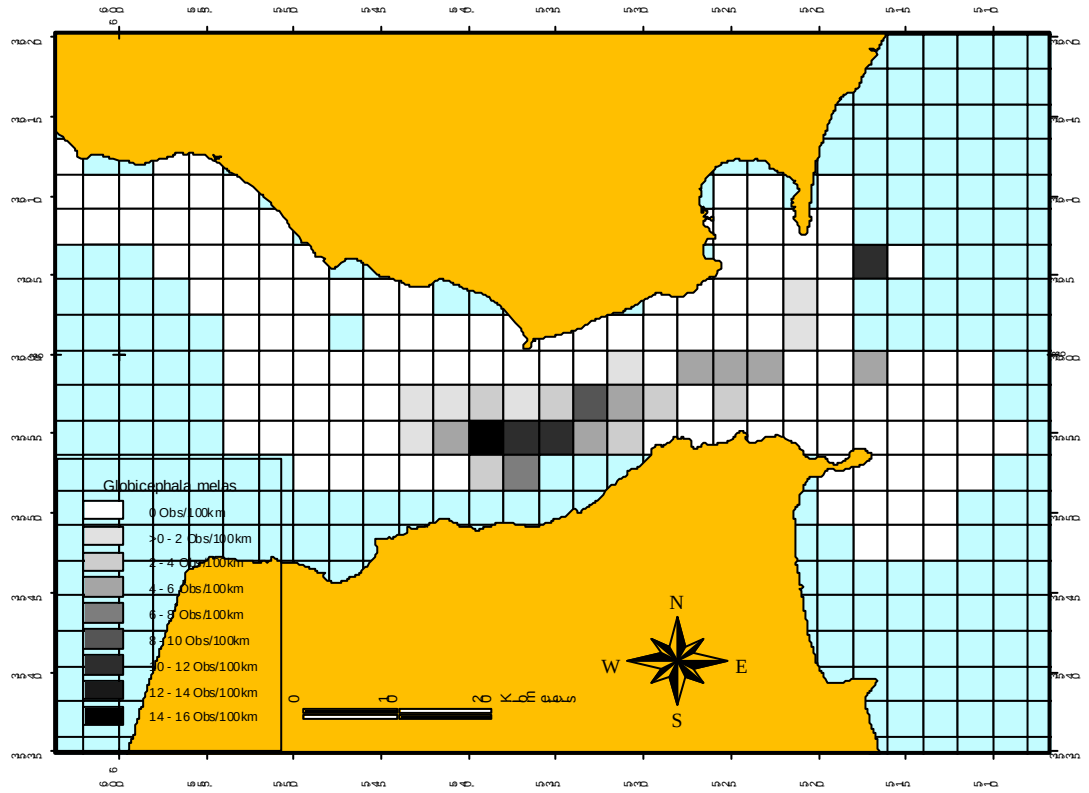
4.1.2. Distribution in relation to bathymetric parameters

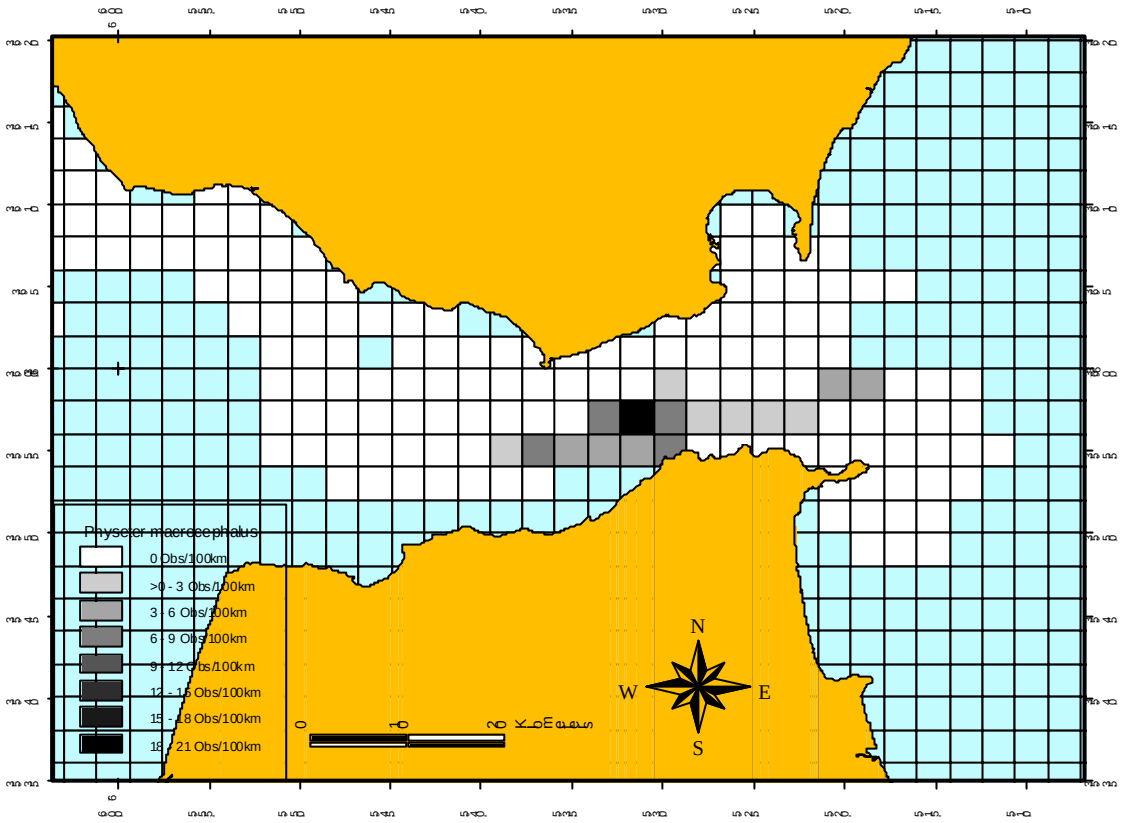
Due to its low encounter rate (ER) (number of sighting per kilometre sailed), the fin whales were removed from these analyses. The spatial distribution of ER for the 6 more commonly observed species are shown in the following maps. The llue area is the area where there is no information about cetacean's distribution.

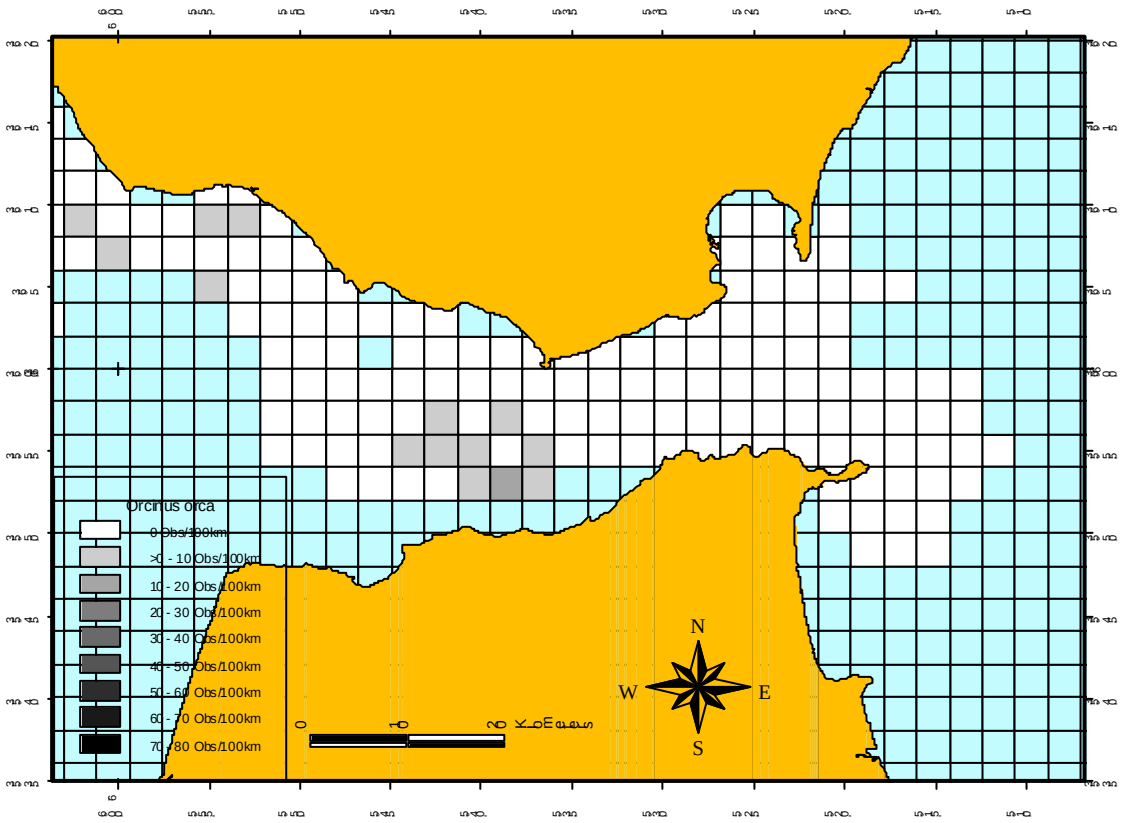

Delphinus delphis
0 Obs/100km
>0 - 2 Obs/100km
2 - 4 Obs/100km
4 - 6 Obs/100km
6 - 8 Obs/100km
8 - 10 Obs/100km
10-12 Obs/100km
12 - 14 Obs/100km
>16 Obs/100km
N
W
E
S
0
10
20
Kilometers


Stenella coeruleoalba
0 Obs/100km
>0 - 3 Obs/100km
3 - 6 Obs/100km
6 - 9 Obs/100km
9 - 12 Obs/100km
12 - 15 Obs/100km
15 - 18 Obs/100km
18 - 21 Obs/100km
>21 Obs/100km
N
W
E
S
0
10
20
Kilometers


Tursiops truncatus
0 Obs/100km
>0 - 3 Obs/100km
3 - 6 Obs/100km
6 - 9 Obs/100km
9 - 12 Obs/100km
12 - 15 Obs/100km
15 - 18 Obs/100km
18 - 21 Obs/100km
>21 Obs/100km
0
10
20 Kilometers
N
W
E
S

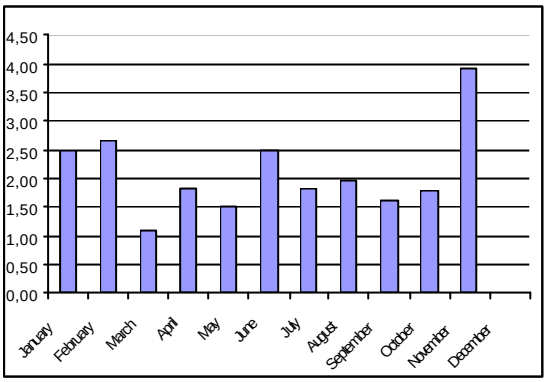

Globicephala melas
0 Obs/100km
>0 - 2 Obs/100km
2 - 4 Obs/100km
4 - 6 Obs/100km
6 - 8 Obs/100km
8 - 10 Obs/100km
10 - 12 Obs/100km
12 - 14 Obs/100km
14 - 16 Obs/100km
0
10
20 Kilometers
N
W
E
S


Physeter macrocephalus
0 Obs/100km
>0 - 3 Obs/100km
3 - 6 Obs/100km
6 - 9 Obs/100km
9 - 12 Obs/100km
12 - 15 Obs/100km
15 - 18 Obs/100km
18 - 21 Obs/100km
N
W
E
S
0
10
20
Kilometers

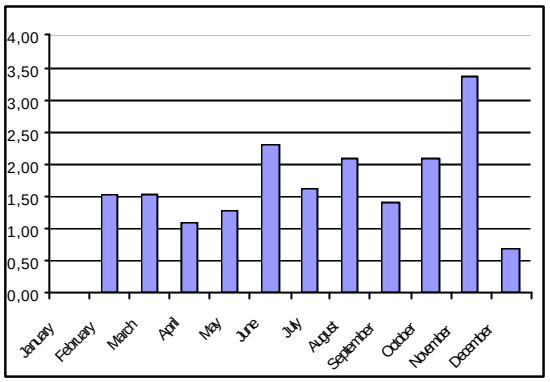

Orcinus orca
0 Obs/100km
>0 - 10 Obs/100km
10 - 20 Obs/100km
20 - 30 Obs/100km
30 - 40 Obs/100km
40 - 50 Obs/100km
50 - 60 Obs/100km
60 - 70 Obs/100km
70 - 80 Obs/100km
N
W
E
S
0
10
20
Kilometers

4.2. CETACEAN TEMPORAL DISTRIBUTION ANALYSES:

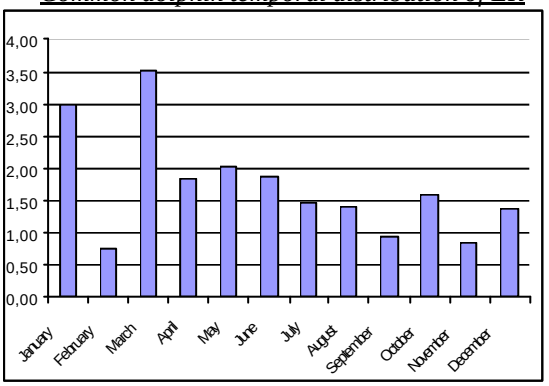
The results of the temporal distribution analyses can be observed on the following figures, where *ER* is the number of group of animal observed for every 100km sailed.



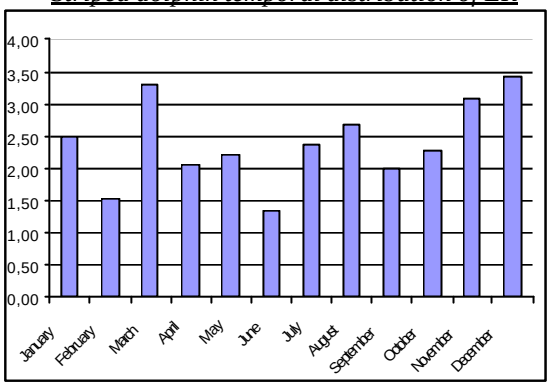
Common dolphin temporal distribution of ER



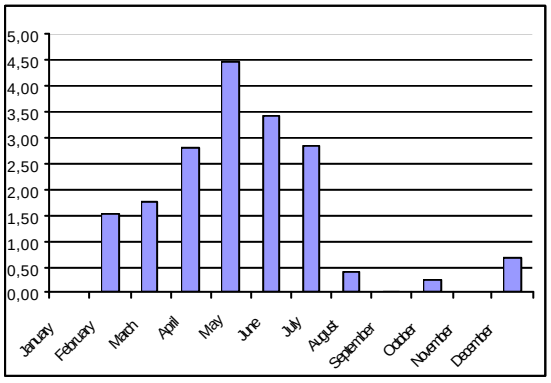
Striped dolphin temporal distribution of ER



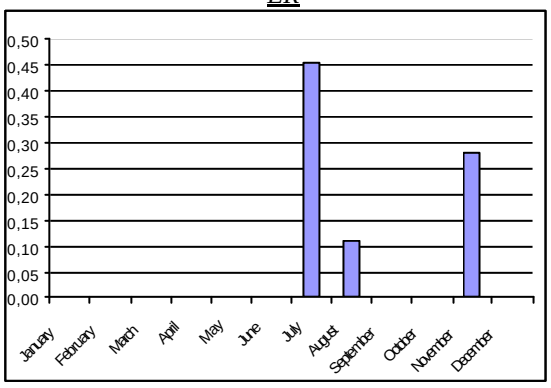
Bottlenose dolphin temporal distribution of ER



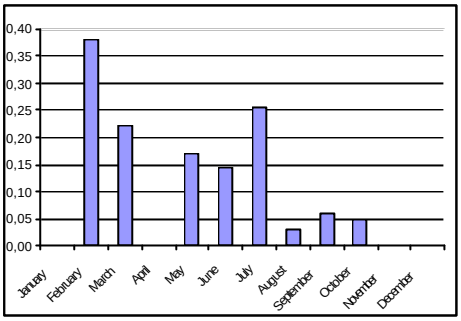
Long-finned pilot whale temporal distribution of ER



Sperm whale temporal distribution of ER



Killer whale temporal distribution of ER



Fin whale temporal distribution of ER

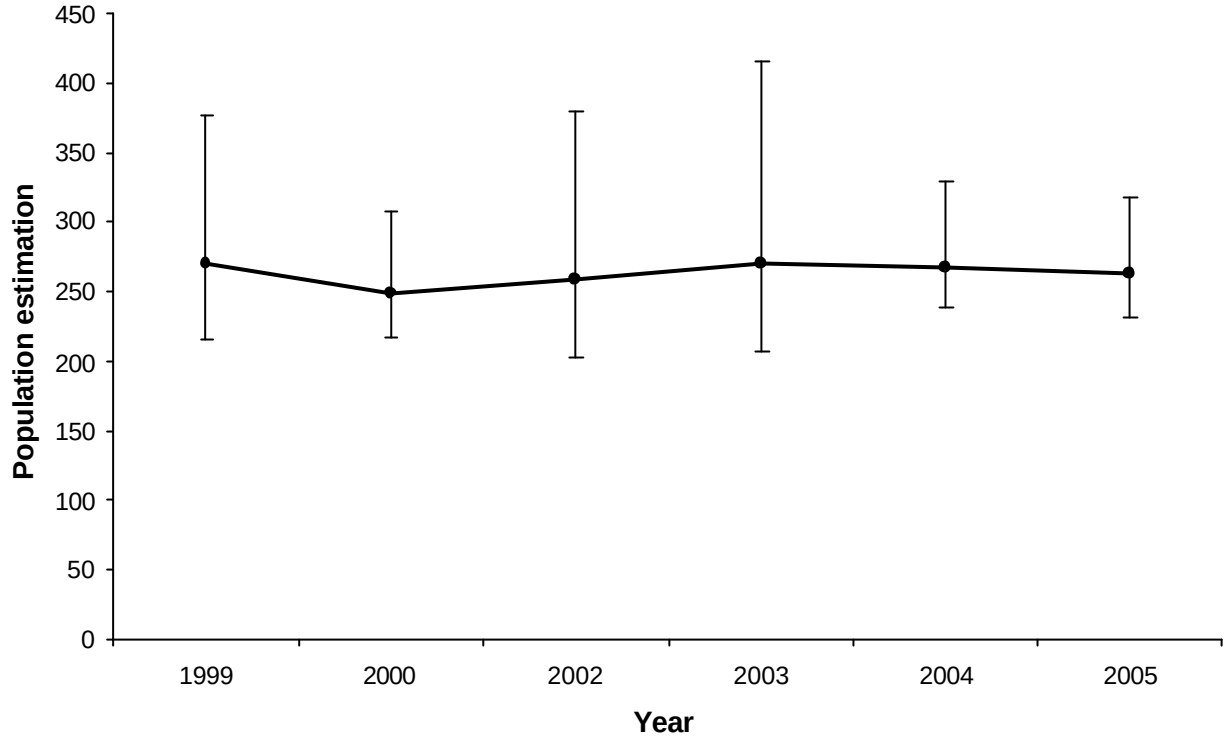
4.3. LARGE CETACEAN SPECIES ABUNDANCE ANALYSES:

Long-finned pilot whales

A total of 8111 pictures representing 15 178 pilot whales, i.e. a given picture can include several individuals, of which 10 782 individual dorsal fins have been analyzed for a total of 186 sightings realized over 107 days in the Strait of Gibraltar. From these, 4579 were fin images of quality Q0, 3140 of Q1 and 3065 of Q2. From 1999 to 2005, a total of 210 individuals have been identified in the catalogue. The results are the followings:

Year	Absolute abundance	Confidence Interval (95%)	Coefficient of variation
1999	270	95% CI: 216-376	0,14
2000	249	95% CI: 218-307	0,09
2001*	441	95% CI: 210-1113	0,47
2002	259	95% CI: 202-380	0,17
2003	270	95% CI: 206-415	0,18
2004	267	95% CI: 238-330	0,08
2005	263	95% CI: 231-319	0,08

*Estimation of abundance of pilot whales between 1999 and 2005. (*results not taken into account due to lack of data and then a very high coefficient of variation)*



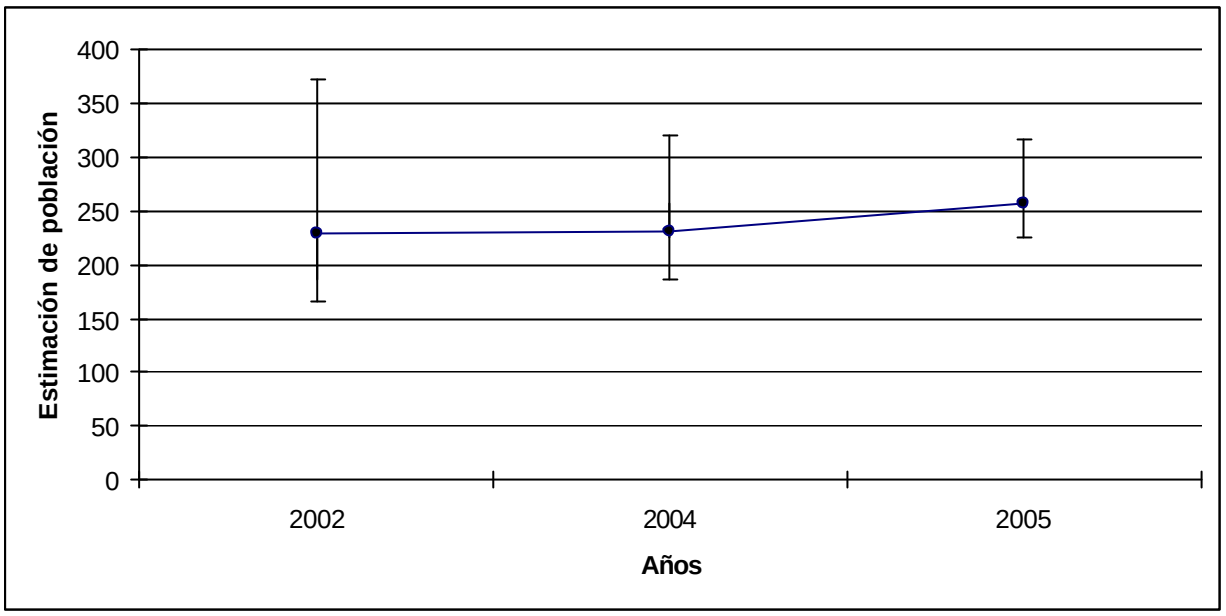
Pilot whale abundance between 1999 and 2005. The results for 2001 are not included.

Bottlenose dolphin

A total of 3458 pictures representing 3571 dorsal fins of bottlenose dolphin have been analyzed, i.e. a given picture can include several individuals, for a total of 44 sightings realized over 32 days in the Strait of Gibraltar. From these, 1097 were fin images of quality Q0, 1324 of Q1 and 1150 of Q2. Between 2001, 2002, 2004 and 2005 a total of 260 individuals have been identified in the catalogue with 70 individuals marked M1, 161 marked M2 and 29 marked M3.

Year	Absolute abundance	Confidence Interval (95%)	Coefficient of variation
2002	230	95% CI: 166-373	0.21
2004	231	95% CI: 187-321	0.14
2005	258	95% CI: 226-316	0.08

Bottlenose dolphin abundance between 2002 and 2005. The abundance for other years have not been estimated yet.



Bottlenose dolphin abundance between 2002 and 2005 (2003 has not been analysed yet)

Killer whales

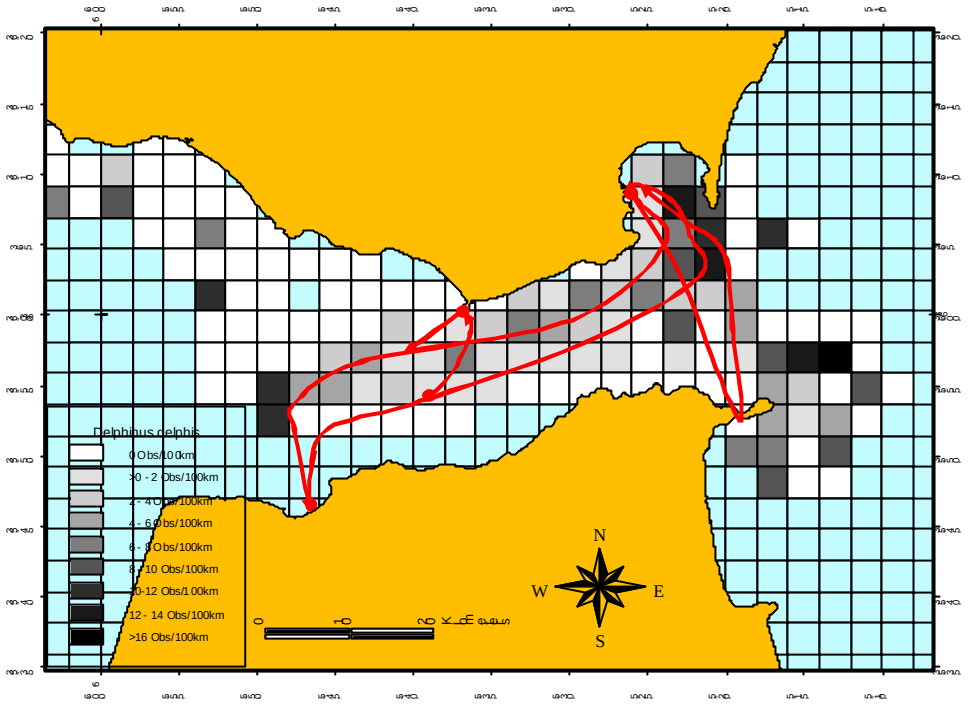
The killer whale population is made of a minimum of 25 individuals identified in the catalogue. Eight more individuals were identified but were not included in the catalogue as they were seen only in one sighting and did not have characteristic marks on the dorsal fin or on the saddle patch that would allow future identification. Therefore there could be around **33 individuals** in the Strait of Gibraltar.

Sperm whales

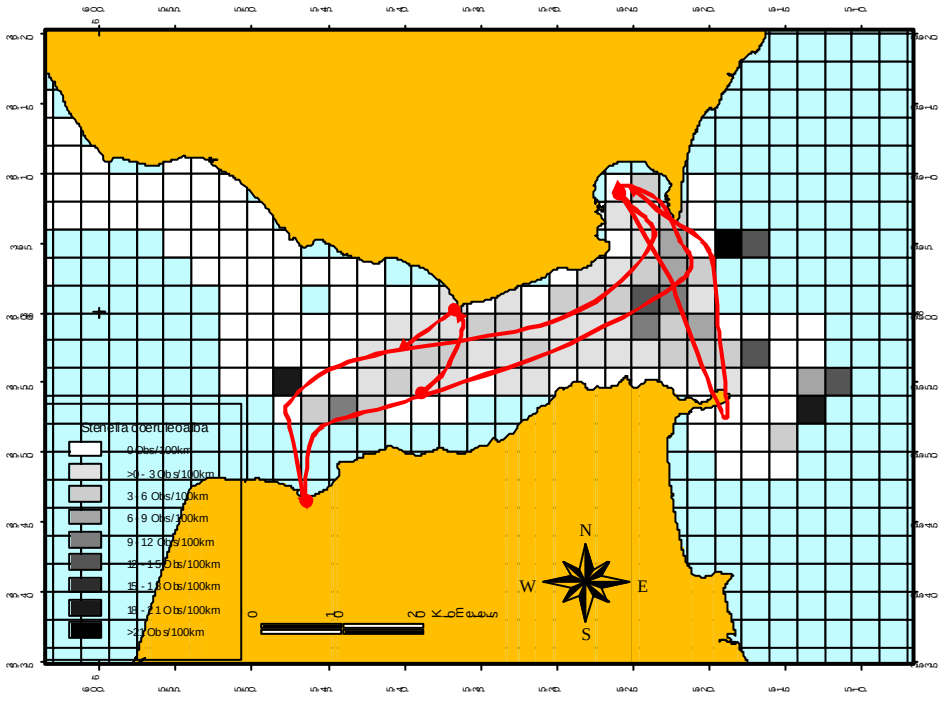
At least 21 individuals use the Strait of Gibraltar as a feeding area. Resightings of the same individuals from year to year in the Strait shows their fidelity to the site.

4.4. OVERLAPPING BETWEEN SHIPS AND CETACEANS ROUTES:

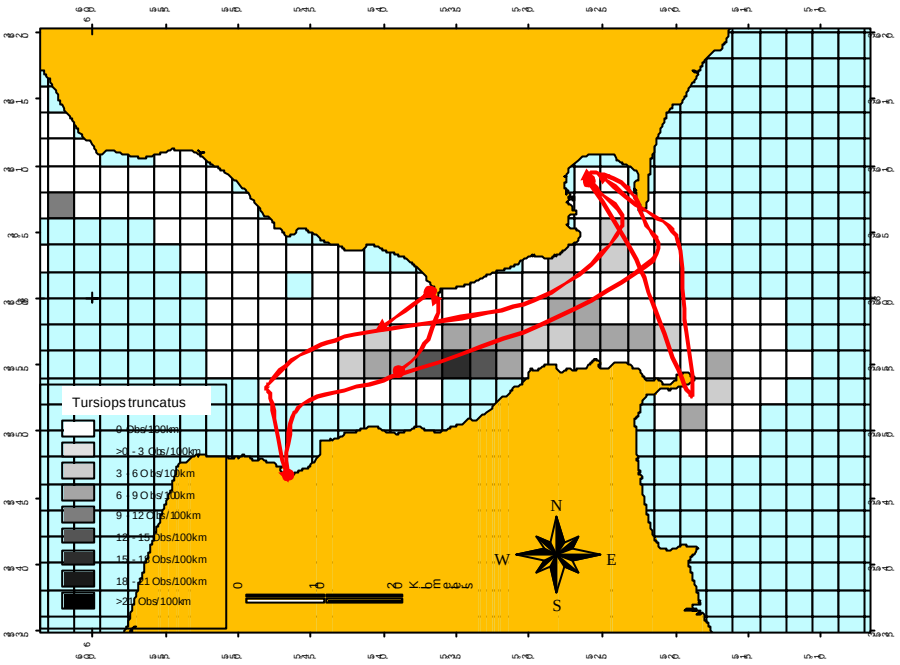
In the following figures the routes of ferries and fast ferries can be observed as they are today and how they are predicted to be with the construction of the new Tangier harbour and the distribution of the different species in the study area.



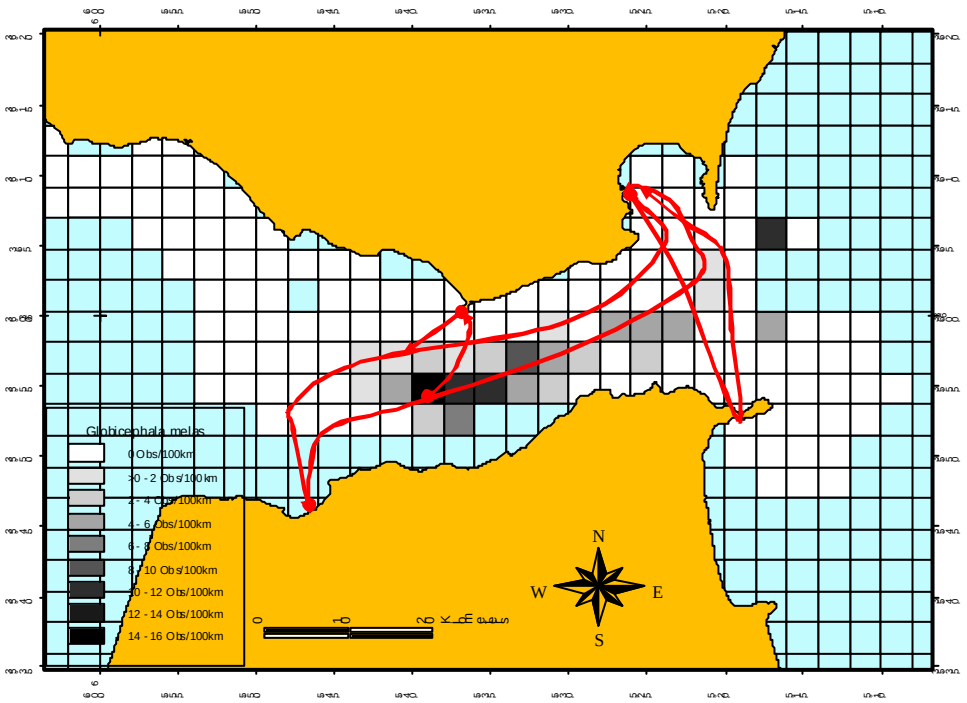
Routes of ferries and fast ferries with the distribution of common dolphins in the Strait



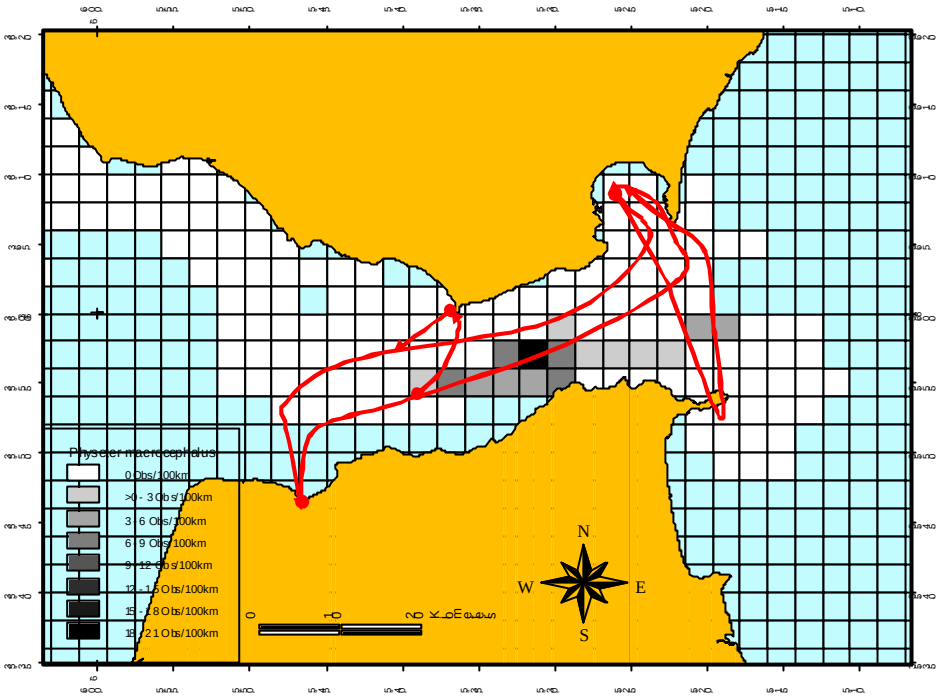
Routes of ferries and fast ferries with the distribution of striped dolphins in the Strait



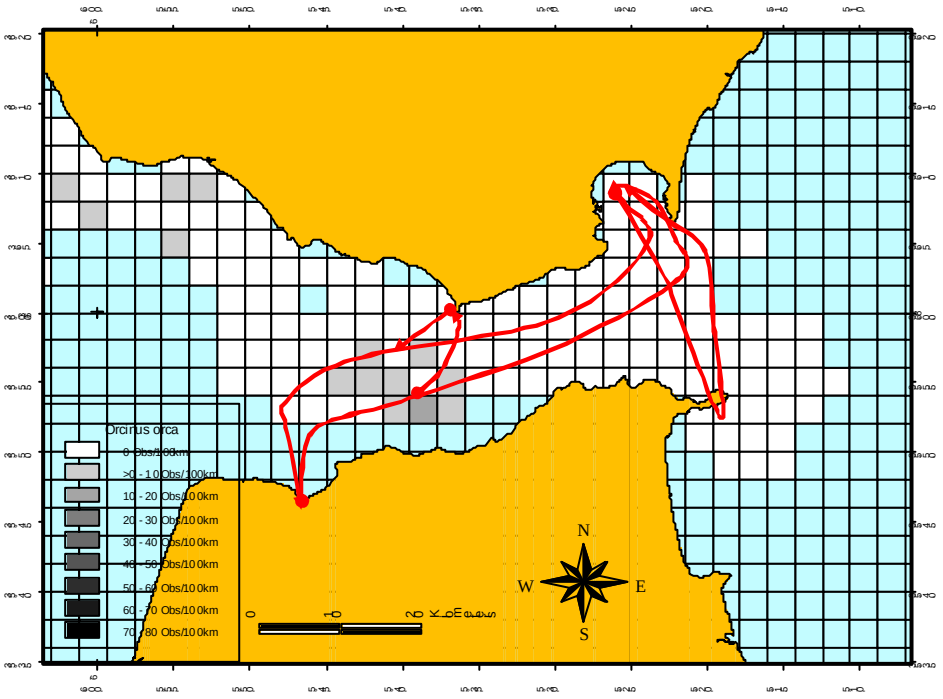
Routes of ferries and fast ferries with the distribution of bottlenose dolphins in the Strait



Routes of ferries and fast ferries with the distribution of long-finned pilot whales in the Strait

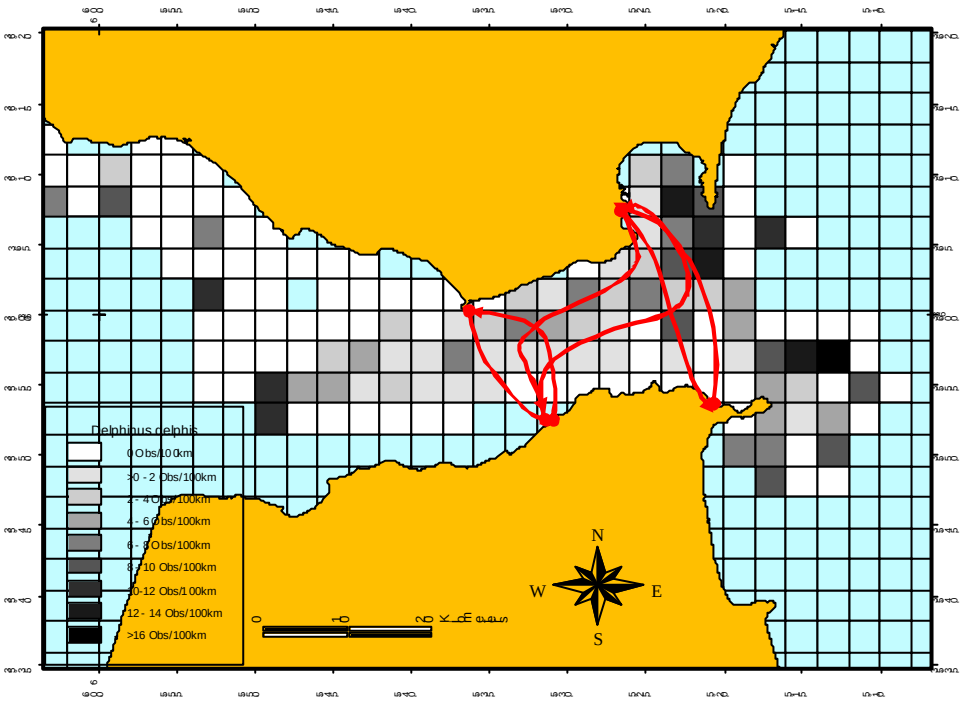


Routes of ferries and fast ferries with the distribution of sperm whales in the Strait

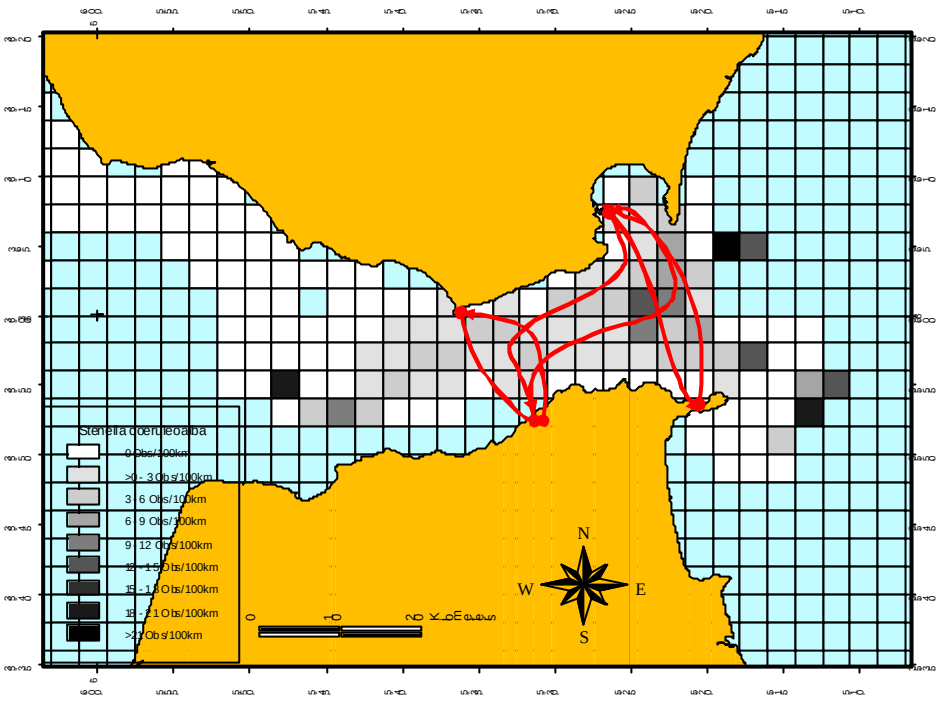


Routes of ferries and fast ferries with the distribution of killer whales in the Strait

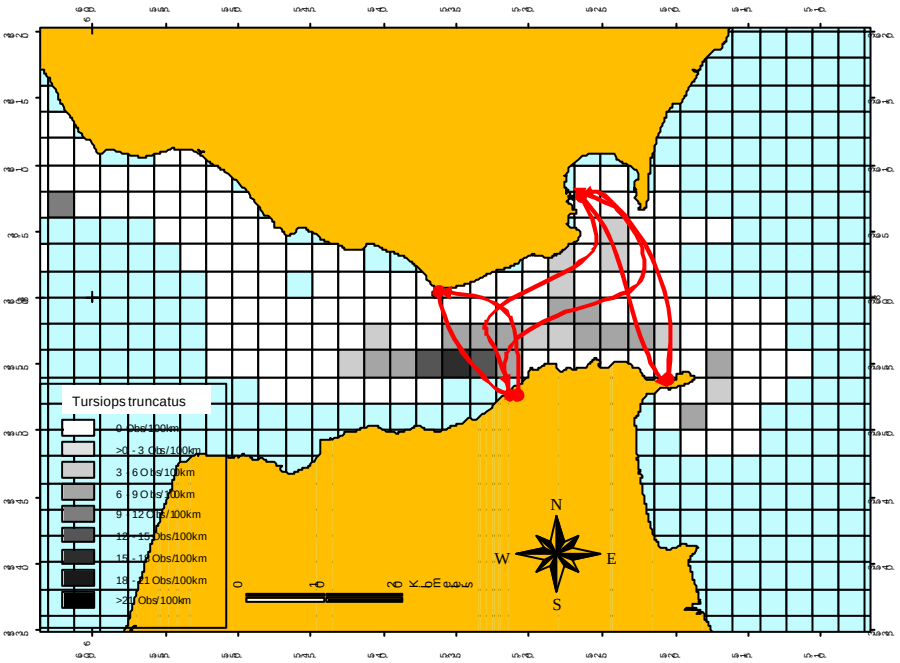
By the end of the year 2007, it is predicted that the new Tangier harbour will start working, redirecting the maritime traffic from Tangier to the new harbour on the Northern coast of Morocco. The new passenger lines will therefore occur in the following way:



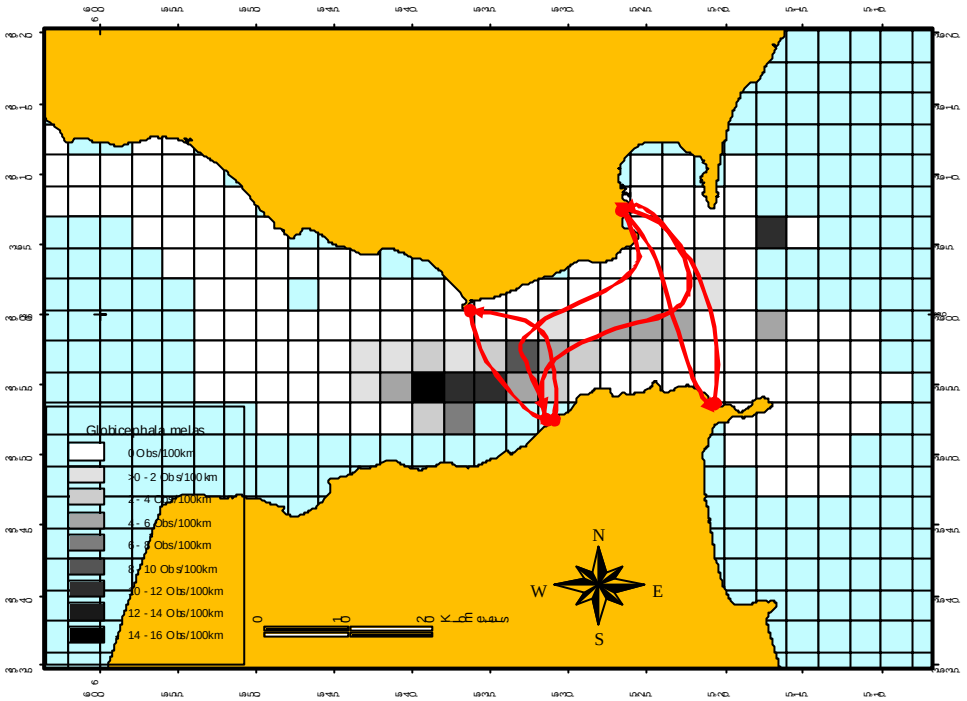
Routes of ferries and fast ferries predicted in the area with the construction of the new Tangier harbour with the distribution of common dolphins



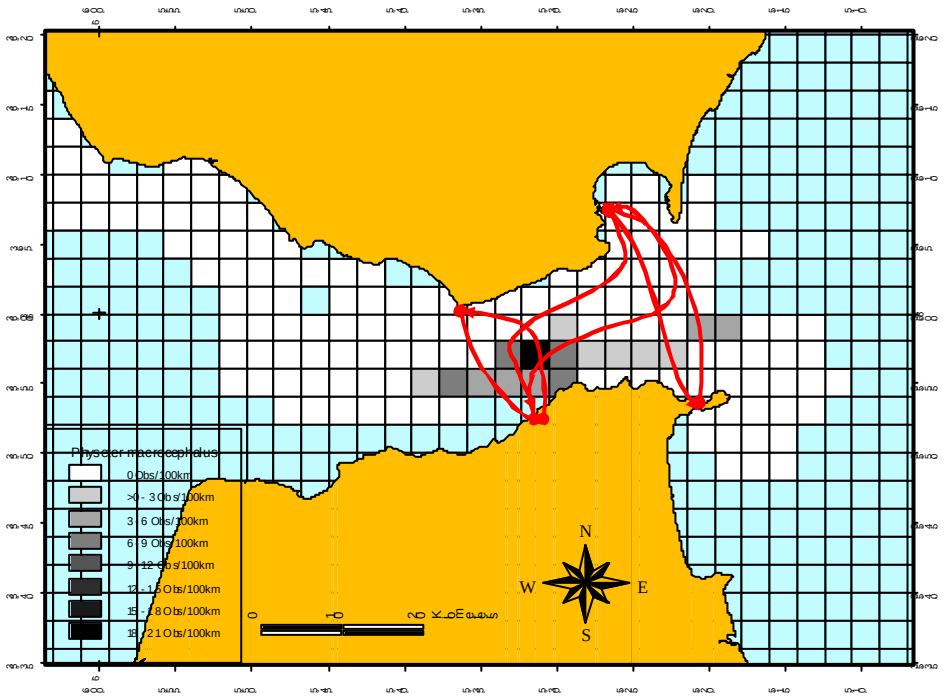
Routes of ferries and fast ferries predicted in the area with the construction of the new Tangier harbour with the distribution of striped dolphins



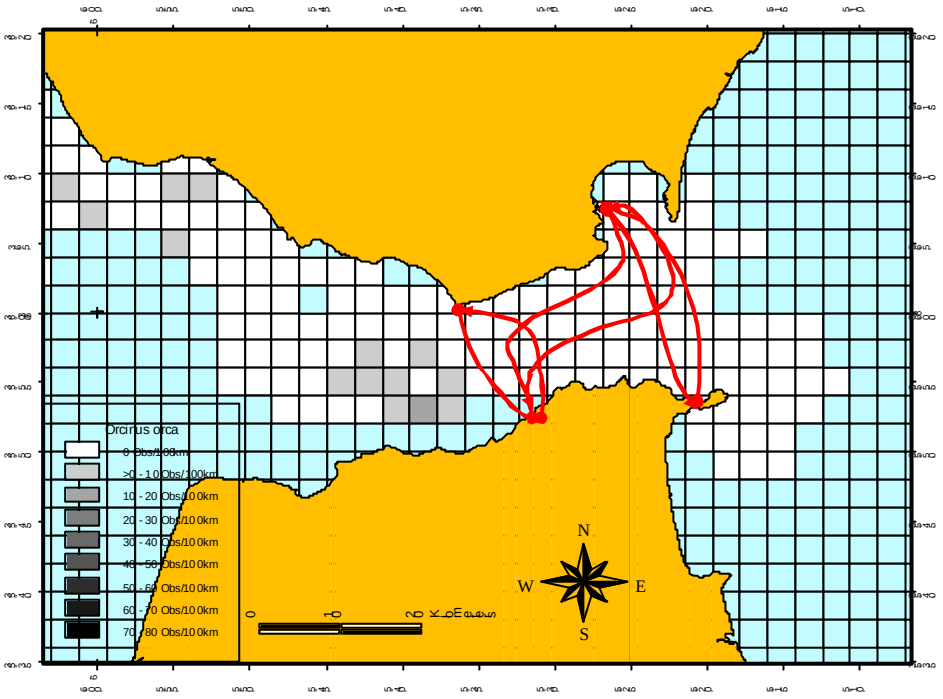
Routes of ferries and fast ferries predicted in the area with the construction of the new Tangier harbour with the distribution of bottlenose dolphins



Routes of ferries and fast ferries predicted in the area with the construction of the new Tangier harbour with the distribution of long-finned pilot whales

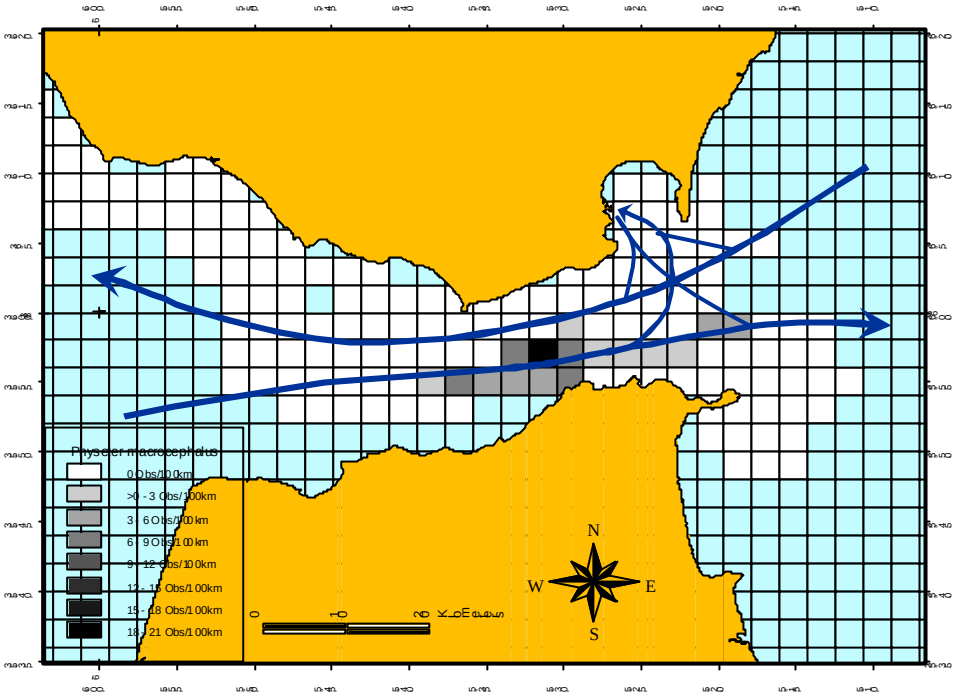


Routes of ferries and fast ferries predicted in the area with the construction of the new Tangier harbour with the distribution of sperm whales

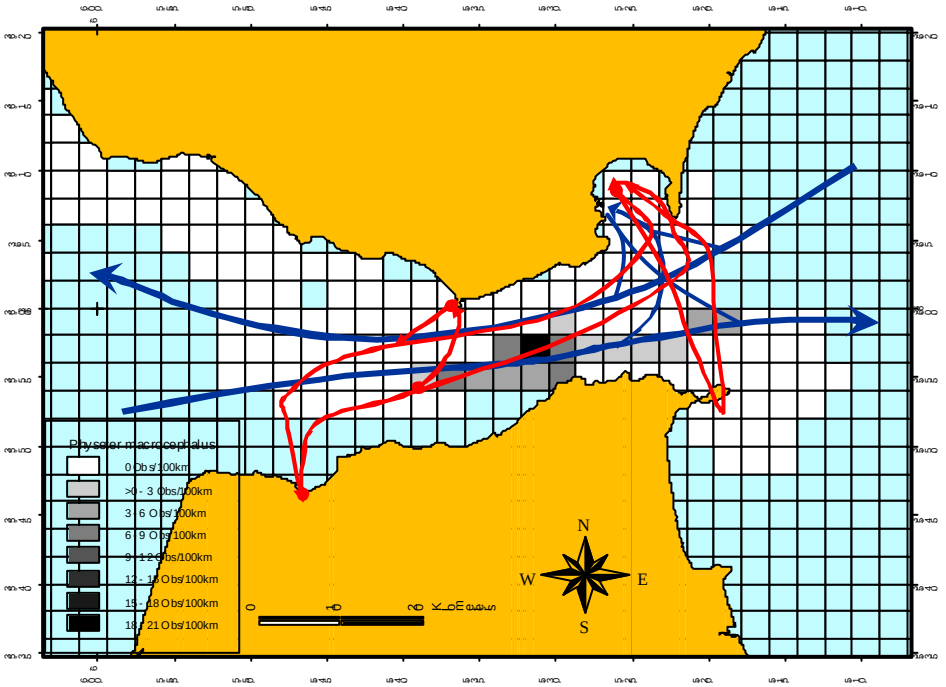


Routes of ferries and fast ferries predicted in the area with the construction of the new Tangier harbour with the distribution of killer whales

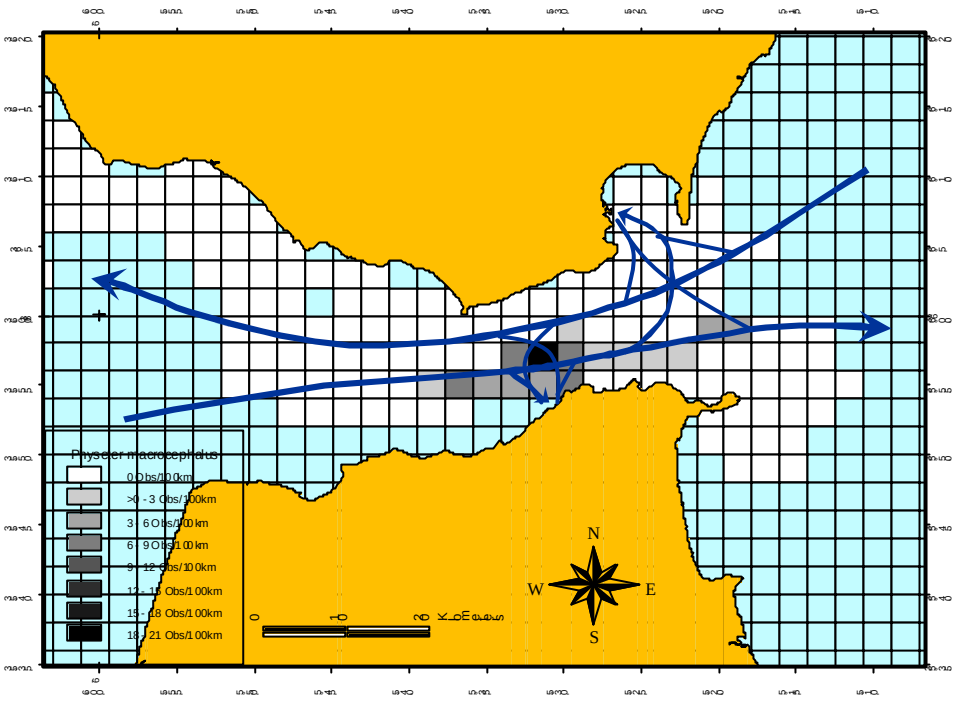
This new harbour will also absorb commercial traffic which will also change the commercial traffic in the area. It can be observed below how the maritime traffic will be with the sperm whale distribution that will probably be the species most affected of the area:



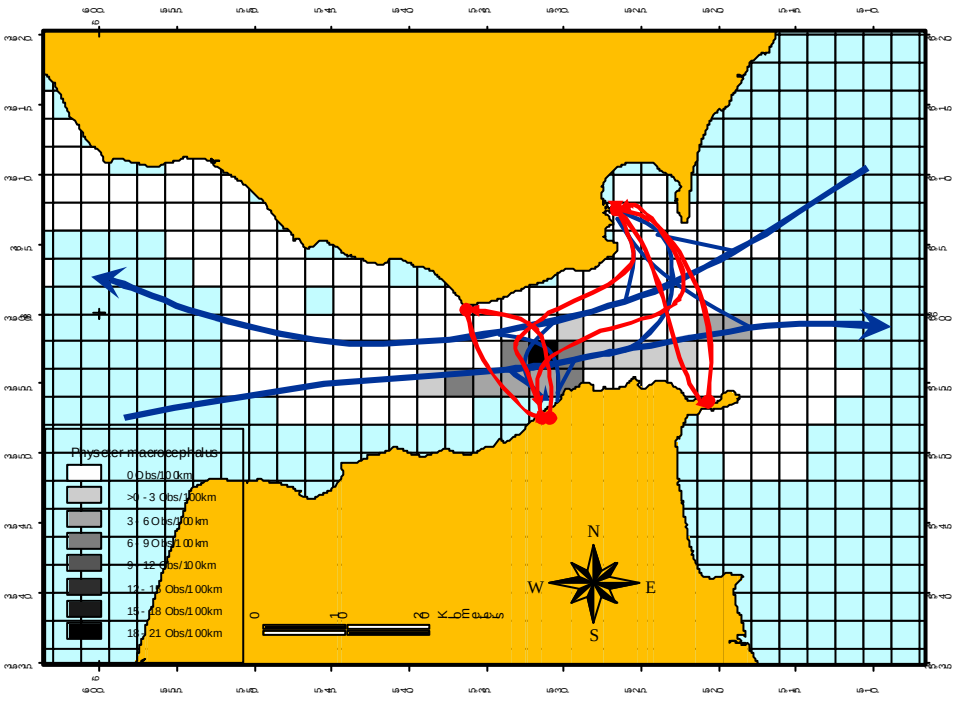
Current commercial traffic in the area and the distribution of sperm whales



Current traffic of commercial boats, ferries and fast ferries in the Strait of Gibraltar and the distribution of sperm whales



Predicted traffic of commercial boats starting on the opening of the new Tangier harbour and the distribution of sperm whales



Total traffic after the opening of the new Tangier harbour in the Strait of Gibraltar and the distribution of sperm whales

4.5. IMPACTS DUE TO COLLISIONS:

A total of two collisions between ships and sperm whales in the Strait of Gibraltar were confirmed. One of them was observed directly by the team of CIRCE in September 2002. Collisions between two ships and two fin whales were also reported and at least one between a long-finned pilot whale and a boat. On the following pictures the collisions with sperm whales and the possibility of more collisions are documented:

Sperm whale hit and killed by a ferry in September 2002

Sperm whale hit by a fast ferry in 2001 stranded on the Moroccan coast of the Strait

A sperm whale and pilot whales close to a commercial ship

Sperm whale close to a ferry

5. DISCUSSION:

5.1. CETACEANS SPATIAL DISTRIBUTION ANALYSES:

The Strait of Gibraltar is characterized by a high diversity of cetaceans with 7 species observed on a regular basis during the time of this study. It could be suggested that this high diversity of cetaceans observed in the Strait of

Gibraltar could be related with a high number of cetaceans transiting in and out of the Mediterranean Sea through the Strait. However, long term works of photo-identification indicate that sperm whales, long-finned pilot whales, bottlenose dolphins, killer whales and common dolphins individuals are at least seasonally resident in the Strait while the status of striped dolphins still needs to be clarified. The most probable hypothesis to explain this high density of cetaceans in the Strait is the high availability of prey along the Strait.

5.2. CETACEANS TEMPORAL DISTRIBUTION ANALYSES:

The commonly observed species in the Strait are the striped, common and bottlenose dolphins, the long-finned pilot, killer, sperm and fin whales while the minke and blue whales and hooded seals would be more occasional and probably due to processes of disorientation. Within the commonly observed species, three groups can be separated. On one hand the species present all year round that are the four first species cited before, on the other hand those that are only observed during certain period of the year that are the killer whales, sperm whales and fin whales. Bottlenose dolphins and long-finned pilot whales are resident, according to the data obtained from their photo-identification catalogues, although it can be observed that there are variations throughout the year. Bottlenose dolphins are more abundant in spring while pilot whales number increase at the end of summer and in winter with a less abrupt change. For common dolphins, observations at sea confirmed that some individuals are present all year round. Its distribution throughout the year presents a maximum by the end of spring. In the case of striped dolphins, it is not possible to talk about an important level of residence for this species. However, it is easy to think that a part of the groups observed are present throughout the year while there is a transient population less sedentary that would use the Strait at the end of summer and during the months of autumn, which is coming from the Alboran Sea or the contiguous Atlantic.

In the case of sperm whales, it is observed that only twenty one individuals used the Strait from the end of winter to mid-summer with a maximum in spring. This population is quite reduced with always the same individuals coming back probably due to feeding processes. The sperm whale populations of the Mediterranean Sea are poorly known with focuses in the areas of the Ligurian Sea, Balearic Islands and Greek archipelagos.

Killer whales were only observed in the study area during the months of July and August. In 90% of the cases they were associated with tuna fisheries. They were always observed feeding on tunas. Year after year the same killer whale individuals were observed.

Finally, the fin whale was confirmed as the only species observed transiting through the Strait without staying to feed. It uses the Strait as a canal of migration between the Mediterranean Sea and the Atlantic. The Mediterranean Sea population is limited to around 3000 individuals which is a reduced population.

5.3. OVERLAPPING BETWEEN ROUTES OF SHIPS AND CETACEANS:

The results of this study show that there is a series of problems between cetaceans and anthropogenic activities in the Strait of Gibraltar.

The construction of the new harbour Oued Rmel could suggest a serious problem for the conservation of the cetacean species of the Strait, and in particular the large size ones such as the fin whale and the sperm whale, if preventive measures are not taken to mitigate collisions and other impacts like acoustic pollution. As observed on the maps of sperm whale distribution and the prediction of new ferries and fast ferries routes in the Strait, the probability that a collision between this species and a passenger ship occurs will increase drastically with the crossing of the middle of the maximum abundance area of the species.

In the case of pilot whales and bottlenose dolphins, the routes will also cross their maximum presence area in the Strait. Although the probability of collision with these species are low and in particular with striped dolphins, common dolphins or killer whales, but what will happen is an increase in acoustic pollution in the area that could be a nuisance on the short and medium term. As said before, only few examples of strandings were detected with signs of death from collision with ships. These data could increase drastically as the main currents existing in the area could already have displaced some hypothetic cases not detected on land.

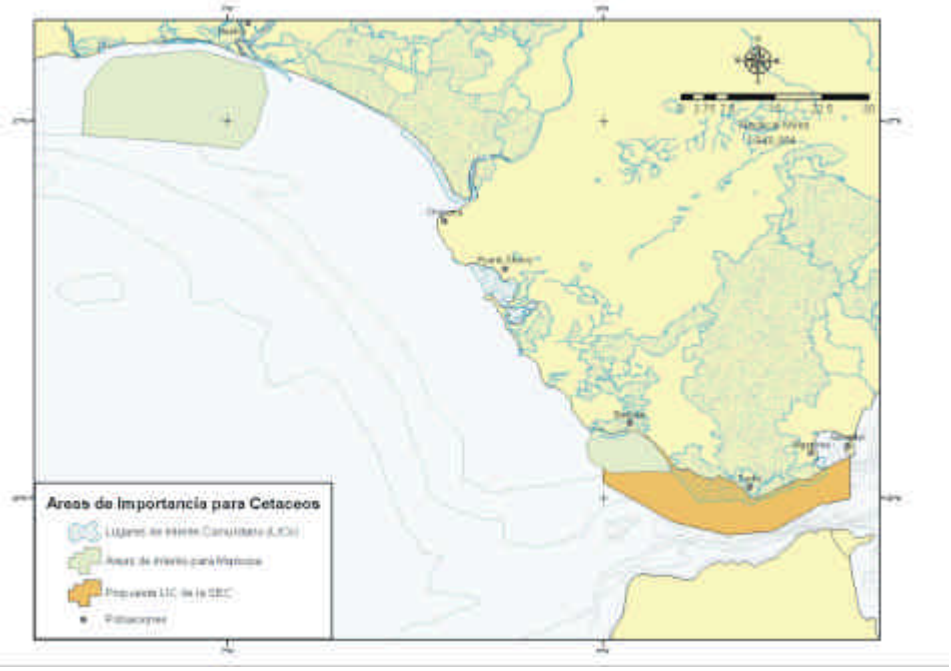
Between 2001 and 2005 new fast ferry lines opened between Algeciras and Tangier and Tarifa and Tangier and it was demonstrated in this document that collisions are reality. Therefore, it could be concluded that the opening of new lines and the congestion of the central part of the Strait will be faced with, will be dramatic for the sperm whale population and could put it in danger of extinction. When the high speed vessels will start transiting in this new area and due to the low manoeuvrability that exist in the area, it could increase the risk of collisions which would be harmful for the animal and for the ships transiting in the area leaving the animal drifting below the surface and therefore creating a danger for navigation. Furthermore, this area is a feeding area for most of the species (sperm whales have always been observed with a feeding behaviour), and intensely transited also by whale watching boats, especially during summer. The presence of boats could also increase the level of stress to which the different cetacean population of the Strait are already exposed.

6. RECOMENDATIONS:

In order to consider an analysis of the current situation and efficient correcting measures, a comparative analysis of the situation with other areas and between themselves is necessary. To analyze the problem in details, the different measures that could be proposed to mitigate possible collisions between ships and cetaceans will be studied from now.

It should not be forgotten that they are species included in the National Catalogue of Endangered Species (Catálogo Nacional de Especies Amenazadas), in its various categories, which requires, as a minimum, management measures. As part of the species concerned there is the sperm whale which is one of the species most affected according to the data by collisions with high speed ships.

Another species that could be affected by these types of ships and have its distribution that coincides with the ferries and fast ferries paths is the bottlenose dolphin. It is a species included in the Annex II of the Habitat Directive for which it is obligatory to designate conservation areas that are called SCIs (Sites of Community Importance) and once they will have a juridical declaration and enter in the Red Natura 2000, they will be called SACs (Special Area of Conservation). In this case the declared SCIs that coincide with the paths of fast ferries will need to take measures in order to maintain the population of bottlenose dolphins in a favourable conservation status, as required by the compromise with this Directive. It is the case in the Canaries Islands, where the path line of high speed ships affect two areas declared as SCIs by the Government of the Canaries due to the presence of bottlenose dolphins. In the case of the Strait the Parque Natural del Estrecho was proposed as a SCI area. The Sociedad Española de Cetáceos (SEC) proposed an enlargement so that this Park comes to the Spanish territorial waters, therefore including the distribution of bottlenose dolphins.



The **precautionary approach** promoted since the Rio Conference in 1992 and ratified by Spain who signed the Biodiversity Convention is, in this case more than never, the principle that should govern the decisions on the measures to be taken. In the Canaries, they are now taking decisions to respect and adopt measures to minimize the impact of these ships on the cetacean populations because the large number of stranded animals up to now does not give more time for delays. But the principle of sustainable development indicates the problem should be prevented and in the case of few data available, it should be opted for the more restrictive measures.

The measures that will be proposed now have been agreed on through the meetings held in Monaco during the 3rd week of November 2005 and in the forum of the "JOINT ACCOBAMS/PELAGOS WORKSHOPS ON FIN WHALE AND COLLISIONS", by a group of international experts. For now, and while CIRCE is in the redaction of the final report, the most urgent recommendations and mitigation measures will be presented. These are described in the following table where their viability, cost and time in which they can be applied are described. They are adapted to the Strait of Gibraltar.

Mitigation measures	Objective of the measure	Viability	Time to introduce	Cost	Notes	Priority
Education projects and training for crew	Decrease of collisions due to knowledge of its existence. Know how to avoid it.	High	Immediate	Low	Need for all the crew to follow the program	1
Independent observers onboard ferries and fast ferries.	1) Alert the crew about the presence of animals. 2) Alert the crew about possible collisions. 3) Document collisions.	High	Immediate	Low	Few applications by night.	1
Education program of marine official organisms (coast guard, Dockers, Tarifa maritime lifeguard...).	Alert about possibilities of collision, importance to document of the collisions.	High	Immediate	Low		2
Provide maritime lines managers with information on seasons of the year, place and species susceptible to problems.	To inform on the areas of possible problems. To take conscience of the problem.	High	Immediate	None		3
Information to the commercial ships transiting through the area.	To take conscience of the risk of collisions.	High through Tarifa tráfico	Immediate	None	Possibility to work with Tarifa tráfico and with hydrographical services.	4
To use the Pelagos Sanctuary of the Ligurian Sea and the Strait of Gibraltar as a model and test area for the mitigation measures.		High	Immediate	None		4
To localize areas where not to sail.		Very low due to the circumstances of the Strait.	Immediate	None. The cost assumed by the companies.	Could create confusion in the area of the Strait.	5
To promote diurnal traffic for passenger ships.	A best cetacean's detectability.	Low	Immediate	High		5
To alert ships in real time of cetacean localization.	To provide information on the localization of the animals.	High in the Strait, especially during the whale watching period.	Immediate	Low	The distribution of sperm whales is very reduced in the area of the Strait which makes it easy to localize and inform the Tarifa tráfico station which can at its time inform ships.	5
Remote detection of animals.	To avoid collisions by localising directly the animal.	Dependent on the technological progress and subvention that the companies want to do.	Long term	Very high		6

Mitigation measures	Objective of the measure	Viability	Time to introduce	Cost	Notes	Priority
Dedicated observers on ship's deck.	1) To alert the crew on the presence of animals. 2) To alert the crew on possible collisions. 3) To document collisions	Very low	Immediate	High		7
Speed limitation in sensible areas.	To reduce the number of collisions. According to different studies the critical speed would be 13 knots.	Technically high. Economically medium...	Immediate	Low	These reductions would only be in the high density areas of cetaceans, allowing high speed in areas with no cetaceans.	8

Hereafter each one of the recommendations will be described according to its order of priority.

6.1 EDUCATION PROJECTS AND TRAINING FOR THE CREW

The objective of this measure is simply to try to alert and to make them aware that the problem exists in the Strait. A lot of the crew of the passenger ships are not aware that there is a problem and therefore they are not completely as aware as they could be. These trainings would also advise on how to try to avoid an animal once it is localized. Therefore it would inform the crew of the more sensitive areas of collisions.

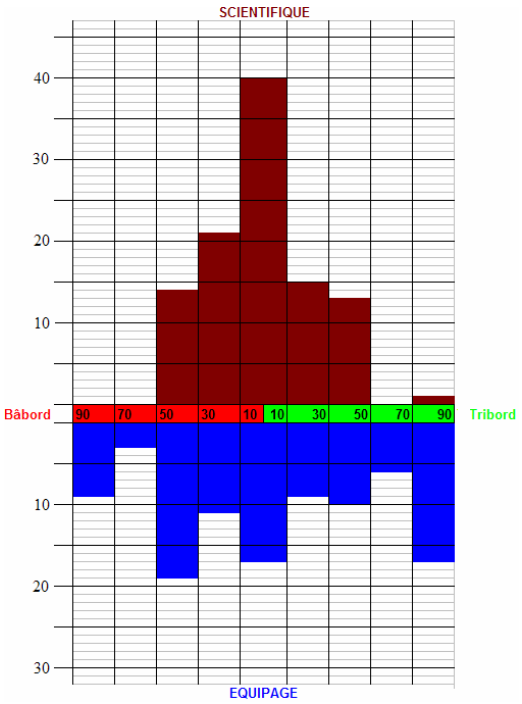
This program should be organized in collaboration with the different shipping companies present in the Strait so that the content would be in accordance with the training of the crew.

6.2 INDEPENDENT OBSERVERS ONBOARD FERRIES AND FAST FERRIES

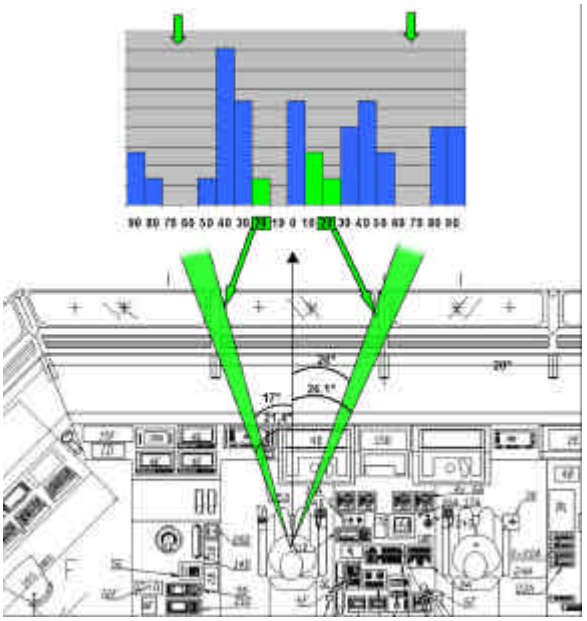
According to a study by Mayol 2005, the observations made by a crew onboard a ferry or a fast ferry are completely different to the ones made by an experimented observer that was onboard. The dedication that a crew has to give to the navigation, and even more in an area as the Strait, makes it difficult for it to focus on the search of animals, which makes it necessary the presence of observers onboard.

	Sc.	Off.
6 milles n.		
5	100	
4 milles n.		
3	95	100
2 milles n.		
1	75	97
0,5		
0 milles n.	23	61

Accumulated percentages of detection distances during the experiment between scientists (Sc.) and crew (Off.) .It would explain that the scientists see 95% of the animals within 3 nautical miles in front of the boat while the crew do it in only 1 mille (97% of these observations realized in this range).



Comparison of detection angles of cetaceans between observers (scientifique) and crew (equipage). It can be observed that the crew does not focus its research effort in front of the ferry.



Explication of detection variations. Due to dead zones between the ship's control tower window partitions.

6.3 EDUCATION PROGRAM OF MARINE OFFICIAL ORGANISMS (COAST GUARD, DOCKERS, TARIFA LIFEGUARD,…).

The idea of this measure is a general awareness of the problem.

6.4 PROVIDE MARITIME LINES MANAGERS WITH INFORMATION ON SEASONS OF THE YEAR, PLACE AND SPECIES SUSCEPTIBLE TO PROBLEMS.

This measure has for objective to provide reliable information to official organisms in charge of realizing nautical maps or to advise sailors on the existing problem. The idea would be to provide spatio-temporal information on the presence of cetaceans susceptible to enter in collision and to reflect it in nautical maps.

6.5 INFORMATION TO THE COMMERCIAL SHIPS TRANSITING THROUGH THE AREA.

The control and tracking station of Tarifa tráfico will inform all ships that transit through the area of the hotspot as is the case for sperm whales in spring- beginning of summer.

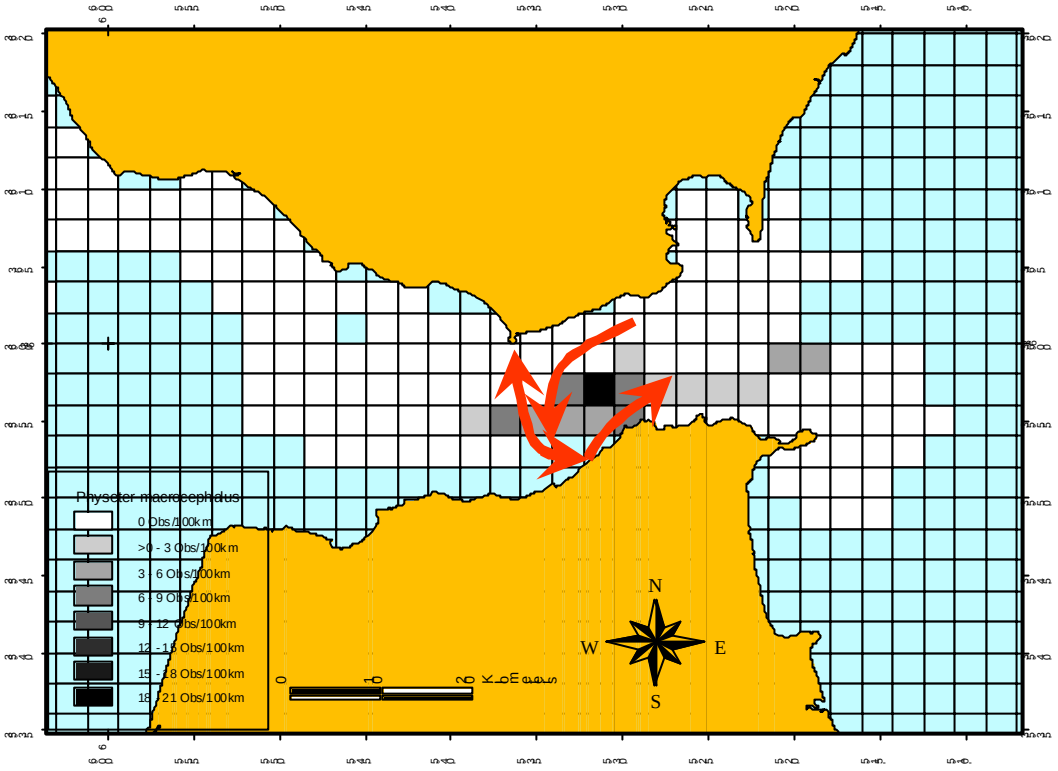
6.6 TO USE THE PELAGOS SANCTUARY OF THE LIGURIAN SEA AND THE STRAIT OF GIBRALTAR AS A MODEL AND TEST AREA FOR THE MITIGATION MEASURES.

These two areas are probably the two areas most known of the Mediterranean Sea. When long term data will be available on population tendencies, it will be easy to detect problems of collisions.

6.7 TO LOCALIZE AREAS WHERE NOT TO SAIL.

One of the propositions is to avoid as much as possible the area most used by sperm whales during spring-summer. This measure needs all the possible collaboration, from shipping companies and official organisms. Hereafter a series of alternative routes are proposed with the construction of the new Tangier harbour. The idea would be to go out of the harbour as close as possible to the Moroccan coast if going to Tarifa and Algeciras. In the same way the most used area would be avoided by commercial ships. This measure could come accompanied with a speed limitation of 13 knots in the entrance and exit of the new Tangier harbour until the most abundant area of sperm whales is passed.

If it is not possible to implement this proposition in the juridical order, it should be proposed to the shipping companies, through an environmental education project, for their knowledge.



Proposition of alternative routes to enter and exit the new Tangier harbour.

6.8 TO PROMOTE DIURNAL TRAFFIC FOR PASSENGER SHIPS.

This measure is practically unviable in the Strait.

6.9 TO ALERT SHIPS IN REAL TIME OF CETACEAN LOCALIZATION.

During spring and summer, and during the time of transiting fin whales, there could be a coordination centre based Tarifa tráfico station that would alert of the presence of these species in the area in its informative news every two hours. The information would come from the whale watching and research boats present in the area, and also from the shipping companies.

6.10 OTHER MEASURES NOT TAKEN INTO ACCOUNT IN THE WORKSHOP DUE TO THEIR HIGH COSTS

One of most efficient measure would be the development of technological tools that would allow the detection of the animals with enough distance in order to manoeuvre. In the 1980's this type of problems occurred when the activity of Jet Foils started in the Canaries. To mitigate this problem, *Kawasaki Heavy Ind.* developed the so called Whale Detector Apparatus. This apparatus is nothing more than an echo sounder that can detect animals or

objects horizontally and allows ships to detect them in order to evade them and avoid a collision. The shipping companies of the Canaries say that their fast ferries are already equipped with this detection apparatus but by looking at the collision data, it appears that the system in fast ferries is either inefficient or is not used adequately. On the lack of rudder, these ships have a very high manoeuvrability considering the speed at which they are going. In an interview with the Captain of the fast ferry *Alcántara* in the Strait of Gibraltar in 2001, it was shown that if an animal or an object was detected at 500 meters, the fast ferry could realize an evasion action in a satisfactory way. Therefore one of the measures proposed is to install these apparatus in all high speed ships transiting near the area of high collision risk. Thus a study of the system should be done to arrive at efficient results with fast ferries. In order to achieve this development, an international collaboration is needed as this measure is very expensive.

7. AKNOWLEDGEMENTS:

Thanks to the 123 volunteers who collaborated in a way or another to this project. Special thanks to Mason Weinrich, Ami Knowlton, Greg Donovan, Simone Panigada, Pascal Mayol and Pierre Beaubrun for what their bring to this document. Finally thanks a lot to Pedro Molina for his help with all the paper work that came with the project