ISCOPE II

**Work Package 3**

# Ship Surveys and Ferry Surveys

*Common Dolphin (© Dave Wall)*

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**ISCOPE II**
**Ship Surveys Project**
**Irish Whale and Dolphin Group**

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government
Marine Institute
NIEA Northern Ireland Environment Agency
An Chomhairle Oidhreachta
The Heritage Council

## Introduction

The waters of Ireland's Exclusive Economic Zone (EEZ) are thought to represent one of the most important cetacean (whales, dolphins and porpoise) habitats in Europe. To date 24 species of cetacean have been recorded, with seven of these having been confirmed as calving within the Irish EEZ, while a number of other species are possibly calving (e.g. minke whale and northern bottlenose whale) (Berrow, 2001). In recognition of their importance for cetaceans, the Irish government declared all Irish waters (within the EEZ) to be a whale and dolphin sanctuary in 1991 (Rogan and Berrow, 1995). Despite this recognition, information on the distribution and relative abundance of cetaceans within the Irish EEZ, especially in offshore waters, is very limited (Wall *et al.* 2006).

The Irish Whale and Dolphin Group (IWDG) have been collecting data on the distribution and relative abundance of cetaceans in Irish waters (including Northern Ireland) since 1991. The IWDG casual and constant effort sightings schemes record data mainly from land-based sightings and surveys (Berrow et al. 2001). The Group has conducted cetacean surveys on board commercial ferries since 2001, on board the Irish Marine Institute offshore research vessel Celtic Explorer since 2003 and on foreign research vessels commencing in 2007.

In 2003, the IWDG initiated the Irish Scheme for Cetacean Observation and Public Education (ISCOPE), which aimed to promote better awareness and knowledge of cetaceans (whales, dolphins and porpoises) in Irish waters, by encouraging public participation in cetacean recording. Under ISCOPE II, which commenced in 2006, the IWDG committed to filling in data gaps that exist in our knowledge of the seasonal distribution and abundance of cetaceans in offshore habitats.

As part of this project commitment the IWDG conducted cetacean distribution and relative abundance surveys on board commercial ferries and research vessels operating within the Irish EEZ. From October 2003 – September 2009 surveys were conducted on board Irish and foreign research vessels as part of ISCOPE, ISCOPE II, the 2004, Heritage Council funded, *West Coast Cetacean Survey* and a number of IWDG funded surveys on ships of opportunity. In addition continuing surveys under the IWDG Ferry Surveys Programme (started in 2001) were brought under the ISCOPE II banner.

# 1. Methods

## *1.1. Survey Platforms*

A wide variety of survey platforms were utilised during these surveys (figure 1). In all 14 vessels, from four countries, operated by seven agencies/companies, were used as survey vessels. These vessels offered a variety of cruising speeds and platform heights, these are summarised in table 1.

**Table 1.** Names, operating agencies, nation states, average cruising speed and platform location and heights of vessels utilised as platforms of opportunity during these surveys.

| Vessel Name | Operator/Agency | Country | Average Cruising Speed (knots) | Platform(s) | Platform Height (meters) |
|---|---|---|---|---|---|
| ***Celtic Explorer*** | Marine Institute | IRL | 8-10 | Crow's Nest | 17 |
| ***Pelagia*** | NIOZ | NL | 10 | Monkey Island / Bridge | 10 / 8 |
| ***CEFAS Endeavour*** | CEFAS | UK | 10 | Monkey Island / Bridge | 14 / 10 |
| ***Corystes*** | AFBI | UK | 10 | Bridge | 8 |
| ***Thalassa*** | IFREMER | FR | 10 | Bridge | 10 |
| ***Celtic Voyager*** | Marine Institute | IRL | 8 | Bridge | 8 |
| ***Tridens*** | IMARES | NL | 10 | Bridge | 8 |
| ***Normandy*** | Irish Ferries | IRL | 17.5 | Bridge | 26 |
| ***European Highlander*** | P&O Ferries | UK | 18-20 | Bridge | 25 |
| ***European Causeway*** | P&O Ferries | UK | 18-20 | Bridge | 25 |
| ***Ulysses*** | Irish Ferries | IRL | 18-20 | Bridge | 30 |
| ***Isle of Inishmore*** | Irish Ferries | IRL | 18-20 | Bridge | 30 |
| ***European Ambassador*** | P&O Ferries | UK | 20-24 | Bridge | 25 |
| ***European Diplomat*** | P&O Ferries | UK | 16 | Bridge | 15 |

**Figure 1.** Some of the 14 commercial ferries and research vessels used as platforms during the surveys.

### *1.2. Ferry Surveys*

Teams of between one and three surveyors conducted observer effort from the bridge of the vessel. Height of the observation platform differed between ships (table 1). Observer effort focused on a 90° arc ahead of the ship, however sightings located up to 90° to port and starboard were included. The observer scanned the area by eye and using binoculars (typically 10 x 40 or 8 x 50).

Bearings to sightings were measured using the ships gyrocompass and distances were estimated with the aid of a distance measuring stick. Environmental data were recorded every 15-20 minutes using Logger 2000 software (IFAW 2000) or paper forms. Sightings were also recorded using Logger 2000 or paper forms. Automated position data were obtained through a laptop computer linked to GPS receiver or from ships instruments.

The survey vessels travelled at an average speed 16-24 knots when on passage and clear of navigation channels. The vessels conducted almost identical transects from month to month, diverging from these routes only due to severe tides, severe weather conditions or when manoeuvring to avoid other ship or boat traffic.

Survey effort was conducted in all sea states and in all visibility conditions. Sightings were identified to species level where possible, with species identifications being graded as definite, probable or possible. Where species identification could not be confirmed, sightings were downgraded (e.g. unidentified dolphin / unidentified whale / unidentified beaked whale etc.) according to criteria established for the IWDG's cetacean sightings database (IWDG 2009).

### *1.3. Ship Surveys*

A single marine mammal observer conducted watches from the bridge, bridge wing, 'Monkey Island' or 'Crow's Nest' of the survey vessel. Height of the observation platform differed between ships (table 1). Observer effort focused on a 90° arc ahead of the ship; however sightings located up to 90° to port and starboard were also included. The observer scanned the area by eye and using binoculars (typically 10 x 40 or 8 x 50).

Bearings to sightings were measured using an angle board and distances were estimated with the aid of a distance measuring stick. Environmental data were recorded every 15-20 minutes using Logger 2000 software (IFAW 2000) or paper forms. Sightings were also recorded using Logger 2000 or paper forms. Automated position data were obtained through a laptop computer linked to GPS receiver or from ships instruments.

The survey vessels travelled at an average speed of 8-10 knots when steaming between stations. The vessels often alternated between steaming from station to station, trawling at 3-4 knots and remaining stationary for CTDs, water sampling and/or plankton hauls.

Survey effort was conducted up to Beaufort sea-state 6 and in visibility ≥500m. As these were surveys onboard vessels of opportunity, the survey was conducted in 'passing mode' and sighted cetaceans were not approached.

Sightings were identified to species level where possible, with species identifications being graded as definite, probable or possible. Where species

identification could not be confirmed, sightings were downgraded (e.g. unidentified dolphin / unidentified whale / unidentified beaked whale etc.) according to criteria established for the IWDG's cetacean sightings database (IWDG 2009).

### *1.4. Relative Abundance Estimates*

Only definite and probable species identifications were used in the analysis. Where species identification could not be confirmed (or were ranked as 'possible' by the observer), sightings were downgraded to 'unidentified dolphin' or 'unidentified whale'. For relative abundance calculations, only sightings collected in Beaufort sea state 3 or less were included in the analysis.

Due to the nature of the surveys undertaken by the various research vessels, the speed of the vessels varied during the survey (e.g. when deploying or retrieving gear) and speed capacities varied between vessels. Research vessels were stationary at times (e.g. when conducting grab samples) and also sometimes conducted short and tight survey lines, which meant the vessels remained within a small geographical area for prolonged periods. For these reasons relative abundance was calculated as the **number of animals encountered per hour of survey time**, rather than per unit area (Reid *et al.* 2003).

Relative abundances were calculated per ICES statistical rectangle, which measured 1 degree of longitude, by 0.5 degrees of latitude. Relative abundances were mapped using ArcView 3.3 GIS software. Mapping layers were designed to show the amount of survey effort (hours) per grid square, which were overlaid by red circles, showing the relative abundance (animals per hour) of the species, calculated for that grid square. Relative abundances from grid squares with higher survey effort were considered more reliable than relative abundances estimated for grid squares with low survey effort.

## 2. Results

### *2.1. Effort*

#### *2.1.1. Ferry Surveys*

From July 2001 – May 2009 a total of **829 hours** of survey effort was conducted on board commercial ferries as part of the IWDG Ferry Surveys Project. 76% (628 hrs) of this effort was completed in sea states ≤3 and 88% (731 hrs) was completed in sea states ≤4.

#### *2.1.2. Ship Surveys*

From October 2003 – September 2009 a total of **2,209 hours** of survey effort was conducted on board Irish and foreign research vessels as part of ISCOPE, ISCOPE II and the 2004, Heritage Council funded, West Coast Cetacean Survey. 49% of this effort was completed in sea states ≤3 (1,083 hrs) and 75.5% was completed in sea states ≤4 (1,668 hrs).

#### *2.1.3. Total Effort*

Total survey effort amounted to **3,039 hours**, with 56.3% of this in sea states ≤3 (1,711 hrs). The majority of survey effort (64.3%) was conducted in the summer and autumn months (figure 2).

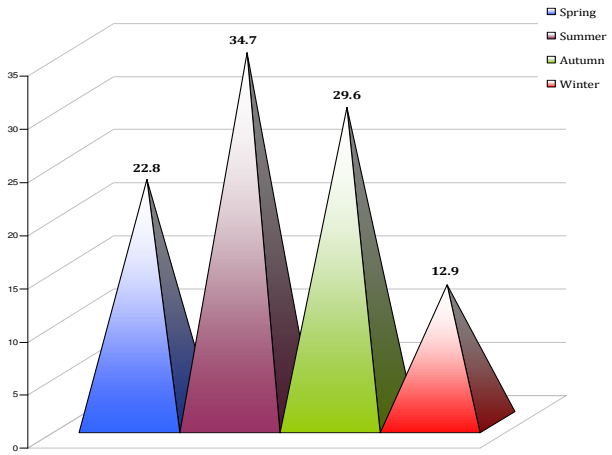



**Figure 2.** Percentage of total survey effort conducted in spring* (April, May, June), summer* (July, August, September), autumn* (October, November, December) and winter* (January, February, March). **Seasons were based on the closest match to the astronomical division of the seasons by the summer/winter solstices.*

## 2.2. *Survey coverage*

### *2.2.1. Geographic Survey Coverage.*

Survey coverage was predominantly over Irish shelf waters, with a small amount of coverage over the Rockall Trough and Rockall Bank (figure 3).

**Spring:** Irish Sea, St. George's Channel, northwest shelf, west shelf, Whittard Canyon, Bristol Channel and English Channel (figure 4a).

**Summer:** Irish Sea, St. George's Channel, northwest shelf & slopes, north slopes of Porcupine Bank, southern Rockall Bank, Rockall Trough, west shelf, Bristol Channel and English Channel (figure 4b).

**Autumn:** Irish Sea, St. George's Channel, Celtic Sea, southwest shelf, northwest Shelf, Bristol Channel and English Channel (figure 4c).

**Winter:** Irish Sea, St. George's Channel, south coast, west shelf, northwest shelf, Rockall Trough, Rockall Bank, Bristol and English Channels (figure 4d).

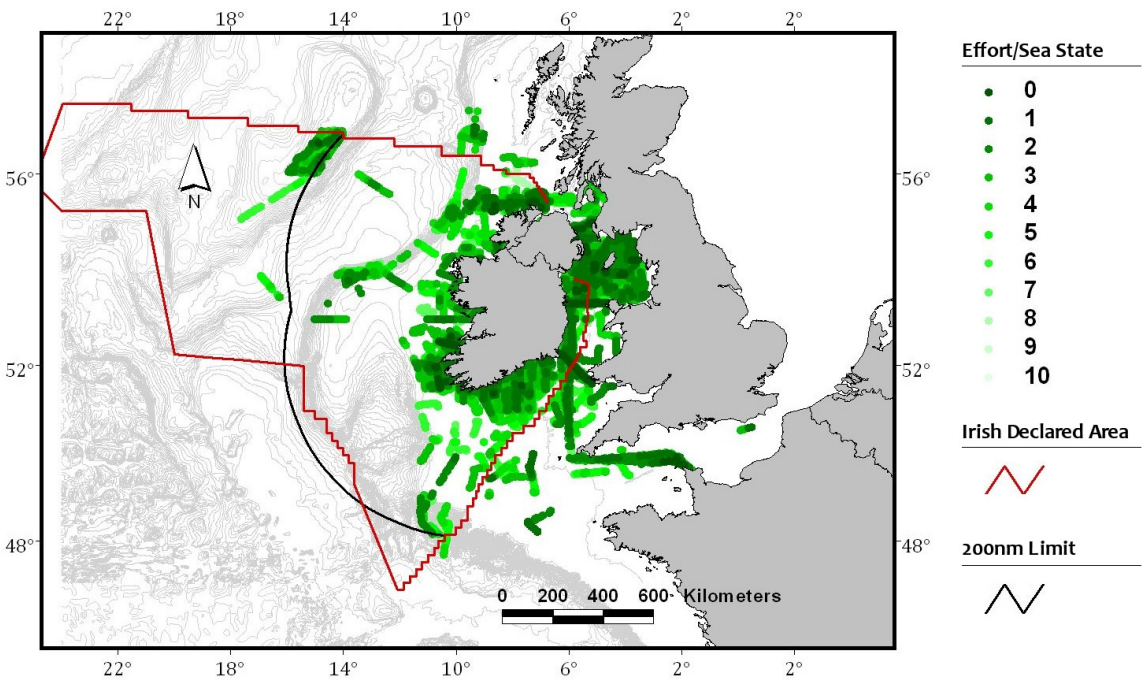



**Figure 3.** Total survey coverage logged from July 2001 to September 2009 – all seasons combined. Each dot represents an environmental record station (c15-20mins of effort). *Darker shading = calmer sea state.*

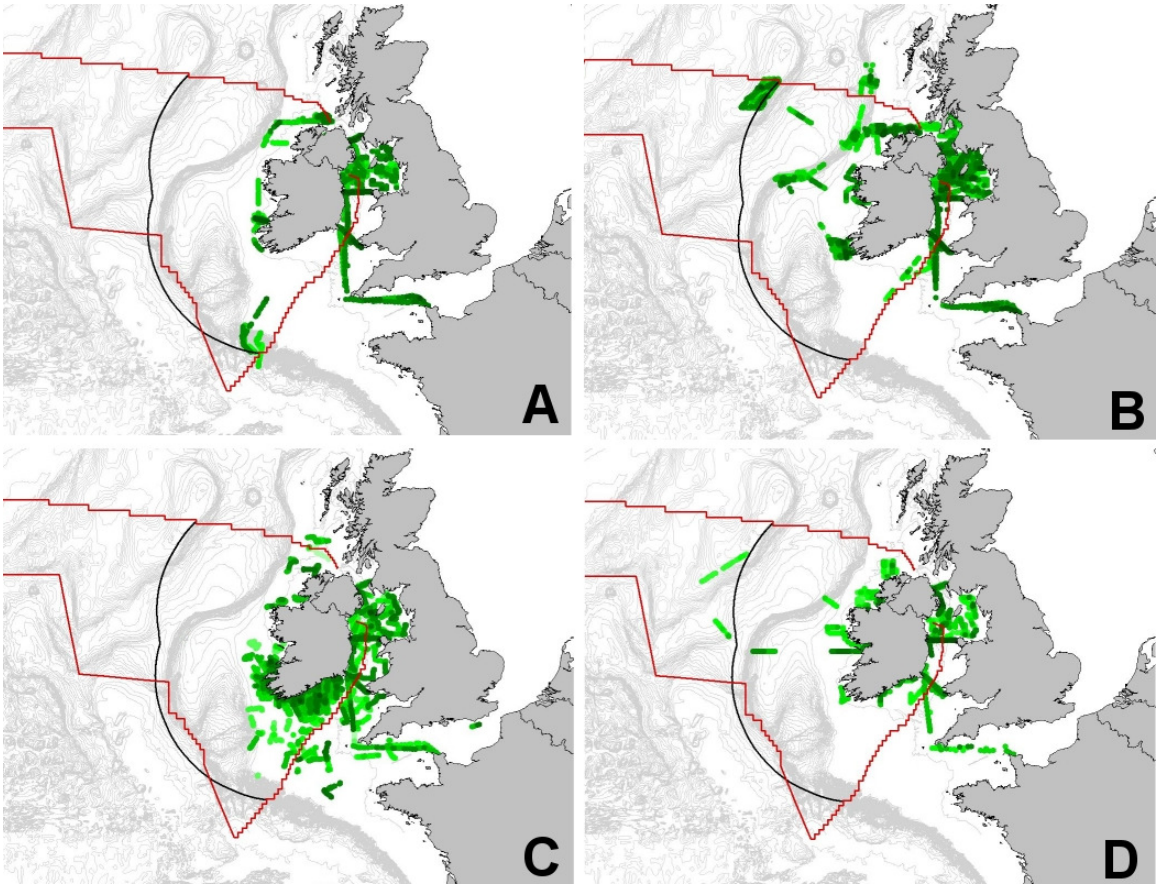



**Figure 4.** Survey effort logged from July 2001 to September 2009 – in spring (A), summer (B), autumn (C) and winter (D). Each dot represents an environmental record station (c15-20mins of survey effort). *Darker shading = calmer sea state.*

### *2.2.2. Survey effort and coverage by research programme*

Seasonal survey effort used in this report was conducted under a number of research programmes: The ISCOPE and ISCOPE II ship surveys programmes, the 2004 (Heritage Council funded) West Coast Cetacean Survey, the IWDG Ferry Surveys Programme and a number of IWDG funded surveys on board platforms of opportunity (fig. 4.1).

An analysis of percentage of total survey effort conducted by each research programme was conducted (fig. 4.2). Surveys conducted under ISCOPE II (2006-2009) constituted the majority of total effort (47% or 1436hrs), followed by the IWDG Ferry Surveys Programme (2001-2009), which contributed 27% of total effort (831hrs). The 2004 West Coast Cetacean Survey contributed 17% (511hrs) of total effort, followed by ISCOPE (2005) at 5% (166hrs) and IWDG funded surveys (2003-2004) at 4% (138hrs).

The majority of survey effort (43%) was conducted on board the Irish State research vessels (RV *Celtic Explorer* and RV *Celtic Voyager*). This was followed by commercial ro-ro ferries at 27% and UK research vessels at 25%. The majority of survey effort in the Irish Sea and, in particular, in Northern Irish waters was conducted on board the Northern Irish research vessel *Corystes* (fig. 4.3).

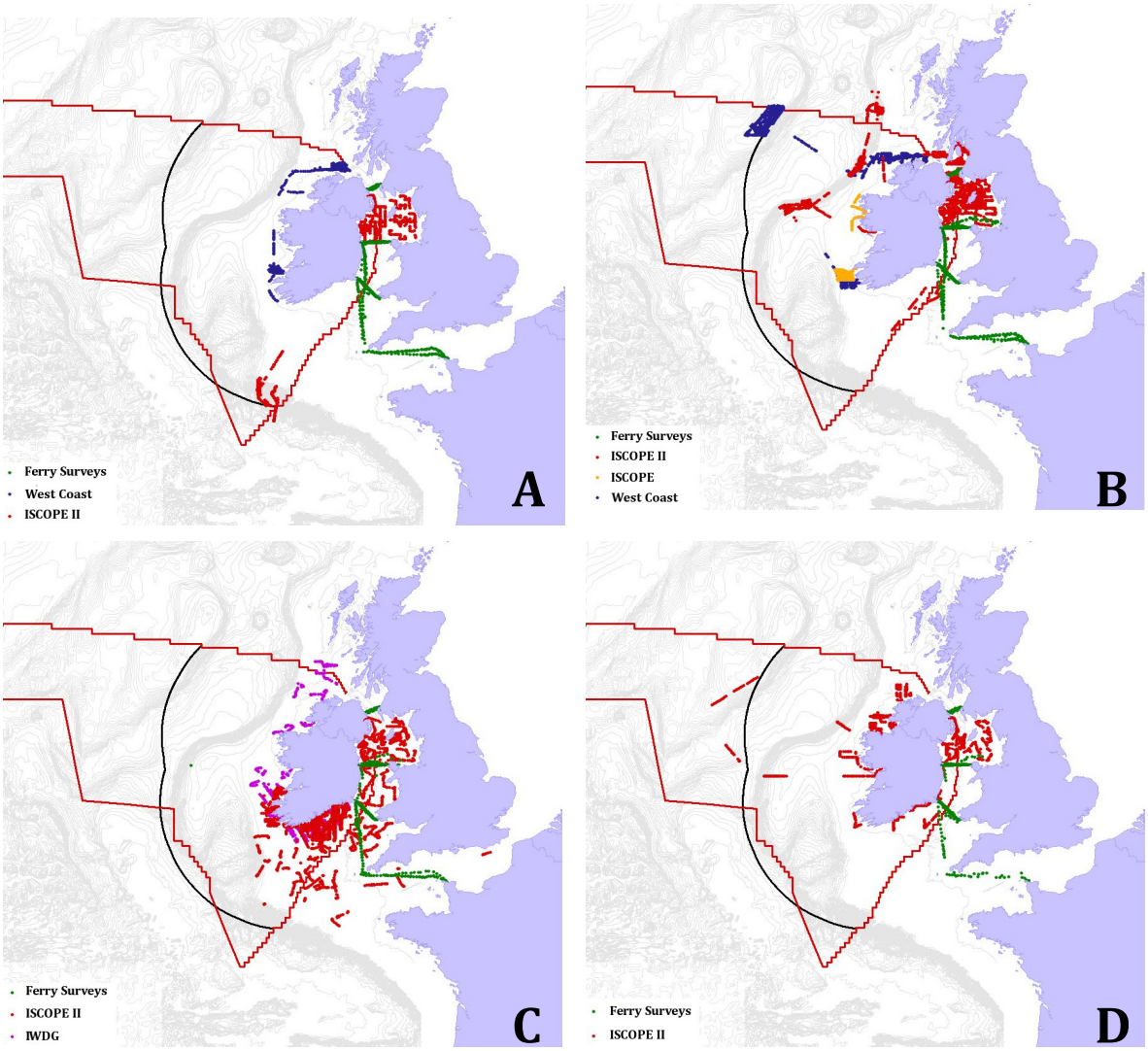



**Figure 4.1.** Survey effort logged in spring (A), summer (B), autumn (C) and winter (D) under IWDG Ferry Surveys (green), ISCOPE II (red), ISCOPE (orange), the West Coast Cetacean Survey (blue) and IWDG Funded Surveys (purple). Each dot represents an environmental record station (c15-20mins of survey effort).

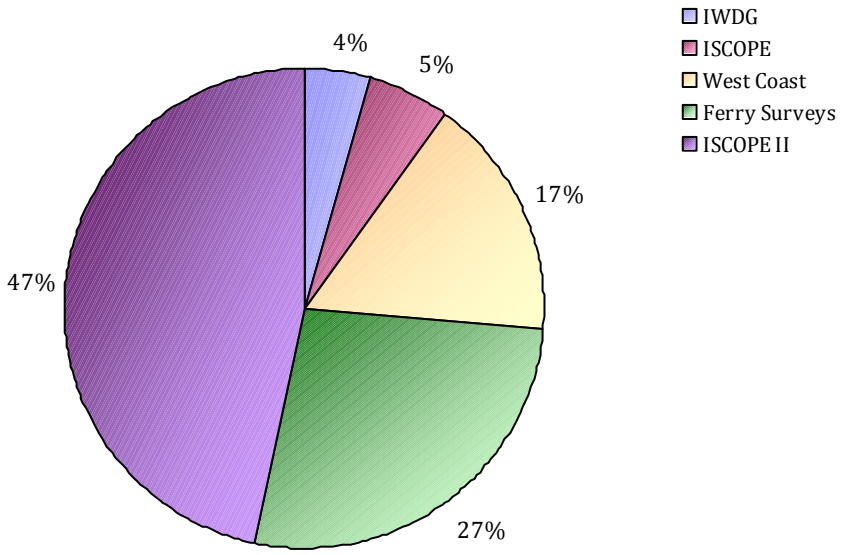



**Figure 4.2.** Percentage of total survey effort logged under IWDG Ferry Surveys, ISCOPE II, ISCOPE, the West Coast Cetacean Survey and IWDG Funded Surveys.

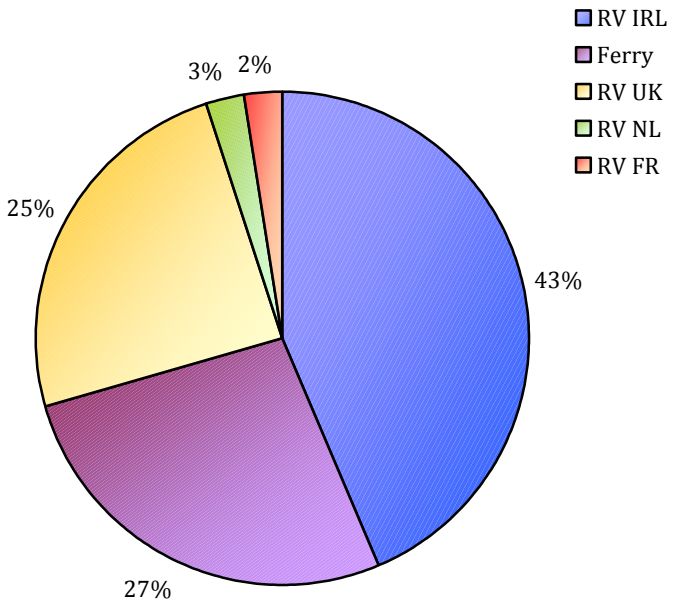



**Figure 4.3.** Percentage of total survey effort logged on Irish (RV IRL), Dutch (RV NL), French (RV FR) and UK (RV UK) research vessels and on commercial ro-ro ferries during the surveys.

### *2.3. Cetacean Diversity, Distribution and Relative Abundance.*

In all 1,827 sightings of 12 cetacean species, totalling 20,736 individuals were recorded. 11 sightings of turtle and shark species and 39 sightings of two seal species were also recorded (table 2).

The confirmed cetacean species recorded were long-finned pilot whale (*Globicephala melas*), Risso's dolphin (*Grampus griseus*), bottlenose dolphin (*Tursiops truncatus*), white-beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), short-beaked common dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*), harbour porpoise (*Phocoena phocoena*), Sowerby's beaked whale (*Mesplodon bidens*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*) and minke whale (*Balaenoptera acutorostrata*).

**Table 2.** Cetacean sightings, counts and group size ranges.

| Species | No. Sightings | No. Individuals | Range of Group Size |
|---|---|---|---|
| *Pilot whale* | *29* | *411* | *1-65* |
| *Risso's dolphin* | *16* | *64* | *1-18* |
| *Bottlenose dolphin* | *10* | *60* | *1-25* |
| *White-beaked dolphin* | *1* | *5* | - |
| *White-sided dolphin* | *56* | *722* | *1-60* |
| *Common dolphin* | *702* | *16,373* | *1-3000* |
| *Striped dolphin* | *3* | *161* | *5-120* |
| *Harbour porpoise* | *558* | *991* | *1-10* |
| *Sowerby's beaked whale* | *1* | *5* | - |
| *Fin whale* | *46* | *67* | *1-5* |
| *Humpback whale* | *2* | *3* | *1-2* |
| *Minke whale* | *77* | *92* | *1-7* |
| *Unidentified beaked whale* | *5* | *7* | *1-2* |
| *Unidentified dolphin* | *218* | *1697* | *1-100* |
| *Unidentified whale* | *45* | *59* | *1-5* |
| *Unidentified cetacean* | *8* | *22* | *1-7* |

An analysis of percentage of total sightings and total individual animals recorded under each research programme was conducted (fig. 4.4). The most sightings (57%) were logged under the IWDG Ferry Surveys Programme, although this only accounted for 16% of the total number of animals recorded. This was predominantly due to the large number of harbour porpoise encountered on these surveys. This species is not typically gregarious, with most sightings being of individuals or groups of 2-3 animals. The **IWDG Ferry Survey Programme accounted for 94% of all**

**harbour porpoise sightings** recorded during the five research programmes, showing the value of these surveys in monitoring this Annexe II protected species in one of it's most important habitats in EU waters, the Irish Sea.

The highest number of individual animals (51%) was logged under ISCOPE II. This was due to high encounter rates during these surveys of gregarious species such as common dolphins and pilot whales, which occur at high relative abundances.

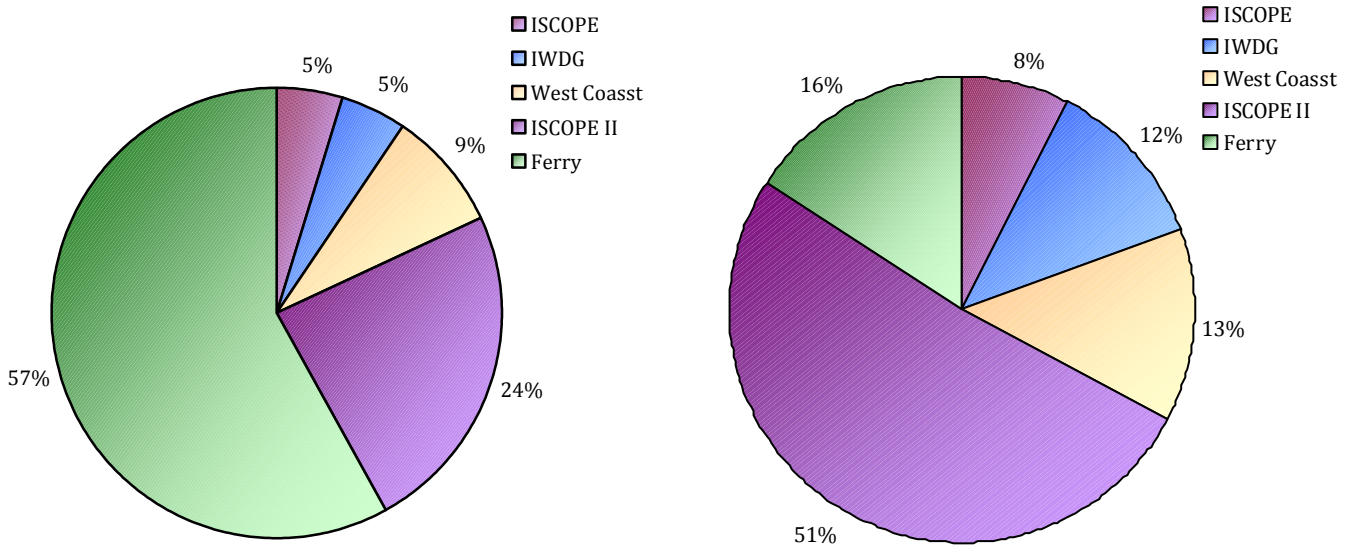
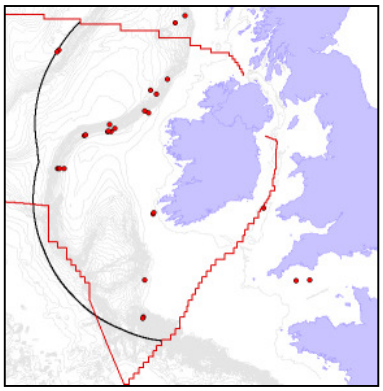



**Figure 4.4.** Percentage of total **sightings** (left) and **individual animals** (right) recorded under IWDG Ferry Surveys, ISCOPE II, ISCOPE, the West Coast Cetacean Survey and IWDG Funded Surveys.

Only three species (common dolphin, harbour porpoise and minke whale) were encountered frequently enough for seasonal relative abundances to be mapped. For other species, grouped relative abundance was mapped, while for four species the number of sightings was too low for relative abundance to be calculated.

The following is a short description of the frequency of sightings, distribution and relative abundance for each species recorded.

### *Long-finned Pilot Whale*



Pilot whales were commonly encountered over the continental shelf slopes and canyons, where the highest relative abundances occurred. This species was occasionally encountered in shallower (<200m) waters over the continental shelf to the southwest of Ireland and England.

Their distribution over deeper waters reflects their diet of deepwater cephalopods. Their occurrence in shelf waters to the southwest of Britain and Ireland has been noted by other UK researchers, with some suggestion that such movements may be linked to inshore migration of some squid species to spawn.

Average group size was 14 animals, however larger groups of up to 65 animals were encountered. These larger groups often consisted of subgroups, spread over a wide area. Juveniles and calves were noted in September and January, though not enough data was collected to allow for seasonal analysis.

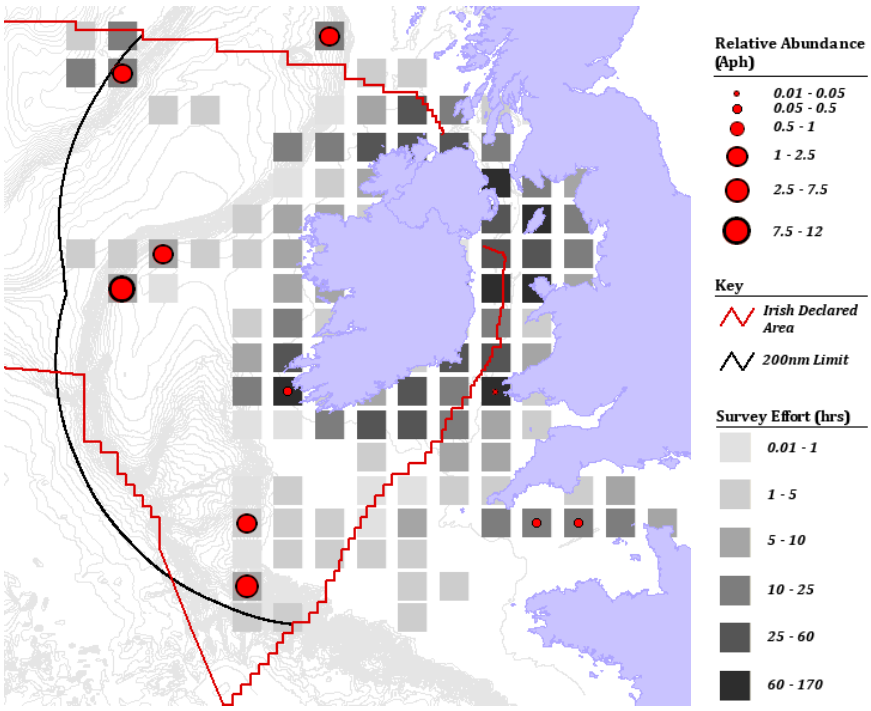
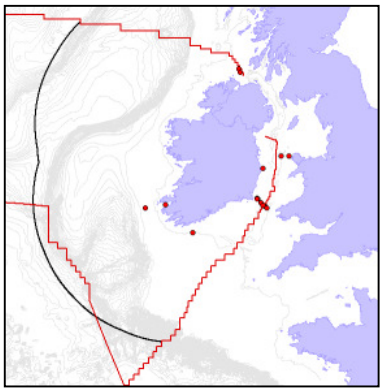



**Figure 5** Map showing relative abundance of **long-finned pilot whales** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

## *Risso's Dolphin*



This species was occasionally encountered during the surveys, with all sightings occurring over the Irish shelf, generally in inshore waters. The majority of sightings were recorded from the Irish Sea and this species is regularly encountered on ferry surveys between south Wales and Rosslare, with the Tuskar Rock area being noted for sightings. Calves and juveniles have been noted from June to December (Sea Trust, 2009).

Though often cited a deepwater species in the literature, virtually all sightings in Irish waters occur in shelf waters (IWDG 2009). Average group size was four animals, however 25% of sightings consisted of single individuals. Some of these were large, well-scarred animals. The largest group size encountered was 18 animals.

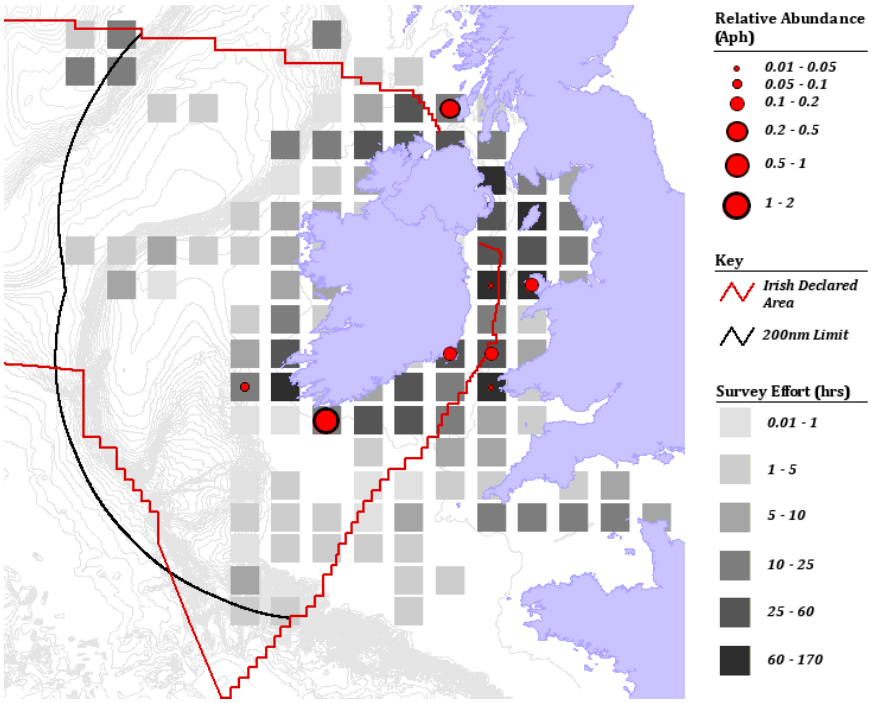
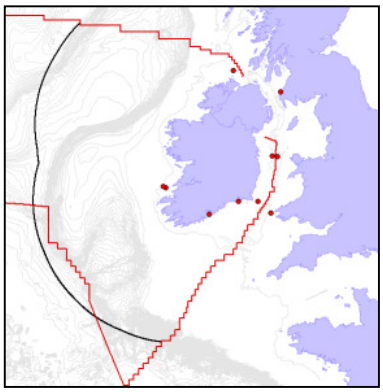



**Figure 6** Map showing relative abundance of **Risso's dolphins** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

## *Bottlenose Dolphin*



Bottlenose dolphins were occasionally encountered in inshore waters and in the Irish Sea. Average recorded group size was 6, with groups of up to 25 animals recorded.

In two cases groups of bottlenose dolphins were encountered at the entrance to estuaries/harbours on the south coast. The first was of a group of dolphins, which was encountered on a number of occasions at the entrance to Cork Harbour. This group is known to be semi-resident (IWDG 2009). The second group was of four animals encountered on one occasion at the entrance to Waterford/Dunmore East harbour.

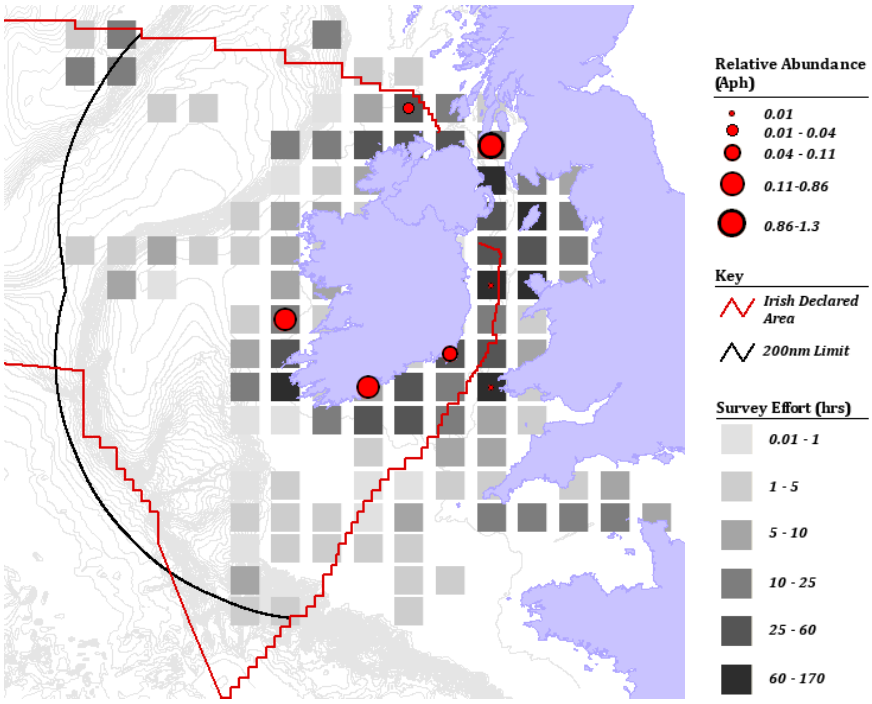



**Figure 7** Map showing relative abundance of **bottlenose dolphins** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

## *Atlantic White-sided Dolphin*

This species was rarely encountered over the Irish shelf. Most sightings and highest relative abundances were recorded over the continental shelf slopes and offshore banks. The highest relative abundances were recorded over the southern Rockall Bank in July, where this species was the most common cetacean species encountered.

Average group size was 13 animals, with groups of up to 60 animals recorded. Though often considered a deep-water species of the continental slopes and abyssal waters, sightings over the Rockall Bank occurred in waters less than 300m deep. White-sided dolphins were only encountered over the Irish shelf on two occasions.

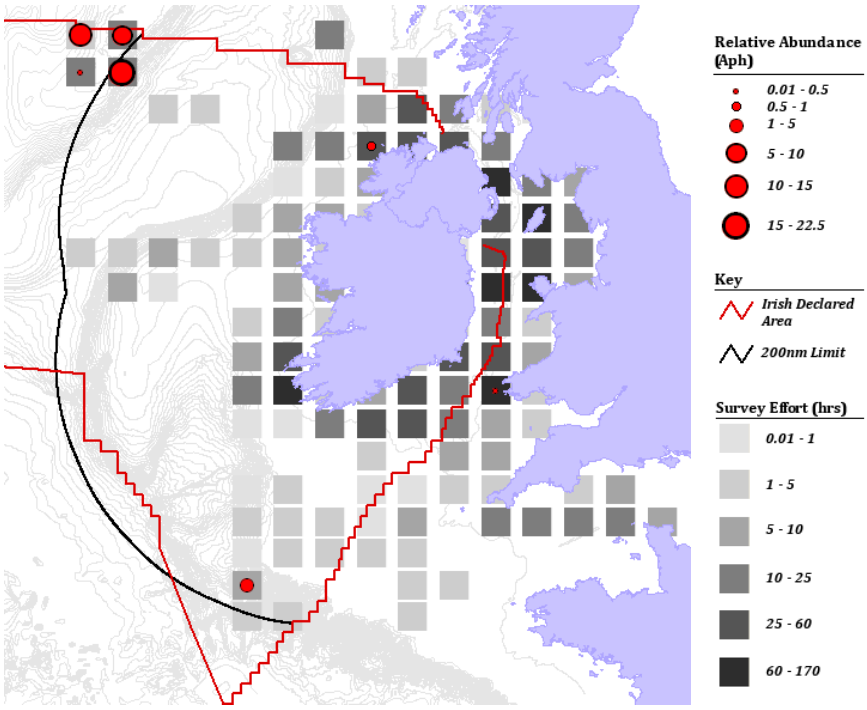
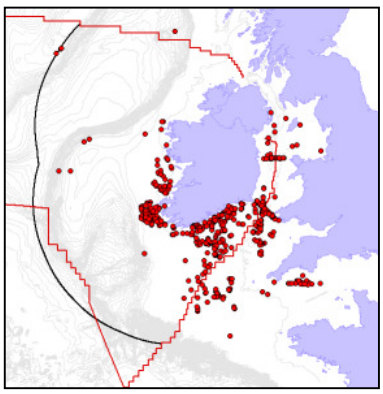



**Figure 8** Map showing relative abundance of **Atlantic white-sided dolphins** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

### *Short-beaked Common Dolphin*



This was the most commonly encountered, widespread and abundant cetacean species encountered during the surveys. There was a strong north/south aspect to their distribution in Irish waters, with highest relative abundances recorded in waters over the Irish shelf, surrounding the southern half of the country, and in particular the south and southwest coasts.

Common dolphin distribution and relative abundance showed a strong seasonal aspect, particularly in the Irish Sea. Common dolphins were present at low relative abundances in the Irish Sea from late spring to late summer, their distribution then shifted south, out of the Irish sea, in Autumn and, particularly, in winter (figure 11). In the St. George's Channel (between Rosslare and south Wales) common dolphins were present at moderate to high relative abundance in spring and summer but at low relative abundance in autumn and winter. It is likely that these changes in distribution are linked to the distribution of pelagic fish species (e.g. herring and sprat) which occur in the Irish Sea in the summer months.

In the Irish Sea and George's Channel, common dolphins were most frequently encountered in areas over the Celtic Deep which lies midway between the Irish and south Welsh coasts. The highest relative abundances of common dolphins were recorded in the Celtic Sea and western approaches to the English Channel during autumn, again this is most likely linked to the presence of a large biomass of schooling pelagic fish in these areas at that time of year. This species was also encountered along the shelf slopes and canyons and, in lower densities, over the Rockall Trough and Rockall Bank.

Average group size for common dolphins was 23, however super-pods of up to 3,000 individuals were recorded. During these surveys 21 super-pods in excess of 100 individuals were recorded, with the largest super-pod of 3,000 animals being recorded off the Welsh coast in June 2005. A number of other super pods in excess of 1,000 animals have been recorded in this area in recent years (Sea Trust, 2009), though the reason for the formation of such super-pods is not known.

Calves and juveniles were noted from May through to December, predominantly in the Celtic Sea and St. George's Channel, though also in the Irish Sea.

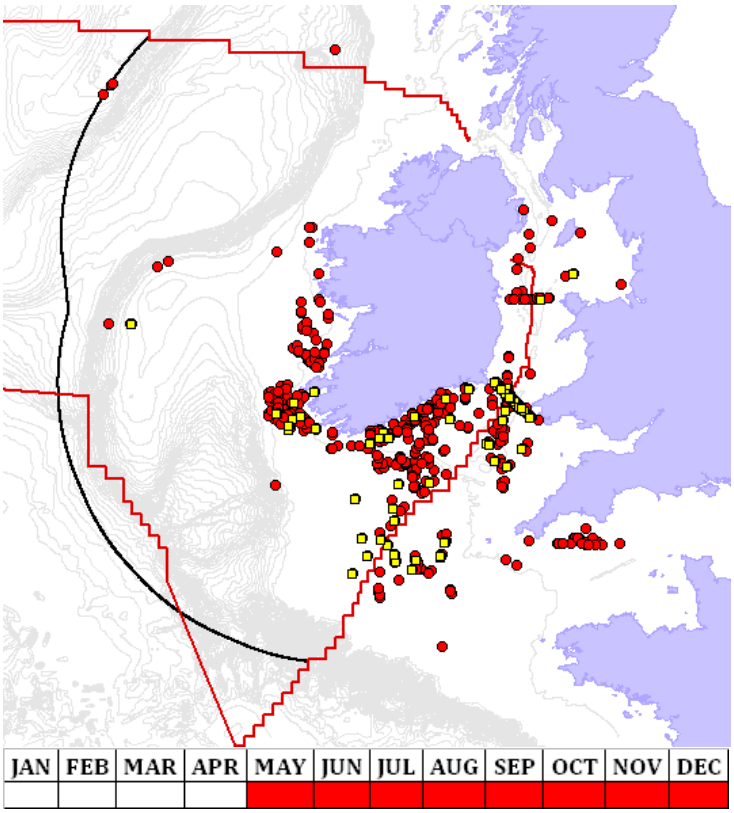



**Figure 9** Map showing distribution of sightings of **common dolphin** calves and juveniles. Yellow dots – calves/juveniles, red dots = all sightings. The chart below the map shows the months in which calves and juveniles were noted. *NB: it should be noted that not all sightings were assessed for juveniles or calves being present.*

**Figure 10** Common Dolphins *(© Dave Wall)*

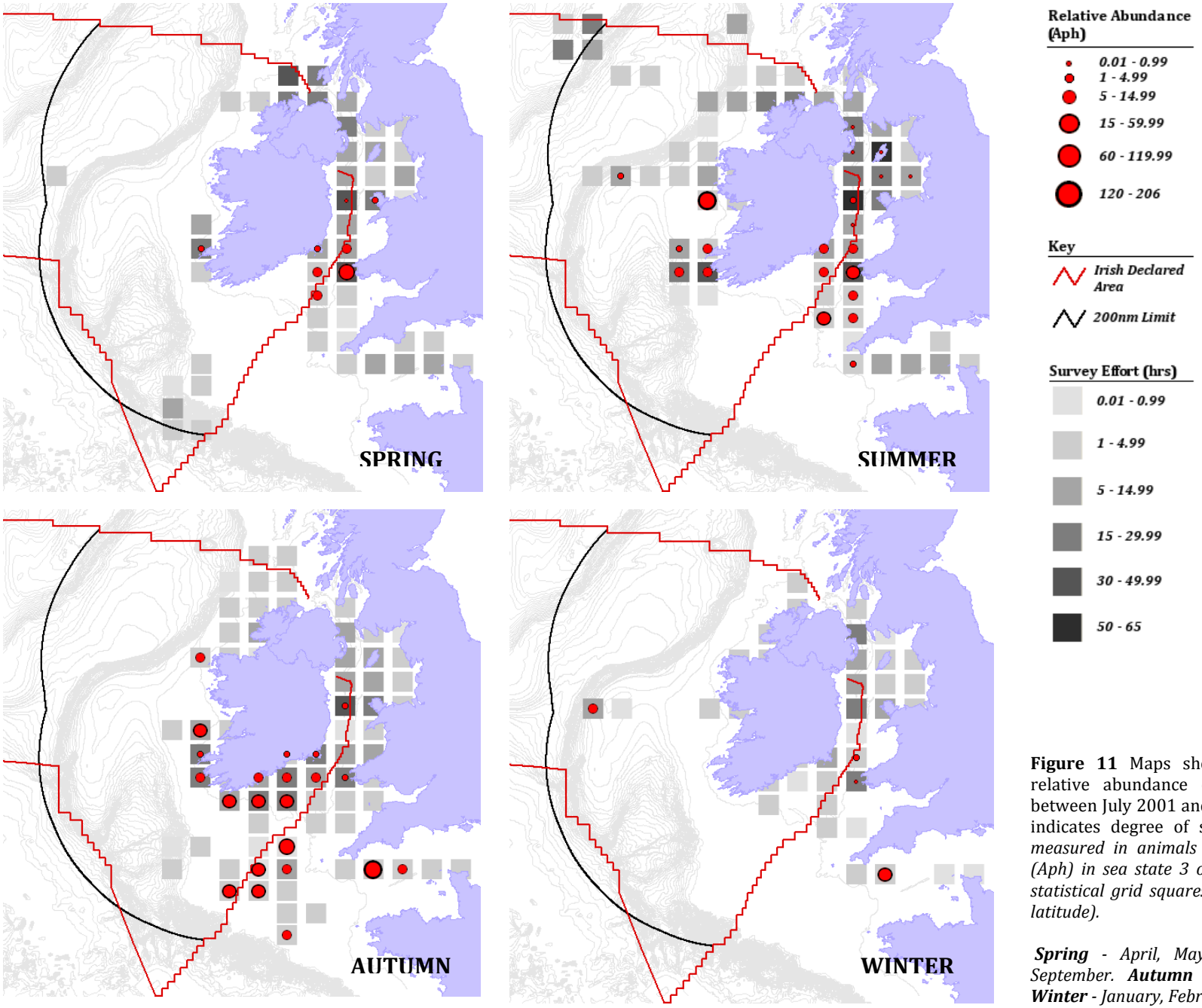
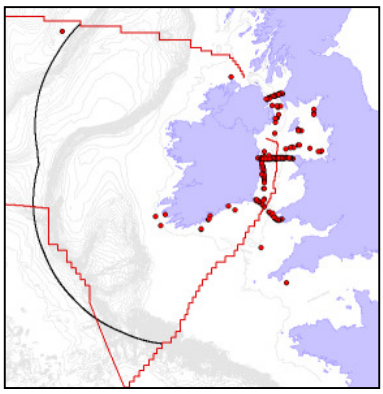



**Figure 11** Maps showing seasonal distribution and relative abundance of **common dolphins** recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

***Spring*** *- April, May, June.* ***Summer*** *- July, August, September.* ***Autumn*** *- October, November, December* ***Winter*** *- January, February, March.*

## *Harbour Porpoise*



Harbour porpoise were most commonly encountered in the Irish Sea and was the most common cetacean species encountered on three ferry-survey routes between Northern Ireland and Scotland and between Ireland and Wales. Porpoise were present in the Irish Sea and St. George's Channel in all seasons (figure 12).

Highest relative abundances were recorded in the Irish Sea, especially in the summer months (figure 14), though this may be an artefact of calmer sea states in summer. A number of issues surround the determination of relative abundance for harbour porpoise in the Irish Sea (see section 2.5). Sea state is a major factor, with sightings rates for harbour porpoise increasing greatly in sea states below 2 (Northridge *et al.*, 1995). This may explain the low number of records for harbour porpoise from St. George's Channel in autumn and winter, as it is more exposed than the central and northern Irish Sea to both Atlantic swells and the prevailing southwesterly winds.

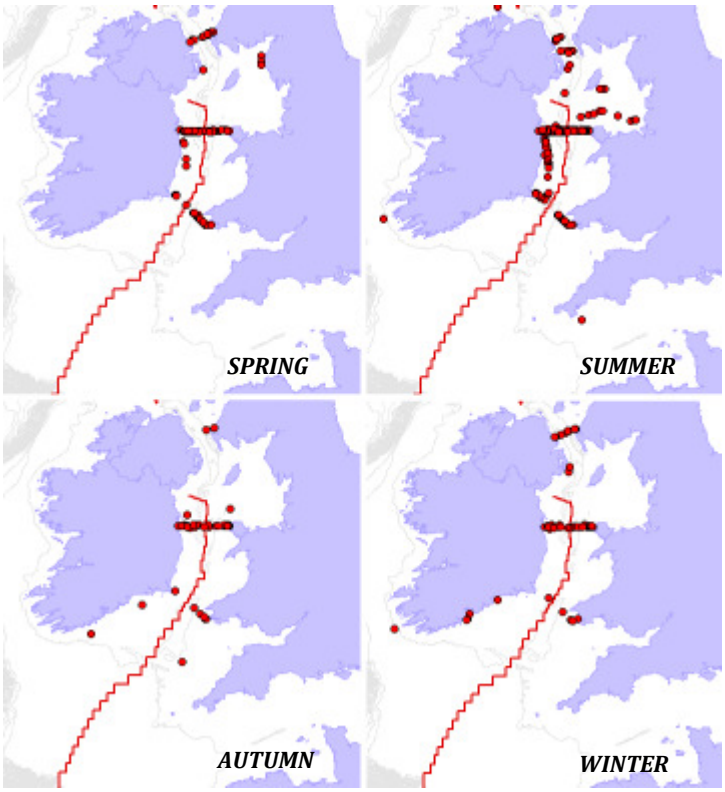



**Figure 12** Maps showing seasonal distribution of **harbour porpoise** in the Irish Sea & St. George's Channel, recorded in all sea states, between July 2001 and September 2009.
*Each red dot represents a sighting.*

Although found throughout the Irish Sea, harbour porpoise sightings elsewhere in Irish waters were restricted to inshore coastal waters. Data collected during the SCANS II survey indicated that this species occurs in waters over the shelf to the south of Ireland (Celtic Sea) in July, however these areas received low survey effort during these surveys.

Harbour porpoise were also recorded in offshore waters over the Rockall Bank during surveys in summer 2004. Waters over the bank are shallow (<300m) and within the feeding depth range for harbour porpoise. Sightings of harbour porpoise over the Rockall Bank have previously been noted by Northridge *et al.* (1995) and by Cronin and Mackey (2002). It is likely that these porpoise originate from shelf areas to the north of the Rockall Bank, rather than from Irish Shelf waters, however no genetic analysis of these animals has been conducted to date.

Calves and juveniles were noted from May through to October, in the Irish Sea and St. George's Channel.

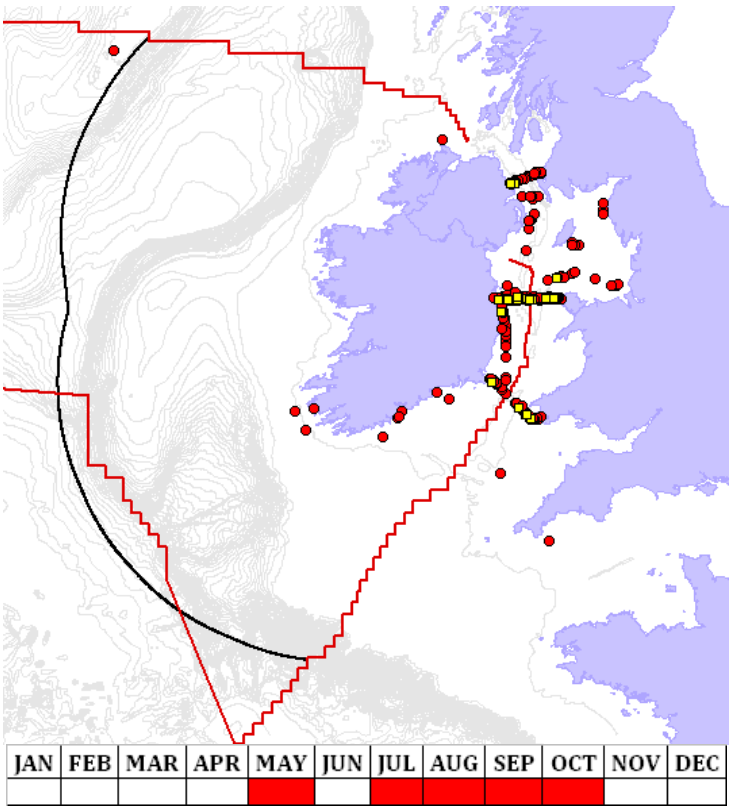



**Figure 13** Map showing distribution of sightings of **harbour porpoise** calves and juveniles. Yellow dots – calves/juveniles, red dots = all sightings. Chart below the map shows the months in which calves and juveniles were noted. *NB: it should be noted that not all sightings were assessed for juveniles or calves being present.*

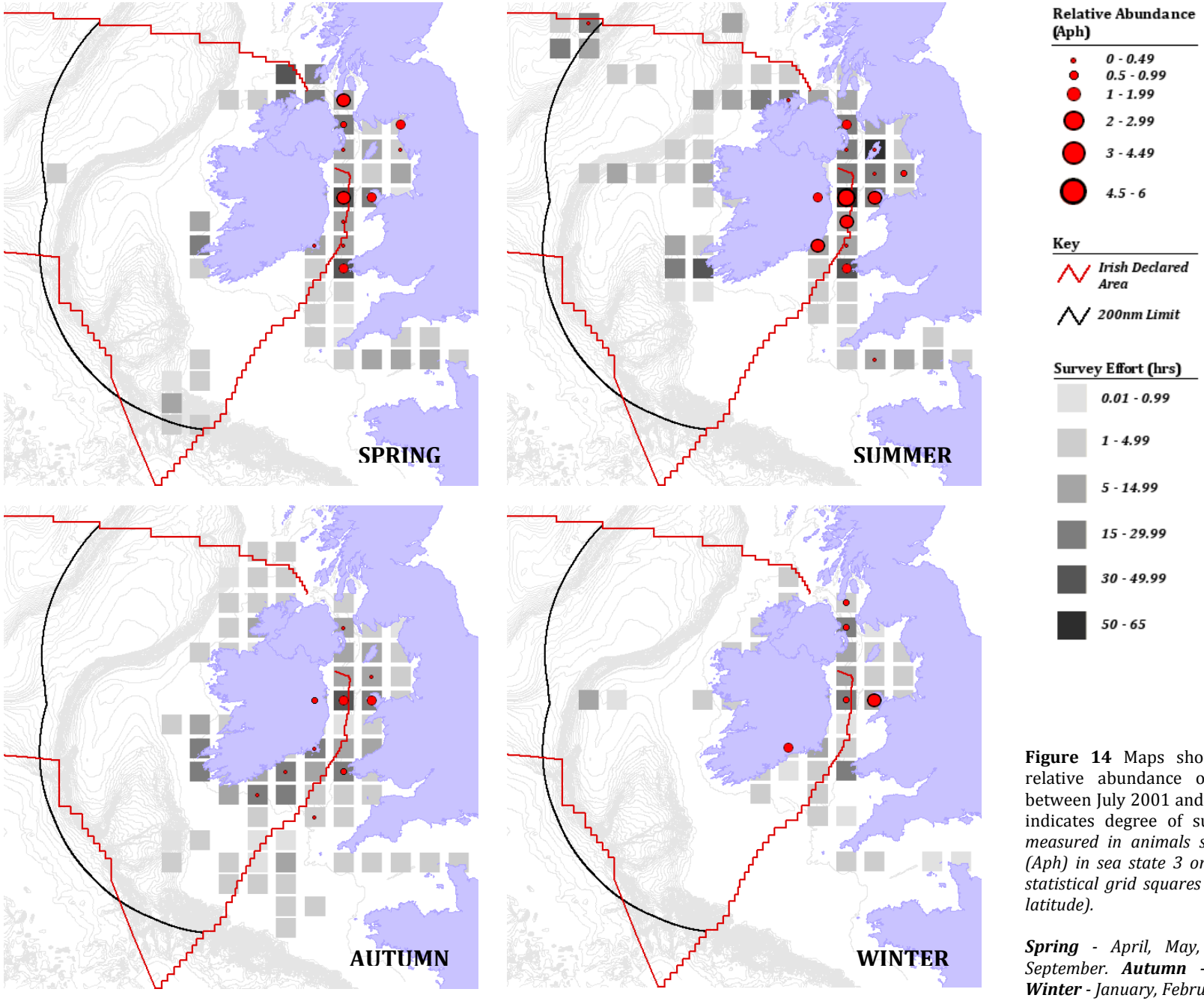
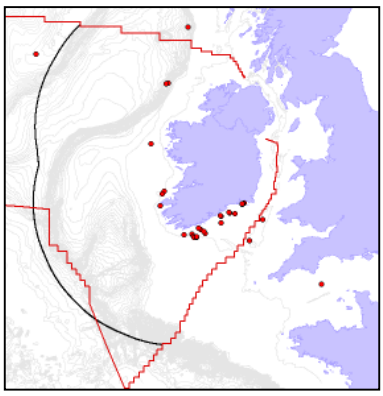



**Figure 14** Maps showing seasonal distribution and relative abundance of **harbour porpoise** recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

***Spring*** *- April, May, June.* ***Summer*** *- July, August, September.* ***Autumn*** *- October, November, December* ***Winter*** *- January, February, March.*

## *Fin Whale*



Most sightings, and the highest relative abundance of fin whales were recorded in shelf waters along the south coast during autumn. The highest relative abundances were recorded off the west Cork Coast east of Cape Clear and west of the Old Head of Kinsale.

This species was also recorded at low relative abundances in the Celtic Deep, the Irish Shelf off the southwest and west coasts, the continental shelf slopes to the northwest of Ireland and the southern Rockall Bank. Group sizes were small with most animals occurring singly or in pairs. A maximum group size of five was recorded but this may have consisted of single animals or pairs of animals occurring in a feeding aggregation, rather than a social group.

The seasonal occurrence of fin whales off the south coast of Ireland is linked to the presence of aggregations of pelagic schooling fish (such as herring, sprat and garfish), which occur along the south and southwest coasts in autumn.

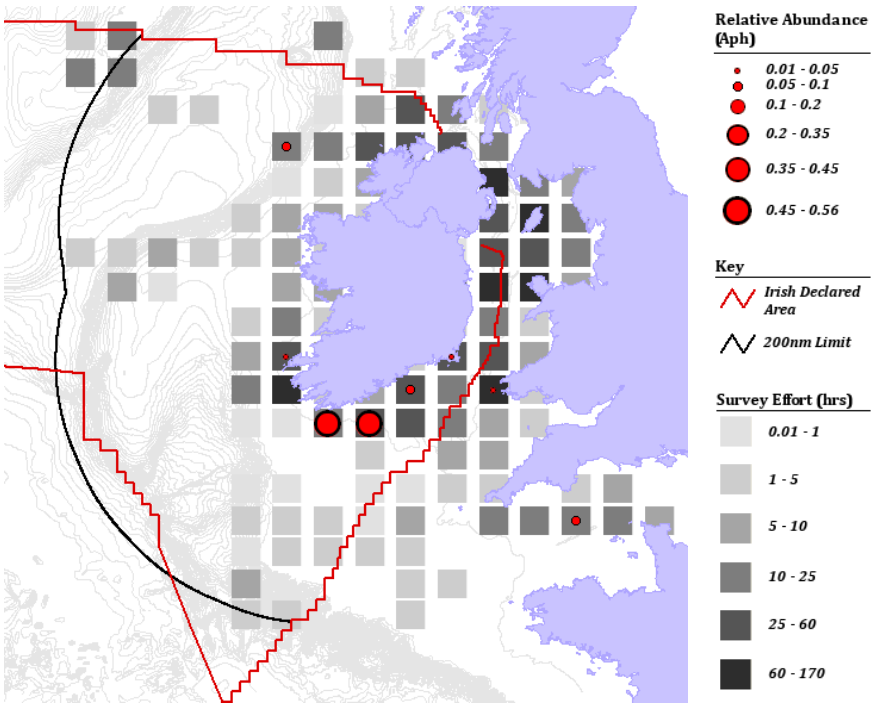
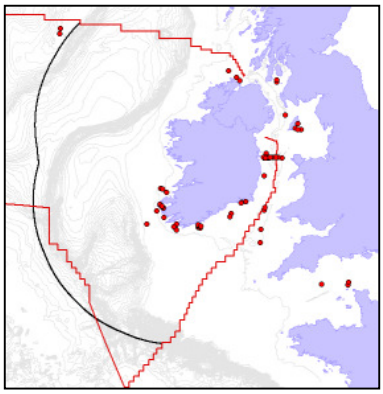



**Fig. 12** Map showing relative abundance of **fin whales** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

### *Minke Whale*



There was a strong seasonal aspect to the distribution and relative abundance of minke whales in Irish waters. Minke whales were present in the Irish Sea and St. George's Channel predominantly in late spring and into the summer, a period that coincides with the presence of schooling pelagic fish (e.g. herring and sprat) in the Irish Sea.

Relative abundance in the Irish Sea declines in autumn, when they are present at high relative abundance off the south and southwest coasts, again coinciding with a high biomass of pelagic schooling fish (e.g. herring, sprat and garfish). Minke whales were largely absent from Irish waters during the winter months.

The highest relative abundance of minke whales recorded during these surveys was in the western part of the Irish Sea during spring. Data from the Dublin-Holyhead ferry survey suggests a peak in minke whale occurrence in the western Irish Sea during May (figure 13).

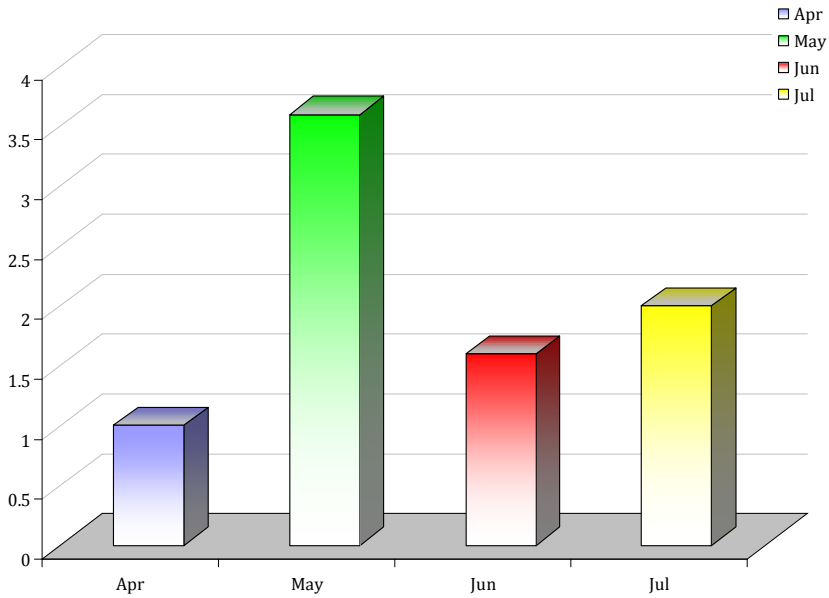



**Fig. 13** Chart showing monthly number of **minke whale** sightings per survey leg on the Dublin – Holyhead ferry survey route from 2002 – 2009.

High minke whale relative abundances were also recorded off the west Cork coast in autumn, east of Cape Clear and west of the Old Head of Kinsale and in late summer

and autumn between the mouth of Dingle Bay and the Skelligs. Minke whales were also recorded in shallow (<300m) offshore waters over the Rockall Bank in July.

The majority of minke whale sightings were of single animals, however groups of up to seven animals have been recorded. It is likely that such 'groups' are aggregations of feeding individuals rather than a social group.

**Fig. 14** Minke Whales *(© Dave Wall)*

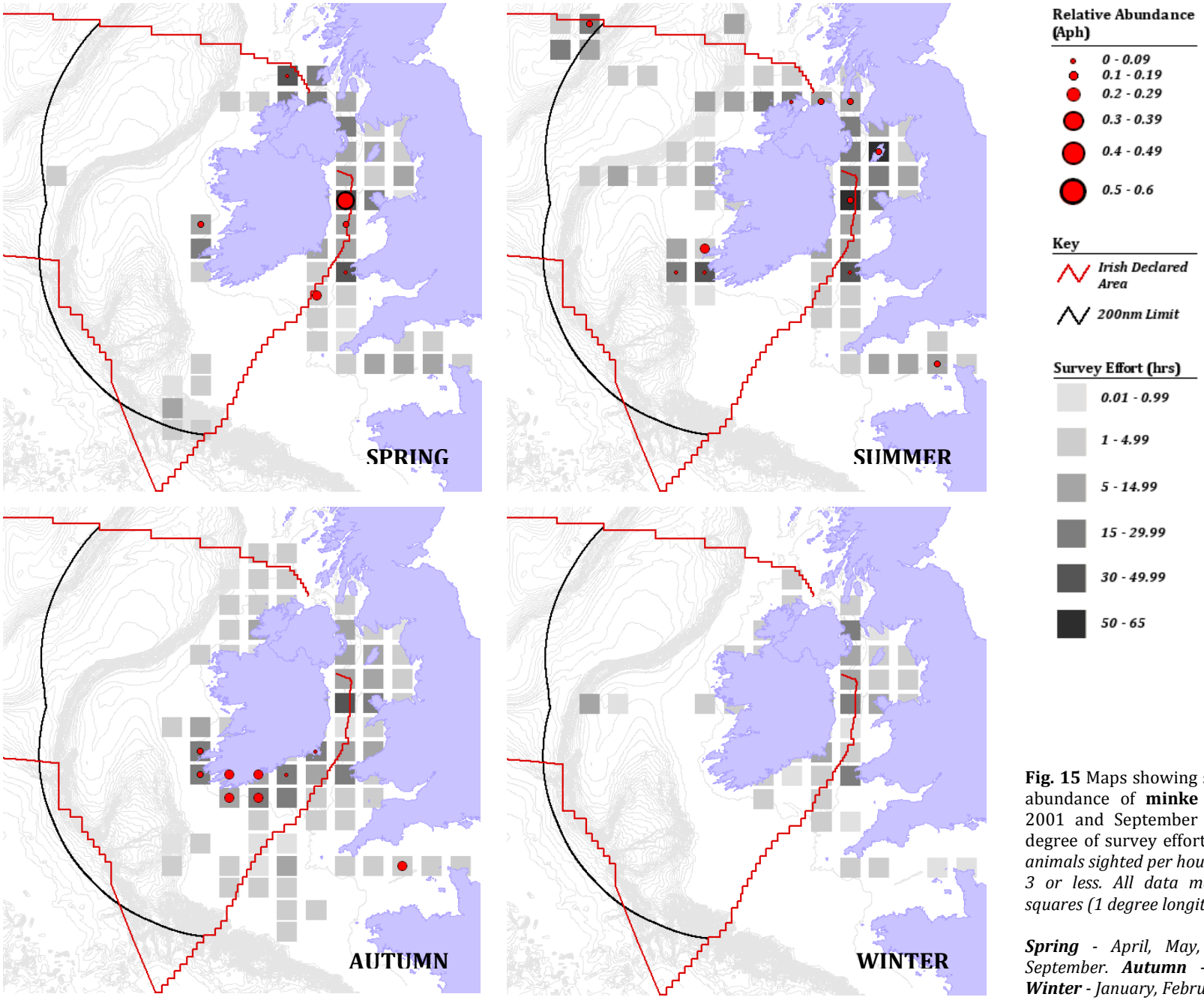
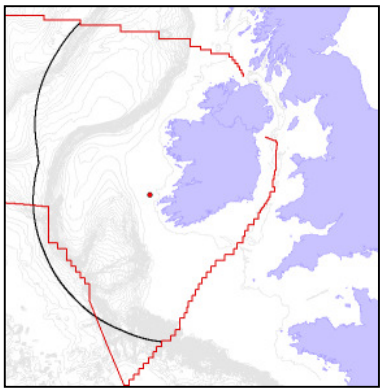



**Fig. 15** Maps showing seasonal distribution and relative abundance of **minke whales** recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

***Spring*** *- April, May, June.* ***Summer*** *- July, August, September.* ***Autumn*** *- October, November, December* ***Winter*** *- January, February, March.*

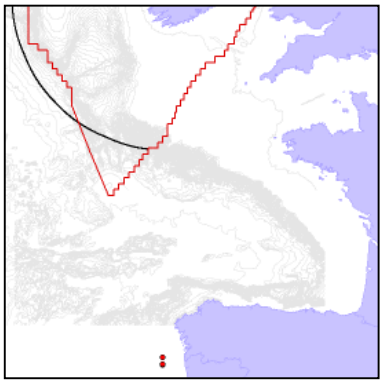
### *White-beaked Dolphin*



Only one sighting of white-beaked dolphin was encountered during the surveys. This was a group of five animals sighted off the Kerry Coast in 2004.

This species, which prefers shallow waters over the continental shelf (<200m) is reported as occurring along the west coast of Ireland prior to 2000, however some researchers have suggested that white-beaked dolphins have suffered a northward shift in their distribution since the turn of the century (Macleod C.D. *pers. comm.*) which may be linked to changes in ocean temperature. Certainly it is rarely recorded in Irish waters at the present time as evidenced by the results of these surveys.

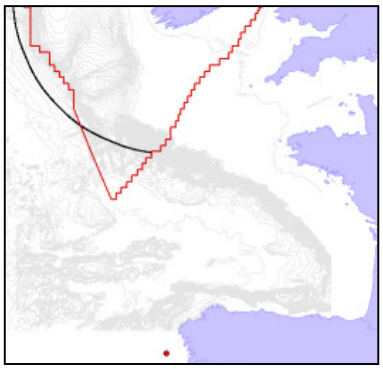
### *Striped Dolphin*



Three groups of striped dolphins were encountered during these surveys. All three groups were encountered off the north coast of Portugal and Spain during a transit from Lisbon to the Whittard Canyon, off the southwest coast of Ireland.

This species, though commonly stranded around the Irish coast, is rarely seen alive in Irish shelf waters. It is typically an abyssal species; with a distribution lying largely to the south of Irish waters and is commonly encountered in the Bay of Biscay.

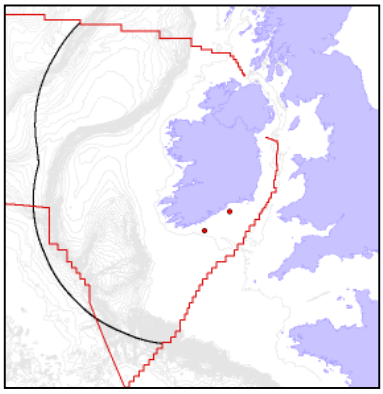
### *Sowerby's Beaked Whale*



One group of Sowerby's beaked whales was encountered during these surveys. A group of five animals was encountered off the north coast of Spain during a transit from Lisbon to the Whittard Canyon, off the southwest coast of Ireland. The group consisted of three adults and two juveniles.

Sowerby's beaked whales are very rarely seen alive in Irish waters, though a number of records of unidentified beaked whales may include individuals of this species. It is a deepwater species, with a distribution lying largely along the slopes and canyons of the continental shelf edge, to the west of Ireland. It is the third most commonly stranded beaked whale species in Irish waters (after northern bottlenose whale and Cuvier's beaked whale).

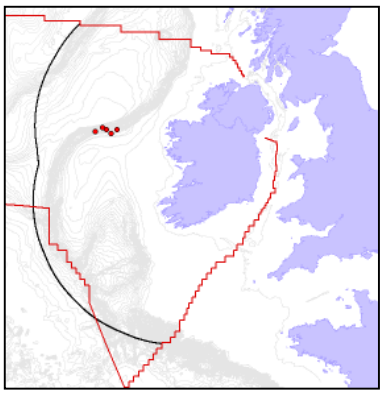
### *Humpback Whale*



Two sightings of this species were recorded during these surveys, both during the autumn, off the south coast. One animal (possibly HBIRL 3) was sighted off Ram Head, Co. Waterford in October 2007. The second animal was observed feeding among a group of fin whales, south of the Old Head of Kinsale, Co. Cork in December 2004.

In common with fin whales, the seasonal occurrence of humpback whales off the south coast of Ireland is linked to the presence of aggregations of pelagic schooling fish (such as herring, sprat and garfish), which occur along the south and southwest coasts in autumn. To date 10 individual humpbacks have been photo-identified in Irish waters, with the vast majority of these having been sighted in more than one year indicating feeding site fidelity among individual humpbacks.

### *Unidentified Beaked Whale*



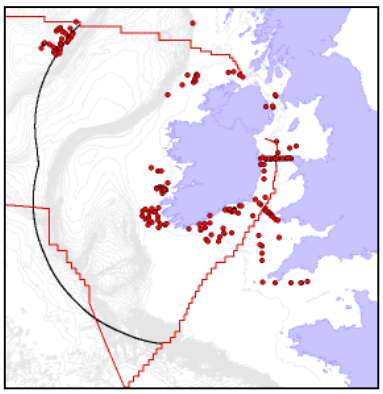
Five sightings of unidentified beaked whales were made during surveys conducted in September 2006-2008 from the Celtic Explorer, during the FSS Deepwater Fisheries Survey. All sightings involved breaching animals, with two of the sightings involving synchronously breaching pairs of animals. Four of the five sighting occurred in sea states greater than five, and detection of the animals was only possible due to their behaviour.

One sighting of two synchronously breaching animals was possibly of a pair of northern bottlenose whales, while two other sightings were judged to be beaked whales that were not northern bottlenose or Cuvier's beaked whales and were most likely Sowerby's or True's beaked whales.

All sightings occurred over the north slopes of the Porcupine Bank, in the vicinity of two large canyon systems. Sub sea canyons are known to be preferred habitat for beaked whales elsewhere in Europe (Williams *et al.*, 1999 and Moulins *et al.*, 2007).

**Fig. 16** Fin Whale *(© Dave Wall)*

## *Unidentified Dolphin*



Where dolphin or porpoise species identity could not be confirmed (e.g. when animals were at too great a distance or only a fleeting glance was obtained), species were downgraded to 'unidentified dolphin', which includes all the dolphin species and harbour porpoise.

In reality the majority of 'unidentified dolphin' sightings were of commonly encountered dolphin species. For example the majority of 'unidentified dolphin' sightings over the Rockall Bank in Summer 2004 were probable Atlantic white-sided dolphins, the majority of 'unidentified dolphin' sightings over the south and southwest Irish shelf were probable common dolphins and the majority of 'unidentified dolphin' sightings in the Irish Sea were probable harbour porpoise or common dolphins.

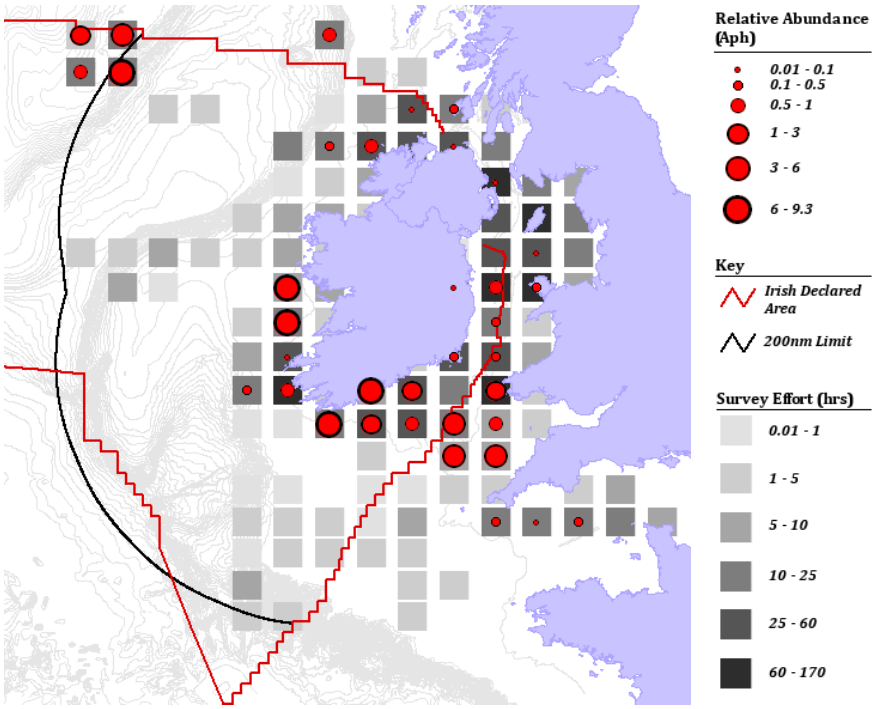
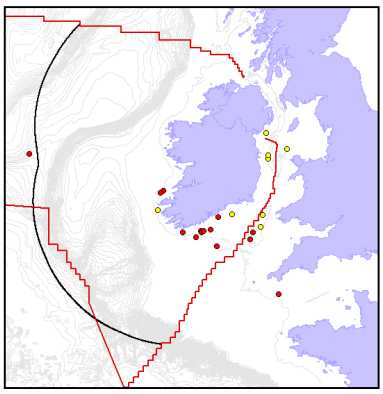



**Fig. 16** Map showing relative abundance of **unidentified dolphins** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

### *Unidentified Whale*



Where whale species identity could not be confirmed (e.g. when only a blow was seen or only a fleeting glance was obtained), species were downgraded to 'unidentified whale'. This category was further subdivided into 'whale blow', (*red dots*) which accounted for large baleen whales (fin/sei/blue or humpback whales) and sperm whales (only in deeper waters). All other whales, including baleen whales without blows (minke) and possible beaked whales (where the animal could not be placed into the 'unidentified beaked whale' category), were listed as 'unidentified whales' (*yellow dots*).

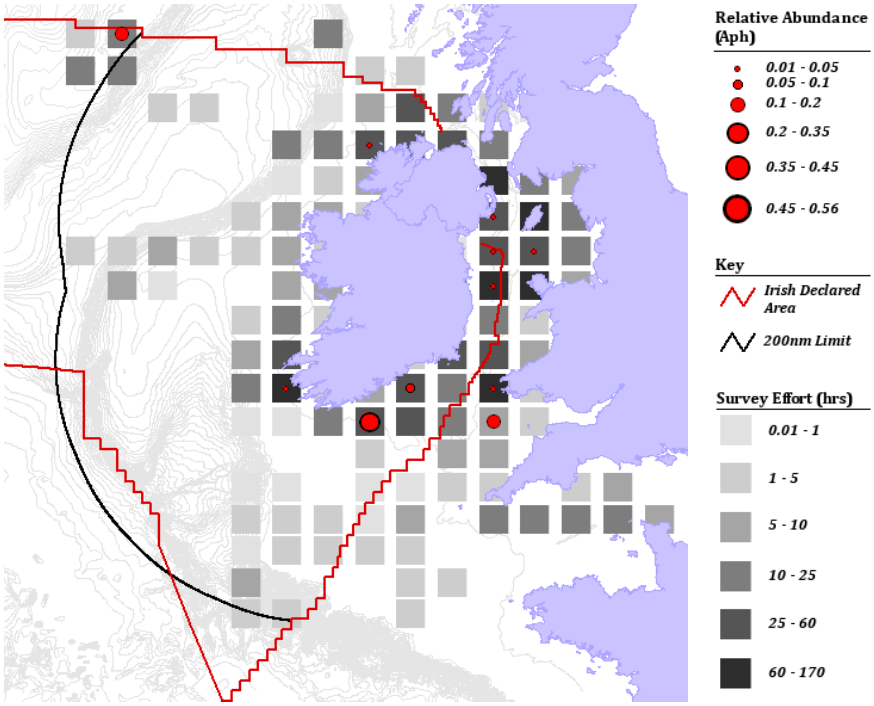



**Fig. 17** Map showing relative abundance of **unidentified whales & whale blows** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less. All data mapped onto ICES statistical grid squares (1 degree longitude X 0.5 degree latitude).*

### *Unidentified Cetacean*

Brief sightings of cetaceans which did not allow for confirmation of the animal as being an 'unidentified whale' or 'unidentified dolphin' were downgraded to 'unidentified cetacean'. This occurred in particular where only a brief glimpse of a breaching animal was obtained or only a view of the dorsal fin.

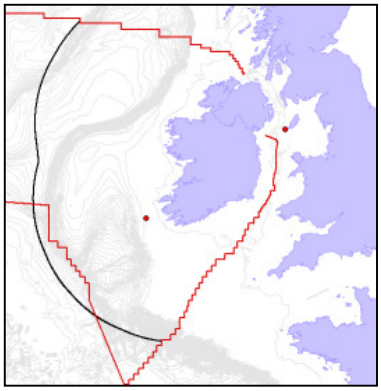
A sighting of an unidentified cetacean that occurred over the Whittard Canyon system, off the Irish southwest coast, in 2007 was thought possibly to be of a pygmy sperm whale. The animal was seen to breach once in calm seas, showing a blunt head and dark body. The nature of its breach matched published descriptions of pygmy sperm whale breaching behaviour. The angle of view of the animal and the brief nature of the sighting did not allow for species identification. Strandings data has indicated that pygmy sperm whales have a distribution lying off the southwest coast of Ireland. The Whittard Canyon system is similar to habitats where pygmy sperm whales have been reported elsewhere (Baird R.W., 2005.

**Fig. 18** Pilot Whales *(© Dave Wall)*

### *2.4. Megafauna Diversity, Distribution and Relative Abundance.*

Other recorded megafauna included leatherback turtle (*Dermochelys coriacea*), basking shark (*Cetorhinus maximus*), grey seal (*Halichoerus grypus*) and common seal (*Phoca vitulina*). Below is a brief description of their distribution and relative abundance (grey seals only).

#### *Leatherback Turtle*

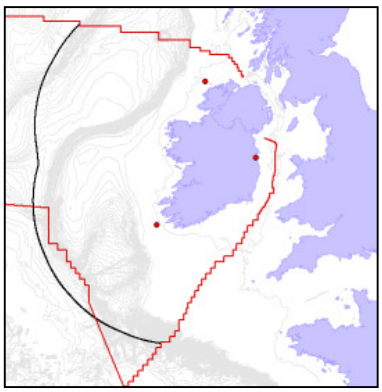


Two leatherback turtles were sighted during these surveys. Bother were sighted in summer, when this species moves north to feed on jellyfish blooms in the waters around Ireland and Britain. The sightings fell within the normal distribution of leatherback turtles in Irish waters (Doyle T.K., 2007 and Houghton *et al.*, 2006).

#### *Basking Shark*

9 sightings of basking sharks were recorded during the surveys. All sightings involved single animals feeding at the sea surface. The majority of sightings were made off the north coast of Ireland and in the north Irish Sea, while two animals were sighted west of Loop Head, Co. Clare and one animal was sighted in the St. George's Channel. All sightings off the north and west coasts occurred between May and August, while the sighting in St. George's Channel occurred in February. All sightings fell within the normal distribution of leatherback turtles in Irish waters (IWDG 2009).

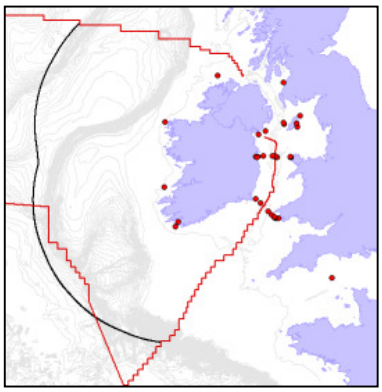
### *Common Seal*



Three sightings of common seals were made during the survey. One sighting occurred within the environs of Dublin Port at the start of a ferry survey in May. The others occurred in waters further from shore, one west of Tory Island, Donegal and the other during a severe gale in September 2004. In the latter case the animal followed the research vessel for a number of hours in extremely heavy seas. All sightings fell within the normal distribution of common seals in Irish waters (Cronin *et al.*, 2004).

**Fig. 19** Grey Seal scavenging astern of angling boat, Howth Head. *(© Dave Wall)*

## *Grey Seal*



Grey seals were encountered throughout the Irish Sea and in all seasons. Sightings of this species also occurred in inshore waters off the west coast. Almost all sightings were of single individuals, however groups of up to three animals together were recorded in the Irish Sea, these groups being aggregations of feeding individuals scavenging around fishing vessels. All sightings fell within the normal distribution of grey seals in Irish waters (Ó Cadhla *et al.*, 2007).

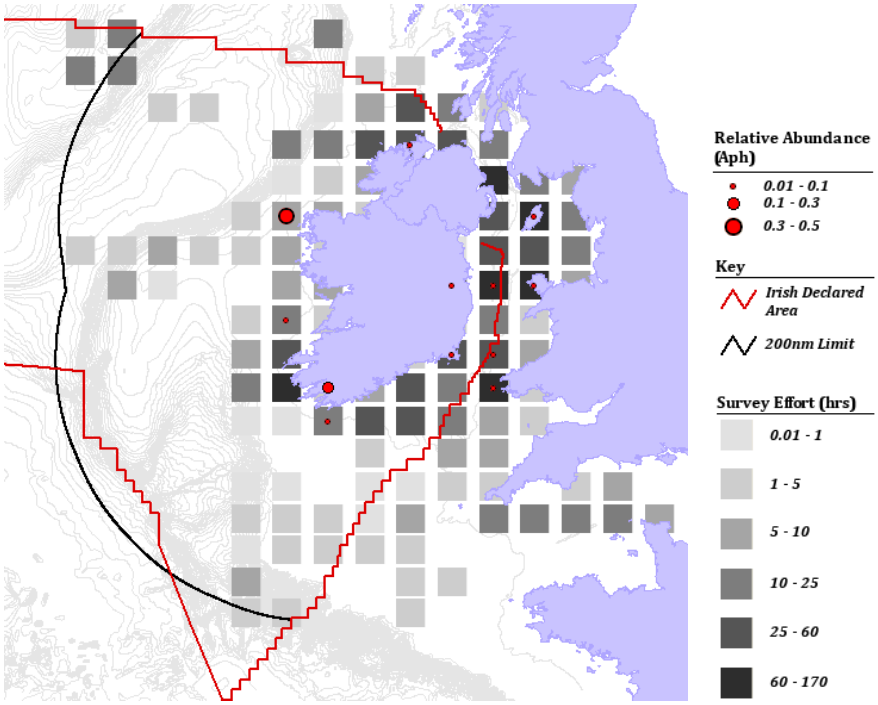



**Fig. 20** Map showing relative abundance of **grey seals** (all seasons combined) recorded between July 2001 and September 2009. Square shading indicates degree of survey effort. *Relative abundance measured in animals sighted per hour of survey effort (Aph) in sea state 3 or less.*

### *2.5. Survey Variables*

A number of contributing factors can affect the results of visuals surveys. One of the major factors is the weather. Sea state, swell and visibility can greatly affect the results of visual surveys. Such effects are species dependent with some species (such as harbour porpoise and beaked whales) very difficult to detect in conditions above sea state 2 (figure 21). Other species due either to their behaviour or the nature of their visual cues can be reliably detected in high sea states (e.g. the blows of large baleen whales can be reliably detected in sea state 5 or higher).

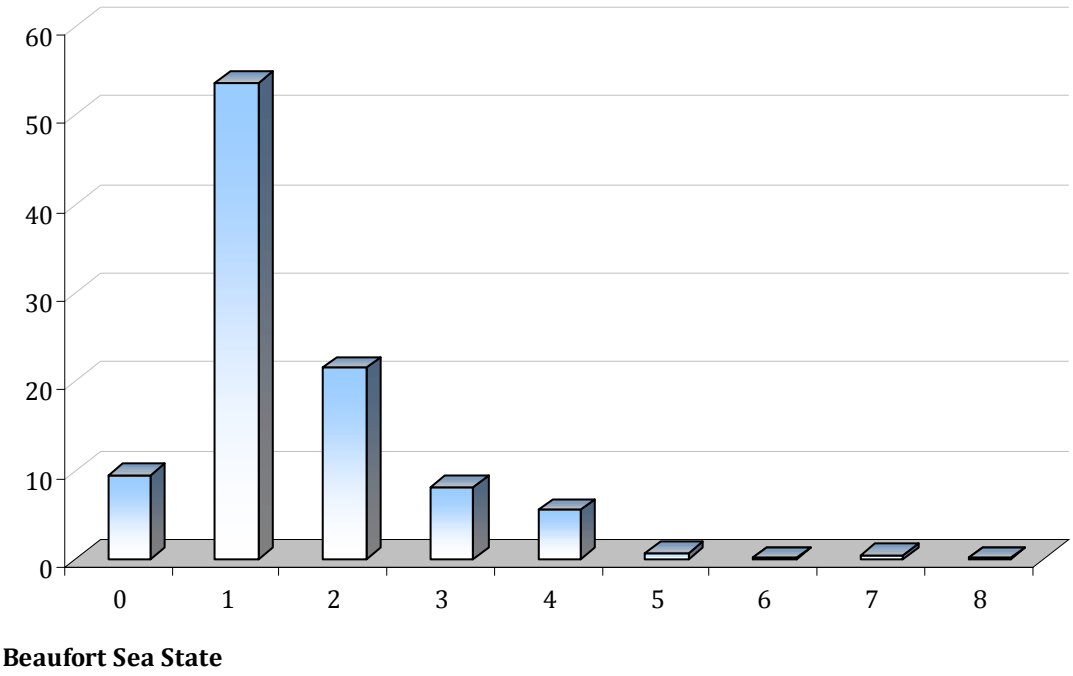


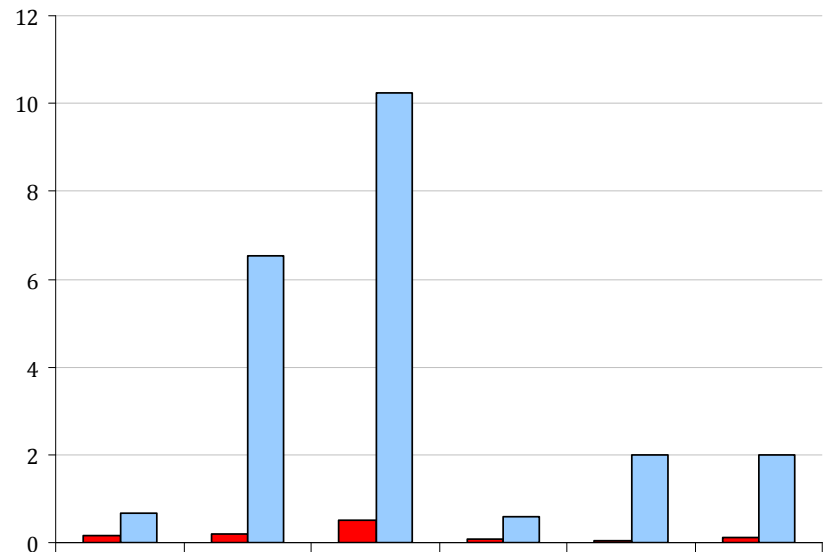

**Fig 21.** Graph showing sightings of harbour porpoise recorded in each sea state* as a percentage of all harbour porpoise sightings recorded. *The low number of sightings recorded in sea state zero reflects the low frequency of occurrence of this sea state within the areas surveyed.

Even in calm sea states, heavy swell may obscure animals at any distance from the ship, however more experienced surveyors can compensate for this to a degree by scanning the peaks of swells as they rise into view. The effects of sea state may also be somewhat compensated for by using a higher survey platform, for example on ferry surveys harbour porpoise were often detected in sea states of three and four due to the high vantage point of the surveyor.

The nature of the survey platform and its activity may also have an effect on the detection rate of cetaceans. Some species actively avoid boat traffic, especially larger

vessels. Commercial ferries provide a good platform for porpoise detection (despite their size) for two reasons. Firstly they typically provide a high observation height, with bridge heights of 15-30m above sea level, which allow the observer to scan well ahead of the vessel and to see down through wave troughs to detect the animals. Secondly they typically travel at high speed of 15-22knots, which means that porpoise are detected by the observer before they have had a chance to detect and react (by moving away) to the vessel. Research vessels typically offer a lower observation height typically 6-8m from the sea surface, though the height of the crow's nest on the R.V. *Celtic Explorer* is 17m above the sea surface, a height comparable with the bridge on smaller ferries. The nature of sound emissions from vessels may also vary, with some research vessels conducting acoustic surveys using scientific sonar, which may disturb cetaceans at a distance.

The experience of the surveyor can play a large part in the detection rate of cetaceans. Some surveyors have a natural ability for visual detection of cetaceans, others improve with time, and some do not improve significantly over time.




| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Sightings per Hour (X100) | 0.15 | 0.21 | 0.52 | 0.09 | 0.05 | 0.11 |
| Survey Time (Hrs/100) | 0.6823 | 6.518 | 10.257 | 0.568 | 1.99 | 1.9908 |

**Fig 22.** Graph showing sightings detection rates for 6 surveyors of varying experience alongside the survey effort logged by that surveyor. Detection rate was calculated as number of sightings per hour surveyed x 100. Survey effort was calculated as survey hours logged divided by 100.

In figure 22 we see the detection rate for 6 surveyors (detection rate measured as: sightings per hour surveyed x 100) versus the number of hours surveyed by each surveyor (divided by 100). The graph indicates that the highest detection rate is ten times greater than the lowest. It also indicates that surveyors with greater experience have a higher detection rate, however some surveyors with low levels of experience have higher detection rates than others with greater experience. While this example **does not** represent a full analysis of the data (for example areas surveyed will have an effect on the results as some areas have higher cetacean relative abundances than others), it does indicate that surveyor variability can have a significant effect on detection rates for cetaceans during surveys.

Survey method also plays a role in the cetacean detection rate. While some cetaceans actively approach ships, others actively avoid them. Therefore survey methods that focus in an area close to the vessel will have significantly lower detection rates and their sightings may be biased towards species that do not actively avoid ships.

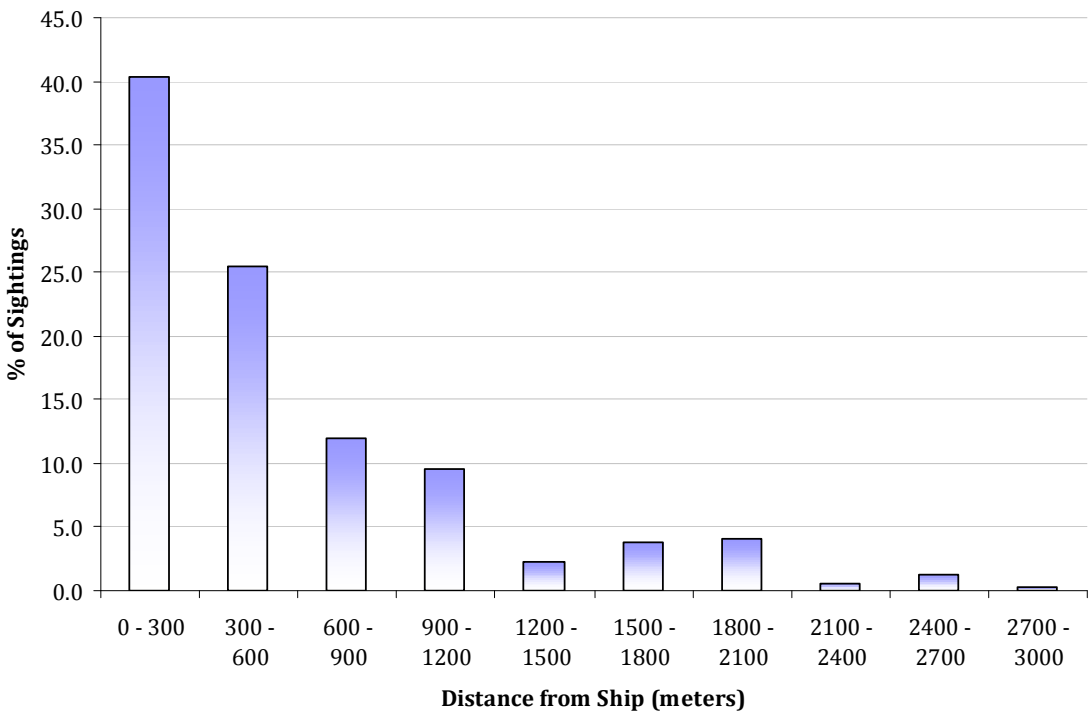



**Fig 23.** Graph showing number of sightings detected at 300m distance intervals as a percentage of all sightings recorded.

Figure 23 shows the number of sightings detected at 300m distance intervals (as a percentage of all sightings recorded) during these surveys. While there is a steady fall off in sightings with greater distance from the survey vessel (with 40.4% of sightings detected within 300m of the ship), more than half (59.6%) of all sightings were detected at distances greater than 300m, 42.2% were detected at distances greater than 500m and 20.9% were detected at distances greater than 1000m.

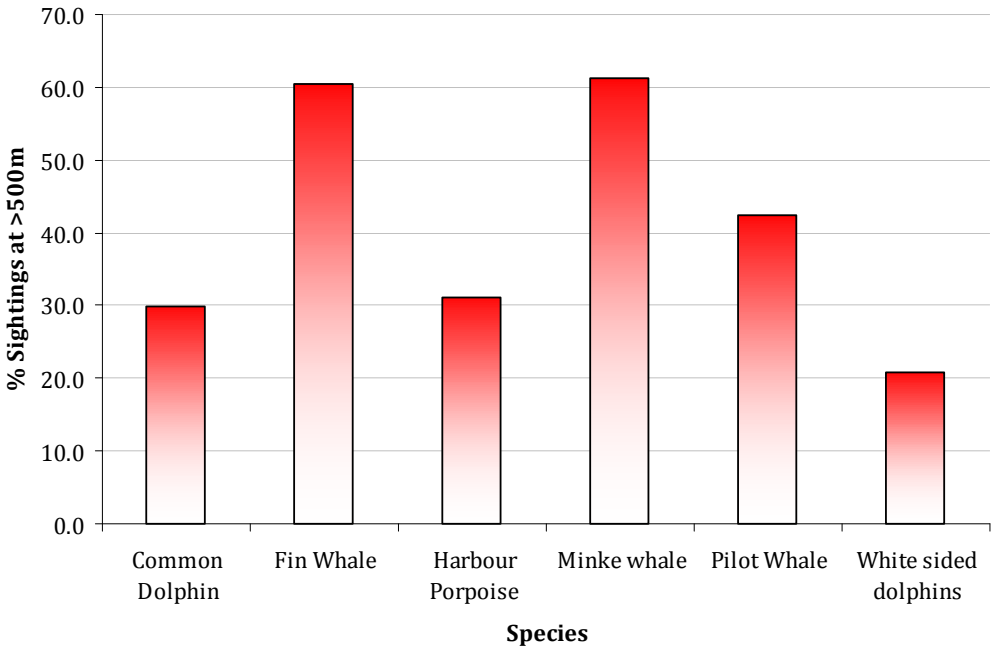



**Fig 24.** Graph showing percentage of sightings detected at ≥500m or for six cetacean species during this study.

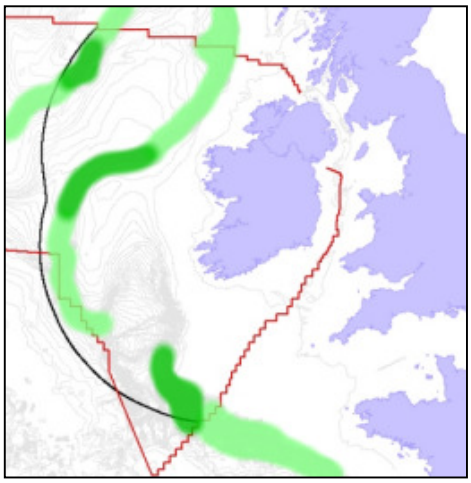
The number of sightings detected at greater distances is higher for some species than others (figure 24) and this should be taken into consideration when analysing sightings data collected using different survey methods.

## 3. Conclusions

### *3.1. Indicated and predicted core habitat for cetaceans in Irish waters.*

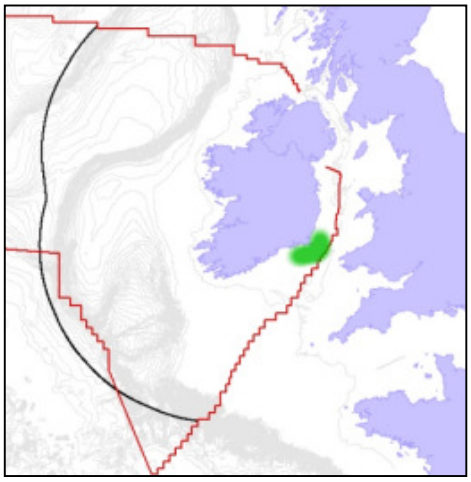
The results of these surveys have indicated a number of areas of core habitat (dark green shading) for cetacean species in Irish waters. **The maps below by no means include all areas of core habitat, or indeed, the habitats of highest priority for each species**, but are indicators, based largely on the data collected during these surveys, of areas core habitat for each species. Where enough data exists, predicted core habitat (light green shading) has been extrapolated, based on similarity to adjacent indicated core habitat.

***Long-finned Pilot Whale***



The slopes and canyons of the east and west slopes of the Rockall Trough were areas that appeared to be of particular habitat value to this species and warrant further survey effort. Pilot whales are deep diving squid feeders (predominantly) and these habitats may offer higher food abundance. The presence of calves (some very young, with neonatal folds clearly visible) within these habitats indicates that they were also used as breeding areas.

***Risso's Dolphin***



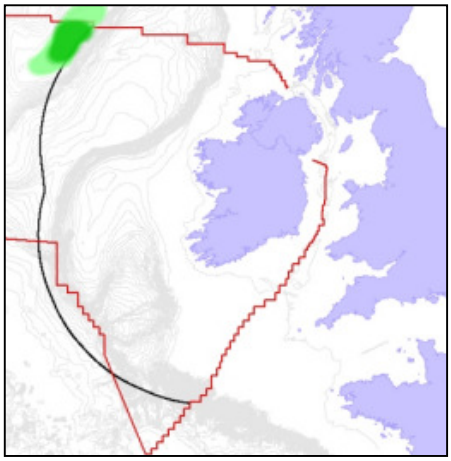
The area of greatest importance indicated for this species during these surveys, was the St. George's Channel between Rosslare and south Wales. There were consistent levels of Risso's dolphin activity in this area and calves have been sighted among some groups of animals (Sea Trust, 2009), indicating the area was of importance for breeding.

This species lends itself readily to photo-identification studies as animals are well marked and can become accustomed to survey vessels after a short period. A photo-identification study of these animals could be conducted at relatively low coast from small boats or a RIB and would generate useful data on populations size, reproductive rate, site fidelity and temporal habitat use.

### *Bottlenose Dolphin*

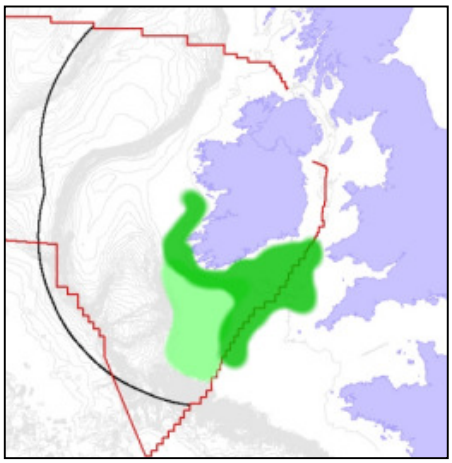
There was not enough data to indicate priority areas for this species.

### *Atlantic White-sided Dolphin*



The southern area of the Rockall Bank was where the highest relative abundance of white-sided dolphins was recorded during these surveys. It was the most common cetacean species encountered in that area. The relative abundance of Atlantic white-sided dolphins recorded during July 2004 in this area was comparable with relative abundances of common dolphins off the south and southwest coasts of Ireland, which makes the southern Rockall Bank the most important habitat for white-sided dolphins yet identified in Irish waters.

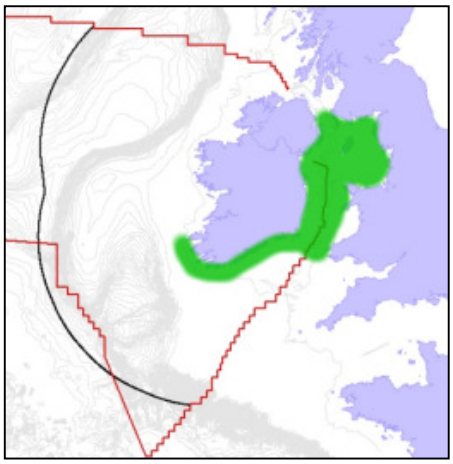
### *Short-beaked Common Dolphin*



The Irish shelf to the South and southwest of Ireland appeared to compose the core habitat for common dolphins in Irish waters. This area was particularly important in autumn when schooling pelagic fish represented an important food source for this species (Brophy *et al.*, 2009). The presence of calves (some with neonatal folds still present) indicated that this area was also of value as a breeding ground.

Particular hot spots of common dolphin activity within this area included the area to the south-west of the Aran Islands, the Celtic Deep and the Labadie Bank, however common dolphins are a highly mobile species that are though to follow food sources (Brophy *et al.*, 2009). The north end of the Celtic Deep and around the North Welsh coast appears to be seasonally important for common dolphins with an increasing number of super-pods of 1000+ animals being recorded here during the summer months (IWDG, 2009 and Sea Trust, 2009).

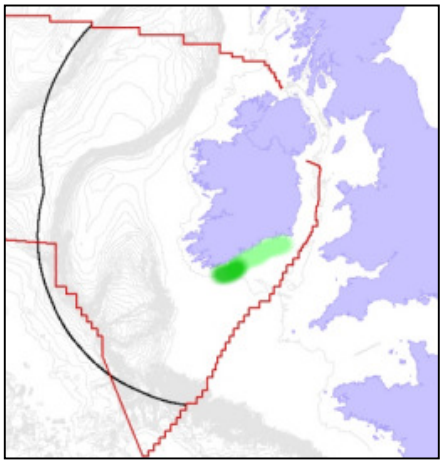
### *Harbour Porpoise*



The Irish Sea and St. George's Channel appeared to represent important habitat for this species in Irish waters. Relative abundance in the south Irish Sea and George's Channel appeared higher than in the north Irish Sea, however this may have been effort related and warrants further survey effort in the Northern half of the Irish Sea. The presence of calves within the area indicated it was used as a breeding ground.

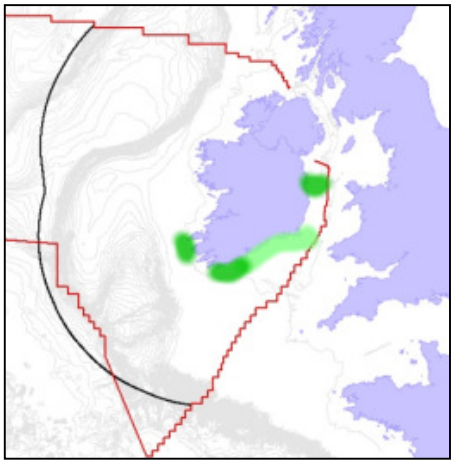
The lack of porpoise sightings from other areas (especially the Celtic Sea) was surprising, given the results from the SCANS II surveys (Hammond and Macleod, 2006) and the reason behind this warrants further investigation.

### *Fin Whale*



The area of most significance for fin whales indicated by the survey data was off the south coast, between Cape Clear and the Old Head of Kinsale. This was a seasonally important feeding ground for this species in Irish waters during the autumn and coincided with the presence of a large biomass of schooling pelagic fish (including herring, sprat and garfish).

### *Minke Whale*



There were a number of seasonally important feeding areas for minke whales in Irish waters indicated by the survey data. The first was in the western Irish Sea from late April to the end of July. This period was thought to coincide with the presence of a large biomass of pelagic schooling fish (including herring and sprat) in that area.

The second area was similar to that indicated for fin whales, lying off the south coast between Cape Clear and the Old Head of Kinsale, but including inshore waters in that area. Again this area was of significance in the autumn and was linked to the presence of a large biomass of pelagic schooling fish (including herring, sprat and garfish) in that area.

The third area lay off the southwest coast between the Blasket Islands and the Skellig Islands, encompassing the mouth of Dingle Bay. This area was important in the summer and autumn and was linked to the presence of a large biomass of pelagic schooling fish (mostly sprat) in that area.

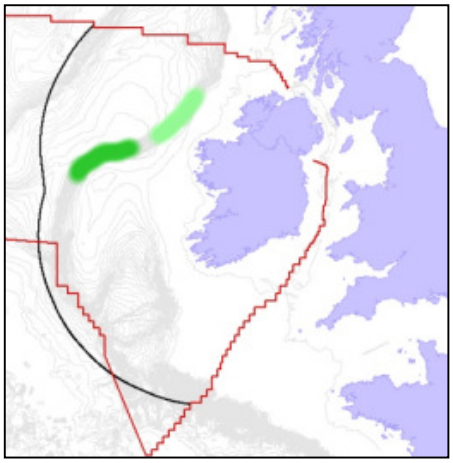
### *White-beaked Dolphin*

The data indicated that this species was not common in Irish waters and no priority habitats were indicated.

### *Striped Dolphin*

The data indicated that this species did not commonly occur in Irish shelf waters and no priority habitats were indicated.

### *Sowerby's Beaked Whale & Unidentified Beaked Whales*



The survey data indicated that the north slopes and canyons of the Porcupine Bank represented good habitat for beaked whale species. With further survey effort it is likely that similar habitat elsewhere on the shelf break will prove to provide important habitat for beaked whale species. Beaked whales are predominantly deep diving squid feeders and these habitats may offer higher food abundance.

### *Humpback Whale*

There was not enough data to indicate priority areas, however due to the similarity of its diet to fin whales and mile whales, the priority areas for these species were likely to be shared with humpback whales.

### *3.2. Suitability of Survey Method.*

The survey method used during these surveys was provided a cost effective tool for the collection of data on cetacean distribution and abundance. Such platforms provided opportunities to survey otherwise inaccessible offshore habitats and to provide platforms for long term monitoring of cetacean distribution and relative abundance in areas of interest (e.g. ferry surveys and Celtic Sea herring acoustic survey). Research vessels were particularly favourable platforms as the simultaneous collection of cetacean data along with environmental and physical oceanographic data (e.g. bathymetric data, benthic samples and fisheries data) enhanced interpretation of results and will assist in an ecosystem approach to marine habitat management.

Year-round surveys produced useful data on seasonal changes in distribution and relative abundance, despite effort being conducted in less than ideal survey conditions. Collection of distance and angle to sightings allows for the future analysis of these data to determine absolute abundance along the survey track (and possibly over wider areas by randomly selecting survey tracks over a that particular area).

Scanning ahead of the vessel, to the horizon, allowed for the detection of species that do not approach, or actively avoid, survey vessels and increased detection rates for all cetacean species (in contrast to surveys which focus on an area close to the ship).

The use of qualified and experienced surveyors is critical in areas where quality data for analysis is required. However surveyors must gain experience at sea. It is possible to send such surveyors on surveys in low priority areas, where survey platforms would otherwise go unused. As long as surveyors are clearly linked with any data they might generate during these surveys, the data can be selected out during analysis, if desired, to ensure data quality.

### 3.3. ***Value of Ferry Surveys Programme in Cetacean Monitoring.***

The IWDG Ferry Surveys Programme provided an ideal platform for surveyor training and for surveyors to gain experience. During these surveys it was possible to have one trainee surveyor surveying alongside a more experienced surveyor, thus collecting quality data while also helping trainings develop their survey skills.

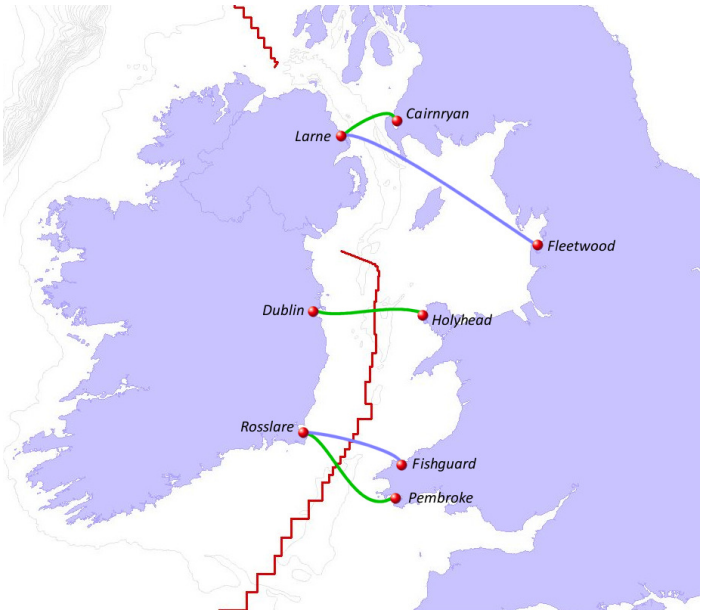



**Fig. 25.** Map showing three IWDG survey routes across Irish Sea (green lines) and two routes surveyed by UK NGO's (blue lines).

The IWDG Ferry Survey Routes form part of an international network of surveys conducted from platforms of opportunity. This network, the Atlantic Research Coalition (ARC) includes two other survey routes conducted across the Irish Sea by UK researchers (Marinelife UK and Sea Trust S&W Wales). Together these survey routes provide monthly monitoring survey coverage from the St. George's Channel

to the North Channel (fig. 25). With IWDG Ferry Surveys accounting for 94% of all harbour porpoise detections during the five research programmes covered by this report, the ferry surveys clearly provide a cost effective long-term temporal and spatial monitoring method for the harbour porpoise (and minke whale) population in the Irish Sea. The addition of a sixth route, south of the Isle of Mann is planned for 2010/2011.

Data from the ferry surveys have enabled the mapping of temporal distribution and relative abundance of harbour porpoise, minke whales and common dolphins in the Irish Sea. This is data that was not previously available and was obtained at minimal cost. With the addition of a new route south of the Isle of Mann and collaboration with partners in the UK, useful data on the spatial distribution of these species should also be achieved.

It is hoped that these surveys will continue to be supported during future funding initiatives as they provide an essential training platform for new surveyors, generate long-term data sets of cetacean temporal distribution and relative abundance for the Irish Sea and form part of a well-established international cetacean survey network (Brereton *et al.*, 2009). All this can be achieved at minimal cost, as this is a volunteer -based survey network.

### 3.4. ***Value of ISCOPE II offshore surveys in Cetacean Monitoring.***

Under ISCOPE II 1,436 hours of offshore survey effort and 317 hours of ferry survey effort were completed. Good spatial coverage of the Irish Sea was achieved in all seasons and of the St. George's Channel was achieved in autumn. Survey coverage of Northern Irish waters was achieved in all seasons, particularly in summer.

Three years of survey coverage was achieved of the feeding grounds of fin and humpback whales off the south and southwest coasts in autumn. These surveys also yielded good data on the distribution of common dolphins and minke whales during this season and indicated areas of core feeding habitat were obtained.

Three years of survey effort in slope and canyon habitat on the north and northwest slopes of the Porcupine Bank were obtained, with data indicating the presence of core habitat for beaked whales, pilot whales and sperm whales in this area.

Additional survey effort was achieved in the Whittard Canyon (SW Shelf Slopes), Celtic shelf and Rockall Bank and Trough.
Three more years of ferry survey effort on three routes across the Irish Sea were obtained adding to a long-term data set of survey effort on these routes. This 8-year data set now represents the longest continuous cetacean line-transect data set in Irish waters.

In all, the ship surveys and ferry surveys conducted under ISCOPE II recorded 1,040 sightings of 12 confirmed cetacean species, two seal species, basking sharks and turtles. 11,439 individual cetaceans were recorded. Data from ISCOPE II, when combined with data from previous surveys conducted by the IWDG, allowed seasonal distribution and relative abundance maps for three species (common dolphin, harbour porpoise and minke whale) to be mapped and for season-combined distribution and relative abundance maps to be created for five other cetacean species and one seal species.

Data from ISCOPE II surveys has contributed to a number of national and international studies (see section 3.5) and will be submitted to the Irish Joint Cetacean database to be hosted at the National Biodiversity Data Centre. The data will greatly increase the ability of the Irish State to meet its commitments on the reporting of favourable conservation status of Irish Cetaceans to the European Commission and form an important baseline data set for the ongoing monitoring of cetacean distribution, abundance and conservation status in Irish waters.

Overall these surveys have achieved their stated objectives of:

1. Providing a cost effective method for the collection of data on cetacean distribution and abundance in Irish waters, as an accompaniment to periodic Europe-wide surveys of cetacean absolute abundance (e.g. SCANS & CODA).

2. Providing a means of conducting long-term monitoring of cetaceans in Irish waters on fixed transects (ferry surveys).

3. Providing data indicating areas of conservation importance to cetaceans in Irish waters and highlighting areas where further research effort is required.

4. Providing a method of surveying habitats, species and seasons that are not adequately covered by periodic Europe-wide surveys (e.g. SCANS & CODA).

### *3.5. Uses of Survey Data.*

During the course of the West Coast Cetacean Survey, ISCOPE and ISCOPE II, survey data generated by these surveys has been used in a number of national and international projects and initiatives. Below is a list of collaborations, data requests and publications achieved using these data.

***Collaboration & Data Requests***

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**2009 – Joint Nature Conservation Committee, UK.** Second stage analysis for Joint Cetacean Protocol. – *Effort and sightings data from ship surveys and ferry surveys in the Irish Sea, St. George's Channel, Bristol Channel and North Celtic Sea.*

**2009 – NPWS, Ireland.** Project planning for NPWS Habitat mapping survey in 2009. – *Beaked whale sightings data from ship surveys.*

**2009 – SMRU Ltd., Scotland.** Strategic Environmental Assessment for offshore wind, wave and tidal development in Northern Ireland. – *Effort and sightings data from ship and ferry surveys in Northern Irish waters.*

**2009 – Northern Ireland Environment Agency, Northern Ireland.** Draft SAC Selection Assessment, Red Bay, County Antrim. – *Effort and sightings data from ship and ferry surveys in Northern Irish waters.*

**2008 – University of Aberdeen, Scotland.** How cetaceans around NW Europe are distributed in relation to climate (particularly sea temperature) and how their distribution is likely to change in the future, given predicted changes in climate from various climate models. (PhD Thesis). – *Sightings data from ship surveys and casual surveys around the Irish coast provided.*

**2008 – Galway-Mayo Institute of Technology, Galway.** GIS Modelling internship (funded by Leonardo da Vinci EU Programme scholarship) factors affecting the distribution of cetaceans off the south coast of Ireland during autumn. – *Effort and sightings data from ship surveys off the south coast Herring Acoustic Surveys provided.*

**2008 – University of Coleraine, Northern Ireland.** The Suitability of Geographic Information Systems for predicting habitat distribution for cetaceans off the Southwest Coast of Ireland (MSc Thesis). – *Effort and sightings data from ship surveys off the southwest coast provided.*

**2008 – Countryside Council for Wales, Wales.** Atlas of marine mammals in Welsh waters (Baines and Evans, 2009). – *Sightings and effort data from ferry surveys in Welsh waters.*

**2008 – Environment and Heritage Service, Northern Ireland.** Review of cetacean sightings and strandings data from Northern Ireland, with recommendations for the designation of Special Areas of Conservation. – *Sightings data from ship and ferry surveys in Northern Irish waters.*

**2007 – National Parks and Wildlife Service, Ireland.** The Status of EU Protected Habitats and Species in Ireland. – *Sightings data from ferry surveys and ship surveys in Irish waters.*

**2007 – Joint Nature Conservation Committee, UK.** Potential Use of Joint Cetacean Protocol Data for Determining Changes in Species' Range and Abundance: Exploratory Analysis of Southern Irish Sea Data (exploratory analysis for Joint Cetacean Protocol). – *Effort and sightings data from ferry surveys in the Irish Sea and St. George's Channel.*

**2007 – National Biodiversity Data Centre, Waterford.** Developing a Joint Cetacean Database for Ireland. – *Sample data from ferry surveys and ship surveys from Irish waters used in preparation of reports and database structure.*

***Publications****

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**Wall D., O'Brien J., Allen B.M. & Meade J. (2006)** Summer Distribution and Relative Abundance of Cetaceans off the West Coast of Ireland. Biology and Environment: Proceedings of the Royal Irish Academy. Vol. 106B, No. 2, 135-142.

**Wall D. (2006)** Leatherback Turtle *Dermochelys coriacea* (L.) sighting off west Cork. Irish Naturalists Journal, Vol. 28, No. 7, 308.

**Wall D., O'Brien J. & Meade J. (2005)** Basking shark *Cetorhinus maximus* (Gunnerus) off Co. Clare, Down and Donegal. Irish Naturalists Journal. Vol. 28, No. 3, 131.

** All publications are available to download from www.iwdg.ie/shipsurveys/*

***Conference Proceedings & Posters****

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**Wall D., P. Tyndall, R. Cosgrave, I. O'Kelly, P. Whooley, C. Ryan and R. Verling. (2009)** Feeding Aggregation of Large Rorquals on the Irish Shelf Slopes During Autumn 2008. *23rd Annual Conference, European Cetacean Society, Istanbul, Turkey.*

**Wall D., Tregenza N. and De Stigter H. (2008)** Exploring the Feasibility of Static Acoustic Monitoring for Deep Diving Whales: Long-finned Pilot Whales & Beaked Whales in the Whittard Canyon System. *22nd Annual Conference, European Cetacean Society, Egmond an See, The Netherlands.*

**MacLeod C.D., Bannon S.M., Brereton T. and Wall D. (2007)** Using passenger ferries to study seasonal patterns of minke whale occurrence In northwest Europe. *Proceedings of Workshop on Minke Whales at 21st Annual Conference, European Cetacean Society, San Sebastian, Spain.*

**Brereton T., MacLeod C., Wall D., Cermeño P., Curtis D., Macleod K., Martin C., Antonio Vazquez J., Benson C., Zanderink F. and Osinga N. (2007)** The Atlantic Research Coalition (ARC): Annual cetacean monitoring at a European scale. *(Poster) 21st Annual Conference, European Cetacean Society, San Sebastian, Spain.*

**Berrow S., Wall D. & Rogan E. (2005)** Recording stranded cetaceans in Ireland. Proceedings of Workshop on Strandings Networks, *19th Annual Conference, European Cetacean Society, La Rochelle, France.*

**Wall D. (2004)** Irish Seabed Survey 2004: Cetacean Distribution & Relative Abundance Survey: Progress Report. *(Poster) 5th Annual Symposium on the Flora and Fauna of Atlantic Islands, Dublin, Ireland.*

**Tom Brereton, Dave Wall, Andy Williams, Clive Martin, Tonio J. Vazquez, Pablo Cermeno & Dave Curtis (2004)** Pan-European cetacean monitoring: the Atlantic Research Coalition (ARC). *(Poster) 18th Annual Conference of the European Cetacean Society, Kolmården, Sweden.*

** All proceedings & posters are available to download from www.iwdg.ie/shipsurveys/*

***Reports****

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**Brereton T., MacLeod C.D., Wall D., Macleod K., Cermeño P., Curtis D., Zanderink F., Benson C., Bannon S., Osinga N., MartinC. and Pinn E. (2009)** Monitoring cetaceans in UK and adjacent waters: Current and potential uses of Atlantic Research Coalition (ARC) data. *ARC Report to the Joint Nature Conservation Committee, Peterborough, UK.*

**Wall D., O'Brien J., Allen B.M. & Meade J. (2004)** Summer Distribution and Relative Abundance of Cetaceans off the West Coast of Ireland. *Final Report to the Heritage Council of Ireland. Project reference 13552.*

**Tom Brereton, Dave Wall, Pablo Cermeno, Dave Curtis, Antonio Vasquez & Andy Williams (2004)** Cetacean monitoring in North-west European waters. *Atlantic Research Coalition (ARC) Report Number 1, 2001.*

** All reports are available to download from www.iwdg.ie/shipsurveys/*

***Cruise Reports****

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**Murray C. (2009)** Cetacean Distribution and Relative Abundance Survey during the AFBI Autumn Herring Acoustic Survey 2009. *Cruise Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Murray C. (2009)** Cetacean Distribution and Relative Abundance Survey during the AFBI Biological Oceanography Survey 2009. *Cruise Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Murray C. (2009)** Cetacean Distribution and Relative Abundance Survey during the AFBI Nephrops Survey 2009. *Cruise Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Murray C. (2009)** Cetacean Distribution and Relative Abundance Survey during the AFBI Summer Herring Acoustic Survey 2009. *Cruise Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Murray C. (2009)** Cetacean Distribution and Relative Abundance Survey during the AFBI Juvenile Gadoid Survey 2009. *Cruise Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Murray C. (2009)** Cetacean Distribution and Relative Abundance Survey during the AFBI Groundfish Survey 2009. *Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Tuffy P. (2009)** Cetacean Distribution and Relative Abundance Survey during AFBI Gadoid Survey 2009. *Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Murray C. (2009)** Cetacean Distribution and Relative Abundance Survey during the Marine Institute Nutrient Survey 2009. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Tuffy P. (2008)** Cetacean Distribution and Relative Abundance Survey during IFREMER Groundfish Survey 2008. *Report to the French Institute for the Exploitation of the Sea.*

**Murray C. (2008)** Cetacean Distribution and Relative Abundance Survey during CEFAS Groundfish Survey 2008. *Report to the Centre for Environment, Food and Agriculture Sciences, Suffolk, England.*

**Tuffy P. (2008)** Cetacean Distribution and Relative Abundance Survey during AFBI Groundfish Survey 2008. *Report to the Agriculture, Food and Biosciences Institute, Belfast.*

**Murray C. (2008)** Cetacean Distribution and Relative Abundance Survey during AFBI Nephrops Assessment Survey 2008. *Report to the Agri-Food and Biosciences Institute, Northern Ireland.*

**Baer J. (2008)** Cetacean Distribution and Relative Abundance Survey during CEFAS Irish Sea Plankton Survey 2008. *Report to the Centre for Environment, Fisheries & Aquaculture Science and the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2007)** Cetacean Distribution and Relative Abundance Survey during FSS Southwest Herring Acoustic Survey 2007. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2007)** Cetacean Distribution and Relative Abundance Survey during FSS Deep Water Survey 2007. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2007)** Cetacean Distribution and Relative Abundance Survey during NIOZ Canyons Survey 2007. *Report to the Royal Netherlands Institute for Sea Research and the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2007)** Cetacean Distribution and Relative Abundance Survey during Rockall Trough Oceanographic Survey 2007. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2007)** Cetacean Distribution and Relative Abundance Survey during FSS Northwest Herring Acoustic Survey 2007. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2006)** Cetacean Distribution and Relative Abundance Survey during FSS Southwest Herring Acoustic Survey 2006. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2006)** Cetacean Distribution and Relative Abundance Survey during FSS Deep Water Survey 2006. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2005)** Cetacean Distribution and Relative Abundance Survey during FSS Southwest Herring Acoustic Survey 2005. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2005)** Cetacean Distribution and Relative Abundance Survey during Irish Seabed Survey: Leg 17. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**O'Brien J. (2004)** Cetacean Distribution and Relative Abundance Survey during FSS Northwest Herring Acoustic Survey 2004. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D., O'Brien J., Meade J. & Allen B.M. (2004)** Summer Distribution and Relative Abundance of Cetaceans off the West Coast of Ireland. *Final report to the Heritage Council, Kilkenny, Ireland.*

**O'Brien J. (2004)** Cetacean Distribution and Relative Abundance Survey during FSS Blue Whiting Survey 2004. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**O'Brien J. (2004)** Cetacean Distribution and Relative Abundance Survey during FSS Northwest Herring Acoustic Survey 2004. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

**Wall D. (2003)** Cetacean Distribution and Relative Abundance Survey during FSS Groundfish Survey 2003. *Report to the Marine Institute, Oranmore, Galway, Ireland.*

## 4. References


**Baines, M.E. and Evans, P.G.H. (2009).** Atlas of the Marine Mammals of Wales. *CCW Monitoring Report No. 68.*

**Baird R.W. (2005)** Sightings of Dwarf (*Kogia sima*) and Pygmy (*K. breviceps*) Sperm Whales from the Main Hawaiian Islands. *Pacific Science, vol. 59, no. 3:461–466.*

**Berrow, S.D., Whooley, P. and Ferriss, S. (2001)** Irish Whale and Dolphin Group cetacean sighting schemes: development of a system to record sightings of cetaceans (whales, dolphins and porpoises) in Irish waters. *Final report to the Heritage Council (Ireland), Kilkenny.*

**Brereton T., MacLeod C.D., Wall D., Macleod K., Cermeño P., Curtis D., Zanderink F., Benson C., Bannon S., Osinga N., MartinC. and Pinn E. (2009)** Monitoring cetaceans in UK and adjacent waters: Current and potential uses of Atlantic Research Coalition (ARC) data. *ARC Report to the Joint Nature Conservation Committee, Peterborough, UK.*

**Brophy J. T., Murphy S. and Rogan, E. (2009)** The diet and feeding ecology of the short-beaked common dolphin (*Delphinus delphis*) in the northeast Atlantic. Paper SC/61/SM 14 presented to the IWC Scientific Committee, June 2009, Madeira, Portugal, (unpublished). 18pp

**Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O' Keeffe, C. (2004).** Harbour seal population assessment in the Republic of Ireland: August 2003. *Irish Wildlife Manuals, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.*

**Cronin, M. and Mackey, M. (2002)** Cetaceans and seabirds in waters over the Hatton-Rockall region. ***Unpublished Cruise Report, Coastal and Marine Resources Centre, University College Cork.***

**Doyle, T. K. (2007)** Leatherback Sea Turtles (*Dermochelys coriacea*) in Irish waters. *Irish Wildlife Manuals, No. 32. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.*

**Hammond P. and Macleod K. (2006)** Progress report on the SCANS II project. *ASCOBANS Committee, Finland, April 2006.*

**Houghton J.D.R., Doyle T.K., Wilson M.W., Davenport J. and Hays G.C. (2006)** Jellyfish aggregations and leatherback turtle

foraging patterns in a temperate coastal environment. *Ecology, 87(8), 2006, pp. 1967–1972.*

**IFAW (2000)** Logger 2000 software. *International Fund for Animal Welfare, London.*

**IWDG (2009)** IWDG Cetacean Sightings Database (Rep. Ireland & Northern Ireland). *http://www.iwdg.ie/Iscope/*

**Moulins A., Rosso M., Nani B. and Würtz M. (2007)** Aspects of the distribution of Cuvier's beaked whale (Ziphius cavirostris) in relation to topographic features in the Pelagos Sanctuary (north-western Mediterranean Sea). *J. Mar. Biol. Ass. U.K., 87, 177–186.*

**Northridge, S.P., Tasker, M., Webb, A. and Williams, J.M. (1995)** Distribution and relative abundance of harbour porpoises (*Phocoena phocoena* L.), white-beaked dolphins (*Lagenorhynchus albirostris* Gray), and minke whales (*Balaenoptera acutorostrata Lacepede*) around the British Isles. *ICES Journal of Marine Science 52, 55-66.*

**Ó Cadhla, O., Strong, D., O'Keeffe, C., Coleman, M., Cronin, M., Duck, C., Murray, T., Dower, P., Nairn, R., Murphy, P., Smiddy, P., Saich, C., Lyons, D. & Hiby, A.R. (2007).** An assessment of the breeding population of grey seals in the Republic of Ireland, 2005. *Irish Wildlife Manuals No. 34. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.*

**Ó Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. & Connolly, N. (2004).** Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II – Cetacean distribution & abundance. *Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38. 82pp.*

**Reid, J.B., Evans, P.G.H. and Northridge, S.P. (2003)** Atlas of Cetacean Distribution in northwest European Waters. Joint Nature Conservation Committee, Peterborough, UK.

**Rogan, E. and Berrow, S.D. (1995)** The management of Irish waters as a whale and dolphin sanctuary. *In A.S. Blix, L. Walløe and Ø. Ulltang (eds), Whales, seals, fish and man, 671..81. Amsterdam. Elsevier Science.*

**Wall D., O'Brien J., Meade J. & Allen B.M. (2006)** Summer distribution and relative abundance of cetaceans off the west coast of Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy, 106B (2), 135 - 142.*

**Sea Trust (2009)** Sea Trust UK sightings reports. *http://www.seatrust.org.uk/*

**Williams A.D., Brereton T.M. & Williams R. (1999)** Seasonal variation in the occurrence of beaked whales in the southern Bay of Biscay. *In Proceedings of the thirteen annual conference of the European Cetacean Society, Valencia, Spain, 5–8 April 1999. European Research on Cetaceans—13*

*(ed. P.H. Evans), pp. 275–280. Cambridge: European Cetacean Society.*