Marine Research Sub-Programme
(NDP 2007–'13) Series

SeaChange
Casadh na Taoide

# Marine Mammals and Megafauna in Irish Waters - Behaviour, Distribution and Habitat Use. *Monitoring Spatial and Temporal Habitat Use and Abundance of Species*

Project-based Award

*Lead Partner: Galway Mayo Institute of Technology/ Irish Whale and Dolphin Group*

NDP National Development Plan
Transforming Ireland

*An Roinn Ealaíon, Oidhreachta agus Gaeltachta*
*Department of Arts, Heritage and the Gaeltacht*

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## Marine Research Sub-Programme 2007–2013

## *Project-based Award*

# *Marine Mammals and Megafauna in Irish Waters - Behaviour, Distribution and Habitat Use* *(PBA/ME/07/005(02))*

## *WP1 Monitoring Spatial and Temporal Habitat Use and Abundance of Cetaceans*


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# PREFACE

## Introduction

Irish waters are internationally important for cetaceans (whales, dolphins and porpoises), with 24 species recorded to date (Berrow, 2001). These range from the harbour porpoise, the smallest species in European waters, to the blue whale, the largest animal to ever have lived on Earth. Some species are relatively abundant and widespread while others are extremely rare and have never been sighted in Irish waters, only known from carcasses stranded on the Irish coast. At least 12 cetacean species are thought to calve within the Irish Exclusive Economic Zone (EEZ)[1] (Berrow, 2001). Marine mammals, including cetaceans and seals, represent almost 50% of the Irish native mammal fauna and, thus, Ireland has a significant conservation obligation to them and their habitats. In 1991 the Irish government recognised the importance of Ireland for cetaceans by declaring all Irish waters within the EEZ a whale and dolphin sanctuary (Rogan and Berrow, 1995).

This diversity of cetacean species in Ireland reflects the range of marine habitats, which extend to 200 nautical miles (nmls) (370km) offshore and comprise an area of 453,000km$^2$. This is a little over six times the area of the land of Ireland. These habitats range from shallow continental shelf waters to shelf slopes, deep-water canyons, offshore banks, carbonate mounds and associated deep water reef systems and abyssal waters.

## Legal Framework

All cetaceans and their habitats are protected under Irish and international law. The Wildlife Act[2] and Wildlife (Amendment) Act[3] entitle all cetaceans and their habitats up to 12nmls from the coast to full protection, including from disturbance and willful interference. All cetacean species occur on Annex IV of the EU Habitats Directive[4] and are, thus, entitled to strict protection, including prevention of deliberate capture or killing, prevention of deliberate disturbance, prevention of deterioration of breeding or resting sites and prevention of capture for sale. There is also a requirement to monitor the incidental capture or killing of these species. Two species, the harbour porpoise and bottlenose dolphin, are on Annex II, which requires the designation of Special Areas of Conservation (SACs) to protect a representative range of their habitats. To date, two candidate SACs have been designated for the harbour

[1] EEZ: a seazone in which a state has special rights over the exploration and use of marine resources.
[2] Wildlife Act (1976)
[3] Wildlife (Amendment) Act (2000)
[4] Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora

porpoise – Roaringwater Bay, Co Cork, and the Blasket Islands, Co Kerry – and one for the bottlenose dolphin – the Lower River Shannon. The European Court of Justice (ECJ) ruled in February 2009 that the Irish government had failed to 'put in place a comprehensive, adequate, ongoing monitoring programme for cetaceans that could enable a system of strict protection for those species to be devised'.

Under Article 17 of the Habitats Directive, each member state must report on the status of all species and habitats listed under the Habitats Directive which occur within the state. The first reporting round was completed in 2007 and covered the period 2000–2007. A conservation assessment requires information on range, habitat, population and future prospects. The conservation assessments for cetacean species were considered very inadequate due to a significant lack of data on range, habitat and population estimates for nearly all cetacean species in Irish waters. The next reporting round will be completed in 2013 and the National Parks and Wildlife Service (NPWS) must ensure that available data are adequate to make a proper conservation assessment, at least for the most abundant and widespread species.

In December 2009, the National Parks and Wildlife Service (NPWS) published its Conservation Plan for Cetaceans in Irish Waters[5]. This plan lists 41 actions. These include conducting further research to determine the distribution, relative abundance and habitat preferences of cetaceans (Action 1); identifying breeding ecology, movements and migration routes (Action 2); devising a programme to effectively monitor cetaceans inside and outside designated areas (Action 3); encouraging the development of passive acoustic monitoring (Action 4); exploring the possibility of using static acoustic monitoring to provide data for monitoring cetaceans (Action 9); including cetacean surveys on fisheries cruises to collect information on the possible relationships between fish and cetacean abundance (Action 18); and carrying out spatial monitoring using GIS to explore the relationship between cetacean distribution and fisheries (Action 19).

The Irish government also has legal obligations to protect cetaceans and other marine megafauna, and their habitats, under a range of other legislation. This includes the Convention on the Conservation of Migratory Species[6] (Bern Convention) and the Convention on the Conservation of European Wildlife and Natural Habitats[7] (Bonn Convention). Under the

[5] Conservation Plan for Cetaceans in Irish Waters (2009). Department of Environment, Heritage and Local Government.
[6] Convention on the Conservation of Migratory Species of Wild Animals (1979)
[7] Convention on the Conservation of European Wildlife and Natural Habitats (1979)

OSPAR Convention[8], Ireland is obliged to address recommendations on the protection and conservation of species, habitats and ecosystems that make it not only relevant to marine mammals and turtles but also to basking sharks.

The National Biodiversity Data Centre recently established a marine mammal database. The data collected during this project will be used for this database in order to make the data available for a range of assessments, including Environmental Impact Assessments, Strategic Environmental Assessments and Appropriate Assessments.

Amendments to the EU Common Fisheries Policy require an Ecosystem Approach to Fisheries Management (EAFM). This requires data on the predators as well as the fish prey and the drivers linking the different ecological systems. This presents a great challenge and member states are exploring how such an approach can be implemented.

The development of a sustainable marine tourism industry has been identified as a national priority by both the Marine Institute and Fáilte Ireland. While marine wildlife tourism has great potential as a high spend product for peripheral coastal regions, the species targeted are usually protected and populations often depleted through over-exploitation. Information on the distribution, abundance and status of these species is essential for responsible development of this resource.

## Marine Mammals and Megafauna in Irish Waters – Behaviour, Distribution and Habitat Use

The research termed *Marine Mammals and Megafauna in Irish Waters – behaviour, distribution and habitat use* attempted to address some of these issues. The project was delivered under six Work Packages. Work Package 1 attempted to increase coverage of offshore waters using platforms of opportunity (both ship and aircraft) to map the distribution and relative abundance of marine megafauna within the EEZ and provide recommendations on how best to meet monitoring obligations for these species. Work Package 2 attempt to develop static and passive acoustic monitoring techniques in order to use these techniques to monitor Annex II species within SACs. Under Work Package 3, we intended to develop experience and capacity in the biotelemetry of marine megafauna through satellite tracking of fin whales (*Balaenoptera physalus*). In Work Package 4, results from eight years of cetacean and other marine megafauna

[8] Convention for the Protection of the Marine Environment of the North-East Atlantic (1992)

surveys concurrent with the Celtic Sea Herring Survey organised by the Marine Institute were used to create a GIS in order to explore ecosystem links.

Thus, the deliverables under this project will provide data which could be used to address a wide range of issues and will contribute to developing policy advice on meeting Ireland's statutory obligations.

# Executive Summary

Cetacean line transect surveys were conducted under Work Package 1 with the following goals:

1. Providing a baseline cetacean distribution and relative abundance data set for the Irish EEZ;
2. Filling spatial and temporal gaps identified in cetacean survey effort within the EEZ;
3. Preparing an Atlas of cetacean distribution and relative abundance for Irish waters;
4. Assessing the temporal use of marine habitats by cetaceans in Irish waters.

Three years of visual surveys of cetacean line transect surveys were conducted by a team of observers, using platforms of opportunity (ships and aircraft accessed at zero charter cost). The survey effort was focused within the Irish Exclusive Economic Zone, outside of the Irish Sea.

In total, 2,305 hours of visual survey effort were conducted during 563 days at sea between March 2008 and January 2011. In addition, 53.3 hours of visual survey effort were conducted during 16 patrol flights with the Irish Air Corps Maritime Squadron between May 2008 and June 2011. Surveys were conducted in all seasons, with the greatest amount of effort and widest geographic coverage achieved in the spring and summer seasons.

A total of 1,301 sightings of 12,942 individual cetaceans were recorded. These included sightings of rarely encountered species such as blue whale and Sowerby's beaked whale. Short-beaked common dolphin was the most abundant and widespread cetacean species encountered over the Irish shelf. Long-finned pilot whale was the most abundant and widespread cetacean in deep water habitats (200m+). The most frequently encountered baleen whale was the fin whale, which was seasonally abundant off the south coast and on the northwest shelf slopes. Sperm whales were frequently encountered on the shelf slopes and in deeper waters, and are possibly the most widespread and abundant large whale species in deep water habitats of the Irish EEZ.

Sightings of two seal species were recorded, with the grey seal accounting for 95% of seal sightings. Seven sightings of basking sharks and three sightings of leatherback turtles were also recorded.

Of the 17 cetacean species recorded during the survey, sufficient data were collected to enable seasonal distribution and relative abundance maps to be prepared for seven of them (fin whale, minke whale, sperm whale, long-finned pilot whale, bottlenose dolphin, short-beaked common dolphin and harbour porpoise). For all other species, a single distribution and relative abundance map, combining data from all seasons, was prepared. Three of the species for which seasonal data were available (fin whale, minke whale and common dolphin) showed strong seasonal changes in habitat use (distribution) and abundance. For minke and fin whales, a temporal (time-related) absence from the Irish EEZ was apparent.

Evidence of calving (indicated by the presence of calves or juveniles in a group) was recorded for eight species (fin whale, sperm whale, pilot whale, Risso's dolphin, bottlenose dolphin, common dolphin, harbour porpoise and beaked whale). In the case of fin and sperm whales, one juvenile was recorded in each case. However, the species are not thought to regularly calve in Irish waters. Comparison with past data sets indicated an increase in sightings of humpback whales, fin whales and beaked whales, although such increases may be a product of differing survey methods and/or survey areas. The data also suggest a decrease in sightings of cold water species such as white-beaked dolphin and Atlantic white-sided dolphin.

Two dedicated multi-disciplinary surveys targeting slope and canyon habitats off the west coast of Ireland were undertaken on board the Irish state research vessel *Celtic Explorer*. The surveys involved collaborators from seven different institutions, collecting data on a range of species and parameters, from oceanographic sampling, micro plankton and macro plankton to cetaceans and seabirds.

A number of sub-reports into aspects of offshore habitat use by cetaceans and survey methods and protocols are also included in this report.

## Aerial Surveys

Aerial surveys, conducted on board the Irish Air Corps Maritime Squadron CASA patrol aircraft, recorded 89 sightings of eight different cetacean species, totalling 866 individuals. An assessment of the use of on-board radar for detecting cetaceans showed the system to be limited in its ability to detect cetaceans at the surface and only capable of detecting them in very fine weather. Recommendations on how an automated visual survey system utilising HD video linked to a position and altitude logger could be used to gain maximum benefit from this unique state resource were made.

## Offshore Bottlenose Dolphins

An assessment of the use of offshore habitats by bottlenose dolphins was conducted, summarising what is known of their offshore distribution and habitat preferences in Irish waters. Offshore bottlenose dolphins showed a preference for continental slope habitat in contrast to a preference for coastal and estuarine habitats exhibited by inshore dolphins. Data from dorsal fin photo-identification, when coupled with the latest published data on Irish bottlenose dolphin population genetics and distribution data from visual surveys, suggests that an offshore ecotype of bottlenose dolphin may exist within the Irish EEZ. The probable presence of an offshore population of bottlenose dolphins within the Irish EEZ warrants further targeted survey effort, incorporating genetic sampling, acoustic recording and photo-identification studies.

## Large Rorqual Migration

The seasonal use of Irish coastal and offshore habitats as foraging and migratory areas for large rorquals (baleen whales) was assessed. Blue and fin whales have been detected acoustically by the US military SOSUS hydrophone array from June through March, with migrating fin whales moving south along the western shelf slopes from August to February and blue whales from July to January. Sightings recorded during these surveys fall within the indicated period of migration. Foraging fin whales were recorded off the south coast from June to January. SOSUS data showed a short migratory period of southward-moving humpback whales off the west coast of Ireland from January to March and foraging humpbacks were present off southern coasts from July to February. Little is known of the relationship between the migratory large rorquals, which occur annually along the Irish shelf slopes, and the animals which forage in waters off the south coast each autumn and winter. Further research is required to define the relationship between the two events and to identify which Atlantic populations the large rorquals occurring in Irish waters belong to.

## Recommendations on Future Cetacean Monitoring on board Platforms of Opportunity

The availability and suitability of platforms of opportunity operating within the Irish EEZ from 2009 to 2011 was analysed with a view to assessing the potential for future cetacean monitoring efforts using such platforms. Between January 2009 and December 2011, some 3,019 survey days were scheduled by Irish and foreign research vessels for surveys conducted partially or completely within the Irish EEZ. To provide a monitoring programme within the framework of the requirement for reporting to the EU on the favourable conservation status of Irish cetacean species, no single survey or survey method will provide robust data on all cetacean species in Irish waters.

In an effort to prioritise surveys to be targeted by ongoing visual cetacean survey effort, platform suitability was prioritised based on a number of factors, including visual survey hours achieved per day at sea, geographical and seasonal coverage obtained, habitat types targeted and data enhancement due to the nature of the host survey. Priority one surveys included surveys providing wide geographic coverage along fixed transects and were repeated annually (or triennially), for example, southwest herring acoustic survey and mackerel egg surveys. Priority two surveys provided reasonable spatial coverage of habitats in seasons outside of those covered by the priority one surveys, for example, Irish groundfish and deep water surveys. Priority three surveys targeted specific habitats, species or temporal periods which were difficult to achieve using other surveys, for example, deep water canyon surveys and one-off surveys offering wide spatial coverage. Additional survey effort for the purposes of filling data gaps may be achieved using other platform types, such as naval service patrols.

In addition to the use of platforms of opportunity, targeted dedicated visual and acoustic surveys of specific species and habitats will be required to achieve specific conservation or monitoring goals.

Protocols for the collection and storage of visual cetacean survey data from ships and aircraft of opportunity were developed based on survey experience, scientific best practice and ensuring compatibility with European data sets and data storage protocols.

Overall the results show a high level of diversity of cetacean species and a high level of the spatial and temporal use of offshore marine habitats by cetacean and megafauna species in Irish waters. The use of platforms of opportunity provided a highly cost-effective means of surveying a wide geographical area and of obtaining seasonal information on the abundance and distribution of cetaceans within the Irish EEZ. The collection of cetacean data alongside oceanographic, fisheries and habitat data enhanced the value of the data collected. Multidisciplinary data collection also allowed for current and future analysis of spatial and temporal use of marine habitats by cetaceans in terms of the physical, chemical and biological characteristics of those habitats.

# 1 INTRODUCTION

As an island at the northwest Atlantic frontier of Europe, Ireland has one of the largest Exclusive Economic Zones (EEZ) in Europe. Currently the Irish EEZ (extending out to a 200nml limit) covers some 890,000 square kilometres of marine habitats. The Irish government is currently negotiating an extension of the EEZ to 300nml, to include the Hatton Bank and continental shelf areas to the west of Rockall and in the southern Celtic Sea, , which will increase the area further. Ireland has an obligation to report to the European Union on the favourable conservation status (FCS) of protected species every six years and this requires comprehensive species and habitat monitoring networks at national level.

Much of the previous distribution and abundance data on cetaceans in Irish waters was gathered as secondary data to seabird surveys conducted under the European Seabirds At Sea (ESAS) survey programme by JNCC (Pollock *et al,* 1997) and CMRC (O'Cadhla *et al,* 2004). Estimates of absolute cetacean abundance (during dedicated cetacean surveys) have been conducted during two SCANS surveys, in 1994 and 2005 (Hammond *et al,* 2002; Hammond, 2006), the SIAR survey in 2000 (O'Cadhla *et al,* 2004) and the CODA survey in 2007 (Hammond *et al,* 2010). Such abundance surveys were extremely seasonal in nature, being conducted during a single summer month and providing a snapshot in space and time of cetacean distribution and relative abundance within all or part of the Irish EEZ. Due to the high cost of such surveys, they were repeated on a very infrequent basis, with a decade passing between SCANS I and SCANS II.

A more structured and long-term data collection and storage system for inshore monitoring of cetaceans was developed under the IWDG ISCOPE project, which involved effort-related, land-based inshore monitoring (Berrow *et al,* 2010). This built on the IWDG's casual sightings database, which has been in operation since 1991.

Offshore monitoring has been less structured, with surveys typically of short duration, ranging from one month for the SCANS and CODA surveys to six months for the IWDG West Coast Cetacean Survey (Wall *et al*, 2006) to three years for the Petroleum Infrastructure Programme-funded CMRC surveys (O'Cadhla *et al,* 2004). From 2006 to 2009, the IWDG conducted an offshore line-transect survey effort on board Irish and EU research vessels as part of the ISCOPE II project (Wall and Murray, 2009). The IWDG has also conducted long-term fixed transect cetacean surveys on commercial ro-ro ferries across the Irish Sea since 2001, as part of an Europe-wide network of similar surveys (Brereton *et al*, 2011). The NPWS has also commissioned a series of localised visual and acoustic surveys of bays and inshore areas from 2007 to the present (Berrow *et al,* 2007; Leeney, 2007; Berrow *et al,* 2008; Berrow *et al,* 2008b; Ingram *et al,* 2009; Oudejans *et al,* 2010; Ryan *et al,* 2010b).

Offshore visual cetacean survey methods have differed according to survey and survey operator. Generally surveys fit into three survey methodologies:

1. ESAS-type surveys: Cetacean distribution and relative abundance data has been collected during European Seabirds at Sea surveys. These surveys focus on a 300m2 box to one side of the vessel and are primarily designed to collect data on seabirds resting on the surface of the sea or flying overhead. Cetacean data is collected as secondary data. Effort data is also recorded. The data from ESAS surveys is typically used to estimate the relative abundance of cetaceans.

2. SCANS-type surveys: A team of four to eight surveyors conduct a double platform line transect survey effort. Two surveyors on the upper platform scan well ahead of the ship with the aid of binoculars to record animals before they are either attracted to or are scared away from the vessel. Two surveyors on the lower platform scan by eye an area close to the ship for cetaceans. Angle and distance to each sighting is recorded, as is effort. SCANS-type surveys can be used to calculate absolute abundance by using data from the upper platform to estimate the rate of missed sightings of the lower platform.

3. Single Platform Line Transect Surveys: One or two surveyors (maybe more in the case of ferry surveys) conduct a line transect survey effort from a single platform. Surveyors focus on a 90-degree arc ahead of the vessel (along its track) but will record sightings up to 90-degree to port or starboard. Angle and distance to the sighting is also recorded. The data from Single Platform Line Transect Surveys is typically used to estimate the relative abundance of cetaceans. However, sufficient data is collected to allow for the estimation of absolute abundance along the track line and perhaps in a wider area.

There has been limited aerial cetacean survey effort within the Irish EEZ. Inshore waters and the Irish Sea were surveyed by aircraft during the SCANS II survey. The IWDG initiated a project called WhaleLog in 1995 with the Air Corps Maritime Squadron, where cameras were provided to obtain images of cetaceans observed during routine maritime patrols. WhaleLog has received regular reports and photographs of cetacean sightings from the Air Corps since 1995. In 2007 this relationship was further developed through improving data collection and dissemination and by gaining airtime through accompanying the CASA aircraft on a number of flights (Berrow, 2007).

Cetacean sightings and survey effort data were historically held by the various survey institutions both in Ireland and abroad. One of the first joint databases for cetacean data was operated by the Joint Nature Conservation Council (JNCC) in the UK, which acts as a repository for ESAS bird and cetacean survey data collected from 1979– 2002 (JNCC, 2011). In recent years, there have been efforts to create a Joint Irish Cetacean Database. This was driven by the National Parks and Wildlife Service and the National Biodiversity Data Centre (Regan *et al,* 2008). This work has led to the creation of a National Data Dictionaries for Marine Mammals, which prescribes a minimum standard for marine mammal data collection in Irish waters and has led to the incorporation of cetacean data into the National Biodiversity Data Centre's online Atlas of Mammals in Ireland (NBDC, 2011). The National Biodiversity Data Centre now acts as a repository for Irish cetacean survey data. Further steps towards a joint European cetacean database are currently underway with the establishing of the Joint Cetacean Protocol (JCP) by the JNCC. Work is underway towards expanding the JCP, which was originally designed as a joint UK database, to act as a joint database for cetacean survey data from northwest European waters (Thomas, 2009).

During the West Coast Cetacean Survey (Wall et al, 2006) and the ISCOPE and ISCOPE II programmes (Wall and Murray, 2010), a practical and cost-effective method to conduct a comprehensive, adequate, ongoing monitoring programme for cetaceans within the Irish EEZ was developed through the use of platforms of opportunity (ships and aircraft) to conduct cetacean distribution and relative abundance surveys. Under Work Package 1 of PReCAST, it was proposed to continue with and to expand on this work by conducting a further three years of visual line transect surveys on board platforms of opportunity and to develop the use of opportunistic aerial survey effort within the Irish EEZ. The objectives of this Work Package were to:

1. Survey offshore areas and seasons with historically poor coverage;
2. Record all marine megafauna, including basking sharks, turtles, seals and cetaceans;
3. Incorporate the use of acoustic survey methods for recording harbour porpoises, sperm whales and dolphins;
4. Develop innovative survey protocols for use of aircraft as platforms of opportunity;

5. Identify key offshore habitats for bottlenose dolphins and beaked whales;
6. Identify migratory routes for large whales off the west coast;
7. Monitor cetacean activity in offshore SACs.

# 2 Methods

## 2.1 Survey Method

A single marine mammal observer conducted visual survey effort from research vessels and naval service vessels between March 2008 and January 2011. The survey effort was conducted either from the ships' bridges, the 'monkey island' (the roof of the bridge) or from the 'crow's nest' (on the R.V. *Celtic Explorer*). Observer effort focused on a 90-degree arc ahead of the ship. However, sightings located up to 90 degrees to port and starboard were also included. Surveyors scanned the area by eye and using binoculars (typically 10X40 or 8X50). Bearings to sightings were measured using an angle board and distances were estimated with the aid of a range-finding stick (Heinemann, 1981).

Environmental data were recorded every 15 minutes using Logger 2000 software (IFAW, 2000). Sightings were also recorded using Logger 2000. Automated position data were obtained through a laptop computer linked to a USB GPS receiver. Survey effort was conducted up to Beaufort sea-state 6 and in moderate to good visibility. As these were surveys onboard vessels of opportunity, the survey was conducted in 'passing mode' and cetaceans sighted 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 (for example, unidentified dolphin, unidentified whale, unidentified beaked whale etc), according to criteria established for the IWDG's cetacean sightings database (IWDG, 2011).

## 2.2 Data Treatment

Effort and sightings data were assigned to ¼ International Council for the Exploration of the Sea (ICES) statistical rectangles (15' latitude x 30' longitude) using ARCView™ GIS software. The total survey effort (hours surveyed in sea state 0– 6) per ¼ ICES statistical rectangle was summed and mapped for each grid square as was the total number of individuals counted per ¼ ICES Rectangle for each species recorded during the surveys. For species with sufficient data, effort and sightings were mapped per season. Seasons definitions were based on the astronomical cycle and were defined as: spring (April, May, June); summer (July, August, September); autumn (October, November, December) and winter (January, February, March). Where data for a species was insufficient to map seasonal effort and sightings, the data were combined into a single map.

An atlas of distribution and relative abundance was prepared. The occurrence of each species was described by temporal and spatial distribution and the data collected during PReCAST were compared to a number of past data sets from Irish waters (table 2.2.1).

**Table 2.2.1: Comparison of data sets utilised in this report**

| Dataset | Time Period | Author(s) |
|---|---|---|
| ***Atlas of cetacean distribution in north-west European waters*** | 1979– 1997 | Reid *et al, 2003* |
| ***Cetaceans and Seabirds of Ireland's Atlantic Margin*** | 1999– 2001 | O'Cadhla *et al,* 2004 |
| ***Small Cetaceans in the European Atlantic and North Sea (SCANS-II)*** | 2005 | Hammond *et al*, 2006 |
| ***Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA)*** | 2007 | Hammond *et al,* 2011 |

## 2.3 Survey Vessels

Twelve vessels from eight host institutions and five different countries were used for ship-based survey efforts during PReCAST (table 2.3.1). Berths on board the vessels were generously provided free of charge by the host institutions. Vessels were sourced either through direct contact with the host institution or by utilising the EU Foreign Vessel Observer Scheme administered by the Marine Institute (Marine Institute, 2011).

**Table 2.3.1:** Survey platforms utilised during PReCAST surveys 2008-2011

| Vessel | Country | Platform Height | Host Organisation | Number of Surveys |
|---|---|---|---|---|
| **R.V. Celtic Explorer** | Ireland | 18m | Marine Institute | 29 |
| **R.V. Celtic Voyager** | Ireland | 8m | Marine Institute | 2 |
| **L.E. Emer** | Ireland | 8m | Naval Service | 1 |
| **L.E. Niamh** | Ireland | 6m | Naval Service | 2 |
| **L.E. Róisín** | Ireland | 6m | Naval Service | 2 |
| **L.E. Orla** | Ireland | 6m | Naval Service | 1 |
| **R.V. Johan Hjort** | Norway | 10m | Institute of Marine Research | 1 |
| **R.V. Pelagia** | Netherlands | 10m | Royal Netherlands Institute for Sea Research | 1 |
| **F.R.V. Scotia** | Scotland | 10m | Marine Scotland Science | 1 |
| **R.V. Tridens** | Netherlands | 10m | Dutch Ministry of Agriculture, Nature and Food Quality | 1 |
| **R.V. Walther Herwig III** | Germany | 14m | Johann Heinrich von Thünen-Institut | 1 |
| **R.V. Song of the Whale** | England | 5.5m | International Fund for Animal Welfare | 1 |

The majority of vessels utilised were engaged in fisheries surveys. However, vessels conducting oceanographic surveys, naval patrols, dedicated cetacean surveys, ROV surveys and geological surveys were also used (figure 2.3.1).

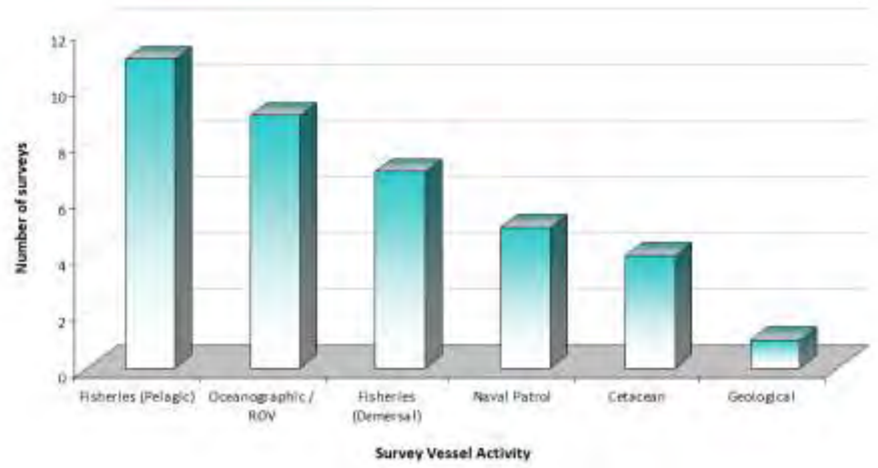



**Figure 2.3.1:** Activity of survey platforms utilised during PReCAST surveys from 2008– 2011

Eight of the vessels used were research vessels, with one of these being a sailing vessel (a 21m yacht). The other four vessels were Irish Naval Service Patrol vessels (figure 2.3.2).

**Figure 2.3.2:** Vessels utilised during PReCAST surveys 2008– 2011

# 3 RESULTS

## 3.1 Geographic Coverage and Survey Effort

From 2 March 2008 to 8 July 2011, 630 days-at-sea were completed on board platforms of opportunity within the Irish EEZ and in adjacent waters (figure 3.1.1). This analysis utilises data collected between 2 March 2008 and 10 January 2011 (563 days-at-sea).

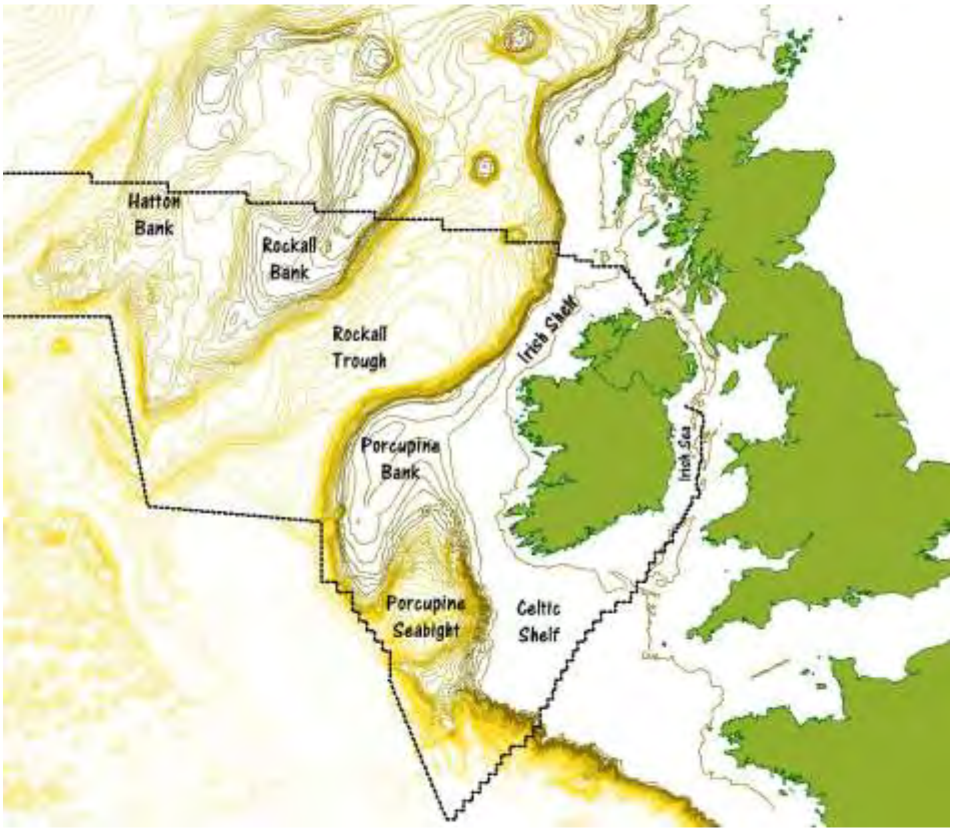



**Figure 3.1.1:** Topographic features within the Irish Declared Area (black dotted line)

### 3.1.1 *Geographic Coverage*

The highest levels of total effort and geographic coverage were achieved over the Irish shelf and northeast slopes of the Rockall Trough. Lower levels of effort and coverage were achieved over the Porcupine Bank, Porcupine Seabight, Rockall Trough and Rockall Bank. Due to the multinational nature of European Union, marine and fisheries research programmes survey effort was also conducted in adjacent UK and French waters (figure 3.1.2).

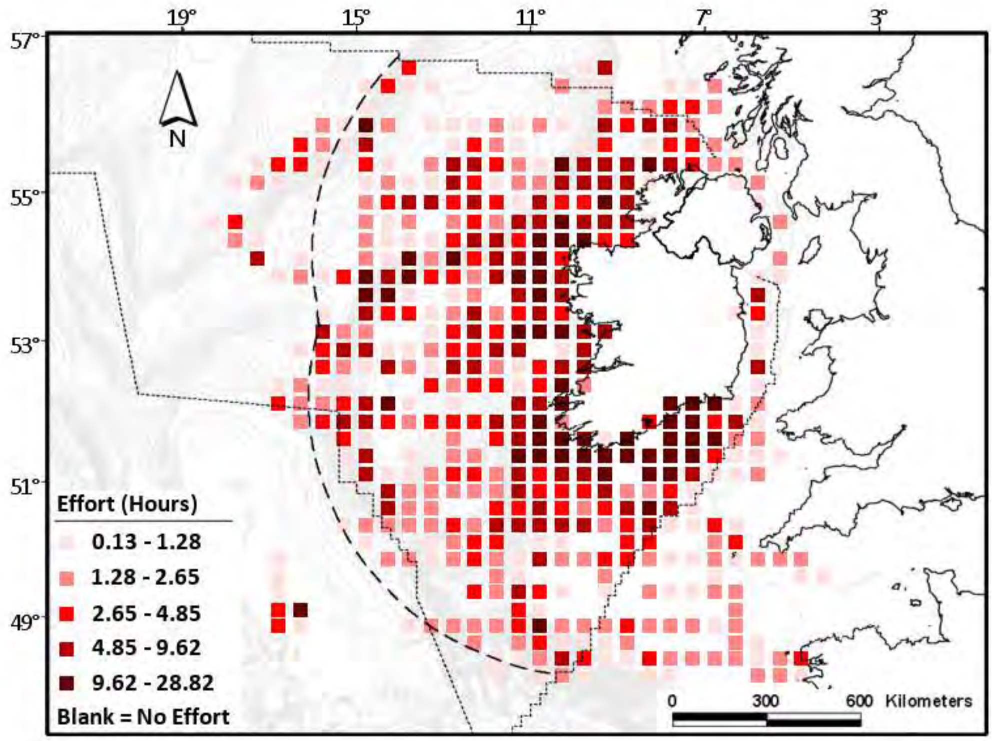



**Figure 3.1.2:** Total survey effort (on-effort hours) for all sea states (0-6) and all seasons per ¼ ICES Statistical Rectangle logged by PReCAST surveyors from 2 March 2008 – 10 January 2011.

Geographic coverage varied with season, depending on survey platform availability and the nature of research surveys or naval patrols in any given season (figure 3.1.3). Wide geographic coverage was achieved in spring, summer and winter, while geographic coverage in autumn was more restricted primarily due to repeat targeting of the Celtic Sea herring acoustic survey during this season as part of PReCAST Work Package 4.

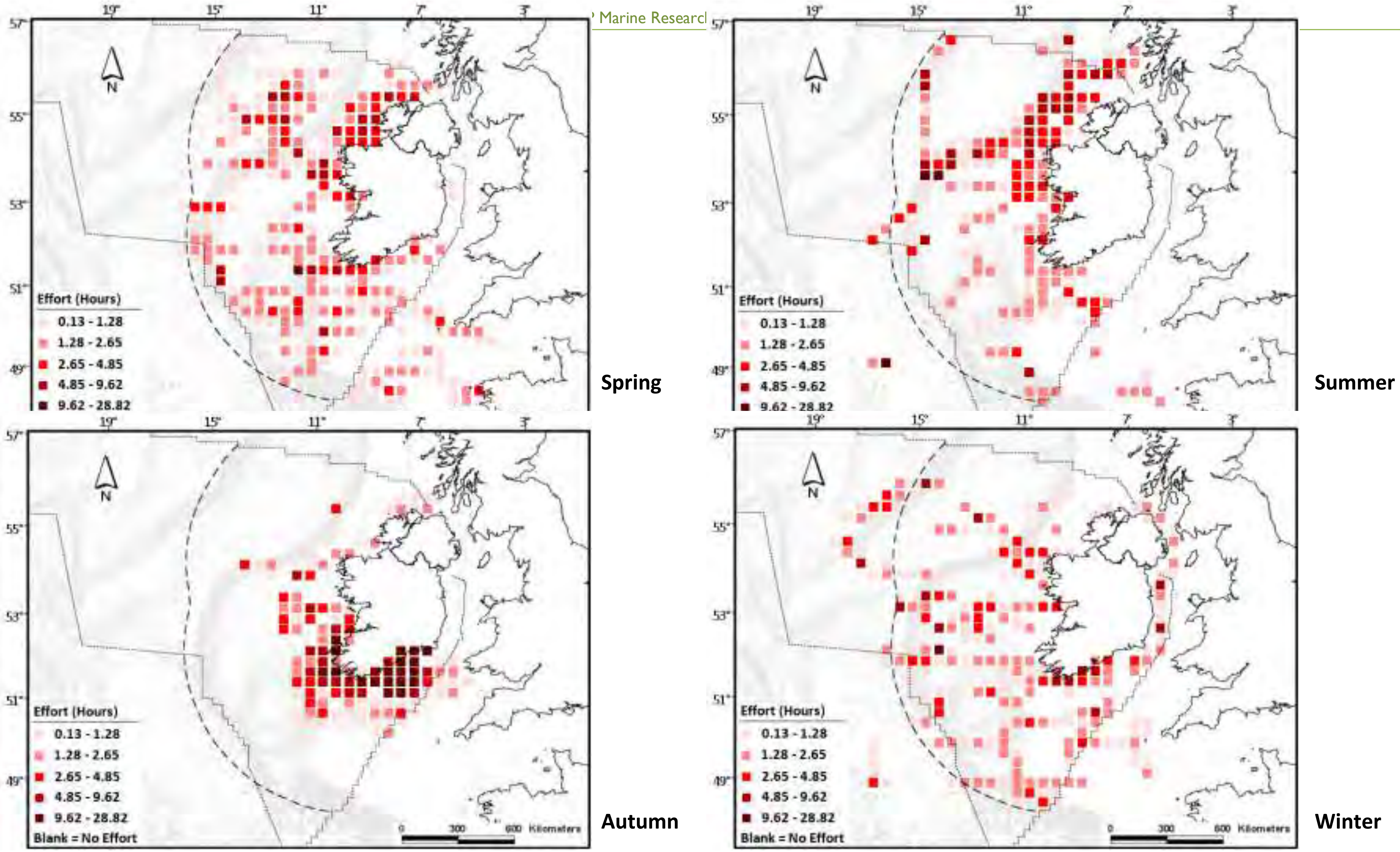



**Figure 3.1.3:** Total survey effort (in hours on effort) for all sea states (0-6) per ¼ ICES statistical rectangle logged by PReCAST surveyors during spring (April, May, June); summer (July, August, September); autumn (October, November, December) and winter (January, February, March)

## 3.2 Survey Vessel Speed

The average speed recorded during the surveys was eight knots. 10% of speed records were between 0-1 knots, reflecting static research vessel operations, for example, deploying gear such as corers, CTD profilers and ROV equipment. 55% of speed records were between 8-12 knots, which encompassed average steaming speed of the majority of the vessels utilised (figure 3.2.1).

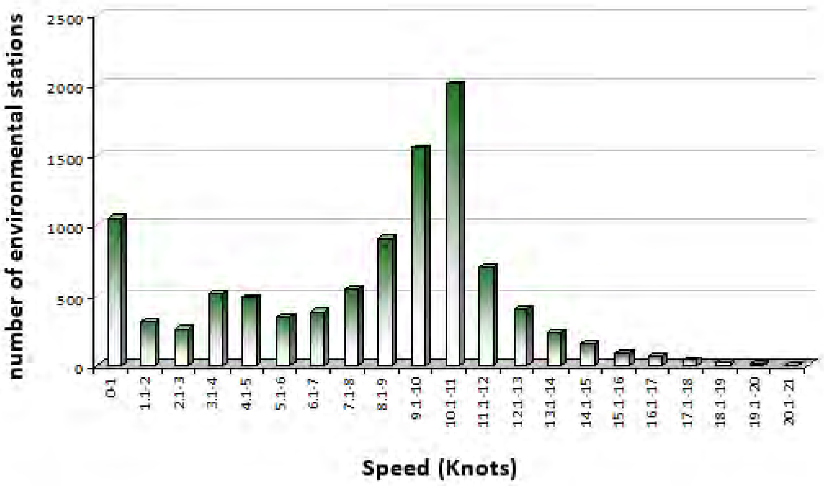



**Figure 3.2.1:** Recorded platform speeds logged at 10,109 environmental record stations

## 3.3 Environmental Conditions

During PReCAST, a total of 2,305 hours of survey effort were conducted in Beaufort Sea State 0-6. The sea state was logged at 10,115 Environment Record Stations during the study period (sea states above Beaufort 6 were excluded). Beaufort Sea State ≤2 was logged at 18.8% of stations, Beaufort Sea State ≤3 was logged at 40.5% of stations and Beaufort Sea State ≤4 was logged at 67.7% of stations (figure 3.3.1).

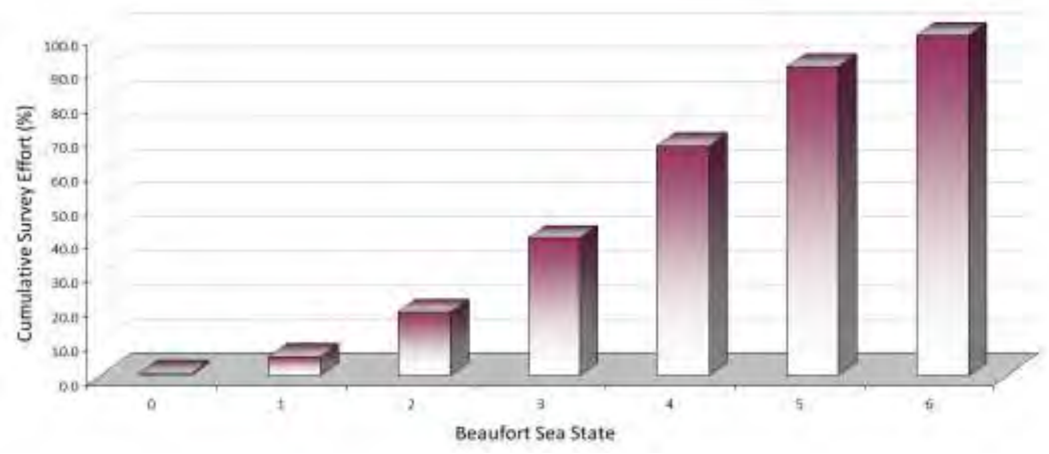



**Figure 3.3.1:** Beaufort Sea States (0-6) logged at 10,115 environmental record stations

The prevalence of sea states varied between seasons (figure 3.3.2) with the best survey conditions (highest prevalence of Beaufort Sea States ≤3) being logged in autumn (October, November, December), when survey effort focused largely along the south and southwest coasts.

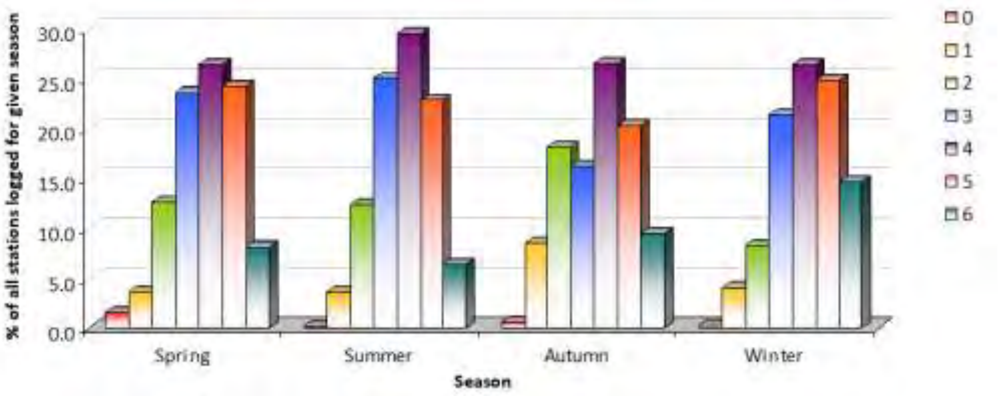



**Figure 3.3.2:** Seasonal prevalence of Beaufort Sea States (0-6) logged at 10,115 environmental record stations

Swell height also varied with season (figure 3.3.3), with the greatest swell heights recorded during the winter months (January, February, March). Swell data may be skewed as in very heavy swell, survey effort was curtailed for safety reasons.

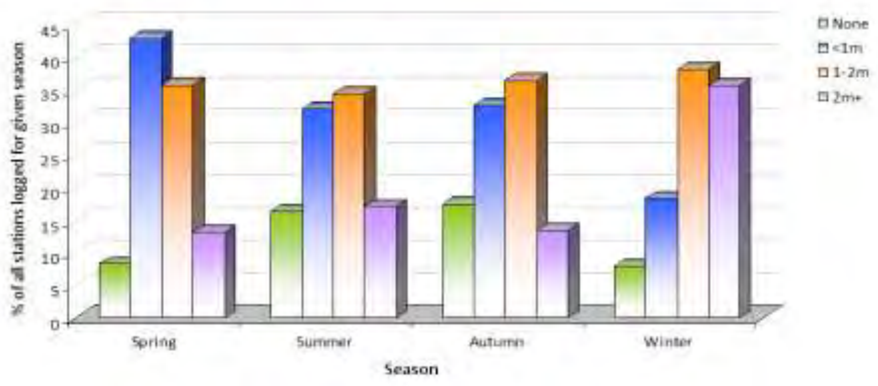



**Figure 3.3.3:** Seasonal prevalence of Swell Heights logged at 10,115 environmental record stations

Foggiest conditions were recorded in spring (figure 3.3.4). However, these results are also skewed due to heavy fog or rain halting survey effort due to loss of visibility.

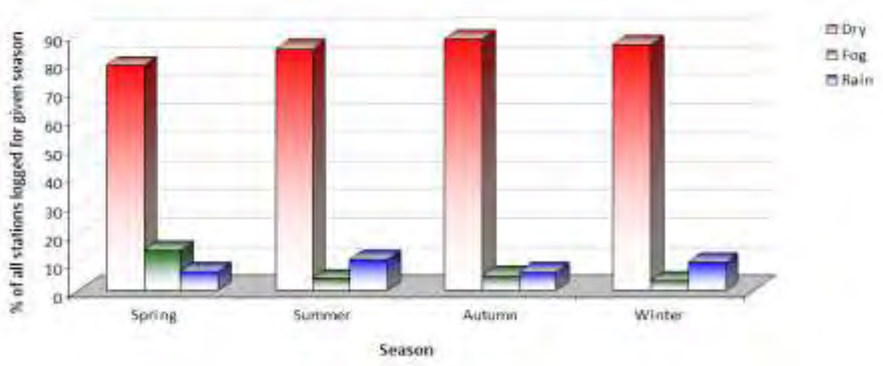



**Figure 3.3.4** Seasonal prevalence of precipitation logged at 10,115 environmental record stations

It should be noted that both sea state and swell height are dependent on survey location, with inshore areas being calmer in certain prevailing winds and some areas of the coast being sheltered from the prevailing westerly or south-westerly swells (figure 3.3.5).

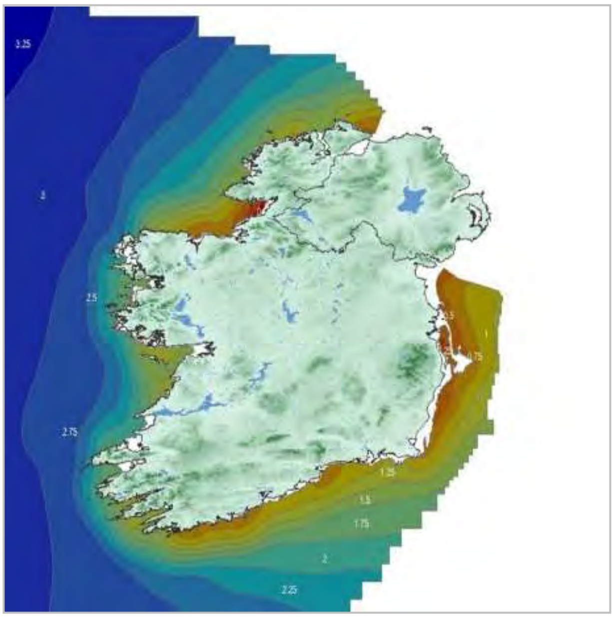


**Figure 3.3.5** Annual average predicted wave heights around the Irish Coast (*Marine Institute, 2005).* Blue colours indicate larger wave/swell heights

## 3.4 Sightings

1301 sightings of 17 different cetacean species, totalling 12,942 individuals, were logged between 2 March 2008 and 10 January 2011 (table 3.4.1).

Short-beaked common dolphin was by far the most abundant and widespread cetacean species encountered over the Irish shelf (figure 3.4.1), accounting for 55% of all sightings and 72% of all individuals recorded. Long-finned pilot whale was the most abundant and widespread cetacean in deep waters (200m+) to the west of Ireland, although short-beaked common dolphins were also seasonally abundant along the shelf slopes.

The most common baleen whale encountered was the fin whale which was seasonally abundant off the south coast and northwest shelf slopes. Sperm whales were also frequently encountered on the shelf slopes and in deeper waters beyond, and are possibly the most widespread and abundant large whale species in the deep (200m+) waters of the Irish EEZ. However, the ecology and diving behaviour of sperm whales mean that acoustic methods are required to accurately estimate their distribution and abundance (see section 4.6).

Sightings of two seal species were recorded, with the grey seal accounting for 95% of seal sightings. Seven sightings of basking sharks and three sightings of leatherback turtles were also recorded (table 3.4.2).

Overall, the results show a high level of diversity in the spatial and temporal use of offshore marine habitats by cetacean and megafauna species in Irish waters. Species distribution and relative abundance maps are presented in section 4.

**Table 3.4.1:** Sightings, counts and group size ranges for all cetacean species sighted during PReCAST ship-based surveys, March 2008 to January 2011

| Species | No. Sightings On | Off | Number of Individuals | Juveniles / Calves | Group Size Range |
|---|---|---|---|---|---|
| **Mysticetes** | | | | | |
| Humpback Whale | 4 | 0 | 6 | 0 | 1 – 2 |
| Blue Whale | 1 | 0 | 1 | 0 | – |
| Fin Whale | 66 | 3 | 143 | 1 | 1 – 8 |
| Minke Whale | 37 | 3 | 41 | 0 | 1 – 2 |
| Fin/Sei/Blue Whale | 10 | 9 | 28 | 0 | 1 – 5 |
| **Odontocetes** | | | | | |
| Sperm Whale | 59 | 5 | 95 | 1 | 1 – 8 |
| Northern Bottlenose Whale | 1 | 0 | 2 | 0 | – |
| Cuvier's Beaked Whale | 1 | 0 | 1 | 0 | – |
| Sowerby's Beaked Whale | 2 | 0 | 5 | 0 | 2 – 3 |
| Killer Whale | 0 | 1 | 2 | 0 | – |
| Long-finned Pilot Whale | 97 | 9 | 1256 | 91 | 1 – 100 |
| Risso's Dolphin | 6 | 0 | 36 | 2 | 1 – 10 |
| Bottlenose Dolphin | 21 | 3 | 488 | 17 | 1 – 200 |
| White-beaked Dolphin | 8 | 0 | 31 | 0 | 1 – 8 |
| Atlantic White-sided Dolphin | 12 | 1 | 365 | 0 | 4 – 250 |
| Short-beaked Common Dolphin | 665 | 54 | 9348 | 156 | 1 – 350 |
| Striped Dolphin | 1 | 1 | 28 | 0 | 8 – 20 |
| Harbour Porpoise | 39 | 0 | 81 | 2 | 1 – 8 |
| **Unidentified Cetacean Classes** | | | | | |
| Unidentified Beaked Whale | 10 | 0 | 18 | 1 | 1 – 3 |
| Unidentified Dolphin (inc. porpoise) | 80 | 11 | 850 | 0 | 1 – 50 |
| Medium Sized Whale (no blow seen) | 11 | 4 | 26 | 0 | 1 – 10 |
| Unidentified Whale (blow) | 52 | 6 | 92 | 0 | 1 – 10 |
| Unidentified Cetacean | 7 | 1 | 9 | 0 | 1 – 2 |

**Table 3.4.2:** Sightings, counts and group size ranges for pinniped and other megafauna species sighted during PReCAST surveys, March 2008 to January 2011

| Species | No. Sightings On | Off | Number of Individuals | Juveniles / Calves | Group Size Range |
|---|---|---|---|---|---|
| **Pinnipeds** | | | | | |
| Grey Seal | 21 | 1 | 23 | 0 | 1 – 2 |
| Common Seal | 1 | 0 | 1 | 0 | – |
| Unidentified Seal | 2 | 0 | 2 | 0 | – |
| **Other Megafauna** | | | | | |
| Basking Shark | 6 | 1 | 8 | 0 | 1 – 2 |
| Leatherback Turtle | 2 | 1 | 3 | 0 | – |

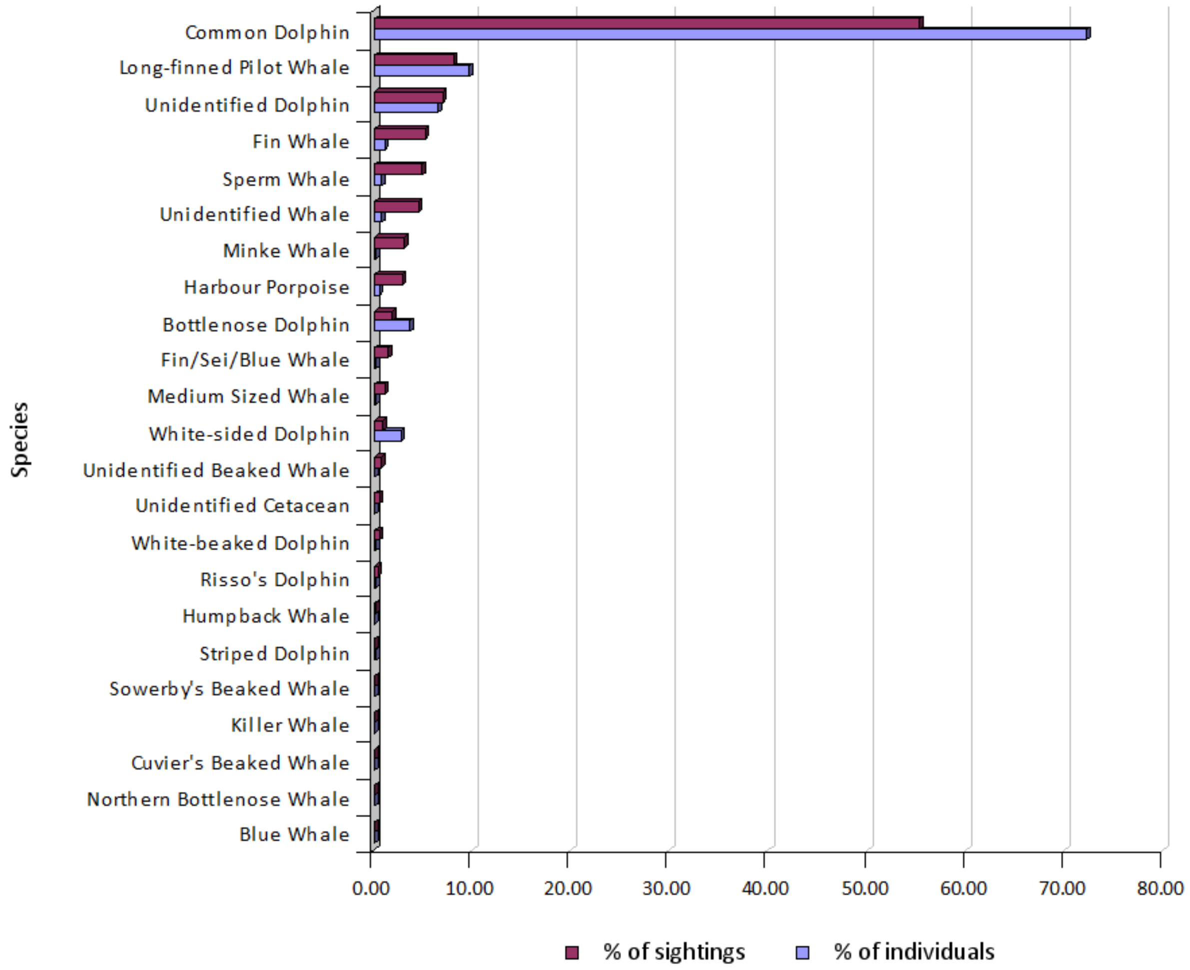



**Figure 3.4.1:** Percentage of total cetacean sightings and percentage of total individual cetaceans accounted for by each species

# 4 Atlas of Distribution and Relative Abundance

## 4.1 Humpback Whale (Megaptera novaeangliae)

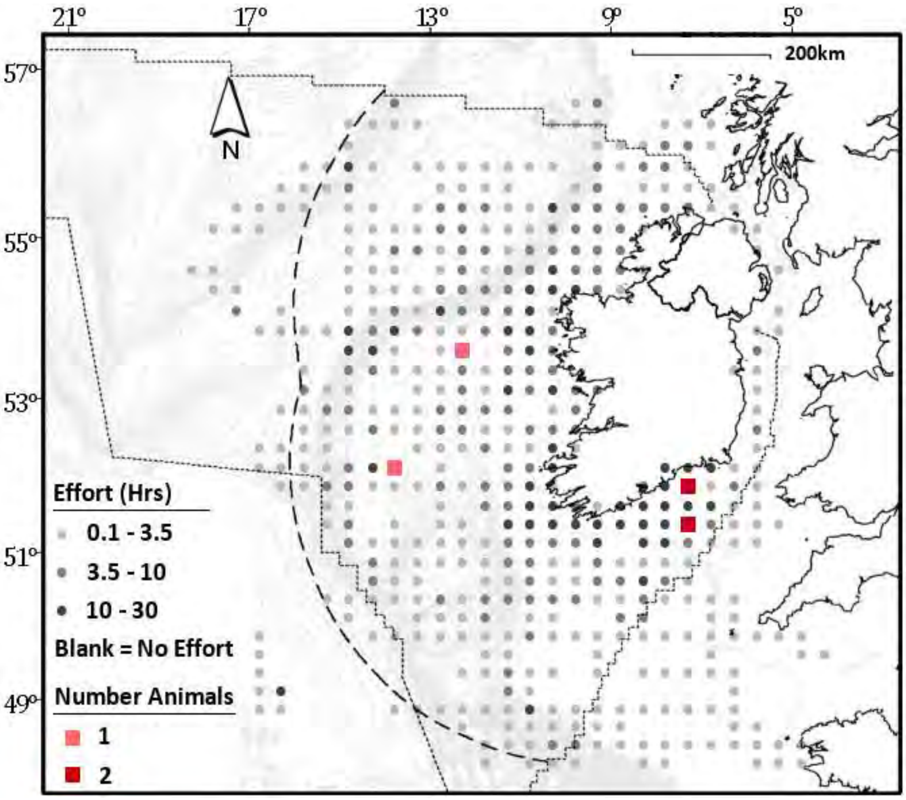



**Figure 4.1.1:** Sightings distribution and total numbers of individuals of humpback whale recorded on and off effort per ¼ ICES statistical rectangle

### 4.1.1 *Sightings summary*

A total of six humpback whales were recorded in four sightings. Two of the sightings involved pairs of animals and two were of single animals. No fluke shots or other identifying features were obtained for comparison with the IWDG Photo-ID catalogue (IWDG 2011b) due to the distance of the sightings from the survey vessels and/or the weather conditions at the time.

### 4.1.2 *Spatial and temporal distribution*

The two sightings of pairs of animals occurred off the southeast coast. This area is known to be a foraging ground for humpback whales in Irish waters during the autumn and winter (Berrow *et al*, in prep) when these animals were sighted. During this period, the whales feed on pelagic schooling fish such as spawning herring and sprat, which are abundant off the south coast in autumn (Marine Institute, 2010).

The two other sightings were of individual humpback whales and were made over the Porcupine Bank, to the west of Ireland, in November and March. The occurrence of humpback whales in this area is not well known, with just a single humpback sighting recorded from the Porcupine Bank in the IWDG sightings database (IWDG, 2011). A seasonal offshore migration of humpback whales along the western seaboard has been described using data from the US Military's SOSUS hydrophone array in the northwest Atlantic. These data describe a southward migration of small numbers of humpback whales which occurs annually from October to March (Charif *et al*, 2001; Charif and Clark, 2009), which overlaps the period of these two sightings.

**Figure 4.1.2:** Humpback whale rolling at the surface (© Dave Wall)

### 4.1.3 *Comparison with Irish data sets*

O'Cadhla *et al* (2004) recorded a single sighting of humpback whales off the northwest shelf, within the Irish EEZ, during their surveys from 1999 to 2001. Reid *et al* (2004) recorded no sightings in 20 years of data. The low numbers of sightings in previous surveys may reflect low seasonal effort in autumn and winter. However, the six animals sighted during PReCAST, along with 13 photo-identified whales in the Irish catalogue (IWDG 2011b) and sightings of new unidentified animals in Irish waters on an annual basis, indicate that this species is showing signs of recovery after suffering extreme population decline of up to 95% in the North Atlantic during the era of commercial whaling (Roman and Palumbi, 2003). The apparent increase in humpback whales in Irish waters is reflective of a documented increase in the North Atlantic humpback whale population as a whole (Stevick *et al*, 2003).

## 4.2 Blue Whale (Balaenoptera musculus)

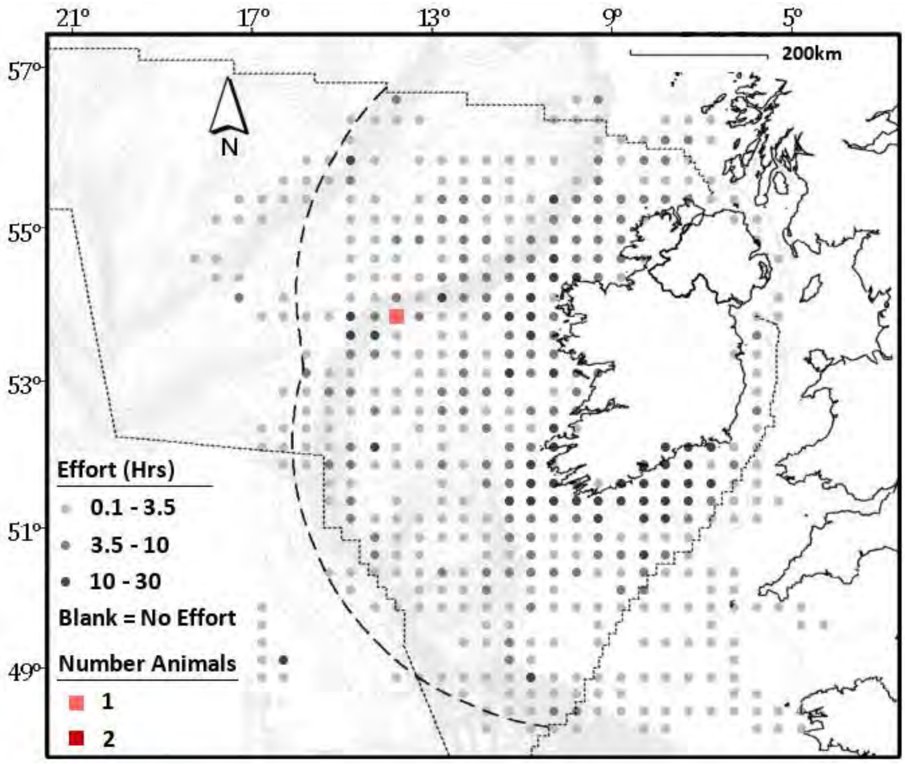



**Figure 4.2.1:** Location of a single blue whale sighting recorded and photographed on the north slopes of the Porcupine Bank in September 2008

### 4.2.1 *Sightings summary*

A single blue whale was sighted on the north slopes of the Porcupine Bank in September 2008. The animal exhibited feeding behaviour and was located among a loose aggregation of fin whales. This was the second blue whale sighted in September 2008 and data gathered at the time suggested that the sightings involved two separate animals that were foraging (Wall *et al*, 2009). The most likely prey species was northern krill. During the sightings, photos were taken of the animals and species identification was confirmed with experts in the United States. The two September sightings represent the first recorded sightings of blue whales in Irish waters for over ten years and are the first blue whales photographed in Irish waters since the Blacksod whaling Station closed in the 1930s.

Charif and Clark (2009), using data from the SOSUS array, show a seasonal movement of blue whales in offshore waters off the west coast between July and February each year and this sighting coincided with that reported period of movement. Numbers of blue whales are still low in the Northeast Atlantic following the end of commercial whaling (Roman and Palumbi, 2003). It is notable that this species was targeted by the Arranmore, Blacksod and Akties Nordhavet/Blacksod Whaling Companies in Co Mayo in the early decades of the 20th century, with 124 animals being landed between 1908 and 1922 (Fairley, 1981). Since that time and prior to 2008, only three sightings of this species were reported from Irish waters, with none being verified by photograph. The last verified image of a blue whale in Irish waters prior to the 2008 sightings was of a blue whale being harpooned and killed by a Blacksod Whaling Station vessel in August 1908 (Paul, 1908).

### 4.2.2 *Comparison with Irish data sets*

O'Cadhla *et al* (2004) recorded a single blue whale in May 2001, approximately 50 miles to the northeast of where the blue whale recorded during this survey was sighted. Just two sightings of blue whales were recorded in the 20 years data set of the JNCC Atlas (Reid *et al*, 2004), with one of the sightings recorded in the Porcupine Seabight, just to the west of the location of the second September 2008 sighting, and the other over the northwest shelf. The data suggest a species which is still struggling to recover from losses during the commercial whaling era, including losses sustained at the hands of the Irish whaling stations at the start of the last century.

**Figure 4.2.2:** Photo montage of Blue Whale fluking, Porcupine Bank, 2008
(© Dave Wall / IWDG/GMIT)

## 4.3 Fin Whale (Balaenoptera physalus)

**Figure 4.3.1:** Fin whale among fishing vessels, Celtic Sea, 2008(© Dave Wall)

### 4.3.1 *Sightings summary*

69 confirmed fin whale sightings of 143 individuals were recorded. Fin whales were the most commonly encountered and abundant baleen whale species recorded. Most sightings were of single animals or pairs of animals. Feeding aggregations of up to eight animals were recorded but group sizes greater than three animals were uncommon (figure 4.3.2). A single record of a juvenile animal was recorded among a group of three animals and was notably smaller in size than the two adults in the group.

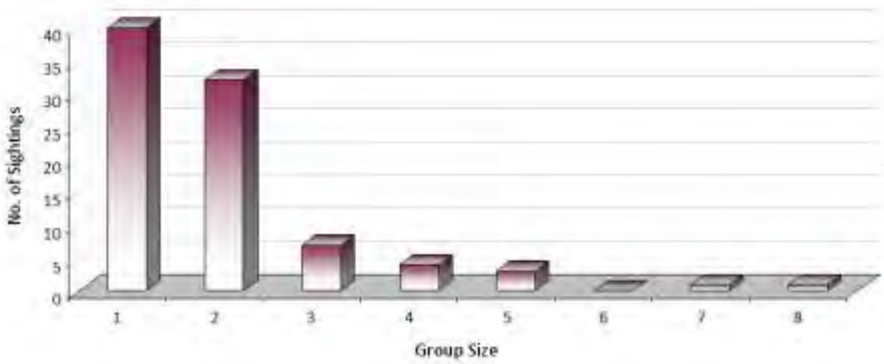



**Figure 4.3.2:** Frequency of occurrence of group size in 88 sightings of fin whale and 'fin/sei/blue'

### 4.3.2 *Spatial and temporal distribution*

Fin whales were recorded predominantly between June and December (figure 4.3.3). The species was largely absent from Irish waters from March to the end of May. However, a few sightings were recorded during this period in offshore waters to the west of Ireland.

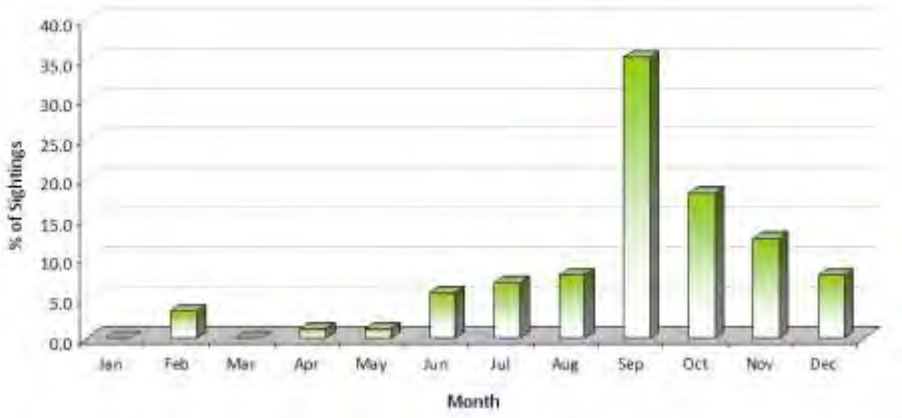



**Figure 4.3.3:** Monthly occurrence of fin whale and 'fin/sei/blue' sightings as percentage of all fin whale and 'fin/sei/blue' sightings

Sightings were recorded in shallow (≤200m) shelf waters and deeper (>200m) waters beyond the continental shelf. Fin whales were seasonally abundant off the south coast in autumn and along the northwest shelf slopes in late summer. Sightings off the south cost in autumn are consistent with a well recorded seasonal abundance of fin whales off the south cost linked to foraging on pelagic schooling fish. The south coast is an important foraging habitat for fin whales in Irish waters, with animals returning year on year to the same foraging areas (Whooley *et. al*, 2011). Prey species such as spawning herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) are abundant off the south coast in the autumn (Marine Institute, 2010).

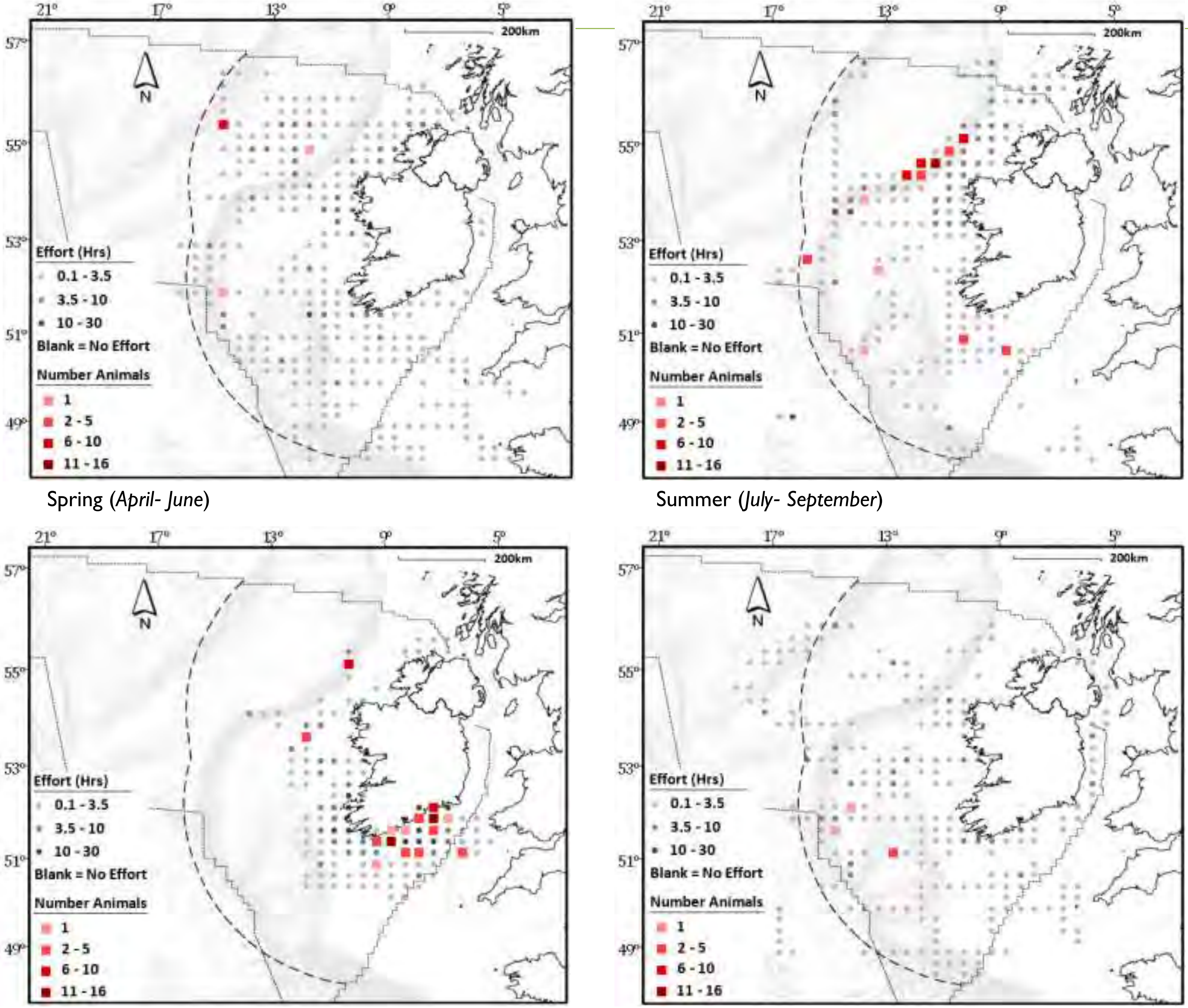
Sightings along the northwest shelf in late summer are consistent with reports by Charif and Clark (2009) of movements of large numbers of fin whales in offshore waters to the west of Ireland. Charif and Clark reported movements in all months of the year, but reaching a peak between September and January. Observations made by Wall *et al* (2009) in late summer 2008 of fin and blue whales foraging on northern krill on the northern slopes of the Porcupine Bank and the eastern slopes of the Porcupine Seabight indicate that animals may also avail of opportunistic foraging opportunities during migration.

### 4.3.3 *Comparison with Irish data sets*

While fin whales were the most common baleen whale species recorded during the PReCAST surveys, O'Cadhla *et al* (2004) recorded a much lower figure of 16 sightings of this species during surveys between 1999 and2001. The sightings occurred off the south coast and in the

Porcupine Seabight. Reid *et al* (2003) recorded this species at relatively low densities over a 20-year timescale but within the same distribution range as recorded during PReCAST.

The large numbers of fin whales recorded during PReCAST, along with regular sightings of fin whales off the Irish South coast and an increasing number of new animals being catalogued year-on-year (Whooley *et al*, 2011), indicate that this species may be recovering from the impact of commercial whaling, which reduced the population by up to 86% in the North Atlantic (Roman and Palumbi, 2003). An indication of stock recovery was evident in some North Atlantic populations during the last stock assessment in 2006 (Reilly *et al*, 2008) and results of the combined CODA and SCANS II surveys gave an estimate of 19,354 to 29,512 animals in northwest European waters (Hammond *et al*, 2011).




Spring (*April- June*)

Summer (*July- September*)

Autumn (*October- December*)

Winter (*January- March*)

**Figure 4.3.4** Seasonal sightings distribution and total numbers of individuals of **fin whale** recorded on and off effort per ¼ ICES statistical rectangle.

## 4.4 'Fin / Sei / Blue' Whale (unidentified)

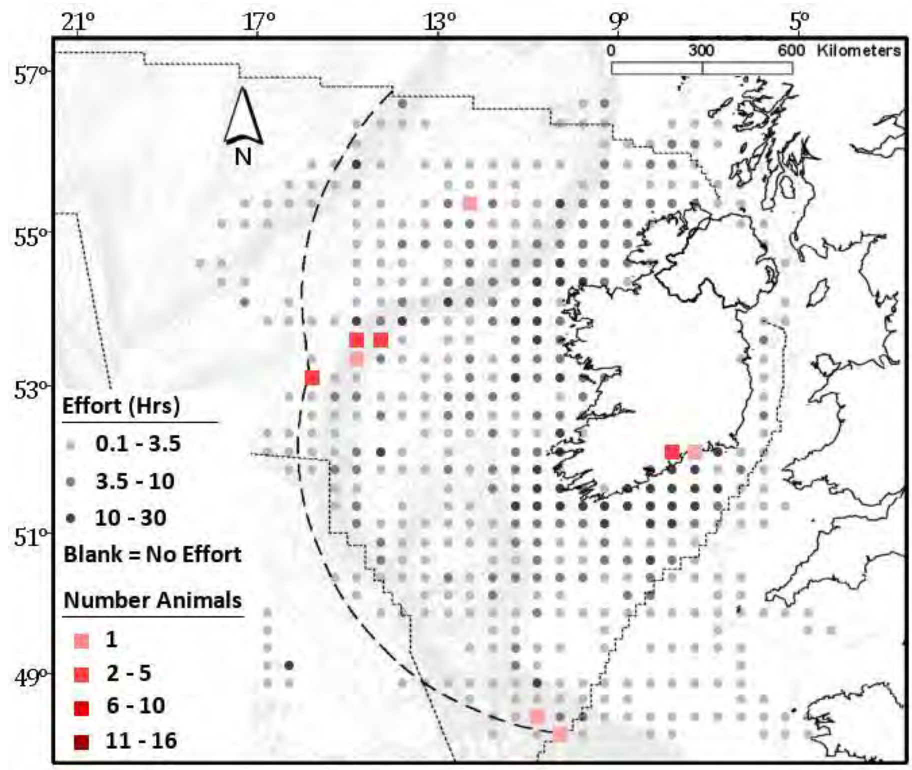



**Figure 4.4.1:** Sightings distribution and total numbers of unidentified animals classed as 'fin, sei or blue whale', recorded on and off effort per ¼ ICES statistical rectangle

### 4.4.1 *Sightings summary*

A total of 19 sightings of 28 individual animals classed as 'fin, sei or blue' whales were recorded. Sightings were assigned to this class if tall columnar blow was seen but the body of the animal was not. A well formed, tall columnar blow is considered distinct enough to rule out humpback whale or sperm whale species but was not characteristic enough to distinguish between fin, sei or blue whales.

'Fin/sei/blue' sightings were often recorded adjacent to or in the same time period as confirmed fin whale sightings and sightings data collected during PReCAST indicated that most if not all 'fin/sei/blue' sightings were of fin whales. The possible exception to this is sightings on the shelf slopes in late summer and autumn, where the presence of blue whales among groups of fin whales could not be ruled out.

### 4.4.2 *Comparison with Irish data sets*

O' Cadhla *et al*, 2004 recorded 17 sightings of 24 animals in this category. Due to the nature of tall columnar blows, which can be seen even in very rough survey conditions, a large number of these animals will remain unidentified at species level. However, if some of these unidentified animals can be assigned to a given species class based on proportions calculated on data from identified animals, these sightings can still prove useful for management and conservation purposes. Hammond *et al* (2011) found that in high density fin whale areas, including a proration of 'fin/sei/blue' sightings to fin whales yielded significantly higher population estimates.

**Figure 4.4.2:** Tall columnar blows beside whale watching vessel (© Dave Wall/IWDG/GMIT)

## 4.5 Minke Whale (Balaenoptera acutorostrata)

**Figure 4.5.1:** Minke whales surfacing (© Dave Wall)

### 4.5.1 *Sightings summary*

40 sightings of minke whales were recorded, totalling 41 animals. All but one of the sightings of minke whales were of individual animals. This is typical for this species. However, feeding aggregations of up to seven animals have been noted in the Irish Sea during IWDG ferry surveys (Wall and Murray, 2009). No calves or juvenile animals were recorded.

### 4.5.2 *Spatial and temporal distribution*

Minke whale sightings occurred from March to November, with a peak in sightings in autumn off the south and southwest coasts. The earliest sightings of minke whales occurred in late winter along the slopes of the continental shelf edge to the southwest of Ireland. Sightings in spring and summer occurred over the western Irish shelf. Minke whales are also seasonally abundant in the western Irish Sea during the late spring and early summer (Wall and Murray, 2009). This species appears to be largely absent from Irish waters in the winter months.

The highest areas of minke whale abundance were recorded off the southwest coast, particularly at the mouth of Dingle Bay and between Dingle Bay and the Skelligs, and off the south coast, primarily between Cape Clear and Cork Harbour, in the autumn. The presence of minke whales off the south and southwest coasts during the autumn are thought to relate to foraging on pelagic schooling fish species such as herring and sprat, which are present off those coasts at that time of year.

#### 4.5.3 *Comparison with Irish data sets*

The SCANS II surveys estimated a July abundance of up to 6,000 minke whales for Celtic Sea, Irish Sea and west of Ireland shelf waters (Hammond, 2006). The SCANS II and CODA surveys combined gave an estimate of 30,410 animals for northwest European waters (Hammond *et al*, 2011). O'Cadhla *et al* (2004) recorded 32 sightings of 36 animals, with a similar distribution pattern in winter, spring and summer as recorded during PReCAST.

Due to limited survey effort in the autumn, O'Cadhla *et al* did not detect any minke whale sightings during this period in contrast to the high minke whale densities detected off the south and southwest coasts during PReCAST. Reid *et al* (2004) showed minke whale abundances in most of the areas detected during the PReCAST surveys. However, the nature of their analysis did not show the strong seasonal trends in distribution and abundance for this species in Irish waters. These examples highlight the importance of obtaining adequate survey coverage in all seasons and for all geographic areas if we are to obtain a full understanding of spatial and temporal habitat requirements of cetacean species in Irish waters.

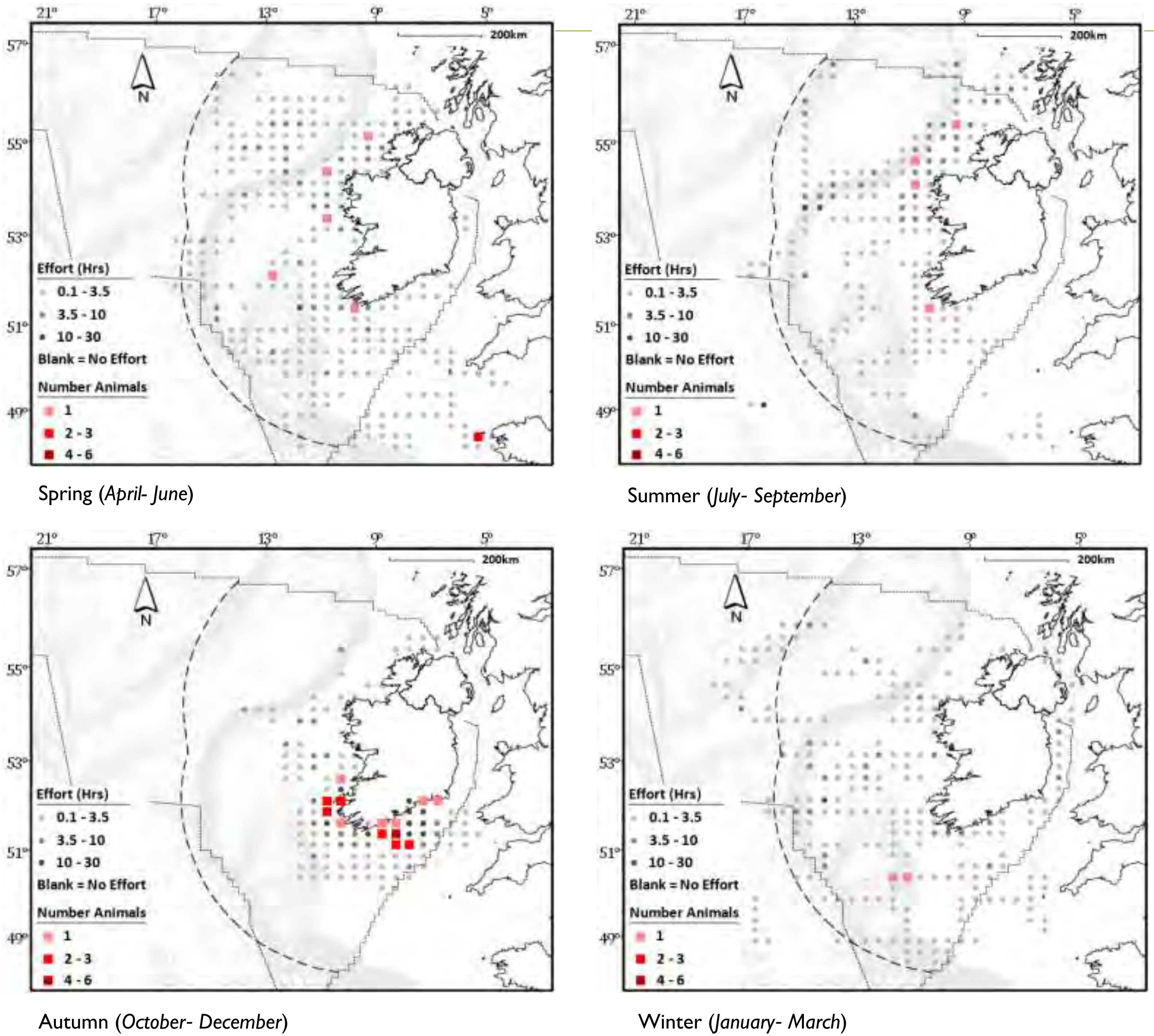



**Figure 4.5.2** Seasonal sightings distribution and total numbers of individuals of **minke whale** recorded on and off effort per ¼ ICES statistical rectangle.

## 4.6 Sperm Whale (Physeter macrocephalus)

**Figure 4.6.1:** Sperm whale logging at the surface, Rockall Trough (© Dave Wall/IWDG/GMIT)

### 4.6.1 *Sightings summary*

64 sightings of sperm whales were recorded, totalling 95 individuals. The number of sightings is high considering this deep water species spends up to 80% of its life below the surface (Watwood *et al*, 2006) and is therefore best detected using acoustic survey methods. In dedicated cetacean surveys conducted during PReCAST (see section 1.2), acoustic detections of sperm whales in 2009 outnumbered visual detections by four to one, and in 2010 no sperm whales were sighted but 18 acoustic detections were made.

55% of sightings were of single animals (figure 4.6.2). However, synchronously diving groups of up to eight animals were recorded. The majority of sperm whales in the higher latitudes of the north Atlantic are males, with females and calves generally remaining in the breeding grounds in tropical waters (Shirihai and Jarrett, 2006). However, a single juvenile animal was sighted close to the R.V. *Celtic Explorer* in January 2010 during a survey in the Rockall Trough. The only previous record of a young sperm whale in Irish waters was a calf which stranded in Co. Clare in 2004 (Berrow and O'Brien, 2005).

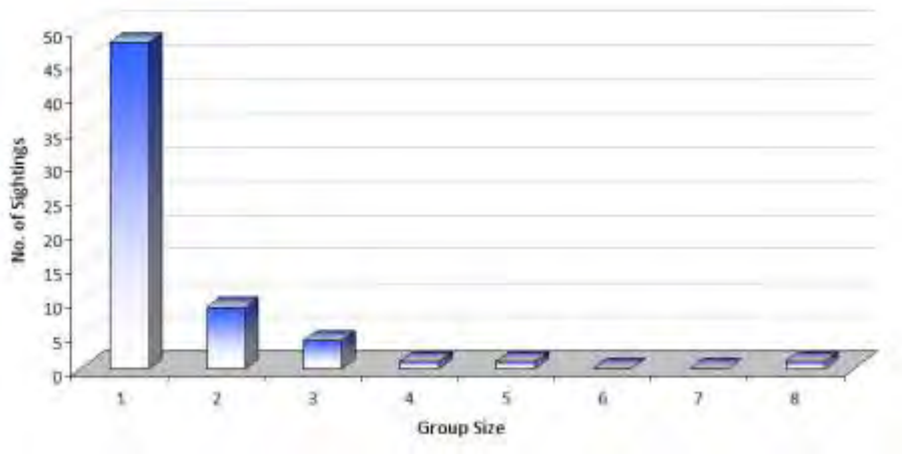



**Figure 4.6.2:** Frequency of occurrence of group size in 64 sightings of sperm whales.

### 4.6.2 *Spatial and temporal distribution*

Sperm whale sightings and acoustic detections were made from February to September (figure 2.6.3). Lack of survey effort in the autumn months precluded assessment of sperm whale presence or absence during those months.

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | | | |

**Figure 4.6.3** Detection positive months for sperm whales recorded during visual and acoustic surveys.

All but one of the sightings occurred in deep waters (>200m) beyond the continental shelf edge. The highest densities of sperm whale sightings were recorded on the north and northwest banks of the Porcupine Bank, where a series of subsea canyons may provide a preferred habitat for this species.

### 4.6.3 *Comparison with Irish data sets*

Few sperm whale sightings were logged in Irish waters during the CODA surveys, with three sightings in deep waters to the southwest of the Porcupine Bank and one sighting in the Rockall Trough. Similarly, only three sightings of this species are recorded in the JNCC Atlas. O'Cadhla *et al* (2004) recorded 32 sightings of 56 animals, with higher densities recorded in spring and summer. It may be that apparent seasonal and spatial variation in sperm whale abundance, reported in O'Cadhla *et al* and this study, reflect variations in offshore survey effort and weather conditions, as sperm whale blows are generally difficult in rough seas.

There can be little doubt that visual surveys greatly underestimate the distribution and abundance of this species which, due to the prolonged periods which it spends diving at depth, does not lend itself to detection by visual survey. An abundance estimate of 2,077 animals in northwest Atlantic waters was calculated based on visual survey data by Hammond *et al* (2011). Acoustic survey data is required to gain a true understanding of temporal and spatial habitat use by sperm whales (see Work Package 2). However, visual sightings are required to validate and interpret acoustic survey results (Barlow and Taylor, 2005).

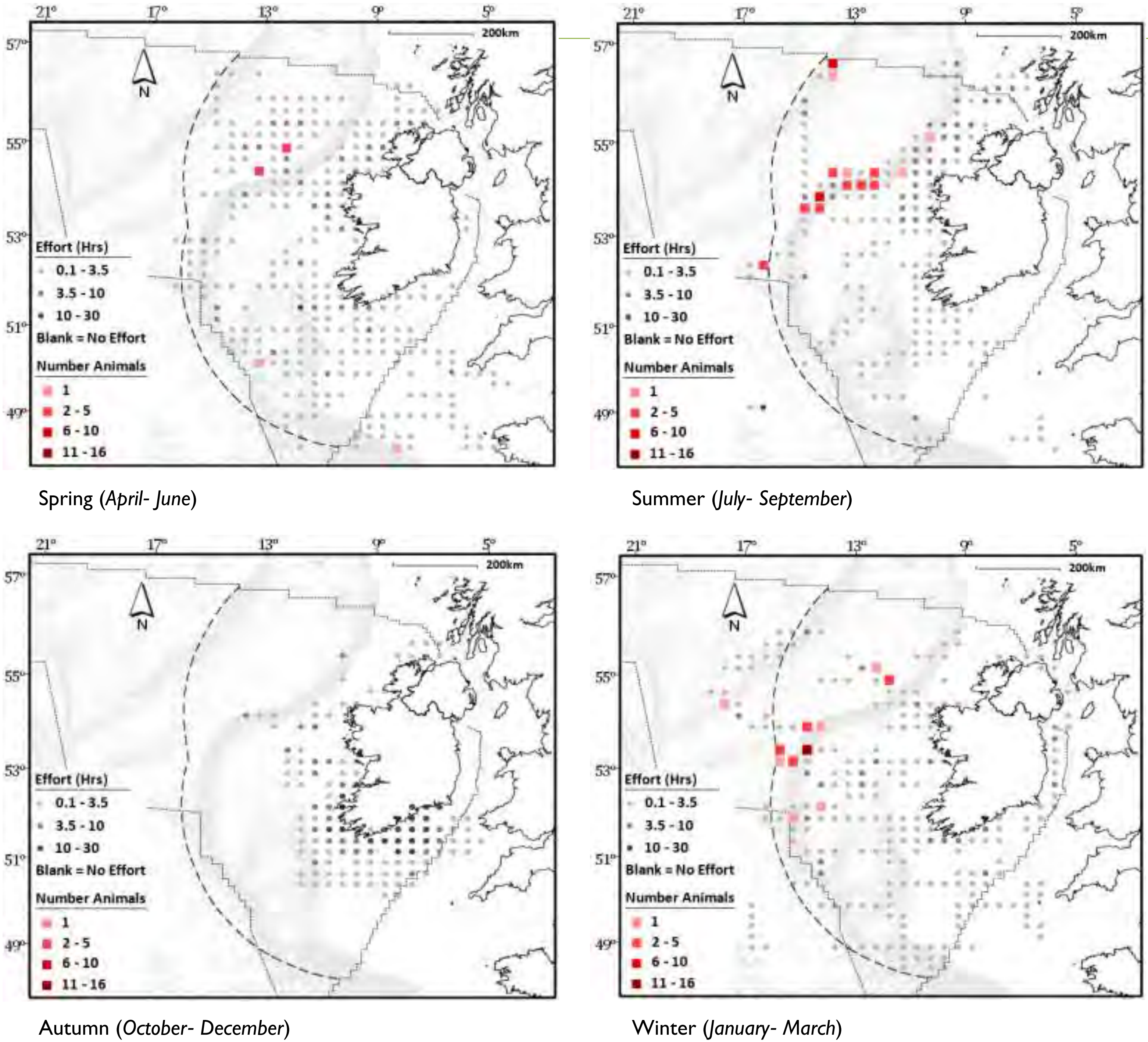



**Figure 5.6.4** Seasonal sightings distribution and total numbers of individuals of **sperm whale** recorded on and off effort per ¼ ICES statistical rectangle.

## 4.7 Northern Bottlenose Whale (*Hyperoodon ampullatus*)

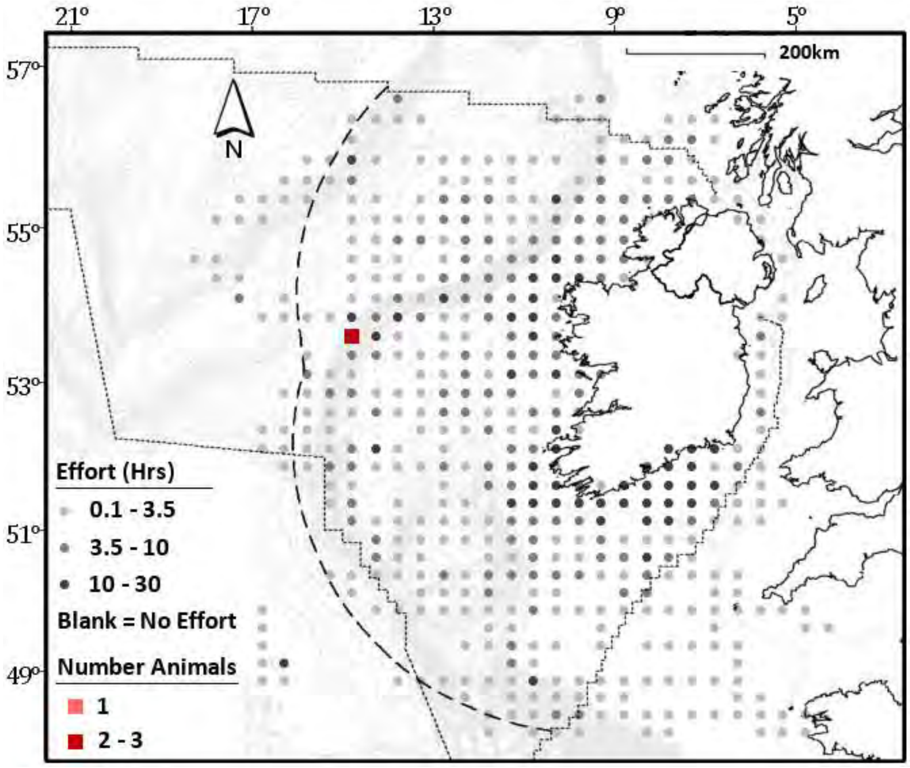



**Figure 4.7.1:** Location of a single sighting of two northern bottlenose whales recorded in a canyon system on the northwest slopes of the Porcupine Bank in August 2009

### 4.7.1 *Sightings summary*

A single sighting of two northern bottlenose whales was recorded during the surveys. Northern bottlenose whales and beaked whales in general are difficult to survey visually as they spend up to 93% of their lives beneath the surface (Barlow and Gisiner, 2006) and beyond the detection of visual observers. When at the surface, they are difficult to detect in anything but the calmest sea states due to their low profile at the surface. Visual detection rates, even in ideal conditions, are low (Barlow and Gisiner, 2006). The two animals were sighted during a dedicated cetacean survey of canyon and slope habitats off the west coast of Ireland (see section 5) and were sighted in sea state four, close to the survey vessel, by two observers.

### 4.7.2 *Spatial and temporal distribution*

The sighting was made in a subsea canyon system on the northwest slopes of the Porcupine Bank in August 2009. Though the canyon had previously not been targeted for cetacean survey, it lies within an area of canyon systems which have yielded consistent beaked whale sightings (see section 4.10).

### 4.7.3 *Comparison with Irish data sets*

O'Cadhla *et al* (2004) recorded a single sighting of two northern bottlenose whales to the far west of Ireland, over the Hatton/Rockall Basin, and two sightings during the SIAR survey, one in the northern Rockall Trough and one over the Irish shelf to the west of Mayo. Reid *et al* (2003) recorded two sightings of this species, one sighting over the north slopes of the Porcupine Bank and one in abyssal waters to the far west of Ireland.

Little is known of this species in northwest European waters and there are no population estimates for the region (Whitehead and Hooker, 2011), although some estimates have been calculated for the far northern latitudes, such as 5,827 estimated for the far northeast Atlantic by Gunnlaugsson and Sigurjónsson (1990).

It is thought that commercial whaling had a significant impact on numbers, with over 65,000 animals killed from the 1850s to the 1970s (Reeves *et al*, 1993), with no evidence that populations have yet recovered from the onslaught (Taylor *et al*, 2008). Northern bottlenose whales were found to be the most commonly sighted beaked whale species in surveys to the north and west of Scotland (Weir *et al*, 2001). In Irish waters, most of what is known about this species comes from stranding records, which indicate a peak in strandings in late summer and early autumn. Northern bottlenose whales are the second most commonly stranded beaked whale species, with strandings recorded on all coasts, including, historically, the Irish Sea (IWDG, 2011c).

## 4.8 Cuvier's Beaked Whale (*Ziphius cavirostris*)

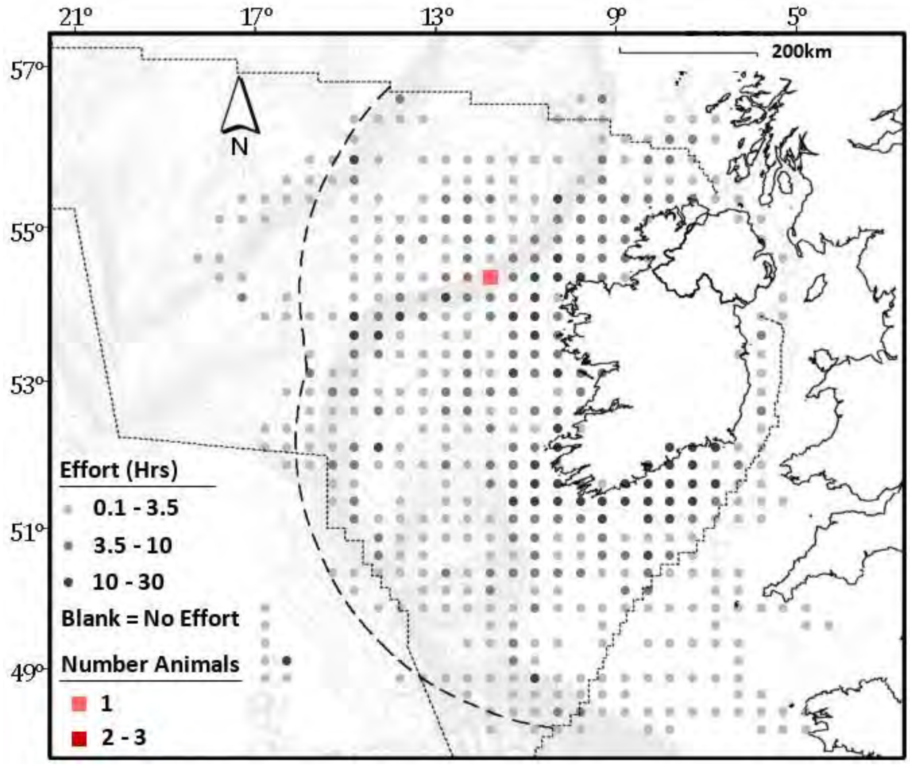



**Figure 4.8.1:** Location of a single sighting of a Cuvier's beaked whale recorded in canyon on the northeastern slopes of the Porcupine Bank in March 2009

### 4.8.1 *Sightings summary*

A single sighting of a probable Cuvier's beaked whale was recorded. Cuvier's beaked whales and beaked whales in general are notoriously difficult to survey visually as they spend up to 93% of their lives beneath the surface and out of reach of visual observers. When at the surface they are difficult to detect in anything but the very calmest sea states due to their low profile at the surface and detection rates even in ideal conditions are low (Barlow and Gisiner, 2006). The sighting of a single breaching animal occurred in sea state five during a fisheries cetacean survey of the Rockall Trough and slopes.

### 4.8.2 *Spatial and temporal distribution*

The sighting was made within an area of canyon systems on the northwest slopes of the continental shelf, west of Belmullet, Co Mayo.

### 4.8.3 *Comparison with Irish data sets*

Cuvier's beaked whale is considered among the most common of the beaked whale species, with a global population in excess of 100,000 animals considered likely. However, no global estimate has been established for this species (Taylor *et al*, 2008). Two sightings of Cuvier's beaked whales were recorded by O'Cadhla *et al* (2004) in waters over the southern Porcupine Bank and in the Rockall Trough. Reid *et al* (2003) recorded two sightings in inshore waters off the southwest coast, which cannot be considered their natural habitat, and a third sighting in deep waters beyond the shelf edge off the northwest coast. During the CODA surveys, the majority of Cuvier's beaked whale sightings occurred to the south, in the Bay of Biscay, whereas only a single Cuvier's sighting was reported from the northern survey area (Hammond *et. al* 2010). Weir *et al* (2001) did not record any sightings of Cuvier's beaked whales during surveys north and west of Scotland.

Cuvier's beaked whale is generally considered a species of warm temperate waters. Irish waters encompass the northern range limit for this species and Cuvier's beaked whales represent the most commonly stranded beaked whale species in Irish waters. Strandings are recorded primarily from the south and west coasts and have been recorded throughout the year (IWDG, 2011c). Whether a high strandings rate reflects a high offshore abundance within the Irish EEZ is unknown as high strandings rates seen in other species do not necessarily reflect a high population abundance in adjacent waters (for example, striped dolphins. See section 5.17).

## 4.9 Sowerby's Beaked Whale (*Mesplodon bidens*)

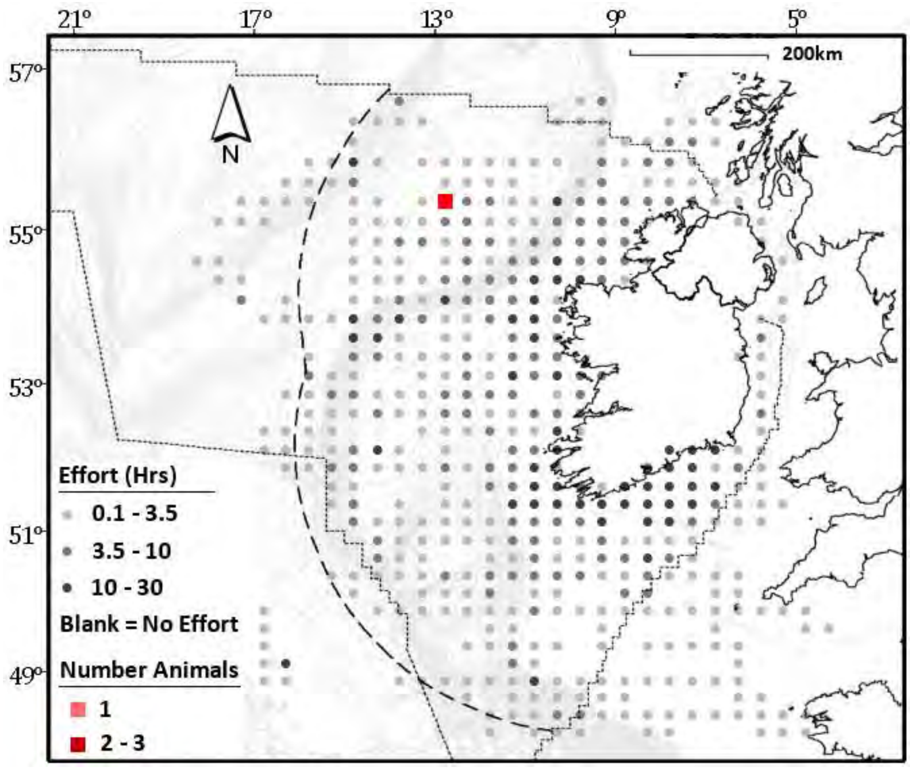



**Figure 4.9.1:** Location of a sighting of two Sowerby's beaked whales. They were sighted and photographed in the Rockall Trough in May 2010

### 4.9.1 *Sightings summary*

Two sightings of Sowerby's beaked whale were recorded. As with the other beaked whale species, Sowerby's are notoriously difficult to survey visually as they spend up to 93% of their lives beneath the surface and out of reach of visual observers. When at the surface they are difficult to detect in anything but the very calmest sea states due to their low profile at the surface, and detection rates even in ideal conditions are low (Barlow and Gisiner, 2006). Sightings of Sowerby's beaked whales, and other beaked whale species, are facilitated by their tendency to breach clear of the water, often in displays of synchronous breaching by two or more individuals.

### 4.9.2 *Spatial and temporal distribution*

One sighting was made within the Irish EEZ, in the centre of the Rockall Trough in water depths of over 3000m. This sighting involved two synchronously breaching individuals which breached multiple times in sea state four about one kilometre from the survey vessel as it passed by. Species identification was supported by a series of photographs (figure 4.9.2) which clearly show the diagnostic elongated beak and slim body of this species. These separate it from the much larger northern bottlenose whale, the blunt beaked Cuvier's Beaked whale and the shorter beaked True's beaked whale.

The second sighting (not shown on map) occurred in UK waters at the northeast slopes of the Rockall Bank. This second sighting was of three animals swimming at the surface in sea state three. Identification was aided by a series of photographs showing the diagnostic elongated beak and slim body of this species (figure 4.9.3).

### 4.9.3 *Comparison with Irish data sets*

Sowerby's beaked whale, along with Northern Bottlenose whale, has a northerly distribution in northwest European waters (Hammond *et al*, 2010). O'Cadhla *et al* (2004) recorded a single sighting in the Rockall Trough during the SIAR survey but Reid *et al* (2003) did not report this species between 1979 and 2001. Many of the beaked whales identified in the northern area of the CODA survey were Sowerby's beaked whales (Hammond *et al*, 2010). Weir *et al* (2001) also sighted a single Sowerby's beaked whale in the northern sector of the Rockall Trough. There are no population estimates for Sowerby's beaked whale and little is known about its biology (Taylor *et al*, 2008). In Ireland, it is the third most commonly stranded beaked whale species, with strandings recorded along the west and southeast coasts. Records of stranded animals have occurred throughout the year (IWDG, 2011c).

**Figure 4.9.2:** Photo montage of two breaching Sowerby's beaked whales in the central Rockall Trough in 2010 (© Dave Wall/IWDG/GMIT)

**Figure 4.9.3:** Photo montage of surfacing Sowerby's beaked whale on the northeast slopes of the Rockall Bank in 2008 (© Dave Wall/IWDG)

## 4.10 Unidentified Beaked Whale Species

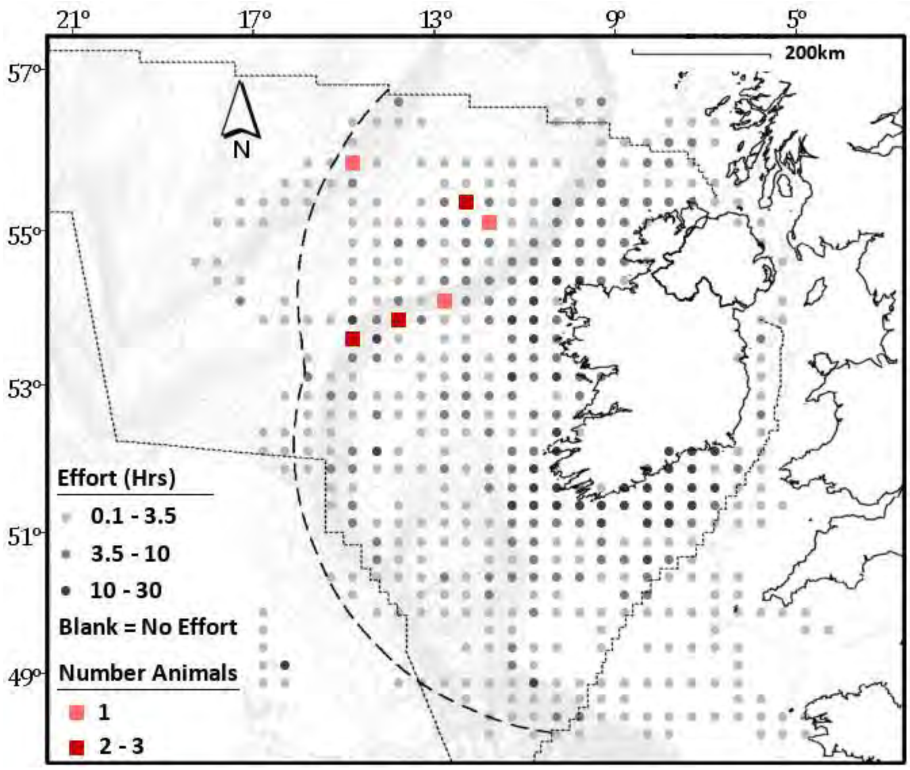



**Figure 4.10.1:** Sightings distribution and total numbers of unidentified beaked whale recorded on and off effort per ¼ ICES statistical rectangle

### 4.10.1 *Sightings summary*

Ten sightings of unidentified beaked whales, totalling 18 animals were recorded. Although beaked whales are notoriously difficult to survey visually as they spend up to 93% of their lives beneath the surface (Barlow and Gisiner, 2006), sightings are facilitated by the tendency of beaked whales to breach clear of the water, often in displays of synchronous breaching by two or more individuals. Other animals were sighted only when they surfaced close to the survey vessel.

### 4.10.2 *Spatial and temporal distribution*

Beaked whale sightings were recorded in all months between March and September (figure 4.10.2). Lack of survey effort in deep water habitats outside of these months precludes determination of presence or absence of beaked whales in autumn and early winter. All beaked whale sightings occurred over slope and canyon habitat, along the slopes of the Rockall Trough or in the deep waters of the central Rockall Trough.

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | |

**Figure 4.10.2** Detection positive months for all beaked whale species recorded during visual surveys.

### 4.10.3 *Comparison with Irish data sets*

Due to their low profile in the water, the tendency of many beaked whale species to avoid vessels and the difficulties in identifying species when clear views of the animals head are not obtained, many beaked whale sightings are not identified at species level. This often leads to beaked whales being treated as a group for the purposes of analysis rather than as separate species (e.g. Hammond *et al*, 2010).

O'Cadhla *et al* (2004) recorded a combined total of 11 sightings of beaked whales (identified and unidentified species). The majority of sightings were recorded in the Rockall Trough and Hatton/Rockall region. Numbers of beaked whale sightings recorded in the Irish EEZ during CODA were also low (Hammond *et al*, 2010) as were beaked whale sightings recorded in Reid *et al* (2003). Of the areas in which beaked whales were recorded, the north slopes of the Porcupine Bank and adjacent deep water areas represent the most consistent location for sightings in Irish waters.

## 4.11 Killer Whale (Oricnus *orca*)

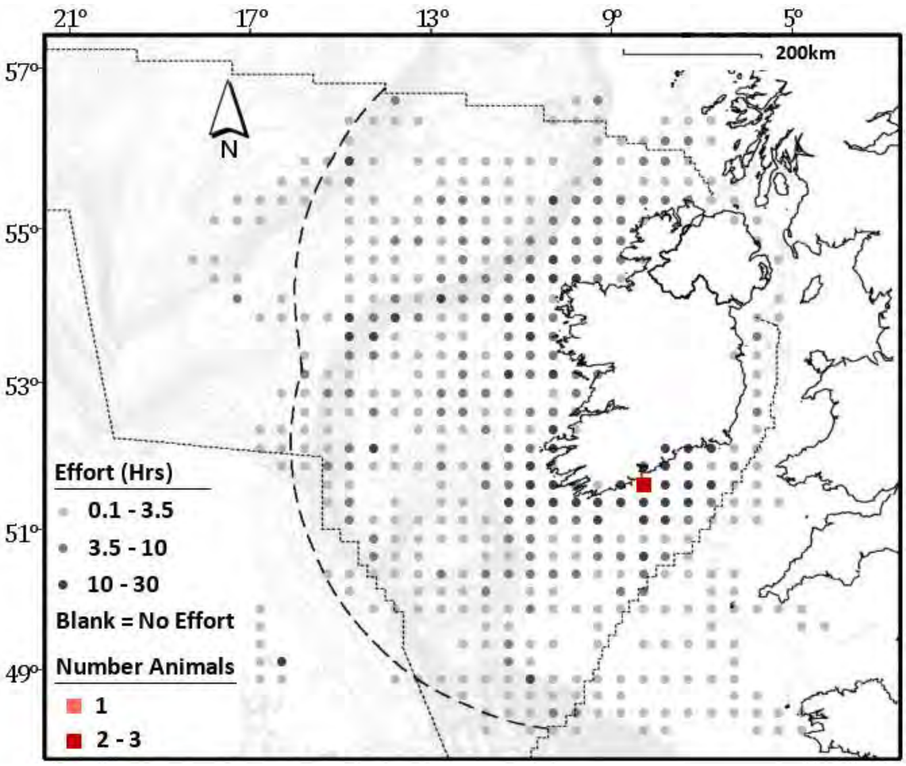



**Figure 4.11.1**: Location of a single sighting of two killer whales recorded in south of Cork Harbour in March 2010

### 4.11.1 *Sightings summary*

A single sighting of two probable killer whales was recorded. The animals were seen breaching at a distance but the observer was experienced and confident of the identification. Killer whales are an uncommon species in Irish waters. However, groups of killer whales previously identified from Scottish waters have been recorded circumnavigating the Irish coast with increasing regularity (IWDG, 2011).

### 4.11.2 *Spatial and temporal distribution*

The sighting of two killer whales was recorded just south of the entrance to Cork harbour in March 2010. Killer whale sightings in Irish waters are typically recorded in waters close inshore and in and around bays and islands (IWDG, 2011).

### 4.11.3 *Comparison with Irish data sets*

O'Cadhla *et al* (2004) recorded one sighting of three killer whales outside Cork Harbour in 2001, one of which subsequently died from septicaemia (Ryan and Wilson, 2003). Reid *et al* (2003) recorded a dozen sightings of this species within the Irish EEZ from 1979 to 1997.

Sightings were recorded over the western shelf and in the Celtic Sea. Killer whales are occasionally recorded by the IWDG casual sightings scheme. with photo-identified individuals belonging to family groups recorded originally off the northwest Scottish coast (IWDG, 2011).

## 4.12 Long-finned Pilot Whale (*Globicephala melas*)

**Figure 4.12.1:** Male pilot whale spy hopping, Hatton Bank, northwest of Ireland, 2008. (© Dave Wall/IWDG/GMIT)

### 4.12.1 *Sightings summary*

106 sightings of long-finned pilot whale were recorded during the surveys. A total of 1,256 animals, including 91 calves/juveniles, were recorded. Group sizes of up to 100 animals were encountered. However, 91.5% of groups consisted of 20 animals or less (figure 4.12.2).

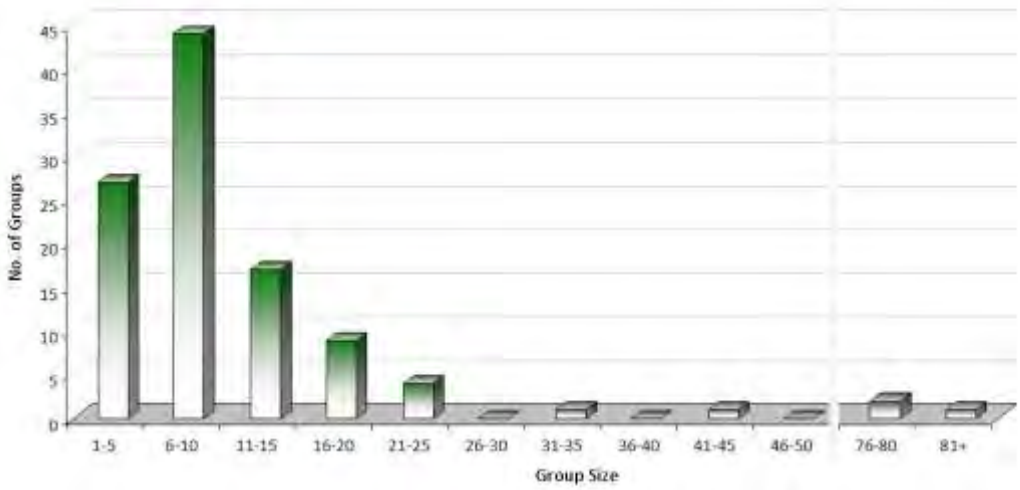



**Figure 4.12.2:** Frequency of occurrence of group size in 106 sightings of pilot whales.

### 4.12.2 *Spatial and temporal distribution*

Pilot whales were recorded throughout the year, except for October and January, though this may be due to lack of effort in deep water habitats in those months.

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |

**Figure 4.12.3:** Detection positive months for pilot whales recorded during visual surveys.

Almost all sightings occurred in deeper waters beyond the continental shelf edge. Highest abundances were recorded in the Rockall Trough and its slopes in spring and summer. Calves were recorded from February through to September (figure 4.12.4), and were recorded throughout the geographic range recorded for adult animals (figure 4.12.5).

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | |

**Figure 4.12.4:** Detection positive months for pilot whale calves/juveniles

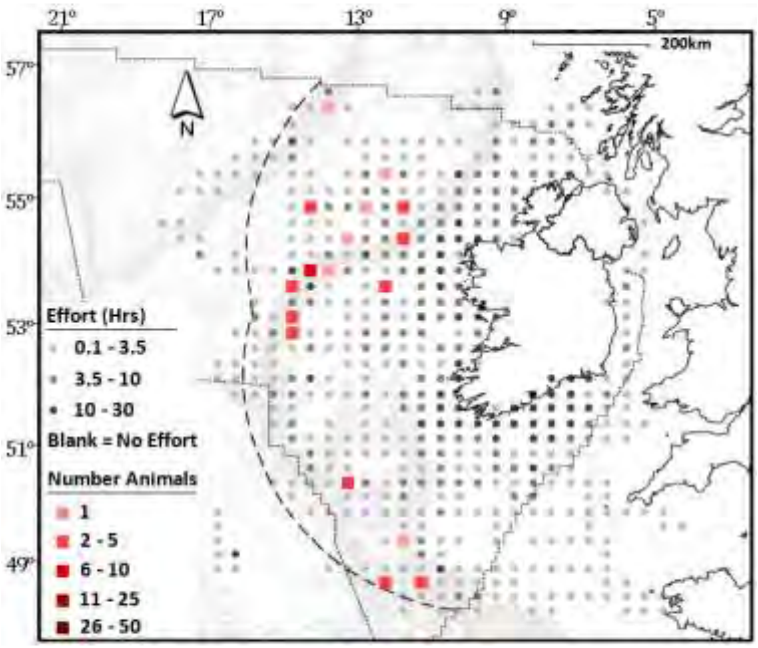
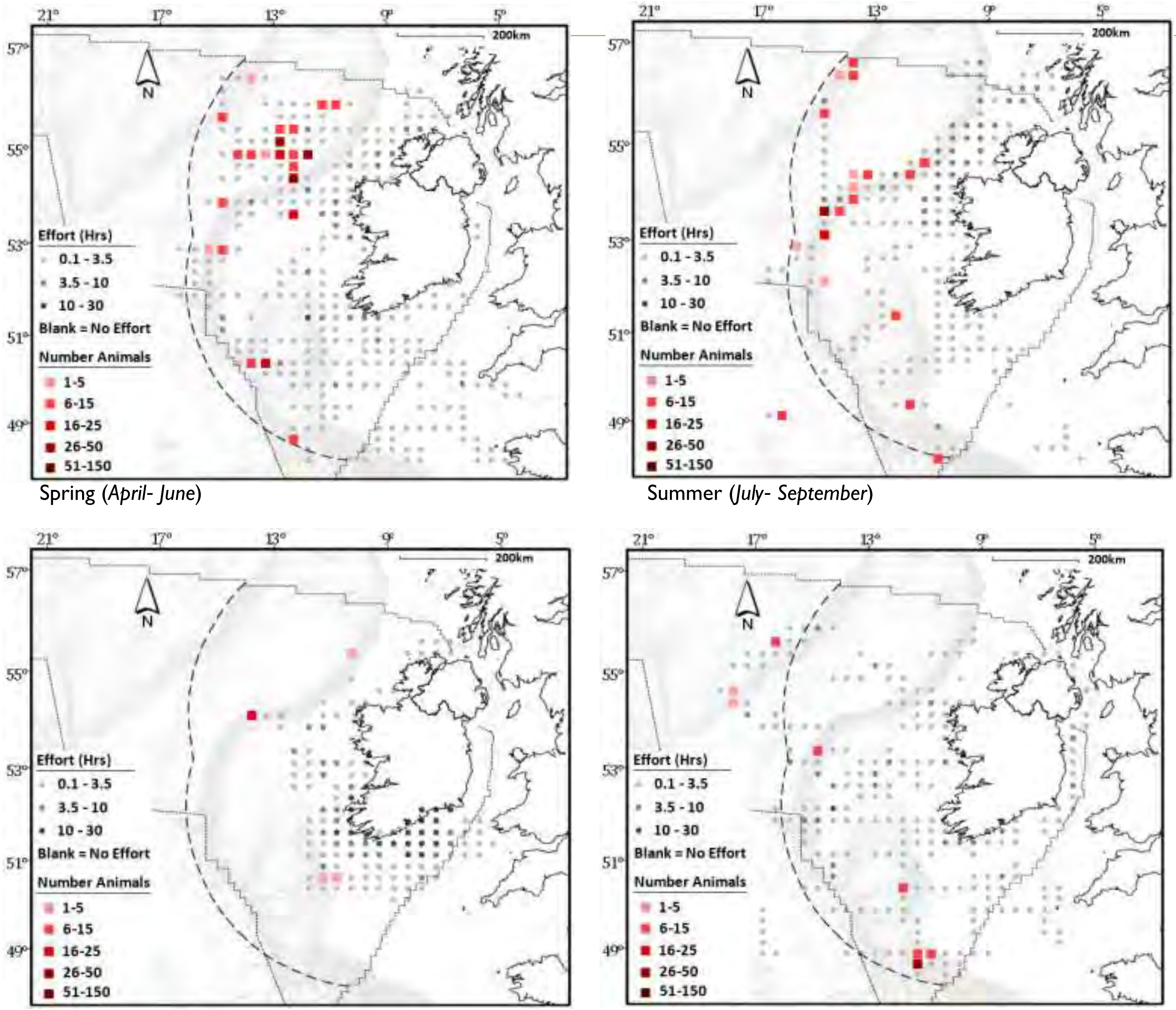



**Figure 4.12.5:** Sightings distribution and total numbers of pilot whale calves/juveniles recorded on and off effort per ¼ ICES statistical rectangle

#### 4.12.3 *Comparison with Irish data sets*

O'Cadhla *et al* (2004) recorded 74 sightings of 686 individuals, with a similar distribution to that found during PReCAST surveys. In common with this study, highest densities of pilot whales were recorded in spring and summer. Reduced offshore effort in the autumn and winter months in both studies did not allow for accurate assessment of presence/absence during these seasons. Reid *et al* (2003) recorded lower densities with a further offshore distribution in comparison to PReCAST or O'Cadhla *et al* (2004). However, the JNCC Atlas suffers from a lack of survey effort in the deeper waters of the continental slopes and offshore banks to the west of Ireland, which most probably explains this difference. Hammond *et al* (2010) recorded a similar distribution to that reported in this study, with most sightings occurring in the slopes and depths of the Rockall Trough.




Spring (*April- June*)

Summer (*July- September*)

Autumn (*October- December*)

Winter (*January- March*)

**Figure 4.12.6:** Seasonal sightings distribution and total numbers of individuals of long– finned pilot whale recorded on and off effort per ¼ ICES statistical rectangle

## 4.13 Risso's Dolphin (Grampus *griseus*)

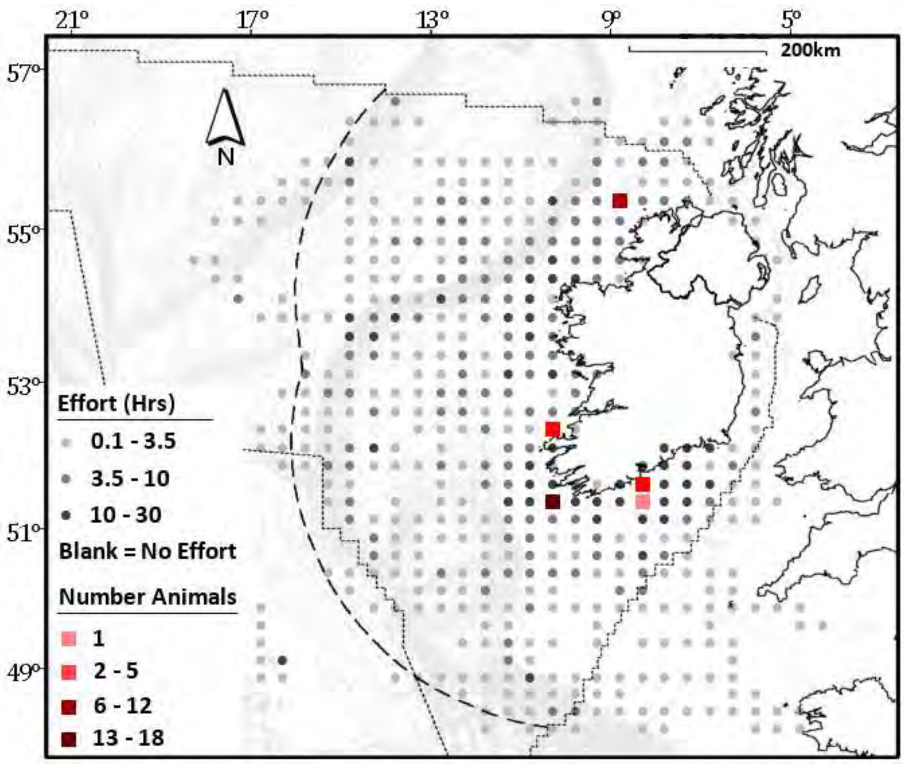



**Figure 4.13.1:** Sightings distribution and total numbers of Risso's dolphin recorded on and off effort per ¼ ICES statistical rectangle

### 4.13.1 *Sightings summary*

Six sightings of Risso's dolphins were recorded, totalling 36 animals. Two calves/juveniles were recorded. By their nature, Risso's dolphins are difficult to observe when actively swimming at sea and some additional calf sightings may have been missed. The presence of calves is consistent with other known breeding groups in the Irish Sea and off the southeast coast of Ireland. Group sizes ranged from one to ten animals.

### 4.13.2 *Spatial and temporal distribution*

Sightings were recorded in April, May and October. All sightings occurred in shallow waters (≤200m) over the Irish shelf. This is in contrast to many locations elsewhere in the world where Risso's dolphins are considered a deep water species (Shirihai and Jarrett, 2006).

### 4.13.3 *Comparison with Irish data sets*

The distribution of Risso's dolphins recorded during PReCAST reflects that of previous studies. Both Reid *et al* (2003) and O'Cadhla *et al* (2004) recorded a distribution overlying the shallow waters of the Irish Shelf and in the Irish Sea.

O'Cadhla *et al* hypothesised that the recorded inshore distribution of Risso's Dolphins in Irish and UK waters may be due to a lack of offshore survey effort. However, the consistent lack of offshore sightings in areas where significant survey effort has been conducted and where other species have been recorded indicate that this is not the case and that this species does indeed maintain a predominantly inshore distribution in Irish and UK waters. Why Risso's dolphins occupy shallow, inshore habitats in Irish and UK waters, as opposed to their preference for deep water habitat reported elsewhere, is not known.

**Figure 4.13.2:** Photo montage of breaching adult Risso's dolphin, Brandon Bay, Co Kerry, 2010 (© Dave Wall/IWDG/GMIT)

## 4.14 Bottlenose Dolphin (*Tursiops truncatus*)

**Figure 4.14.1**: Offshore bottlenose dolphins, NW Slopes, August 2009 (© Dave Wall/IWDG/GMIT)

### 4.14.1 *Sightings summary*

24 sightings of bottlenose dolphins, totalling 488 (including 17 calves/juveniles), were recorded. Group sizes ranged from one to 200 animals. 75% of groups consisted of one to 15 animals (figure 4.14.2).

A group encountered on the northwest slopes of the Irish Shelf in August 2009 consisted of at least 200 individuals. This was the largest single bottlenose dolphin group ever recorded in Irish waters. 10% of the animals within this super group were photo-identified by taking photographs of their dorsal fins (see section 6.3.5). No matches were obtained between this group and any animal in the IWDG coastal bottlenose dolphin photo-ID catalogue or in the Shannon Estuary photo-ID catalogue. This, and the fact that the animals within this super group appeared larger and more heavily scarred than bottlenose dolphins encountered in coastal sites or the Shannon Estuary, indicated that these animals may represent an offshore ecotype (see section 9).

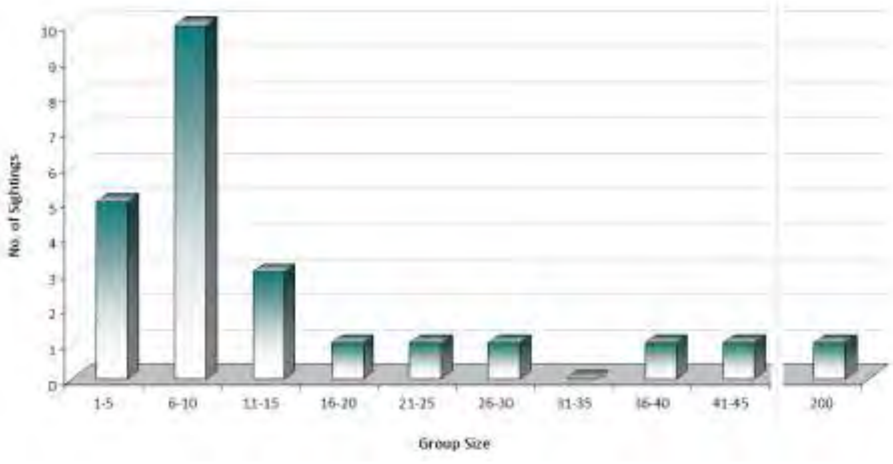



**Figure 4.14.2:** Frequency of occurrence of group size in 24 sightings of bottlenose dolphins

### 4.14.2 *Spatial and temporal distribution*

Bottlenose dolphins were sighted throughout the year (figure 4.14.3) and were sighted over a variety of habitats: over the Irish shelf, offshore banks, shelf slopes and in the deep waters of the Rockall Trough. This species was sometimes seen in association with pilot whales and/or Atlantic white-sided dolphins in deeper waters.

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |

**Figure 4.14.3:** Detection positive months for bottlenose dolphins recorded during visual surveys

Calves or juveniles were noted throughout the year (figure 4.14.4) and were recorded throughout most of the recorded range of the adult animals (figure 4.14.5).

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ✓ | | ✓ | | ✓ | | ✓ | | | | ✓ |

**Figure 4.14.4:** Detection positive months for bottlenose dolphin calves/juveniles recorded during visual surveys

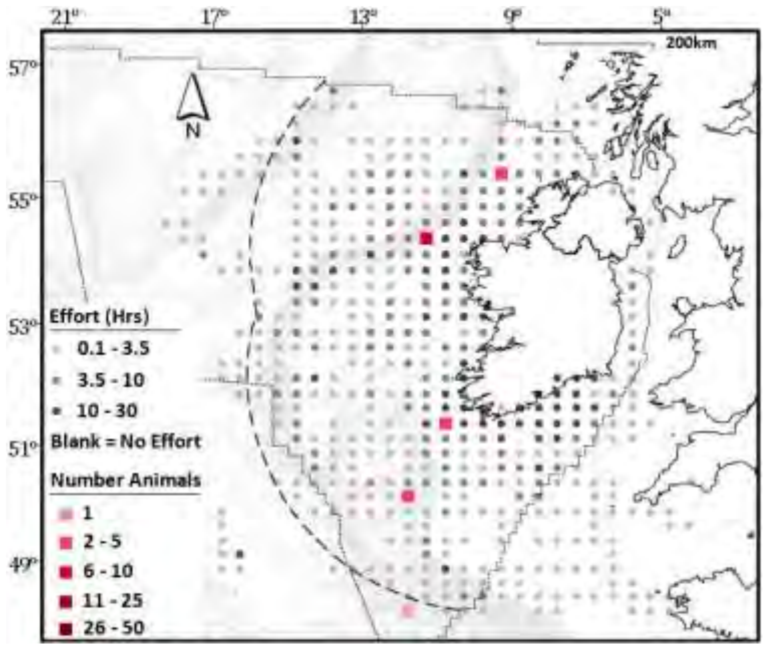



**Figure 4.14.5:** Sightings distribution and total numbers of **bottlenose dolphin calves/juveniles** recorded on and off effort per ¼ ICES statistical rectangle

### 4.14.3 *Comparison with Irish data sets*

Bottlenose dolphins in Irish waters have long been know to have a coastal distribution, with one resident breeding group in the Shannon Estuary (Berrow *et al*, 1996) and at least one other semi-resident group in Cork harbour (Ryan *et al*, 2010.) O'Brien *et al* (2009) have described long range movements of bottlenose dolphins around the Irish (and UK) coasts. The PReCAST survey data largely failed to record these coastal animals as survey effort was focused in offshore waters. However, the offshore distribution data adds to a body of evidence from previous visual surveys (Reid *et al*, 2003; O'Cadhla *et al*, 2004 and Hammond *et al*, 2010) that there are bottlenose dolphins in Irish waters with an offshore distribution focusing on the continental shelf slopes, offshore banks and over the deeper waters of the Rockall Trough. Recent genetic evidence (Miriman *et al*, 2011), coupled with these offshore sightings and data from offshore photo-ID (see section 5.3.5), suggest there is an offshore population of bottlenose dolphins within the Irish EEZ which is largely separate from the coastal or estuarine populations.

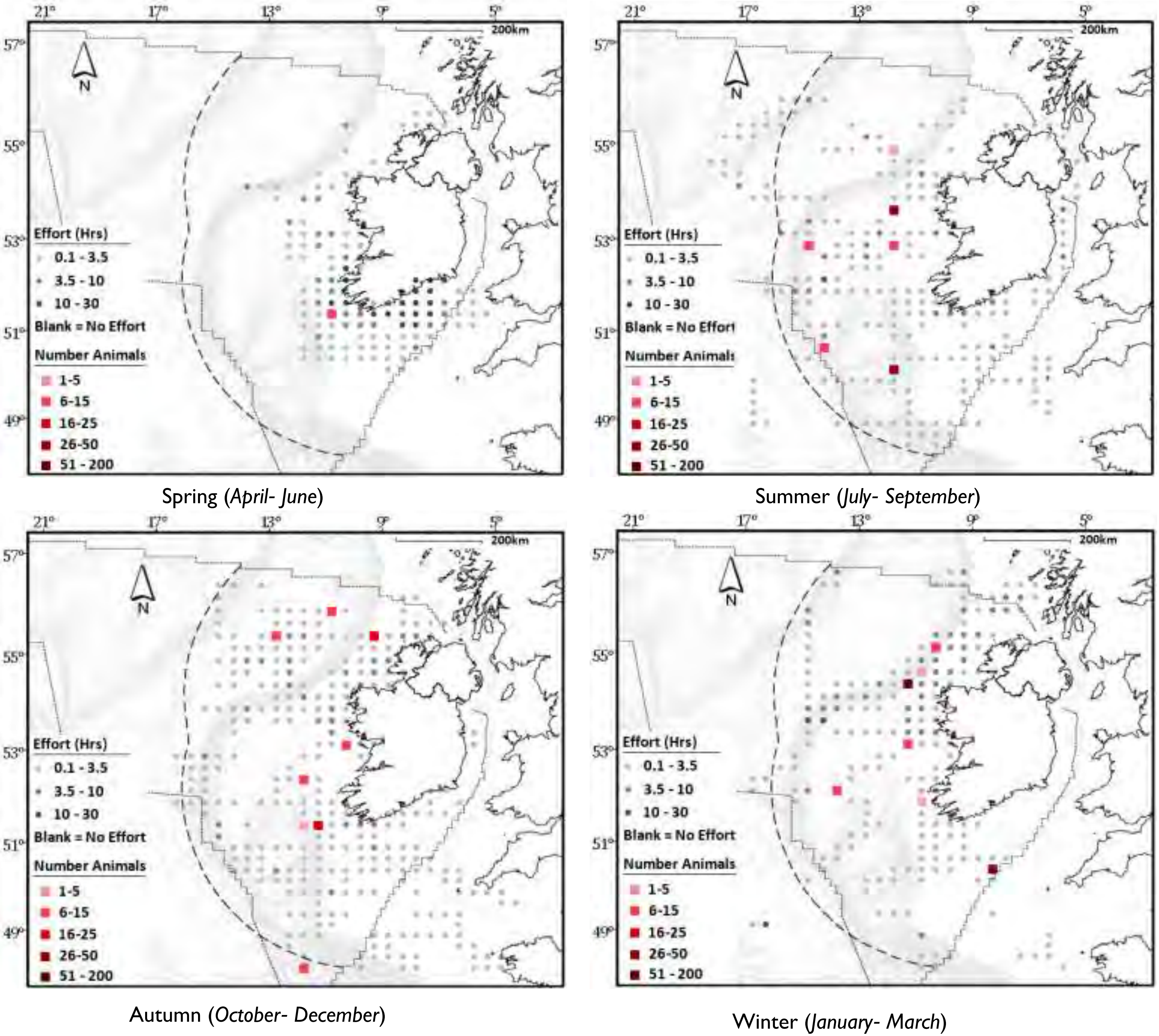



**Figure 5.14.6** Seasonal sightings distribution and total numbers of individuals of **bottlenose dolphin** recorded on and off effort per ¼ ICES statistical rectangle.

## 4.15 White-beaked Dolphin (Lagenorhynchus albirostris)

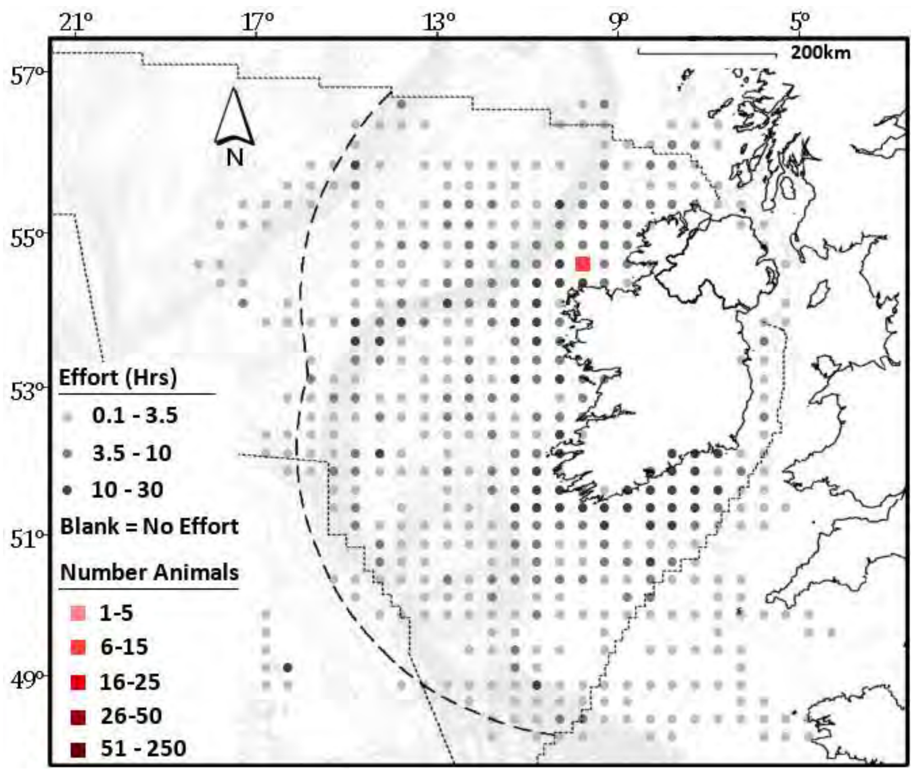



**Figure 4.15.1:** Location of two sightings of white-beaked dolphins, sighted north of Erris Head in June 2010

### 4.15.1 *Sightings summary*

Eight sightings of white beaked dolphins, totalling 31 animals were recorded. Group sizes ranged from one to eight animals.

### 4.15.2 *Spatial and temporal distribution*

Of eight sightings of white-beaked dolphins, two occurred in Irish waters. The remaining six sightings were recorded in the North Sea as the Dutch research vessel *Pelagia* returned to Texel in the Netherlands after a six-week survey off the south and west Irish coasts. The two Irish sightings – possibly of the same group of animals as both groups consisted of seven or eight animals – occurred one day apart, north of Erris Head, Co Mayo, in June 2010.

### 4.15.3 *Comparison with prior data sets*

The lack of sightings of this species compares strongly to data from Reid *et al* (2003), which suggest that white beaked dolphins were once relatively common along the outer shelf to the west and northwest of Ireland. O'Cadhla *et al* recorded 25 sightings of this species, predominantly along the shelf slopes to the west and northwest of Ireland. Only four sightings of white-beaked dolphin were recorded within the Irish EEZ during the SCANS II survey (Hammond *et al*, 2006). Learmonth *et al* (2006) and Macleod *et al* (2005) suggest that cold water species such as white-beaked dolphins may be suffering a northward habitat shift due to rising average sea temperatures in the waters around northwest Europe. Since 2004 only three sightings of this species have been recorded during IWDG ship or ferry surveys, suggesting that the white-beaked dolphin is a species in decline in Irish waters.

**Figure 4.15.2:** Bow riding white-beaked dolphin, North Sea, 2008 (© Dave Wall/IWDG/GMIT)

# 4.16 Atlantic White-sided Dolphin (*Lagenorhynchus actus*)

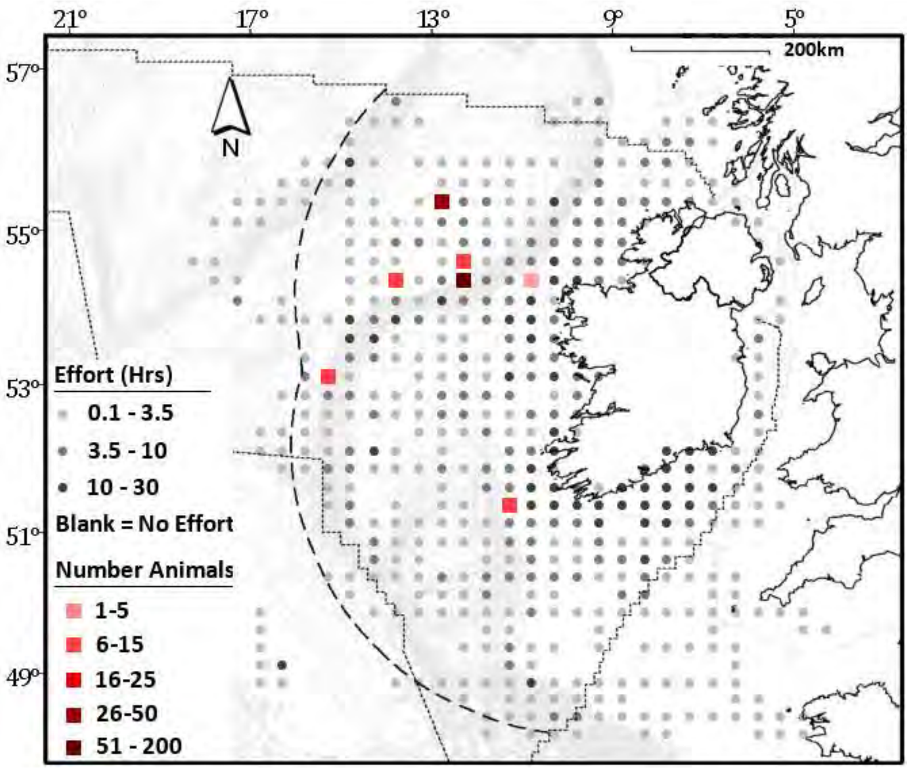



**Figure 4.16.1** Sightings distribution and total numbers of Atlantic white-sided dolphin recorded on and off effort per ¼ ICES statistical rectangle

### 4.16.1 *Sightings summary*

13 sightings of Atlantic white-sided dolphins, totalling 365 animals were recorded. Some sightings were of mixed species groups of pilot whales and/or bottlenose dolphins and white-sided dolphins. Species group size ranged from four to 250 animals. 53% of groups consisted of less than ten individuals, 31% of groups consisted of ten to 15 animals and two groups consisted of 30 or more animals. A sighting on the northwest shelf slopes in June 2010 consisted of a well-spread out group of upwards of 250 animals. This is the largest single group of Atlantic white-sided dolphin recorded in Ireland to date (IWDG, 2011).

### 4.16.2 *Spatial and temporal distribution*

The highest abundance of animals and sightings occurred in deep waters (>200m) to the northwest of Ireland. Sightings were made from February to July (figure 4.16.2). A single sighting was recorded on the eastern slopes of the Porcupine seabight to the southwest of Ireland.

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ✓ | | ✓ | | ✓ | ✓ | | | | | |

**Figure 4.16.2:** Detection positive months for white-sided dolphins recorded during visual surveys

### 4.16.3 *Comparison with prior data sets*

The number of sightings of white-sided dolphin recorded during PReCAST was low when compared to O'Cadhla *et al* (2004), who found that Atlantic white-sided dolphins were the 'second most numerous cetacean species' recorded during their study. O' Cadhla *et al* also reported a northward shift in white-sided distribution during the summer months, which is consistent with this species' preference for colder water temperatures (Shirihai and Jarrett, 2006). Reid *et al* (2003) recorded most sightings to the northwest of Ireland and only a few in the Celtic Sea or Celtic shelf edge. Hammond *et al* (2010) recorded insufficient numbers of sightings of this species during the CODA offshore survey of 2007 to calculate a density estimate.

It is not clear whether the low number of sightings of this species recorded during PReCAST indicates a decline in numbers due to climatic change or if the high numbers recorded during the PIP surveys (O'Cadhla *et al*, 2004) were unusual The JNCC Atlas data, as well as the CODA data, indicate that this species is relatively uncommon within the majority of the Irish EEZ, exhibiting a preference for colder waters to the north of the Porcupine Bank. Wall *et al* (2006) found high relative abundances of this species in the summer over the relatively shallow waters of the Rockall Bank.

The sighting of a super pod of over 250 animals in June is consistent with findings elsewhere that suggest the presence of super groups of white-sided dolphins during the summer months, which are believed to encompass the breeding season for this species (O'Cadhla *et al*, 2004).

## 4.17 Short-beaked Common Dolphin (*Delphinus delphis*)

**Figure 4.17.1:** Common dolphins in the Celtic Sea (© Dave Wall)

### 4.17.1 *Sightings summary*

719 sightings of common dolphins were recorded, totalling 9,348 animals. Common dolphins were by far the most frequently encountered and abundant cetacean species recorded during the surveys. At least 156 calves or juveniles were encountered. Group sizes ranged from one to 350 animals (figure 4.17.2), with 87% of groups consisting of 20 or fewer animals.

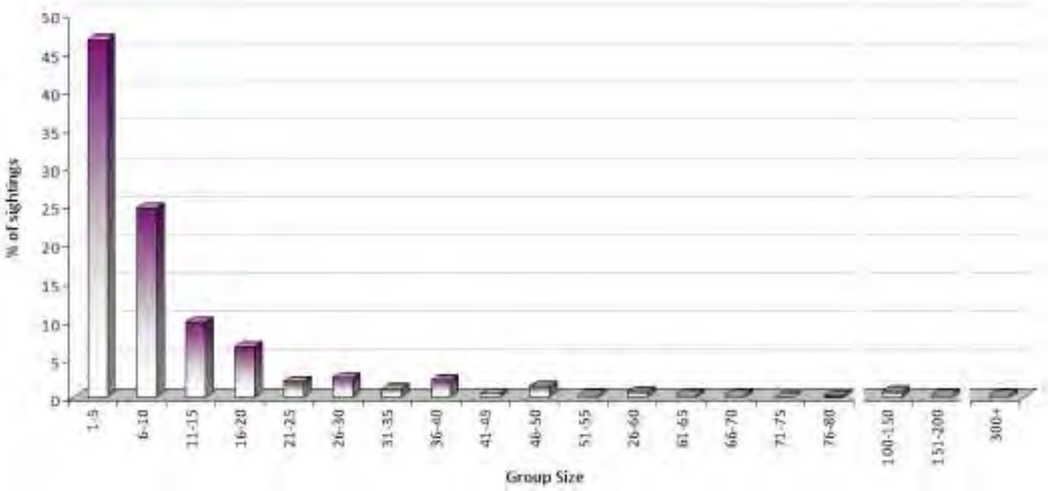



**Figure 4.17.2:** Frequency of occurrence of group size in 719 sightings of common dolphins

### 4.17.2 *Spatial and temporal distribution*

Common dolphins were predominantly recorded in habitats over the Irish Shelf and slopes. Common dolphin abundance was low in spring but increased in summer and autumn before declining again in winter (figure 4.17.3). There appeared to be an offshore movement associated with higher densities in the summer months, with animals moving into shelf slope habitats and deep waters to the west of the shelf slopes.

In autumn high densities of animals were found inshore around the south and west coasts and this appeared to be linked to the presence of schooling pelagic fish in these areas during that time of year. In winter there was a reduced distribution of common dolphins over much of the Irish shelf. However, large groups of animals were still encountered and some high abundances remained over canyon systems to the southwest of Ireland.

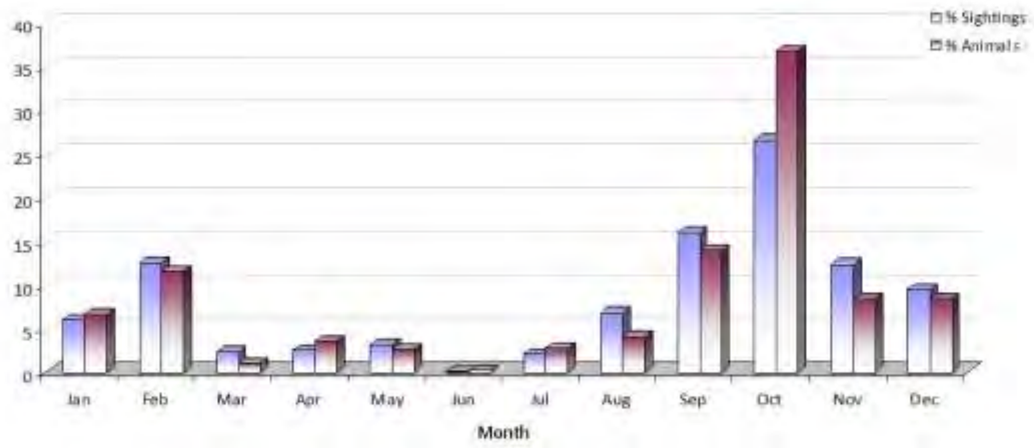



**Figure 4.17.3:** Monthly totals sightings counts and total individual counts of common dolphins

Calves were sighted predominantly in late summer and autumn (figure 4.17.4) which is consistent with the published parturition period for northern Atlantic short-beaked common dolphins of July to August (ICES, 2005). Calves and/or juveniles were recorded throughout the recorded range of the adult animals (figure 4.17.5).

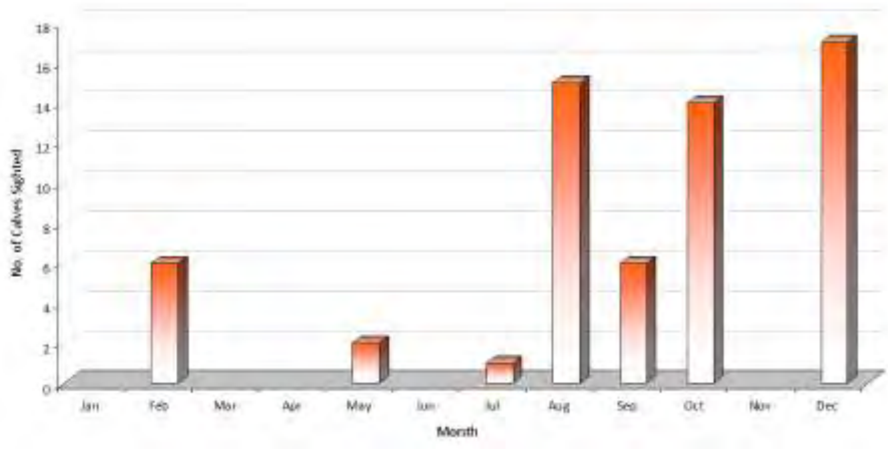



**Figure 4.17.4:** Monthly sightings of calves during visual surveys

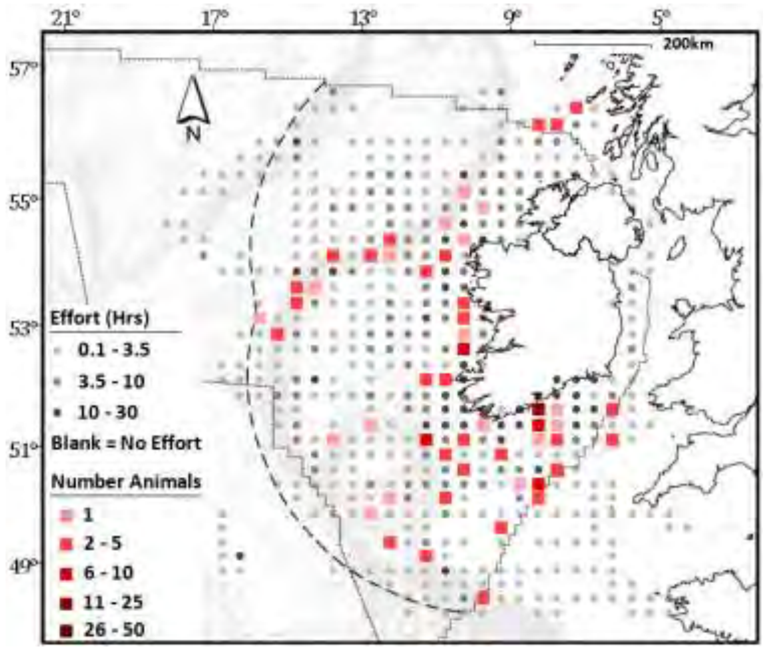



**Figure 4.17.5:** Sightings distribution and total numbers of **common dolphin calves/juveniles** recorded on and off effort per ¼ ICES statistical rectangle

### 4.17.3 *Comparison with prior data sets*

The finding that common dolphins were the most widespread and abundant cetacean species recorded during PReCAST surveys is consistent with findings of previous studies (Reid *et al*, 2003; O'Cadhla *et al*, 2004, Hammond, 2006). PReCAST data show a strong seasonal trend in common dolphin distribution and abundance, with common dolphins being recorded at lower relative abundance and with a restricted inshore and southerly distribution during the winter and spring and at high relative abundance with a wider distribution spreading into shelf and offshore habitats in the summer.

Although survey effort was restricted during the autumn, it showed high densities of common dolphin off the south and southwest coasts of Ireland, most probably linked to the very large biomass of pelagic schooling fish species which occupy these waters during the autumn months (Marine Institute, 2010).

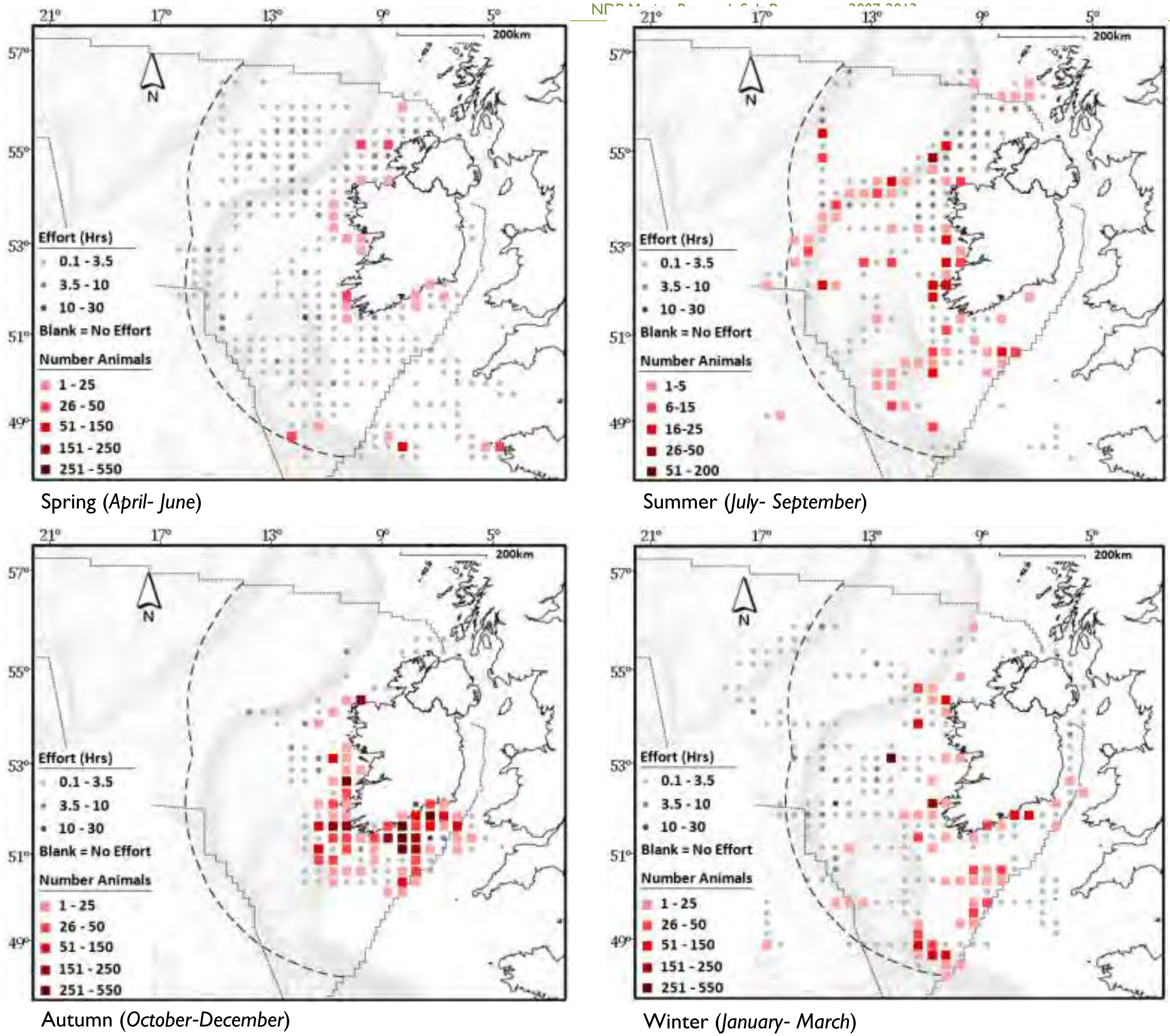



**Figure 5.17.6** Seasonal sightings distribution and total numbers of individuals of **common dolphin** recorded on and off effort per ¼ ICES statistical rectangle.

## 4.18 Striped Dolphin (Stenella coeruleoalba)

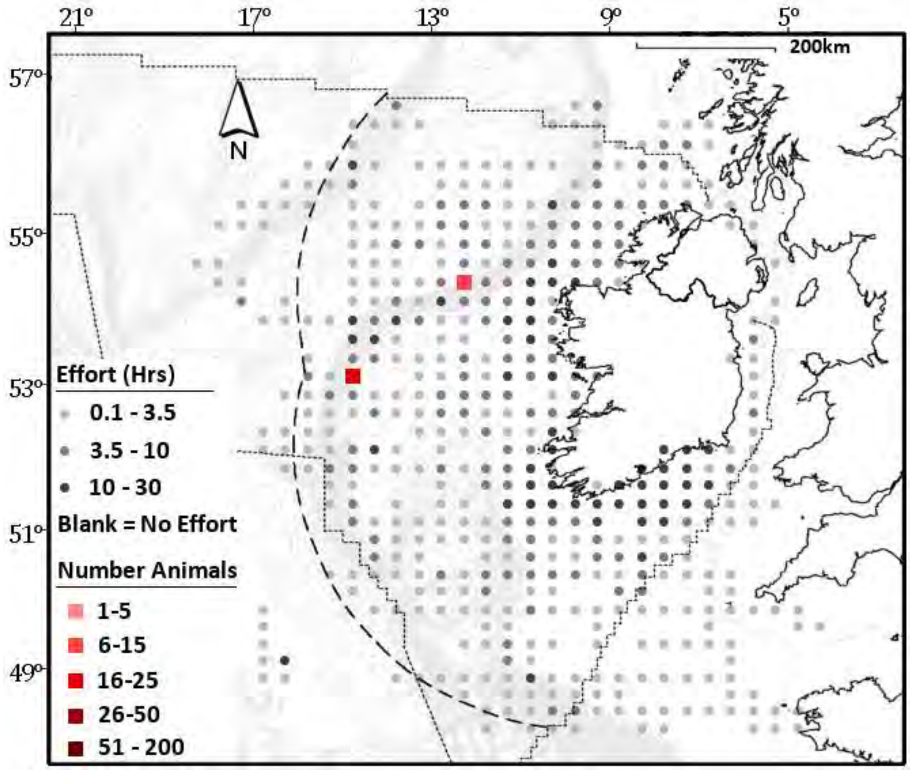



**Figure 4.18.1:** Sightings distribution and total numbers of striped dolphin recorded on and off effort per ¼ ICES statistical rectangle

### 4.18.1 *Sightings summary*

Two sightings of striped dolphins, totalling 28 animals were recorded. Group sizes were 20 animals in the first sighting and eight animals in the second.

### 4.18.2 *Spatial and temporal distribution*

Sightings took place in August and September. This ties in with a general trend in Irish waters of striped dolphin sightings occurring from July to November (IWDG, 2011) and with a peak in strandings occurring in the latter half of the year (IWDG, 2011c).

### 4.18.3 *Comparison with prior data sets*

The low number of sightings of striped dolphin during the PReCAST surveys contributes to the idea that Irish waters very much represent the northern limit for this species in northwest European waters. Reid *et al* (2003) recorded no sightings of this species in Irish or UK waters between 1979 and 1997. O'Cadhla *et al* (2004) recorded 17 sightings of 135 animals between 1999 and 2001, and Hammond *et al* (2010) recorded five sightings during the CODA survey

(2007). The low number of sightings of this species in Irish waters is at variance with the large number of strandings which occur around the Irish coast each year (IWDG, 2011). It is possible that the high strandings to sightings ratio reflects the fact that striped dolphins are a warm water species which struggle to survive in the colder waters of the Irish EEZ.

## 4.19 Harbour Porpoise (*Phocoena phocoena*)

### 4.19.1 *Sightings summary*

39 sightings of harbour porpoise, totalling 81 animals were recorded. Group size ranged from one to eight animals (figure 4.19.2), with 38% of sightings consisting of individual porpoises and 95% of sightings consisting of group sizes of three or fewer animals.

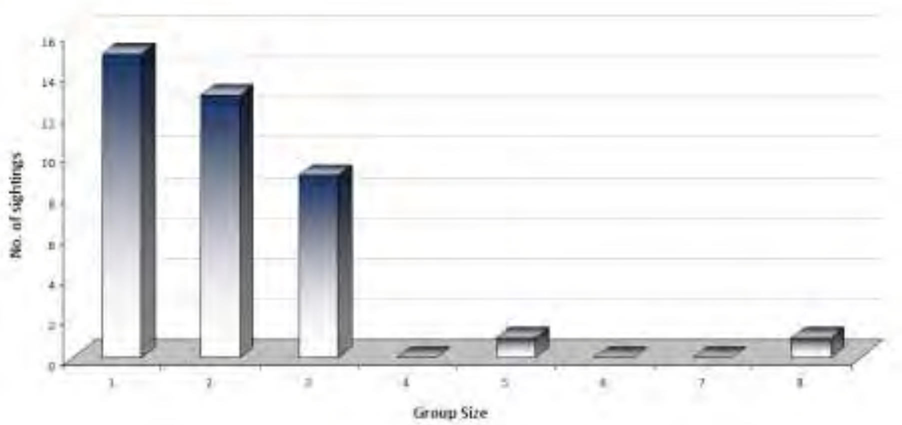



**Figure 4.19.1:** Frequency of occurrence of group size in 39 sightings of harbour porpoise

### 4.19.2 *Spatial and temporal distribution*

Harbour porpoises were recorded in waters over the Irish shelf and in the Irish Sea. Sightings occurred throughout the year but with few sightings during the summer months. Highest densities were recorded off the south coast in autumn.

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓ | ✓ | ✓ |

**Figure 4.19.2:** Detection positive months for harbour porpoise recorded during visual surveys

### 4.19.3 *Comparison with Irish data sets*

The distribution and relative abundance of harbour porpoise recorded during the current study is similar to that found by O'Cadhla *et al* (2004). Harbour porpoise show a restricted inshore distribution predominantly on the northwest, southwest and south coasts and in the Irish Sea. No significant offshore distribution was recorded for this species, although Reid *et al* (2003) and Hammond (2010) reported the species to be distributed at high densities throughout the Celtic Sea. The absence of sightings in the summer months is unusual. However, it should be noted that the survey vessels used generally did not cover inshore habitats (within a mile or two of the coast), which appear to be the stronghold of this species off the south and west coasts (IWDG, 2011).

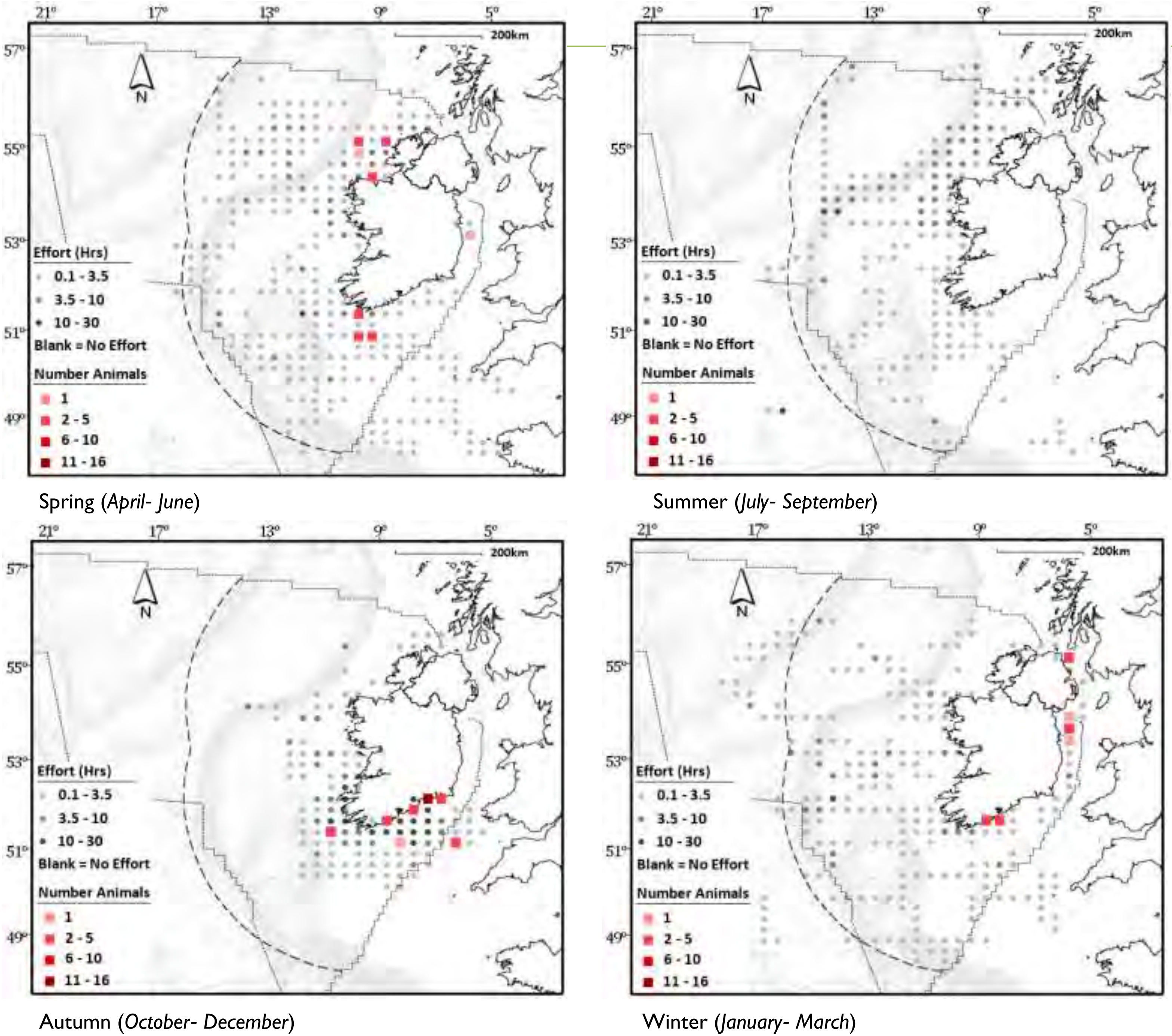



**Figure 4.19.3** Seasonal sightings distribution and total numbers of individuals of **harbour porpoise** recorded on and off effort per ¼ ICES statistical rectangle.

## 4.20 Unidentified Whale (Blow)

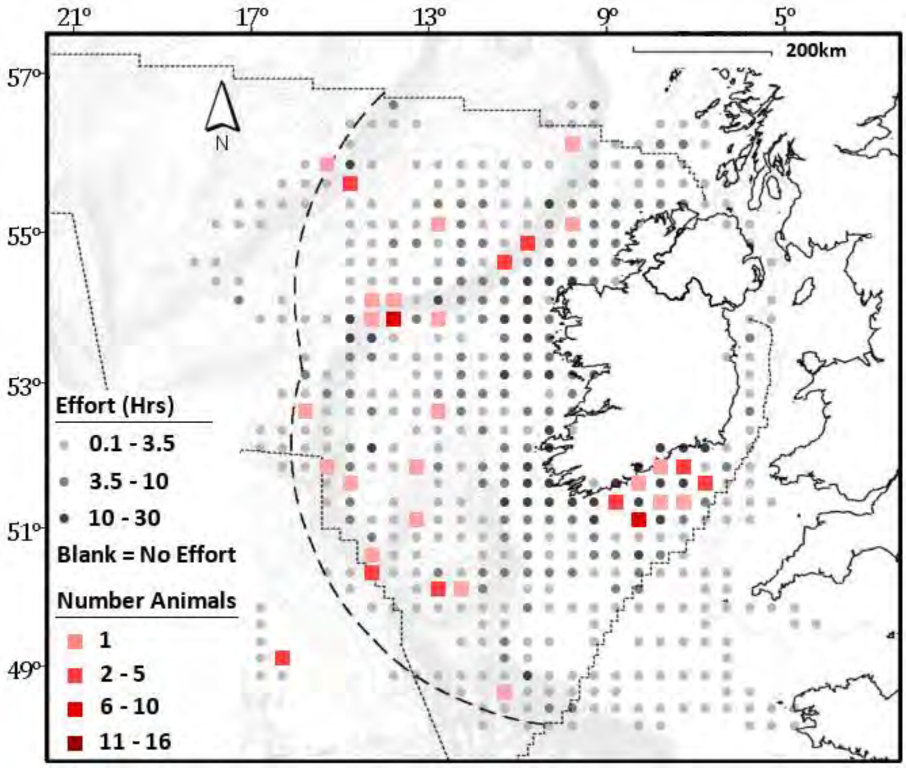



**Figure 4.20.1:** Sightings distribution and total numbers of unidentified whales (blows) recorded on and off effort per ¼ ICES statistical rectangle

### 4.20.1 *Sightings summary*

58 sightings of a whale blow were recorded where the animal was not seen and where the blow was not distinctive enough to classify it as 'fin/sei/blue'. This accounted for a total of 92 animals. The species involved may have been any of the large whale species with a distinct blow (i.e. blue, fin, humpback, sei or sperm whale).

### 4.20.2 *Spatial and temporal distribution*

Unidentified whale blows were seen in all areas with the exception of the Irish Sea. In areas such as the south coast during autumn, it is most likely that the species involved was either fin whale or humpback whale. In deeper waters offshore and along the continental shelf slopes, other species such as sperm whale, sei whale and blue whale were possible, although the characteristic blowing pattern of sperm whales made it unlikely that this species would not be identified.

## 4.21 Medium-sized Whale (no blow)

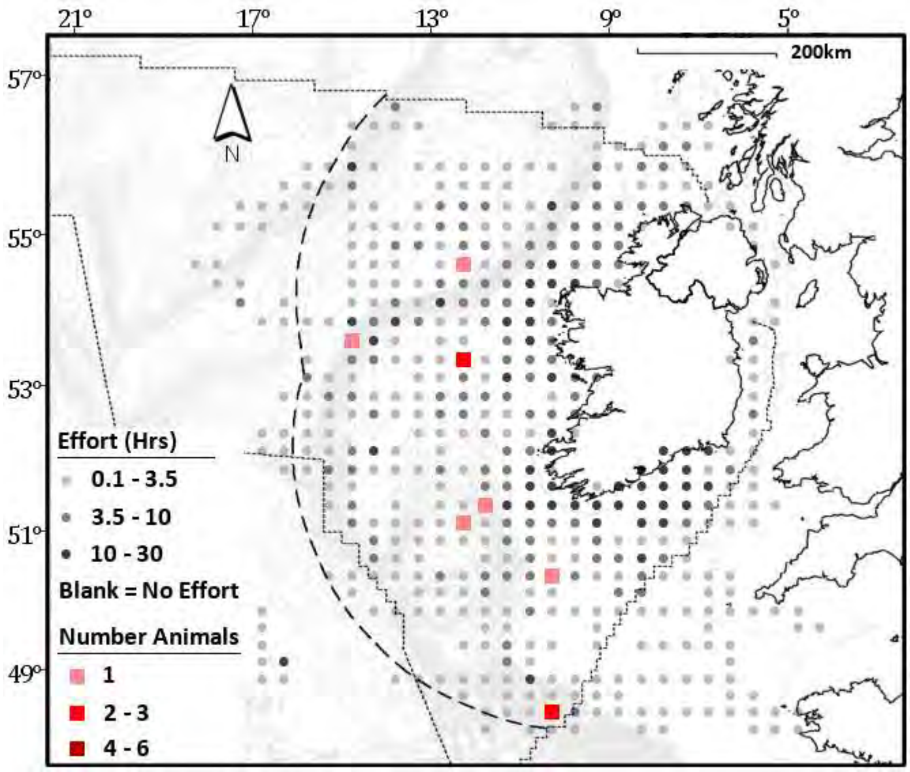



**Figure 4.21.1:** Sightings distribution and total numbers of medium sized whales (no blow) recorded on and off effort per ¼ ICES statistical rectangle

### 4.21.1 *Sightings summary*

A total of 15 sightings of medium-sized whales (larger than pilot whales) where no blow was seen were recorded. This accounted for a total of 26 animals. The species involved may have been minke whales or beaked whales.

### 4.21.2 *Spatial and temporal distribution*

Many of the sightings of medium-sized whales were recorded along the shelf edge and were considered to be possibly beaked whales but, based on the information available during the sighting, minke whales could not be ruled out.

## 4.22 Unidentified Dolphin

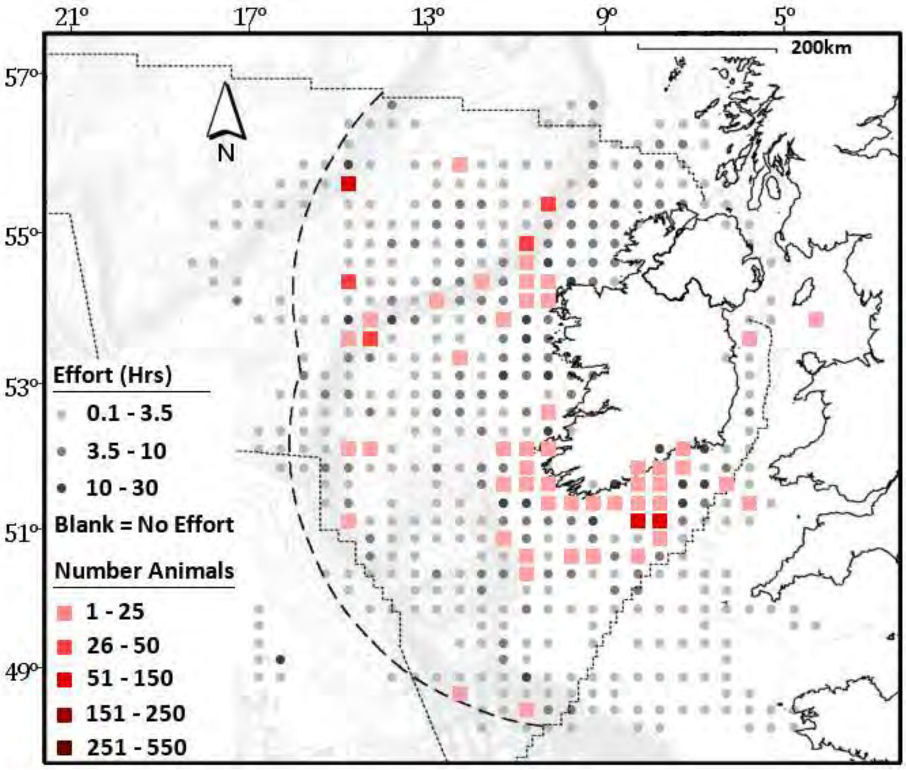



**Figure 4.22.1:** Sightings distribution and total numbers of unidentified dolphins (including harbour porpoise) recorded on and off effort per ¼ ICES statistical rectangle

### 4.22.1 *Sightings summary*

A total of 91 sightings of unidentified dolphins were recorded where not enough of the animal was seen to determine species identity. This accounted for a total of 850 animals. The species involved may have been any of the oceanic or coastal dolphin species or harbour porpoises.

### 4.22.2 *Spatial and temporal distribution*

Unidentified dolphins were recorded in all areas. Many of the animals were probably of species which were commonly seen in a given area and season. However, even if the sighting occurred among a series of sightings of a particular species, if the species identity could not be confirmed from the information available during the sighting, then the animals were classed as unidentified.

## 4.23 Grey Seal (Halichoerus grypus)

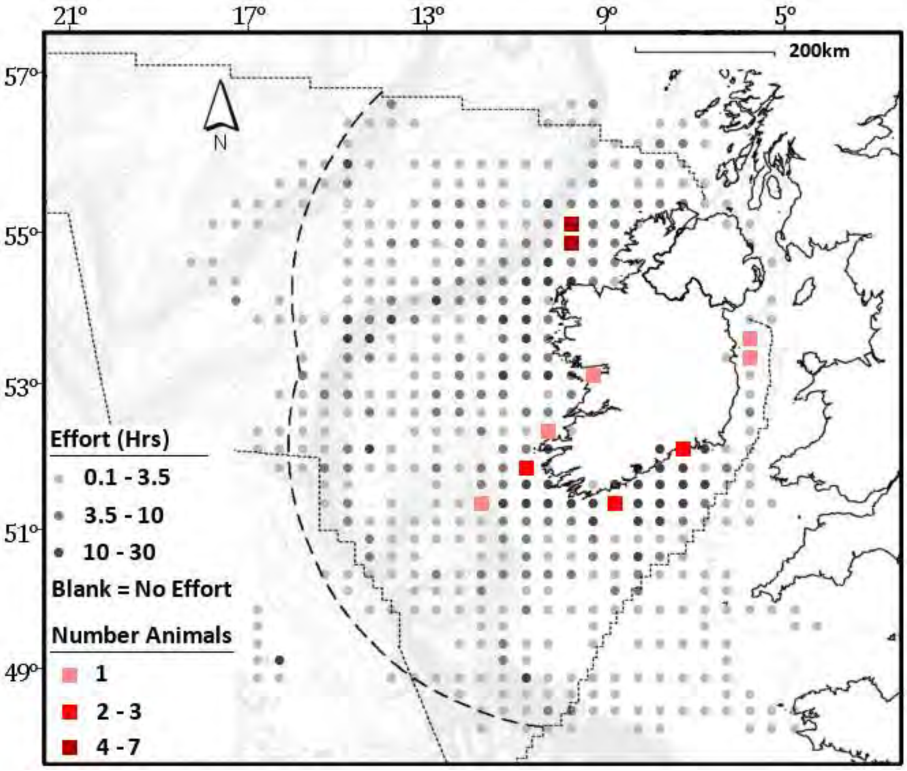



**Figure 4.23.1:** Sightings distribution and total numbers of grey seals recorded on and off effort per ¼ ICES statistical rectangle

### 4.23.1 *Sightings summary*

22 sightings of grey seals were recorded, totalling 23 individuals. 21 of the 22 sightings were of single animals, typically logging or feeding at the surface.

### 4.23.2 *Spatial and temporal distribution*

Grey seals were recorded predominantly in inshore waters over the Irish Shelf. However, animals were also sighted far from land on the outer northwest Irish Shelf and in waters over continental shelf slopes to the southwest of Ireland. Animals were sighted throughout most of the year (figure 4.23.2).

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |

**Figure 4.23.2:** Detection positive months for grey seal recorded during visual surveys

### 4.23.3 *Comparison with Irish data sets*

The distribution of grey seal sightings reflects the known distribution of grey seal pupping colonies around the Irish coast. The highest densities of sightings correlate quite closely with the largest seal colonies, e.g. the Inishkea and Magehra colonies contributing to high seal densities over the northwest shelf, the Lambay and Ireland's Eye colonies on the east coast, and the Blasket, Roaringwater Bay and Saltee colonies on the south coast (O'Cadhla *et al*, 2005). Grey seals are also capable of covering very large distances at sea and may be expected to turn up at any point over Irish shelf waters (UCC, 2011).

**Figure 4.23.3:** Grey Seal hauled out on rocks, High Island, Co. Cork (© Dave Wall)

## 4.24 Common (Harbour) Seal (*Phoca vitulina*)

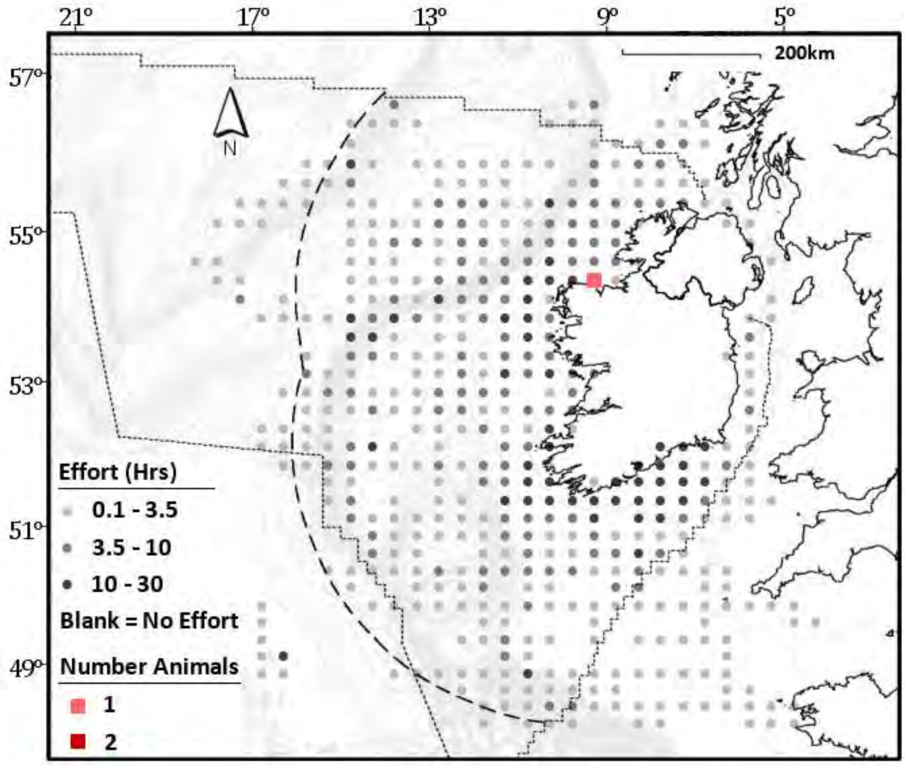



**Figure 4.24.1:** Location of a single sighting of a common seal recorded at the mouth of Killala Bay in May 2010.

### 4.24.1 *Sightings summary*

A single sighting of one common seal was recorded.

### 4.24.2 *Spatial and temporal distribution*

The sighting was recorded in inshore waters at the mouth of Killala Bay, Co Mayo, in May 2010.

### 4.24.3 *Comparison with Irish data sets*

The single sighting of a common seal off Erris Head reflects the nearby location of haul out sites in Kilalla Bay and Broadhaven Bay (Cronin *et al*, 2004).

## 4.25 Basking Shark (Cetorhynchus maximus)

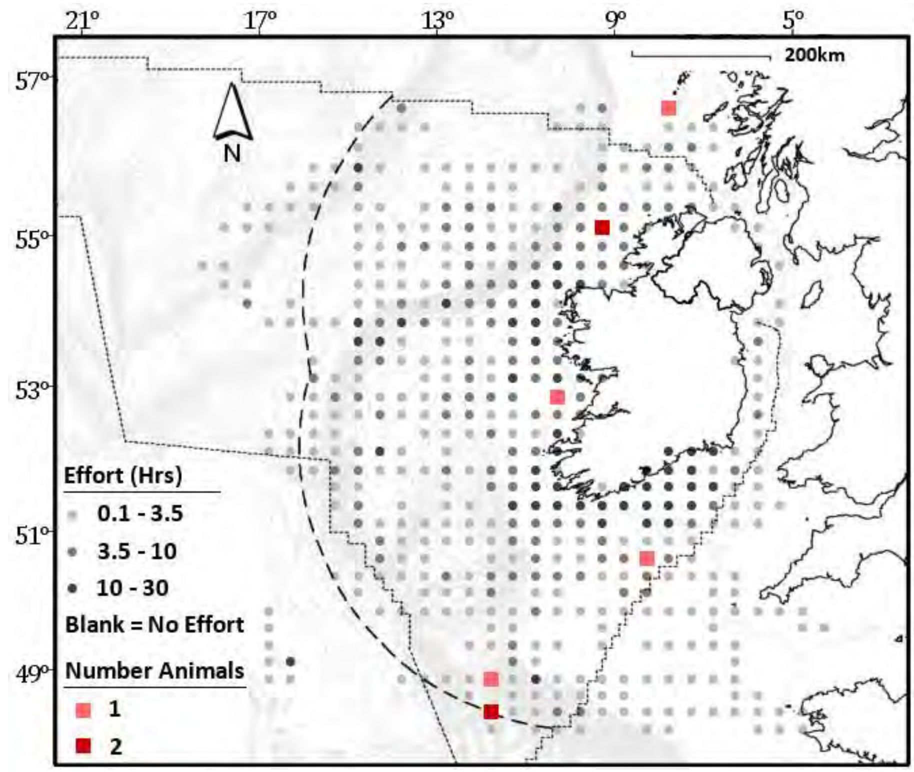



**Figure 4.25.1:** Sightings distribution and total numbers of basking sharks recorded on and off effort per ¼ ICES statistical rectangle

### 4.25.1 *Sightings summary*

Seven sightings of basking shark were recorded, totalling eight animals. All but one of the sightings were of single animals feeding at the surface. During one sighting of two animals, a basking shark breached clear of the water beside the survey vessel. In another case, a basking shark was caught in the trawl net during a pelagic fishing survey. The animal was released from the net in a badly injured state.

### 4.25.2 *Spatial and temporal distribution*

Four of the sightings were recorded in shallow waters (≤200m) over the continental shelf. However, two sightings occurred in deep waters over the shelf slopes to the far southwest of Ireland. Sightings were recorded between April and September (figure 4.25.2), which is within the normal reporting period for basking sharks in Irish waters (IWDG, 2011).

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ✓ | ✓ | | ✓ | | ✓ | | | |

**Figure 4.25.2:** Detection positive months for basking shark recorded during visual surveys

### 4.25.3 *Comparison with Irish data sets*

While the majority of basking shark sightings fell within the known range for this species in Irish waters, the two sightings of basking sharks on the shelf edge to the far southwest of Ireland are the furthest offshore records for this species recorded to date in the Irish EEZ (IWDG, 2011).

**Figure 4.25.3:** Basking shark feeding on ctenophores, Puffin Sound, Co Kerry (© Dave Wall)

## 4.26 Leatherback Turtle (*Dermochelys coriacea*)

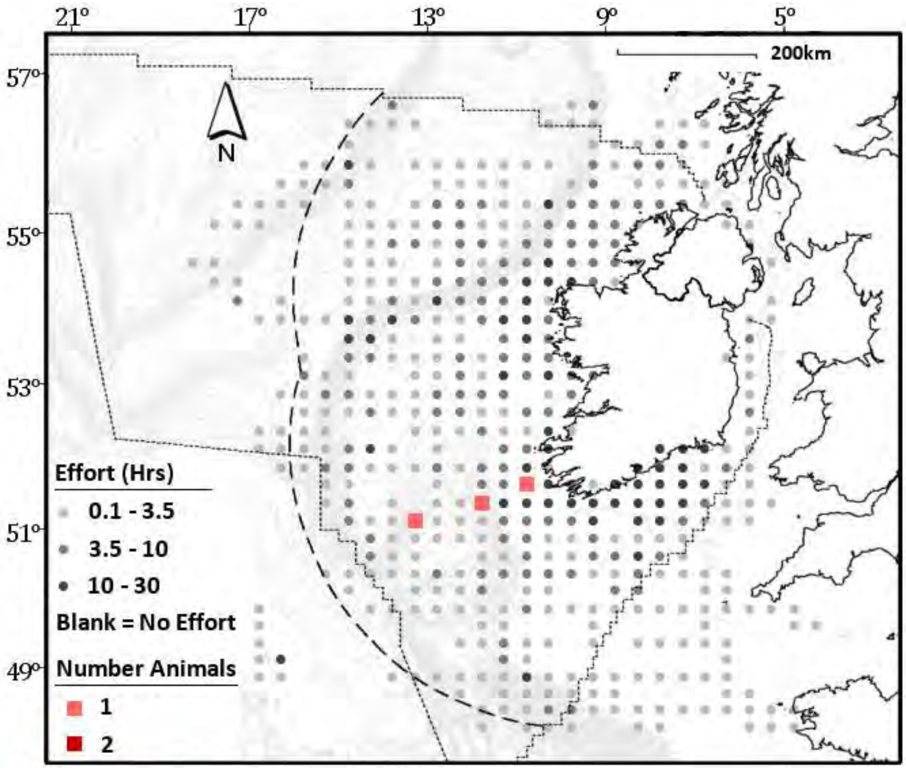



**Figure 4.26.1:** Sightings distribution and total numbers of leatherback turtles recorded on and off effort per ¼ ICES statistical rectangle

### 4.26.1 *Sightings summary*

Three sightings of single leatherback turtles were recorded.

### 4.26.2 *Spatial and temporal distribution*

All three sightings were recorded off the southwest coast within the described range for this species in Irish waters (Berrow and King, 2009). One was recorded over the shallow waters (≤200m) of the Irish shelf, whereas two were recorded in the deeper waters of the Porcupine Seabight. Sightings were recorded in June, August and September, which is within the normal reporting period for leatherback turtles in Irish waters (IWDG, 2011).

## 4.27 Discussion of Irish data set comparisons

### 4.27.1 *Variability in data collection methods*

It is not clear how differing survey methods may have affected the detection rates for different cetacean species. O' Cadhla *et al* (2004) employed European Seabird at Sea survey (ESAS) methods, which are designed primarily for seabird surveying and 'significantly reduced the observer's likelihood of detecting cetaceans outside the relatively narrow field-of-view on one side of the moving vessel' (O'Cadhla *et al*, 2004).

Detection distance data for cetacean sightings collected during PReCAST indicate that adherence to a 300m survey box will lead to significant under-recording of species which actively avoid survey vessels (e.g. offshore bottlenose dolphins) and whale blows which tend to show against the horizon (figures 4.27.1 and 4.27.2). A possible example of the effects of the two differing survey methods is in the low numbers of fin and sperm whales detected by O'Cadhla *et al* compared to those detected during PReCAST. One must therefore be cautious when assuming apparent increases in the occurrence of certain species when comparing data collected by different survey methods, unless that increase is backed up by other data sources.

The problems encountered in comparing cetacean distribution and abundance data collected by different survey methods could be reduced in future by agreeing a standard methodology for European cetacean surveys. The Atlantic Research Coalition (ARC) has progressed this issue through working to standardise line transect survey methods conducted by researchers on commercial ferries in northwest European waters (Brereton *et al*, 2009).

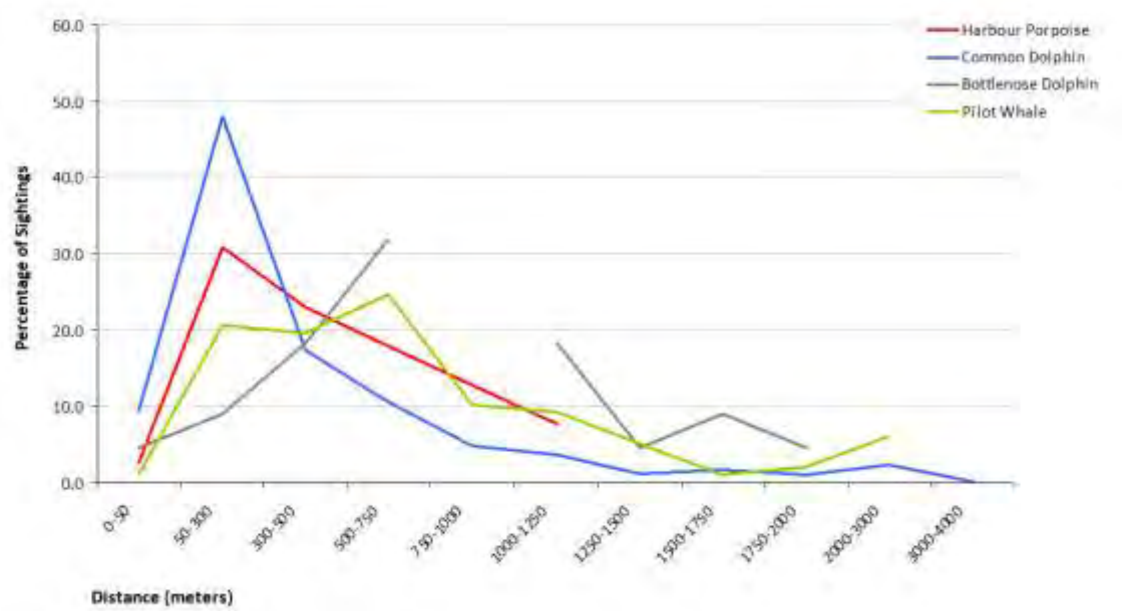



**Figure 4.27.1:** Detection distances recorded during PReCAST for harbour porpoise (n=39); common dolphin (n=671); bottlenose dolphin (n=22); and pilot whale (n=97)

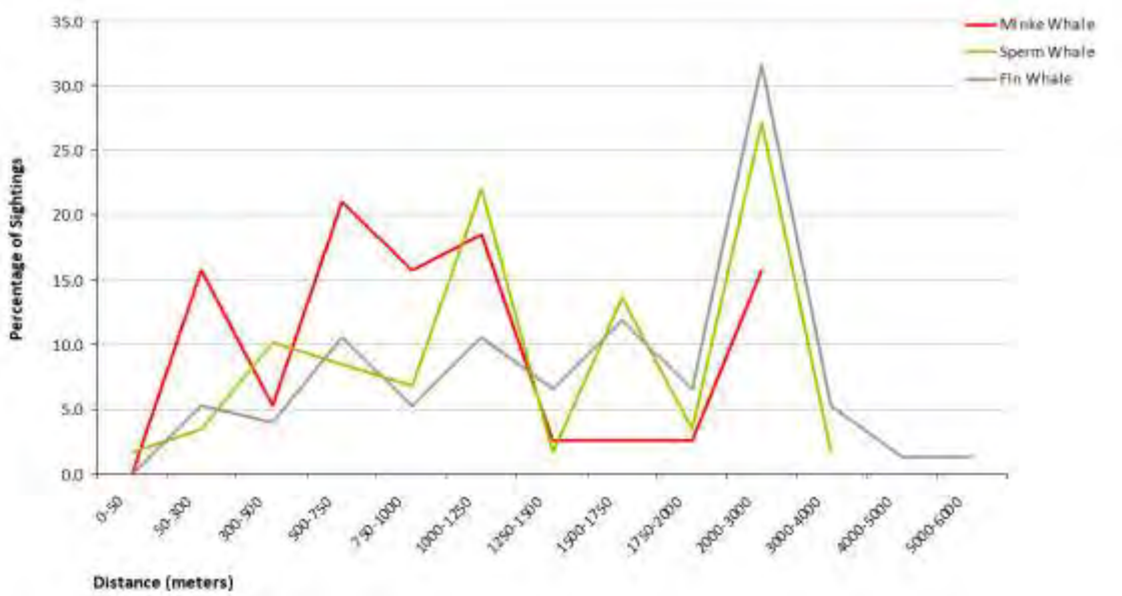



**Figure 4.27.2**: Detection distances recorded during PReCAST for minke whales (n=38); sperm whales (n=59); and fin whales (including fin/sei/blue whales, n=76)

### 4.27.2 *Presentation of data at appropriate temporal scale*

The temporal scale at which data is presented also has an effect on apparent changes in abundance and, particularly, distribution. Data presented at long temporal scales (e.g. 20 or 30 years of data) will suffer from data compaction, especially in terms of reported distribution. If one was to look at a square kilometre of ocean for long enough, eventually almost every species in the ocean would make an appearance. An example of this in the data is the reporting of deep water species from inshore waters. Many of these sightings are linked to subsequent strandings and cannot be considered part of the normal distribution for the species. Species which undergo seasonal shifts in distribution will cover a far greater range when data is presented in a single map rather than as a series of seasonal maps. Similarly, species which undergo temporal shifts in distribution over a period of many years will appear to have a far wider distribution than in reality when mapped on a long temporal scale. It is, therefore, important that data is collected at appropriate seasonal scales and is presented at appropriate temporal scales to avoid misrepresenting the current or seasonal species range.

### 4.27.3 *Observer effect*

Observers can differ significantly in their ability to detect sightings, their ability to identify species and their ability to estimate numbers of animals. Inexperienced surveyors will generally miss many sightings which experienced surveyors detect. Until surveyors have got their 'eye in', data from such observers needs to be treated with caution.

During PReCAST a number of different surveyors undertook visual line transect surveys. Data from four randomly selected surveyors was analysed to assess their average sightings detected per hour of survey effort. The data presented in figure 4.27.3 is used only to indicate that differences in observer detection rates can exist. The detection rates may also be affected by other factors such as the area surveyed and season surveyed. Average sightings detected per survey hour among the four surveyors ranged from 0.6 sightings per hour to 0.1 sightings per hour.

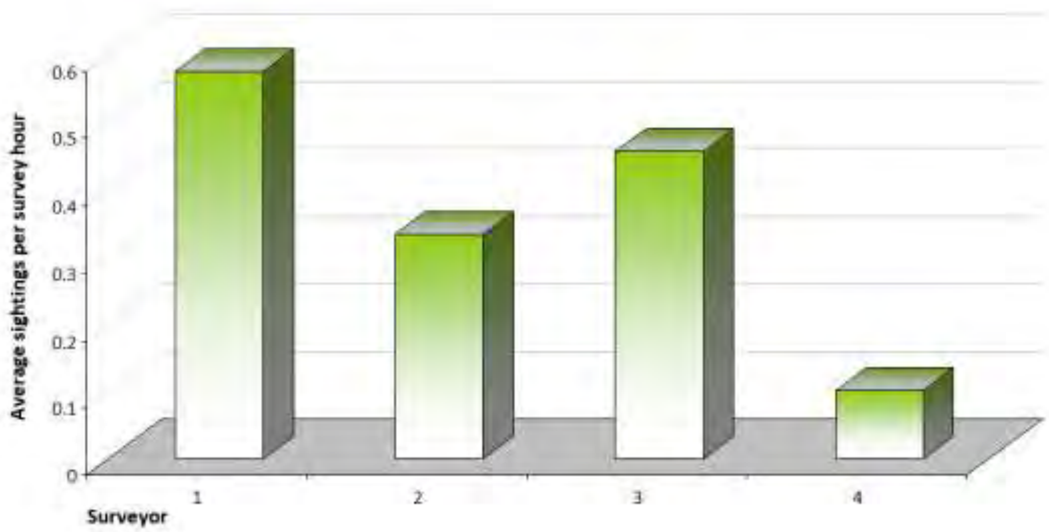



**Figure 4.27.3:** Average sightings rate per survey hour of four surveyors who conducted line transect survey effort during PReCAST

# 5 Cetaceans on the Frontier Surveys 2009 and 2010

## 5.1 Objectives and Methods

In August 2009 and February 2010, dedicated ship time on board the R.V. *Celtic Explorer* was secured under the Marine Institute's Ship Time Programme. A full cruise report from each survey can be downloaded on the IWDG website (www.iwdg.ie/shipsurveys/). The two multidisciplinary surveys of slope and canyon habitats along the west coast of Ireland incorporated a number of survey objectives:

### 5.1.1 *Dedicated double platform cetacean visual surveys (2009 and 2010)*

A double platform cetacean survey design, based on methods used during the SCANS II and CODA surveys (Hammond, 2006, and Hammond et al, 2010), was employed. The method was a combination of line transect, distance sampling and mark-recapture methods. Three types of survey mode were used during the survey. In sea states up to sea state 4, double platform survey mode was used. In sea states of 5 and 6, single platform survey mode was employed. In sea states greater than 6, in heavy rain, much reduced visibility or where conditions were unsafe for surveying from the monkey island or crow's nest, a watch was kept from the bridge.

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, 2011).

#### 5.1.1.1 *Double Platform Survey Mode*

A team of six surveyors was used to survey from two platforms. Two surveyors operated from the primary platform, located on the monkey island, 12m above the waterline (figure 6.1). The primary platform surveyors scanned the area around the ship out to a distance of 1,000m by eye. Sighting species identification and group size were confirmed with the aid of 8 X 50 binoculars. The port side primary surveyor scanned an arc from 10 degrees starboard to 90 degrees port, while the starboard side primary surveyor scanned an arc from 10 degrees port to 90 degrees starboard. Angles were read using an angle board placed between the two observers and distances were measured using the aid of a distance-measuring stick. Sightings were relayed to the data recorder and duplicate identifier via two-way radio. The second surveyor recorded a duplicate of sighting data onto a digital voice recorder.


**Figure 5.1:** Position of Cetacean survey and bird survey platforms on R.V. *Celtic Explorer*

Another two surveyors surveyed from the tracker platform, located on the 'crows nest' 17m above the waterline (fig. 5.1). The tracker platform surveyors surveyed ahead of the ship (500m+) in order to spot animals before they reacted to the presence of the ship and before the primary platform surveyors spotted them. The port side tracker scanned an arc 60 degrees to port and starboard using 8 X 40 Opticron™ binoculars, while the starboard side tracker scanned an arc 40 degrees to port and starboard using 10X40 Zeiss™ binoculars. Angles were read using an angle board placed between the two observers and distances were measured using the aid of a distance-measuring stick. Sightings were relayed to the data recorder via two-way radio. The second surveyor recorded a duplicate of sighting data onto a digital voice recorder. The role of the trackers was to locate animals at a distance from the ship and track them as they approached or passed by the vessel.

The data recorder was positioned on the crow's nest deck within an enclosed survey platform (figure 5.1). The recorder logged details of primary and tracker platform sightings into an access database using IFAW Logger 2000™ (IFAW, 2000). The data recorder also logged details of observer rotations, waypoints and changes in the environment every 30 minutes or as required.

The duplicate identifier was situated on the crow's nest deck beside the trackers, where he/she could listen to them. The duplicate identifier also received details of the primary platform sightings via a two-way radio. The role of the duplicate identifier was to match sightings made by the primary platform with those being tracked by the tracker platform. Sightings matched between the two platforms were termed duplicates and were ranked as 'definite', 'probable', 'possible', 'remote' or 'not a duplicate'.

Primary platform and tracker platform surveyors formed survey pairings, which remained unchanged during the survey. Primary and tracker surveyors swapped from port to starboard every 30 minutes while data recorder and duplicate identifier changed every hour. Primary and tracker platform surveyors acted as data recorder and duplicate identifier in rotation.

#### 5.1.1.2 *Single platform survey mode*

A team of three surveyors was used to survey using the primary platform. Two surveyors operated from the primary platform, located on the 'monkey island' 12m above the waterline. The primary platform surveyors scanned the area around the ship, out to a distance of 1,000m by eye. Species identification and group size were confirmed with the aid of 8X50 binoculars. The port side primary surveyor scanned an arc from 10 degrees starboard to 90 degrees port, while the starboard side primary surveyor scanned an arc from 10 degrees port to 90 degrees starboard. Angles were read using an angle board placed between the two observers and distances were measured using the aid of a distance-measuring stick. Sightings were relayed to the data recorder via two-way radio. The second surveyor recorded a duplicate of the sighting data onto a digital voice recorder.

#### 5.1.1.3 *Bridge watch mode and auxiliary sightings*

Two surveyors, either primary or tracker, kept a watch from the port and starboard wings of the bridge for any animals in the vicinity of the ship. Sightings were logged onto paper forms and were entered in the database as auxiliary sightings. Sightings recorded at other times by members of the ship or scientific crew were also entered in the database as auxiliary sightings.

### 5.1.2 ***Towed Hydrophone Acoustic Cetacean Survey (2009 and 2010)***

A towed hydrophone setup was used consisting of a 200m array having two elements, separated at 25cm, and no depth sensor. This was set up with a MAGREC Ltd HP-27st buffer-box. A National Instrument DAQ-6255 USB soundcard connected the output from the buffer-box to a laptop. This laptop used PAMGUARD (version 1.6.01) Beta software for data acquisition and click detection. An external USB GPS unit provided GPS data to the setup. A 1

TB hard drive provided storage and backup facility for the data collected. Raw recordings and click files were stored and backed up every day.

### 5.1.3 *Deep C-Pod Deployments (2009)*

Two Deep C-PODs (underwater static acoustic monitoring units) were deployed during the survey. One Deep C-POD was deployed on a benthic mooring in 1,500m of water, with the sensor facing upwards towards the surface (figure 5.2). A second Deep C-POD was deployed at 500m water depth on the mooring for the M6 Weather Buoy. The buoy was moored in 3200m of water. The POD was deployed with the sensor facing down towards the seabed.

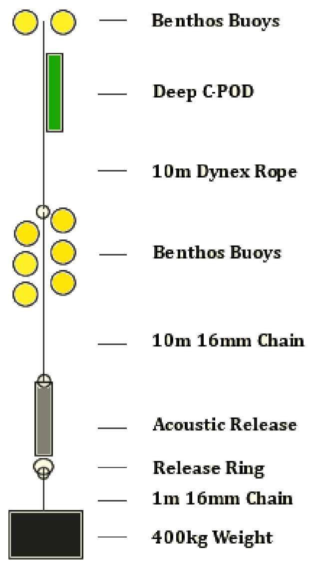



**Figure 5.2:** Mooring used to deploy Deep C-POD in 1,500m water depth on north slopes of Porcupine Bank

### 5.1.4 *ABCD Hydrophone Array (2009)*

A static acoustic hydrophone array was deployed in deep water to quantify existing background noise levels and to aid in the detection of baleen whales and other cetacean species, some of which cannot be detected using towed arrays due to vessel and hydrodynamic noise. A 5-hydrophone array was initially tested using ISHMAEL software and an ASIO interface sampling at 192 kHz. Later the hydrophones were lowered using a ship's winch on a steel cable with a significant weight.

### 5.1.5 *Cetacean Biopsy and Photo-ID (2009 and 2010)*

A six-metre rigid inflatable boat (figure 5.3) was carried on board the ship to allow photo-identification and biopsy sampling of target cetacean species. The species to be targeted were fin whales, humpback whales, bottlenose dolphins, sperm whales, pilot whales and beaked whales.

For the 2009 survey, a licence to perform biopsies on these species using crossbow and/or biopsy pole was obtained from the National Parks and Wildlife Service of the Department of the Environment (License No. 82/2009). Whales would be sampled with a licensed 150lb Barnett Panzer crossbow and dolphins would be sampled using a 130lb crossbow, with tips supplied by Fin Larsen, or with the biopsy pole.

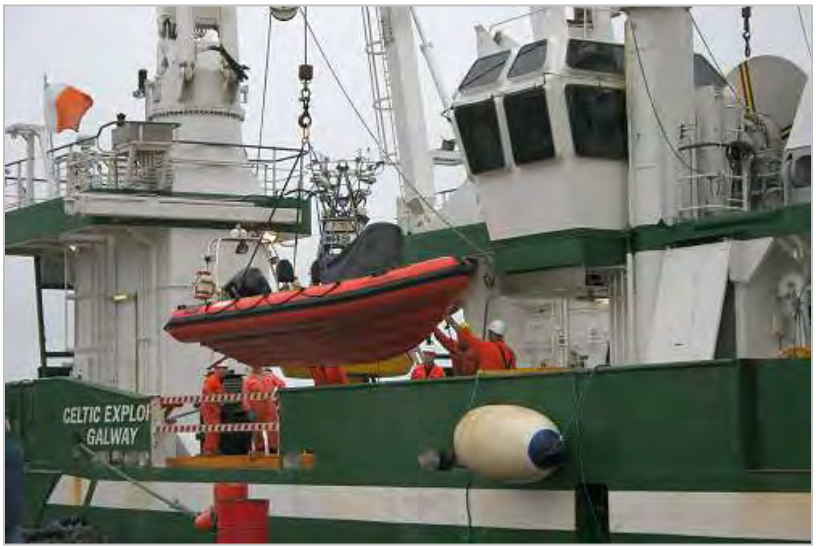



**Figure 5.3:** IWDG's 6m RIB, Muc Mhara, being loaded on board the R.V. *Celtic Explorer*

A number of Digital SLR cameras and telephoto zoom lenses were carried on board for the purposes of obtaining photo-identification images of target cetacean species should the opportunity have arisen.

## 5.2 Survey Effort, Geographic Coverage and Participants

### 5.2.1 *2009 Survey*

53.7hrs of on-effort survey time were logged, with 6.7% (3.6hrs) of this at Beaufort Sea State three or less, 32.9% (17.7 hrs) at Beaufort Sea State four or less, and 80.3% (43.1hrs) at Beaufort Sea State five or less (figure 6.4). Additional time was spent watching from the bridge during poor weather. However, these data were considered off-effort and sightings from these watches were logged as auxiliary sightings. 3.6hrs of double platform survey effort were recorded. Due primarily to poor weather conditions, the rest of the survey effort was completed in single platform mode.

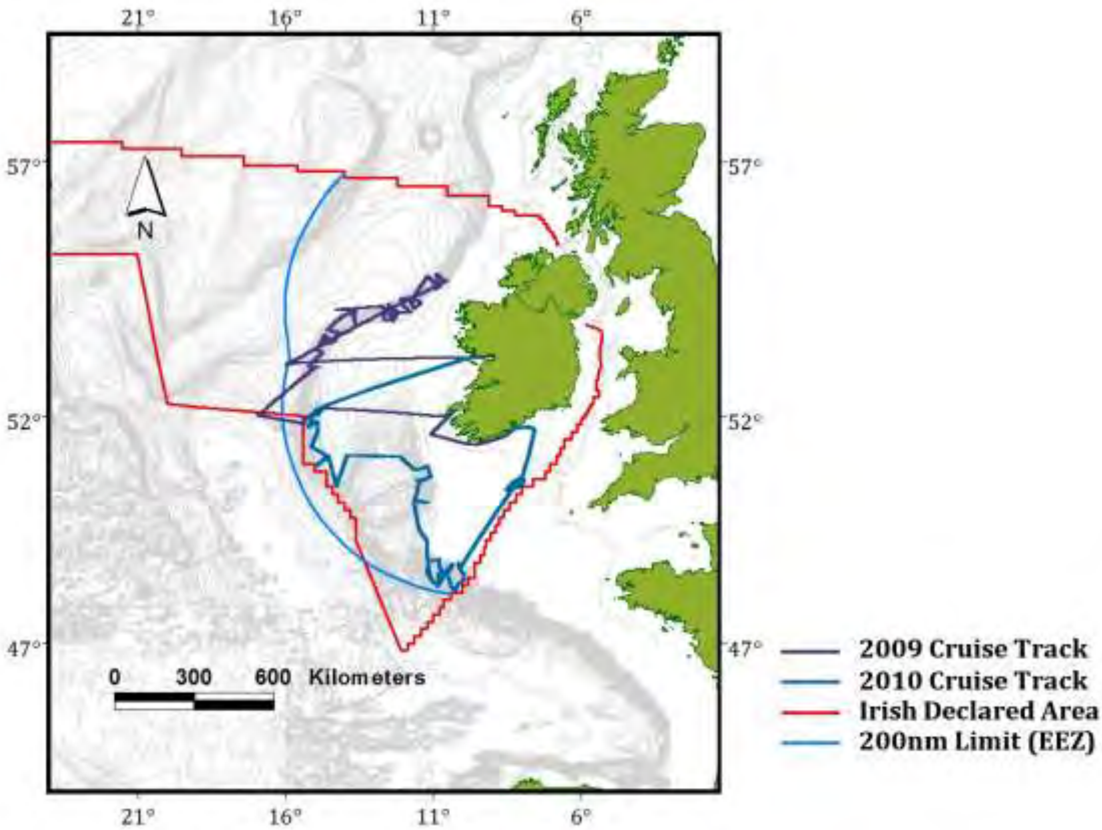



**Figure 5.4:** Cruise tracks from 2009 and 2010 multi-disciplinary surveys of slope and canyon habitats off the west coast of Ireland

### 5.2.2 *2010 Survey*

80.6hrs of on-effort survey time were logged, with 20.7% (16.7hrs) of this at Beaufort Sea State three or less, 58.5% (47.15hrs) at Beaufort Sea State four or less, and 88.6% (71.4hrs) at Beaufort Sea State five or less (figure 6.4). Additional time was spent watching from the bridge during poor weather. However, these data were considered off-effort and sightings from these watches were logged as auxiliary sightings. 25.6hrs of double platform survey effort, 27.5hrs of single platform survey effort and 27.5hrs of bridge watching were logged.

A total of 29 scientists, students and technicians from ten different institutes or organisations participated in the two surveys (table 5.1).

**Table 5.1:** Names, roles and affiliations of participants in the 2009 and 2010 surveys

| Name | Role | Affiliation | 2009 | 2010 |
|---|---|---|---|---|
| **Dave Wall** | Cetacean Survey (chief scientist) | IWDG/GMIT | ✓ | ✓ |
| **Simon Berrow** | Cetacean Survey | IWDG | ✓ | |
| **Joanne O'Brien** | Cetacean Survey / Photo ID | IWDG/GMIT | ✓ | ✓ |
| **Conor Ryan** | Cetacean Survey / Photo ID | IWDG/GMIT | ✓ | ✓ |
| **Anneli Englund** | Cetacean Survey | University College Cork | ✓ | |
| **Mary Coleman** | Cetacean Survey | University College Cork | | ✓ |
| **Debbi Pedreschi** | Cetacean Survey | IWDG | ✓ | |
| **Laura Kavanagh** | Cetacean Survey | IWDG | ✓ | ✓ |
| **David Williams** | Cetacean Survey | IWDG | ✓ | |
| **Patrick Lyne** | Cetacean Survey | IWDG | | ✓ |
| **Hilary Healy** | Cetacean Survey | IWDG | | ✓ |
| **Lucy Hunt** | Cetacean Survey | IWDG | | ✓ |
| **Sophie Hansen** | Cetacean Survey | GMIT | | ✓ |
| **Dermot Breen** | Bird Survey | National Parks and Wildlife | ✓ | |
| **David Tierney** | Bird Survey | National Parks and Wildlife | ✓ | |
| **Maggie Hall** | Bird Survey | Birdwatch Ireland | ✓ | |
| **Anthony McGeehan** | Bird Survey | Birdwatch Ireland | ✓ | |
| **Jackie Hunt** | Bird Survey | Birdwatch Ireland | | ✓ |
| **Alex Borawska** | Bird Survey | Birdwatch Ireland | | ✓ |
| **Rossa Meade** | Bird Survey | GMIT | | ✓ |
| **Jeppe Dalgaard Balle** | Acoustics | St. Andrew's University | ✓ | |
| **Eugene McKeown** | Acoustics | Biospheric Engineering | ✓ | |
| **Cillian Roden** | Plankton and CTDs | GMIT | ✓ | |
| **Jane Kelleher** | Plankton and CTDs | University College Cork | ✓ | ✓ |
| **Darren Craig** | Plankton and CTDs | GMIT | | ✓ |
| **Fien de Raedemaecker** | Plankton and CTDs | GMIT | | ✓ |
| **Andy Wallace** | Dropcamera* | Seatronics Ltd. | ✓ | |
| **John Boyd** | Dropcamera* | Marine Institute | ✓ | |
| **Gabriel Levy** | Documentary cameraman | Crossing the Line Films | ✓ | |

* Contracted by National Parks and Wildlife Service. ** Contracted by IWDG.

## 5.3 Results

### 5.3.1 *Cetacean Visual Survey*

183 sightings of at least eight cetacean species, totalling 1,522 individuals were recorded. The results of the cetacean visual surveys are incorporated into the atlas of cetacean distribution and relative abundance presented in section three of this report.

**Table 5.2:** Sightings, counts and group size ranges for cetaceans sighted during the surveys

| Species | Number of Sightings | Number of Individuals | Range of Group Size |
|---|---|---|---|
| Bottlenose dolphin | 6 | 257 | 1-200 |
| Common dolphin | 134 | 1075 | 1-50 |
| Striped dolphin | 1 | 20 | - |
| Killer whale | 1 | 2 | - |
| Long- finned pilot whale | 12 | 118 | 1-25 |
| Fin whale | 3 | 6 | 2 |
| Sperm whale | 3 | 3 | - |
| Northern bottlenose whale | 1 | 2 | - |
| Fin/sei/blue (blows) | 14 | 18 | 1-2 |
| Unidentified beaked whale | 1 | 3 | - |
| Unidentified dolphins | 8 | 29 | 1-8 |
| Unidentified small whale | 2 | 4 | 1-3 |
| Unidentified cetacean | 1 | 1 | - |

Identified cetacean species recorded during the surveys were fin whale (*Balaenoptera physalus*), sperm whale (*Physeter macrocephalus*), northern bottlenose whale (*Hyperoodon ampullatus*), killer whale (*Orcinus orca*), long-finned pilot whale (*Globicephala melas*), bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*) and striped dolphin (*Stenella coeruleoalba*). All sightings of unidentified whale blows were thought to be of fin whales but were classed as fin/sei/blue, according to the IWDG's cetacean sightings database classification scheme (IWDG 2011).

A sighting of three simultaneously breaching beaked whales in a canyon on the north slopes of the Porcupine Bank in 2009 was too distant to allow for species confirmation.

A large group- in excess of 200 - bottlenose dolphins was encountered on the northwest slopes of the Irish shelf on 26 August. The ship was diverted to approach the group, which was travelling at high speed, to confirm species identification, obtain photo-identification images and record vocalisations. This is the largest confirmed group of bottlenose dolphins recorded to date in Irish waters.

### 5.3.2 *Towed Hydrophone Surveys*

#### 5.3.2.1 *Towed Hydrophone Survey 2009*

135.4 hours of recordings from the hydrophone array were collected. This data underwent preliminary analysis, resulting in a total of 127 identified acoustic detection events involving at least five species. As these results were based on a preliminary analysis of the data, changes in the final dataset should be expected. From associated visual sightings, two detection events were identified as bottlenose dolphins, 11 as common dolphins, five as long-finned pilot whales and one as striped dolphins. 58 sperm whale detection events, 48 unidentified dolphin detection events and two unidentified cetacean detection events were also recorded without associated visual sightings. An in-depth analysis of this data is included in PReCAST Work Package 2.

Sperm whales were the species most commonly identified in acoustic detection events during the survey. Sperm whales were encountered in the Porcupine Abyssal Plain and in deep-water canyons on the slopes of the Porcupine Bank and Northwest Shelf. Pilot whales were encountered on the slopes and canyons of the Porcupine Bank (figure 5.5). Dolphin acoustic detections were most commonly recorded in abyssal waters and in the canyons systems of the Porcupine Bank and Northwest Shelf (figure 5.6).

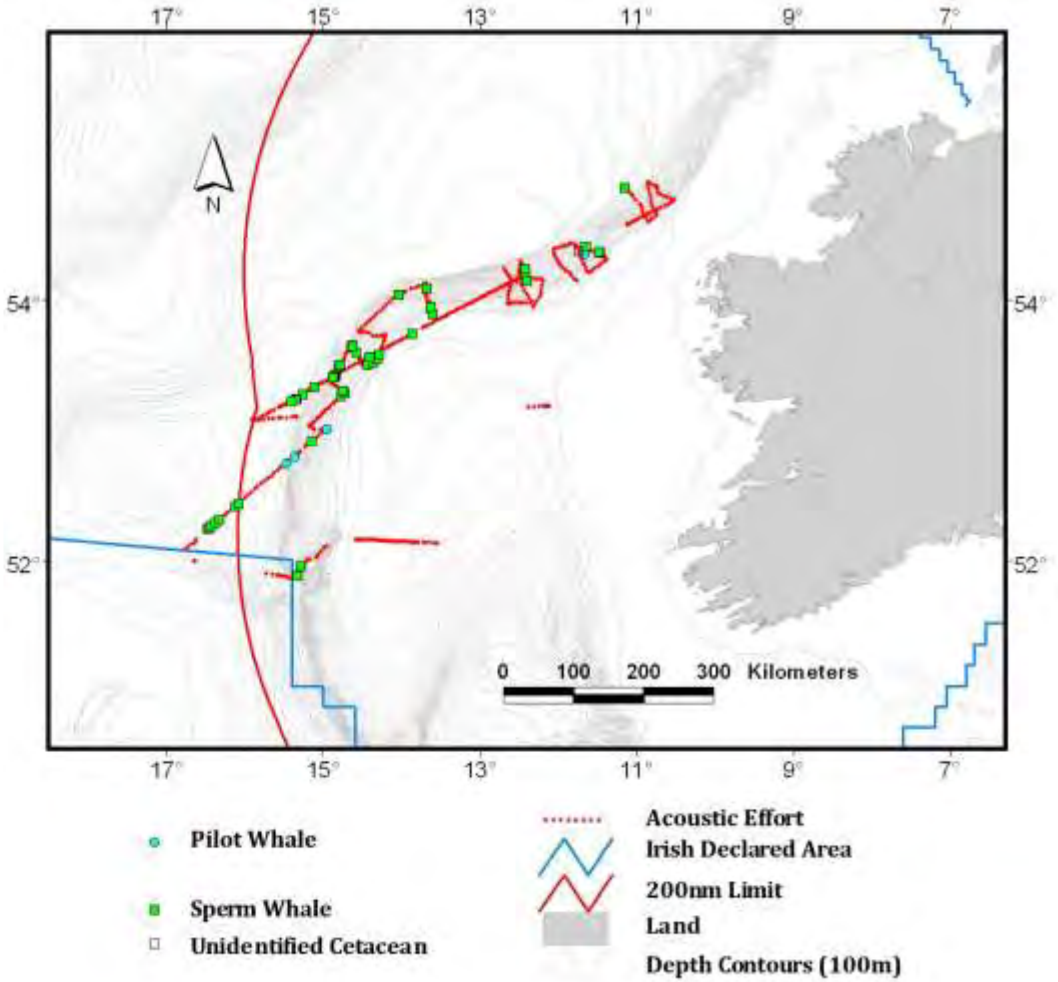



**Figure 5.5:** Distribution of acoustic detections of sperm whales and pilot whales recorded during the 2009 Cetaceans on the frontier survey

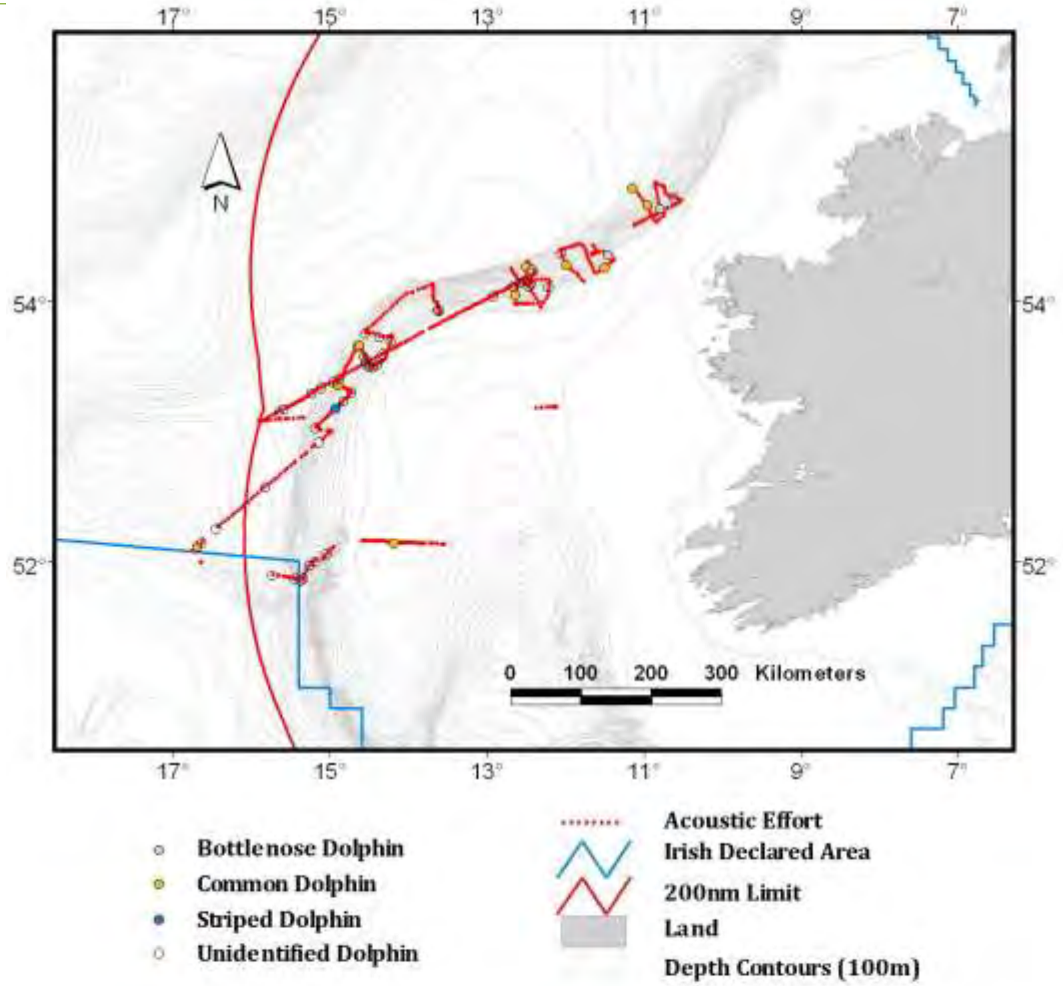



**Figure 5.6:** Distribution of acoustic detections of common, bottlenose and unidentified dolphin species recorded during the 2009 Cetaceans on the frontier survey

#### 5.3.2.2 *Towed Hydrophone Survey 2010*

130.3 hours of recordings from the hydrophone array were collected. This data underwent preliminary analysis, resulting in a total of 367 identified acoustic detection events involving at least four species. As these results were based on a preliminary analysis of the data, changes in the final dataset should be expected. From the acoustic data and associated visual sightings, two detection events were identified as bottlenose dolphins, 42 as common dolphins, eight as long-finned pilot whales, 18 as sperm whales, 91 as unidentified dolphin clicks and 206 as unidentified dolphin whistles. The acoustic data will undergo further in-depth analysis, which may reveal more information on source species, number and duration of detection events. A copy of the acoustic files was also sent to the Sea Mammal Research Unit in St Andrew's University in Scotland, where researchers are looking at the potential and problems in using towed hydrophone arrays to monitor beaked whales.

Sperm whales were the most commonly encountered acoustic detection events during the survey. Sperm whales were encountered in the slopes and canyons of the southwest Porcupine Bank and the eastern Porcupine Sea Bight. Pilot whales were encountered in canyons on the east slopes of the Porcupine Sea Bight and the Whittard Canyon System (figure 5.7).

Dolphin acoustic detections were commonly recorded in slope and canyon habitat along the southern slopes of the Porcupine Bank, the Whittard Canyon and the eastern slopes of the Porcupine Sea Bight (figure 5.8). Dolphin detections were also common over the Celtic Shelf. Dolphin whistle detections were almost continuously detected in some areas of the survey route, though it is difficult to interpret how far away the vocalising animals were. Generally dolphin clicks appeared to be only recorded when the animals were within a few hundred metres of the array.

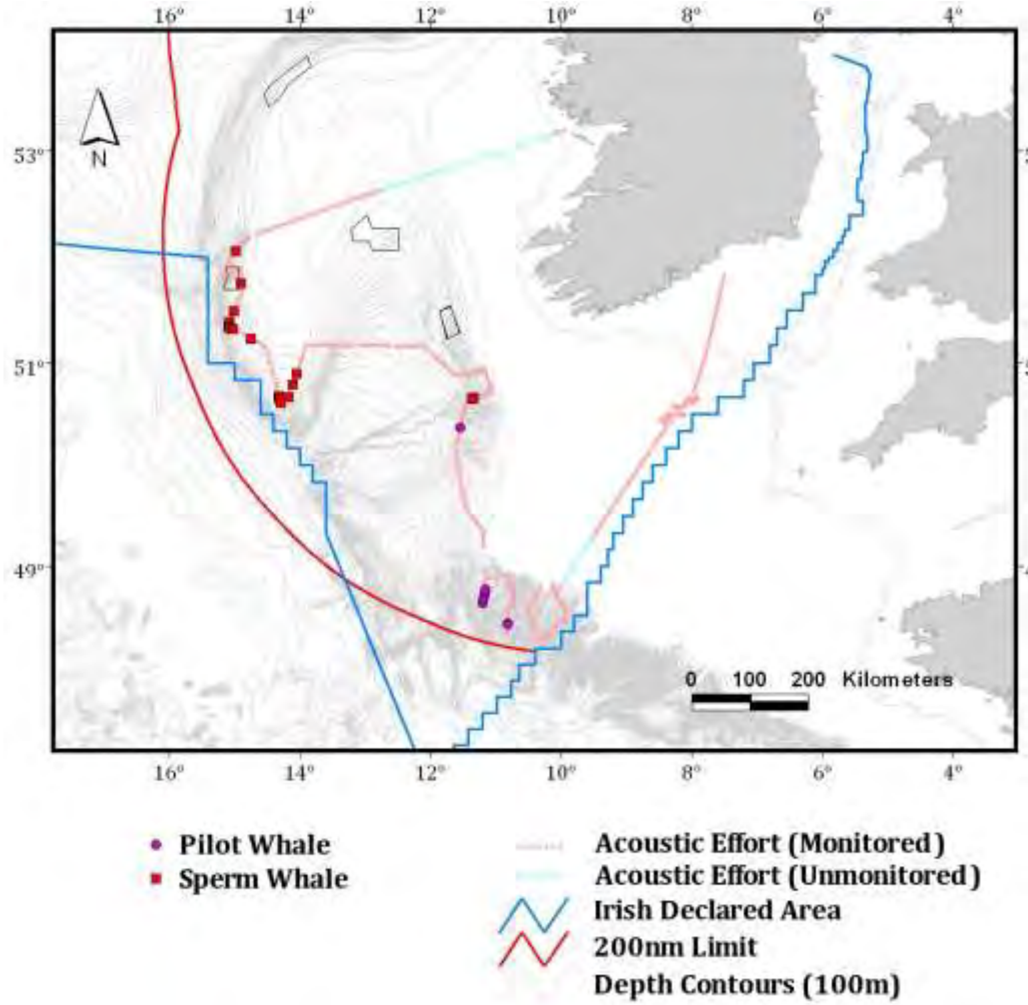



**Figure 5.7:** Distribution of acoustic detections of sperm whales and pilot whales recorded during the 2010 Cetaceans on the frontier survey

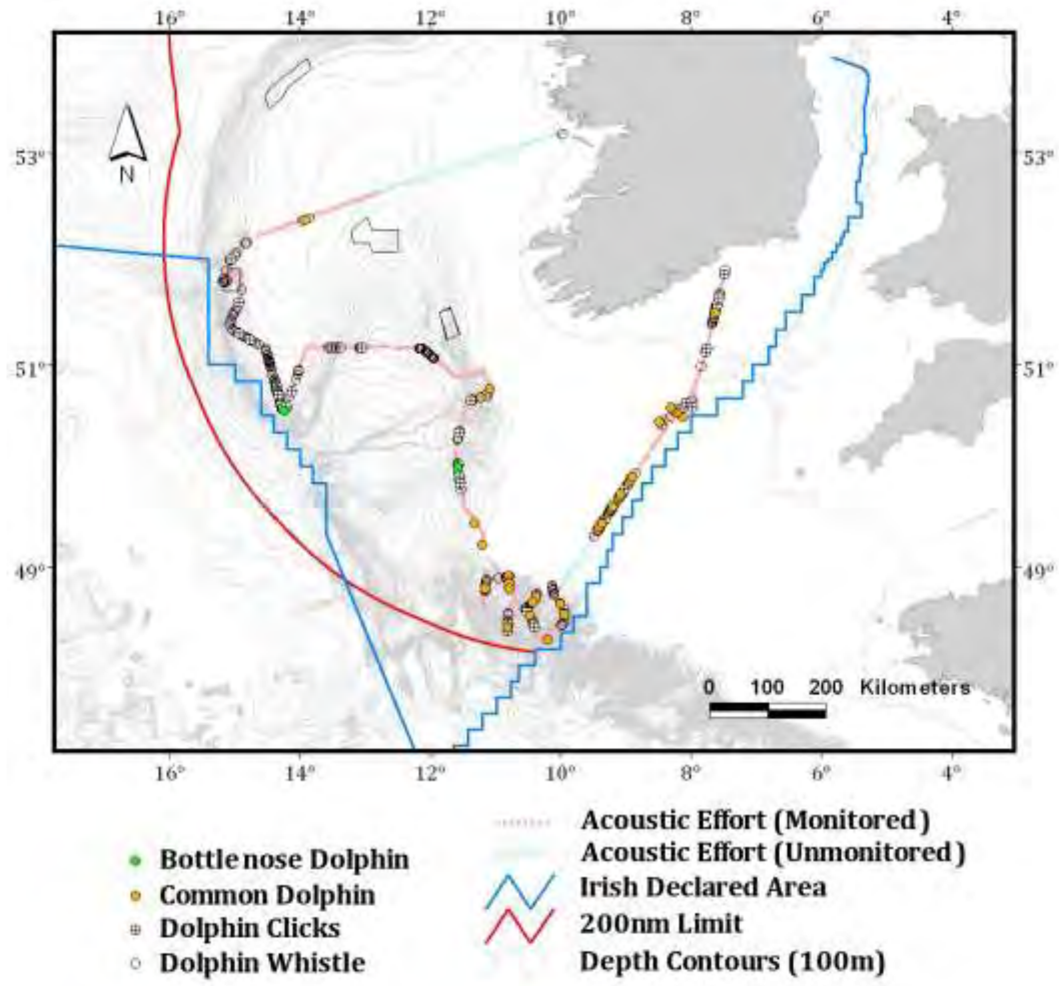



**Figure 5.8:** Distribution of acoustic detections of common, bottlenose and unidentified dolphin species recorded during the 2010 Cetaceans on the frontier survey

#### 5.3.2.3 *Bottlenose Dolphin Vocalisations (2009 and 2010)*

Participation in the Cetaceans on the Frontier survey provided a valuable opportunity to sample vocalisations of offshore bottlenose dolphins to compare with inshore recordings as part of a study being conducted by Anneli Englund of University College Cork. Recordings were successfully made during some of the encounters with bottlenose dolphins during the survey cruises (figure 5.9). Recordings were made using the 200m towed array, having a frequency range between 2 kHz and 96kHz sampling at 96kHz, 24bit (48kHz effective bandwidth).

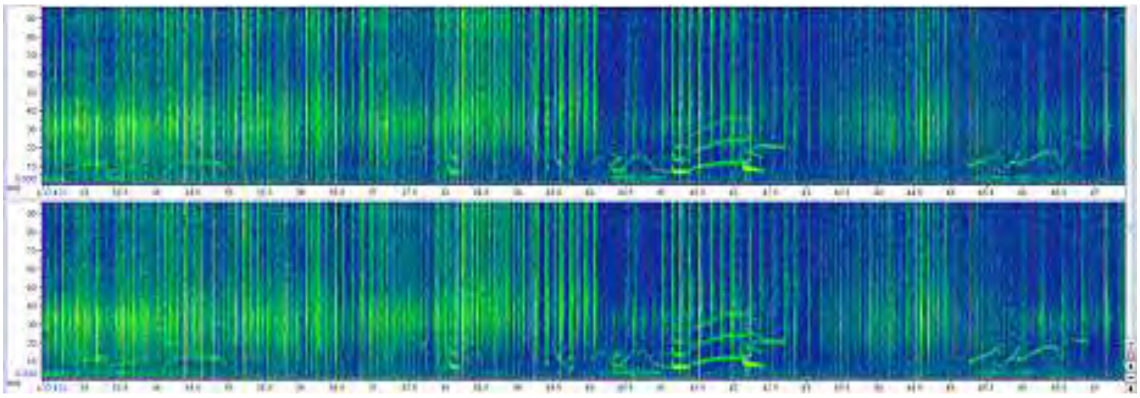


**Figure 5.9:** Screen shot from programme Raven Pro (Cornell Lab of Ornithology), showing bottlenose dolphin whistles and echolocation from a recording made during the Cetaceans on the Frontier survey 2009

### 5.3.3 ***Deep C-Pod Deployments (2009)***

Two Deep C-PODs were successfully deployed during the 2009 survey. Deep C-PODs can record data for up to five months. The second POD was deployed on a benthic mooring (figure 5.2) on a bank between two canyon systems on the north slopes of the Porcupine Bank at a depth of 1,500m. This POD was retrieved in December 2009 and was found to have malfunctioned and failed to log click data. The problem was identified by the manufacturer as being due to the hydrophone gain being set too close to its maximum at the point of manufacture and associated problems with the thickness of the plastic casing surrounding the hydrophone element. This problem has been rectified in subsequent Deep C-Pods.

The POD deployed on the M6 Weather Buoy was recovered in March 2011, on renewal of the M6 buoy. The POD was found to have far exceeded the maximum data collection endurance expected by the manufacturer and collected data for a seven-month period from 28 August 2009 to 26 March 2010. This data is still undergoing analysis. However, a summary report is presented in PReCAST Work Package 2.

### 5.3.4 *ABCD Hydrophone Array (2009)*

Due to weather conditions during the cruise, it was only possible to deploy the hydrophones on three occasions. On two of these deployments, the hydrophones were ineffective due to the requirement to operate the ships Dynamic Positioning (DP) system and difficulties in getting sufficient distance between the hydrophones and the vessel in order to reduce the effects of ship-generated noise.

A 5-hydrophone array was initially tested using ISHMAEL software and an ASIO interface sampling at 192 kHz. This set-up worked satisfactorily, but due to vessel noise and weather conditions, no recordings of cetaceans were made. Subsequent testing of the system revealed a significant level of 'electrical noise' from the ships electrical system, which was introduced via the hydrophone cables. Testing with a known source through the system without hydrophones demonstrated this clearly. An attempt to utilise PAMGuard software was not successful, but some recordings were made using it.

A third attempt to deploy the hydrophones using a ship's winch on a steel cable with a significant weight was conducted. It is calculated that on this occasion the hydrophones were 135m under the water and some 70m below the thermocline. Conditions at the time were such that wind speed was increasing from 10 knots to 20 knots and the vessel was drifting in an offshore current of over 1 knot. Power supply to the system was by battery only, eliminating much of the electrical noise. The hydrophone cables were fixed to the ship's cable (for hauling) by duct tape, which proved insufficient to hold it securely, particularly when the ship's DP system was operating. Use of the DP system resulted in vibration from eddy currents generated by the vessels thrusters. By adjusting the DP system, this source of interference was minimised.

### 5.3.5 *Cetacean photo-identification and biopsy*

Due to poor weather conditions prevailing during the two surveys, it was not possible to launch the IWDG RIB for the purposes of conducting photo-identification or biopsies.

An encounter with a group of 200 or more bottlenose dolphins occurred on the slopes of the Northwest Shelf on 26 August 2009, and another encounter with a group of 40 bottlenose dolphins occurred on the slopes of the southwest Porcupine Bank on 24 February 2010. During these encounters, the ship approached the groups for the purpose of confirming species identification and in both cases, some of the group approached the vessel to bow ride.

The interactions allowed for the collection of photographic images for the purpose of conducting photo-identification studies.

Following processing of these photographs, 30 useable bottlenose dolphin photo-identification images were obtained (figure 5.10). These images were catalogued and are available on the photo-identification section of the IWDG website (www.iwdg.ie). Photo-identification images obtained during the encounter were compared with existing catalogues of inshore bottlenose dolphins from Ireland to attempt to determine whether these are part of an inshore population. However, no matches were found.

During an encounter with a group of 20 pilot whales on 25 February 2010, eight photo-ID images of animals carrying identifying scars or breastplate patterns were collected. These images were catalogued and made available on the photo-identification section of the IWDG website (www.iwdg.ie).

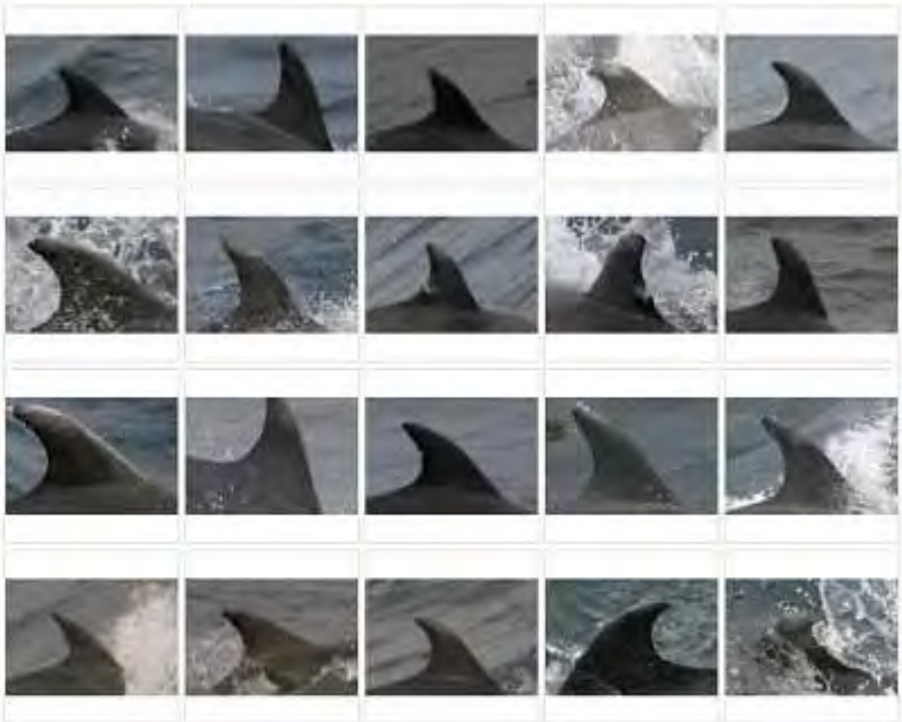


**Figure 5.10** A selection of photo-identification images obtained from a two encounters with bottlenose dolphins on 26 August 2009 and 24 February 2010

# 6 Aerial Surveys on Platforms of Opportunity

## 6.1 Introduction

In 1995 the IWDG initiated a project called WhaleLog in conjunction with the Irish Air Corps Maritime Squadron. WhaleLog cameras were provided to Air Corps Maritime patrol craft to obtain images of cetaceans observed during routine patrols. Since that time, the Air Corps Maritime Squadron obtains photographs and video images using its own high specification on-board cameras and WhaleLog has received regular reports and photographs of cetacean sightings from the Air Corps since 1995 (Berrow, 2007). In 2007 this relationship was further developed by improving data collection and dissemination, and by IWDG surveyors accompanying Air Corps Maritime Patrols to conduct visual cetacean survey effort.
Under PReCAST this relationship with the Air Corps Maritime Squadron was further developed and aerial surveys for cetaceans were more regularly conducted on Maritime Squadron patrol flights. It was also proposed to examine anecdotal evidence from Air Corps Maritime Squadron radar operators that schools of dolphins could be identified on the radar in favourable sea conditions.

## 6.2 Survey Methods

### 6.2.1 *Visual survey*

Two observers accompanied 16 Air Corps Maritime Squadron patrol flights within the Irish EEZ, conducted between 30 May 2008 and 27 June 2011. Patrols were conducted on board one of the Maritime Squadron's two CASA CN 235 maritime patrol aircraft (figure 6.1). One observer was positioned in the cockpit and recorded positional and environmental data using the aircraft's cockpit instrument gauges. This observer also opportunistically recorded sightings through the aircraft's cockpit windows. The second observer surveyed for cetaceans from one of the aircraft's two bubble windows. Due to the difficulty in detecting cetaceans at the surface when wave clutter is present, aerial surveys were conducted only when sea conditions were forecast at sea state two or less.

**Figure 6.1:** Irish Air Corps Maritime Squadron Casa CN 235 patrol aircraft (© Dave Wall)

Survey effort focused from an angle of 10 degrees from vertical to 45 degrees from vertical Sightings made by the bubble window observer were logged using a Garmin™ 72 handheld GPS unit. This unit also recorded the altitude of the aircraft at the time each sighting was made.

### 6.2.2 *Radar detection of cetaceans*

As part of a study into the capability of the CASA's onboard APS-143C(V)3 Ocean Eye Radar to detect cetaceans at the surface, a record was made of whether sightings made had been initially detected by radar and at what distance the target was identified.

## 6.3 Results

### 6.3.1 *Survey Effort and Geographic Coverage*

16 surveys on board Air Corps Maritime Squadron patrol aircraft were conducted during PReCAST, totalling 53.33 hours of survey effort (table 6.1).

**Table 6.1:** Summary details of 16 aerial surveys conducted under PReCAST 2008-2011

| Date | Vessel | Sightings | Species | Individuals |
|---|---|---|---|---|
| 30/05/2008 | CASA | 4 | 2 | 93 |
| 23/06/2008 | CASA | 0 | – | – |
| 08/08/2008 | CASA | 11 | 2 | 234 |
| 24/09/2008 | CASA | 3 | 2 | 55 |
| 07/01/2009 | CASA | 7 | 3 | 16 |
| 18/02/2009 | CASA | 0 | – | – |
| 20/04/2009 | CASA | 1 | 1 | 6 |
| 03/06/2009 | CASA | 9 | 3 | 121 |
| 13/08/2009 | CASA | 17 | 4 | 190 |
| 13/08/2010 | CASA | 5 | 4 | 37 |
| 19/08/2010 | CASA | 0 | – | – |
| 25/08/2010 | CASA | 5 | 1 | 41 |
| 30/08/2010 | CASA | 13 | 4 | 48 |
| 20/01/2011 | CASA | 6 | 2 | 15 |
| 03/06/2011 | CASA | 3 | 1 | 4 |
| 27/06/2011 | CASA | 5 | 2 | 6 |

Survey effort predominantly encompassed the western Irish Shelf, Porcupine Bank and South coast, with one survey covering the northern Rockall Trough and Rockall Bank (figure 6.2).

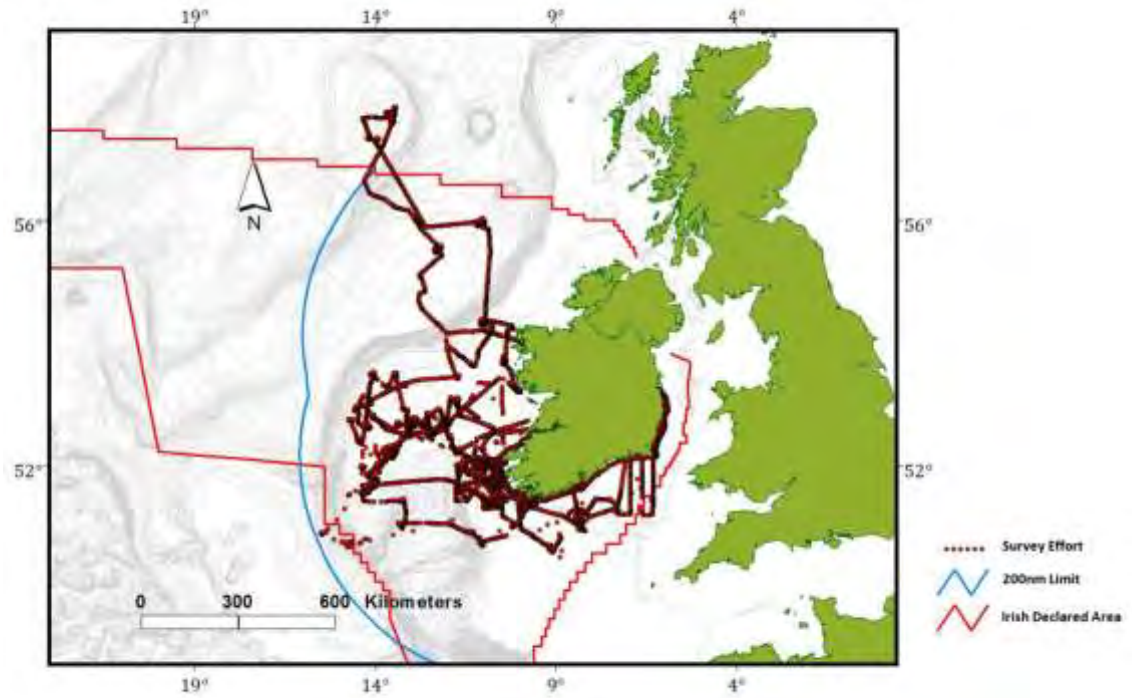



**Figure 6.2:** Aerial survey effort logged between April 2008 and June 2011

### 6.3.1.1 *Aerial cetacean and seabird survey of the oil spill area off southwest Ireland*

During a survey on 18 February 2009 the CASA maritime patrol aircraft was tasked with surveying a large oil spill which had occurred in the Celtic Sea during refuelling operations on board a Russian aircraft carrier. The oil spill location and adjacent area were surveyed by the Maritime Squadron to record the extent of the spill and identify any outlying patches. During this task PReCAST surveyors accompanied the patrol and a continuous watch for cetaceans was maintained.

### 6.3.1.2 *Dedicated aerial survey of the Celtic Sea*

Following a request to the Department of Defence and in collaboration with the Air Corps Maritime Squadron, a dedicated aerial survey of the Celtic Sea was planned for January 2011. The planned survey grid covered the south coast of Ireland from the coastline to 111km offshore. Survey lines were positioned 28km apart (figure 6.3).

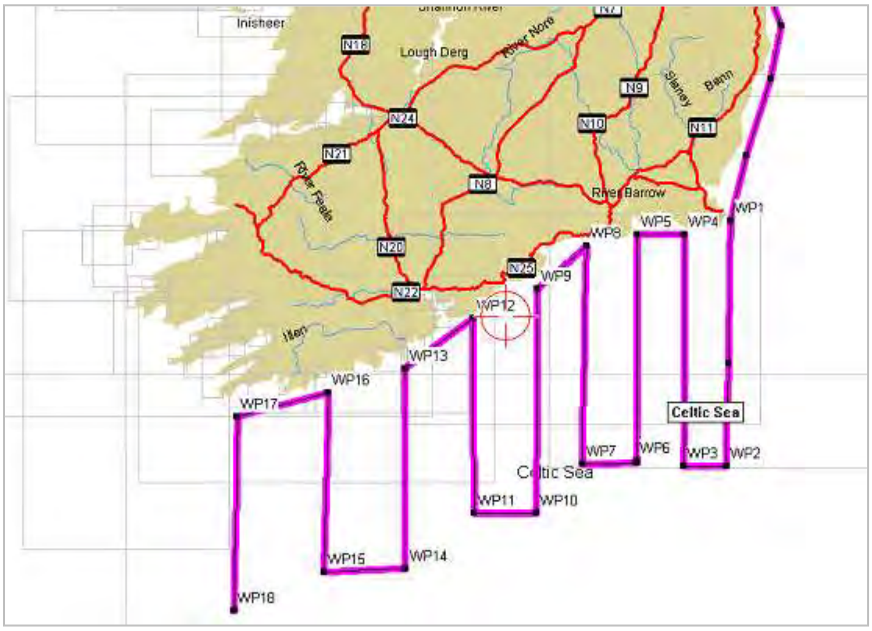



**Figure 6.3** Planned survey track for dedicated aerial survey of the Northern Celtic Sea, January 2011

### 6.3.2 *Sightings*

89 sightings of eight different cetacean species and one shark species were logged, totalling 866 individuals (table 6.1). Cetacean species recorded were fin whale, sperm whale, minke whale, pilot whale, Risso's dolphin, bottlenose dolphin, common dolphin and harbour porpoise. A single basking shark was also recorded (table 6.2, figures 6.4 and 6.5).

**Table 6.2:** Sightings, counts and group size ranges for cetacean and other megafauna species sighted during PReCAST aerial surveys from April 2008 – June 2011

| Species | Number of Sightings | Number of Individuals | Group Size Range |
|---|---|---|---|
| **Cetaceans** | | | |
| Fin whale | 7 | 37 | 1 – 20 |
| Sperm whale | 5 | 6 | 1 – 2 |
| Minke whale | 7 | 8 | 1 – 2 |
| | | | |
| Pilot whale | 2 | 85 | 40 – 45 |
| Risso's dolphin | 1 | 5 | – |
| Bottlenose dolphin | 2 | 36 | 6 – 30 |
| Common dolphin | 19 | 394 | 1 – 50 |
| Harbour porpoise | 2 | 6 | 1 – 5 |
| | | | |
| Fin/sei/blue whale | 3 | 3 | – |
| Unidentified whale | 2 | 3 | 1 – 2 |
| Unidentified dolphin | 17 | 101 | 1 – 15 |
| | | | |
| **Other megafauna** | | | |
| Basking shark | 1 | 1 | – |

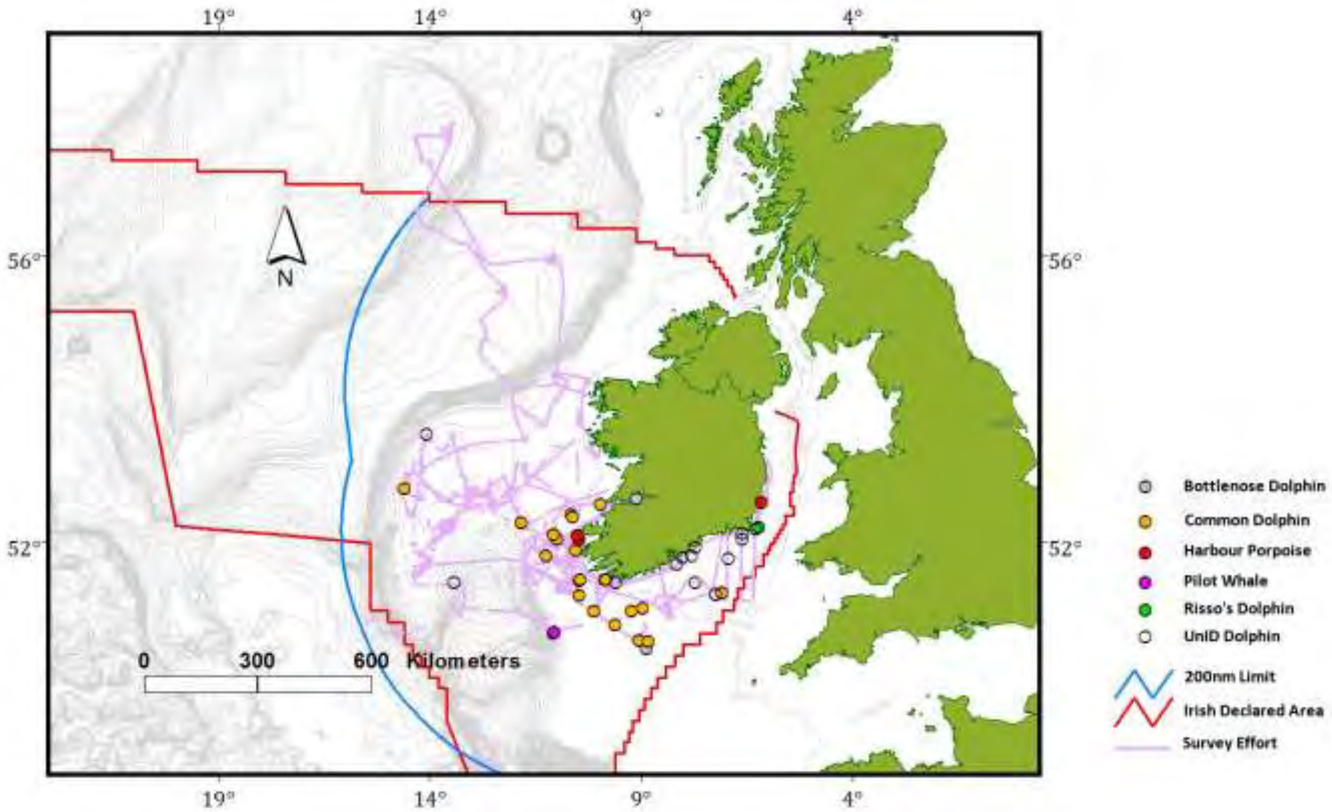



**Figure 6.4** Distribution of dolphin sightings recorded during PReCAST aerial surveys.

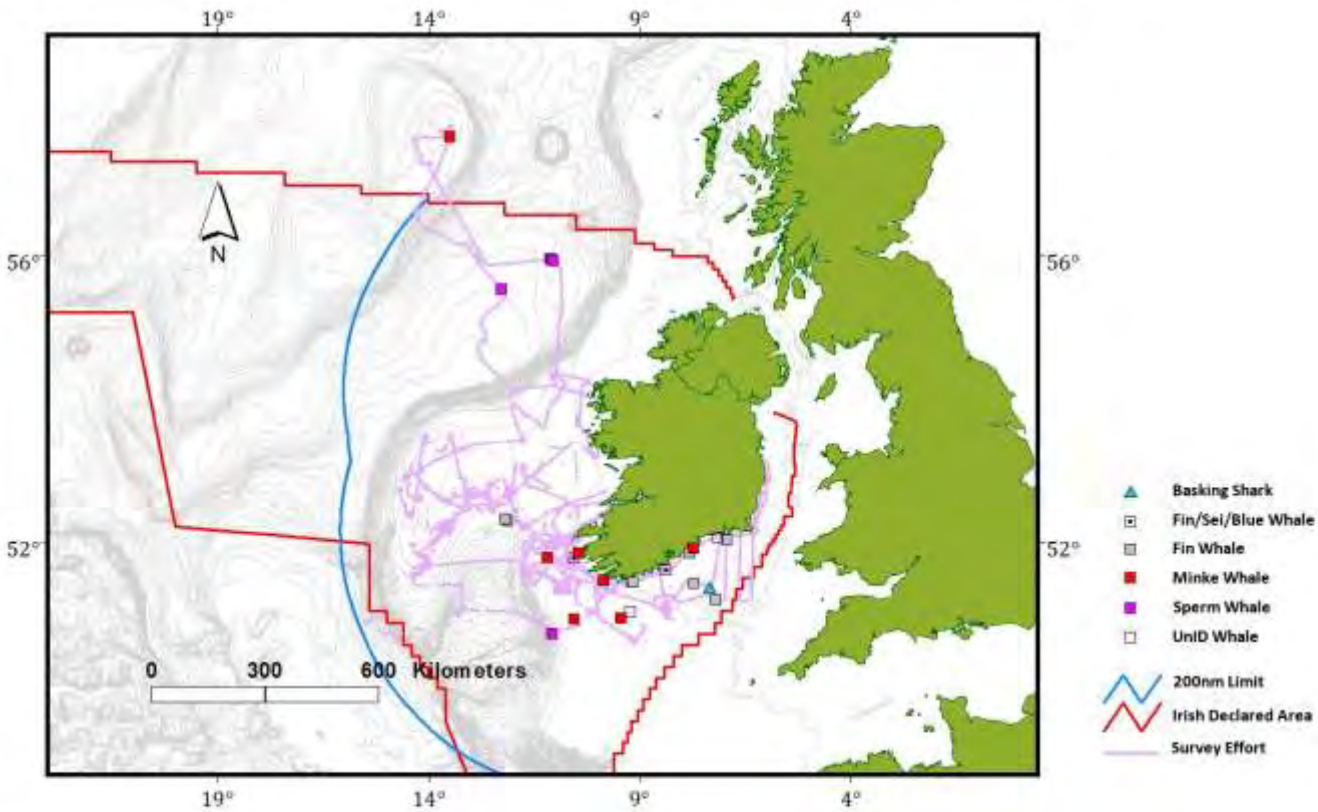



**Figure 6.5:** Distribution of whale and basking shark sightings recorded during PReCAST aerial surveys

#### 6.3.2.1 *Aerial cetacean and seabird survey of the oil spill area off southwest Ireland*

No cetaceans were recorded during the survey despite favourable sea conditions around the oil spill site. Seabird abundance was also low suggesting that there was low potential for impact of the oil spill on either marine birds or mammals.

#### 6.3.2.2 *Dedicated aerial survey of the Celtic Sea*

Due to a technical problem with the aircraft, the dedicated aerial survey had to be halted after only three transects. The aircraft returned to base and it was not possible to re-schedule another dedicated allocation of flight time. During the brief survey time, three sightings were recorded of two cetacean species (fin whale and harbour porpoise) and three sightings of unidentified dolphins were also logged.

### 6.3.3 ***Efficacy of survey technique***

Aerial surveys are a tried and tested tool for conducting aerial surveys for cetaceans species around the world. Typically the technique used for aerial surveys is to survey a pre-defined strip of water below or to one side of the aircraft. To achieve this with any degree of accuracy, the speed and elevation of the flight path should ideally be constant (Pike *et al*, 2009; Kelly *et al*, 2009; Panigada *et al*, 2011).

In using a platform of opportunity as the aerial survey platform, the ability to fix the speed and altitude of the aircraft is by and large lost. However, with accurate recording of aircraft altitude, position and speed, it may be possible to extract and use data from periods within a flight when the altitude and speed of the aircraft fall within acceptable boundaries for conducting aerial cetacean surveys. Donovan and Gunlaugsson (1987) established an optimal survey altitude of 229m (750ft) for surveys targeting both large and small cetaceans. Typical ground speeds for aerial surveys lie below 200kmph (110knots) (Pike *et al*, 2009; Kelly *et al*, 2009; Panigada *et al*, 2011).

During active patrols, when below travelling altitudes <1,000m, the CASA maritime patrol aircraft spend more than 80% of their patrol time at altitudes between 60– 350m (1148ft) (see figure 5.6) and are, therefore, in the range of useful altitude for surveying cetaceans (Donovan and Gunlaugsson, 1987).

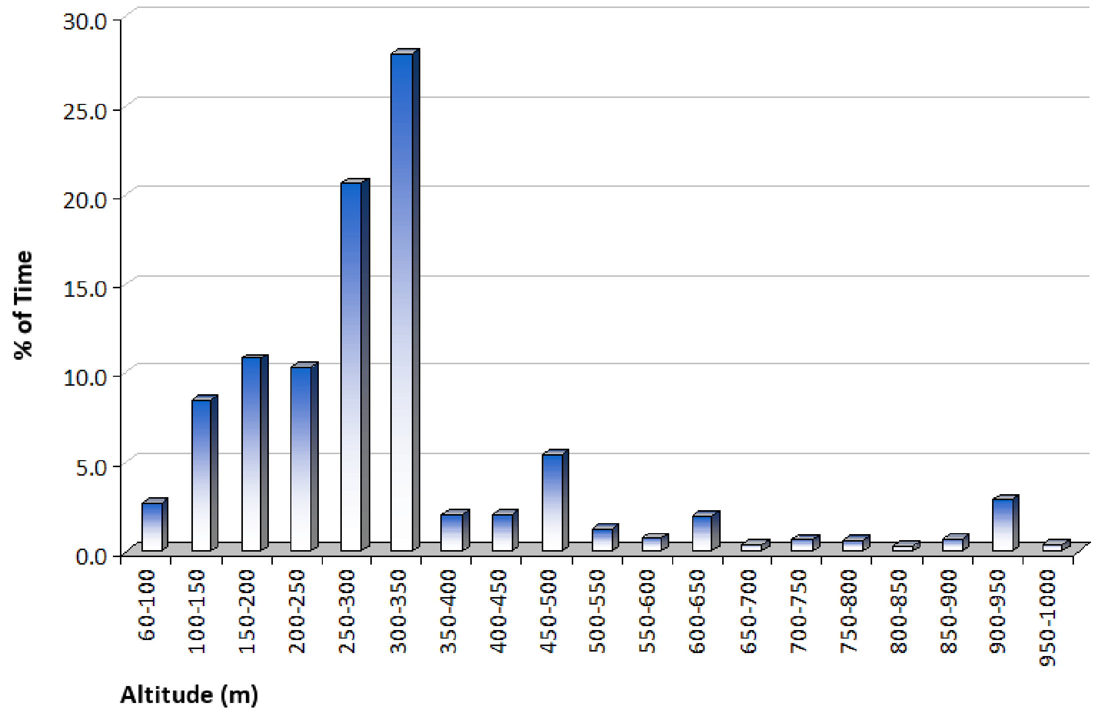



**Figure 6.6:** Percentage of time spent at altitudes below 1000m by CASA maritime patrol aircraft while on active patrol

During active patrols the CASA maritime patrol aircraft spend more than 89% of their patrol time at speeds in excess of 250kph (135kt) (see figure 6.7) and are, therefore, in the excess of ideal survey speed for conducting cetacean aerial surveys (Donovan and Gunlaugsson, 1987). However, the CASA maritime patrol aircraft also spend 88.6% of their patrol time at speeds of less than 350kph (189kt), which allow for cetaceans to be detected, while not being ideal for estimates of group size or identification to species level.

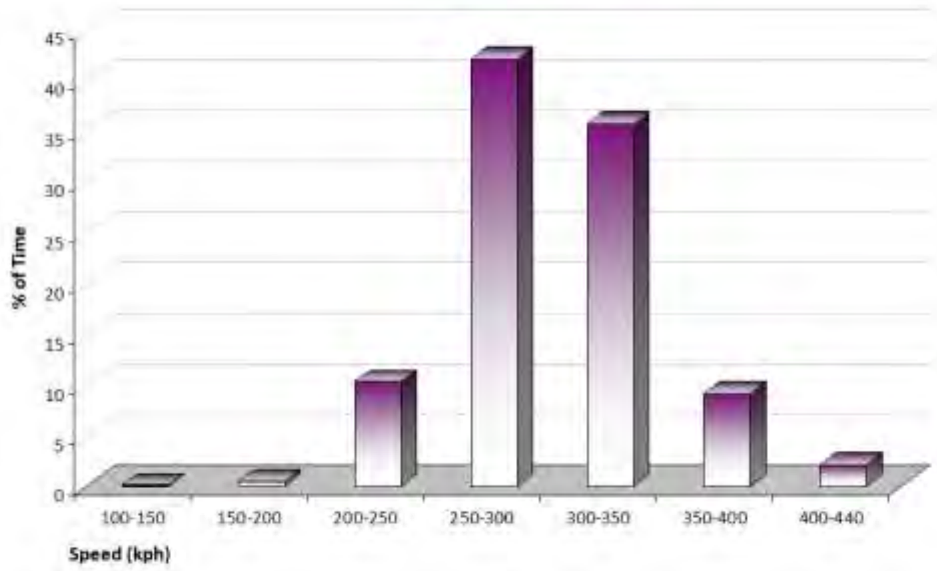



**Figure 6.7:** Percentage of time spent at speeds from 100 – 440kph by CASA Maritime patrol aircraft while on active patrol

While it is not possible to strengthen the value of the data collected during aerial surveys on the CASA patrol aircraft by limiting speed or altitude, the value of the data may be increased by developing the survey technologies used. Since it is important to know the exact position, speed and altitude of the aircraft at all times, the addition of a computerised and fully automated logging system to collect this information on a continuous basis during survey flights would be hugely beneficial. The use of continuous HD video recording to monitor a transect strip may help to overcome problems encountered in the estimation of group sizes and the identification of species due to the flight speed of the aircraft (Thaxter and Burton, 2009). Such a system would allow for the determination of cetacean and seabird distribution and relative abundance, while eliminating the primary cost of such surveys – the lease of the aircraft.

Despite the current limitations of the survey method and platform, the achieved average sightings rate of 16.23aph (animals per hour of survey time) was high when compared to sightings rates achieved during ship surveys (Wall *et al*, 2006). This is predominantly due to the rapid coverage of distance achieved by the CASA patrol aircraft and the targeting of effort in only calm survey conditions. If the standard of data collection can be enhanced using available technologies at a reasonable cost, and bearing in mind that aerial survey techniques are not appropriate for all cetacean species, the Maritime Squadron CASA patrol aircraft may offer an effective and productive means of surveying cetaceans, seabirds and other marine megafauna within the Irish EEZ.

### 6.3.4 *Radar detection of cetaceans*

The number of sightings which were detected first by radar was low with only three confirmed detections. In discussion with the Air Corps radar operators, radar detections of cetaceans were most likely to occur in very calm sea states (Beaufort 2 or less) when objects such as buoys were also detectable. Larger groups of animals were more likely to be detected than small groups, as in large groups, some proportion of the animals is always at the surface whereas small groups or individuals only offer an intermittent radar signal. Both large whales and groups of dolphins were detected by the radar and a maximum detection range of 2,500m was recorded for a large rorqual. It is doubtful that radar could be used to survey cetaceans in anything but the calmest sea states, with no swell.

# 7 Assessment of Changes in GAP Analysis of Cetacean Survey Coverage and Effort in Irish Waters following PReCAST

## 7.1 PReCAST Survey Gap Analysis Update - January 2011

This section updates the Gap Analysis presented in the PReCAST interim reports 2009 and 2010. Only data from PReCAST ship surveys from March 2008 to January 2011 were used for this analysis. Effort collected in Beaufort Sea States 0– 6 was included. Effort was calculated as hours of survey effort conducted. Survey effort conducted outside of the Irish Declared Area and Northern Irish territorial waters was not included in the Gap Analysis.

The Irish Declared Area was broken down into survey zones suitable for the planning of surveys of cetacean relative abundance and distribution, based on:

1. The working areas of naval and scientific vessels (as representing the most common platforms utilised during surveys on platforms of opportunity);
2. Habitat types (e.g. shelf versus slopes);
3. Extent of geographical coverage likely to be achieved during any one survey.

On this basis, the Irish Declared Area was broken down into 15 Survey Areas (table 7.1, figure 7.1):

**Table 7.1:** 15 survey areas defined for purposes of GAP analysis

| Area Description | Area Description |
|---|---|
| North West (<200m) | West (<200m) |
| South West (<200m) | South (shelf waters) |
| East (shelf waters) | Celtic Sea (<200m) |
| Porcupine Bank (< 500m) | Northern Irish territorial waters |
| Porcupine Slopes and Canyons (>500m) | North Slopes and Canyons (>200m) |
| Rockall Trough East (within EEZ) | Rockall Trough West (outside EEZ) |
| Hatton (bank and surrounding areas) | Seabight and Canyons (including Goban Spur) |
| Rockall Bank (southern bank and surrounding areas) | |

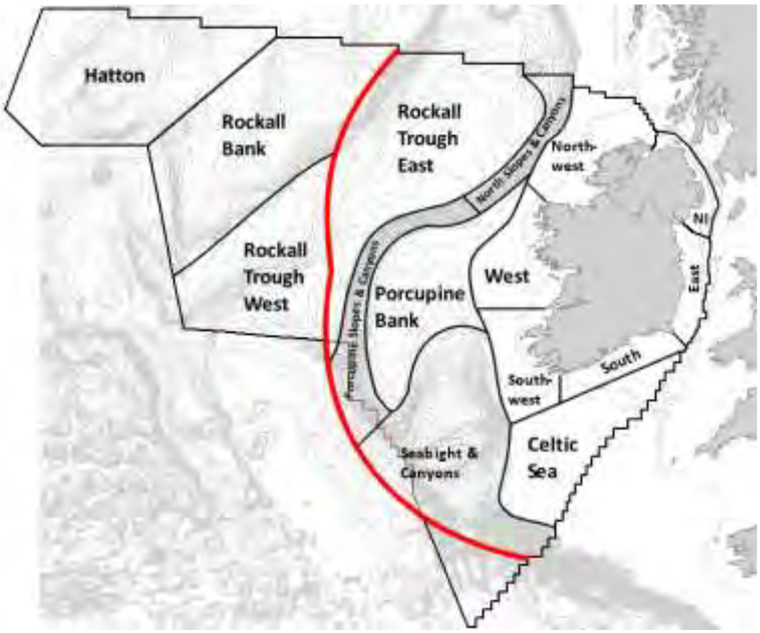



**Figure 7.1:** Map of survey zones selected for cetacean survey GAP analysis. Red line denotes Irish Exclusive Economic Zone

Survey effort was assigned to survey areas using GIS Software. Seasonal effort for each survey area was summed and assigned to categories as per figure 7.2 below. Maps were prepared showing seasonal survey effort (figure 7.3) and seasonal geographic coverage per survey area (figure 7.4).

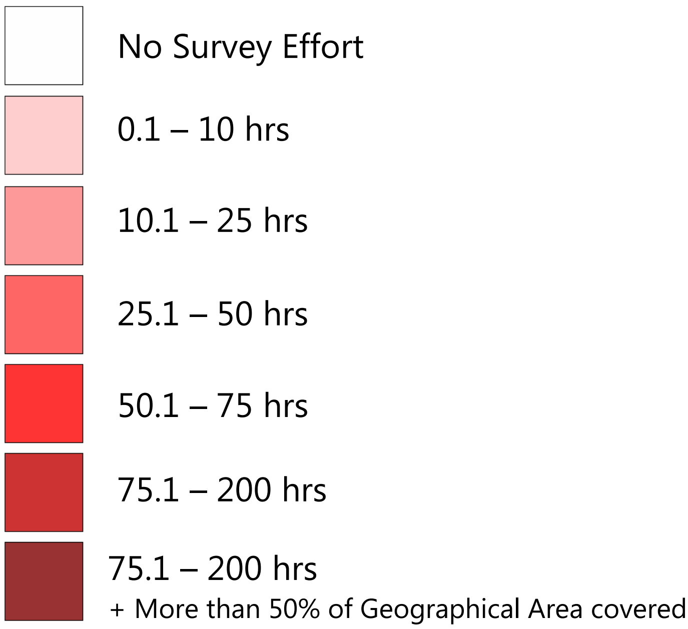
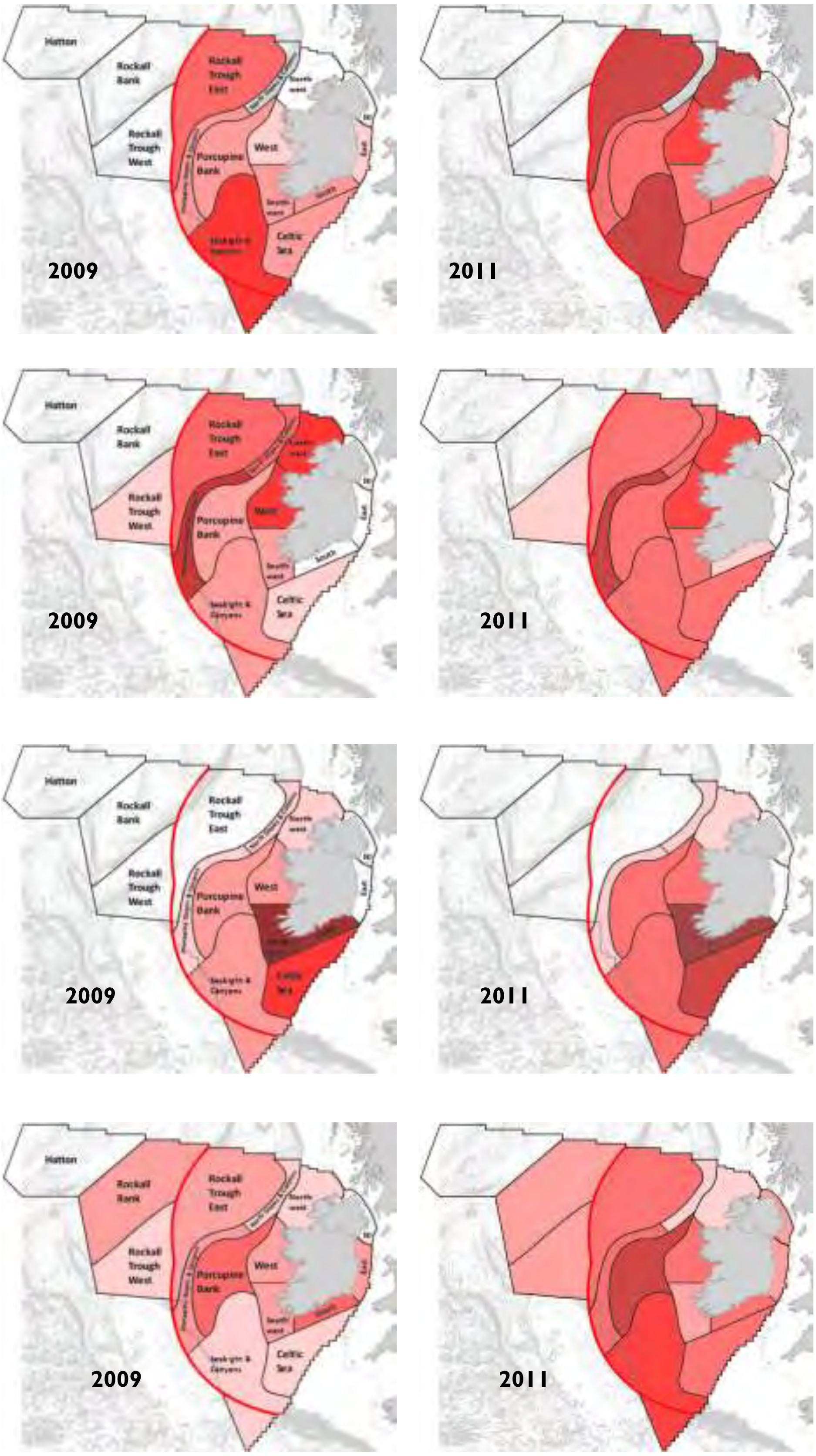



**Figure 7.2:** Scale showing shading indicating survey effort (hours) allocated to survey areas in maps (figure 7.1), with darker shading indicating greater survey effort




**Spring**
*(April, May, June)*

**Summer**
*(July, Aug, Sep)*

**Autumn**
*(Oct, Nov, Dec)*

**Winter**
*(Jan, Feb, Mar)*

**Figure 7.3:** Accumulated seasonal survey effort achieved within the 15 survey zones under PReCAST: December 2009 (left) and January 2011 (right)

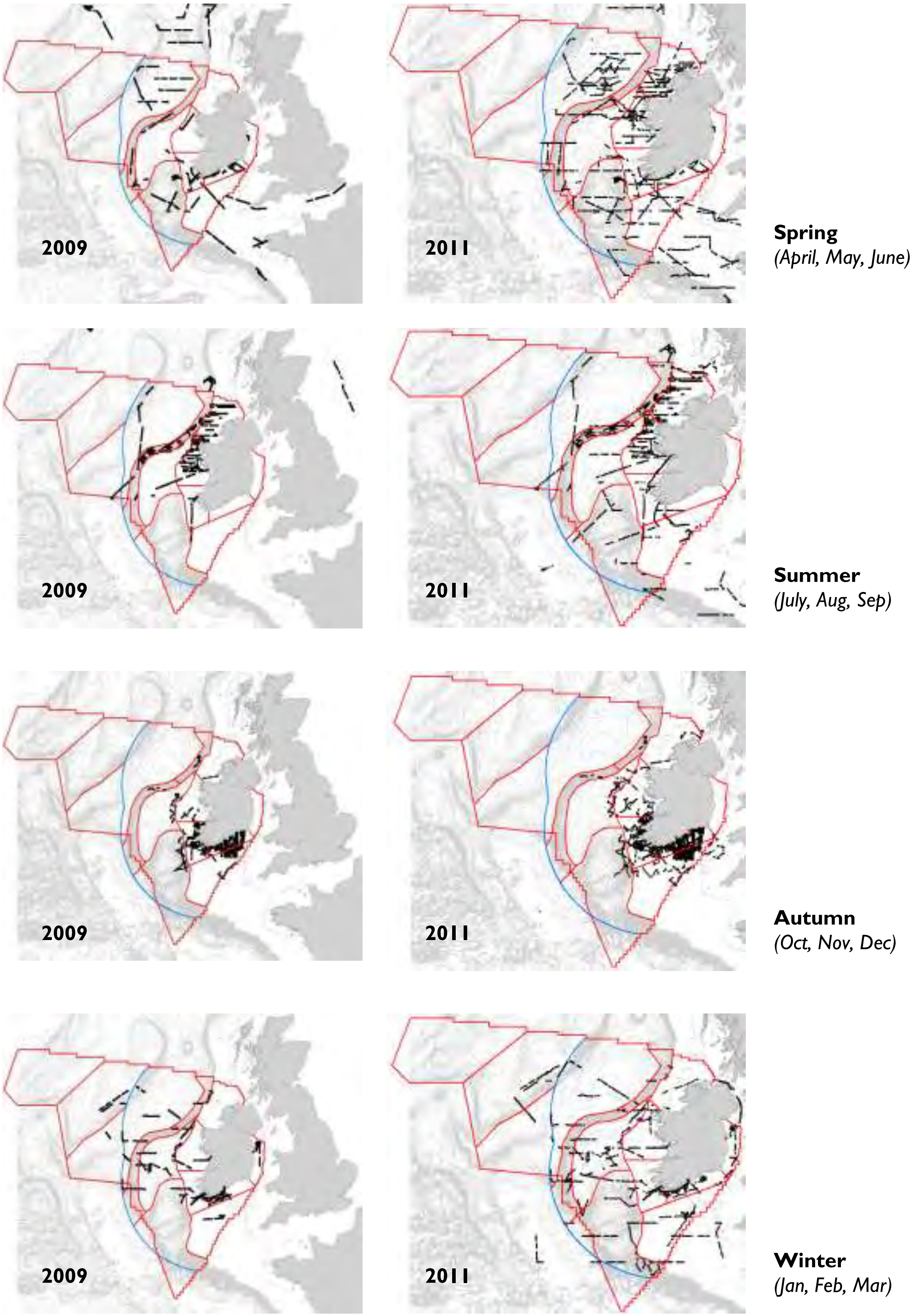



**Figure 7.4:** Accumulated seasonal geographic coverage achieved within the 15 survey zones under PReCAST: December 2009 (left) and January 2011 (right)

## 7.2 Gap Analysis (Survey Type and Coverage): Pre- and Post-PReCAST

This section updates the IWDG Gap Analysis of 2008. Only data from SCANS, CODA, SIAR, PIP/CMRC/ESAS, IWDG and PReCAST surveys from 1999 to 2011 were considered for this analysis. Surveys were weighted according to survey method and degree of geographic coverage of each survey zone (table 8.2). Dedicated cetacean surveys designed to calculate absolute abundance (e.g. SCANS and SIAR surveys) received the heaviest weighting, followed by dedicated cetacean surveys on board vessels of opportunity (e.g. IWDG surveys where cetaceans are the primary focus of the survey) and, finally, non-dedicated cetacean surveys on board vessels of opportunity (e.g. ESAS surveys which are primarily designed to survey seabird abundance). It should be noted that this analysis did not take account of the relative amount of survey time in each survey zone but considered only the survey types and relative geographic coverage for each zone.

The degree of coverage was also taken into account, particularly in the case of surveys conducted on board vessels of opportunity. These surveys were given three ratings, the highest being for multi-annual surveys, providing >50% coverage in the same survey zone; then surveys providing >50% coverage of a survey zone; and, finally, surveys providing <50% coverage of a survey zone. Surveys were allocated points on a five-point scale:

**Table 7.2:** Survey weighting scores according to survey method and degree of geographic coverage within the survey area

| Weighting Score | Area Description |
|---|---|
| 1 | Non-dedicated cetacean surveys on board vessels of opportunity (e.g. ESAS) providing <50% coverage of the survey area |
| 2 | Dedicated cetacean surveys on board vessels of opportunity (e.g. IWDG) providing <50% coverage of the survey area |
| 3 | Non-dedicated cetacean surveys on board vessels of opportunity (e.g. ESAS) providing >50% coverage of the survey area |
| 4 | Dedicated cetacean surveys on board vessels of opportunity (e.g. IWDG) providing >50% coverage of the survey area |
| 5 | Dedicated cetacean surveys designed to calculate absolute abundance (e.g. SCANS and SIAR surveys) |

Where a survey zone was covered by multi-annual dedicated cetacean surveys on board vessels of opportunity (e.g. IWDG), providing >50% coverage of the survey area, the point allocation was doubled (e.g. south coast IWDG surveys 2004-2008).

Points were allocated to each of the 15 survey zones for each of four seasons according to the degree of geographic coverage of each survey zone by each survey method. Allocated points for each survey zone were summed and used to rank the survey effort within each survey zone according to a six level scale, with darker shading indicating higher survey effort / geographic coverage (figure 7.5), and maps showing the summed survey effort per survey zone were prepared (figure 7.6).

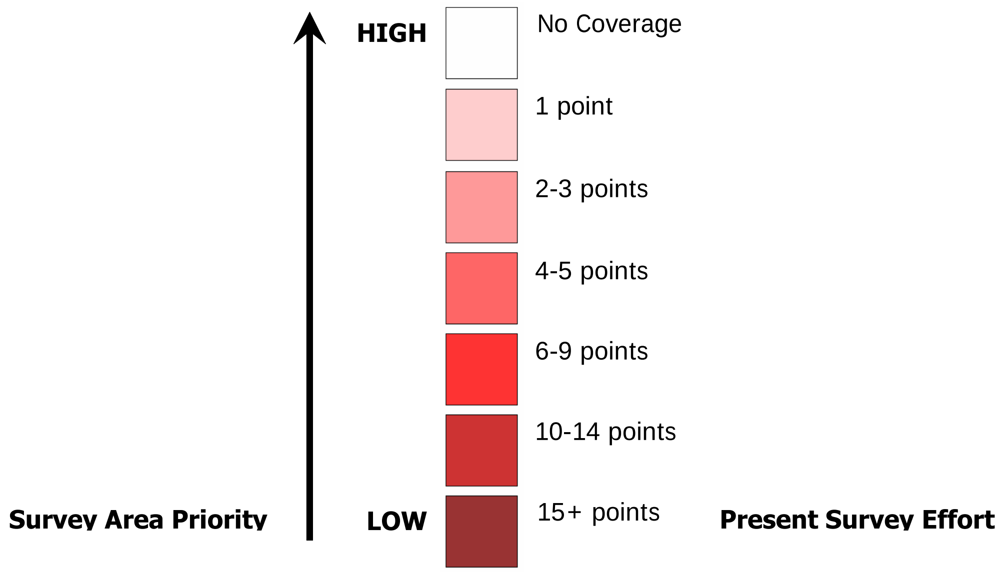



**Figure 7.5:** Scale (right) showing shading indicating survey coverage points allocated to survey zones in maps (figure 7.6), with darker shading indicating greater survey effort and (left) survey zone priority, with lighter shading indicating higher priority for future survey within given survey zone

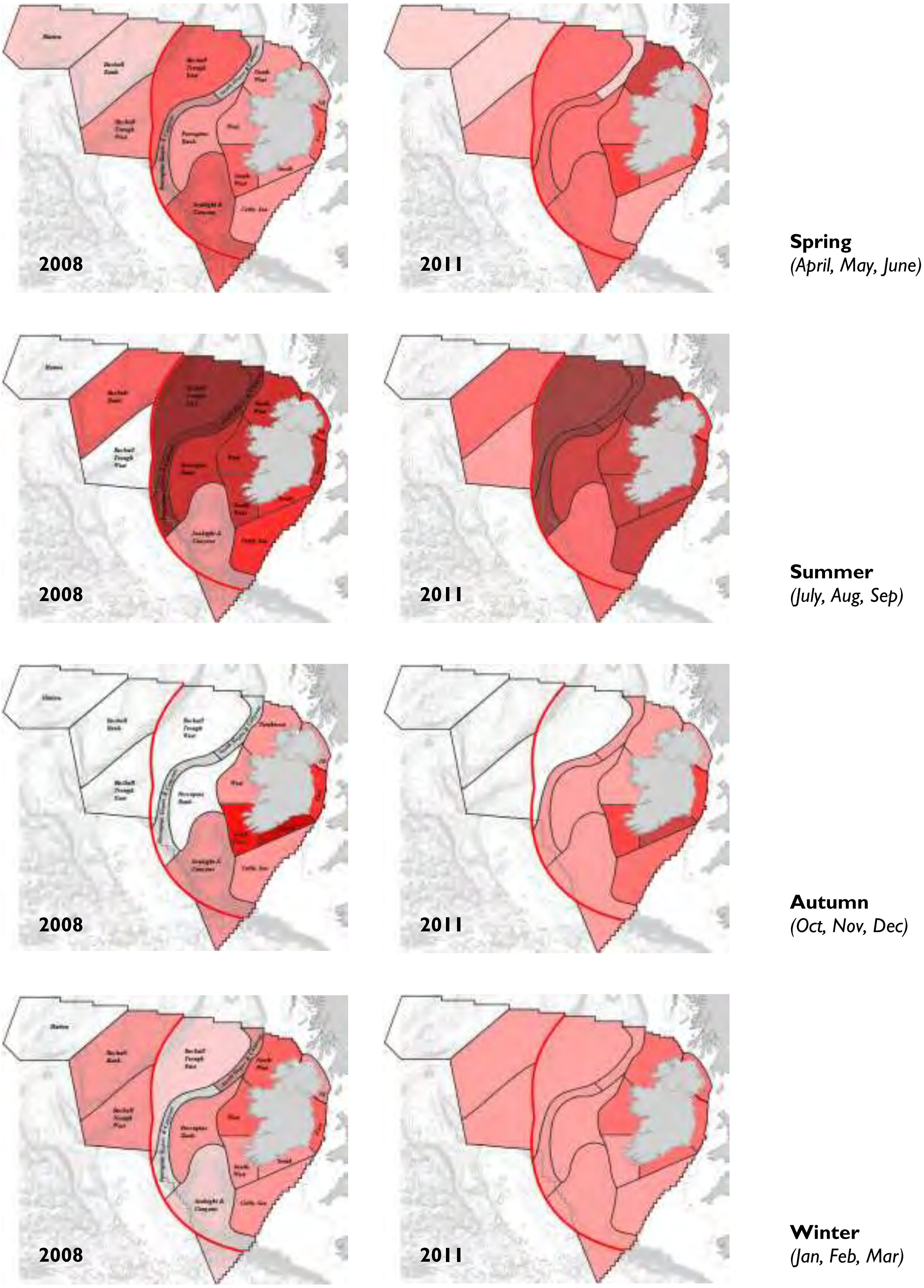



**Figure 7.6:** Accumulated seasonal survey coverage points allocated to the 15 survey zones prior to PReCAST (2008) and after PReCAST (2011)

# 8 Assessment of the occurrence of Bottlenose Dolphins in Offshore Habitats of the Irish EEZ

## 8.1 Introduction

The bottlenose dolphin (*Tursiops truncatus*) has a wide distribution in Irish waters, is the second most frequently sighted dolphin species in inshore waters and is the third most frequently stranded dolphin species (Berrow *et al*, 2010). Bottlenose dolphins breed within the EEZ and a resident breeding population has been identified in the Shannon Estuary on the west coast of Ireland (Berrow *et al* 1996; Ingram 2000).

Habitat use by bottlenose dolphins ranges from estuaries and inshore coastal habitat to the offshore shelf, offshore banks and abyssal waters (O'Cadhla *et al*, 2004; Englund *et al,* 2008; O'Brien *et al*, 2009). While the use of estuarine and inshore coastal habitats by bottlenose dolphins in Irish waters is relatively well understood, little is known of the offshore habitat requirements for this species.

The SCANS II (Hammond 2006) surveys recorded sightings of bottlenose dolphins from shelf and shelf edge waters. The surveys produced a population estimate of 12,645 animals for the northwest European shelf. The CODA deep water cetacean surveys, conducted in 2007, calculated a population of 17,245 animals for the waters to the west of Ireland (block 1 and 2), the UK and France (Hammond *et al* 2010). Both population estimates were, however, based on a low number of sightings over a vast survey area and perhaps warrant treatment with some caution.

The population structure of bottlenose dolphins in Irish waters is not clear. Animals resident within the Shannon Estuary are thought to exercise a high degree of site fidelity (Englund *et al*, 2008) and photo-identified individuals from this population are rarely sited elsewhere around the Irish coast (O'Brien *et al*, 2009). The majority of bottlenose dolphin records in Irish waters are of coastal groups and photo-identification studies suggest that a pan-coastal population may exist with individuals making long-range movements around the Irish coast and into UK and European mainland coastal waters (O'Brien *et al*, 2009; Robinson *et al*, submitted).

Genetic studies elsewhere have indicated that an offshore ecotype of bottlenose dolphin can exist even where no obvious boundaries to interchange exist (Tezanos-Pinto *et al,* 2008). Recently presented genetic data from strandings on the Irish coast suggest the presence of a well mixed genetic group which differs significantly from the identified inshore and estuarine populations identified from biopsy studies (Mirimin *et al*, 2011).

This report presents an assessment of the presence of bottlenose dolphins in Irish offshore habitats, based on data collected during the PReCAST Project 2008-2011, ESAS survey data and SCANS II survey data.

## 8.2 Data Sources

A number of published and unpublished data sources were used as comparison data in this report.

### 8.2.1 *Line Transect Surveys – PReCAST Project*

Marine mammal observers conducted visual survey effort from platforms of opportunity (including Irish and foreign research vessels, and Irish Naval Service vessels) between March 2008 and January 2011. Survey methods were as described in section 2.1 of this report.

### 8.2.2 *Line Transect Surveys – Non-PReCAST*

Marine mammal observers conducted visual survey effort from platforms of opportunity (including commercial ferries and Irish and foreign research vessels) during a number of monitoring programmes between July 2001 and January 2011. Survey methods were as described in section 2.1 of this report.

### 8.2.3 *Irish Whale and Dolphin Group casual sightings databases 1999–2010*

The IWDG co-ordinates two sighting schemes, a casual sighting scheme which collects sightings made opportunistically while carrying out other activities (e.g. sailing, fishing, walking), and an effort-related scheme (Berrow *et al*, 2010) where watch or transect survey effort is also recorded. Sightings from both schemes were recorded in a standardized format. An online sightings form prompts the observer for information on size, blow, fin and head shape, behaviour and high/low/best estimate of numbers present. It also provides space to report environmental data. Sightings data were submitted to the IWDG through a number of channels including submitting a sighting form, reporting online through the IWDG website (www.iwdg.ie) and reporting directly by phoning in records on the IWDG phone line.

In order to ensure the quality of the data maintained on the database, each sighting record was assessed to determine whether the basic information on the sightings form was complete, providing, for example, date, location and contact information of the observer. All records were then assessed by IWDG using their experience in field identification of cetaceans and knowledge of the observer to determine whether the species reported was accurate, based on the description of each sighting. Some records were submitted with photographs or video to verify the record. If the record was submitted verbally, the observer was asked to describe what was seen by prompting for information without giving hints as to what the characteristic should look like. Other factors such as weather conditions, especially sea state, observer experience and confidence level, were also factors used in assessing records. If insufficient information was provided to verify the sighting record, then the species identification was downgraded to a level which the information provided warrants.

For this analysis, sighting searches were restricted to bottlenose dolphins only (no downgraded species data) and only data collected from 1999 to 2010 were used.

### 8.2.4 *ESAS Data 1999–2003*

Surveyors from the JNCC Seabirds at Sea Team (SAST) and the Coastal and Marine Resources Centre (CMRC) at University College Cork carried out a programme of survey and research on seabirds and cetaceans in the marine environment in the northeast Atlantic from 1979 to 2003. The methods used were those described in Camphuysen and Garthe, 2004. Bottlenose dolphin sightings collected from 1999-2003 were used in this analysis.

### 8.2.5 *SCANS II Data 2005*

During 2005 the SCANS II project surveyed the waters of the European continental shelf from Norway south to the Straits of Gibraltar using ship-based and aerial surveys. The project was coordinated by the University of St Andrews in Scotland and supported by 11 partners in 10 European countries. Methods used were those described in Hammond, 2006. Only bottlenose dolphin sightings were used in this analysis.

## 8.3 Methods

### 8.3.1 *Habitat use analysis*

Only offshore sightings were used in this analysis. For the purposes of the analysis, 'offshore sightings' were defined as those sightings which occurred further than 12nm from the coast.

The 12nm cut-off is somewhat arbitrary. However, it does roughly match the distance offshore one could expect to monitor from a shore-based station with a telescope and when all sightings (inshore and offshore) are plotted, the 12nm limit broadly differentiates between the dense occurrence of coastal sightings and the more dispersed offshore sightings.

To assess the occurrence of bottlenose dolphins in offshore habitats (beyond 12nm from shore), sightings were assessed for location habitat type and water depth. All measurements were derived from the Geological Survey of Ireland's online INFOMAR Public Viewer (GSI, 2011). Location habitat types were classed into one of five types, based on descriptions of five commonly occurring offshore habitats (table 8.1).

**Table 8.1:** Offshore habitat types and descriptions

| No. | Habitat Type | Description |
|---|---|---|
| **1** | Shelf | Waters over the Irish Continental Shelf (≤200m Depth) |
| **2** | Slope and Canyon | Waters over the Irish Continental Shelf Slopes or slopes of offshore banks (201–2,500m) |
| **3** | Offshore Bank | Shallow waters over offshore banks (0–200m) |
| **4** | Abyssal | Waters deeper than 2,500m |

The percentage area covered by three habitat categories - Shelf; Slope and Canyon/Offshore Bank (combined); and Abyssal - within the Irish EEZ was calculated using an online GIS viewer which contained detailed multibeam bathymetry imaging collected during the Irish National Seabed Survey. Expected bottlenose dolphin sightings frequencies for each habitat class were calculated from these data and compared to observed sightings frequencies collected during this study (table 8.2). A Chi-Squared test was conducted to test whether observed sightings frequencies differed significantly from what would be expected for the three habitat types.

### 8.3.2 *Photo-identification study*

During dedicated offshore cetacean surveys conducted by the IWDG and GMIT in 2009 and 2010, two large bottlenose dolphin pods were encountered. In August 2009 a pod of 200 animals was encountered on the continental shelf slopes west of Belmullet, Co Mayo, and in February 2010, a pod of 40 animals was encountered on the eastern slopes of the Porcupine Seabight. In both cases, the animals were approached for the purposes of obtaining photo-identification images. Following Wursig and Wursig (1977), fin images from 25 individually recognisable animals were obtained.

These images were compared to those in the Irish Coastal Bottlenose Dolphin and Shannon Dolphin and Wildlife Foundation catalogues, comprising 320 individuals, to investigate for matches. Markings used to identify individuals included nicks or notches on the trailing edge of the dorsal fin (ranging from one to several) and scratches or scars (O'Brien *et al*, 2009).

## 8.4 Results

### 8.4.1 *Sightings*

A total of 1,270 sightings collected between 1999 and 2011 within five data sets were available for this analysis. 145 of these sightings were classed as 'offshore sightings', as they occurred further than 12nm from shore, and these were used for the habitat analysis. A summary of sightings data collected during PReCAST, non-PReCAST ship surveys, the IWDG databases, ESAS surveys and SCANS II are presented in table 8.3.

143 of the 145 sightings involved group sizes of one to 45 animals, whereas two sightings involved super pods of at least 100 and 200 individuals respectively. A super pod of 200 animals was sighted on the shelf slopes to the west of Belmullet on 26 August 2009 and a group of 100 animals was recorded over the Porcupine Bank in September 2007. Most sightings within the IWDG online databases were recorded from inshore habitats, with just 92 of 1,157 (8%) sightings being recorded offshore. Group sizes of coastal sightings ranged from one to 200 animals.

**Table 8.3:** Numbers of sightings, individuals, calves/juveniles and group size ranges for the four data sets examined

| Survey | Survey Period | No. Sightings | No. Animals | No. Calves/Juv. | Group Size Range |
|---|---|---|---|---|---|
| **PReCAST** [1] | 2008-2011 | 21 | 502 | 7 | 2-200 |
| **IWDG Ship Surveys** [2] | 2001-2011 | 4 | 43 | 2 | 1-16 |
| **IWDG Online Databases** [3] | 1999-2010 | 92 | 998 | No Data | 1-100 |
| **ESAS Surveys** [4] | 1999-2003 | 17 | 124 | No Data | 2-25 |
| **SCANS II** [5] | 2005 | 11 | 109 | 5 | 1-17 |

*Only offshore (>12nm) sightings data are presented in this table: 1) Total dataset was 26 sightings, totalling 524 individuals. 2) Total dataset was 17 sightings, totalling 116 individuals. 3) Total dataset was 1,157 sightings, totalling 12,111 individuals 4) Total dataset was 37 sightings, totalling 419 individuals. 5) Total dataset was 33 sightings, totalling 222 individuals*

Sightings of offshore bottlenose dolphins collected during PReCAST fell within the known offshore distribution for this species in Irish waters (figure 8.1). The majority of sightings appearing to focus on the continental shelf slopes to the west of Ireland, with some sightings also occurring over the shelf to the west, northwest and southwest. Few sightings occurred in deeper abyssal waters to the northwest and southwest of Ireland. The lack of sightings in the Irish Sea is due to minimal effort in that region during PReCAST.

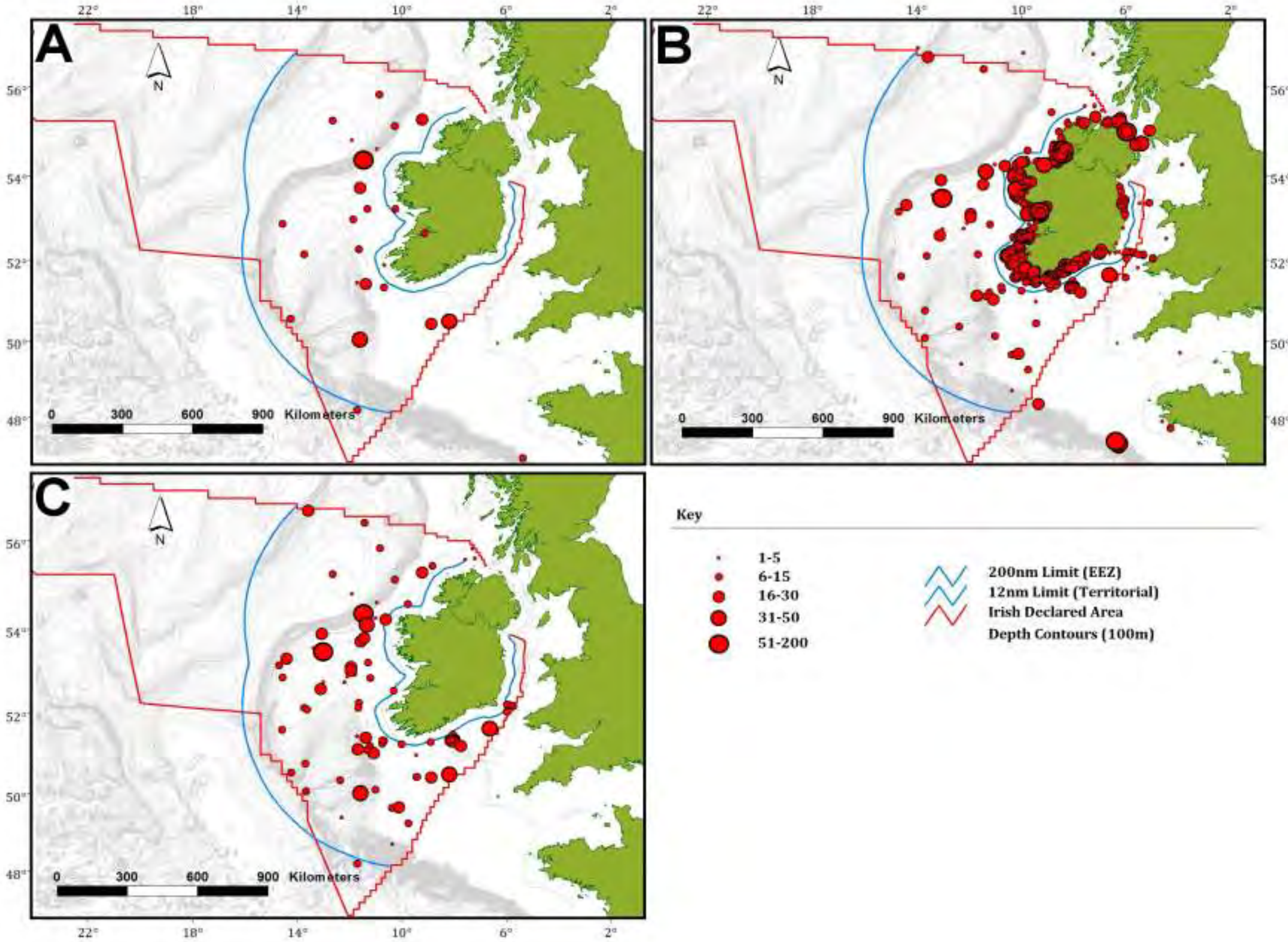



**Figure 8.1:** Distribution and group sizes of bottlenose dolphin sightings recorded under PReCAST 2008– 2011 (figure A) and all other surveys 1999– 2011 (figure B). Figure C shows distribution and group sizes for all offshore bottlenose dolphin sightings within the Irish EEZ (lying outside the 12nm limit) that were used in this analysis

### 8.4.2 *Offshore Habitat Use*

Multiple sightings from identical coordinates were discounted from this analysis to remove the possibility of duplicates in the data. 88 sightings were assigned a water depth using INFOMAR seabed survey data provided on the INFOMAR public viewer (www.infomar.ie) and habitat type based on the classifications in table 6.1. Offshore sightings of bottlenose dolphins occurred in water depths ranging from 54m to 3,322m. 80% of sightings were recorded in water depths of less than 500m. 43% of sightings occurred over shelf habitat, 39% over slope and only 6% occurred over abyssal habitat or offshore banks (figure 8.3).

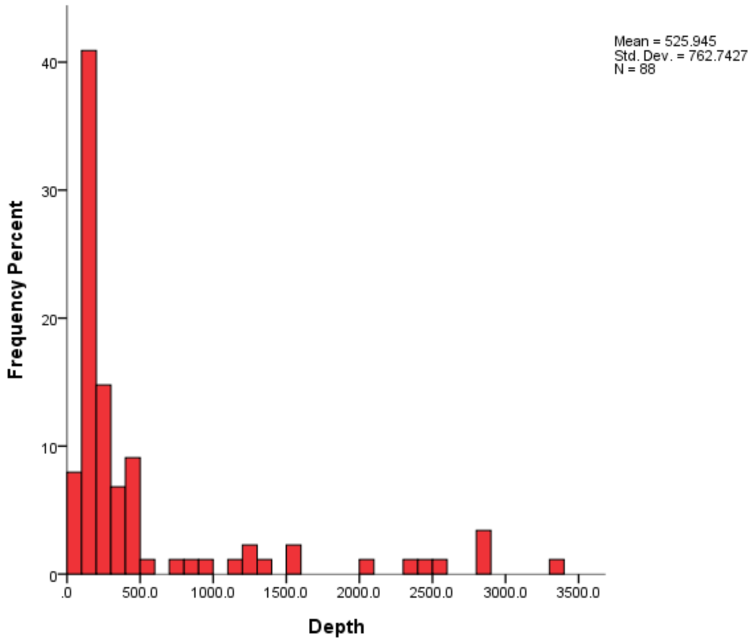



**Figure 8.2:** Percentage of 88 offshore bottlenose dolphin sightings occurring in water depths between 50 and 3500m

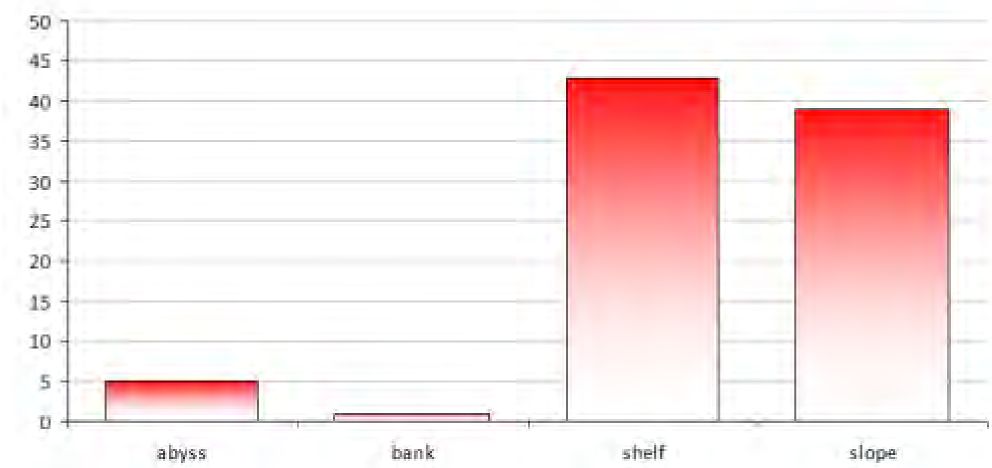



**Figure 8.3:** Percentage of 88 offshore bottlenose dolphin sightings occurring in four offshore habitat types

The observed frequency of occurrence of bottlenose dolphins among the four habitat types (Shelf, Slope/Canyon, Bank and Abyssal) differed significantly from the expected frequencies based on the area of each habitat available within the Irish EEZ ($X^2$= 53.5, P=<0.0001, df=3). The data indicate that bottlenose dolphins show a preference for shallower offshore waters (<500m), with a distribution which focuses predominantly on continental shelf, slope and canyon habitats. Sightings were recorded in all months of the year (figure 8.4).

**Table 8.2:** Calculated areas of four offshore habitat types within the Irish EEZ and observed versus expected sightings frequencies for each habitat type, based on 88 offshore bottlenose dolphin sightings

| No. | Habitat Type | % Area | Sightings (Expected | Sightings (Observed) |
|---|---|---|---|---|
| 1 | Shelf | 37.17 | 32.7 | 43 |
| 2 | Slope and Canyon | 20.65 | 18.2 | 39 |
| 3 | Offshore Bank | 4.75 | 4.2 | 1 |
| 4 | Abyssal | 37.42 | 32.92 | 5 |

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Figure 8.3:** Detection positive months for offshore bottlenose dolphin sightings 1999– 2011

### 8.4.3 *Photo-identification Study*

No matches were found between the animals photographed in offshore waters in 2009 and 2010 and those contained in the Shannon Dolphin, Irish Coastal Bottlenose Dolphin or University College Cork catalogues (*Ryan C. and Englund A. personal comments*). The offshore animals sighted appeared larger and more heavily scarred when compared to inshore animals by researchers on board ship who were familiar with inshore and estuarine populations. The offshore animals appeared to have larger fins, with a higher percentage of animals with nicks on the upper part of the dorsal fin than was observed on inshore animals (*Ryan C., personal comment*).

## 8.5 Discussion

PReCAST offshore surveys have contributed significantly to the database of Irish offshore bottlenose dolphin sightings. The number of sightings recorded during the current study is comparable with that collected during CMRC/PIP surveys from 1999 to 2001 (O'Cadhla *et al*, 2004). This data and the results of previous studies indicate that bottlenose dolphins occur with regularity in offshore habitats but at relatively low population densities, with only 26 sightings recorded in 2,305 hours of visual survey effort and 53.3 hours of aerial survey effort during PReCAST, and low numbers of sightings recorded during the CMRC/PIP, SCANS II and CODA surveys (O'Cadhla *et al* 2004, Hammond 2006, Hammond *et al* 2010).

Historically there has been limited offshore cetacean survey effort within the Irish EEZ (Reid *et al*, 2003). Targeted surveys for bottlenose dolphins have focused primarily on coastal or estuarine habitats during the summer months (e.g. Ingram *et al* 2000, Rogan *et al* 2000, Ingram and Rogan 2003, Ingram *et al* 2009). Data from ESAS surveys conducted by the JNCC (Pollock *et al*, 1997) and CMRC (O'Cadhla *et al*, 2004) from 1980 to 2003 provided the first data that bottlenose dolphins occurred throughout the year in offshore areas of the Irish EEZ. These data were enhanced by population estimates from the SCANS II and CODA surveys (Hammond, 2004, Hammond *et al*, 2010), although both surveys were highly seasonal in nature and population estimates derived from the data were based on very few sightings over a large survey area. Sightings of offshore bottlenose dolphins collected during PReCAST fell within the described offshore distribution for this species in Irish waters, with the combined data sets indicating that bottlenose dolphins occurred in offshore habitats of the Irish EEZ throughout the year.

The results of this analysis indicate that bottlenose dolphins in Ireland's offshore waters occur primarily in shallower waters of less than 500m depth. The analysis did not account for the amount of survey effort within each habitat type, due to lack of effort data for many of the data sets, and incorporated data from an extended period. Therefore, the results should be treated with some caution. Offshore bottlenose dolphins elsewhere have been reported from a variety of water depths, from shallow coastal waters in Australia (Corkeron and Martin, 2004) to waters in excess of 2,000m (Mead and Potter 1995, Wells *et al* 2006) off the eastern coast of America, and have been reported making dives in excess of 450m while foraging (Leigh *et al*, 2007).

It is notable that none of the 25 photo-identified animals examined were matched to existing bottlenose dolphin catalogues for inshore or estuarine populations. O'Brien *et al* reported a 19% re-sighting rate for coastal bottlenose dolphins, while re-sighting rates of up to 85% have been reported from the Shannon Estuary population (Englund *et al*, 2008). Results to date indicate that there are a significant number of well-marked bottlenose dolphins in Irish offshore habitats which have not been recorded inshore to date and may exist in relative isolation to coastal and estuarine populations groups. While there appears to be no barrier to the integration of coastal and offshore animals, population separation of inshore and offshore animals has been noted elsewhere (Hoelzel *et al* 1998). Indeed, photo-ID and genetic studies in Irish waters have already shown that such separation already exists to a large extent in inshore habitats between the Shannon Estuary and coastal populations (Englund *et al* 2008, Mirimin *et al* 2011).

It is noteworthy that researchers experienced in inshore and estuarine bottlenose dolphin identification, who witnessed the offshore groups and/or photographs, commented on the large size and well-marked dorsal fins of the offshore animals. Offshore bottlenose dolphins in the western Atlantic have been found to have a body size on average 15% larger than those in near shore populations (Mead and Potter 1995).

Inshore and offshore forms of bottlenose dolphin have been identified in the western North Atlantic, based on morphology and ecological markers (Mead and Potter 1995), and on fixed genetic differences (Leduc and Curry 1997, Hoelzel *et al* 1998, Reeves *et al* 2003), with a future possibility of inshore and offshore forms eventually being assigned to different species (Hammond *et al*, 2008). Data on the presence of bottlenose dolphins in offshore habitats presented in this report, coupled with the photo-identification results and personal observations on offshore animal size and appearance by experienced bottlenose dolphin researchers, lend credence to suggestions that an offshore ecotype for bottlenose dolphins exists in Irish waters. Recently presented genetic data from strandings on the Irish coast (Mirimin *et al*, 2011) indicate the presence of a third, well mixed, genetic group of bottlenose dolphins that differs significantly from coastal and estuarine populations identified from biopsy studies.

Further research is needed to define the population structure and identity of offshore bottlenose dolphins in Irish waters. Offshore bottlenose dolphins may represent an important population of this Annexe IV species within the Irish EEZ, with the largest of the offshore groups recorded during this study containing more animals than is estimated for the entire Shannon Estuary population (Englund *et al*, 2008). Targeted photo-id and genetic sampling effort of offshore animals will enable their population structure and movements to be described and additional survey effort may yield a more robust estimate of population size, group size and habitat preference of this species in offshore waters of the EEZ.

Anecdotal evidence based on personal observations during the PReCAST surveys indicated that offshore bottlenose dolphins did not readily approach large vessels. Close encounters and successful photo-ID images were only obtained through diverting the survey vessel from its course and gradually tracking and merging with the animals over the course of 30 minutes to one hour. As this is not normally feasible when using platforms of opportunity, a dedicated vessel will be required to conduct targeted survey and sampling of offshore bottlenose dolphins in the Irish EEZ.

# 9 Assessment of the Timing and use of Rockall Trough Migration Corridor by Large Rorquals (Baleen Whales)

## 9.1 Introduction

The seasonal occurrence of foraging large rorquals in inshore waters off the south coast of Ireland has been well documented in recent years (IWDG, 2011, Whooley *et al*, 2011), with the presence of whales linked to the large biomass of schooling pelagic fish present off the south coast in autumn (Healy *et al*, in prep).

Data from the US Navy's SOSUS array (a hydrophone array used for monitoring submarine movements in the north Atlantic) has indicated that a seasonal movement of large rorquals (fin, blue and humpback whales) also occurs along the Irish Shelf edge (Charif and Clark, 2009) and aggregations of feeding whales were noted along the shelf edge in 2008 by Wall *et al* (2009). In order to assess the temporal movements of large rorquals within the Irish EEZ, all large whale sightings data within the IWDG ship surveys databases were mapped and analysed using GIS.

## 9.2 Data Sources

### 9.2.1 *Line Transect Surveys – PReCAST Project*

Marine mammal observers conducted visual survey effort from platforms of opportunity (including Irish and foreign research vessels, and Irish Naval Service vessels) between March 2008 and January 2011.

### 9.2.2 *Line Transect Surveys – Non-PReCAST*

Marine mammal observers conducted visual survey effort from platforms of opportunity (on board Irish and foreign research vessels) during a number of monitoring programmes between July 2001 and January 2011.

## 9.3 Methods

Visual survey methods were as described in section 1.1 of this report. For this analysis, sightings of fin, blue and humpback whales, fin/sei/blue whales and unidentified whale blows from PReCAST, the West Coast Cetacean Survey (Wall *et al*, 2006), ISCOPE II (Wall and Murray, 2010) and IWDG ship surveys (Berrow et al, 2010) were combined. The majority of fin/sei/blue whale sightings were thought to be of fin whales (see section 4.4). The majority of unidentified whale blows were thought to be large rorquals. While it is possible that some unidentified whale blows may have been sperm whales, sperm whale blow patterns were usually distinct enough to identify blows to species level and, therefore, the number of sperm whales in this species class was thought to be low.

## 9.4 Results

247 sightings of 452 large rorquals were used in the analysis. These consisted of one sighting of a single blue whale (*Balaenoptera musculus*); 124 sightings of fin whales (*Balaenoptera physalus*), totalling 261 animals; six sightings of humpback whales (*Megaptera novaeangliae*), totalling nine animals; 31 sightings of animals classed as fin/sei/blue whales (see section 4.4), totalling 57 animals; and 86 sightings of unidentified whale blows (see section 4.19), totalling 125 animals (figure 9.1).

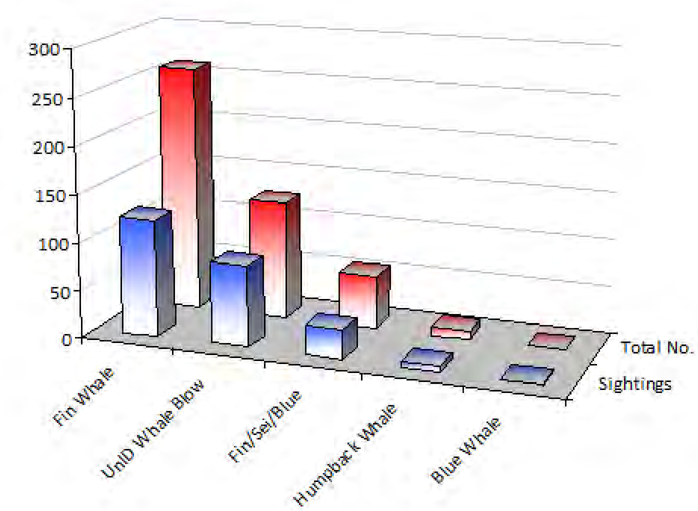



**Figure 9.1:** Large rorqual sightings data utilised during this analysis

The gathering of data on the monthly distribution of large rorquals within the Irish EEZ was limited by the distribution of survey effort. However, a pattern of large rorqual distribution was evident from the data (figure 9.2). Large rorquals appeared to be generally absent from the Irish EEZ during March, April and May. From June through to January, large rorquals were detected in the deeper waters of the Irish Shelf edge, the slopes of the Porcupine Bank and in the Rockall Trough. Particularly high densities were recorded along the edge of the Irish Shelf and the Porcupine Bank in August and September. However, lack of survey effort in shelf slope habitats in October, November and December did not allow for assessment of densities along the shelf edge in these months.

Large rorquals were present in foraging grounds off the south coast of Ireland from July through to December. The highest densities of whales were recorded in August and from October to December. The lack of survey effort precluded assessment of large rorqual abundance and distribution off the south coast in September.

The majority of large rorquals recorded off the south coast and along the shelf edge were fin whales. Humpbacks were present in far fewer numbers and most sightings were recorded off the south coast. On two occasions, single humpback whales were recorded over the Porcupine Bank. Only one sighting of a blue whale was confirmed, over the northwest slopes of the Porcupine Bank (figure 9.3).

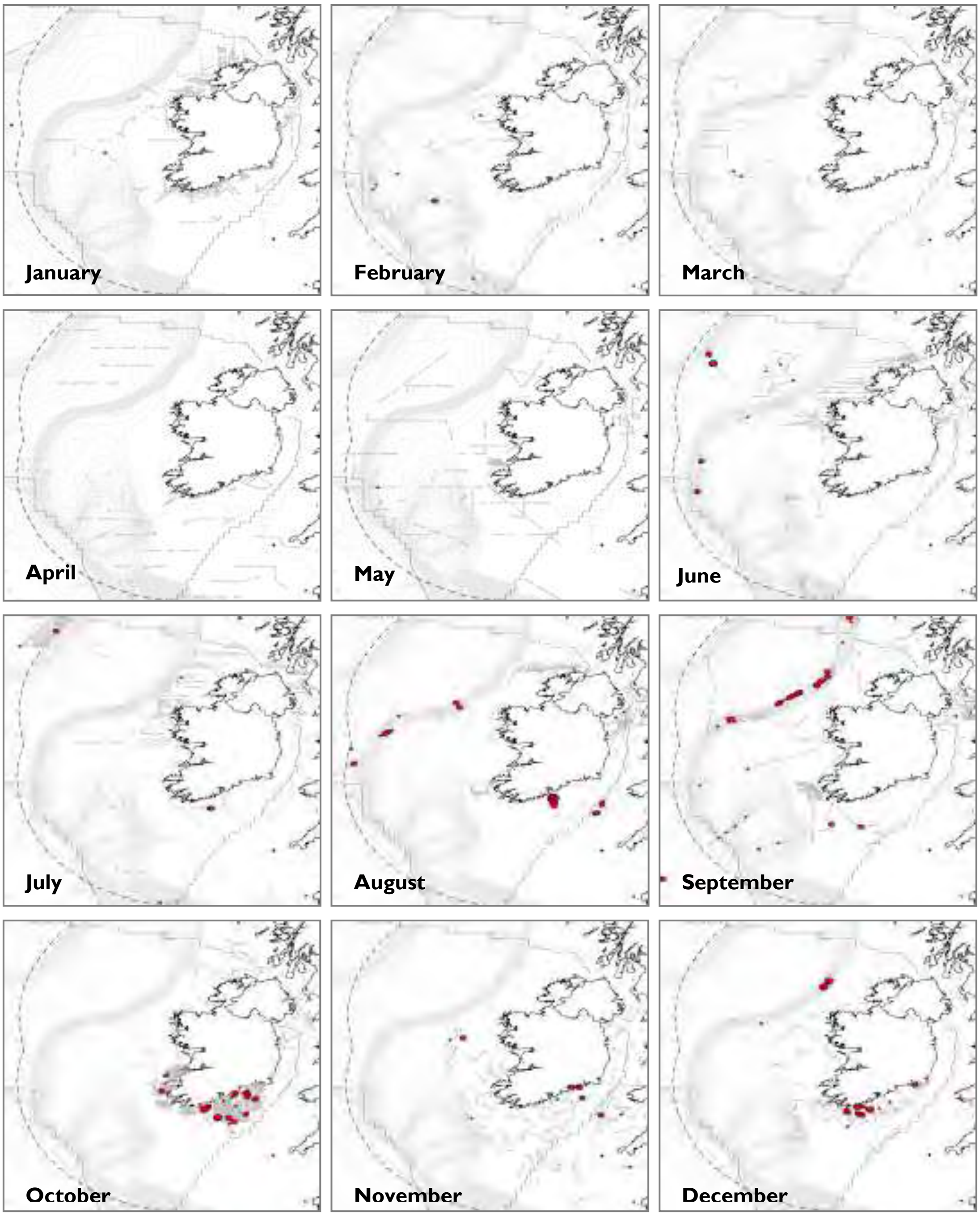



**Figure 9.2:** Monthly distribution and group sizes of large rorquals recorded within the Irish EEZ from 2003-2011 (Group size key as in figure 9.3)

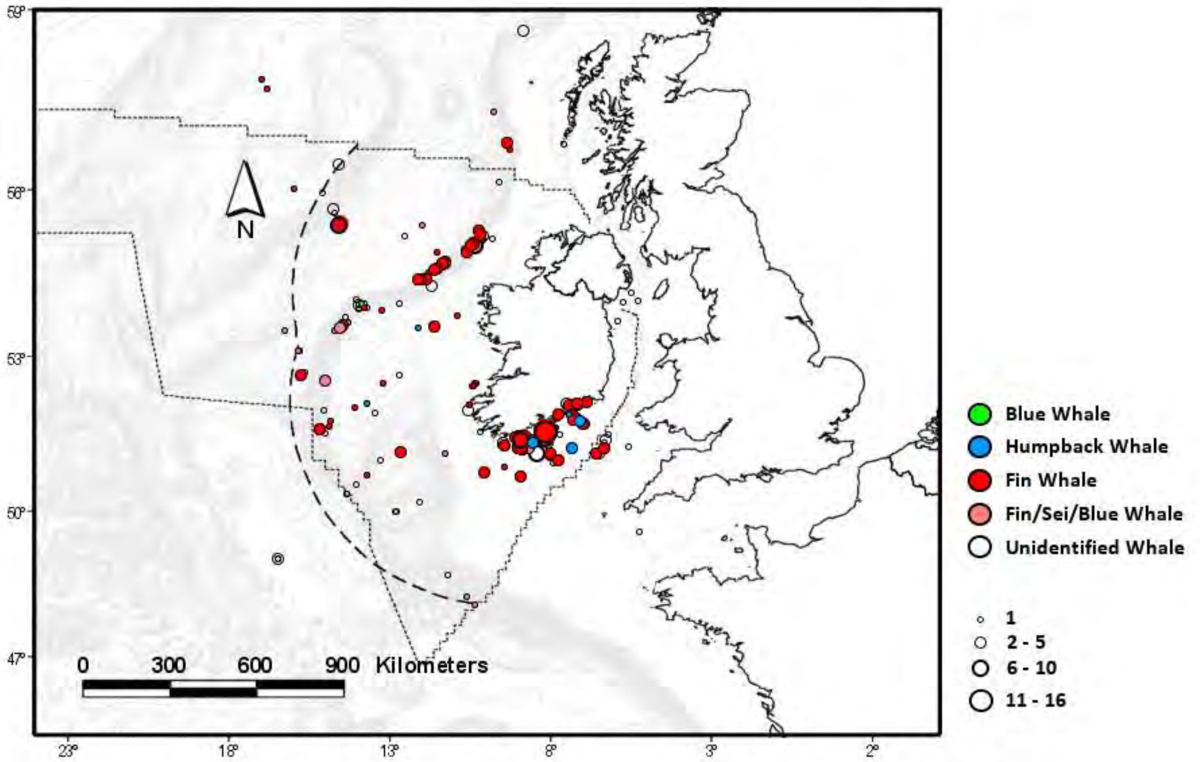



**Figure 9.3:** Distribution and group sizes of large rorqual species recorded within the Irish EEZ from 2003-2011

## 9.5 Discussion

### 9.5.1 *Temporal and spatial distribution of large rorquals off the south Irish coast*

The monthly distribution pattern of large rorquals off the south coast of Ireland described during this analysis is largely in line with that described by Whooley *et al* (2011). The majority of sightings along the south coast were recorded during August and December. The presence of fin and humpback whales off the south coast overlaps with the period of spawning for winter spawning herring in the Celtic Sea (Saunders *et al*, 2010) and it is thought that large rorquals feed on herring and other small pelagic schooling fish while in these foraging grounds. While the temporal presence of large rorquals off the south coast appears to remain constant from year to year, their distribution varies on an annual basis, largely depending on where the main biomass of herring is located (O'Donnell *et al*, 2006, 2007, 2008 and Saunders *et al*, 2009, 2010).

### 9.5.2 *Temporal absence of large rorquals from Irish waters*

Whooley *et al* (2011) describe fin whales being largely absent from the south coast from March through to May. Their finding corresponds with the results of this analysis. However, this analysis shows that the absence of large rorquals from March through to May each year is not restricted to the south coast alone, but appears to apply to the Irish EEZ as a whole.

Acoustic data from the SOSUS array analysed by Charif *et al* (2009) indicate that fin, blue and humpback whales are absent from the deeper waters to the west of Ireland during April, May and June. It would appear that a discrepancy of approximately one month's difference exists between the visual and acoustic data. Possible reasons for this apparent discrepancy include:

- SOSUS can only detect vocalising animals,
- SOSUS does not cover the shallow waters of the continental shelf,
- SOSUS data regions cover areas to the far west of Ireland that lie outside the Irish EEZ,
- Gaps exist in the monthly spatial distribution of survey effort, especially in deep water habitats to the west of Ireland.

### 9.5.3 *Temporal migration of large rorquals in waters to the west of Ireland*

#### 9.5.3.1 *Fin Whale*

Data from SOSUS indicate that seasonal movement of fin whales occurs annually in offshore waters to the west of Ireland between August and March, with a southward movement being suggested by time differences in peak detections by the east Atlantic versus western Atlantic SOSUS arrays (Charif and Clark, 2009). The data from this analysis, when account is taken of months and areas which received little or no survey effort, indicate the presence of large rorquals (predominantly fin whales) from June through to February. Defining the complete migratory period for fin whales was not possible due to gaps in survey effort in offshore habitats during some months.

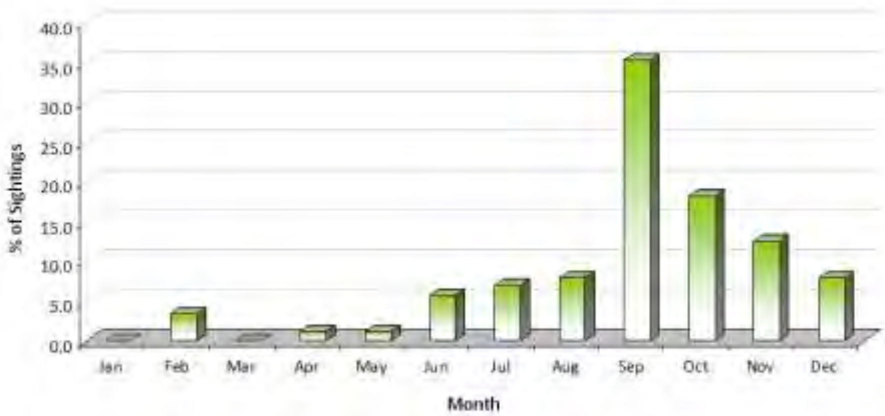



**Figure 9.4:** Monthly occurrence of fin whale and 'fin/sei/blue' sightings as percentage of all fin whale and 'fin/sei/blue' sightings

Visual survey data indicated a peak in fin whale occurrence from June to December (figure 9.4), with the tail end of this peak largely undetected due to low survey effort in offshore areas in January and February. The acoustic data from SOSUS indicated a peak from August and continuing into February (Charif and Clark, 2009). Outside of these few scraps of information, little is known of the migratory movements of fin whales in the Irish EEZ or in the North Atlantic. Nor is it known where animals foraging or passing through the Irish EEZ go to breed. Genetic data suggest the presence of several recently diverged populations in the North Atlantic (Bérubé *et al*, 1998).

#### 9.5.3.2 *Humpback Whale*

SOSUS data show a short migratory period of southward moving humpback whales off the west coast of Ireland from January to March (Charif and Clark, 2009). The visual data indicated that humpback whales occurred off the south coast from October to December, though single individuals were detected over the Porcupine Bank in November and March. The number of humpback whales sightings was too low to assess temporal trends in distribution for this species within the Irish EEZ.

Humpback whales in the North Atlantic migrate south to tropical springtime breeding grounds off the Cape Verde Archipelago and West Indies, with data suggesting separate migratory movements based on feeding ground and sex (Stevick *et al* 2003). Recent satellite tagging studies provided evidence of a single female humpback, tagged off the West Indies, migrating north-eastward to the west of the Rockall Bank during July 2010 (data provided by Phil Clapham, NOAA). While photo identification studies have linked individuals from the Cape Verde and West Indies breeding grounds to primary feeding grounds off Greenland (Stevick *et al* 2003, Wenzel *et al* 2009), there have been no matches of Irish humpbacks to either of the known breeding grounds in the North Atlantic (IWDG 2011).

#### 9.5.3.3 *Blue Whale*

The single sighting of a blue whale recorded during PReCAST occurred in September. This lies within the main migratory period for blue whales off the west coast of Ireland detected by the SOSUS array, which occurred from July to January (Charif and Clark, 2009). Little is known of their migratory movements or breeding grounds in the north Atlantic. However, whaling records indicate that blue whales were present across the southern half of the North Atlantic during the autumn and winter months and further north during spring and summer (Reeves *et al* 2004).

## 9.6 Conclusions

Both the visual and acoustic survey data indicate that fin whales (and blue whales) migrate along the slopes of the Irish Shelf and Porcupine Bank between June and March each year, and that large rorquals are largely absent from the Irish EEZ in the months of April and May.

Static passive acoustic survey methods provide a useful tool for determining temporal movements of large rorquals. However, as the SOSUS array does not cover the shallow waters of the Irish shelf, additional acoustic monitoring locations would enhance our knowledge of the temporal presence of large rorquals within the Irish EEZ.

There are limits in using acoustic methods to assess the abundance of migrating animals, as only vocalising males can be detected (Charif and Clark, 2009). Acoustic monitoring needs to be accompanied by appropriate visual surveys to assess animal abundance, group size and group composition. During a PReCAST visual survey along the slopes of the northwest Irish Shelf in September 2008, 39 large rorqual sightings were recorded in a three-day period, totalling 79 animals, indicating that substantial numbers of large rorquals were present in the area at that time.

Little is known of the relationship between the migratory large rorquals which occur annually along the Irish shelf slopes and the animals which forage in waters off the south coast each autumn and winter. The foraging and migratory periods overlap each other and both inshore and shelf edge animals appear to leave Irish waters between March and June each year. It may be that the waters of the south coast of Ireland act as a feeding ground for large rorquals migrating along the western shelf edge or the two events may be largely independent of each other. While it has been assumed that animals moving southwards along the shelf edge are migrating, both fin and blue whales have been observed feeding on krill in shelf slope waters (Wall *et al*, 2009). It is not known if shelf edge foraging occurs on an annual basis or is opportunistic and based on the occasional availability of krill biomass.

# 10 Recommendations on Future Cetacean Monitoring Effort on Board Platforms of Opportunity within the Irish EEZ

## 10.1 Introduction

One of the primary constraints on offshore monitoring effort is the costs involved. The reality for Ireland is that a vast expanse of marine habitat, in excess of ten times the area of our terrestrial habitat, must be monitored on an ongoing basis and an effective and cost efficient means of doing so must be designed. The main expense in any offshore cetacean survey is ship charter costs and in northwest Europe, the primary means of avoiding such expense is by utilising the many platforms of opportunity which exist in northwest European waters. These platforms range from commercial ferries to research vessels and naval (and fisheries) patrol vessels.

In Ireland, commercial ro-ro ferries offer a range of survey platforms, with regular transits taking place across fixed routes. However, ferries offer limited geographic coverage as they operate predominantly on the east coast and no ferry routes exist in the vast majority of Ireland's offshore habitats. Naval service vessels can prove excellent survey platforms and have been used during PReCAST and CMRC/PIP Surveys (O'Cadhla *et al*, 2004). Geographic coverage provided by naval patrols can be sporadic and may be strongly biased towards areas where commercial fisheries are in operation, with a corresponding bias in cetacean detections.

Research vessels perhaps offer the greatest potential as survey platforms. The large variety of Irish and EU research programmes which operate in Irish waters each year target many different offshore habitat types and offer the potential for greatest geographic coverage within the Irish EEZ. The use of research vessels as platforms also offers the potential to enhance the value of any cetacean distribution and abundance data collected as it may be combined with additional data collected during the host surveys to provide means of interpreting and enhancing both data sets (Wall *et al*, 2006). From a cetacean survey perspective, a number of host survey types may be prioritised in an effort to monitor cetaceans and their habitats:

1. Surveys which provide wide geographic coverage, enabling large areas to be covered in and efficient manner,
2. Surveys which target specific habitat types, such as deep water canyons which are associated with specific cetacean species and are often not assessed or targeted using wide-scale cetacean surveys,
3. Surveys which collect data of high value in the interpretation of habitat and resource use by cetaceans (e.g. fisheries surveys which target cetacean prey species).

## 10.2 Factors Affecting Offshore Survey Productivity

During PReCAST a total of 2,305 hours of survey effort was conducted in Beaufort Sea State 0-6. The highest amount of survey hours was logged in spring and the lowest in winter (figure 10.1). Survey hours per day-at-sea ranged from an average of 3.9 per day-at-sea in spring to 4.7 per day-at-sea in winter (figure 10.2). Average survey hours achieved per day-at-sea were affected by factors such as survey/patrol type, poor weather conditions (sea state 6+, very heavy swell or much reduced visibility) or vessels going to anchor/shelter. Despite the longer daylight hours during the spring and summer months, average survey hours per day-at-sea were below that achieved during autumn and winter surveys. This was predominantly due to a high proportion of ROV, oceanographic and benthic surveys being conducted during the calm summer months. During such surveys, the vessels remained static for extended periods. When the vessel was static for extended periods, a routine of visual sampling was generally conducted where surveyors would conduct effort for, for example, one hour in every three hours.

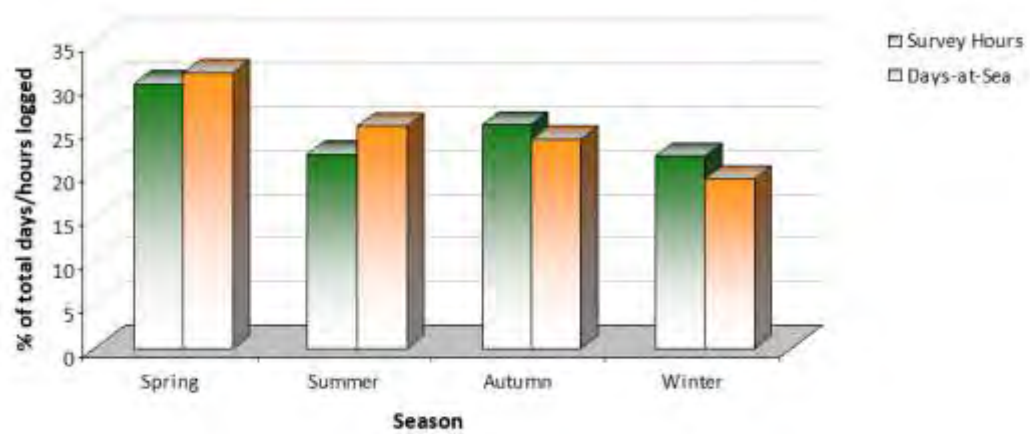



**Figure 10.1:** Survey hours and days-at-sea and per season as percentage of total survey hours/days-at-sea logged during PReCAST surveys

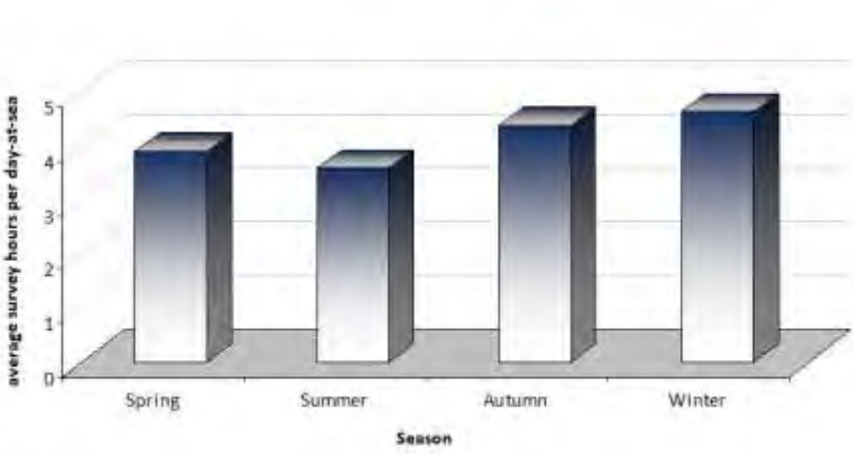



**Figure 10.2:** Average survey hours per day-at-sea per season logged during PReCAST

Survey hours per day-at sea varied with vessel activity (figure 10.3). Pelagic acoustic and trawl fish surveys resulted in the highest ratio of survey hours per day-at-sea, whereas naval patrols and demersal fisheries resulted in the lowest. The loss of survey productivity in naval patrols was primarily due to vessels going to anchor during periods of poor weather when boarding operations were not possible. This was compounded by the fact that naval patrols were largely utilised in the winter months when weather conditions were poor. Loss of productivity in demersal fishing surveys resulted from a number of factors, including poor weather conditions at the time of year when these surveys were conducted, and extended daytime periods of trawling at 3-4 knots, when effort sub sampling was often employed to reduce the risk of duplicate recording of sightings.

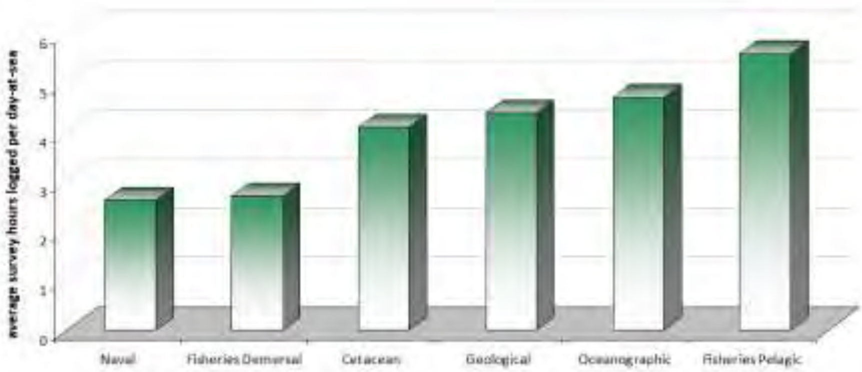



**Figure 10.3:** Average survey hours per day-at-sea (in sea state 0–6) achieved during PReCAST surveys, according to survey platform activity

## 10.3 Availability of Survey Platforms within the Irish EEZ

### 10.3.1 *Irish Research Vessels*

Of the two Irish state research vessels, the Celtic Explorer offers the most suitable platform for offshore survey, both in terms of survey area coverage and availability of berths. The Celtic Explorer has been extensively used under PReCAST, and by the IWDG under previous research programmes, as a survey platform. While previously she has conducted the majority of her survey programme in waters within or adjacent to the Irish EEZ, she is increasingly being chartered by overseas research groups with survey programmes in the North Sea and in Canada.

Between January 2009 and December 2011, the R.V. *Celtic Explorer* scheduled 685 survey days within or adjacent to the Irish EEZ. Survey types fell broadly into five survey categories: cetacean, pelagic fisheries, demersal fisheries, oceanographic and geological/ROV.
The majority of planned survey days (32%) were for pelagic fishing surveys targeting a pelagic schooling fish and mackerel eggs. Geological/ROV and demersal fishery surveys accounted for 48% of scheduled survey days, while oceanographic surveys and cetacean surveys accounted for 19.9% of planned survey days (figure 10.4).

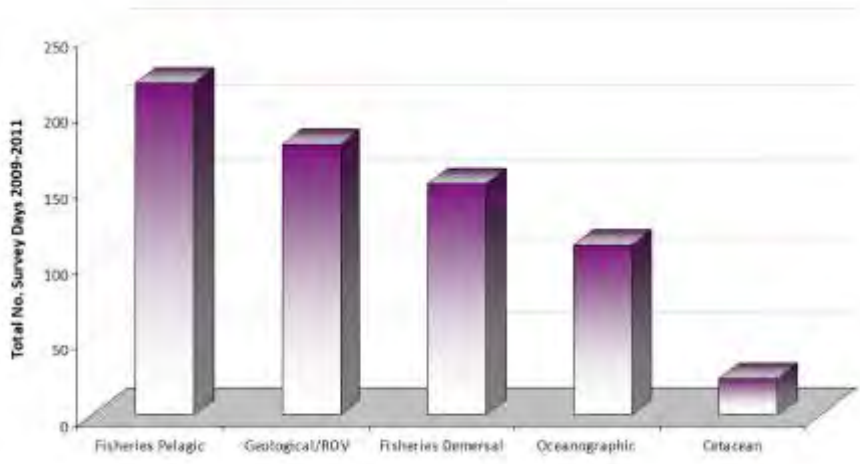



**Figure 10.4:** Total number of survey days scheduled for five survey types by RV *Celtic Explorer* from January 2009 – December 2011

### 10.3.2 *Foreign Research Vessels*

From January 2009 until September 2011, foreign research vessels scheduled 2,242 survey days where all or part of the survey falls within the Irish EEZ (figure 10.5). If only 20% of the planned survey days actually operate within the Irish EEZ, this still amounts to 448 days of foreign vessel survey effort within the Irish waters, though surveyors would have to remain on the vessel while it operated outside of Irish waters.

The majority of planned survey days (38%) was for demersal fishing surveys targeting a variety of fish species and including deep water trawl surveys. Oceanographic and pelagic trawl and acoustic surveys accounted for 54% of scheduled survey days, while geological/ROV surveys and cetacean surveys accounted for 8% of planned survey days (figure 10.5).

Recent moves toward a joint European Cetacean database to meet the demands of Favourable Conservation Status (FCS) reporting, primarily through the work of the Joint Cetacean Protocol (Thomas, 2009), need to be matched by a Europe-wide, standardised method of data collection and survey management. As many marine research surveys are now funded as part of EU multinational collaborative projects, it is commonplace for Irish and EU research vessels to conduct survey effort within the EEZ of more than one member state during any given survey. It would, therefore, make sense for monitoring of offshore habitats to be managed and funded on an EU level with coordinated targeting of survey effort by monitoring teams from coastal member states. This would help to avoid repetition of survey effort and help to achieve better temporal and spatial coverage of northwest European waters within each six-year reporting timeframe for FCS.

Such a network would need to use a standardised survey methodology that is adequate for determining the relative abundance and distribution of cetaceans but also gathers sufficient data to determine cetacean absolute abundance along the survey transect. An example of a Europe-wide monitoring network may be found in the Atlantic Research Coalition, a network of researchers conducting line transect survey effort to a similar methodology across northwest Europe (Brereton *et al* 2011).

If such a programme was to be established, a pool of experienced and calibrated surveyors would be required. Surveyors within this pool would be tested to determine a number of factors, including ability to detect sightings at a range of distances, ability to accurately record angle and distance measurements, and accuracy in species identification and group size estimates. Similar calibration tests were employed during the SCANS II and CODA surveys (Hammond 2006, Hammond *et al* 2010) with a view to minimising errors due to surveyor variability.

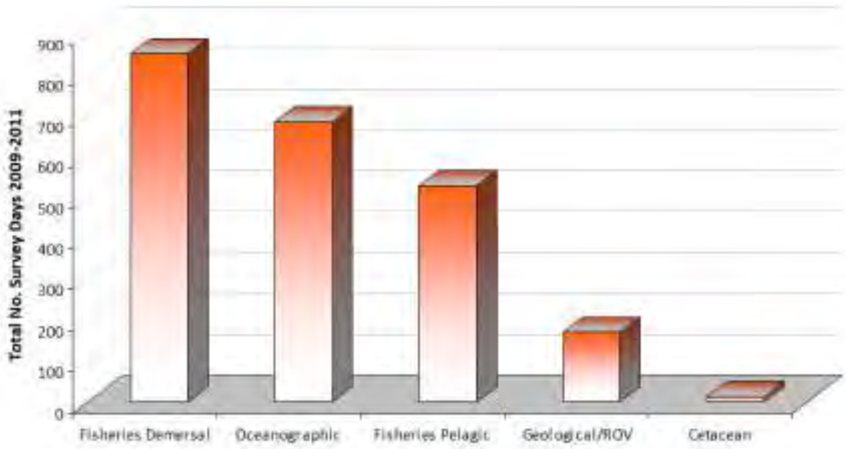



**Figure 10.5:** Total number of survey days scheduled for five survey types by foreign research vessels from January 2009 to September 2011

### 10.3.3 *Naval Service Patrol Vessels*

Irish naval service patrols operate on a year-round basis. Typical patrols last for four weeks. During PReCAST, Naval Service patrols were most frequently used in the winter months when the availability of suitable research vessels was low. Due to the fact that much of the Naval Service's time is spent conducting boarding operations of fishing vessels, naval service platforms may offer particularly useful platforms when assessing the impact of cetacean/fisheries interactions on cetacean species.

## 10.4 Potential for Spatial and Temporal Coverage of the Irish EEZ

Between January 2009 and December 2011, 3,019 survey days were scheduled by Irish and foreign research vessels for surveys planned to be partially or completely conducted within the Irish EEZ. A strong seasonal aspect was evident in the occurrence of different survey types. Pelagic fisheries surveys occurred predominantly in winter and spring, with little survey effort taking place in summer or autumn. Demersal fisheries surveys occurred in summer, autumn and winter, with low survey effort taking plce in spring. Oceanographic surveys occurred predominantly in spring, with lower survey effort taking place in summer and winter. Geological/ROV surveys occurred mainly in summer (figure 10.6).

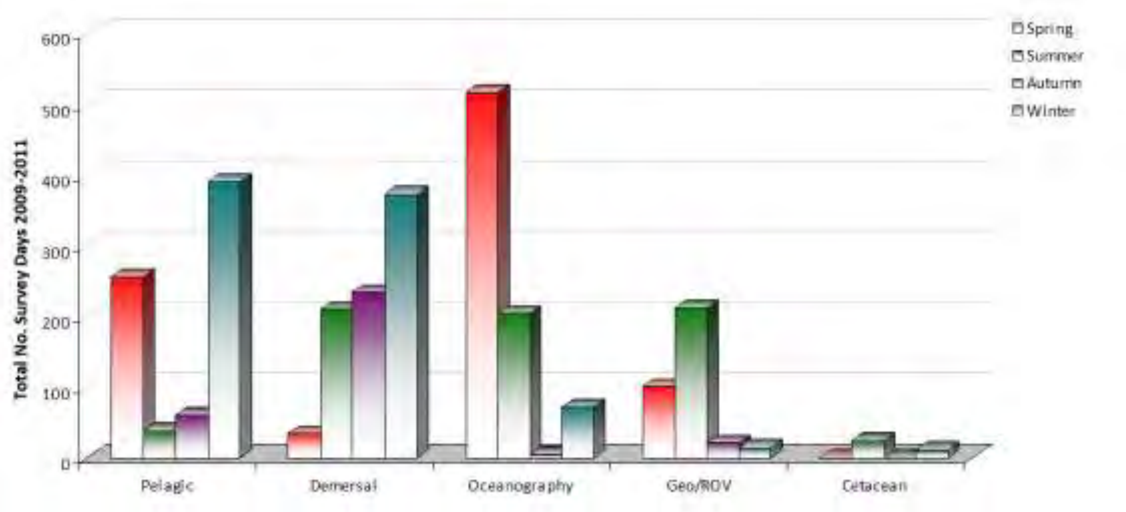



**Figure 10.6:** Total number of survey days per season scheduled for five survey types by Irish and foreign research vessels from January 2009 to September 2011
***(Spring**: Apr/May/Jun; **Summer**: Jul/Aug/Sep; **Autumn**: Oct/Nov/Dec; **Winter**: Jan/Feb/Mar.)*

Different survey types also tended to focus on different habitats (figure 10.7). For example, while pelagic fishery surveys targeted shelf and deep water habitats, demersal fishery surveys primarily targeted shallower continental shelf waters. From another standpoint, in order to survey Irish Sea habitats for cetaceans, one would have to target demersal fisheries and oceanographic surveys.

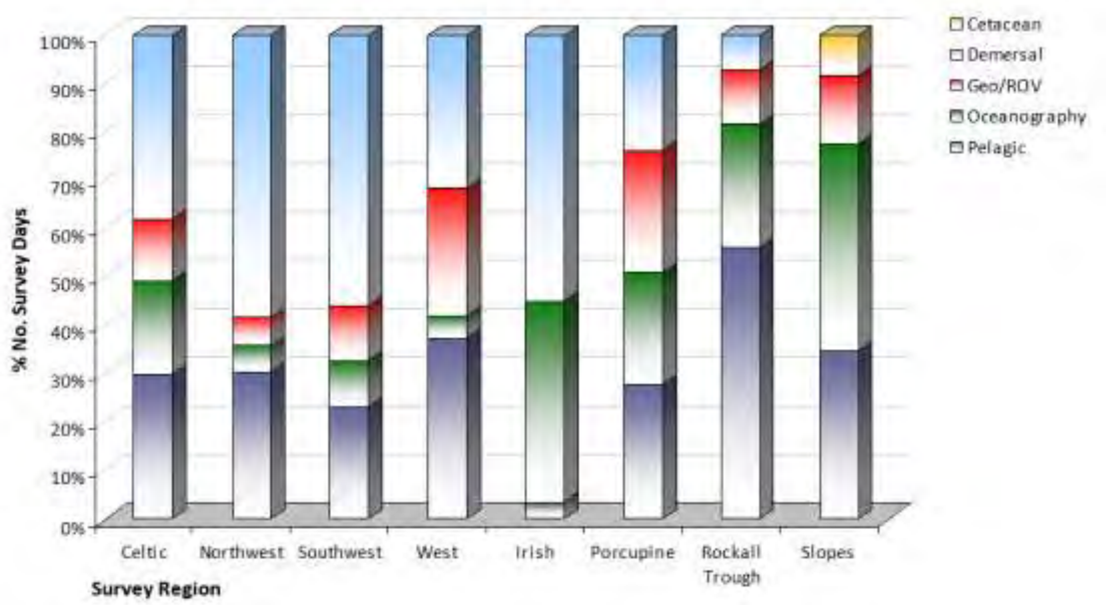



**Figure 10.7:** Proportion of survey days scheduled per survey region for five survey types by Irish and foreign research vessels from January 2009 to September 2011
***(Celtic**: Celtic Sea and south coast; **Northwest**: north and northwest continental shelf; **Southwest**: southwest continental shelf; **West**: western continental shelf; **Irish**: Irish Sea; **Porcupine**: Porcupine bank, seabight and abyssal plain; **Rockall Trough**: Rockall Trough and slopes of Rockall Bank; **Slopes**: continental shelf slopes.)*

## 10.5 Priority Platforms of Opportunity for Cetacean Monitoring

To provide a monitoring programme within the framework of the requirement for reporting on favourable conservation status of Irish cetacean species, no single survey or survey method will provide robust data on all cetacean species in Irish waters. Differences in species habitat preference, biology and behaviour and temporal variations in species habitat use and abundance mean that a suite of survey methods is required to collect adequate data to determine the FCS of cetacean species in Irish waters.

The prioritisation of survey effort on particular platforms will depend on conservation and monitoring priorities. However, in general, surveys may be targeted based on a list of priorities (table 10.1).

### 10.5.1 *Priority 1 Surveys*

Surveys which provide good spatial coverage of offshore habitats should be prioritised. Ideally surveys should be repeated on an annual basis. However, some wide-scale fisheries surveys are repeated on a biannual or triennial basis. The highest priority should be given to surveys which already have a cetacean baseline dataset available. A number of pelagic fishery acoustic and trawl surveys fall into this category:

1. **Southwest Herring Acoustic Survey**. This survey is conducted on an annual basis by the Marine Institute and covers waters over the Irish Shelf to the southwest and south of Ireland in October. The IWDG and PReCAST have conducted line transect surveys for cetaceans during the southwest herring acoustic survey since 2004. Data from the survey is being used to assess ecosystem links between foraging cetaceans, their prey and the ecosystem in which they are based.

2. **Northwest Herring Acoustic Survey**. This survey is conducted on an annual basis by the Marine Institute and covers waters over the Irish Shelf to the northwest of Ireland and west of Scotland in March and April. The IWDG and PReCAST have conducted line transect surveys for cetaceans during the 2004, 2007, 2009, 2010 and 2011 surveys. Though sightings rates are typically low, the survey offers good spatial coverage of northwest waters.

3. **Blue Whiting Acoustic Survey.** This survey is conducted on an annual basis by the Marine Institute and vessels from Norway, the Netherlands and Russia. The survey covers waters over the Irish shelf edge and to the west over the Rockall Trough,

Porcupine Bank, Porcupine Seabight and Rockall Bank, and occasionally further west to the Hatton Bank. The IWDG and PReCAST have conducted line transect surveys for cetaceans during the 2004, 2008 and 2011 Marine Institute surveys and during the 2009 Dutch survey. Species encountered are deep diving cetaceans, large rorquals and oceanic dolphins. Surveys on non-Irish research vessels target a greater proportion of the Irish EEZ as the Celtic Explorer typically covers the northern half of the survey area.

4. **Mackerel Egg Survey.** Conducted on a triennial basis, this is a multinational survey that conducts multiple transects throughout the Irish EEZ (excluding the Irish Sea) from March to July. As the survey is repeated across a number of months, the mackerel egg survey offers wider temporal coverage than other pelagic surveys. The survey covers a wide variety of shelf, slope and deep water habitats and species. Under PReCAST, researchers conducted cetacean surveys on board five separate mackerel egg surveys during 2010. The survey is due to be repeated in 2013.

### 10.5.2 *Priority 2 Surveys*

These are generally demersal trawl surveys which provide reasonable spatial coverage of habitats in seasons outside of those covered by the priority 1 surveys. Surveys are repeated on an annual basis. However, due to their nature, the geographic coverage provided during the survey is sporadic and vessel speeds tend to be low while the vessel is trawling. The highest priority should be given to surveys which already have a cetacean baseline dataset available. A number of pelagic fishery acoustic and trawl surveys fall into this category:

1. **Groundfish Survey:** This survey is conducted on an annual basis by the Marine Institute and covers waters over the entire Irish Shelf (excluding the Irish Sea) from September to December. Survey transects are sporadic as trawling is conducted throughout daylight hours. IWDG and PReCAST have conducted line transect surveys for cetaceans during the 2003, 2009 and 2010 groundfish surveys.

2. **CEFAS Groundfish Survey:** This survey is conducted on an annual basis by the Centre for Environment, Fisheries and Aquaculture Science (UK) and covers the Irish Sea and eastern Celtic Sea in November and December. Survey transects are sporadic as trawling is conducted throughout daylight hours. The IWDG conducted a line transect surveys for cetaceans during the 2010 CEFAS groundfish survey.

3. **Deep water Survey:** This survey was conducted on an annual basis by the Marine Institute and covered the northwest continental shelf slopes and north slopes of the Porcupine Bank in September. Spatial coverage was sporadic as trawling is conducted throughout daylight hours. Howeverc the survey is unique in focusing entirely on shelf slope habitat as well as canyon habitat. The survey also targets the main migratory period for large rorquals along the Irish Shelf edge and has yielded the highest number of beaked whale sightings of any surveys conducted in Irish waters. The IWDG conducted a line transect surveys for cetaceans during the 2006, 2007, 2008 and 2009 deep water surveys. The deep water survey was suspended in 2010 due to funding issues. However, it is expected to re-commence in future years.

4. **Oceanographic Survey:** This is an annual fixed transect survey conducted by the Marine Institute, , covering a transect from Galway Bay, across the Porcupine Bank and Rockall Trough before transiting the eastern slopes of the Rockall Bank and returning across the Rockall Trough and northwest Irish Shelf. Spatial coverage is confined to a fixed line transect, which is repeated each year in January or February. IWDG and PReCAST have conducted line transect surveys for cetaceans during the 2007 to 2011 oceanographic surveys (excluding 2008 when the survey was delayed).

#### 10.5.3 *Priority 3 Surveys*

Priority 3 surveys are those which target specific habitats, species or temporal period,s which are difficult to sample using other surveys. Examples may include specific deep water canyon surveys, one-off surveys offering wide spatial coverage within the Irish EEZ or surveys which offer a unique opportunity to collect data on a specific cetacean conservation issue or where a cetacean survey enhances, and is enhanced by, a multi-disciplinary ecosystem survey.

Additional platforms may need to be utilised in order to fill in spatial or temporal data gaps for the purposes of FCS reporting. In these cases, other platform types such as naval patrol vessels may need to be utilised.

In addition to the use of platforms of opportunity, targeted dedicated visual and acoustic surveys of specific species and habitats will be required to achieve specific conservation of monitoring goals, for example, for population counts, monitoring of habitat use by deep diving cetacean species and obtaining photo-ID and genetic samples for population assessment.

**Table 10.1:** Priority one and priority two platforms of opportunity and surveys to be utilised for ongoing cetacean monitoring within the Irish EEZ

| Survey Name | Repetition | Month | Target of Survey | Target cetacean species | Baseline Data Set | Additional data value |
|---|---|---|---|---|---|---|
| **Priority 1 Surveys** | | | | | | |
| **Southwest Herring Acoustic Survey** | Annual | October | Pelagic schooling fish: herring, sprat, mackerel | Foraging rorquals: minke, fin and humpback whales; common dolphins, harbour porpoise, oceanic dolphin species. | 2004 - 2010 | Ecosystem links between foraging rorquals and dolphin and their prey. |
| **Northwest Herring Acoustic Survey** | Annual | June | Pelagic schooling fish: herring, sprat, mackerel | Common dolphins, harbour porpoise, oceanic dolphin species. | 2004, 2007, 2009, 2010, 2011 | |
| **Blue Whiting Survey** | Annual | March/April | Blue whiting | Deep water species including sperm whale, large rorquals, beaked whales, pilot whales and oceanic dolphins. | 2004, 2008, 2009, 2011 | |
| **Mackerel Egg Survey** | Triennial | March – July | Mackerel eggs | All | 2010 x 5 | Wide temporal and spatial coverage. |
| **Priority 2 Surveys** | | | | | | |
| **Groundfish Survey** | Annual | September – December | All non-pelagic fish species | All shelf species | 2003, 2009, 2010 | |
| **CEFAS Groundfish Survey** | Annual | November – December | All non-pelagic fish species | All shelf species | 2010 | |
| **Deep water Survey** | Annual (suspended) | September | Deep water fish species | Beaked whales, large rorquals, sperm whales, pilot whales and oceanic dolphins. | 2006, 2007, 2008, 2009 | Unique coverage of slope and canyon habitat with potential for study of deep water prey species (cephalopods). |
| **Oceanographic Survey** | Annual | January or February | Oceanographic sampling | Primarily deep water species, large rorquals and oceanic dolphins. | 2007, 2009, 2010, 2011 | Fixed line transect survey. |

# 11 Survey and Data Storage Protocols

## 11.1 Visual Surveys on Platforms of Opportunity

### 11.1.1 *Visual Line Transect Survey Protocol*

The observer should conduct survey effort from either from the ship's bridge, the monkey island (the roof of the bridge) or from the crow's nest (e.g. on the R.V. *Celtic Explorer*). The survey station with the best all-round view should be used. Observer effort should focus on a 90 degree arc ahead of the ship (along the transect line). However, sightings located up to 90 degrees to port and starboard should also be included. Observers should scan the area by eye and using binoculars (typically 10X40 or 8X50). Bearings to sightings should be measured using an angle board and distances should be estimated with the aid of a range-finding stick (Heinemann, 1981).

Environmental data should be recorded every 15 minutes, preferably using Logger 2000 software (IFAW, 2000). Sightings should also be recorded using Logger 2000. Automated position data should be obtained through a laptop computer linked to a USB GPS receiver or NMEA feed from the ship's GPS. Survey effort should be conducted up to Beaufort sea-state 6 and in moderate to good visibility. Using vessels of opportunity, the survey will be conducted in 'passing mode' and cetaceans sighted are usually not approached. Sightings should be identified to species level where possible, with species identifications being graded as 'definite', 'probable' or 'possible'. Where species identification cannot be confirmed, sightings should be downgraded (e.g. unidentified dolphin / unidentified whale / unidentified beaked whale), according to criteria established for the IWDG's cetacean sightings database (IWDG, 2011).

The IFAW Logger data logging software, when connected to a GPS, will log positional and time/date information. The minimum environmental/effort data and sightings data required for cetacean visual line transect surveys are presented in tables 11.1 and 11.2.

**Table 11.1:** Minimum data required when logging survey and environmental effort for visual line transect survey

| Variable | Description | Units/Format | Mandatory? |
|---|---|---|---|
| **Date** | Current date | dd/mm/yyyy | Yes |
| **Vessel** | Name of ship/platform | text | Yes |
| **Observer Name(s)** | Name of each observer conducting survey effort | text | Yes |
| **Position on Ship** | Bridge, monkey island, crow's nest etc. | text | Yes |
| **Time** | Time environmental/effort record was taken | hh:mm | Yes |
| **Latitude** | Position (latitude) at which environmental/effort record was taken | dd.mm.ss | Yes |
| **Longitude** | Position (latitude) at which environmental/effort record was taken | dd mm.ss | Yes |
| **Course** | Ships course | degrees (true) | Yes |
| **Speed** | Ships speed | knots | Yes |
| **Sea State** | Beaufort sea state | Beaufort sea state 0– 12 | Yes |
| **Visibility** | Horizontal distance it is possible to see | code or kilometres | Yes |
| **Cloud** | Cloud cover | fractions of 8 (e.g. 2/8) | Yes |
| **Swell Height** | Height of swell from trough to peak | code or metres | Yes |
| **Wind Speed** | True wind speed | knots | No |
| **Wind Direction** | Direction wind is blowing from | degrees (true) | No |
| **Precipitation Type** | Rain, hail, snow, fog etc. | text | Yes |
| **Precipitation Intensity** | Degree of precipitation | code | Yes |

**Table 11.2:** Minimum data required when logging sightings for visual line transect survey.

| Variable | Description | Units/Format | Mandatory? |
|---|---|---|---|
| **Date** | Current date | dd/mm/yyyy | Yes |
| **Vessel** | Name of ship/platform | text | Yes |
| **Observer Name(s)** | Name of each observer conducting survey effort | text | Yes |
| **Position on Ship** | Bridge, monkey island, crow's nest etc. | text | Yes |
| **Start Time** | Time sighting was first noticed | hh:mm | Yes |
| **End Time** | Time sighting ended | hh:mm | No |
| **Latitude** | Position (latitude) at which environmental/effort record was taken | decimal degrees or dd mm.ss | Yes |
| **Longitude** | Position (latitude) at which environmental/effort record was taken | decimal degrees or dd mm.ss | Yes |
| **Sea State** | Beaufort sea state | Beaufort sea state 0– 12 | Yes |
| **Visibility** | Horizontal distance it is possible to see | code or kilometres | Yes |
| **Sighting Reference Number** | Unique identifier given to sighting | code | No |
| **Bearing (Angle)** | Bearing to sighting – centre of group or location of individual | degrees relative to ships course or true | Yes |
| **Distance** | Distance to sightings – location of individual or centre of group | metres | Yes |
| **Species** | Species common name or Latin name. In the event species cannot be identified, species sub-class according to IWDG Cetacean database protocol | text | Yes |
| **Certainty** | Confidence of species identification | definite, probable or possible | Yes |
| **Number** | Total number of animals sighted – figure should be a best estimate for the group. Do not give group size ranges | number | Yes |
| **Number Adults** | Total number of adult animals sighted (best estimate) | number | No |
| **Number Juveniles** | Total number of sub-adult animals sighted (best estimate) | number | No |
| **Number Calves** | Total number of calves sighted (best estimate) | number | No |
| **Behaviour** | Behaviour of animal(s) at time of sighting | code – more than one behaviour may be entered | No |

### 11.1.2 *Visual Line Transect Survey Data Storage and Archiving*

Visual line transect data collected during surveys on vessels of opportunity should be stored in digital format as Microsoft Excel™ or Microsoft Access™ files. Copies of the data should be stored on hard drive and backed up to at least one other hard drive in a separate physical location (e.g. PReCAST data is stored by the Galway-Mayo Institute of Technology and by the Irish Whale and Dolphin Group).

A further copy of the complete, cleaned dataset should be lodged with the National Biodiversity Data Centre (NBDC), which is located at Beechfield house, Carriganore WIT West Campus, Co Waterford. At the NBDC, the data will be stored as part of the Joint Irish Cetacean Database, which is planned as a repository for all past and future cetacean visual survey and sightings data collected in Ireland. The Joint Irish Cetacean Database is based on Recorder 6 software and has been designed to accommodate data from a variety of sources while ensuring that a minimum standard is adhered to for data entered to the database (table 11.3).

Metadata from the Joint Irish Cetacean Database will be available as online maps via the NBDC website. Requests for access to the original data can be made to the NBDC, who will then forward the request to the data provider. Access to the data will require agreement from the data provider and may be subject to a written data-sharing agreement and agreement on acknowledgement and joint authorship rights. Access to the original data may be refused based on projects or publications underway or planned by the data provider. It is likely that restriction of access rights by the data provider to data held at the NBDC will lapse after a fixed period, although this has yet to be clarified.

**Table 11.3:** Cetacean data dictionary for data providers supplying data to the Joint Irish Cetacean Database (© National Biodiversity Data Centre)

| Attribute name | Description | Format | Values | Import Notes | Prerequisites in Recorder Database |
|---|---|---|---|---|---|
| **Date*** | Date the animal was sighted | dd/mm/yyy | | Date format must be valid for Recorder to import | |
| **Record number/id** | Unique identifier for the sighting | Numeric | | | |
| **Record type** | Situation in which the record was taken | Drop down menu (ddm) | Stranding, sighting | This needs to contain a word or phrase describing the type of record, which may need to be split out from the sample type data if they have been lumped into one field | Record Type term for Stranding, Sighting. |
| **Sample type** | Method of taking the record | Drop down menu (ddm) | Transect, land-based timed watch, incidental | See above. Map the casual entry to Field Observation | Sample Type terms for line-transect, ship-transect, land-based timed watch, incidental, other boat survey, aerial survey. |
| **Survey title** | Title of the survey | Text | | Data will have to be split on this field, and imported one survey at a time. Surveys should have the keyword 'Cetaceans' attached | There should be a survey keyword –'Cetaceans'. |
| **Species*** | Latin name, e.g. *Delphinus delphis* | Text | | This could be a higher taxon for uncertain determinations? Match to species using the checklist matching page | A species dictionary with all required cetacean species. |
| **Time of day** | Time of day the animal was sighted | hh:mm in local time | | The effort data gives the start time of the whole transect. The individual records can each have their own precise time and will then be placed into separate samples | |
| **Latitude*** | Latitude in decimal degrees | Alphanumeric | | Values should be decimal, not minutes/seconds, and joined with the longitude into a single field lat, long | |
| **Longitude*** | Longitude in decimal degrees | Alphanumeric | | Values should be decimal, not minutes/seconds, and joined with the latitude into a single field lat, long | |
| **Observer name** | Observer's first name, initial and surname | Text | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Observer code** | Code representing the observer | Text | | If an observer is represented as a code, then the individual should be added to Recorder's Names and Addresses screen and the Import Wizard matching facility used to link it to the code. Note that if the same code is used in subsequent imports for different people, Recorder will try to do the original match so care needs to be taken! | |
| **Most common behaviour** | The primary activity of the animal at the time the sighting was recorded | ddm | Surfacing, Slow swim, Fast swim, Blow, Feeding, Breach, Tail slap, Spy Hopping, Bow riding, Logging, Sexual, Aggression, None, Milling, Fluke | The data will have to be pre-processed to ensure that all the categories match | Measurement Type – Behaviour (for Taxon Occurrence). Qualifier – Animal's main activity, Unit – Category (text) with allowable values matching list under Values column. |
| **Second most common behaviour** | The secondary activity of the animal at the time the sighting was recorded | ddm | Surfacing, Slow swim, Fast swim, Blow, Feeding, Breach, Tail slap, Spy Hopping, Bow riding, Logging, Sexual, Aggression, None, Milling, Fluke | The data will have to be pre-processed to ensure that all the categories match | Measurement Type – Behaviour (for Taxon Occurrence). Qualifier – Animal's secondary activity. Unit – Category (text) with allowable values matching list under Values column. |
| **Other behaviour** | Text description of behaviour, if not in one of selected categories | Alphanumeric | Anything not in the above lists | Use this field only when data in a behaviour column cannot be allocated to one of the categories | Measurement Type – Behaviour (for Taxon Occurrence). Qualifier – Animal |
| **Cue** | The trigger for the observation – i.e. blow, circling seabirds, etc. | Text | | Max 20 characters, although this may be enhanced in a future version of Recorder | Measurement Type – Cue (for Taxon Occurrence). Qualifier – Observation. Unit = Description (text). |
| **School size** | Number of animals in the group | Numeric | | An exact number, or specify a range when you are unsure | Already present. |

| | | | | | |
|---|---|---|---|---|---|
| **Number of adults** | Number of adults in the group | Numeric | | | Already present. |
| **Number of juveniles** | Number of juveniles in the group | Numeric | | | Already present. |
| **Direction travelling** | Direction the animal(s) were travelling | Numeric | degrees | The direction of travel for both vessel and animal should be stored as degrees (of 360). Typically compass readings are from ships gyro-compass which reads True North (rather than magnetic north). Directions of travel given as N,S,E,W etc. need to be converted to degrees. | Measurement Type – Direction (for Taxon Occurrence). Qualifier – Animal Travel. Unit – degrees (number). |
| **Sighting distance** | Distance of animal(s) from observer | Numeric | km or m | | Measurement Type – Distance (for Taxon Occurrence). Qualifier – Sighting. Unit – m or km (number) |
| **Course of vessel** | Course of the vessel | Numeric | degrees | The direction of travel for both vessel and animal should be stored as degrees (of 360). Typically compass readings are from ships gyro-compass which reads True North (rather than magnetic north). Directions of travel given as N,S,E,W etc. need to be converted to degrees. | Measurement Type – Direction (for Sample). Qualifier – Vessel Travel. Unit – degrees (number). |
| **Speed of vessel** | Speed of the vessel | Alphanumeric | | | Measurement Type – Speed (for sample). Qualifier – Vessel Travel. Unit – knots (number). |
| **Photo ID** | ID of the photo associated with the sighting | Alphanumeric | | | Measurement Type – Identifier (for Taxon Occurrence). Qualifier – Photo. Unit – ID (text). |
| **Animal ID** | Individual ID number for that animal | Alphanumeric | | | Measurement Type – Identifier (for Taxon Occurrence). Qualifier – Animal Unit – ID (text). |

| | | | | | |
|---|---|---|---|---|---|
| **Mean length** | Mean length of the animal | Numeric | m | Why is this mean length? Is it the mean of the entire pod? | Measurement Type – Length (for Taxon Occurrence). Qualifier – Animal Unit – m (number). |
| **Time at start** | Time at start of the transect or timed watch | Time | | Where there is effort data, this should also be imported, and additionally a species added to the imported row for Cetacean, Count=0, Taxon Occurrence Comment = "Observation created to allow effort based transect data to be imported." When the effort data contains measurements that should be also available as part of the observation record (e.g. sea state if this was not recorded with the observation), then before importing the effort, data needs to be joined with the sightings data to put the data into a single row for import. The sighting should be joined to the previous effort record. | |
| **Sample duration** | Number of minutes watched during which the observation was made | Numeric | | If necessary data should be changed to duration in minutes rather than "Time at End" for consistency.. | |
| **Latitude at start** | Latitude in decimal degrees | Numeric | | Lat and Long should be joined into one field with a comma. Where there is either start and end data, or effort data along the transect, these should be represented on separate rows in the import spreadsheet with a null observation attached. See time at start for more information. | |
| **Latitude at end** | Latitude in decimal degrees | Numeric | | | |
| **Longitude at start** | Longitude in decimal degrees | Numeric | | | |
| **Longitude at end** | Longitude in decimal degrees | Numeric | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Transect width** | Width of the recording transect | Numeric | m | | Measurement Type – Width (for Sample). Qualifier – Transect. Unit – m (number). |
| **Sea state (Beaufort)** | Condition of the sea surface with respect to waves and swell | ddm | Beaufort wind force scale | Limit to exact values on Beaufort scale | Measurement Type – State (for Sample). Qualifier – Sea. Unit – Beaufort (number). Set up list of allowed values for each value on Beaufort scale. |
| **Visibility** | Distance the observer could see | Numeric | km | | Measurement Type – Visibility (for Sample). Qualifier – Atmosphere. Unit – km (number). |
| **Glare** | amount of view obscured by glare (degrees) | Numeric | degrees | We generally only record visibility, though other record glare. The value applies to each environmental station (in IWDG data this is every 15– 30 mins) or when that value changes (at which point another environmental effort station is logged). As far as I can recall in ESAS data they log environment at the start and end of the transect, when a course change is logged or if the environment changes significantly. | Measurement Type – View (for Sample). Qualifier – Obscured by Glare. Unit – Degrees (number). |
| **Swell height** | Height in metres of the sea swell | ddm | Light (0–1m), Moderate (1–2m), Heavy (2m+) | | Measurement Type – Swell (for Sample). Qualifier – Sea. Unit – Category (text, set up allowed values for items listed in Values column or just Light, Moderate, Heavy). |
| **Wind force** | Description of wind speed based on sea conditions | ddm | Beaufort wind force scales | | Measurement Type – Force (for Sample). Qualifier – Wind. Unit – Beaufort (number). |

| | | | | | |
|---|---|---|---|---|---|
| **Wind Direction** | Direction of the wind | ddm | Compass bearing – eight points | | Measurement Type – Direction (for Sample). Qualifier – Wind. Unit – Compass point (text. Set up allowed values N, NE, E, SE, S, SW, W and NW). |
| **Cloud cover** | The fraction of the sky obscured by clouds | ddm* | | Recorded as a score of 8, with 0 being completely clear skies and 8 being completely overcast. | Measurement Type – Coverage (for Sample). Qualifier – Cloud. Unit – 0–8 (number, set up allowed values 0 to 8). |
| **Precipitation type** | Type of precipitation | ddm* | Sleet, None, Rain, Hail, Fog/Mist, Snow | | Measurement Type – Form (for Sample). Qualifier – Precipitation. Unit – Category (text, set up allowed values for entries in Values column). |
| **Precipitation intensity** | Approximate rate of the fall of precipitation | ddm* | Intermittent Heavy, Continuous Heavy, Intermittent Light, Continuous Light | | Measurement Type – Rate (for Sample). Qualifier – Precipitation. Unit – Category (text, set up allowed values for entries in Values column). |
| **Platform type** | Type of platform from which the observation was made, e.g. cliff, ship, oil rig | ddm* | Small boat/RIB, ship, rig/platform, land | | Measurement Type – Form (for Sample). Qualifier – Platform. Unit – Category (text, set up allowed values for entries in Values column). |
| **Platform Name** | This should be the name of the vessel or other platform (e.g. oil rig) used to collect the data and will enable data on height of observer to be calculated. | Alphanumeric | | | Measurement Type – Name (for Sample). Qualifier – Platform or Vessel. Unit – Text (text). |
| **Observation height** | Height of platform above sea level | Numeric | m | | Measurement Type – Height (for Sample). Qualifier – Platform. Unit – m (number). |

| | | | | | |
|---|---|---|---|---|---|
| **Angle/Bearing** | Angle from the observer of the animal | Numeric | degrees | The angle from observer to sighting should be recorded as a true bearing in degrees. This means data needs to be converted as most observers will use an angle board and the true bearing is related to the direction of ships travel. E.g. our bearings to sightings are recorded as degrees 0–180 with 90deg being 'dead ahead' and 180deg being 90deg to starboard. Essentially all these conversions need to be done prior to the date being entered to the database. I will endeavour to do this for our data but it would be good if we could write a macro for doing this in Excel or incorporate into the DB a way of converting angle readings from relative to true angle. | Measurement Type – Bearing (for Sample). Qualifier – Observer to Sighting. Unit – degrees (number). |
| **Water depth** | | | m | | Measurement Type – Depth. Qualifier – Sea Bed. Unit – m (number). |
| **Sea Surface Temperature** | Temperature of the sea surface. | Numeric | Celsius | | Add qualifier for Sea surface to existing measurement type Temperature. |
| **Vessel activity** | Description of vessel activity in the vicinity | Alphanumeric | | | Measurement Type – Activity. Qualifier – Vessels. Unit – Description (text) |

## 11.2 Aerial Surveys on Platforms of Opportunity

### 11.2.1 *Aerial Survey Protocol*

Two observers should accompany the Air Corps Maritime Squadron patrol flight. Patrols are conducted on board one of the Maritime Squadrons' two CASA CN 235 maritime patrol aircraft. One observer should be positioned in the cockpit and record positional and environmental data using the aircraft's cockpit instrument gauges. This observer should also opportunistically record sightings through the aircraft's cockpit windows. The second observer should survey for cetaceans from one of the aircraft's two bubble windows.

Due to the difficulty in detecting cetaceans at the surface when wave clutter is present, aerial surveys should be conducted only when sea conditions are forecast at sea state two or less.

Survey effort should focus from an angle of 10 degrees from vertical to 45 degrees from vertical. Sightings made by the bubble window observer should be logged using a handheld GPS unit. This unit also records the altitude of the aircraft at the time each sighting is made. The minimum environmental/effort data and sightings data required for aerial surveys are presented in tables 11.4 and 11.5.

It has been highlighted in section 6.3.3 that the value of the data collected may be increased by developing these survey methods and the technologies used. The addition of a computerised and fully automated logging system to collect the exact position, speed and altitude of the aircraft at all times would be hugely beneficial. The use of continuous HD video recording to monitor a transect strip would help overcome problems encountered in the estimation of group sizes and the identification of species due to the flight speed of the aircraft.

**Table 11.4:** Minimum data required when logging survey and environmental effort for aerial surveys on board platforms of opportunity

| Variable | Description | Units/Format | Mandatory? |
|---|---|---|---|
| **Date** | Current date | dd/mm/yyyy | Yes |
| **Aircraft** | Identity or Call Sign of aircraft | text | Yes |
| **Observer Name(s)** | Name of each observer conducting survey effort | text | Yes |
| **Position on Aircraft** | Position of each observer – cockpit, bubble window etc. | text | Yes |
| **Time** | Time environmental/effort record was taken | hh:mm | Yes |
| **Latitude** | Position (latitude) at which environmental/effort record was taken | Decimal degrees or dd mm.ss | Yes |
| **Longitude** | Position (latitude) at which environmental/effort record was taken | Decimal degrees or dd mm.ss | Yes |
| **Altitude** | Aircraft's altitude | Feet or metres | Yes |
| **Course** | Ship's course | Degrees (true) | Yes |
| **Speed** | Ship's speed | Knots | Yes |
| **Sea State** | Beaufort Sea State | Beaufort Sea State 0– 12 | Yes |
| **Visibility** | Horizontal distance it is possible to see | Code or kilometres | Yes |
| **Cloud** | Cloud cover | Fractions of 8 (e.g. 2/8) | Yes |
| **Cloud Base Height** | Height of cloud base | Feet or metres | Yes |
| **Swell Height** | Height of swell from trough to peak | Code or metres | Yes |
| **Wind Speed** | True wind speed | Knots | No |
| **Wind Direction** | Direction wind is blowing from | Degrees (true) | No |
| **Precipitation Type** | Rain, Hail, Snow, Fog etc. | Text | Yes |
| **Precipitation Intensity** | Degree of precipitation | Code | Yes |

**Table 11.5:** Minimum data required when logging sightings during aerial surveys on board platforms of opportunity.

| Variable | Description | Units/Format | Mandatory? |
|---|---|---|---|
| **Date** | Current date | dd/mm/yyyy | Yes |
| **Aircraft** | Identity or Call Sign of aircraft | text | Yes |
| **Observer Name(s)** | Name of each observer conducting survey effort | text | Yes |
| **Position on Aircraft** | Position of each observer – cockpit, bubble window etc. | text | Yes |
| **Sighting Time** | Time sighting was perpendicular with the centre line on the bubble window | hh:mm | Yes |
| **Latitude** | Position (latitude) at which environmental/effort record was taken | Decimal degrees or dd mm.ss | Yes |
| **Longitude** | Position (latitude) at which environmental/effort record was taken | Decimal degrees or dd mm.ss | Yes |
| **Altitude** | Aircraft's altitude at time of sighting | Feet or metres | Yes |
| **Waypoint Number** | GPS Waypoint Reference if used – Lat/Long data must be extracted and entered in the database when processing survey data. | Number | No |
| **Declination** | Angle of declination to sighting from bubble window | Degrees | Yes |
| **Species** | Species common name or Latin name. In the event species cannot be identified, enter species sub-class according to IWDG Cetacean database protocol. | Text | Yes |
| **Certainty** | Confidence of species identification | Definite, probable or possible | Yes |
| **Number** | Total number of animals sighted – figure should be a best estimate for the group. Do not give group size ranges. | Number | Yes |
| **Number Adults** | Total number of adult animals sighted (best estimate) | Number | No |
| **Number Juveniles** | Total number of sub-adult animals sighted (best estimate) | Number | No |
| **Number Calves** | Total number of calves sighted (best estimate) | Number | No |
| **Behaviour** | Behaviour of animal(s) at time of sighting | Code – more than one | No |

| | | | |
|---|---|---|---|
| | | behaviour may be entered | |
| **Reaction to Aircraft** | Behavioural reaction to the aircraft (if any) | Code | No |

### 11.2.2 *Aerial Survey Data Storage and Archiving*

Aerial survey data should be stored in digital format as Microsoft Excel™ files. The original GPS data are stored as Garmin Mapsource™ files. Copies of the data should be stored on hard drive and backed up to at least one other hard drive in a separate physical location (e.g. PReCAST data is stored by the Galway-Mayo Institute of Technology and by the Irish Whale and Dolphin Group).

A further copy of the complete dataset may be lodged with the National Biodiversity Data Centre (NBDC). In order to lodge aerial survey data in the Joint Irish Cetacean Database at the NBDC, the database needs to be adapted to add additional data columns for altitude, cloud base height, angle of declination and reaction to the aircraft.

# 12 RECOMMENDATIONS

## Recommendation 1 – *Survey Method*

Species specific detection distances recorded during PReCAST (see section 4.27.1) raises the question of the appropriateness of using incidental cetacean sightings during seabird surveys as a method of monitoring cetacean species. In view of the ongoing use of ESAS survey methods for cetacean monitoring and the amalgamation of data sets using dedicated cetacean survey methods and seabird survey methods, a robust and independent scientific assessment of cetacean detection rates by dedicated line transect survey methods (e.g. IWDG/PReCAST and ARC) versus ESAS survey methods should be conducted. The study should provide assessment of 1) sightings detection rates per km/hr of both survey methods, 2) differences in the species specific detection rates by both survey methods. We recommended that dedicated cetacean line transect surveys are the most appropriate method of recording cetacean occurrence and density.

## Recommendation 2 – *Minimising Observer Effects*

Data on differences in observer sightings detection rates indicate a need for the use of experienced and preferably calibrated observers when conducting marine mammal monitoring programmes. The establishment of a calibrated marine mammal observer panel for conducting monitoring contracts in Irish waters should be considered. An approved training system for new observers coupled with opportunities for observers to gain at-sea experience is also desirable.

## Recommendation 3 – *Priority Surveys for Future Survey Effort*

### *Priority One*

Surveys on platforms of opportunity which provide good spatial coverage of offshore habitats should be prioritised for future survey effort. Ideally surveys should be repeated on an annual basis. However, some wide-scale fisheries surveys are repeated on a biannual or triennial basis. The highest priority should be given to surveys which already have a cetacean baseline dataset available. These priority one surveys are listed in section 10.5.1 of this report.

### *Priority Two*

Demersal trawl surveys which provide reasonable spatial coverage of habitats in seasons outside of those covered by the priority one surveys should also receive high priority for future survey effort. The highest priority should be given to surveys which already have a cetacean baseline dataset available. A number of pelagic fishery acoustic and trawl surveys fall into this category and are listed in section 10.5.2 of this report.

***Priority Three***

Surveys which target specific habitats, species or temporal periods which are difficult to monitor using other survey platforms should also be prioritised. Examples may include specific deep water canyon surveys, one-off surveys offering wide spatial coverage within the Irish EEZ or surveys which offer a unique opportunity to collect data on a specific cetacean conservation issue or where a cetacean survey enhances (and is enhanced by) a multi-disciplinary ecosystem survey.

***Filling Data Gaps***

Other platform types, such as naval patrol vessels, should be utilised in order to fill in spatial or temporal data gaps for the purposes of FCS reporting.

### **Recommendation 4** – *Detecting Seasonal Changes in Distribution and Abundance*

As many cetacean species in Irish waters exhibit seasonal changes in abundance and distribution, any planned cetacean monitoring programmes for the Irish EEZ and for EU waters should collect sufficient data to enable seasonal changes in species abundance and distribution within the given survey area to be assessed.

### **Recommendation 5** – *Targeted Surveys for Conservation and Monitoring*

Targeted dedicated surveys of specific cetacean species and habitats should be used to contribute to defined conservation and monitoring goals, e.g. population estimates, monitoring of habitat use by deep diving cetacean species and photo-ID and genetic sampling for population assessment.

### **Recommendation 6** – *Development of Collaboration with Air Corps Maritime Patrol*

The feasibility of fitting a GPS position and altitude data logging system coupled to a HD Video Camera and data recorder on board the two Air Corps Maritime Squadron CASA CN 235 aircraft should be examined. Such a system would provide a cost-effective method for collecting continuous cetacean and seabird distribution, and relative abundance data within the Irish EEZ.

As in the case of the aerial cetacean and seabird survey of the oil spill area off southwest Ireland conducted by PReCAST and reported to NPWS in 2009, the use of trained observers on board Air Corps patrol flights offers an opportunity for the rapid assessment of the impacts of incidents such as pollution on marine mammals and seabirds in offshore habitats at minimal cost.

## **Recommendation 7** – *Species Specific Recommendations*

### *Bottlenose Dolphins*

A targeted survey of offshore bottlenose dolphin habitat within the Irish EEZ should be conducted, with the primary aims of:

- Obtaining photo-identification images for comparison with Irish coastal and estuarine photo-identification catalogues and EU photo-identification catalogues,
- Collecting biopsy samples for genetic comparison with coastal and estuarine populations,
- Providing an absolute abundance estimate of the population of bottlenose dolphins in Irish offshore waters,
- Gathering acoustic recordings of offshore bottlenose dolphin vocalisations for comparison with coastal and estuarine populations.

Such a survey should preferably be conducted from a sailing vessel to ensure high quality acoustic data and due to noted avoidance of large survey vessels by offshore bottlenose dolphins (see section 8.5).

### *White-beaked Dolphins*

The range of white-beaked dolphins in Irish waters should be re-assessed, based on sightings and strandings data collected within the past 5-6 years, which suggests a northward contraction of the range of this species in Irish waters.

### *Humpback Whale and Fin Whale*

In light of the increasing numbers of humpback and fin whales using waters off the south coast of Ireland as a seasonal foraging ground, the identification by genetic or other means of the stock from which Irish humpback and fin whales originate should be prioritised.

## **Recommendation 8** – *Data Archiving*

A copy of all future cetacean survey and monitoring data funded by the State and a copy of all past publicly funded cetacean survey data should be lodged with the National Biodiversity Data Centre.

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# APPENDIX

Common and species names used in text



Herring (*Clupea harengus*)

Sprat (*Sprattus sprattus*)

Northern krill (*Meganyctiphanes norvegica*)

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