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Cetaceans and Seabirds of Ireland's Atlantic Margin

Trip Reports

April - July 2002



COASTAL & MARINE RESOURCES CENTRE
ENVIRONMENTAL RESEARCH INSTITUTE
UNIVERSITY COLLEGE
CORK



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TABLE OF CONTENTS

	Page No.
Research Objectives	4
Introduction	5
Methods	7
Survey Methods	9
Results & Discussion	13
Conclusion	66
Acknowledgements	68
References	69
Appendices A - E	72-74

RESEARCH OBJECTIVES

The primary research objectives of the current study are as follows:

1. Expand upon the baseline information, generated in the initial 27-month study, on the distribution and relative abundance of cetacean and seabird populations in waters of the Porcupine-Rockall-Hatton region;
2. Identify major concentrations of cetaceans and seabirds in these waters, which will assist in the evaluation of seasonal trends in their distributions;
3. Where possible, survey regions not covered during the initial study;
4. Carry out duties of marine mammal observers as outlined in the JNCC guidelines on minimising acoustic disturbance to marine mammals during periods of active seismic survey;
5. Continue to examine the feasibility of using hydrophones to monitor cetacean responses to seismic activity; and
6. Provide high quality independent scientific information essential for conservation and management purposes.

INTRODUCTION

A major offshore survey of cetacean and seabird populations was conducted by observers from the Coastal and Marine Resources Centre (CMRC) in southwestern and western Irish waters between July 1999 and September 2001. This survey was a 2.5-year project undertaken on behalf of the Rockall Studies Group (RSG) and the Porcupine Studies Group (PSG) of the Petroleum Infrastructure Programme. The programme was set up by the Petroleum Affairs Division (PAD) of the Department of the Marine and Natural Resources in 1997. The overall scientific programme was allocated £300,000 by the RSG, PSG and PAD, making it the most significant offshore study of whales, dolphins and seabirds ever conducted in Irish waters.

Figure 1 outlines the full transect survey effort achieved during the 27-month study. It represents a total of 442 survey-days at sea, most of which (296 survey-days) were obtained during the spring and summer months (April - September). The most spatially extensive surveys were achieved in spring, where the effort extended west to the Rockall and Hatton Banks, the southern sector of the Rockall Trough, and southwest over the Porcupine Bank, Porcupine Seabight and the Goban Spur. The Rockall Bank was also comprehensively surveyed during summer, together with the length of the continental shelf edge and the deep-water region west of the Goban Spur. The gaps in survey effort, which existed in the region north and south of Hatton-Rockall region and through the Hatton-Rockall Basin, were partially addressed during the current study.

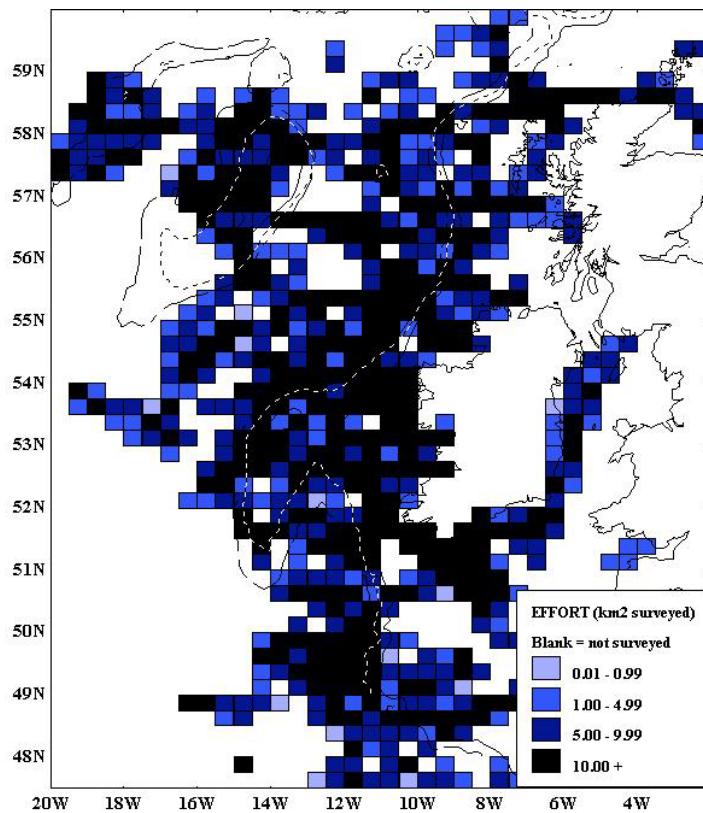


Figure 1. Total survey effort achieved during the 27-month study period, July 1999–September 2001.

The results of the 27-month study confirmed that Ireland's Atlantic Margin forms a highly significant region for seabird and cetacean populations. Varying concentrations of diverse seabird and cetacean assemblages were recorded throughout the study period over a range of marine habitats, including deep oceanic basins, the productive continental slope and the relatively shallow habitats of the continental shelf and the Rockall Bank and Hatton Bank (see Aguilar *et al.* (2002), Mackey *et al.* (2002) & Ó Cadhla *et al.* (2002)).

Of the 37 seabird species recorded, five species dominated the initial survey, namely Northern Fulmar, Northern Gannet, Black-legged Kittiwake, Common Guillemot and Manx Shearwater. However, the seasonal offshore records of migratory species, such as Great and Sooty Shearwaters, Lesser Black-backed Gull, and Pomarine, Arctic and Long-tailed Skuas were also noteworthy. The 20 cetacean species recorded, included rare, endangered and migratory species of baleen whale (e.g. Northern Right Whale, Blue Whale), and rarely encountered toothed whale (e.g. Sowerby's Beaked Whale, Cuvier's Beaked Whale, False Killer Whale). Offshore areas of importance for both resident and migratory species (i.e. the Porcupine Shelf, the Porcupine Seabight off southwestern Ireland and parts of the Rockall Trough, Rockall Bank and Hatton Bank) were identified on the basis of species richness and relative abundance, and as such, were deemed as potential candidate areas for conservation.

The current study was funded by the PSG, Enterprise Energy Ireland (EEI) and the Geological Survey of Ireland (GSI). The financial backing enabled trained seabird and cetacean observers to participate in four offshore surveys, which were conducted between April and July 2002. The results of the current study expand upon and compliment the findings of the initial groundbreaking survey, in that it reaffirms the importance of

Ireland's Atlantic Margin to both resident and migratory macro-vertebrate species. The data relating to the seabird and cetacean distribution and relative abundance generated from the four 2002 surveys are presented in this report.

METHODS

Between 13th April and 29th July 2002 experienced seabird and cetacean observers from the CMRC's *Cetaceans & Seabirds at Sea* team conducted ship-based surveys of offshore seabird and cetacean populations. Surveys were conducted on "vessels of opportunity", which were scheduled to be at sea in the study area for a period of days or weeks, and whose host organisations [REDACTED] during the current study and such as the S.V. *Akademie*.

1. STUDY A

The primary study area is located west of Ireland (Fig. 1; see also Fig. 2). This area includes the adjoining parts of the "Porcupine Shelf," the "Rosemary Bank," the "Rockall Trough," and the "Rockall Basin," all of which received research attention during the Rockall Bank, also known as the Hatton-Rockall Bank, cruise (see Fig. 1).

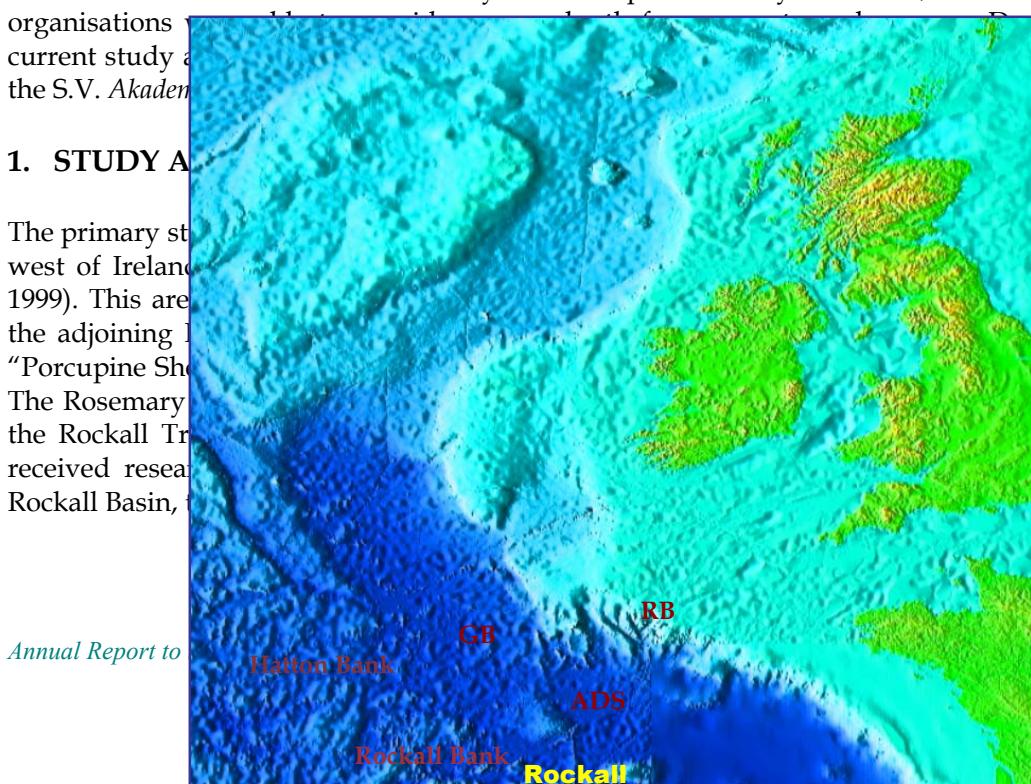




Figure 2. The primary study area during the 4-month study period, 13th April – 29th July 2002
Plate I. The Russian research vessel *Akademik Mstislav Vsevolodovitch* used to be an ideal observation platform
(GBB = George Bligh Bank, NDS = North Down Seamount, RD = Rosemary Bank).

2. SURVEY METHODS

In order to optimise sea time and data collection capabilities, sightings of cetaceans and seabirds were recorded on all occasions and in all possible weather conditions using the methods outlined below:

2.1. CETACEAN & SEABIRD STRIP-TRANSECT SURVEYS

The primary visual survey method used aboard vessels of opportunity was that proposed by Tasker *et al.* (1984) of the JNCC in Scotland. Originally designed as a standard method for counting seabirds at sea, the survey technique has been expanded to include cetacean sighting records, since cetaceans are regularly seen in the field by observers conducting ship-based seabird surveys. Often referred to as the "JNCC" or "Seabirds at Sea" method, it has been used for many years throughout western European waters and is a cost-effective and logically undemanding means of counting of seabirds and marine mammals in the open sea. The method generally consists of a strip-transect survey (Buckland *et al.*, 1993) conducted by a single scientific observer who records survey effort, environmental conditions (e.g. glare, wind strength, swell height, water depth), positional data, and sightings of the various species encountered to one side of the vessel's trackline.

In the present study, as in other *Seabirds at Sea* surveys, the method required that the host vessel was travelling on a straight course, at a constant speed of 5-15 nautical miles per hour (knots), and in sea conditions no greater than those of Beaufort Force 6. Observers were situated on the ship's monkey-island (i.e. above the bridge) at a platform height of

~11m above sea level. The observer conducted visual scans with the naked eye in a 90° bow-to-beam sector forward of the ship, concentrating on a 300m-wide strip, from which seabird density estimates may be calculated. Water-resistant binoculars (*LEICA* 10x42) were only used to confirm biological parameters such as species identification, group size, group composition or behaviour.

Cetaceans were surveyed in the same manner as seabirds associated with the water (*see* Tasker *et al.*, 1984; Mackey *et al.*, 2002). In addition, data concerning the angle of the initial cetacean sighting from the ship's course and the approximate distance from the observer were also recorded. Cetacean group sizes, group composition, sighting cues, surfacing intervals, behaviour (normal swimming, foraging, breaching, etc.), and any associations with birds or other cetacean species were also noted.

Although the primary focus of the study was to observe cetaceans and their reactions to seismic activity, the standard JNCC survey for seabirds and cetaceans was employed once the seismic operation was established (*i.e.* post-soft start). The JNCC survey method was also used when the vessel was steaming between stations, and during ocean bottom seismometers (OBS) deployment (Plate II) and retrieval. Sighting data collected while on full transect effort were used to determine species distribution and relative abundance estimates. The data collected will ultimately contribute to a central European Seabirds at Sea (ESAS) database. Further information required for density estimates (*i.e.* transect status: *see* Tasker *et al.* (1984)) was also recorded for analysis at a later date. In addition, seabird group sizes, group composition (number of adults and juveniles, dark, light and intermediate morphs), flight direction, behaviour (diving, feeding, kleptoparasitism, preening, sleeping, etc.) and any associations with cetaceans or other seabird species were also noted.

In addition, environmental conditions (*e.g.* wind direction and strength, sea state, cloud cover, water depth, visibility, etc.) and the host vessel activity and position were recorded every 90 minutes or as required (*e.g.* if the vessel changes course, if wind conditions changed, etc.).



Plate II. Deployment of an ocean bottom seismometer (OBS) from the S.V. *Akademik Boris Petrov*, May 2002.

2.2. INCIDENTAL SURVEYS

Point-survey methods were employed for cetaceans when the observers were “off-effort” during unsuitable weather conditions (e.g. sea conditions greater than Beaufort Force 6, heavy mist, extreme glare), during periods of frequent vessel course and speed fluctuations or when the ship was stationary. Such surveys involved the observer performing scans in all directions, using both the naked eye and LEICA 10x42 binoculars from the monkey-island. All data parameters collected on full transect surveys (i.e. species, group size, behaviour, distance from ship, etc) were also recorded during incidental surveys. In addition, environmental conditions and the host vessel activity and position were recorded.

2.3 ALTERNATIVE SURVEY METHODS

During past surveys, it became clear to CMRC observers that primary use of the *Seabirds at Sea* method, which was designed for counting seabirds, significantly reduced the observer’s likelihood of detecting cetaceans outside the relatively narrow field-of-view on one side of the moving vessel. Consequently a number of single-observer and dual-observer surveys were conducted to examine alternative means of simultaneously counting seabirds and cetaceans, while maintaining the standard *Seabirds at Sea* approach in parallel with trial methods. Sighting data collected by the observers during these trials are collated here under incidental sightings and will be analysed at a later date.

2.4. PRE-SOFT START CETACEAN-ONLY SURVEYS

As a part of our duties as Marine Mammal Observers (MMO), visual and acoustic surveys for cetaceans were employed, where possible, before each seismic operation:

2.4.1. Visual check for cetaceans

The visual method used for detecting cetaceans prior to seismic operations was established in the JNCC guidelines on minimising acoustic disturbance to marine mammals (JNCC, 1998; JNCC, 2002). The general method employed is summarised below:

- Beginning at least 30 minutes before the commencement of any seismic operation, the MMOs carried out a 360° visual scan for marine mammals, concentrating on an area within 500m of the observation platform;
- The sea surface was first scanned slowly with the naked eye, followed by a binocular scan using Leica 10x42 waterproof binoculars;
- Where two observers were available, one MMO was responsible for the acoustic detection of cetaceans, whilst the other MMO carried out the visual scan. When acoustic monitoring was not possible, both MMOs would conduct visual scans;
- Details of each visual scan (i.e. sightings/non-sightings) were passed on via walkie-talkie to personnel on the bridge, as well as the crew on the lower deck responsible for airgun/sparkarray deployment (Plate III);

- If marine mammals are detected within 500m of the ship, a delay in the start of the seismic sources is recommended. The delay allows the animals sufficient time to move away. The delay period is at least 20 minutes after the last sighting;
- The soft-start approach was carried out prior to each seismic survey line. Pre-soft start visual scans for cetaceans were conducted prior to seismic operations where light conditions were suitable. The same approach was employed when technical difficulties impeded airgun operations, and restarts were required;
- Airgun power was gradually built up from a low energy start-up. The recommended minimum period for each soft-start is 20 minutes;
- Data recorded during soft-start periods included the following:
 - airgun activity: time of soft-start, time when full power was reached and time when firing stopped;
 - pre-shooting search: times when visual check for cetaceans commenced and ceased;
 - presence or absence of cetaceans in the 30-minute period prior to the soft-start and what action (if any) was taken in the event of the presence of cetaceans during this period;
 - weather conditions and positional data;
 - in the case of a sighting: species, description of animal(s), position, distance, direction of travel, depth, group size, and behaviour.



Plate III. Cetacean sightings/non-sightings within 500m of the ship prior to seismic operations were relayed via walkie-talkies to the bridge and the working stern deck.

2.4.2. Acoustic check for cetaceans

Details of the methods used for acoustic monitoring of toothed cetacean vocalisations, together with the acoustic hardware and software employed and the resultant data types, are outlined in Aguilar *et al.* (2002).

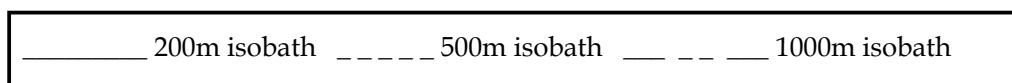
3. DATA COLLECTION AND ANALYSIS

Seabird and cetacean sighting data and all associated effort, environmental and positional data were recorded on paper and subsequently coded for entry into a standard computer database system using Corel Paradox® 9 software. Database coding manuals and support were provided by the JNCC in Aberdeen.

Seabird and cetacean positional and effort-related data gathered during full "on-effort" surveys form the basis of the survey effort and seabird relative abundance plots generated using *Dmap for Windows* version 7.0 (Morton, 1999). These are displayed as ¼ International Council for the Exploration of the Sea (ICES) area units, each measuring 15' latitude x 30' longitude. These area blocks are the units of coverage used by the JNCC and other international research groups as a standard means of displaying survey effort and seabird relative abundance and density, thereby allowing the direct comparison of international research results. Due to the relatively small size of the 4-month dataset, all data relating to commonly encountered seabird species received relative abundance (birds/km surveyed) and distribution analyses. Data relating to rarely encountered seabird species and coastal/inshore species are represented using sighting location maps.

Due to an observed reduction in the detectability of cetaceans in the field when conducting the single-observer Seabirds at Sea method, it was considered that true cetacean abundance per ¼ ICES block could not be accurately represented here via an analysis of "on-effort" sightings. Nor did incidental surveys conform to dedicated point transect sampling theory. As a result, the data collected for cetaceans are considered most appropriate in the presentation of species distribution patterns. With this purpose in mind, all cetacean sighting data, collected both on- and off-effort were included in the following graphical analysis. This dataset includes cetaceans seen outside of the 90° bow-to-beam survey zone and beyond the 300m strip-transect area utilised in previous studies of this kind (e.g. Pollock *et al.*, 1997; Pollock *et al.*, 2000).

Bathymetric contours in all associated survey effort maps and relative abundance, distribution and sighting location maps are represented in the following manner:



RESULTS & DISCUSSION

1. TRIP SUMMARIES

Four surveys were conducted during the spring-summer period of 2002. Three separate vessels-of-opportunity were involved in the 4 trips, which ranged in length of eight days to 45 days (Appendix A). The observer also attempted to assess any behavioural responses of cetaceans to the 2-D or 3-D seismic operations. The observer was also asked to inform seismic scientific staff of cetacean presence (i.e. within 500m of ship) prior to activating equipment (i.e. sparkarray and/or airguns). In addition to standard visual scans, acoustic equipment was successfully employed to monitor toothed cetacean vocalisations during one trip. The overall total survey effort (km^2) achieved for each $\frac{1}{4}$ ICES square (measuring 15' latitude x 30' longitude) during the 4-month study period is highlighted in Figure 3. A total transect area of 1,649 km^2 received full survey effort during 101 survey days at sea. Brief summaries of each of the four trips follow:

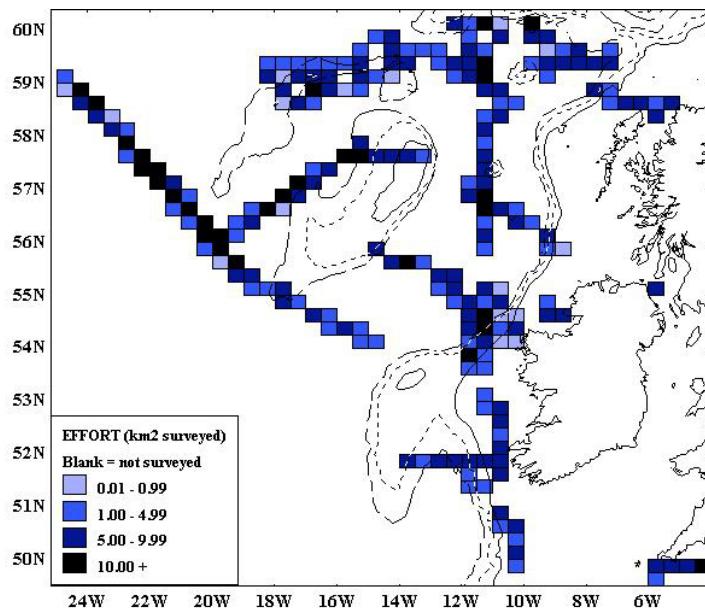


Figure 3. Total survey effort achieved during the 4-month survey period, 13th April – 29th July 2002.

Trip 1 - S.V. Akademik Boris Petrov (I): 13th April – 20th April.

The first survey for 2002 was conducted from the Russian research vessel, S.V. *Akademik Boris Petrov* (Plate II), on behalf of the PSG. The single observer achieved moderate survey effort, which extended from outside the Shannon Estuary westwards to both the eastern and western slopes of the Porcupine Seabight (Figure 4). Survey effort was also gained outside the area of interest, south of the Cornish coast. A total of 121km² transect area received full survey effort during the 8-day 2-D seismic operation. The CMRC acoustic monitoring equipment (i.e. hydrophone streamer, cable, amplifier box, recording equipment and associated software) was used to obtain approximately 141 hours of recordings, which will be analysed at a later date.

The first “Petrov” survey was the least productive in terms of number of species encountered: ten species of seabird and only one confirmed cetacean species were recorded. The most commonly encountered seabirds were the Northern Gannet, Northern Fulmar and Lesser Black-backed Gull. In addition to the eleven Short-beaked Common Dolphins, a further 54 unidentified dolphins and two unidentified whales were observed.

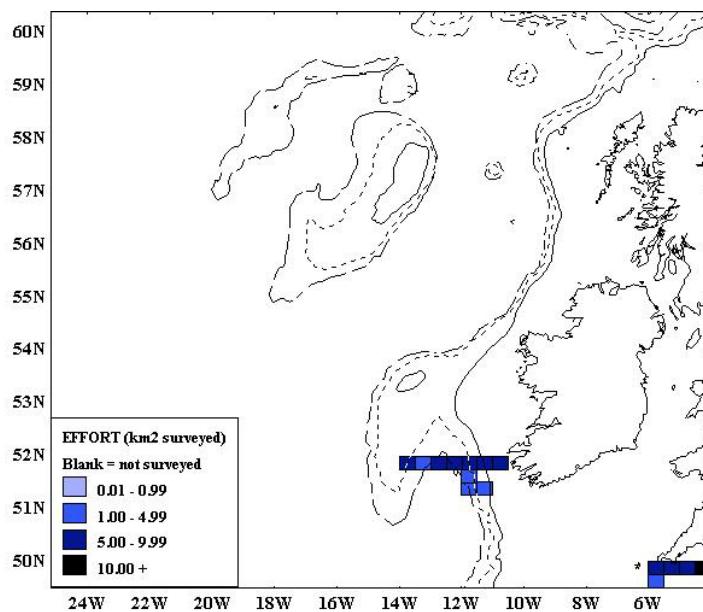


Figure 4. Total survey effort achieved aboard the S.V. *Akademik Boris Petrov*, 13th April – 20th April.

Trip 2 - S.V. Akademik Boris Petrov (II): 30th April – 30th May.

Between April 30th and May 30th 2002, two observers conducted ship-based surveys for cetacean and seabird populations from the Russian research vessel, S.V. *Akademik Boris Petrov* (Plate II), on behalf of the GSI. The primary study area for the 5-week cruise comprised the offshore waters south and west of the Hatton Bank (down to ~3020m depth) and along the Hatton-Rockall Basin (~1200m deep), which lies between the Hatton and Rockall Banks (Figure 5). The western extreme of the survey area edged over the eastern slope of the Iceland Basin (beyond 24°W). The Rockall Trough, Rockall Bank and the continental shelf also received brief survey time as the vessel steamed to and away from the primary study area. An approximate transect area of 669km² was patrolled during 31

survey-days. Although the observers were employed specifically to conduct MMO scans for cetaceans prior to 2-D seismic operations, standard surveys JNCC surveys for both seabirds and cetaceans were employed outside of the soft-start periods.

Acoustic monitoring of toothed cetacean vocalisations was attempted throughout the first three weeks of the survey. Due to prioritised commitments, the CMRC acoustic hardware (i.e. hydrophone streamer, cable and amplifier box) could not be utilized during the second *Petrov* survey. As such, a hydrophone streamer (containing hydrophones and pre-amplifier) and a filter box were provided by the GSI and were used in conjunction with the recording equipment and associated software described by Aguilar *et al.* (2002). Unfortunately, the borrowed acoustic hardware was not compatible with seismic set-up utilised by GeoPro. As such, acoustic recordings or subsequent analysis were possible. A detailed summary of the acoustic methods used and the subsequent problems encountered are outlined in Cronin & Mackey (2002).

In contrast to the first "*Petrov*" survey, the second survey encountered the greatest number of species in 2002: 23 seabird species, seven coastal bird species and 12 cetacean species were recorded. The relatively high encounter rate was due in part to the presence of two observers, to the extensive area surveyed and also to the trip coinciding with the offshore migration of many seabird (e.g. skuas, Arctic Tern), coastal bird (e.g. Great Northern Divers, waders) and cetacean (e.g. large baleen whales) species. Although Northern Fulmars and Black-legged Kittiwakes were the most numerous seabird species, the relatively high number of migrating small skua species in the Hatton-Rockall region and of Manx Shearwaters off Rockall were of greatest interest. The Long-finned Pilot Whale was the most frequently encountered cetacean species, while the sightings of Blue Whales, Sowerby's Beaked Whales and Northern Bottlenose Whales in the Hatton-Rockall region, together with the concentration of Minke Whales near Rockall were also noteworthy.

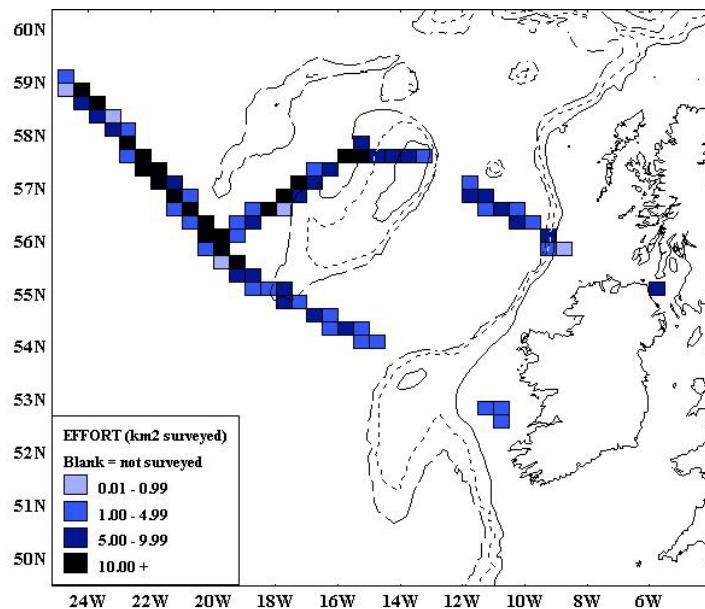


Figure 5. Total survey effort achieved aboard the S.V. *Akademik Boris Petrov*, 30th April – 30th May.

Trip 3 - S.V. *Seisquest*: 6th June – 19th July.

A survey for cetacean, seal and seabird species was carried out during a 3-D seismic survey operated by Veritas DGC Inc. within the Slyne Trough (Corrib Gas Field) in the northeast Atlantic, to the west of County Mayo (Figure 6). Additional survey effort was achieved within the northern sector of the Minch, across the Rockall Trough and along the eastern edge of the Porcupine Seabight. A transect area of 362km² was surveyed by a single observer during 44 days at sea.

Although the “*Seisquest*” survey achieved the greatest number of days at sea, the number of species encountered was relatively low: 17 seabird species and six cetacean species were recorded. This was due in part to the restricted survey area covered and to the considerable amount of ship downtime. As was noted in all 2002 surveys, the Northern Fulmar, Northern Gannet and Black-legged Kittiwake were the most commonly encountered seabird species. The Long-finned Pilot Whale, Bottlenose Dolphin and Short-beaked Common Dolphin were the most numerous cetaceans. In addition to the six Fin Whale sightings, a further eleven unidentified large whale were recorded. Approximately 40% of all cetacean records could not be identified to species during the “*Seisquest*” survey.

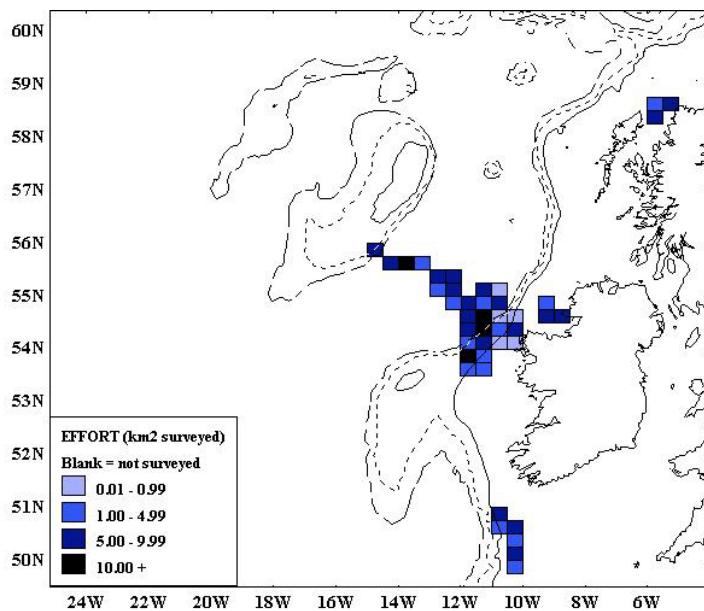


Figure 6. Total survey effort achieved aboard the S.V. *Seisquest*, 6th June – 19th July.

Trip 4 - R.R.S. James Clark Ross: 12th July – 29th July.

As part of the BGS's regional geophysical survey in the Hatton-Rockall area, a single observer was invited to conduct general surveys of the offshore cetacean and seabird populations on behalf of the PSG. The primary study area during the cruise extended from the continental shelf edge, north-west of the Isle of Lewis, across the northern sector of the Rockall Trough, concentrating in the area around the Rosemary Bank, and westward to a region north of the George Bligh Bank and the Hatton Bank (Figure 7). Surveys were also conducted on the homeward leg, as the vessel steamed south over the Anton Dohrn Seamount, through the Rockall Trough and over the continental shelf southwest of Ireland. A total transect area of 496km² received full survey effort during the 18-day cruise.

The final survey was the second most productive survey for 2002, in terms of species encountered: 18 seabird species, three coastal bird species and nine cetacean species were recorded. The Manx Shearwater joined the Northern Fulmar and Northern Gannet as the three most numerous seabird species for the trip, while Black-legged Kittiwake was recorded in relatively lower concentrations. The Long-finned Pilot Whale was comfortably the most frequently encountered cetacean species, although Sperm Whales and Fin Whales were also recorded in relatively high numbers.

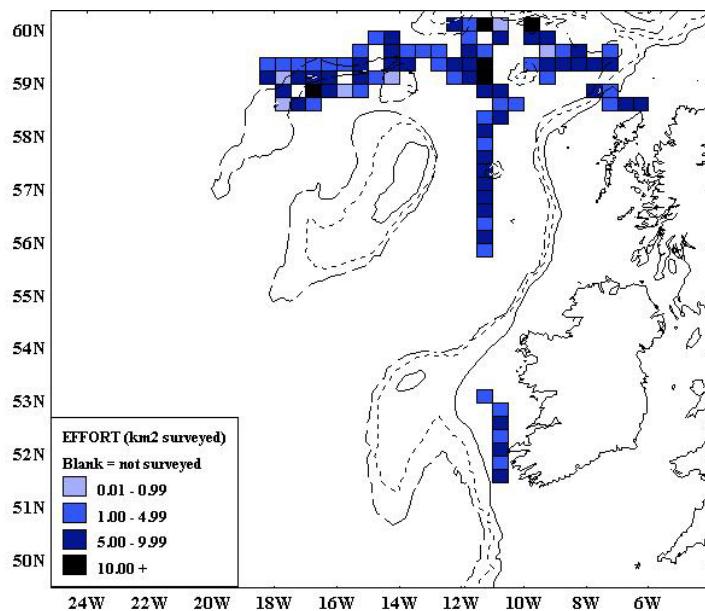


Figure 7. Total survey effort achieved aboard the R.R.S. *James Clark Ross*, 12th July – 29th July.

2. CETACEAN DISTRIBUTION

This section outlines the sighting records of those cetaceans observed using full, incidental and cetacean-only survey methods. A total of 821 individual cetaceans of 15 species were recorded during the 4-month survey, including four species of mysticetes (baleen whales) and 11 odontocete (toothed whale) species (see Appendix B). A further 175 individuals could not be identified to species level.

2.1. MYSTICETES (Baleen whales)

Mysticetes include most of the larger whales, such as the rorquals, right whales and the Gray Whale (*Eschrichtius robustus*) and have baleen plates in place of teeth. The baleen plates hang from the upper jaws and overlap inside their mouth to form a sieve, which filters planktonic crustaceans, pelagic fish and squid from the ocean. Four species of baleen whale (n=49 animals) were positively identified during the survey period, including Fin Whale, Sei Whale, Minke Whale and Blue Whale.

Fin Whale *Balaenoptera physalus*

The Fin Whales (Plate IV) was the most numerous and most frequently encountered baleen whale species recorded: 25 animals were observed during 17 encounters over the course of the 4-month study. Eight animals were recorded during May, during four encounters west of the Hatton Bank, in water depths between 2700-2850m (Figure 8). In the subsequent three-week survey of the north Hatton Bank in July (2002), 11 Fin Whales were recorded during five encounters in depths between 1130-2025m, highlighting the relative importance of this region to this large migratory species. A further six Fin Whales were recorded travelling north in the deeper waters of the Bay of Biscay (between 44-46°N) during the second half of July. Although the annual movements of this large species remains unclear, Evans (1987) suggested that the continental shelf may form an important migration guide for Fin Whales, as they move between their high latitude summer feeding grounds and their low latitude wintering grounds. The importance of the continental shelf, west of Ireland, was supported by the relatively high acoustic detection rate of Fin Whales using bottom-mounted hydrophone (SOSUS) arrays (Clark & Charif, 1998). The reduced detection rates between May and July reported by Clark and Charif (1998) may be explained by the distant offshore distribution observed in the current study.

Fin whales have a reputation for showing indifference to shipping traffic, and like the sperm whales mentioned previously, they displayed little to suggest that they were affected by the seismic activity. Although one large individual breached clear of the water in a very spectacular display, it cannot be said with any certainty that this behaviour was in response to the airguns and sparkarray. Three individuals observed well ahead of the ship's trackline, steadily swimming directly towards the vessel, moved past at a cautious distance (~400m) without breaking their "stride". Another group of three Fin Whales that were observed during seismic operations, displayed no obvious behavioural changes as they approached the vessel to a distance of 1500m.

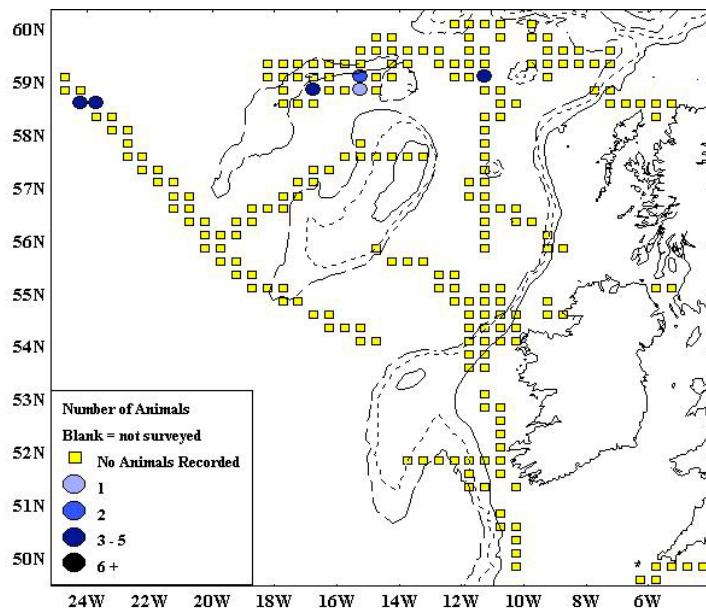


Figure 8. Distribution of the Fin Whale, 13th April – 29th July 2002.



Plate IV. An adult **Fin Whale** surfaces and exhales in close proximity to the research vessel.



Plate V. A **Minke Whale** breaks the surface over the shallow waters of the Rockall Bank. The diagnostic white pectoral band (*bottom left*) and sharply pointed snout are clearly visible.

Minke Whale *Balaenoptera acutorostrata*

The Minke Whale (Cover Plate & Plate V) is the smallest and most abundant of rorquals (i.e. sleek-bodied baleen whales with pleats on the underside of the mouth) (Carwardine *et al.*, 1998). The Minke Whale was the second most frequently encountered baleen whale species during the survey period. Twenty Minke Whales were observed during 13 encounters. Of great interest, was the relatively high number of Minke Whales observed over the shallow offshore waters of the Rockall Bank (<400m) during the final days of May. Nine animals of different ages were recorded in close proximity to Rockall itself (Figure 9), while a further four individuals were observed the following morning travelling towards Rockall, highlighting the importance of this region during May. Although small numbers of Minke Whale were observed by Ó Cadhla *et al.* (2002) over the Rockall Bank, the high concentration observed during the current study were not reported, highlighting the patchiness of cetacean distribution in both space and time. During May, 15 Minke Whales were recorded while the ship was steaming, two animals were observed while the ship was stationary and the remaining animal was noted during OBS deployment. Two additional Minke Whales were observed in early July during seismic operations, as they swam slowly across the ship's bow 800m ahead of the trackline over the northern slope of the Hatton Bank (Figure 9).

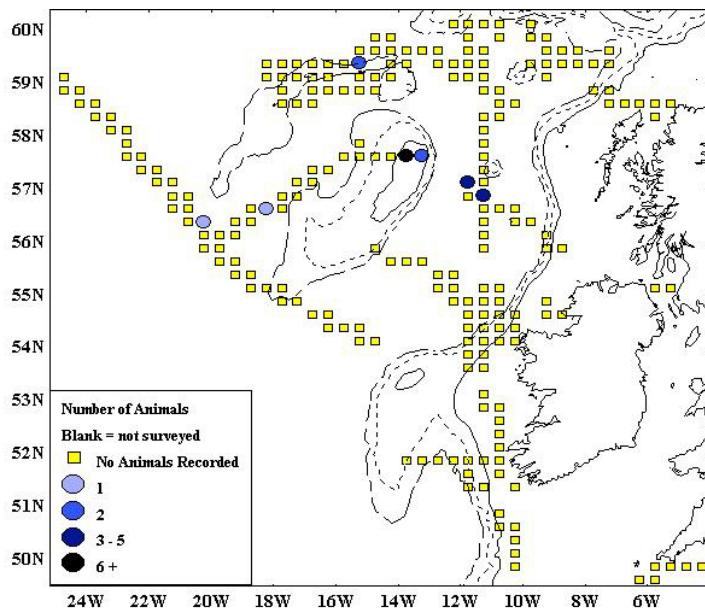


Figure 9. Distribution of the Minke Whale, 13th April – 29th July 2002.

Minke Whales are found virtually worldwide, some populations appear to be resident year round and individuals may have exclusive home ranges in some areas (Carwardine, 1995). In contrast to the findings of the recent *Cetaceans and Seabirds at Sea* study, where all but one of 36 Minke Whales observed were recorded in water depths less than 800m (Ó Cadhla *et al.*, 2002), 40% of the Minke Whales recorded during the current study were observed over the Hatton-Rockall Basin and the Rockall Trough at depths ranging between 1315m and 2400m (Figure 9). The offshore distribution noted during the current study also contrasts with the observations of Northridge *et al.* (1995), who noted the movement of Minke Whales into coastal waters between April and June.

Sei Whale *Balaenoptera borealis*

One Sei Whale was observed in early May in a water depth of 1100m during OBS deployment (Figure 10). The animal appeared to be swimming away from a passing cargo vessel and passed within 600m of the research vessel's stern. The Sei Whale is less well known than the other members of the rorqual family and its occurrence at specific localities is apparently less easy to predict than most other rorquals (Reeves *et al.*, 2002).

Generally considered to be a deepwater pelagic species, the 43 Sei Whales noted during the 27-month "Cetaceans and Seabirds at Sea" study, were widely distributed in deepwater, slope and shelf habitats (Ó Cadhla *et al.*, 2002). Data from the whaling stations in Ireland suggest that most animals were taken in July and August. Further north, the Scottish whaling stations reported Sei Whales from April to October, with a peak in June, and catches occurred both on and off the shelf. Thompson (1929) reported variations in the inter-annual catch, suggesting that in some years Sei Whales were absent from the whaling grounds.

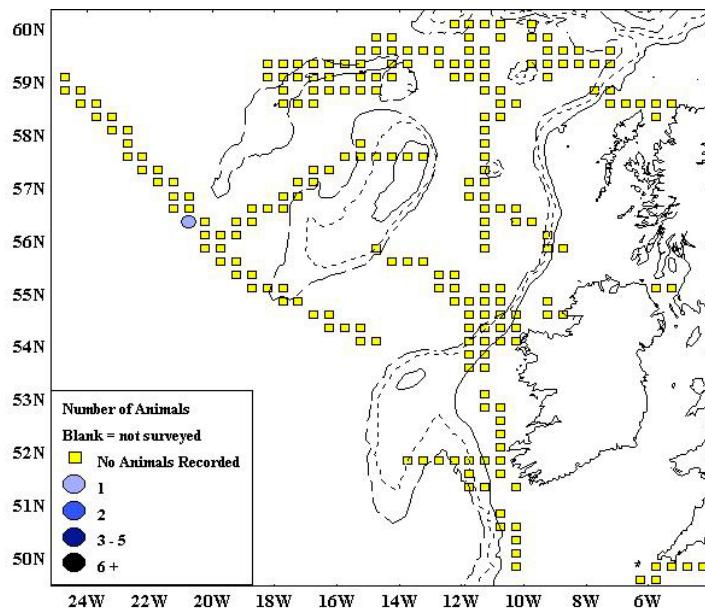


Figure 10. Sighting location of one Sei Whale, 2nd May 2002.

Blue Whale *Balaenoptera musculus*

The Blue Whale is the largest of the whales, growing to a length of 33m, the average size however, is much smaller (~24m; see Nishiwaki, 1950). Three individuals in total were observed during the present survey in two encounters during mid-May, along the eastern slope of the Iceland Basin (depth~2750m; Figure 11). Extremely tall blows were initially observed at a distance of 4500m from the ship. The very long back of the largest animal remained visible as it moved through the surface, however no dorsal fin was sighted. Although the animals' surfacing pattern was generally calm and unobtrusive, one of the whales was observed lunging forward displacing a large volume of white water in its wake, while another animal's tail fluke was noted slicing through the ocean's surface. The ship was involved with OBS deployment at the time the animals were sighted. The animals' large blows were observed for almost two hours, while the whales themselves appeared to be continually travelling very slowly in a northerly direction. The relative size of the whales' blows, the extreme length of the body, the animals' surfacing behaviour and the lack of an obvious dorsal fin allowed for the animals' positive identification. A single Blue Whale was recorded by Ó Cadhla *et al.* (2002) during their 27-month survey of Ireland's Atlantic margin. This individual was observed in the deeper waters of the Rockall Trough at the end of May, highlighting the potential importance of the offshore regions, west of Ireland, for this large, migratory species during spring-summer period. In contrast, Clark and Charif (1998) reported minimal Blue Whale acoustic activity within the study area between April and June.

Three main populations of Blue Whale are recognized - the North Atlantic, North Pacific and southern hemisphere. The Blue Whale was hunted close to extinction by the whaling industry and only a few hundred are believed to remain in the northern hemisphere where they may migrate between low latitude wintering grounds and high latitude summering grounds and are found mainly along the edge of the continental shelf. The individuals sighted during the survey could possibly have been migrating to high latitude feeding grounds.

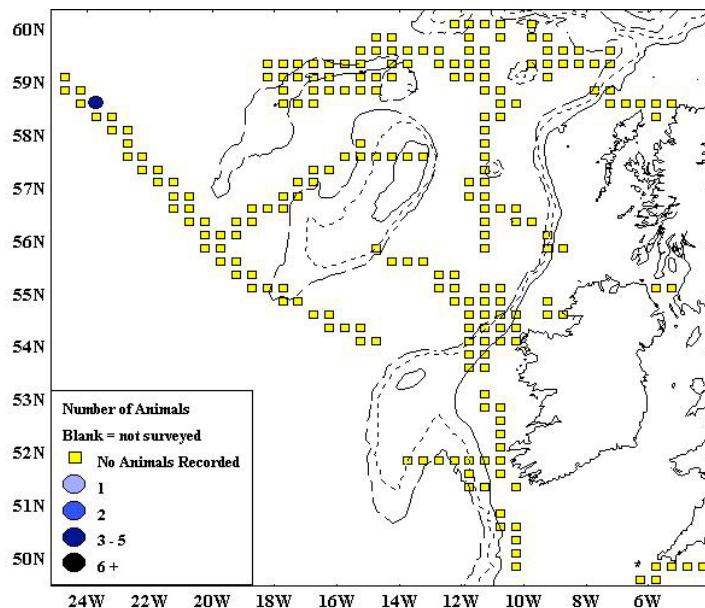


Figure 11. Sighting location of three Blue Whales, 15th May 2002.

2.2. ODONTOCETES (Toothed whales, dolphins & porpoises)

The toothed cetaceans observed during the study feed by grasping their prey (crustaceans, fish, squid, marine mammals) with their conical-shaped teeth (whales and dolphins) or spatulate-shaped teeth (porpoises). Eleven species of toothed cetaceans ($n=597$ animals) were positively identified during the survey.

Sperm Whale *Physeter macrocephalus*

Sperm Whales are usually found offshore where they typically dive to depths of 300-600m in search of the large squid species, which form the greater portion of their diet (Jaquet & Gendron, 2002). They are oceanic whales, rarely venturing into waters less than 500m deep (Baumgartner *et al.*, 2001), although they can be sighted in inshore waters as shallow as 200m (Jaquet *et al.*, 2000). They are commonly found in submarine canyons at the edge of the continental shelf (Whitehead *et al.*, 1992). There were 20 Sperm Whales sighted on the survey during 15 encounters, although nine animals were observed in close proximity to other individuals (i.e. within 1-2km). The majority of animals were recorded in water of depths between 1470m and 2900m, however three individuals were observed over a 4-5mile course at a depth of ~590m over the Hatton Bank (Figure 12). Twelve of the 15 Sperm Whale encounters occurred during seismic operations. In most instances, the whales appeared to display total indifference to the acoustic activities, although two individuals surfaced within 300m of the active airguns. Another large individual surfaced 2-3 miles ahead of the ship and appeared to be swimming quickly away from the ship's trackline, while surfacing at relatively frequent intervals. It eventually slowed its swimming and surfacing rates as it approached the ship within 1500m, before going into a deep dive. In most encounters, Sperm Whales were observed "fluking-up" indicative of a deep dive (Jaquet *et al.*, 2000).

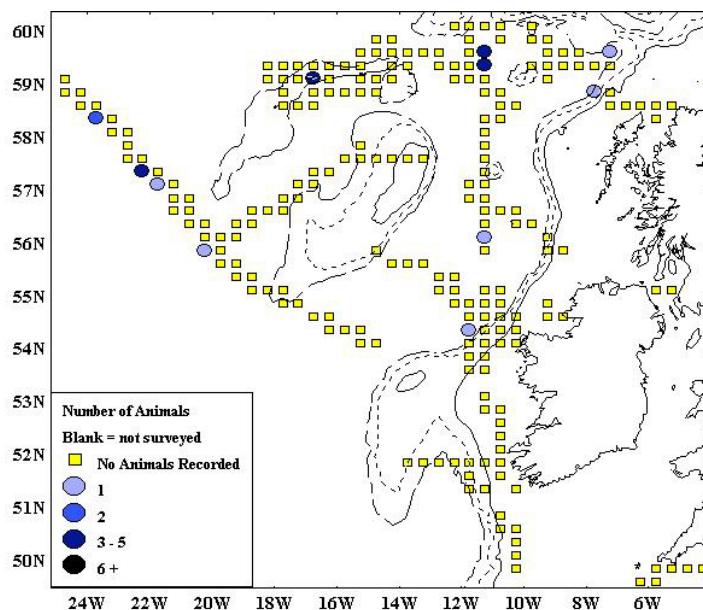


Figure 12. Distribution of the Sperm Whale, 13th April – 29th July 2002.

Long-finned Pilot Whale *Globicephala melas*

The Long-finned Pilot Whale (Plate VI) was the most numerous and frequently encountered cetacean on the survey with a total of 449 individuals observed during the 4-month survey period. This deep-diving species accounted for over 54% of all individuals recorded (see Appendix B). Group size varied between four and 31 (average~9-10 animals/group) and comprised of adults only, adults and juveniles, or adult, juvenile and calf groups. The sightings were recorded during 47 separate encounters, 24 of which occurred during seismic activity.

Apparent reactions to the seismic operations varied. On most occasions the Pilot Whales showed no apparent interest, particularly when they were occupied in apparent sub-surface feeding frenzies. However, the Pilot Whale was the only cetacean species that appeared to display a positive response to seismic operations (i.e. actively approached vessel and acoustic arrays). This investigative behaviour was also observed during the 27-month Cetaceans and Seabirds at Sea study, where Pilot Whales displayed a curious interest in the noise generated from the airguns of two different seismic vessels, situating themselves within 10m of the active arrays (Ó Cadhla *et al.*, 2002). During the current study, immature Pilot Whales were observed swimming in close association (within 30m) of the sparkarray, in a similar manner to bow-riding dolphins. On most occasions however, Pilot Whales were observed swimming rapidly towards the ship until they get within 150-300m. At this point, they tended to slow to a cautious pace, swimming as a tight unit parallel and in the opposite direction to the vessel. Once level with the stern/array region, most groups milled about in the one position, sometimes quite actively, before moving off in various directions relative to the ship's course. A single long-term close encounter occurred as the ship's crew retrieved current meters from the Rockall Trough. The animals, pictured in Plate VI, displayed numerous forms of behaviour during this hour-long exhibition, including spyhopping, logging, tail-slapping, milling and fluking.

Pilot Whales observed during non-seismic activities were frequently recorded within 200m of the vessel, and remained associated with the vessel for up to 30 minutes. Those animals observed during OBS retrieval operations may have been attracted to the OBS locating signal, which communicated with the vessel at frequencies of 9-13kHz.

Apart from a single sighting of 18 animals over the continental slope northwest of Co. Mayo (depth~300m), all Pilot Whales in the present survey, were observed in waters deeper than 1000m (Figure 13). The vast majority of the 686 Long-finned Pilot Whales recorded by Ó Cadhla *et al.* (2002), were observed in close association with the slopes of the continental shelf and the Rockall and Hatton Banks. This distinctive distribution pattern is likely to be prey-related, as Pilot Whales primarily feed on squid species that also concentrate in the same deepwater channel habitat (Bloch *et al.*, 1993). Multi-species encounters involving Pilot Whales are common, and were frequently recorded during the 27-month study. Species recorded in close association with pilot whales during the study included Atlantic White-sided Dolphins, Short-beaked Common Dolphins, Bottlenose Dolphins, False Killer Whales and Sei Whales (Ó Cadhla *et al.*, 2002). During 2002, multi-species encounters involved Pilot Whales together with Atlantic White-sided Dolphins and Short-beaked Common Dolphins on five separate occasions.

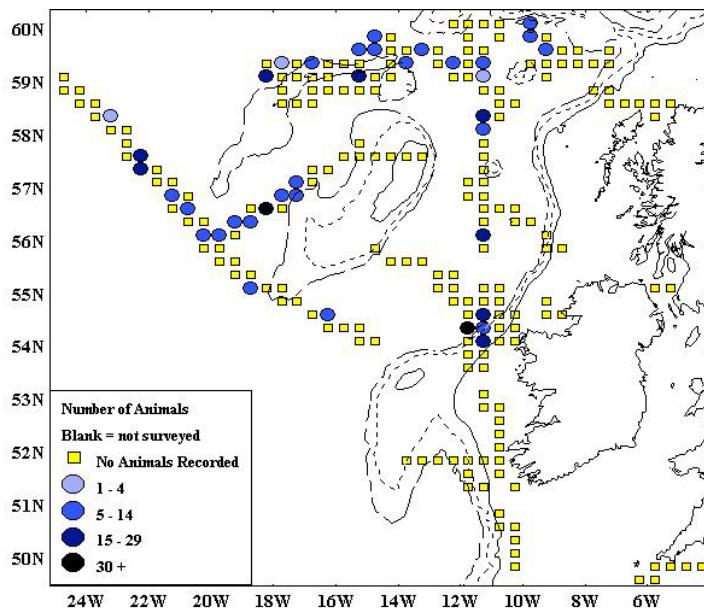


Figure 13. Distribution of the Long-finned Pilot Whale, 13th April – 29th July 2002.



Plate VI. A family group of **Long-finned Pilot Whales** spyhop and mill about in close proximity to the R.R.S. *James Clarke Ross*. This squid-eating species was the most numerous and most frequently encountered cetacean during 2002.

False Killer Whale *Pseudorca crassidens*

Two adult False Killer Whales were observed on May 8th, southwest of the Hatton Bank in a water depth of 1500m during OBS retrieval operations (Figure 14). The two adults, which were observed slowly swimming within 50m of the vessel, may have been attracted by the pings of the OBS location signals (9-13kHz). The current record represents one of the most northern sightings of this typically temperate/tropical species. Ó Cadhla *et al.* (2002) reported the sighting of 19 false killer whales during three separate encounters over the Rockall and Hatton Banks in June 2000, although these sightings were further east than the current record. False Killer Whales, as the name suggests, can often be confused with female and juvenile Killer Whales (*Orcinus orca*) due to its large prominent dorsal fin. Although their long black bodies may resemble pilot whales, False Killer Whales are characterised by their highly acrobatic displays, distinctive size and shape of the dorsal fin, colouration, body dimensions and relatively narrow head and body. They are mainly seen in deeper offshore waters and sometimes in deep coastal waters, the whales' distribution may be prey-related, as the squid and small fish they feed upon also concentrate along the same shelf-edge habitat (Reeves *et al.*, 2002).

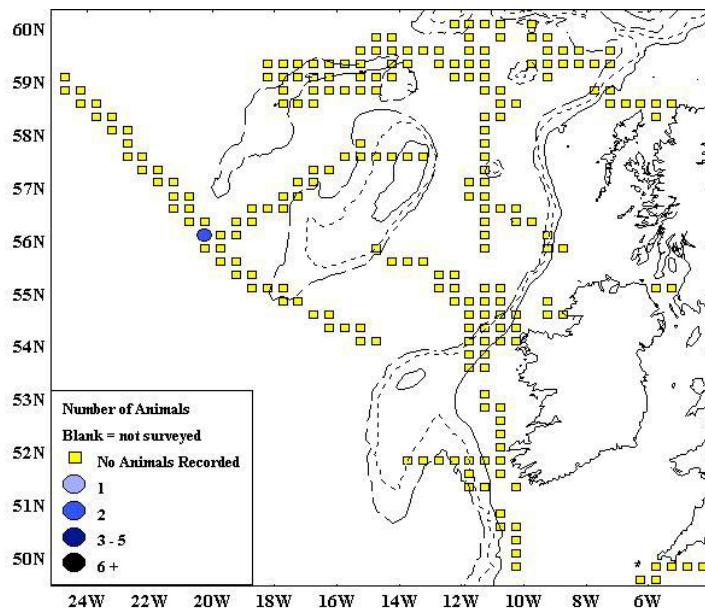


Figure 14. Sighting location of two False Killer Whales, 8th May 2002.

Northern Bottlenose Whale *Hyperoodon ampullatus*

Two adult Northern Bottlenose Whales were observed during May in two separate encounters, one at a distance of approximately 600m from the S.V. *Akademik Boris Petrov*, the other at a distance of 1500m. Both animals were observed during a series of spectacular breaches, displaying a similar pattern of four breaches before disappearing from view. The species' most distinctive feature, the bulbous forehead (Plate VII), together with a dolphin-like beak was evident during both sightings. No seismic activity was taking place at the time of either sighting. One encounter occurred in a water depth of 2900m, the second in a water depth of 1400m and in close proximity to a seamount along the eastern slope of the Hatton-Rockall Basin (Figure 15). Ó Cadhla *et al.* (2002) reported the presence of two adult Northern Bottlenose Whales in close proximity to the same seamount in August 2001. This species is thought to be most common in deep water habitats, beyond the continental shelf and is commonly found in areas with relatively steep topography such as submarine canyons (Hooker *et al.*, 2002).

The Northern Bottlenose Whale is confined to the northern hemisphere and there appears to be pockets of abundance, for example north of Sable Island, Canada and between Iceland and Jan Mayen. The species is not commonly seen in Irish waters although there have been 27 reported strandings of Northern Bottlenose Whale throughout the last century (Berrow & Rogan, 1997; Rogan *pers comm.*, 2002).

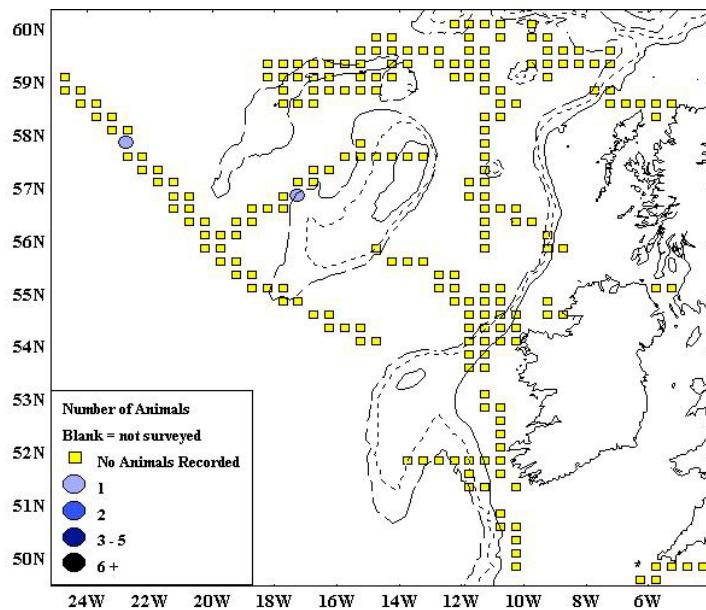


Figure 15. Distribution of the Northern Bottlenose Whale, 13th April – 29th July 2002.



Plate VII. The bulbous forehead (melon) is clearly visible in this juvenile **Northern Bottlenose Whale**, which stranded on Bere Island, Co. Cork in 1998.

Sowerby's Beaked Whale *Mesoplodon bidens*

A total of eight individuals were observed during two encounters, recorded within the space of 50 minutes, west of the Rockall Bank on May 20th (Figure 16). Sea conditions were close to perfect (i.e. sea state 1-2) during both sightings, which occurred in close proximity to a seamount along the eastern edge of the Hatton-Rockall Basin. Although Sowerby's Beaked Whales are considered to be shy animals that avoid all forms of shipping traffic, both groups appeared to actively approach the vessel in an investigative manner. The second group comprising five animals (four adults and one immature) approached the vessel to within 120m. The animals' characteristic features (long and narrow beak, flat head and hump anterior to blowhole) were clearly evident during each surfacing. There was no seismic activity during either encounter.

Although this North Atlantic species is one of the most commonly stranded *Mesoplodon* species, there have been few sightings at sea. Ó Cadhla *et al.* (2002) reported only one encounter of four Sowerby's Beaked Whales, sighted along the eastern edge of the Rockall Trough, west of Co. Mayo (August 2000). Stranding records of Sowerby's Beaked Whale from the last century report three females from counties Wexford, Galway and Sligo (Berrow & Rogan, 1997).

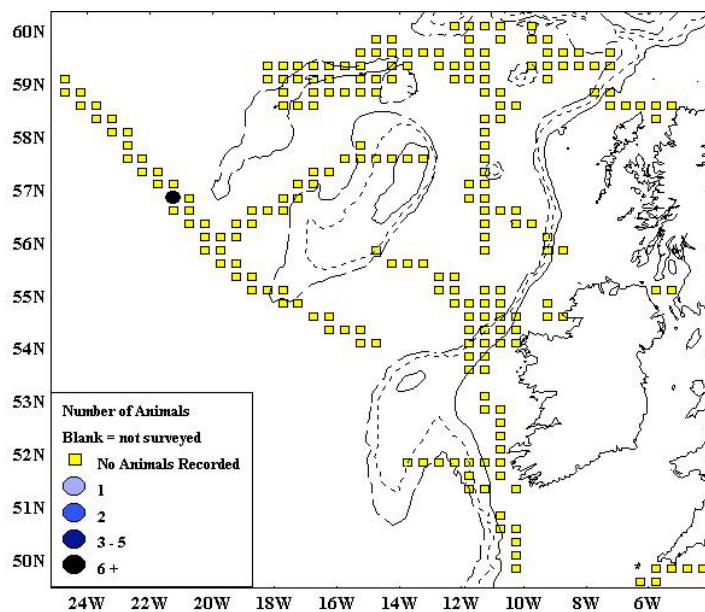


Figure 16. Sighting location of eight Sowerby's Beaked Whales, 20th May 2002.

Risso's Dolphin *Grampus griseus*

A single-family group of five Risso's Dolphins were encountered on July 12th over the continental shelf (depth~130m) swimming in a southeast direction towards the Isle of Lewis (Figure 17). The tall, erect dorsal fins, the rounded melon and the grey scarred bodies of the three adults were clearly visible as the group surfaced within 400m of the R.R.S. *James Clark Ross*. The darker, unscarred bodies of a juvenile and a calf were also recorded in close proximity to one of the adults. Pollock *et al.* (2000) reported regular sightings of this squid-eating species around the Western Isles, where they are possibly resident (Atkinson *et al.*, 1997). Ó Cadhla *et al.* (2002) recorded 13 Risso's Dolphins during 5 separate encounters.

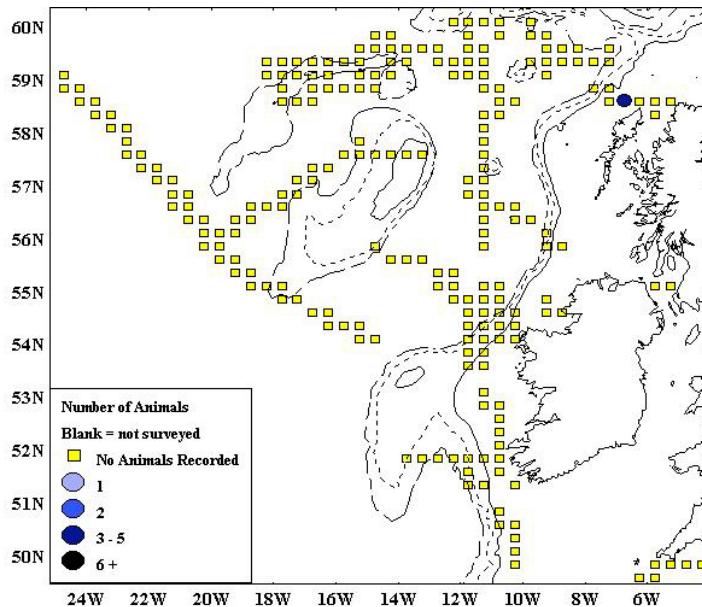


Figure 17. Sighting location of five Risso's Dolphins, 12th July 2002.

Harbour Porpoise *Phocoena phocoena*

The Harbour Porpoise is usually found in coastal waters with most sightings occurring in shelf waters shallower than the 200m isobath (Pollock *et al.*, 1997; Pollock *et al.*, 2000; Ó Cadhla *et al.*, 2002). Some seasonal movements have been documented, which may be related to prey availability (Leopold *et al.*, 1992). A group of four individuals were observed in the present study in offshore waters in close proximity to Rockall, at a depth of approximately 300m (Figure 18). The ship was steaming at the time of observation. The group was sighted in close association with a small family group of Minke Whales. Although small numbers have been reported occupying waters over the Rockall Bank (Northridge *et al.*, 1995), this record represents the first offshore observation of Harbour Porpoise made by the Irish Cetaceans and Seabirds at Sea team. The other sighting event involved a dead individual recorded during seismic operations in early July.

Harbour Porpoises were recorded during 52 encounters by Ó Cadhla *et al.* (2002), with all 173 individuals sighted in waters over the continental shelf and the vast majority of animals recorded very close to the coast. The relative abundance of the inconspicuous Harbour Porpoise may be underestimated due to the associated sighting difficulty in moderate-rough weather. Over 77% of all Harbour Porpoise sightings during the 27-month

period occurred when wind speeds were less than Beaufort Force 3 (Ó Cadhla *et al.*, 2002). The Rockall sighting was recorded at a wind speed of Beaufort Force 1.

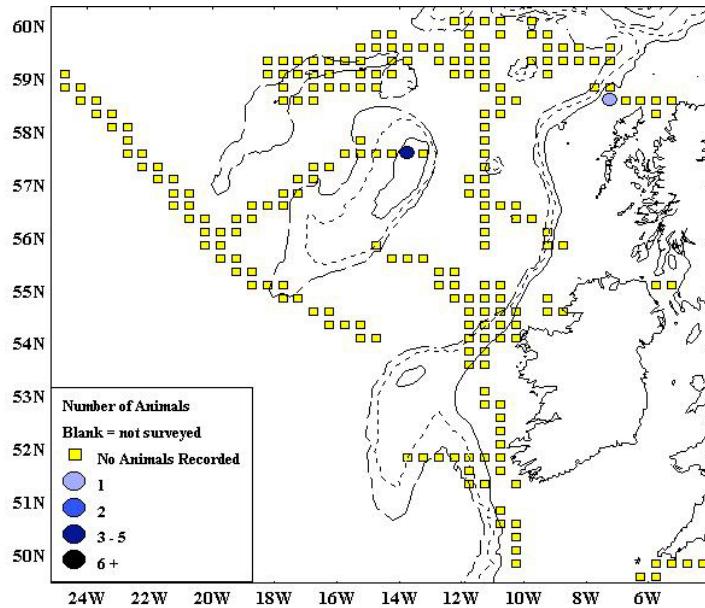


Figure 18. Distribution of the Harbour Porpoise, 13th April – 29th July 2002.

Bottlenose Dolphin *Tursiops truncates*

A single group of 30 Bottlenose Dolphins were observed on June 6th, as the research vessel was steaming off the NW coast of mainland Scotland (Figure 19). The acrobatic group were recorded at a distance of two kilometres, surrounded by a large number of diving Northern Gannets. Pollock *et al.* (2000) also reported similar sighting locations for Bottlenose Dolphins between April and August, as did Ó Cadhla *et al.* (2002) between July and September.

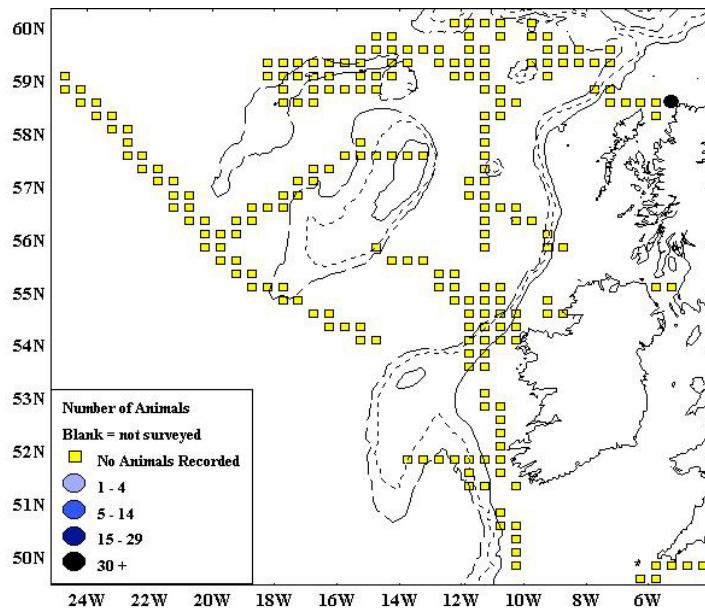


Figure 19. Sighting location of 30 Bottlenose Dolphins, 6th June 2002.

White-beaked Dolphin *Lagenorhynchus albirostris*

Three adult White-beaked Dolphins were observed off the north coast of the Western Isles on July 12th (Figure 20). This high-latitude species was the most commonly encountered cetacean recorded by Pollock *et al.* (2000) in shelf waters, particularly in the northern portion of the Minch between May and October. Northridge *et al.* (1995) observed that the highest sighting rates of White-beaked Dolphins were associated with the Outer Hebrides. Ó Cadhla *et al.* (2002) reported limited sightings of White-beaked Dolphins in the same region.

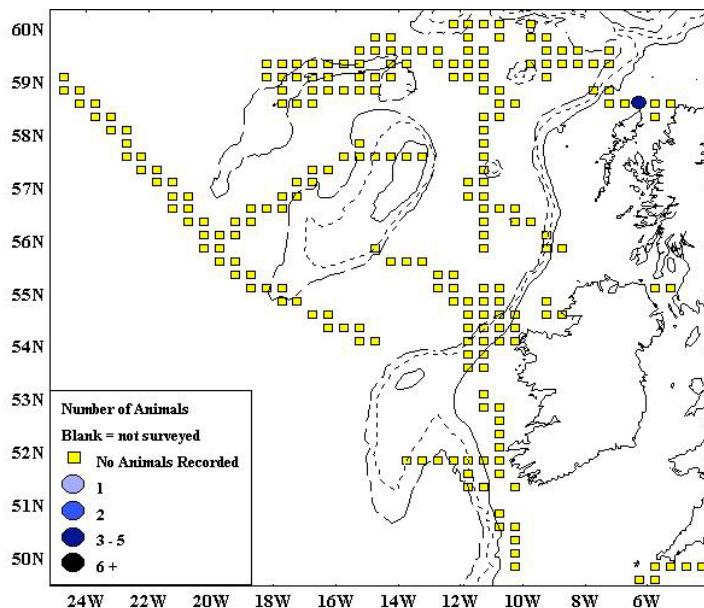


Figure 20. Sighting location of three White-beaked Dolphins, 12th July 2002.

Atlantic White-sided Dolphin *Lagenorhynchus acutus*

The Atlantic White-sided Dolphin is generally recorded on the continental shelf and over the slope and makes summer forays into shallower waters to the north and west of Britain (Pollock *et al.*, 2000). During the current study, 18 Atlantic White-sided Dolphins were recorded during four separate encounters between May 19th and July 20th. All sightings occurred in offshore waters with a depth greater than 1300m. Two encounters occurred in close proximity to the slope region of the continental shelf and the Hatton Bank (Figure 21). This association with the shelf edge was also noted by both Pollock *et al.* (2000) and Ó Cadhla *et al.* (2002). Although it was the second most numerous cetacean species recorded by Ó Cadhla *et al.* (2002), where it was also recorded throughout the Irish Atlantic Margin, the Atlantic White-sided Dolphin was only the seventh most numerous species encountered during 2002. A recent dedicated cetacean survey (SIAR) conducted over the shelf, slope and deep water habitats west of Ireland (August, 2000), estimated the Atlantic White-sided Dolphin population to be between 1,134 - 10,015 animals over an approximate area of 120,000km² (Ó Cadhla *et al.*, 2002).

The Atlantic White-sided Dolphin is a sociable animal that is often seen in the company of Humpback Whales, Fin Whales, Long-finned Pilot Whales, White-beaked and Common Dolphins (Pollock *et al.*, 2000). During the current study, a group of six Atlantic White-sided Dolphins, comprising four adults and two calves, were observed closely associated

with of a family group of 20 Pilot Whales, in depths of 2500m west of the Hatton Bank (Figure 21). Although the Pilot Whales remained within 100m of the vessel for over 30 minutes, the Atlantic White-sided Dolphins disappeared from view after only five minutes. The vessel was involved in OBS retrieval operations during the encounter. A similar multi-species encounter, also involving Pilot Whales, was observed on July 1st along the eastern edge of the Rockall Trough (Figure 21). The Atlantic White-sided Dolphin was one of two cetacean species that showed any sign of avoidance during seismic operations, where individuals kept an unusually cautious distance from the research vessels.

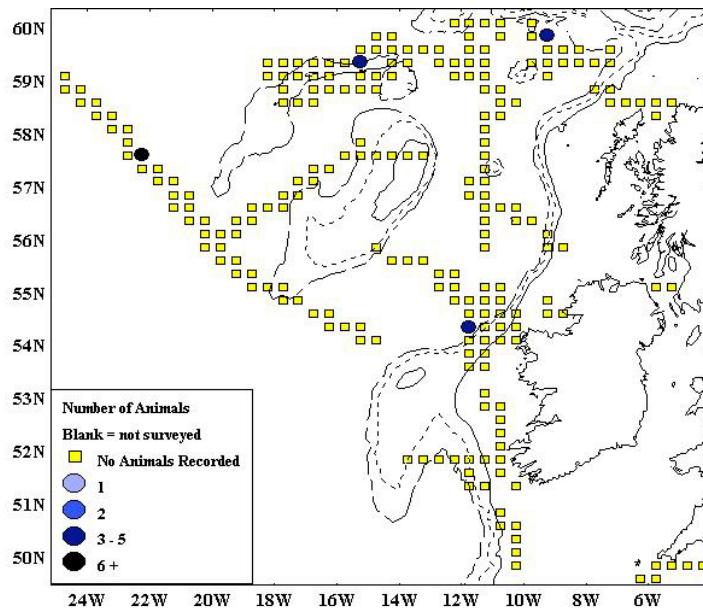


Figure 21. Distribution of the Atlantic White-sided Dolphin, 13th April – 29th July 2002.

Short-beaked Common Dolphin *Delphinus delphis*

Common Dolphins are one of the most abundant of all cetacean species, with the probable worldwide population numbering millions (Reeves *et al.*, 2002). Common Dolphins are strongly attracted to moving vessels and due to their highly acrobatic behaviour, and tendency to form large active schools, they can be seen from considerable distances. Two distinct forms (short-beaked and long-beaked) have recently been granted separate species status (Carwardine, 1995). Although the short-beaked form (Plate VIII) was recently reported as the most numerous and most frequently encountered cetacean species recorded by Ó Cadhla *et al.* (2002), only 55 individuals were recorded during ten encounters throughout the current survey period. Although relatively scarce, the Short-beaked Common Dolphin was the only cetacean species recorded during all four surveys in 2002. This wide-ranging species was observed in all offshore habitats: over the relatively shallow waters of the Rockall Bank and the continental shelf, the slope region west of Co. Mayo and the deeper waters north of the Hatton Bank and over the Rockall Trough (Figure 22). Together with the Atlantic White-sided Dolphin, the Short-beaked Common Dolphin was the only other species that showed any potential sign of avoidance during seismic operations, where individuals kept an unusually cautious distance from the research vessels.

Ó Cadhla *et al.* (2002) noted that the Short-beaked Common Dolphin appeared to be widespread along the west coast in moderate numbers, but absent from the north coast and

the Irish Sea. Short-beaked Common Dolphins were regularly encountered in the deep waters of the Rockall Trough, and offshore records were generally associated with strong depth gradients (Ó Cadhla *et al.*, 2002).

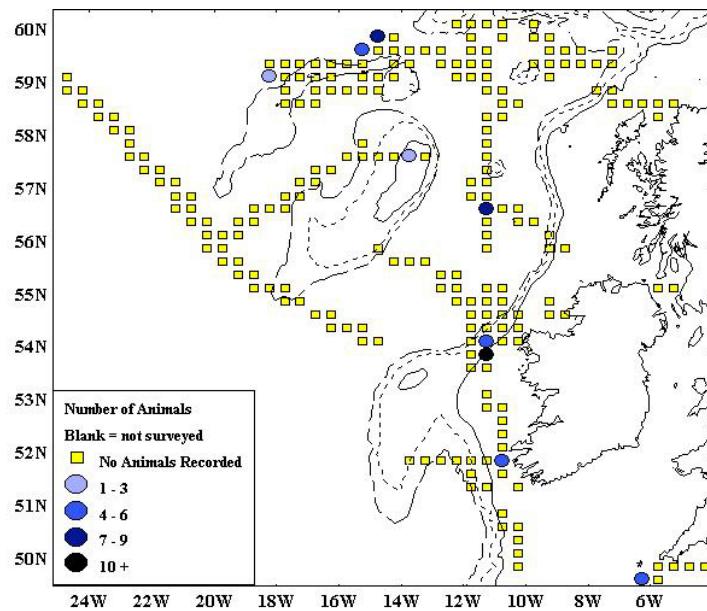


Figure 22. Distribution of the Short-beaked Common Dolphin, 13th April – 29th July 2002.



Plate VIII. Relatively few **Short-beaked Common Dolphins** were observed during the 4-month survey period.

2.3. UNIDENTIFIED CETACEANS

Approximately 21% of all cetaceans recorded during 2002 could not be identified to species level, due to a variety of factors (e.g. weather conditions, distance from vessel, indistinct cues, etc). A total of 175 unidentified cetaceans were recorded in 42 encounters during the 4-month survey period. This unidentified group is sub-divided into nine categories based on the available sighting information. The numerical breakdown of the unidentified cetaceans observed between April and July 2002 is outlined in Appendix B. The nine unidentified cetacean categories are outlined below:

Cetacean species

This category applies to those observations, in which it was impossible to determine whether the animal was a whale, a dolphin or a porpoise. In these situations the sighting cue is usually nothing more than a series of distant splashes or a quick glance of an animal's back or dorsal fin. Nineteen "cetacean species" were recorded from six encounters during the current study.

Whale species

Frequent sightings involving vague size estimation, indistinct head and dorsal fin shape and uncertain breathing patterns were adequate enough to classify an animal as an "unidentified whale species". This category includes sightings of unidentified large, medium, small whales and beaked whales. A total of ten unidentified whales were recorded.

Large whale species

When enough information is recorded to discount dolphins, porpoises and medium, small and beaked whales but the observer is still unsure of the animal's true identification, it is described as a "large whale species". In the current study area, such a category would include unidentified Blue, Fin, Sei, Humpback, Northern Right and Sperm Whale sightings. Five large whales could not be identified with further certainty during 2002.

Blue/Fin/Sei Whale

Sometimes the body size, dorsal fin shape, surfacing pattern or blow height, angle and shape can narrow the level of uncertainty described in "Large whale species" further, so that the animal in question was likely to be one of the three largest whales (i.e. Blue Whale, Fin Whale or Sei Whale). Six large whales were identified as "Blue/Fin/Sei Whale" during 2002.

Medium whale species

When enough information is recorded to discount dolphins, porpoises and large whales but the observer is still unsure of the animal's true identification, it is described as a "medium whale species". In the current study area, such a category would include unidentified Minke, Killer, False Killer and Long-finned Pilot Whales, together with Risso's Dolphins and beaked whales sightings. This category may also include immature large whales. Only one "medium whale species" could not be identified with further certainty during 2002.

Beaked whale species

Sometimes the body size and colour, dorsal fin shape and position, blowhole and head morphology or the degree of scarring can narrow the level of uncertainty described in “Medium whale species” further, so that the animal in question was likely to be one of the five beaked whale species (i.e. Cuvier’s, Sowerby’s, True’s and Gervais’ Beaked Whales and Northern Bottlenose Whale) relevant to the current study. Only one medium whale was identified as “beaked whale species” during 2002.

Pilot/False Killer Whale

The identification of black-coloured medium-sized whales can often be impossible in the field. The “Pilot/False Killer Whale” category includes all unidentified “blackfish” relevant to the study area (i.e. Long-finned Pilot Whale and False Killer Whale). The category also includes female and immature male Killer Whales, which can also resemble the smaller blackfish species. During the current study, seven unidentified blackfish were recorded during a single encounter.

Unidentified dolphins

This category includes the distant sightings of small cetaceans (i.e. dolphins and porpoises). The encounter may involve distant sighting of dorsal fins or breaching, acrobatic individuals, or the close sighting of an indistinct body size, shape or colouring. Over 70% of all unidentified cetaceans sightings (n=124 animals/17 encounters) during 2002 fell into this category.

Common/Striped dolphins

Sometimes the dolphin’s shape and size can be discerned, however, the colouring and patterning remain unclear. If the individual’s beak is identified as prominent and the body size as relatively small (compared to White-beaked, Atlantic White-sided and Bottlenose Dolphins), then it is likely to be a Common Dolphin or a Striped Dolphin. A single sighting of two small cetaceans was identified as “Common/Striped Dolphins” in 2002.

3. BIRD DISTRIBUTION AND ABUNDANCE

This section outlines the sighting records of those bird species observed using the survey methods referred to in the methods section. A total of 14,199 birds of 43 species were recorded during the five-week study. These comprise 28 species of seabirds (n=14,116; Appendix C), nine species of inshore and coastal residents/migrants/vagrants (n=70; Appendix D) and six species of terrestrial vagrants (n=13; Appendix E). A further 166 seabirds and coastal birds were recorded, but could not be identified to species level, 49% of which were unidentified skuas.

Comments in brackets after a species' Latin name indicate the **level of vulnerability** of each species to oil pollution, as outlined in Tasker *et al.* (1990). Levels of vulnerability are defined as follows:

- W** = species spends a substantial period of its life on the water surface.
- P** = waters west of Britain are important for a large proportion of the species.
- R** = species rare on a world basis.
- U** = unknown vulnerability. Indicator not provided in Tasker *et al.* (1990).

This classification is based upon:

1. The relative amount of time each species spends in contact with the water;
2. The importance of the waters west of Britain and Ireland to the world population of the species.

3.1. SEABIRDS

The majority of seabirds will be located in close vicinity of their coastal breeding sites for the majority of the study period. As such, low offshore concentrations of seabirds were expected, with the bulk of the birds being non-breeding adults and juveniles. The four main seabird groups (Procellariiformes, Stercorariidae, Laridae, and Alcidae) were recorded throughout the study area. The **procellariidae** (fulmars, petrels and shearwaters) form a group of highly pelagic birds capable of long-range travel. Members of the **stercorariidae** (skuas) family are relatively aggressive birds that also undergo annual long-distance migrations. The **laridae** (larids: gulls) are a familiar group of seabirds often associated with human fishing activities. The four representative species of the **alcidae** (alcids: auks), Common Guillemots, Razorbills, Atlantic Puffins and Little Auks, were all recorded during the 4-month study period. The auks are regarded as the seabird group most vulnerable to hydrocarbon pollution due to the large amount of time they spend in contact with the ocean's surface. The following summary is an account of the seabird species recorded.

Procellariidae - the Fulmars & Shearwaters

This group of highly pelagic birds are characterised by the straight beak with a hooked tip and the tube-shaped nostril structure, which serves to secrete seawater salt. This group was represented by seven species during the study: Northern Fulmar, Cory's Shearwater, Great Shearwater, Sooty Shearwater, Manx Shearwater, European Storm-petrel and Leach's Storm-petrel.

Northern Fulmar *Fulmarus glacialis* (Vulnerability: Moderate)

By far the most frequently encountered and widespread seabird species ($n=6,887$: ~49% of total) was the Northern Fulmar (Plate IX), which was a constant companion throughout the 4-month survey period. Although low concentrations (i.e. <1 bird/km) were recorded in most areas surveyed, relatively high concentrations (i.e. >5 birds/km) were periodically observed in association with fishing vessels (Figure 23). Moderate to high concentrations of Northern Fulmars were also noted in the vicinity of Rockall, along with congregations of other seabird species including the Manx Shearwater, Common Guillemots and Northern Gannets. Approximately 43% of Northern Fulmar records were considered to be either flying around or sitting on the water in association with the survey vessels, a considerably higher proportion than the 28% reported by Mackey *et al.* (2002). A further 21% of Northern Fulmar records were considered to be associated with fishing vessels, which is also higher than the 13.5% reported by Mackey *et al.* (2002).

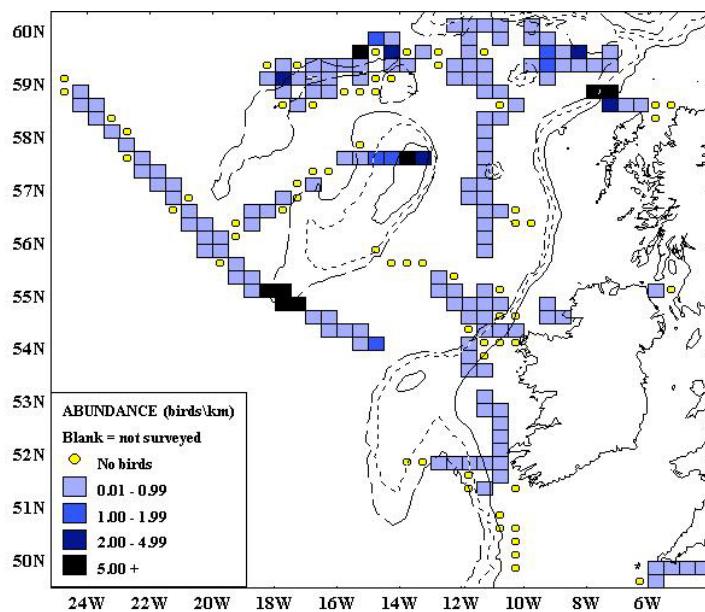


Figure 23. Northern Fulmar relative abundance, 13th April – 29th July 2002.



Plate IX. A Northern Fulmar flies over the unusually calm waters of the Hatton Bank. The Northern Fulmar was the most numerous seabird species encountered throughout the survey period.

Cory's Shearwater *Calonectris diomedea* (Vulnerability: U)

A single Cory's Shearwater was recorded flying in close association with the S.V. *Akademik Boris Petrov*'s stern on May 18th. This observation marks one of the most northwestern records of this Mediterranean-breeding species (Figure 24). The sighting coincided with a Northern Bottlenose Whale encounter west of the Hatton Bank. Stone *et al.* (1995) and Pollock *et al.* (2000) recorded Cory's Shearwater at similar latitudes very close to the Western Isles between July and October. The majority of the 21 Cory's Shearwater recorded by Mackey *et al.* (2002) over the course of their 27-month survey, were observed close to the Porcupine Bank and Goban Spur. This species might be expected to become more numerous in the Rockall-Hatton area if the effects of global warming become more widespread.

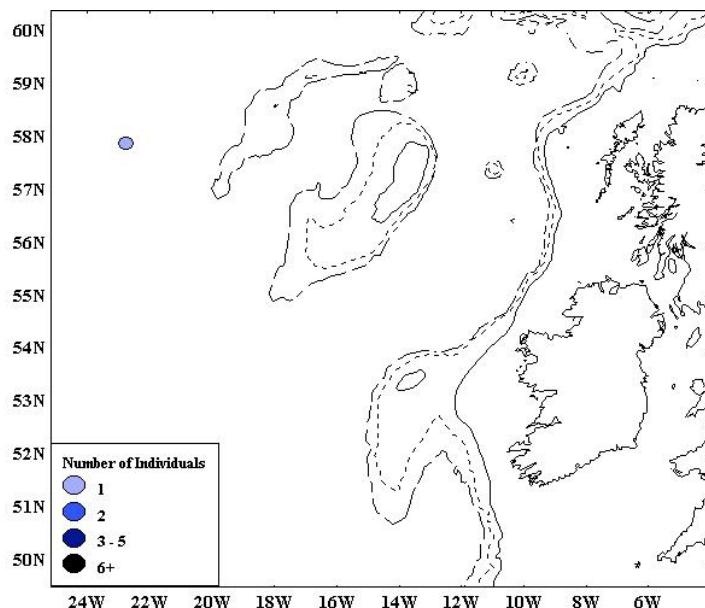


Figure 24. Sighting location of Cory's Shearwater, 18th May 2002.

Great Shearwater *Puffinus gravis* (Vulnerability: **U**)

Three Great Shearwaters were recorded during two encounters in June and July. Two birds were observed over the continental slope, northeast of the Porcupine Bank, while a single bird was noted flying in close proximity to the Blasket Islands in late July (Figure 25). This pelagic traveller usually does not appear over Irish waters in large numbers until August, where it persists until October during its return migration to its South Atlantic island breeding grounds (e.g. Tristan de Cunha) (Svensson & Grant, 1999). The majority of Great Shearwater sightings recorded by Mackey *et al.* (2002) and Pollock *et al.* (2000) were noted between August and October, although large numbers have been reported west of Ireland as late as November (Stone *et al.*, 1995). As such, the study period of the current survey preceded the seasonal movement of Great Shearwaters into Irish waters.

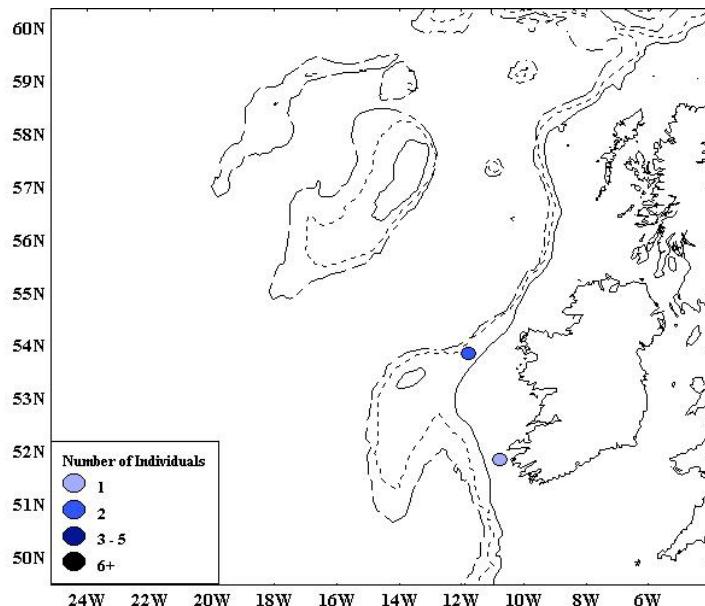


Figure 25. Great Shearwater sighting locations, 13th April – 29th July 2002.

Sooty Shearwater *Puffinus griseus* (Vulnerability: **High**)

Ten Sooty Shearwaters were recorded in nine encounters during their clockwise migration of the Atlantic Ocean. Individual sightings of eight birds were recorded over the Hatton Bank and the northern sector of the Rockall Trough between July 15th – 28th. This northwest distribution pattern was also observed by Stone *et al.* (1995) in July. A pair of Sooty Shearwaters was also noted northwest of Achill Island (County Mayo) on June 22nd (Figure 26). As is the case in the Great Shearwater, the study period of the current survey preceded the seasonal movement of Sooty Shearwaters into Irish waters. Mackey *et al.* (2002) recorded concentration peaks between August September, while Pollock *et al.* (2000) observed highest numbers between July and October.

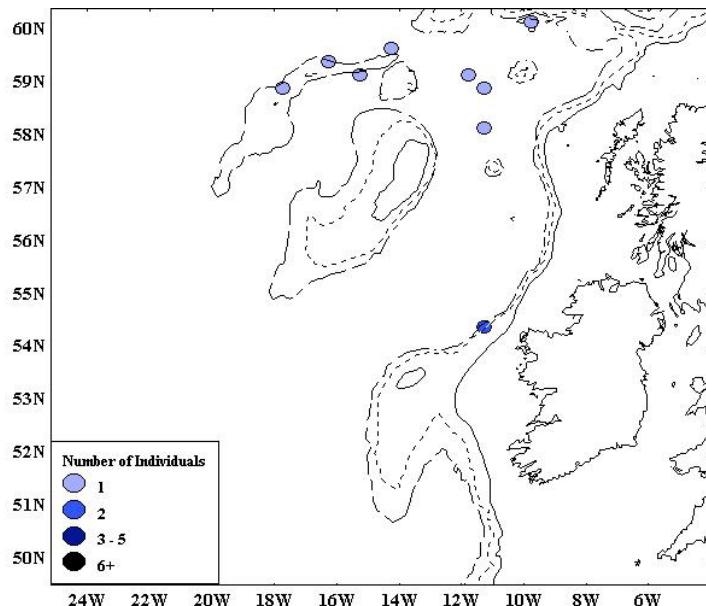


Figure 26. Sooty Shearwater sighting locations, 13th April – 29th July 2002.

Manx Shearwater *Puffinus puffinus* (Vulnerability: **Very high**, W, P)

A large proportion of the world's Manx Shearwater population breeds on islands off Irish, Scottish and Welsh coasts (Lloyd *et al.*, 1991). As such, the relative high number of this medium-sized petrel (compared to other shearwaters) was expected. The 634 "manxies" were distributed throughout the study throughout the 4-month study period (Figure 27). This widespread distribution pattern was also observed by Mackey *et al.* (2002) between April and September, however it contrasts with the coastal distribution reported by Stone *et al.* (1995) and Pollock *et al.* (1997) for the same period. Over 80% of the 330 Manx Shearwaters recorded during May were closely associated with the shallowest waters of the Rockall Bank, highlighting the importance of this offshore fishing ground to this pelagic species. Mackey *et al.* (2002) also reported relatively high offshore concentrations of Manx Shearwaters between April and June. It should be noted that the levels reported for the Rockall region during the current study are probably an underestimation, due to the diminishing light conditions experienced at the time of peak counts. Outside of the Rockall region, the Manx Shearwater was observed in low concentrations throughout the survey area.

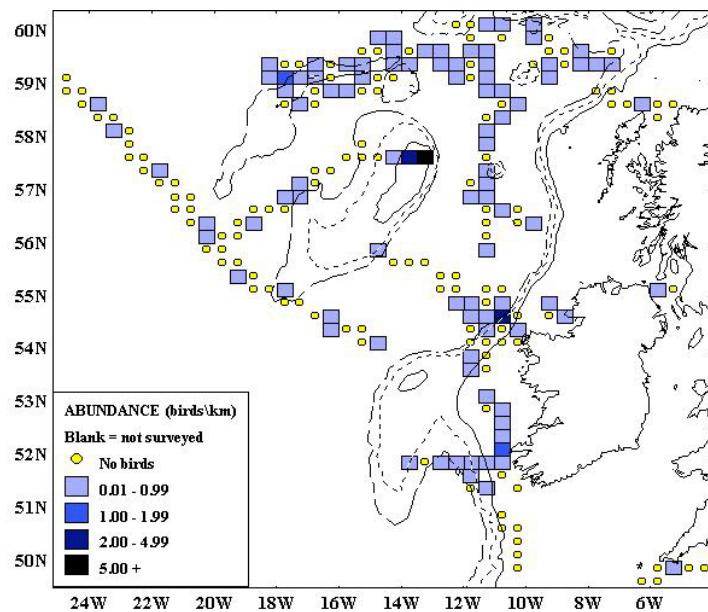


Figure 27. Manx shearwater relative abundance, 13th April – 29th July 2002.

Hydrobatidae - the Storm Petrels

The storm petrels are the smallest seabirds breeding in Ireland and Britain. Two of the three storm petrel species routinely observed in Irish waters were recorded during 2002: European Storm-petrel and Leach's Storm-petrel. Although the Wilson's Storm-petrel (*Oceanites oceanicus*) has been recorded in Irish waters between May and October (Mackey *et al.*, 2002; Irish Rare Birds Committee, 1998), it was not observed during the current study. It should be noted that storm petrels are very difficult to record in the field due to their small size, and abundances listed below are likely to be underestimated.

European Storm-petrel *Hydrobates pelagicus* (Vulnerability: Moderate)

Approximately 80% of the 59 European Storm-petrels recorded during the 4-month study period were recorded over the deep waters of the northern sector of the Rockall Trough, around the Rosemary Bank and Anton Dohrn Seamount, and close to the Blasket Island and Puffin Island (County Kerry) breeding colonies during July (Figure 28). Limited May European Storm-petrel records involved four birds observed during three encounters south of the Hatton Bank and along the Hatton-Rockall Basin. A further eight birds were observed over shelf waters to the west and the south of Ireland during the "Seisquest" survey (June-July). Mackey *et al.* (2002) also recorded the European Storm-petrel in both deep and shallow water habitats, with highest concentrations reported for July and August. In contrast, Stone *et al.* (1995) and Pollock *et al.* (1997) reported high coastal and shelf concentrations, southwest of Ireland, in July and August, while very few European Storm-petrels were recorded beyond the 200m isobath. Both Mackey *et al.* (2002) and Pollock *et al.* (1997) observed limited offshore sightings, west of the continental slope between April and June.

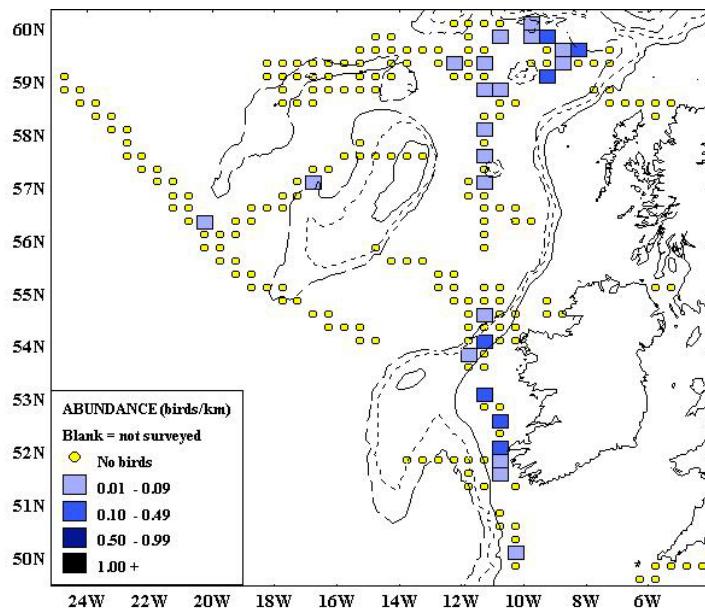


Figure 28. European Storm-petrel relative abundance, 13th April – 29th July 2002.

Leach's Storm-petrel *Oceanodroma leucorhoa* (Vulnerability: **Moderate**)

The relatively large Leach's Storm-petrel was observed to the western limits of the survey, over the Iceland Basin in May, over the northern sector of the Rockall Trough in July, and over the slope and shelf west of Ireland also during July (Figure 29). The apparent high relative abundances recorded over the Iceland Basin are due to the minimal survey effort achieved for this region. In reality, only three Leach's Storm-petrels were recorded west of 24°W. Pollock *et al.*'s (1997) and Mackey *et al.*'s (2002) suggestion that this local breeder displayed a preference for slope and deep water habitats was supported by the limited number of records from the current study.

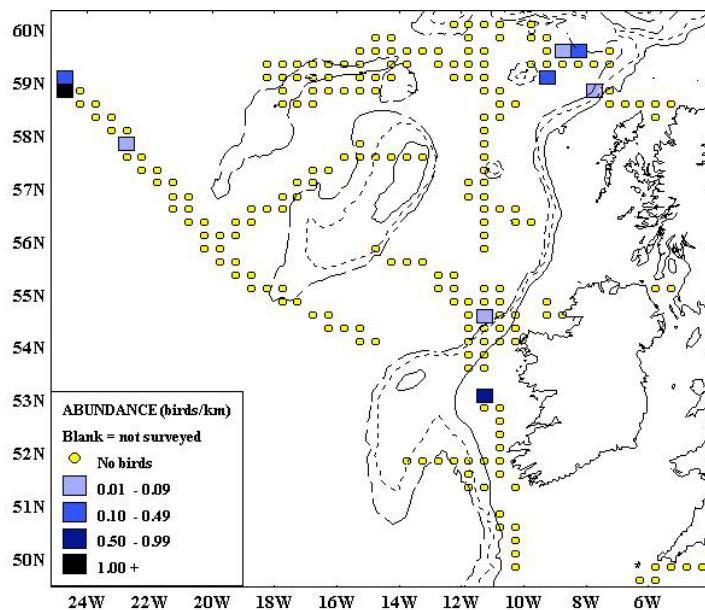


Figure 29. Leach's Storm-petrel relative abundance, 13th April – 29th July 2002.



Plate X. Juvenile **Northern Gannet** observed over the Porcupine Seabight with fishing line attached to beak.

Sulidae - the Northern Gannet

Northern Gannet *Morus bassanus* (Vulnerability: High, P)

The sole member of this group to be found west of Ireland is the Northern Gannet, the largest seabird species breeding in Ireland and Britain. This deep-diving species was the third most numerous seabird encountered during the study (n=1,901). Their distribution was widespread but highest densities were seen as the *James Clark Ross* steamed north of the huge gannetry at St Kilda in July (Figure 30). The majority of adult Northern Gannets were recorded within foraging range of their breeding colonies (St Kilda, Little Skellig, the Bull Rock). Over 23% of those birds where age-classes was identified were juveniles (Plate X), which were regularly recorded in low concentrations west of the Rockall Trough during May. During an extended multi-species encounter on May 28th, as the "Petrov" anchored within sight of Rockall, approximately 30 Northern Gannets were observed actively diving within 100m of the offshore landmark. Other species observed in relatively high offshore concentrations during the 6-hour encounter included Manx Shearwaters, Northern Fulmars, Black-legged Kittiwakes, Common Guillemots, together with Minke Whales and Harbour Porpoises.

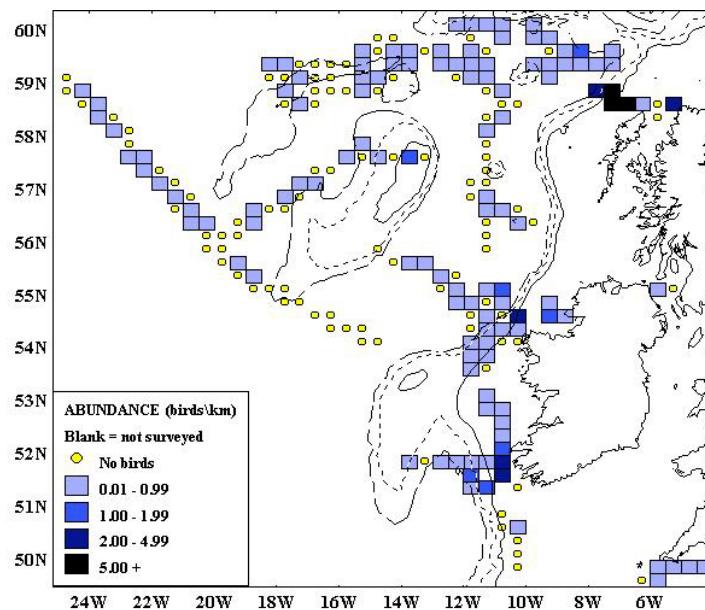


Figure 30. Northern Gannet relative abundance, 13th April – 29th July 2002.

Stercorariidae – the Skuas

The most interesting seabird observations made throughout the 2002 surveys involved the smaller members of the skua family. All four skua species that are routinely observed west of Ireland were recorded: the Pomarine Skua, Arctic Skua, Long-tailed Skua and Great Skua. Three of the four skua species were recorded in the greatest numbers seen during a single offshore survey west of Ireland. During the same survey (i.e. "Petrov" survey), an additional 81 skuas were recorded, but could not be identified to species level. The "Petrov" survey coincided with the May return migration of the smaller skuas from southern hemisphere wintering grounds to northern breeding colonies. The total numbers of small skuas (see Appendix B) recorded during this trip, makes the survey the most significant ever conducted in this region. Mackey *et al.* (2002) reported that 82% of all skua sightings throughout the Porcupine-Rockall-Hatton region involved the larger Great Skua (also known as the "bonxie"). In contrast, only 14.6% of all skua sightings during the current survey involved the "Bonxie", while Pomarine Skua sightings accounted for approximately 40% of all skua records. Also noteworthy was the relatively high frequency of Long-tailed Skuas encountered throughout the survey: the 275 Long-tailed Skuas recorded during this five-week study was over ten times greater than was recorded during the recent 27-month study of the Porcupine-Rockall-Hatton region (Mackey *et al.*, 2002). The Hatton-Rockall region is obviously an area of great importance during the spring migration period for the smaller skua species and for offshore movements of the Great Skua.

Approximately 90% of all Pomarine Skua observations involved the common light plumage morphs, while 67% of the observed Arctic Skuas possessed the darker plumage – the more common morph of this species. Dark and light morphs of both species were frequently recorded together. Only light morph Long-tailed Skuas were recorded. An additional 81 skuas were recorded, but were not identified to species level.

Over 77% of the smaller skua species (i.e. Pomarine, Arctic and Long-tailed Skuas) were recorded heading either north, northeast or northwest during their spring migration to the feeding/breeding grounds of the Arctic tundra, after wintering off southwest Africa or southeast South America (Furness, 1987). The actual heading of bonxies was difficult to determine due to their habit of associating with survey vessels for extended periods.



Plate XI. An adult **Pomarine Skua** scans the ocean surface ahead of the ship. The **Pomarine Skua** was the most numerous skua species encountered throughout 2002.

Pomarine Skua *Stercorarius pomarinus* (Vulnerability: U)

The Pomarine Skua was the most numerous and frequently encountered skua species throughout the 2002 study period. Mackey *et al.* (2002) reported that Pomarine Skuas accounted for less than 7% of all skua records. During the current study however, Pomarine Skuas were involved in approximately 36% of all skua sightings where identification was possible. Over 97% of Pomarine Skua sightings were recorded south of the Hatton-Rockall region (Figure 31) during a 4-week period in May (1st- 29th). The largest daily totals were recorded on May 14th and 15th, during which 83 individuals were observed close to the western extremes of the "Petrov" survey. The Pomarine Skua was the only small skua species to be recorded over the Rockall Trough in 2002. Low concentrations of this lemming-eating species were also observed over the Hatton-Rockall Basin and in close proximity to Rockall in May, north of the Hatton Bank/George Bligh Bank region and along the continental slope, west of County Mayo in July.

Only 15.5% of all Pomarine Skua sightings involved kleptoparasitic (i.e. piracy) attacks on Black-legged Kittiwakes, Lesser Black-backed Gulls and on other Pomarine Skuas. A further 13% were recorded approaching, scanning (Plate XI) or disturbing flocks of seated Black-legged Kittiwakes and Northern Fulmars. Juvenile kittiwakes were occasionally observed returning the aggression, by "chasing" individual Pomarine Skuas away from the flock. Pomarine Skuas and Great Skuas were also occasionally noted observing Arctic Skuas as they attacked Black-legged Kittiwakes, possibly with the intention of stealing the regurgitated offerings of the small gull species. Mixed-species attacks were occasionally observed, where "teams" of Pomarine Skuas together with either Long-tailed, Arctic or Great Skuas would gang-attack their victims. Pomarine Skuas were also observed during non-aggressive mixed-species encounters, as they rode a thermal in close association with Black-legged Kittiwakes and Lesser Black-backed Gulls.

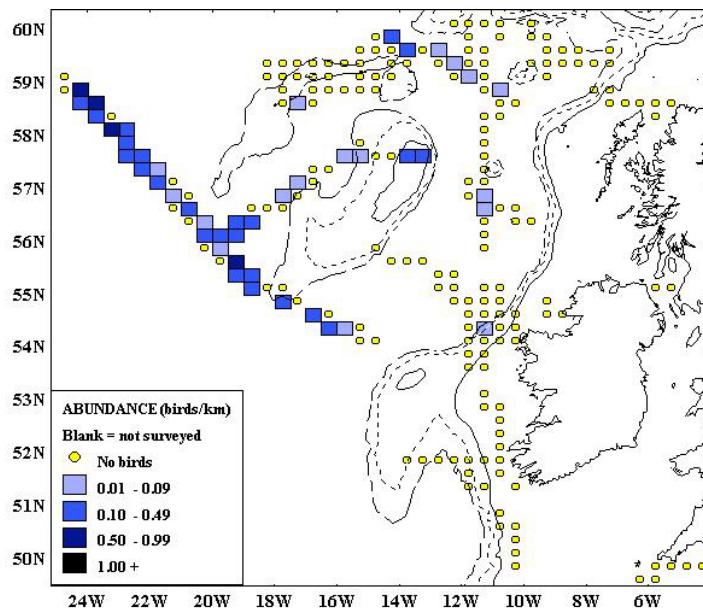


Figure 31. Pomarine Skua relative abundance, 13th April – 29th July 2002.

Arctic Skua *Stercorarius parasiticus* (Vulnerability: **Moderate**)

Approximately 94% of the 126 Arctic Skuas recorded in 2002 were observed during a 4-week period in May (2nd-29th). This period coincides with the return migration from South American and southwest African wintering grounds to Arctic breeding sites (Malling Olsen & Larsson, 1997), which accounts for the relatively high encounter rate (cf. Mackey *et al.*, 2002). The majority of Arctic Skua encounters occurred along the transect line between the southern sector of the Hatton-Rockall Basin and the Iceland Basin (Figure 32). The relative small group sizes (< four birds) are reflected in low concentrations, which never exceeded 0.5 birds/km. Unlike the Long-tailed Skua, the Arctic Skua was rarely observed along the Hatton-Rockall Basin. An additional 6 Arctic Skuas were recorded in July over the Hatton Bank and northwest of the Rosemary Bank.

Arctic Skuas displayed the greatest rate of kleptoparasitic (i.e. piracy) attacks throughout the survey, supporting the view that this "Parasitic" skua takes almost all its food at sea by stealing it from other birds (Malling Olsen & Larsson, 1997). Approximately 50% of sightings involved Arctic Skuas attacking, disturbing or approaching juvenile and adult Black-legged Kittiwakes, with varying degrees of success. Lesser Black-backed Gulls, Arctic Terns and Northern Fulmars were occasional targets of similar attacks. The common occurrence of Black-legged Kittiwakes within the Hatton-Rockall region during May is likely to be of great importance to the success of the Arctic Skua's offshore spring migration.

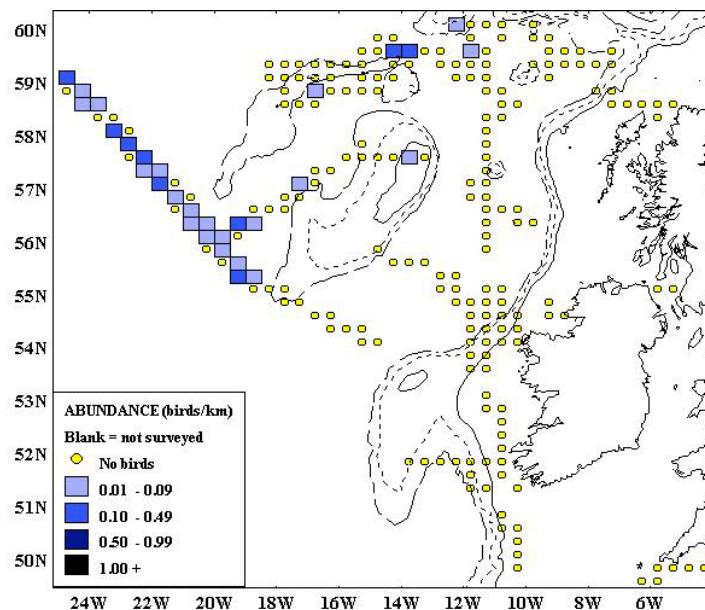


Figure 32. Arctic Skua relative abundance, 13th April – 29th July 2002.

Long-tailed Skua *Stercorarius longicaudus* (Vulnerability: **Moderate**)

The Long-tailed Skua was the second most numerous skua species recorded during the 4-month study period (Appendix B). Approximately 98% of the 281 Long-tailed Skuas recorded during 2002 were observed during a 3-week period in May (6th-27th), which coincided with the northern return migration. The "Petrov" records support the suggestion of Malling Olsen and Larsson (1997) that the spring passage in the North Atlantic peaks in a short period in the latter half of May. The 275 birds recorded during this period, contrasts with the 27 Long-tailed Skuas recorded in 27 months by Mackey *et al.* (2002). During the current study, over 100 Long-tailed Skuas were recorded during a single day (23rd May) over the Hatton-Rockall Basin, the largest single group comprising 17 birds.

Geographically, relatively moderate to high concentrations of the Long-tailed Skua were recorded through the Hatton-Rockall Basin (Figure 33). Lower abundances were noted southwest of the Rockall Bank and the Hatton Bank in May, and over the Hatton Bank in July. Long-tailed Skuas were not observed east of 16°W.

Over 84% of Long-tailed Skuas observed during May were recorded heading either north, northeast or northwest during their return (spring) migration to the feeding/breeding grounds of the Arctic tundra, after wintering off southwest Africa or southeast South America (Furness, 1987; Malling Olsen & Larsson, 1997). A further six Long-tailed Skuas were recorded in July, flying in various directions over the Hatton Bank (Figure 33).

Although kleptoparasitic attacks by the other three skua species was regularly observed, only three Long-tailed Skua were recorded involved in separate unsuccessful attacks on Black-legged Kittiwakes. The vast majority of these tiny skuas were not distracted by the ship's progress as they proceeded on with their spring passage.

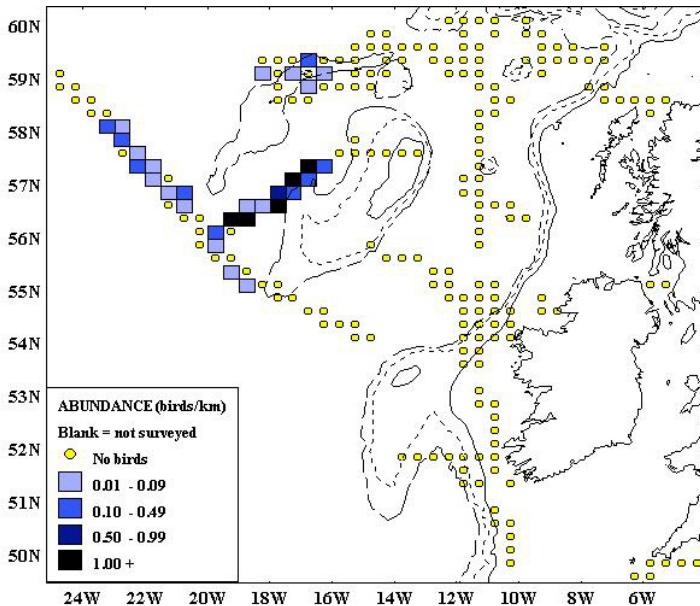


Figure 33. Long-tailed Skua relative abundance, 13th April – 29th July 2002.

Great Skua *Stercorarius skua* (Vulnerability: Moderate)

The Great Skua (Plate XII) was the only skua species recorded during all four surveys during 2002. The Great Skua was the most frequently encountered skua species during Mackey *et al.*'s (2002) 27-month survey, accounting for 82% of all skua-related records. However during the current study, the bonxie was involved in only 21% of all skua sightings. This relatively low representation was the result of the return migration of small species that was recorded during the 5-week May survey of the southern Hatton-Rockall region. The Great Skua was the most widespread skua, where it was recorded in low to moderate concentrations throughout the Porcupine-Rockall-Hatton region (Figure 34). Lowest encounter rates were experienced over the deep waters of the Rockall Trough. Although Mackey *et al.* (2002) rarely encountered Great Skuas west of the continental slope during summer months, the current study regularly recorded the large skua over the Hatton Bank/George Bligh Bank region and the northern sector of the Rockall Trough throughout July.

The proportion of Great Skuas involved in kleptoparasitic attacks (~18%) was slightly higher than that recorded for the Pomarine Skua, with a further 11% displaying some form of interest in typical victim species (i.e. Black-legged Kittiwakes, Lesser Black-backed Gulls). Mackey *et al.* (2002) reported that bonxies targeted Great Shearwaters and Northern Gannets during 90% of the observed kleptoparasitic attacks. Although Great Shearwaters were rarely recorded during 2002, the low concentrations of Northern Gannets were largely ignored by all kleptoparasitic species.

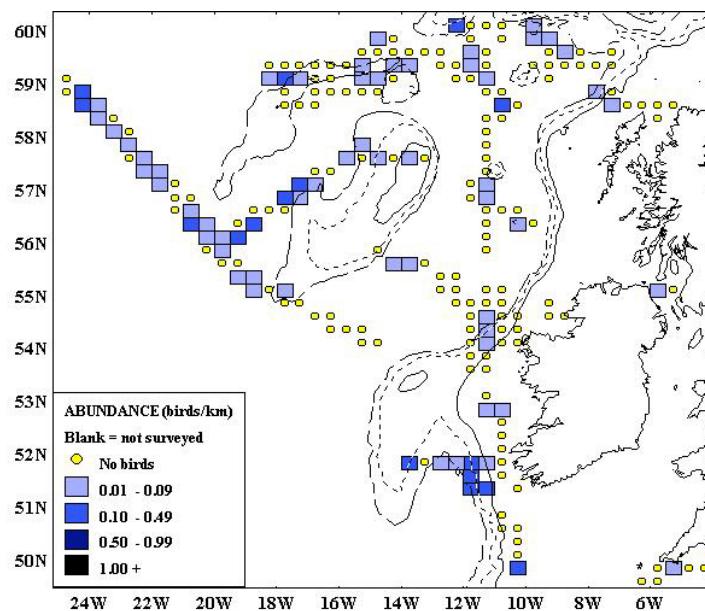


Figure 34. Great Skua relative abundance, 13th April – 29th July 2002.



Plate XII. An adult **Great Skua** examines a potential food morsel on the ocean's surface.



Plate XIII. Adult **Lesser Black-backed Gulls** (pictured) outnumbered juvenile birds by an approximate ratio of 3:1 during 2002.

Laridae – the Gulls

In terms of the number of species encountered per family, the larids displayed the greatest representation. Eight species of gull were recorded throughout the study period: Black-legged Kittiwake, Lesser Black-backed Gull, Great Black-backed Gull, Black-headed Gull, Yellow-legged Gull, Herring Gull, Iceland Gull and Sabine's Gull (Appendix C). However, the 3,017 gulls/kittiwakes recorded, represent only 21% of the total seabird count. Black-legged Kittiwake and Lesser Black-backed Gull numbers accounted for 99% of the total gull count, with the remaining six species contributing only 30 individuals.

Sabine's Gull *Larus sabini* (Vulnerability: U)

A single adult Sabine's Gull was recorded over the deep waters south of the Hatton Bank on May 24th (Figure 35). Mackey *et al.* (2002) recorded two Sabine's Gulls over the Hatton Bank during June. June records of this high Arctic breeder were also reported by Pollock *et al.* (1997), who also observed individuals south of the Hatton Bank.

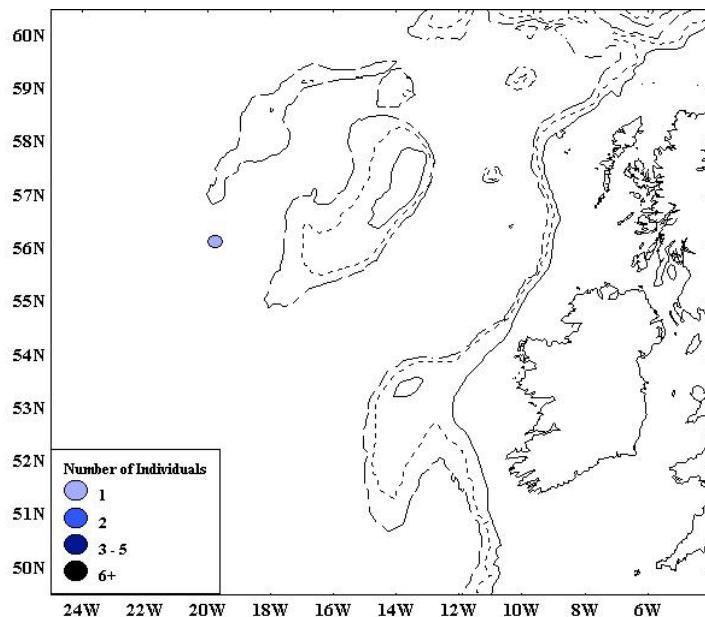


Figure 35. Sighting location of Sabine's Gull, 24th May 2002.

Lesser Black-backed Gull *Larus fuscus* (Vulnerability: Moderate, P)

Annual Report to the PSG, EEI and GSI– May 2003.

Approximately 16% of all gull sightings involved the migratory Lesser Black-backed Gull (Plate XIII). Where age class was determined, approximately 74% of Lesser Black-backed Gulls were identified as adults. This represents a higher proportion than was observed for the Black-legged Kittiwake (54%). Highest offshore concentrations were recorded west of the Hatton Bank in mid-May, and over the George Bligh Bank and Ymir Ridge in July (Figure 36). Similar concentrations were reported by Mackey *et al.* (2002) over the Hatton Bank between April and June. The regular sightings southwest and west of the Hatton-Rockall region in May is in contrast to the sparse records over the Hatton Bank and Rockall Trough during July. The moderate concentrations noted over the continental shelf, east of the Porcupine Seabight during April, were also observed by Pollock *et al.* (1997) between February and April. Close to 52% of all Lesser Black-backed Gull sightings were considered to be associated with the research vessel, which agrees with the findings of Mackey *et al.* (2002).

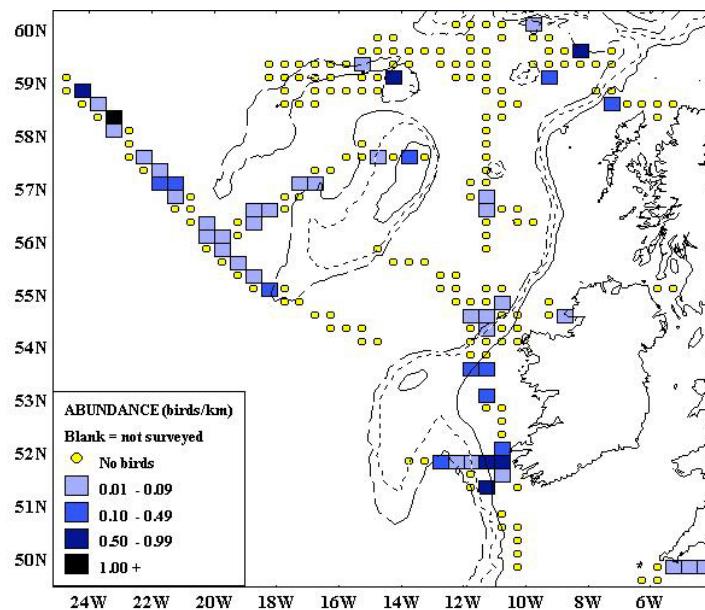


Figure 36. Lesser Black-backed Gull relative abundance, 13th April – 29th July 2002.

Herring Gull *Larus argentatus* (Vulnerability: **Moderate**, P)

Fourteen Herring Gulls were recorded between April and June close to coastal habitats along Counties Donegal and Antrim and south of the Cornish coast (Figure 37). Herring Gulls are coastal scavengers, whose numbers have decreased significantly since the late 1970s and early 1980s (Creme *et al.*, 1997). They were rarely recorded beyond the relatively shallow waters of the continental shelf, west of Ireland during the 27-month survey between July 1999 and September 2001 (Mackey *et al.*, 2002).

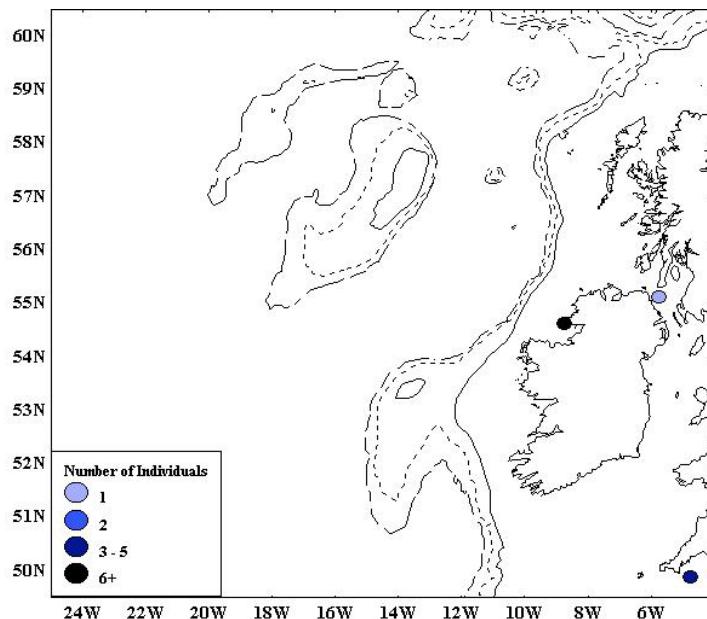


Figure 37. Herring Gull sighting locations, 13th April – 29th July 2002.

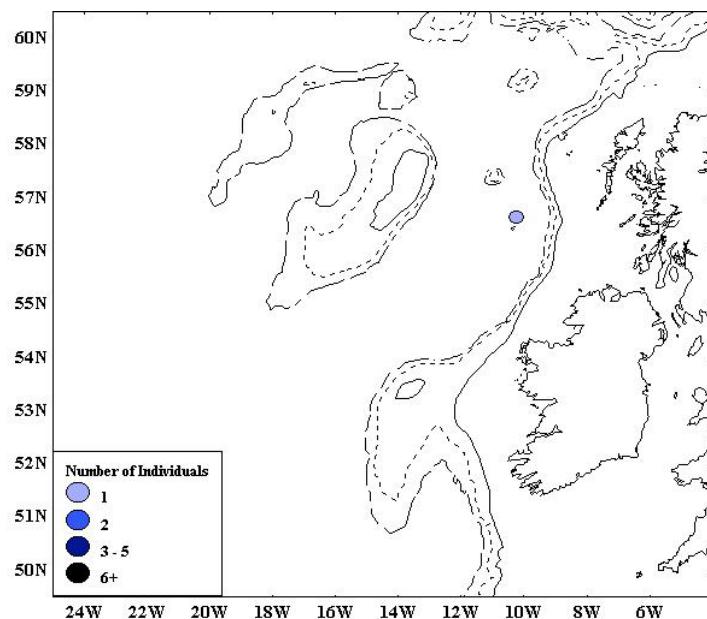


Figure 38. Sighting location of Iceland Gull, 29th May 2002.

Iceland Gull *Larus glaucopterus* (Vulnerability: **U**)

A single 2nd winter Iceland Gull was recorded over the deep waters of the Rockall Trough, north of the Hebrides Terrace Seamount on May 29th (Figure 38). Mackey *et al.* (2002) reported February sightings of Iceland Gulls over the north Rockall Trough and southeast of the Western Isles, Scotland.

Great Black-backed Gull *Larus marinus* (Vulnerability: **Moderate**, P)

Only nine Great Black-backed Gulls were recorded in coastal habitats or over the continental shelf (Figure 39). The most offshore sighting occurred over the slope of the northeast edge of the Porcupine Seabight during mid-April. Mackey *et al.* (2002) also noted that this large, aggressive gull was rarely encountered in the offshore waters west of Ireland during spring and summer months.

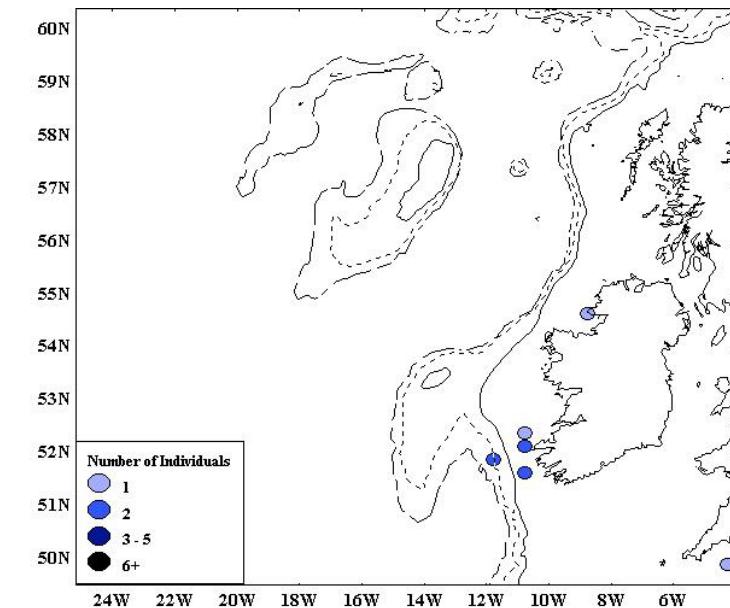


Figure 39. Great Black-backed Gull sighting locations, 13th April – 29th July 2002.



Plate XIV. Adult and juvenile **Black-legged Kittiwakes** were frequently encountered in relatively large feeding flocks during May.

Black-legged Kittiwake *Rissa tridactyla* (Vulnerability: **High**)

Approximately 83% of all larid sightings involved the Black-legged Kittiwake, which were recorded in low to high densities throughout the study area (Figure 40). This diminutive gull species was the second most numerous seabird species recorded ($n=2,514$), representing over 17% of the total count. Over 87% of all Black-legged Kittiwake sightings were recorded on the Petrov survey (30th April – 30th May), during which relatively large feeding groups (40-50 birds) of adults and juveniles (Plate XIV) were observed as far west as the Iceland Basin (Figure 40). This surface-feeding species was frequently observed during successful shallow-diving exercises. The prey items caught were just as frequently stolen during kleptoparasitic attacks by Arctic Skuas, and to a lesser extent by Pomarine and Great Skuas. Lesser Black-backed Gulls and juvenile kittiwakes were also observed as the aggressor of kleptoparasitic attacks. Approximately 40% of all Black-legged Kittiwake records were considered to have some association with the survey vessel, which can be significant when trying to determine population densities.

Of those offshore sightings where age-class was recorded, approximately 46% involved juveniles. This proportion peaked in May (56%) when most breeding seabirds are in close proximity to their colonies. Juvenile Black-legged Kittiwakes were commonly recorded giving acrobatic chase to some of those smaller terrestrial species (e.g. Wheatear) and migrant wader (e.g. Dunlin) species that ventured too far from the safety of the survey vessel.

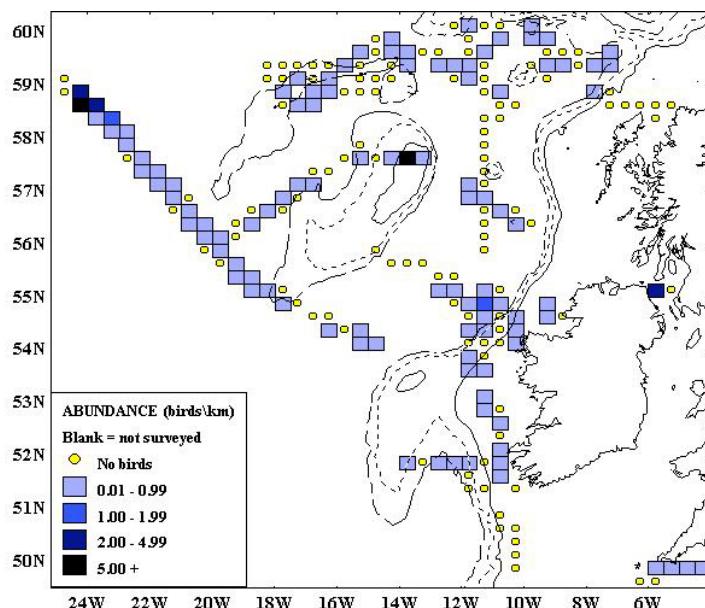


Figure 40. Black-legged Kittiwake relative abundance, 13th April – 29th July 2002.

Sterninae – the Terns

A total of 179 terns were recorded during the study, 97% of which involved the long-distance migrant the Arctic Tern (Appendix C). The only other tern species identified was the Common Tern (*Sterna hirundo*) during two separate encounters in May and July.

Arctic Tern *Sterna paradisaea* (Vulnerability: Moderate)

All Arctic Tern records were observed west of the continental slope, with the majority occurring over deepwater environments (i.e. >1000m) (Figure 41). Most Arctic Tern sightings involved individual sightings of relatively large numbers of birds (i.e. ~20-60 birds), giving rise to the apparent high concentrations highlighted in Figure 41. One group of 15-20 Arctic Terns was recorded riding high on a thermal vortex. Highest concentrations were recorded throughout the second half of May, including flocks southwest and west of the Hatton Bank, along the southwest edge of the Rockall Bank and a group of 20 adults heading northeast over the Rockall Trough. This long-distance migrant was not recorded between April 30th and May 11th as the "Petrov" crossed the southern sectors of the Rockall Trough, Rockall Bank and Hatton-Rockall Basin. A relatively large feeding group of 45-50 birds were simultaneously recorded heading north with a group of three Blue Whales over the deep waters of the Iceland Basin.

Northern-bound birds recorded in May, were likely to be observed during the return migration to their breeding grounds across northern Europe. Arctic Tern sightings during Mackey *et al.*'s (2002) 27-month study were restricted to the return migration period (May-June) and the outward migration to Antarctic wintering grounds during August and September.

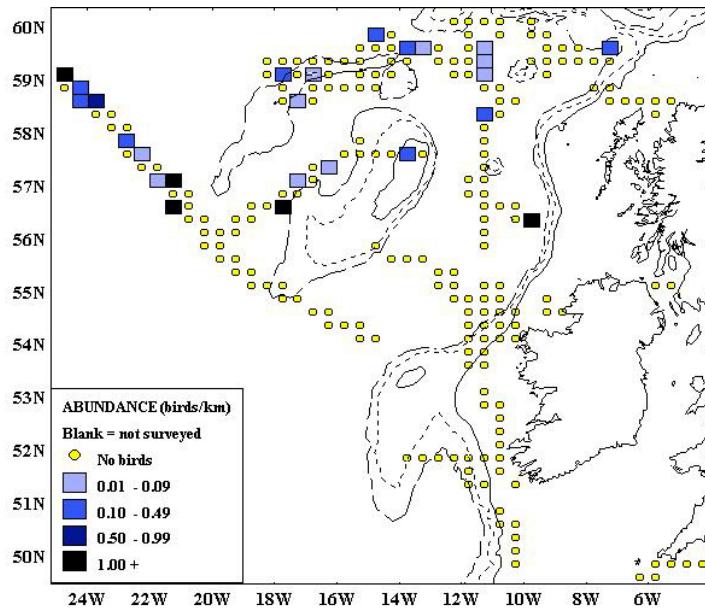


Figure 41. Arctic Tern relative abundance, 13th April – 29th July 2002.

Alcidae – the Auks

Four of the five alcid species commonly recorded in Irish waters were recorded during the 4-month study: Common Guillemot, Razorbill, Little Auk and Atlantic Puffin. The Black Guillemot (*Cephus grylle*), which inhabits coastal waters, was not observed during surveys in 2002. The auks are regarded as one of the most vulnerable seabird groups to hydrocarbon pollution due to the large amount of time they spend in contact with the ocean's surface (Webb *et al.*, 1995). It should be noted that, like the storm petrels, the alcids are very difficult to record in the field due to their small size, and the associated relative abundances are likely to be underestimated.

Common Guillemot *Uria aalge* (Vulnerability: Very high W, P)

Over 32% of all auk sightings involved the spasmodic records of the Common Guillemot (n=112 birds), 64% of which were recorded during May. Almost 67% of the Common Guillemots recorded during the Petrov trip were noted in close proximity to Rockall (Figure 42), highlighting once more the importance of this shallow offshore region to non-breeding seabirds during May. Interestingly, Mackey *et al.* (2002) only recorded Common Guillemots west of the shelf edge between April and June. In contrast, Common Guillemots were observed throughout July in low concentrations over the Hatton Bank, around the Rosemary Bank and over the deep water of the Rockall Trough, south of the Anton Dohrn Seamount and over the Hebrides Terrace Seamount (Figure 42). Stone *et al.* (1995) also reported low concentrations of Common Guillemots over the Rockall Bank between May and July.

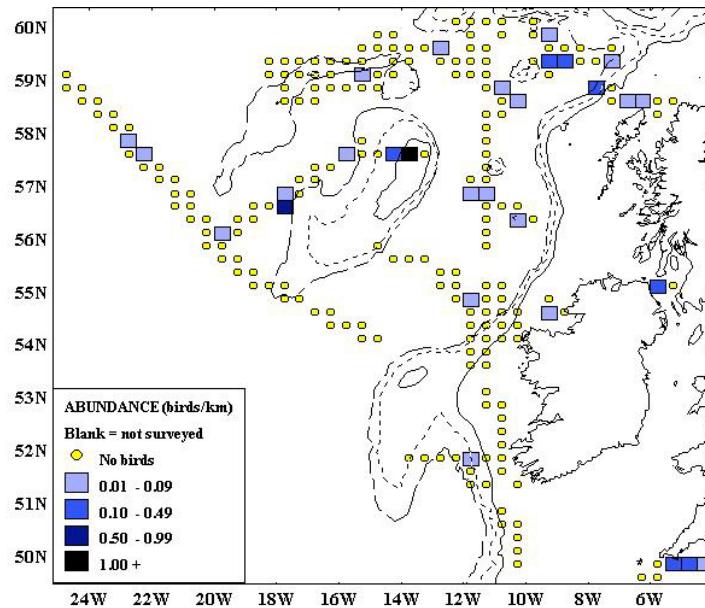


Figure 42. Common Guillemot relative abundance, 13th April – 29th July 2002.

Razorbill *Alca torda* (Vulnerability: Very high W, P)

All 37 Razorbills observed in the current study were recorded during the second half of May. Two of the Razorbill records were single birds observed in deep water environments: one over the Rockall Trough and the other over the Hatton-Rockall Basin. The remaining 35 Razorbills were made close to breeding grounds, near the Mull of Kintyre (Figure 43). The vast majority of Razorbills recorded by Mackey *et al.* (2002) were observed over the continental shelf. The only Razorbills recorded noted over deeper water during the 27-month study, were observed along the eastern edge of the Rockall Bank in April and June. Although Stone *et al.* (1995) reported Razorbill close to the Rockall Bank between April and June, a single bird was observed further west in the current study over the Hatton-Rockall Basin (Figure 43).

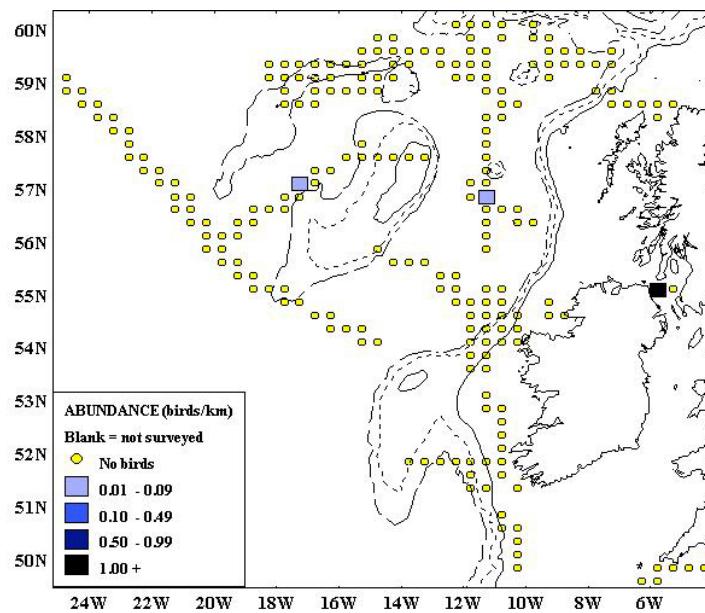


Figure 43. Razorbill relative abundance, 13th April – 29th July 2002.

A total of six Little Auks were recorded in May during five separate encounters on the ocean's surface south and southwest of the Hatton Bank (Figure 44). A single Little Auk had been previously recorded over the Hatton Bank in May by Mackey *et al.* (2002). Adult birds recorded so far south during May are likely to be non-breeding individuals, as breeding Little Auks would have migrated north to their breeding grounds in Greenland, Jan Mayen, Bear Island, Spitzbergen and Novaya Zemlya (Lockley, 1974).

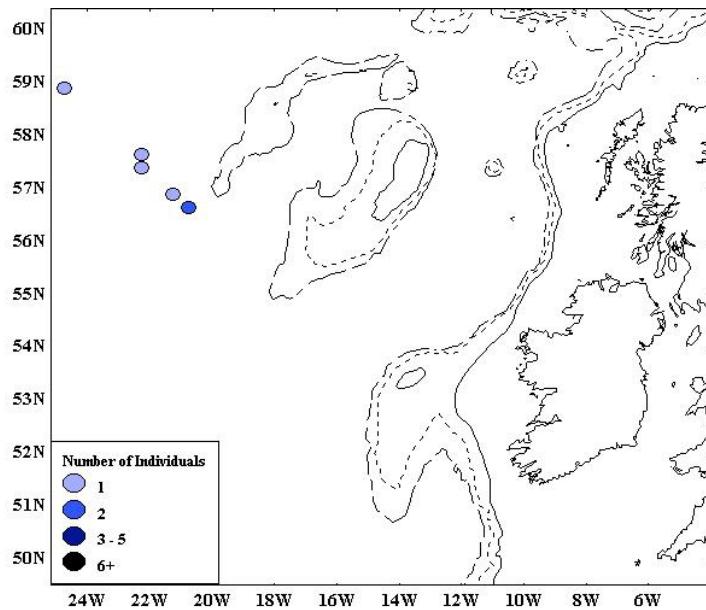


Figure 44. Little Auk sighting locations, May 2002.



Plate XV. The **Atlantic Puffin** was the most numerous and widespread auk recorded during the survey.
Atlantic Puffin *Fratercula arctica* (Vulnerability: **Very high** W, P)

Approximately 55% of all alcid sightings ($n=346$) involved the charismatic Atlantic Puffin (Plate XV), which is often regarded as the most pelagic of the auks (Pollock *et al.*, 1997; Pollock *et al.*, 2000). The Atlantic Puffin was recorded throughout the study area in concentrations that never exceeded one bird per kilometre (Figure 45). Spasmodic observations were recorded in May south and west of the Hatton Bank, along the Hatton-Rockall Trough and over the Rockall Bank. During July, the Atlantic Puffin was regularly encountered over the northern section of the Rockall Trough, around the Rosemary Bank. Occasional July records were also noted over the Hatton Bank and over the central region of the Rockall Trough, south of the Anton Dohrn Seamount. The springtime pattern of relatively low offshore Atlantic Puffin concentrations over a wide area was also noted by Mackey *et al.* (2002). The concentrations observed in July near the breeding colonies of the Western Isles, were recorded by Mackey *et al.* (2002), Pollock *et al.* (2000) and Stone *et al.* (1995) in higher numbers during the chick-rearing period of June and July. Most Atlantic Puffin sightings comprised one or two birds although groups of up to seven birds were observed.

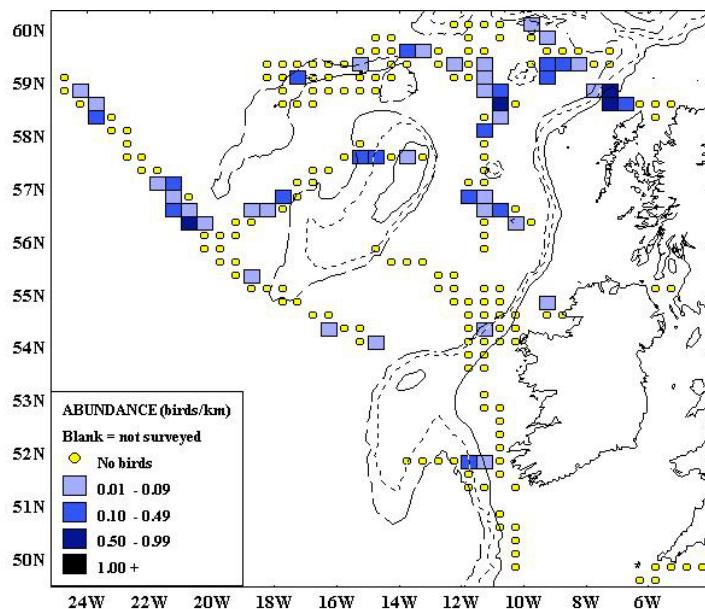


Figure 45. Atlantic Puffin relative abundance, 13th April – 29th July 2002.

INSHORE & COASTAL BIRDS

The inshore and coastal birds included 13 Great Northern Divers, six wader species, ten Great Cormorants and a pair of European Shags (Appendix D).

Great Northern Diver *Gavia immer* (Vulnerability: Very high, W)

The Great Northern Diver was recorded on ten separate occasions during May, either singularly or in pairs. Eighty percent of flying Great Northern Divers were recorded heading in a westerly direction towards their summer breeding grounds of Canada or Greenland. A further two birds were observed heading north towards Iceland. All adult divers were recorded in their summer plumage. A single juvenile Great Northern Diver was recorded sitting on the water in close association with an adult diver. It was interesting to observe that Great Northern Divers were recorded along the length of the Hatton-Rockall Basin (Figure 46), once more highlighting the importance of this region to migratory birds. The two offshore encounters of Great Northern Divers, west of Ireland (Rockall Trough and southwest Hatton Bank), reported by Mackey *et al.* (2002), were also recorded during May.

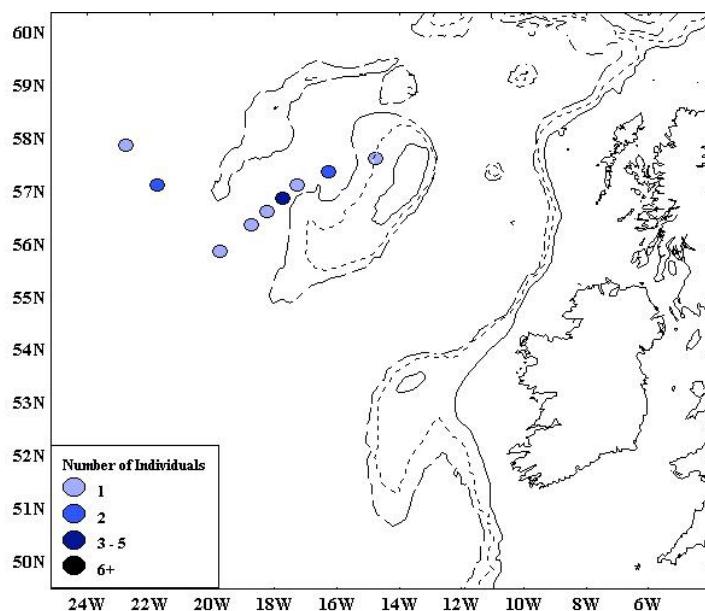


Figure 46. Great Northern Diver sighting locations, May 2002.

Waders

Six wader species ($n=45$) were recorded offshore during their annual migrations between breeding and wintering grounds: Eurasian Oystercatcher, Ringed Plover, Dunlin, Whimbrel, Redshank and Ruddy Turnstone. Many of the waders, including Whimbrel, Dunlin, Redshank and Ruddy Turnstone remained perched on the survey vessel for days at a time, before continuing with their migration. Eleven May and 17 July Whimbrel records were responsible for approximately 62% of all wader sightings.

Great Cormorant *Phalacrocorax carbo* (Vulnerability: Very high W, P)

Ten Great Cormorants were recorded on April 13th off the Cornish coast (Figure 47). As their plumage lacks water repellent properties, this resident species is generally confined to coastal waters, estuaries and freshwater lakes and reservoirs (Lloyd *et al.*, 1991).

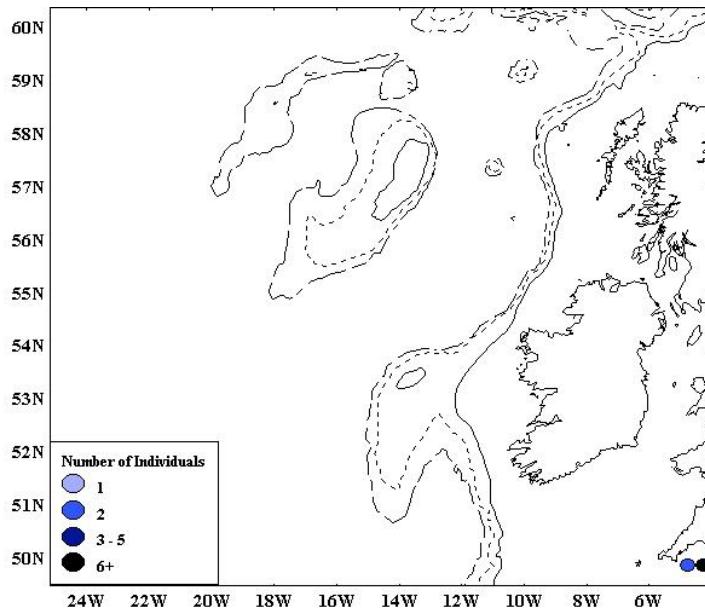


Figure 47. Great Cormorant sighting locations, 13th April 2002.

European Shag *Phalacrocorax aristotelis* (Vulnerability: Very high W, P)

A pair of European Shags was recorded west of the Blasket Islands on July 29th (Figure 48). This resident species is generally restricted to coastal and estuarine habitats (Lloyd *et al.*, 1991).

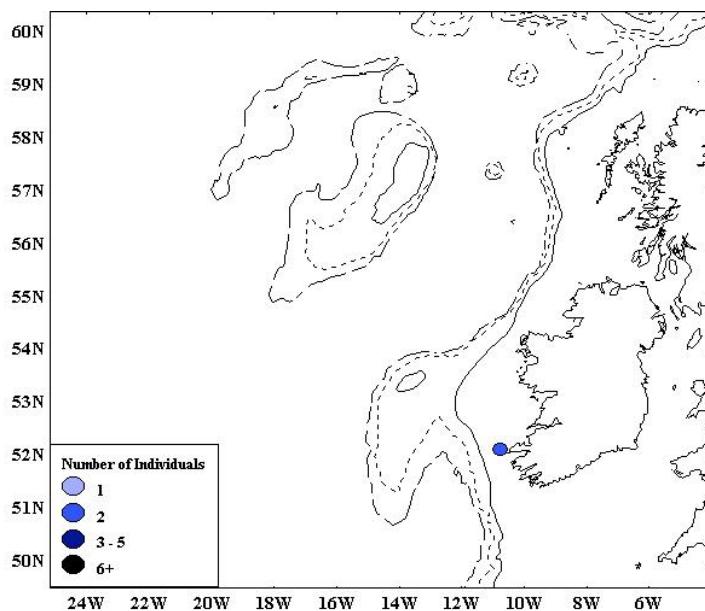


Figure 48. European Shag sighting location, 29th July 2002.

TERRESTRIAL VAGRANTS

The terrestrial vagrant group included six species of moderate to small passerine species: Rock Dove (*Columba livia*), Swift (*Apus apus*), Barn Swallow (*Hirundo rustica*), House Martin (*Delichon urbica*), Pied Wagtail (*Motacilla alba*) and Wheatear (*Oenanthe isabellina*) (Plate XVI). The 13 individuals recorded from this group (Appendix E) were probably blown off-course by strong easterly winds during overland migrations.



Plate XVI. An adult Wheatear finds shelter amongst rope on the foredeck of the S.V. *Akademik Boris Petrov*, May 2002.

4. MISCELLANEOUS SPECIES

Sunfish *Mola mola*

A single sunfish (Plate XVII) was recorded on 22nd July along the northwest edge of the Hatton Bank (~58° 59'N, 16° 24'W: Figure 49). The sighting of the 2m (diameter) fish is the most northern record of this typically temperate species recorded by the Irish *Cetaceans and Seabirds Team*. The most northerly sunfish recorded during the recent 27-month study was at 58° 35'N, 17° 20'W during mid-June 2000 (M. Mackey, CMRC, 2003, *pers. comm.*).

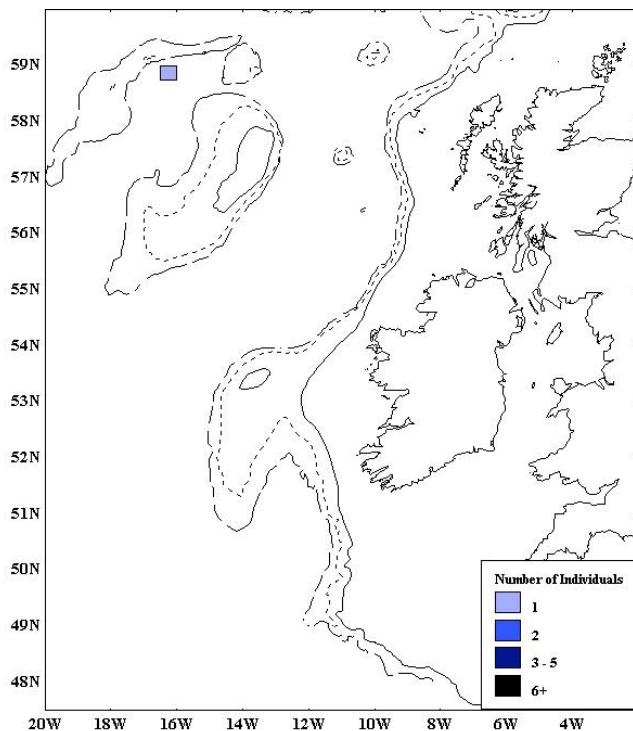


Figure 49. Sunfish sighting location, 22nd July 2002.



Plate XVII. A Sunfish attracts the attention of a Northern Fulmar.

CONCLUSION

A total of 821 individual cetaceans of 15 species were recorded during the 4-month survey. Four species of mysticetes (baleen whales; n=49 animals) and 11 odontocete (toothed whale; n=597 animals) species were identified. A further 175 animals could not be identified to species level, the majority (~71%) of which were unidentified dolphins.

The most numerous and frequently encountered cetacean species throughout the survey was the Long-finned Pilot Whale (n=449 animals), which was the only species displaying any obvious reaction to seismic operations. Most cetacean sightings occurred in waters deeper than 1000m, however interesting records of relatively high numbers of Minke Whales in the relatively shallow waters (<200m) surrounding Rockall, and the sighting of Harbour Porpoise in the same region are noteworthy. These sightings suggest that the Rockall Bank, part of which is included in Ireland's Exclusive Economic Zone, may represent an important offshore habitat for both the Minke Whale and Harbour Porpoise. Further cetacean surveying in this region is recommended to ascertain seasonal trends in distribution. The sightings of Sowerby's Beaked Whales, Northern Bottlenose Whales and Blue Whales in the Hatton-Rockall region in May is noteworthy, as was the relatively low number of Short-beaked Common Dolphins encountered throughout the study period.

No cetaceans were observed during the visual pre-soft start scans, carried out as part of the MMO duties. Although the use of hydrophones was met with limited success during the current survey, acoustic monitoring of cetaceans during seismic operations in conjunction with visual checks is highly recommended, as it may increase detection success. There is a serious lack of information on the acoustic properties of many of the less well-known species, in particular the beaked whales, and surveys such as those carried out as part of the National Seabed Mapping Program provide excellent opportunities to address this data gap. Five cetacean species were sighted during seismic activity; however, the level of disturbance caused by seismic activity was difficult to assess. While some species appeared to keep a cautious distance from seismically active vessels (i.e. Atlantic White-sided Dolphin and Short-beaked Common Dolphin), other species appeared indifferent (i.e. Fin Whale and Sperm Whale), while the Long-finned Pilot Whale would, on occasion, display genuine interest in the acoustic operations. Considering documented evidence of the negative impacts of seismic activity on cetaceans (Ketten *et al.*, 1993), it is recommended that strict adherence to the JNCC guidelines for minimising acoustic disturbance on cetaceans (JNCC, 1998; JNCC, 2002) continue to be maintained.

The distribution of the 28 seabird species (n=14,116 birds) recorded during the current study was generally widespread in low concentrations. The four most frequently encountered seabird species reported by Mackey *et al.* (2002) (i.e. Northern Fulmar, Northern Gannet, Black-legged Kittiwake and Manx Shearwater), were also reported in relatively large numbers during 2002. The relatively large concentrations of migrating small skua species (i.e. Pomarine, Arctic and Long-tailed Skuas) recorded south of the Hatton Bank and along the Hatton-Rockall Basin, together with the unusually high number of offshore Great Northern Diver sightings along the Hatton-Rockall Basin, highlights the importance of these regions to migratory seabird species during their spring migration. However, the current study period was too early to record other migratory species, such as Great Shearwater, Sooty Shearwater and European Storm-petrel, in the concentrations reported by Mackey *et al.* (2002). The relatively high numbers of non-breeding resident species such as Manx Shearwater, Common Guillemot, Northern Fulmar and Northern Gannet around Rockall, highlighted the importance of this relatively shallow offshore region for non-breeding and juvenile seabirds during May.

In many ways the results of the 2002 surveys reflected the findings of the original 27-month study, in that frequently recorded species such as Northern Fulmar, Northern Gannet and Long-finned Pilot Whale were once again dominant. However, the patchy nature of spatial and temporal distribution patterns was highlighted by the chance encounters with migratory movements and previously unrecorded offshore concentrations of both seabirds and cetaceans. This patchiness also highlights the need to maintain an offshore survey program, to ensure that rarely observed phenomena, such as the timing, location and nature of migrational movements, are recorded and reported. Considering the relatively recent move towards the establishment of marine Special Areas of Conservation, designated under the EU Habitats Directive on the Conservation of Natural Habitats and of Fauna and Flora (1992), any such information on the distribution and abundance of cetacean and seabird populations in Irish territorial waters will prove valuable and may have important management implications.

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Go raibh mile maith agaibh go léir.

PHOTOGRAPHIC CREDITS

Apart from Plate III, all photographic images used in this report are © Mick Mackey, 2003. Plate III is © Michelle Cronin, 2003.

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Appendix A: Offshore survey programme, 13th April – 29th July 2002.

Survey Dates	Vessel Name	Vessel Activity	Main Location
13 th April - 20 th April	S.V. <i>Akademik Boris Petrov</i>	Seismic	Off SW Ireland
30 th April - 30 th May	S.V. <i>Akademik Boris Petrov</i>	Seismic	South Hatton/Rockall
6 th June - 19 th July	S.V. <i>Seisquest</i>	Seismic	Off NW Ireland
12 th July - 29 th July	R.R.S. <i>James Clark Ross</i>	Seismic	North Hatton/Rockall

Appendix B: Cetacean species recorded during all surveys, 13th April – 29th July 2002.

Common Name	Latin Name	Total
Baleen Whales		
Fin Whale	<i>Balaenoptera physalus</i>	25
Minke Whale	<i>Balaenoptera acutorostrata</i>	20
Blue Whale	<i>Balaenoptera musculus</i>	3
Sei Whale	<i>Balaenoptera borealis</i>	1
Toothed Whales & Dolphins		

Sperm Whale	<i>Physeter macrocephalus</i>	20
Northern Bottlenose Whale	<i>Hyperoodon ampullatus</i>	2
Sowerby's Beaked Whale	<i>Mesoplodon bidens</i>	8
Long-finned Pilot Whale	<i>Globicephala melas</i>	449
False Killer Whale	<i>Pseudorca crassidens</i>	2
Risso's Dolphin	<i>Grampus griseus</i>	5
Harbour Porpoise	<i>Phocoena phocoena</i>	5
Bottlenose Dolphin	<i>Tursiops truncatus</i>	30
White-beaked Dolphin	<i>Lagenorhynchus albirostris</i>	3
Atlantic White-sided Dolphin	<i>Lagenorhynchus acutus</i>	18
Common Dolphin	<i>Delphinus delphis</i>	55
Unidentified Cetacea		
Cetacean sp.		19
Whale sp.		10
Large Whale sp.		5
Blue/Fin/Sei Whale	<i>Balaenoptera</i> sp.	6
Medium Whale sp.		1
Beaked Whale sp.		1
Pilot/False Killer Whale		7
Common/Striped Dolphin		2
Dolphin sp.		124
TOTAL		821

**Appendix C: Seabird species recorded during all surveys,
13th April – 29th July 2002.**

Common Name	Latin Name	Total
Northern Fulmar	<i>Fulmarus glacialis</i>	6,887
Cory's Shearwater	<i>Calonectris diomedea</i>	1
Great Shearwater	<i>Puffinus gravis</i>	3
Sooty Shearwater	<i>Puffinus griseus</i>	10
Manx Shearwater	<i>Puffinus puffinus</i>	634
European Storm-petrel	<i>Hydrobates pelagicus</i>	59
Leach's Storm-petrel	<i>Oceanodroma leucorhoa</i>	23
Northern Gannet	<i>Morus bassanus</i>	1,901
Pomarine Skua	<i>Stercorarius pomarinus</i>	350
Arctic Skua	<i>Stercorarius parasiticus</i>	126
Long-tailed Skua	<i>Stercorarius longicaudus</i>	281
Great Skua	<i>Stercorarius skua</i>	204
Unidentified Skua	<i>Stercorarius</i> spp.	21
Unidentified Small Skua	<i>Stercorarius</i> spp.	60
Sabine's Gull	<i>Larus sabini</i>	1
Black-headed Gull	<i>Larus ridibundus</i>	3
Lesser Black-backed Gull	<i>Larus focus</i>	473
Herring Gull	<i>Larus argentatus</i>	14
Yellow-legged Gull	<i>Larus argentatus cachinnans</i>	2
Iceland Gull	<i>Larus glaucopterus</i>	1

Great Black-backed Gull	<i>Larus marinus</i>	9
Black-legged Kittiwake	<i>Rissa tridactyla</i>	2,514
Common Tern	<i>Sterna hirundo</i>	2
Arctic Tern	<i>Sterna paradisaea</i>	191
Common Guillemot	<i>Uria aalge</i>	112
Razorbill	<i>Alca torda</i>	37
Little Auk	<i>Alle alle</i>	6
Atlantic Puffin	<i>Fratercula arctica</i>	191

Appendix D: Coastal/inshore species recorded during all surveys, 13th April – 29th July 2002.

Common Name	Latin Name	Total
Great Northern Diver	<i>Gavia immer</i>	13
Great Cormorant	<i>Phalacrocorax carbo</i>	10
European Shag	<i>Phalacrocorax aristotelis</i>	2
Eurasian Oystercatcher	<i>Haemtopus ostralegus</i>	4
Ringed Plover	<i>Charadrius hiaticula</i>	1
Dunlin	<i>Calidris alpina</i>	7
Whimbrel	<i>Numenius phaeopus</i>	28
Redshank	<i>Tringa totanus</i>	2
Ruddy Turnstone	<i>Arenaria interpres</i>	3

Appendix E: Terrestrial bird species recorded during all surveys, 13th April – 29th July 2002.

Common Name	Latin Name	Total
Rock Dove	<i>Columba livia</i>	2
Swift	<i>Apus apus</i>	2

Barn Swallow	<i>Hirundo rustica</i>	3
House Martin	<i>Delichon urbica</i>	1
Pied Wagtail	<i>Motacilla alba</i>	1
Wheatear	<i>Oenanthe isabellina</i>	4