

Distributions of Cetaceans, Seals, Turtles, Sharks and Ocean Sunfish recorded from Aerial Surveys 2001-2008

WWT Consulting
Report to
Department of Energy and Climate Change

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Data, including GIS-ready files, used in the production of this report are available from WWT Consulting. It is hoped that cetacean data will also be made available through the Joint Cetacean Protocol being developed by JNCC and turtle, shark and Ocean Sunfish data will be submitted to the relevant recording bodies.

Contents

Contents

Figures

1. ACKNOWLEDGEMENTS

2. INTRODUCTION

3. METHODS

Aerial survey

Survey area

Coverage

Analysis and map production

Coverage

Observations and relative density

4. RESULTS

Cetaceans

Cetacean species

Whales

Dolphin species

Harbour Porpoise

Seals

Seal species

Common Seal

Grey Seal

Turtles

Turtle species

Sharks

Shark species

Basking Shark

Ocean Sunfish

5. DISCUSSION

Minke Whale

Bottlenose Dolphin

Common Dolphin

White-beaked Dolphin

Atlantic White-sided Dolphin

Risso's Dolphin

Killer Whale

Harbour Porpoise

Seals

Turtle species

Basking Shark

Ocean Sunfish

6. REFERENCES

7. FIGURES

APPENDIX I. PLACE AND FEATURE NAMES REFERRED TO IN TEXT.

Figures

Figure 1 – Coverage by aerial surveys made by WWT Consulting between 2001 and 2008.

Coverage was calculated by summing number of observers actively recording under survey conditions per 2km Ordnance Survey Great Britain grid cell across all surveys between 2001 and 2008.

Figure 2 – Relative densities of cetacean species recorded during aerial surveys 2001-2008. This species group includes unidentified cetaceans but not those identified as 'dolphin species'.

Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

Figure 3 – Locations of whales identified to species during aerial surveys 2001-2008.

Figure 4 – Relative densities of dolphin species recorded during aerial surveys 2001-2008.

Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

Figure 5 – Locations of dolphins identified to species during aerial surveys 2001-2008.

Figure 6 – Relative densities of Harbour Porpoise recorded during aerial surveys 2001-2008.

Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

Figure 7 – Relative densities of seal species recorded during aerial surveys 2001-2008. Relative

densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

Figure 8 – Locations of seals identified to species during aerial surveys 2001-2008.

Figure 9 – Relative densities of turtle species recorded during aerial surveys 2001-2008. Relative

densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

Figure 10 – Relative densities of shark species recorded during aerial surveys 2001-2008.

Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

Figure 11 – Locations of Basking Shark recorded during aerial surveys 2001-2008.

Figure 12 – Relative densities of Ocean Sunfish recorded during aerial surveys in 2008. Relative

densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

1. ACKNOWLEDGEMENTS

- 1.1** The ‘Distributions of Cetaceans, Seals, Turtles, Sharks and Ocean Sunfish recorded from Aerial Surveys 2001-2008’ report has been produced for the Department of Energy and Climate Change (DECC). Data presented in this report were collected through aerial surveys for waterbirds conducted for the following organisations, to whom we are grateful for commissioning the surveys and agreeing to the non-avian data being presented here: DECC (and its predecessors: Department for Business, Enterprise and Regulatory Reform and Department of Trade and Industry), the Joint Nature Conservation Committee, Department for Environment, Food and Rural Affairs, Natural England, Countryside Council for Wales, Scottish Natural Heritage, Airtricity, Amec Project Investments, Casella Stanger, Centrica Energy, DONG Energy, Greater Gabbard Offshore Winds Limited, Kentish Flats Limited, London Array Limited, London Power, Natural Power Company, NEG Micon, Ormonde Energy Limited, Powergen Renewables Ireland Limited, RWE Npower, Scira Offshore Energy Limited, Scottish Power Limited, Seascope Energy Limited, Thanet Offshore Wind Limited and Warwick Energy Limited.

2. INTRODUCTION

- 2.1** Data on the distributions and abundances of cetaceans, seals, turtles, sharks and Ocean Sunfish presented here were collected opportunistically during aerial surveys for waterbirds conducted by Wildfowl and Wetlands Trust Consulting (WWT Consulting, formerly the Wetlands Advisory Service).
- 2.2** Since the *Sea Empress* oil spill off the south-west coast of Wales in 1996, the Wildfowl and Wetlands Trust and WWT Consulting have undertaken aerial surveys for waterbirds around the UK coast.
- 2.3** Initial data were collected to assess the impact of the oil spill on Common Scoter *Melanitta nigra* wintering along the Welsh coast (Cranswick *et al.* 1998), but have since extended in range to collect all waterbird species data for the identification of Special Protection Areas (SPAs), monitoring of waterbird numbers and distribution, and for Strategic Environmental Assessments and Environmental Impact Assessments for Offshore Windfarm developments (OWF).
- 2.4** From 2001 surveys adopted a new distance-sampling methodology developed in Denmark by National Environment Research Institute (NERI). It was found that as well as recording the precise locations of waterbirds, other animal groups and species such as cetaceans (whales, dolphins and porpoises), seals, turtles, sharks and Ocean Sunfish could also be recorded without impeding the collection of waterbird data. Such data were recorded using exactly the same methods as for birds, thus being collected opportunistically but systematically during the surveys.
- 2.5** Initial survey coverage was limited to areas of known concentrations of waterbirds, where there was particular conservation or development interest, including Carmarthen Bay, Cardigan Bay, the North Wales coast and around Blackpool and Barrow-in-Furness (Cranswick *et al.* 2003, WWT Wetlands Advisory Service 2003, Cranswick *et al.* 2004).
- 2.6** As a result of increased OWF interest, the then Department of Trade and Industry (DTI) (subsequently the Department for Business, Enterprise and Regulatory Reform (BERR), and Department of Energy and Climate Change (DECC)), supported by other Government departments, agencies and industry, commissioned a large-scale survey of strategic areas identified for the second round of OWF development. Adjoining areas identified as potentially important for birds were also included.
- 2.7** The first comprehensive survey was undertaken by WWT Consulting in 2004/05 (DTI 2006), with a subsequent programme of surveys from winter 2005/06 through to summer 2006 (BERR 2007). These provided large-scale survey data covering the nearshore waters of strategic windfarm areas in north-west England (from Anglesey to the Solway Firth), in the Greater Wash and in the Thames (from Flamborough Head, Yorkshire, to Sandwich Bay, Kent).
- 2.8** BERR commissioned a third and fourth programme of aerial surveys to be undertaken between January and March 2007 and October 2007 and August 2008, respectively, which included repeat surveys of many of the areas surveyed previously, as well as new areas particularly around Wales, the South-West, South and South-East (WWT Consulting 2007, WWT Consulting in press). Additional areas were surveyed for individual windfarm companies and the statutory nature conservation agencies; the Joint Nature Conservation Committee, English Nature (subsequently Natural England) and Countryside Council for Wales.
- 2.9** This report details the distributions of all records of cetaceans, seals, turtles, sharks and Ocean Sunfish collected in areas of waterbird surveys around the UK coast between 2001 and August 2008 using the standardised aerial survey methodology (see below).

- 2.10** Although the data were collected using distance-sampling methods this report focuses on the distribution of these species and does not present analyses of detection functions for each species and the calculation of estimates using distance analysis.

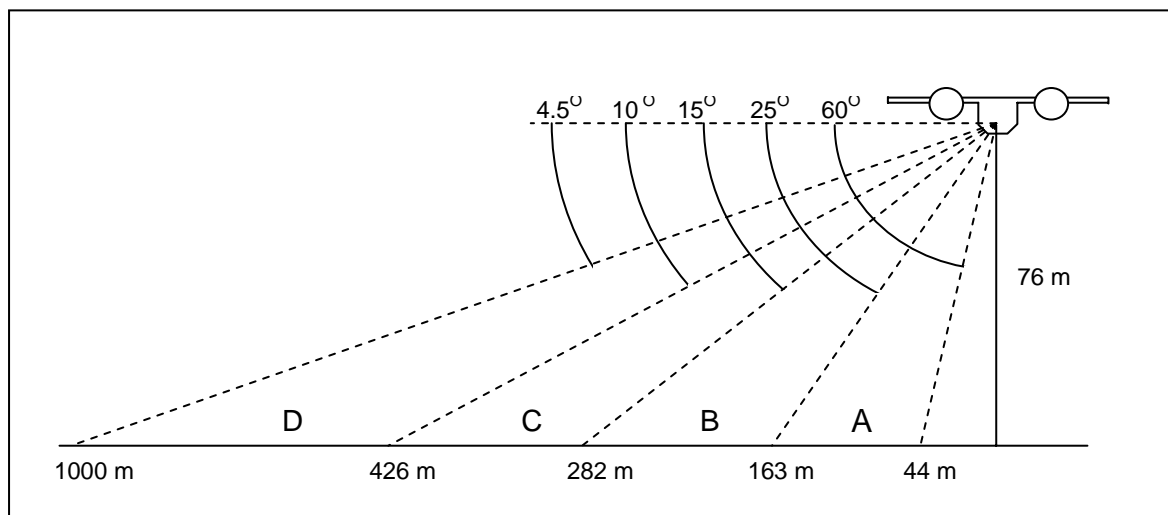
3. METHODS

Aerial survey

- 3.1** The data presented in this report were collected opportunistically during surveys for waterbirds, using a methodology designed specifically for mapping their distribution and determining abundance estimates. Given this, the time spent identifying other animal groups had to be balanced with time spent searching for and identifying birds. Thus many sightings that could have been identified to species given longer views had to be assigned species groups (see below), and a small number of animals may have been missed if they occurred in areas of high bird density.
- 3.2** The methodology used was originally developed in Denmark by NERI (Kahlert *et al.* 2000; see also Camphuysen *et al.* 2004). This involved a ‘distance sampling’ approach (see Buckland *et al.* 2001), whereby observations were assigned a distance band, to estimate their range from the aircraft. Because observations further from the observer were more difficult to detect, recording of distance allows the number of ‘missed observations’ to be estimated. This approach allows future statistical analyses of the data to calculate estimates of numbers in areas with confidence limits.
- 3.3** Aerial surveys were undertaken by WWT Consulting using experienced observers whose previous projects have included aerial surveys of many OWF sites, and surveys to identify sites for classification as SPAs.
- 3.4** A number of Partenavia PN68 aircraft were used, flying at an altitude of 76m and at a speed of approximately 185kmh⁻¹. This airspeed may have increased to approximately 200kmh⁻¹ in conditions presenting a strong tailwind. The location of the aircraft was recorded every five seconds using a GPS, with a second, backup GPS recording location every eight seconds.
- 3.5** A series of north-south transects spaced 2km apart was designed to cover the areas of interest for each project, such as bays or OWF footprints. Transects that ran north-south reduced the effect of glare during the survey, thus aiding the detection and identification of species. For ease of planning, transects followed eastings of the Ordnance Survey Great Britain grid, which itself was independent of environmental variables. The transects were assigned to flying blocks, which represented the optimal length of survey that could be flown in a single day (approximately 600 km), ensuring that whole features such as bays, estuaries, sand or mud banks or windfarm footprints were included within a single block where possible, and not split between several.
- 3.6** For each observation, which could have been a single animal or group of animals, the species, number, behaviour, distance band and the time at which it was perpendicular to the flight path of the aircraft were recorded using a dictaphone.
- 3.7** Using a clinometer, observations were located into one of four distance bands covering an area from 44m to 1,000m either side of the aircraft (Figure i); those beyond 1,000m from the flight path of the aircraft were not recorded. Though not applicable to all other animal observations, the survey method assumed that all birds in distance Band A were detected, so effort was concentrated on this band. Inevitably, more birds and other animals may have been missed further from the aircraft in other bands owing to their distance from the aircraft and the need for the observers to concentrate observation on the area of sea nearest the flight line.

- 3.8** Surveys were generally made during a four-hour period centred on midday GMT to minimise the effects of glare on counts. Surveys were undertaken in good weather conditions, generally with wind speeds of 15 knots or less.
- 3.9** Survey was suspended during the turns between transects, though significant observations, *e.g.* notable bird species, cetaceans or large flocks of birds, were sometimes recorded on an *ad hoc* basis. These data were excluded from these results.

Figure i – Distance bands used for aerial survey (not to scale).

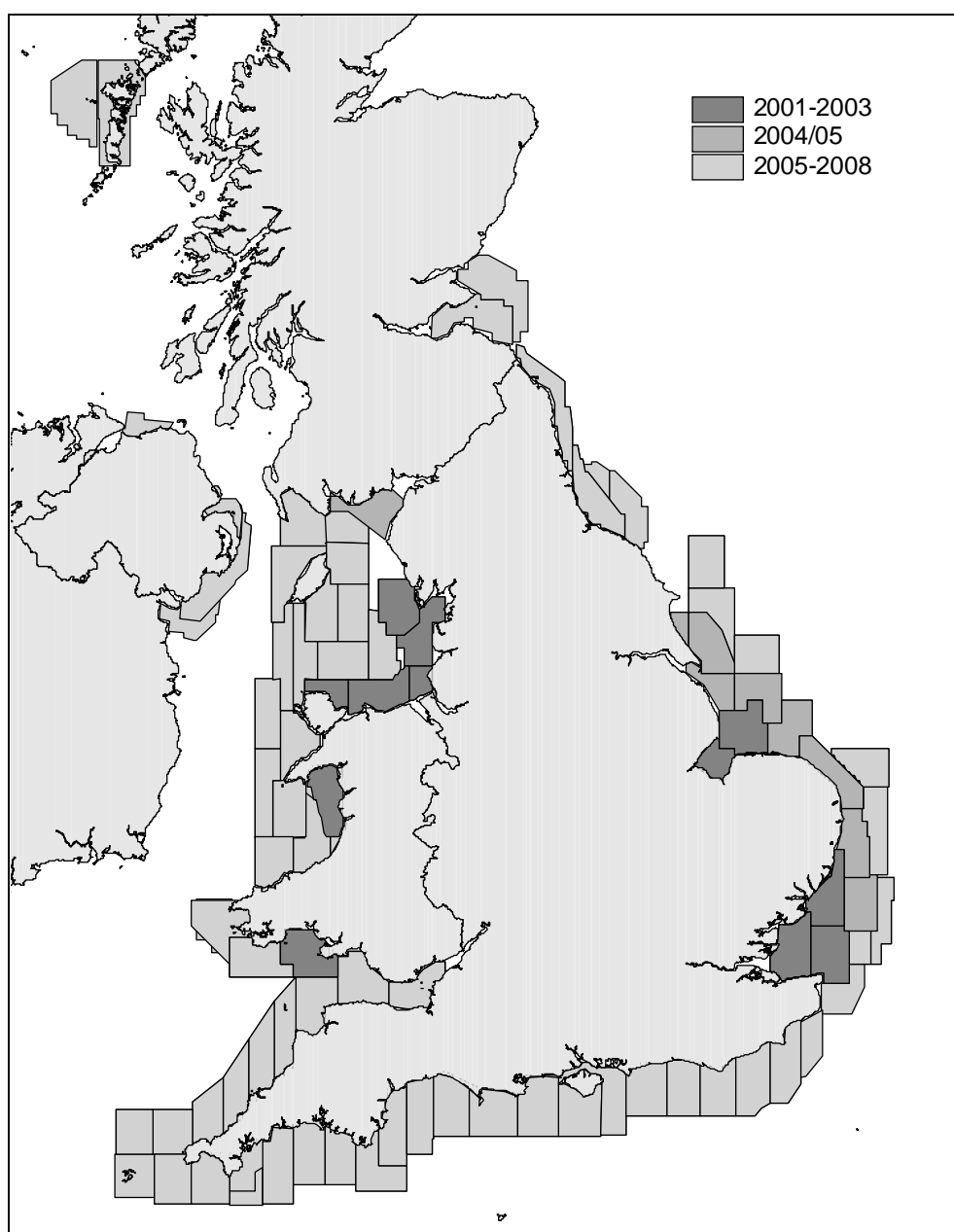


- 3.10** Given the limited time available for identifying non-avian species during these surveys, and the inherent difficulty of reliably identifying species from often only partial views, not all observations were identified to species level, and so were assigned to species groups.
- 3.11** Species groups used for cetaceans were: ‘dolphin species’ (Bottlenose Dolphin *Tursiops truncatus*, Common Dolphin *Delphinus delphis*, White-beaked Dolphin *Lagenorhynchus albirostris*, Atlantic White-sided Dolphin *Lagenorhynchus acutus* and Risso's Dolphin *Grampus griseus*) and ‘cetacean species’ (including Harbour Porpoise *Phocoena phocoena*, Bottlenose Dolphin, Common Dolphin, White-beaked Dolphin, Atlantic White-sided Dolphin, Risso's Dolphin, Long-finned Pilot Whale *Globicephala melas*, Killer Whale *Orcinus orca*, Sperm Whale *Physeter macrocephalus*, Fin Whale *Balaenoptera physalus* and Minke Whale *Balaenoptera acutorostrata*).
- 3.12** Seals not identified as Common Seal *Phoca vitulina* or Grey Seal *Halichoerus grypus* were assigned to the group ‘seal species’.
- 3.13** No turtles were identified to species and although the majority of UK records are of Leatherback Turtle *Dermochelys coriacea*, given the occasional record of other possible confusion species, all observations were recorded as ‘turtle species.’
- 3.14** Basking Shark *Cetorhinus maximus* was the only shark identified to species, with other observations being recorded as ‘shark species.’
- 3.15** Where seen clearly, Ocean Sunfish *Mola mola* were readily identified to species.
- 3.16** Behaviour codes assigned to observations included whether they were stationary or moving, and if moving, in which direction.

3.17 During the survey observers recorded sea state, based on the Beaufort Scale, cloud cover, in octas, any physical conditions such as haze, rain and glare, and a subjective assessment of 'visibility.' This was recorded at the start of each transect and whenever conditions changed. The recorded visibility was a subjective assessment of the overall 'detectability' of observations based on the combination of these conditions. Visibility categories were defined as 'excellent', 'good', 'moderate', 'poor' and 'bad'. When a combined effect of sea state, cloud cover and glare conditions resulted in 'poor' visibility (observer regularly felt they were missing a proportion of observations in the inner distance band) on several transects, surveys would be abandoned. Data collected during poor conditions were then analysed to determine whether they should be kept or discarded.

Survey area

Figure ii – Increasing coverage from aerial survey blocks flown by WWT Consulting between 2001 and 2008. Note actual shapes of some blocks changed between years and many blocks were repeated over several years.



- 3.18** Figure ii shows how aerial survey coverage of the UK coast and offshore areas by WWT Consulting has increased since 2001. Many blocks have also received repeat coverage (see below).

Coverage

- 3.19** Where possible, individual flying blocks were flown throughout the year to cover the changing use of the sea during the annual cycle of different waterbird species. To facilitate co-ordinating this coverage, the year was divided into seven Periods, covering from October to August. Thus, in any year a survey block may have been flown up to seven times. Many blocks were also repeated between years. Conversely, some blocks were only surveyed once or a very few number of times to collect just initial baseline data.

Analysis and map production

Coverage

- 3.20** ArcView 3.2 was used to convert GPS track data from each survey into continuous track lines. Portions of track lines between transects when the observers had stopped counting were removed, as were any other areas not adhering to standard survey conditions, such as climbing over a windfarm or turning to avoid a boat.
- 3.21** Coverage was assigned to tracks depending on how many observers were counting (this was normally two, but if one observer had to stop, for example to liaise with the pilot, then this section of track line was assigned a coverage of just one). Track lines of different survey blocks and of different times (Periods and years) were then merged to obtain overall coverage for each section of track (see Figure 1).

Observations and relative density

- 3.22** Interpolation of the GPS data enabled the position of the aircraft to be determined at each second. The precise location of each observation was calculated by linking the time (to the nearest second) at which they were recorded to the interpolated GPS position at that time. The positions of observations detected were recorded either side of the flight path at a distance in the middle of the distance band in which they were seen. The location of most observations was consequently considered to be accurate to within 200-300m.
- 3.23** Relative densities for species and species groups were calculated by splitting observations into 2km x 2km (Ordnance Survey GB) cells then summing these and normalising by coverage. This provided the number of observations per kilometre of survey effort. Relative density maps were then produced showing values for each species or species group in 2km x 2km grid cells.
- 3.24** Note that the range of relative density values may vary markedly between species and reference should be made to the key in each figure to interpret apparent high concentrations of observations appropriately.

4. RESULTS

- 4.1** Figure 1 shows the coverage achieved through aerial surveys carried out by WWT Consulting between 2001 and 2008. As the surveys were commissioned to obtain data on waterbird numbers and distribution, the areas with highest coverage tended to be those areas of high waterbird abundance. More recent surveys have expanded the range to include new areas of the coast and further offshore, that are either of interest for different bird species such as terns or for OWF development.
- 4.2** Place names referred to in the text are shown in Appendix 1.

- 4.3** The relative density maps presented show total numbers recorded normalised by survey effort (coverage). Observations maps show locations of records of particular species.

Cetaceans

Cetacean species

- 4.4** Relative densities of observations assigned as ‘cetacean species’ are shown in Figure 2.
- 4.5** A total of 662 observations of 926 individuals were recorded as ‘cetacean species’.
- 4.6** In the north-west, from Barrow in Furness to Llandudno, unidentified cetaceans were recorded frequently but at a low density to about 30km offshore. Further offshore, towards the Isle of Man, records became sparser, but relative density increased.
- 4.7** Around Anglesey and Caernarfon Bay, records were frequent and at a high density. A cluster occurred about 30km west of Anglesey. Records continued to occur at a similar frequency and density around Cardigan Bay, again to approximately 30km offshore.
- 4.8** South and west Wales and north Devon and Cornwall generally had high frequencies of records at high densities, with sightings decreasing close to the Bristol Channel and increasing further south. Clusters occurred around Hartland Point up to approximately 20km offshore, and around St. Ives to about 30km offshore.
- 4.9** Clusters of unidentified cetaceans were found at high densities off Lizard Point and south-west of Lands End on the south Cornish coast, with another cluster about 60km east of Lizard Point. From Start Point to Margate records were very sparse, especially lacking around the Isle of Wight.
- 4.10** North of Margate, records increased dramatically until reaching the north Norfolk coast. Sightings were frequent, and of a moderate density. Sightings decreased towards the outer Thames estuary.
- 4.11** Sightings offshore from The Wash dropped in both density and frequency before increasing again further north, particularly in areas further offshore.

Whales

- 4.12** The locations of large cetaceans identified to species level are presented in Figure 3.
- 4.13** In total, nine Minke Whales were identified, located in three areas. These were approximately 30km west of Anglesey in an area which corresponded to the edge of the Celtic Deep, approximately 30km north of St. Ives and north-east of Flamborough Head. Six animals were seen during one survey north-east of Flamborough Head on 20th May 2008, with the other records coming from May, July and August 2008.
- 4.14** There was one record of a Killer Whale, recorded on 2nd July, 2008, again in a survey block north-east of Flamborough Head.

Dolphin species

- 4.15** Relative densities of observations assigned as ‘dolphin species’ are shown in Figure 4.
- 4.16** Dolphins were recorded at low density and low frequency in the north-west, with numbers of records increasing along the north Wales coast towards Anglesey. A loose cluster of records occurred between Anglesey and the Isle of Man.
- 4.17** Most records in Cardigan Bay occurred within 30km of the coast, and had a scattered distribution. Areas of highest density occurred in survey areas off south and west Wales and the north Devon

and Cornwall coast, and sightings here had a high frequency. A cluster of records occurred offshore from St. Ives.

- 4.18** The south coast showed very loose clusters of observations at low density, west of the Isles of Scilly, west of Lizard Point and east of Start Point. From Lyme Bay east along the coast to Margate records were very scarce.
- 4.19** A loose cluster of records occurred north-east of Margate, decreasing further north until another loose cluster north-east of Flamborough Head.
- 4.20** The locations of dolphins identified to species level are presented in Figure 5.
- 4.21** In total, 52 Bottlenose Dolphins were recorded. These were mainly recorded as individuals or in small groups of up to three animals, with the exception of nine recorded together on 14th February 2006 and 10 recorded on 27th July 2008. This species was recorded in all months except April, August and October.
- 4.22** Bottlenose Dolphins recorded were predominantly around the Welsh coast, mainly in Cardigan Bay, with some sightings around Anglesey, and slightly further north towards the Isle of Man. There were just five records of single animals on the east coast, four north-east of Margate and one 34km north of the Norfolk coast.
- 4.23** Most of the 488 Common Dolphins identified occurred off south and west Wales and the north Devon and Cornwall coast. 69% of records occurred between May and August. With the exception of one record 30km east of Havergate on 3rd March 2006, all winter records came from south of Pembrokeshire and around Cornwall. During the summer they were recorded in high numbers near Lundy Island with 212 being recorded in one survey on 7th August 2008 and with more scattered occurrence around the south-west and in Cardigan and Caernarfon Bays. Two summer records came from further north, one near the Isle of Man on 14th July 2008 and one near Luce Bay on 16th May 2008.
- 4.24** White-beaked Dolphins were identified in small numbers in the north-east, off Flamborough Head, with six being recorded in the same survey (two off transect) on 31st March 2008, three recorded east of Start Point on 8th June 2008 and one in Cardigan Bay on 27th July 2008.
- 4.25** There were positive identifications of five Atlantic White-sided Dolphins, three of which were seen together a short way offshore from Fleetwood in the north-west on 17th January 2002, and two which were identified about 20km north-west of Hartland Point in Devon on 7th August 2008.
- 4.26** Two observations of Risso's Dolphins were made to the west of Anglesey. The first was of three animals recorded 2.5km offshore on 24th June 2008 and the second of a single animal 35km offshore on 8th August 2008.

Harbour Porpoise

- 4.27** Relative densities of Harbour Porpoises are shown in Figure 6.
- 4.28** In total, 4,588 records comprising 5,439 animals were made of Harbour Porpoise. Most records were of individual animals, with fewer in small groups of up to seven individuals (mean group size 1.19). Records were made in all months, with 82% made between October and March, which may partly reflect increased coverage through these months.
- 4.29** In the north-west, Harbour Porpoises were recorded throughout the region, but more in coastal than offshore areas. Porpoises were recorded off the Mull of Galloway, within Wigtown Bay and up the Solway Firth as far as was surveyed. They were not recorded in Luce Bay.

- 4.30** From Barrow in Furness to Anglesey, porpoises occurred at a fairly uniform low density, but at a high frequency. They were observed in a band extending up to approximately 30km offshore. They were found more scattered, but at higher density to the south-east of the Isle of Man. There was a cluster of records to the west of Anglesey around the eastern edge of the Celtic Deep.
- 4.31** Porpoises were distributed throughout Caernarfon and Cardigan Bays at a moderate density, with a small cluster of higher density near Strumble Head. Porpoises were not recorded in St Brides Bay. From Milford Haven east to the Bristol Channel, Porpoises were recorded offshore to the extent of the survey, and as far into the channel as Minehead.
- 4.32** Generally, off the north Devon and Cornwall coasts, porpoises were found closer to shore than they were in surveys off Wales and the North-West. A cluster of records occurred off Land's End.
- 4.33** Records were sparser on the south coast, with sporadic records east of Lizard Point and a loose cluster occurring in Start Bay. Sightings started increasing from the Isle of Wight east towards Dover, and also seemed to occur progressively closer to the shore.
- 4.34** The survey areas north of Dover to the north Norfolk coast contained a high number of records. Porpoises occurred in this area at higher densities and frequencies than recorded elsewhere. Within this area there was a dense cluster offshore of Southwold. A survey including this area in 2005 counted 242 animals. Records were limited closer inshore towards the Thames Estuary.
- 4.35** Sightings decreased offshore from the north Norfolk coast and The Wash to a lower density. Records started increasing again north and west of Spurn Head, particularly in areas further offshore, where some high density clusters were found.

Seals

Seal species

- 4.36** Relative densities of observations assigned as 'seal species' are shown in Figure 7.
- 4.37** A total of 1,357 observations of 6,915 individual seals were recorded. Of these only 114 observations (118 individuals) were identified to species, with the remainder, 1,243 observations of 6,797 individuals, recorded only as 'seal species'. The majority of seals recorded were in herds on beaches or rocky shores, with fewer individuals recorded in the water.
- 4.38** On the west coast seals were mostly recorded in an arc following the coast from Barrow in Furness, south to Anglesey to about 30km offshore. Records were frequent and at a low density. In the rest of the surveyed area in the northern Irish Sea they showed a more scattered distribution at a low density. Seals occurred frequently in Cardigan Bay, with slightly more records in the northern half. Again, records were limited to approximately 30km offshore.
- 4.39** In the south-west records were scattered and at a low density, with loose clusters offshore of St Ives and Land's End. Records on the south coast east of Lizard Point to Dover were sparse. North of Dover and into the outer Thames Estuary records increased in frequency before becoming sparser up the coast of East Anglia.
- 4.40** Records were frequent offshore from the north Norfolk coast and The Wash and occurred at a low density. Records extended offshore to the limits of survey coverage. Sightings decreased around Flamborough Head and became sparse further north until increasing again around the Farne Islands.
- 4.41** The locations of seals identified to species level are presented in Figure 8.

Common Seal

- 4.42** On the west coast positive identifications of Common Seals occurred off the north Wales coast and south-west of Barrow in Furness. On the east coast there were records offshore from Great Yarmouth and north-east of the Wash. In total only 13 Common Seals were identified, which reflected the dependence on good sightings to confirm this species.

Grey Seal

- 4.43** Most of the 101 Grey Seal records occurred on the west coast, from Barrow in Furness to Anglesey, and in Cardigan Bay, particularly within 20km of the coast and around Shell Flat. Records were scattered on the east coast and ranged from Margate to Hornsea. Records were made in all months, with 68% of records coming from October to March, though this may be due to differences in coverage.

Turtles

Turtle species

- 4.44** Figure 9 shows the relative densities of observations assigned as ‘turtle species’.
- 4.45** All three turtle sightings occurred in or around Carmarthen Bay. One animal was recorded on 3rd November, 2007 and two were recorded on 6th July 2008.

Sharks

Shark species

- 4.46** Relative densities of observations assigned as ‘shark species’ are shown in Figure 10.
- 4.47** Most of the shark species recorded were on the west coast of the UK, with a cluster of sightings around 30km offshore of Plymouth, another off Land’s End and another off St Ives. Records continued at a low frequency and density north towards the Isle of Man, and at a much lower frequency east along the south coast, with just two recorded on the east coast, in the outer Thames Estuary. There was one record in the Sound of Harris from surveys around the Uists in July 2007.
- 4.48** Of the 30 records of unidentified ‘shark species’ 22 were recorded in summer months, between May and August. These included all those recorded along the south coast, and the majority recorded along the west coast. Winter records were of two animals in the south-west of Caernarfon Bay in December 2007, four off the north coasts of Devon and Cornwall in October and November 2007 and the two records in the outer Thames Estuary in November 2005 and February 2008.

Basking Shark

- 4.49** The only sharks identified to species level were Basking Sharks, the locations of which are shown in Figure 11.
- 4.50** The majority of Basking Shark records were made in June, July and August, with three made during winter months. Of these, one recorded on 27th November 2007 was north-east of the Isle of Man, one on 28th January 2008 was in Caernarfon Bay and one on 26th March 2008 was in Cardigan Bay.
- 4.51** Ten were seen in one survey on 26th June 2008, 30-34km north of St Ives. Records continued to occur north, into Cardigan Bay and in the Irish Sea towards the Isle of Man. There were two records off the south coast, one 30km south of Plymouth and one about 20km south of Hastings.

Ocean Sunfish

- 4.52** The relative densities of Ocean Sunfish are shown in Figure 12.

- 4.53** Ocean Sunfish were recorded on the west and south-west coast of the UK, south of the Isle of Man predominantly around Cornwall. All records were made in June, July or August, 2008. Off Cornwall, records occurred in two main clusters, one south-west of Land's End and the other extending south from Plymouth. These clusters each related to single surveys on 22nd and 27th July 2008, with over 30 sunfish recorded per survey.
- 4.54** Records continued up the north coast of Cornwall, with a looser cluster at lower density north of St Ives. There were a few records in Cardigan Bay and the most northerly observation occurred midway between Anglesey and the Isle of Man.

5. DISCUSSION

- 5.1** Through the aerial surveys for waterbirds described in this report, 7,103 sightings of 14,667 individual non-avian animals and of 12 species (plus 'turtle species') were recorded between 2001 and 2008.
- 5.2** The survey method was comparable to that used for the collection of previous cetacean data such as by JNCC's Seabirds at Sea Team (Pollock *et al.* 2000) and that of the Small Cetacean Abundance in the North Sea (SCANS) project (Hammond *et al.* 2002). Differences in methodology included the number and widths of distance bands used and altitudes and flying speeds of aircraft. Data from these and other cetacean surveys are presented in Reid, Evans and Northridge's '*Atlas of Cetacean distribution in north-west European Waters*' (2003), with which comparisons for individual species are made.

Unidentified cetacean species

- 5.3** A total of 5,602 sightings of 7,582 individual cetaceans were recorded over the period. Of these, the majority were identified as Harbour Porpoises, with the next most recorded category being unidentified 'cetacean species', containing 662 records of 926 individuals. The distribution of these unidentified species closely matched that of Harbour Porpoise, and it is likely that many of the records of this group were of this species but that positive identification was not possible due to poor views.
- 5.4** Likewise, the distribution of unidentified dolphin species was similar to those positively identified to species and it is likely the majority recorded around South Wales, Devon and Cornwall were Common Dolphins, whilst those further north, around the Welsh coast and Liverpool Bay, included more Bottlenose Dolphins. Smaller numbers here, and on the east coast may also have included the less commonly recorded species, particularly White-beaked Dolphin, Atlantic White-sided Dolphin and Risso's Dolphin.
- 5.5** While of limited use for studies on individual species, the distribution of these unidentified cetacean and dolphin species do indicate that the Irish Sea, Celtic Sea and North Sea areas have relatively high importance for cetaceans in general, with fewer numbers using the English Channel.

Minke Whale

- 5.6** The distribution and relative abundances of records of Minke Whale from these aerial surveys support the distributions presented in the *Atlas*, with occasional sightings in the south-west and Celtic Sea and much higher frequencies off north-east England.

Bottlenose Dolphin

- 5.7** The distributions presented for this species also agree closely with those reported in the *Atlas*, with most frequent sightings around west and north Wales and slightly fewer around south Wales, Devon and Cornwall. Notable exceptions occurred north-east of Kent and south of Isle of Man which were not identified previously. Those recorded north-east of Kent were of four animals recorded during the same survey. Without more detailed behavioural data it is not known whether these animals

were transiting between areas or foraging. Williams *et al.* (1996) suggested seasonal movements along the south coast which may relate to prey availability and which may account for the variability in record distribution.

Common Dolphin

- 5.8** The data presented for Common Dolphin also closely matches the distribution presented in the *Atlas*, with highest frequencies around Pembrokeshire and off the Devon and Cornwall coasts. Interestingly, the record near Luce Bay on 16th May 2008 and that 30km east of Havergate on 3rd March 2006 closely match the locations of previous occasional records.
- 5.9** The results presented here do suggest higher numbers were recorded around Lundy and closer to the north Cornwall coast than reported previously. This may represent a real difference in distribution, relate to the larger scale at which data is presented in the *Atlas*, or to differences in coverage. Further analyses of the original datasets would be needed to investigate this.

White-beaked Dolphin

- 5.10** Although very few records of White-beaked Dolphin were collected during these surveys, the distribution of frequencies relates well to those presented previously, with most records in the north-east, off Flamborough Head and occasional records off the south and west coasts. Coverage further to the north on the east coast was limited for the waterbird surveys, particularly in offshore areas where higher numbers of White-beaked Dolphins have been previously reported.

Atlantic White-sided Dolphin

- 5.11** Very few records of this species were made, which corresponds to the reduced distribution away from the continental slope reported in the *Atlas*. Records were made in Liverpool Bay and the outer Bristol Channel where they have previously only been rarely recorded. The lack of observations from the east coast may be attributable to records assigned to 'dolphin species' given the potential confusion with White-beaked Dolphins with sub-optimal views.

Risso's Dolphin

- 5.12** As with the previous species, very few records were made of this more westerly species. Those records made were within the range shown in the *Atlas* and supported the seasonal trend reported there, both coming from summer months.

Killer Whale

- 5.13** Only one record of Killer Whale was made. This was in an area not identified in the *Atlas*, north-east of Flamborough Head. Though not present here in cetacean atlases, they have been reported in this area in the popular press, usually from land-based sea-watchers and opportunistically from boats.

Harbour Porpoise

- 5.14** A total of 4,588 sightings comprising 5,439 individual animals were made of Harbour Porpoise. The results show similar distributions to those presented in the *Atlas*, with higher frequencies close to shore around the west coast and off the Lincolnshire and Yorkshire coasts, but with much higher frequencies recorded off the coast between Norfolk and Kent.
- 5.15** These results are similar to those recorded in the SCANSII project (2006), in which much larger numbers of Harbour Porpoises were recorded in the southern North Sea than in the 1994 SCANS surveys which supported the *Atlas*. In the SCANSII report, changes in prey distribution were suggested as a possible cause of this change, though further research is required.

Seals

- 5.16** Comparatively few seals were identified to species given the risk of confusion between Common and Grey Seals with sub-optimal views. The distributions presented are within those presented elsewhere, (NBN Gateway: <http://data.nbn.org.uk/> and JNCC website SAC species accounts: www.jncc.gov.uk/ProtectedSites/SACselection/species.asp), though with higher frequencies recorded in Liverpool Bay. Though large numbers have been recorded at haul out sites on Hilbre Island and along the north Wales coast, further study would be required to estimate total numbers from the data and to investigate where these animals breed and forage.

Turtle species

- 5.17** The three turtle sightings were all made in Carmarthen Bay, an area already recognised for a high incidence of sightings. The relatively few sightings despite the large size of many turtles sighted in the UK may be due to their behaviour and low profile in the water which would make them harder to detect during aerial survey, particularly in further distance bands.

Shark species

- 5.18** A total of 30 observations of 'shark species' were recorded. Of these, 21 records came from around Devon and Cornwall, three from Wales, four from south-east England and East Anglia and one from north-west England. It is considered likely, given this distribution that many of these records relate to poor views of Basking Sharks. Others were suspected to be different species on the basis of what details could be discerned given poor views. These may have included members of the Order Lamniformes (Mackerel Sharks, which include Basking Sharks) or of the Order Carcharhiniformes (Ground Sharks), both of which are well represented in the areas surveyed, (Vas, 1991) and which can occur near the surface.

Basking Shark

- 5.19** A total of 22 sightings, comprising 28 Basking Sharks were recorded. The distribution of records reflected well distributions previously reported, showing the importance particularly of the coasts of Cornwall, Wales and the Isle of Man for this species (Marine Conservation Society website: <http://www.mcsuk.org/marineworld/baskingsharks/>).

Ocean Sunfish

- 5.20** Recording of sunfish only began during aerial surveys in 2008. In this year, 89 records were made comprising 107 animals. The distribution of records was within the areas of existing highest sightings rates, mainly off the coast of Cornwall, with fewer records up the Welsh coast and towards the Isle of Man (NBN Network: <http://www.nbn.org.uk/> and MarLIN: <http://www.marlin.ac.uk/species/Molamola.htm>).

Concluding remarks

- 5.21** The data presented here were collected by a standard methodology that enables estimates of abundance to be calculated through distance analysis. Such techniques were applied to data collected during the SCANS and SCANSII projects and it is hoped that further analysis of these data will include investigating correction factors of each species in different recorded sea states, detection functions of each species with distance and the derivation of abundance estimates that can be combined with other datasets for conservation monitoring.
- 5.22** These data and those reported previously by JNCC (Pollock *et al.* 2000) show how extensive and precise data on the distribution of non-avian species can be collected during aerial surveys for waterbirds, without impeding original objectives.
- 5.23** Given the particular importance of the species recorded, it is therefore recommended that non-avian data should be collected using this systematic but opportunistic approach during all aerial surveys of inshore and offshore areas where methodologies allow. It would be of further benefit if such

datasets were standardised and compiled centrally, such as through the Joint Cetacean Protocol being developed by JNCC (JNCC, pers. comm.).

- 5.24** As interest in new offshore areas is developing for OWF development, it is hoped that much new non-avian data can be collected from aerial surveys as part of the SEA and EIA processes.

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7. FIGURES

Figure 1 – Coverage by aerial surveys made by WWT Consulting between 2001 and 2008. Coverage was calculated by summing number of observers actively recording under survey conditions per 2km Ordnance Survey Great Britain grid cell across all surveys between 2001 and 2008.

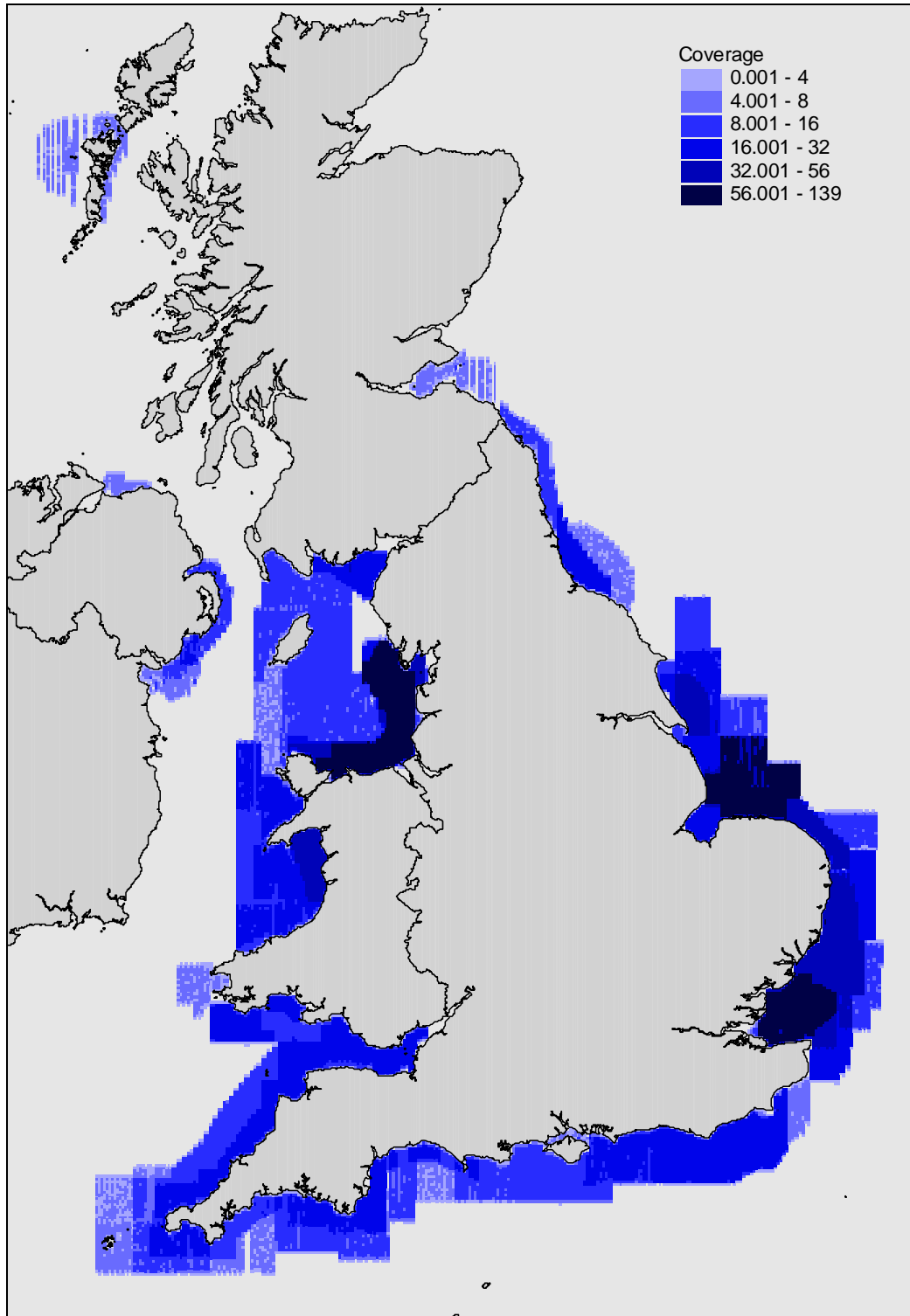


Figure 2 – Relative densities of cetacean species recorded during aerial surveys 2001-2008. This species group includes unidentified cetaceans but not those identified as ‘dolphin species’. Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

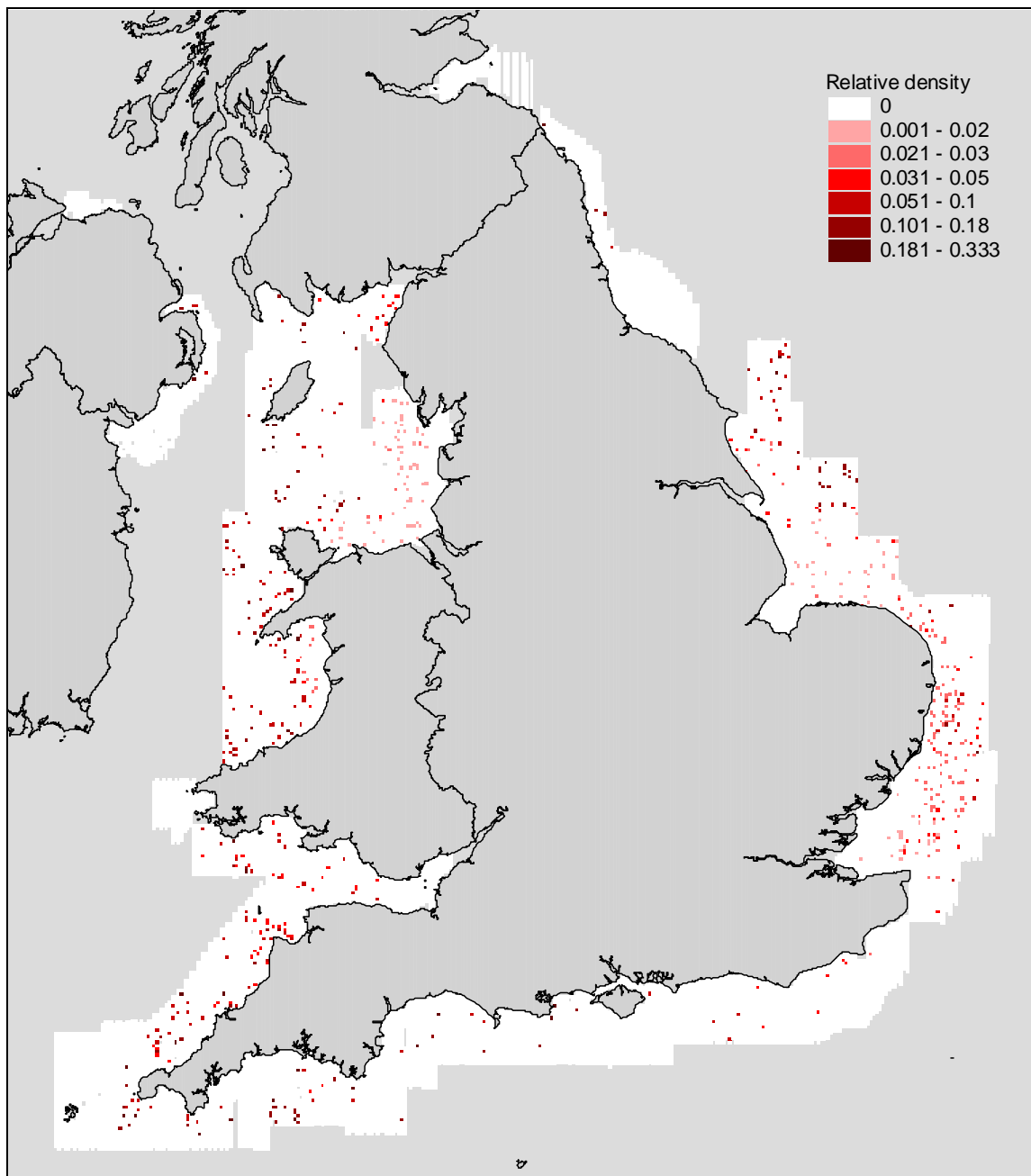


Figure 3 – Locations of whales identified to species during aerial surveys 2001-2008.

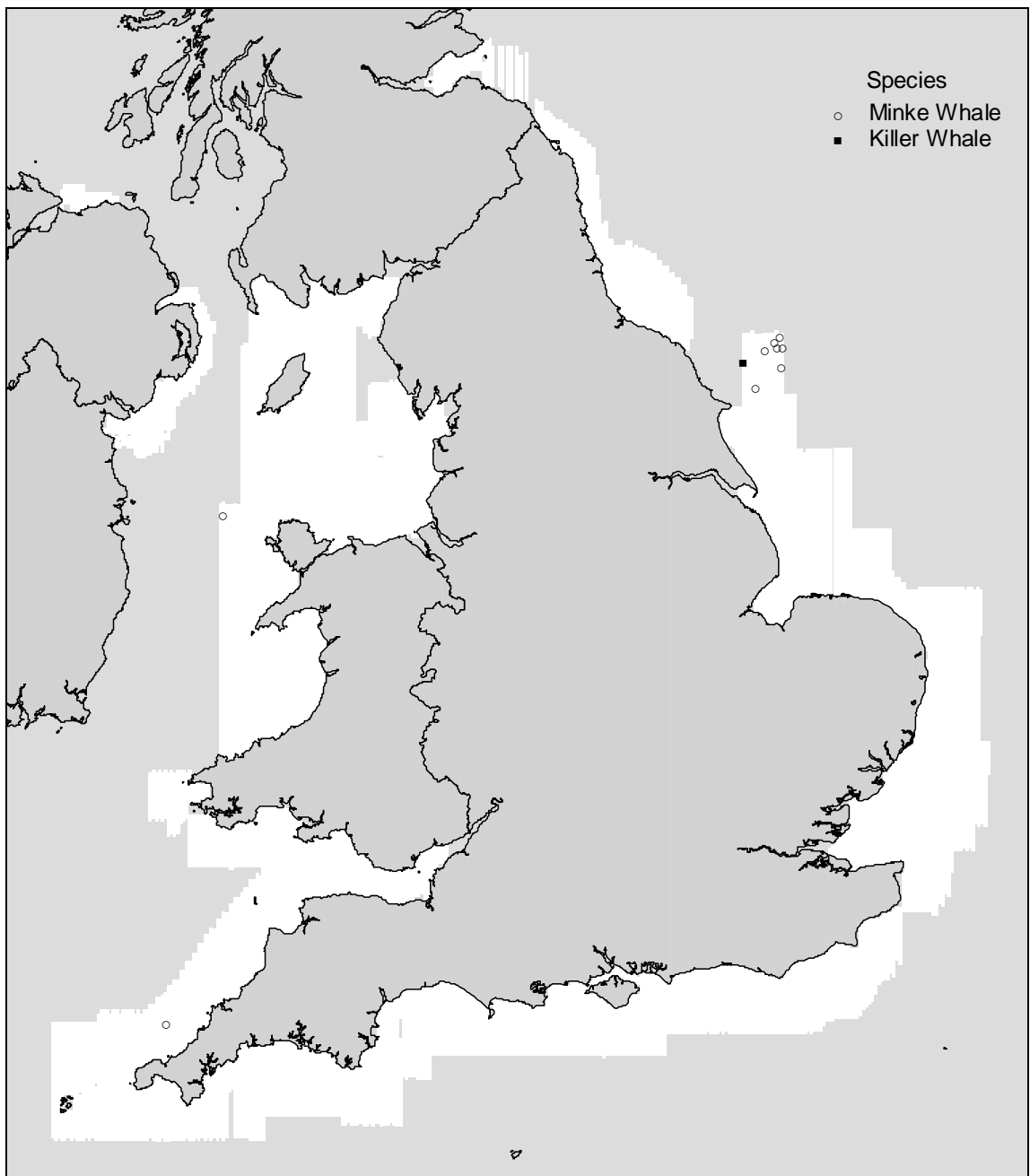


Figure 4 – Relative densities of dolphin species recorded during aerial surveys 2001-2008. Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

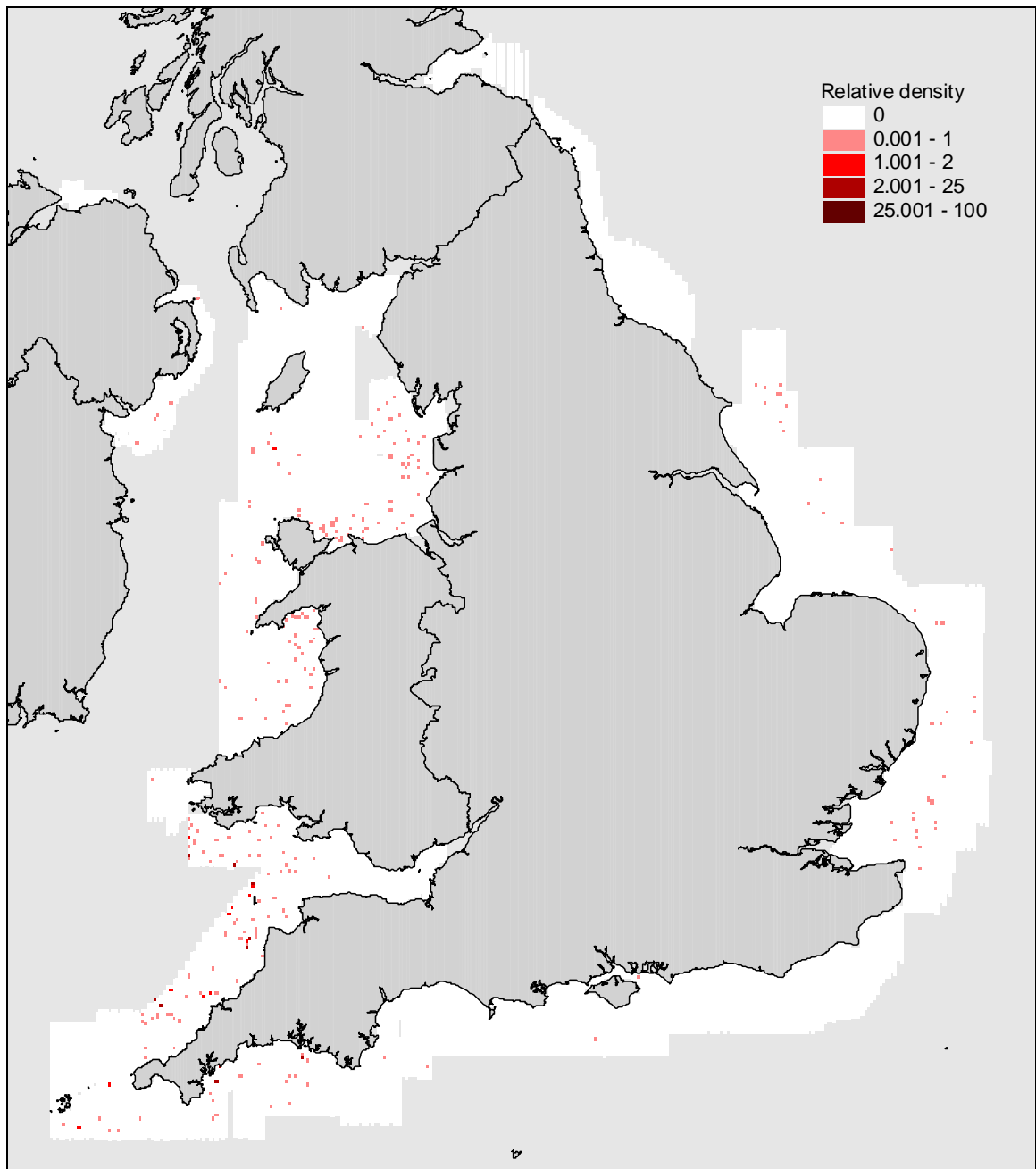


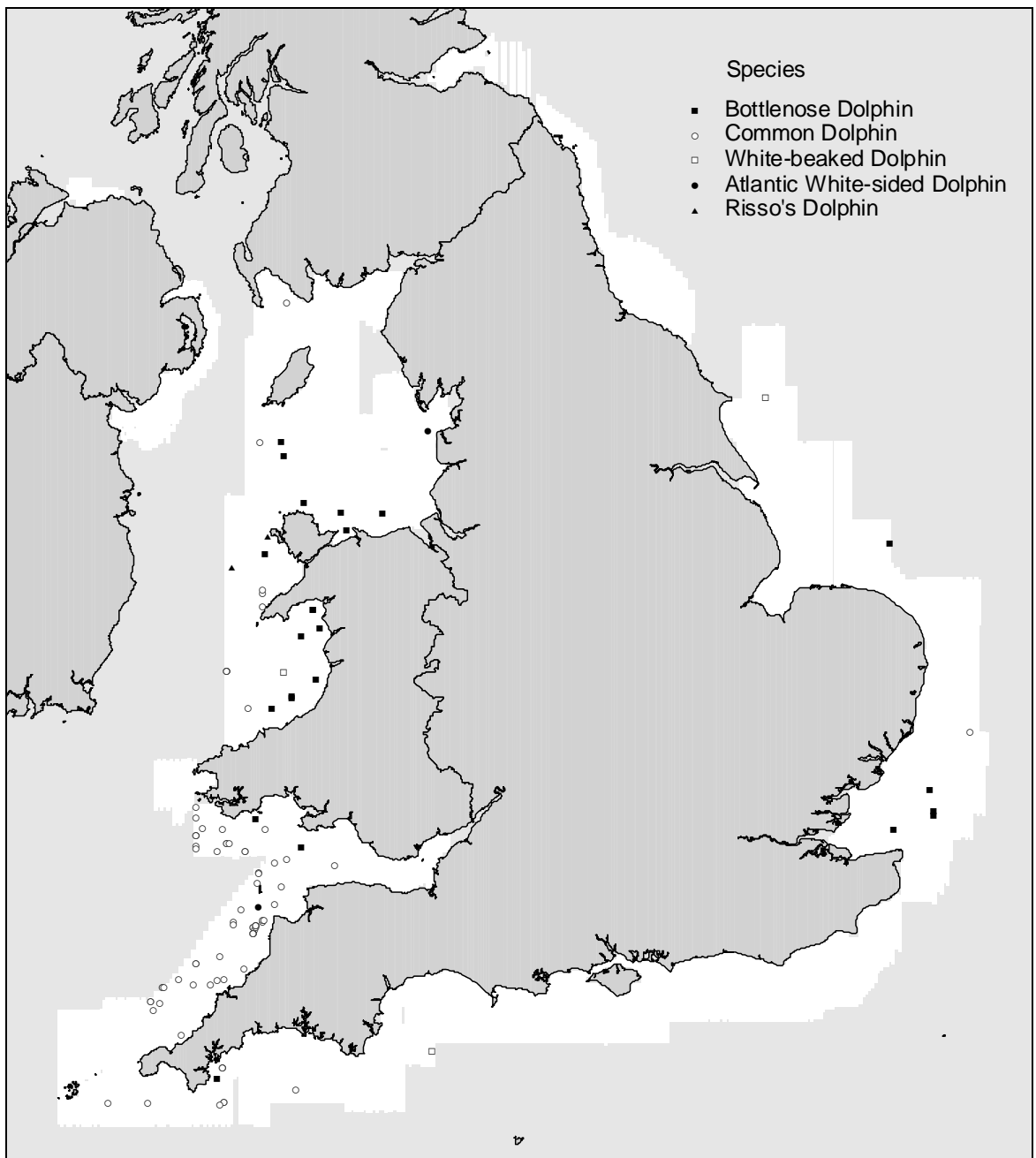
Figure 5 – Locations of dolphins identified to species during aerial surveys 2001-2008.

Figure 6 – Relative densities of Harbour Porpoise recorded during aerial surveys 2001-2008. Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

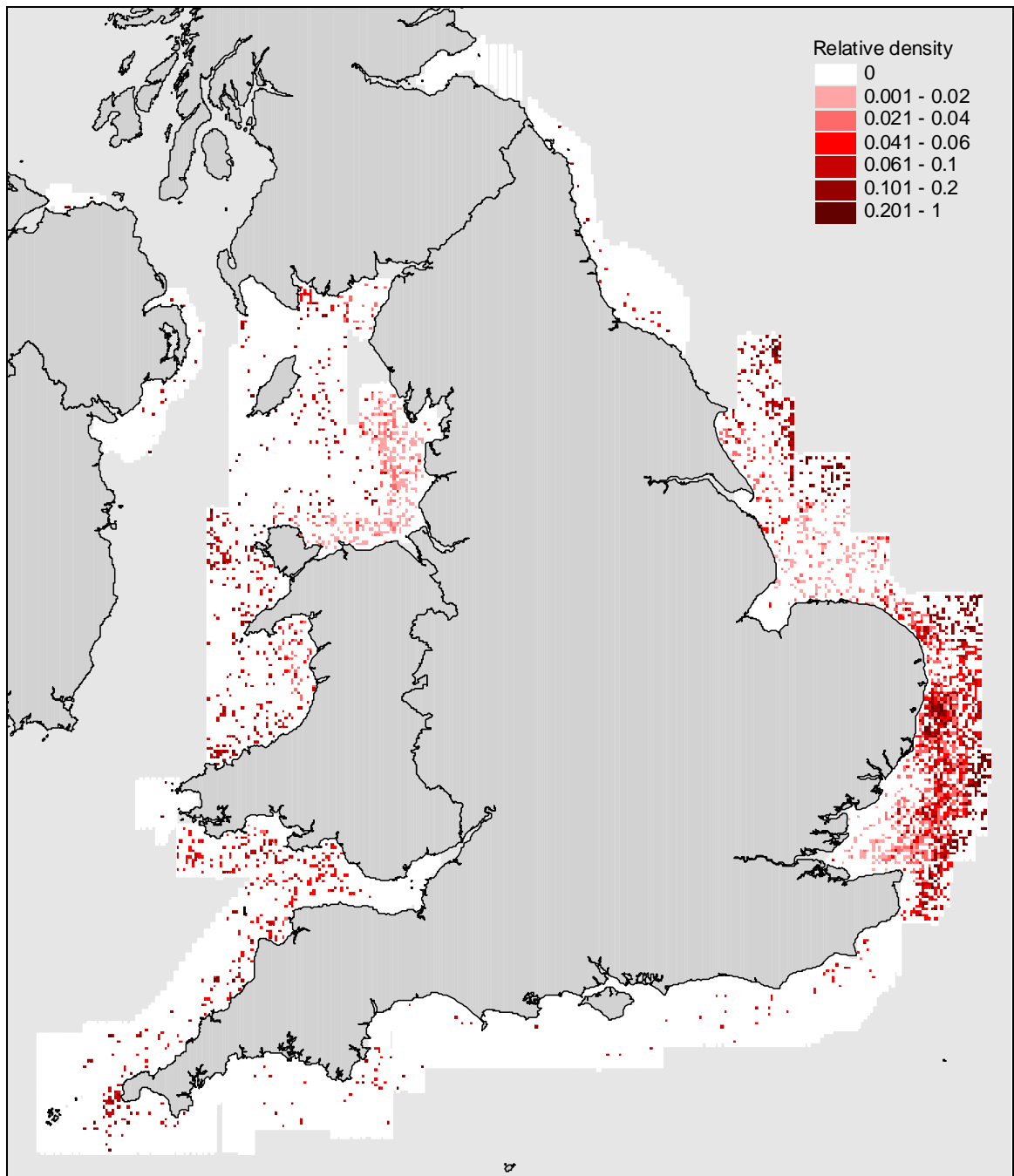


Figure 7 – Relative densities of seal species recorded during aerial surveys 2001-2008. Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

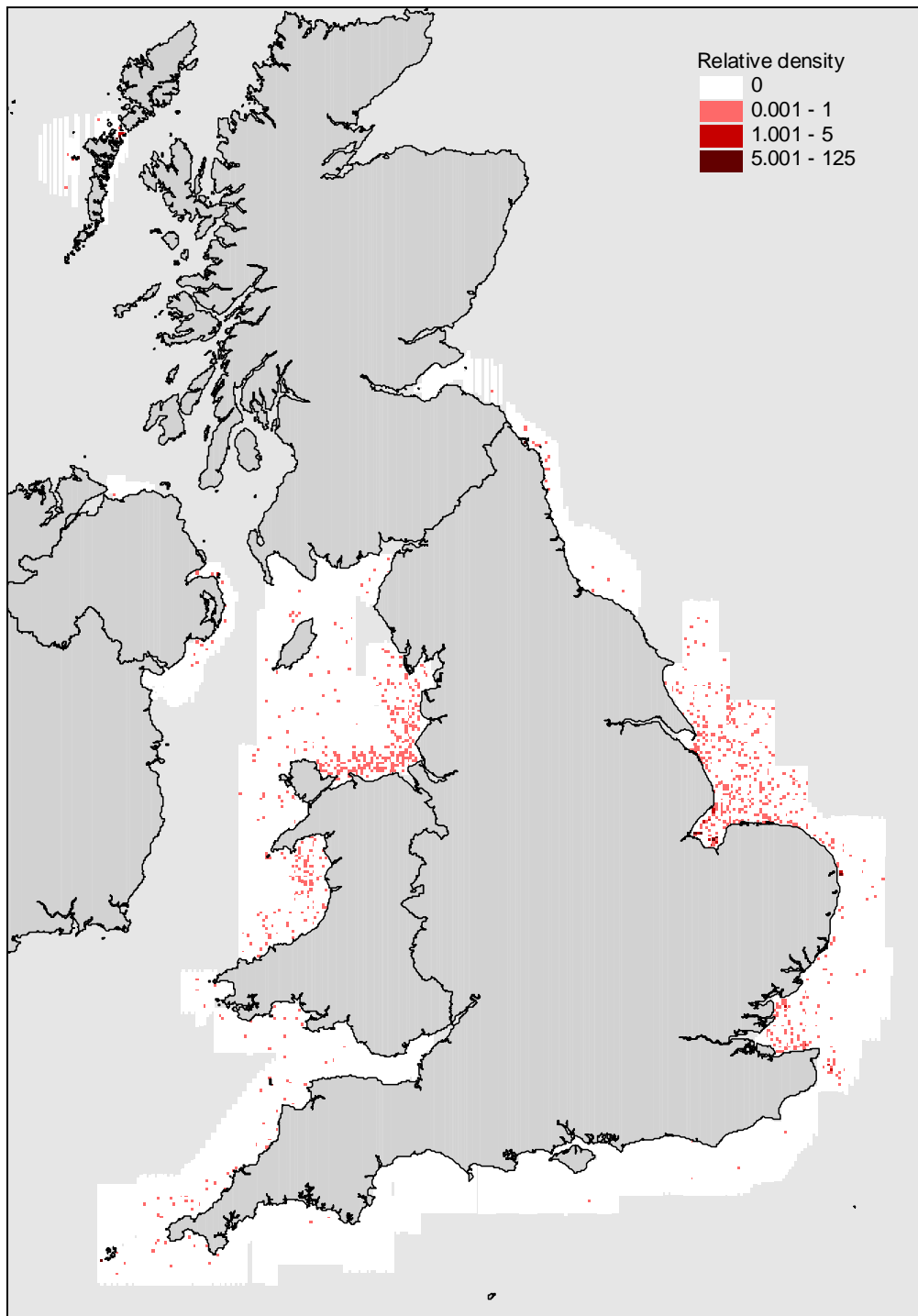


Figure 8 – Locations of seals identified to species during aerial surveys 2001-2008.



Figure 9 - Relative densities of turtle species recorded during aerial surveys 2001-2008. Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

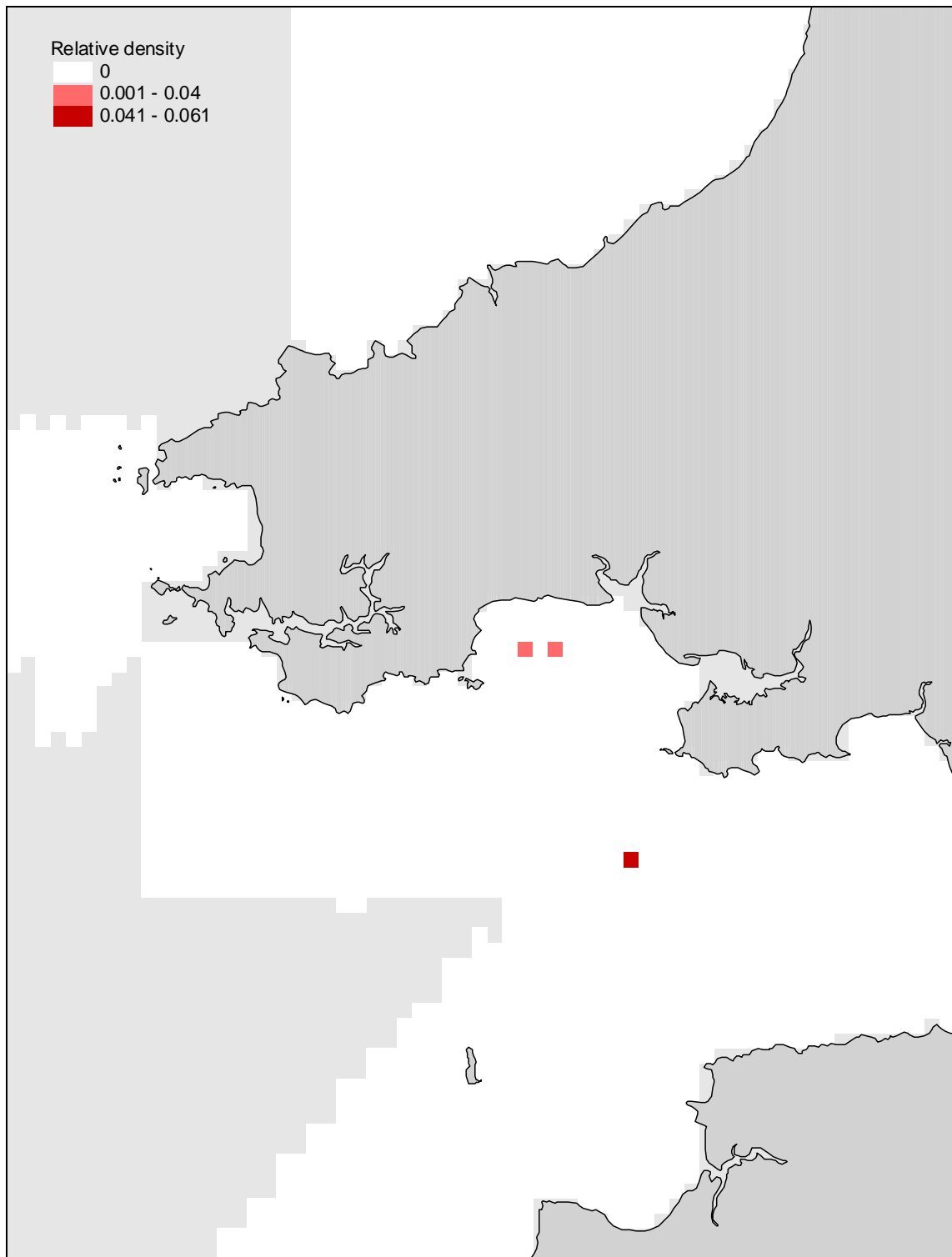


Figure 10 - Relative densities of shark species recorded during aerial surveys 2001-2008. Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.

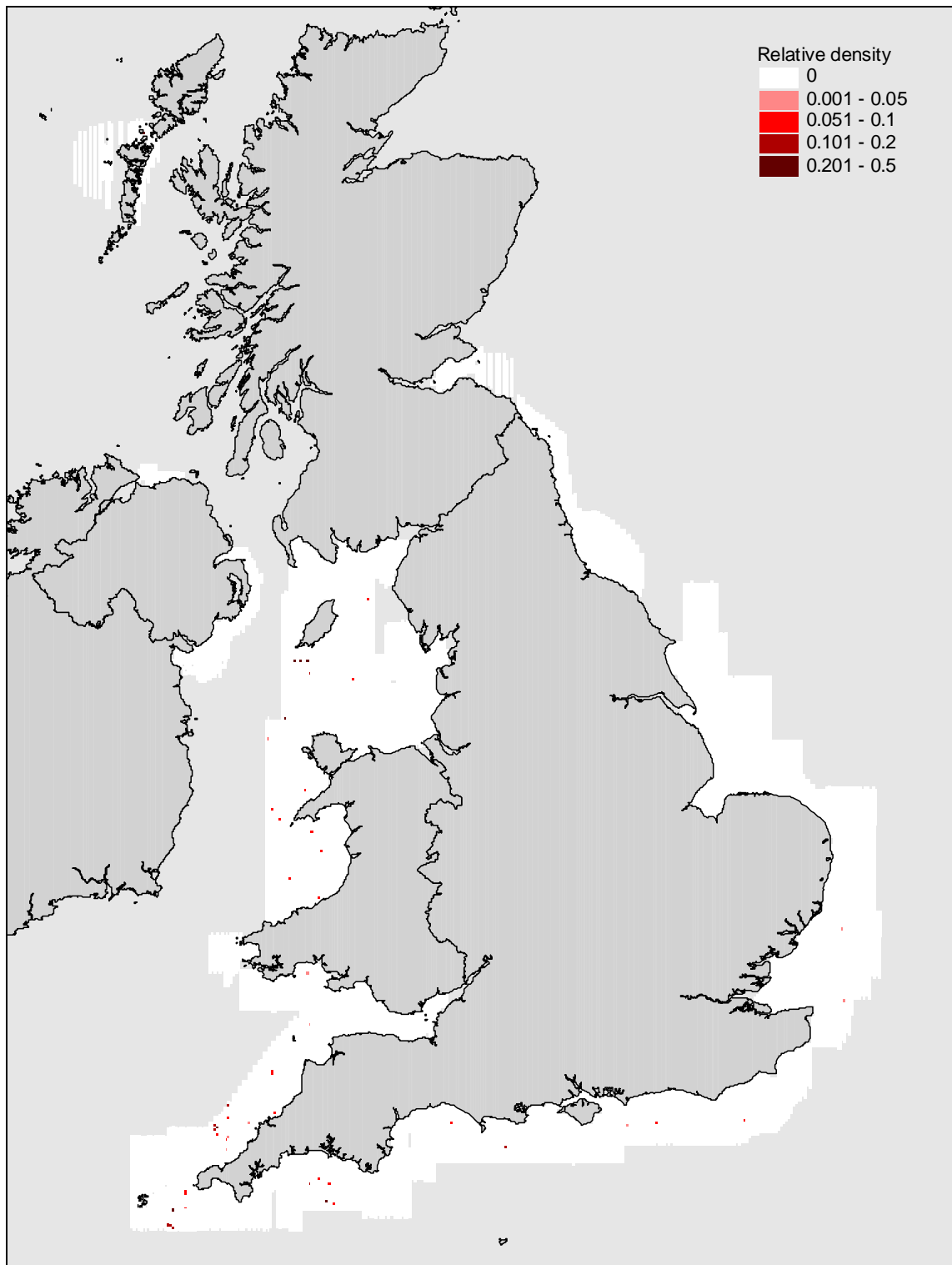
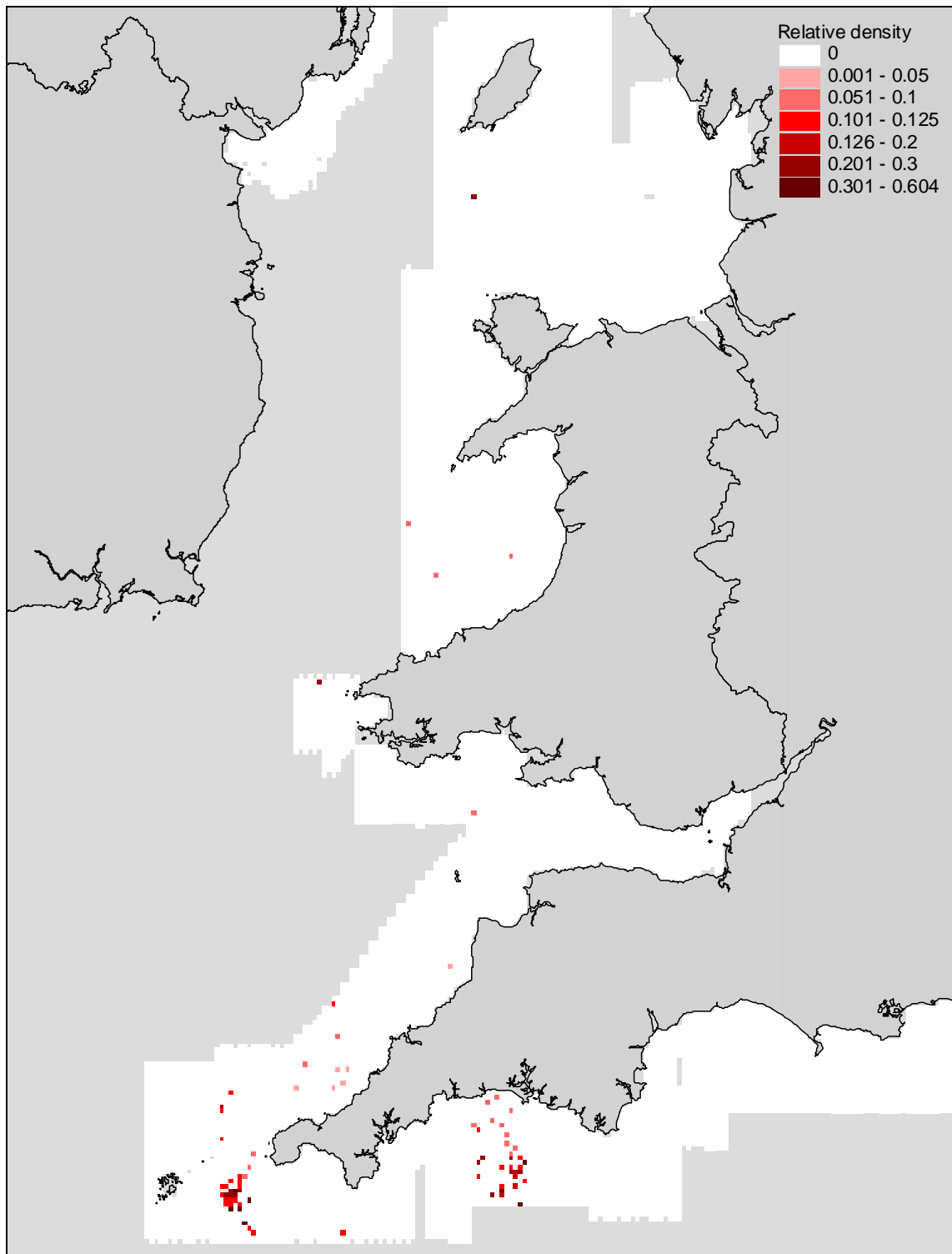


Figure 11 – Locations of Basking Shark recorded during aerial surveys 2001-2008.



Figure 12 – Relative densities of Ocean Sunfish recorded during aerial surveys in 2008. Relative densities were calculated by normalising number of observations by coverage per 2km Ordnance Survey Great Britain grid cells.



APPENDIX I. Place and feature names referred to in text.

