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## Baseline Monitoring data on Procellariiformes (Shearwaters) in the Bay of Biscay

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This paper presents baseline data concerning the year round status and distribution of shearwater (Procellariiforme) species in the Bay of Biscay and western English Channel from a preliminary analysis of sightings data collected through Biscay Dolphin Research Programme (BDRP) surveys between September 1995 and February 2001. Six species of shearwater were recorded in the Bay of Biscay through BDRP surveys; Cory's Shearwater *Calonectris diomedea*, Great Shearwater *Puffinus gravis*, Sooty Shearwater *Puffinus griseus*, Manx Shearwater *Puffinus puffinus*, Mediterranean Shearwater *Puffinus yelkouan (mauretanicus)*, and Little Shearwater *Puffinus assimilis*. The two large shearwater species are largely present from late July to early October in the deeper waters (>1000m) of the Bay (44-47°N). The largest concentrations of birds are present at presumed areas of upwelling near the northern Celtic-Biscay shelf edge, where flocks of up to 1000 Great and 400 Cory's Shearwater have been recorded from surveys. Unlike Cory's Shearwater, Great Shearwater is often still found in large numbers up to late October. Sooty Shearwater does not occur in large numbers but is distributed throughout the survey area on migration. Manx Shearwater is found in the largest numbers in the English Channel and off the Brittany coast in the April-June period and is largely absent from the Bay itself. Mediterranean Shearwater occurs in low numbers with a fairly even distribution of records from May to November. Little Shearwater is a rare although regular species August-October.



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### 1. Introduction

The Bay of Biscay has long been known as an important stopover for various shearwater species, although there is comparatively little evidence of systematic seabird surveys within the area, in comparison to UK waters and the North Sea. Great Shearwater has been recorded in high densities along the northern Celtic/Biscay shelf edge (Bourne 1986, Voous & Wattel 1963). Cory's Shearwater is known to disperse into the Bay in the summer months; non-breeders from May-June and other

birds, in large numbers from July-October (Cramp 1977, Guerin 1999). The Bay is also known as an important moulting site for Mediterranean Shearwaters of the race *P. y. mauretanicus*, which congregate in coastal areas on the shelf (Le Mao & Yésou 1993). There is little historical evidence that the area is important for Manx, Sooty or Little Shearwater.

The Biscay Dolphin Research Programme is a voluntary marine research and conservation organisation, established in 1995 and sponsored by P&O Portsmouth. The aim of the first five years of study was to establish baseline data on

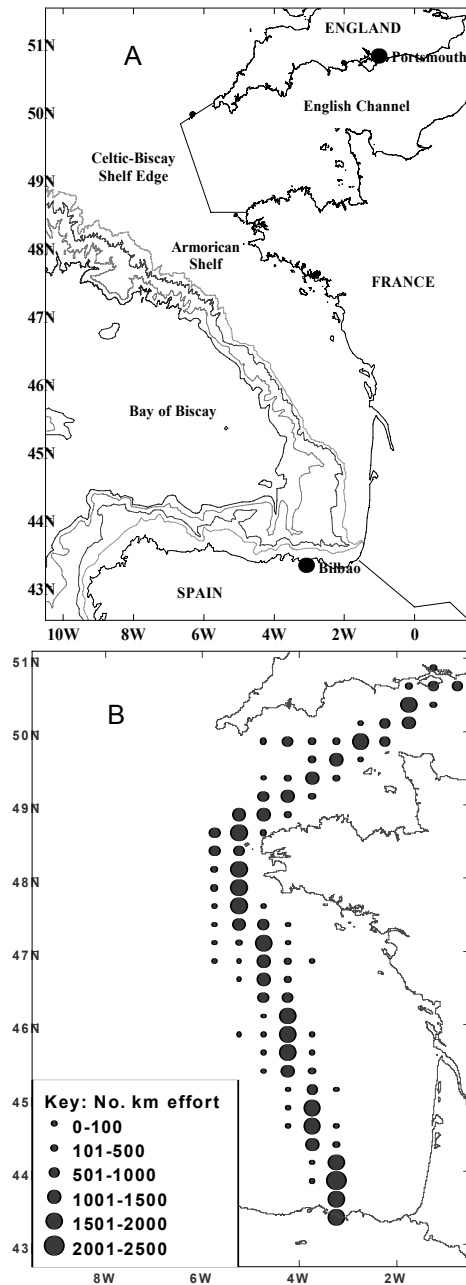


Fig. 1. Study area and survey coverage 1995-2001, (a) Study area, (b) Survey coverage (1a: depth contours from right to left are 200m, 1000m, 2000m, 4000m).

the distribution, behaviour and relative abundance of cetaceans, seabirds and

other marine organisms along the route of the *Pride of Bilbao*, a commercial ferry which sails from Portsmouth (England) to Bilbao (northern Spain).

## 2. Study area and methods

The study area is situated in temperate waters of the northeast Atlantic, between latitudes 43°N to 51°N and 0°W to 8°W. It comprises two major sea areas, the English Channel and Bay of Biscay (Fig. 1a).

Throughout the survey period, the recording priority of the BDRP was to generate reliable monitoring data on cetaceans. Seabird recording necessarily came second, and this in combination with the limited manpower, the rapid speed of the ship and the extraordinarily high viewing platform, militated against recording seabirds using standardised seabird monitoring techniques (Tasker *et al.* 1984). Seabird surveys were undertaken exclusively from the P&O Portsmouth cruise-ferry, the *Pride of Bilbao*, which sails from Portsmouth (southern England) to Bilbao (northern Spain) traversing British, French and Spanish waters. The ferry follows a set route although the course alters from time to time. Effort-related sightings data were obtained from a total of 85 ICES (International Council for the Exploration of the Sea) rectangles (Each measures 15' latitude by 30' longitude (Fig. 1b).

Monthly seabird surveys were undertaken year-round from the *Pride of Bilbao*. Each return crossing extended over four days. In summer, this enabled the whole of the route to be sampled at least once during daylight hours and in winter approximately 75% of the route, the main gap in coverage then being the northern Celtic

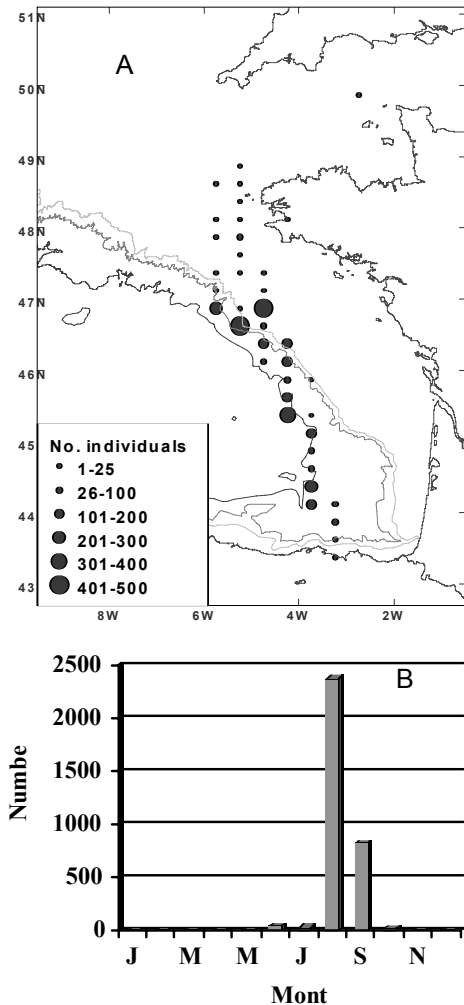


Fig. 2. Cory's Shearwater in the Bay of Biscay. (a) Distribution of 1995-2000, (b) seasonal abundance.

Biscay shelf edge. Most survey trips were undertaken in the last week of each month.

On each trip, effort-related seabird recording was carried out during available daylight hours by three experienced volunteer observers. Recording was made from a fixed position on the bridge of the ship, at a height of 32m above the surface. The ship's speed was 15-22 knots. Each seabird was counted once only, sightings

being grouped into minute-long periods. Between 1995 and July 2000, all birds were counted within an assumed strip-width of 4km, measured as 2km either side of dead ahead. For each seabird sighting the following recordings were made: species name, number seen, and where possible, age and sex. Notes on behaviour were also made including oiled birds and associations with fishing vessels and cetaceans.

From August 2000, refinements to the methodology were made to enable estimations to be made of bird density in the ICES rectangles. All birds ahead of the ship were recorded only once as being either inside an imaginary recording box, 300×300m, on the starboard side, or outside the box (but presumed within 2km). Effort data was collected simultaneously with sightings data, to enable the number of sightings to be scaled to recording effort and the calculation of relative frequency, abundance and density to detect change. At 15-30 minute intervals, or whenever the ships' course changed, a range of variables was measured, including the ship's speed and course, and sea and weather variables such as sea state and windspeed (Evans 1995).

Between 1995 and February 2001 63 (four-day) survey trips were made, resulting in more than 65 000km of completed search effort. Bird data were collected on 51 trips, totalling just under 50 000km of survey effort, coverage occurring evenly through the seasons (N=16-18 trips).

Using formulas in MS Excel spreadsheets, we calculated the number of km of survey effort travelled per ICES rectangle (30' latitude by 15' longitude) and the latitude and longitude of all bird sightings (from timings).

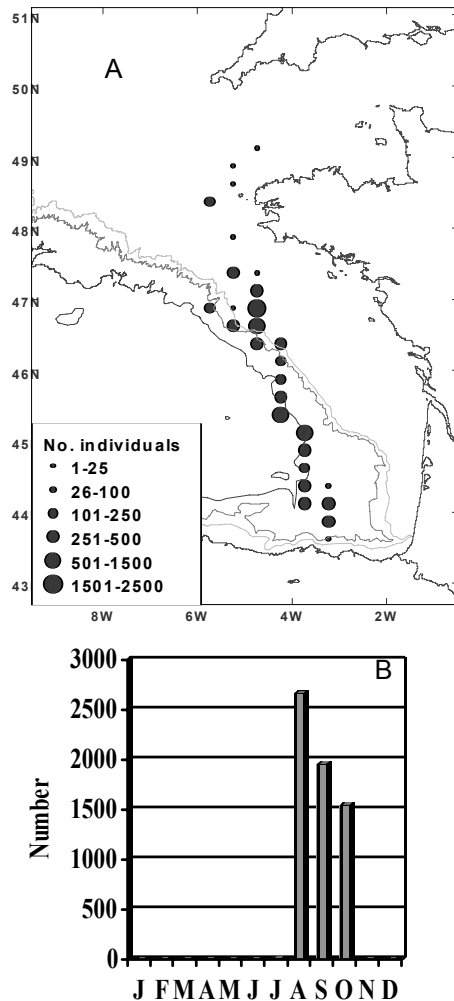


Fig. 3. Great Shearwater in the Bay of Biscay. (a) Distribution of 1995-2000, (b) seasonal abundance.

### 3. Results

#### Cory's Shearwater.

Only four birds were recorded in March/April. Small numbers of birds were regularly seen in June/July, a total of 70 (2% of all birds) being recorded. Numbers increased markedly in August, 2386 (72%) being recorded. During September

and October numbers 'dropped off', 831 (25%) and 21 (<1%) recorded respectively. Four (<1%) in November marked the seasonal limit of the species' inhabitancy of the bay (Fig. 2b). Cory's Shearwater was found mainly in areas of deep water >1000m deep and at areas of presumed upwelling to the north of the Celtic-Biscay shelf edge. Only seven (<1%) birds were recorded in the English Channel (Fig. 2a).

#### Great Shearwater.

Great Shearwater was recorded from July-November. Small numbers were seen in July (10=<1% of total birds), followed by a major influx in August (2662=43%) and September (1955=32%) with numbers remaining high in October (1545=25%). Thereafter, a rapid drop off occurred, only two (<1%) being seen in November (Fig. 3b). The distribution of Great Shearwater was largely similar to Cory's that of Shearwater, the majority of records occurring in water of a depth >1000m, between the latitudes of 44°N to 47°N, a cluster of records occurring around the 4000m mark over the abyssal plain of the bay. Large numbers were also seen within 50km of the northern Celtic-Biscay shelf edge at presumed areas of upwelling, mainly in late October 2000. Only 4 (<1%) birds were recorded in the English Channel (Fig. 3a).

A comparison has been made between the two peak years (1999 and 2000) for large shearwater species (Fig. 4). This is of particular interest when considering the arrival and departure dates of each species. Cory's Shearwater arrived in large numbers in August of both years and then disappeared again by October. In 1999, Great Shearwater was present in large numbers in late August but had largely disappeared from the area by late

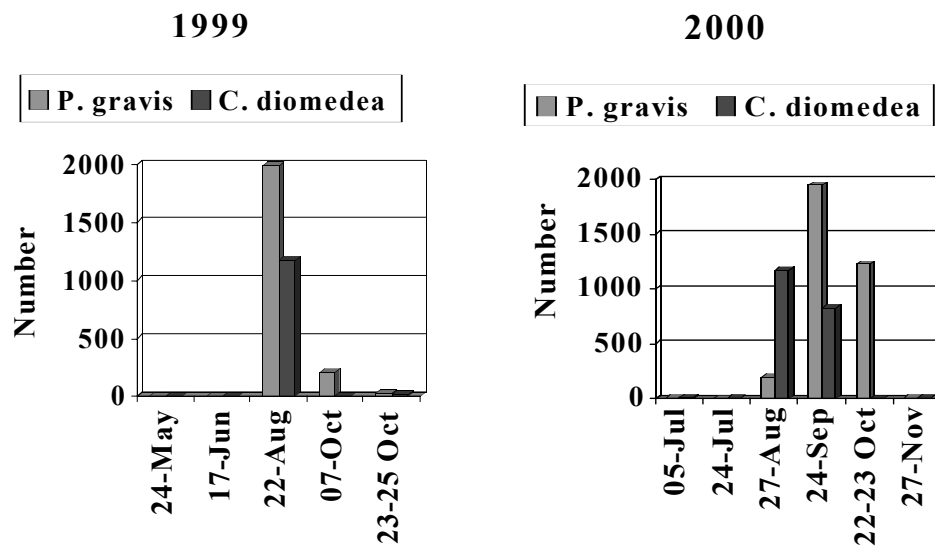


Fig. 4. Seasonal abundance of Great Shearwater and Cory's Shearwater in the Bay of Biscay in 1999 and 2000.

October, but in 2000, birds had only just begun to arrive in August and were then present in high numbers in both September and October. In the latter month high numbers were present unusually far north from  $46^{\circ}22'N$  to  $46^{\circ}57'N$  in waters of a depth  $<200m$ . On October trips, the ferry rarely reaches the northern end of the Celtic-Biscay shelf edge before dark and so numbers of Cory's Shearwater present may be much higher in August and September when daylight permits observations.

#### Sooty Shearwater.

Sooty Shearwater occurred in low numbers throughout the study area during the autumn months. There were records of single birds in February, April, July and December and the main peak occurred in August (18=15%), September (86=73%) and October (6=5%). There were small peaks evident just to the north of the northern Celtic-Biscay shelf edge around the canyons of the southern bay (Fig. 5a). However, in contrast to the two larger species, a substantial proportion of the total

was recorded in the English Channel: 21 birds (18%) compared with 97 in the Bay of Biscay (Fig. 5b).

#### Manx Shearwater.

Manx Shearwater has a distinctly different seasonal distribution to the other shearwaters covered in this paper. Manx was seen mainly during the spring months March-June ( $c80\%$  of birds) (Fig. 6b). During the autumn (July-October) only 38 birds ( $c24\%$ ) were seen. Furthermore, only 12 birds ( $c7\%$ ) were in water of depth  $>1000m$ , a high proportion of these being recorded in the shallow waters of the English Channel ( $c56\%$ ) (Fig. 6a).

#### Mediterranean Shearwater.

Records of Mediterranean Shearwater were fairly evenly spread through the survey area in small numbers (57 birds recorded), although only 8 ( $c14\%$ ) were seen in the English Channel). A small peak is noticeable around the Cap De Breton canyon in the south of the bay. Seasonally, there is a fairly wide spread of records, the peak peri-

od being June-November (c95% of birds). The concentration of records during October is probably not representative of the seasonal inhabitancy of this species and includes a single group of 16 birds (Fig. 7).

**Little Shearwater.**

It is difficult to come to any firm conclusions about the status and distribution of Little Shearwater in the survey area because of the small sample size. Only 10 birds were recorded, including 8 in August

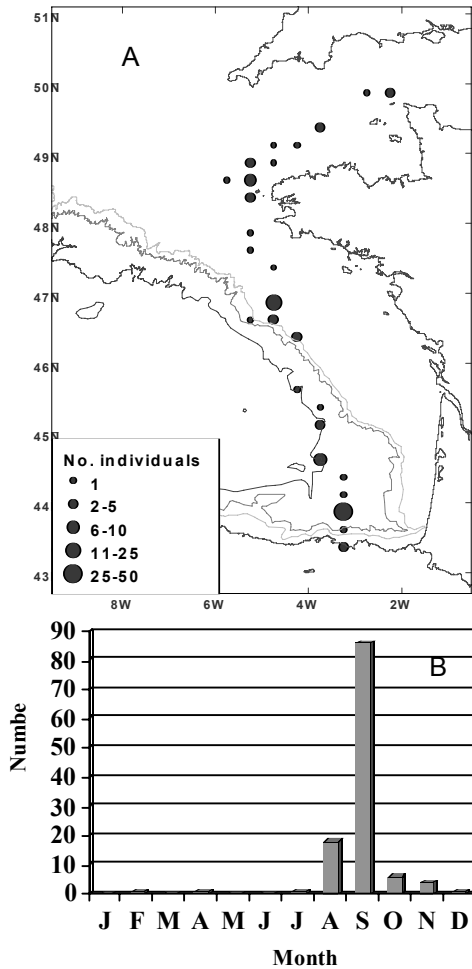


Fig. 5. Sooty Shearwater in the Bay of Biscay. (a) Distribution of 1995-2000, (b) seasonal abundance.

1999, all of which were between 44°00'N [B4] and 46°05'N in or near to deep water areas. Eight birds were recorded over water of depth >4000m.

**4. Discussion**

This section will concentrate on comparing the previously-known status and distribution of the shearwater species under dis-

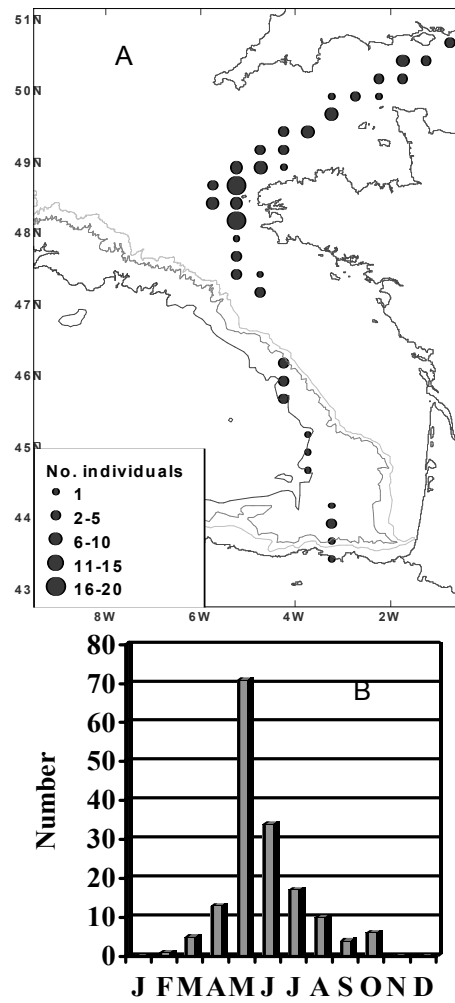


Fig. 6. Manx Shearwater in the Bay of Biscay. (a) Distribution of 1995-2000, (b) seasonal abundance.

cussion in this paper with the results of the BDRP surveys of 1995-2001. At present we have insufficient data to comment on possible food sources for these species in the survey area although there is of course an intimate link between food and their presence.

**Cory's Shearwater.** Cory's Shearwater breeds only in the North-East Atlantic

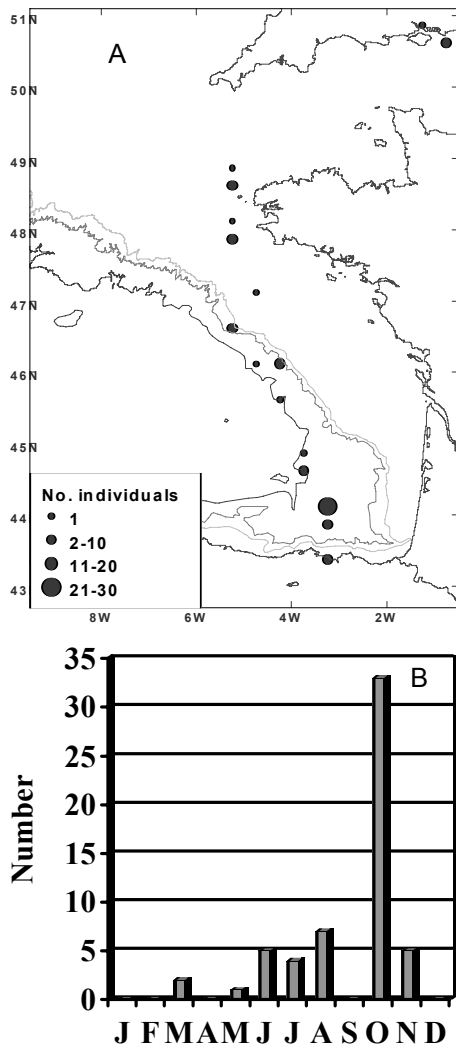


Fig. 7. Mediterranean Shearwater in the Bay of Biscay. (a) Distribution of 1995-2000, (b) seasonal abundance.

Ocean and the Mediterranean Sea, nominate *C.d. diomedea* nesting in the Mediterranean and the Atlantic race *C.d. borealis* on various islands between 15°N and 40°N. Birds are present in the breeding areas from late February until October-November when southbound trans-equatorial dispersal begins from all colonies to wintering grounds in the South Atlantic. Non-breeding birds are known to disperse across the Atlantic where they are found off the eastern coastline of North America in good numbers from July-October (Cramp 1977, Haney & McGillivray 1985). They also disperse into the Bay of Biscay, mainly into coastal waters, during the early autumn (Guerin 1999, Cramp 1977). Birds then seem to move into deeper water from August-October before southbound migration begins. Large numbers can be seen off Galicia (northwest Spain) from late August-November, a migratory peak occurring in October (Paterson 1997). Birds are rarely seen north of Irish waters (Bourne 1986, Skov *et al.* 1994, Stone *et al.* 1995) and are rarely found in waters of temperatures <13°C (Skov *et al.* 1994).

The results show that Cory's Shearwater is recorded infrequently in spring and early summer when it is present in large numbers in coastal Biscay (Guerin 1999) and then moves into deeper waters during August to late September before migrating south for the winter. We do not know whether the birds we recorded were *C.d. diomedea* or *C.d. borealis* because of the difficulty of separating these subspecies at sea. There are currently no records in the study area of 'Cape Verde Shearwater' *C.d. edwardsii* although it is possible that it may occur as its dispersal range is poorly known.

Great Shearwater breeds only on four islands in the South Atlantic, principally on the Tristan da Cunha Group at an approximate latitude of 37°S, where c2 million pairs breed (Voous & Wattel 1963). The species is a trans-equatorial migrant, migrating north from April to June before congregating in offshore waters off eastern North America from June to August. Most breeding birds are back at their colonies by September (Rowan 1952). In the survey area, the peak numbers are seen from August to October and it is likely that most birds, if not all, are non- or pre-breeders that follow the prevailing west winds to feed in upwelling zones in the Bay of Biscay, and do not undergo a moult (Bourne 1986). It is also likely that most breeding birds return to the South Atlantic through a mid-ocean route (Bourne 1995), which may explain why numbers in the northeast Atlantic seem to be substantially lower than those in North American waters from June to August. Great Shearwaters appear to congregate only in eutrophic water zones, migrating rapidly through dystrophic regions (Voous & Wattel 1963).

Although the Bay of Biscay seems to be the most important site for this species in European waters, it is possible that it also occurs in high densities off the Irish shelf edge, the circumstantial evidence being the high numbers recorded sporadically off coastal watchpoints (Newell 1968). However, dedicated surveys in these waters have not produced high densities (Stone *et al.* 1995). Great Shearwater is certainly infrequent north of latitude 55°N except in the waters off southeast Greenland (Skov *et al.* 1994). It is probable that significant numbers also

occur off the shelf edge around northwest Spain where large numbers are reported regularly during northwest winds off Galicia, up to 3000 birds being noted in a day (Paterson 1997).

In Biscay, numbers and arrival dates vary from year to year, but the reasons are unclear, although the availability of food certainly plays a large role in their occurrences on the other side of the Atlantic (Brown *et al.* 1981).

The only known breeding colonies of Sooty Shearwater in the South Atlantic are in the Cape Horn region and in the Falkland Islands (Philips 1963). As with the Great Shearwater, Sooty migrates north first into North American waters from May to June, and at that time the two species are present in an approximate ratio of 100:1 in favour of Great Shearwater (Philips 1963). However, when they arrive in northeast Atlantic waters from late July to early October, the numbers of the two species are similar, counts in the thousands being recorded most years off the west of Ireland and very occasionally in the North Sea (Various observers *pers comm*). It has been suggested that all North Atlantic birds are non breeders or pre-breeders (Cooper *et al.* 1991), which would partly explain the disparity between records of Sooty and Great Shearwaters on each side of the Atlantic.

In the survey area, Sooty Shearwater is not particularly common (Fig. 5) and does not congregate in numbers in areas of great depth differential as the large shearwaters do. The species seems to prefer colder waters for feeding because the main concentrations in the northeast Atlantic are further north; *e.g.* Rockall Bank and the Faeroese fishing grounds (Cramp 1977, Stone *et al.* 1995).



Approximately 94% of the world's population of Manx Shearwater breeds in the waters of Britain and Ireland. The most important areas for this species are off the west coast of Scotland, the Celtic Sea and the waters off southwest Wales and around the Irish Sea coast (Stone *et al.* 1995).

In the survey area, most birds seen in spring were north of latitude 48°N in the southwestern approaches and English Channel. It seems likely that migrant Manx Shearwaters head straight to wintering grounds off the east coast of South America (Cramp 1977). Birds that have been observed in the deeper waters of the Bay of Biscay are likely either to be adults roaming widely (spring and summer) or young birds (autumn).

As their name suggests, Mediterranean Shearwaters breed only in the Mediterranean Sea. Their movements, as with most shearwater species, are imperfectly known. However there is evidence of a large moulting population of birds in coastal waters of the Bay of Biscay during post-breeding dispersal in June. The greatest numbers are found off Vendée in July and the Mor Braz area of Brittany in mid-August to early September, when small numbers are recorded regularly in the English Channel and North Sea (Le Mao & Yésou 1993). Most birds return to the Mediterranean Sea in September and October, although some winter off southwestern Spain and along the Atlantic coast of Morocco (Le Mao & Yésou 1993). The wintering range is inadequately known, partly because this species fairly recently was split from Manx Shearwater (Cramp 1977), and more recently still was split further into Yelkouan (yelkouan) and Balearic (mauretanicus) Shearwaters (Snow &

Perrins 1998), although not all authorities agree. Because of the near-impossibility of separating the two latter species by sight, this paper continues to treat both as 'Mediterranean Shearwater'.

In the survey area the low numbers of individuals recorded makes it difficult to ascertain any definite trends as to seasonal distribution and status. Birds have been recorded fairly evenly throughout the March-November period, a peak occurring in late summer and autumn (especially October). Records are fairly well spread over the area, coming from all sectors. The best area for sightings seems to be over the Cap De Breton canyon in the southern Bay.

In the North Atlantic, probably fewer than 10 000 pairs of Little Shearwater breed on the Azores, Canary Islands, Madeira and Cape Verde Islands (Snow & Perrins 1998). They seem largely to be sedentary, which has encouraged their high degree of subspeciation worldwide (Cramp 1977). However they may be more dispersive than we realise. Records from British, Irish and even North American waters suggest that individuals may wander widely.

In the survey area, very small numbers were recorded during August-October but other observers have seen the species regularly from the ferry, sometimes up to 20 in a trip (Various observers *pers comm*). However, because of the difficulties of validating claims, we decided not to compare our data to that of these other observers.

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Tab. 1. Survey effort (km travelled) by season in the English Channel and Bay of Biscay on bird recording trips.

Season (Months)	No of trips	English Channel km travelled	Bay of Biscay km travelled
Spring (Mar-Jun)	17	8683	11912
Summer/Autumn (July-Oct)	18	5198	9830
Winter (Nov-Feb)	16	7338	5629
Total		21219	27370

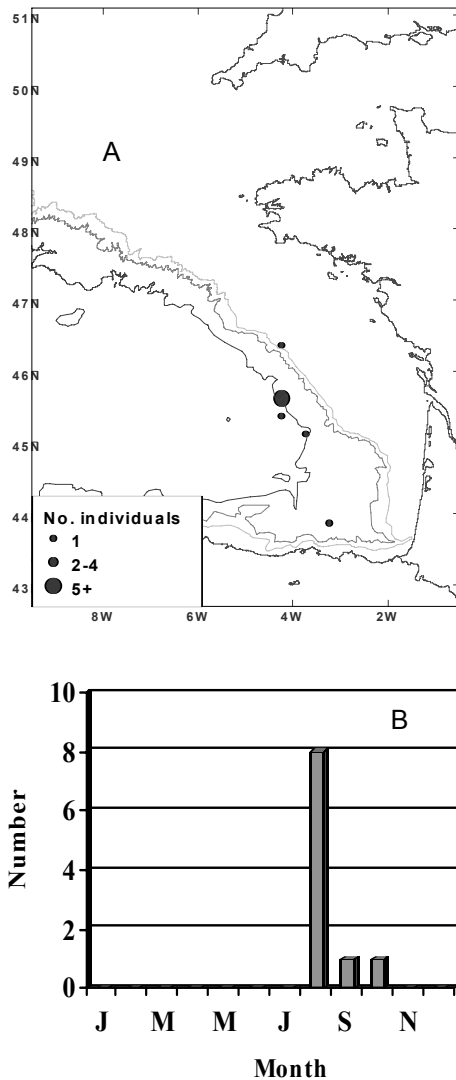


Fig. 8. Little Shearwater in the Bay of Biscay. (a) Distribution of 1995-2000, (b) seasonal abundance.

and supplied casual records to aid in the interpretation of BDRP data. For help with data entry, we would like to thank Nigel Bourn, Nigel Symes, Helen Williams, and especially Sally Taylor. Finally, we would like to thank the other BDRP surveyors for their recording efforts including Paula Bates, Dr Tim Melling, Russel Neave, Robin Plowman, Andy Schofield, Nigel Symes, Gordon Trunkfield and Rolf Williams.

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