Cape Verde 2006

Humpback whale breaching off Cape Verde © Simon Berrow

Funded by

Cape Verde 2006

Report prepared by Dr Simon Berrow
On behalf of the Irish Whale and Dolphin Group

Cape Verde 2006 survey team

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May, 2006

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Introduction

The number of humpback whale (*Megaptera novaengliae*) sightings around Ireland has increased considerably since 2003 with sightings received from all around the Irish coast (see www.iwdg.ie/sightings). This is also reflected elsewhere in Europe with an increase in humpback whale sightings reported from Northern Scotland, SW England and one recently in the Mediterranean Sea. The Irish humpback whale catalogue now contains fluke images of six individual humpback whales (Whooley *et al*. 2005). These images account for nearly one half of the entire number of individual humpback whale fluke images in Europe (see www.europhlukes.net). We predict that the number of fluke images obtained from Ireland and other parts of Europe, will increase, which increases the probability of re-sighting these whales at their breeding grounds.

In 2003, the Irish Whale and Dolphin Group (IWDG) organized the first Irish Humpback Whale Expedition (Berrow 2003a). This expedition involved sailing from Ireland to Cape Verde Islands off West Africa searching for humpback whales. The purpose of the expedition was to try and locate the breeding grounds of humpback whales recorded off Ireland.

After a two month, 4000 km journey, south to Cape Verde the Irish Humpback Whale Expedition spent a month locating and recording humpback whales around Boavista and Santa Antao. A total of 11 useable fluke images were collected and submitted to the North Atlantic Humpback Whale catalogue (Berrow 2003a). This was a significant contribution to the total number of images submitted from Cape Verde as only 41 individual whales had been identified prior to this expedition. However, none of these images could be matched to Ireland or any other feeding grounds in the North Atlantic. Despite not finding any fluke matches, the IWDG was recognised as making a significant contribution to the knowledge of humpback whales in the Cape Verde (Wenzel *et al*. 2004). The support of fellow researchers in Cape Verde and in the US and Switzerland encouraged us to return to Cape Verde to try and build on the success of the first expedition.

Recent developments in knowledge of humpback whales off Cape Verde

Recent historical reviews of whaling logs from the North Atlantic has suggested that humpback whale density in Cape Verde in the 19th century was comparable to that in the major West Indies whaling grounds (Reeves *et al*. 2002). Clearly this is not the case today as humpback whales are still not abundant in the Cape Verde. It is likely that this population is still severely depleted after commercial whaling, which might have removed at least 1100 humpback whales (Reeves *et al*. 2002). Jann *et al.* (2003) made the first match of a humpback whale from Cape Verde to a high latitude feeding ground. A humpback whale photographed off Boavista in 1999 matched a whale photographed off Iceland in 1982 (Jann *et al*. 2003). More recently a humpback photographed off Boavista in 2004 was matched to one photographed off Norway in 1984 (Wenzel *et al*. 2004).

Up to 2004 the total number total number of fluke imagers from Cape Verde had increased to 62 with 10 re-sightings. This high re-sighting rate suggests the population is very small and genetic studies suggest it is genetically distinct (Stevick *et al*. 2003). It is essential that we continue to increase the number of individually recognisable whales in Cape Verde to further aid attempts at matching whales at other sites but also so that we can derive a robust abundance estimate.

Objectives

The main objective of this expedition was to contribute to the knowledge of cetaceans, especially humpback whales, around Cape Verde. In addition to obtaining fluke images we also attempted to obtain tissue samples using a biopsy dart delivered by a standard crossbow and obtain sound recordings.

Objectives:

1. to obtain fluke images of humpback whales
2. to obtain tissue samples of humpback whales
3. to obtain sound recordings of humpback whales
4. to record all species of cetacean observed around Cape Verde
5. to record sperm whale codas
6. to facilitate researchers from INDP

Methods

Expedition personnel flew from Dublin, Cork and Shannon in Ireland, via London Heathrow and Lisbon, to the island of Sal in Cape Verde. After two days they flew on an internal flight to Mindelo on Sao Vicente arriving on 25 February 2006. A 46 foot Bavaria yacht (SV Adrianna) was chartered for one month from Lutz Meyer-Scheel.

Sightings effort

Sighting effort was logged in two ways. It was initially planned to run the IFAW software LOGGER, which acquires the ships position directly through a GPS receiver. However as we were under sail for long periods the yachts batteries were not always able to supply sufficient power. In these cases we used a handheld Garmin® GPS 72 to plot the track of the vessel and position of sightings. This was downloaded onto a laptop each evening using Garmin® MapSource software.

Environmental data was also put into LOGGE, when used, every 30-60 minutes or when the direction of travel was changed. A continuous watch for cetaceans was maintained from the yacht during daylight hours. Whenever possible, at least two dedicated observers were positioned each on the port and starboard side of the upper deck, or if the weather was too rough, in the cockpit. The position of each sighting was recorded by entering a waypoint into LOGGER or the GPS. For humpback whales the position was marked as close to the actual whale as possible.



Photo-identification

Many species of cetacean have distinctive markings or colouration, which is specific to that individual, through which individuals can be recognised. Notches and nicks often occur on the dorsal fins of dolphins. Humpback whales have distinctive markings on the underside of their tail flukes. Images of all species observed were obtained using a variety of camera gear including two Canon D20 Digital SLR camera with 70-200 f2.8 USM lenses with either a 1.4x or 2.0x converter. A Canon EOS 500 camera with 200-500mm lense with 200-400ASA Kodachrome film was also used.

The position, behaviour, relative size and the number of all dolphins and whales was recorded during each encounter.

Acoustic monitoring and recording

Acoustic survey was carried out using a 100m towed stereo hydrophone which was also towed behind the survey vessel during the first two weeks (25 February –11 March) and a 17m HP30 hydrophone during the second leg (11-26 March). The former was used to detect sperm whales, which are the subject of Ricardo Antunes PhD. Ricardo particularly wanted to record sperm whale codas: social vocalisations associated with sperm whale maternal groups. The stereo element allows the listener to obtain some idea of directionality depending on which headphone the vocalisations are louder.

An attempt was made to record the songs of humpback whales. Recordings of humpback vocalisations were made for as long a period as possible, preferably uninterrupted. If the background noise became loud, or the songs, faint, high pass filters were used to try and minimise background noise or, if too intense, recordings were stopped.

Genetic samples

A 120lb standard crossbow was used in an attempt to biopsy humpback whales. Whales were approached from the side but only those that surfaced within 10m and started their terminal dive (when they normally fluke) were to be sampled. Their behaviour before, during and after a biopsy attempt was recorded as per standard protocols (Clapham and Matilla, 1993).

Plankton samples

Ten plankton samples were obtained from around the Cape Verde archipeligo. These will be analysed by Dr Cilian Roden in Ireland. Samples were collected via a vertical tow through between 15-40m of water using a fine (120 μm) mesh plankton net. The net was washed out and samples stored in 10% formaldehyde.

Amphipod samples

A request to catch amphipods from Cape Verde was also received from Dave McGrath from the Galway-Mayo Institute of Technology, Galway, Ireland. Baited traps made from plastic bottle were set on six nights, while at anchor, with shark and fish offal as bait. On four other occasions light sticks were used in conjunction with bait in an attempt to attract these invertebrates.

Results

Cruise Plan

The survey was divided into two legs. The objective of the first leg was to survey the area around the island of Maio in collaboration with Beatrice Jann. This was expected to be the more challenging of the two legs as this area is more exposed to the wind and swell, with less shelter and the sites for whales are less known. However, the narrow continental shelf connecting Boavista with Maio, with deep water close by, provide the opportunity to observe more interesting and rare species. The second leg concentrated on locating whales around Boavista, which provides the best opportunities to encounter humpback whales in Cape Verde.

Table 1. Summary of daily log during Cape Verde 2006.

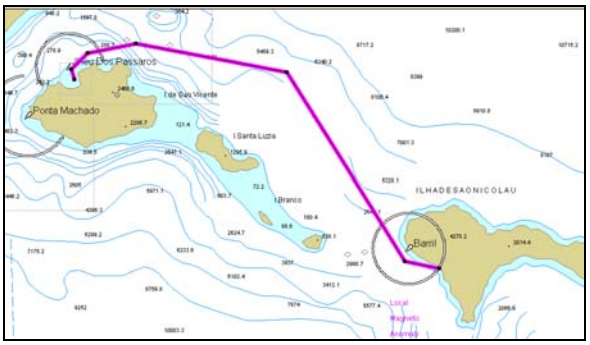
Date	Anchorage (start)	Objective	Distance Travelled (nmls)	Number of Encounters (Acoustic)	Anchorage (end)
Leg 1					
25.02	Mindelo, Sao Vicente	passage	58	1 Unid	Tarrafel, Sao Nicolau
26.02	Tarrafel, Sao Nicolau	passage	105	2 SFPW, BND	Sal Rei, Boavista
27.02	Sal Rei, Boavista	humpbacks	22	1 HW	Pt. Lacado, Boavista
28.02	Pt. Lacado, Boavista	sperm	50	(1) SW	Pt. Lacado, Boavista
01.03	Pt. Lacado, Boavista	humpbacks	44	1 RTD	Pt do Maio, Maio
02.03	Pt do Maio, Maio	passage	73	0	Pt do Maio, Maio
03.03	Pt do Maio, Maio	humpbacks	15	1 HW	Pt do Maio, Maio
04.03	Pt do Maio, Maio	humpbacks	17	1 HW	Pt do Maio, Maio
05.03	Pt do Maio, Maio	humpbacks	36	3 HW, RTD, SSSD	Pt do Maio, Maio
06.03	Pt do Maio, Maio	passage	132	2 Unid	Tarrafel, Sao Nicolau
07.03	Tarrafel, Sao Nicolau	dolphins	10	1(1) BND (SW)	Tarrafel, Sao Nicolau
08.03	Tarrafel, Sao Nicolau	sperm	74	4 SD	Tarrafel, Sao Nicolau
09.03	Tarrafel, Sao Nicolau	passage	102	1 (1) HW, Unid	Sal Rei, Boavista
10.03	Sal Rei, Boavista	passage	53	1 HW	Palmeira, Sal
Total			**791**	**22**	
Leg 2					
12.03	Palmeira, Sal	passage	45	1 HW	Sal Rei, Boavista
13.03	Sal Rei, Boavista	humpbacks	26	3 HW	Sal Rei, Boavista
14.03	Sal Rei, Boavista	humpbacks	34	1 HW	Sal Rei, Boavista
15.03	Sal Rei, Boavista	humpbacks	27	4 HW, RTD	Sal Rei, Boavista
16.03	Sal Rei, Boavista	humpbacks	20	2 HW	Sal Rei, Boavista
17.03	Sal Rei, Boavista	humpbacks	15	1 HW	Pt. Lacado, Boavista
18.03	Pt. Lacado, Boavista	humpbacks	40	2 HW	Sal Rei, Boavista
19.03	Sal Rei, Boavista	humpbacks		1 HW	Sal Rei, Boavista
20.03	Sal Rei, Boavista	passage	115	1 Unid	Tarrafel, Sao Nicolau
21.03	Tarrafel, Sao Nicolau	dolphins	24	0	Tarrafel, Sao Nicolau
22.03	Tarrafel, Sao Nicolau	passage	31	0	St Luzia
23.03	St Luzia	passage	32	0	Mindelo, Sao Vicente
Total			**409**	**16**	

BND=Bottlenose dolphin *Tursiops truncatus*, HW=Humpback whale *Megaptera novaeangliae*, RTD=Rough-toothed dolphin *Steno bredanensis*, SFPW=Short-finned pilot whale *Globicephala macrorhynchus*, SSSD=Short-snouted Spinner dolphin, SD=Pan-tropical Spotted dolphin *Stenella attenuata*, SW=Sperm whale *Physeter macrocephalus*, Unid=Unidentified dolphin

Weather conditions during the first leg were not very favourable for surveying cetaceans. Sea-state 3 or less was recorded on only 15% of occasions, mainly towards the end of the leg when a dust storm calmed the sea but also reduced visibility to, at times, less than 1km. A total of 791 nmls (1400km) was surveyed with 20 sightings and two acoustic encounters logged. Seven species were recorded (sperm whales only acoustically), six species of odontocetes and one mysticete, (humpback whale). Most sightings (60%) were of dolphins, with only six sightings of humpback whales.

During the second leg we travelled 409 nmls and had 16 encounters with most time was spent surveying the waters around Boavista. During eight days we had 13 encounters with humpbacks. The second objective of leg 2 was to survey suitable habitat around Sao Nicolau, Branco, St Luzia and Sao Vicente for humpback whales. Despite favourable weather (sea-state ≤3) for 55% of the time, no whales (or dolphins) were observed, suggesting whales are extremely scarce or only occur on passage.

Maps showing the surveyed each day taken are presented



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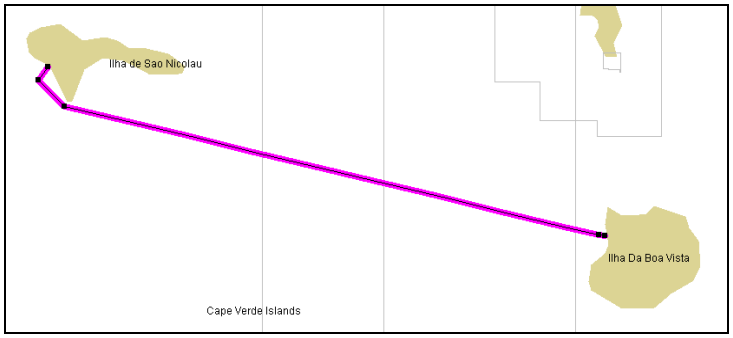

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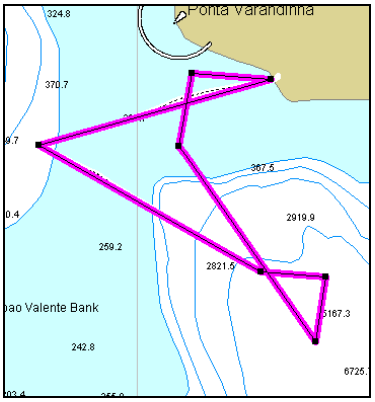

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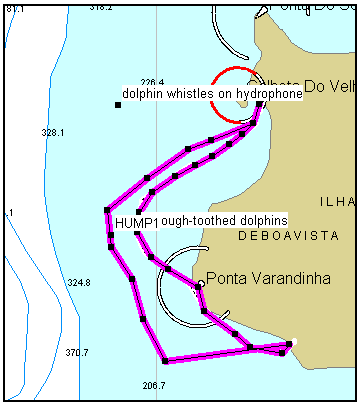

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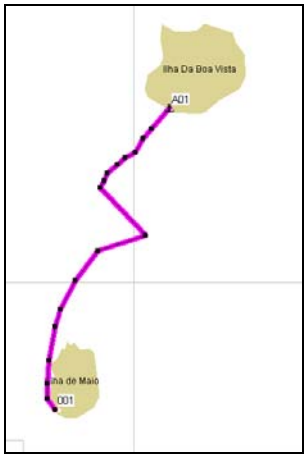

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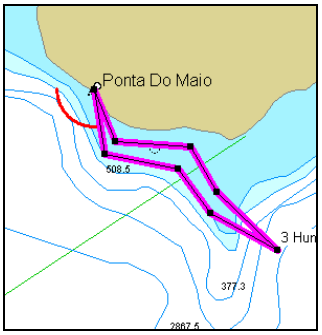

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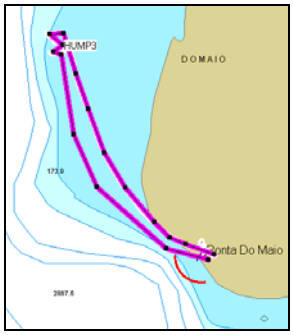

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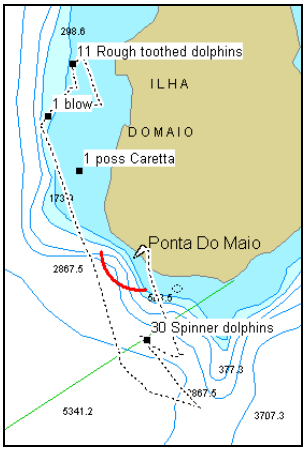

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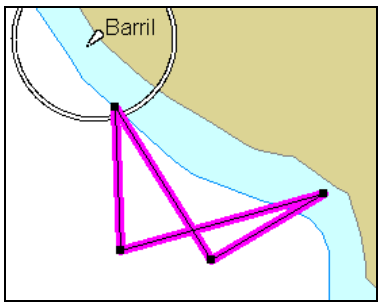

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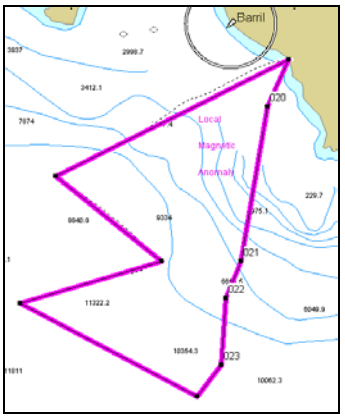

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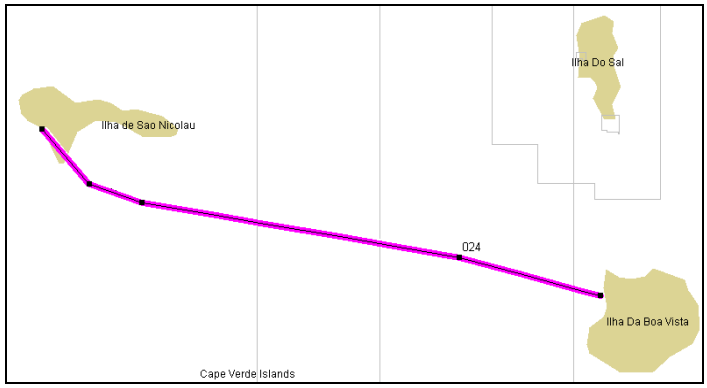

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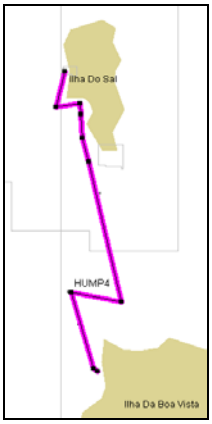

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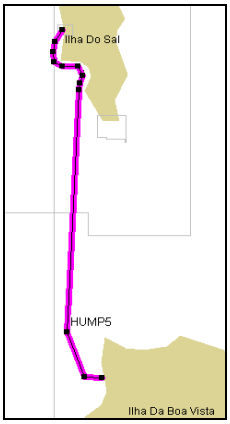

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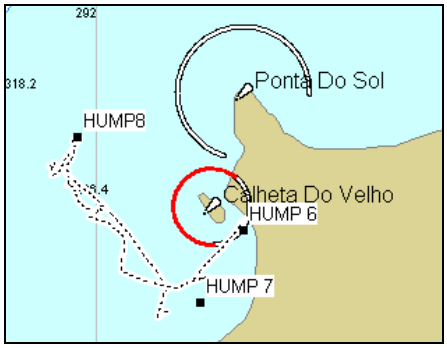

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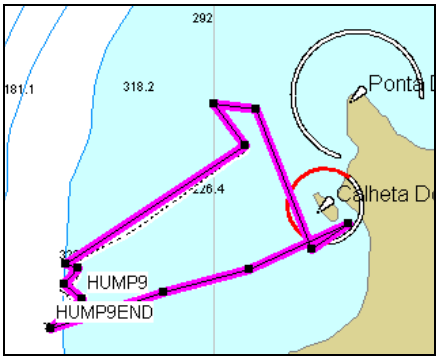

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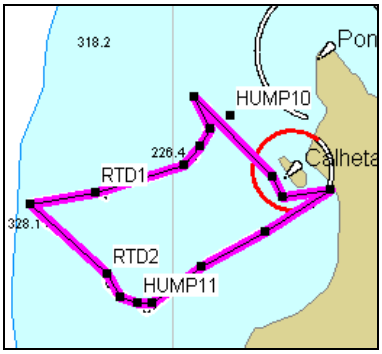

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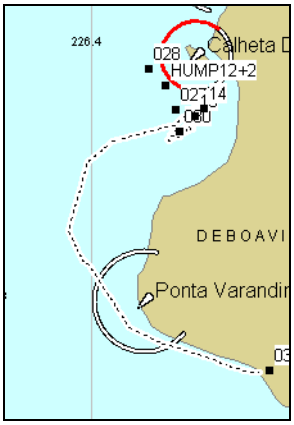

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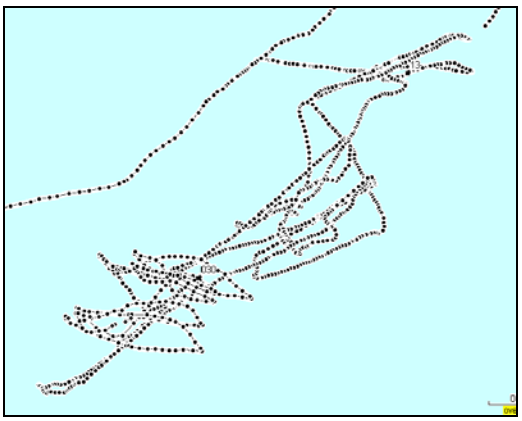

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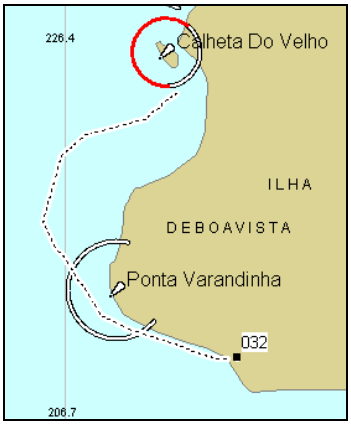

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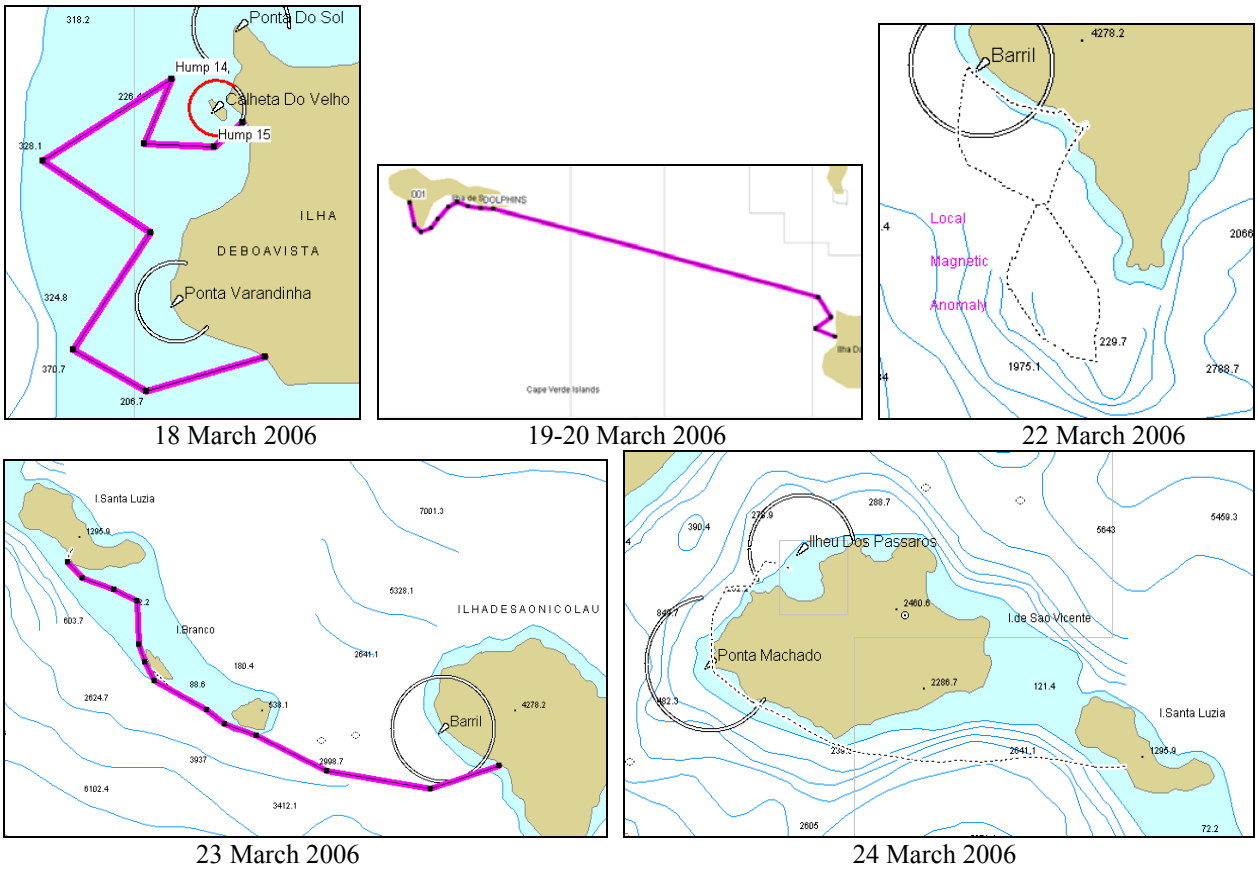


Figure 1. Maps showing daily route surveyed for cetaceans

Cetacean species recorded

At least seven cetacean species were recorded, one baleen (humpback whale) and six odontocetes (sperm whale, short-finned pilot whale, bottlenose, rough-toothed, pan-tropical spotted and short-snouted spinner dolphin).

Humpback whales *Megaptera novaeangliae*

Humpback whales were the most frequently observed species. Most sightings were around Boavista (Fig. 2a) but three sightings of 3 whales in total were made off the island of Maio (Fig. 2b). A total of 16 sightings or encounters of a total of 42 whales recorded. However many of these individuals around Boavista, were re-sightings. Two adults with calves born this year were observed in Baia de Sal Rei, Boavista on 13 March. Group size varied from 1 to 6 (mean = 2.8). Groups of more than two whales were observed on six occasions. The behaviour of these groups was very dynamic with what appeared to be two large (males ?) whales showing aggression to each other (charging/surface splashing), while a smaller whale (female ?) was in attendance. These might have been adult males competing to gain access to a female for mating.

Some individuals were re-sighted over a number of days suggesting a degree of residency. One individual was recorded on 27 February and again 14 days later, on the 13 March.

The first humpback whale singing was recorded on 9 March at N16º22.50' W23º59.16' while on passage to Boavista. Singing was heard in deep water (>2000m) about 13.5 nmls south of Ponta Leste off the east tip of Sao Nicolau. Recordings were made off Boavista on 16 March in Baia de Sal Rei.

Table 2. Summary of humpback whale sightings and encounters in Cape Verde 23 February – 26 March 2006

Date	Encounter	Location	Position	Number	Behaviour	Comments
27.02	Hump 1	Boavista	N16 04.820 W23 02.200	1	Leap/breach. Tail slapping	Fluke images - poor
03.03	Hump 2	Maio	N15 04.129 W23 08.470	3		Fluke image
04.03	Hump 3	Maio	N15 12.887 W23 16.638	2	1 breached twice	Fluke image
05.03		Maio	N15 13.597 W23 17.029	1	Blow	No images
09.03		Sao Nicolau	N16 22.500 W23 59.160		Heard on hydrophone	
10.03	Hump 4	Boavista	N16 19.069 W22 58.786	1	Fluke seen once	No Images
12.03	Hump 5	Boavista	N16 14.108 W22 58.758	4-6		Diving images
13.03	Hump 6	Boavista	N16 09.405 W22 55.225	2 (1)	Adult + calf	Images; none of fluke
13.03	Hump 7	Boavista	N16 07.125 W22 56.610	2 (1)	Calf reaching and tail slapping	Calf fluke image
13.03	Hump 8	Boavista	N16 12.296 W23 00.580	2		Fluke images
14.03	Hump 9	Boavista	N16 07.158 W23 04.387	3 (1)	1 breaching	Fluke images
15.03	Hump 10	Boavista	N16 11.771 W22 58.199	2		Fluke images
15.03	Hump 11	Boavista	N16 06.209 W23 01.115	3-4		Fluke images - poor
16.03	Hump 12	Boavista	N16 09.138 W22 57.348	6 (2)		Fluke images
16.03	Hump 13	Boavista	N16 07.594 W22 56.886	1	singing	No images
17.03		Boavista	N16 08.232 W22 55.755	1	Blow	No images
18.03	Hump 14	Boavista	N16 11.445 W22 58.330	2		Fluke image
18.03	Hump 15	Boavista	N16 08.515 W22 56.407	2 (1)		
19.03	Hump 16	Boavista	N16 11.711 W23 00.199	3	1 breaching	Images

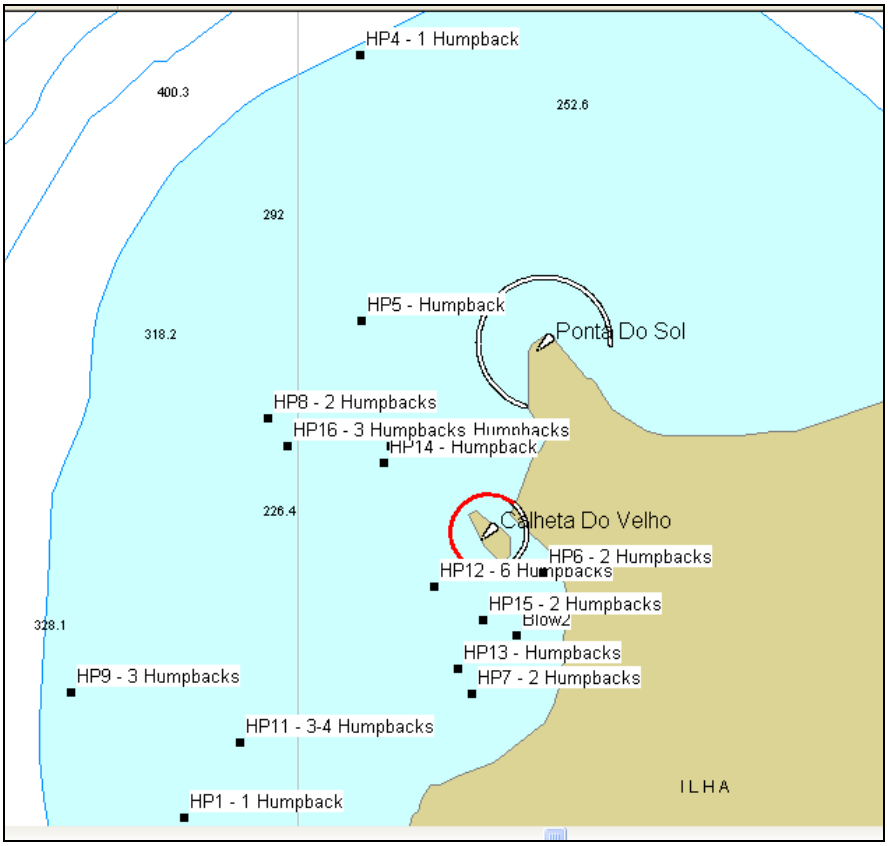


Figure 2a. Location of humpback whale sightings around Boavista

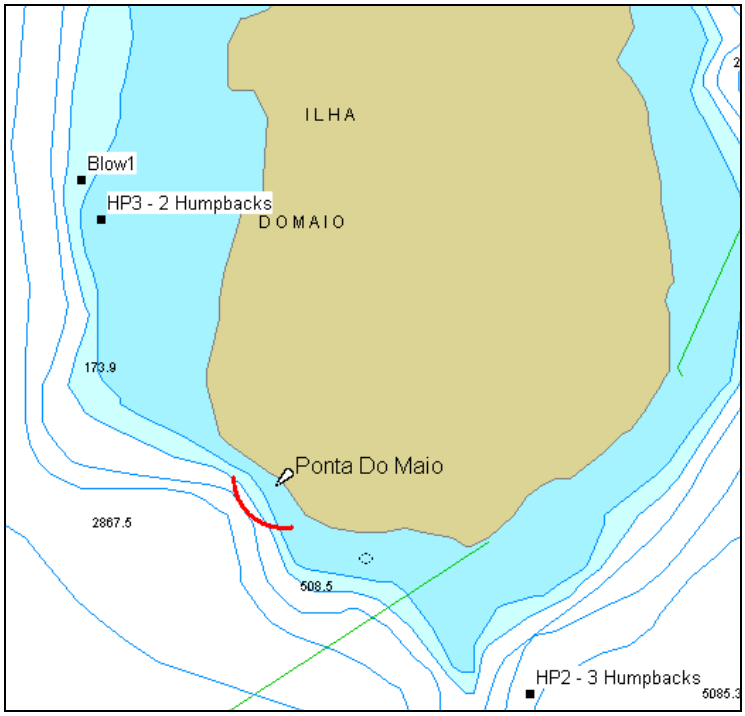


Fig. 2b. Location of humpback whale sightings around Maio

Sperm whales *Physeter macrocephalus*

Table 3 Summary of sperm whale acoustic detections in Cape Verde 23 February – 26 March 2006

Date	Location	Position	Comments
28.02	Pta Lacacao	N15 50.304 W22 50.477	Heard for 20-30 minutes, clicks recorded
07.03	Sao Nicolau	N16 14.640 W24 17.891	On passage from Maio, heard for 3-4 hours including a male

No sperm whales were sighted but they were heard on two occasions.

On the second occasion vocalisations attributed to male vocalisations were recorded suggesting an adult male was occurring at lower latitudes.

These data will be used in Ricardo Antunes PhD thesis.

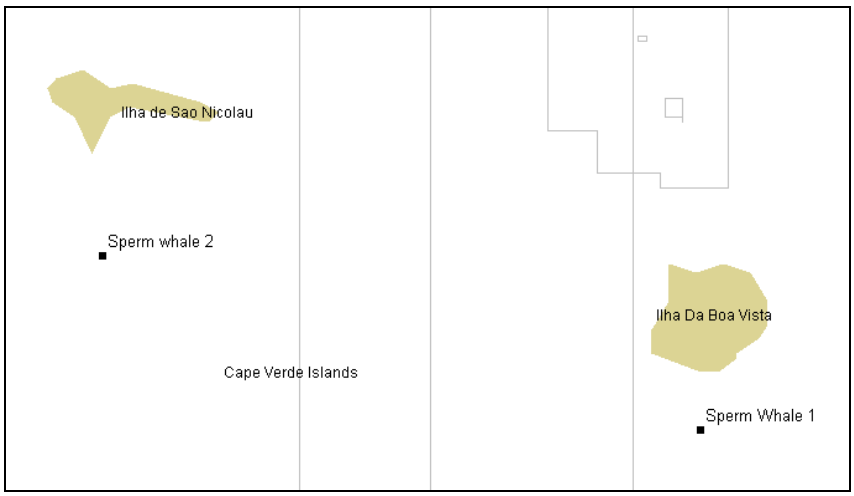


Fig. 3. Location of sperm whale acoustic detections.

Rough-toothed dolphin *Steno bredanensis*

Rough-toothed dolphins were the most widespread of the dolphin species encountered. They were recorded on four occasions, three off Boavista and one off Maio. A sighting of 2-3 dolphins off Maio on 5 March might have been rough-toothed and two dolphins photographed briefly in deep water between Sao Nicolau and Boavista might also have been of this species. Individual dolphins could be identified off Boavista using photo-identification. They are known to be frequently encountered in this area (Hazevoet and Wenzel, 2000; Jann *pers. comm*.). This technique could be used to establish a photo-identification catalogue and monitor their movements and behaviour. This is a poorly understood species and Cape Verde is clearly a good site in which to locate and study them.

Table 4. Summary of rough-toothed dolphin sightings in Cape Verde 23 February – 26 March 2006

Date	Location	Position	Number	Behaviour	Comments
01.03	Boavista	N16 04.070 W23 00.080	6	Bowriding briefly	
05.03	Maio	N15 15.719 W23 15.978	11 (1)	Bowriding and surfing waves	
15.03	Boavista	N16 09.470 W23 02.407	5	Bowriding	feeding
15.03	Boavista	N16 06.209 W23 01.115	6	In association with humpbacks	incl calf

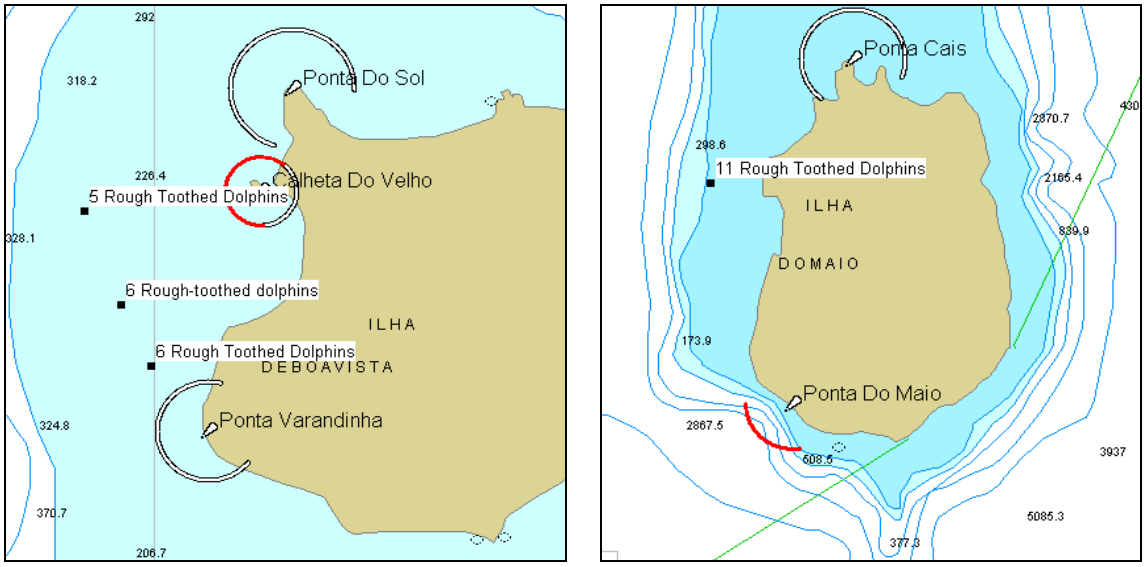


Fig. 4. Distribution of rough-toothed dolphin sightings off Boavista and Maio

(Common) Bottlenose dolphin *Tursiops truncatus*

Bottlenose dolphins were observed on at least two occasions off Tarrafel on Sao Nicolau. It is likely that the unidentified dolphin which approached the vessel at the same location during darkness on 25 February was this species. A group of 20 dolphins were observed at distance on 20 March off Sao Nicolau, which might have been bottlenose. Photo-identification recorded at least four individuals. It is quite likely that a group regularly occurs off Sao Nicolau and it would be worth exploring whether these could be "resident". Most records of this species are off Sal (Hazevoet and Wenzel, 2000).

Table 5. Summary of bottlenose dolphin sightings in Cape Verde 23 February – 26 March 2006

Date	Location	Position	Number	Behaviour	Comments
26.02	Tarrafel	N16 30.107 W24 21.469	12	Swimming slowly. Tail slapping.	With SFPW
07.03	Sao Nicolau	N16 34.161 W24 21.595	12 (1)	Spread out travelling, approached boat	Images

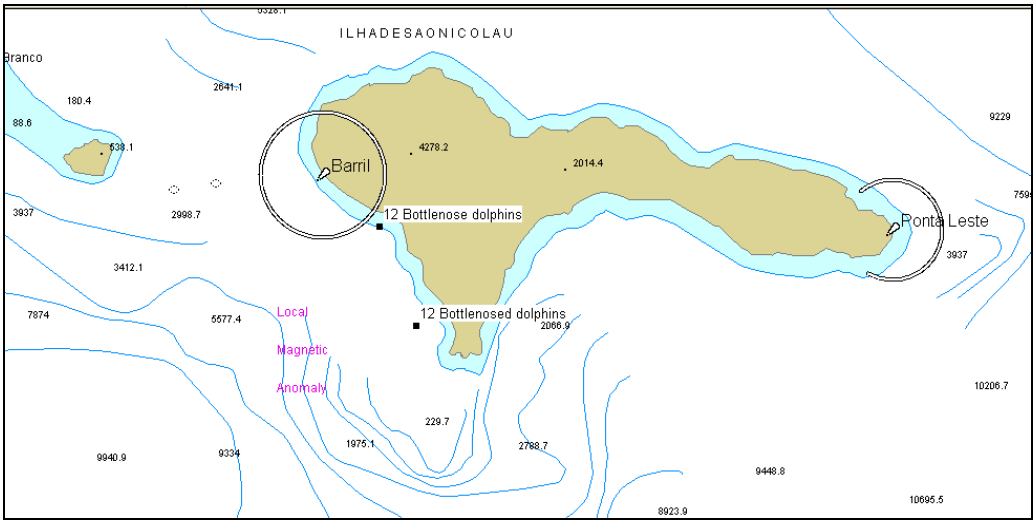


Figure. 5. Distribution of bottlenose dolphin sightings around Sao Nicolau

Pan-tropical Spotted dolphin *Stenella attenuata*

Four sightings of spotted dolphins were recorded on the same day, south of Sao Nicolau. They were identified as *Stenella attenuata* from the white tip on the beak of adults, dark cape and abundance of spots. Species identification is consistent with Hazevoet and Wenzel (2000).

Figure 6. Pan-tropical spotted dolphins off Sao Nicolau on 8 March 2006

On the first sighting adult dolphins only stayed with the vessel for a short period (<2 minutes) but five juveniles bow-rided for 20 minutes. They were all apparently foraging when first sighted with numerous surface rushes recorded. The second group consisted of juveniles and adults which stayed with the vessel for 30 minutes and the third group consisted of at least two and probably 3 adult-calf pairs. Thus there was apparently some segregation by age and sexual maturity. Photo-identification recorded at least seven individuals. Photo-identification although difficult, due to their fast surfacing, is possible and could be carried out opportunistically and might reveal something about their movements and longevity around Cape Verde.

Table 6 Summary of pan-tropical spotted dolphin sightings in Cape Verde 23 February – 26 March 2006

Date	Location	Position	Number	Behaviour	Comments
08.03	Sao Nicolau	N16 31.435 W24 23.390	10-20 (>5)	Some breaching	Images
08.03	Sao Nicolau	N16 22.255 W24 24.953	10		Images
08.03	Sao Nicolau	N16 20.083 W24 25.877	6	Bowriding	Acoustic recordings
08.03	Sao Nicolau	N16 16.154 W24 26.131	(>2)		Images

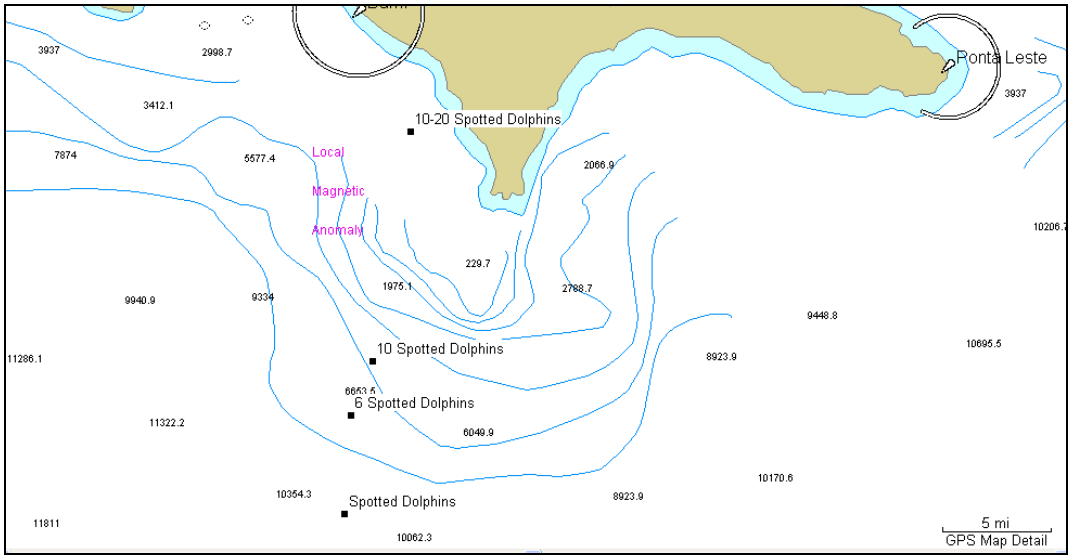


Fig. 7. Distribution of pan-tropical spotted dolphin sightings around Sao Nicolau

Short-snouted spinner dolphin *Stenella clymene*

There was one sighting of around 30 spinner dolphins off Maio on 5 March. They were identified as *Stenella clymene* due to falcate dorsal fin, dark cape and pale grey eye stripe from eye to flipper. These dolphins also approached the boat after we had pursued them for a short period and bow-rided for 2-30 minutes – this behaviour is more typical of short-snouted rather than long-snouted spinner dolphins. Hazevoet and Wenzel (2000) recorded just one sighting of spinner dolphins, which they attributed to *Stenella longirostris*.

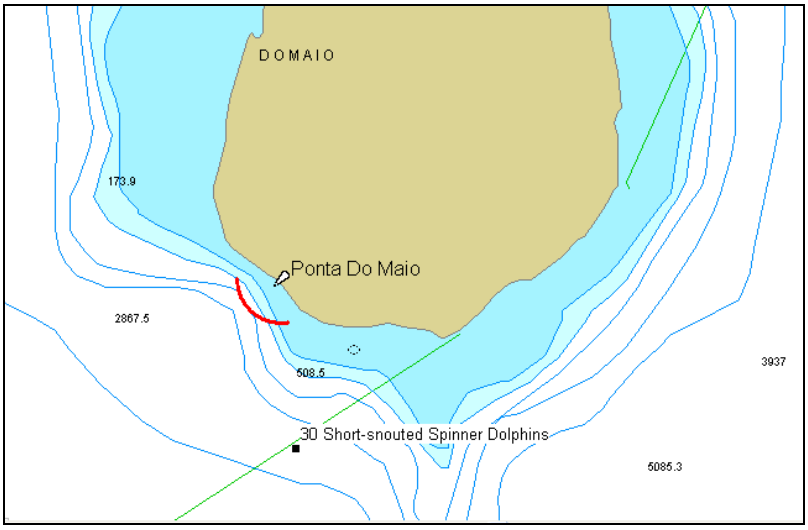


Fig. 8. Position of sighting of short-snouted spinner dolphin off Maio

Table 7. Summary of short-snouted spinner dolphin sightings in Cape Verde 23 February – 26 March 2006

Date	Location	Position	Number	Behaviour	Comments
05.03	Maio	N15 04.544 W23 12.859	30	Jumping	Images

Short-finned pilot whale *Globicephala macrorhynchus*

There was one sighting of short-finned pilot whales, a large group off Sao Nicolau, observed with around 12 bottlenose dolphins. Some of the adult males had very distinctive dorsal fins, including one with damage apparently caused by gillnets or other fishing gear. These distinctive individuals provide an excellent opportunity to carry out photo-identification to learn something about their movements and longevity around Cape Verde.

Table 8. Summary of short-finned pilot sightings in Cape Verde 23 February – 26 March 2006

Date	Location	Position	Number	Behaviour	Comments
26.02	Tarrafel	N16 30.107 W24 21.469	30-50	Logging with BND	Recordings and images.

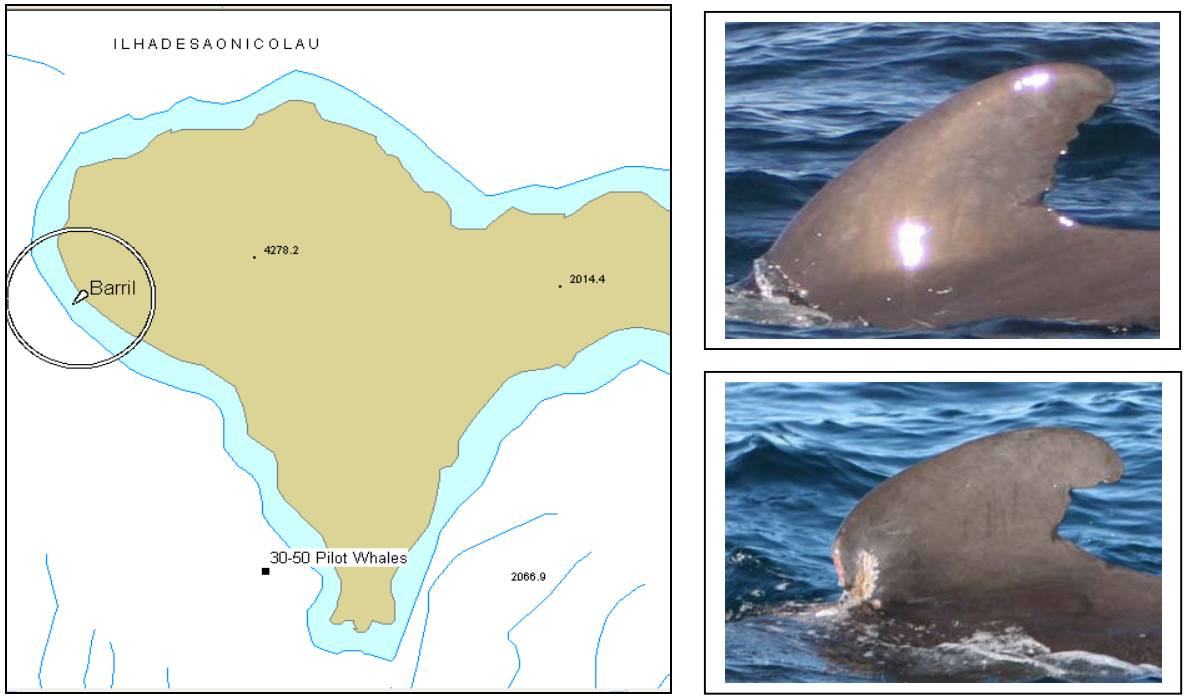


Figure 10. Position of short-finned pilot whale sighting off Sao Nicolau

Unidentified dolphins

There were five sightings of unidentified dolphins. Images were only obtained for one (see below), which although proved inconclusive were probably of rough-toothed dolphins.

Table 9. Summary of unidentified dolphin sightings in Cape Verde 23 February – 26 March 2006

Date	Location	Position	Number	Behaviour	Likely species
25.02	Tarrafel hbr	N16 34.437 W24 22.969	1	Surfaced twice next to boat in dark	Bottlenose dolphin
06.03	Maio	N15 27.050 W23 40.990	2-3	Swam by boat underwater	Rough-toothed
06.03	Maio-Sao Nicolau	N15 22.289 W23 37.642	1	Dolphin swam past boat	?
09.03	Sao Nicolau-Boavista	N16 15.354 W23 17.587	2	Approached boat briefly, half breach observed, tall dorsal fin, short snout	Rough-toothed (images)
20.03	Sao Nicolau	N16 32.374 W24 06.699	20	In distance, did not approach boat	Bottlenose dolphin

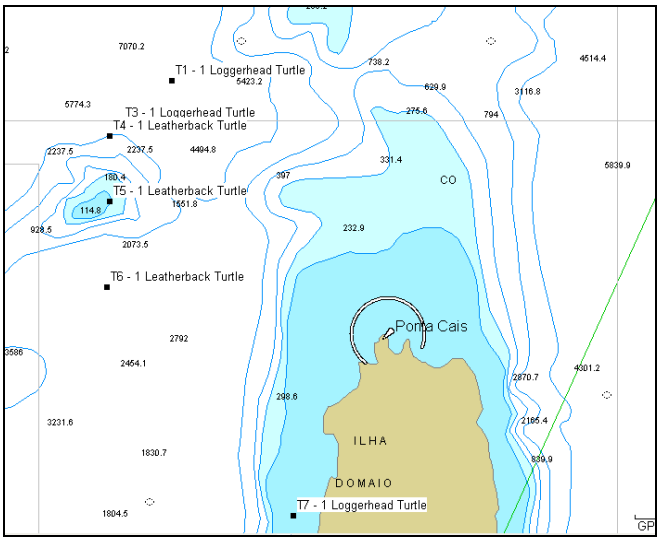
Turtles

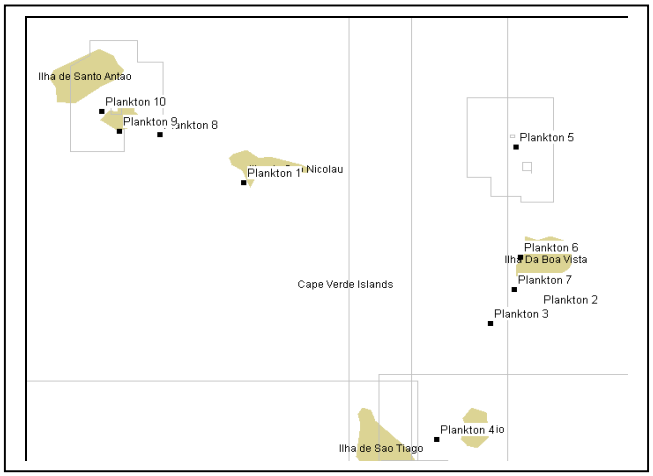
There were seven sightings of at least two species of marine turtle, most during a short period, on the shelf edge to the north of Maio.

Interestingly, during a visit to Saint Luzia on 22 March a fisherman, who was part of a group camping on the island, fetched a green turtle from his boat. After showing us this animal and informing us it had been caught incidentally on a fish line he returned it to the sea.

Table 10. Summary of turtle sightings in Cape Verde 23 February – 26 March 2006

Date	Species	Location	Position	Number	Behaviour
02.03	Loggerhead	Nr Maio	N15 31.870 W23 21.570	1	Swimming slowly
02.03	Loggerhead	Nr Maio	N15 29.890 W23 24.010	1	Swimming slowly
02.03	Loggerhead	Nr Maio	N15 29.890 W23 24.010	1	Swimming slowly
02.03	Leatherback	Nr Maio	N15 29.290 W23 24.570	1	Swimming slowly
02.03	Leatherback	Nr Maio	N15 26.190 W23 24.570	1	Swimming slowly
02.03	Leatherback	Nr Maio	N15 22.170 W23 24.720	1	Swimming slowly
05.03	? Loggerhead	Maio	N15 11.396 W23 15.688	1	





Plankton

Ten samples of phyto- and zooplankton were taken. Samples were taken from a wider range of water depths, geographical spread and current conditions as possible.

It is generally believed that although abundance and densities of plankton around Cape Verde are generally low, species diversity is high. A separate report will be produced once these samples are fully analysed.

Table 11. List of plankton samples taken in Cape Verde

Sample	Date	Location	Position	Sample Depth (m)	Water Depth (m)
1	26.02	Tarrafel, Sao Nicolau	N16 30.107 W24 21.469	40	200
2	28.02	Boavista	N15 50.304 W22 50.477	40	>1000
3	02.03	Boavista-Maio	N15 45.870 W23 05.670	30	100
4	04.02	Maio	N15 09.460 W23 22.158	30	>1000
5	12.02	Baia de Mordeira, Sal	N16 41.320 W22 57.670	15	20
6	16.02	Baia de Sal Rei, Boavista	N16 06.730 W22 56.490	15	20
7	18.02	Curralhino, Boavista	N15 56.670 W22 58.380	15	50
8	23.02	St Luzia	N16 45.320 W24 47.080	15	50
9	23.02	Sao Vicente	N16 46.240 W24 59.560	30	57
10	23.03	Mindelo, Sao Vicente	N16 52.490 W25 04.980	20	80

Photo-identification

Photo-identification was used extensively during this survey. It is a powerful technique but does have limitations and constraints. Images of individually recognisable individuals were obtained for humpback whales (fluke images) and five species of dolphin (rough-toothed, bottlenose, pan-tropical spotted, short-snouted spinner dolphins and short-finned pilot whales).

Photo-identification of humpback whales in Cape Verde has been carried out since 1991 and their is a well established photo-identification catalogue but similar studies on other species have not been carried out. Species such as rough-toothed and bottlenose dolphins could justify specific, targeted studies. Bottlenose dolphins can be found regularly off Tarrafel on Sao Nicolau and rough-toothed off Baia de Sal Rei on Boavista. Photo-identification of spotted, spinner and short-finned pilot whales would be more opportunistic but by encouraging researchers and tourists to collect and send any images taken to the Cape Verde authorities then very useful information about movements and their use of Cape Verde waters can be easily obtained.

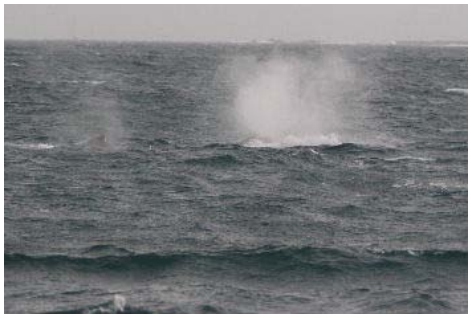
Table 12. List of species and occasions where images of dolphins, suitable for photo-identification were obtained

Species	Date	Location	Number	Comment
Bottlenose dolphin	07.03	Sao Nicolau	12 (1)	Images
Rough-toothed dolphin	01.03	Boavista	6	
Rough-toothed dolphin	15.03	Boavista	12	
Short-finned pilot whale	26.02	Tarrafel	30-50	Recording and images. Male with injured dorsal fin.
Short-snouted spinner dolphin	05.03	Maio	30	Images
Pan-tropical spotted dolphin	08.03	Sao Nicolau	10-20	Images

Images suitable for individual recognition were obtained from a total of 14 humpback whales (see Appendix I). Eleven of these are considered good images, two average (CVI_2006_8, CVI_2006_9) and one only a partial fluke (CVI_2006_12) was photographed.

Table 13. List of humpback whale photo-identification images were obtained

Encounter	Location	Number	Behaviour	Comments
Hump 1	Boavista	1	Breach/pectoral slapping	Adult with white patch on RHS of dorsal fin (CVI_2006_05)
Hump 2	Maio	3	Small (juv.) present	1 fluke (CVI_2006_01) + poor image of a second whale
Hump 3	Maio	2	1 breached twice	1 fluke image (CVI_2006_02)
Hump 6	Boavista	2 (1)	Adult with calf	Adult with slight speckling on RHS dorsal fin
Hump 7	Boavista	2 (1)	Breaching/tail slapping	Calf fluke image (CVI_2006_03)
Hump 8	Boavista	2		(CVI2006_04, CVI_2006_05)
Hump 9	Boavista	3 (1)	1 breaching	Fluke images (CVI_2006_06, CVI_2006_07(poor image))
Hump 10	Boavista	2		Fluke images (CVI_2006_08, CVI_2006_09)
Hump 11	Boavista	3-4		Fluke images - poor
Hump 12	Boavista	6 (2)		Fluke images (CVI_2006_10, CVI_2006_11, CVI_2006_12)
Hump 14	Curralinho	2		Fluke image (CVI_2006_13)
Hump 15	Curralinho	2 (1)		
Hump 16	Boavista	3	1 breaching	Images (CVI_2006_11, CVI_2006_14)


Preliminary examination of the 14 humpback whale fluke images obtained showed that five were re-sightings in Cape Verde (Wenzel, *pers. comm*.). Amazingly, two (CVI_2006_05 and CVI_2006_08) are re-sightings from the IWDG expedition to Cape Verde in 2003 (CVI_2003_08 and CVI_2003_07). There were no matches to any images contained in the Irish Humpback Whale Catalogue held by the IWDG. Copies of the Cape Verde images have been submitted to the North Atlantic Humpback Whale Catalogue, Bar Harbor, Maine, USA to see if there are any matches with whales photographed elsewhere in the North Atlantic.

A copy of all photo-identification images, for all species, has been lodged with INDP in Mindelo, Sao Vicente.

Acoustic recordings

No humpback whales were heard between 25 February and 8 March. A humpback whale was heard faintly at N16º22.50' W23º59.16' 9 March during a passage between Sao Nicolau to Boavista. Singing was heard in deep water (>2000m) about 13.5 nmls south of Ponta Leste off the east tip of Sao Nicolau and is likely this whale was on passage itself rather than the hydrophone picking up a whale singing from shallow continental shelf waters. No humpbacks whales were observed on return to Sao Nicolau between 20-22 March.

Singing at Boavista was also infrequent compared with 2003 where singing was heard nearly every day. We were in Boavista nearly one month earlier during 2006 which suggests singing off Boavista occurs later in the season. The best and longest duration of humpback singing was recorded on 16 March in Baia de Sal Rei. Two whales were singing for periods of 30-40 minutes and 2.5 hours of recordings were made. In order to keep as close to the whales as possible without disturbing them, short tracks were sailed over the position (see Fig. 1. 16 March detail) throughout the recordings.

In addition recording of short-finned pilot whales and bottlenose dolphins were recorded on 26 February off Sao Nicolau and short recordings of spotted dolphins on 8 March were also obtained.

Genetic samples

Only one biopsy attempt of humpback whales was made during the survey. This was due to the difficulties in approaching close enough to biopsy. However skin samples from 19 melon-headed whales *Peponocephala electra* were obtained from a mass stranding in 2003 on Saint Luzia. Skin could still be recovered from the carcasses and nineteen different individuals were sampled. No length or gender data could be obtained but each carcass was associated with a different crania to ensure samples were taken from different animals.

Susan Chivers from NOAA in La Jolla, California has expressed an interest in analysing these samples to test for genetic differences with samples from samples obtained from the Pacific.

Discussion

The second IWDG humpback whale expedition to Cape Verde recorded 36 sightings or encounters of seven species, during the 1200 nautical miles surveyed. Most sightings were of humpback whales but six species of odontocetes were also recorded.

Most sightings of humpback whales were around Boavista with three additional sightings of three animals (likely to be the same group) observed off Maio. No humpbacks were observed around Sao Nicolau, Branco, St Luzia and Sao Vicente despite considerable survey effort in good sea conditions. Humpbacks were heard singing off Sao Nicolau on one occasion but they were probably on passage as they were recorded in deep water (>1000m).

Fluke shots of 14 individual humpback whales were obtained and have been submitted to the North Atlantic Humpback Whale Catalogue for matches. Of these, five were re-sightings (two from the IWDG expedition in 2003). Such a high re-sighting rate suggests the abundance of humpbacks around Cape Verde is very low.

Around 2.5 hours of good recordings of humpback whale vocalisations were recorded and await analysis. Only one biopsy was attempted on a humpback whale and no genetic sample was obtained. However 19 skin samples of melon-headed whales were obtained from a mass stranding on St Luzia in 2003.

Potential for whalewatching and science-based tourism

There is potential for whale research and the development of wildlife tourism, including whalewatching in Cape Verde. A major constraint to whalewatching on humpback whales is unfavourable weather conditions, as whales occur only seasonally, through the winter and spring (December-April). However weather constraints have not stopped whalewatching developing in other locations with poor conditions, but development requires careful planning and infrastructure. Certainly in Boavista, where whales occur in highest abundance, close to shore and tourism is developing rapidly on the island, there is the potential for economically viable whalewatching. However Boavista, and especially Baia de Sal Rei, is the most important known site for humpback whales in Cape Verde and may be listed as "critical habitat for adult-calf pairs" and any tourism development must be carried out within a very strong framework to prevent excessive disturbance.

A framework for the development of whalewatching is proposed by Berrow (2003b) and should be considered if whalewatching is to be promoted in Cape Verde. These include monitoring, code of conduct, research and education. Done properly, whalewatching not only provides economic benefits, but can make a significant contribution to the conservation of cetaceans and their habitat. In Cape Verde the most successful operations are those that incorporate other marine areas of interest, such as turtle watching, as well as cetaceans into a tourism experience. Greater protection, than is currently implemented, may be required to ensure this very important habitat is not degraded.

Science tourism, as distinct from traditional tourism, can also contribute to the knowledge and conservation of marine biodiversity around Cape Verde (Merino and Berrow, 2004). It is important that visiting scientists are required to contribute sightings and photo-identification images to a Cape Verde Photo-identification catalogue for as many species as possible as well as facilitating Cape Verde researchers.

Impact of tourism development infrastructure

Cape Verde is currently experiencing unprecedented overseas investment. This investment is driving tourism infrastructure development on a number of islands including Sal, Boavista and Maio. This investment is welcome and essential to increase the standard of living and quality of life of the Cape Verde people, however in order to ensure the health of their environment it is important to put in place structures and policies to ensure this protection. The government of Cape Verde are signatories to the Biodiversity Convention, which requires countries to protect biodiversity and halt biodiversity loss by 2010.

The government of Cape Verde should be careful about which areas they allow infrastructure development. A balance between tourism and the environment will enhance tourism and not compete. People want to visit turtle breeding beaches, snorkel and dive on diverse reefs and have a sense of remoteness and wilderness and will pay extra for that privilege. Providing space for conservation and the protection of marine biodiversity as well as tourism infrastructure is essential.

Marine Protected Areas, such as that recently established around St Luzia should be encouraged as a management tool. Large areas of the Baia de Sal Rei, Boavista would be the most suitable site for the protection of humpback whales.

Investment companies also have a responsibility to ensure sensitive development and the maintenance of biodiversity. The latter would be facilitated by the development of a **Marine Research and Education Centre** in Sal Rei, Boavista. Boavista not only is the best site for breeding humpback whales but has very important turtle nesting sites, seabird breeding colonies and coral reefs. The centre should be located in the centre of town and provide high quality information on the marine life and biodiversity around Boavista and Cape Verde. Interpretation could include deploying a fixed hydrophone in the bay to enable visitors to listen to the sounds of singing humpback whales. Such a facility could enable benign acoustic monitoring and research as well as a unique visitor experience. A **Marine Research and Education Centre** could provide facilities for researchers both from within Cape Verde and overseas. By locating in Boavista, adjacent to a rapidly developing tourism industry, the cost of running such a facility could be partially funded by visits from tourists and collaborations with the developers. Such a facility could also be funded by people on volunteering holidays (e.g. http://www.earthwatch.org).

Summary and Recommendations

In summary, this survey has shown:

1. A total of 38 cetacean encounters were recorded during 1200 nmls of survey effort
2. At least seven species were recorded including six odontocetes (sperm whale, short-finned pilot whale, bottlenose, rough-toothed, pan-tropical spotted and short-snouted spinner dolphin) and one mysticete (humpback whale) were recorded
3. The waters around Boavista were the most important area surveyed for humpback whales in Cape Verde
4. Humpback whales off Boavista exhibited some degree of residency during the breeding season
5. There was a high re-sighting rate of individual humpback whales between years
6. Dolphins were frequently seen off Tarrafel on Sao Nicolau
7. Images of individually recognisable short-finned pilot whale, bottlenose, rough-toothed, pan-tropical spotted and short-snouted spinner dolphin were obtained and can form the basis of photo-identification catalogues

We recommend the following points should be considered in order to and ensure that the Cape Verde take full advantage of its' marine resources while ensuring that its marine biodiversity is protected and, where possible, enhanced:

1. The is potential for developing whalewatching, especially off Boavista,
2. Whalewatching should only be encouraged if a proper framework for sustainable development is in place
3. Baia de Sal Rei, at Boavista is a very important habitat for breeding humpbacks and adult-calf pairs and should be listed as "critical"
4. More photo-identification images of humpback whales are required to locate feeding grounds and to derive a robust abundance estimate
5. Visiting mariners (yacht charters, scientists) should be encouraged to contribute to photo-identification catalogues
6. Marine conservation and research should work with development companies to ensure that the marine environment, which is attracting visitors to Cape Verde, is not degraded by development but enhanced.
7. Marine biodiversity, including cetaceans, turtles, seabirds and reefs, should become part of the visitor experience and in turn, this tourism should fund marine research and education
8. A Marine Research and Education Centre could be established in Sal Rei, Boavista

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On both visits to Cape Verde we have had great support from Sonia Elys Merino and Vanda Monteiro at Instituto Nacional de Desenvolvimento da Pesca (INDP). There encouragement, together with that from colleagues Beatrice Jann and Fred Wenzel are the main reason why we have returned to Cape Verde. We hope it was worth the effort.

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Appendix I: Catalogue of individually recognisable humpback whales from Cape Verde in 2006

CVI_2006_1

CVI_2006_2

CVI_2006_3

CVI_2006_4

CVI_2006_5

CVI_2006_6

CVI_2006_7

CVI_2006_8

CVI_2006_9

CVI_2006_10

CVI_2006_11

CVI_2006_12

CVI_2006_13

CVI_2006_14