SEABIRD AND CETACEAN SURVEYS IN THE VICINITY OF THE CHINGUETTI OIL FIELD, OFFSHORE MAURITANIA. MARCH, 2003

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SEABIRD AND CETACEAN SURVEYS IN THE VICINITY OF THE CHINGUETTI OIL FIELD, OFFSHORE MAURITANIA.
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EXECUTIVE SUMMARY

The occurrence of marine mammals and seabirds in the vicinity of the proposed Chinguetti Oil Development was surveyed between March 11 and 22, 2003. The survey covered approximately 500 nautical miles (NM) of predefined line transects within a 400 NM^2 area on the Continental slope, approximately 45NM west of the Mauritanian coastline.

Migratory shearwaters, terns, skuas, storm petrels, gannets and gulls were abundant in the study area, suggesting the shelf-break within the study area is important for non-resident seabirds (Palaearctic migrants, Mediterranean and Southern Hemisphere seabirds). Pomarine skuas were by far the most abundant seabirds and this part of the Mauritanian shelf appears to be a globally significant wintering area for this species. Eight of the recorded species nest locally and six of these were recorded only in the vicinity of Nouakchott. The remaining two possibly resident species comprised the Mauritanian royal tern, which was very uncommon, and the common tern, which was probably from a West-Palaearctic rather than from a West African origin.

Eight species of cetaceans were observed the study area, comprising seven Odontocete and one Mysticete species. Common dolphins were the most abundant species observed, comprising greater than 75% of all cetaceans sighted.

Previous surveys indicate that this area of the Mauritanian shelf break is important to a greater number and variety of cetaceans than were observed in this survey. This suggests that the area may be visited by transient species not observed on this occasion, or may be more important at other times of the year than when the survey was conducted.

Key findings:

Key findings of the field survey were:

- Relatively few marine mammal sightings (seventeen sightings of eight species totalling approximately 655 individuals);
- One large pod of over 500 common dolphins accounted for approximately 75% of the total numbers of cetaceans;
- The distribution of the few cetaceans that were observed corresponded to the shelf break within the survey area;
- A Sei whale was observed apparently sub-surface lunge feeding in the shallower water to the east of the shelf break;
- The shelf break is of significance for non-resident seabirds, with 48 species being recorded in this area;
- High seabird abundances were most likely related to the northern migration of many species that breed in Arctic waters;
- The Pomarine skua was the most abundant seabird in the area, suggesting that this part of the Mauritanian shelf is a globally significant wintering area for this species.

Recommendations:

This survey provides a 'snap shot' of the seabird and marine mammal species present within the proposed Chinquetti Development area. A previous survey conducted in January 2000 indicated that many other species use this area, and thus seasonal and temporal differences may exist. Longer-term studies would be required to give definitive abundance and distribution estimates of the many seabird and marine mammal species that occur on this section of the north-west African shelf break.

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1. INTRODUCTION

Woodside Mauritania Pty Ltd (Woodside) is the operator of five petroleum permits covering offshore Mauritanian waters, in north-west Africa. Initial exploration drilling was successful, resulting in the Chinguetti and Banda discoveries.

Prior to a decision on commerciality of the Chinguetti field, Woodside determined that a major study of the existing marine environment was required to support any decision regarding development. The field is located on the continental shelf in the vicinity of major up-welling phenomena supporting productive commercial fisheries. The environmental characteristics of the area are largely unknown.

Twenty-four species of cetaceans (whales, dolphins and porpoises) have been recorded in Mauritanian coastal waters of the Baie du Lévrier, the Banc d'Arguin region and coastal waters along the "Grande Beach" (central and southern coastline of Mauritania south of Cape Timiris to the Senegal River delta) (Robineau and Vely, 1998; Nieri *et al.*, 1999; Camphuysen, 2003). Bottlenose dolphins (*Tursiops truncatus*) and the Atlantic humpbacked dolphins (*Souza teuzii*) are residents within the Banc d'Arguin region and some other cetaceans (e.g. common dolphin and killer whale) are common visitors to that area. The various cetacean species are a mixture of both temperate and tropical zoological groups (Campredon, 2000; Robineau and Vely, 1998). Little information is available on cetacean diversity, distribution and abundance in the deeper offshore waters adjacent to the Mauritanian coastline. The population dynamics and distribution are poorly understood and there is very little information for cetacean species occurring in Mauritanian waters with relation to calving, nursing, breeding or resting areas.

As part of the greater environmental study, Woodside commissioned Bowman Bishaw Gorham to undertake a survey of marine mammal and seabird usage within the Chinguetti area. The study was conducted by the authors between March 11 and 22, 2003 (Figure 1). This report presents the results of the study.

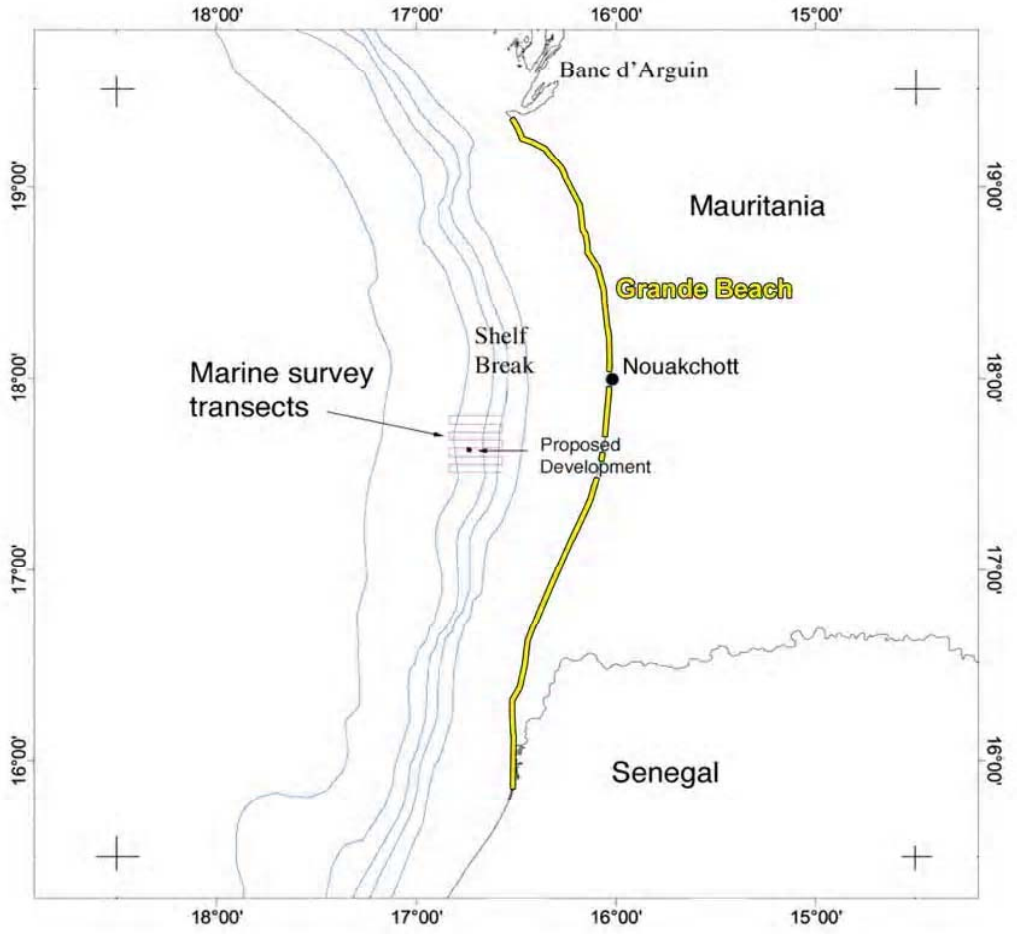

Figure 1: Location map of the study area and marine fauna survey transect lines

2.0 EXISTING INFORMATION

2.1 CETACEANS

There have been only limited dedicated cetacean surveys conducted within the survey area and, as a consequence, very little information exists on the diversity and abundance of species. A recent survey combining oceanographic sampling and seabird and cetacean feeding ecology was conducted during January 2000, from Cadiz (Spain) south to Dakar in Senegal, sampling a number of east-west transects across the shelf break (Camphuysen, 2003). That study reported that, after adjusting for observer effort, cetaceans were found to be slightly more numerous over the shelf edge area than on either side of the break, while seabirds showed within group differences in abundance for these areas.

A list of the cetacean species recorded in Mauritanian waters both from sightings and stranding (Robineau and Vely, 1998; Camphuysen, 2003) is included below:

Sub Order: Mysticetes (Baleen whales)

Blue whale (*B. musculus)* (presumed due to large, tall blows sighted) and
Fin whale (*B. physalus*);
Humpback whale (*Megaptera novaeangliae*);
Minke whale (*Balaenoptera acutorostrata*);
Sei whale (*B. borealis*).

Sub Order: Odontocetes (Toothed whales)

Atlantic spotted dolphins (*Stenella frontalis*);
Atlantic humpbacked dolphin (*Sousa teuszii*);
Blainville's beaked whale (*Mesoplodon densirostris*);
Bottlenose dolphin (*Tursiops truncatus*);
Clymene dolphin (*Stenella clymene*);

Common porpoise (*Phocoena phocoena*);
Cuvier's beaked whale (*Ziphius cavirostris*);
Common dolphin (*Delphinus delphis);*
Gervais' beaked whale (*M. europaeus*);
Killer whale (*Orcinus orca*);
Long-finned pilot whale (*Globicephala melas*);
Melon-headed whale (*Peponocephala electra*);
Northern bottlenose whale (*Hyperoodon ampullatus*);
Pygmy sperm whale (*Kogia breviceps*);
Risso's dolphin (*Grampus griseus*);
Rough-toothed dolphin (*Steno bredanensis*);
Short-finned pilot whale (*G. macrorhynchus*);
Sperm whale (*Physeter macrocephalus*);and
Striped dolphin (*S. coeruleoalba*);

There are 35 species of cetaceans recorded for the northeast tropical Atlantic (from Madeira to Senegal). The 11 species that have not been recorded in Mauritanian waters are almost all pelagic species. While some of these species are rare in the region, most are relatively common in deep offshore waters far from the coast (Robineau and Vely, 1998). This suggests that some of these species may occur as vagrants in the Chinguetti Development area.

The information detailed in this section is derived from a small number of Mauritanian studies (Camphuysen, 2003; Robineau and Vely, 1998) and from regional data (Rice, 1998; Reeves et al, 2002; Perry *et al.*, 1999). Details are presented on a number of species from the list of known species having recognised conservation status in the region and their likely occurrence in the study area.

2.1.1 Sub order: Mysticeti (Baleen Whales)

Humpback whale (*Megaptera novaeangliae*)

Humpback whales have a world-wide distribution, with most populations recovering well from sustained whaling during the 20th Century that reduced numbers to perhaps 10% of the original population (Reeve *et al*, 2002). The entire North Atlantic population is now estimated to be over 10,000 individuals, with the majority migrating from Arctic feeding areas to tropical breeding areas in the western Atlantic (Perry *et al*., 1999). There is no reliable estimate of the population that moves to the tropical eastern Atlantic adjacent to northwestern Africa, but it is assumed to be very low.

Until the late 1990's, humpback whales had only been recorded once off the coast of Mauritania from an individual stranded in the Baie du Lévrier in 1954 (Robineau and Vely, 1998). However, during seismic acquisition in 2002, humpback whales were observed and consequently confirmed with photographic evidence (Burton, 2003 in prep). This species has apparently never been recorded off the coast of Senegal and has only been observed once off the coast of Morocco (Alconcle, 1967: cited in Robineau and Vely, 1998). It is expected that humpback whales visit the offshore waters of Mauritania and the Cape Verde Islands during their annual migration from cold waters in the North Atlantic to warmer tropical waters, where they calve and breed. Humpback whale calving and breeding takes place in the Northern Hemisphere between January and March (Perry *et al*., 1999). The only documented winter concentration of humpback whales in the eastern North Atlantic is found off the Cape Verde Islands (Kellogg, 1929; cited in Perry *et al*., 1999). This was confirmed by the YoNAH (Years of the North Atlantic Humpback Whale) project (Smith *et al.*, 1999).

It is unlikely that the humpbacks will feed whilst on their wintering grounds and any feeding that does take place off Mauritania is regarded as opportunistic (Perry *et al*., 1999).

While humpback whales are known to pass through Mauritanian waters, it is unknown whether this area represents significant or critical habitat (migratory routes, aggregation, breeding, resting or feeding areas) for them.

Blue whale (*Balaenoptera musculus musculus*)

Blue whales have a worldwide range and are comprised of three sub-species. The summer range of blue whales (*B.m.musculus*) in the North Atlantic extends from the northeastern coasts of America and Canada, up to 80° N in the Arctic, in waters of Iceland, Norway, and the Barents Sea and down to the Bay of Biscay. The winter range is almost unknown, but some occur around the islands of the Cape Verde Archipelago and along the African mainland from Ras Nouadhibou, Mauritania, south to Cape Vert, Senegal (Rice, 1998). Blue whales are considered very rare in the eastern North Atlantic and there is no reliable estimate of the population in this area. Their international status is classified as "Protected Stocks" by the IWC (Perry *et al*, 1999). Details on migration distribution and timing, and breeding grounds remain unclear.

Camphuysen (2003) observed large baleen whales off the Mauritanian coast with some thought to be blue whales, based on the observed tall slender blows, although they may be easily mis-identified as fin whales. Possible sightings of blue whales during the extensive seismic survey off Mauritania in 2002 could not be confirmed from the photographic evidence (Burton, 2003).

Fin whale (*Balaenoptera physalus*)

Second largest of the great whales, Fin whales are a worldwide cosmopolitan species and are considered rare in the eastern North Atlantic, with no reliable estimate of their population available. Their status in the North Atlantic is classified as "Protected Stocks" by the IWC (Perry *et al*, 1999) and is considered 'endangered' internationally. They are believed to be generally abundant in the North Atlantic and their seasonal movements appear to be complex (Reeve *et al*, 2002). Their summer distribution is similar to that of blue whales while their winter distribution extends

south to at least the Canary Islands off western Africa (Rice, 1998). No detailed information exists on their seasonal abundance or breeding areas off western Africa.

A pod of 6 fin whales were observed lunge feeding in waters off Western Sahara, just to the north of Mauritania, in January 2000 (Camphuysen, 2003). There also appeared to be a near-shore foraging preference for the large baleen whales.

Sei whale (*Balaenoptera borealis*)

Sei whales occur worldwide from high to low latitudes, inhabiting both shelf and offshore waters. Compared with the other Balaenopterid whales, they are generally found more frequently in temperate latitudes (Reeve *et al*, 2002). This species undertake seasonal migrations from high latitude feeding areas to low latitude breeding areas, the locations of which remain unknown. In the northeast Atlantic they are thought to winter in waters south of Spain, with sightings recorded off Cape Blanc, Mauritania (Rice, 1998). Their international status remains 'endangered' with no information available on their distribution, seasonal abundance or breeding areas off western Africa (Perry *et al*, 1999).

2.1.2 Sub order: Odonticeti (Toothed Whales)

Killer whale (*Orcinus orca*)

Killer whales are wide spread and considered the most cosmopolitan of all cetaceans. They are more abundant in high latitudes where high densities of prey are present. Killer whales have been recorded off western Africa, from Morocco in the north to the Baie du Lévrier in the south. Other sightings have been confined to four areas of the Mauritanian coast: between the eastern side of the Baie du Lévrier south to Cape Timiris; along the Grande Beach; on the Banc d'Arguin; and on the continental shelf, west of the Banc d'Arguin.

Anecdotal information suggests that the killer whales in the Baie du Lévrier are not a local population, but are more likely to be migrating through the area. The majority

of killer whale sightings tend to be in the summer months, at a time when there are good sources of prey such as fish, bottlenose dolphins and monk seals. Prey species are likely to be most abundant in the Banc d'Arguin region and may attract feeding killer whales (Hammond and Lockyear, 1988).

Killer whales are not considered to be an endangered species. There is concern that some local populations may be threatened by pollution, ship traffic, depleted prey sources and whale-watching interference.

Common dolphins (*Delphinus delphis; D. capensis*)

Common dolphins are described as two species of the genus *Delphinus*: a short-beaked offshore form, D. *delphis;* and a long-beaked coastal form, *D. capensis* (Rice, 1998). Both species have wide, disjunct distributions in tropical and temperate waters, with some marginal overlap that provides scope for confusion with identification. Their distributions in waters of northwest Africa extend south to Gabon.

Short-beaked common dolphins are the most abundant cetaceans along the coast of Mauritania (Camphuysen, 2003). They tolerate cooler water conditions than some other species, such as *Stella sp.*

Common dolphin are abundant off the Grande Beach near Nouakchott and are common throughout the entire coastal waters of Mauritania (Robineau and Vely, 1998). Short-beaked common dolphins appear to be more abundant over the shelf and the shelf edge than in deeper waters (Camphuysen, 2003). Camphusysen (2003) did not observe any long-beaked common dolphins in his study.

Bottlenose dolphin (*Tursiops truncatus*)

The bottlenose dolphin is a wide-ranging cosmopolitan species, occurring in oceans and coastal seas in a variety of habitats in both temperate and tropical latitudes. The bottlenose dolphin remains abundant and widely distributed, but some regional and

local populations that are considered at risk due to pollution, habitat degradation and fishery conflicts (Reeve *et al*, 2002).

Bottlenose dolphins have been observed in Mauritanian coastal waters around Cape Sainte-Anne, Tidra Island and Thila Peninsula off Banc d'Arguin, along the Grande Beach and in the Baie du Lévrier (Camphuysen, 2003). Bottlenose dolphins are resident along the east coast of Baie du Lévrier between the bottom of the bay and Cape Sainte-Anne (Robineau and Vely, 1998).

Atlantic humpbacked dolphin (*Sousa teuszii*)

The Atlantic humpbacked dolphin, also known as the Cameroon river dolphin or Guinean dolphin, is endemic to the north west coast of Africa, extending from Dakhla Bay south to Cameroon. The typical habitat for this species is sheltered, shallow, sand banks or silty channels and turbulent waters near the coast, usually close to river mouths in water temperatures in excess of 15C. There are no specific population estimates available for this species in northwestern Africa, although it is suspected that local depletion of populations occurs due to the impacts of human activities, such as fishing and pollution. It's generally inshore distribution is unlikely to extend into the Chinguetti region.

There have been strandings of this species along the coast of Mauritania, in locations within the Banc d'Arguin, south of Tidra Island, along the Iwik Peninsula, north of Cape Tagarit, west of Tidra Island and off Grande Beach. Robineau and Vely (1998), suggested that this species is found most commonly in the north of Baie du Lévrier and south of Iwik, both within the boundaries of the Banc d'Arguin national park. Anecdotal information indicates that this species also visits the waters around Nouamghar.

Common (harbour) porpoise (*Phocoena phocoena*)

Common, or harbour porpoises are small, inconspicuous cetaceans that are restricted to the North Pacific and North Atlantic inshore coastlines, and are limited to

temperate and subarctic waters. Common porpoises are known to inhabit the waters of northwest Africa, from Morocco south to Dakar in Senegal (Rice, 1998). They appear to be semi-isolated from European populations, with African individuals being slightly larger than those that inhabit the coastlines of Europe. Coastal up-welling provides ideal conditions for this species, similar to conditions found in European waters.

In Mauritanian waters, common porpoises are frequent visitors to the area west of the Baie du Lévrier and along the Grande Beach, and are occasional visitors to the Banc d'Arguin area (Robineau and Vely, 1998). They appear to frequent these areas in May and September, during warm periods in which up-welling is weaker, and to move to the west of Cape Blanc once up-welling intensifies in autumn (Robineau and Vely, 1998).

They are not an endangered species, although local populations are under pressure from pollution and various human activities which impact on their coastal habitat.

2.2 SEABIRDS

The distribution of seabirds and their general migration patterns off western Africa is known only from observations from passing freighters and research vessels, particularly in the offshore waters adjacent to the Banc d'Arguin. Camphuysen (2003) noted a high diversity of seabird species in January 2000, showing within-group differences in spatial distribution between the shelf break and areas either side of it.

Seabird distribution over the oceanic waters from the 20 m to 500 m depth contour, between Cape Blanc and Cape Timiris west of the Banc d'Arguin was surveyed in 1988, at the end of the up-welling season (Leopold, 1993). The survey revealed that the Mauritanian shelf slope area supported several categories of seabirds, including local breeders and birds migrating to breeding colonies at higher latitudes (e.g. skua, black tern and Sabine's gull). The area also supported immature (sub-adult) individuals of northern hemisphere species (e.g. gannet, several gull and tern species,

British storm-petrel and some skua and shearwater species) and adults of Antarctic species (e.g.Wilson's storm-petrel) that moult and spend the winter in the area.

Storm petrels (Oceanitidae) were the most abundant seabirds, with an average density of 14.5/km^2, with Wilson's storm-petrel (*Oceanites oceanicus*) being particularly common. Storm petrels were most abundant over water patches rich in zooplankton.

Leopold (1993) also recorded: four species of shearwater, particularly Cory's shearwater (*Calonectris diomedea*); the northern gannet; several species of skua; several gull species, including Sabine's gull, Audouin's gull and the lesser black-backed gull; and seven species of tern, including the locally-breeding Mauritanian royal tern (*Sterna maxima)*. It was not possible to relate patterns of seabird density with other environmental features during the survey due to the trawlers operating in the waters, whose wastes provided a highly attractive food source around which the birds would congregate.

The main seabird breeding areas of the wider regions are in Mauritania, Senegal and Gambia. The oceanic islands, including the Cape Verde archipelago, also have important seabird nesting sites, although in many places these are declining (Wells and Bleakley, 1995; and references cited therein).

3.0 SURVEY METHODS

3.1 OBSERVATION PLATFORM

The survey was conducted from the "MV Clupea", which is a work boat approximately 50m in length. This provided an ideal platform for visually monitoring for cetaceans and seabirds. Marine fauna were primarily monitored from in front of the bridge, approximately 9 m above sea level.

3.2 SURVEY AREA

The study area extended between 17°30'N – 17°48'N and 16°33'W – 16°50'W and was surveyed systematically following eight parallel transects (Transects 1 - 8; Fig. 2), perpendicular to the shelf break. Each transect was surveyed three times between 12 and 20 March 2003 and monitoring continued during transit between transects (either to the west or to the east of the survey area). The survey vessel covered approximately 500 NM of predefined line transects within a 400 NM^2 area. Observations commenced each day just after sunrise and concluded just before sunset.

Routes sailed the morning of 12 March, for a separate task, crossed several of the parallel transects, and all 5-minute counts were allocated to the nearest transect. On the home journey, 20 March 2003, the area between the Chinguetti Development area and Nouakchott harbour was surveyed.

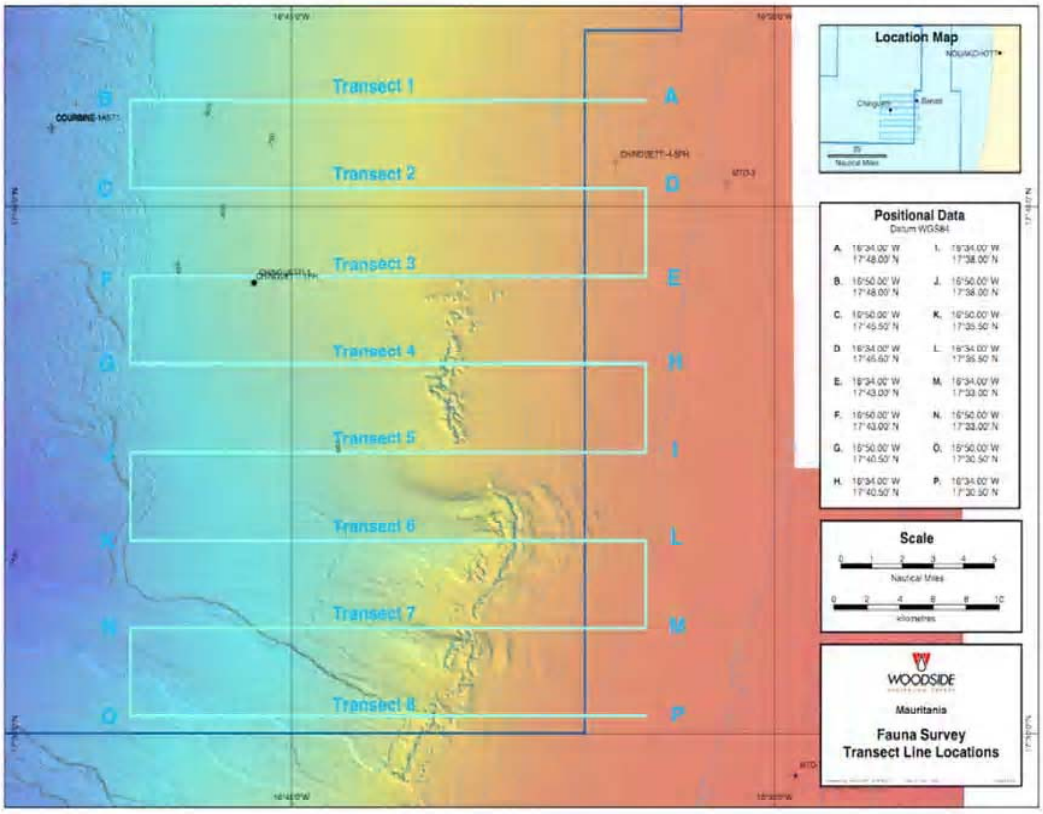

Figure 2. The Chinguetti Development study area and associated bathymetry.

3.3 SURVEY METHODS

The marine fauna monitoring program was conducted by two experienced observers over 12 days. The observers had previous experience monitoring cetaceans and seabirds from vessels in ocean waters offshore Europe and Mauritania and the Indian and southern oceans.

The observers visually monitored and identified marine mammals and seabirds, within a 1-2 km radius of the vessel, whilst the vessel steamed pre-determined survey lines. Two SLR cameras with telephoto lenses were used to photographically record whales and seabirds to assist with identification, especially of animals at longer range. A pair of Fujinon 7x50 reticule binoculars calibrated with the ship's radar, and a pair of Zeiss 10x60 non-reticule binoculars were used by the observers for distance

estimation and identification. During calibration of the Fujinon binoculars a number of distance measurements were made for a series of graticule markers and the means graphed to produce a regression equation for predicting distance estimates for the remaining markers. This graph was consulted when estimating distances. Positions were recorded on a hand-held GPS (Garmin II+) in WGS84 datum.

Methods of observing seabirds and cetaceans were similar to standard strip-transect methods developed for ship-based seabird surveys in north-west European waters (Tasker *et al.* 1984), but with extra attention and systematic coding of seabird primary moult stages, foraging behaviour and interactions between species (Camphuysen & Webb 1999; Camphuysen & Garthe 2001).

Following Tasker *et al.* (1984), a 300m wide transect was surveyed on one side and in front of the vessel, including a snap-shot count for flying birds and counting over 5-minute intervals, from which densities could be calculated (n/km^2). A simultaneous 180° scan for seabirds was performed, to enlarge the sample size, and while these data were not suitable for calculating densities, they provided counts of birds per km travelled (n/km) and per unit time and allowed for analyses of species, plumage and age composition. In addition to the strip-transect data, line-transect data were collected for marine mammals, including exact time (GMT), angle of first sighting (angleboard) and distance away from the observation platform, as calculated using reticle bins (Buckland *et al.* 1993).

The observers also looked for indications of the presence of seabirds, cetaceans and other marine fauna, for example splashes, ‘blows’ (exhalations), the bodies of individual animals and rafts of seabirds. Animals sighted were identified with the aid of binoculars and species identification was verified using reference material if required. Details of all sightings, start and end times, locations, weather conditions and observer position were entered into a computer database for plotting using DMAP and GIS (Geographical Information System) software.

Based on detailed bathymetric data provided by Woodside, the study area was subdivided into six depth zones (Table 1 and Appendix 1). The homeward journey, essentially entirely in the shallowest depth zone (<200m depth), provided continuous gradients towards the coast that put the otherwise rather isolated offshore data within the study area in a greater context.

Data were summarised in 2 NM x 2 NM squares to allow the calculation of densities and to represent distribution patterns and density gradients (Figure 3). Observer effort and survey tracks from each day have been provided as a series of plots in Appendix 2. Summary data showing areas covered and time spent within each depth zone, weather conditions during the survey and allocation of observations to each transect and depth zone are included with each species group in the results.

Table 1. Observer effort (number of 5-minute periods and area surveyed km^2) within depth zones for each transect and over the shelf during transit to port.

Transect	<200 m	200-400m	400-600m	600-800m	800-1000m	>1000 m	Hours
Shelf	68						5.7
1		37	27	20	17	14	9.6
2		42	26	20	18	21	10.6
3		47	33	25	19	15	11.6
4		50	15	28	19	16	10.7
5		38	15	13	31	38	11.3
6	3	31	9	22	37	34	11.3
7	17	36	16	12	15	33	10.8
8	14	20	13	13	14	29	8.6
Prop (%)	9.4	27.9	14.3	14.2	15.7	18.5	90.0
Transect	**<200 m**	**200-400m**	**400-600m**	**600-800m**	**800-1000m**	**>1000 m**	**Km^2**
Shelf	19.0						19.0
1		9.8	6.9	5.4	4.6	3.8	30.4
2		12.5	7.6	5.7	5.2	5.4	36.4
3		13.7	9.4	6.6	4.9	3.8	38.4
4		13.9	4.2	8.2	5.5	4.5	36.3
5		10.4	4.1	3.6	7.4	8.8	34.3
6	0.8	8.5	2.7	6.3	9.5	8.5	36.4
7	4.7	9.6	4.4	3.7	4.6	9.3	36.1

8	3.8	5.7	3.7	3.9	4.2	8.2	29.4
Prop (%)	9.5	28.3	14.5	14.6	15.5	17.6	296.8

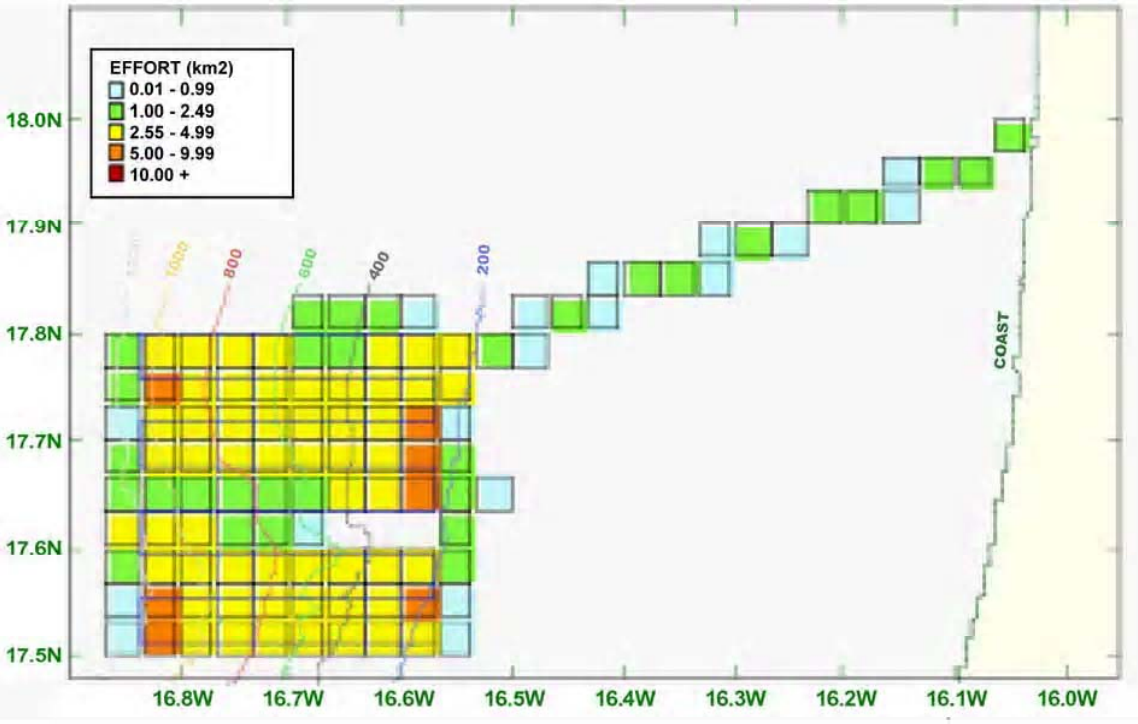

Figure 3. Observer effort (km^2) within 2NM squares over the survey area and transit to Nouakchott.

4.0 RESULTS

A complete list of the cetaceans and seabirds sighted during the survey is provided in Appendix 3.

4.1 CETACEANS

A summary of cetacean sightings and counts from the strip-transect and line-transect surveys are provided in Tables 2 and 3 and Figure 4. Seven species of Odontocete (655 individuals), one Mystecete species (sei whale) and an unidentified medium-sized whale were observed in seventeen sightings during the survey (Table 2). The single sei whale was observed and photographed on 17 March (Plate 1).

Dolphins were generally observed in small pods. The most abundant species were common dolphins, clymene dolphins and long-snouted spinner dolphins (Table 2). Juvenile common and clymene dolphins were observed on two occasions (Table 3). One very large mixed pod of common dolphins (probably long-beaked, *Delphinus capensis*), striped dolphins and long-snouted spinner dolphins approached the ship on 19 March. This pod was probably feeding, indicated by a large number of associated northern gannets.

Table 2. Summary of cetacean species and numbers observed during the survey.

Species	***Genus species***	**Sightings**	**Numbers**
Atlantic hump-backed dolphin	*Souza teuszii*	1	2
Bottlenose dolphin	*Tursiops truncatus*	3	10
Clymene dolphin	*Stenella clymene*	1	40
Common dolphin (short beaked)	*Delphinus delphis*	4	26
Long-beaked common dolphin	*Delphinus capensis*	1	500
Risso's dolphin	*Grampus griseus*	3	17
Striped dolphin	*Stenella coeruleoalba*	1	15
Long-snouted spinner dolphin	*Stenella longirostris*	1	40
Sei whale	*Balaenoptera borealis*	1	1
medium whale large fin	*unidentified*	2	4

Table 3. Cetacean species and sighting positions recorded throughout the survey area.

Species	Number	Age	Latitude	Longitude	Day	Mth	Remarks
Common dolphin	8	Ad	17.66	-16.55	12	3	Swimming fast, not avoid ship
Common dolphin	1	Juv					Calf at the tail of adult
Bottlenose dolphin	3		17.78	-16.62	12	3	Wheeling or swimming slowly
Common dolphin	6		17.51	-16.67	14	3	Swimming fast, not avoid ship
Clymene dolphin	38	Ad	17.76	-16.58	15	3	Swimming fast, not avoid ship
Clymene dolphin	2	Juv					Calf at the tail of adult
Bottlenose dolphin	2		17.51	-16.57	16	3	Wheeling or swimming slowly
Common dolphin	11		17.57	-16.57	16	3	At the bow of the ship
Sei whale	1		17.63	-16.58	17	3	Apparently feeding
Risso's dolphin	6		17.63	-16.71	17	3	Approaching ship
Bottlenose dolphin	5		17.72	-16.73	17	3	Escape from ship
Risso's dolphin	7		17.68	-16.63	18	3	Wheeling or swimming slowly
Risso's dolphin	4		17.80	-16.64	18	3	Approaching ship
medium whale large fin	2		17.59	-16.80	19	3	Wheeling or swimming slowly
Long-beaked common dolphin	500		17.63	-16.57	19	3	Approaching ship
Striped dolphin	15						Approaching ship
Long-snouted spinner dolphin	40						Acrobatic leaps
Atlantic hump-backed dolphin	2		17.93	-16.16	20	3	Wheeling or swimming slowly

All cetacean sightings were in the central and eastern sections of the survey area (Figure 4), except for two sightings of unidentified medium-sized whales with large dorsal fins to the west of the survey area. No conclusions relating to the density and spatial and temporal distributions can be made due to the relatively low numbers of animals observed.

Plate 1. A solitary sei whale observed sub-surface lunge feeding.

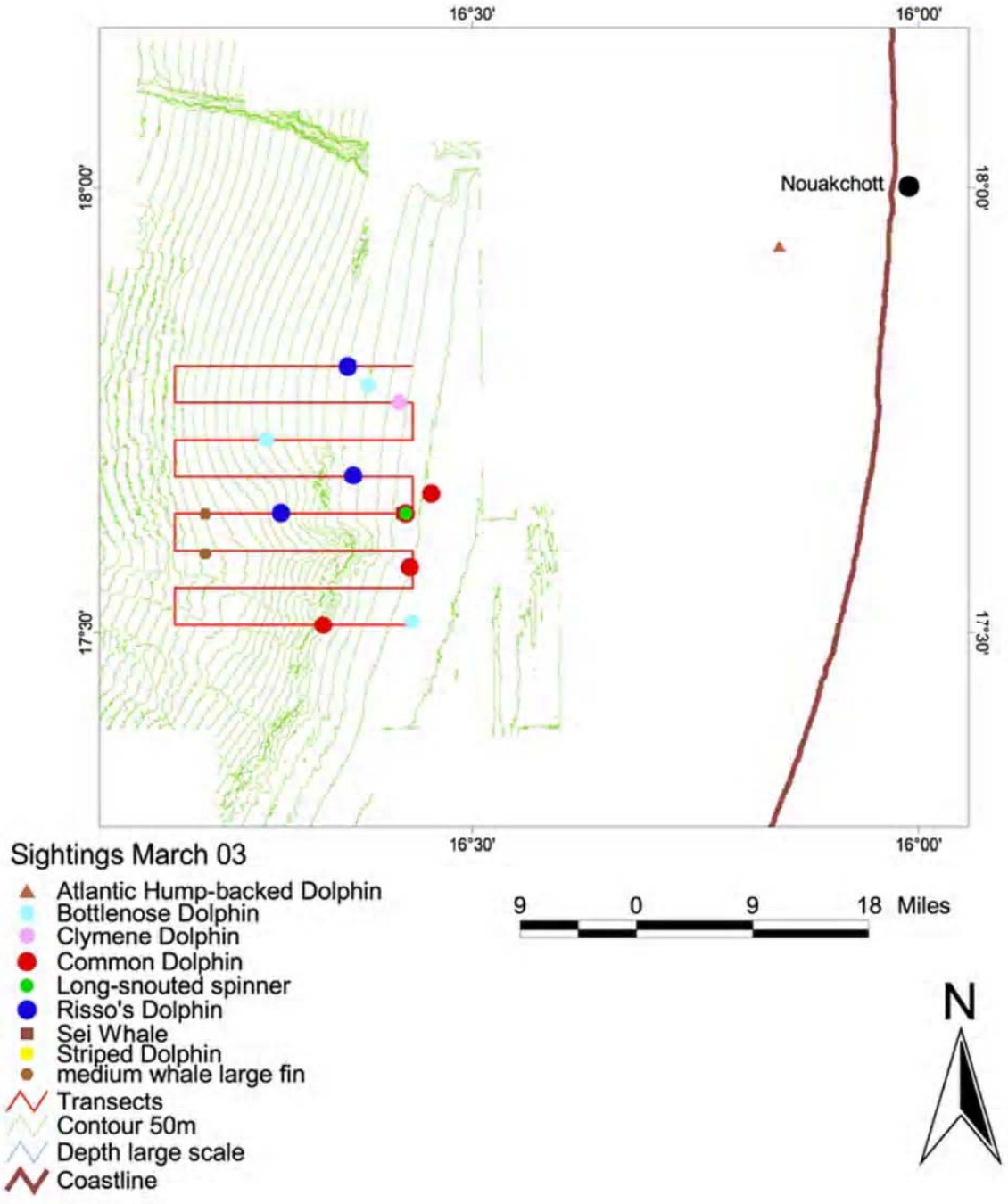

Figure 4. Distribution of cetaceans observed during the survey.

4.2 SEABIRDS

Seabird data have been presented below in family or genus groupings. Abundance data and species lists are presented in Tables 5 to 13. Many of the seabird species were attracted to fishing vessels, therefore, their distribution was affected by the movements of these fishers.

4.2.1 Shearwaters (Family: Procellariidae)

Four species of shearwater were observed, represented by 207 individuals (Table 4). These species originate from a wide variety of locations (Appendix 2). Cory's shearwater (*Calonectris borealis*) and little shearwaters (*Puffinus assimilis*) observed in the survey area may have been en-route to breeding areas in the Canary Islands and Azores. Scopoli's shearwater (*Calonectris diomedea*) probably migrates from the Mediterranean, while the great shearwater (*Puffinus gravis*) breeds exclusively in the southern South Atlantic.

Table 4. Numbers of each shearwater species observed during the survey.

Common name	***Species***	**Number**
Cory's shearwater	*Calonectris borealis*	87
Great shearwater	*Puffinus gravis*	1
Little shearwater	*Puffinus assimilis*	2
Scopoli's shearwater	*Calonectris diomedea*	21
Scopoli's/Corys shearwater	*Calonectris spp.*	96

Cory's shearwaters (*Calonectris* spp.) are common non-breeding visitors off both the west and south coasts of Africa (Brown *et al*. 1982; Ryan 1997). Until recently, Cory's shearwater was generally considered polytypic, with *C. d. diomedea* occurring in the Mediterranean, *C.d. borealis* breeding in the east Atlantic, and a third subspecies, *C. d. edwardsii*, endemic to the Cape Verde Islands (Cramp & Simmons 1977, del Hoyo *et al*. 1992, Thibault *et al.* 1997). The Cape Verde subspecies was considered distinctive (smaller, bill more slender and black instead of yellow, tail relatively longer) and Hazevoet (1995) treated this race as a separate species: *C. edwardsii*.

Sangster *et al.* (1999) also considered the Atlantic and Mediterranean varieties of Cory's shearwater as specifically distinct (Cory's shearwater *C. borealis* and Scopoli's shearwater *C. diomedea*, respectively) based on phylogeographic analysis of allozymes and mitochondrial DNA, qualitative differences in vocalisations and analysis of morphological characters.

Scopoli's and Cory's shearwaters were both positively identified on numerous occasions, but with the latter being four times more numerous. Cape Verde shearwaters were not observed and although a certain number of *Calonectris* shearwaters remained unidentified, we have no evidence for their occurrence within the study area during the survey. Scopoli's and Cory's shearwaters were typically solitary (158x solitary, 16x duo, 1x trio, 1x 5, 1x6) and slowly flying northwards, low over the ocean. Most *Calonectris* spp. shearwaters were flying NW, N, or NE, in keeping with the spring migration (return flights to nesting colonies).

Most shearwaters encountered off Mauritania have been adults. During visual surveys conducted in January 2000 (Camphuysen 2003), Cory's shearwaters were not observed and although Scopoli's shearwaters were sighted, these did not appear to be migrating. During the present study Cory's and Scopoli's shearwaters were widespread within the study area but uncommon between the study area and the port. These observations suggest that migratory *Calonectris* spp. shearwaters kept an offshore migration route (Figure 5).

Calonectris spp. shearwaters appear to occur year-round in the region with peak abundance in autumn (Sep-Nov; Bourne & Dixon 1975; Bourne 1983; 1989; Cheshire 1991; 1994), lower numbers in winter and spring (Dec-Mar; Lambert 1971; Bourne & Dixon 1973; Chapman 1985; Cheshire 1992) and a population increase in April-May (Rooth 1963; Leopold 1993).

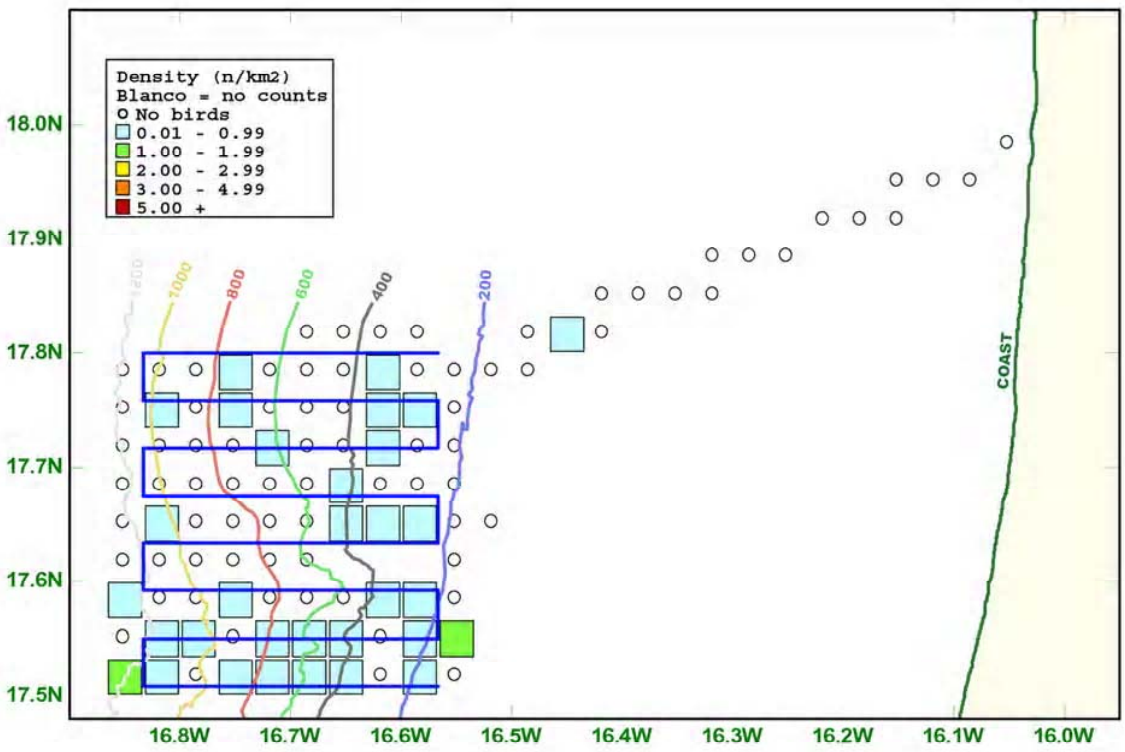

Figure 5. Densities of Scopoli's and Cory's shearwaters (combined, including unidentified individuals).

4.2.2 Storm-petrels (Family: Hydrobatidae)

Bulwer's petrel *Bulweria bulwerii* and the remaining four species of storm petrels (Table 5) breed in a variety of areas, as far apart as the Antarctic (Wilson's storm-petrel *Oceanites oceanicus*) and the sub-arctic (Leach's storm-petrel *Oceanodroma leucorhoa*). Bulwer's petrel and the band-rumped storm-petrel *Oceanodroma castro* breed nearby in Macronesia (Appendix 3). The European storm-petrel *Hydrobates pelagicus* most likely originate from either west European, or Mediterranean colonies.

Table 5. Numbers of each storm petrel species observed during the survey.

Common name	***Species***	**Number**
Band-rumped storm-petrel	*Oceanodroma castro*	38
Bulwer's petrel	*Bulweria bulwerii*	1
European storm-petrel	*Hydrobates pelagicus*	702
Leach's storm-petrel	*Oceanodroma leucorhoa*	95
Wilson's storm-petrel	*Oceanites oceanicus*	351
unidentified storm-petrel	*Oceanodroma/Hydrobates/Oceanitus*	194

Storm petrels were abundant throughout the study area. The European storm petrel and Wilson's storm petrel were the most abundant species, both being abundant around fishing vessels (471 European storm petrels and 110 Wilson's storm petrels). The birds appeared to patter and surface-peck over oily slicks in the wake of these vessels. None of the Leach's and band-rumped petrels positively identified occurred in association with fishing vessels. European and Wilson's storm petrels not associated with a fishing vessel, tended to be more abundant in the north-westerly part of the study area (Figures 6 a-d). Most foraging and resting flocks of storm petrels, in the north-westerly region, were dense, mixed-species flocks of two to four species. Leach's and band-rumped storm petrels were restricted to the deeper water regions of the study area. No petrels were observed during transit to Nouakchott.

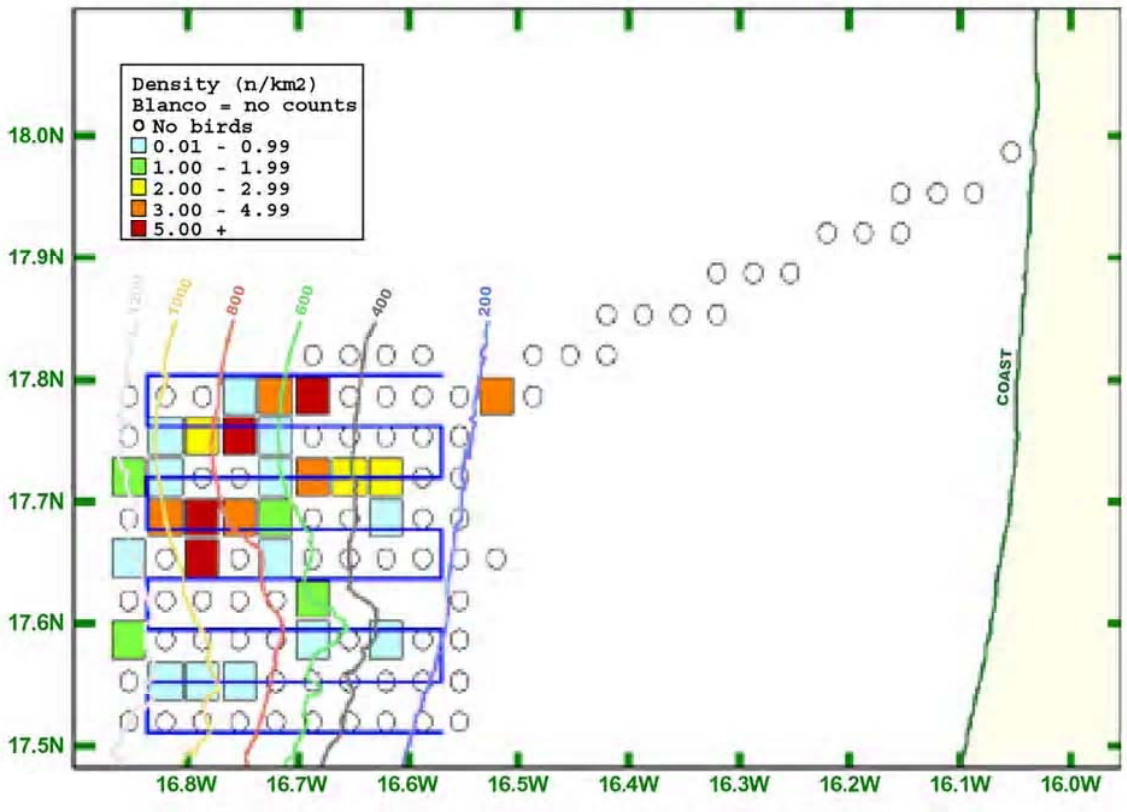

Figure 6a Densities of European storm petrels

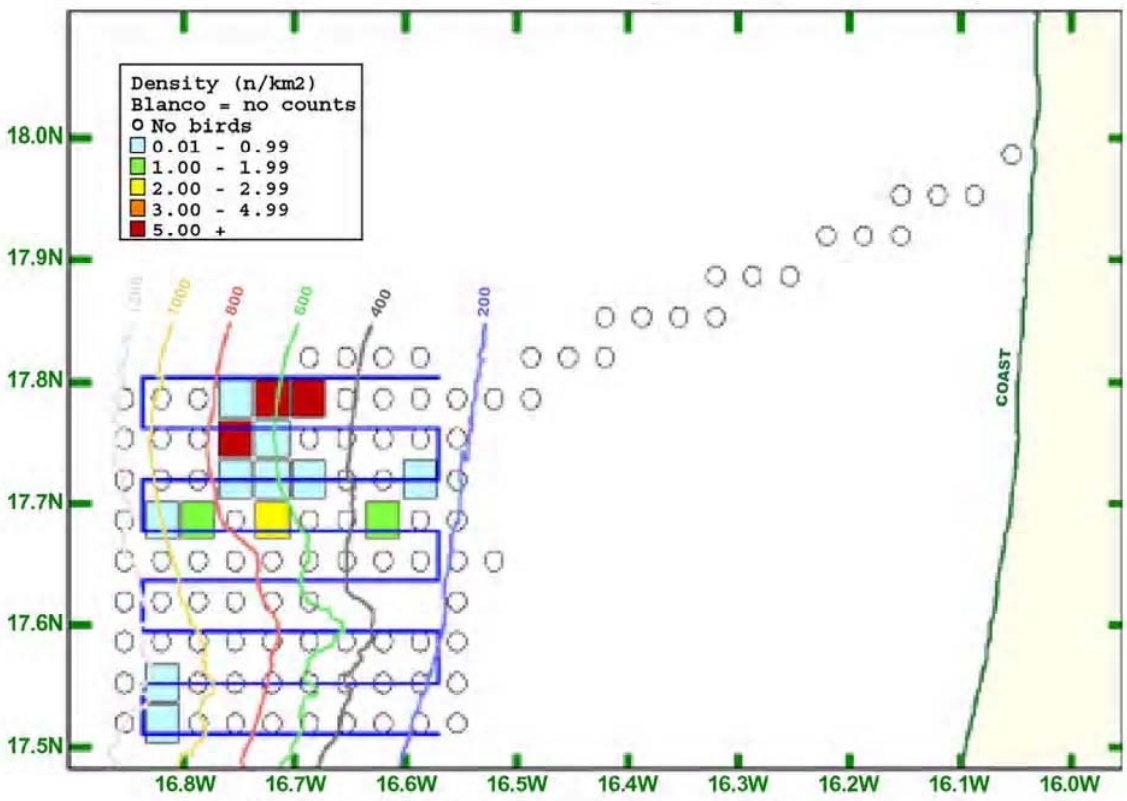

Figure 6b. Densities of Wilson's storm petrels

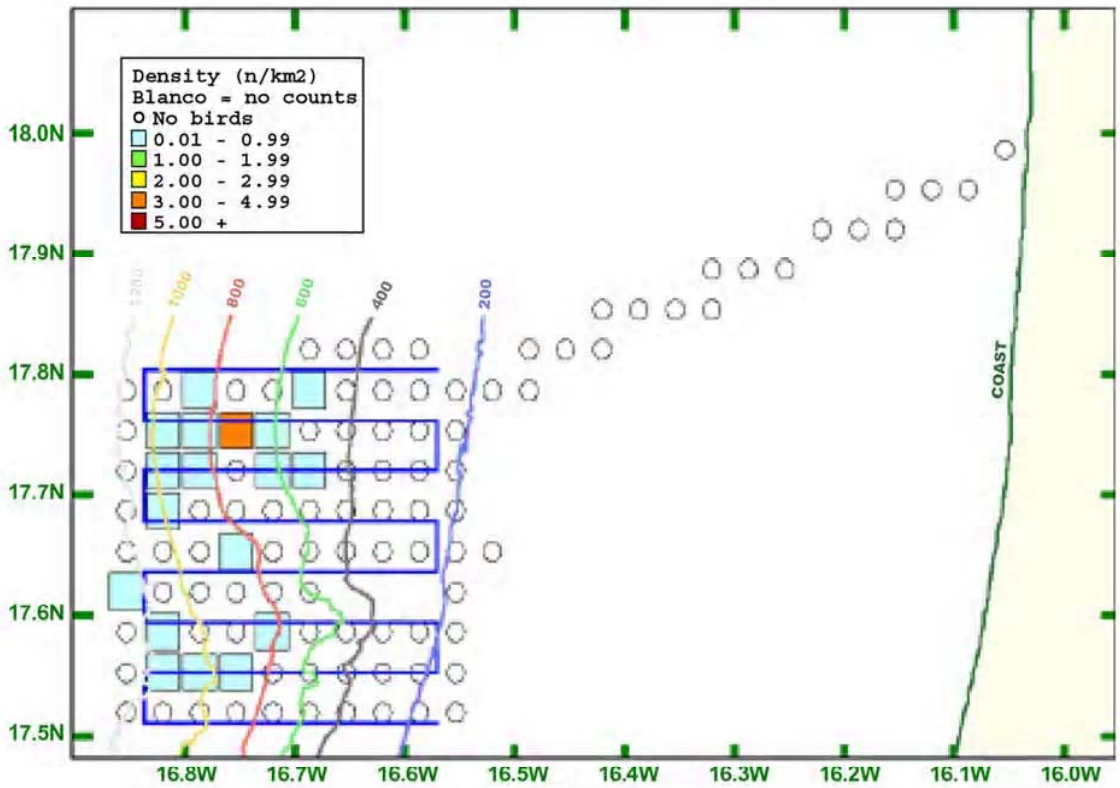

Figure 6c. Densities of Leach's storm petrels

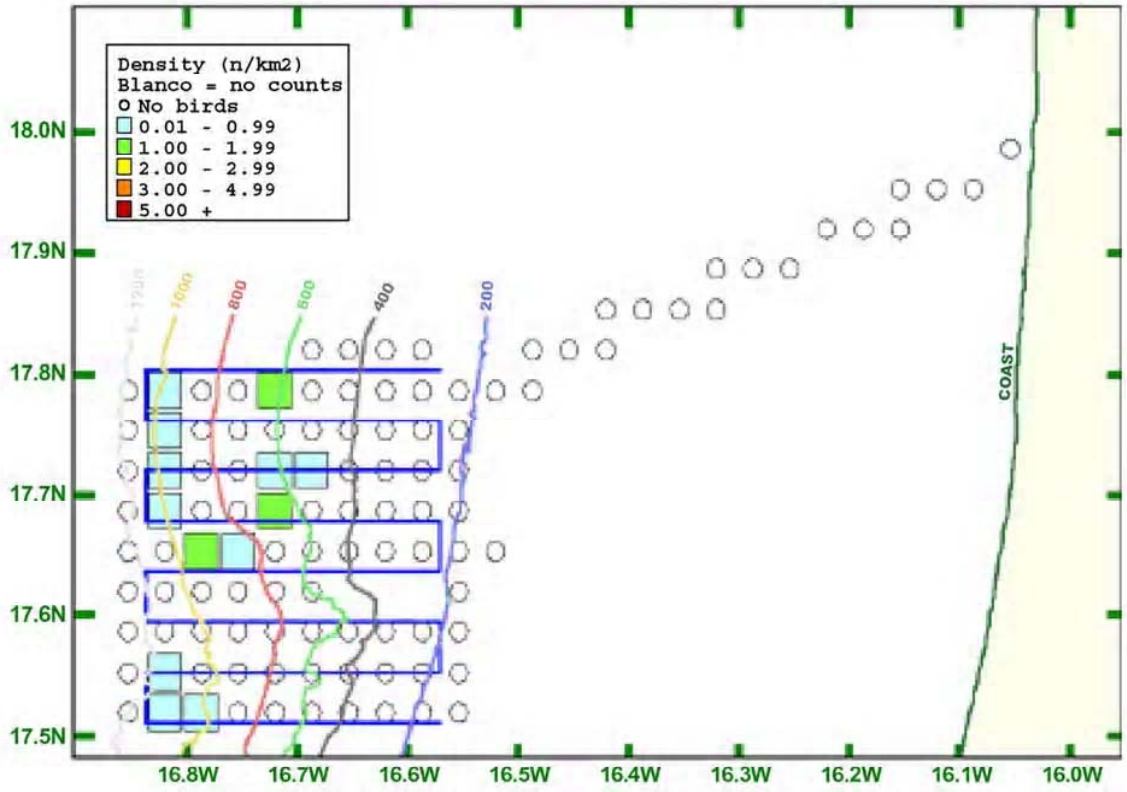

Figure 6d. Densities of Band-rumped storm petrels

4.2.3 Gannets (Family: Sulidae)

Northern gannets (*Morus bassanus*) were widespread at low densities throughout the study area but appeared to be more abundant closer to the coast (Table 6, Figure 7). The nearest known breeding grounds of northern gannets (ignoring isolated breeding attempts within the Mediterranean) are found in NW France, Britain and Ireland.

Table 6. Numbers of northern gannets observed during the survey.

Common name	***Species***	**Number**
Northern Gannet	*Morus bassanus*	854

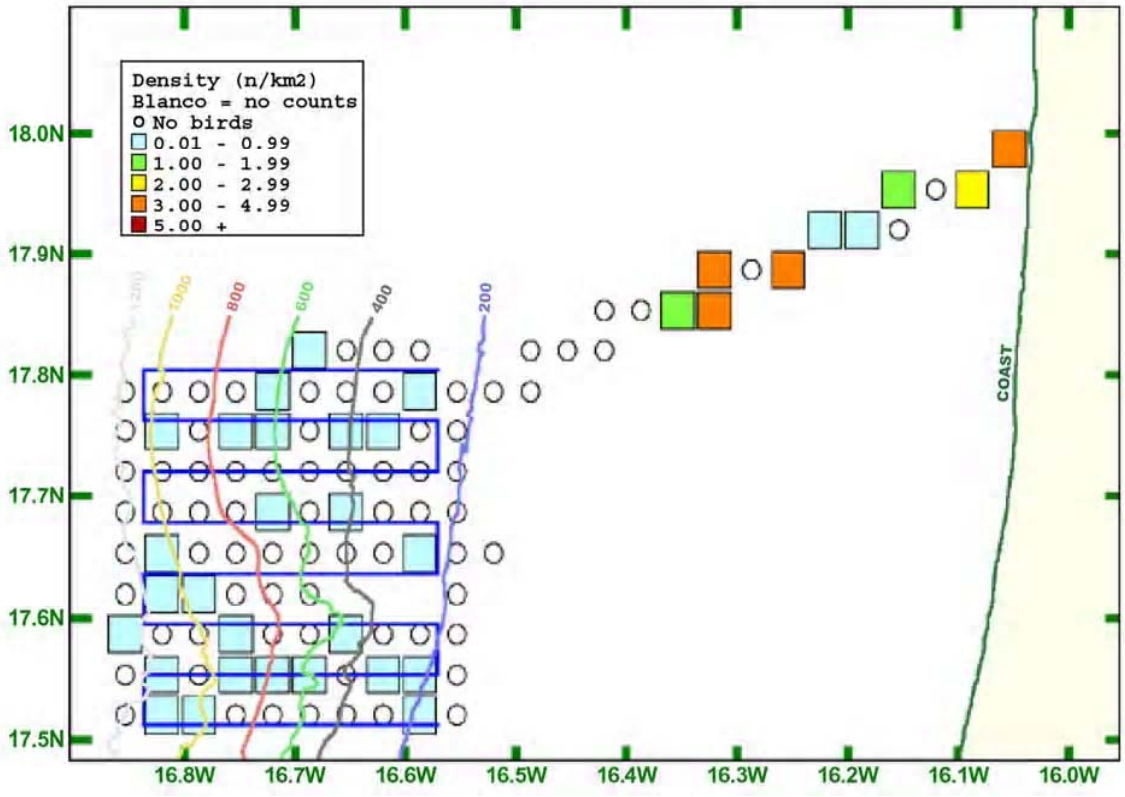

Figure 7. Densities of northern gannets in the study area.

Northern gannets were observed in association with vessels, including fishing boats and the survey vessel, and with pods of cetaceans (Table 7). Many northern gannets were attracted to the survey vessel and they probably seek feeding opportunities around any vessel in these waters. Many (45%) of the northern gannets not associated to vessels were flying south or southwest.

The age composition of northern gannets in March 2003 was very different to that observed in January 2000 (Camphuysen, 2003), with a much lower percentage of adult birds. Mauritanian waters are part of northern gannet wintering grounds and most adults appeared to have left by the time of the current survey.

Table 7. Numbers of northern gannets observed during the survey.

Associated with or direction of flight	outside transect	In transect
Flying, no apparent direction	32	6
Heading N	63	3
Heading NE	32	3
Heading E	23	5
Heading SE	36	3
Heading S	84	2
Heading SW	90	8
Heading W	33	2
Heading NW	20	
Associated with cetaceans	105	
Associated with observation base	69	
Associated with fishing vessel	110	68
MSFA participant, joining flock	1	

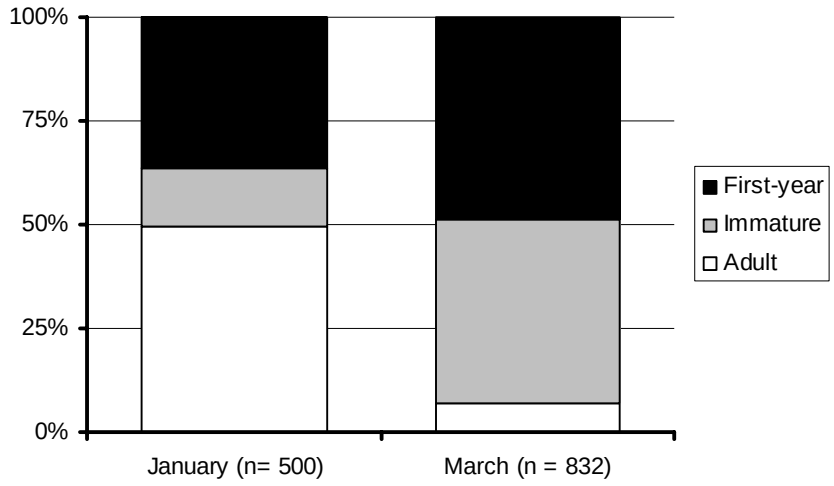

Figure 8. Age composition of northern gannets in and around the study area in January 2000 (Camphuysen 2003) and in March 2003 (current survey).

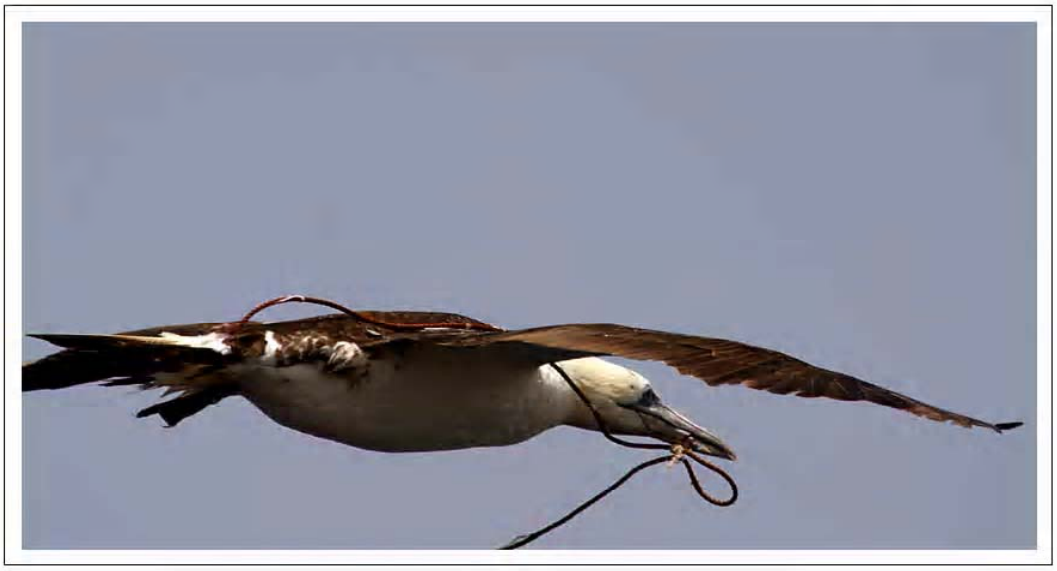

Plate 2. A second year immature northern gannet with a rope around the lower mandible.

4.2.4 Waders

The grey phalarope (*Phalaropus fulicaria*) is the only genuine seabird of the wader group found off Western Africa (Table 8). They primarily breed in the high Arctic, with isolated pairs nesting in Iceland. Whimbrels (*Numenius phaeopus*) and red knots (*Calidris canutus*) are west Palearctic migrants that winter in large numbers in Africa.

Table 8. Numbers of waders observed during the survey.

Common name	***Species***	**Number**
Grey Phalarope	*Phalaropus fulicaria*	441
Red Knot	*Calidris canutus*	6
Whimbrel	*Numenius phaeopus*	1

In January 2000, grey phalaropes were confined to the Moroccan upwelling zone, and no bird were recorded off Mauritania (Camphuysen, 2003). In March 2003, grey phalaropes were widespread in offshore Mauritanian waters (Figure 9), often foraging in small flocks over floating objects such as slicks, drifting rafts of seaweed and "lines of foam and flotsam". Phalarope foraging behaviour frequently involved numerous short flights between feeding areas. All birds observed were pale grey and none appeared to be beginning their pre-nuptial moult.

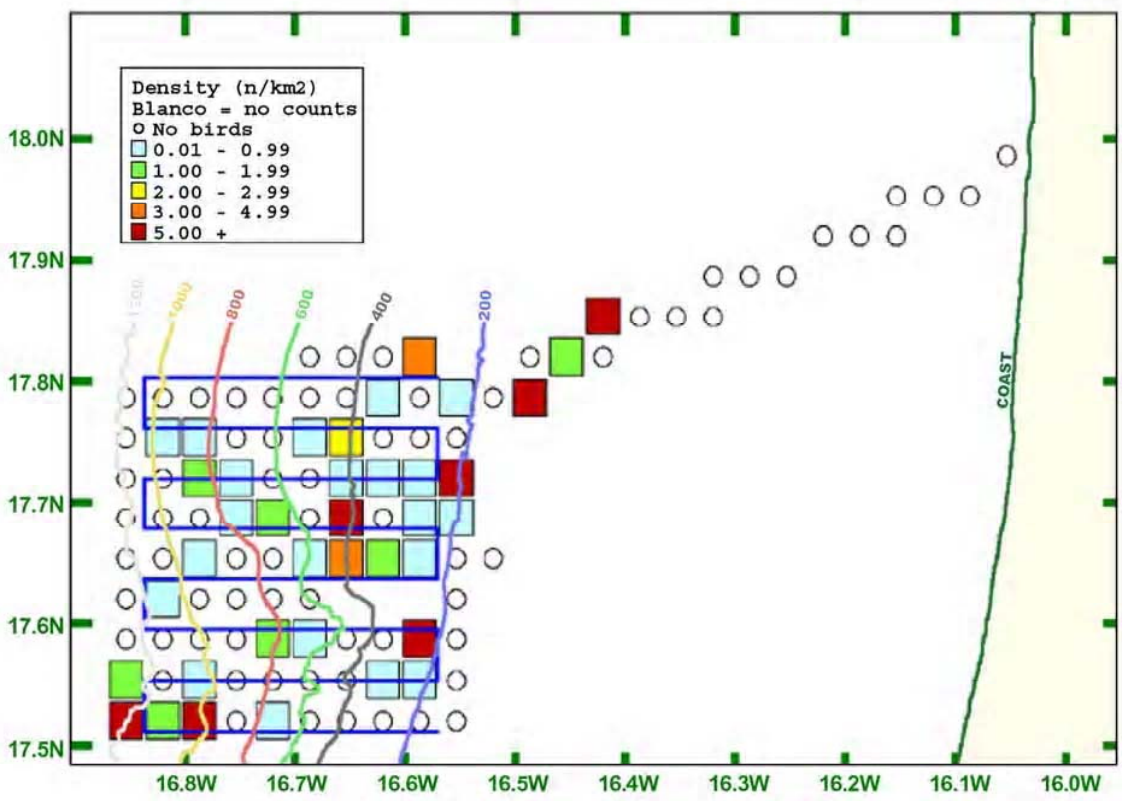

Figure 9. Densities of grey phalarope in the survey area, March 2003.

Phalaropes have been recorded in northwest African waters before, however their specific identity remains unclear. Rooth (1963) observed many hundreds of phalaropes in April 1962, but apparently incorrectly identified them as red-necked phalaropes (*Phalaropus lobates*) at 25°02'N, 16°08'W (16 April 1962), and several at 19°54'N, 17°42'W (25 April 1962).

Lambert (1971) recorded a flock of 570 phalaropes just SW of the study area. Bourne (1985) recorded flocks of several thousand red-necked phalaropes in February 1974, located at 17°55'N, 18°01'W. Cheshire (1992) recorded 350 phalaropes in Mar 1990 at 15.7°N, 18°W. Mayo (1948) reported grey phalaropes "off the West African coast, generally well out to sea, from September to February, sometimes as many as 50 or 60 together, but more usually in small parties", but failed to indicate where. In most reports the phalaropes are west of the western boundary of the study area. Brown (1979) reported grey phalaropes to be the only seabirds associated with an offshore oceanic 'front' and he suggested that this and similar boundary zones are important feeding areas during the pelagic phase of this species' annual cycle.

4.2.5 Skuas

Four species of skua were positively identified (Table 9), all originating from breeding grounds far to the north in the Atlantic Ocean (great: *Stercorarius skua*; Arctic: *S. parasiticus*; and long-tailed: *S. longicaudus*) or Siberia (Pomarine skua: *S. pomarinus*).

Table 9. Numbers of skuas observed during the survey.

Common name	***Species***	**Number**
Arctic skua	*Stercorarius parasiticus*	93
Long-tailed skua	*Stercorarius longicaudus*	244
Great skua	*Stercorarius skua*	97
Pomarine skua	*Stercorarius pomarinus*	3218
Unidentified skua	*Stercorarius sp.*	36

Pomarine skuas were by far the most abundant seabirds in the area in both January 2000 (Camphuysen, 2003) and March 2003. Pomarine skuas return to their breeding grounds in May and June (Maher 1974). In March 2003, many skuas had completed wing moult and birds with long, twisted tail-feathers appeared more prevalent, indicating that the skuas were preparing for the breeding season. The beginning of the northward migration was also indicated by the change from random flight patterns and associations with fishing vessels in January 2000, to predominantly northwards flight paths and weaker association with vessels in March 2003 (Table 10).

Pomarine skua densities were highest on the shelf side of the shelf-break (400-200m depth; Figure 10). Data collected during transit to port suggested that skuas were less abundant nearer the mainland coast.

The ocean overlying the Mauritanian shelf, including the study area, appears to be among the most important wintering areas for Pomarine skuas in the world.

Table 10. Flight direction of Pomarine skuas observed in January 2000 (Camphuysen 2003) and during the current survey.

Pomarine Skua behaviour	January 2000	March 2003
Heading N	38	428
Heading NE	32	577
Heading E	68	62
Heading SE	35	53
Heading S	15	63
Heading SW	13	53
Heading W	29	85
Heading NW	15	158
Total non-associated skuas	245	1479
Moving north (NW-NE) (*n*)	114	1248
Moving north (%)	46.5	84.4
Associated with fishing vessel	1361	644
Associated with observation base	871	243
At fishing vessels (%)	54.9	27.2
Ass. observation base (%)	35.2	10.3
Total number observed	2477	2366

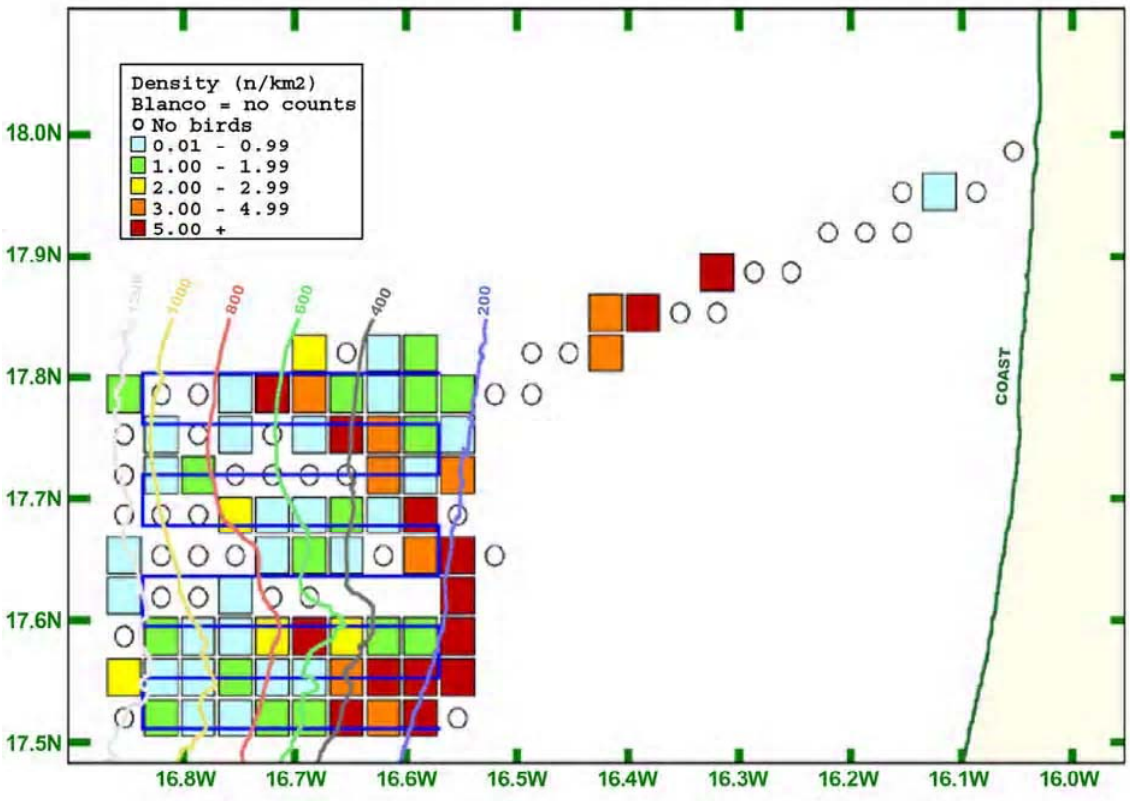

Figure 10. Densities of Pomarine skuas in the survey area, March 2003.

Long-tailed skuas were much less abundant than Pomarine skuas (Table 9). Long-tailed skuas were often observed foraging in similar areas to grey phalaropes (Figure 11). Both were surface pecking in these waters and both are believed to feed predominantly on surface plankton/nekton but did not form mixed feeding groups. Most long-tailed skuas were moulting to summer plumage, but in contrast to Pomarine skuas, very few had actually moulted the central tail feathers. Few had the long feathers that characterise the species.

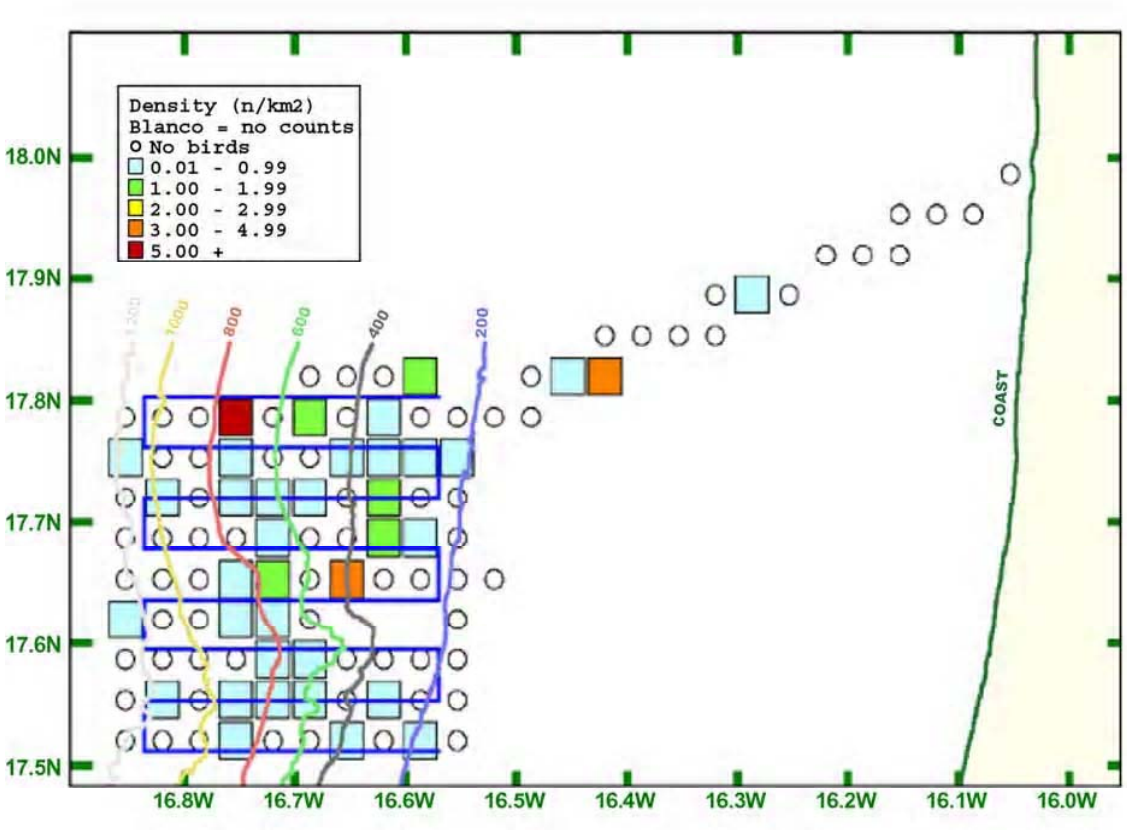

Figure 11. Densities of long-tailed skuas in the survey area, March 2003.

Arctic skuas (*Stercorarius parasiticus*) were the least numerous of the smaller skuas (Table 9, Figure 12). Most birds were immature or adults in winter plumage. Very few birds were observed actively foraging.

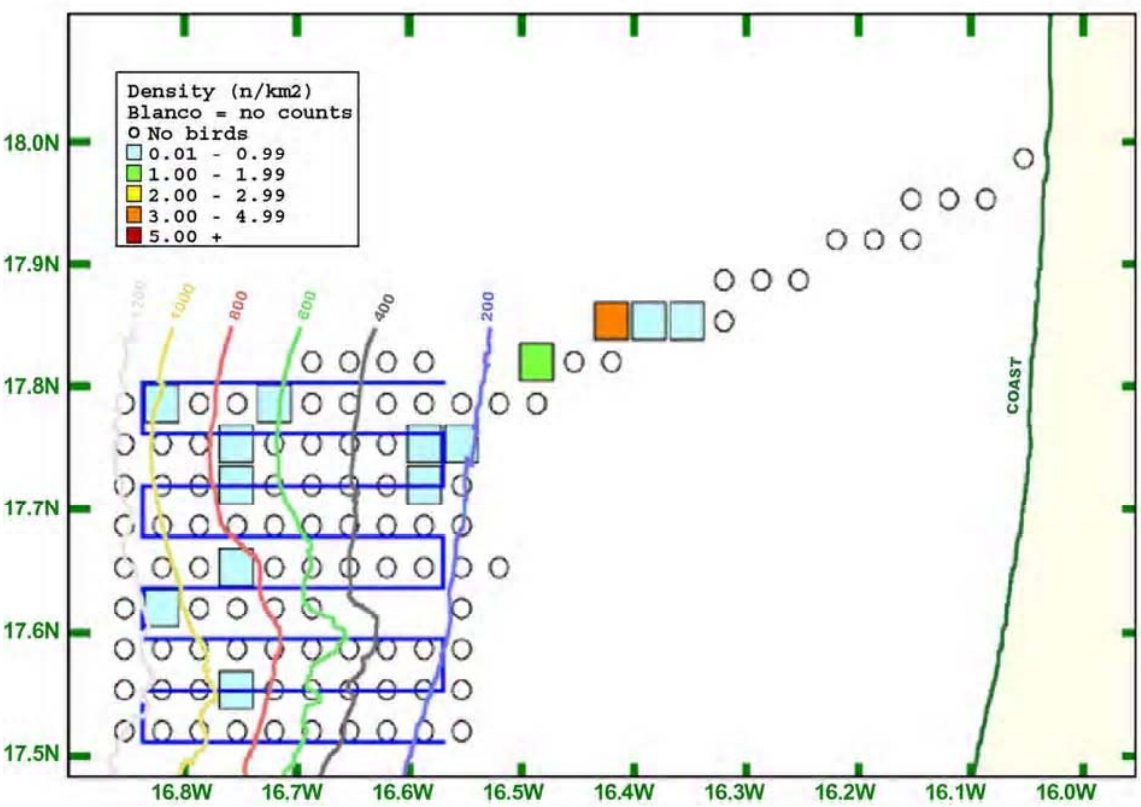

Figure 12. Densities of Arctic skua in the survey area, March 2003.

Although several wing-moulting great skuas (*Stercorarius skua*) were observed, none of the birds (perhaps with the exception of a ragged individual seen in poor light conditions) showed characteristics of the south polar skua (*Stercorarius maccormickii*). All birds were reddish and both immature birds and adult great skuas were regularly observed in the offshore study area (Figure 13).

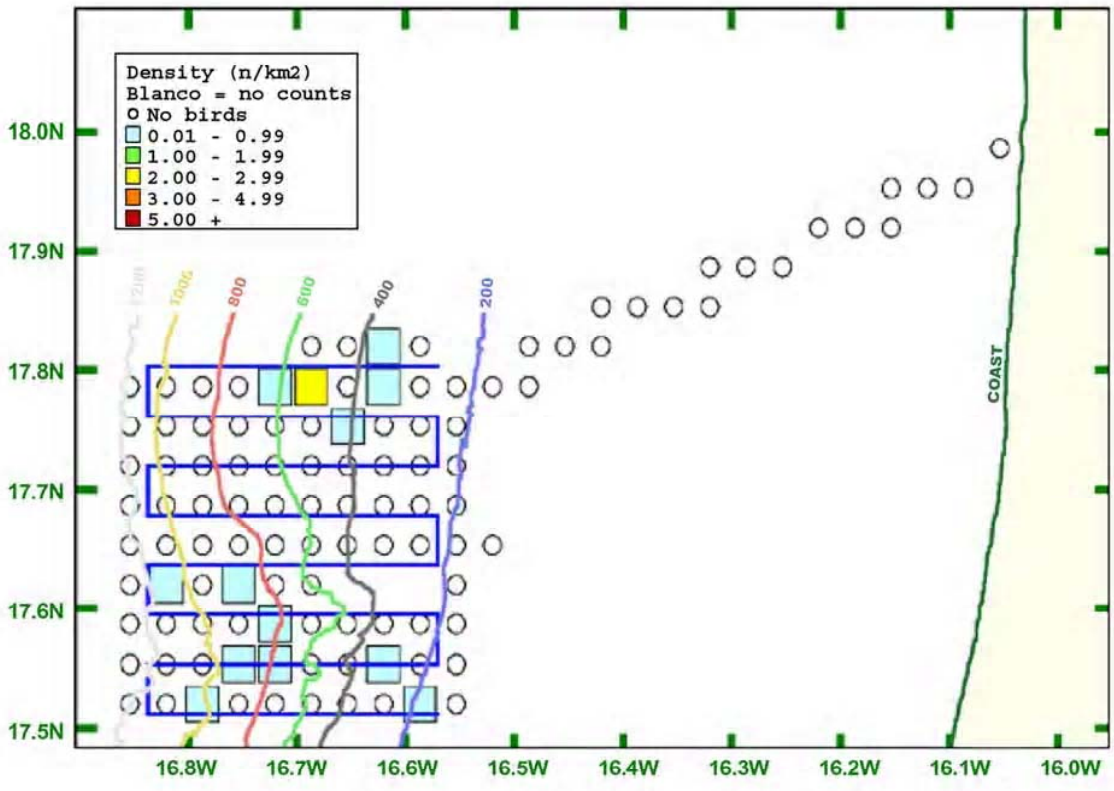

Figure 13. Densities of the great skua in the survey area, March 2003.

4.2.6 Gulls

Lesser black-backed gulls (*Larus fuscus graellsii*) were abundant in the study area, while Audouin's gulls (*L. audouini*), Mediterranean yellow-legged gulls (*L. michahellis*) and Sabine's gulls (*L. sabini*) were much less common (Table 11). Lesser black-backed gulls are a European sub-species of the black-backed gull (*L.fuscus*). This is a highly migratory species that flies south from Europe to the west coast of Africa in winter. Sabine's gull nests in the Arctic in summer, and migrates south for winter.

Table 11. Numbers of gulls observed during the survey.

Common name	***Species***	**Number**
Audouin's gull	*Larus audouinii*	5
Lesser black-backed gull	*Larus fuscus graellsii*	621
Mediterranean yellow-legged gull	*Larus michahellis*	6
Unidentified large gull	*Larus spp.*	50
Sabine's gull	*Larus sabini*	2

4.2.7 Terns

Five species of terns were recorded in the study area, (sandwich tern: *Sterna sandvicensis*; Mauritanian royal tern: *S. maxima albidorsalis*; roseate tern: *S. dougallii*; common tern: *S. hirundo;* and Arctic tern: *S. paradisaea*) (Table 12). The black tern (*Chlidonias niger*) was seen over the shelf between the study area and the coast.

Table 12. Numbers of terns observed during the survey.

Common name	***Species***	**Number**
Black tern	*Chlidonias niger*	1
Common / Arctic tern	*S. hirundo / S. paradisaea*	103
Roseate tern	*Sterna dougallii*	2
Common tern	*Sterna hirundo*	78
Mauritanian royal tern	*Sterna maxima albidorsalis*	4
Arctic tern	*Sterna paradisaea*	247
Sandwich tern	*Sterna sandvicensis*	57
Unidentified tern	*Sterna spp.*	250

Arctic terns were the most abundant terns within the study area (Table 12, Figure 14). Adult birds in both winter plumage and summer plumage occurred in mixed flocks with immature birds (2nd calendar year). Arctic Terns were searching for prey even over deeper offshore waters. Only during calm weather would numerous terns alight on the superstructure of the vessel. The densities of all terns combined are shown in Figure 15.

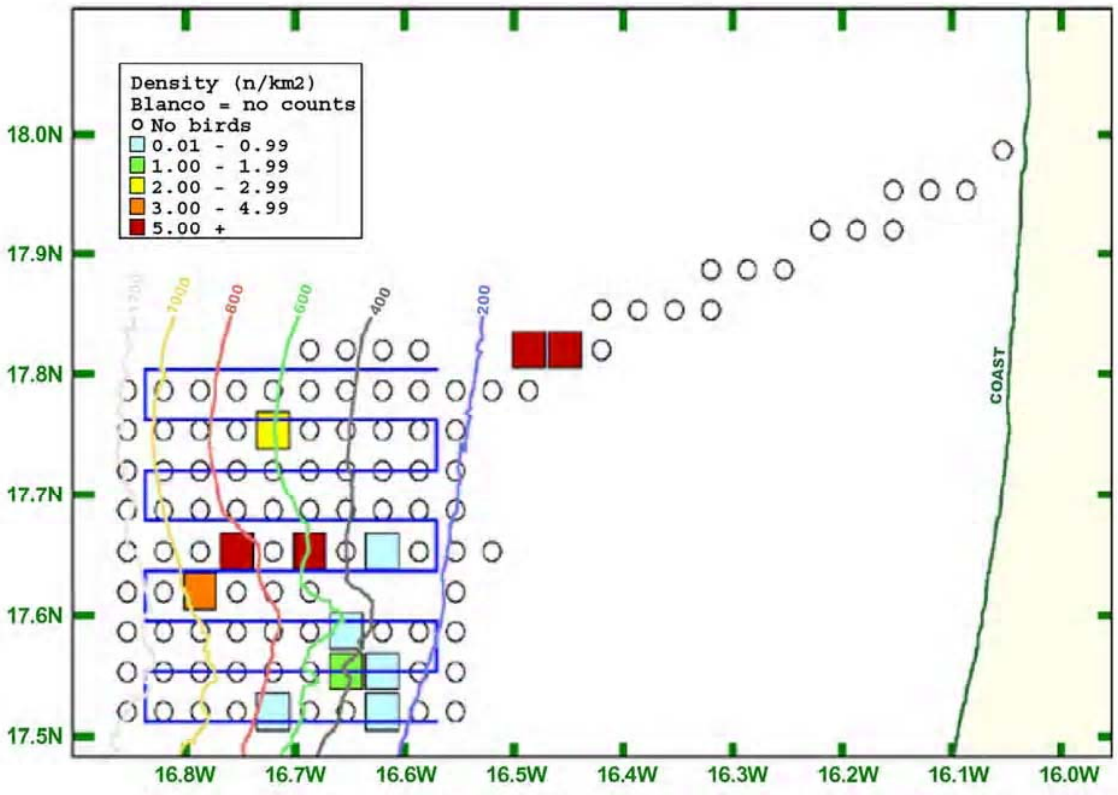

Figure 14. Densities of Arctic terns in the survey area, March 2003.

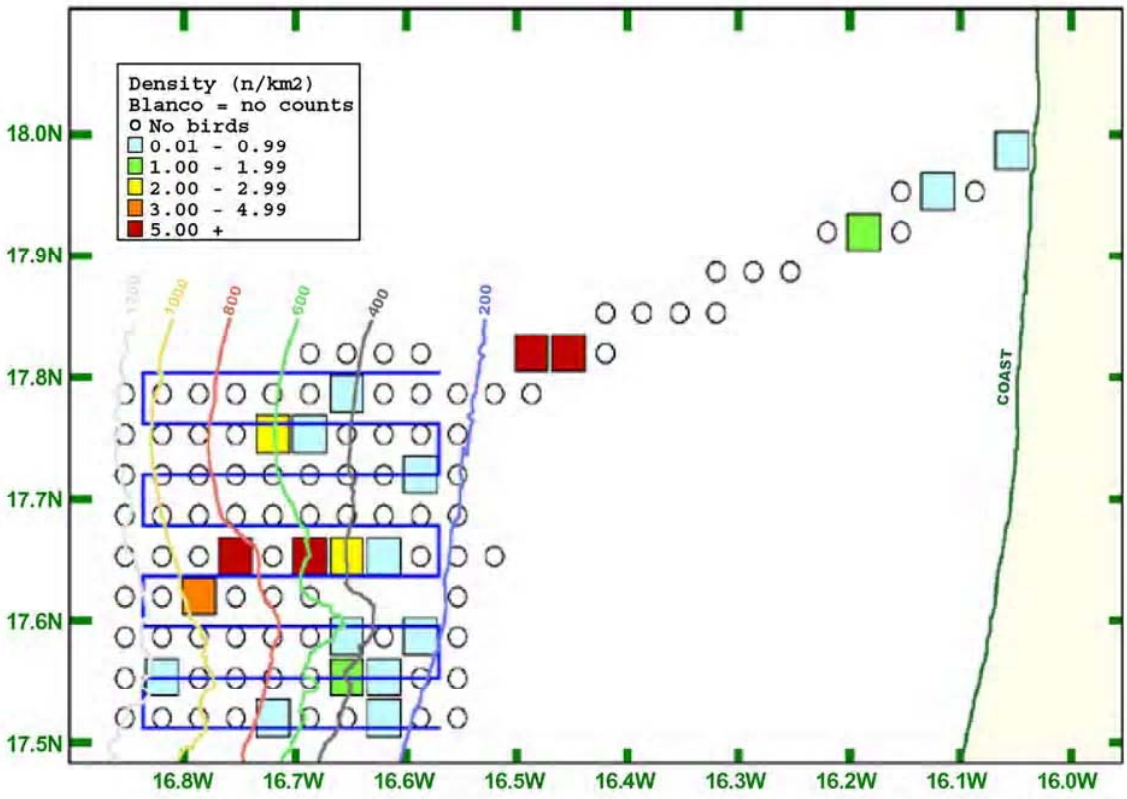

Figure 15. Densities of all terns combined in the survey area, March 2003.

4.2.8 Summary

Seabird diversity and overall numbers of seabirds were higher near the coast than in the deeper waters further offshore (Figure 16). Leach's storm petrels were only found in deeper offshore waters, while several species were restricted to the inner shelf area. Most pelagic seabirds occurred throughout the study area, but generally in higher numbers both on and over the shelf break.

Pomarine skuas were by far the most numerous seabirds in the area, and there is little doubt that Mauritanian shelf waters are one of the most important wintering areas for this species in the world.

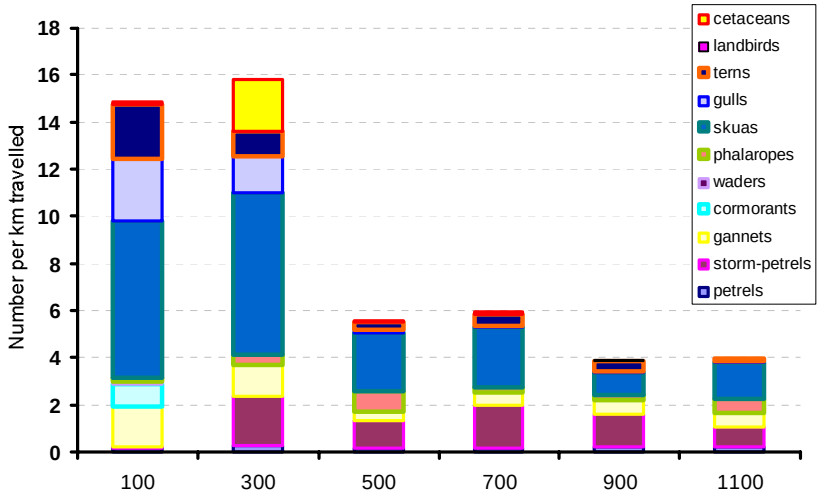

Figure 16. Relative abundance (number of animals per km steamed) of seabirds and cetaceans observed compared to distance from the coast. Includes seabirds recorded in association with fishing vessels.

4.3 FISHERIES

Commercial fishing trawlers were frequently observed in the shallower part of the study area and were not encountered in waters deeper than 800m. Trawler types observed were beam-trawlers (exclusively over the shelf), medium sized stern trawlers and very large freezer trawlers. Large numbers of trawlers were observed over the period of the study and it was difficult to accurately identify individual vessels and therefore total numbers could not be determined each day.

5.0 DISCUSSION

High and varying numbers of seabirds were observed during the entire period of the survey, with low to moderate numbers and diversity of marine mammals. Abundance estimates for marine mammals were not attempted in this study due to low sample sizes, nor were any quantitative associations with environmental conditions made. Density plots of seabirds are presented and this discussion centres on possible explanations for the lower than expected abundance of marine mammals and on the distribution of seabirds and their sighting rates.

5.1 CETACEANS

While a large number of cetaceans (>655) were recorded during the survey most of these were in one large pod of common dolphins (*Delphinus delphus*). Seven species of cetaceans were observed in the study area and one on the inner shelf. Larger Odontocete or Mysticete whales were rarely observed.

In January 2000, large cetaceans including beaked whales and sperm whales were more abundant along the shelf break, or near to it (Camphuysen, 2003). One possible explanation for the relatively low number of sightings made during the current survey is a possible variation in up-welling patterns and associated prey species densities in the area. Differences in species abundance exist on a temporal scale, as shown by the study undertaken in January 2000, however further studies are required to quantify spatial and temporal characteristics of the population.

While humpback whales are known to pass through Mauritanian waters, it is unknown whether this area represents significant or critical habitat (migratory routes, aggregation, breeding, resting or feeding areas) for the species. However, given the very low numbers of humpback whales reported on the accepted wintering grounds, it is possible that other areas, including Mauritanian waters could be seasonally important.

The distribution and migration patterns of Sei whales are not well documented in this area. Sei whales are diffusely distributed in waters off western Africa. Coupled to the

low population size in the North Atlantic, this suggests that Sei whale abundances are likely to be low in the study area.

Similarly, humpback, fin and blue whales are expected to occur on a low density, sporadic basis in the area. Sperm and beaked whales are likely to be present in the study area, probably in the deeper waters.

The absence of these whales from the study area on this occasion does not indicate the area is not significant for whales. Whale movements are highly variable in space and time and this area may be important in other years or at other times of year.

5.2 SEABIRDS

A high diversity and abundance of seabird species were recorded within the survey area and on transit to Nouakchott. The results of this survey were 27 species and >8000 individuals observed in the study area or on transit (Appendix 4). The Pomarine skua was by far the most abundant species, accounting for over 45% of the birds observed. Other abundant species included northern gannets (11%), European storm-petrels (9%), lesser black-backed gulls (7%) and grey phalaropes (5%).

The results indicate that the shelf-break at the Chinguetti Development study area is of significance mainly for non-resident seabirds (Palaearctic migrants, Mediterranean and Southern Hemisphere seabirds) (Appendix 3). Of the eight locally nesting species observed, six were recorded only in the vicinity of Nouakchott. Of the remaining two local residents offshore in the Chinguetti study area, the Mauritanian royal tern was very scarce and the common terns observed were most probably from a West-Palaearctic rather than from a West African origin.

6. CONCLUSIONS

Even though the number of cetacean sightings were relatively low (17 pods), the distribution of these sightings (seven Odontocete species and one baleen whale) was spread evenly through the central and eastern parts of the study area. As a result of low sample sizes no conclusions can be made on abundance or density of the cetaceans, or on any association with oceanographic features.

Large numbers of seabirds were observed during the survey. The results indicate that the shelf-break at the study area is of significance mainly for non-resident seabirds (Palaearctic migrants, Mediterranean and Southern Hemisphere seabirds). Pomarine Skuas were by far the most numerous seabirds in the area, and there is little doubt that this part of the Mauritanian shelf seas is one of the most important wintering areas for this species in the world.

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APPENDIX 1

APPENDIX 1 Details of effort for the survey in relation to each transect and depth category.

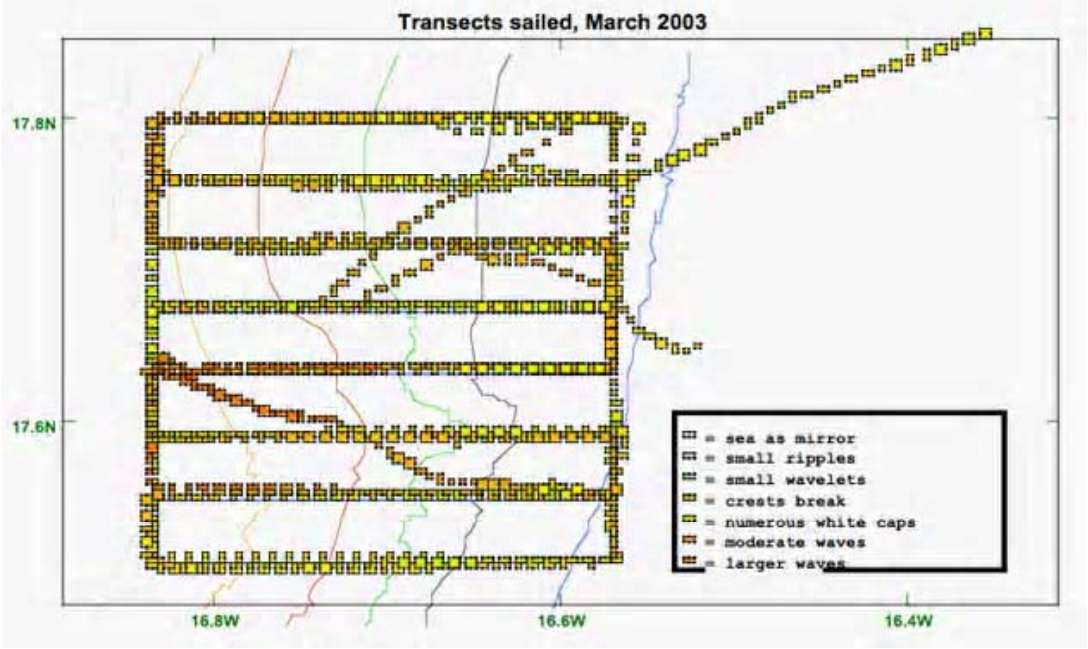

Figure 1. Transects sailed in the Woodside study area (homeward journey not completely illustrated).
Dots represent individual 5-minute counts of the strip-transect surveys, where colours are indicative of the sea-state during the surveys (see legend). The boundaries of the different depth zones are shown in colour, with the shallower waters in the east (right) and deeper waters in the west (left).

The five minute counts were allocated to each of the transects (Figure 2) and to the depth categories (Figure 3).

Figure 2. Allocation of individual 5-minute counts to each transect (No's 1-8).

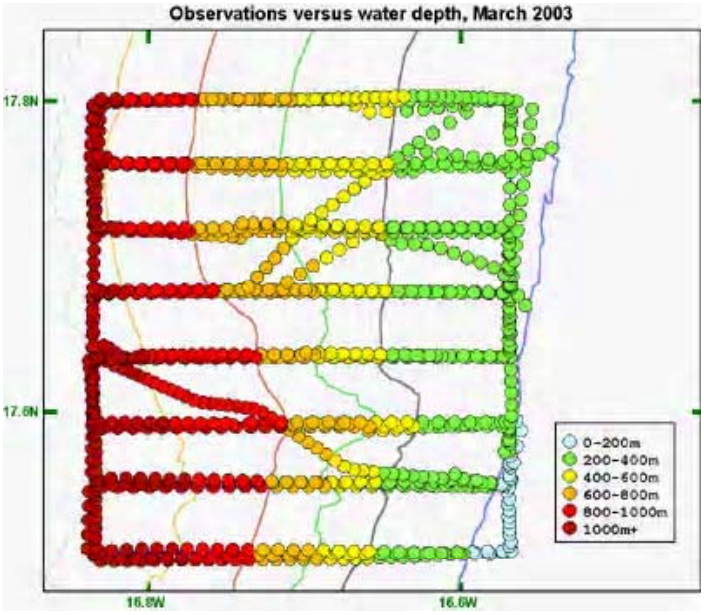

Figure 3. Allocation of individual 5-minute counts to each depth zone. Homeward journey plots (not illustrated) were allocated to the 0-200 m deep waters.

APPENDIX 2

Appendix 2. **Seabird breeding areas.**

Shearwaters

Scopoli's shearwater *Calonectris diomedea*
Mediterranean islands
Cory's shearwater *Calonectris borealis*
Berlengas (Portugal), W to Azores and S to Canary Islands
Great shearwater *Puffinus gravis*
Nightingale and Inaccessible Island (Tristan da Cunha), 50-100p Falkland Islands (Woods & Woods 1997)
Little shearwater *Puffinus assimilis baroli*
Azores to Canary Islands

Storm-petrels

Bulwer's petrel *Bulweria bulwerii*
Pantropical E Atlantic from Azores to Cape Verde Isl, in Pacific from E China and Bonin isl to Hawaii, Phoenix and Marquesas isl
Wilson's storm-petrel *Oceanites oceanicus oceanicus*
Subantarctic islands, from Cape Horn to Kerguelen Islands. S Georgia abundant (100.000+), widespread breeder. Falkland Isl 5000+
European storm-petrel *Hydrobates pelagicus*
NE Atlantic, from S Island and W Norway through Britain to NW France, N Spain, Salvage and Canary islands, also in Mediterranean, from E Spain east to Greece and perhaps Turkey
Band-rumped storm-petrel *Oceanodroma castro*
E Atlantic, from Berlengas (Portugal) and Azores to Ascension and St Helena, in Pacific off E Japan, on Kauai (Hawaii) and at Galapagos
Leach's storm-petrel *Oceanodroma leucorhoa leucorhoa*
N Pacific, from NE Japan and east through Kuril and Aleutian Isl to S Alaska and southeast to C California; N Atlantic from NE USA and E Canada to Iceland, Faeroe Is N Scotland and NW Norway, southern Africa

Gannets

Northern gannet *Morus bassanus*
North Atlantic, 46-50°N on west side (Newfoundland), Channel Islands to N Norway in east, accidentally breeding Mediterranean

Waders

Grey phalarope *Phalaropus fulicaria*
Circumpolar, on coasts of Arctic Ocean

Skua

Great skua *Stercorarius skua*
Iceland, Faeroe Isl, N Scotland, recently established breeding Jan Mayen, Svalbard, Bear Isl, N Norway and Veshnjak Isl, Kola Peninsula (NW Russia)
Pomarine skua *Stercorarius pomarinus*
Tundras of N Russia, N Alaska and N Canada
Arctic skua *Stercorarius parasiticus*
Circumpolar in coastal tundra, mainly within 57°-80°N
Long-tailed skua *Stercorarius longicaudus longicaudus*
Arctic and subarctic uplands of Scandinavia and Russia east to delta of River Lena

Gulls

Audouin's gull *Larus audouinii*
Mediterranean coasts, main breeding area Ebro Delta (NE Spain) and Chafarinas Isl (off NE Morocco), scattered colonies east to Tunesia, Aegean Sea, S Turkey and Cyprus
Mediterranean yellow-legged gull *Larus michahellis michahellis*
W and S Europe and NW Africa east through Mediterranean: France, Iberian Peninsula; Mediterranean basin, also Madeira and Canary Is.
Lesser black-backed gull *Larus fuscus graellsii*
Iceland, Faeroes, Britain, France and Iberia (*f. graelsii*), Netherlands, Denmark, S Norway, and isolated population NE Spain (Ebro Delta) (*f. intermedius*).
Sabine's gull *Larus sabini sabini*
Arctic Canada to W Greenland, Svalbard and Siberia

Terns

Sandwich tern *Sterna sandvicensis sandvicensis*
Europe, east to Caspian Sea
Mauretanian royal tern *Sterna maxima albididorsalis*
Mauritania (5300p), Senegal (22693p) to Guinea, occasionally further south
Roseate tern *Sterna dougallii dougallii*
Nova Scotia to New York and Florida, south through Gulf of Honduras and West Indies to islands off N Venezuela and also Azores, NW Europe, and E and S Africa from S Somalia to Tanzania and S Cape Province
Common tern *Sterna hirundo hirundo*
N America to northern S America, Atlantic islands, Europe, North Africa (Tunisia) and W Africa (Mauritania (200p), Senegal (70p), erratically Nigeria) through Middle East and Black and Caspian Seas
Arctic tern *Sterna paradisaea*
Iceland, Britain and Netherlands through Scandinavia and across Asia, mainly north of Arctic Circle, to bering Strait; isolated breeding Kamchatka and Franz Josef Land, Aleutians and N Alaska across to NW and NE Greenland and S to British Columbia and New York
Black tern *Chlidonias niger niger*
S Scandinavia south to S Spain and east through E Europe and W Asia to Lake Balkhash and Altai

APPENDIX 3

Appendix 3. Seabird regional geographical occurrence.

Seabird name	Seabird species	Arctic	Sub-arctic	NW Europe	W Medit	Macaro-nesia	Local	Sub Antarctic
Bulwer's petrel	*Bulweria bulwerii*					X		
Scopoli's shearwater	*Calonectris diomedea*				X			
Cory's shearwater	*Calonectris borealis*					X		
Little shearwater	*Puffinus assimilis*					X		
Great shearwater	*Puffinus gravis*							X
European storm-petrel	*Hydrobates pelagicus*			X		(X)		
Wilson's storm-petrel	*Oceanites oceanicus*							X
Band-rumped storm-petrel	*Oceanodroma castro*					X		
Leach's storm-petrel	*Oceanodroma leucorhoa*		X	X				
Northern gannet	*Morus bassanus*			X				
Great white pelican	*Pelecanus onocrotalus*						X	
Moroccan cormorant*	*Phal. carbo moroccanus*						X	
West-African cormorant*	*Phal. carbo lucidus*						X	
Red knot	*Calidris canutus*	X						
Whimbrel	*Numenius phaeopus*			X				
Grey phalarope	*Phalaropus fulicaria*	X						
Long-tailed skua	*Stercorarius longicaudus*	X						
Arctic skua	*Stercorarius parasiticus*	X	X	X				
Pomarine skua	*Stercorarius pomarinus*	X						
Great skua	*Stercorarius skua*		X	X				
Audouin's gull	*Larus audouinii*				X			
Lesser black-backed gull	*Larus fuscus graellsii*			X				
Slender-billed gull*	*Larus genei*						X	
Mediterranean gull*	*Larus melanocephalus*			X	X			
Yellow-legged gull	*Larus michahellis*				X	X		
Black-headed gull*	*Larus ridibundus*			X				

Seabird name	Seabird species	Arctic	Sub-arctic	NW Europe	W Medit	Macaro-nesia	Local	Sub Antarctic
Grey-headed gull*	*Larus cirrocephalus*						X	
Sabine's gull	*Xema sabini*	X						
Black tern	*Chlidonias niger*			X				
Roseate tern	*Sterna dougallii*			X		X		
Common tern	*Sterna hirundo*			X	X		X	
Caspian tern*	*Sterna caspia*			X			X	
Mauretanian royal tern	*Sterna maxima albidorsalis*						X	
Arctic tern	*Sterna paradisaea*	X	X	X				
Sandwich tern	*Sterna sandvicensis*			X				
Number of species		7	4	15	5	6-7	8	2

Note that some species occur in more than one region, so that the total number of species does not add up to the number of species observed.

Seabirds marked with an asterisk (*) were exclusively observed within or nearby Nouakchott harbour

APPENDIX 4

Appendix 4. Number of seabird and cetacean species observed in the study area and over the shelf.

Seabird name	***Genus species***	**Number**
Bulwer's petrel	*Bulweria bulwerii*	1
Scopoli's shearwater	*Calonectris diomedea*	21
Scopoli's/Corys shearwater	*Calonectris spp.*	96
Cory's shearwater	*Calonectris borealis*	87
Little shearwater	*Puffinus assimilis*	2
Great shearwater	*Puffinus gravis*	1
European storm-petrel	*Hydrobates pelagicus*	702
unidentified storm-petrel	*Oceanodroma/Hydrobates/Oceanitus*	195
Wilson's storm-petrel	*Oceanites oceanicus*	351
Band-rumped storm-petrel	*Oceanodroma castro*	38
Leach's storm-petrel	*Oceanodroma leucorhoa*	95
Northern gannet	*Morus bassanus*	871
Red knot	*Calidris canutus*	6
Whimbrel	*Numenius phaeopus*	1
Grey phalarope	*Phalaropus fulicaria*	441
Long-tailed skua	*Stercorarius longicaudus*	243
Arctic skua	*Stercorarius parasiticus*	93
Pomarine skua	*Stercorarius pomarinus*	3201
Great skua	*Stercorarius skua*	97
Skua	*Stercorarius spec.*	36
Audouin's gull	*Larus audouinii*	5
Lesser black-backed gull	*Larus graellsii*	621
Mediterranean yellow-legged gull	*Larus michahellis*	6
unidentified large gull	*Larus spec.*	50
Sabine's gull	*Xema sabini*	2
Black tern	*Chlidonias niger*	1
Common / Arctic tern	*S. hirundo / S. paradisaea*	103
Roseate tern	*Sterna dougallii*	2
Common tern	*Sterna hirundo*	78
Mauritanian royal tern	*Sterna maxima albidorsalis*	4
Arctic tern	*Sterna paradisaea*	247
Sandwich tern	*Sterna sandvicensis*	57
Tern	*Sterna spec.*	250

Cetacean name	***Genus species***	**Sighting**	**Number**
Sei whale	*Balaenoptera borealis*	1	1
Common dolphin (short beaked)	*Delphinus delphis*	4	26
Long-beaked common dolphin	*Delphinus capensis*	1	500
Risso's dolphin	*Grampus griseus*	3	17
Atlantic hump-backed dolphin	*Souza teuszii*	1	2
Clymene dolphin	*Stenella clymene*	1	40
Striped dolphin	*Stenella coeruleoalba*	1	15
Long-snouted spinner dolphin	*Stenella longirostris*	1	40
Bottlenose dolphin	*Tursiops truncatus*	3	10
Medium whale large fin	*unidentified*	2	4