

SUMMER DISTRIBUTION AND RELATIVE ABUNDANCE OF CETACEANS OFF THE WEST COAST OF IRELAND

Dave Wall, Joanne O'Brien, John Meade and Brendan M. Allen

ABSTRACT

From May to September 2004 a survey of cetacean distribution and relative abundance was conducted on board a 'ship of opportunity'—a vessel used as a survey platform but not chartered for this purpose—off the west coast of Ireland. In total, 508 hours of survey effort were completed, with 304.2 hours in Beaufort sea-state 3 or less. Two hundred and thirty one sightings of eight species—common dolphin *Delphinus delphis* (L.), Atlantic white-sided dolphin *Lagenorhynchus acutus* (Gray), bottlenose dolphin *Tursiops truncatus* (Montagu), harbour porpoise *Phocoena phocoena* (L.), Risso's dolphin *Grampus griseus* (Cuvier), pilot whale *Globicephala melas* (Traill), minke whale *Balaenoptera acutorostrata* (Lacepede) and fin whale *Balaenoptera physalus* (L.)—were recorded, totalling 2,933 individuals. The greatest diversity and relative abundance were recorded on the Rockall Bank where Atlantic white-sided dolphin was the most abundant species. The common dolphin was the most abundant species recorded on the continental shelf to the south-west of Ireland, while the relative abundance of cetaceans off the north coast was very low. The data suggest that cetacean species composition and relative abundance can vary greatly between adjacent marine habitat types and over relatively small geographical distances.

D. Wall
(corresponding
author; e-mail:
dave.wall@iwdg.ie)
J. O'Brien, J. Meade
and B.M. Allen, Irish
Whale and Dolphin
Group, Merchants
Quay, Kilrush, Co.
Clare.

INTRODUCTION

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

Despite this recognition, information on the distribution and relative abundance of cetaceans within the Irish EEZ, especially in offshore waters, is very limited. Dedicated surveys that aimed to derive absolute abundance are limited to a 1994 survey of the Celtic Sea (Hammond *et al.* 1995) and an area covering the Irish shelf edge, Rockall Trough and Porcupine Bank in 2000 (Ó Cadhla *et al.* 2004). Gordon *et al.* (1999) carried out a dedicated visual and acoustic survey off the north-west coast in 1993; however, abundance estimates were not calculated. Leopold *et al.* (1992) derived an abundance estimate for harbour porpoise on a 'ship of opportunity' (ShOp) during a fisheries cruise along the south-west coast of Ireland. A

number of studies onboard 'ships of opportunity' have presented maps of the distribution of cetaceans in Irish waters (Northridge *et al.* 1995; Pollock *et al.* 1997; Berrow *et al.* 2001; Reid *et al.* 2003; Ó Cadhla *et al.* 2004). However, despite these surveys, many gaps in coverage still exist, especially off the north-west coast and in all waters outside of the summer months. Published distribution maps are therefore only indicative. There is an urgent need for more accurate data on the distribution and abundance of cetaceans in Irish waters in order to comply with a number of EU and International Directives (e.g. EU Habitats Directive 1992 (European Union 1992), OSPAR Convention 1992 (OSPAR 1998), EU Council Regulation 812/2004 Concerning Small Cetacean Bycatch (European Union 2004)) and national conservation initiatives (e.g. National Biodiversity Plan (DAHGI 2002)).

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

Received 17 January
2005. Accepted 14
February 2006.
Published 31 July
2006.

This survey is the first extensive cetacean relative abundance and distribution survey conducted by the IWDG off the Irish west coast and provides data on cetaceans from waters off the north coast that have been particularly under-recorded to date. Here we present data on the distribution and relative abundance of all cetacean species recorded in the survey areas from May to September 2004.

MATERIALS AND METHODS

The survey was conducted on board the R.V. *Celtic Explorer* as an ancillary project of the National Seabed Survey (Geological Survey of Ireland 2004) between 11 May and 23 September 2004. The survey area covered three distinct geographical regions: the southern Rockall Bank (Area 1), the north Donegal/Derry coast (Area 2) and the Irish shelf from County Clare to County Cork (Area 3) (Fig. 1). The survey areas were opportunistic and based on predetermined locations chosen by the Geological Survey of Ireland (GSI) for the 2004 seabed survey.

A single marine mammal observer was carried on each leg of the survey and conducted watches from the 'crow's nest' located above the bridge, 18m above sea level. 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 10 × 50 binoculars. Bearings to sightings were measured using an angle board and distances were estimated with the aid of reticule binoculars. 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 Garmin® GPS 72.

The survey vessel travelled at an average speed of 9 knots (16.8km hr⁻¹) and followed track lines selected for multibeam surveys of the seabed. Distance between track lines was based on the swath width and depth of water (O'Brien *et al.* 2005). Surveying was conducted up to Beaufort sea-state 6 and in moderate to good visibility. As this was a survey onboard a vessel 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.

Only definite and probable species identifications were used in the analysis. Where species identification could not be confirmed, sightings were downgraded to unidentified dolphin or unidentified whale. For relative abundance calculations, only sightings collected in

Beaufort sea-state 3 or less and visibility of 5km or more were included in the analysis. Due to the nature of the geological survey, the speed of the vessel varied during the survey (e.g. when deploying or retrieving gear), the ship was stationary at times (e.g. when conducting grab samples) and it also sometimes conducted short and tight survey lines, which meant the vessel remained within a small geographical area for prolonged periods. For these reasons, relative abundance was calculated as the number of animals encountered per hour of survey time, rather than per unit area (Reid *et al.* 2003). The depth of water in which each sighting occurred was obtained from Garmin Mapsource® navigation software.

RESULTS AND DISCUSSION

A total of 508 hours of survey effort was recorded with 304.2 hours (59.9%) in Beaufort sea-state 3 or less (Fig. 1). The probability of detecting species of small cetacean decreases significantly in sea-states greater than Beaufort 3 (Hammond *et al.* 2002). A total of 231 sightings of eight cetacean species were recorded (Table 2), totalling 2,933 individuals. Possible sightings of a group of white-beaked dolphin (*Lagenorhynchus albirostris*, Gray), a northern bottlenose whale (*Hyperoodon ampullatus*, Forster) and a humpback whale (*Megaptera novaeangliae*, Lesson) were also made. For 35.9% of sightings, identification to species level was not possible. Such sightings were recorded as either unidentified dolphin species (73 sightings) or unidentified whale species (10 sightings).

The common dolphin was the most frequently sighted cetacean species over the continental shelf off the south-west coast (Fig. 2), where an encounter rate of 7.99 animals per hour (aph) was recorded. No common dolphins were recorded off the north coast and only three sightings of this species were made over the Rockall Bank. Group size ranged from 1–300 animals with a mean of 20 (SD = 41.3), with larger groups consisting of associations of smaller groups of animals. In such 'super-groups' it was not possible to distinguish where one group ended and the next began and so numbers were summed. On six occasions calves or juveniles were noted among groups. Sightings of common dolphins occurred in water depths in the range 51–260 m, with a mean depth of 126.4 m (SD = 44.9). The results presented here are consistent with previous studies, which have shown that common dolphins are mainly distributed off the south and west coasts, with few sightings off the north or east coasts (Berrow *et al.* 2001; Reid *et al.* 2003).

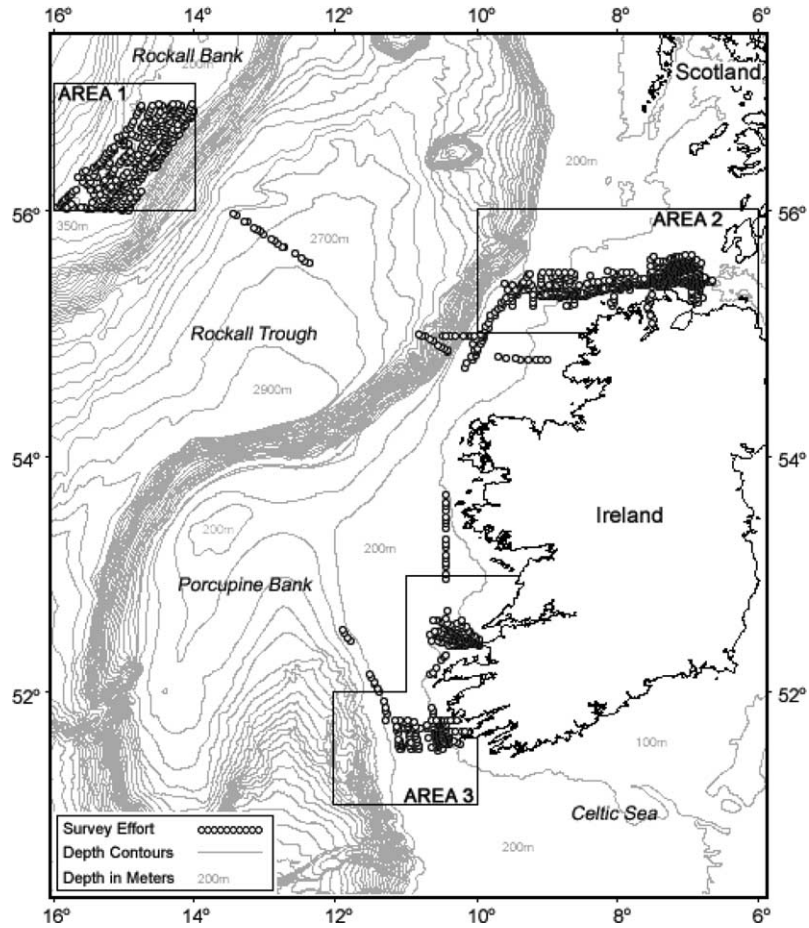


Fig. 1— Area boundaries and survey effort from May– September 2004. Each circle represents an environmental record station.

Atlantic white-sided dolphins were the most frequently sighted species in offshore waters, with 9.66 aph recorded over the Rockall Bank (Fig. 2). Only a single sighting of this species was recorded over the continental shelf (off north-west Donegal) during this survey. Group size ranged from 1–60 animals, with a mean of 13.4 (SD = 10.5). On one occasion a calf was sighted among a group of ten animals. Sightings occurred in water depths ranging from 104–307 m, with a mean depth of 234.1 m (SD = 38.3). A single group of five animals was sighted in a water depth of 2350 m, close to the continental shelf edge, to the north-west of Erris Head. Atlantic white-sided dolphins seem to prefer areas of high bottom relief (100–500 m) adjacent to deep water canyons and troughs. This species is rarely sighted in inshore waters and are mainly distributed along the continental shelf edge and offshore banks (Reid *et al.* 2003), though it is the fourth most frequently stranded cetacean species in Irish waters (Berrow and Rogan 1997).

Unidentified dolphin species accounted for a large number of sightings on the Rockall Bank and

to the south-west of Ireland (relative abundances: 2.96 aph and 3.85 aph). Atlantic white sided dolphins encountered over the Rockall Bank appeared to actively avoid the survey vessel, resulting in 42% of dolphin sightings over the bank not being confirmed to species level. The majority of these sightings were thought to be of Atlantic white-sided dolphin, while the majority of those unidentified off the south-west coast were thought to be common dolphins. Only two sightings of harbour porpoise were recorded (Fig. 3), with one sighting of four animals recorded in waters over the Rockall Bank (water depth 170 m). Sightings of harbour porpoise over the Rockall Bank have previously been noted by Northridge *et al.* (1995) and by Cronin and Mackey (2002). Two sightings of bottlenose dolphins were confirmed during the survey off the north and south-west coasts. The single sighting of bottlenose dolphins (group size of 10) off the south-west coast occurred 25 km west of the mouth of the Shannon estuary. The low incidence of sightings of this species in this area was surprising, considering the relatively close proximity to the

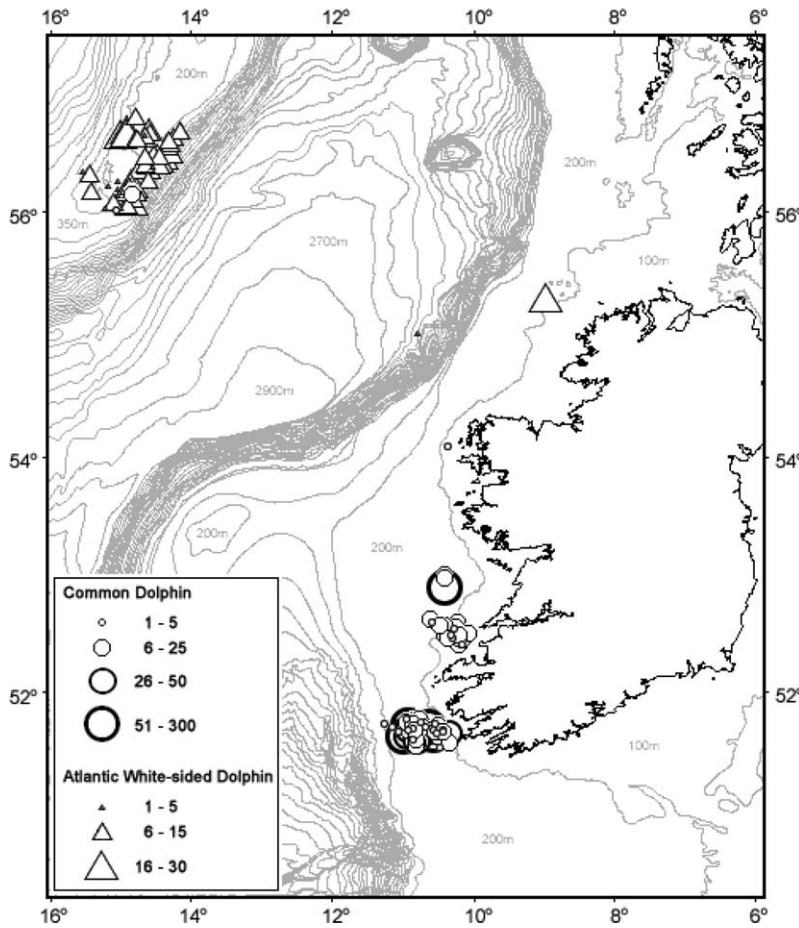


Fig. 2— Distribution and group sizes of Atlantic white-sided dolphin and common dolphin recorded during the survey.

Shannon estuary, which is the site of the only known resident group of bottlenose dolphins in Ireland (Berrow *et al.* 1996). Two sightings of Risso’s dolphins were made to the north-east of Malin Head. Both sightings consisted of two animals and occurred in water depths of 40–55 m.

Five sightings of pilot whales occurred during the survey (Fig. 3). Group sizes ranged from 6–15 animals, with a mean group size of 15 (SD = 4.5). Pilot whale sightings occurred in deeper waters off the shelf edge and over the southern edge of the Rockall Bank. Sightings occurred in water depths of 260–2568 m, with a mean depth of 273.3 m

(SD = 11.5) over the Rockall Bank and a mean depth of 2159 m (SD = 578.4) over the shelf edge. During the survey of the Rockall Bank (Area 1) a simultaneous survey was being conducted on the Hatton Bank (250–300 km to the north-west) by the Coastal and Marine resources Centre (CMRC), University College Cork. This survey recorded a higher relative abundance of pilot whales, with the species accounting for up to 60% of sightings at that location (M. Mackey, pers. comm.).

Two species of baleen whale were identified during the survey. A single sighting of a fin whale was recorded over the southern end of the Rockall

Table 1— Cetacean species diversity, sightings, counts and relative abundance for each area surveyed.

Area	Number of species	Number of sightings	Number of individuals	Relative abundance* (all species)
1	6	105	1082	13.2
2	5	22	83	0.4
3	3	97	1610	12.1

*Relative abundance measured as animals per hour surveyed.

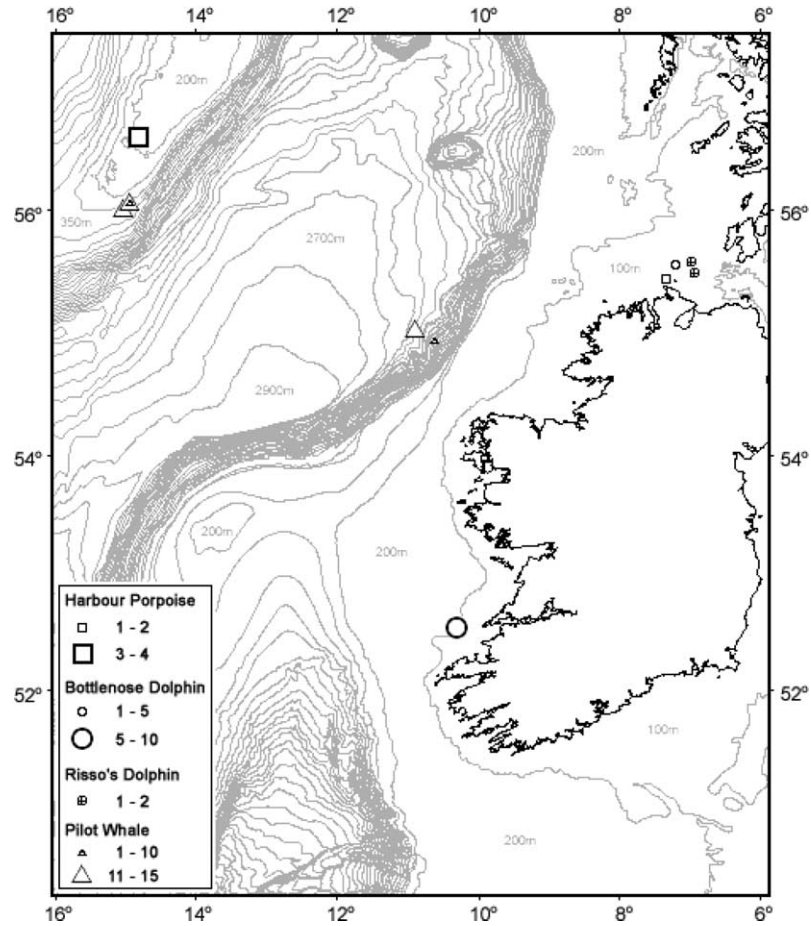


Fig. 3— Distribution and group sizes of all other dolphin and porpoise species recorded during the survey.

Bank in 420 m water depth. A sighting of a group of three unidentified large baleen whales on the Rockall Bank (290 m water depth) was also thought to have been of this species. No sightings of this species occurred inshore. Fin whales are thought to migrate seasonally along the shelf edge to the west of Ireland (Fairley 1981; Clarke and Chariff 1998). Minke whales occurred at low relative abundances in all three areas (< 0.4 aph). Seven sightings of this

species were confirmed (Fig. 4), with six of those sightings being single animals. Minke whale sightings occurred in water depths of 35–205 m, with a mean depth of 115.1m (SD = 72.5). This species occurs in all inshore waters with the majority of sightings occurring from May to October (Berrow *et al.* 2001).

The results of this survey show that both offshore and continental shelf habitats off the Irish

Table 2— Number of definite, probable and possible sightings of the eight cetacean species identified during the survey.

Species	Definite	Probable	Possible	Total
Common dolphin <i>Delphinus delphis</i>	63	8		71
Atlantic white-sided dolphin <i>Lagenorhynchus acutus</i>	31	17	3	51
Pilot whale <i>Globicephala melas</i>	5			5
Bottlenose dolphin <i>Tursiops truncatus</i>	1	1		2
Harbour porpoise <i>Phocoena phocoena</i>	2			2
Risso's dolphin <i>Grampus griseus</i>	2			2
Minke whale <i>Balaenoptera acutorostrata</i>	4	3		7
Fin whale <i>Balaenoptera physalus</i>	1		3	4
Total	109	29	6	144

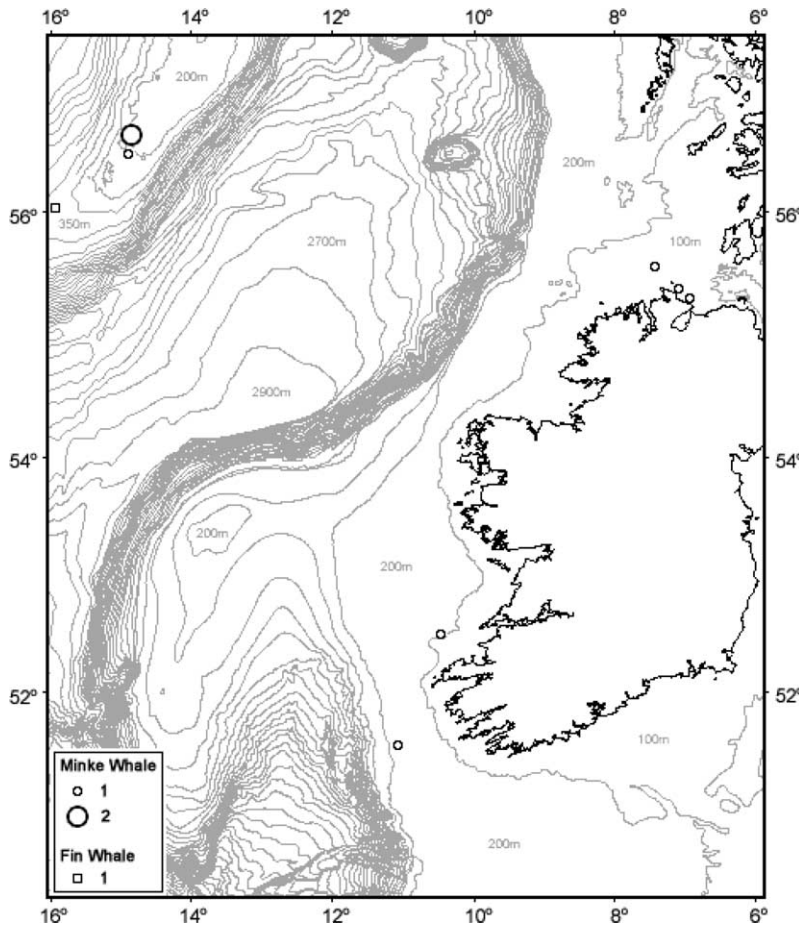


Fig. 4— Distribution and group sizes of fin whale and minke whale recorded during the survey.

west coast are important for cetaceans and that cetacean species diversity can vary greatly across relatively short geographical distances. The offshore habitat of the Rockall Bank (Area 1) had the highest species diversity, with six species (harbour porpoise, Atlantic white-sided dolphin, common dolphin, pilot whale, minke whale and fin whale) identified. This area also had a high relative abundance of cetaceans (13.2 aph for all species pooled) (Table 1). Relative abundance on the continental shelf varied greatly between the north and south-west coasts. Relative abundance of cetaceans off the north Donegal/Derry coast (Area 2) was very low (0.4 aph for all species pooled), even though survey effort was the highest of the three areas (204 hrs). Species diversity was high, however, with sightings of five species (harbour porpoise, Atlantic white-sided dolphin, Risso's dolphin, bottlenose dolphin and minke whale) confirmed. Relative abundance of cetaceans off the south-west coast (Area 3) was high (12.1 aph for all species pooled), though species diversity was low with just three species (common dolphin, minke whale and bottlenose dolphin) identified.

The use of 'Ships of opportunity' provides a cost-effective tool for the collection of data on cetacean distribution and abundance. Such platforms can provide opportunities to survey otherwise inaccessible offshore habitats and enable long-term monitoring of cetacean distribution and relative abundance in areas of interest (Brereton *et al.* 2004). Research vessels are particularly favourable platforms as the simultaneous collection of cetacean data along with environmental and physical oceanographic data (e.g. bathymetric data, benthic samples, fisheries data, etc.) enhances interpretation of results and assists in an ecosystem approach to marine habitat management.

The results of this survey have implications for the conservation and management of cetacean populations in Irish waters. Differences in species distribution and relative abundance across geographical areas and between different marine habitats must be considered when drawing up management plans for cetaceans and marine habitats. Further survey effort is required to quantify cetacean relative abundance for all marine habitat types (e.g. deep water coral reefs, offshore banks and deep water canyons) and in all months (to quantify seasonal variation).

ACKNOWLEDGEMENTS

We thank the Marine Institute and the Geological Survey of Ireland for facilitating access to the RV *Celtic Explorer* during the 2004 National Seabed Survey. Thanks to the Captains and crews of the RV *Celtic Explorer* for their assistance during the surveys and to Fiona Fitzpatrick of the Marine Institute for her support and encouragement in organising these surveys. We also thank our fellow researchers on board the RV *Celtic Explorer* and the Party Chiefs during each leg of the survey for their interest and support. The helpful comments of Dr Simon Berrow on earlier drafts of this paper are greatly appreciated. Thanks also to Mick Mackey for information given on the Hatton Bank survey. These data were collected using Logger 2000 software developed by the International Fund for Animal Welfare (IFAW) to promote benign and non-invasive research. This project was sponsored by a grant under the Heritage Council Wildlife Grants scheme (Grant No.13552).

REFERENCES

- Berrow, S. 2001 Biological diversity of cetaceans (whales, dolphins and porpoises) in Irish waters. In J. Nunn (ed.), *Marine biodiversity in Ireland and adjacent waters*, 115–19. Belfast. Ulster Museum.
- Berrow, S.D. and Rogan, E. 1997 Cetaceans stranded on the Irish coast, 1901–1995. *Mammal Review* **27** (1), 51–76.
- Berrow, S.D., Holmes, B. and Kiely, O.R. 1996 Distribution and abundance of bottle-nosed dolphins *Tursiops truncatus* in the Shannon Estuary. *Biology and Environment: Proceedings of the Royal Irish Academy*, **96B**, 1–9.
- Berrow, S.D., Whooley, P. and Ferriss, S. 2001 *Irish Whale and Dolphin Group cetacean sighting schemes: development of a system to record sightings of cetaceans (whales, dolphins and porpoises) in Irish waters*. Final report to the Heritage Council (Ireland), Kilkenny.
- Clark, C.W. and Charif, R.A. 1998 *Acoustic monitoring of large whales to the west of Britain and Ireland using bottom mounted hydrophone arrays, October 1996–September 1997*. Report No. 281. Peterborough. Joint Nature Conservation Committee.
- Brereton, T., Wall, D., Cermeño, P., Vasquez, A., Curtis, C. and Williams, A. 2004 *Cetacean monitoring in north-west European waters*. Report no. 1. Dorset. Atlantic Research Coalition.
- Cronin, M. and Mackey, M. 2002 Cetaceans and seabirds in waters over the Hatton–Rockall region. Unpublished Cruise Report, Coastal and Marine Resources Centre, University College Cork.
- DAHGI 2002 *National Biodiversity Plan*. Department of Arts, Heritage, Gaeltacht and the Islands.
- European Union 1992 *Council directive on the conservation of natural habitats and of wild fauna and flora*. EU Council Directive, 92/43/EEC.
- European Union 2004 Council Regulation (EC) No 812/2004 of 26.4.2004 laying down measures concerning incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88/98. *Official Journal L 150* **30/04/2004**, 0012–31.
- Fairley, J.S. 1981 *Irish whales and whaling*. Belfast. Blackstaff Press.
- Geological Survey of Ireland 2004 Irish National Seabed Survey. Website: <http://www.gsiseabed.ie/> (accessed 27 June 2006).
- Gordon, J., Berrow, S.D., Rogan, E. and Fennelly, S. 1999 Acoustic and visual survey of cetaceans off the Mullet peninsula, Co. Mayo. *Irish Naturalists Journal*, **26**, 251–9.
- Hammond, P.S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Collet, A., Heide-Jørgensen, M.P., Heimlich-Boran, S., Hiby, A.R., Leopold, M.F. and Øien, N. 1995 *Distribution and abundance of the harbour porpoise and other small cetaceans in the North Sea and adjacent waters*. Final report to the European Commission, LIFE contract: 92–2/UK/027, 240 pp.
- Hammond, P.S., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Jørgensen, M.P., Heimlich, S., Hiby, A.R., Leopold, M.F. and Øien, N. 2002 Abundance of harbour porpoise and other cetaceans in the North Sea and adjacent waters. *Journal of Applied Ecology* **39**, 361–7.
- IFAW 2000 *Logger 2000 software*. London. International Fund for Animal Welfare.
- Leopold, M.F., Wolf, P.A. and Van de Meer, J. 1992 The elusive harbour porpoise exposed: strip transect counts off south-western Ireland. *Netherlands Journal of Sea Research*, **29**, 395–402.
- Northridge, S.P., Tasker, M., Webb, A. and Williams, J.M. 1995 Distribution and relative abundance of harbour porpoises (*Phocoena phocoena* L.), white-beaked dolphins (*Lagenorhynchus albirostris* Gray), and minke whales (*Balaenoptera acutorostrata Lacepede*) around the British Isles. *ICES Journal of Marine Science* **52**, 55–66.
- O'Brien, J., Berrow, S. and Wall, D. 2005 The impact of Multibeam on cetaceans: a review of best practice. Unpublished report, Irish Whale and Dolphin Group. Website: <http://www.iwdg.ie/downloads/Multibeam.pdf> (accessed 27 June 2006).
- Ó Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. 2004 *Cetaceans and seabirds of Ireland's Atlantic margin. Volume II—Cetacean distribution and abundance*. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38. Cork. Coastal and Marine Resources Centre, University College.
- OSPAR 1998 *Convention for the protection of the marine environment of the north-east Atlantic*. OSPAR Commission, London.
- Pollock, C., Reid, J.B., Webb, A. and Tasker, M.L. 1997 *The distribution of seabirds and cetaceans in the waters around Ireland*. Joint Nature

- Conservation Committee Report no. 267. Peterborough. Joint Nature Conservation Committee.
- Reid, J.B., Evans, P.G.H. and Northridge, S.P. 2003 *Atlas of cetacean distribution in north-west European waters*. Peterborough. Joint Nature Conservation Committee.
- Rogan, E. and Berrow, S.D. 1995 The management of Irish waters as a whale and dolphin sanctuary. In A.S. Blix, L. Walloe and Ø. Ulltang (eds), *Whales, seals, fish and man*, 671–81. Amsterdam. Elsevier Science.