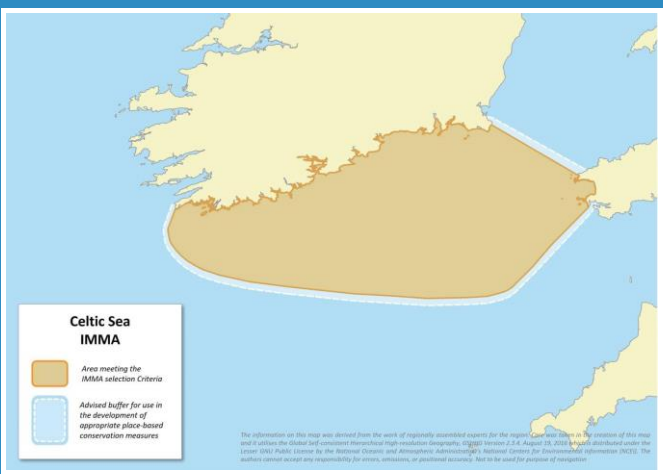

Area Size

29 663 km²

Qualifying Species and Criteria

Fin whale – *Balaenoptera physalus*

Criterion A; C (2)

Minke whale – *Balaenoptera acutorostrata*

Criterion C (2)

Humpback whale – *Megaptera novaeangliae*

Criterion C (2)

Marine Mammal Diversity

Criterion D (2)

Balaenoptera acutorostrata, Balaenoptera physalus, Delphinus delphis, Globicephala melas, Grampus griseus, Halichoerus grypus, Megaptera novaeangliae, Phoca vitulina, Phocoena phocoena, Tursiops truncatus

Celtic Sea IMMA

Summary

The waters south of Ireland, east to the Celtic Deep entirely overlie the European continental shelf. Although twenty marine mammal species have been recorded in the area, and nine are regular inhabitants of the region, the focus of this IMMA is on three species of baleen whale that occur in the Celtic Sea across several months of the year with a strong peak in November: fin whales (*Balaenoptera physalus*), common minke whales (*Balaenoptera acutorostrata*), and humpback whales (*Megaptera novaeangliae*). These whales have been shown to be associated with spawning concentrations of sprat (*Sprattus sprattus*), young herring (*Clupea harengus*) and other forage fish. Seven other marine mammal species occur regularly in the region, including harbour porpoises (*Phocoena phocoena*), bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*), Risso's dolphins (*Grampus griseus*), grey seals (*Halichoerus grypus*), and harbour seals (*Phoca vitulina*).

Description:

The main front in the Atlantic region is the Irish Shelf Front that occurs to the south and west of Ireland (at *c.* 11° W) around the 150 m isobath and exists year-round (Huang et al., 1991). This front marks the boundary between water over the Irish shelf (often mixed vertically by the tide) and offshore North Atlantic water. The turbulence caused by the front brings nutrients from deeper water to the surface where they promote the growth of phytoplankton, especially of diatoms in spring, but also where there is increased stratification, dinoflagellates. These in turn are fed on by swarms of zooplankton and associated with these, aggregations of fish, seabirds and cetaceans.

Where tides are only moderate, uneven bottom topography can have a considerable mixing effect, as, for example, around the edges of the basin that forms the Celtic Deep. Eddies that occur downstream of headlands and islands (Pattiaratchi et al., 1986), and narrow channels that produce very strong local tides (Pingree & Mardell, 1986), can lead to mixing, which results in small-scale convergences, divergences and shear zones that occur in a tidal rhythm, favouring biological productivity and associated aggregations of fish, seabirds and cetaceans (Evans, 1990; Webb et al., 1990; Baines & Evans, 2012; Waggitt et al., 2017).

The Celtic Deep (with depths mainly of between 100 m and 115 m) extends from west of Pembrokeshire, Wales along a north-east to south-west axis in the direction of south-west Cornwall, broadening out and becoming shallower, forming part of the Celtic Sea.

Species richness of fish and invertebrates is relatively high in the Celtic Sea due to the range of depths, diversity of substrate types, and the region being located at the interface of the Lusitanian and Boreal provinces, thus defining the northern and southern limit of the distribution of many species (Ellis et al., 2013; Martinez et al., 2013; Hernvann et al., 2020). A major spawning ground for herring occurs off the south coast of Ireland (O'Sullivan et al., 2013).

The IMMA contains three Special Areas of Conservation for marine mammals: the Roaringwater Bay and Islands SAC for harbour porpoises (NPWS, 2014), and the Saltee Islands SAC for grey seals (NPWS, 2013) in Irish waters, and the Pembrokeshire Marine SAC for grey seals, harbour porpoises and bottlenose dolphins in UK waters (NRW, 2018).

Figure 1: Skomer Island, Pembrokeshire. Photo credit: D Ord

Figure 2: Strumble Head, Pembrokeshire. Photo credit: D Ord

Criterion A: Species or Population Vulnerability

The fin whale (*Balaenoptera physalus*) is classified as Vulnerable on the Red List (Cooke, 2018). The IMMA seasonally supports a population of fin whales (Whooley et al., 2011), which are present from July until February each year.

Figure 3: Fin whale (*Balaenoptera physalus*).
Photo credit: P Whooley

Figure 4: Fin whale (*Balaenoptera physalus*) skim feeding in West Cork. Photo credit: P Whooley

Criterion C: Key Life Cycle Activities Sub-criterion C2: Feeding Areas

The mixing of different water masses caused by tidal currents or changes in bathymetry can lead to frontal systems developing, as observed at the Celtic Sea front, with stratified regions adjacent to these (Pingree et al., 1978; Savidge & Foster, 1978; Simpson, 1981; Miller et al., 2014).

Atlantic herring (*Clupea harengus*), European sprat (*Sprattus sprattus*) and Atlantic mackerel (*Scomber scombrus*) are abundant pelagic fish species in the Celtic Sea which support large scale fisheries (Marine Institute, 2013; Volkenandt et al., 2015). The seasonal aggregations of fin whales recorded around the Celtic Sea front off southern Ireland coincide with the presence of high zooplankton concentrations and the spawning of herring and sprat in the region (Pingree et al., 1978; Simpson, 1981; Evans et al., 2007; O'Sullivan et al., 2013; Miller et al., 2014; Volkenandt et al., 2015; Evans & Waggitt, 2023).

Concurrent sighting surveys for fin whales, minke whales (*Balaenoptera acutorostrata*) and humpback whales (*Megaptera novaeangliae*) were carried out simultaneously from 2007 to 2013 during dedicated fisheries acoustic surveys assessing the abundance and distribution of forage fish (herring, sprat, and mackerel) (Volkenandt et al., 2015). Probabilities of spatial overlap between baleen whales and forage fish were analysed and compared with the probability of a random encounter. For estimations of foraging threshold and prey selectivity, mean fish biomass and fish length were calculated when baleen whales and forage fish co-occurred. Whales were dominantly observed in areas with herring and sprat, while areas with mackerel were not targeted. A prey detection

range of up to 8 km was found. Fish densities were correlated to total fish abundance. The authors concluded that by linking baleen whale distribution to high-density herring and sprat areas, the Celtic Sea could be identified as a prey hot spot for baleen whales during autumn.

A stable isotope analysis of fin whales and humpback whales in the Celtic Sea showed a preference for sprat and juvenile herring (Ryan et al., 2014), whilst studies elsewhere (west Scotland) have recorded minke whales lunge feeding directly on sandeel (Ammodytidae) (Macleod et al., 2004), sprat and juvenile herring (Anderwald et al., 2011, 2012). Stomach contents analysis of minke whales from the UK has also shown that the species commonly feeds upon sandeel, herring and sprat (Pierce et al., 2004). Minke whales and humpback whales have frequently been observed lunge feeding on shoals of fish in the Celtic Sea in close vicinity to one or more of these three forage fish species (P.G.H. Evans, S. Berrow, C. Ryan, *pers. comm.*).

Figure 5: Minke whale (*Balaenoptera acutorostrata*) breaching. Photo credit: P Whooley

Criterion D: Special Attributes
Sub-criterion D2: Diversity

Although all of the IMMA lies on the continental shelf, habitats range from relatively deep trenches and basins (>100 metres depth) to shallower shelf seas, islands, and coastal bays, providing a variety of marine habitats that sustain a high diversity of marine mammals.

Twenty-two marine mammal species (twenty cetaceans and two seal species) have been recorded in the IMMA, of which nine species are regularly sighted (Evans & Waggitt, 2020, 2023).

Fin whales and minke whales occur regularly along the south coast of Ireland from the Mizen Head in west Cork eastwards across to the coast of west Pembrokeshire in Wales encompassing the Celtic Deep, with frequent coastal sightings also of humpback whales which are showing signs of recovery from whaling activities of this North Atlantic population (Evans et al., 2007; Whooley et al., 2011; Volkenandt et al., 2015; Ryan et al., 2016; Evans & Waggitt, 2023; Blazquez et al., 2023).

Between 1999 and 2022, images of individual humpback whales were collected in Irish coastal waters, the great majority coming from within the Celtic Sea (Blazquez et al., 2023). A total of 120 humpback whales have been identified and included in the Irish Whale and Dolphin Group Photo-ID catalogue. Resighting rates have been high and consistent, reaching over 80% in some years, while the mean resighting rate over the period 1999-2020 was 63%, with relatively high site fidelity (Berrow & Whooley, 2022).

Photo-identification of humpback whales was also used to establish an annual easterly movement along the southern coast of Ireland, mirroring that of their preferred prey of herring and sprat (Ryan et al., 2016). Most sightings in the south-west occurred in August but further east sightings peaked in November (Ryan et al., 2016). Two photo-identified individuals were recorded travelling between Ireland and Iceland, Norway and the Netherlands (Ryan et al., 2016). Two separate abundance estimates for the species have been obtained using mark-recapture modelling techniques (Blazquez et al., 2023): (1) using open population maximum likelihood mark-recapture

models based on the POPAN formulation, a humpback whale "superpopulation" size of 154 ± 9 (95% CI = 138–172, CV = 0.06) was obtained, the highest estimate in any single year being 77 ± 8 individuals; and (2) using a multi-site mark-recapture model selection framework based on Bayesian inference, annual abundance estimates up to 76 ± 11 were obtained for the same period. This study found an increased presence of humpback whales in inshore Irish waters across the years, especially during the last decade although numbers still remain low.

Figure 6: Humpback whale (*Megaptera novaeangliae*) lunge feeding. Photo credit: W Cork

Figure 7: Humpback whales (*Megaptera novaeangliae*) bubble net feeding with seabirds in West Cork.
Photo credit: P Whooley / IWDG

Sightings of fin whales in British and Irish shelf seas are clustered within the Celtic Sea, from the south-west coast of Ireland along its south coast eastwards to the western edge of the Celtic Deep, with peak sightings occurring in November (Whooley et al., 2011; Evans & Waggitt, 2020, 2023; Irish Whale & Dolphin Group and Sea Watch Foundation sightings databases). On occasions, group sizes in the region have numbered more than twenty individuals, higher than recorded anywhere else in British and Irish waters.

Minke whales occur commonly throughout the region in depths exceeding 50 m, with many sightings close to the coast of southern Ireland (Evans & Waggitt, 2020, 2023; Irish Whale & Dolphin Group and Sea Watch Foundation sightings databases). Peak numbers in the Celtic Deep and southern Irish Sea occur between July and September declining markedly between October and March (Evans & Waggitt, 2023). Off the south coast of Ireland, minke whales have been sighted in all months of the year, although numbers are lowest between December and March (Irish Whale & Dolphin Group sightings database). Dedicated surveys (in June and July 2015, November 2015 and February 2016, May and July 2016, and November 2016 and March 2017) showed highest minke whale predicted densities off south-west Ireland (west Cork and Kerry) (Rogan et al., 2018). Along the south coast of Ireland, design-based density estimates were highest in summer, with a corrected estimate of 0.236 animals per km² (stratum 8), dropping further offshore to between 0.012 and 0.013 animals per km² (stratum 4) (Rogan et al., 2018). In the Celtic Deep between Ireland and Wales, predicted densities from a large-scale collation of dedicated surveys including SCANS and ObSERVE, ranged from 0.015 to 0.030 animals per km² (Evans & Waggitt, 2023).

Harbour porpoises (*Phocoena phocoena*) occur throughout the IMMA (Wall et al., 2013; Evans & Waggitt, 2020). Summer design-based density estimates in Irish offshore waters of the Celtic Sea (stratum 4) from the ObSERVE surveys were 0.227 animals per km² in summer, dropping to 0.06 animals per km² in winter (Rogan et al., 2018). In the coastal strip (stratum 8), the summer density estimate was 0.208 animals per km² and 0.06 animals per km² in winter. Predicted densities were highest in the south-west and south-east of Ireland (Rogan et al., 2018). In and around the Celtic Deep between Ireland and Wales, predicted densities were highest closest to the coast of the two countries where depths are 50 metres or less, with mean estimates ranging between 0.24 and 0.48 animals per km² between May and November dropping to between 0.18 and 0.24 animals per km² between December and April (Evans & Waggitt, 2023).

There is no discrete coastal population of bottlenose dolphins (*Tursiops truncatus*) within the IMMA, although members of the population that is predominantly resident to Cardigan Bay in West Wales sometimes range along the coast of west Pembrokeshire (Feingold & Evans, 2012; Lohrengel et al., 2017; Evans & Waggitt, 2021). Bottlenose dolphins are uncommon but regularly seen along the south coast of Ireland without showing any particular site fidelity, whilst animals from the large population of the pelagic ecotype are widely distributed offshore, although their main distribution is along the shelf edge further to the south (Rogan et al., 2018; Waggitt et al., 2020; Hammond et al., 2021). During the ObSERVE surveys in 2015-16, there were considerably more sightings of bottlenose dolphins in 2016 compared to 2015 and in winter than in summer with abundance estimates twice as high whilst there were more sightings in 2016 than 2015 (Rogan et al., 2018). Densities were highest in winter 2016, occurring in the Celtic Sea (stratum 4) with a predicted high density area offshore in the southern part (Rogan et al., 2018). Design-based density estimates were only 1.16 animals per km² in summer and 0.34 animals per km² along the south coast (stratum 8) whereas offshore (stratum 4), they ranged between years from 0.06 to 0.09 animals per km² in summer, and 0.10 to 0.93 animals per km² in winter (Rogan et al., 2018).

Common dolphins (*Delphinus delphis*) are also found throughout the region, mainly in waters deeper than 50 metres (Evans et al., 2007; Wall et al., 2013; Evans & Waggitt, 2020, 2023; Irish Whale & Dolphin Group and Sea Watch Foundation sightings databases). In and around the Celtic Deep between Ireland and Wales, predicted densities were highest where depths exceeded 50 m, with mean estimates ranging between 0.245 and 0.49 animals per km² between June and October dropping to between 0.18 and 0.24 animals per km² between November and May (Evans & Waggitt, 2023). Common dolphin abundance can vary greatly between years when it may peak at different times within the summer. A series of line transect surveys of the Celtic Deep in 2004-06 showed densities varying from 0.38 animals per km² to 0.69 animals per km², with greatest numbers, and a general increase, between June and August (Evans et al., 2007).

Figure 8: Common dolphin (*Delphinus delphis*) in the Celtic Deep. Photo credit: PGH Evans

Risso's dolphins (*Grampus griseus*) are uncommon in the region, although there are clusters of sightings off west Pembrokeshire in West Wales and around the Saltee Islands in Co. Wexford in south-east Ireland (Evans & Waggitt, 2020, 2023; Irish Whale & Dolphin Group and Sea Watch Foundation sightings databases). Sightings are highest between April and October. During the ObSERVE surveys, the mean density in summer along the south coast of Ireland (stratum 8) was 0.0565 animals per km² whilst offshore (stratum 4), densities ranged from 0.013 animals per km² in summer to 0.0006 animals per km² in winter (Rogan et al., 2018).

Figure 9: Risso's dolphin (*Grampus griseus*) in Celtic Deep. Photo credit: PGH Evans

Grey seals (*Halichoerus grypus*) breed in small numbers in Pembrokeshire, west Wales and along the south coast of Ireland (Kiely et al., 2000; Strong et al., 2006; O'Cadhla et al., 2008, 2013; Baines & Evans, 2012; Bull et al., 2017; Morris & Duck, 2019; SCOS, 2022). Annual pup production in Wales has been estimated at 2,250 (SCOS, 2022), of which the great majority are from colonies in Pembrokeshire (Baines & Evans, 2012; Bull et al., 2017; SCOS, 2022). Annual pup counts at one of the two largest breeding sites in Pembrokeshire around Skomer Island, showed sustained increases since 1983, estimated at 10.2% between 2011 and 2015, with 240 pups counted in 2015 (Bull et al., 2017). The other large breeding site is at Ramsey Island and the north Pembrokeshire mainland coast where 380 pups were counted between August 2015 and December 2016 (Morgan et al., 2018).

Around the Republic of Ireland, surveys undertaken between 2009 and 2012 estimated pup production for the main site on the south coast, the Saltee Islands (Co. Wexford), with at least 151 pups counted (O'Cadhla et al., 2013). More recently, aerial surveys in August 2017/18 targeting moulting harbour seals (*Phoca vitulina*), also counted grey seals. yielding estimates of 550 grey seals and 33 harbour seals (Morris & Duck, 2018). Further west along the south coast, in Roaringwater Bay and environs, several small colonies of grey seals exist, yielding a total of 411 grey seals and 115 harbour seals for that area. From tagging studies in the UK, it has been estimated that, on average, 72% of the populations of harbour seals (Lonergan et al., 2013) and 24% of grey seals (Russell et al., 2016) are hauled out, and therefore available for counting during these surveys. Movement studies of tagged grey seals have found them frequently utilising the Celtic Deep between Pembrokeshire and Ireland as well as moving all along the south coast of Ireland (Carter et al., 2017, 2022).

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Acknowledgements

We would like to thank the participants of the 2023 IMMA Regional Expert Workshop for the identification of IMMAs in the North East Atlantic Ocean. Funding for the identification of this IMMA was provided by the Water Revolution Foundation. Other sponsors for the workshop included OceanCare and ORCA (orca.org.uk), and substantial administrative support to the IMMA Secretariat was provided by the Tethys Research Institute and Whale and Dolphin Conservation.

Suggested Citation: IUCN-MMPATF (2024) Celtic Sea IMMA Factsheet. IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force, 2024.

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