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Front cover | Capa: Red-veined darter *Sympetrum fonscolombii* (Selys, 1840), male, Barril, São Nicolau, 9 April 2009 (Richard Ek)

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Recent data on whales and dolphins (Mammalia: Cetacea) from the Cape Verde Islands, including records of four taxa new to the archipelago

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Keywords: Cetacea, whales, dolphins, Cape Verde Islands, distribution

ABSTRACT

Based on both stranding and sighting records, recent data on the status and distribution of whales and dolphins in the Cape Verde Islands are presented, including records of four taxa new to the archipelago, viz. Common minke whale *Balaenoptera acutorostrata*, Dwarf sperm whale *Kogia sima*, beaked whale *Mesoplodon* cf. *europaeus* and False killer whale *Pseudorca crassidens*. Distribution elsewhere in the tropical eastern Atlantic and some taxonomic issues are discussed.

RESUMO

São apresentados dados recentes sobre a distribuição de baleias e golfinhos em Cabo Verde, obtidos com base em registos de avistamentos e arrojamentos, incluindo quatro taxa novos para o arquipélago, viz. Baleia-anã *Balaenoptera acutorostrata*, Cachalote-anã *Kogia sima*, baleia-de-bico *Mesoplodon* cf. *europaeus* e Orca-bastarda *Pseudorca crassidens*. É igualmente discutida a distribuição no Atlântico leste tropical, bem como um conjunto de aspectos taxonómicos.

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INTRODUCTION

The Cape Verde Islands are situated in the eastern Atlantic, *ca*. 500 km west of Senegal, West Africa. The archipelago consists of 10 islands (nine of which are inhabited) and several uninhabited islets (Fig. 1). The total land area is 4,033 km², scattered over 58,000 km² of ocean. While the terrestrial climate is dry tropical, sea conditions are heavily influenced by the cool Canary current that flows from the north. Average sea surface temperatures range from 20º C in February-March to 26º C in September-October.

The occurrence of Cetacea in the archipelago of Cape Verde was most recently summarized by Hazevoet & Wenzel (2000), who listed 18 species, including one only tentatively identified (*Balaenoptera* cf. *borealis*), while records of another (Long-finned pilot whale *Globicephala melas*) are no longer considered valid (see account on Short-finned pilot whale *G. macrorhynchus* below).

During the past decade, a basic stranding scheme, coordinated by the second author (VM) at the *Instituto Nacional de Desenvolvimento das Pescas* (INDP) in Mindelo, São Vicente, has been developed, while the first author (CJH) aims to collect all information on cetacean distribution (both sightings and strandings) in the Cape Verde region. Combined, these efforts – designated the Cape Verde Cetacean Database – have resulted in a considerable increase in data having become available compared to pre-2000 years. However, much depends on the continued efforts of only a handful of people. For instance, the large number of stranding data from Boavista are almost solely due to the presence there of the third author (PL), who also maintains a modest collection of specimens, the Boavista Reference Collection (BVRC). In marked contrast, stranding data from the Fogo-Brava area (where there is only limited beach front and most coast consists of cliffs) are just about absent. Over the past 10 years, observation effort has also grown due to other factors. In addition to a number of dedicated pelagic surveys (see below), the growing popularity of Cape Verde as a holiday and/or birdwatching destination has resulted in an ever increasing number of opportunistic observations being reported. Moreover, a local whale-watching industry is emerging, particularly on the islands of Sal and Boavista, which have turned into ever expanding centres of tourism. It is expected that at least some of the data resulting from touristic whale-watching activities will be made available for inclusion in the Cape Verde Cetacean Database. Whale-watching has already resulted in a considerable number of fluke photos of Humpback whales *Megaptera novaeangliae*, thus contributing to 20 years of research on these migrant mysticetes in Cape Verde (cf. Wenzel *et al*. 2009).

Since Hazevoet & Wenzel (2000), the first documented occurrences of Fin whale *Balaenoptera physalus* in Cape Verde seas were published by Moore *et al*. (2003), while Torda *et al*. (2010) reported the first records of Fraser's dolphin *Lagenodelphis hosei*. Results of ongoing research on the wintering population of Humpback whales in Cape Verde were recently summarized by Wenzel *et al*. (2009). Jann *et al*. (2003) reported on a Humpback whale photographed in the Denmark Strait off Iceland and resighted in Cape Verde. Here we report on four cetacean taxa newly recorded in the Cape Verde region, as well as detailing records of a number of other species. These include strandings and incidental observations, as well as observations made during dedicated surveys aboard research vessels – the Spanish *Proyecto Hydrocarpo* in 2003 and 2005 (Anonymous 2006) and by the Irish Whale and Dolphin Group (IWDG) in 2003 and 2006 (Berrow 2003, 2006).

The current paper does not intend to comprehensively overview all cetacean taxa recorded in the Cape Verde region. While all stranding data that we are aware of have been included (except for one unidentified rorqual *Balaenoptera* sp.), sightings of some of the commoner species (e.g. *Steno bredanensis*, *Stenella attenuata*, *S. frontalis*, *Globicephala macrorhynchus*) are not detailed as these were too numerous for the present purpose.

METHODS

The geographical limits of the study area are broadly defined as latitudes 14º-18º and longitudes 22º-26ºW. A few records just outside this range have been included when they add significantly to the status information of the species in Cape Verde seas. Records prior to 2000 were compiled by Hazevoet & Wenzel (2000) and, with few exceptions, data herein stem from the years 2000-2010, although older records are included when appropriate. Two sources of data were employed, i.e. sightings and strandings. The latter were verified through photographs, documented voucher skulls or skeletal specimens. Sightings were accepted when detailed written descriptions and/or photographs were available, or when recorded by an experienced observer familiar with the species concerned. Taxonomy follows Rice (1998). In the following, 'West Africa' refers to those countries bordering the tropical East Atlantic coast from Mauritania in the north to Angola in the south.

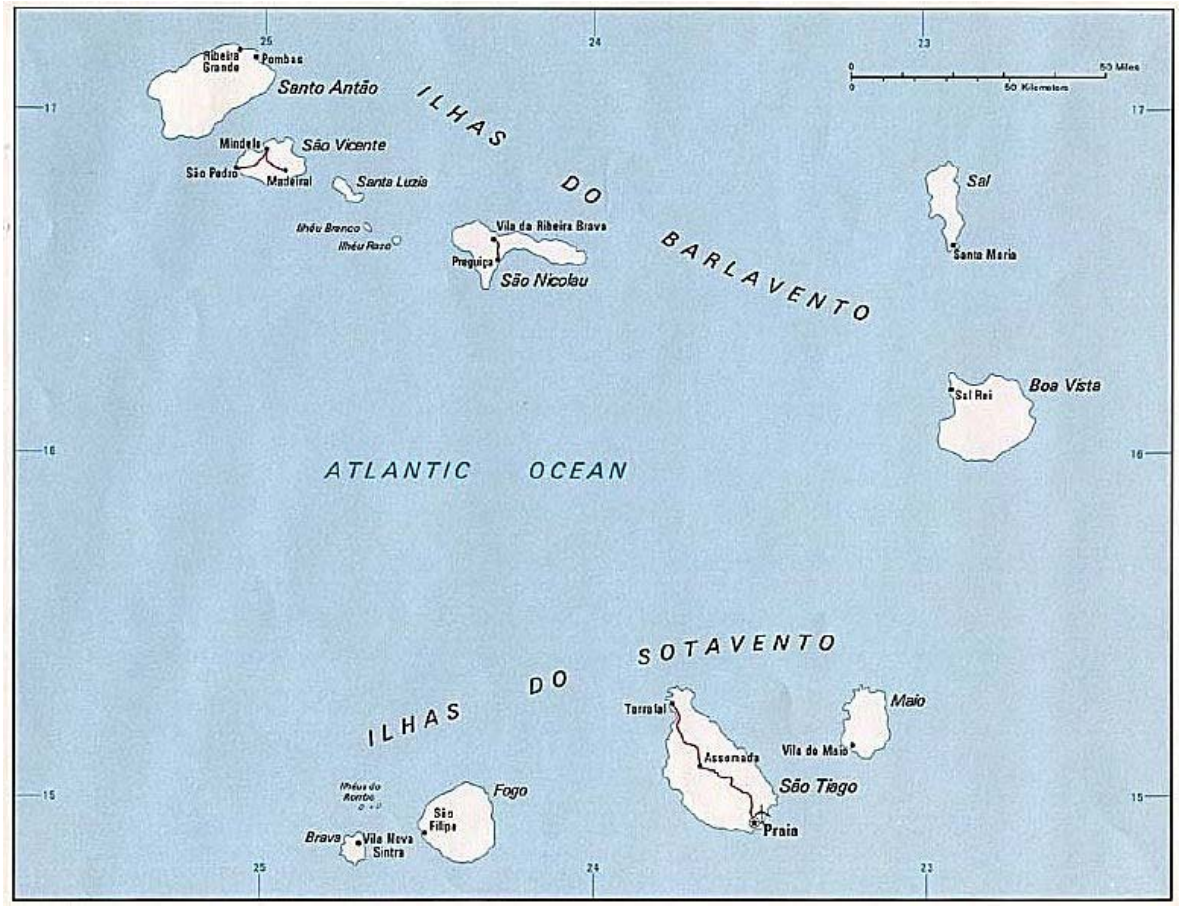

Fig. 1. Map of the Cape Verde Islands.

SPECIES ACCOUNTS

Common minke whale *Balaenoptera acutorostrata* Lacépède, 1804

A Common minke whale (length 4-5 m) was found stranded at Praia de Boa Esperança, Boavista, 12 May 2000 (Fig. 2). The animal showed three parallel cuts on its left flank and rostrum, clearly marks of a collision with a ship's propeller. General morphology, size and white patches on the flippers confirmed the identification as Common minke whale. The skull was preserved, but unfortunately was subsequently destroyed by dogs.

This is the first documented record of *B. acutorostrata* for the Cape Verde Islands. Previously, a juvenile whale, stranded at Cidade Velha, Santiago, 2 November 1983, photographs of which appeared in a local newspaper (see Hazevoet & Wenzel 2000), was said to be "likely a minke whale" by Lagendijk (1984), but listed (without further reasoning) as Fin whale *B. physalus* by Reiner *et al.* (1996). Subsequently, the animal was identified as probably a Sei whale *Balaenoptera* cf. *borealis* (Hazevoet & Wenzel 2000).

Common minke whale occurs in the Atlantic and Pacific Oceans, as well as at tropical latitudes in the southern hemisphere (Rice 1998). In West Africa, there are sightings off Western Sahara, strandings from Mauritania and Senegal, possible sightings off The Gambia (Van Waerebeek *et al.* 1999) and a bycatch landing from Guinea (Bamy *et al.* 2010). The collision of a minke whale with a ship's propeller off Boavista is only the second documented case of a whale struck by a vessel in West Africa, after a Sei whale was brought into the port of Dakar, Senegal, on the bow bulb of a container ship (Félix & Van Waerebeek 2005).

Fig. 2. Common minke whale *Balaenoptera acutorostrata*, Praia de Boa Esperança, Boavista, 10 May 2000 (Nuria Varo).

Fig. 3. Bryde's whale *Balaenoptera brydei*, 20º55'N, 22º25'W, 20 October 2009 (Mike Greenfelder).

Bryde's whale *Balaenoptera brydei* Olsen, 1913

A Bryde's Whale was observed at 20˚55'N, 22˚25'W, 20 October 2009 (Fig. 3), and another was seen within one mile of Porto Novo, Santo Antão, 21 October 2009 (Mike Greenfelder & Richard White *in litt.*). Both animals showed the diagnostic three ridges on the rostrum. Previously, Hazevoet & Wenzel (2000) reported a cow and calf off Tarrafal, São Nicolau, 28 September 1988, and a stranded calf on Boavista, 29 February 1996 (both listed as *B. edeni*).

'Bryde's whales' occur in tropical and subtropical oceans around the world. The taxonomy of the Bryde's whale *B. edeni/brydei* complex is confused and in need of further study (Perrin & Reeves 2004). Until recently, most authors followed Junge (1950), who considered *edeni* and *brydei* to be conspecific, a conclusion now deemed premature (cf. Rice 1998, Mead & Brownell 2005). Although in recent years considerable effort has been made in clarifying the taxonomy of these whales, studies have mostly dealt with Indo-Pacific populations (e.g. Perrin *et al.* 1996, Yoshida & Kato 1999, Kanda *et al.* 2007), while Atlantic populations have not been considered so far. Pending results of further research and following Best (2007), we refer Atlantic populations to *brydei*.

Due to possible confusion with Sei whale *B. borealis*, the status of Bryde's whale in the East Atlantic off West Africa is unclear. Ruud (1952) reported catches of Bryde's whale off Gabon, Congo and Angola. There are two (both juvenile) stranding records from Senegal (Cadenat 1955, Van Waerebeek *et al.* 2000, 2003), while at least some of several unidentified balaenopterids stranded on the Senegalese coast during the 1940s and 1950s may have been Bryde's whales (Van Waerebeek *et al.* 2000). There are also stranding records from Western Sahara

(Notarbartolo di Sciara *et al.* 1998) and Guinea (Bamy *et al.* 2010). Weir (2010a) concluded that many of the whaling records from the Gulf of Guinea, referred to as Sei whale in whaling logs, were in fact Bryde's whale and listed catches off Côte d'Ivoire, Ghana, Gabon, São Tomé, Annobón (Equatorial Guinea), Congo and Angola. Weir (2007) found Bryde's whale to be the most numerous *Balaenoptera* whale off Angola, with a total of 19 sightings during surveys in 2004 and 2005. Additionally, they were common off southern Angola during the summer in coastal waters (Weir 2010b) and nine sightings were obtained in waters off Gabon in March-August 2009 (de Boer 2010b). Recent sightings (including cow and calf pairs) have also been reported from the Azores (<10; Steiner *et al*. 2007) and the Canary Islands (>100; Ritter & Neumann 2006), together with the Cape Verde records indicating a regular occurrence in the northeastern subtropical to tropical Atlantic.

Sperm whale *Physeter macrocephalus* Linnaeus, 1758

Sperm whale was the second most important target (after Humpback whale) for 19th century whalers in Cape Verde seas and, based on logbooks of American whaleships, Townsend (1935) mapped a large number of catches from the area. During the years 2000-2010, sightings of Sperm whale were regularly reported and the species is apparently still widespread in Cape Verde seas. Indeed, with 25 sightings and 16 acoustical records in seven weeks, Moore *et al.* (2003) found the Sperm whale to be the most commonly detected cetacean around the Cape Verde archipelago during surveys in November-December 2000, when it was commonly found in waters deeper than 500 m, north and west of Sal and Boavista, and between Boavista and São Nicolau. We are aware of four stranding events during the past 10 years, each involving a single animal (Table 1).

Date	Sex & length	Location	Source
10 January 2003	pregnant ♀, TL 11.5 m	Praia do Norte, São Vicente	INDP
22 October 2005	sex unknown, TL 8 m	Ponta Preta, Sal	INDP
8 March 2006	♀, TL 7.5-8 m	Praia de Roque, Boavista	INDP, PL
28 May 2009	unknown	Pedra Badejo, Santiago	Expresso das Ilhas

Table 1. Strandings of Sperm whale *Physeter macrocephalus* in the Cape Verde Islands during the years 2001-2010. INDP – Instituto Nacional de Desenvolvimento das Pescas; PL – Pedro López.

The Sperm whale occurs throughout the deep waters of all the world's oceans and confluent seas, from the equator to the edges of the polar pack ice (Rice 1998). There are many records from the tropical East Atlantic (e.g. Townsend 1935, Cadenat 1954, 1956, Slijper *et al.* 1964, Van Waerebeek *et al.* 2000, 2009, Weir 2007, 2010a, de Boer 2010b), with females and immatures being present throughout the year and adult and sub-adult males migrating to higher latitudes in spring/summer, returning to lower latitudes in winter (Rice 1989, 1998).

Dwarf sperm whale *Kogia sima* (Owen, 1866)

The carcass of a kogiid of unknown sex and in an advanced state of decomposition was found at Ponta Forno Cal, Boavista, in late August 2004. The skull and mandible were preserved (Fig. 4), but subsequently lost. The specimen was identified as Dwarf sperm whale *Kogia*

sima rather than Pygmy sperm whale *K. breviceps* because of 1) the short and rounded snout compared to the more elongated snout of *breviceps* (only in juveniles of *breviceps* the rostrum is slightly less in length than width); 2) the short mandibular symphysis (long in *breviceps*); 3) the left and right cranial fossae being similar in shape and size (left fossa being conspicuously longer and narrower than right fossa in *breviceps*); 4) the sagittal septum at the vertex being noticeably narrow (thick-set in *breviceps*) (cf. Owen 1866, Handley 1966, Ross 1979, Nagorsen 1985, Caldwell & Caldwell 1989, Porter & Morton 2003). The mandibles of both *K. sima* and *K. breviceps* are unusually delicate for a toothed whale, often being paper thin and translucent (Caldwell & Caldwell 1989), and often resulting in broken mandibles during skeletal preparation (cf. Fig. 4).

Fig. 4. Skull and mandible of Dwarf sperm whale *Kogia sima*, Ponta Forno Cal, Boavista, 3 September 2004 (Nuria Varo).

This is the first documented record of Dwarf sperm whale for the Cape Verde Islands. A listing, without further details, for Cape Verde (Martin *et al.* 1992) is not accepted. The precise geographic range of *K. sima* is unknown, but stranding records suggest that it is distributed throughout tropical and warm temperate waters worldwide (Nagorsen 1985, Caldwell & Caldwell 1989, Jefferson *et al.* 1993). In West Africa, there are stranding records from Senegal (Maigret & Robineau 1981) and a bycatch landing from Ghana (Van Waerebeek *et al.* 2009). There are also stranding records from the Canary Islands (Hutterer 1994) and the Azores (Gonçalves *et al.* 1996). Weir (2007) reported 14 sightings of *K. sima* offshore of northern Angola, noting that it was the fifth most commonly sighted cetacean in Angolan waters during surveys in 2004 and 2005.

Based on cytochrome *b* sequencing, Chivers *et al.* (2005) found two reciprocally monophyletic groups within *K. sima*, one Indo-Pacific and the other Atlantic, but these authors stopped short of formally recognizing a third species of *Kogia* because of a lack of additional molecular and biological evidence. Should further research justify recognizing a third *Kogia* based on a division between Indo-Pacific and Atlantic populations, then the latter would be in need of a new name, as the type locality of *Physeter* (*Euphysetes*) *simus* Owen, 1866 is Andhra Pradesh (formerly Madras Presidency), India.

Cuvier's beaked whale *Ziphius cavirostris* (G. Cuvier, 1823)

Three individuals were seen at 14º49´N 24º36´W (depth 1,000 m), east of Brava, 4 September 2003, two at 14º55´N 23º40´W (depth >500 m), southwest of Santiago, 5 September 2003, and again two at 15º32´N 23º02´W (depth 1,600 m), north of Maio, 6 September 2003 (Proyecto Hydrocarpo). The animals off Santiago and Maio were seen taking 2-3 breaths before diving. Identification of these individuals was based on the characteristic brownish body colour, the small falcate dorsal fin at the rear third of the body length and tail shape, which was clearly seen before the deep dive. Two of the individuals

east of Brava were breaching 3-4 times and, apart from the characteristics mentioned above, the characteristic short and blunt head and body shape were noted (photographs of these observations exist, but these are currently unavailable due to logistical reasons).

The only previous record of Cuvier's beaked whale in the Cape Verde region was of a group of five individuals at 14º19´N 23º13´W, just south of the archipelago (Haase 1987). Cuvier's beaked whale occurs in all temperate and tropical oceans around the world (Rice 1998, MacLeod *et al.* 2006). In West Africa, there are stranding records from Mauritania and Senegal (Robineau & Vély 1998, Van Waerebeek *et al*. 2000), and a landing from Ghana (Van Waerebeek *et al.* 2009), while Weir (2006) observed the species off Angola. There are numerous stranding and sighting records from the Canary Islands (e.g. Vonk & Martin Martel 1988, 1989, Martin *et al*. 1992, 2004, Aguilar de Soto *et al.* 2007).

Beaked whale *Mesoplodon* cf. *europaeus* (Gervais, 1855)

Four beaked whales *Mesoplodon* sp., probably including a mother and calf pair, were seen at 16º32'N, 22º52'W (depth 500-1,000 m), south of Santa Maria, Sal, 11 February 2010 (Fig. 5-6). The adults were *ca.* 4.5-5 m in length, the presumed juvenile *ca.* 3-3.5 m.

More than 20 photographs were obtained of these animals, but none clearly showed the beak, rendering specific identification problematic. Therefore, a number of experts on the identification of *Mesoplodon* whales were consulted. Based on the photographs, Diane Claridge and Vidal Martin (*in litt.*) identified these whales as Gervais' beaked whale *M. europaeus*, because of the unique dorsal colouration pattern, characterized by a dark line on the back, with vertical fringes or streaks along the flanks of the dorsum. These characteristics have not been described previously in the literature, but are now considered diagnostic of *M. europaeus* and have been genetically confirmed through biopsy samples (Diane Claridge and Vidal Martin *in litt.*). However, as this concerns as yet unpublished information, we refrain from unambiguously referring the animals seen off Sal to *M. europaeus*. Besides, colour may be lighter in an active animal dissipating body heath, whereas an inactive animal may appear dark grey to black (Norman & Mead 2001).

This constitutes the first record of *Mesoplodon* whales for the Cape Verde Islands. Gervais' beaked whale is endemic to the warm-temperate to tropical Atlantic (MacLeod *et al.* 2006). In West Africa, it is known from strandings in Mauritania (Robineau & Vély 1993, 1998) and Guinea-Bissau (Reiner 1980). In the Canary Islands, there have been 23 strandings and 30 well-documented at sea observations since 1980 (Vonk & Martin Martel 1988, Martin *et al.* 1990, 2004; Vidal Martin *in litt.*).

Fig. 5-6. Beaked whales *Mesoplodon* cf. *europaeus*, off southern Sal, 11 February 2010 (Linda Aspden).

Rough-toothed dolphin *Steno bredanensis* (G. Cuvier *in* Lesson, 1828)

First reported from the region in 1989 (Hazevoet & Wenzel 2000), Rough-toothed dolphin is now known to be amongst the commoner dolphin species occurring in Cape Verde seas. Over the past decade many sightings were reported and it was the dolphin species most frequently encountered during the IWDG surveys in April 2003 and February-March 2006 (Berrow 2003, 2006). We know of three strandings – a single animal (sex unknown), 2.45 m in length, at Praia de Estoril, Boavista, 7 March 2001 (INDP, PL), a live stranding of a juvenile in bad condition at Praia de Ervatão, Boavista, 3 October 2010 (PL), and a mass stranding of 43 animals at Praia de Estoril and 10 at nearby Ilhéu de Sal Rei, Boavista, out of a group of *ca.* 100 that appeared close to the shore (of which *ca.* 50 were returned to the sea with the help of local people or managed to return to the open sea by themselves), 19 October 2010 (A Nação, Expresso das Ilhas; Fig. 7). In addition, a Rough-toothed dolphin was landed by local fishermen at Santa Maria, Sal, 15 August 2010 (BG). It is unknown if this was caught as bycatch or deliberately taken. A mandible (without number or further data) of the species is kept at the INDP premises in São Vicente.

Rough-toothed dolphin is distributed in deep tropical and subtropical oceanic waters worldwide (Miyazaki & Perrin 1994) and is probably found throughout the tropical and subtropical East Atlantic (cf. Jefferson *et al.* 1997, de Boer 2010a, b, Weir 2010a).

Fig. 7. Rough-toothed dolphins *Steno bredanensis*, Praia de Estoril, Boavista, 20 October 2010 (Mário Évora/A Nação).

Pantropical spotted dolphin *Stenella attenuata* (Gray, 1846)

Pantropical spotted dolphin is thought to be one of the commoner dolphin species in Cape Verde seas and numerous sightings were reported over the past 10 years. Only a single stranding came to our notice. On 1 April 2005, 17 Pantropical spotted dolphins stranded at Praia de Laginha in the town of Mindelo, São Vicente (INDP; Fig. 8). With the help of the local population, these dolphins were returned to the sea and were not seen or heard of thereafter. An alleged record of *ca.* 30 Clymene dolphins *S. clymene* off southern Maio, 5 March 2006 (Berrow 2006), in fact concerned Pantropical spotted dolphins, as demonstrated by photographs of the animals.

Pantropical spotted dolphin occurs in tropical and subtropical seas worldwide between *ca.* 40ºN and *ca.* 40ºS (Perrin 2001). It is likely to be widely distributed off West Africa. However, because at sea identification of spotted dolphins can be difficult for inexperienced observers, the possibility of confusion with *S. frontalis* exists. Morever, as the taxonomy of these dolphins was only sorted out by Perrin *et al.* (1987), it is often unclear to which taxon records previous to that date should refer. Distribution off West Africa is poorly understood and was summarized by Jefferson *et al.* (1997) and Weir (2010a). The latter specified a number of cases in which *attenuata* had been wrongly identified as *frontalis* and *vice versa*. For detailed information on the identification of Pantropical spotted dolphin, see Perrin (2001).

Fig. 8. Pantropical spotted dolphins *Stenella attenuata*, Praia de Laginha, Mindelo, São Vicente, 1 April 2005 (Carlos Pulú).

Atlantic spotted dolphin *Stenella frontalis* (G. Cuvier, 1829)

Like its pantropical congener, Atlantic spotted dolphin ranks amongst the dolphin species most often encountered in Cape Verde waters and there were numerous reports of sightings (including photographic evidence) over the past 10 years. Only a single stranding was reported to us. A total of *ca.* 30 Atlantic spotted dolphins stranded at Praia da Chave, Boavista, 29 and 30 April 2006 (Fig. 9-10), of which 11 adults and three juveniles died, while the remainder were retuned to the sea by local people (INDP, PL).

Atlantic spotted dolphin is endemic to the tropical and warm-temperate Atlantic, from *ca.* 45ºN to *ca.* 35ºS in the west and from the Azores, Madeira, the Canary Islands and Mauritania to Angola in the east (Perrin 2002, Weir 2007, 2010a, de Boer 2010b). As in Pantropical spotted dolphin, proper understanding of its distribution is hampered by identification problems and its confused taxonomy in the past. For detailed information on the identification of Atlantic spotted dolphin, see Perrin (2002).

Fig. 9-10. Atlantic spotted dolphin *Stenella frontalis*, immature and adult, Praia da Chave, Boavista, 29 April 2006 (Pedro López).

Melon-headed whale *Peponocephala electra* (Gray, 1846)

Prior to the year 2000, only two records of Melon-headed whale were known from Cape Verde, i.e. one found at Praia do Norte, São Vicente, 10 July 1993, and one harpooned by fishermen off Tarrafal, São Nicolau, 16 December 1994 (cf. Reiner *et al*. 1996, Hazevoet 1999, Hazevoet & Wenzel 2000), but a considerable number of records has become known since. Strandings during the years 2001-2010 are summarized in Table 2. Of three animals stranded at Praia de Santa Monica, Boavista, 8 November 2003, two were returned to the sea by fishermen, while the other died. At Baía da Murdeira, Sal, 20 October 2005, seven of the nine stranded animals were returned to the sea by volunteers, while two died. Of *ca*. 70 animal stranded at Praia de Boca da Salina, Boavista, 19 November 2007, *ca.* 65 were refloated by volunteers, while five remained grounded and died.

In addition, the following sightings of Melon-headed whale were reported: 20-50 animals at 16º43´N 24º39´W, northeast of Santa Luzia, 23 May 2005 (Proyecto Hydrocarpo), 75-100 animals traveling eastwards in various smaller groups, off the southern tip of Brava, 30 September 2008 (Mike Greenfelder *in litt.*), *ca.* 15 between Sal and Boavista, 2 October 2009 (BG), and *ca.* 100 at 16º47'N, 24º48'W, between Santa Luzia and São Vicente, 9 October 2010 (PL).

Date	Number	Location	Source
August 2001	>30, incl. adults and young	Praia de Abrolhal, Boavista	INDP, PL
27 September 2001	one adult ♂, TL 240 cm	Praia de Boca da Salina, Boavista	INDP, PL
1 October 2003	*ca.* 150	northern shore of Maio	INDP
1 November 2003	165, incl. several pregnant ♀♀	Praia dos Achados, Santa Luzia	INDP
8 November 2003	three, incl. adult ♂, TL 270 cm	Praia de Santa Monica, Boavista	INDP, PL
6 May 2004	54, incl. several pregnant ♀♀	Ponta Rica de Porto Cais, Maio	INDP
20 October 2005	nine	Baía da Murdeira, Sal	INDP
17 November 2007	*ca.* 265	Praia da Chave, Boavista	GG, MR
19 November 2007	*ca.* 70	Praia de Boca da Salina, Boavista	GG, MR

Table 2. Stranded Melon-headed whales *Peponocephala electra* in the Cape Verde Islands during the years 2001-2010. INDP – Instituto Nacional de Desenvolvimento das Pescas; GG – Gabriella Gatt; MR – Manuel Rodrigues; PL – Pedro López.

Fig. 11. Melon-headed whales *Peponocephala electra*, Praia da Chave, Boavista, 18 November 2007 (courtesy of Gabriella Gatt).

In view of the number of strandings and sightings and the number of animals involved, we may conclude that Melon-headed whale occurs commonly in Cape Verde seas. Melon-headed whale is distributed throughout the world's tropical and subtropical deep oceanic waters, mostly from 20ºN to 20ºS, with records from temperate regions probably representing strays (Jefferson & Barros 1997, Rice 1998). Reports from West Africa are scarce (cf. Jefferson *et al*. 1997), with records from Mauritania (Robineau & Vély 1998), Senegal (van Bree & Cadenat 1968), Guinea-Bissau (Van Beneden & Gervais 1880, van Bree & Duguy 1977), Ghana (Ofori-Danson *et al.* 2003, Van Waerebeek *et al.* 2009), off Gabon (Findlay *et al.* 2006, de Boer 2010b) and off Angola (Weir 2007, 2010a).

Melon-headed whale is highly gregarious, occurring in groups of up to 500 animals, with apparently strong social bonds (Jefferson & Barros 1997). Mass strandings of up to 250 animals have been reported (Jefferson & Barros 1997, Southall *et al.* 2006, Brownell *et al.* 2009), rendering the events on Boavista in November 2007 (Table 2; Fig. 11) amongst the largest known so far (cf. Brownell *et al.* 2006).

False killer whale *Pseudorca crassidens* (Owen, 1846)

Photographs of a mass stranding at Praia do Canto, Boavista, involving 14 False killer whales (Fig. 12), were kindly put at our disposal by Mr. José Geraldo Évora of Boavista. The precise date of the event could not be determined anymore, but this was either during the late 1980s or early 1990s. Apparently, all animals died on the beach. A single animal of unknown sex, *ca*. 2.5-3 m in length, was found at Praia de João Barrosa,

Fig. 12. False killer whale *Pseudorca crassidens*, Praia do Canto, Boavista, *ca.* 1990 (courtesy of José Geraldo Évora).

Boavista, 22 July 2007 (Fig. 13). In addition, the right mandible of a False killer whale (BVRC 025) was retrieved from an indeterminate beach on Boavista at some time during the last decade.

These are the first documented records of False killer whale for the Cape Verde Islands. Previously, Odell & McClune (1999) mapped a single record, without a source or further details, near the Cape Verde archipelago. False killer whale occurs worldwide in tropical to warm temperate seas, usually in deep offshore waters (Stacey *et al.* 1994, Rice 1998), but records from West Africa are few. A skull was collected in Côte d'Ivoire (van Bree (1972), Ofori-Danson *et al.* (2003) listed a record from Ghanaian coastal waters, Debrah *et al.* (2010) reported landings from Ghana, Van Waerebeek *et al.* (2001) reported a specimen from Benin, Van Waerebeek & De Smet (1996) detailed a live stranding from Gabon and there has been at least one sighting off Gabon (Findlay *et al.* 2006). Weir (2007) recorded nine sightings (including pods of up to 35 animals) offshore of Angola.

Fig. 13. False killer whale *Pseudorca crassidens*, Praia de João Barroso, Boavista, 22 July 2007 (Carlos Angulo Preckler).

Killer whale *Orcinus orca* (Linnaeus, 1758)

A female or juvenile male Killer whale was photographed by yachtsmen off western Boavista, 21 September 2001 (Fig. 14). The animal in the photograph shows a medium-sized and horizontally oriented eye-patch and no cape, thus – at least in outward appearance – corresponding to type A of Pitman & Ensor (2003), the 'regular' Killer whale of worldwide distribution. Whether the Killer whales occurring in Cape Verde would genetically

correspond to ENA (Eastern North Atlantic) type 1 of Morin *et al.* (2010) remains to be seen, due to the lack of sampling in the tropical Atlantic. ENA type 1 contains animals previously categorized as a generalist type (North Atlantic type 1) that includes individuals specializing on fish and individuals that are thought to predate both fish and mammals (Foote *et al.* 2009).

Hazevoet & Wenzel (2000) listed a single sighting record of Killer whale for the Cape Verde Islands, i.e. a pod of nine animals south of Sal, 29 February 1996. Killer whales are distributed throughout the world's oceans, although they are more common at high latitudes (Dahlheim & Heyning 1999). Records from West Africa were summarized by Jefferson *et al.* (1997); see also Hammond & Lockyer (1988), Van Waerebeek *et al.* (2009), Weir (2010a) and Weir *et al.* (2010).

Fig. 14. Killer whale *Orcinus orca*, off western Boavista, 21 September 2001 (Wolfgang Ensbacher).

Short-finned pilot whale *Globicephala macrorhynchus* Gray, 1846

During the past decade, seven stranding events of Short-finned pilot whale have come to our attention (Table 3). In the late October/early November 2009 stranding, carcasses were spread over a large stretch of beach, with most between 16º13'N, 22º44'W and 16º12'N, 22º45'W (Fig. 15). The two strandings in June 2010 received considerable attention in the local press (cf. Table 3; note that the photograph in the *Expresso das Ilhas* report does not pertain to the stranding event on Sal), as well as on television.

Date	Number	Location	Source
5 August 2002	1 ♂, 8 ♀♀	Praia de Escurralete, Santo Antão	INDP
25 January 2003	>12 adults	Praia de Boa Esperança, Boavista	INDP, PL
21 June 2003	5 adults, 1 juv	Praia das Gatas, Boavista	INDP, PL
late Oct/early Nov 2009	46, incl. >10 ♂♂, 4 juv	Praia do Carvão and Praia de Abrolhal, Boavista	PL
19 June 2010	*ca.* 50	Praia do Coqueiro, Santa Cruz, Santiago	A Semana
19 June 2010	42	Praia de Monte Leão, Sal	A Semana Expresso das Ilhas
28 September 2010	3 ♂♂, 2 ♀♀	Praia de Boa Esperança, Boavista	GG, MR

Table 3. Stranded Short-finned pilot whales *Globicephala macrorhynchus* in the Cape Verde Islands during the years 2001-2010. INDP – Instituto Nacional de Desenvolvimento das Pescas; GG – Gabriella Gatt; MR – Manuel Rodrigues; PL – Pedro López.

Fig. 15. Short-finned pilot whales *Globicephala macrorhynchus*, Mindelo, São Vicente, 6 August 2002; stranded at Praia de Escurralete, Santo Antão, 5 August 2002 (Carlos Pulú).

Fig. 16. Short-finned pilot whales *Globicephala macrorhynchus*, Praia de Abrolhal, Boavista, 8 November 2009 (Pedro López).

Fig. 17. Short-finned pilot whales *Globicephala macrorhynchus*, Praia do Coqueiro, Santa Cruz, Santiago, 19 June 2010 (Eneias Rodrigues/A Semana).

Fig. 18-19. Short-finned pilot whales *Globicephala macrorhynchus*, Praia de Monte Leão, Sal, 19 June 2010 (Jacquie Cozens/www.sostartarugas.org).

Mass strandings of Short-finned pilot whale have been a long known phenomenon in the islands and in the past the meat of these whales was readily flensed and often preserved for later consumption (cf. Hazevoet & Wenzel 2000). Today, on Boavista, teeth of stranded pilot whales are often extracted for use in the production of tourist souvenirs. The animals on Santiago and Sal in June 2010 were removed and burried within a day by the local authorities, thus preventing any proper investigation of the events. Short-finned pilot whale is one of the commoner cetaceans occurring in the Cape Verde region (Hazevoet & Wenzel 2000) and apart from the strandings listed here, many live sightings were reported during the last 10 years.

Short-finned pilot whales inhabit tropical to warm-temperate seas worldwide. In the East Atlantic, they occur from the Azores, with occasional records as far north as the Bay of Biscay, to Angola in the south (Nores & Pérez 1988, Prieto & Fernandes 2007, Weir 2007, 2010a).

A stranding record of 5-8 Long-finned pilot whales *Globicephala melas* on Sal in March 1995 (Hazevoet & Wenzel 2000) is no longer accepted. Identification was carried out in the field, but no specimens were preserved or photographs made. Moore *et al.* (2003) referred skulls of 34 pilot whales found on the eastern shore of Boavista in December 2000, to *G. melas.* As no photographs of these skulls were published and no specimens were preserved, it is impossible to establish their taxonomic identity. Moore *et al.* (2003) gave some cranial measurements, but these are not diagnostic as there is a large degree of overlap in condylobasal length between the two taxa (cf. van Bree 1971). Earlier, Lagendijk (1984) – who surveyed Cape Verde seas in March 1984 – reported sightings of both *G. melas* and *G. macrorhynchus*, without, however, specifying how these were distinguished.

In the eastern North Atlantic, the southernmost record of *G. melas* is from 17º13'N in Mauritania (Robineau & Vély 1998). Prieto & Fernandes (2007) reported two confirmed sightings of *G. melas* from the Azores in 2003 and 2006 and reviewed previous references to the species in that archipelago, finding them unsubstantiated. Similarly, a pilot whale caught in Madeira in June 1936 was reported as *G. melas* (Nobre 1938), but the published photographs show it to be *G. macrorhynchus*. In the Canary Islands, where *G. macrorhynchus* is common, there are only two records of *G. melas*, i.e. one each from the eastern islands of Lanzarote and Fuerteventura (specimens in the Museo de Cetáceos de Canarias, Lanzarote; Vidal Martin *in litt.*). Properly distinguishing between the two species of pilot whale only became widespread after van Bree (1971) had shed light on their taxonomy. There are no validated records of Long-finned pilot whale for the Cape Verde Islands and its occurrence there should be regarded as unsubstantiated.

DISCUSSION

During the past 10 years, there has been a considerable increase in observation effort of cetaceans in Cape Verde, resulting in a previously unheard of number of records. For instance, whereas Hazevoet & Wenzel (2000) were able to report only a handful of records of Melon-headed whale *Peponocephala electra*, Rough-toothed dolphin *Steno bredanensis*, Common dolphin *Delphinus* sp., Striped dolphin *Stenella coeruleoalba*, Pantropical *S. attenuata* and Atlantic spotted dolphin *S. frontalis*, all of these have been frequently reported during the past 10 years and are now known to regularly occur in the study area. Sightings of Short-finned pilot whale *Globicephala macrorhynchus* and Bottlenose dolphin *Tursiops truncatus*, both already considered common by Hazevoet & Wenzel (2000), were also frequently reported. No stranding records of Common dolphin, Striped dolphin or Bottlenose dolphin were received. Species most often observed during the Proyecto Hydrocarpo surveys in August–September 2003 and May 2005 were Short-finned pilot whale, Pantropical spotted dolphin and Atlantic spotted dolphin (Anonymous 2006), while Rough-toothed dolphin was the cetacean most often seen during the IWDG surveys in April 2003 and February-March 2006 (Berrow 2003, 2006). During the years 2000-2010, no records were received of Risso's dolphin *Grampus griseus* and Spinner dolphin *S. longirostris*, both of which have been reported from Cape Verde seas in the past (cf. Reiner *et al.* 1996, Hazevoet & Wenzel 2000). Reiner *et al.* (1996) reported the sighting of a Blue whale *Balaenoptera musculus*, but there have been no recent reports of the species. So far, beaked whales *Mesoplodon* spp. have remained exceedingly rare, with only the very first known sighting being reported here. Whether this reflects a true pattern of spatial and numerical distribution or merely reflects their elusive behaviour remains to be established.

Only few bycatches or purposeful catches of cetaceans have come to our attention and their incidence in Cape Verde artisinal fisheries is apparently low at present. However, as a large foreign (predominantly Japanese and Korean) fishery fleet roams Cape Verde seas, we do not know what is really going on in this connection and investigation of the matter is warranted.

During the years 2007-2010, at least six mass strandings took place on the islands of Sal, Boavista and Santiago. In each of these cases, the stranded animals were removed and burried immediately after the event by the local authorities and no proper pathological investigation was carried out. Although health concerns have been given to justify these speedy actions, at the same time they have given rise to conspiracy theories amongst the general public, as they were perceived as an indication that the authorities "were trying to hide the true cause" of these strandings, the implication being that the dolphins had become victims of the use of sonar by submarines or other naval activities. However, without proper investigation, any guess as to the cause of these strandings amounts to mere speculation. It is therefore highly desirable that in case of future mass strandings, qualified personnel are given the time and opportunity to carry out autopsies and collect samples soon after the event and before any removal actions are undertaken. Indeed, empiricism is what is most needed if we want to come closer to an understanding of the many possible causes that may give rise to cetacean mass strandings (Bradshaw *et al.* 2006).

With the possible exception of Humpback whale (cf. Wenzel *et al.* 2009), despite the recent increase of attention given to cetaceans in Cape Verde, knowledge of their spatial and temporal distribution in the region is only just beginning to take shape. Observers who visit Cape Verde and its seas are urged to either publish their observations or to make them available to the present authors for inclusion in the Cape Verde Cetacea Database, maintained simultaneously in São Vicente and Lisbon.

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The effects of tourism, beachfront development and increased light pollution on nesting Loggerhead turtles *Caretta caretta* (Linnaeus, 1758) on Sal, Cape Verde Islands

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Keywords: Cheloniidae, Loggerhead, *Caretta caretta*, threats, conservation, Cape Verde Islands

ABSTRACT

Loggerhead *Caretta caretta* is now the only species of marine turtle nesting on the island of Sal, Cape Verde Islands. Since 2008, ADTMA - SOS Tartarugas has patrolled all the southern beaches of the island in order to protect nesting females and to collect nesting data. Although hunting is still a major issue, with 90 turtles killed in 2009, habitat loss and light pollution are becoming an ever more serious threat. Construction sites, hotels, apartment buildings and restaurants close to beaches, bright lights and illegal removal of sand are contributing to a marked decrease in the total number of nesting turtles on some beaches. In 2009, beaches on Sal experienced an average increase in nests of 200%, while the beach most affected by construction (Tortuga Beach) saw a decrease of nests of 7.3% (from 19.1% of total number of nests in 2008 to 11.8% in 2010). This beach also recorded a much lower nest to emergence ratio than normal (17.6% of emergences resulting in nests compared to 29.9% in other areas), indicating reluctance to nest due to light pollution and other disturbances.

RESUMO

Actualmente, a tartaruga-comum *Caretta caretta* é a única tartaruga marinha a nidificar na ilha do Sal, Cabo Verde. A organização ADTMA-SOS Tartarugas tem vindo, desde 2008, a monitorizar todas as praias do sul da ilha de forma a proteger as fêmeas e a recolher dados relativos à nidificação. Apesar da caça continuar a ser um problema, com 90 tartarugas mortas em 2009, a perda de habitats e a poluição luminosa são ameaças cada vez mais significativas. Estaleiros de construção, hotéis, blocos de apartamentos e restaurantes perto das praias, a iluminação intensa e a remoção ilegal de areias têm vindo a contribuir para um acentuado decréscimo no número total de tartarugas em algumas praias. Em 2009, as praias do Sal tiveram um aumento médio do número de ninhos de 200%, embora a praia mais afectada pela construção (Tortuga Beach) teve um decréscimo de ninhos de 7.3% (19.1% em 2008 para 11.8% em 2010 no número total de ninhos). Esta praia também registou uma razão entre rastos e ninhos muito mais baixa do que é normal (17.6% de rastos resultantes em ninhos, comparado com 29.9% noutras áreas), indicativa de uma relutância em nidificar devido à poluição luminosa e a outras perturbações.

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INTRODUCTION

In 2008, the *Associação das Amigos das Tartarugas do Ambiente (ADTMA) - SOS Tartarugas* was founded to protect nesting Loggerhead turtles *Caretta caretta* on the island of Sal, Cape Verde Islands. When the project began only occasional surveys of the nesting population had been done and no work had taken place regarding the impact of tourism development on habitat and the behaviour of turtles. Prior to 2008, the Câmara Municipal (City Hall) of Sal island, implemented patrols in conjunction with the National Armed Forces. However, this did not include data collection, so no information existed on the number of turtles, nests or turtles being killed.

The island of Sal has few resources and must exploit the good weather and long, sandy beaches for tourism. This has resulted in a dramatic increase in apartments and hotels on the south and south-western side of the island (cf. Fig. 16). Marine turtles are protected by law (Decreto Lei No 7/002) and any disturbance could (in theory) result in a fine or a jail sentence. The law allows construction 80 m from the high water mark, but this regulation is not always adhered to or enforced.

The south-western shore of the island has, in the past, been the highest density nesting area on the island (Gonçalves 2007), but construction has had a significant impact on the quality and availability of beaches available to turtles.

Fig. 1. Algodoeiro in 2008.

At the start of the 2008 nesting season, Algodoeiro was undisturbed by construction (Fig. 1), but during the season, work on the resort of Paradise Beach began (Fig. 2), soon to be followed by Cotton Bay (cf. Fig. 16). During 2009, construction of Tortuga Beach began, as well as work on desalination facilities by Aguas Ponta Preta which led to open ditches for a large part of 2009 and 2010.

Fig. 2. Algodoeiro in 2010.

In 2010, some parts of Tortuga Beach are occupied, work has begun on Dunas Beach resort and continues on Paradise Beach and Cotton Bay. Throughout the various phases of building there has been disturbances through increased lighting, noise from night-time work, compaction of sand and loss of habitat due to ditches, debris and fences (Fig. 3-4).

It has previously been noted that coastal development is a major hazard to marine turtles, as the destruction of nesting space can result in decline and local extinction. Light pollution has been noted to affect the site choice of nesting females and to disorientate hatchlings. This leads to an increase in hatchling mortality and a decrease in nesting attempts by females (Witherington 1992).

The increase of tourists to Sal island has also seen more unregulated turtle walks on the beaches at night. Due to lack of knowledge, unauthorised guides often interrupt nesting or destroy nests through not following established international guidelines for viewing nesting turtles. Even worse, guides have been known to allow turtles to be killed by hunters. Further loss of habitat is caused by increased amount of beach furniture and permanent structures as more beach bars and restaurants are constructed (Fig. 5-6).

In this study, three years of data have been analysed specifically comparing areas with tourism development and areas without, to give an indication of the effects of construction and lights on nesting behaviour, the number of nests and any disorientation of adults and hatchlings turtles.

Fig. 3-6. In clockwise order: Open ditches at Algodoeiro; Paradise beach fench, 40 m from sea; Watersports centre increasingly encroaching on nesting beach (Angulo's Surf Centre, Santa Maria); Beach furniture and inappropriate lighting (Odjo D'Agua Hotel, Santa Maria).

METHODS

During the years 2008-2010, patrols have been conducted working in two shifts during the night from the beginning of June until the end of October (21.00 PM – 01.00 AM & 01.00 AM – 06.00 AM) on Algodoeiro, Costa Fragata and Serra Negra (Fig. 7). In addition, morning surveys were conducted between 06.00 and 10.00 AM from the beginning of June until the end of November to collect data from smaller beaches and beaches not patrolled regularly at night. A bi-weekly island survey was conducted to collect data from all northern nesting beaches. Data are collected for every turtle emergence. Rangers record a minimum of time, date, beach, high water mark, activity type and GPS position as well as additional observations, including disorientation or difficulty in constructing a nest. Nests in areas where emerging hatchlings are likely to be affected by lights were relocated to one of two hatcheries or to another part of the beach. Hatchling orientation was evaluated by analysing the direction of tracks after hatching for those left *in situ*. Data have been collected for two full nesting seasons in 2008 and 2009 and data collection is underway in 2010. For the purposes of this paper, data from 12 June to 7 September are being compared for all three years.

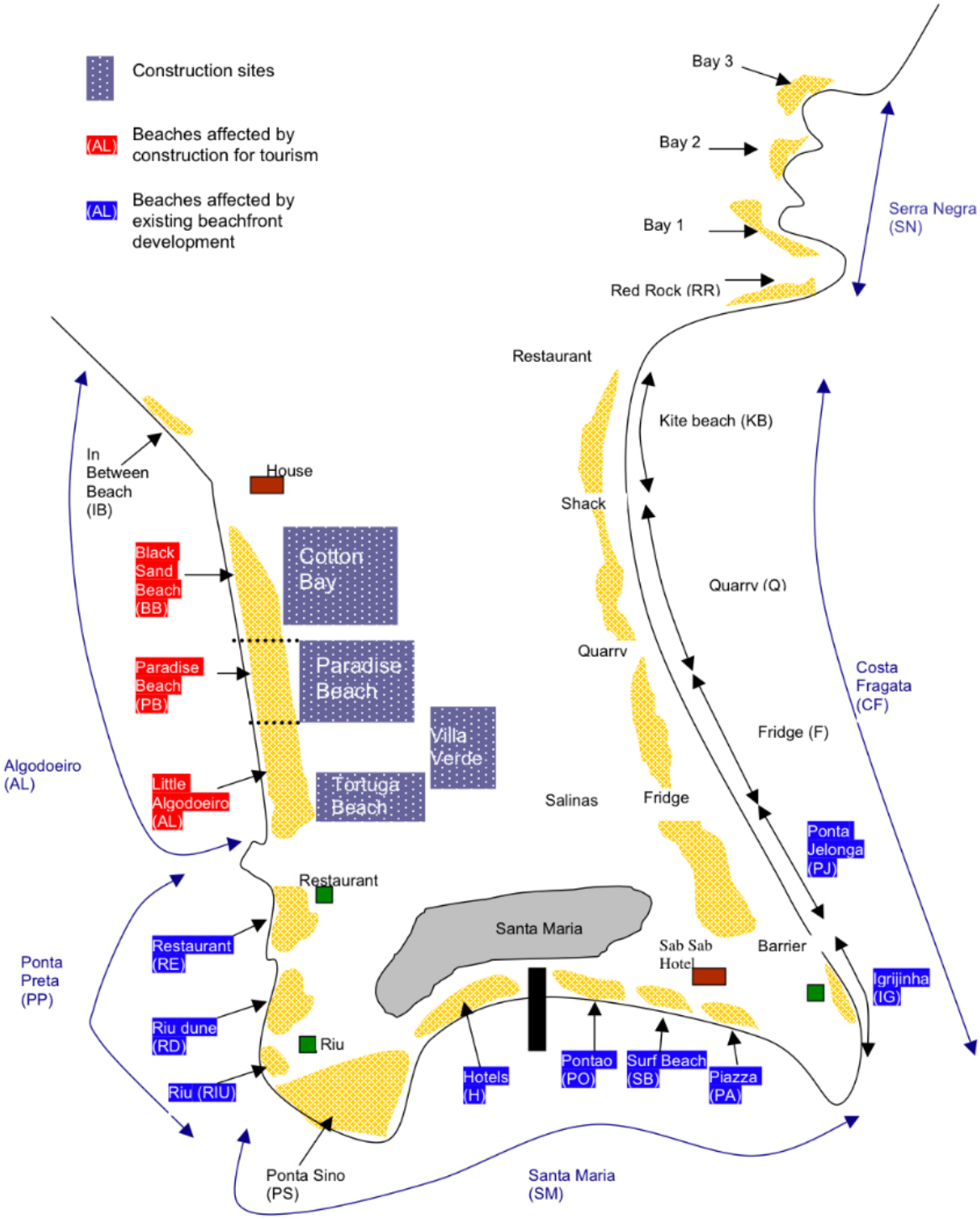

Fig. 7. Map showing the locality of Loggerhead nesting beaches in the southern part of Sal.

RESULTS

In the first year of the project (2008), a total of 1238 tracks and 347 nests were recorded (Cozens 2009). In 2009, in common with all islands in Cape Verde, the number of nests increased substantially to 3590 tracks, of which 1037 were nests (Lino *et al.* 2010). Preliminary data on turtle activities in 2010 show a slight increase when compared to 2008, with a current total of 1369 activities, 357 of which are nests (Fig. 8).

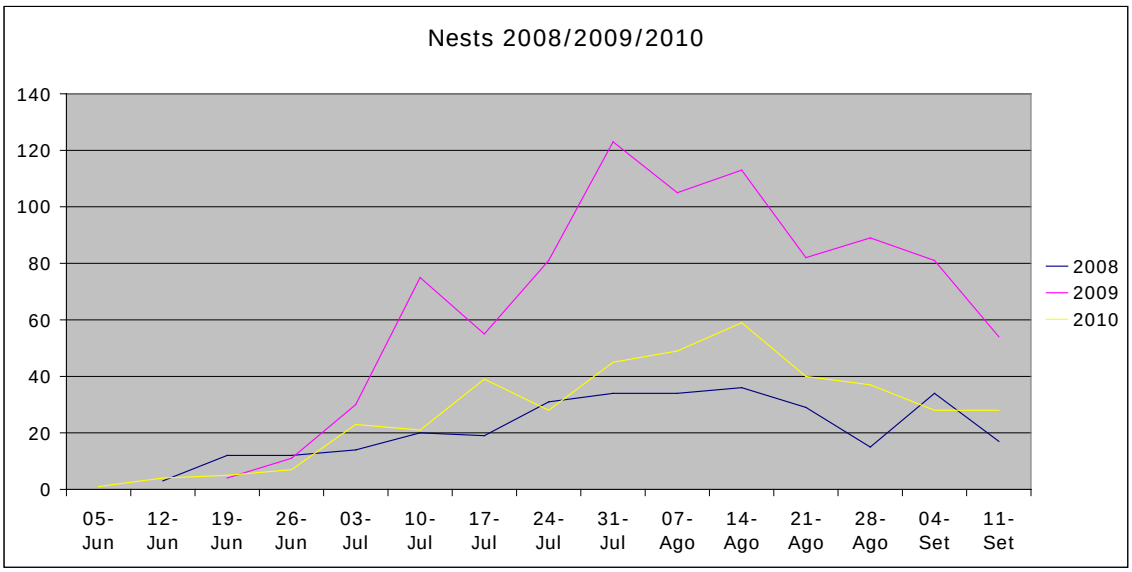

Fig. 8. Number of nests on Sal, 2008-2010.

Over the last three years, the sections of the beach known as Ponta Jelonga (Costa Fragata/east coast) and Black Sand Beach (Algodoeiro/west coast) (Fig. 7) have consistently had the highest percentage of the total number of nests, accounting for 25% of all nests on Sal (Table 1). However, if Serra Negra is taken as a whole (since the sections are much smaller than those on Costa Fragata or Algodoeiro), it accounts for between 15% and 29% of all nests and shows a marked increase over the three years (Fig. 9).

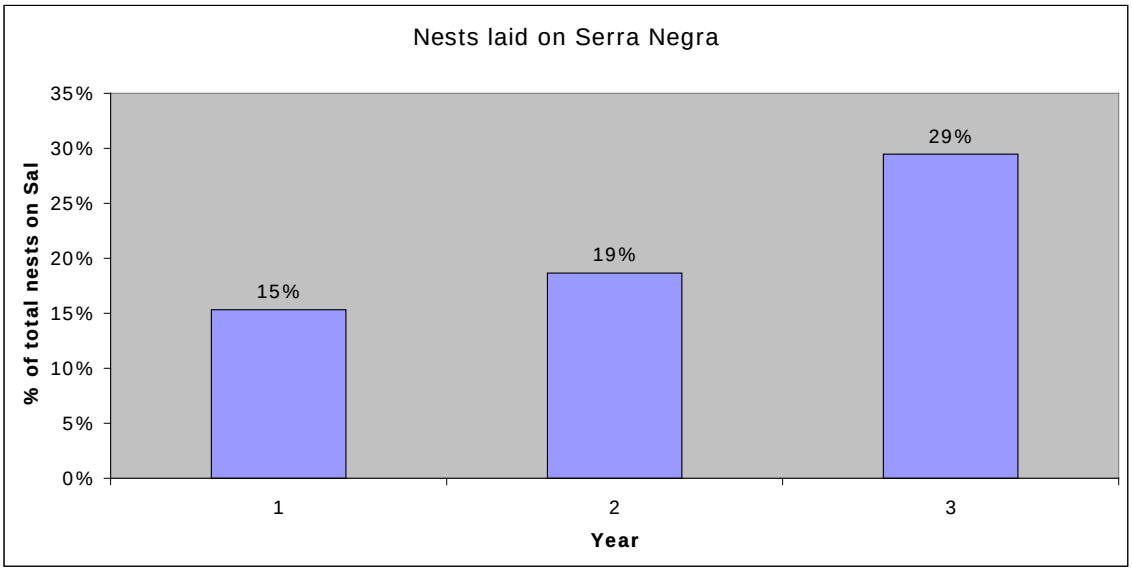

Fig. 9. Number of nests on Serra Negra, Sal, 2008-2010.

Beach	Section of beach	Number of nests			% of total nests		
		2008	2009	2010	2008	2009	2010
Serra Negra	B1	12	49	35	3,50%	4,60%	9,60%
	B2	20	56	27	5,80%	5,20%	7,40%
	B3	12	52	26	3,50%	4,90%	7,20%
	RR	9	43	19	2,60%	4,00%	5,20%
Costa Fragata	KB	7	68	19	15,30%	6,30%	5,20%
	Q	18	111	29	5,20%	10,40%	8,00%
	F	24	57	20	6,90%	5,30%	5,50%
	PJ	47	151	45	13,60%	14,10%	12,40%
Santa Maria	PA	8	1	1	2,30%	0,10%	0,30%
	SB	5	27	3	1,40%	2,50%	0,80%
	PO	1		0	0,30%	0,00%	0,00%
	H	1	9	0	0,30%	0,80%	0,00%
	PS	9	20	8	2,60%	1,90%	2,20%
Ponta Preta	RIU	5	24	6	1,40%	2,20%	1,70%
	RD	13	14	5	3,80%	1,30%	1,40%
	RE	6	9	7	1,70%	0,80%	1,90%
Algodoeiro	AL	27	54	15	7,80%	5,00%	4,10%
	PB	39	136	28	11,30%	12,70%	7,70%
	BB	38	119	48	11,00%	11,10%	13,20%
	IB	10	8	1	2,90%	0,70%	0,30%
Northern Beaches	CADJ	5	5	4	1,45%	0,47%	1,10%
	CFUND	3	15	3	0,87%	1,40%	0,83%
	MUD	4	6	1	1,16%	0,56%	0,28%
	MAD		1	1	0,00%	0,09%	0,28%
	ML	20	32	5	5,78%	2,99%	1,38%
	PL	0	1		0,00%	0,09%	0,00%
	JP	1	2	2	0,29%	0,19%	0,55%
	CAL	1		2	0,29%	0,00%	0,55%
	FJ		1	1	0,00%	0,09%	0,28%
	PAR	1	1	2	0,29%	0,09%	0,55%

Table 1. Distribution of Loggerhead nests on Sal Island, 2008-2010. The two sections with the most nests are highlighted (consistently accounting for 25% of all nests).

Over the past three years, Paradise Beach (PB) and Little Algodoeiro (AL), the areas most affected by construction sites (Cotton Bay, Paradise Beach, Tortuga Beach and Dunas Beach resort) have shown a decreasing trend in the total percentage of nests being laid in the area (Fig. 10).

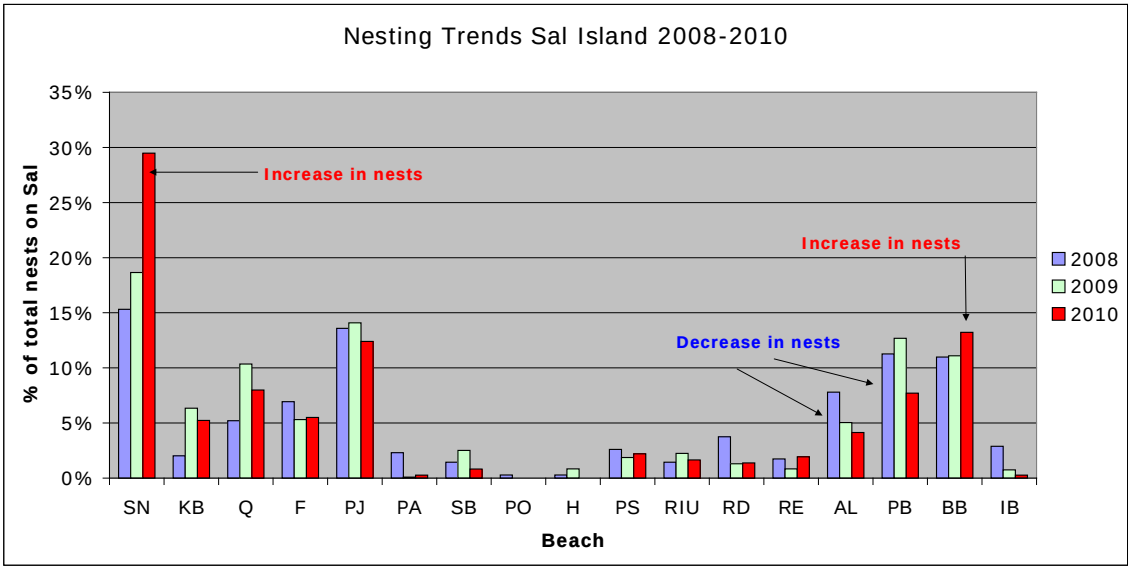

Fig. 10. Increasing number of nests laid on beaches with no development versus decreasing number laid on those with development, Sal, 2008-2010.

Nesting on Little Algodoeiro (AL) has almost halved since 2008 and Paradise Beach (PB) saw a small increase in 2009, but has now dropped below 2008 figures by around 3%, almost 5% lower than 2009. Santa Maria (SM), the area most affected by existing hotels, restaurants and bars has also seen a marked decrease in nesting over the three years (Fig. 11).

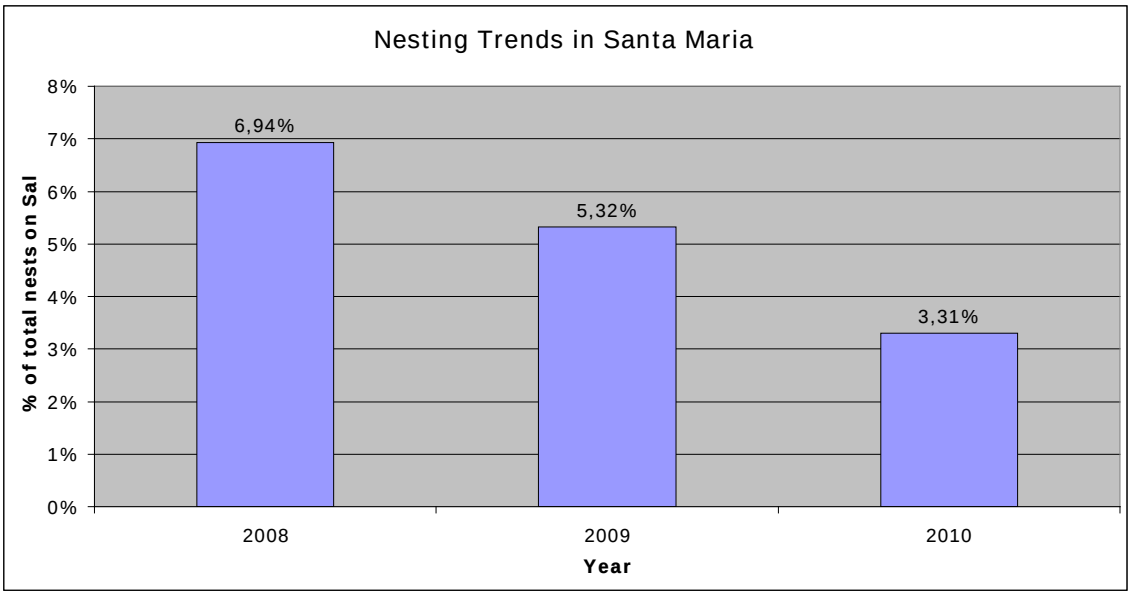

Fig. 11. Decreasing number of nests laid on beaches in Santa Maria with tourism facilities (bars, restaurants, hotels, apartments etc.), 2008-2010.

Over the last three seasons, nests that been have left in these brightly lit areas have seen emergent hatchlings become disorientated by the lights, heading to construction sites, bars, hotels and restaurants instead of the sea (Cozens 2009). An increasing number of nests have required relocation in the area around the construction sites due to the threat of light pollution and in 2009 and 2010 removal of every nest outside Tortuga Beach/Resort Group (AL) was necessary. This is also the case for nests in Santa Maria (SM). By contrast, no nests have ever been relocated from Serra Negra (SN) due to lights and very few on Costa Fragata (CF) require relocation for this reason. On the island as a whole, there is an increasing need for nests to be relocated due to light pollution. Between 2008 and 2010, there was an increase of 23.76% in the number of nests moved due to the threat of hatchling disorientation caused by lights, from 7.23% in 2008 to 30.99% in 2010 (Fig. 12).

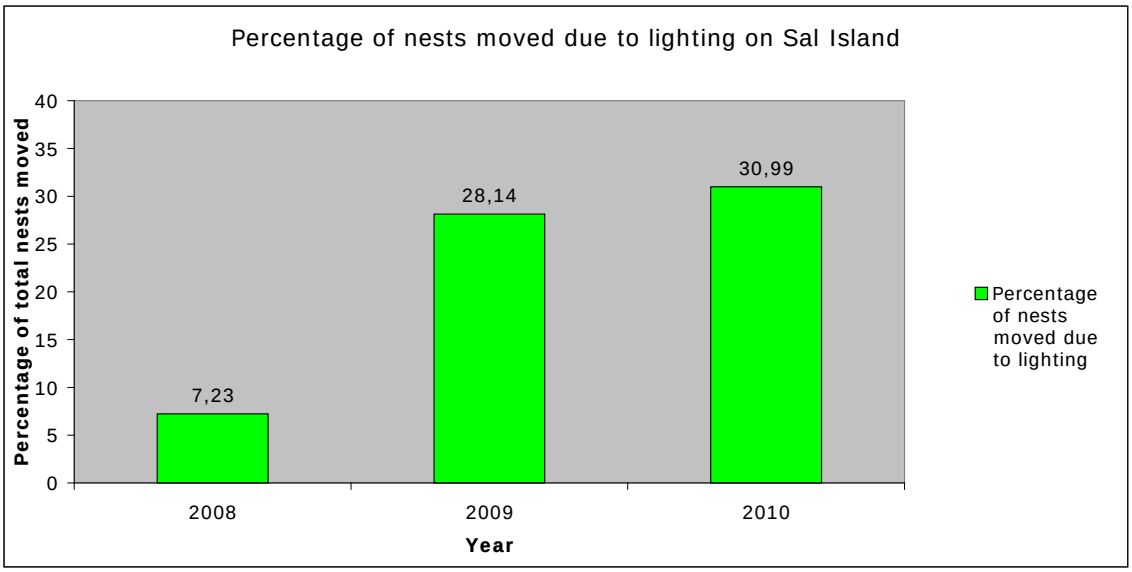

Fig. 12. Increasing number of nests requiring relocation due to light pollution.

This becomes even more alarming when comparing the east coast (CF) with the west coast (AL). The percentage of nests that experienced hatchling disorientation and had therefore been affected by lights on the west coast has almost doubled from 26.67% in 2008 to 75.46% in 2010 (48% increase) (Fig. 13).

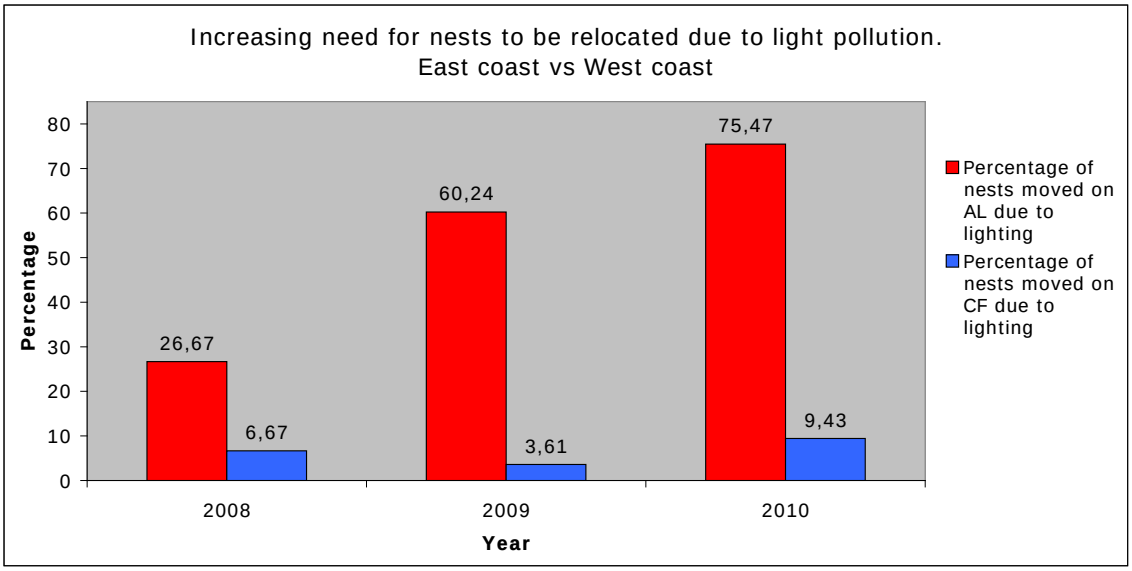

Fig. 13. Comparison of nests requiring relocation due to lights on east and west coasts of Sal.

Fig. 14. Rangers rescue turtle hatchlings that have fallen into open pits on Algodoeiro.

Open ditches due to construction close to the high water mark pose a threat to both hatchlings and adult females and has led to hatchlings falling into cement pits (Fig. 14). Live and dead hatchlings are also frequently found on construction sites and the ditches in front of them. Construction traffic has caused compaction of the sand and debris and heavy machinery left on the beaches have further limited available nesting areas (Fig. 15).

Fig. 15. Compaction of sand due to construction traffic on Algodoeiro.

Disruption to nesting through lighting also contributed to a higher than usual ratio of false crawls and nesting attempts on the beach in front of The Resort Group development of Tortuga Beach (AL). It is generally accepted that the number of nests laid in a season will equal around 30% of total tracks without nests. The average ratio on Sal is 28-30%, but on this particularly beach the ratio is much lower (17.86%) indicating a reluctance to nest in this area, most likely because of light pollution or noise (Table 2).

BEACH	TOTAL TRACKS	FALSE CRAWLS	NESTS	% NESTS
AL	84	69	15	17,86%
PB	97	68	29	29,90%
SN	476	334	142	29,83%

Table 2. Comparison of false crawl/nesting ratio on Sal, 2010. AL has a significant lower ratio of nests to false crawls than other beaches with no disturbance, indicating a reluctance to nest on this beach.

DISCUSSION

Coastal development is a major hazard to marine turtles – the destruction of nesting space can result in decline and local extinction. Light pollution has been recorded to affect the site choice of nesting females and to disorientate hatchlings leading to an increase in hatchling mortality and a decrease in nesting attempts by females (Witherington 1992).

The results on Sal during 2008-2010 indicate a trend towards decreasing nesting activity in areas where there is tourism activity or where there is construction or development for tourism. This is particularly the case on Little Algodoeiro (AL) and Paradise Beach (PB) where nesting has decreased by 4% from 2008 to 2010. Beaches such as Ponta Jelonga or Serra Negra (up 6%) on the south-eastern side of Sal are mostly unaffected by lights or tourism development and the percentage of nests has remained stable or increased over the last three years. Black Sand Beach (BB) on the east coast has also shown an increase, possibly due to disturbance on Algodoeiro (AL) and Paradise Beach (PB) causing turtles to move further north along the same coast. However, the possibility exists that turtles on Sal will travel further north to find beaches free of lighting and be at risk of being killed by hunters on unpatrolled beaches. Unfortunately, the next beach north of this area is Monte Leão, an undeveloped but also unprotected beach with a high mortality rate of nesting turtles, i.e. 87% of all turtles killed on Sal were killed on northern, unprotected beaches and 41% of those were at Monte Leão. Therefore a tendency to swim north to Monte Leão after being unable to nest on Algodoeiro may result in the turtle being killed.

With four large resorts under construction, one of which is starting to be occupied, these sites are rapidly encroaching on some of the most important nesting beaches on Sal. Black Sand Beach is of particular concern. This section of beach has a consistently high percentage of the total number of nests and a good hatching success rate, yet planning permission has been given to create a marina at the northern end. It seems possible that if this project goes ahead and all the resorts open, loss of one of the most important nesting beaches in Sal is inevitable (Fig. 16). Degradation of the south-western coastline has become more apparent over the three years that SOS Tartarugas has been patrolling the beaches. Compacted sand on Paradise beach has led to a decrease in the available space that nesting turtles have left to lay their eggs. A construction fence towards the back of the beach has made it easier for vehicles to drive along causing the compaction of sand, leaving only a few metres of sand suitable for nesting turtles. These few metres are prone to inundation later in the season when large swells cause higher than usual tides.

Security spotlights used by all of the construction sites are far from turtle friendly. These lights create problems not only in front

of the sites, but along the entire south-western coast. As more resorts open and roads are built to service these resorts, more lighting will be installed and the problems will increase. Lighting pollution may be considered as a form of habitat loss. When females are unable to nest, they may choose another less suitable nesting site outside of their normal range. If a suitable nesting site is not found, it could be possible for the turtle to release her eggs at sea. Other issues, such as the number of hatchlings produced, sex ratios and hatchling fitness may all be affected by the choice of a less suitable nesting location (Witherington & Martin 1986). It also seems likely that disturbance will be caused by tourists and residents visiting the beaches unsupervised during the turtle nesting season. Increased habitation invariably brings issues of pollution and litter and there are already problems with nest predation by dogs living on construction sites.

Turtles tend to nest on dark beaches, but many still nest on beaches where the influences of lights are present. When this occurs, the female turtles are putting the lives of their offspring under threat due to the disorientation caused when the hatchling emerges from the nest. On an unlit beach hatchlings will instinctively head towards the sea, however lighting can disrupt this nocturnal behavior (Witherington & Martin 1986). Therefore turtles may continue to nest in areas affected by light pollution on Sal, but increasing amounts of intervention will be required by SOS Tartarugas and the Câmara Municipal of Sal since more nests will need to be relocated to hatcheries, creating strain on already limited resources of finance and manpower.

Tourism on Sal is a necessity for economic growth and it is possible for turtle friendly lighting to be installed and development to continue in a way that minimises disturbance. However, in order for this to happen there has to be the will from developers to preserve the natural beauty of Sal's beaches and for the laws that protect this endangered species' habitat to be upheld. Surveys conducted by SOS Tartarugas amongst tourists and residents have shown a clear indication that once they are aware of the issues, the majority of people will choose a turtle friendly business over one that contributes to the extinction of Loggerheads on Sal.

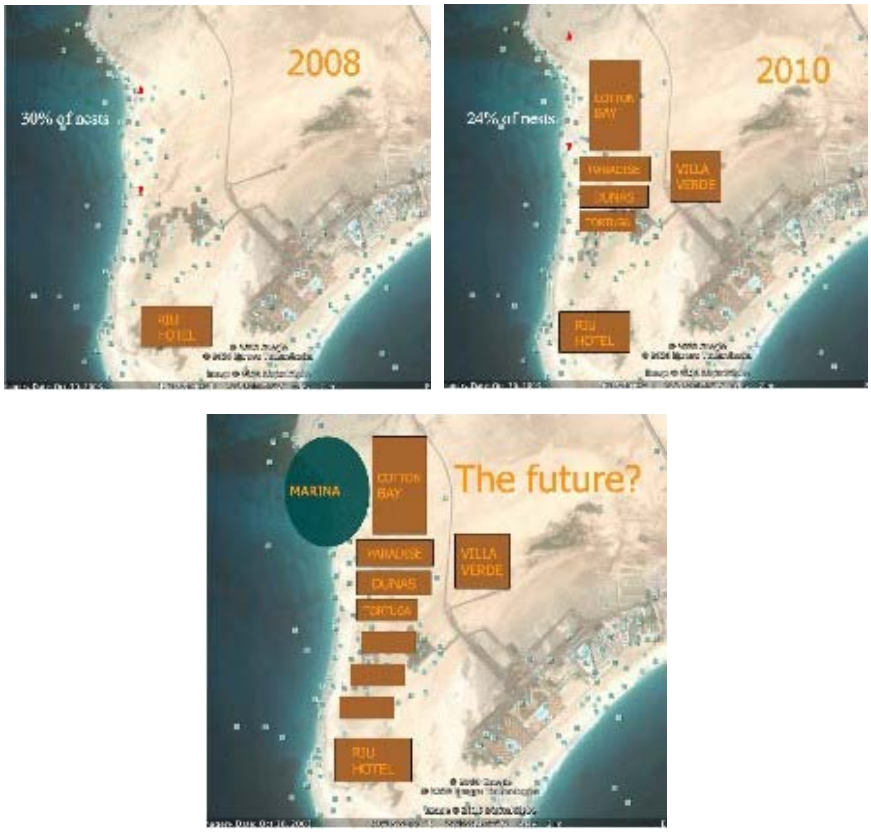

Fig. 16. The growth of tourists resorts on the island of Sal showing the site of the planned marina.

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Short note | Nota breve

Dragonflies (Insecta, Odonata) of São Vicente, Cape Verde Islands: 10 species on a desert island

Andreas Martens & Cornelis J. Hazevoet

Keywords: Odonata, dragonflies, Cape Verde Islands, distribution, phenology

The island of São Vicente, Cape Verde Islands, has no natural and permanent surface fresh water habitats. Surprisingly, with records of 10 species of dragonflies, the island is the most species-rich in the archipelago so far (cf. Aistleitner *et al.* 2008, this study). Knowledge of Odonata from São Vicente is based on a small number of reports, mostly including single records only (Calvert 1893, Kirby 1897, Lobin 1982, Aistleitner *et al.* 2008). During a visit to the island in August 2009, AM recorded four species as single adults. Two species were recorded on 26 August 2009, after two days of heavy rainfall which caused extensive temporary waterflows and pools in the main courses of river beds, on the plains, as well as on roads and sports grounds in and around the town of Mindelo. In March and April 2010, CJH observed numerous odonates at the basins of the local sewage cleaning plant (Estação de Tratamento de Áquas Reciduais – ETAR) at Ribeira da Vinha, *ca*. 3 km southwest of Mindelo. The sewage plant (in operation since 1986) consists of six basins, each containing successively cleaner water (Fig. 1-2). Species observed in August 2009 and March-April 2010 were:

Anax imperator Leach, 1815 – One adult in feeding flight between buildings and under trees at hotel Foya Branca, west of São Pedro (16°49,83'N, 25°04,27'W), alt. 9 m, 10 August 2009. A female at Clube Nautico, an open air bar and restaurant in Mindelo (16º53,24'N, 24º59,33'W), alt. 5 m, 8 March 2010. One male and one female at the sewage plant (16º52,12'N, 25º00,29'W), alt. 4 m, 30 March and 1 April 2010. These are the first records for São Vicente.

Crocothemis erythraea (Brullé, 1832) – One male at an ephemeral pool south of Mindelo (16°51,33'N, 25°00,33'W), alt. 31 m, 26 August 2009. About 25 imagines at the sewage plant (16º52,12'N, 25º00,29'W), alt. 4 m, 26 & 30 March and 1 April 2010. The only previous record for São Vicente is of two males and two females collected at a water hole east of Monte Verde, 19 December 1978 (Lobin 1982).

Orthetrum trinacria (Selys, 1841) – About 150 imagines at the sewage plant (16º52,12'N, 25º00,29'W), alt. 4 m, 26 & 30 March and 1 April 2010. The only previous record for São Vicente is of a male collected at a water hole east of Monte Verde, 19 December 1978 (Lobin 1982).

Pantala flavescens (Fabricius, 1798) – One male patroling over swimming pool at hotel Foya Branca, west of São Pedro (16°49,83'N, 25°04,27'W), alt. 9 m, 7 & 10 August 2009. The only previous record for São Vicente is of a male collected, 26 December 1895 (Kirby 1897).

Sympetrum fonscolombii (Selys, 1840) – One male at the sewage plant (16º52,12'N, 25º00,29'W), alt. 4 m, 30 March, and three males there, 1 April 2010. These are the first records for São Vicente.

Trithemis annulata (Palisot de Beauvois, 1807) – One female at a dry river bed near

Madeiral (16°49,30'N, 24°56,04'W), alt. 191 m, 26 August 2009. Previous records were by Leonardo Fea in November 1898 and by Werner Barkemeyer at the golf course at the southwestern outskirts of Mindelo, 19 March 2001 (Aistleitner *et al*. 2008).

At present, the sewage plant is being expanded, with eight new basins currently under construction. Presumably as a result of these works, the ditches at ETAR's entrance, normally dry, were unindated and, judging from the state of the vegetation, had apparently been so for a considerable period of time (Fig. 3). In March-April 2010, *C. erythraea* was more numerous at these ditches than at the main basins, where *O. trinacria* was the dominant species. Larvae of *O. trinacria* are known to be tolerant of ionic stress (Suhling *et al.* 2003) and thus may be able to survive the adverse conditions of the sewage basins. Apart from the sewage plant, the only near-permanent surface fresh water sources in São Vicente are a number of wells and tanks near human habitation in the interior of the island.

We consider the presence of *Brachythemis leucosticta* (Burmeister, 1839) and *Pseudagrion glaucescens* Selys, 1876 on São Vicente to be unconfirmed. Both were reported from Porto Grande (Mindelo) during the late 19th century (Calvert 1893), when it was an important port of call for steam ships. Dijkstra & Matushkina (2009) found '*Brachythemis leucosticta*' to include a cryptic species, *B. impartita* (Karsch, 1890). Both forms occur in West Africa and are possible candidates for the old record from São Vicente, although *B. impartita* seems more likely as it is much more common in the adjacent African mainland and has demonstrated more wandering habits, with *B. leucosticta* being rather local, mainly at large rivers. *P. glaucescens* belongs to a large African genus, which has been subject to many taxonomic changes during the past 100 years (cf. Dijkstra 2003). In addition, there is an incomplete male *Pseudagrion* specimen that remained unidentified at the species level (Calvert 1893). A re-examination of these specimens seems warranted.

Apart from these standing questions, an overview of phenological data (Table 1) shows that knowledge of the spatial and temporal distribution of Odonata in São Vicente (and indeed in the Cape Verde archipelago as a whole) remains poor.

	J	F	M	A	M	J	J	A	S	O	N	D
Lestes pallidus												
Ischnura senegalensis												
Anax ephippiger												
Anax imperator												
Crocothemis erythraea												
Orthetrum trinacria												
Pantala flavescens												
Sympetrum fonscolombii												
Tramea limbata												
Trithemis annulata												
Zygonyx torridus												

Table 1. Known flight season of 11 Odonata species from the Cape Verde Islands (light grey fields; records from São Vicente in dark grey). Data from Lobin (1982), Aistleitner *et al*. (2008), Vieira (2008), Martens (2010), Richard Ek (*in litt.*) and this study. Only known from specimens collected during the late 19th century, no seasonal data are available for *Brachythemis leucosticta*, *Pseudagrion glaucescens* and *Trithemis arteriosa*.


Fig. 1-2. Basins at the sewage plant, São Vicente, 26 March 2010 (Cornelis J. Hazevoet)


Fig. 3. Ditch at the sewage plant's entrance, São Vicente, 26 March 2010. Fig. 4. *Orthetrum trinacria*, sewage plant, São Vicente, 26 March 2010 (Cornelis J. Hazevoet)

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Short note | Nota breve

First record of Straw-coloured fruit bat *Eidolon helvum* (Kerr, 1792) for the Cape Verde Islands

Saray Jiménez & Cornelis J. Hazevoet

Keywords: Chiroptera, Pteropodidae, *Eidolon helvum*, Cape Verde Islands, distribution

On 8 September 2010, at 9:45 AM, a fruit bat was seen flying at a height of *ca*. 2 m over the sea off Ervatão, southeastern Boavista, Cape Verde Islands (16º 02' N, 22º 41' W). After a while, the animal landed in the beach vegetation. When captured, it did not offer any resistance to being handled and it was taken to the nearby sea turtle station, operated by the NGO Cabo Verde Natura 2000. The bat – which proved to be a female – was placed in an improvised cage made of plastic netting where it eagerly fed on the food provided, i.e. tomato, apple and banana. At 16:00 PM, the following biometric data were taken: head width 31.6 mm, humerus 81.1 mm, ulna 121.2 mm, tarsus 49.7 mm. When restrained for taking body measurements, the bat attempted to defend itself with its mouth. Its teeth appeared to be worn. A large number of ecto-parasites (tick-like bugs) were removed from the pelage of the animal, but none of these were collected and preserved. On 11 September, the bat weighted 220 g. During four days in captivity, the bat showed a preference for tomatoes and different fruits, while cucumber and insects (crickets) were refused. On 12 September, injuries on the bony protuberances of the wings, caused by contact with the wall of the cage, were noted and it was decided to place the bat out of the cage, allowing it to hang freely from a piece of plastic netting. The animal remained there for one hour, feeding quietly, and then flew away. After about 15 minutes, it appeared again at its resting place, stayed for a few minutes and finally disappeared in the darkness of the night.

During its stay at Ervatão, several pictures of the bat were taken (Fig. 1). These unequivocally allowed the animal to be identified as Straw-coloured fruit bat *Eidolon helvum* (Kerr, 1792). This is the first documented record of Straw-coloured fruit bat (and indeed of any species of fruit bat) for the Cape Verde Islands (cf. Azzaroli Puccetti & Zava 1988). Straw-coloured fruit bat is locally common and widespread in sub-Saharan Africa from Senegal in the west to Ethiopia in the east and to South Africa in the south (DeFrees & Wilson 1988, Bergmans 1990, African Chiroptera Report 2010). *E. helvum* is a migratory species in parts of its range, with populations migrating from the West African forest into the savannah zone during the major wet season (African Chiroptera Report 2010). Roosts of up to half a million to more than one million animals have been reported from Ivory Coast and Nigeria, respectively, reaching their peak during the later half of the dry season (Thomas 1983). In West African countries adjacent to Cape Verde, the species is common and widespread in Guinea-Bissau (Rainho & Franco 2001). In Senegal, there are records from Ziguinchor in the south, near St. Louis in the north, as well as from intermediate regions (Bergmans 1990). In Mauritania, two dead adults were found in Nouakchott, 20 September 1993, and a colony of several 100s, said to occur during the wet season from May-June to September-October,

was present there during 1993-1995 (Cosson *et al*. 1996). Furthermore, there is a specimen in the collection of the zoological museum of Berlin, which, according to the label, was caught at sea near Las Palmas, Canary Islands, 8 April 1915 (Bergmans 1997). If anything, the present record from the Cape Verde Islands agrees with the species' known period of occurrence in Mauritania.

Fig. 1. Straw-coloured fruit bat *Eidolon helvum*, Ervatão, Boavista, Cape Verde Islands, 9 September 2010 (Adolfo Marco)

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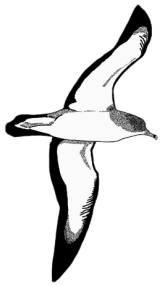

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