Diversity, distribution and occurrence of toothed cetaceans in the Bay of Biscay and western English Channel (1998-2002)

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ABSTRACT

Data on diversity, distribution and occurrence of pelagic cetaceans are generally difficult to collect. Such information is beneficial for most management and conservation purposes. Data collected during ferry-based surveys in the western English Channel and Bay of Biscay between 1998 and 2002 were analysed to investigate the occurrence, diversity and distribution of toothed cetaceans in these waters. More than 17,800 nautical miles were surveyed and 1,008 encounters of mono-specific groups (20,481 individuals) were recorded. Thirteen species, including delphinids (*Delphinus delphis*, *Stenella coeruleoalba*, *Tursiops truncatus*, *Globicephala melas*, *Grampus griseus*, *Orcinus orca*, *Pseudorca crassidens*), ziphiids (*Ziphius cavirostris*, *Hyperoodon ampullatus*, *Mesoplodon bidens*, *Mesoplodon mirus*), the harbour porpoise (*Phocoena phocoena*) and the sperm whale (*Physeter macrocephalus*). The common dolphin was the most frequently encountered species, followed in decreasing occurrence by striped and bottlenose dolphins, long-finned pilot whale, harbour porpoise, Cuvier's beaked whale and sperm whale. This study underlines an exceptional toothed cetacean diversity and this may be attributable to the presence of a wide range of potential habitats in the Bay of Biscay. In addition, the Bay of Biscay is probably an interface for both cold temperate species (such as the harbour porpoise, the long-finned pilot whale and the northern bottlenose whale) and warm temperate species (striped dolphin and Cuvier's beaked whale). As many interactions between fisheries and small cetaceans are known to occur in the Bay of Biscay and western English Channel, these data provide preliminary evidence on the importance of this area for toothed cetaceans.

***Keywords*:** Europe, distribution, index of abundance.

INTRODUCTION

Data on cetaceans, particularly those occurring predominantly offshore, are generally difficult to collect. The cost of dedicated surveys, providing quantitative information on the abundance and habitat preferences of species, for example, do not permit regular surveys. Platforms of opportunity provide a cost-effective alternative for collecting data on species occurrence and relative abundance.

Offshore populations of toothed cetaceans have been poorly studied in the English Channel and Bay of Biscay compared with coastal populations of bottlenose dolphins (*Tursiops truncatus*) in the English Channel (see for example Williams *et al.*, 1996; Liret, 2001; Lahaye & Mauger, 2000) and long-finned pilot whales (*Globicephala melas*) in the coastal waters of the central Bay of Biscay (Van Canneyt *et al.*, 1999; Lahaye *et al.*,

2002). Duguy (1983) generated one of the first descriptions of cetacean populations in the Bay of Biscay based, in particular, on stranding records along the French coast. Additionally, there have been several opportunistic cetacean surveys of distribution and relative abundance (Evans, 1980; Northridge *et al.*, 1995; Brereton *et al.* 1999; Fletcher and Curtis, 1999; Brereton and Williams, 2001; Rosen *et al.* 2000; Van Canneyt *et al.,* 2000; Weir, 2001; Williams *et al.*, 2002; Kiszka *et al.*, 2004; Walker *et al.*, 2004) of cetaceans in the English Channel and Bay of Biscay.

Dedicated surveys to estimate cetacean abundance (Buckland *et al.*, 1993; Goujon, 1996; Hammond *et al.*, 2002) have also been conducted in the area. Abundance estimates of 62,000 [CI 95% (35,000-108,000)] common dolphins (*Delphinus delphis*) and 73,843 striped dolphins (*Stenella coeruleoalba*) [CI 95% (36,113-150,990)] were estimated in the Bay of Biscay and adjacent waters (Goujon, 1996). Buckland *et al.* (1993) estimated long-finned pilot whale (*Globicephala melas*) abundance as 12,335 individuals [CI 95% (3,924-38,148)] for a survey block in the oceanic Bay of Biscay and its adjacent waters during the North Atlantic Sighting Survey (NASS) – 1989. The Small Cetacean Abundance Survey in the North Sea and adjacent waters (SCANS) did not record any cetaceans in the English Channel; common dolphin and harbour porpoise (*Phocoena phocoena*) abundance in the Celtic Sea was estimated as 75,000 individuals [CI 95% (22,900-248,900)] and 36,280 (CI 95%) individuals, respectively (Hammond *et al.*, 2002).

Preliminary studies suggest that harbour porpoises, common and bottlenose dolphins are the most frequently encountered species in the English Channel and occur year-round. Some changes in seasonal occurrence of these species have been noted (Brereton & Williams, 2001; Macleod & Walker, 2004). In the Bay of Biscay, the common dolphin seems to be the most abundant species, followed by striped, bottlenose dolphins and long-finned pilot whales (Goujon, 1996; Van Canneyt *et al.*, 2000). Other odontocete species, such as the pygmy killer whale (*Feresa attenuata*), the false filler whale (*Pseudorca crassidens*), the melon-headed whale (*Peponocephala electra*) and the killer whale (*Orcinus orca*) (Williams *et al.*, 2002; Van Canneyt *et al.*, in press) are rarely seen in the Bay of Biscay.

Organistation Cetacea (ORCA) is conducting a long-term monitoring program, dating back to 1995, of cetaceans in the English Channel and Bay of Biscay. This short communication presents preliminary results on the distribution, diversity and occurrence of toothed cetaceans in this area.

MATERIALS AND METHODS

Survey method

Two ferry-lines operating between the southern coast of the UK and northern Spain (*The Pride of Bilbao*: Portsmouth-Bilbao and *Val de Loire*: Plymouth-Santander) were used as platforms of opportunity. Both ships follow a fixed route through the English Channel and Bay of Biscay. Both ships travel at a relatively constant speed of 20 knots.

All surveys involved a return ferry journey. Data were collected from July 1998 to September 2002, mainly during the summer months. The observation effort was significantly higher on the *Pride of Bilbao* than on the *Val de Loire* (see Table 1). At least two or more experienced observers carried out surveys, primarily on the "monkey island" (37m above sea level). Observers searched 180° ahead of the ship from the port and the starboard sides and forward ahead of the bow. Surveys involved continuous scanning with the naked eye interspersed with occasional scans with binoculars. Environmental and survey effort were recorded at the start and end of each survey leg and at half hourly intervals or when conditions changed. The environmental variables recorded were wind speed and direction, sea state, cloud coverage and precipitation. Survey effort was quantified by recording the ship's position using a handheld Global Positioning System (GPS) *Garmin* XII. Additionally, for each sighting, observers recorded GPS position, group size and behaviour. All data were collected on paper sheets and later logged in an Excel database post-survey.

Analysis: spatial distribution and occurrence

To investigate the spatial distribution and occurrence of cetaceans, the survey region was divided into 225 cells (or "quadrats"), each 20 nm^2. The region was also divided into 3 sub-regions so that comparisons between species and areas could be made:

i) Shelf waters of the Western English Channel and Western Approaches (north of 47°30'N);
ii) Shelf, shelf edge, and deep oceanic waters of the northern Bay of Biscay (47°30'-45°30'N); and

iii) Deep oceanic waters and submarine canyons (Santander and Torrelavega) of the southern Bay of Biscay (45°30'-43°30'N).

Occurrence was calculated for each sub-region and each quadrat, by species using the Spatial Analyst extension of *ArcGIS 8.2*. Occurrence, or encounter rate, was defined as:

$$\frac{n}{L} \times 100$$

where n is the number of encounters and L is the total distance traveled (i.e. survey effort) in nautical miles (nm).

Differences in occurrence between sub-regions were tested for using a non-parametric Kruskal- Wallis test.

RESULTS

Effort and data collected

Between 1998 and 2002, 147 surveys were completed through the English Channel and Bay of Biscay (Figure 1), totaling 17,873 nautical miles of survey effort. Most survey effort was conducted on the *Pride of Bilbao* (N=17,075 nm made on the *Pride of Bilbao* vs. 798 on the *Val de Loire*). The amount of survey effort varied between sub-regions; 15.9% of effort in the western English Channel and western approaches, 54.6% in the northern Bay, and 29.5% in the southern Bay. There was also variability in observation effort according to seasons and years (Figure 2). Effort increased significantly between 1998 and 2002 (r=0.84, p<0.001), and was concentrated between July and September (Figure 2).

1,008 toothed cetacean sightings were recorded during the surveys which amounted to 20,481 individuals. We rejected all unidentified cetaceans in the analysis and considered only single species groups (Table 2). Small delphinids were the most frequently encountered (common and striped dolphins), followed by the bottlenose dolphin, the long-finned pilot whale and the harbour porpoise. Three large delphinids, the Risso's dolphin, the killer whale and the false killer whale, were rare. The largest toothed whale species encountered were the sperm whale, and four beaked whale species (the Cuvier's beaked whale being the commonest).

Distribution, group size and occurrence

The spatial distribution of sightings, with the respect to group size of encountered groups, is presented in the figure 2. The spatial distribution of toothed cetaceans, with respect to group size, varied between species. However, these differences were less significant in the largest species.

Harbour porpoise

The harbour porpoise was encountered on 114 occasions, with a total number of 313 individuals. Encounter rate throughout the area was 0.49/100nm. Of the 3 sub-areas, occurrence peaked at 3.43/100nm in the western English Channel and Western Approaches and was lowest in the northern Bay of Biscay, where only one sighting was recorded. No sightings were made in the southern Bay of Biscay. Group size was generally small ($\hat{y}$=2.75; SD=1.8), although group size ranged from 1-10 individuals. The geographical distribution of the harbour porpoise is limited and is restricted to the northeast of the survey area.

Common dolphin

The common dolphin was by far the most commonly sighted species, accounting for more than 50% of individuals sighted (n = 329 sightings, 11,297 individuals), with an average occurrence of 1.84/100nm. Occurrence decreased from 2.46, 2 and 0.95 for the western Channel, northern Bay and southern Bay of Biscay, respectively. Group size was highly variable ($\hat{y}$=38.1; SD=73.5) ranging from 1 to 600 individuals. There was significant variation between group size according to each sub-area, especially between the western Channel and the northern Bay of Biscay (Kruskal-Wallis; H=4.38; p=0.036), as well as between the northern and the southern Bay (Kruskal-Wallis; H=3.975; p=0.04). The largest aggregations were observed in the northern Bay of Biscay.

Striped dolphin

The striped dolphin was the second commonest species recorded with 187 sightings and 6,103 individuals. Over the entire survey region, the occurrence of the striped dolphin was 1.05/100nm and increased from 0.03, 0.91 and 2.18 from the western Channel to the southern Bay of Biscay. Group size varied from 1-250 individuals, with a mean of $\hat{y}$=32.67 (SD=34.6). The striped dolphin was distributed predominately in the Bay of Biscay

particularly the south and was encountered only once in the central English Channel. This species is essentially oceanic and occurs beyond the shelf edge.

Bottlenose dolphin
There were 110 sightings of bottlenose dolphins amounting to 1,556 individuals. Throughout the survey area, the occurrence of the bottlenose dolphin was 0.62/100nm. Occurrence decreased from 0.87, 0.66 and 0.31 from the western Channel to the southern Bay of Biscay. Mean group size was 14 (SD=11.9) and was not significantly different between the southern and northern Bay of Biscay (Kruskal-Wallis; H=1.70; p=0.43).

Long-finned pilot whale
The long-finned pilot whale was encountered at 134 occasions of 895 individuals. Occurrence was 0.09/100nm, 0.89/100nm and 0.92/100nm, in the western Channel, in the northern and the southern Bay of Biscay, respectively, and 0.75/100 nm overall. Group size was relatively small ($\hat{y}$=6.8; SD=5.1) with a maximum of 30 and did not vary between the sub-regions (Kruskal-Wallis; H=0.01; p=0.94). The species is widely distributed in the central and southern Bay of Biscay, with only two sightings in the western approaches of the English Channel.

Sperm whale
The sperm whale was regularly sighted throughout the study area, with 42 encounters comprising 68 individuals. Group size ranged from 1-4 ($\hat{y}$=1.6; SD=0.9). Occurrence throughout the survey area was 0.23/100 nm. Occurrence was higher in the southern Bay of Biscay (0.8), especially in the area of the Santander canyon, compared to the northern Bay (0.09). No sightings were made in the English Channel.

Cuvier's beaked whale
The Cuvier's beaked whale showed similar patterns of distribution to the sperm whale and an overall occurrence of 0.34/100nm. Group size was larger and more variable than for the sperm whale ($\hat{y}$=2.4; SD=1.1). The Cuvier's beaked whale encounter rate was 0.09/100 nm in the northern Bay compared to 1.2/100nm nm in the southern Bay. Sighting rates were particularly high in the area of the Santander canyon.

Rare species (n<15)
The Risso's dolphin was relatively rare in the study area, with only 14 confirmed sightings of 58 individuals (0.08/100nm). Group sizes were small ($\hat{y}$=4, SD=2.8). The species was more commonly sighted in the central and southern Bay of Biscay, but did occur in the western English Channel. Risso's dolphin sightings occurred essentially in deep oceanic waters, but three sightings were also made in the shelf waters of the western English Channel ($\hat{y}$= 1,926; SD=1,376; min.=81; max.=3,852). Nine sightings (0.05/100nm) of northern bottlenose whales were made in the deep oceanic waters of the southern Bay of Biscay ($\hat{y}$=2,851; SD=1,334; min.=972; max.=4,470). The killer whale was sighted on five occasions in the central and southern Bay, with group sizes ranging from one to five individuals (SD=1.6). Two groups of false killer whales were also sighted in the same area, with six and seven individuals in each group. Both killer and false killer whale sightings occurred in deep oceanic waters (>2,000m). Two other beaked whale species were encountered on single occasions in the southern Bay of Biscay: True's beaked whale (*Mesoplodon mirus*) and Sowerby's beaked whale (*Mesoplodon bidens*). Two unidentified mesoplodon whale groups were encountered in July 1999, involving two and five individuals. Both sightings occurred in deep oceanic waters (>2,000m).

DISCUSSION AND CONCLUSION

Few studies have been conducted to assess the distribution, occurrence and habitat preference of cetaceans in the English Channel and Bay of Biscay. Platforms of opportunity, such as ferries, are a valuable means of monitoring cetaceans and can be used on a long-term basis. In this study, they enabled access to little known offshore areas for a very low cost. However, the use of platforms of opportunity often incurs limitations and biases in spatial and temporal coverage (for example, in this study there was reduced coverage over the continental shelf and spatially narrow coverage in deep oceanic waters). Nevertheless, the survey routes used in this study enabled surveying to be completed through several habitat types (shelf, shelf edge, and oceanic ecosystems) and record data to investigate how toothed cetaceans distribute in relation to these different habitats. The diversity of toothed cetaceans is high in the area, with typical shelf species, like the harbour porpoise, and oceanic species such as beaked and sperm whales (see for example Evans, 1987). Delphinids, especially common, striped, bottlenose dolphins and long-finned pilot whales are particularly common in the Bay of Biscay. The results of this study and others (Evans, 1980; Rosen *et al*., 2000; Brereton & Williams, 2001; Kiszka *et al*., 2004) show that the common dolphin and the harbour porpoise are the most frequently encountered

species in the western English Channel. The greater toothed cetacean species diversity in the Bay of Biscay may be attributable to the diverse range of habitats for these predators. The depth and seabed topography of the English Channel is comparatively uniform, while the Bay of Biscay comprises shelf, shelf edge and deep oceanic waters. In addition, the Bay of Biscay is an interface area between cold and warm temperate waters attracting species typical of cold temperate water, such as the harbour porpoise, the northern bottlenose whale and the long-finned pilot whale and warm temperate water such as the striped dolphin and the Cuvier's beaked whale. The other species such as the bottlenose dolphin, the common dolphin, the Risso's dolphin and the sperm whale are wide-ranging. They can occur both in cold, warm temperate and tropical waters (for reviews see Gaskin, 1982; Evans, 1987; Rice, 1998).

In conclusion, the Bay of Biscay and the English Channel are significant areas where a vast variety of toothed cetaceans occur. Despite major threats facing these top predators in this area (over fishing, incidental catches in fishing gear, habitat degradation, etc.), no long-term plan to quantify these threats and their impact on cetaceans have been investigated.

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Table 1: Observation effort on the *Pride of Bilbao* and *Val de Loire*, respectively, from 1998 to 2002 (in nautical miles).

	February	March	April	May	June	July	August	September	October
1998	0-0	0-0	0-0	0-0	0-0	465.7-0	1,639.9-0	747.9-0	0-0
1999	0-0	0-0	0-0	0-0	0-0	1,059.4-0	532.9-0	82.2-0	0-0
2000	0-0	0-0	0-0	0-0	0-0	0-0	1,184.3-0	0-0	410.5-0
2001	0-0	0-368.3	0-0	0-0	713.5-0	606.6-0	2,448-330	1,026.3-0	0-0
2002	291.2-0	0-98.8	173.91-0	270.6-0	422.5-0	1,407.4-0	1,973.1-0	1,617.9-0	0-0

Table 2: Number of sightings and individuals (with their respective proportions) for each encountered toothed cetacean species recorded from 1998 to 2002.

Species	**N sightings**	**N individuals**	**% sightings**	**% individuals**
Common dolphin	329	11,297	32.6	55.2
Striped dolphin	187	6,103	18.6	29.8
Long-finned pilot whale	134	895	13.3	4.4
Harbour porpoise	114	313	11.3	1.5
Bottlenose dolphin	110	1,536	10.8	7.6
Cuvier's beaked whale	60	146	6	0.6
Sperm whale	42	68	4.2	0.3
Risso's dolphin	14	58	1.4	0,3
Northern bottlenose whale	9	32	0.9	0.2
Killer whale	5	16	0,5	0,1
False killer whale	2	13	0,2	0,1
Sowerby's beaked whale	1	3	0.1	0.02
True's beaked whale	1	1	0.1	0.005
TOTAL	**1,008**	**20,481**	**100**	**100**

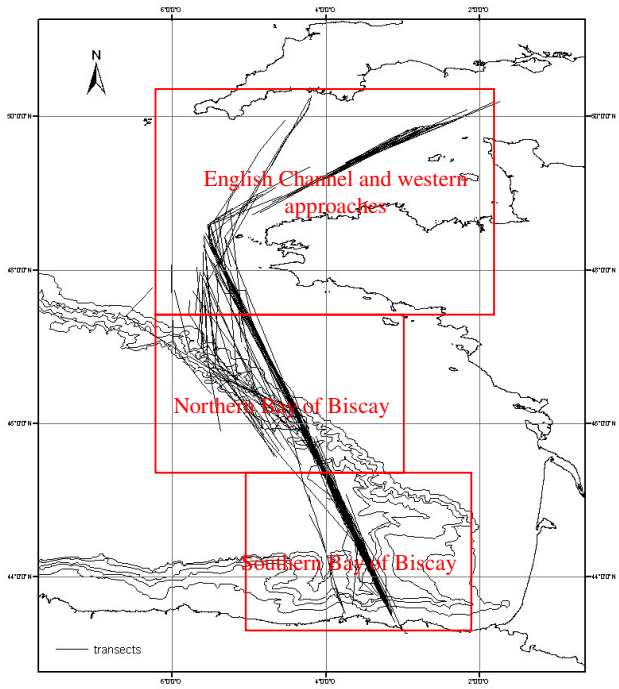

Figure 1: Survey coverage in the English Channel and Bay of Biscay onboard both of the platforms, from 1998 to 2002.

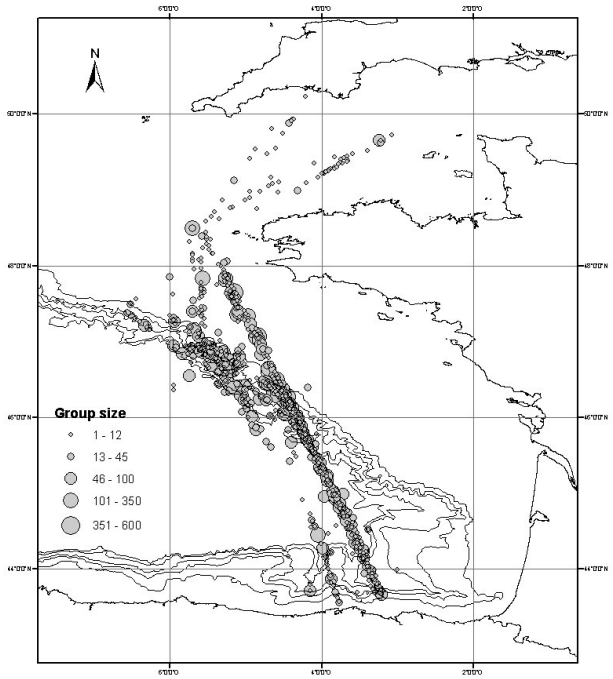

Figure 2: Distribution of toothed cetacean sightings in the English Channel and Bay of Biscay onboard both of the platforms, from 1998 to 2002.