Supporting information for aerial survey data
(All site data (Access database) version)
Joint Nature Conservation Committee

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Contents

Background

In 2000, JNCC identified approximately 50 initial marine areas of search (AoS) around the UK coast where existing evidence suggested they potentially held important aggregations of seaduck, divers, and grebes outside the breeding season. These were subjected to further investigation to inform the identification of important marine areas which may be appropriate for designation as Special Protection Areas (SPAs) under the Birds Directive. Data was collected largely using visual aerial surveys, but also using shore-based counts and boat surveys.

Aerial surveys were deemed to be the most suitable method in cases where species are prone to disturbance by boat (Schwemmer et al., 2011). Digital aerial surveys can be carried out at higher elevation than visual aerial surveys (hence cause even less disturbance to birds), but were a novel, untested survey method at the time, hence these aerial data were collected by visual surveys.

However, aerial surveys might underestimate numbers of birds close inshore as the planes cannot survey close to coasts with steep cliffs. They might also underestimate cryptic species that are difficult to detect from planes such as grebes and black-throated diver.

Visual aerial survey data collection

Between 2000/01 and 2009/10, repeated visual aerial surveys were carried out during winter (October – March) in many of the AoS, often over a number of years. The number of seasons of survey for each AoS varies, as does the number of surveys within a particular season.

Aerial surveys were carried out from a small plane flown at 76m (250ft) above the sea, at a speed of 185km per hour (100 knots) to minimise the flushing of birds from the water by the approaching aircraft (Kahlert et al., 2000). A line transect method was used, with observations assigned to four distance bands (or only three distance bands prior to October 2002) running perpendicular either side of the transect line. East-west transect lines were spaced at 1.85km (1` latitude), while north-south transect lines were spaced at 2km (2` longitude), and oriented perpendicular to the coast in order to sample across the depth gradient which was expected to be the principle environmental gradient influencing the distribution of birds at the site. At the Outer Hebrides, transects were spaced at 4km due to logistical constraints. These distances maximised detection of birds located between transects, while minimising the risk of double counting birds on neighbouring transects.

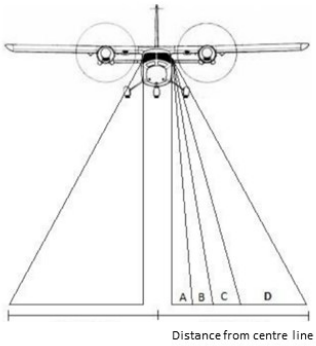
Observations of individuals and flocks were assigned to one of four distance bands, according to their perpendicular distance from the transect line (Figure 1). The first 44m from the track line were out of sight underneath the plane and were not recorded. Observers determined these distances using a clinometer, using fixed angles of declination from the visual horizon. The most common effective transect widths used were 881m or 956m surveyed on either side of the plane. In a few earlier surveys a different method was used, counting up to 500m either side of the plane (distance band ‘W’), however, data from port and starboard were pooled.

Figure 1. Widths of Distance bands.

Distance from transect centre line

Underneath plane	Band A	Band B	Band C	Band D	Effective transect width*
0-44m	44-162m	163-282m	283-426m	427-925m	881m on each side
0-44m	44-162m	163-282m	283-426m	427-1000m	956m on each side
0-44m	44-500m				912m (both sides combined)

*Transect width referred to in the database



Observers recorded numbers of birds and time (to the nearest second) of observation from both sides of the aircraft. A Global Positioning System (GPS) recorded the location of the aircraft every second.
Survey flights were undertaken between 09:00hrs and 18:00hrs GMT.
Optimal conditions for survey flights were: excellent visibility (to the horizon), calm seas of sea state 3 or less (wind ≤ 10 knots, swell ≤ 0.6m), high altitude light cloud cover and little or no precipitation. Some surveys were conducted in sub-optimal conditions, but never in sea states exceeding 4 (wind > 16 knots) or in low cloud (below 500 ft).

How to calculate effort

The observation effort at each location is the area covered by the survey. It can be calculated by the distance travelled in km (in the Position table) multiplied with the width of the transect in km (in the Trip table).

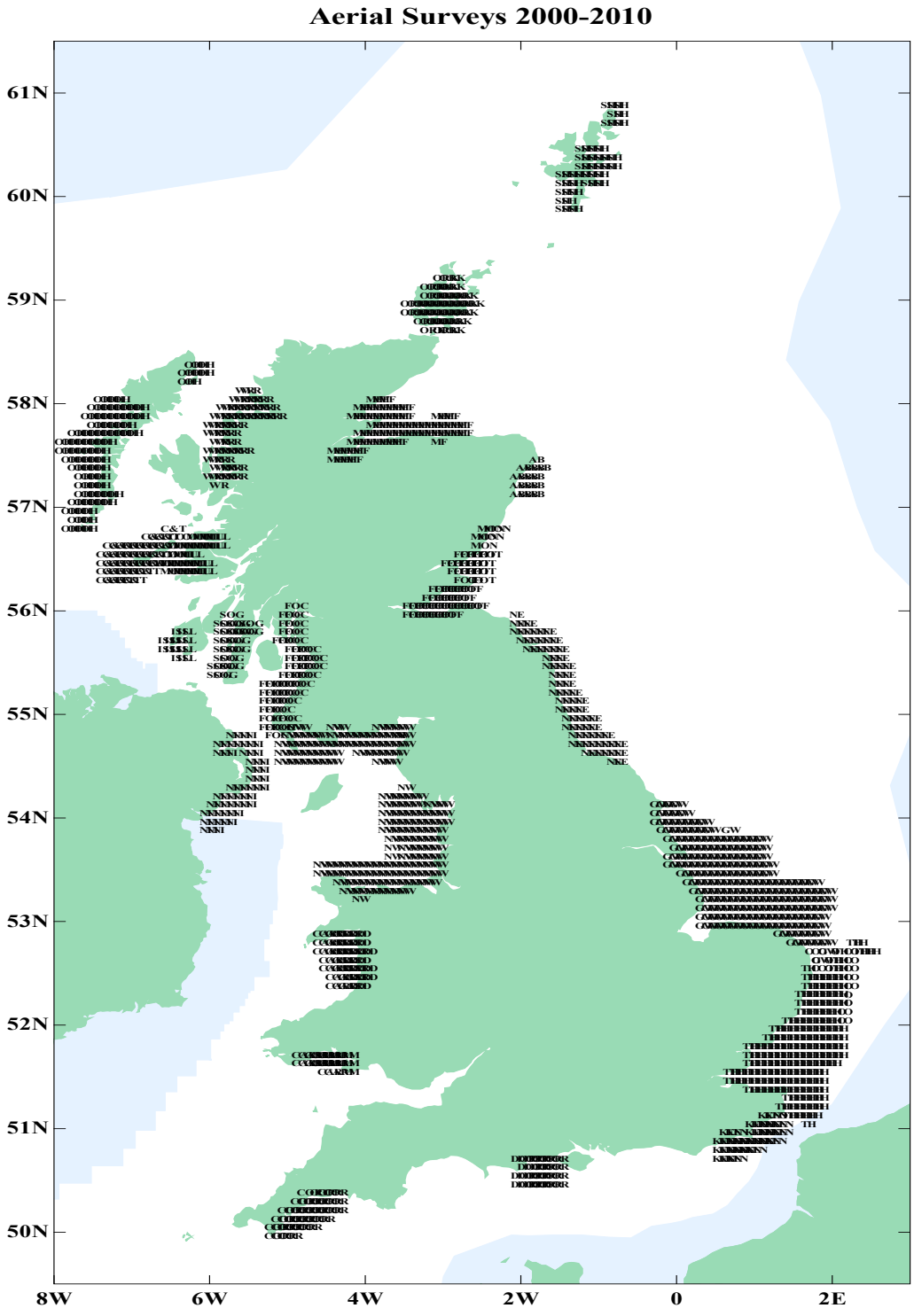
If there were two observers (see 'no of observers' in the Trip table), the transect width can be calculated by doubling the effective transect width, as they were both surveying one entire transect width, one on port, the other on starboard. If there was only one observer, the transect width does not need to be doubled.

There are a few exceptions to this:
If the 'Posmark' in the Position table indicates 'A', 'B', 'X' or 'Y', only one of two observers were able to survey, so in these incidents, the effective transect widths should not be doubled either, even if there were two observers on the trip. But this refers only to these particular positions.

Areas of Search

The visual aerial surveys in the database have taken place between 2000/01 and 2009/10 and covered various Areas of Search (see Annex 1 for detailed list of AoS).

Figure 2. Areas of Search covered between 2000 and 2010. From Pollock and Barton (n.d. unpublished).



Area	Area initials
Aberdeen	AB
Cardigan Bay	CARD
Carmarthen Bay	CARM
Coll and Tiree	C&T
Firth of Clyde	FOC
Firth of Forth	FOF
Firth of Tay	FOT
Greater Wash	GW
Islay	ISL
Mid Dorset	DOR
Montrose	MON
Moray Firth	MF
Mull	MUL
North East	NE
North West	NW
Northern Ireland	NI
Orkney	ORK
Outer Hebrides	OH
Shetland	SH
Sound of Gigha	SOG
South Cornwall	COR
South Kent	KEN
Thames	TH
Wester Ross	WR

Data collected

The data in the database is organised in three different tables: the trip table holds the data about the overall survey trip, the position table holds all data related to all positions (or locations) surveyed during a survey trip, and the species table holds all data concerned with the species information collected at the locations. Tables are linked to each other through trip keys, position keys and species keys. The information provided in these database tables is described as follows:

Table 1. Trip table data. Adapted from Pollock and Barton (n.d. unpublished).

Trip table	
Trip Key	Primary key to link these data to the position table and the species table.
Date	Date of survey in one code
Year	Year of survey
Month	Month of survey
Day	Day of survey
Base type	3 = aeroplane
Base name	Code 913: Partenavia (PN68) Code 903: Britten Norman Islander (BN2A) Code 933: Cessna 337
Spp observed	1= all spp (WWT surveys) 11=divers, ducks, grebes, marine mammals & little gulls (JNCC surveys)
Method	3= all obs, no transect operated (for 2000/01 surveys with strip transect and total count method) 5=Full transect, but no scan data for outside the transect
Transect width	The first 44m either side of the transect line not recorded because not visible Transect width varies depending on who conducted surveys and location of surveys Most surveys had port & starboard observers, only three surveys had just one observer. • 881m: JNCC surveys with transects spaced 1.85 km apart- 925m counted each side (transect width =925-44=881m) • 912m: JNCC surveys in 2000/01 counted 500m each side of plane (total transect width=1000-88=912m); data not separated into port and starboard but pooled • 956m: JNCC surveys in Outer Hebrides with transects spaced 3.7km apart & WWT surveys with transects spaced 2km apart- 1000m counted each side (transect width=1000-44=956m)
No. of observers	usually two observers; 1 port, 1 starboard There are 3 trips where there was only 1 observer
surveyed by	JNCC or WWT
Country	England, Scotland or Northern Ireland
Area	Names of areas are mostly as per original datasets. It should be noted that some areas overlap with each other. Also note: No bird data recorded for transects flown in Mid-Dorset on 20/2/09. This is the only trip with no bird data
Area initials	These were used for mapping purposes to show where surveys conducted.
Subarea	Names of subareas are mostly as per original datasets and are not exclusive with many areas of overlap.

Table 2. Position table data. Adapted from Pollock and Barton (n.d. unpublished).

Position Table	
Position key	Primary key to link these data to the trip table and the observations table.
Trip key	Indicates to which trip these data belong.
Time in seconds	
Posmark	A Port start, no starboard start B Starboard start, no port start C Port & starboard start I Interpolated position M Midpoint (from GPS) S Start (incidental sightings) X Port end, no starboard end Y Starboard end, no port end Z Port & starboard end
Transect no.	
Latitude	
Longitude	
Distance_Km	Distance travelled in km.

Table 3. Observations table data. Adapted from Pollock and Barton (n.d. unpublished).

Observations table	
Species key	Primary key to link these data to the trip table and the position table.
Position key	Indicates to which position these data belong.
Trip key	Indicates to which trip these data belong.
Transect indicator	1= out of transect (some incidental sightings recorded between transects) 2 = 'in transect'
Euring	Euring code for bird species recorded. Vessels and floating matters are blank.
English name	English names for bird species recorded. Vessels and floating matter are also recorded.
Count	Number of individuals
Age	Age of individuals
Sex	Sex of individuals
Behaviour	See behaviour codes in Annex 2.
Band	Distance bands
Time in seconds	
Observer	Code for individual observer
Seat	P= port S=Starboard (not recorded during JNCC surveys in 200/01 and 20080120.)
Transect no.	Transect number
Latitude	
Longitude	

References

Kahlert, J., Desholm, M., Clausager, I., Petersen, I.K., 2000. Environmental impact assessment of an offshore wind park at Rødsand. Technical report on birds.
Pollock, C., Barton, C., unpublished, n.d. Collation of JNCC aerial survey data into a central database. Contract No: C12-0207-0627 (Report to the JNCC).
Schwemmer, P., Mendel, B., Sonntag, N., Dierschke, V., Garthe, S., 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecol. Appl. 21, 1851–1860.

Annex 1 Areas of Search

Table 4. Detailed list of Areas of Search as surveyed between 2000/01 and 2009/10

Country	Area	Area initials	Subarea
England	Greater Wash	GW	GW1
England	Greater Wash	GW	GW1 & GW2 (eastern)
England	Greater Wash	GW	GW1 & GW2 (western)
England	Greater Wash	GW	GW1a
England	Greater Wash	GW	GW1b
England	Greater Wash	GW	GW2
England	Greater Wash	GW	GW2 & GW1 (eastern)
England	Greater Wash	GW	GW2 & GW1 (western)
England	Greater Wash	GW	GW3
England	Greater Wash	GW	GW4
England	Greater Wash	GW	GW5
England	Greater Wash	GW	GW6
England	Greater Wash	GW	GW6 (part)
England	Greater Wash	GW	Norfolk
England	Greater Wash	GW	central
England	Greater Wash	GW	east
England	Greater Wash	GW	gw1a&gw2
England	Greater Wash	GW	gw1a&gw2(part)
England	Greater Wash	GW	gw2(part)&gw5(part)
England	Greater Wash	GW	gw5(part)
England	Greater Wash	GW	gw6(part)&th7(part)
England	Greater Wash	GW	west
England	Mid Dorset	DOR	
England	South Cornwall	COR	
England	South Kent	KEN	
England	Thames	TH	
England	Thames	TH	TH1
England	Thames	TH	TH2
England	Thames	TH	TH3
England	Thames	TH	TH4
England	Thames	TH	TH5
England	Thames	TH	TH6
England	Thames	TH	TH7
England & Scotland	North East	NE	NE1
England & Scotland	North East	NE	NE2
England & Scotland	North West	NW	Liverpool Bay
England & Scotland	North West	NW	Luce Bay
England & Scotland	North West	NW	NW 6a & 5 (part)
England & Scotland	North West	NW	NW1
England & Scotland	North West	NW	NW3
England & Scotland	North West	NW	NW4
England & Scotland	North West	NW	NW5
England & Scotland	North West	NW	NW5&6
England & Scotland	North West	NW	NW5+6a
England & Scotland	North West	NW	NW5+6b
England & Scotland	North West	NW	NW6
England & Scotland	North West	NW	NW6 & 5 (part)
England & Scotland	North West	NW	NW6a
England & Scotland	North West	NW	NW6b
England & Scotland	North West	NW	Solway & Wigtown
England & Scotland	North West	NW	Solway Firth

Table 5. continued.

Country	Area	Area initials	Subarea
Northern Ireland	Northern Ireland	NI	Belfast Lough
Northern Ireland	Northern Ireland	NI	Dundrum Bay
Northern Ireland	Northern Ireland	NI	NI1
Northern Ireland	Northern Ireland	NI	NI101
Northern Ireland	Northern Ireland	NI	NI102
Scotland	Aberdeen	AB	Bay
Scotland	Aberdeen	AB	Beach
Scotland	Coll and Tiree	C&T	
Scotland	Firth of Clyde	FOC	
Scotland	Firth of Forth	FOF	
Scotland	Firth of Tay	FOT	
Scotland	Islay	ISL	Loch Indaal
Scotland	Montrose	MON	
Scotland	Moray Firth	MF	Dornoch Extended Area
Scotland	Moray Firth	MF	Dornoch Firth
Scotland	Moray Firth	MF	Inverness Firth
Scotland	Moray Firth	MF	Moray Extended Area
Scotland	Moray Firth	MF	Moray Firth
Scotland	Mull	MUL	
Scotland	Mull	MUL	Sound of Mull
Scotland	Orkney	ORK	Scapa Flow
Scotland	Orkney	ORK	Scapa and N Orkney
Scotland	Outer Hebrides	OH	
Scotland	Outer Hebrides	OH	Broad Bay
Scotland	Shetland	SH	East
Scotland	Shetland	SH	SW
Scotland	Shetland	SH	Unst
Scotland	Sound of Gigha	SOG	
Scotland	Wester Ross	WR	Inner Sound
Scotland	Wester Ross	WR	Sealochs
Wales	Cardigan Bay	CARD	
Wales	Carmarthen Bay	CARM	

Annex 2 Behaviour codes

Table 6. Behaviour codes

Survey by	Behaviour code	Description
JNCC	F	Flying
JNCC	S	Sea
WWT	0	used only for floating matter
WWT	1	*Unknown to author*
WWT	10	*Unknown to author*
WWT	11	*Unknown to author*
WWT	13	*Unknown to author*
WWT	15	*Unknown to author*
WWT	17	*Unknown to author*
WWT	18	*Unknown to author*
WWT	19	*Unknown to author*
WWT	2	*Unknown to author*
WWT	20	*Unknown to author*
WWT	21	*Unknown to author*
WWT	22	*Unknown to author*
WWT	23	*Unknown to author*
WWT	24	*Unknown to author*
WWT	25	*Unknown to author*
WWT	26	*Unknown to author*
WWT	3	*Unknown to author*
WWT	4	*Unknown to author*
WWT	5	*Unknown to author*
WWT	6	*Unknown to author*
WWT	B	Sat on a buoy
WWT	D	Diving
WWT	F	Flying
WWT	L	Loafing (i.e. Birds on land or sandbanks)
WWT	MB	Stationary (used for boats and cetaceans etc)
WWT	ME	Moving E
WWT	MENE	Moving ENE
WWT	MESE	Moving ESE
WWT	MN	Moving N
WWT	MNE	Moving NE
WWT	MNNE	Moving NNE
WWT	MNNW	Moving NNW
WWT	MNW	Moving NW
WWT	MS	Moving S
WWT	MSE	Moving SE
WWT	MSSE	Moving SSE
WWT	MSSW	Moving SSW
WWT	MSW	Moving SW
WWT	MU	Moving - Direction Unknown
WWT	MW	Moving W
WWT	S	Sea
WWT	U	Flushing