

CETACEANS OFF SOUTH UIST IN RELATION TO PROPOSED ERISKAY CAUSEWAY

Dr Peter G.H. Evans

**Sea Watch Foundation
c/o Department of Zoology,
University of Oxford,
South Parks Road,
Oxford OX1 3PS**

INTRODUCTION The waters adjacent to the Western Isles are probably the richest of any coastal region in the UK for cetaceans (whales, dolphins, and porpoises), and one of the most important regions in north-west Europe (Evans, 1998). Twenty species of cetaceans have been recorded since 1980 along the coasts or in the nearshore waters (within 60 km of the coast). Of these, eleven species are either present throughout the year or recorded annually as seasonal visitors. Some of these are pelagic species that normally live along or west of the continental shelf edge, and they rarely come close to the coasts of the Western Isles. In and immediately around the Sound of Barra (including Eriskay Sound), a total of eight species have been recorded live since 1980.

STATUS & ECOLOGY The status, seasonal occurrence and ecology of the eight species of cetaceans recorded in recent years in the locality are given below:

Minke Whale (*Balaenoptera acutorostrata*) Worldwide distribution in tropical, temperate and polar seas of both hemispheres. International protection includes Appendix I status (trade strictly controlled, and not for primarily commercial purposes, with exception of West Greenland) of CITES (Convention on International Trade in Endangered Species, in force from July, 1975); Appendix III (protected) of BERN Convention on the Conservation of European Wildlife and Natural Habitats (in force from June 1982); one of the species managed by the International Whaling Commission. Status listed by IUCN (1991) as insufficiently known.

The minke whale is widely distributed along the Atlantic seaboard of Britain and Ireland but also occurs regularly in the northern and central North Sea as far south as Yorkshire. It is seen occasionally in the Irish Sea but is rare in the Channel and southernmost North Sea.

There is some indication of an increase since the 1980's, with populations concentrated in the northern North Sea, and around North and West Scotland. Indeed, in the Minches and Sea of Hebrides, it has become the second most frequently observed species in summer months. The species is mainly observed between May and October.

It occurs regularly off the east coasts of South Uist, Eriskay, and Barra and in the Sound of Barra, but we have no records of it from within the Sound of Eriskay where the waters are probably too shallow for the species to favour this area. Although most commonly seen singly or in loose groups of up to three, in late summer minke whales may form feeding aggregations numbering between 5 and 15 individuals. The Sea of Hebrides provides a rich feeding ground for minke whales, which prey upon a variety of fish species, notably herring, sandeel, cod, haddock, saithe, as well as krill. Breeding occurs between autumn and spring, but there is no information on whether calves are born mainly offshore or in the region.

Killer Whale or Orca (*Orcinus orca*) Worldwide distribution in tropical, temperate and polar seas in both hemispheres (with greatest abundance at higher latitudes). International protection includes Appendix II status of CITES; Appendix II of BERN Convention (from 1987). Status listed by IUCN (1991) as insufficiently known.

Although killer whale numbers in the North Atlantic appear to be greatest in subarctic and arctic waters, the distribution of the species extends south to the Caribbean, Azores, Madeira and occasionally the Mediterranean. Although widely distributed, most sightings occur along the Atlantic seaboard and in the northern North Sea. The species occasionally enters the Irish Sea, mainly off the coasts of SW Wales. It is scarce in the Channel and virtually absent from the southernmost North Sea.

Although uncommon, killer whales are regularly observed in the Sea of Hebrides where recognisable individuals have been seen repeatedly in the same region over a period of at least ten years. They are mostly seen between May and September. Like the minke whale, the species may be seen anywhere off the east coasts of South Uist, Eriskay, and Barra, but we have no records of it from within the Sound of Eriskay. However, killer whales may come into shallow coastal waters in pursuit of seals, which form part of their diet, along with a wide variety of fish species (particularly herring, cod, and mackerel) and other marine vertebrates (such as porpoises and sharks). Group size varies between 1 and 15, though usually between 2 and 8 are seen, with groups (termed pods) having very stable membership. Breeding occurs between autumn and spring, when small calves have been seen in the Outer Hebrides.

Risso's Dolphin (*Grampus griseus*) Worldwide distribution in tropical and temperate seas in both hemispheres. International protection includes Appendix II of CITES; Appendix II of BERN Convention (from 1987); Appendix II (North and Baltic Sea populations) of CMS (Convention on Migratory Species) Agreement. Status listed by IUCN (1991) as insufficiently known.

In the Northeast Atlantic, the Risso's dolphin is fairly common and widely distributed north to the Shetland Isles of Scotland. It occurs regularly in coastal waters, mainly along the Atlantic seaboard but also in the Irish Sea and northern North Sea. It is rare or absent in the central and southern North Sea and eastern portion of the Channel. The species is nowhere common but is seen most frequently between May and September, particularly the latter three months of July, August and September.

The largest populations of Risso's dolphins in UK are reported from the Minches and Sea of Hebrides. Although more common in the north of this region (particularly around the Eye Peninsula), the species occurs regularly east of South Uist, Eriskay and Barra. We have no reports of it within the Sound of Eriskay, although elsewhere in the Hebrides, the species has been seen entering very shallow sounds. Risso's dolphins feed mainly upon cephalopods (octopus, cuttlefish and small squid), and the area is important both for feeding and breeding (calving occurring mainly between April and September). Groups usually comprise 5-20 individuals although sometimes aggregations of 50-100 individuals have been recorded.

Bottlenose Dolphin (*Tursiops truncatus*) Worldwide distribution in tropical and temperate seas in both hemispheres. International protection includes Appendix II status of CITES; Appendix II of BERN Convention; Appendix II (North and Baltic Sea populations) of CMS Agreement. Status listed by IUCN (1991) as insufficiently known.

Along the Atlantic seaboard of Europe, the bottlenose dolphin is locally fairly common off the coasts of Spain, Portugal, NW France, Western Ireland, NE Scotland and the Irish Sea. All those localities receive influence from the Gulf Stream. Essentially an inshore species, in British and Irish waters the bottlenose dolphin is most frequently sighted within 10 km of land, although also occurs in offshore waters, often associated with other cetaceans such as long-finned pilot whales. Bottlenose dolphins are present throughout the year in various bays in Western Ireland; in the Irish Sea (particularly Cardigan Bay); and the Moray Firth. Elsewhere in Britain, the species has been scarce in the central and southern North Sea, but it occurs seasonally at particular localities along the south coast of England.

Although generally rare in Northwest Scotland and the Northern Isles, there is a small resident community of bottlenose dolphins that live in the Sound of Barra and these enter the Sound of Eriskay where it may occur in very shallow waters (probably making use of those shallows to capture

fish). They have been seen in all months of the year though most frequently between April and September, with groups usually varying between one and ten individuals including at least one young. The species usually breeds either in spring (March - May) or early autumn (August - September). Bottlenose dolphins feed upon a variety of demersal (e.g. mullet, eel, flounder, dab, sole, turbot, and cod) and pelagic fish (e.g. salmon, bass, herring) as well as marine invertebrates (crustaceans).

White-beaked Dolphin (*Lagenorhynchus albirostris*) Distribution restricted to temperate and subpolar seas of the North Atlantic. International protection includes Appendix II status of CITES; Appendix II of BERN Convention (from 1987); Appendix II (North and Baltic Sea populations) of CMS Agreement. Status listed by IUCN (1991) as insufficiently known.

The white-beaked dolphin occurs from central W Greenland, Greenland Sea and the southern Barents Sea south to Newfoundland, Cape Cod and SW Ireland. It is common in British and Irish waters, with a similar distribution to the Atlantic white-sided dolphin though less pelagic and apparently more abundant at least in coastal waters. Its distribution is centred mainly upon the central and northern North Sea, but extending westwards to N and NW Scotland, and southwards towards SW Britain and Ireland. It is occasionally observed in the western Channel, Irish Sea and southernmost parts of the North Sea.

White-beaked dolphins are common in the Hebrides, particularly in the north Minches, but they also occur regularly in the Little Minch and Sea of Hebrides (mainly along the east coast of the Western Isles). The species has been seen off the east coast of South Uist, Eriskay and Barra but not observed (according to our records) within the Sound of Eriskay itself where the waters are probably too shallow for them to occur there more than occasionally. White-beaked dolphins feed upon mackerel, herring, cod, poor-cod, bib, whiting and hake, as well as squid, octopus, and benthic crustaceans. The region is used both for feeding and breeding. They breed mainly between May and August.

Atlantic White-sided Dolphin (*Lagenorhynchus acutus*) Distribution restricted to temperate and subpolar seas of the North Atlantic. International protection includes Appendix II status of CITES; Appendix of BERN Convention (from 1987); Appendix II (North and Baltic Sea populations) of CMS Agreement. Status listed by IUCN (1991) as insufficiently known.

This species is relatively abundant in mainly offshore waters from central West Greenland, Iceland and the southern Barents Sea south to Cape Cod (United States) and SW Ireland. It is less commonly recorded than the closely related white-beaked dolphin in coastal waters of Britain and Ireland, where its distribution is concentrated around the Scottish Outer Hebrides, Northern Isles and northern North Sea. Elsewhere, it occurs regularly off the west coast of Ireland, southwest approaches to the Channel and in the central North Sea, but only occasionally in the Irish Sea, the eastern Channel and southernmost North Sea.

Although less commonly encountered in the Sea of Hebrides than the white-beaked dolphin, white-sided dolphins may occur in large schools numbering up to 500 individuals at the southern end. Most sightings occur in July and August. Its diet reflects its more oceanic ecology, with species like herring, mackerel, horse mackerel, blue whiting, and silvery pout being important. Squid are also taken. Breeding apparently occurs between February and September, probably mainly between May and July.

Common Dolphin (*Delphinus delphis*) Worldwide distribution in tropical, subtropical and temperate seas in both hemispheres. International protection includes Appendix II status of CITES; Appendix II of BERN Convention; Appendix II (North and Baltic Sea populations) of CMS Agreement. Status listed by IUCN (1991) as insufficiently known.

The common dolphin is widely distributed in the NE Atlantic, mainly in deeper waters from the Iberian Peninsula north to west Scotland. In British and Irish coastal waters, its distribution has a mainly western and southern component. It is common in the western approaches to the Channel and

the southern Irish Sea, off the west coast of Ireland, and around the Inner Hebrides north to the Isle of Skye. In some years, the species occurs further north and east, around Shetland and Orkney, and in the northern North Sea. It is generally rare in the southern North Sea and eastern portion of the English Channel. In recent years, there have been a number of sightings of common dolphins off Northern Scotland, in the Northern Isles and well into the North Sea.

Common dolphins have been seen off the east coast of South Uist in June and July, with group sizes numbering up to 200 animals. The species has not been recorded in the Sound of Eriskay itself, and since it favours deep waters, this is unlikely to be used to any extent. The diet of the common dolphin includes blue whiting, poor cod, hake, sardine, anchovy, and whiting, as well as small squid, octopus, cuttlefish, and crustaceans. The regions is used both for feeding and breeding, with calves born mainly between June and September.

Harbour Porpoise (*Phocoena phocoena*) Distribution restricted to temperate and subarctic seas of the northern hemisphere. International protection includes Appendix II status of CITES; Appendix II of BERN Convention; Appendix II (North and Baltic Sea populations) of CMS Agreement. Status listed by IUCN (1991) as insufficiently known.

In the NE Atlantic, the harbour porpoise is widely distributed in coastal waters from the Barents Sea south to the coast of France, although in the last thirty years, it has become scarce in the southernmost North Sea, English Channel and Bay of Biscay. Nevertheless, it is the commonest cetacean recorded in British and Irish waters, though most abundant along the south and west coasts of Ireland, western and northern Scotland including the Hebrides and Northern Isles. Regular though in smaller numbers in East Scotland and NE England, and in some coastal areas within the Irish Sea (mainly off SW Wales). Only small numbers occur in SW England, and the species becomes scarce eastwards along the south coast of England, in the Thames estuary and off East Anglia. General declines noted in coastal areas of the southern North Sea during the 1970's, extending and including some more northern and Atlantic sites during the early 1980's with some indication of a reversal in this trend in the late 1980's - the present.

Porpoises are common all along the eastern (and western) seaboard of the Outer Hebrides including South Uist, Eriskay, and Barra, and the species occurs in Barra Sound and has been recorded in the Sound of Eriskay. As elsewhere, porpoises can be found sometimes in very shallow waters. The species is apparently resident throughout the year in the region, although peak numbers are recorded between July and September. The area is used both for feeding and breeding. The main diet of porpoises is small fish (usually less than 40cm length) such as young herring, sprats, sand-eels, whiting, saithe, and pollack, although particularly in winter months, prey such as dab, flounder, sole, and cod are taken. Breeding occurs mainly between May and August.

EFFECTS OF ANTHROPOGENIC SOUND UPON CETACEANS Cetaceans living entirely within an aquatic environment rely heavily on sound both to acquire information about their environment and for communication (Evans, 1987). Additional sounds may therefore cause disruptions to their lives, distracting, annoying or even frightening them, as well as providing the potential for causing behavioural and physiological upset.

Since the industrial era, humans have developed a number of highly intense sources of sound. The more powerful the engine that a vessel possesses, the greater the amount of sound (at least at low frequencies) it will produce. Supertankers, in particular, produce sound intensities of between 187 dB (at 50 Hz) and 232 dB (at 2 Hz) re 1 μ Pa, at very low (particularly <10 Hz) frequencies.

Besides propeller and engine sound generated by vessels during commercial, military and recreational activities, surface vessels and submarines employ active sonar which uses sonic or ultrasonic waves to locate submerged objects, at the same time introducing brief, high-intensity pulses into the marine environment that sometimes may be transmitted over great distances. Source levels of sound are c. 200-250 dB re 1 μ Pa at frequencies up to 200 kHz. High resolution sidescan sonar (generally below 14 kHz) is also used in geophysical seismic surveys particularly during oil

and gas exploration, along with lower resolution explosive techniques (airguns, sleeve exploders, etc.) mainly at frequencies below 500 Hz (Richardson *et al.*, 1995).

Most of the sounds generated from maritime activities (with the exception of sonar) are at frequencies lower than 1 kHz. However, when a surface vessel travels at high speed, the propeller may cavitate and produce much higher frequency sound (between 2 and 20 kHz).. Measurements of various small craft (up to 15 m length, 240 hp engine) indicated source levels ranging from 100-125 dB re μ Pa at 2 kHz and 60-105 dB re μ Pa at 20 kHz. Cavitation is also more likely to occur when the propeller is damaged.

The auditory sensitivities of porpoises, dolphins and the smaller toothed whales are greatest at very high frequencies - between 10 and 150 kHz, with a hearing threshold of about 40 dB at those frequencies, increasing to around 100 dB at 1 kHz and 120 dB at 100 Hz, at least for those species for which data are available (Richardson *et al.*, 1995). Although there is no quantitative information on the auditory sensitivities of baleen whales (like the minke whale), results of recent investigations suggest that greatest hearing sensitivities occur between 100 Hz and 5 kHz, on the assumption that whales will hear approximately over the same frequency range as the sounds they produce. Using this argument, we would expect minke whales to be most sensitive to frequencies of between 60-140 Hz.

The sounds produced by toothed whales and dolphins may conveniently be divided into: (1) pure tone whistles generally in the frequency range 500 Hz - 20 kHz, used mainly for communication; and (2) pulsed sounds or clicks varying from 500 Hz to 150 kHz, used mainly for echolocation. Source levels for both types of sound are estimated usually to be between 150 and 200 decibels, although pulsed sounds for non-echolocatory purposes may be produced at source levels of 115 dB, mainly in the frequency range below 20 kHz. Most of these measurements were made in captivity and it should be noted that animals can modify their sound production (particularly its intensity) in confined situations, and indeed do so also in open water.

The sounds produced by baleen whales may be classified into four types: (1) low-frequency moans, typically with frequencies of 12-500 Hz and of 0.4 to 36 seconds duration; (2) gruntlike thumps and knocks with most sound energy concentrated between 40 and 200 Hz; (3) chirps, cries and whistles at frequencies between 1 and 10 kHz; and (4) clicks or pulses at frequencies up to 20-30 kHz and lasting from 0.5 to 5 msec. Sound source levels range between 150 and 200 decibels, at frequencies of 500 Hz or less.

To summarise, most toothed whales, dolphins and porpoises can hear sounds over a wide range of frequencies from 75 Hz to 150 kHz, with greatest sensitivity around 20 kHz (although low frequency hearing has not been fully investigated), whereas the hearing of baleen whales probably ranges from frequencies of 10 Hz to 10 kHz, with greatest sensitivity usually below 1 kHz (this is based on sound production levels since no audiograms exist). Major differences in hearing between baleen and toothed whales is further supported by anatomical differences between the hearing organs of these two groups.

Sounds generated within the hearing range of cetacean species tend to elicit the following types of response: movement away from the sound source; increased dive times; and bunching of social groups. In some cases, a whale or dolphin may shift the sound frequency at which it is communicating. Longterm effects upon survival and reproduction of cetaceans has scarcely ever been demonstrated, but because of the extreme difficulty of distinguishing from other anthropogenic factors and natural environmental changes, it is impossible to say whether these occur.

IMPLICATIONS FOR CETACEANS OF A CAUSEWAY FROM SOUTH UIST TO ERISKAY The building of a causeway between the islands of South Uist and Eriskay has two possible implications upon cetacean species living in the area: (1) the causeway will serve as a land barrier preventing movement of animals between the western and eastern sides of the Sound of

Barra; and (2) the construction, and subsequent use of the causeway by motor vehicles will cause sound disturbance to local cetacean populations.

From the status review above, it is clear that there are only two species that are likely to be affected to any great extent. These are: bottlenose dolphin and harbour porpoise. Both are listed in Annex II of the EU Habitats Directive as species whose conservation requires the designation of Special Areas of Conservation. Both species enter the Sound of Eriskay although they are more common in the deeper waters of the Sound of Barra. They both occur in the area throughout the year, and use it for giving birth and nursing their calves, for socialising, mating and feeding.

The plan is to construct culverts of about 10 metres width under the causeway to help enable animals to pass either side of this land barrier. To my knowledge, there have been no instances of a comparable construction being made in the vicinity of a resident population of either bottlenose dolphins or harbour porpoises so it is difficult to predict with any confidence how successful this may be for either species. Both species are known to enter very shallow waters, and bottlenose dolphins will in some parts of the world actually beach themselves on banks of sand or mud in pursuit of fish prey. Once driven ashore, the fish are readily captured by the dolphins. There are no observations of the species doing this in the UK although this may be because there are few comparable situations. Although both species occur in fairly narrow channels, these are generally at least 100 metres wide. In my opinion, it is likely that both species will be deterred from crossing from one side of the causeway to the other, and are more likely to move around the island of Eriskay if they wish to travel any distance. On the other hand, that is not necessarily going to cause a serious interference for either species since they frequently travel along coastlines. Harbour porpoises do not have any strong social structure, usually feeding and travelling either singly or in loose groups of 2-4 animals. A newly-formed land barrier is therefore unlikely to disrupt their behaviour in any sustained manner. Bottlenose dolphins do live in social units, however, and have preferred home ranges which they use on a longterm basis. From our current knowledge of the local population, individuals mainly use the waters west and south of Eriskay (we occasionally see them in the Sea of Hebrides east of South Uist and Eriskay, but they are commonly seen off the north-east corner of Barra and particularly in the western portion of the Sound of Barra). It is therefore likely that the population will concentrate its activities west of the causeway and within the main part of Barra Sound. Although we have no information on preferred habitats in the area, since it is this latter region which is mainly used by the local population, the creation of a land barrier in the very shallow waters of Eriskay Sound (maximum depths 10 metres) in itself is not likely to lead to a population decline for any cetacean species.

The other possible impact of the causeway construction is through sound disturbance and local habitat modification. The building material for the causeway is being extracted from a site about one kilometre inland on South Uist. Thus it is unlikely that the blasting operations will cause much sound disturbance underwater in the Sound of Eriskay. Materials will then be taken by heavy vehicle and end-tipped so that again there does not appear to be much danger of sounds being generated underwater except as a result of the actual construction (and then subsequent use) of the carriageway. Presumably although use of the causeway will increase over time, it will probably never receive heavy traffic. Elsewhere in Britain, both bottlenose dolphins and harbour porpoises do frequently pass under bridges taking quite large volumes of traffic (e.g. the bridge across the Inverness Firth at Kessock) without signs of disturbance (they are disturbed more by speedboats in the vicinity). So long as the construction of the causeway does not lead to increased human waterborne disturbance in the vicinity, it seems unlikely that it will have a major impact on cetacean populations in the area.

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