

Considerations about regulations of boat-traffic off the southcoast of Pico/Azores



Presented by
Anke Kügler
Denise Castle
2005/2006

Table of contents

1	Preface	4
2	The Azores-archipelago	5
2.1	Location and Geological origin	5
2.2	History	5
2.3	Economy	5
2.4	Development from Whaling to Whalewatching	6
2.4.1	Biodiversity of Cetaceans species	6
2.4.2	History of Whaling	6
2.4.3	Development of Whalewatching	7
3	Cetaceans	7
3.1	Systematics	7
3.2	Evolution	8
3.3	Adaption to the aquatic environment	8
3.4	Discription of species	8
4	Problems of Whalewatching	10
4.1	Whalewatching-rules	10
4.2	Possible threats for Cetaceans caused by boat-traffic	10
4.2.1	Changes of behavior-patterns	11
4.2.2	Dangers for physical health	12
4.2.3	Other dangers	12
4.3	The importance of Whalewatching-tourism for the Azores	12
5	Material and Methods	13
5.1	Observationtime and –area	13
5.2	Kind of observation: Boatbased observations	13
5.3	Observationdata	13
5.3.1	Definition: Sighting	13
5.3.3	Nautical Map	15
5.4	Table and graphs/charts	15
6	Results	15
6.1	General results	15
6.2	Main species	17
6.2.1	Species	17
6.2.2	Behavior	17

6.2.3 Observation time	18
6.2.4 Observed areas	18
7 Analysis and discussion	19
7.1 General results	19
7.2 Main species	20
7.2.1 Species	20
7.2.2 Behavior	20
7.2.3 Observation time	21
7.2.4 Observed areas	21
7.3 Possible sources of error	22
8 Suggestions for a possible solution	22
8.1 Abatement of boat-traffic: Consideration about boat-routes	22
8.2 Problem of the vigias	23
8.3 Installation of a “Water guard”	24
9 Public relation	24
9.1 European Association of Aquatic Mammals	24
9.2 Competitions	26
9.3 Whale and Dolphin Magazin	27
9.4 Radio report	27
10 Conclusion	28
Glossary	30
Bibliography	32
Literature	33
Acknowledgements	35
Appendix	36

1 Preface

People have been fascinated by whales and dolphins for thousands of years. All times there were stories and narrations about lone dolphins, that lived close to men. There even had been some close friendships between dolphins and humans. Nevertheless people started killing whales and so they were nearly exterminated. After many species were threatened with extinction most of the nations noticed that they have to quit whaling. Today the International Whaling Commission (IWC) controls the abundance of the prohibition of whaling. Due to this the populations slowly recover.

Over the last decades commercial Whalewatching developed all over the world. Since the beginning of the 1990s it also emerged on the Azores, a group of islands in the Atlantic Ocean. Nowadays, seeing a whale or dolphin alive is the number-one wish of many tourists.[1] On the other hand Whalewatching makes it possible to study the Cetaceans more detailed. Due to larger and more specific data they can be protected in better ways.

The observation of whales is the subsistence of many Azorean people, as these kind of tours are very popular among tourists. But “[...] whale watching alone, if performed over longer periods in an unsustainable manner, can pose a serious threat to Cetaceans populations. This can lead to the assumption, that the use of whales for tourist purposes probably is just one more form of harmful exploitation of cetaceans [...]” [2] Off the southcoast of the Island of Pico it repeatedly had been observed, that given Whalewatching-regulations were not followed. Migration caused by interferences of the boats would have fatal consequences for the whales as well as the archipelago. Therefore it is important to find ways to protect the animals and fulfill the wish of thousands of tourists at the same time. Fixed routes, which the Whalewatching-vessels have to follow, could be one possible solution, as they would reduce stress on the whales.

This project introduces considerations about possible Whalewatching-routes to help protecting the popular marine mammals, based on data from Cetaceans-research of the summers of 2004 and 2005.

2 The Azores-archipelago

2.1 Location and Geological origin

Nine islands of volcanic origin form the Azores, being located in the middle of the Atlantic Ocean about 1400 km off the coast of Portugal and building up the highest elevation of the Mid-Atlantic Ridge. The archipelago lays between 39°56' to 36°43' northern latitude and 24°46' to 31°16' western longitude. It covers an area of approximately 2.333 square kilometers.

In the region of the Azores the North American, Eurasian and African tectonic plates hit on each other. The tectonical processes at the edges of these plates had caused the formation of the islands about 4 million years ago. Today there still might be eruptions of the active volcanos as well as earthquakes. (s. *Images 2 and 3, Photos 1 and 2*)

2.2 History

The probable first notification of the Azores in a nautical map is from the year 1351. However not until 1427 the islands Santa Maria and São Miguel were discovered, when Prince Henry the Navigator started the Portuguese “Age of Discoveries”. On the 15th of August 1439 the settlement of Santa Maria began.

Starting in 1926 many young Azoreans emigrated to USA. This leads to an increase of poverty of the archipelago, which at this time is dependant on Portugal. Since 1975 the Azores are autonomous and form the *Região Autónoma dos Açores*. Even though they still belong to the Portuguese national territory and therefore are a member of the European Union, the Azores have an own parliament and government today.

2.3 Economy

Economically, agriculture is the most important branch of industry of the Azores. Cattle breeding and dairy farming still have got their high status on every of the nine islands. [3] Despite the original importance of farming it is almost exclusively used for the maintenance of the locals and there is no export of the products except to the Portuguese mainland.

Nowadays, fishery still plays a minor role. Mainly tuna and smaller fish species of the Atlantic are caught. There is no fishery fleet on the Azores. Furthermore, fishing with different types of nets is forbidden and it is only permitted to angle in the waters of the islands. Fishery is still almost only used for the own needs of the inhabitants. In addition the development of the fishery is impacted by the terms of the European Union of 1992/93 because of its sanctions, regulations and monitorings. [4]

An increasing and more and more important branch of the economy for the autonomous region is the tourism, especially Whalewatching-tourism. However, due to the geographical conditions (scarps, no sandy beaches) there probably won't be any mass tourism.

The big diversity of Cetaceans species is the main reason for many tourists to come to the islands. Still in 1987 the last Spermwhale had been killed off the Island of Pico. Before whaling had been an important economical factor for the Azoreans for more than 200 years.

Since 1991 more and more Whalewatching-organisations develop, especially on the Islands of Pico, Faial and Sao Miguel.

2.4 Development from Whaling to Whalewatching

2.4.1 Biodiversity of Cetaceans species

Advantaged of their location and the steep underwater slopes, the Azores have a high diversity of marine animals such as squid and pelagic fish. These are food for different species of Cetaceans, which is the reason for the big diversity of Cetaceans in the area of the Azores. Therefore the waters around the islands are, at least temporarily, home to approximately 22 whale species, resident as well as transient ones. With high regularity wandering baleen whales like Blue whale (*Balaenoptera musculus*), Finback whale (*Balaenoptera physalus*) or Sei whale (*Balaenoptera borealis*) can be seen. Once a year they travel from the mating areas near the equator, where the females calve, too, to the nutrientrich feedinggrounds in the arctic waters. Thus they are only seen from April to June on the Azores, when they pass by the islands.

Other species are resident and therefore seen throughout the year in Azorean waters. One of these species is the Spermwhale (*Physeter macrocephalus*). But only females and calves can be seen in summer-time, because they raise their calves in this region while male animals arrive in september, coming from Norway.

Other resident species are several dolphin species like Risso's dolphin (*Grampus griseus*), Bottlenose dolphin (*Tursiops truncatus*), Atlantic spotted dolphin (*Stenella frontalis*) and Common dolphin (*Delphinus delphis*).

Infrequently seen are Beaked whales, especially Sowerby's beaked whale (*Mesoplodon bidens*) and Northern bottlenose whale (*Hypercoodon ampullatus*), as well as Pilot whales (*Globicephala macrorhynchus*) and Orcas (*Orcinus orca*).

2.4.2 History of Whaling

Whaling on the Azores started in 1765 when Northern American Whaling-boats came to the islands. Since this time the Azores were a refueling stop for whalers from all around the

world. Increasingly more Azoreans worked on the whalingvessels. In the meantime domestic Whaling industry developed, independent from the American vessels, which had its bloom in the 18th and 19th century. There was whaling in the whole archipelago, but played the most important role on the islands of Pico and Faial. Officially whaling ended in 1984 and was forbidden by the government in 1987, following the international end of whaling by the IWC in 1986.

Almost exclusively hunted had been *Physeter macrocephalu*. Used were the meat and the precious train oil from the blubber of the animal. Until the discovery of petroleum the oil was used in many different ways. The bones were squelched and used as fertilizer or together with the teeth used for carvings.

2.4.3 Development of Whalewatching

Due to the high biodiversity and regularity with which whales can be seen, the Azores are one of the best spots for Whalewatching as well as research. Commercial whalwatching had been startet in 1991 on Pico by Serge Viallelle, only four years after the last whale had been killed. Since this time the branch increases exponentially. [5] Today it is an important branch of the economy and therefore has replaced whaling.

3 Cetaceans

3.1 Systematics

Whales are mammals and belong to the Phylum Chordata and therefore to the Subphylum of the vertebrates. The Order of the Cetaceans consists of about 13 families, depending on the literature. It can be divided into two suborders, Mysticeti (baleen whales), which filter their food with the help of horny plates, and Odontoceti (toothed whales).

The Cetaceans contain of approximately 80 different species. The exact number differes between 76 [6] and 81 [7]. Especially due to modern research methods such as DNA-analysis single species could be identified, which had been related to another species before. Today it is thought that there are more then 80 species.

The majority of Cetaceans are Odotoceti with 70 species. To these belong Dolphins, River dolphins, Porpoises, Beaked whales and Spermwhales, as well as Beluga and Narwhale. Number and size of the theeth differ extremely. [8] The biggest toothed whale is *Physeter macrocephalus* with up to 18m in length, while the smallest is the Hector's dolphin (*Cephalorhynchus hectori*) with 1.2 to 1.67m.

The suborder Mysticeti consists of eleven species. They are divided into the family *Eschrichtiidae* with one species and the families *Balaenopteridae* and

Balaenidae/Neobalaenida. Compared to the big differences in size of the Odontoceti, the species are longer than 10m, except Pygmy Right whale and Dwarf Minke whale. Thus they are considered as “big whales”.

3.2 Evolution

Due to the findings of fossils and skeletons it is likely that the Cetaceans descend from terrestrial animals of the tertiary. Still there are many different theories of the evolution and the relations of the species. This is particularly caused by missing links between the species and families. However, findings of skulls make clear, that due to the evolution in order to adapt to the marine living, the nose had moved to the forehead. [9]

3.3 Adaption to the aquatic environment

Besides the order of Sirenia and contrary to other marine mammals like the Pinnipeds, Cetaceans are the only mammals that stay in the water their whole life. They cannot survive on land anymore. As a result of convergence to adapt to the living in water, whales have many fish-like characteristics. Still these build up on elementary mammal characteristics. [10]

Special adaption and specific behaviors exist in anatomy, breathing, diving, reproduction and behavior. They are fully adapted to the aquatic environment and therefore extremely vulnerable to disturbances and changes.

3.4 Description of species

Although there already are more than 20 different species being sighted in the waters of the Azores, five species are considered as main species due to regularity of location and time of sightings.

3.4.1 Spermwhale (Physeter macrocephalus)

With 18m in length and about 50t in weight of the males and 11 to 13m and 20t of the females, the Spermwhale is the biggest toothed whale. The side-face of *Physeter macrocephalus* is very characteristic and square-shaped. It has got 40 to 50 teeth in the lower jaw, while there are none in the upper jaw. Spermwhales have one single blowhole in the frontal left part of the head. Therefore the blow of *Physeter macrocephalus* is directed to the front and left and mostly looks bushy. The dorsal fin is three-cornered, small and not significant. The fluke is triangular and notched concavely. It is characteristic with every animal.

Spermwhales chase Cephalopods in the deep-sea. They dive up to 3000m deep and stay under water for up to three hours. The scars, which can be found all over the body, are likely to be

caused by fights with giant squid. These have been found in the stomachs of dead animals as well.

Spermwhales can be found in every ocean. Males especially occur in polar waters while juveniles and females with calves are mostly found in equatorial waters. One mating area and nursery is on the Azores, off the southcoast of Pico in particular. (s. *Photo 3*)

3.4.2 Risso's dolphin (*Grampus griseus*)

The size of Risso's dolphin is about 3 to 4m and its weight about 300 to 500kg. It does not have a beak like other dolphins. The melon is very distinct. The main color of adult animals is dark grey, but they have many white scars, which are caused by fights with squid or other conspecifics. The dorsal fin is big, sickle-shaped and characteristic for every individual. Like Spermwhales Risso's dolphin only have got teeth in the lower jaw. Food for *Grampus griseus* are squid (*Loligo vulgaris*) and other cephalopods as well as crustaceans. Risso's dolphins live in big pods and mainly occur in tropical and warm moderate waters. (s. *Photo 4*)

3.4.3 Atlantic spotted dolphin (*Stenella frontalis*)

Spotted dolphins reach about 2.4m in length and weigh 100 to 140kg. They have a distinct beak and the melon is easy to see. Adults have got the eponymous spots in different intensity while juveniles and calves lack these. Therefore the latter are easily mistaken for other species. The main color of *Stenella frontalis* is dark grey and the lower side is lighter.

They live in pods of about 50 individuals, but there also are records of more than 200 animals at a time. The principal food are schooling fish and squid. Spotted dolphins only live in the tropical and warm moderate parts of the Atlantic ocean. (s. *Photo 5*)

3.4.4 Common dolphin (*Delphinus delphis*)

Delphinus delphis can easily be identified because of the yellowish-ocker-colored hourglass mark on its bodyside and the significant and characteristic face figures. The animals have got a long beak and a well-defined melon. The flippers are long and pointy, the dorsal fin is big and sickel-shaped. *Delphinus delphis* gets about 2m long and 100 to 140kg heavy.

Common dolphins feed on schooling fish like herrings (*Clupea harengus*) and pilchards (*Sardina pilchardus*) and cephalopods like squid. They often hunt in groups. Pods can consist of more than 1000 animals. (s. *Photo 6*)

3.4.5 Bottlenose dolphin (*Tursiops truncatus*)

The 2 to 4m long animal is the most popular cetacea and is commonly considered as "dolphin". The animals are dark grey and lighter on the lower side. Beak and melon differ

between the single animals, but are always very distinct. The flippers are bended and pointy and approximately one sixth of the length of the animal. The dorsal fin is sickel-shaped and measures one tenth of the body length long. The fluke is bended and notched clearly.

Bottlenose dolphins feed among other things on eel (*Anguilliformes*), salmon (*Salmo salar*), cephalopods and tuna(*Thunnus*). They occur worldwide, mostly near the coast. Often a pod rounds up their prey on sandbanks in shallow waters. (s. *Photo 7*)

4 Problems of Whalewatching

4.1 Whalewatching-rules

All boats must obey official rules during the trips in order to avoid stress for the animals. The most important rules are:

- There shouldn't be more than 3 boats at a time inbetween 150m around an animal or a group.
- The minimum distance of 50m towards whales and 100m towards calves must be kept, except for having a special scientific admission.
- It is forbidden to pass through a pod, to hunt or to encircle animals and to separate calves from their mothers.
- If the animals show explicit signs of disturbance, all boats have to leave immediately at a slow pace.
- There must not be more than 2 swimmers in the water at once. Boats must check wether there already are other swimmers in the water and must not let their own customers go into the water if this is the case, even if they offer the option "Swimming with dolphins" as well.
- Swimming with whales is forbidden except for having a special scientific admission.
- Skippers have to pay attention, that the general rules of swimming with dolphins are abided.
- There are special rules for spermwhale observations: the maximum speed of the vessel is predetermined and the boat must come in a 45°-angel from behind.

4.2 Possible threats for Cetaceans caused by boat-traffic

The impacts of Whalewatching have always been topic on conferences, because yet it's not clear what possible negative effects it has on Cetaceans. Especially resident pods and whales need special consideration because they are more often confronted with Whalewatching-boats than transient animals.

According to a longterm-study by Fabian Ritter from M.E.E.R. e.V Whalewatching could have different short- and longterm effects on Cetaceans. Short-term effects might be instant changes of behavior, separations of mothers and calves or collisions. An increasing breathing frequency and therefore less absorption of oxygen or unprepared diving of *Physeter macrocephalus* is possible as well. This in turn could cause threats to the health of the animals.

If the disturbance and therefore the stress for the animals become frequently, long-term effects are possible. Impacts might be big changes in the behavior pattern, diseases, lower reproduction rates and migration from the affected areas.

Thus, too much boat-traffic could harm both, the animals and the Whalewatching-economy, for the latter is based on the whales that might migrate due to the frequently disturbance.

Furthermore it's been observed, that many Whalewatching-rules were reneged and therefore caused a additional threat besides the possible general impacts of Whalewatching.

4.2.1 Changes of behavior-patterns

In the time between May and August boats go out to watch whales and dolphins almost on a daily basis, starting from Lajes do Pico. They more often go to resident pods, because due to the experience of the skippers they can be found in certain areas. On Pico this concerns a Risso's dolphin pod in the Bay of Ribeiras, which was identified as a resident pod with the help of photoidentification.

As the bay is a resting place, repeating disturbance of too many boats could cause changes of the behavior of the animals. They have no time to rest, to hunt and for social interactions, therefore they might become ill or even die.

If the animals are forced to dive too early without being prepared because of the vessels or if the breathing frequency increases exhaustion during the long dives or malpractices could be caused. Hence this might lead to an aggravation of the health status and long-term to the death of the animal.

Especially whales use some specific, sheltered bays for calving and nursery. These regions are good for Whalewatching, as the whales appear regularly. However, if the boats disturb the mammals in those areas the whales have no chance for resting and swim away. The calves might get exhausted and possibly die. If it continues it is likely that the whales migrate away from the regions and will not come back to the nurseries. This has an impact on reproduction which is especial critical with endangered species because of a decline of population-rates.

Off the southcoast of Pico this concerns the Spermwhales as females use the protected regions as a nursery and calves can be seen very often in summer.

When boat-routes are arranged, the animals get used to time, place and regularity in which boats arrive with the time and can decide themselves if they stay in the area at this time. So they won't be disturbed, because the animals are free to decide if they want have contact or withdraw from the particular region.

4.2.2 Dangers for physical health

High boat-traffic poses a great danger to the whales and dolphins. There often are bad accidents, when Skippers don't keep the minimum distance or encircle groups and the animals are harmed by the dangerous ship's propeller. Effects reach from slight injuries to the death of single animals. For instance, on the Azores a whale was identified with the help of PhotoID and had been seen repeatedly which has lost half of its fluke likely through a ship's propeller. (s. Photos 16 and 17)

Injuries of this kind could mean disadvantages with swimming, hunting or other activities or even death. There is no record how many injuries are caused by boats per year, yet.

4.2.3 Other dangers

Even though there are rules, many tourists ignore them and therefore endanger the whales. Rubbish thrown in the water can hurt the animals and wrong behavior while "Swimming with Dolpins" could endanger both swimmer and dolphin.

Reasons for this malpractice mostly are that there is too little information provided by the organisations and most importantly there is no instance controlling the abidance of the general rules.

Boats often had been watched driving too close or too fast next to the whales or that there were too many swimmers in the water. That is why it is absolutely necessary to give the conditions for installing control instances in the following years.

4.3 The importance of Whalewatching-tourism for the Azores

Nowadays, Whalewatching is next to farming one of the most important economic factors of the Azores. Since the islands are quite inhospitable, production is only subsistencial and only little can be exported (e.g. tea, cheese). The huge diversity of Cetaceans species has become the main reason for thousands of tourists to visit the islands today. Furthermore Whalewatching gives scientiests the chance to collect a lot of data in an easy way. Thus it plays an important role in the research of the Cetaceans. Thus it is important that the whales and dolpins stay in the waters around the Azores so that the basic for whalewathing-tourism

and therefore the important economic factor and livelihood of the Azorean people remains guaranteed.

5 Material and Methods

5.1 Observationtime and –area

The observationtime was the period between the end of June and mid-September 2004. The used data was from 08th July 2004 to 19th September 2004.

The region of the observations was off the southcoast of Pico covering the area from 38°16' to 38°26' northern latitude and 27°52' to 28°38' western longitude. This reagon is 700 to 1800 m deep.

5.2 Kind of observation: Boatbased observations

The data was exclusively collected during boatbasedd observations. All trips started from Lajes do Pico (38°24' latitude, 28°15'longitude).

For the observation-trips the vessels of the Whalewatching-organization AquaAcores from Lajes were used. This organization allocates 3 vessels of different size, which are also used for tourism. The biggest one, “Abismo”, is 11m long and for 10 persons maximum. “Baleeiro” is 8m in length and intended for 8 persons while the smallest one is 6.4 m and for 6 persons. The vessels reach 13, 25 and 23 mph at most and 11 and the two smaler vessels 16-17 mph at an average. (*s. Photos 18-20*)

Depending on weather there where trips twice a day at 10:00 a.m. and 2:00 p.m. One trip lasted 3 to 4 hours.

5.3 Observationdata

5.3.1 Definition: Sighting

A observation was called a sighting, when there had been at least one individual of the order of Cetacea of which the species could be defined without doubts and which could be observed at least 1 minute.

5.3.2 Obsevation-logs

The data collected during the whalewatch-trips was noted in observation-logs for analyzation afterwards. (*s. Appendix*) Furthermore data of portuguese observers was used.

Sighting's coordinates

The exact sightings locations were determined with the help of the Global Positioning System (GPS). If there wasn't a GPS aboard during a trip, the local skippers estimated the approximate position and the distance from shore. The coordinates were then determined afterwards.

Species

The species of sighted whales could be determined because of explicit characteristics like blow, color, painting, tail fluke, dorsal fin, shape of the head and size. (*s. Photos 8 and 9*)

Group-size

The group size of dolphin-pods was estimated by counting the animals seen at one time and setting the amount as one third of the pod. Then twice the visual-determined number was added.

Getting the number of whales was easier for you can get the exact number by counting the seen blows.

Group-structure

It was tried to determine the group structure of the seen pod or animals. Possibilities were "adult", when only adult animals were seen; "juvenile", when there had been at least one juvenile; "calves" with at least one calf in the group and "all" when at least one individual of adults, juvenile and calves were seen.

Behavior

As far as it was possible, the behavior of the observed animals was noted. The following behavior patterns were possible: (*also s. Photos 10-15*)

(1) Resting	The animal/the group stays calm at one place without any noticeable activity.
(2) Feeding	Especially dolphin pods; the group swims fast and formed up, contingently bait ball observable, typical hunting patterns can be seen.
(3) Travelling	The animals move fast in one direction without any other noticeable activities or interest in boats.
(4) Interested	The animals show interest in Whalewatching-vessels. Signs can be spyhopping or that swimmers can go into the water.

(5) Avoiding	The individuals depart from the boats at a great pace, dive immediately when a boat arrives and might show signs like lobtailing or other activities to show, that they feel disturbed by the boats.
(6) Social active	This behavior pattern includes activities like mating, breaching, wave-surfing or other high-activity patterns.
(7) No pattern	No behavior patterns are noticeable
(8) Rest and dive	The animals stay calm at first and dive finally
(9) Dive	Especially whales, e.g. Spermwhale, descents after a short time for possible hunting of because they might be disturbed by the boat. The tail fluke can be seen.

Further Data

Furthermore date, time, observation-duration, weather, wave-level, windspeed, winddirection and the name of the observing vessel was noted in the log.

5.3.3 Nautical Map

Sightings

The location of the sightings were marked in a nautical map of the region, using the determined coordinates. One dot accords to one sighting and different colors were used for different species (*s. Image 5*)

Classification

For better overview the observation-region had been classified in the following 10 subareas. (*s. Image 4*)

5.4 Table and graphs/charts

The collected data was copied in a table for better analyzis, using a special code for the single information. Later the data was presented in different graphs and charts.

6 Results

6.1 General results

In the year 2004 355 sightings had been recorded. 145 were from the vessel Abismo, 123 from Baleeiro and 93 from Amadeus. 209 sightings were in the morning and 146 in the afternoon. The number of sightings of main species is 315 (89%). The main species were seen 181 times in the morning and 134 times in the afternoon.

During the observation time 12 different Cetaceans species had been seen. Some species were seen daily, others rarely.

The most observed species was *Physeter macrocephalus*. Furthermore, two Mysticeti-species had been sighted: the Seiwhale (*Balaenoptera borealis*) four times and the Finback whale (*Balaenoptera physalus*) one time. These sightings were at the beginning of July. Two times there had been calves as well. In 2004 of the beaked whales only Northern bottlenosewhale (*Hypercoodon ampullatus*) five times, Sowerby's beaked whale (*Mesoplodon bidens*) 13 times and Cuvier's beaked whale (*Ziphius cavirostris*) one time had been sighted. Only adult animals had been seen in the middle of July and the beginning of August. Besides five species of dolphins (*Delphinidae*) had been sighted, including the main species.

27% of the sightings had been in the subarea 2, 17% each in 3 and 7, 15% in 8 and 12% in 4. In the subareas 1 and 5 was one sighting each and there was none in the subarea 10.

Of the possible behavior patterns "resting" had been registered 34 times, "feeding" ten times, "travelling" 156 times, "interested" 40 times, "avoiding" five times, "social active" 21 times and "rest and dive" 39 times and "dive" three times. 47 times the behavior could not be determined.

"Travelling" was the most sighted behavior with the dolphins, the baleen whales and the Spermwhales. It is the most frequently seen behavior with 44%.

In the year 2005 there were 229 sightings of which 112 had been by Abismo, 75 by Baleeiro and 30 by Amadeus. 125 sightings were in the morning and 104 in the afternoon. Main species were sighted 219 times (96%). They had been seen 120 times in the morning and 99 times in the afternoon. Altogether 9 different species were seen that summer.

This year the mostly seen species had been *Physeter macrocephalus* as well. There were no registered sightings of baleen whales. Pilot whales had been seen twice, Sowerby's beaked whales six times and Striped dolphin and Northern Bottlenosewhale once each. The Sowerby's beaked whales were seen at the end of June/beginning of July and in the middle of August and the Northern Bottlenose whale and the Pilot whales were seen in the middle of August.

28% of the sightings had been in the subarea 2, 17% in 3, 18% in 4, 15% in subarea 7, 19% in 8 and 3% in 9.

The behavior "resting" had been noticed six times, "feeding" 14 times, "travelling" 64 times, "interested" 19 times, "avoiding" 17 times, "social active" 30 times, "rest and dive" 53 times and "dive" 7 times. 19 times the behavior could not be determined.

In the year 2005 “travelling” was the most behavior as well with 28% and the second most common behavior was “rest and dive” with 23%. (s. *Charts 1-4*)

6.2 Main species

6.2.1 Species

In 2004 Spermwhales had been seen 150 times of which 48 times calves were seen. Risso’s Dolphins were seen 65 times. Half of the sightings were of adults. Spotted dolphins had been seen 52 times and common dolphins 30 times. In that year the least seen Cetaceans were Bottlenose dolphins with 24 sightings. Within the dolphin species all age classes were sighted and except *Grampus griseus* the pods most of the time consisted of more than 20 animals, sometimes even more than 50.

In the year 2005 there were less sightings. The mostly seen whale had been *Physeter macrocephalus* as well (83 times). Only 11 times calves were seen, but 23 times juveniles. Risso’s dolphins were seen 61 times with no calves. Spotted dolphins were seen 31 times, Common dolphins 17 times and Bottlenose dolphins 27 times. The Spermwhales were single animals with bigger groups at the end of August. The pods of the dolphins consisted of more than 50 animals most of the time. (s. *Charts 1 and 2*)

6.2.2 Behavior

“Travelling” was the most sighted behavior in 2004. Spermwhales travelled 52 times. 39 times *Physeter macrocephalus* rested and then dived. Thus the behaviors which are useful for Whalewatching were 85%. Still these are the behaviors in which the whales are most vulnerable to disturbances.

Risso’s dolphins travelled 37 times, Spotted dolphins 17 times, Common dolphins 11 times and Bottlenose dolphins 14 times. 7 times the dolphins were feeding and 30 times they were interested in the boats. Especially the juveniles of *Stenella frontalis* were interested. Only one time Risso’s dolphins avoided the vessels.

Besides the dolphin species were very social active (14 times). (s. *Chart 5*)

In 2005 the main species were travelling 56 times and is the mostly seen behavior. But Spermwhales only travelled 9 times, Spotted dolphins 7 times, Bottlenose dolphins (10 times) and common dolphins only twice. Most of the time Risso’s dolphins (28 times) were travelling. “Rest and dive” (53 times) was the most frequently seen behavior pattern of *Physeter macrocephalus*. Three times they were interested and five times they avoided the boats.

Stenella frontalis was the most interested species (12 times) followed by *Grampus griseus* (eight times). The other species were interested five times each. Besides Risso's dolphin were avoiding the boats eight times, while the other dolphins were not avoiding the boats at all.

14 times the dolphin species were seen feeding. The Risso's dolphins were social active eight times, the Spotted dolphins seven times and each of the other species five times. (s. Chart 6)

6.2.3 Observation time

In both 2004 and 2005 the main species had been seen throughout the whole observation time period. There were only few single days when they had not been seen. Especially the Spermwhale calves stayed in the area over the summer. (s. Charts 2 and 3)

In 2004 56% of the sightings of Spermwhales, 58% of the Risso's dolphins, 58% of the Spotted dolphins, 63% of Common and 46% of Bottlenose dolphins were in the morning, 44% (Spermwhale), 42% (Risso's dolphin, Spotted dolphin), 37% (Common dolphin) and 54% (Bottlenose dolphin) of the sightings were in the afternoon. (s. Chart 7)

In 2005 49% of the sightings each of Spermwhales and Risso's dolphins, 59% of Common dolphins, but 63% of Bottlenose dolphins and 66% of Spotted dolphins were in the morning. 51% of the sightings (Spermwhale, Risso's dolphin), 41% (Common dolphin), 37% (Bottlenose dolphin) and 34% (Spotted dolphin) were seen in the afternoon. (s. Chart 8)

6.2.4 Observed areas

In the year 2004 most of the sightings were in the subarea 2. Spermwhales were sighted 32 times, Risso's dolphins 29 times. *Physeter macrocephalus* was second mostly sighted in the subareas 9 (29 times) and 8 (24 times). Risso's dolphins had been seen 22 times in the area 3. This is the region of the bay of Ribeiras. Other sightings of these species were in 6, 7 and 8, but were more seldom.

The other dolphin species were mostly seen in 3, 4, 7 and 8. The most sightings of *Stenella frontalis* were in the subarea 8 (13 times) while the most sightings of *Delphinus delphis* and *Tursiops truncatus* were in 2 and 3. There were no sightings in the subareas 1 and 10 and only some few and not of all species in 5 and 6.

In 2005 the most sightings of Spermwhales (30 times), Risso's dolphins (20 times) and Bottlenose dolphins (8 times) were in the subarea 2. Common dolphins (two times) and Spotted dolphins (3 times) were seldom seen there. 10 to 15 sightings each of Spermwhales and Risso's dolphins were registered in the areas 3, 4 and 8. The most Spotted dolphins were seen in 4, 7 and 8. Only Common dolphins (once), Spotted dolphins (once) and Spermwhales

(four times) were seen in area 9. Where there were more Bottlenose dolphins there were less Spotted dolphins and Common dolphins and vice versa. There were no registered sightings in the subareas 1, 5, 6 and 10 in 2005. (s. *Charts 9 and 10, Image 5*)

7 Analysis and discussion

7.1 General results

Still little is known about the occurrence of Cetaceans of the Azores. An only exception is the Spermwhale, as there is some data from the whaling time. [11]

Due to the geographical location in the middle of the Atlantic Ocean, geographical features such as steep underwater slopes and being rich of nutrients caused by upswelling currents, there is a high diversity of Cetaceans species on the Azores. Species of Mysticeti pass the islands when they travel from the polar feeding grounds to the equatorial mating- and breeding-areas. This is the reason why baleen whales were only seen up to the beginning of July. As they are single-living animals and only form big groups in the mating-grounds, the size of the sighted groups were always below 10. There is almost nothing known about Beaked whales, yet, because they are very shy. Due to rare sightings there is only little data to draw conclusions. There are no explanations to appearance, group structure and behavior of the animals. On the other hand, the main species belong to the mostly seen species worldwide.

There are no known reasons for the many sightings in the subareas 2, 3, 4, 7 and 8. Accounts might be sources of food and chasing behavior. Due to the steep underwater slopes much fish appear very near the coast which might explain the high diversity of Cetaceans in these areas. Furthermore currents and tides might be causal for this spread. The few sightings in the subareas 1, 5, 6 and 10 are possibly caused by their big distance from the harbor and therefore long running times. However, the frequency of sightings in the areas 2, 3, 4, 7 and 8 show that these suit fixed boat-routes.

Due to too little research in behavior patterns of the Cetaceans off the southcoast of Pico so far, there are no explanations to these. “Travelling” could be the most registered pattern because of movements of food, tide and calling resting places. Furthermore the resident species might have some kind of daily routine which makes them travel between the islands of Faial and Pico. At least with *Tursiops truncatus* there is this assumption.

Only a few times the animals avoided the boats, which shows that they were not disturbed by the boats until now. In opposite many times different species were interested, which is a good assumption for Whalewatching. On the other hand, 73 times in 2004 and 59 times in 2005 a

behavior had been registered which includes resting. There shouldn't be too much disturbance of the boats because the animals need the time to rest or prepare long dives. They might be forced to dive unprepared or collide with a vessel because of the low activity and awareness while resting. It is absolutely necessary that the boats abide to the official rules.

7.2 Main species

7.2.1 Species

The Spermwhale is the mostly seen whale on the Azores. That is why it had been chased in former times and now is one basis for Whalewatching. Only females, calves and juveniles are in Azorean waters the whole year, because of the warm moderate waters and the steep underwater slopes. Already near the coast it is more than 1000m deep. As *Physeter macrocephalus* chases cephalopods in the deep sea it is a good condition for their occurrence. Off the southcoast of Pico is an important Spermwhale-nursery. Hence many calves and juveniles can be observed. Due to the high diversity there is a big chance of seeing Spermwhales. On the other hand it is important that they are not disturbed as they are very vulnerable to stress.

The species *Grampus griseus* hunts deep-sea fish and cephalopods as well. There is little known about the social and grouping behavior of Risso's dolphins, but it is considered that they swim in little subgroups of 2 to 5 animals. The Risso's of Pico are very resident. Thus they often are sought by the skippers, when there are no other whales to see. As they are relatively shy as well, they are mostly threatened by too much Whalewatching, too.

Stenella frontalis, *Delphinis delphis* and *Tursiops truncatus* are some of the most frequent species all over the world. The species of the Azores are offshore types, which only occur near the coast due to the location of the islands. In the time between June and July they have offsprings and therefore calves are often seen. As they live in big pods, are coltish and curious, they are good for Whalewatching. Boats might disturb them while chasing, being social active or resting. Furthermore pods and mother and calves might be divided because of the vessels.

7.2.2 Behavior

"Travelling" was possibly the most seen behavior because of movements of food or Spermwhales changing diving sites. The animals are active and not so much vulnerable to disturbances. As Spermwhales and Risso's dolphins swim slowly, they are easy to observe. That is why this behavior is proper for Whalewatching. On the other hand, the animals must not be disturbed during resting, which was the second most seen behavior.

The *delphinidae* had been very interested. Especially the smaller dolphins are very curious and coltish and have a distinctive social behavior. They often come near to the boats, jump or swim in the blister. Therefore they are very good for Whalewatching. That the relatively shy Risso's dolphins were interested in the boats, too, is a good sign. According to local skippers they have become more and more trusting in the last years.

Still, too much boat-traffic might disturb mating and thus would have negative effects on the populations. As the animals were often seen feeding, it is important that they are not interrupted. The boats possibly interfere or drive away the prey fish.

7.2.3 Observation time

The main species are resident, that means they stay in the Azorean waters the whole year. That is because they could be seen during the whole observation time period. In September the male Spermwhales arrive from Norway and there are big social meetings.

The number of sightings of the main species in the morning and in the afternoon is nearly the same. Thus the chance for sightings during tours till 2:00pm and tours after 2:00pm is similar.

7.2.4 Observed areas

Spermwhales had been seen along the whole southcoast and more distant from the coast. Especially between Lajes and Calheta were many sightings and many calves occurred in this area. This might be due to currents and feeding grounds. The Spermwhale calves wait on the surface while their mothers go on long and deep dives. If they were unprotected and exposed to hard currents, they would have been extremely threatened. The many appearances point out that it is unlikely to be the case in these areas.

Grampus griseus was mostly seen in the bay of Ribeiras and to the west of Lajes. One pod in the bay of Ribeiras is resident and therefore can always be found there. It is likely that this region is used for resting as well. Thus long-lasting stress and possible migration from the bay would have fatal impacts on the animals. According to latest data the Risso's dolphins near Lajes do Pico were often seen feeding. Local fishermen state that the region is very suitable to fish squid. Hence possible hunting grounds of *Grampus griseus* might be located there.

There are only little information about the reasons of the occurrences of the other dolphin species. Coherences with currents, tides and therefore appearances of food might be possible. Besides there are supposed to be two pods of *Tursiops truncatus* which often meet off the southeast of Pico. This thesis is supported by PhotoID.

The dolphins had also been seen in the same areas as Spermwhales and Risso's dolphins. Thus these are suitable for fixed boat-routes.

7.3 Possible sources of error

It must be pointed out that there may be some sources of error concerning the collected data. Due to the fact that the boats only went to areas, where the Vigias had seen whales or dolphins, it is allegeable, why there are not sightings far away from the coast. But this also shows that these areas are qualified for boat-routes, because they had always been approached. Furthermore it should not be ignored, that it was not possible to collect data every day. Some expeditions could not take place because of bad weather conditions. This happened mostly in September. So it is not possible to say how long one can sight the main species in this month. So it is necessary to collect more data, to find proven regularities regarding sighting-area and -time of the species.

Besides it should be regarded, that most of the time of the summer 2005 at least one Whalewatching-vessel of AquaAcores was disabled, and therefore there were less sightings.

8 Suggestions for a possible solution

8.1 Abatement of boat-traffic: Consideration about boat-routes

Too much traffic of Whalewatching-vessels could be regulated with the help of boat-routes. Every boat follows a fixed route. On the basis of the sightings-data, especially the locations of sightings, three different routes are possible off the southcoast of Pico. They go through these areas and therefore the chance for observations is very high. Moreover the routes consider, that until now the tours were often towards the bay of Ribeiras or S. Mateus and the boats stayed in this region. Therefore the routes achieve the duration of a Whalewatching-tour of three to four hours. (*see Image 1*)

Route 1

Route 1 runs from Lajes do Pico further out to the sea, about 3 - 4 miles away off the coast till S. Mateus ($38^{\circ}24'5''/28^{\circ}27'5''$). After that it runs along the coast back to Lajes. One has the chance to see Risso's Dolphins and also fully grown Spermwhales.

Occasionally one can see Common Dolphins and Spotted Dolphins, even Manta Reys (*Manta birostris*) were already seen in this area

Route 2

Route 2 runs from Lajes do Pico a few miles out to sea. After that it runs parallel with the coast towards S. Mateus and afterwards from Sao Jao ($38^{\circ}24'5''/28^{\circ}20'4''$) back towards Calheta ($38^{\circ}24'/28^{\circ}5'7''$). On the level of Ribeiras ($38^{\circ}24'5''/28^{\circ}20'4''$) there is the turning point of the route. Then it runs along the coast through the Bay of Ribeiras back to the

harbour. It is a good chance to see Sperm Whales and Risso's Dolphins. Furthermore one can often watch Spotted Dolphins there, too.

Route 3

Route 3 runs along the coast towards Calheta. It is very likely on this part of the route to see Risso's Dolphins, Common Dolphins and Spotted Dolphins. On the way back, which runs a few miles away from the coast, one can spot Sperm Whales and you have a big chance to watch calves, too. They often stay in this area, and especially the seldom Sowerby's Beaked Whale.

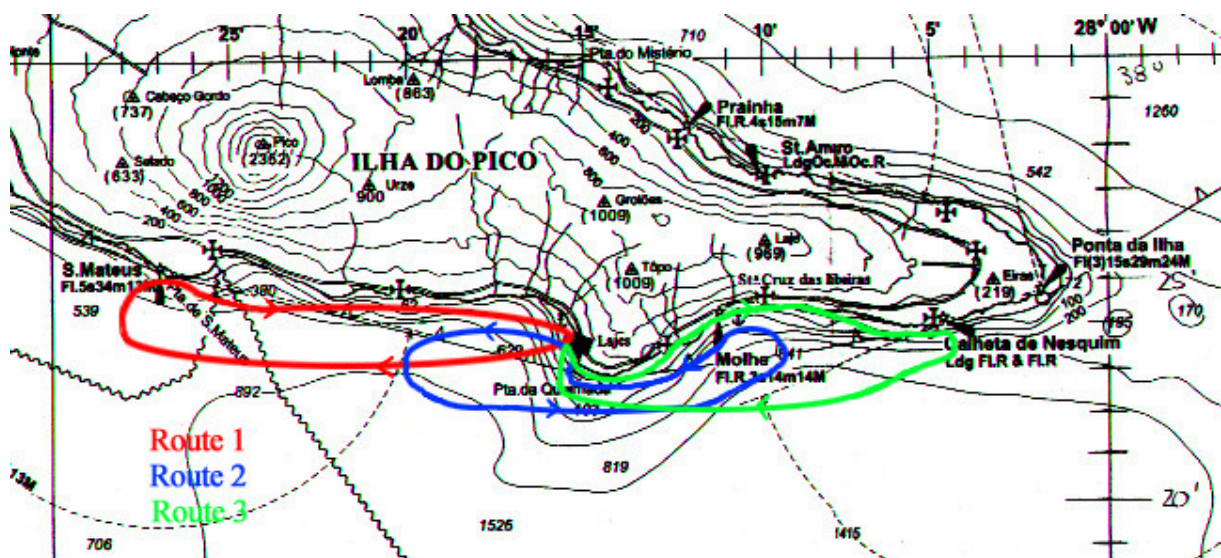


Image 1: Possible routes

Consideration of the time

It would be possible that per route two boats run twice a day with a half hour intervall, that makes 12 possible tours a day. Because of rotation between the organisations, for example one day one organisation runs one of the routes and the next day another organisation runs this and so on. There will always be the same chance for observation for every of the organisations of Lajes do Pico.s

8.2 Problem of the vigias

The profession of the vigias is a very traditional activity. It has been used in whaling-time but still did not lose its function. Nowadays the vigias on the look-outs tell the skippers via radio when a whale or a dolphin pod is sighted. They give the skippers the exact position of the observation and so the boats can go there immediately. Still the proffession must not be eliminated with the use of boat-routes, as it is a big Tradition and the only source of income for many Azoreans on Pico.

Although it seems contradictorily, vigias still are of a very big use when establishing boat-routes. Today every organisation has its “personal” vigia who does not tell the skippers from other organisations. When there are defined routes, the vigias along the coast could be free to tell every skipper who is going by this route the vigia is watching, when he has seen something. It is more efficient and still gives a high chance of seeing whales, higher than if the boats go along the routes without anybody telling them about sightings. Still, even though the vigias tell the approximate coordinates of the observation, the boats must follow the defined routes, but e.g. could go faster at the beginning when a whale or dolphin pod has been sighted at a farther distance. Therefore there might be a longer observation time.

8.3 Installation of a “Water guard”

Some kind of “Water guard” should frequently control the abundance of the boat-routes as well as the other whalewathing-rules. Contempt of those should involve that the respective boats are reported and a warning should be issued. If it happens repeatedly there should be fines and even loss of the licence could be possible.

9 Public relation

It is difficult to have a hand in realizing the suggestions of the introduced solution of the problem, as possible boat-routes will only be established by the government of the Azores and the responsible Ministry. However, we tried to introduce the problem and the considerations to the public. Thus, people with more influence or contacts might get aware of the project.

9.1 European Association of Aquatic Mammals

In March 2005, we had the possibility to take part at the EAAM and present our suggestions for boat-routes off the southcoast of Pico.

This international conference took place from the 12th to 14th of March at the Dolfinarium in Harderwijk, Netherlands. That’s exactly where the EAAM was founded 33 years ago.

We were very happy to be able to be there, because that meant a possibility to present our ideas and get to know marine scientists.

In the beginning it was planned, that our tutor went with us, but during our journey there we got to know that she couldn’t come. Of course that made us even more excited and nervous but in the end we got along well with our English. We had to translate the whole thesis into English because there were scientists zoo-directors, vets and so on from all over Europe, USA and Israel at this conference.

In the morning of March 12th, we listened to some “science sessions” during which scientists presented their latest research results. Topics were e.g. “Is there intelligence without hands”, “Neonate mortality in bottlenose dolphins: experiences and results of Duisburg Zoo“ or “Study of ‘social’ facilitation on bottlenose Dolphin (*Tursiops truncatus*)”. Those reports were very interesting and informative and, although we had a few problems with some English terms, we understood most of it.

Later during the afternoon, we hang up our posters, because the Poster session was supposed to start at 6 p.m. The Poster session took place on a boat that was going to cross the IJsselmeer during the presentation-time. Every participant got a poster wall and could arrange it freely.

When the session began at 6 p.m., the participants arrived and the boat started. At the beginning we were quite nervous, but we didn’t have much time for that, because very soon there were a lot of people who were interested in our project. After we explained our routes-suggestion to a man from Belgium, he told another woman, that we have interesting tales to listen at. Therefore we never got bored, because all the time interested people were with us. Furthermore many became attentive due to our model of the Island of Pico, which we had created, and everybody asked about the thesis and our project. In the course of time we chatted with a man from Tenerife, who’d already experienced the problems of Whalewatching-tourism and the migrating of several species himself, a scientist from the USA and many more.

When we were about to clean up, two other members came to see us, who, of course, we presented everything. We could give our thesis to one of them and he offered help, to make the considerations more popular because he has useful contacts. The other asked, if the next day we would come again and when we told him, that unfortunately it would be too expensive for us, he gave the permission, that we could participate for free. It turned out, that he was one of the organizers and we were very happy and thankful and therefore we could listen to furthermore presentations on Sunday. However, at noon we regrettably had to say good-bye for we still had a long way home.

Alltogether we are very pleased with the weekend, thankful for the possibility to go there and maybe the realisation of the routes is one step nearer. (*also s. Appendix*)



9.2 Competitions

The project participated in the German contest “Jugend forscht” in 2004 in the field of Biology. It won a 2nd prize and a special prize “Environment” in the regional contest of Southeastern Thuringia of “Jugend forscht”. Especially during the public visitation on the second day people showed a great interest in the topic and our suggestions to eliminate the problem.

Furthermore the project took part in the 2004 contest “BundesUmweltWettbewerb”, which is an nationwide German environmental contest dealing with environmental problems and considerations about possible solutions. There it won the first prize for sustainability.



“Jugend forscht”

9.3 Whale and Dolphin Magazin

We contacted the “Whale and Dolphin Magazine” from England and asked if there is any interest in the problem and our solution and if it is possible to release it in one of the upcoming issues. The magazine is very common among marine biologists, researchers and environmentalists. Due to this, this project could reach a bigger audience and the biologists could follow the problem and so they could help to succeed.

9.4 Radio report

During our stay on the Azores Barbara Wiedemann, a reporter, accompanied us. She wanted to do a report about our research-camp for a radio-show. This report was on air at the 22th September 2004 at 3 pm at WDR 5. Two other smaller reports were on air at Deutschlandfunk and WDR 2.

The reports told about our general research work at the Azores, about the problem of too much tourism and that we're going to participate in the German environmental contest BUW.

10 Conclusion

Whalewatching allows a contact between men and those animals, which have been fascinating us for thousands of years. Due to this contact it is possible to learn more about the marine mammals and therefore protect them better. Till today this contact was made by men and the needs of the animals were seldom or never respected. Fixed Whalewatching-routes like those presented in this paper make it possible for the whales and dolphins to decide on their own. If they feel disturbed they can withdraw. On the other hand they can seek the contact with humans themselves.

For tourists, today Whalewatching is one of the main reasons to visit the Azores. So the Azores are interesting for the tourists because of the big diversity of Cetaceans species. The Whalewatching-tourism is an increasing and therefore major branch of the economy and so it is very important for the local people living there. Every year new organisations emerge, the Whalewatching is booming. Nevertheless, the base are the whales and dolphins. To ensure this basis in the future it is important to prevent the Cetaceans from migrating away from the region. On the Canary Islands this already has happened. As a result of too much boat-traffic the former frequently seen whales and dolphinpods migrated from the area. To inhibit this on the Azores there must be considerations of regulations of the boat-traffic. One possibility is to establish fixed routes. In Morey Firth, Scotland such routes on a voluntary basis already work without problems.

Furthermore there is the question, whether more licenses should be permitted yearly or if there should be stronger regulations as well to prevent the number of Whalewatching-organisations from getting too big. Moreover it is important to have somebody, who checks, whether the boats abide by the Whalewatching-rules. Still, too many boats don't abide by the rules and for example go too near to the whales.

In August 2004 a conference took place at the isle of Pico, where it was decided that the several Whalewatching-organisations want to work closer together. Especially scientists take advantage of this, because it eases their work. This possible teamwork makes up a good basis for talks about defined boat-routes. Nevertheless it is necessary to test the routes, to see how the whales react and if they do their job. Besides more data of the populations of the southcoast of Pico must be collected to approve a regularity in sightingsarea, -time and behavior.

However, this project might be a starting point for discussions on the important topic. In the summer of 2005 the suggestions were sent to the Gouvernement and the University of the Azores. The reactions were positive. In the next years there will be collaborations between Dr. Christina Schnug and the Department of Economy and Tourism and the University. Among other things the behavior of *Physeter macrocephalus* against vessels and the state of health of the species will be more observed. This already started in the summer of 2005, when breathing frequency and nutritional status were noted. Furthermore the PhotoID-catalogue had been extended. In the next years, this data could be basis for considerations about Whalewatching-routes to regulate the boat-traffic off the southcoast of Pico in order to protect the local Cetaceans-species.

Glossary

Blow: The blow is the condensed breath of the whale. Especially the blow of large whales is easy to see. By observing the blow it is possible to identify different species of whales.

Blubber: A layer of fat which insulates the Cetaceans and stops the loss of heat of the poikilothermal animals.

Breaching: When breaching the animals leap completely or partly out of the water. Reasons for this can be exploration of the surroundings, communicational or social activities or moving from one area to another.

Cetacea (*lat.*): The order of whales, being classified into two major groups: toothed whales (Odontoceti) and the baleen whales (Mysticeti). Often they are just called whales and dolphins. They belong to the class of mammals.

Fluke: Name for the horizontal tail fin of the whales (by fish it is vertical). The fluke is just made of fibrous connective tissue and serves as locomotion.

Krill: Krill are small crustaceans, which are found in arctic waters. Krill is the principal food of baleen whales.

Lobtailing: Lobtailing is one behavior of whales and dolphins where they slap hard with their fluke onto the water surface. That often means that the whale is agitated and for example feels disturbed by Whalewatching boats. It can also be caused by conflicts inside the group.

Photoidentification/Photo-ID: This is used to identify each individual whale. Of dolphins mainly the dorsal fin is photographed. Of bigger whales normally it is the fluke, because each whale has individual markings and shapes. Afterwards they can be recognized similar to a finger-print by human-beings.

Pinnipedia (*lat.*): Order of the seals. They are also regarded as aquatic carnivores and consist of three families.

Resident: Resident whales stay in one area their whole life and move only seasonally in their own territory.

Sirenia (*lat.*): Order of manatees and dugongs, being close related to ungulates.

Skipper: The name given to a captain of a small boat.

Spyhopping: typical behavior of whales, keeping their head above the water allowing them to observe the vicinity.

Transient: Transient whales often travel very long distances in the search of plancton, mainly the baleen whales. They do not have stable territories.

Vigia: The vigia is an Azorean name for a person who searches for whales with binoculars.

In the past vigias sent up signal rockets to spot the area where whales had been seen so that the whalers knew exactly where to go. Today however modern technics are used such as radio communication and funk, to tell the positions to the skippers of the Whalewatching-boats.

Bibliography

- [1] Calderan, S.: Too close for comfort? (3/2004), p. 24
- [2] Ritter, F.: Interactions of Cetaceans with Whale Watching Boats (2003), p. 52
- [3] <http://www.azoren-online.com/azoren/informationen/wirtschaft/index.shtml>
- [4] http://europa.eu.int/comm/fisheries/doc_et_publ/factsheets/facts/de/pcp7.htm
- [5] Carwardine, M.: Wale und Delphine in europäischen Gewässern (2003), p. 68
- [6] Keller, J: Wale und Delphine (2004), p. 24
- [7] Carwardine, M.: Wale, Delpine & Tümmler (2000), p. 19
- [8] Carwardine, M.: Wale, Delpine & Tümmler (2000), p. 18
- [9] Ridgway, S.: Mammals of the sea (1972), p. 503
- [10] Carwardine, M.: Wale, Delpine & Tümmler (2000), p. 62
- [11] Kohn, M.: Räumliche und zeitliche Verteilung von Cetaceen (2003), p. 42

Picture credits

As following there is no source declared for an image or photograph, it was made ourselves during working out the project.

Image 2: Grosser Weltatlas, p. 190

Image 3: Carwardine, M.: Wale und Delfine in europäischen Gewässern (2003), p. 65

Image 4: Dr. Christina Schnug

Photo 4: Dagmar Schröder

Photo 7: Marcus Richter

Photo 11: Dagmar Schröder

Photo 12: Dagmar Schröder

Photo 16: Marcus Richter

Photo 21: Theresa Senti

Photo 22: Theresa Senti

Photo 23: Dr. Christina Schnug

Photo 24: Dagmar Schröder

Photo 25: Theresa Senti

Literature

Campbell, Neil A.; Reece, Jane B.: Biologie. 6th Edition, Berlin: Spektrum Akademischer Verlag GmbH Heidelberg. 2003

Carwardine, Mark: Delphine. Biologie, Verbreitung, Beobachtung in freier Wildbahn. Augsburg: Naturbuch-Verlag. 1996.

Carwardine, Mark: Wale und Delfine in europäischen Gewässern. Beobachten, Bestimmen, Erleben. 1st Edition, Bielefeld: Delius Klasing Verlag. 2003.

Carwardine, Mark; Hoyt, Erich; Fordyce, R. Ewan; Gill, Peter: Wale, Delphine & Tümmler. Köln: Könnemann Verlagsgesellschaft mbH. 2000.

de Frias Martins, António M.: Azoren. Inseln in grün und blau. Ribeiro & Caravana Editores. 2000.

Evans, Peter G. H.: The natural History of. Whales & Dolphins. Kent: Christopher Helm Ltd, Imperial House. 1987

Farinha, Nuno; Correia, Fernando: Cetáceos dos Açores. Baleias, Golfhons e Toninhas. Património Natural Açoriano, Mirandela. 2003.

Keller, Jörg (Ed.): Wale und Delphine. Köln: Karl Müller Verlag GmbH. 2004.

Kiefner, Ralf: Wale & Delphine weltweit. 1st Edition. Hamburg: Jahr Top Special Verlag, 2002.

Kohn, Marion: Räumliche und zeitliche Verteilung von Cetacea im Süden der Insel Pico, Azoren, Sommer 2003. Universität Bremen, Fachbereich 02: Biologie

Morton, Brian; Britton, Joseph C.; de Frias Martins, António M.: Coastal Ecology of the Açores. Sao Miguel: Ponta Delgada. 1998.

Ritter, Fabian: Interactions of Cetaceans with Whale Watching Boats. Implications for the Management of Whale Watching Tourism, Berlin: M.E.E.R e.V. 2004.

Martin, Anthony R.: Das große Bestimmungsbuch der Wale & Delphine. 1991. München: Mosaik Verlag GmbH.

Ridgway, Sam H. (Ed.): Mammals of the sea. Biology and medicine. Charles C. Thomas. 1972.

Soury, Gérard: Das grosse Buch der Delphine. Bielefeld: Delius Klasing und Co. 1997.

Steffen, Andrea; Steffen, Wilfried: Pottwale. Im dunklen Blau des Meeres. Königswinter: HEEL Verlag GmbH. 2003.

Wandrey, Rüdiger: Die Wale und Robben der Welt. Vorkommen, Gefährdung, Schutz. Stuttgart: Franckh-Kosmos Verlags-GmbH & Co. 1997.

without author: Grosser Weltatlas. Die Erde in modernen Kartenbildern, Illustrationen und Fotos. Freiburg: Verlag Herder

Magazines:

Bridgland, Rebecca: Sharing of Ideas. In: Whale and Dolphin Magazine, 2/2004, Dorset [Druckort], p. 16.

Calderan, Susannah: Too close for comfort?. In: Whale and Dolphin Magazine, 3/2004, Dorset [Druckort], p. 24-26.

Kelm, Bettina: Unvergessliche Begegnung mit der großen Art. Sanftes Whale-Watching vor La Gomera. In: Naturschutzblätter. Umwelt, Klima, Energie, Technologie, 3/2005. p. 4-7.

Parsons, Garvin: The Azores. A world of their own. In: Whale and Dolphin Magazine, 3/2004, Dorset [Druckort], p.16-21.

Saward, Rachel: Discover Faial. A holiday with a difference. In: Whale and Dolphin Magazine, 3/2004, Dorset [Druckort], p.21-22.

Internet:

Martin, Roman: <http://www.azoren-online.com/>, August 2005.

without author: <http://www.espacotalassa.com>, December 2004.

without author: <http://www.aquaacores.com>, December 2004.

without author: Durchsetzung der Rechtsvorschriften im Fischereisektor, 11/01/1998,
http://europa.eu.int/comm/fisheries/doc_et_publ/factsheets/facts/de/pcp7.htm
May 2005

without author: <http://www.destinazores.com/>, August 2005.

Sonstige Quellen:

“Dolphin Space Programme” – Flyer. Touchstone Heritage Management Consultants Ltd. 1995.

Acknowledgements

We would like to thank Dr. Christina Schnug for giving teenagers, who want to become marine biologists, the chance to get practical experience, which is hard to get in Germany. Further on we'd like to thank her for her encouragement and help with the project and that she made it possible, that we could participate in this year's EAAM conference.

Moreover we would like to thank our parents, because they made it possible, that we could take part in the dolphin camp on the Azores. After all, they helped us during this project with advice and financial. Therefore it was possible for us to meet several times despite great distances and to take part in EAAM conference in the Netherlands.

Special thanks go to Marlene Biehl, who helped us working out the project. We also thank Markus Oehme, Marie Nagel, and Tanja Schlemm for proof-reading and Marcus Richter, Dagmar Schröder and Theresa Senti for providing the used photographs. They all helped us with helpful comments and the one or other encouraging word.

Appendix

The Azores



Image 2: Location of the Azores

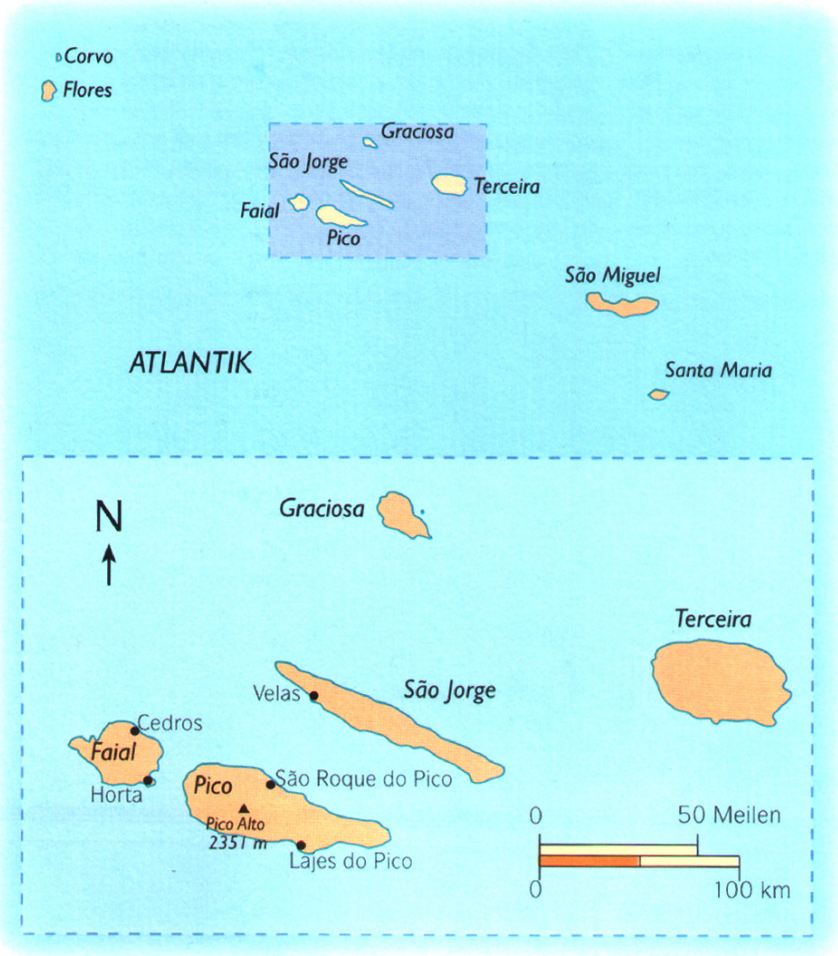


Image 3: Islands of the Azores



Photo 1: Island of Pico – Mount Pico



Photo 2: Lajes do Pico

Discriptions of Species



Photo 3: Discription of Species – *Physeter macrocephalus*



Photo 4: Discription of Species – *Grampus griseus*



Photo 5: Discription of Species – *Stenella frontalis*



Photo 6: Discription of Species – *Delphinus delphis*



Photo 7: Discription of Species – *Tursiops truncatus*

Determination of the Species due to characteristic attributes



Photo 8: Characteristic attributes – Blow (*Physeter macrocephalus*)



Photo 9: Characteristic attributes – Fluke (*Physeter macrocephalus*)

Specific behavior patterns



Photo 10: Behavior pattern – Spyhopping (*Grampus griseus*)



Photo 11: Behavior pattern – Spyhopping (*Physeter macrocephalus*)



Photo 12: Behavior pattern – Lobtailing (*Physeter macrocephalus*)



Photo 13: Behavior pattern – Breaching (*Stenella frontalis*)



Photo 14: Behavior pattern – Social active (*Stenella frontalis*)



Photo 15: Behavior pattern – Social meeting (*Physeter macrocephalus*)

Injuries caused by boats



Photo 16: Injuries – „Halffluke“ (*Physeter macrocephalus*)



Photo 17: Injuries (*Delphinus delphis*)

Boats



Photo 18: Boats – Abismo



Photo 19: Boats – Baleeiro



Photo 20: Boats – Amadeus

Research



Photo 21: Fieldwork



Photo 22: Fieldwork



Photo 23: Analyzing the data



Photo 24: Analyzing the data

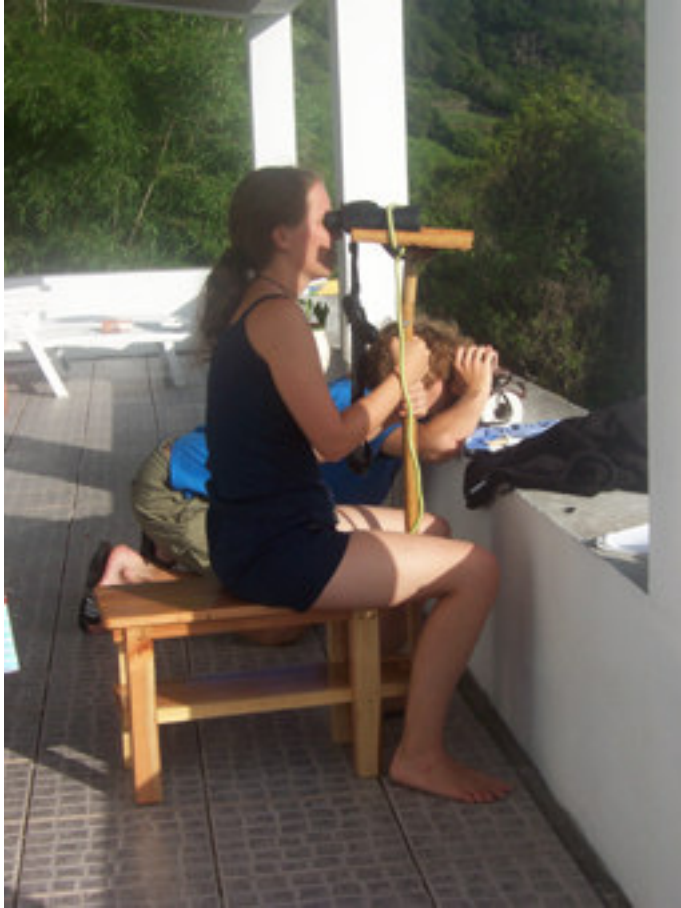


Photo 25: Landbased observation

Pictures from Eaam-conference



Configuration of our posters





Visit of the dolphinarium



Az 6 0028

X

Beobachtungsprotokoll



GPS N: 38.22.937
W: 028.06.723

Tag: 28.7.04
Uhrzeit: 11:58 - 12:18

Beobachter:

Wetter:
Wellenhöhe:

Kamera & Objektiv:

Film:

Fotospezifisches:

Art: Risso

Gruppengröße: 5-15

Gruppenzusammensetzung:

adult

Verhalten:

traveling

2 Schwimmer

~ 892 m Tiefe

WS: 11
W: 0.7

Wd: SWW
cc: 26

Wight (1)

Allocation of the Area

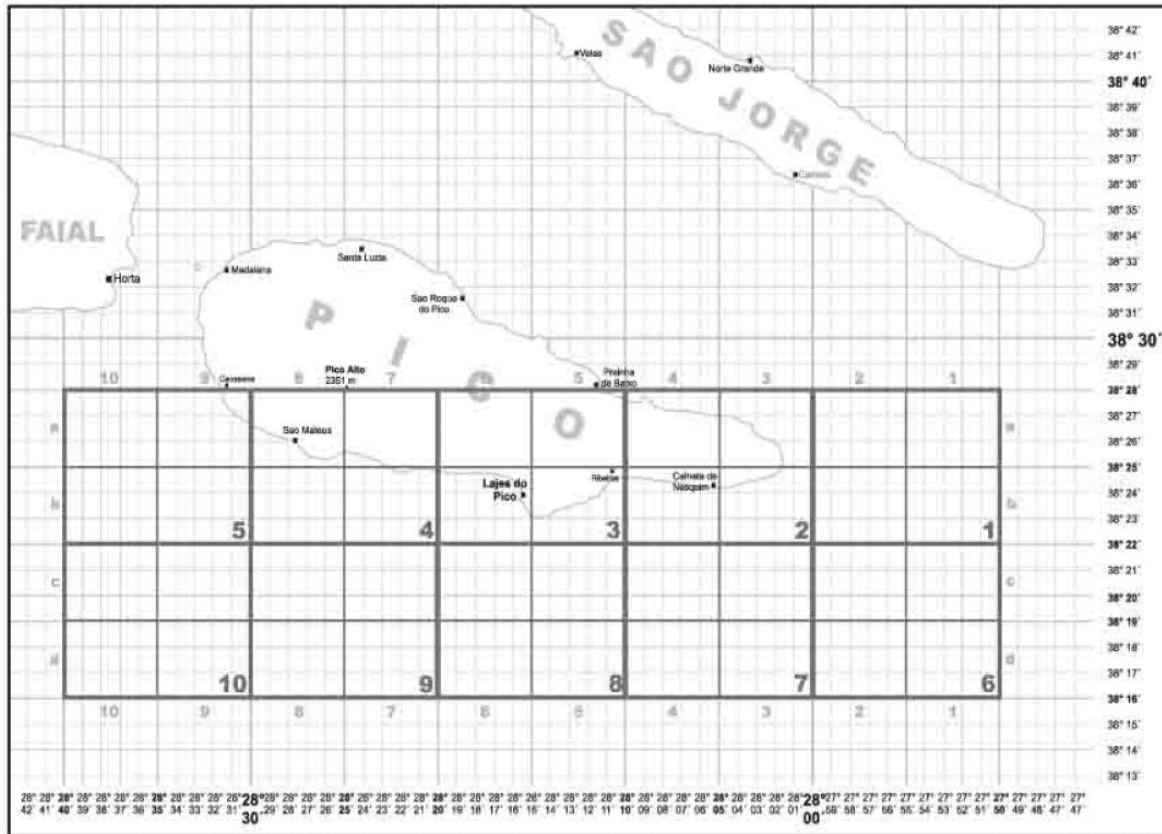


Image 4: Allocation of the Area

- subarea 1: 27°50'-28°00' and 38°28'-38°22'
- subarea 2: 28°00'-28°10' and 38°28'-38°22'
- subarea 3: 28°10'-28°20' and 38°28'-38°22'
- subarea 4: 28°20'-28°30' and 38°28'-38°22'
- subarea 5: 28°30'-28°40' and 38°28'-38°22'
- subarea 6: 27°50'-28°00' and 38°22'-38°16'
- subarea 7: 28°00'-28°10' and 38°22'-38°16'
- subarea 8: 28°10'-28°20' and 38°22'-38°16'
- subarea 9: 28°20'-28°30' and 38°22'-38°16'
- subarea 10: 28°30'-28°40' and 38°22'-38°16'

Charts

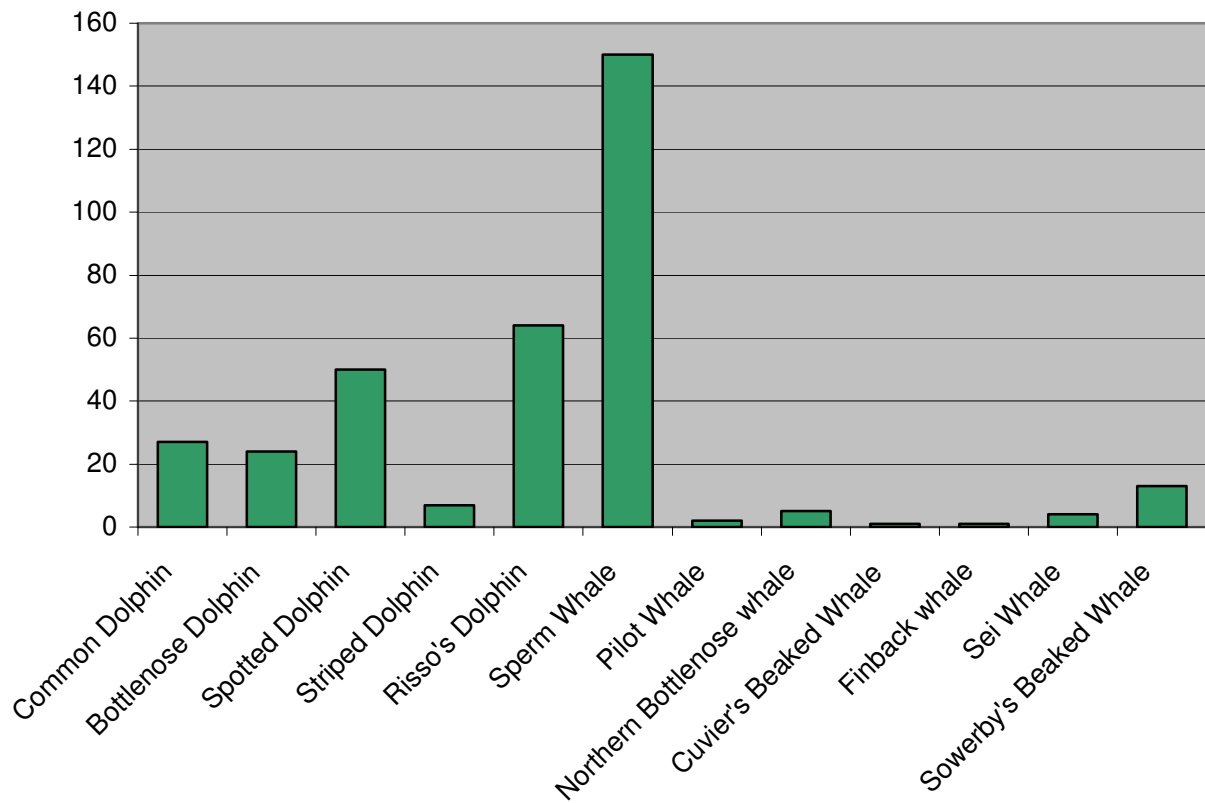


Chart 1: Species sighted 2004

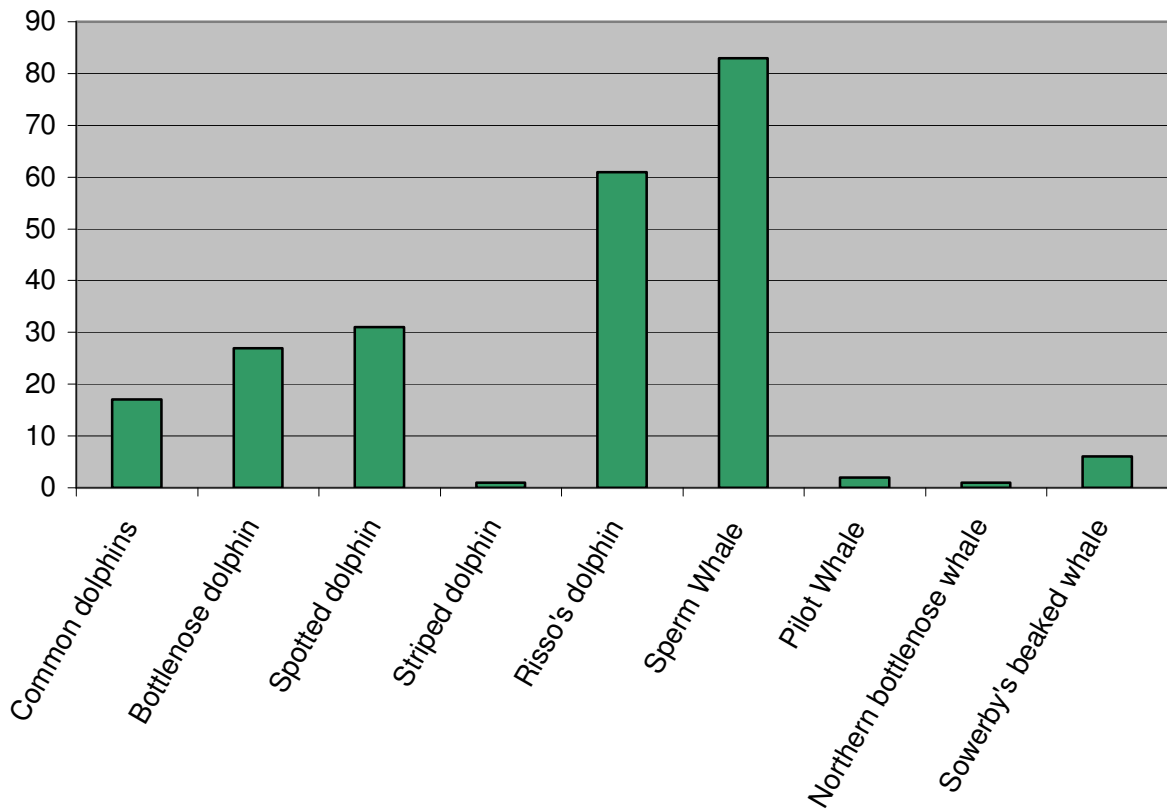


Chart 2: Species sighted 2005

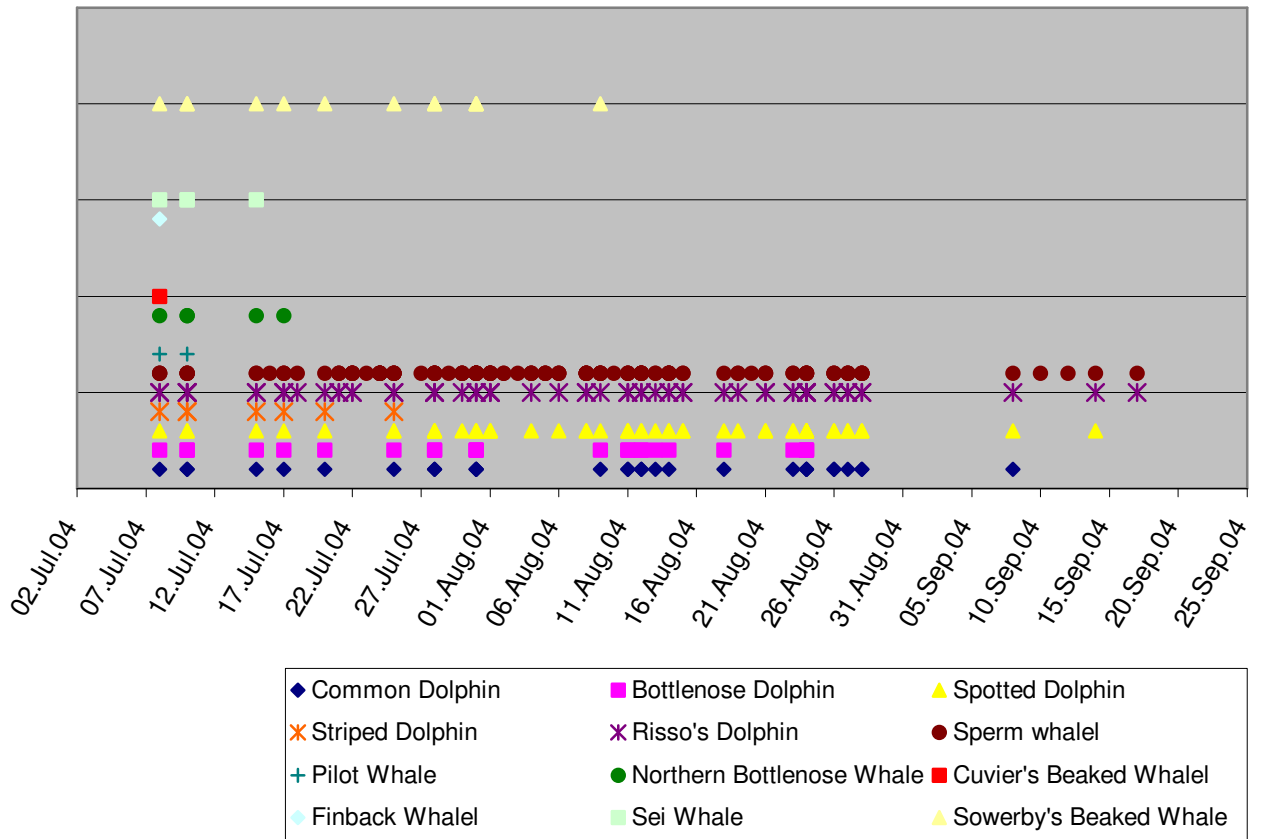


Chart 3: Daily Sightings of July 08 2004 to September 19 2004

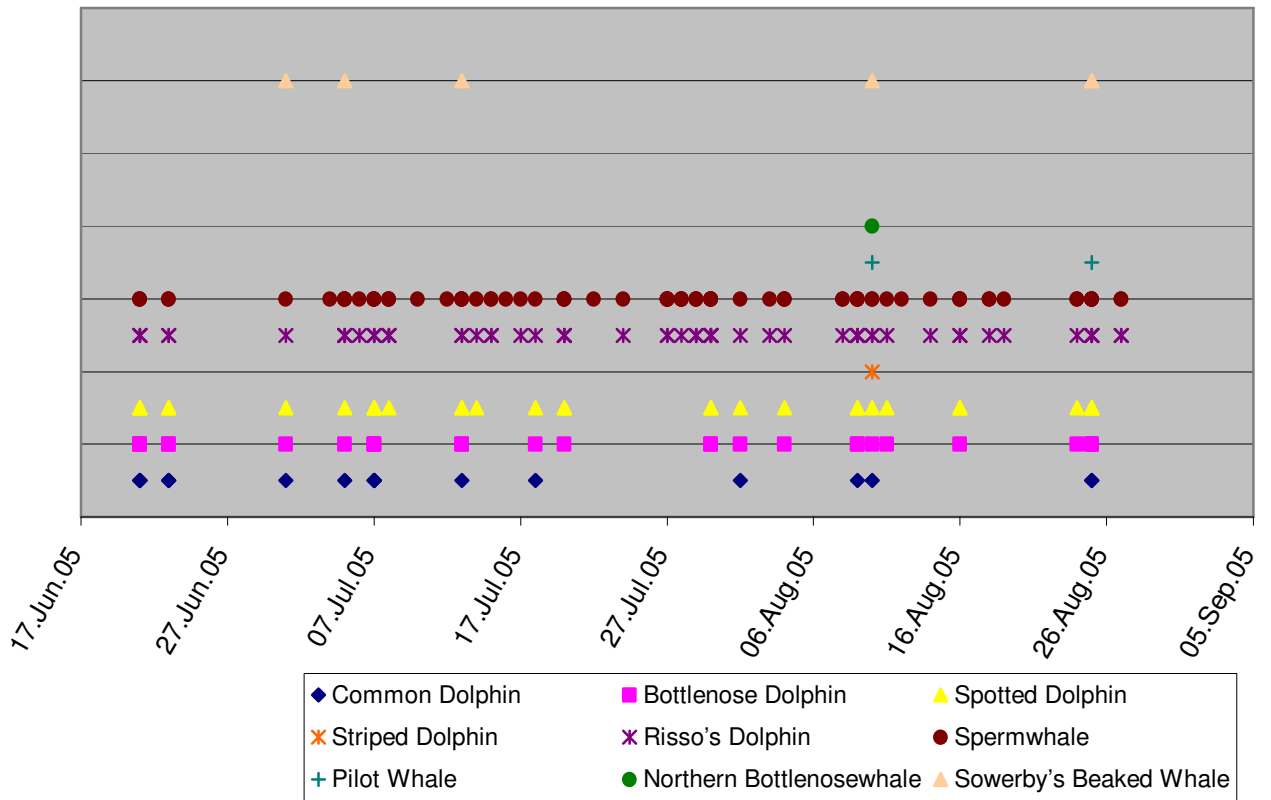


Chart 4: Daily sightings of June 17 2005 to September 05 2005

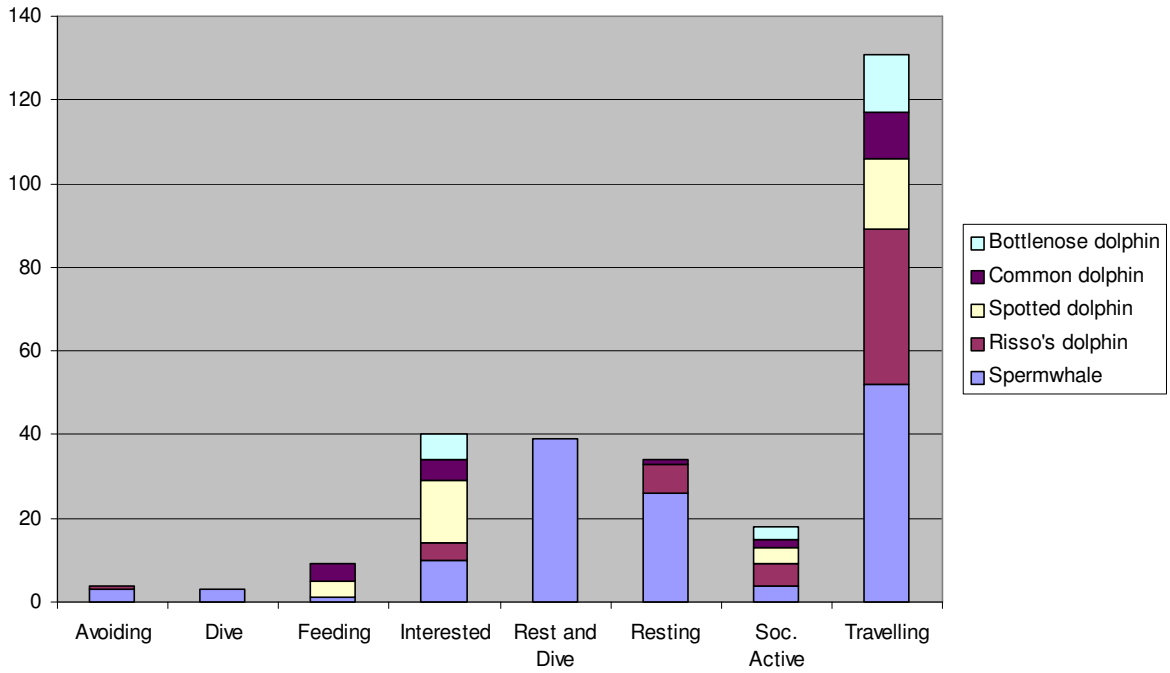


Chart 5: Behavior of main species 2004

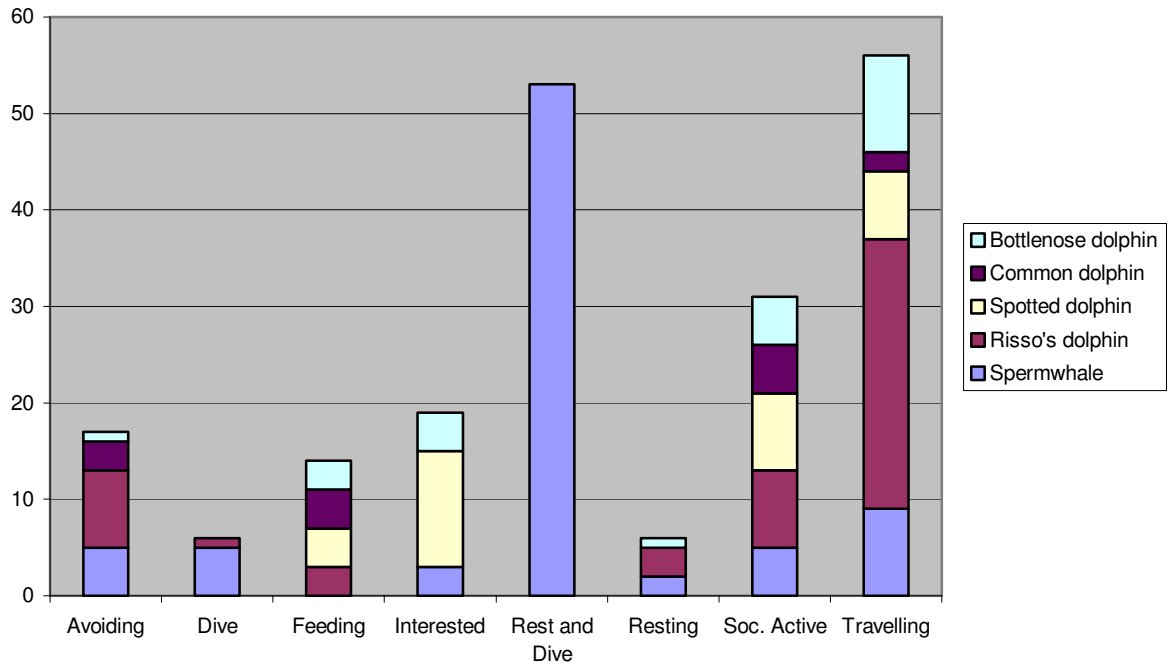


Chart 6: Behavior of main species 2005

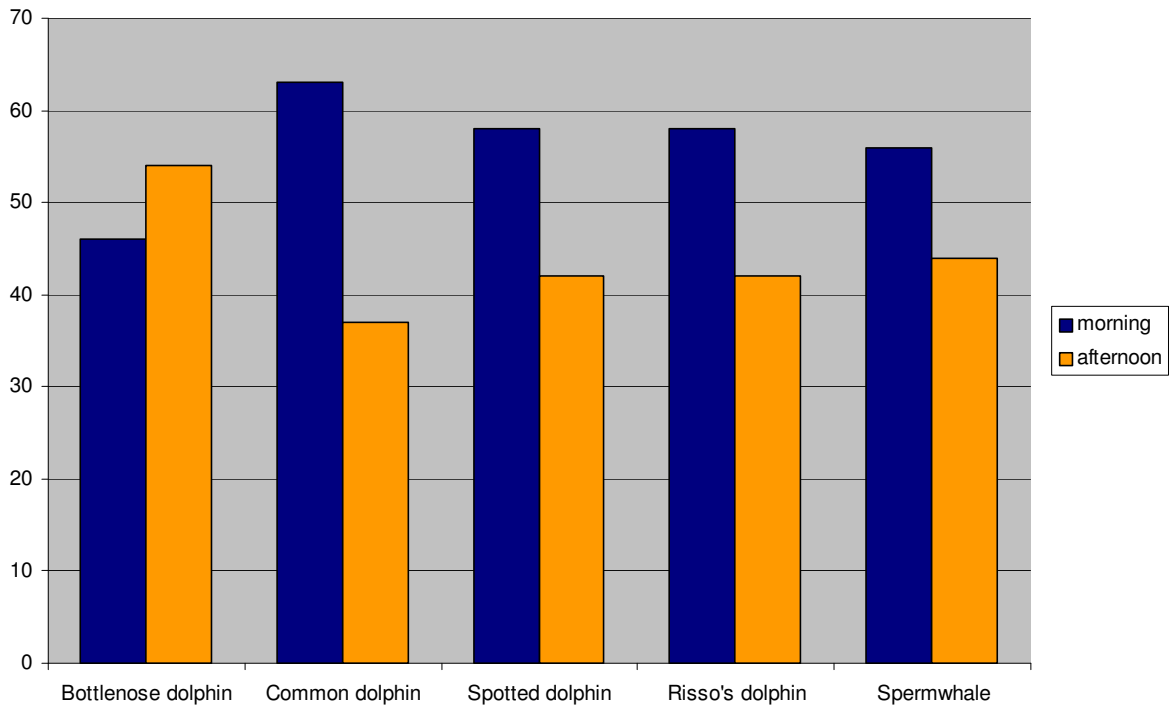


Chart 7: Time of day of main species sightings (in percent) 2004

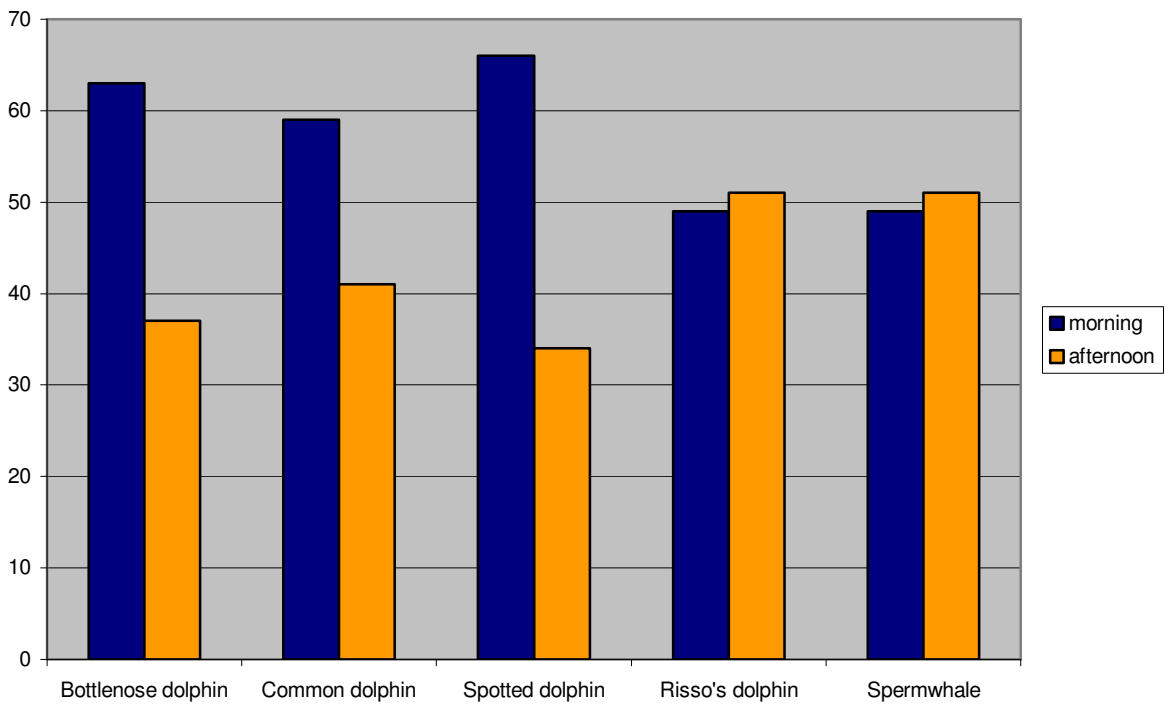


Chart 8: Time of day of main species sightings (in percent) 2005

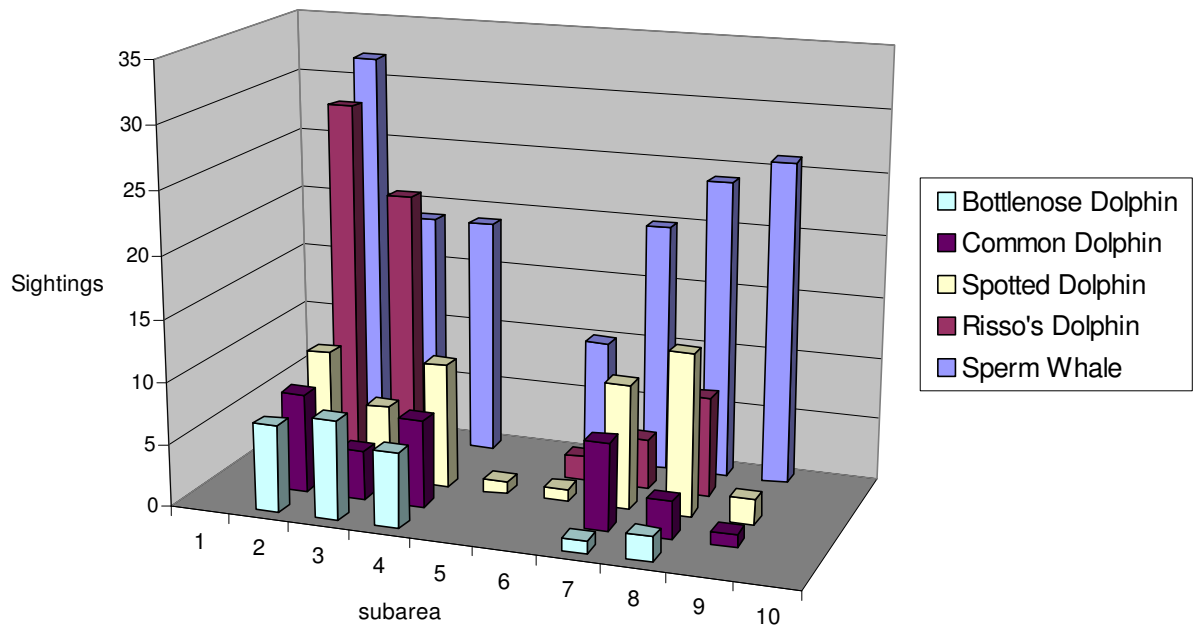


Chart 9: Sightings of main species in subareas 1-10 in 2004

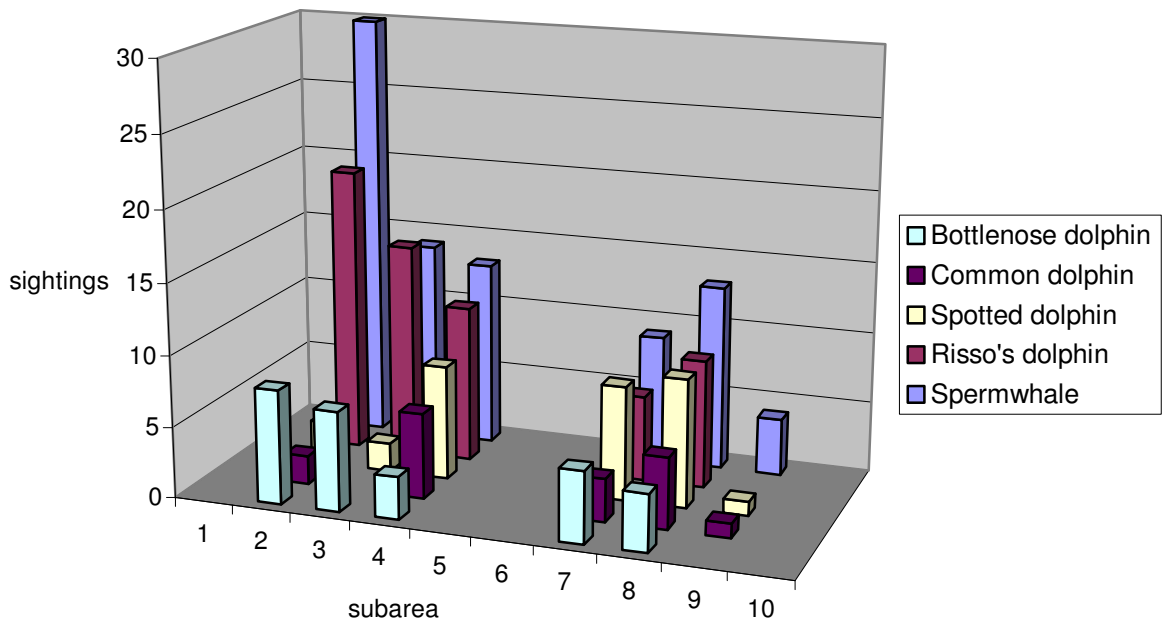


Chart 10: Sightings of main species in subareas 1-10 in 2005

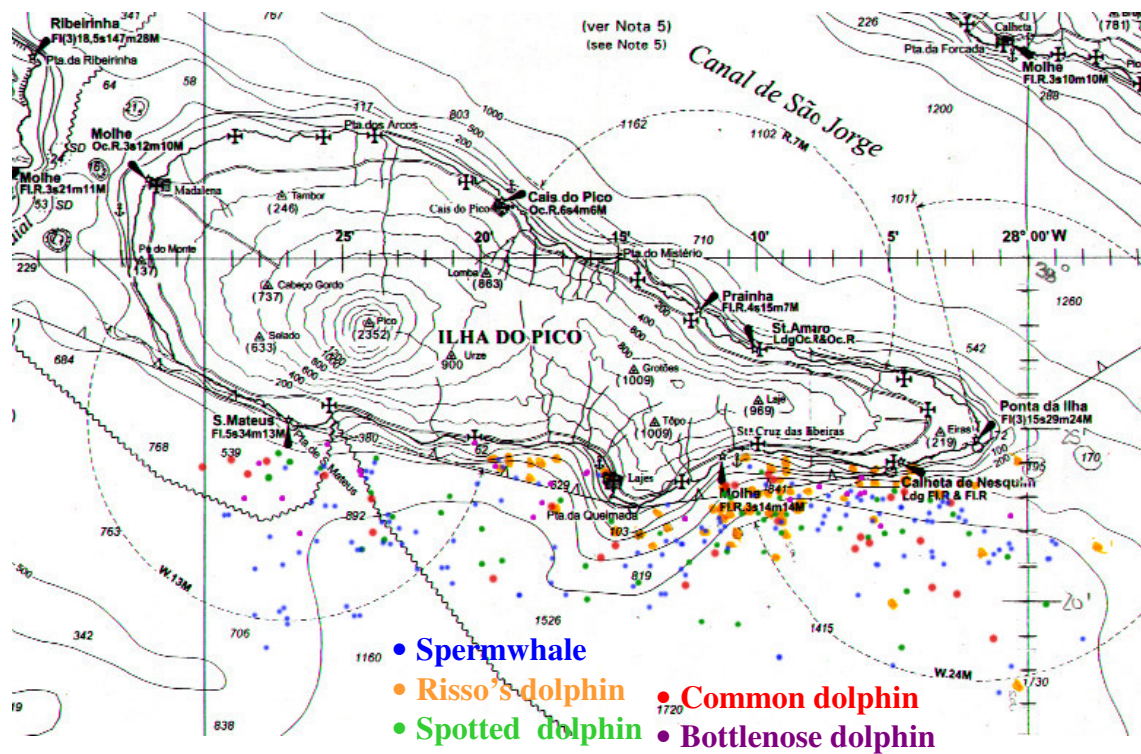


Image 5: Sightings 2004

Model of the Island of Pico

We made a model of the island of Pico for illustration in which we marked the considered routes.

scale:

length/width: 1 cm=10 km

height: 1 cm = 200 m

measures:

length: 59 cm

width: 42 cm

height: 15,5 cm

