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Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters: Appendix 1 - Data sources

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Appendix 1: Data Sources

Contents

Anderwald and Evans (2010): Cetaceans of the east Grampian region

Species: Bottlenose dolphin, harbour porpoise, white-beaked dolphin, minke whale, Risso's dolphin, killer whale, Atlantic white-sided dolphin, short-beaked common dolphin, long-finned pilot whale, humpback whale, fin whale, northern bottlenose whale, striped dolphin and sperm whale.
Relevant Draft Plan Option Region: North, North East
Relevant Draft Plan Option Area: E3
Area: East Grampian coastline
Year(s): 1973-2010
Month(s): All
Outputs: Sightings maps

Anderwald and Evans (2010) present systematic land- and vessel-based survey data along with casual sightings records from the Sea Watch Foundation national database covering the East Grampian coastline, with data presented from 1973 to 2010 (Figure 1). Data presented in the report also includes sightings from the Northern North Sea Cetacean Ferry Surveys (NORCET) surveys, and data from regular sea-based surveys mainly in the coastal waters between Stonehaven and Aberdeen since 1998. Most effort was coastal and so has no overlap with any Draft Plan Option sites, although boat-based effort to the east of Aberdeen does overlap with Draft Plan Option site E3.

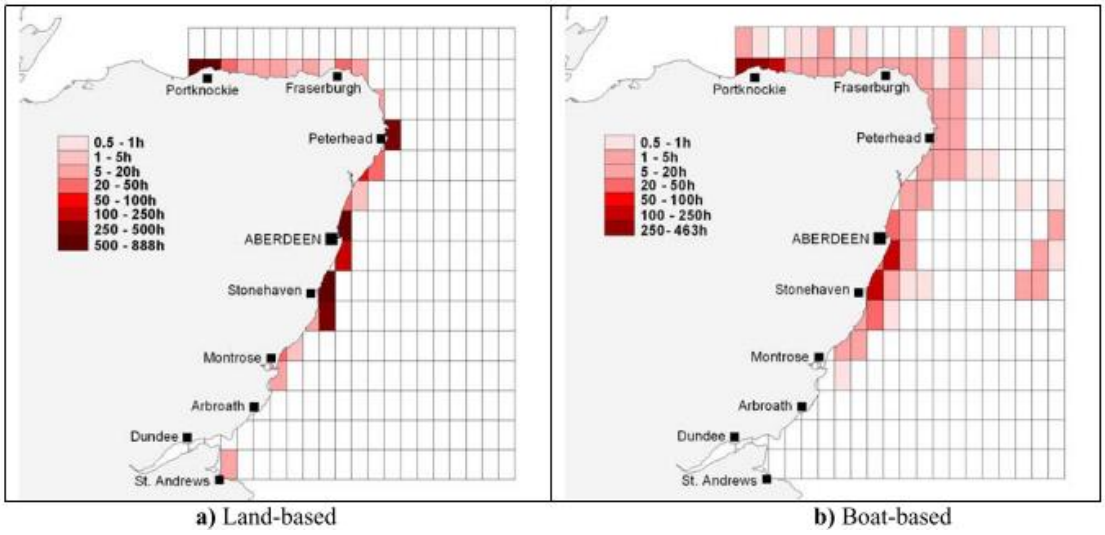

Figure 1 Distribution of effort during land- and vessel-based surveys presented in the 'Cetaceans of the East Grampian Region' report by Sea Watch Foundation (Anderwald and Evans 2010)

APEM and Marine Scotland: Strategic aerial surveys

Strategic aerial surveys along the east coast of Scotland are being commissioned to be undertaken by APEM by Marine Scotland. These surveys are primarily for birds, but marine mammal sightings will also be recorded. We cannot report on the exact start date of the surveys, or the survey route, but it is likely some Draft Plan Option areas may be covered.

Atlas of Cetacean Distribution: Reid et al. (2003)

Species: Humpback whale, minke whale, sei whale, fin whale, short-beaked common dolphin, white-beaked dolphin, Atlantic white-sided dolphin, Risso's dolphin, long-finned pilot whale, harbour porpoise, sperm whale, northern bottlenose whale, beaked whale spp., Mesoplodon spp., bottlenose

dolphin, striped dolphin, killer whale, northern right whale, blue whale, pygmy sperm whale, Cuvier's beaked whale, Sowerby's beaked whale and false killer whale.
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area:
Area: Whole UK
Year(s): 1979-1997
Month(s): All
Outputs: Map of sightings rates per standard hour surveyed

The Joint Nature Conservation Committee (JNCC) compiled and present the 'Atlas of Cetacean Distribution in north-west European waters' using data collected by various organisations between 1979 and 1997 (Reid et al. 2003). The data used within the Atlas included cetacean sightings data from three main sources: European Seabirds at Sea database (ESAS), Sea Watch Foundation and Small Cetaceans in European Atlantic waters and the North Sea (SCANS). This data can also be found within the Joint Cetacean Database, which is curated by JNCC. The ESAS surveys were designed for seabirds, but marine mammals were recorded (usually at 10-minute intervals) with year-round cetacean records. The Sea Watch Foundation data consisted of both land-based and offshore vessel surveys and the SCANS survey in 1994 included a combination of aerial and vessel surveys. Reid et al. (2003) used only sightings data that had associated effort data for their analysis and the maps presented in the Atlas. The final database consisted of 61,000 hours of observation, and 31,000 sightings of 138,000 individual cetaceans from the 28 cetacean species known to occurred in waters off north-west Europe in the previous 25 years.

There are several assumptions or limitations to the datasets included in the analysis. For example, variables such as the number of observers present and observer's experience may affect the probability of sighting a cetacean, though this was not corrected for as Reid et al. (2003) assumed they did not bias sightings rate by area. The data ranged from 1979 to 1997 and are treated as a snapshot of distribution over this period, thus not allowing for any consideration of inter-annual shifts in distribution. Likewise, no seasonal differences in distribution are considered. The analysis assumed that none of the data biases were systematic. Thus the patchiness of data needs to be considered when interpreting the maps, and the authors state that it would be "*inappropriate to infer too much about local densities of animals at the individual cell level*" and that the maps are intended more to show relative densities at the regional level.

Effective effort was calculated for eight of the 28 species presented and was calculated for each cell (an area/time combination) by multiplying search effort (minutes) in each sea state category by the appropriate correction factor informed by general additive modelling, and summing the total. For species where there were too few data to allow estimation of correction factors, sightings rates were presented as numbers of animals observed per unit search time, uncorrected.

Booth et al. (2013): Porpoise in the Hebrides

Species: Harbour porpoise
Relevant Draft Plan Option Region: North, West
Relevant Draft Plan Option Area: W1, N4
Area: Hebrides
Year(s): Visual: 2003-2010, Acoustic: 2004-2010
Month(s): April - Sept
Outputs: Predicted distribution and identification of habitat preference

Booth et al. (2013) used data from the Hebridean Whale and Trust (HWDT) collected from their survey vessel Silurian between April and September. The aim of the study was to identify the habitat preferences of harbour porpoise in the Hebrides; using Generalised Additive Models (GAMs) with Generalised Estimating Equations (GEEs) to identify the relationship between porpoise density and oceanographic covariates. Systematic surveys were conducted (visual from 2003-2010 and also towed acoustic from 2004-2010) following a systematic zig-zag pattern to ensure even coverage of the study area (as far as possible). A total of 58,059 km of visual survey effort (in Beaufort sea state ≤ 3), and 56,495 km of acoustic survey effort (in all sea states) was used in the analysis. The survey data overlaps with Draft Plan Option areas W1 and N4 to a lesser extent. As Booth et al. (2013) uses HWDT data, care should be taken when using both these datasets to assess distribution to ensure abundance or site use is not overestimated.

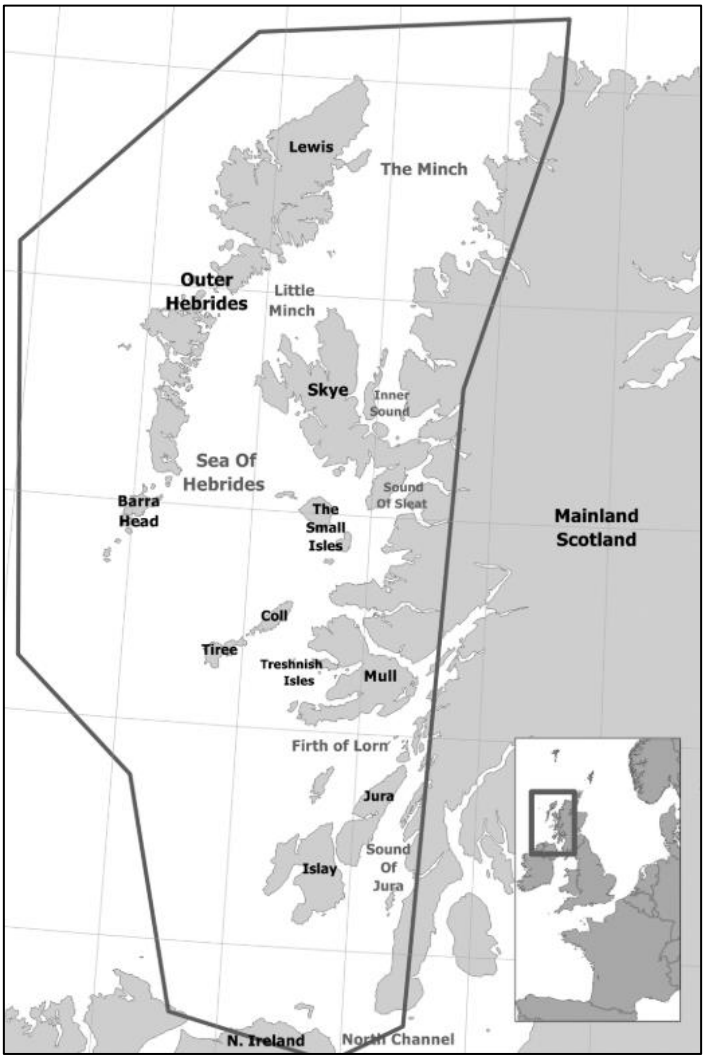

Figure 2 Survey area covered within Booth et al. (2013).

Cetaceans of the Atlantic Frontier: (Weir et al. 2001)

Species: Fin whale, sei whale, minke whale, humpback whale, sperm whale, northern bottlenose whale, Sowerby's beaked whale, killer whale, long-finned pilot whale, Atlantic white-sided dolphin, white-beaked dolphin, Risso's dolphin, bottlenose dolphin, short-beaked common dolphin and harbour porpoise.
Relevant Draft Plan Option Region: North, North East, West, South West
Relevant Draft Plan Option Area: None
Area: West and north Scotland
Year(s): 1979-1998, effort varied yearly
Month(s): All months of the year (not for all years), effort varied monthly
Outputs: Abundance and distribution data

Weir et al. (2001) present the data from surveys carried out throughout the year from chartered vessels, ferries and various vessels of opportunity e.g. research vessels, covering waters >2,300 m in depth to the north and west of Scotland between 1979 and July 1998 (study area: latitudes 55°00′N and 63°00′N, and longitudes 02°00′E and 11°30′W). The data are from surveys carried out by the Seabirds at Sea Team (SAST) of the JNCC, with data added to the European Seabirds at Sea (ESAS) database, and data from both databases are used in the analysis. The SAST surveys were carried out primarily for seabirds, with sightings of marine mammals conducted as an additional task. The survey covered a total of 155,308 km, though coverage had strong seasonal variation, with almost double the level of coverage during the summer months of May to October (100,177 km) than in winter (55,130 km). Most coverage was achieved in July (27,871 km), with least coverage in December (6,380 km). Survey coverage also varied geographically in respect to season, for example winter coverage of deep waters along the shelf edge was poor. The best year-round coverage was for inshore waters along the continental shelf, particularly the Minches and the Pentland Firth. Survey coverage also differed between years; surveys in earlier years mainly focusing on the North Sea, with emphasis moving to the shelf waters of north and west Scotland between 1986 and 1994 and deep waters being little covered during this time. The majority of offshore surveys in the Atlantic Frontier were more recent, between 1995 and 1998. Surveys were more intense along the continental shelf edge to the north and west of Shetland and the Western Isles from 1997 onwards, concentrating on waters where seabird and cetacean distribution is poorly known, despite oil license blocks being granted in those areas. Thus, the data was required to sufficiently inform oil contingency plans and Environmental Impact Assessments.

Between 1979 and July 1998, a total of 11,248 individual cetaceans of 15 species were recorded in the study area. An additional 907 animals were not identified to species level. The surveys did not record distance and angle to sighting, though animals were noted as being within or outside of the 300 m transect band. There was a concentration in observer effort to one side of the vessel. Due to the opportunistic way data were collected, the SAST methodology cannot be used to estimate absolute population densities of marine mammals sighted during the surveys, and instead Weir et al. (2001) present data for the most numerous species into a measure of abundance, using the number of individuals sighted per km of trackline travelled. Weir et al. (2001) therefore present cetacean distribution in three ways dependent on number of individual sightings per species: as sightings locations for species with <100 individual sightings, as number of individuals by species for species with 100-1,500 individuals observed, and as ‘abundance’ of species for species with >1,500 individuals sighted. For the latter abundance maps, survey effort was grouped by quarterly ICES (International Council for the Exploration of the Sea) rectangles (15′ latitude by 30′ longitude). Weir et al. (2001) highlight that the methodology does not allow for accurate

between species comparison of produced maps, due to variability in species detectability, though the maps do provide an indicative measure of individuals per km to inform distribution through the study area.

The uneven levels of survey coverage both spatially and temporally may result in inconsistencies in the distributions presented by Weir et al. (2001), especially affecting the number of sightings and consequent distribution estimates for some of the rarer, more seasonal species. Weather conditions inherently restrict survey opportunities, and also affect detectability of certain species. For example, high swell heights and higher sea states can reduce sightings rates for all species, but especially for the more inconspicuous species such as harbour porpoise.

Note that this data is also presented in a report published by JNCC in the previous year: 'The distribution of seabirds and marine mammals in the Atlantic Frontier, north and west of Scotland' (Pollock et al. 2000). The Pollock et al. (2000) report includes additional data from 1999, which makes up an extra 1,234 cetacean sightings. Therefore, both sightings maps are presented alongside one another in the report.

ESAS shipboard (1994-2010) and aeroplane survey data (1994 only, no marine mammal sightings) are included in the Joint Cetacean Protocol Database (Paxton et al. 2016). ESAS shipboard data (1980 to 2011) were also one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

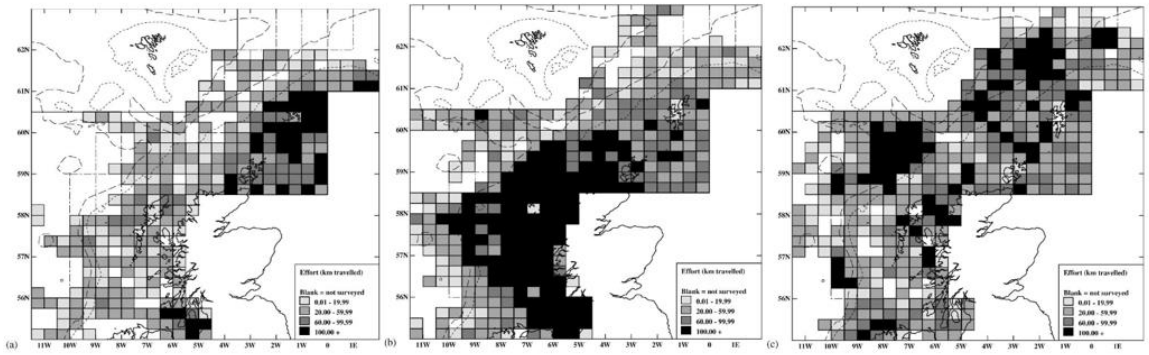

Figure 3 Survey effort between (a) 1979 and 1985; (b) 1986 and 1994; (c) 1995 and 1998 (Weir et al. 2001).

Clyde Porpoise CIC

Species: Harbour porpoise
Relevant Draft Plan Option Region: West, South West
Relevant Draft Plan Option Area: None (closest W1 and SW)
Area: Firth of Clyde
Year(s): Unknown
Month(s): Unknown
Outputs: Unknown

The Clyde Porpoise CIC[1] is a community interest project focused on the research and conservation of marine species in the Clyde area. Visual and acoustic surveys are conducted from a research yacht using volunteers who are trained while onboard. Data are

[1] https://www.clydeporpoise.org/

collected on marine mammal distribution and abundance and photo-ID is conducted on harbour porpoise. In addition, sightings data are collected and reported by the public. Both visual and acoustic data on porpoise, collected by the Clyde Porpoise CIC during 25 surveys between October 2016 and November 2017, was used in a MSc thesis to assess the fine scale distribution of porpoise in the Firth of Clyde (Brown 2018).

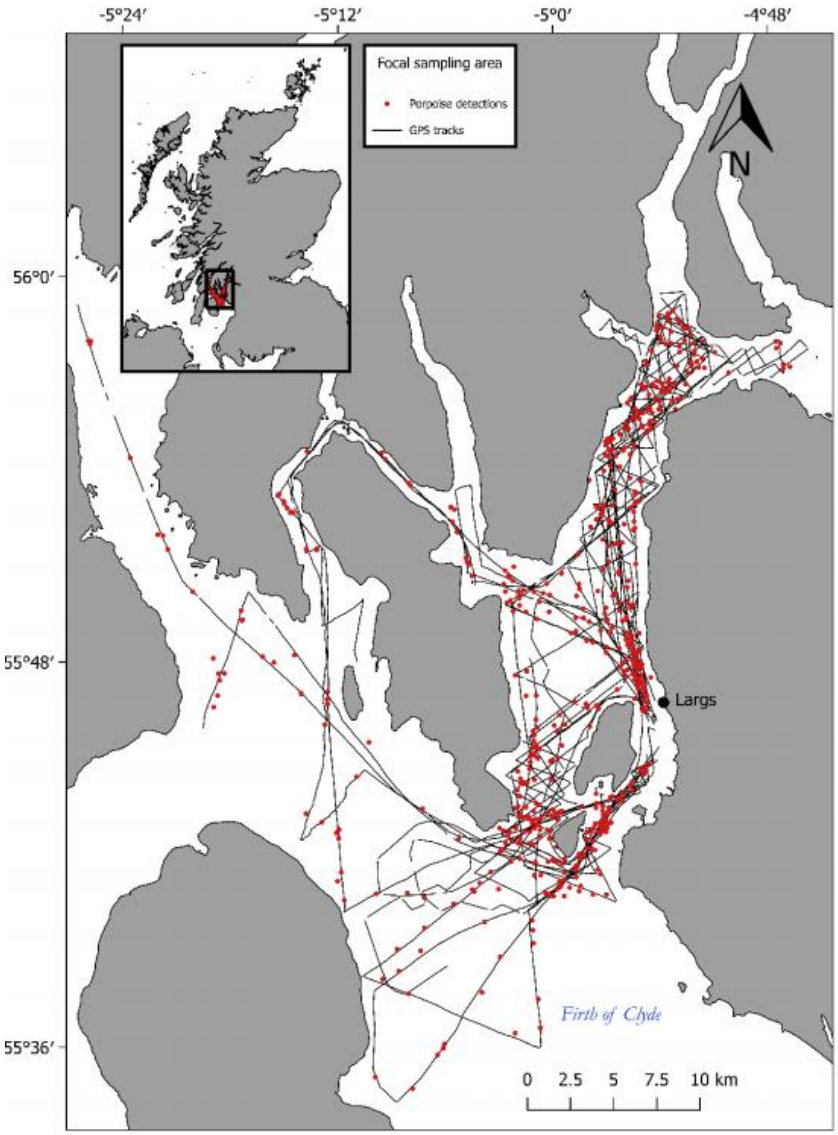

Figure 4 Vessel tracks and harbour porpoise detections from 25 surveys in the Firth of Clyde 2016-2017 (Brown 2018)

CODA: Cetacean Offshore Distribution and Abundance in European and Atlantic

Species: Common dolphin, striped dolphins, bottlenose dolphin, long-finned pilot whale, sperm whale, minke whale, fin whale and beaked whale spp.
Relevant Draft Plan Option Region: North
Relevant Draft Plan Option Area: None
Area: Offshore, beyond the west coast continental shelf

Year(s): 2007
Month(s): July
Outputs: Distribution and abundance estimates for offshore species

The Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA) project[2] (Hammond et al. 2009) aimed to estimate the abundance and habitat of cetaceans beyond the continental shelf, and was supported by institutes and governments in France, Ireland, Spain and the UK. The project aimed to inform conservation status of all cetacean species, and to assess the impact of bycatch of common dolphins and then to develop a management framework for determining safe bycatch limits for common dolphins within the surveyed area. The surveys consisted of visual vessel surveys along 9,651 km of transects covering a 968,000 km^2 survey area in July 2007 (Figure 5). Design-based and/or model-based estimation methods were used to estimate abundance of common dolphins, striped dolphins, bottlenose dolphins, long-finned pilot whales, sperm whales, minke whales, fin whales and beaked whales (Cañadas et al. 2009a, Hammond et al. 2009, Macleod et al. 2009). Density surface maps are also available for those aforementioned species, however the offshore nature of the surveys means there is no density estimates available from the CODA surveys that cover the Draft Plan Option areas. Because the CODA surveys do not overlap the Draft Plan Options regions, data from these surveys have not been presented in the species accounts.

Data from the CODA surveys are included in the Joint Cetacean Protocol Database (Paxton et al. 2016), and were incorporated in the analysis when producing the species distribution maps presented by Waggitt et al. (2020).

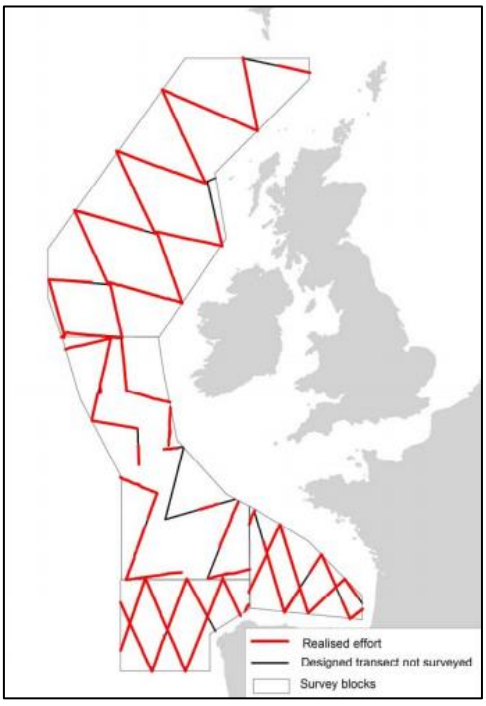

Figure 5 Survey blocks, designed cruise tracks and realised effort for the CODA surveys.

[2] http://biology.st-andrews.ac.uk/coda/

COMPASS: Collaborative Oceanography and Monitoring for Protected Areas and Species

Species: Harbour porpoise, dolphin species
Relevant Draft Plan Option Region: North, West, South West
Relevant Draft Plan Option Area: No direct overlap, but close to N2, N3, N4, W1 and SW1.
Area: West Scotland
Year(s): 2017 - present
Month(s): All
Outputs: Tables of detection-positive hours (DPH) separated as either dolphin species or porpoise.

The COMPASS project[3], funded through the EU INTERREG VA programme, consists of a network of 12 static passive acoustic monitoring buoys across the waters of Republic of Ireland, Northern Ireland and West Scotland. The aim of the project is to develop marine observational and data management capacity in order to effectively monitor and manage cross-border MPAs. The monitoring buoys are fitted with the latest oceanographic sensors, acoustic recorders and advanced fish tracking technology. For cetaceans, the aim is to use the buoys to detect and monitor changes in cetacean occurrence, develop methodologies to identify cetacean species from acoustic detections, and to monitor and report on ambient noise levels. The COMPASS consortium consists of five partners working in the marine research; the Agri-Food and Biosciences Institute, in conjunction with the Marine Institute, Inland Fisheries Ireland, Scottish Association for Marine Science and Marine Science Scotland.

Preliminary analysis of the first two years of monitoring show a large degree of variability in rates of detection between sites, with generally higher rates of detection in winter, and stronger seasonal patterns tending to be at deeper water sites (Edwards et al. 2019). Whilst analysis so far has only covered dolphin species and porpoise, there is potential for data analysis to detect other odontocete species, mysticetes and pinnipeds. Preliminary analyses of March and April 2018 found detections of humpback whales at three sites: Tolsta, Stoer Head and Stanton Banks (Risch et al. 2019).

[3] https://compass-oceanscience.eu/

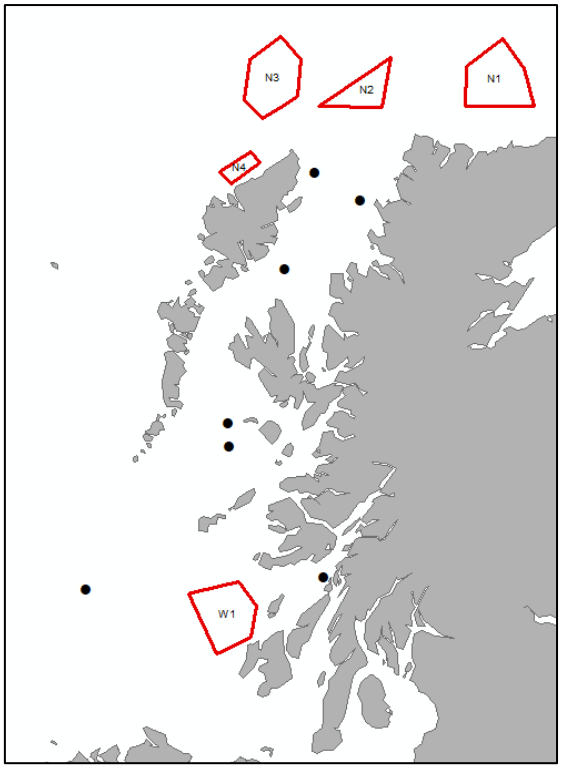

Figure 6. COMPASS passive acoustic monitoring sites (red dots) on the west coast of Scotland. Overlaid for reference are the Draft Plan Option areas.

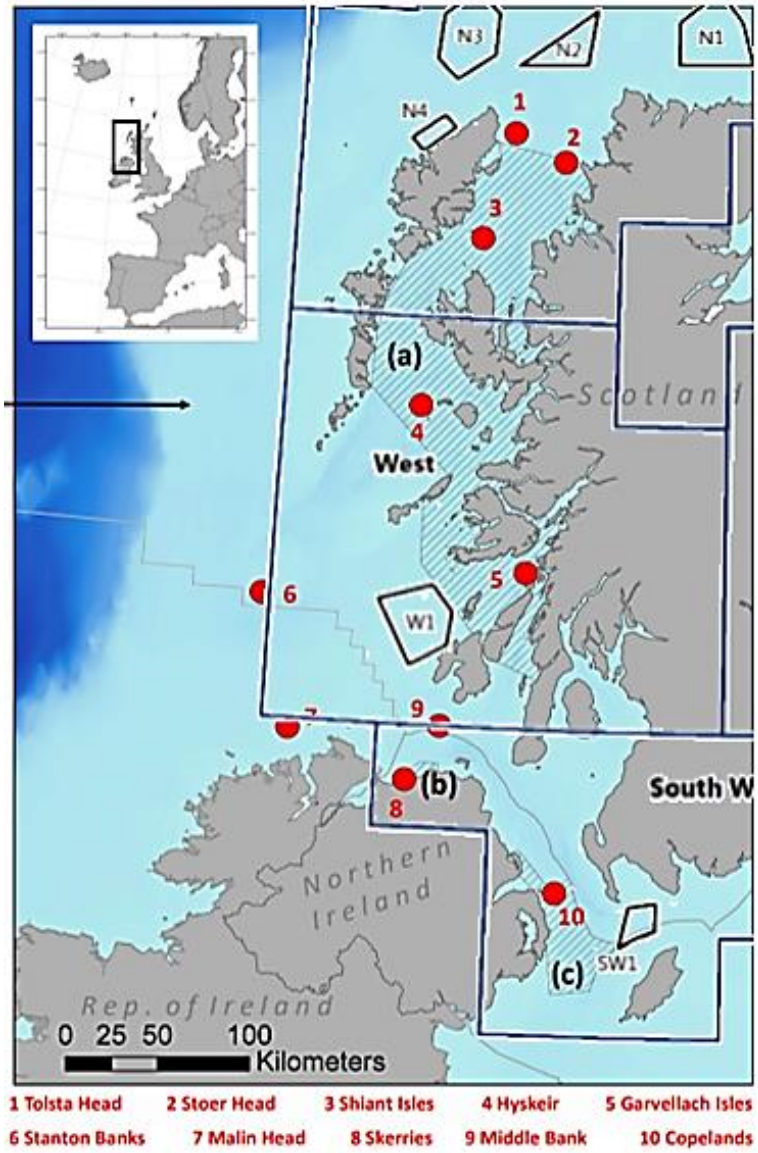

Figure 7 Location of C-PODs deployed since 2017 as part of the COMPASS project. Crosshatched areas represent Special Area of Conservation for harbour porpoise: a) Inner Hebrides and Minches SAC b) Skerries and Causeway SAC c) North Channel SAC (Edwards et al. 2019). Overlaid for reference are the approximate Draft Plan Options areas and regions.

CRRU: Cetacean Research and Rescue Unit

Species: Bottlenose dolphin, harbour porpoise and minke whale
Relevant Draft Plan Option Region: North East
Relevant Draft Plan Option Area: None (closest to NE5)
Area: Southern Moray Firth
Year(s): 1997-current
Month(s): Summer
Outputs: Sightings data

The CRRU[4] is a marine conservation charity aiming to understand and conserve coastal cetacean species in the inshore waters of the outer Moray Firth. The CRRU primarily surveys bottlenose dolphins, however they also collate data on minke whales and harbour porpoise and have used a varied of methods including photo-ID, behavioural studies, focal follows and applied remote sensing. The primary CRRU study area extends between Lossiemouth and Fraserburgh and covers an area of 880 km^2 (Figure 8). Surveys are conducted by volunteers who are trained onsite.

Four years of data from CRRU, spanning from 2009 to 2015 are included in the Waggitt et al. (2020) analysis.

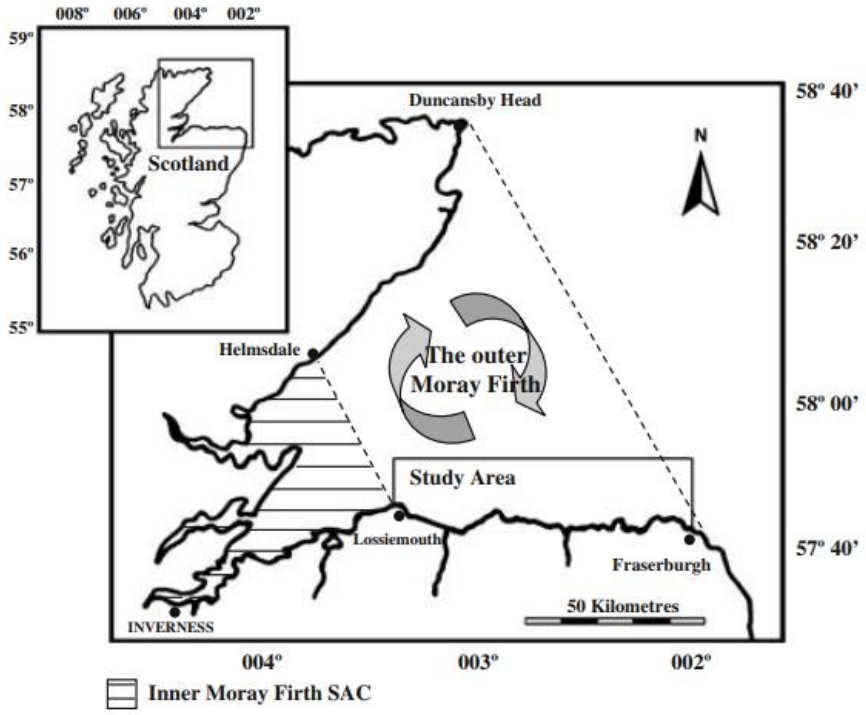

Figure 8 Location of the primary CRRU study area within the southern Moray Firth (Robinson et al. 2009).

ECOMMAS: East Coast Marine Mammal Acoustic Study

Species: Harbour porpoise, dolphin species
Relevant Draft Plan Option Region: North East and East
Relevant Draft Plan Option Area: None (closest is NE4, NE5, NE6, E3)
Area: Coastal east Scotland
Year(s): 2013-present
Month(s): All (summer only in 2013)
Outputs: Tables of detection-positive days (DPD) and detection-positive hours (DPH)

The ECOMMAS project[5] began in 2013 and has deployed 30 acoustic recorders (C-PODs) and 10 broadband acoustic recorders along the east coast of Scotland. There are two deployments undertaken per year, with data covering April to November. The aim is to

[4] http://www.crru.org.uk/
[5] http://marine.gov.scot/information/east-coast-marine-mammal-acoustic-study-ecommas

collect data on the relative abundance of dolphins and porpoise. Every mooring carries one C-POD, with some moorings also including an SM2M device. Since the surveys use passive acoustic methods, they are only able to detect vocalizing marine mammal species. The C-POD data are presented as detection-positive days (DPD) and detection-positive hours (DPH). The proportion of DPD and median DPH are then calculated for both species. The data are also available as raw data, if specifically requested.

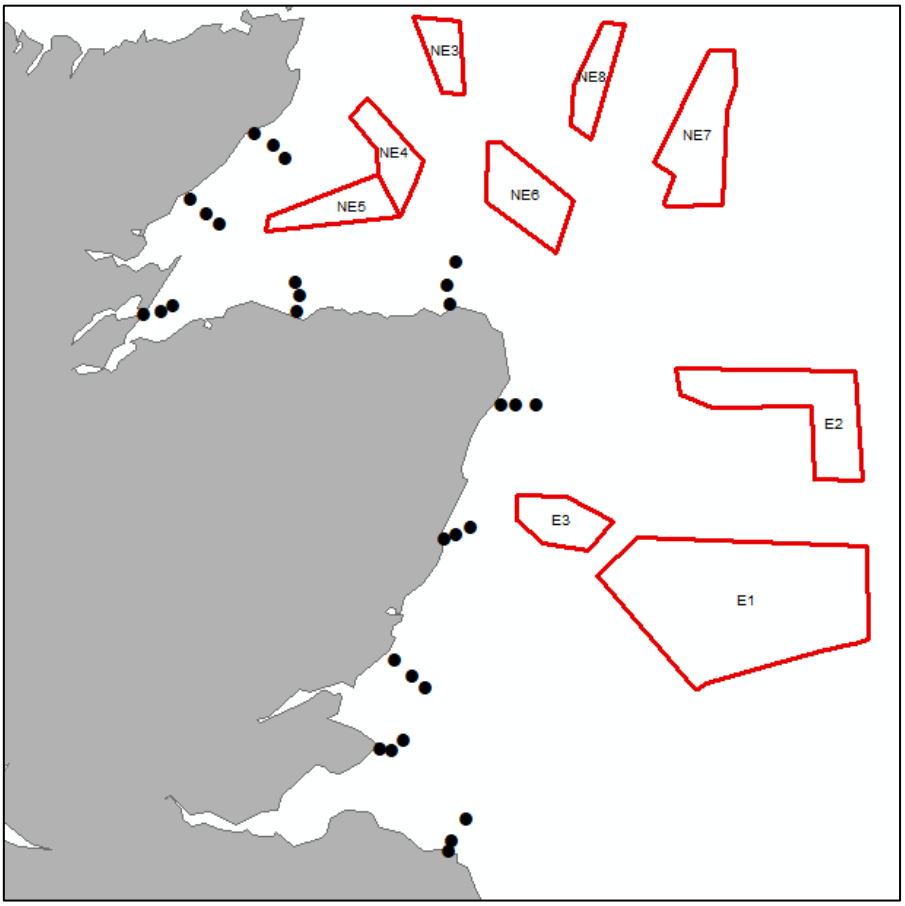

Figure 9. ECOMMAS acoustic monitoring sites along the east coast of Scotland. Overlaid for reference are the Draft Plan Option areas.

Embling (2007): Cetaceans in West Scotland

Species: Sperm whale, harbour porpoise, delphinids (not classified to species level)
Relevant Draft Plan Option Region: North, West, North East
Relevant Draft Plan Option Area: N1, N2, N3, N4, W1
Area: North and West Scotland
Year(s): 2003-2005
Month(s): May, Jul, Sep, Oct
Outputs: Sighting distribution maps

Passive acoustic monitoring was used to detect harbour porpoise, delphinids and sperm whales in the offshore waters west of Scotland, between July 2003 and October 2005. Hydrophones towed behind platform of opportunity vessels were used to collect data on cetacean distributions, and detection data are presented on sperm whales, harbour porpoise

and delphinids, although dolphins are not identified to species-level. This resulted in 11,475 km of survey effort, and 1,247 nine km segments (Figure 10) with 624 hours of listening effort. Generalised additive models were then used to relate species' distribution to a range of environmental variables.

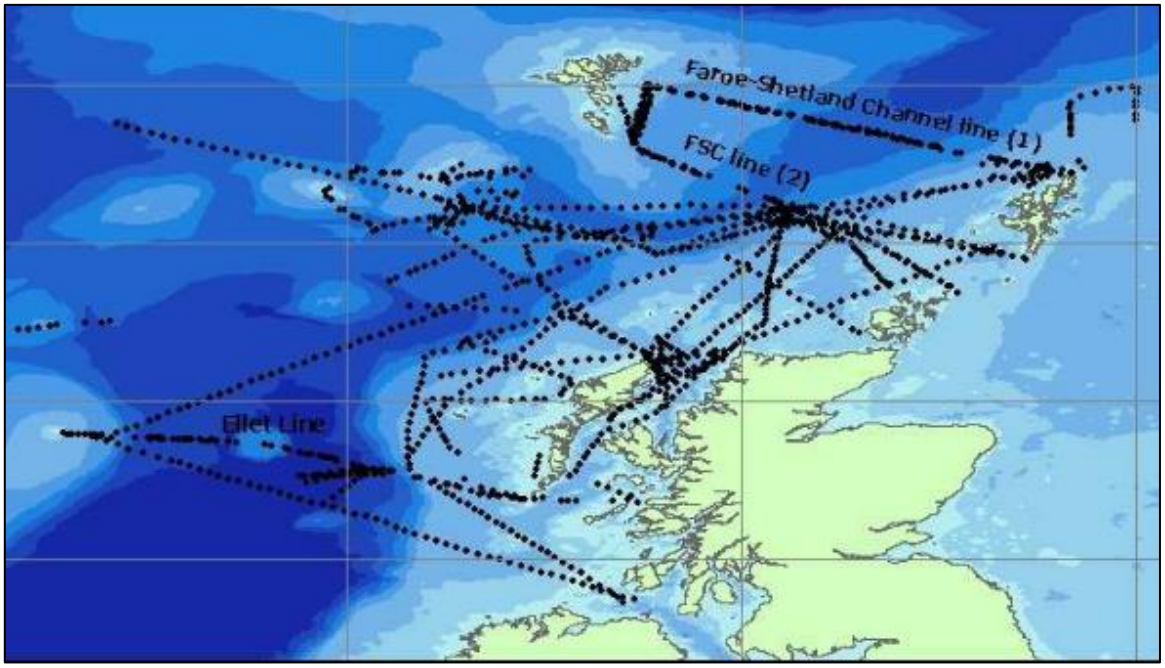

Figure 10 Survey area off the west coast of Scotland with 9 km surveyed segments overlaid (each black dot is a 9km segment) for surveys carried out opportunistically between July 2003 and October 2005. This does not include the inshore survey effort also carried out as part of this study (Embling 2007)

Evans et al. (2011): Cetaceans in the Pentland Firth and Orkney waters

Species: All cetaceans
Relevant Draft Plan Option Region: North, North East
Relevant Draft Plan Option Area: N1, NE2 and NE3.
Area: Pentland Firth and Orkney Isles
Year(s): 1980-2010
Month(s): All
Outputs: Sightings maps

Evans et al (2011) collated data from 12 sources, including Sea Watch Foundation, ESAS, SCANS I and SCANS II, and the John O'Groats ferry[6], to assess the abundance and behaviour of cetaceans in the Pentland Firth and Orkney waters. This combined dataset contained data obtained from opportunistic, casual and systematic surveys with data spanning thirty years from 1980 to 2010. No effort data were presented in this report alongside the sightings data which prevented the calculation of density estimates for any of the cetacean species. Whilst the sightings cannot be used to inform relative abundance, they can be utilised to highlight presence of species in these areas. Sightings and species presence are especially relevant to Draft Plan Options sites N1 and NE2.

[6] See Evans et al. (2011) for the list of data sources used.

FSC Millport

Relevant Draft Plan Option Region: West, South West
Relevant Draft Plan Option Area: None (closest W1 and SW)
Area: south west Scotland, Firth of Clyde

FSC Millport[7] is an educational field centre on the Isle of Cumbrae in the Firth of Clyde, and has been run by the Field Studies Council since 2014. Prior to this the centre was a higher education institute run by the University of London in partnership with Glasgow University between 1970 and 2013. Throughout both ownership periods, the field centre has delivered educational courses on marine mammal identification, including boat-based survey and transect techniques. The data recorded from such courses have historically been submitted to various places. Between 1999 and 2018, data recorded during marine mammal courses (including surveys in the Clyde and the Minches) was submitted to either HWDT or Sea Watch Foundation. Since 2016, marine mammal sightings recorded during surveys are usually uploaded to iRecord (which ultimately then feeds into the National Biodiversity Network) and/or Sea Watch Foundation.

HWDT: Hebridean Whale and Dolphin Trust

Species: Bottlenose dolphin, Common dolphin, Harbour porpoise, Humpback whale, Killer whale, Minke whale, Risso's dolphin and White-beaked dolphin
Relevant Draft Plan Option Region: North, West, South West
Relevant Draft Plan Option Area: N4 and W1
Area: Hebrides
Year(s): 2003-2017 (data collected since but not provided)
Month(s): Apr to Oct
Outputs: Sightings per unit effort

The Hebridean Whale and Dolphin Trust (HWDT)[8] maintains a dataset of marine mammal and other marine megafauna sighting locations, acoustic recordings, photographs, and associated effort for the west coast of Scotland from 2003 – present. HWDT carry out dedicated visual and acoustic surveys aboard their research vessel, Silurian, covering a wide geographical area off the west coast of Scotland (Figure 11). Surveys operate between April and October, though since January 2019 a winter monitoring programme has also been introduced. Since 2002, Silurian has used a towed hydrophone system to collect acoustic data in order to detect cetaceans, and >6,000 hours of recordings have been collected. Data are currently being prepared for analysis.

HWDT also collate sightings data from other sources, e.g. Tobermory based whale-watching operator Sea Life Surveys and the Irish Whale and Dolphin Group. To encourage sightings submissions from the general public, in July 2017 HWDT launched Whale Track, a sightings platform consisting of a web-portal[9] and a smartphone app, which allows anyone on the west coast of Scotland to collect effort-based sightings data. Data are currently being prepared for analysis.

[7] https://www.field-studies-council.org/locations/millport/
[8] hwdt.org
[9] whaletrack.hwdt.org

The Hebridean Marine Mammal Atlas[10] (Hebridean Whale and Dolphin Trust 2018) presents the results of 15 years of survey data between 2003 to 2017, resulting in nearly 200 surveys, 144,000 hours on board Silurian and 105,368 km travelled conducting surveys. The surveys are conducted along straight, random transect lines using standard line transect methodology. Surveys go “off effort” for photo-ID purposes. Between 2003 and 2017 the surveys recorded 30,389 individual marine animals during 13,131 sightings, of which 11,493 sightings and 28,170 animals were identified to species level. A total of 10 cetacean and two pinniped species have been sighted.

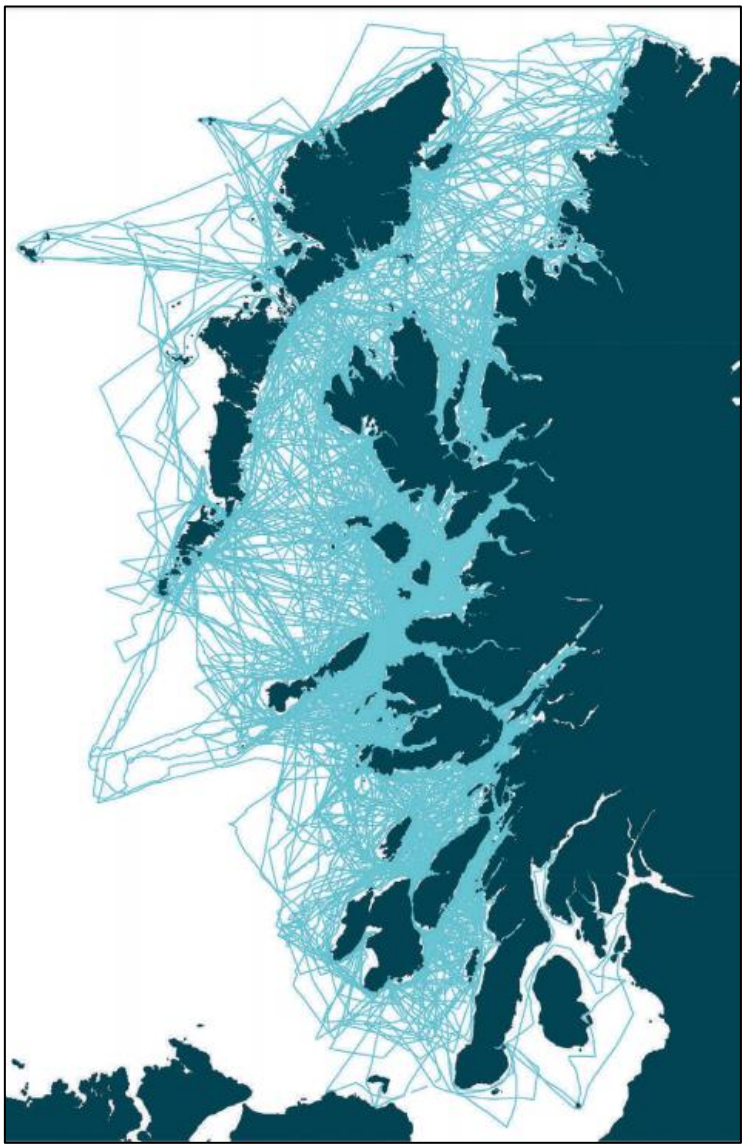

Figure 11 HWDT 15 years of visual and/or acoustic surveys on the Silurian (Hebridean Whale and Dolphin Trust 2018)

[10] https://hwdt.org/hebridean-marine-mammal-atlas

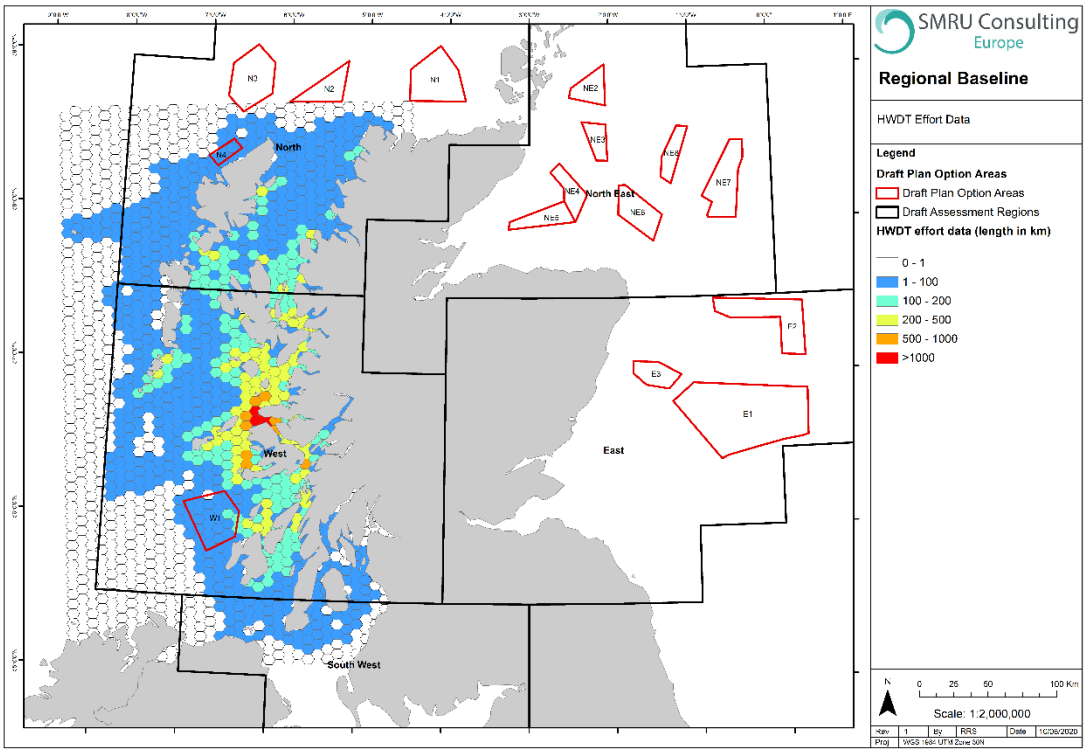

Figure 12 HWDT visual survey effort 2003-2019[11]. Overlaid for reference are the Draft Plan Option areas.

Data collected by HWDT on eight surveys between 2003 around the Hebrides and north-east Scotland are included in the Joint Cetacean Protocol Database (Paxton et al. 2016). HWDT data collected between 2002 to 2015 were also one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

HiDef Ltd (2015): Strategic surveys in Scotland

Species: Harbour porpoise, minke whale, harbour seal, grey seal, white-beaked dolphin, bottlenose dolphin
Relevant Draft Plan Option Region: North East, East
Relevant Draft Plan Option Area: NE5, E3
Area: Coastal east Scotland, Orkney
Year(s): 2014
Month(s): Aug-Nov
Outputs: Sightings data

[11] Hebridean Whale and Dolphin Trust 2020. Marine wildlife sightings and associated effort for the west coast of Scotland. Silurian Dataset 2003 – 2019. Supplied 30th April 2020. Made available under agreement on terms and conditions of use, and accessible via Hebridean Whale and Dolphin Trust (HWDT), Tobermory, United Kingdom.

In 2014, HiDef Aerial Surveying Ltd[12] were contracted by Marine Scotland to conduct 11 surveys between August and November covering the east coast of Scotland, the southern Moray Firth and parts of Orkney, totaling 7,022.7 km of trackline (Figure 13). The purpose of the surveys was to provide information on the distribution of marine mammals and seabirds to assist the deployment of offshore marine renewable energy and the development of a network of MPAs in Scottish waters. The surveys were primarily coastal and so there was little overlap with Draft Plan Option areas, however, the data are useful to inform characterisation of potential offshore cable routes and landfall areas.

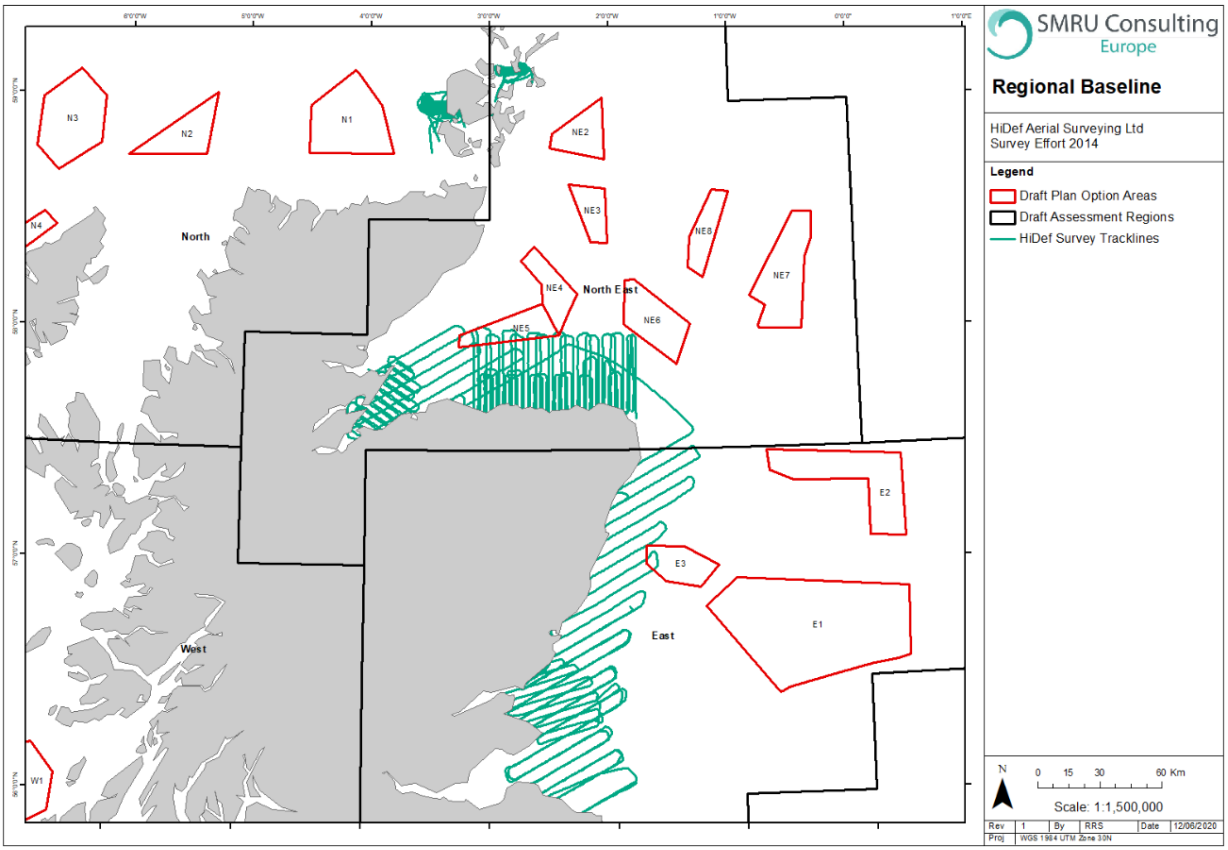

Figure 13 Survey tracklines conducted during the HiDef aerial surveys in 2014. Overlaid for reference are the Draft Plan Option areas.

Heinänen and Skov (2015): Harbour Porpoise modelling to inform SAC designation

Species: Harbour porpoise
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1994-2011
Month(s): Summer (Apr-Sep) and Winter (Oct-Mar)
Outputs: Density surface maps

[12] https://hidef.bioconsult-sh.de/

Heinänen and Skov (2015) conducted a detailed analysis of 18 years of survey data on harbour porpoise around the UK between 1994 and 2011 held in the Joint Cetacean Protocol (JCP) database. The goal of this analysis was to try to identify “discrete and persistent areas of high density” that might be considered important for harbour porpoise with the ultimate goal of determining SACs for the species. The analysis grouped data into three subsets: 1994-1999, 2000-2005 and 2006-2011 to account for patchy survey effort and analysed summer (April-September) and winter (October- March) data separately to explore whether distribution patterns were different between seasons and to examine the degree of persistence between the subsets.

The authors note that “*due to the uneven survey effort over the modelled period, the uncertainty in modelled distributions vary to a large extent*”. In addition, the authors stated that “*model uncertainties are particularly high during winter*”. The uncertainty of the modelled density estimates (visualised by the patterns of relative standard errors) indicates that robust model predictions in all shelf waters of the North Sea and in most parts along the north-west Scottish coast. However, model uncertainties are particularly high during winter as well as offshore off northwest Scotland.

Inter-Agency Marine Mammal Working Group (IAMMWG 2015): Harbour porpoise density to inform SAC designation

Species: Harbour porpoise
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1965-2014
Month(s): Summer and winter
Outputs: Modelled occurrence of harbour porpoise

The UK statutory nature conservation bodies (SNCBs) (including Joint Nature Conservation Committee (JNCC), Natural England (NE), National Resources Wales (NRW), Department of Environment Northern Ireland (DoE NI) and Scottish National Heritage (SNH)) used sea-based data from Heinänen and Skov (2015) and land-based data from a consortium led by the Sea Watch Foundation (Evans et al. 2015) to model the occurrence of harbour porpoise around the UK between 1994 and 2014 in order to identify possible SACs for harbour porpoise (IAMMWG 2015). The dataset used by Heinänen and Skov (2015) is detailed in Section 0. The dataset used by Evans et al. (2015) included >70,000 hours of watches from 678 sites round the UK since 1965. Figure 14 shows the number of years coverage around the UK in 5x5 km grid cells. Areas of search were identified from the survey data (taking into account the confidence in the underlying model predictions and the number of years of data available) and further refined to define boundaries that represent the distributional range of harbour porpoises in UK waters, taking into consideration the land-based data where boundaries were near the coast.

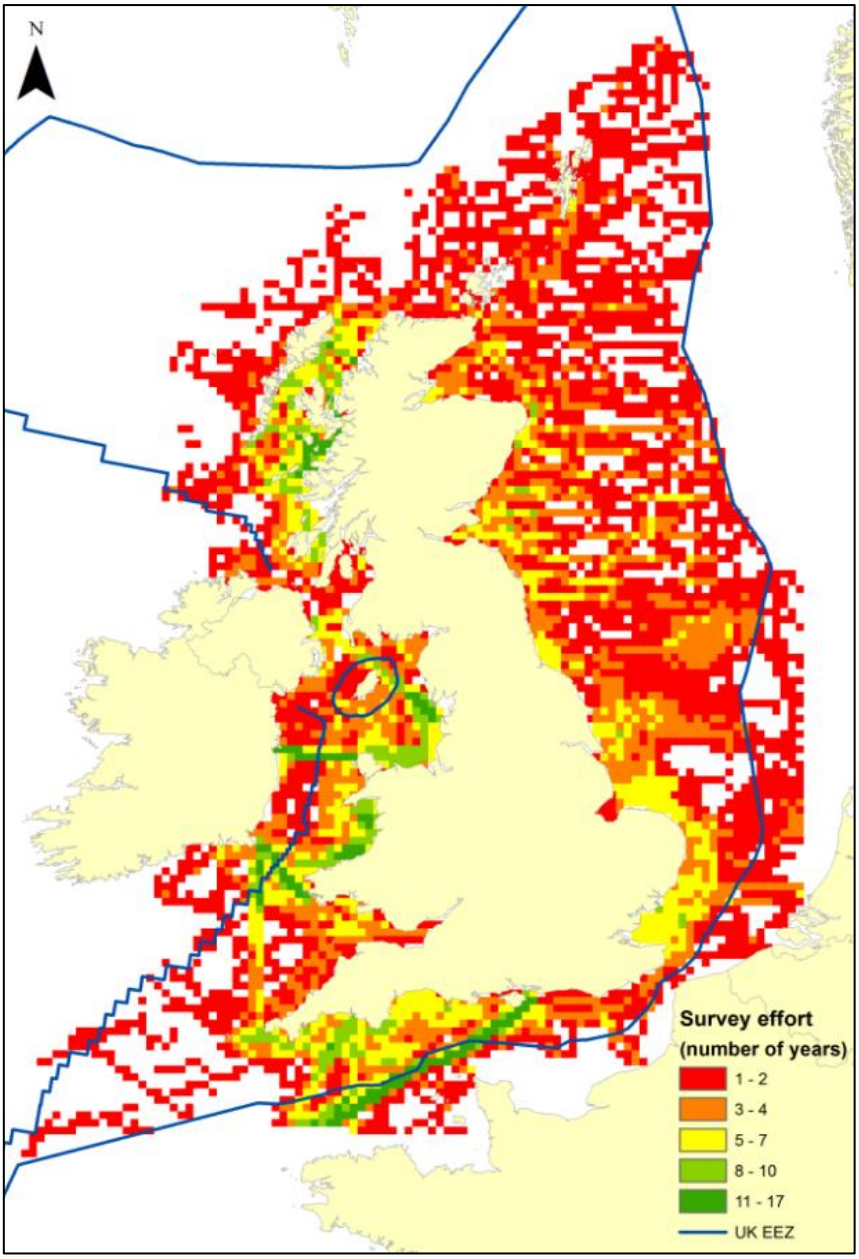

Figure 14 Number of years with survey coverage in each 5km x 5km grid cell within UK EEZ. Red pixels indicate those areas that have only one or two years in which surveys occurred, whilst orange, yellow and green pixels indicate areas when surveys occurred in three or more years. Obtained from IAMMWG (2015)

Irish Whale and Dolphin Group

Species: Unknown
Relevant Draft Plan Option Region: South West
Relevant Draft Plan Option Area: SW1
Area: Unknown
Year(s): 2006 - present
Month(s): Unknown
Outputs: Unknown

The Irish Whale and Dolphin Group[13] (IWDG) are an Irish-based sightings and stranding scheme. Part of this work includes a ferry survey programme which conducts line transect surveys for cetaceans on various routes, with one route which enters Scottish waters and has been ongoing since 2006 (2006-2012: Larne-Cairnryan, 2013-present: Belfast-Cairnryan). However, IWDG have little data covering Scottish waters, and sightings of interest are passed on to HWDT (Simon Berrow, pers comms, 5th May 2020), and therefore no IWDG data were shared with SMRU Consulting to include in this report. IWDG sightings may be represented in work that includes HWDT datasets.

Data collected by IWDG on 'big boat' vessels between 2003 and 2009, and on ferries between 2001 and 2010, are included in the Joint Cetacean Protocol Database (Paxton et al. 2016). IWDG data collected between 2001 and 2016 were also one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

Joint Cetacean Protocol data analysis: Paxton et al. (2016)

Species: Harbour porpoise, minke whale, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, white-beaked dolphin and Atlantic white-sided dolphin
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1994-2010
Month(s): Summer
Outputs: Estimate spatial and temporal patterns of abundance

The JCP Phase III analysis included datasets from 38 sources[14], totalling over 1.05 million km of survey effort between 1994 and 2010 from a variety of platforms. The JCP Phase III analysis was conducted to combine these data sources to estimate spatial and temporal patterns of abundance for seven species of cetaceans (Paxton et al. 2016).

In 2017, JNCC released R code[15] that can be used to extract the cetacean abundance estimates for summer 2007-2010 (average) for a user-specified area. This code was originally created by Charles Paxton at the Centre for Research into Ecological and Environmental Modelling (CREEM) and was modified by JNCC to include abundance estimates that are scaled to the SCANS III results.

There are several limitations of this dataset. The data are between 10 and 26 years old and as such, and so do not provide a recent density estimate against which to assess impacts for any future EIAs. The authors state that the JCP database provides relatively poor spatial and temporal coverage, that the results should be considered indicative rather than an accurate representation of species distribution, and that due to the patchy distribution of data, the

[13] https://iwdg.ie/
[14] Cardigan Bay Marine Wildlife Centre, CODA 2007, University of Aberdeen, Cornwall Wildlife Trust, DECC, DONG Energy, East Anglia Offshore Wind Ltd, ScottishPower Renewables, EDP Renewables, Repsol Nuevas Energias UK, Eneco, E.on Energy Solutions Limited, European Seabirds at Sea, Forewind Ltd, HiDef Aerial Surveying Ltd, Hebridean Whale and Dolphin Trust, DHI, Marine Observers, Irish Whale and Dolphin Group, Mainstream Renewable Power
Marine Awareness North Wales Wildlife Trust, Marine Conservation Research Ltd, University of Aberdeen Lighthouse Field Station (projects funded by DECC, and Talisman Energy (UK) Ltd), Whale and Dolphin Conservation Society and WWT Consulting.
[15] https://hub.jncc.gov.uk/assets/01adfabd-e75f-48ba-9643-2d594983201e

estimates are less reliable than those obtained from SCANS surveys. In addition, the authors categorically state that the JCP Phase III outputs cannot be used to provide baseline data for impact monitoring of short term change or to infer abundance at a finer scale than 1,000 km^2 because of issues relating to standardizing the data (such as corrections for undetected animals and potential biases) from so many different platforms/ methodologies and the strong assumptions that had to be made when calculating detection probability. In addition, the density estimate obtained from the Data Analysis Tool is an averaged density estimate for the summer 2007-2010 and is therefore not representative of densities at other times of the year.

Joint Cetacean Data Programme (JCDP)

The JCDP[16] is a project currently managed by JNCC, which plans to collate all UK-wide existing cetacean monitoring data that has been collected at all spatial and temporal scales, in order for this collation of data to be used for a range of analyses which can then inform conservation and policy needs. The JCDP has just completed Phase 1, although the outcomes of this are currently unpublished. In Phase 1, work has been undertaken to develop draft data sharing agreements suitable for such a wide range of datasets, and the scope of the work has been developed and submitted to funders. At the time of writing, we are not aware when the JCDP project will recommence, but this will likely be an extremely useful resource when available.

[16] https://jncc.gov.uk/our-work/joint-cetacean-data-programme/

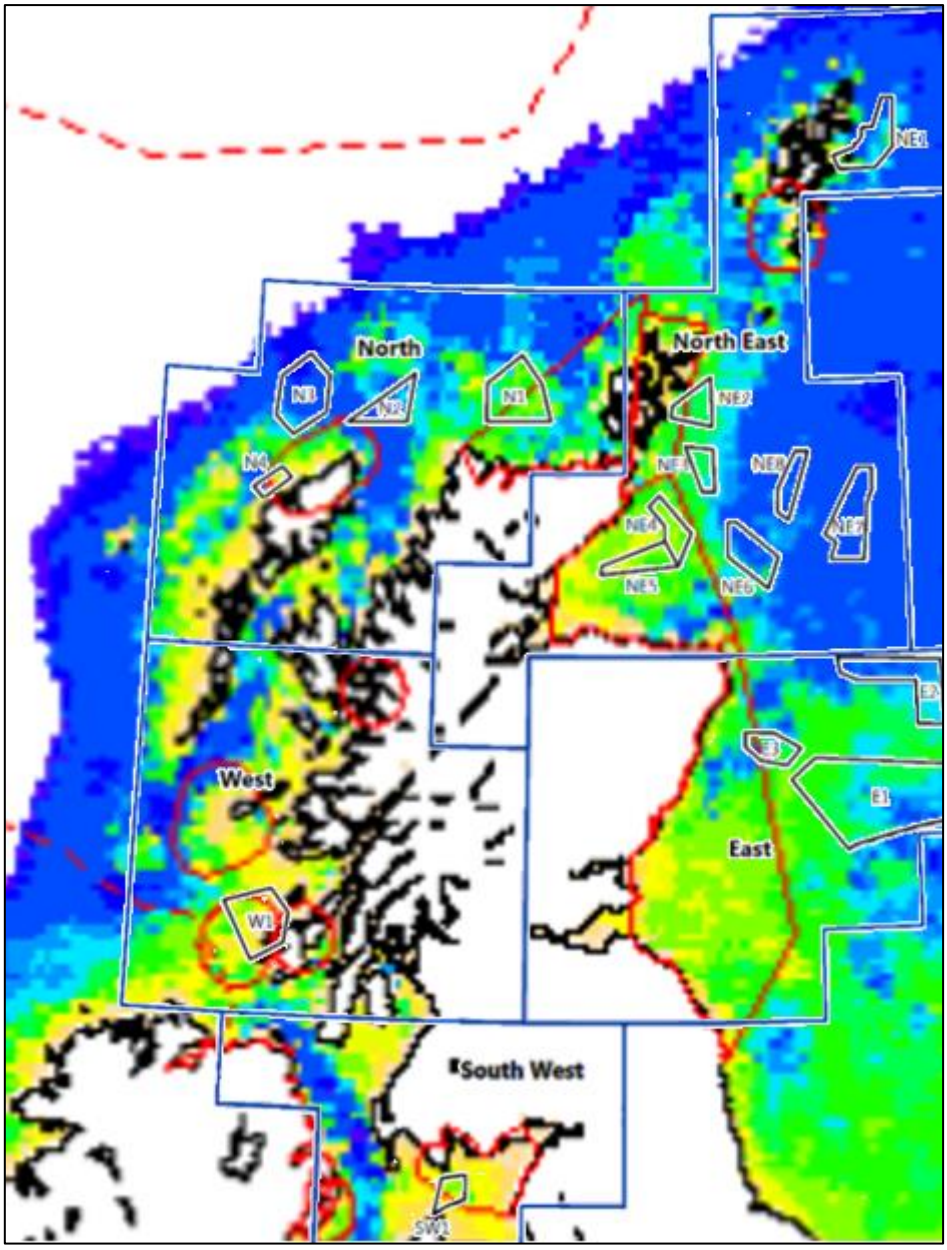

Figure 15 The Scottish section of the JCP Phase III region showing (red lines) areas of interest for offshore development where estimates of abundance are of special commercial interest. Colour denotes depth. Overlaid are the approximate locations of the DPO areas and regions for reference.

Lighthouse Field Station (University of Aberdeen): Bottlenose dolphin surveys

Species: Bottlenose dolphin. Sightings of other cetacean species are noted, including harbour porpoise, minke whale, sperm whale, common dolphin and humpback whale.
Relevant Draft Plan Option Region: North East
Relevant Draft Plan Option Area: None (closest to NE5)
Area: Moray Firth SAC
Year(s): 2002-2016
Month(s): May to September
Outputs: Sightings and associated effort, photographs for individual identification

Photo identification (photo-ID) surveys in the Moray Firth SAC have been conducted since 2002 in order to monitor the condition of bottlenose dolphins within the SAC (Cheney et al. 2012, Cheney et al. 2014, Cheney et al. 2018). Surveys are conducted in the summer months between May and September, in Beaufort sea state 3 or less. Survey routes are chosen randomly in order to maximise the probability of sightings while also obtaining reasonable coverage of the core study area. The surveys are concentrated in the Inner Moray Firth between Cromarty, Inverness and Balintore, with more occasional surveys to the north and along the southern coast of the Moray Firth to Cullen (Figure 16). Effort and sightings data have been provided for 2002 to 2016; surveys were conducted in 2017, 2018 and 2019 but have not yet been reported on and so are not included here.

The surveys were primarily coastal and so there is no overlap with Draft Plan Option areas, however, the data are useful to inform characterisation of potential offshore cable routes and landfall areas.

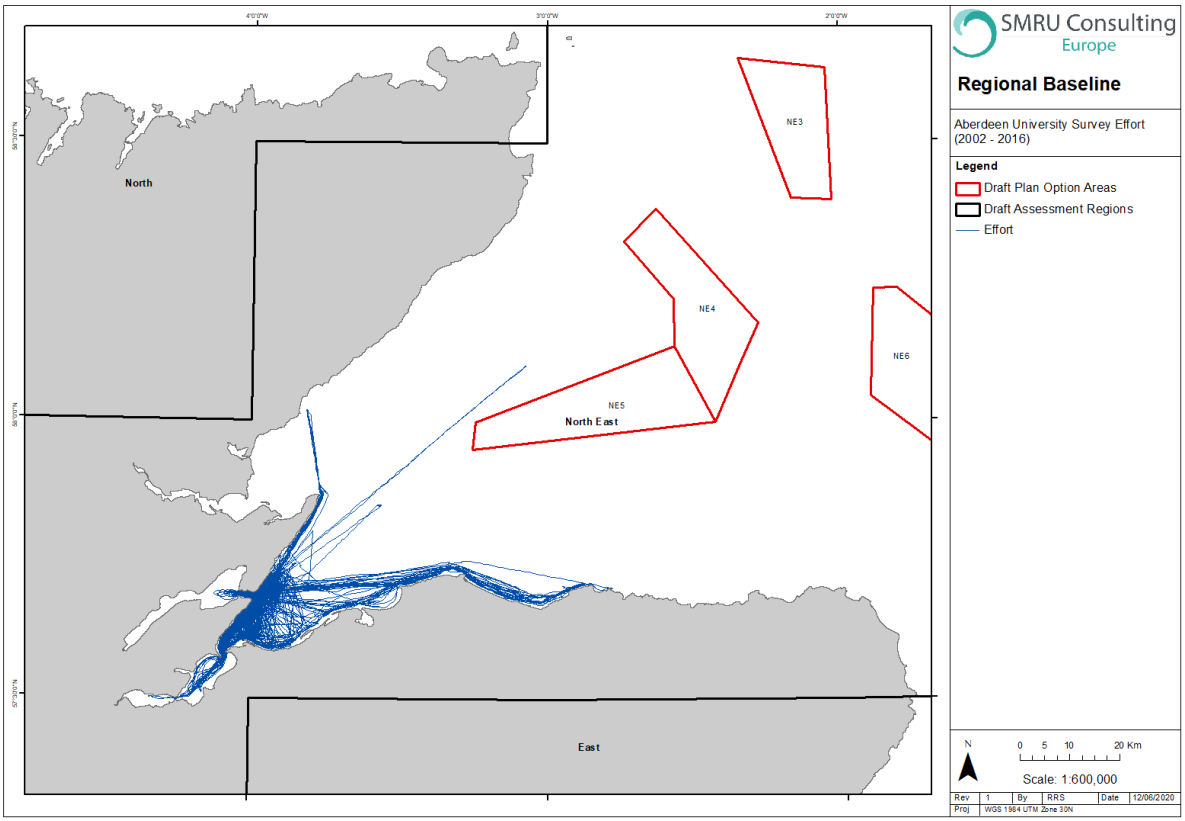

Figure 16 Bottlenose dolphin photoID trip lines surveyed by AULFS between 2002 and 2016. Data provided by Barbara Cheney. Overlaid for reference are the Draft Plan Option areas.

Macleod et al. (2003): Cetacean surveys off north west Scotland

Species: Atlantic white-sided dolphin, fin whale, sei whale, long-finned pilot whale, sperm whale, common dolphin, harbour porpoise, white-beaked dolphin and Risso's dolphin
Relevant Draft Plan Option Region: North
Relevant Draft Plan Option Area: N3, N4
Area: Outer Hebrides; west of the Shetland Islands and the Faroe-Shetland Channel
Year(s): 1998
Month(s): July-Aug

Outputs: Maps of distribution of sightings and group sizes

A double-platform line transect survey was conducted in July and August 1998 to investigate the distribution and abundance of cetaceans in north-west Scotland. The transects consisted of 2,156.5 km of effort, split into three survey strata: Outer Hebrides, west of the Shetland Islands and the central Faroe-Shetland Channel (Figure 17), chosen as they were areas licensed for oil exploration. A total of 304 marine mammal sightings were recorded (911 individuals), however, since the surveys were conducted in "passing mode" the vessel did not approach any marine mammals for species identification or for estimation of group size, and thus only 184 of the sightings were identified to species level.

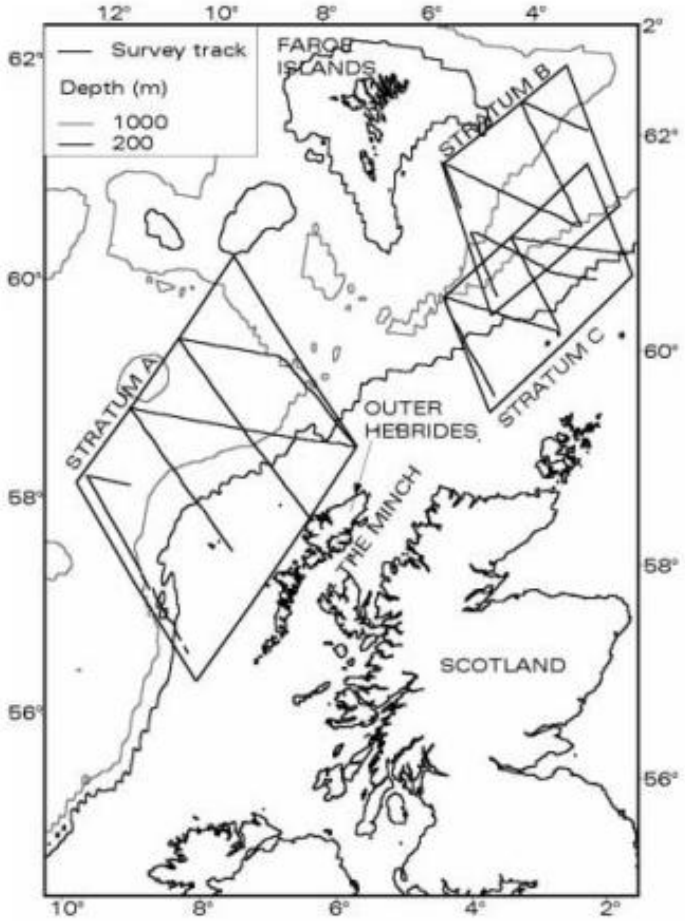

Figure 17 Survey transects and strata covered in July/August 1998 (Macleod et al. 2003)

Macleod et al. (2003) provide maps of distribution of sightings and group sizes for various cetacean species. Some survey tracks overlap the Draft Plan Option areas (e.g. the Stratum A survey covers the N3 and N4 in the North region (Figure 17)), so the survey data although quite dated does geographically overlap some relevant sites.

MacLeod et al. (2008): White-beaked and short-beaked common dolphins in UK waters

Species: Short-beaked common dolphin, white-beaked dolphin
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1983-1998
Month(s): May-Oct
Outputs: Sightings maps.

Sightings of white-beaked and short-beaked common dolphins were obtained by the Seabirds at Sea Team (SAST) of the Joint Nature Conservation Committee (JNCC) in summer months (May-Oct) between 1983 and 1998. The surveys were primarily conducted to record seabirds, however, observers also collected data on cetaceans observations. Sightings maps were provided for both species recorded in UK shelf waters <200 m depth. In total there were 336 sightings of white-beaked dolphins and 233 sightings of common dolphins.

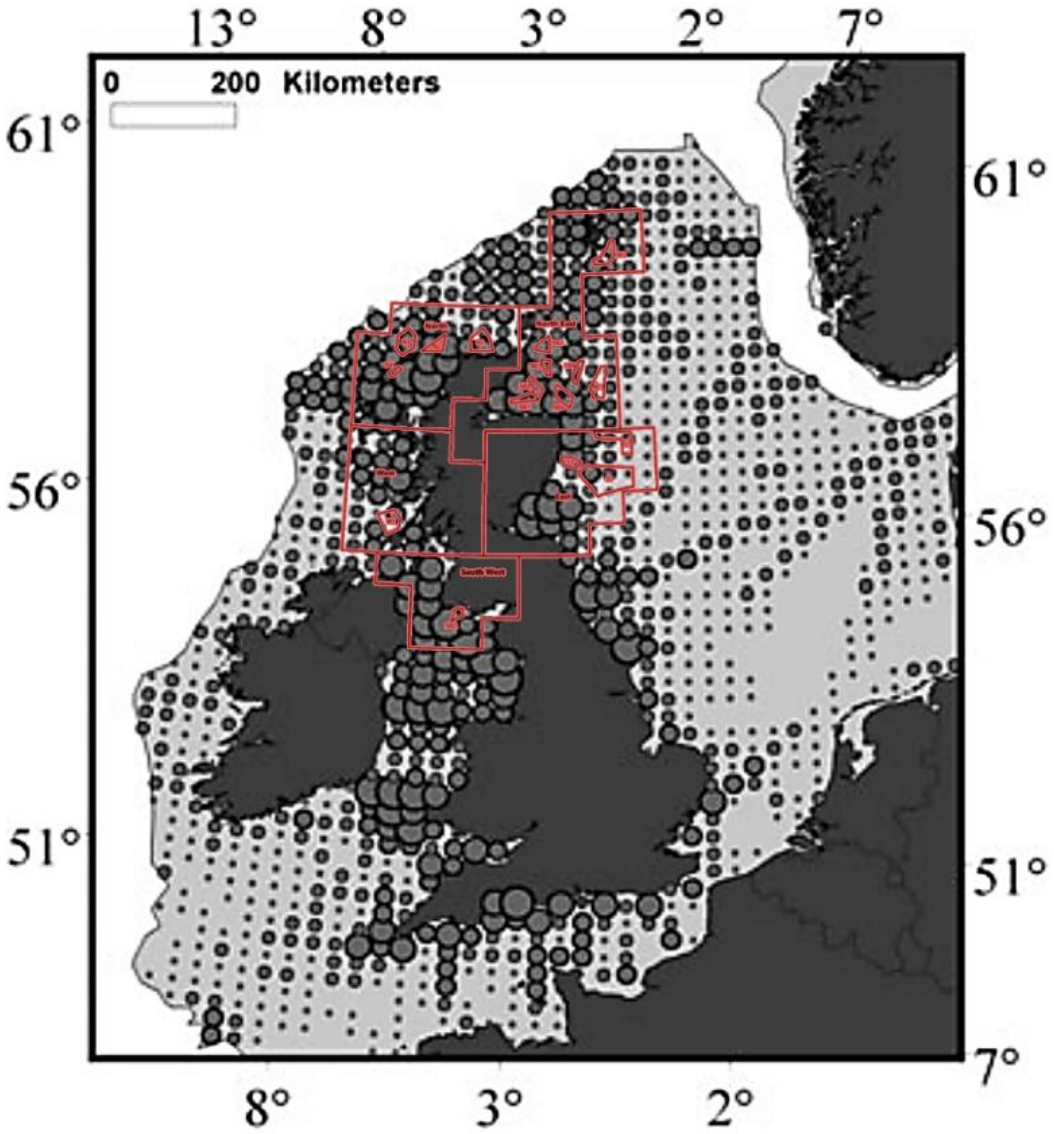

Figure 18 Total effort by Seabirds at Sea Team (SAST) surveys in shelf waters for summer months between 1983 and 1998. Smallest circles, 0 –100 km^2 surveyed; largest circles, .1000 km^2 surveyed; grey shading, shelf waters of less than 200 m water depth. Note: SAST survey efforts in non-shelf waters are not shown on this figure. Approximate locations of Draft Plan Option regions and sites are Overlaid for reference.

MARINELife

Species: Atlantic white-sided dolphin, bottlenose dolphin, short-beaked common dolphin, harbour porpoise, minke whale, Risso's dolphin, grey seal, harbour seal, 'cetacean sp.', 'dolphin sp.', 'whale sp.' and 'seal sp.'.
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: SW1, E1, NE7
Area: Belfast – Glasgow, Belfast – Liverpool, Belfast – Heysham, Heysham-Warrenpoint, Rosyth-Zeebrugge
Year(s): 2008-2019
Month(s): All
Outputs: Sightings and effort records.

MARINElife[17] is a UK-based charity established in 1995 to co-ordinate and develop various collaborative seabird and cetacean monitoring projects. Part of this work includes monthly systematic cetacean and seabird surveys on a variety of commercial shipping routes in UK waters, as well as on opportunistic small vessel surveys. Both effort and sightings are recorded, as well as other metadata. For the purposes of this project, MARINElife have provided all marine mammal sightings data within Scottish waters between 2008 and 2019. Effort varied yearly, with between 2 and 12 months represented each year, and 1-2 days effort per month. Beaufort sea state during effort varied between 0 and 8.

Data from MARINElife surveys between 1995 and 2010 are included in the Joint Cetacean Protocol Database (Paxton et al. 2016). MARINElife data collected between 2008 and 2014 were also one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

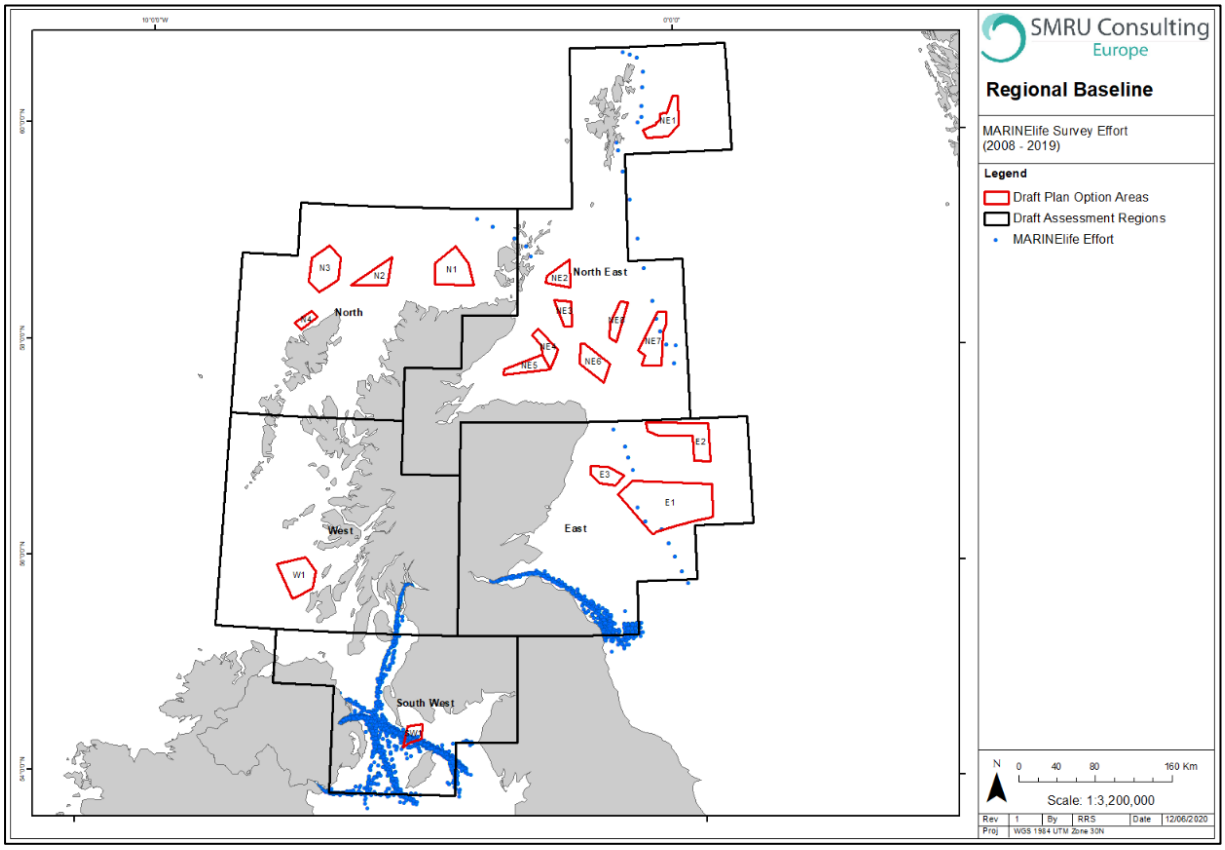

Figure 19 MARINElife effort (strata start and end locations) between 2008 and 2019 within Scottish waters.

MarPAMM: Marine Protected Area Management & Monitoring

Species: Harbour porpoise, dolphin species
Relevant Draft Plan Option Region: West
Relevant Draft Plan Option Area: W1
Area: Hebrides
Year(s): 2019 - present
Month(s): May - Nov

[17] http://www.marine-life.org.uk/

Outputs: Tables of detection-positive hours (DPH)

The MarPAMM project[18] is an EU INTERREG Va regional project, funded by the Special EU Programmes Body (SEUPB). The MarPAMM project is developing tools for monitoring and managing protected coastal marine environments in Ireland, Northern Ireland and Western Scotland, and are collecting data on the abundance, distribution and movement of marine protected species.

The project is ongoing and is expected to conclude by 31 March 2022. The MarPAMM consortium consists of statutory organisations (Agri-Food and Biosciences Institute, Marine Scotland and Scottish Natural Heritage), academic institutions (University College Cork; Ulster University; Scottish Association for Marine Science) and a Non-Governmental Organisations with expertise in a relevant field (BirdWatch Ireland).

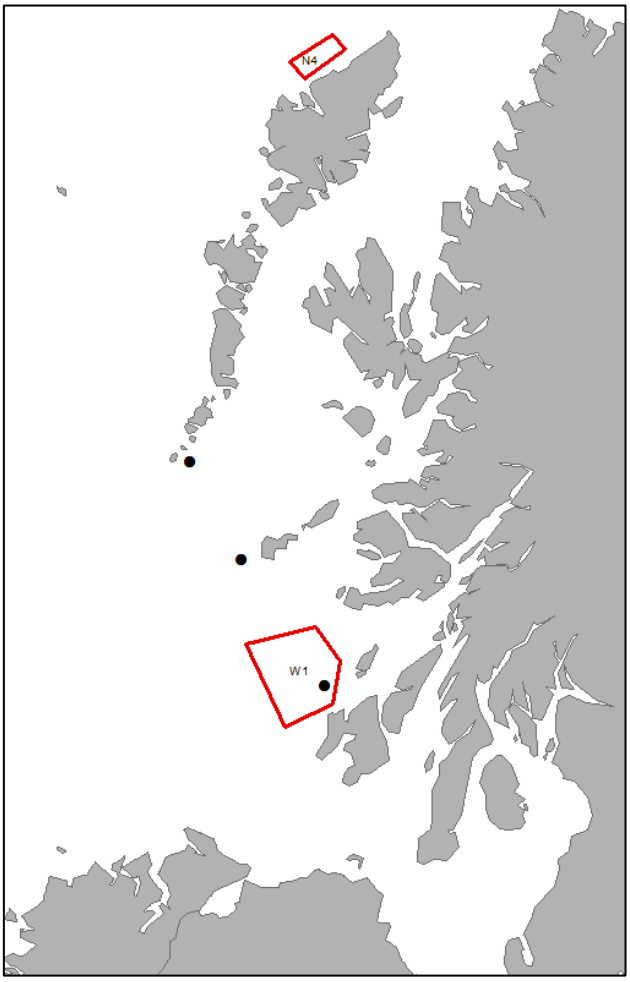

Figure 20. Locations of MarPAMM acousitc monitoring stations on the west coast of Scotland. Overlaid for reference are the Draft Plan Option sites

[18] http://www.mpa-management.eu/

MERP Project: Cetacean species distribution maps*:* Waggitt et al. (2020)

Species: Atlantic white-sided dolphin, bottlenose dolphin, fin whale, harbour porpoise, killer whale, long-finned pilot whale, minke whale, Risso's dolphin, short-beaked common dolphin, sperm whale, striped dolphin and white-beaked dolphin.
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1980-2018
Month(s): All
Outputs: Species distribution maps available at monthly and 10 km^2 density (animals/km^2) scale

The aim of the MERP project (Marine Ecosystems Research Programme)[19] was to produce species distribution maps of cetaceans and seabirds at basin and monthly scales for the purposes of conservation and marine management. A total of 2.68 million km of survey data in the Northeast Atlantic between 1980 and 2018 were collated and standardized. Only aerial and vessel survey data were included where there were dedicated observers and where data on effort, survey area and transect design were available. The area covered by Waggitt et al. (2020) comprised an area spanning between Norway and Iberia on a north-south axis, and Rockall to the Skagerrak on an east-west axis.

Waggitt et al. (2020) predicted monthly and 10 km^2 densities for each species (animals/km^2), and estimated the probability of encountering animals using a binomial model (presence-absence model), and estimated the density of animals if encountered using a Poisson model (count model). The product of these two components were used to present final density estimations (Barry and Welsh 2002). The outputs of this modelling were monthly predicted density surfaces for 12 cetacean (and 12 seabird) species at a 10 km resolution. The cetacean maps provide density estimates for all Regional Boundaries and Draft Plan Option sites within the Draft Sectoral Marine Plan for Offshore Wind Energy. There is no indication of whether the more recent sightings data are weighted more heavily than older data, which limits interpretation of how predictive the maps are to current distribution patterns.

The Supplementary Materials provided by Waggitt et al. (2020) include a table of data providers, with distance and temporal coverage. However, there is no thorough description of each dataset, and so it is unclear which datasets include data gained within Scottish waters, and for which species they are relevant to. Such a document, similar to the description of datasets provided as Appendix II of Paxton et al. (2016) for use when interpreting the Joint Cetacean Protocol dataset, would be extremely useful when interpreting the species distribution maps, and when comparing with the outputs with our similar data collations.

[19] https://www.pml.ac.uk/Research/Projects/Marine_Ecosystems_Research_Programme_(MERP)

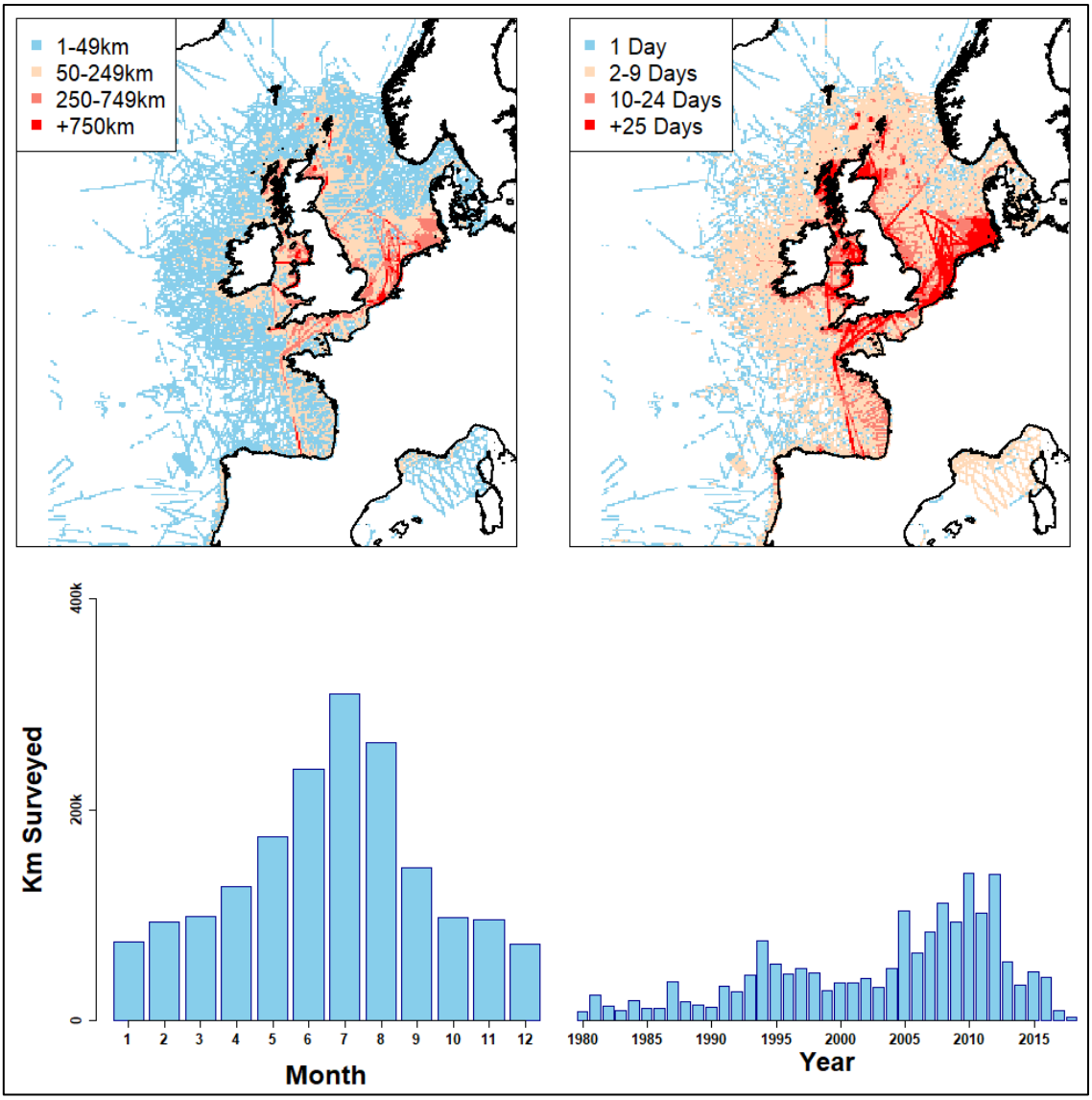

Figure 21 Summaries of cetacean surveys showing spatial and temporal variations in distances travelled by vessels and aircraft, and spatial variations in the number of surveys per 10 x 10km cell (Supplementary Information; Waggitt et al. 2020)

The authors list three key limitations of the data analysis and the resulting distribution maps which require the maps to be interpreted carefully. Firstly, the influence of small or sub-populations on the model is limited, secondly, the model doesn't account for large changes in populations within the study period and thirdly, although seasonal movement were detected, there were also many instances of seasonal changes in densities without changes in overall distribution. The authors state that because of these limitations, the maps "*should not be used as a representation of absolute densities and fine-scale distributions*" and recommend that instead, they are used as a "*general illustration of relative densities and broad-scale distribution over several decades*".

NASS (North Atlantic Sightings Surveys)

Species: Minke whale, fin whale, sei whale, long-finned pilot whale, humpback whale, sperm whale, pilot whale, northern bottlenose whale, killer whale, white-beaked dolphin, and Atlantic white-sided dolphin.

Relevant Draft Plan Option Region: North, North East and East
Relevant Draft Plan Option Area: N1, NE1, NE2, NE3, NE4, NE5, NE6, NE7. NE8, E1, E2 and E3.
Area: North and east Scottish waters, North Sea, North Atlantic
Year(s): 1987, 1989, 1995, 2001, 2007 and 2015.
Month(s): All late June until the first week of August, except 1989 July-August.
Outputs: Sightings, abundance and distribution data,.

The North Atlantic Sightings Surveys (NASS) are internationally co-ordinated large-scale ship and aerial cetacean surveys which cover a large but variable portion of the North Atlantic, with six surveys over a 28-year period: 1987, 1989, 1995, 2001, 2007 and 2015. The original surveys were organised under the Scientific Committee of the International Whaling Commission (IWC), whereas those since 1989 were planned by the Scientific Committee of the North Atlantic Marine Mammal Commission (NAMMCO), with on-going oversight by IWC. Whilst sightings of all cetacean species were recorded, the surveys had a particular focus on fin whales, minke whales, sei whales and long-finned pilot whales, with survey methods and spatial and temporal extent sometimes optimised to suit the target species (Pike et al. 2019a). NASS data relevant to Scottish waters and the Draft Plan Options were likely ship-based data, as aircraft were only utilised for coastal areas of Iceland and Greenland, although the 2007 Cetacean Offshore Distribution and Abundance in European and Atlantic (CODA) survey (see section 0) was planned in conjunction with the 2007 NASS survey (Hammond et al. 2009).

Ongoing surveys have informed various peer review articles covering species abundance and distribution of the North Atlantic (Borchers et al. 2009, Cañadas et al. 2009b, Gunnlaugsson et al. 2009, Øien 2009, Víkingsson et al. 2009, Andersen and Olsen 2010, Pike et al. 2019a, Pike et al. 2019b), with some covering Scottish waters, and most published in the NAMMCO Scientific Publications series. For some years, the surveys did not appear to enter relevant Draft Plan Option regions, though for others e.g. 1995 and 2001, the surveys covered two Draft Plan Option regions (North and North East).

Between surveys, there is a variation in method, for example there was a switch to the double platform survey method for post-1995 surveys, and later surveys often had more observers and thus greater observing power (Pike et al. 2019a). This has implications for the interpretation of the data. For example, mark-recapture distance sampling is only possible for survey data post-1995 as surveys prior to this did not use double platforms.

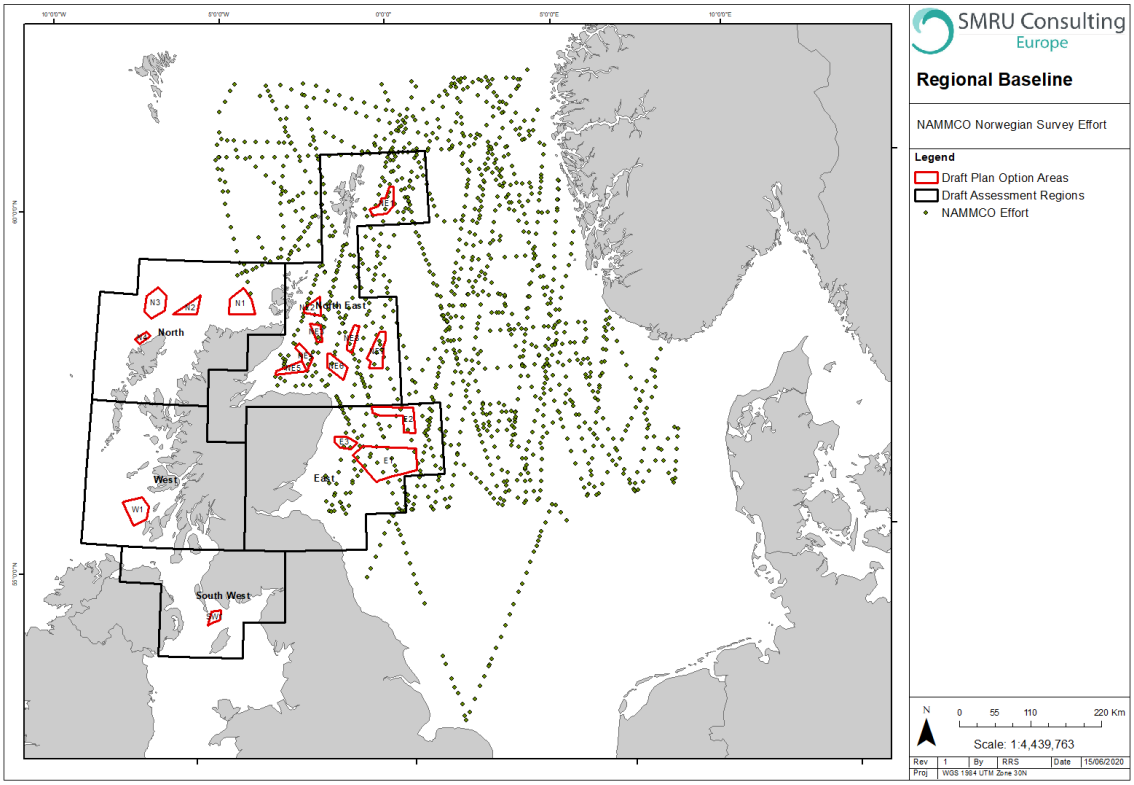

Figure 22 NAMMCO survey effort during surveys in 1989, 1995, 1998, 2004, 2009. Data provided free of charge. Draft Plan Option regions and areas Overlaid for reference.

Northern North Sea Cetacean Ferry Surveys (NORCET)

Species: Harbour porpoise, bottlenose dolphin, white-beaked dolphin, minke whale, Atlantic white-sided dolphin, Risso's dolphin, common dolphin, humpback whale, long-finned pilot whale and killer whale.
Relevant Draft Plan Option Region: North East, East
Relevant Draft Plan Option Area: close to NE1 NE2 NE3, NE4, NE6, NE8 and E3
Area: Ferry route between Aberdeen-Orkney-Shetland
Year(s): 2002-2007. End date unclear.
Month(s): May to September
Outputs: Unknown

The Northern North Sea Cetacean Ferry (NORCET) surveys were run as a collaborative project between the University of Aberdeen, Sea Watch foundation, the East Grampian Coastal partnership and Northlink Ferries. Volunteers carried out whale and dolphin transect surveys on fixed ferry routes aboard the MV Hascosay between Aberdeen and the Northern Isles, with the aim to collect data on cetacean occurrence and distribution in the northern North Sea between Aberdeen, Orkney and Shetland. It was initially a student project at Aberdeen but expanded into a joint collaboration survey team. There was at least one survey a month between May and September between 2002 and 2007, with up to 16 hours survey effort per survey, depending on daylight.

NORCET data from 2004 are included in the Joint Cetacean Protocol Database (Paxton et al. 2016). NORCET data collected between 2004 to 2015 were also one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

Offshore Developments

Developers of offshore renewables (wind, tidal and wave) have to provide a detailed marine mammal baseline characterisation in order to inform their impact assessment. Therefore, developers conduct baseline marine mammal monitoring to obtain detailed and recent abundance and density estimates.

The disadvantage of these surveys is that they are usually very site-specific, for example, the surveys may cover the offshore array area and a small buffer area. However, while they are unlikely to cover the Draft Plan Option areas, they do provide an indication of species present in the proximity of the general area/region and can provide data on seasonality of occurrence etc.

Moray Firth Offshore Developments: baseline marine mammal surveys

Species: Harbour porpoise, bottlenose dolphin, minke whale, harbour seal, grey seal
Relevant Draft Plan Option Region: North East
Relevant Draft Plan Option Area: NE3, NE4, NE5, NE6
Area: Moray Firth
Year(s): 2004-2017
Month(s): Various but many year-round sources
Outputs: Various – sightings maps, density surfaces

Visual surveys:

As detailed in Moray Offshore Windfarm (West) Limited (2018), there have been several visual surveys conducted in the Moray Firth since 2004. These surveys have been conducted for various reasons including ongoing research, surveys for oil and gas projects and surveys for offshore windfarm projects; and include both site specific surveys and regional surveys of the Moray Firth. The surveys conducted are summarized in Table 1 the survey effort is depicted in Figure 23.

Table 1 Summary of the Visual Surveys for Marine Mammals Conducted in the Moray Firth. Table obtained from Moray Offshore Windfarm (West) Limited (2018)

Survey	Dates	Method	Area
Beatrice Demonstrator baseline surveys	2004 (Aug, Sep & Oct) and 2005 (Apr, May, Jun & July)	Boat based visual	Moray Firth SAC
DECC Outer Moray Firth	2009 (Jun, Aug, Sep & Oct)	Boat based visual	Outer Moray Firth

DECC aerial surveys	2010 (Aug & Sep)	Aerial visual	BOWL & Moray East Development area, central Moray Firth, coastal Moray Firth
Moray East pre-application surveys	April 2010 to March 2012	Boat based visual	Moray East Offshore Windfarm and a 4 km buffer
BOWL pre-application surveys	April to September 2010	Boat based visual	Beatrice Offshore Windfarm site and buffer
CRRU minke whale surveys	Summers since 2010	Boat based visual	Between Lossiemouth and Fraserburgh
HiDef Moray West pre-construction surveys	April 2016 to March 2017 monthly	Aerial digital video	Moray West Site plus a 4 km buffer

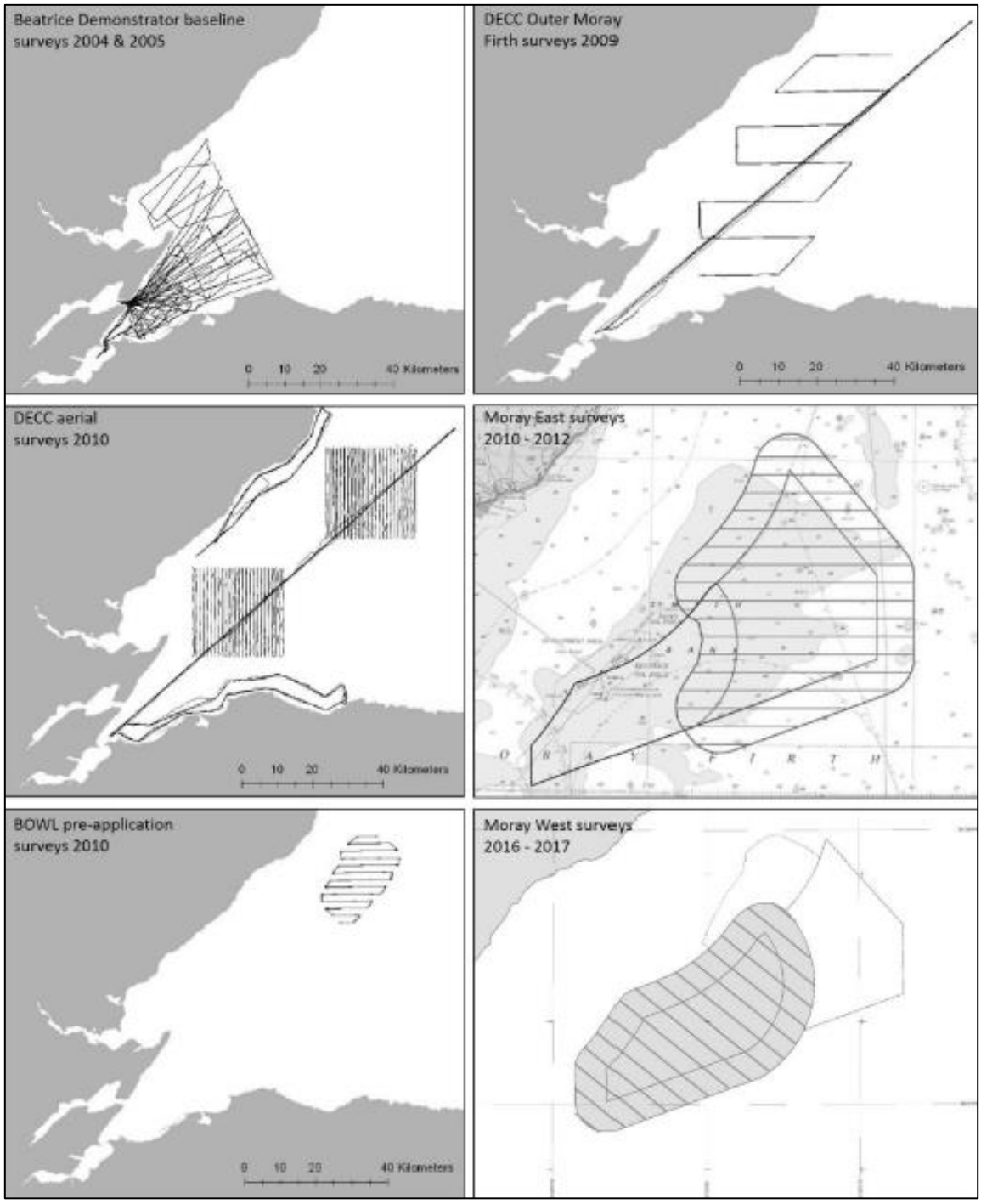

Figure 23 Locations and effort covered by the visual surveys conducted in the Moray Firth. Image obtained from Moray Offshore Windfarm (West) Limited (2018)

Acoustic surveys:

As detailed in Moray Offshore Windfarm (West) Limited (2018), there have been several acoustic surveys conducted in the Moray Firth since 2001 using click detector devices (C-

PODS and their predecessor TPODS[20]) and sound recorders (EARs[21] and SM2Ms[22]) to determine the presence/absence of vocalizing marine mammals. These surveys are summarized in Table 2 and locations of devices for each survey are presented in Figure 24.

Table 2 Summary of the Acoustic Surveys for Marine Mammals Conducted in the Moray Firth. Table obtained from Moray Offshore Windfarm (West) Limited (2018)

Survey	Dates	Method	Area
Beatrice Demonstrator	Between August and October in 2005, 2006 and 2007	TPODs	Sutors of Cromarty, Beatrice, Lossiemouth.
SNH & SEERAD[23] surveys	2006 to 2009	-	14 sites within the inner Moray Firth.
DECC surveys	2009 and 2010	C-PODs + EARs	Throughout the Moray Firth.
BOWL MMMP	Since 2001 year round	C-PODs	Main sites: Sutors of Cromarty, Chanonry, Lossiemouth and Spey Bay. Additional sites summer 2014-15: around Lossiemouth and Spey Bay.
East Coast Marine Mammal Acoustic Study (ECOMMAS)	Since 2013	C-PODs and SM2Ms	Within the Moray Firth: Cromarty, Helmsdale, Latheron, Spey Bay and Fraserburgh.

[20] Cetacean Porpoise Detector (C-POD) and Timing Porpoise detector (TPOD) developed by Chelonia Ltd http://www.chelonia.co.uk
[21] Ecological Acoustic Recorders (EARs) developed by the University of Hawaii and NOAA Fisheries
[22] Song Meter SM2M developed by Wildlife Acoustics www.wildlifeacoustics.com
[23] Scottish Executive Environment and Rural Affairs Department

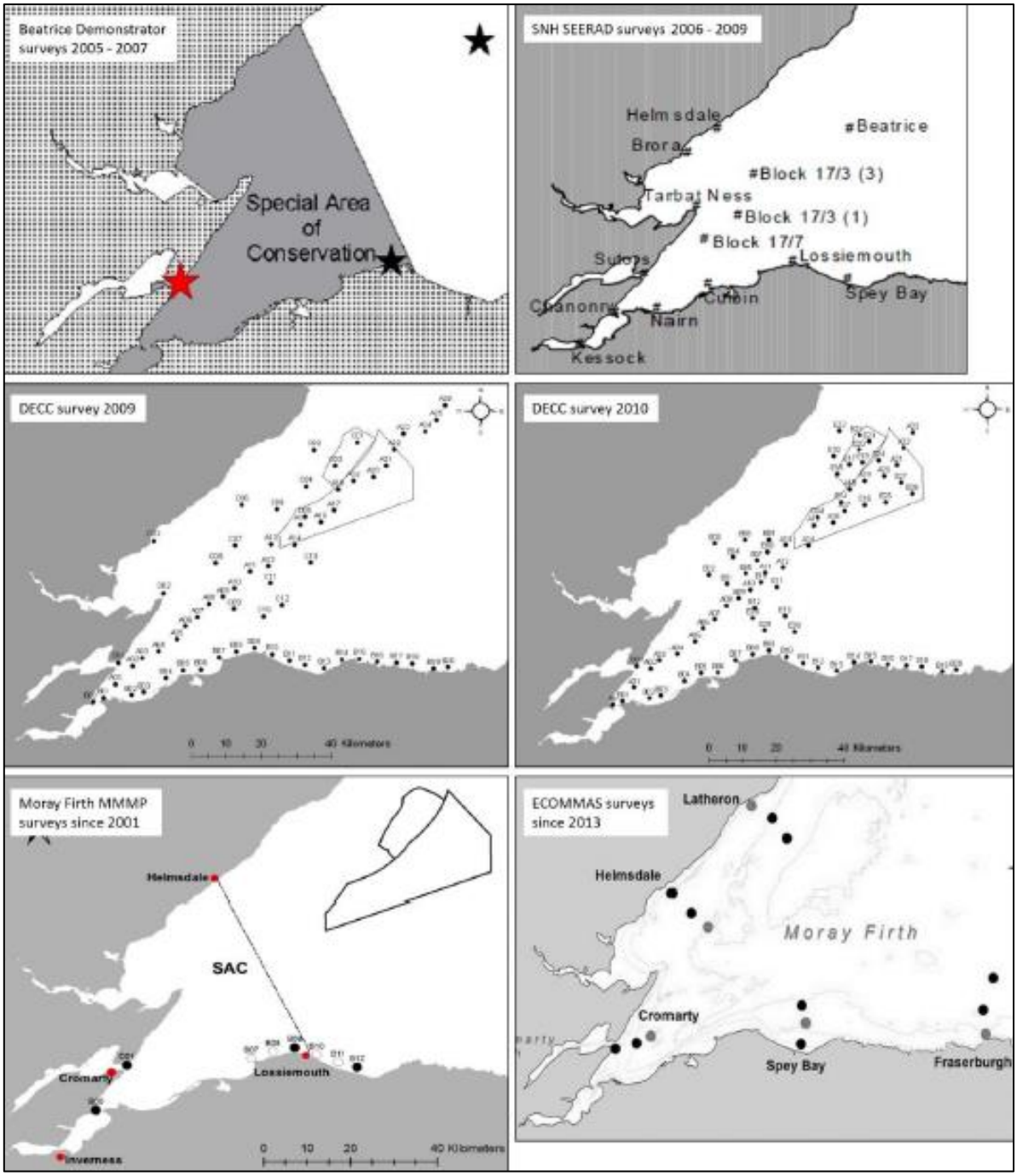

Figure 24 Locations of the acoustic surveys conducted in the Moray Firth. Image obtained from Moray Offshore Windfarm (West) Limited (2018)

Boat survey data by MORL in the Outer Moray Firth in 2010 are included in the Joint Cetacean Protocol Database (Paxton et al. 2016).

Forth and Tay Offshore windfarms

Seagreen Phase 1

Species: Harbour porpoise, minke whale, white-beaked dolphin, grey seal, harbour seal
Relevant Draft Plan Option Region: East

Relevant Draft Plan Option Area: None (closest to E1 and E3)
Area: South east Scotland – Forth and Tay region
Year(s): 2010-2011
Month(s): All
Outputs: Sightings maps

Seagreen Wind Energy Limited commissioned ECON Ecology to conduct 19 months of boat-based surveys of seabirds and marine mammals between May 2010 and November 2011 (Sparling 2012). The survey area included the entire Firth of Forth Round 3 Zone with transect lines spaced 3.7 km apart. There were four survey routes spaced 300 m apart which were rotated so that each route was surveyed once per season. Total transect length ranged from 931- 943 km (depending on the route used) and total transect distance covered across all 19 surveys was 17,017 km. The methodology employed followed standard methods for visual line transect surveys.

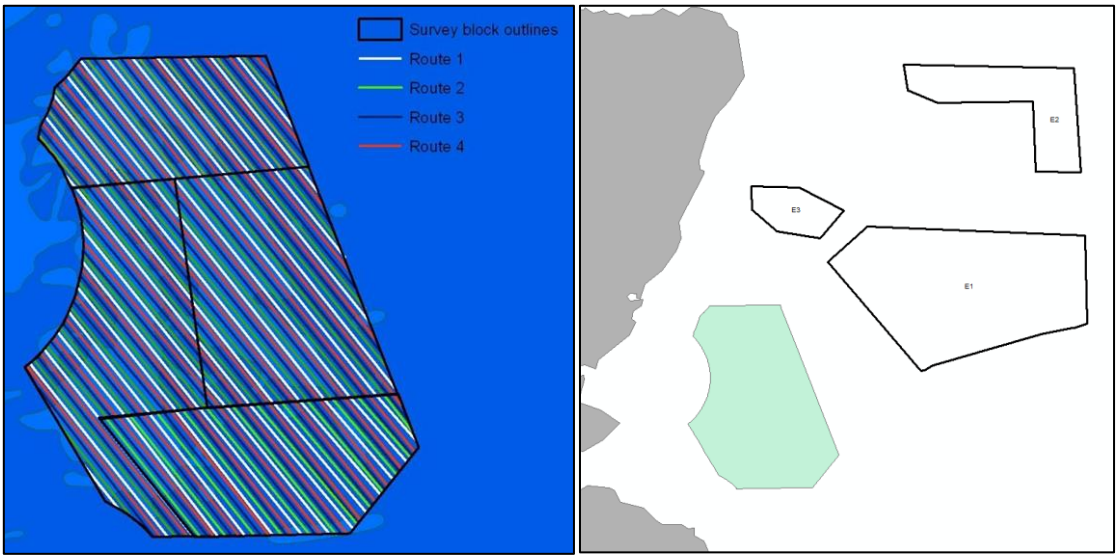

Figure 25 Boat-based transect lines for the Seagreen Firth of Forth Round 3 Zone (Sparling 2012) (left) in relation to the Draft Plan Option areas (right).

Seagreen Phase 2 & 3

Species: Harbour porpoise, minke whale, white-beaked dolphin, grey seal, harbour seal
Relevant Draft Plan Option Region: East
Relevant Draft Plan Option Area: None (closest to E1 and E3)
Area: Seagreen 2 & 3 + 12km buffer
Year(s): 2019-2020
Month(s): All

Currently, baseline surveys are being conducted for marine mammals as part of the Seagreen Phase 2 & 3 baseline characterisation. These involve HiDef aerial surveys of the array areas plus a 12 km buffer. While the surveys are incomplete at this stage, sightings have been of the expected marine mammal species in the area: harbour porpoise, grey seals, minke whales and white-beaked dolphins.

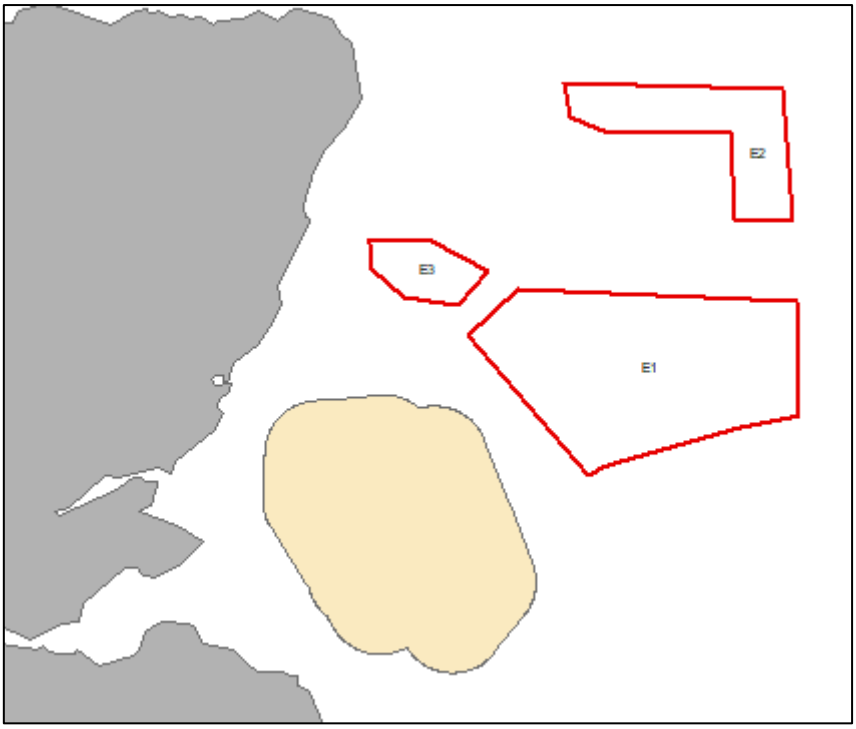

Figure 26 Aerial survey area for ongoing Seagreen Phase 2 & 3 baseline characterisation[24].

Neart na Gaoithe

Species: Harbour porpoise, minke whale, white-beaked dolphin, killer whale, grey seal, harbour seal
Relevant Draft Plan Option Region: East
Relevant Draft Plan Option Area: None (closest to E1 and E3)
Area: Neart na Gaoithe array area + 8 km buffer
Year(s): 2009-2012
Month(s): All

Mainstream Renewable Power commissioned Natural Research (Projects) Ltd, Cork Ecology and Bureau Waardenburg to conduct seabird and marine mammal baseline surveys for the Neart na Gaoithe offshore windfarm project (Neart na Gaoithe 2012). The surveys consisted of vessel-based surveys, conducted monthly for three years between November 2009 and October 2012, covering the array area plus an 8 km buffer, and consisting of transects spaced 2 km apart (Figure 27). Only one survey (November 2010) was missed due to bad weather, full coverage was achieved for the other months (Natural Research Projects Limited and Cork Ecology 2012, Neart na Gaoithe 2012, 2018). The surveys followed the standard COWRIE (Collaborative Offshore Wind Research into the Environment) methodology using an adaptation of the JNCC Seabirds at Sea survey method to record birds and marine mammals. Marine mammals were recorded concurrently with the seabird surveys and used the same methodology as for birds on the water. The survey area included ahead of the ship and out to one side of the survey vessel in a 90° arc and the count interval for surveys was 1 minute. For marine mammals, the angle and distance was estimated for each sighting as well as species, number direction and behaviour. All surveys were conducted in sea state 4 or less.

The main limitation of these surveys is that they were concurrent with bird surveys. As the surveys were not dedicated marine mammal surveys they did not follow recommended

[24] Survey area shapefile provided by Martha Lovatt, SSE 27/04/2020

marine mammal survey methodology and this may have led to the possibility of animals being missed, although it is not possible to quantify this.

In addition to the visual surveys, monthly acoustic surveys using a towed hydrophone were conducted between 2010 and 2011, resulting in 2,579 km of line transects covering a total area of 2,140 km^2.

Boat survey data covering Neart na Gaoithe from 2009 and 2010 were included in the Joint Cetacean Protocol Database (Paxton et al. 2016).

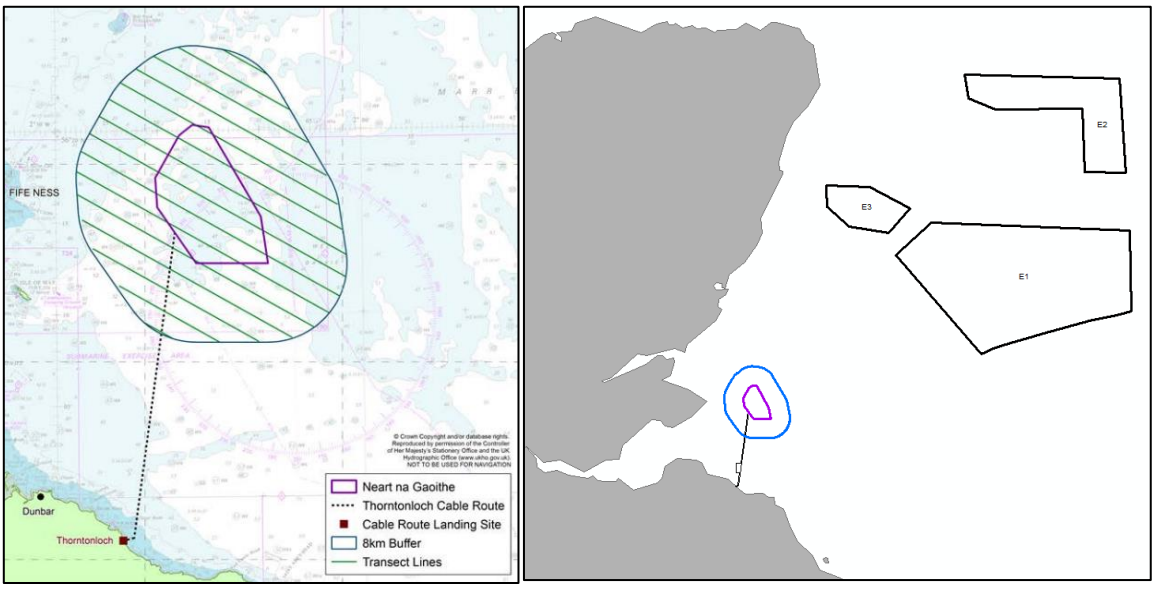

Figure 27 Study area and boat-based transect lines for the Neart na Gaoithe site-specific marine mammal surveys (Neart na Gaoithe 2012) (left) in relation to the Draft Plan Option areas (right).

Inch Cape

Relevant Draft Plan Option Region: East
Relevant Draft Plan Option Area: None (closest to E1 and E3)
Area: Inch Cape array area + 4 km buffer
Year(s): 2010-2012
Month(s): All

Between September 2010 and September 2012, vessel-based seabird and marine mammal surveys were conducted as part of the Inch Cape offshore windfarm baseline surveys (Inch Cape 2012). The survey area covered the array area and a 4 km buffer, and was surveyed using adapted COWRIE methods. The survey consisted of 14 transects totalling 219 km, spaced 2 km apart. With the exception of September 2010, all monthly surveys were >96% completed. Surveys were conducted in sea state 4 or less, with most effort (>80%) between sea state 0-3.

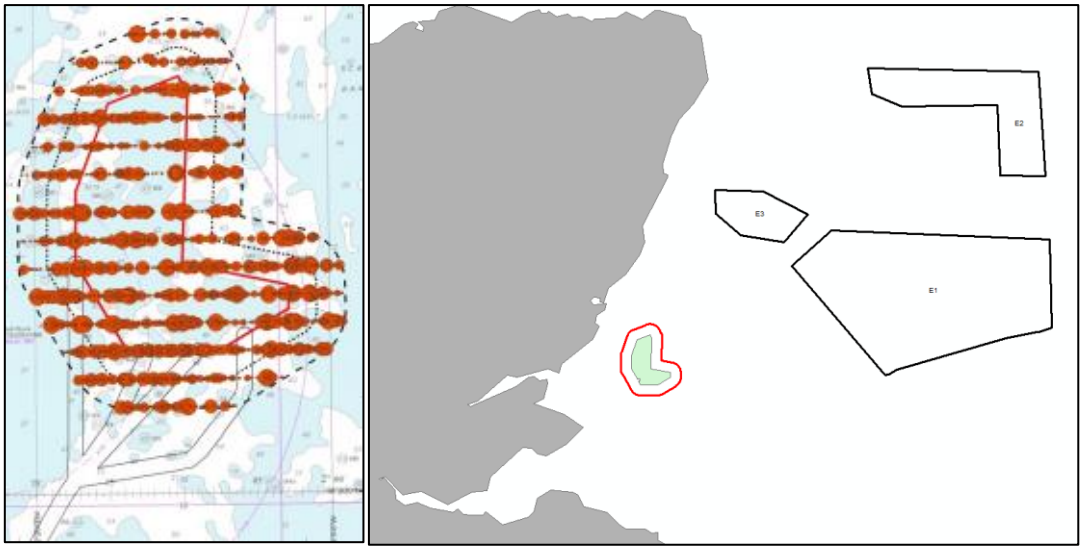

Figure 28 Transect lines surveysed (left) (Inch Cape 2012) and location of Inch Cape in relation to DPO areas (right).

Crown Estate aerial surveys

Species: Bottlenose dolphin, grey seal, harbour porpoise, killer whale, minke whale, white-beaked dolphin, common dolphin, long-finned pilot whale
Relevant Draft Plan Option Region: East
Relevant Draft Plan Option Area: None (closest to E1 and E3)
Area: Firths of Forth and Tay
Year(s): 2009-2010
Month(s): Jan, Feb, Mar, May, Jun, Jul, Aug, Nov, Dec

The Crown Estate commissioned a series of aerial surveys of the Scottish Territorial Waters and Round 3 sites within the Firths of Forth and Tay during summer 2009 (May, Jun, Jul, Aug, total 9 days) and winter 2009-2010 (Nov, Dec, Jan, Feb, Mar, total 15 days). The surveys employed standard visual aerial survey methods to record seabirds and marine mammals. There were a total of 45 transects within the survey area, resulting in 17,864.6 km of track observed on the port side and 18,318.5 km observed on the starboard side (Grellier and Lacey 2012).

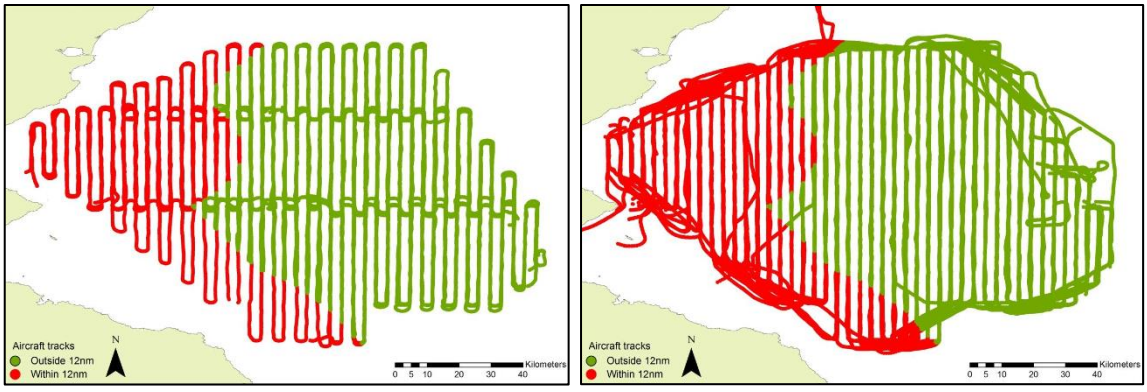

Figure 29 Aerial transects surveyed as part of the Crown Estate commissioned surveys of the Firths of Forth and Tay. Left = summer transects, right = winter transects (Macleod and Sparling 2011).

Density Modelling

Species: Harbour porpoise, white-beaked dolphin, minke whale
Relevant Draft Plan Option Region: East
Relevant Draft Plan Option Area: None (closest to E1 and E3)
Area: Firths of Forth and Tay
Year(s): 2009-2011
Month(s): All

DMP Statistical Solutions UK Limited provided a statistical analysis of the combined Crown Estate aerial surveys of the Firths of Forth and Tay and the project specific vessel based surveys (Mackenzie et al. 2012); this analysis was then summarised in King and Sparling (2012). The aim of the analysis was to provide up to date estimates of density for harbour porpoise, white-beaked dolphin and minke whale. Statistical models were used to generate the species density maps and abundance estimates; with density estimates provided in 5 km x 5 km grid cells.

EMEC Wildlife Observation Programme

Fall of Warness

Species: Harbour seal, grey seal, harbour porpoise, minke whale, white-beaked dolphin, Risso's dolphin, killer whale
Relevant Draft Plan Option Region: North
Relevant Draft Plan Option Area: N1
Area: Orkney Isles
Year(s): July 2005 to March 2014
Month(s): All
Outputs: Sightings

At the EMEC Fall of Warness site, land-based surveys were conducted from a trailer shelter at ~50 m above sea level. Observations were conducted with a 4-hour watch format, 5 days per week (~80 hours/month). The survey area was divided into a grid that was ~500 m x 500 m per cell. Between July 2005 and March 2011 a total of 1,711 hours of survey contained a marine mammal sighting (Robbins 2012b). Between April 2013 and March 2014 a total of 909 hours of observation were conducted (EMEC 2014b).

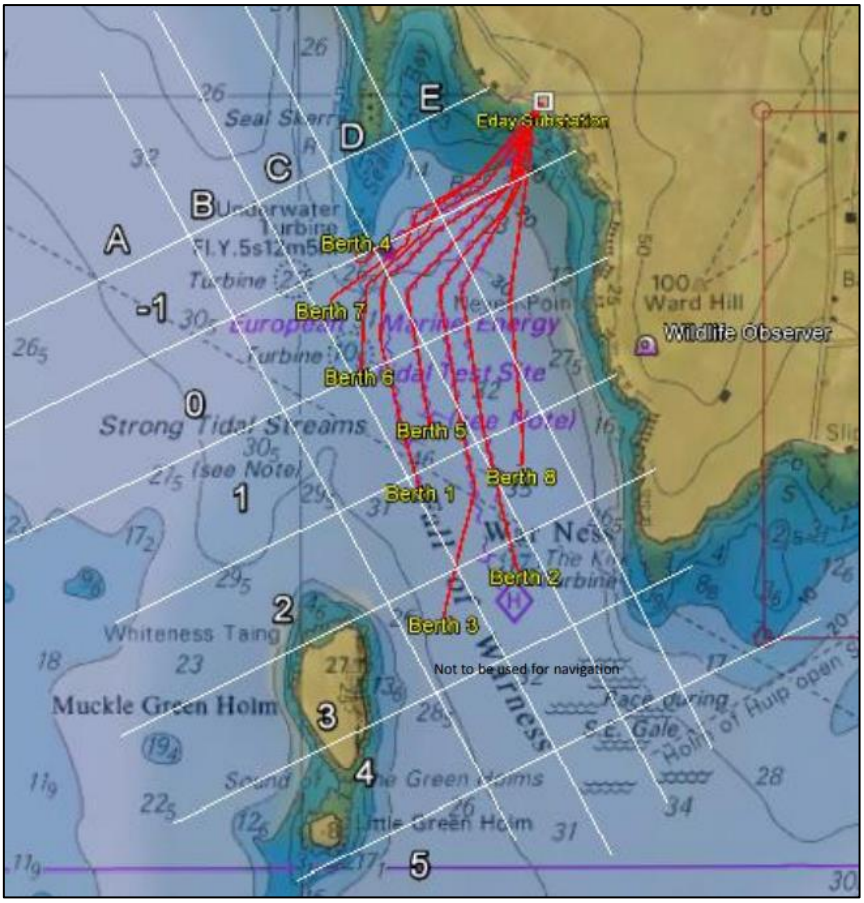

Figure 30 Observation grid for EMEC's Fall of Warness tidal test site (EMEC 2014b)

Billia Croo

Species: Harbour seal, grey seal, harbour porpoise, humpback whale, minke whale, bottlenose dolphin, white-beaked dolphin, Atlantic white-sided dolphin, Risso's dolphin, short-beaked common dolphin, long-finned pilot whale and killer whale.
Relevant Draft Plan Option Region: North
Relevant Draft Plan Option Area: N1
Area: Orkney
Year(s): March 2009 to March 2014
Month(s): All

At the EMEC Billia Croo site, land-based surveys were conducted from a look-out shelter at ~110 m above sea level. Observations were conducted with a 4-hour watch format, 5 days per week (~80 hours/month). Between March 2009 and March 2011 the surveys resulted in 1,891 hours where birds and mammals were observed (Robbins 2012a). Between April 2013 and March 2014 the surveys resulted in 886 hours of effort (EMEC 2014a).

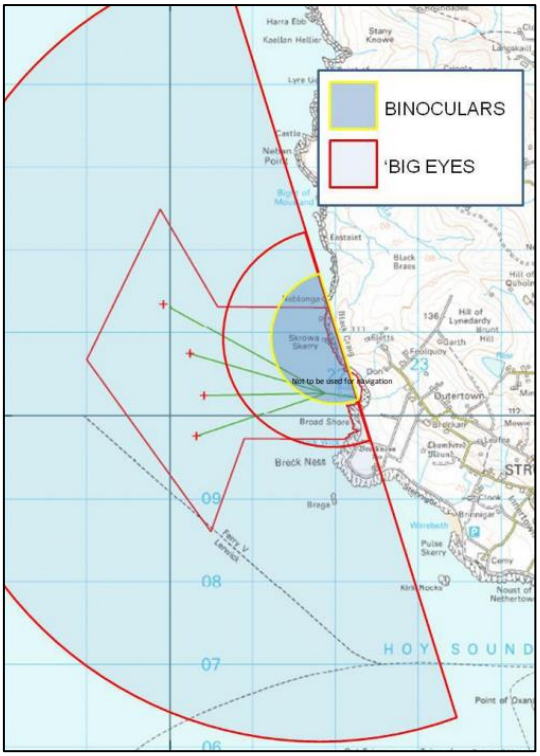

Figure 31 Survey area for EMEC's Billia Croo wave test site (EMEC 2014a)

ORCA

Species: Harbour porpoise, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, white-beaked dolphin, killer whale, minke whale, fin whale, sei whale, harbour seal, grey seal (and basking shark).
Relevant Draft Plan Option Region: West, North, North East and East
Relevant Draft Plan Option Area: close to NE1 NE2 NE3, NE4, NE6, NE8, E3
Area: West coast, Hebrides, Moray Firth, North Sea
Year(s): 2016-2019
Month(s): March (2019), April (2016, 2017 and 2019), May (2017-2019), June (2016-2019), July, August, September (all 2017-2019), October (2019).
Outputs: Sightings and effort data

ORCA[25] conduct visual surveys from ferry platforms, using observers who have completed the ORCA Marine Mammal Surveyor course. ORCA have provided visual survey effort and sightings data between April 2016 and October 2019 along the following ferry routes:

- Aberdeen to Lerwick (Northlink)
- Oban to Castlebay (CalMac)
- Oban to Tiree, Coll & Colonsay (CalMac)
- Ullapool to Stornoway(CalMac)
- Ardrossan to Campeltown (CalMac)
- Uig to Lochmaddy & Tarbert (CalMac)

[25] https://www.orcaweb.org.uk/

Whilst none of these routes directly traverse or have any data for the Draft Plan Option Areas (Figure 32), the Aberdeen-Lerwick ferry route passes adjacent to four Draft Plan Option within the NE region (NE2, NE3, NE4 and NE6).

Data from ORCA surveys in 2009 and 2010 are included in the Joint Cetacean Protocol Database (Paxton et al. 2016). ORCA data collected between 2006 to 2015 were also one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

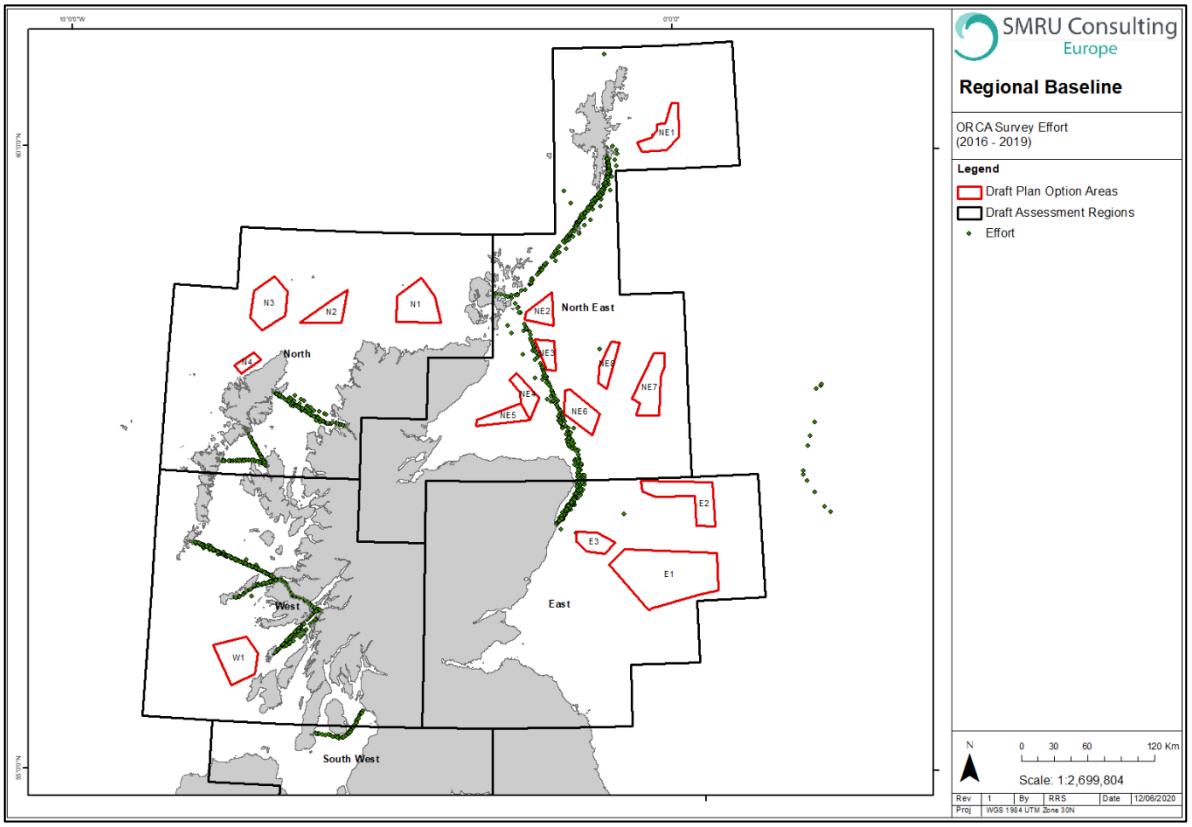

Figure 32 All effort data collected by ORCA during ferry surveys between 2016 and 2019. Overlaid for reference are the Draft Plan Option regions and sites..

Paxton et al. (2014): Distribution of minke whales, Risso's dolphins and white-beaked dolphins to inform MPA designation

Species: Minke whale, Risso's dolphin, white-beaked dolphin
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: Dependent on species
Area: Scottish territorial waters
Year(s): 1994-2012
Month(s): All
Outputs: Estimate relative densities

Paxton et al. (2014) estimated the relative density of minke whales, Risso's dolphins and white-beaked dolphins in Scottish waters in order to inform MPA designations. The analysis

used the JCP dataset[26] in addition to data provided by SNH to estimate densities for minke whale (2000 – 2012), Risso's dolphin (1994 – 2012) and white-beaked dolphin (1994 – 2012). In total, up to 23 data sources were used, containing data from at least 172 survey platforms (both vessel and aerial) and up to 180,300 km of effort. Figure 33 shows the realized effort for white-beaked dolphins, which had the greatest extent. The sightings data were corrected to account for imperfect detection and availability of animals at the surface (perception and availability bias). The estimated numbers were then modelled as a function of space, time and other explanatory variables (depth, sediment type, sandeel index, chlorophyll concentration, fronts, tidal energy and sea surface temperature).

The authors note that some regions modelled are associated with high uncertainty due to the low effort in the area (e.g. in general there was little effort in the northern North Sea and the east coast of Scotland), and that interpolation is higher for the winter and autumn density surfaces due to limited data. The authors state that "*The models explained only a small proportion of the total variation observed in the densities and the estimated coefficients of variation even in the cases without model selection uncertainty are large*".

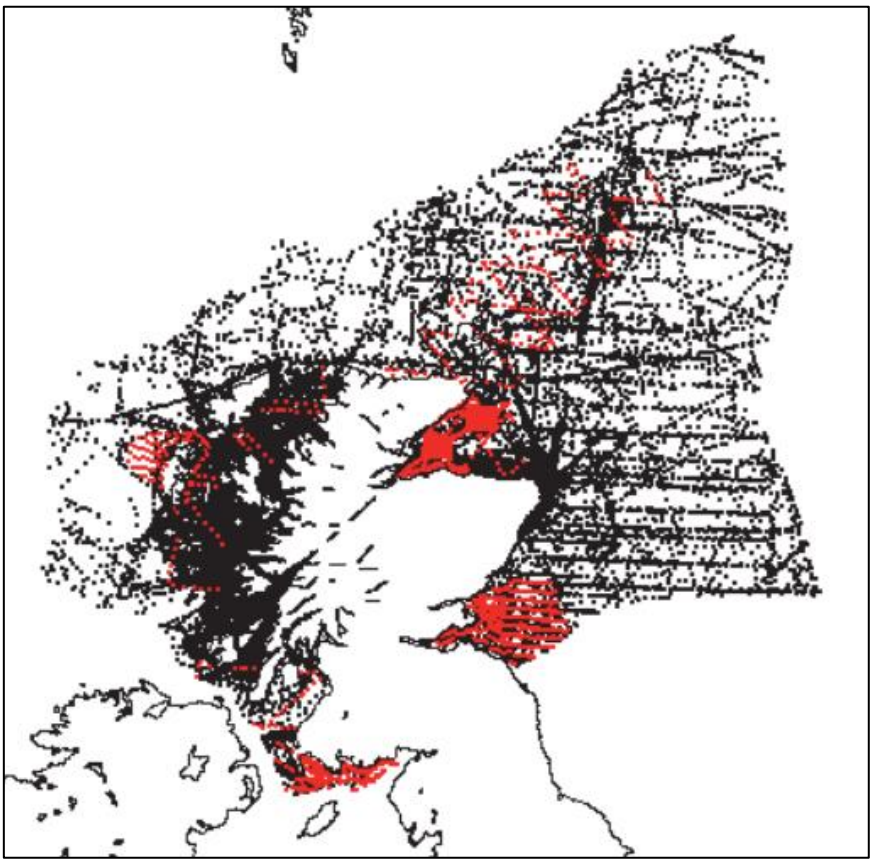

Figure 33 Realized effort for white-beaked dolphin by platform type. Each point represents the midpoint of a segment of effort from the period 1994 – 2012: black is boat effort and red is aeroplane effort. Paxton et al. (2014).

[26] See Paxton et al. (2014) for a full list of acknowledgements of organisations that collected, compiled and provided data.

Publicly Available Data repositories

The National Biodiversity Network (NBN) [27] is a collaborative partnership created to exchange biodiversity information, with the aim of improving the availability of high resolution and high-quality data to provide the evidence base for all environmental decision-making in the UK. All uploaded data kept in the NBN Atlas and available publicly, and licensed under Creative Commons Licenses or an Open Government License. The aim of the NBN Atlas is to promote more open sharing of data, so the data can be used as evidence base for environmental decision making or to better understand the UK's biodiversity. The NBN Atlas holds data on Scottish marine mammals. For example, data partners sharing marine mammal data to the NBN Atlas include Seasearch and the North East Scotland Biological Records Centre. No data from the NBN are presented in this report.

Rogan et al. (2017): Deep diving cetaceans in the North-East Atlantic

Species: Sperm whale, long-finned pilot whale, northern bottlenose whale, Cuvier's beaked whale and Sowerby's beaked whale
Relevant Draft Plan Option Region: None
Relevant Draft Plan Option Area: None
Area: Offshore off North-west Scotland
Year(s): 2005, 2007
Month(s): July
Outputs: Surface maps of smoothed predicted abundance

Rogan et al. (2017) collated data from SCANS II (see Section 0), CODA (see Section 0) and T-NASS (see Section 0) to provide information on abundance and distribution of five deep diving cetacean species: sperm whale (n=65), long-finned pilot whale (n=59), northern bottlenose whale (n=15), Cuvier's beaked whale (n=17) and Sowerby's beaked whale (n=6). The total combined study area covered 3,023,280 km^2 in the North-East Atlantic, of which 47,225 km was surveyed on transect. All surveys were conducted using the same double platform line transect method (Hammond et al. 2013). Detection functions were estimated and for pilot whales and "large whales" sample sizes allowed for mark-recapture distance sampling with the double platform data. As there were insufficient sightings of sperm whales and beaked whales conventional distance sampling models were used. Covariates used for fitting the detection functions included: sightability, swell height, sea state, vessel, cue, height of the observer on the primary platform and group size. Data were only collected in the summer months, so inferences on abundance and distribution should not be extended beyond that season.

[27] https://nbn.org.uk/

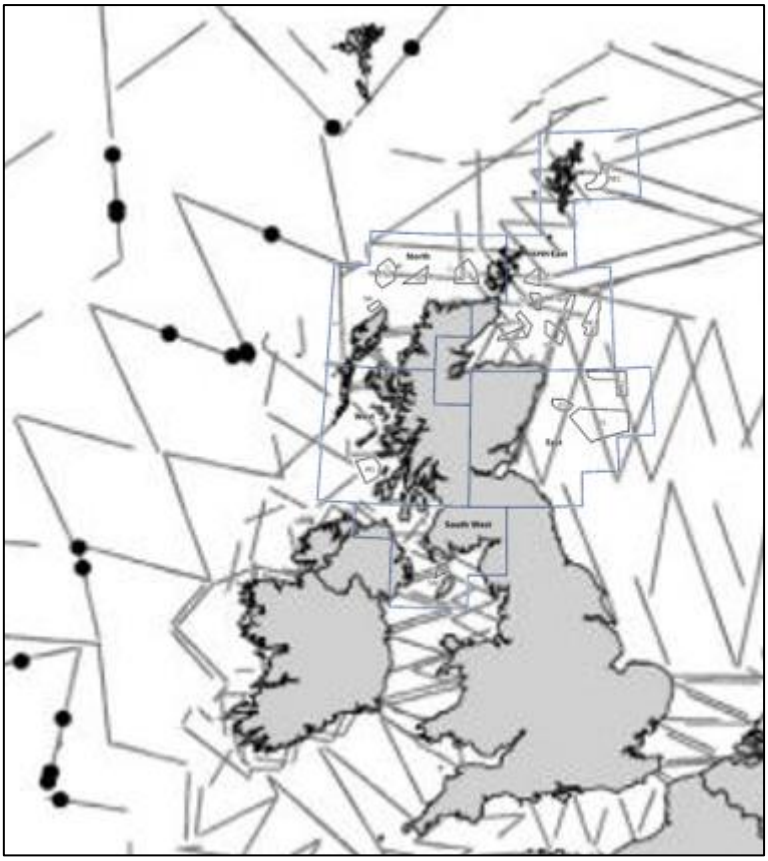

Figure 34 Distribution of survey effort and sightings of sperm whales in the survey area (Rogan et al. 2017). Overlaid for reference are the Draft Plan Option areas and regions.

Russell et al. (2017): Seal at-sea usage maps

Species: Harbour seal and grey seal
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1991-2015
Month(s): All
Outputs: Average at-sea density estimates at a 5km grid cell resolution

The seal at-sea usage maps were created to predict the at-sea density of seals in order to inform impact assessments and marine spatial planning. The original SMRU seal density maps were produced as a deliverable of Scottish Government Marine Mammal Scientific Support Research Programme (MMSS/001/01) and were published in Jones et al. (2015). These have since been revised to include new seal telemetry and haul-out count data and modifications have been made to the modelling process (Russell et al. 2017). The analysis uses telemetry data from 270 grey seals and 330 harbour seals tagged in the UK between 1991 – 2015, and haul-out count data from 1996 - 2015 to produce UK-wide maps of estimated at-sea density with associated uncertainty. The combined at-sea usage and haul-out data were scaled to the population size estimate from 2015. The at-sea usage maps provide density estimates for all Regional Boundaries and Draft Plan Option sites within the Draft Sectoral Marine Plan for Offshore Wind Energy.

The at-sea usage maps present the mean number of harbour seals and grey estimated to be in the water in that cell at any given time, and do not reflect seasonal or annual changes, and instead represent an overall average. A short note covering future potential updates, limitations and recommendations etc. for the seal at-sea usage maps with specific reference to the Draft Plan Option sites is provided in Appendix 4: Seal Abundance and Distribution.

There have been finer spatial resolution harbour seal usage maps produced, for example Jones et al. (2017) presented at-sea harbour seal usage maps of the Orkney Isles and the north coast of Scotland at a scale of 0.6x0.6 km derived from telemetry data of 60 adult harbour seals tagged between 2003 and 2015.

SCANS: Small Cetacean Abundance in the North Sea

Species: Small cetaceans
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1994, 2005 and 2016
Month(s): July
Outputs: Estimates of abundance for small cetacean populations

The main objective of the SCANS surveys was to estimate small cetacean abundance and density in the North Sea and European Atlantic continental shelf waters. The SCANS I surveys were completed in 1994 (Hammond et al. 2002), SCANS II[28] in July 2005 (Hammond et al. 2006) and SCANS III[29] in July 2016 (Hammond et al. 2017) and all comprised of a combination of vessel and aerial surveys (Figure 35). Both aerial and boat-based survey methodologies were designed to correct for availability and detection bias and allow the estimation of absolute abundance (Hammond et al. 2017). The aerial surveys involved a single aircraft method using circle-backs (or race-track) methods whereas the boat-based surveys involved a double platform 'primary' and 'secondary' tracker methodology.

The SCANS III aerial surveys covered all Regional Boundaries and Draft Plan Option sites within the Draft Sectoral Marine Plan for Offshore Wind Energy.

While the SCANS surveys provide sightings, density and abundance estimates at a wide spatial scale, the surveys are conducted during a single month, every 11 years and therefore do not provide any fine scale temporal or spatial information on species abundance and distribution. Furthermore, due to the change in survey blocks used across the SCANS surveys direct comparison between the surveys for abundance and density information is not possible.

A short note covering future of SCANS, limitations and recommendations etc. with specific reference to the Draft Plan Option areas is provided in Appendix 3: SCANS Surveys.

Data from SCANS I and SCANS II surveys are included in the Joint Cetacean Protocol Database (Paxton et al. 2016), and were also two sources of data incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

[28] http://biology.st-andrews.ac.uk/scans2/
[29] https://synergy.st-andrews.ac.uk/scans3/

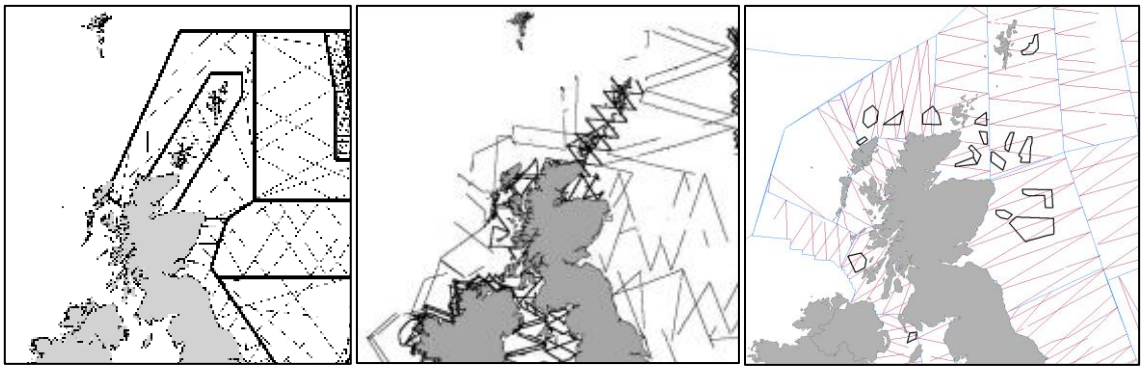

Figure 35 SCANS survey effort. Left: SCANS I cruise tracks (Hammond et al. 2002), Middle: SCANS II transects (grey = shipboard effort; black = aerial effort) (Hammond et al. 2006) and Right: SCANS III transects (Hammond et al. 2017)

Scotland's Marine Atlas

Species: Grey seal, harbour seal, harbour porpoise, bottlenose dolphin, minke whale, white-beaked dolphin, fin whale, short-beaked common dolphin, Atlantic white-sided dolphin, Risso's dolphin, killer whale, sperm whale, long-finned pilot whale, northern bottlenose whale, Sowerby's beaked whale.
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: All Scottish waters
Year(s): Not reported
Month(s): Not reported
Outputs: Encounter rate maps

The Scottish Marine Atlas[30], last published by Marine Scotland in 2011, provides information for the 'National Marine Plan', and is an assessment of the condition of Scotland's seas based on scientific evidence from data and analysis, supported by expert judgement (Baxter et al. 2011). The Marine Atlas presents grey and harbour seal count and density data collected by the Sea Mammal Research Unit between 2007-2009. For cetaceans, data are presented as average encounter rate for each species.

Experts are currently working on updating the Marine Atlas, which will be publicly available in the near future (A. Hall, personal communication). The data used to inform the marine mammal assessments presented within the updated Atlas include the most recent harbour seal and grey seal pup production and total population size estimates (SCOS 2019), SCANS III data, and the most up-to-date east coast of Scotland population vital rate and population size estimates (Arso Civil et al. 2017, Arso Civil et al. 2018, Arso Civil et al. 2019).

Sea Watch Foundation

Species: All cetacean species
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Coastal Scotland from land-based watches, some vessel-based data also available
Year(s): Unknown

[30] https://www.gov.scot/publications/scotlands-marine-atlas-information-national-marine-plan/

Month(s): All
Outputs: Sightings and effort data

The Sea Watch Foundation[31] (formerly the UK Mammal Society Cetacean Group) is a national marine environmental charity working to improve the conservation of cetaceans in Britain and Ireland. The foundation has a network of observers including volunteers, zoologists, ornithologists, fishermen, yachtsmen and the coastguard, and has been collecting marine mammal sightings in UK and Irish waters since the mid-1960s. Sightings are entered into the Sea Watch National Database, which currently comprises over 60,000 records with more than 2,000 voluntary contributors. Unfortunately, Sea Watch Foundation declined to share sightings records for the purpose of this project, though details of how to make data requests are available on their website.

Data from the Sea Watch Foundation has resulted and contributed to numerous peer reviewed journal articles and reports that inform on the abundance and distribution of marine mammals in UK waters. For example, fine-scale information on sightings of marine mammals in the Pentland Firth and Orkney waters between 1980 and 2010 are presented in Evans et al. (2011), whilst a finer-scale analysis of sightings data covering the East Grampian coastline are presented in Anderwald and Evans (2010).

Boat-based data from Sea Watch Foundation surveys between 1994 and 2008 are included in the Joint Cetacean Protocol Database (Paxton et al. 2016). Sea Watch Foundation data collected between 1978 to 2016 were also one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020).

SMRU: Bottlenose dolphin surveys

Species: Bottlenose dolphin. Opportunistic sightings data of harbour porpoise and minke whale.
Relevant Draft Plan Option Region: East
Relevant Draft Plan Option Area: None
Area: Tay and St Andrews Bay.
Year(s): 2009-present
Month(s): May-September
Outputs: Sightings and associated effort, photographs for individual identification

Bottlenose dolphin photo-ID surveys have been conducted in the Tay and St Andrews Bay regularly since 2009, in conjunction with the University of Aberdeen Lighthouse Field Station. Surveys are conducted in the summer months between May and September, in Beaufort sea state 3 or less. Survey routes are chosen randomly in order to maximise the probability of sightings while also obtaining reasonable coverage of the core study area.

The surveys were primarily coastal and so there is no overlap with Draft Plan Option areas, however, the data are useful to inform characterisation of potential offshore cable routes and landfall areas (Figure 36).

[31] https://www.seawatchfoundation.org.uk/

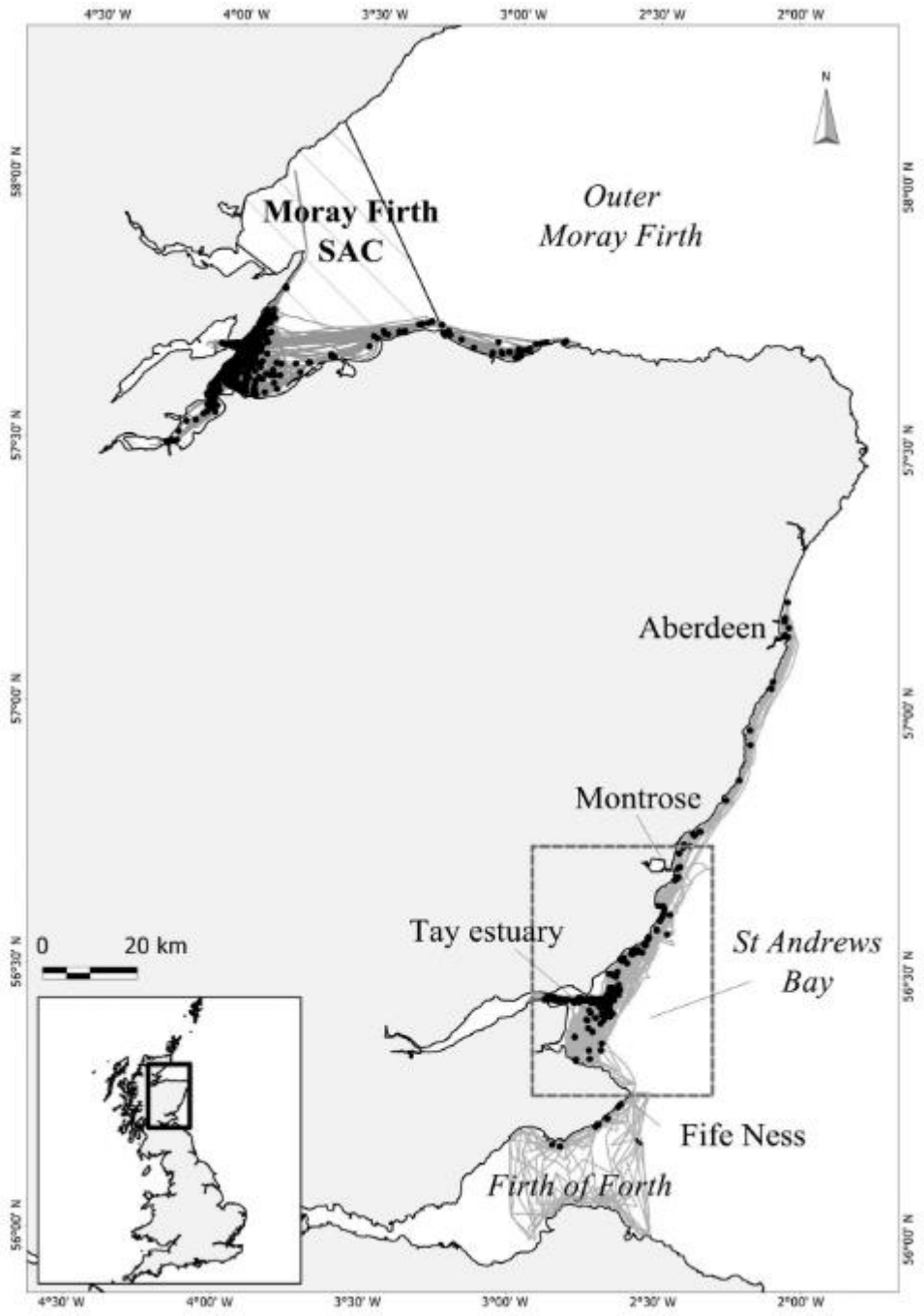

Figure 36 Overall sampling area along the east coast of Scotland between the Moray Firth and the Firth of Forth, covering the current population's main distributional range, including the subareas of St Andrews Bay and the Tay estuary (dashed box), and the Moray Firth Special Area of Conservation (SAC). Survey effort conducted from 2009 to 2015 is shown (grey lines) with locations of bottlenose dolphin encounters (black dots) (Arso Civil et al. 2019).

SMRU: Seal telemetry data

Species: Harbour seal and grey seal
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: Whole UK
Year(s): 1988-2018

Month(s): All
Outputs: GPS locations with associated dive data, which are ultimately used to develop seal at-sea usage maps

The Sea Mammal Research Unit (SMRU)[32] has deployed telemetry tags on grey seals and harbour seals in the UK since 1988 and 2001, respectively. These tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. There are two types of telemetry tag which differ by their data transmission methods; data transmission can be through the Argos satellite system (Argos tags) or mobile phone network (phone tags). Both types of transmission result in location fixes, but data from phone tags comprise better quality and more frequent locations. Since 1988 a total of 355 grey seals (Table 3) and 461 harbour seals (Table 4) have been tagged with ARGOS or GPS tags in UK waters. All tag data were provided by Dr Debbie Russell at SMRU. SMRU Consulting holds a copy of these data which can be requested by specific projects under a data request license.

Table 3 Number of grey seals tagged in UK waters with ARGOS or GPS tags each year between 1988 and 2018

	East Scot	Moray Firth	N Coast & Orkney	NE Eng	SE Eng	Shetland	W Eng & Wales	West Scot	Western Isles
1988					1				
1989					1				
1990	3								
1991				5					
1992				7					
1993	2		3	4					
1994				4					
1995									23
1996	7		9						4
1997	7			1					
1998	10		7			7			
2001	12								
2002	12								
2003								21	
2004	1						18	12	
2005	4				10				
2006	2								
2008	9			10					
2009							5		
2010			14				12		

[32] http://www.smru.st-andrews.ac.uk/

2011									
2012									
2013	8								
2014	5								
2015	2				21				
2016	2								
2017			9				12	12	12
2018		10	5				10		

Table 4 Number of harbour seals tagged in UK waters with ARGOS or GPS tags each year between 2001 and 2018

	East Scot	**Moray Firth**	**N Coast & Orkney**	**NE Eng**	**SE Eng**	**Shetland**	**W Eng & Wales**	**West Scot**	**Western Isles**
2001	10								
2002	5								
2003	10		7		5	8		6	
2004		5	8		11	7		9	
2005		5			8			8	
2006				12	9				21
2008	6			10					
2009							5	1	
2010				12					
2011	5		14					15	
2012	6		17		33			14	
2013	4	4						10	
2014		22	4					8	
2015		30							
2016			20		20				
2017	4		23					8	
2018			12						

SMRU: Seal haul-out count data

Species: Harbour seal and grey seal
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: None
Area: Whole UK
Year(s): August counts: 1996-current, Grey seal pup counts: 1989-current
Month(s): August haul-out count (harbour and grey seals), autumn pup count (grey seals)
Outputs: Haul-out count for population estimates

Harbour seals

Surveys of harbour seals are carried out during the summer months. The main population surveys are carried out when harbour seals are moulting, during the first three weeks of August, as this is the time of year when the largest numbers of seals are ashore. The counts obtained represent the number of seals that were onshore at the time of the survey and are an estimate of the minimum size of the population. They do not represent the total size of the local population since a number of seals would have been at sea at the time of the survey. However, telemetry data from tagged seals are used to scale this estimate to take account of the proportion of animals at sea at the time of survey. It is noted that these data refer to the numbers of seals found within the surveyed areas only at the time of the survey; numbers and distribution may differ at other times of the year.

Grey seals

Grey seals are also counted on all harbour seal surveys, although these data do not necessarily provide a reliable index of population size. Grey seals aggregate in the autumn to breed at traditional colonies, therefore their distribution during the breeding season can be very different to their distribution at other times of the year. SMRU's main surveys of grey seals are designed to estimate the numbers of pups born at the main breeding colonies around Scotland. Breeding grey seals are surveyed biennially between mid-September and late November using large-format vertical photography from a fixed-wing aircraft. The SMRU grey seal pup counts round the UK are augmented by surveys conducted by SNH, The National Trust, Lincolnshire Wildlife Trust and Friends of Horsey Seals.

Social Media

Species: All marine mammals, particularly bottlenose dolphin, killer whale and humpback whale.
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: None, sightings tend to be coastal
Area: Coastal Scotland
Year(s): Around 2015 onwards
Month(s): All
Outputs: Sightings information

Social media provides those interested in marine mammals to update dedicated social media groups with sightings information, organise watches, and share information of good sightings viewpoints. There are various groups focusing on Scottish waters, for example there are Facebook groups entitled the Forth Marine Mammal Project[33], Shetland Orca Sightings[34], Berwick Dolphin Watch[35], Orca Survey Scotland[36] and the Hebrides and NW Scotland Cetacean Sightings[37] group. These pages either focus on specific areas or species and are a source of information of the latest and ongoing sightings for that local area or species. In some cases, dedicated page administrators coordinate and collate sightings

[33] https://www.facebook.com/groups/377706222613082/
[34] https://www.facebook.com/groups/shetlandorcasightings/
[35] https://www.facebook.com/groups/BDW18/
[36] https://www.facebook.com/orcasurveyscotland/
[37] https://www.facebook.com/groups/HebridesandNWScotlandCetaceanSightings/

information and submit this data to Sea Watch and/or WDC. We have not separately attempted to collate any social media sightings data as part of this project.

Data from the Forth Marine Mammal Project contributed to a peer-reviewed publication on the 'sudden seasonal occurrence' of humpback whales within the Firth of Forth in the winter months of 2017 and 2018 (O'Neil et al. 2019). Citizen science sightings data and photographs were used to photo-identify at least four unique individuals, with one whale seen in the Forth in February 2018 matched to a whale seen in Svalbard, Norway, in May 2017. The authors suggest the sightings occurrence may follow a slow sightings increase of humpbacks in the Forth over the previous two decades, possible driven by wider population recovery (O'Neil et al. 2019). However, frequency of humpback whale sightings in the Forth in 2019 was lower than the prior two years, and currently (15 April 2020) there are no confirmed sightings in 2020 (Ronnie Mackie, pers comms).

St Abb's Marine Station

The St Abb's Marine Station[38] does not currently undertake marine mammal research or monitoring, however, there is a possibility that the station will begin to record incidental marine mammal sightings from 2020 onwards (E. Chapman, personal communications), so this may in future be a resource for marine mammal baseline information in the local southeast Scotland area.

Stone (2015): Marine Mammal Observations during seismic surveys

Species: Harbour seal, Grey seal, Ringed seal, Bowhead whale, Northern right whale, Gray whale, Humpback whale, Blue whale, Fin whale, Sei whale, Minke whale, Sperm whale, Northern bottlenose whale, Sowerby's beaked whale, Cuvier's beaked whale, Short-finned pilot whale, Long-finned pilot whale, Killer whale, False killer whale, Risso's dolphin, Bottlenose dolphin, White-beaked dolphin, Atlantic white-sided dolphin, Short-beaked common dolphin, Striped dolphin, Pantropical spotted dolphin, Atlantic spotted dolphin, Harbour porpoise
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: All
Area: All UK and adjacent waters
Year(s): 1994-2010
Month(s): All
Outputs: Species distribution plots

In a report put together by JNCC, Stone (2015) analyse data from 1,196 seismic surveys in UK and adjacent waters between 1994 and 2010. This totaled 181,000 hours of visual monitoring for marine mammals and 9,000 hours of acoustic monitoring. Visual watches are carried out from vessels during daylight hours, with observers all trained to a minimum level in marine mammal ID and survey technique. There were 9,073 marine mammal sightings or acoustic detections, comprising 124,024 individuals. The data were collected to examine the effects of seismic operations on marine mammals, but are also useful for the purposes of this report to demonstrate presence of marine mammals in Scottish waters.

The species distribution plots presented in the Appendix 1 of Stone (2015) represent summing of the number of individuals of each species in each offshore oil and gas licensing block (10' latitude x 12' longitude). Where shifts in distribution over time were apparent,

[38] http://marinestation.co.uk/

sighting rates in different areas over five year periods were calculated using only sightings that had accompanying effort data. To reduce bias, sightings rates for each five year period were calculated using only visual data from months of peak occurrence of animals (June to September).

Visual effort varied throughout the year, and was mainly confined to the North Sea in the first quarter. Visual effort was also strongly influenced by available daylight, which limits the extent of surveying during the winter months.

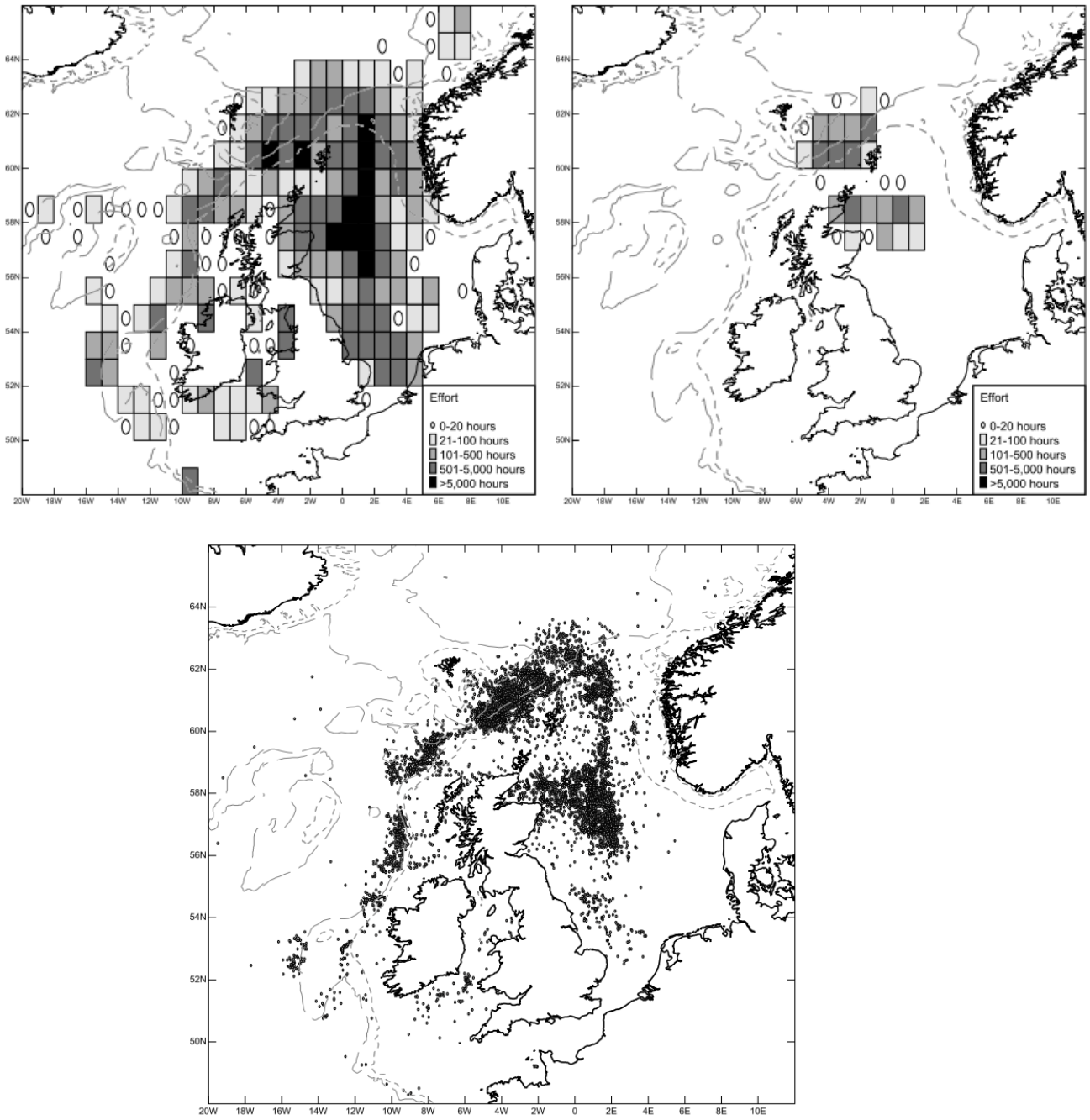

Figure 37 Visual effort (top left) and PAM effort (top right) during seismic surveys from 1996-2010. Bottom: Sightings and acoustic detections of marine mammals during seismic surveys, 1994-2010 (short dashed line = 200m isobath; long dashed line = 1,000m isobath). (Stone 2015)

WDC: Shorewatch

Species: Beaked whale spp., bottlenose dolphin, striped dolphin, common dolphin, harbour seal, Cuvier's beaked whale, fin whale, grey seal, harbour porpoise, humpback whale, killer whale, minke whale, North Atlantic right whale, northern bottlenose whale, pilot whale, pygmy sperm whale, Risso's dolphin, sei whale, Sowerby's beaked whale, sperm whale, white-beaked dolphin, white-sided dolphin
Relevant Draft Plan Option Region: All
Relevant Draft Plan Option Area: None
Area: Coastal mainland Scotland and Hebrides
Year(s): 2005-2019
Month(s): Year-round, frequency of effort varies across time and site
Outputs: Sightings maps (on effort and casual)

Whale and Dolphin Conservation[39] (WDC) are a UK-based charity dedicated to protecting whales and dolphins worldwide. Part of this works includes research, and so WDC run the Shorewatch programme[40], which supports volunteers to conduct effort-based marine mammal watches from specific sites on the Scottish coastline. Shorewatches have been ongoing in Spey Bay since 2005, and at other sites since 2010 (Figure 38). Hourly 10-minute scans are conducted by trained observers when the sea state is 4 or less, with at least 2km visibility. Any sightings, effort and associated metadata are recorded. If cetaceans are encountered, species ID and ID confidence are recorded. The aim is for effort to be evenly spread throughout the year and across daylight hours.

[39] https://uk.whales.org/
[40] http://www.wdcs.org/national_regions/scotland/shorewatch/

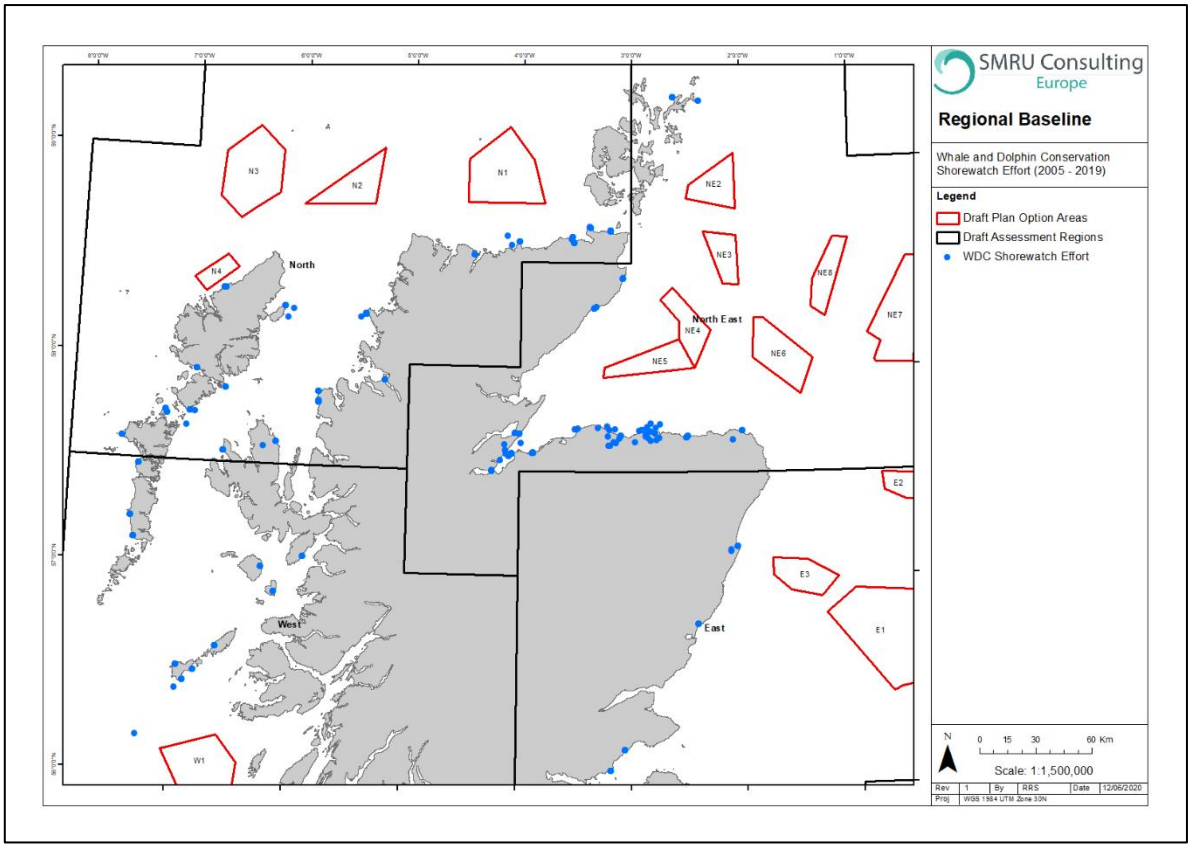

Figure 38 WDC Shorewatch sites in Scotland[41]. Overlaid for reference are the Draft Plan Option areas.

WDC data collected between 1999 and 2009 were one of the data sources incorporated into the modelling to produce species distribution maps presented by Waggitt et al. (2020), although it is unclear whether this included WDC data from Scottish waters.

Webb et al. (2018): Aerial surveys of the Sea of the Hebrides pMPA

Species: Minke whale, grey seal, harbour seal, white-beaked dolphin, harbour porpoise and Risso's dolphin
Relevant Draft Plan Option Region: West
Relevant Draft Plan Option Area: W1
Area: Hebrides
Year(s): 2016
Month(s): Aug-Sept
Outputs: Relative density and relative abundance estimates, sightings and spatial distribution maps

HiDef Aerial Surveying Limited were contracted by JNCC to carry out a pilot study to trial the suitability of digital aerial surveys for collecting data to assess distribution and abundance of basking sharks and minke whales in the Sea of the Hebrides proposed MPA. They carried

[41] Whale and Dolphin Conservation 2020. Shorewatch sites around Scotland. WDC Shorewatch Dataset 2005-2019. Supplied 15th April 2020. Made available under agreement on terms and conditions of use, and accessible via the WDC Shorewatch Programme, whales.org/Shorewatch | Shorewatch.data@whales.org

out three surveys in August and September of 2016 following transects spaced either 7.5 or 15km apart, and covering up to 719km^2 of the pMPA 10,309km^2 sea area.

One minke whale was observed on two of the three surveys. Webb et al. (2018) suggested that aerial surveying as a technique was ineffective to collect minke whale data, likely due to their long and deep dives leading to shorter periods of time at the surface for detection from fast moving aerial survey platforms. This effect of availability bias will have an effect on any associated abundance estimates. Therefore for minke whales and potentially other long and deep diving species, other survey methods may be more appropriate and cost-effective.

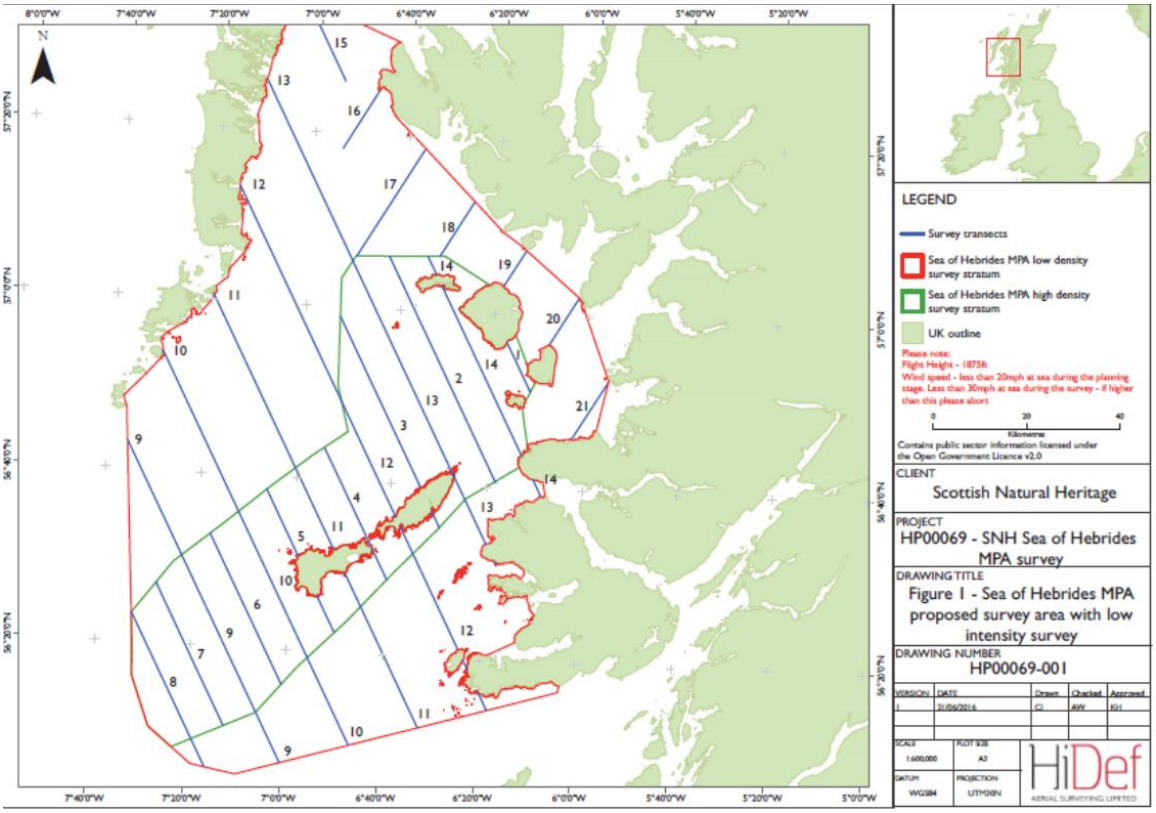

Figure 39 Survey transects of HiDef Ltd aerial surveys around the Sea of Hebrides pMPA

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