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**Wintering seaducks, divers and grebes in UK inshore areas:
Aerial surveys and shore-based counts 2004/05**

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List of Abbreviations

AEWA	African-Eurasian Migratory Waterbird Agreement
EC	European Community
GB	Great Britain
GIS	Geographical Information System
GMT	Greenwich Mean Time
GPS	Global Positioning System
JNCC	Joint Nature Conservation Committee
NERI	National Environmental Research Institute (Denmark)
ODBC	Open Database Connectivity
SAST	Seabirds at Sea Team
SPA	Special Protection Area
WWT	Wildfowl and Wetlands Trust
VBA	Visual Basic for Applications

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1. SUMMARY

During December 2004, February 2005 and March 2005, the JNCC conducted aerial surveys of wintering aggregations of seaducks, divers and grebes within a number of UK inshore areas. The aim of the surveys was to collect data on the wintering numbers and distribution of inshore waterbirds in areas of the UK known to be important for this group of species. The surveys were carried out as part of the JNCC annual programme of surveillance of wintering inshore waterbirds in the UK.

The areas covered by aerial surveys in 2004/05 were: Scapa Flow; the Dornoch, Moray and Inverness Firths; Aberdeen Bay; the Firth of Tay and St Andrews Bay; the Firth of Forth; the west coast of the Outer Hebrides; Coll, Tiree and part of the west coast of Mull; and the Sound of Gigha. Surveys were conducted from light aircraft, following a line-transect method designed to collect data that were suitable for both distance sampling (to estimate total numbers of birds by correcting for a decrease in detectability with distance from the transect line) and geostatistical modelling (to identify areas with the highest densities of birds). In addition, shore-based counts were conducted within the Aberdeen Bay area in June, August, September (incomplete survey), November and December 2004, and in May 2005 to provide additional data on inshore waterbird numbers.

Eleven species of inshore waterbirds were recorded comprising: red-throated diver *Gavia stellata*, black-throated diver *Gavia arctica*, great northern diver *Gavia immer*, common eider *Somateria mollissima*, long-tailed duck *Clangula hyemalis*, common scoter *Melanitta nigra*, velvet scoter *Melanitta fusca*, greater scaup *Aythya marila*, common goldeneye *Bucephala clangula*, red-breasted merganser *Mergus serrator* and goosander *Mergus merganser*. In addition, birds were recorded that could be identified only as diver species or scoter species. Little gulls *Larus minutus* were also recorded. No great crested grebe *Podiceps cristatus*, red-necked grebe *Podiceps grisegena* or Slavonian grebe *Podiceps auritus* were recorded.

Within the areas surveyed, several sub-areas were particularly important for inshore waterbird species: the coastline between Nairn and Lossiemouth in the Moray Firth; the inshore parts of St Andrews Bay, the mouth of the Firth of Tay; the inshore parts of the Firth of Forth; east of Berneray and west of Eriskay in the Outer Hebrides; and the waters around Tiree.

2. INTRODUCTION

During the winter of 2004/05, the Joint Nature Conservation Committee (JNCC) Seabirds At Sea Team (SAST) conducted aerial surveys of wintering aggregations of seaducks *Anatidae*, divers *Gaviidae* and grebes *Podicipididae*, hereafter referred to as inshore waterbirds. The surveys were conducted as part of the JNCC annual winter survey programme, which aims to collect data on non-breeding numbers and distributions of these species within UK coastal areas known to be important for inshore waterbirds. In addition, the JNCC conducted shore-based counts of inshore waterbirds within the Aberdeen Bay area. These counts were conducted to collect additional data on the numbers and distribution of inshore waterbirds within this area.

The survey programme, in conjunction with similar surveys by the Wildfowl and Wetlands Trust (WWT), supports two international conservation instruments: the African-Eurasian Migratory Waterbird Agreement (AEWA) (Convention on Migratory Species 1999), and the European Community (EC) Birds Directive (EEC 1979). In support of the first of these, the survey programme is intended to continue to support the UK's obligations to monitor important populations of inshore waterbirds. In support of the second, the data collected during these surveys will be used to inform the process of identifying inshore areas as potential marine Special Protection Areas (SPAs) (Johnston *et al.* 2002; McSorley *et al.* 2005; Webb *et al.* 2004; Webb *et al.* in prep.).

The aerial survey method used during the 2004/05 surveys has previously been used by both JNCC and WWT for dedicated aerial surveys of coastal waters for aggregations of inshore waterbirds (Dean *et al.* 2003; Dean *et al.* 2004a; Dean *et al.* 2004b; Cranswick *et al.* 2003). This is a line-transect sampling method, based on that developed by the National Environmental Research Institute (NERI) in Denmark (Kahlert *et al.* 2000), but with minor modification. The Surveys by JNCC were conducted in Scottish inshore waters only; WWT conducted surveys in the inshore waters of England and Wales (WWT Wetlands Advisory Service 2005). In the areas surveyed, the method proved to be a time and cost effective technique for surveying large coastal areas for aggregations of some species of inshore waterbirds. The method permits the collection of spatially precise and accurate data on the distribution of inshore waterbirds along sample line-transects. These data may be used to estimate population size and to model the density distribution or presence/absence of recorded species using analytical techniques such as distance sampling (Buckland *et al.* 2001) and geostatistical interpolation (Cressie 1991). Examples of these types of analyses can be found in McSorley *et al.* (2005); Webb *et al.* (2004) and Webb *et al.* (in prep.).

During the 2004/05 winter, as in previous winters, the JNCC aimed to carry out repeated aerial surveys of each of the main firths along Scotland's east coast (Dornoch, Moray, Inverness, Tay and Forth) as well as Aberdeen Bay, Scapa Flow, the west coast of the Outer Hebrides, Coll and Tiree, and the west coast of Mull. In addition, we aimed to conduct surveys of the Sound of Gigha, another potentially important area for wintering inshore waterbirds.

This report outlines the methods used during the 2004/05 aerial surveys and shore-based counts, presents the recorded numbers and diurnal distributions of the species observed in each survey area, and discusses considerations for future surveys.

3. TARGET SPECIES

The target species for these surveys were those inshore waterbirds that winter within coastal areas of the UK and are listed in Table 1 of the AEWA Action Plan (Convention of Migratory Species 1999), or in Annex I of the EC Birds Directive (EEC 1979), or are migratory species regularly occurring in the UK. These species comprise red-throated diver *Gavia stellata*, black-throated diver *Gavia arctica*, great northern diver *Gavia immer*, great crested grebe *Podiceps cristatus*, red-necked grebe *Podiceps grisegena*, Slavonian grebe *Podiceps auritus*, greater scaup *Aythya marila*, common eider *Somateria mollissima*, long-tailed duck *Clangula hyemalis*, common scoter *Melanitta nigra*, velvet scoter *Melanitta fusca*, common goldeneye *Bucephala clangula*, red-breasted merganser *Mergus serrator* and goosander *Mergus merganser*. In addition, little gulls *Larus minutus* and cetaceans were recorded.

4. AERIAL SURVEY METHODS

The line-transect survey method applied during the 2004/05 surveys was developed in Denmark by the NERI (Kahlert *et al.* 2000) to collect data suitable for analysis using distance sampling (Buckland *et al.* 2001). Distance sampling provides a statistically robust method of describing the rate at which the numbers of birds missed by observers increases with distance from the transect line, allowing total population size to be estimated, with confidence limits.

In addition, the survey method applied during these surveys permits the collection of bird density or presence/absence data at a fine spatial scale, suitable for geostatistical interpolation (Cressie 1991). Geostatistical interpolation methods allow the spatial distribution of a sampled variable (e.g. bird density or presence/absence) to be modelled to identify the most important areas in the distribution.

Previous deployment of the line-transect sampling method (Dean *et al.* 2003; Dean *et al.* 2004a; Dean *et al.* 2004b; WWT unpublished data) has proved successful in providing data suitable for both distance sampling and geostatistical analyses (McSorley *et al.* 2005; Webb *et al.* 2004; Webb *et al.* in prep.).

4.1 Aircraft

Surveys were conducted from a Partenavia (PN-68) aircraft, which has a high-winged design, allowing observers an unobstructed view of the sea, is capable of relatively low cruising speeds, so maximising observation time, and is twin-engined, so satisfying various legal and safety requirements. The aircraft was not fitted with bubble windows. In contrast to previous years, the Britten-Norman Islander (BN2A) aircraft was not used at all.

The target altitude and cruising speed were standardised at 76m (250 feet) and 185km h⁻¹ (100 knots) respectively. Based on test flights using this type of aircraft in the Kattegat, Denmark, Kahlert *et al.* (2000) suggest that these standards optimise detection and identification of birds, while minimising the flushing of birds from the water by the approaching aircraft.

The lack of bubble windows prevented observers from viewing the strip of water directly below the aircraft. Any birds present within this strip could not be observed. At the target altitude of 76m this strip extended approximately 44m port and starboard of the transect line.

4.2 Survey areas

During December 2004, February 2005 and March 2005, aerial surveys were made of:

- Scapa Flow (Orkney)
- Dornoch, Moray and Inverness Firths (Highland)
- Aberdeen Bay (North East Scotland)
- Firth of Tay and St Andrews Bay, and the Firth of Forth (East Scotland)

- The west coast of Harris, North Uist, Benbecula, South Uist and Barra (Outer Hebrides)
- The Sound of Gigha (South West Scotland)
- The waters around Coll, Tiree and Mull (Inner Hebrides)

Fourteen surveys were completed over 12 days. In addition, one survey was flown that was only partially completed (Firth of Tay, 12/12/04). No survey area was covered more than once in any one month. The locations of each survey area are shown in Figure 1 and the dates and locations of each survey flight are indicated in Table 1.

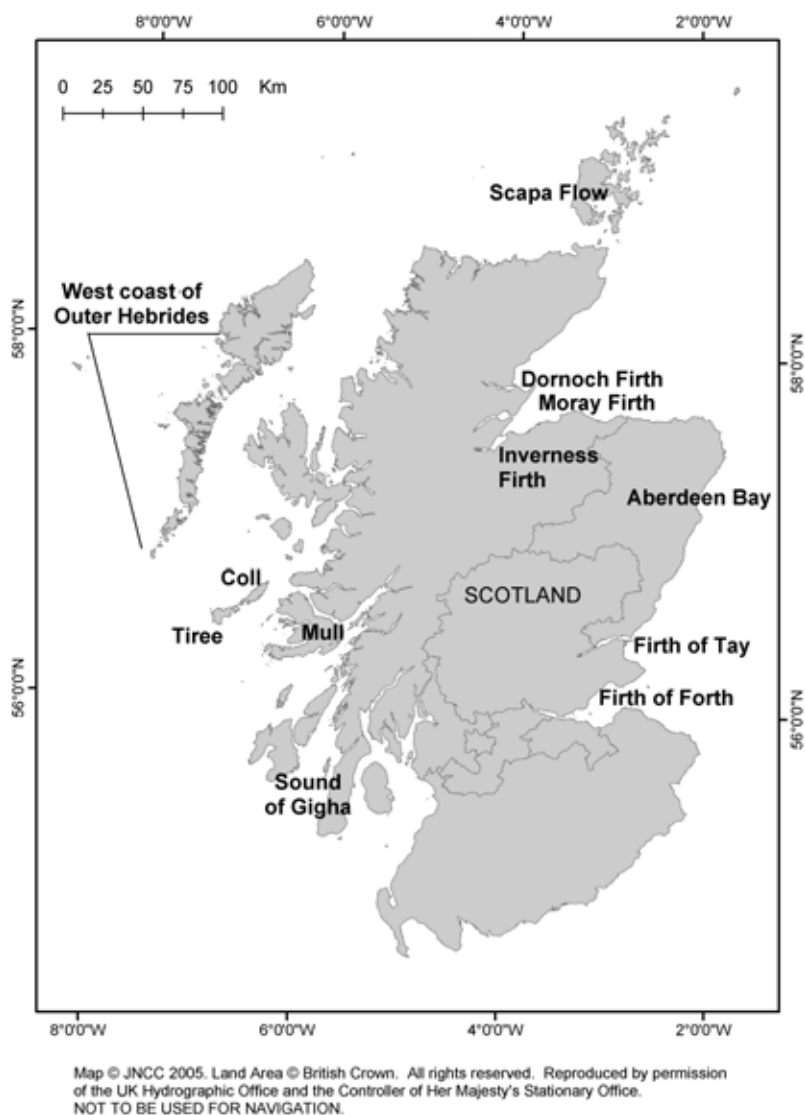


Figure 1. Locations of inshore areas surveyed by the JNCC during winter 2004/05.

Table 1. Numbers of transects scheduled (TS) and flown (TF) within each area surveyed during December 04, February 05 and March 05. * denotes incomplete survey. The aircraft used was a Partenavia. Start and End Times do not include travel times to and from the survey sites.

Area	Date	TS	TF	Start Time (GMT)	End Time (GMT)
Aberdeen Beach	11 Dec 04	16	16	11:02	12:22
Aberdeen Beach	17 Feb 05	17	17	10:16	11:43
Coll and Tiree	26 Mar 05	14	14	10:11	12:07
Coll and Tiree	26 Mar 05	12	10	14:00	15:43
Dornoch Firth	06 Mar 05	10	10	15:32	16:39
Firth of Forth	12 Dec 04	18	18	10:01	12:13
Firth of Forth	03 Feb 05	18	18	10:53	13:07
Firth of Tay*	12 Dec 04	18	12	13:44	15:14
Firth of Tay	02 Feb 05	18	18	11:18	13:34
Firth of Tay	18 Mar 05	18	18	11:48	13:53
Inverness Firth	06 Mar 05	6	5	14:29	14:42
Moray Firth	06 Mar 05	35	33	09:50	12:31
Moray Firth	06 Mar 05	12	12	14:48	15:51
Mull	25 Mar 05	12	12	11:23	12:51
Outer Hebrides	07 Mar 05	7	7	15:38	16:47
Outer Hebrides	08 Mar 05	22	22	07:22	09:58
Outer Hebrides	08 Mar 05	5	5	12:32	13:22
Outer Hebrides	08 Mar 05	5	5	13:48	14:13
Scapa Flow	07 Mar 05	18	18	10:45	12:38
Sound of Gigha	09 Mar 05	29	29	10:37	12:28

Within each survey area, a regular grid of evenly spaced, parallel transect lines was defined as described in Dean *et al.* (2004a). East-west transect lines were spaced at 1.85km (1 minute (') latitude) apart, except along the west coast of the Outer Hebrides and Coll and Tiree, where transects were spaced at 3.7km (2' latitude) apart. North-south transect lines were spaced at 2km (2' longitude) apart.

The aircraft was generally flown within 50m of the intended transect line, except where ships or offshore platforms necessitated small temporary detours. The locations and extents of all transects surveyed during the 2004/05 aerial surveys are shown in Figures 2-13.

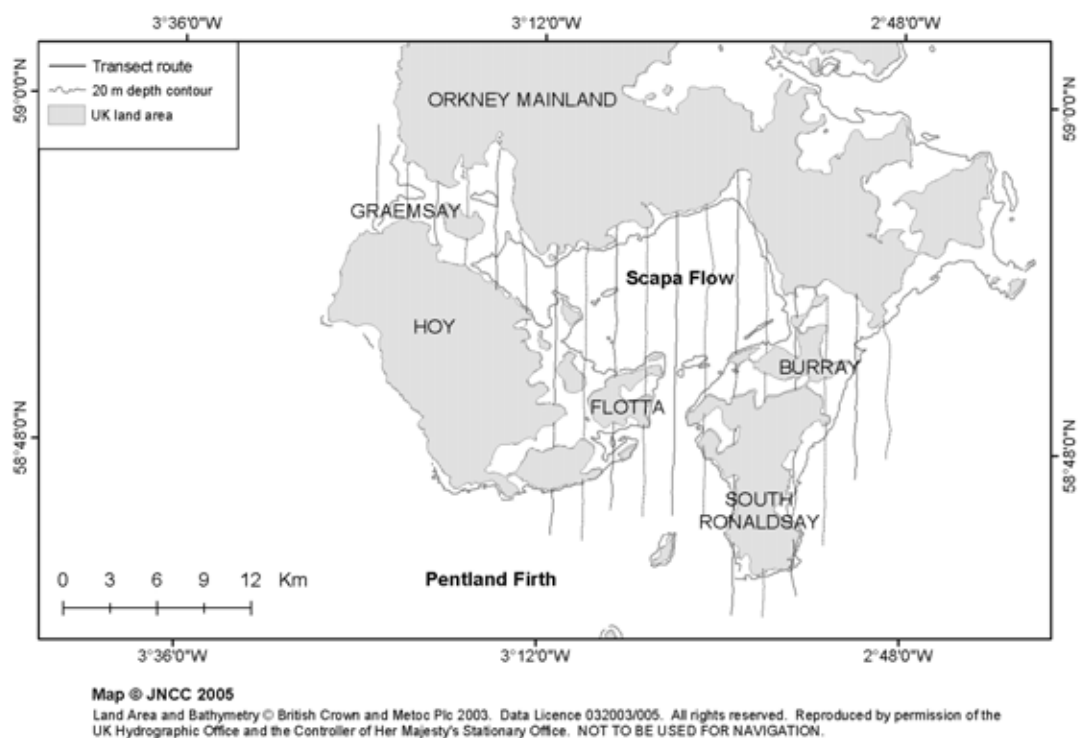


Figure 2. Locations of line-transects surveyed in Scapa Flow on 7 March 2005.

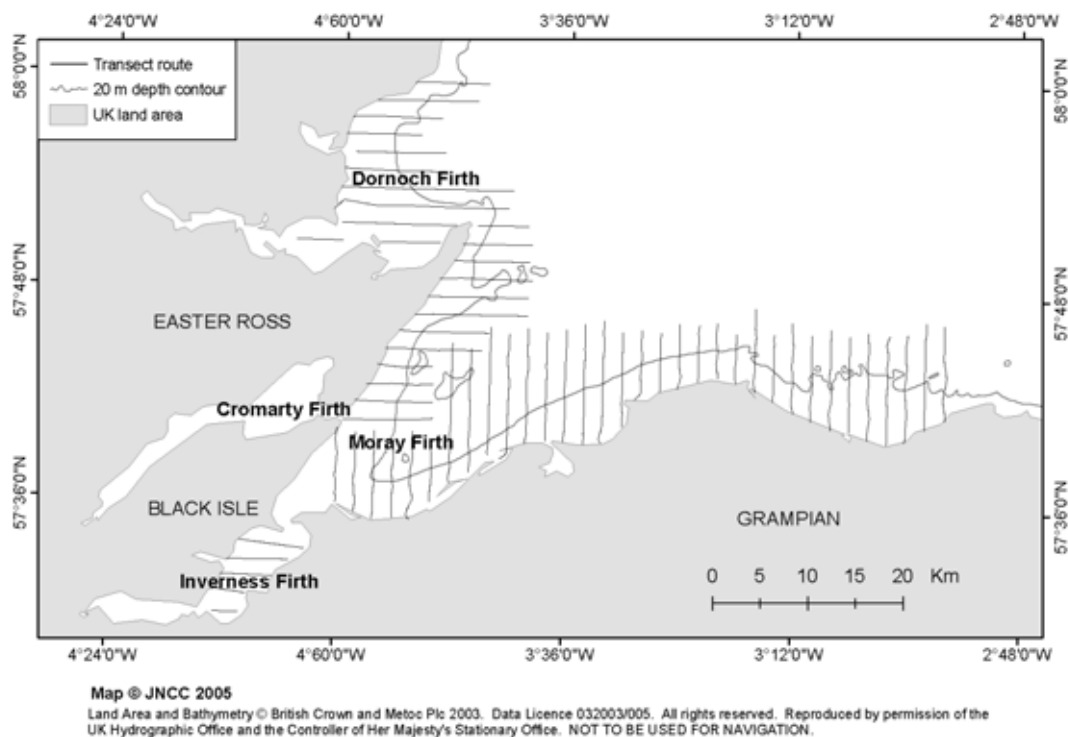


Figure 3. Locations of line-transects surveyed in the Dornoch, Inverness and Moray Firths on 6 March 2005.

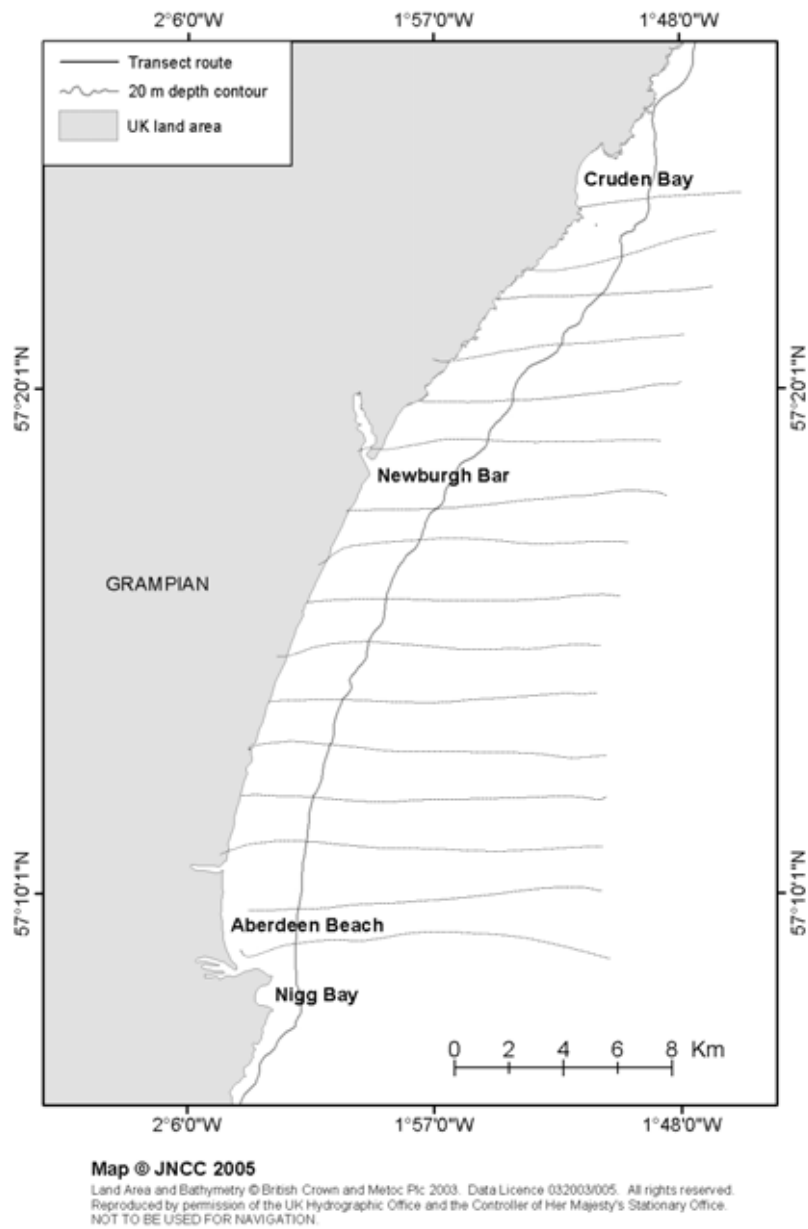


Figure 4. Locations of line-transects surveyed in Aberdeen Bay on 11 December 2004.

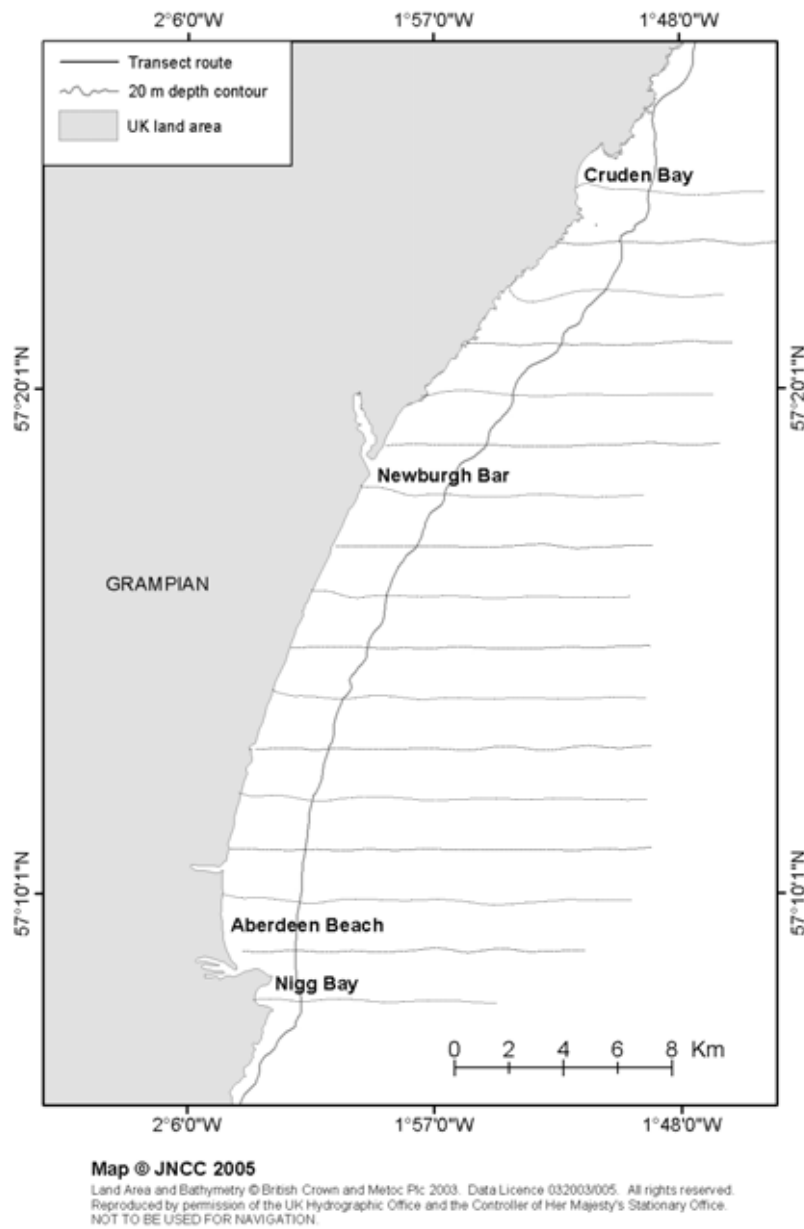


Figure 5. Locations of line-transects surveyed in Aberdeen Bay on 17 February 2005.

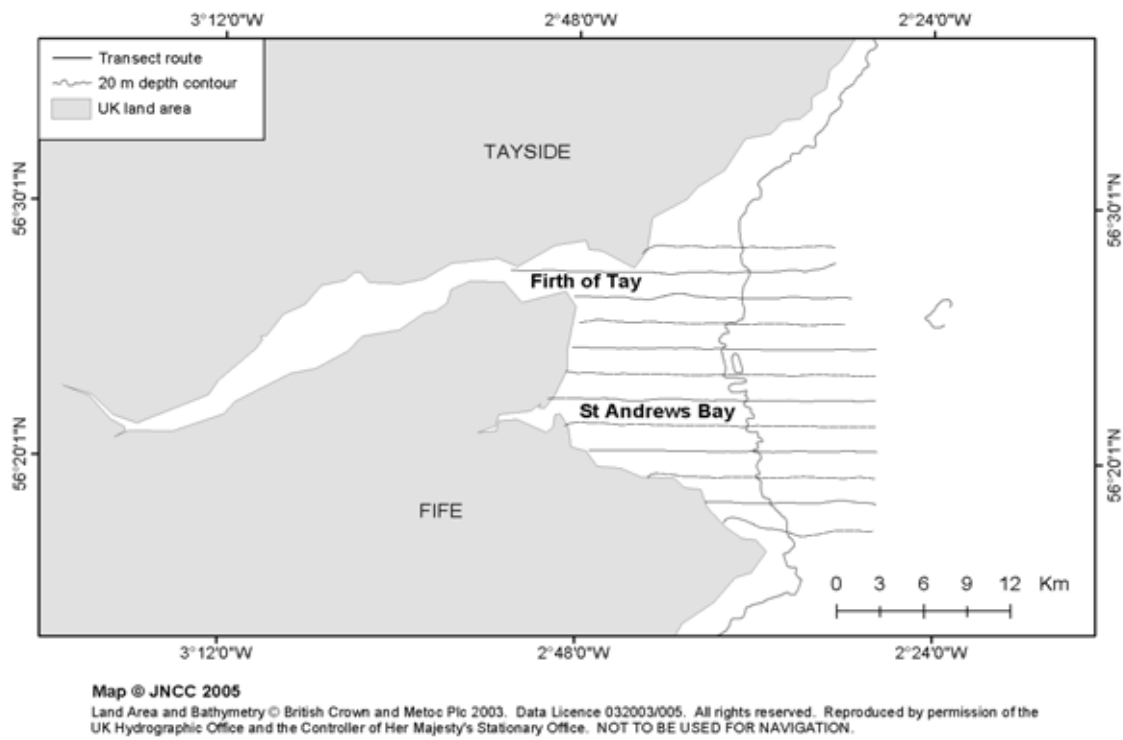


Figure 6. Locations of line-transects surveyed in the Firth of Tay on 12 December 2004.

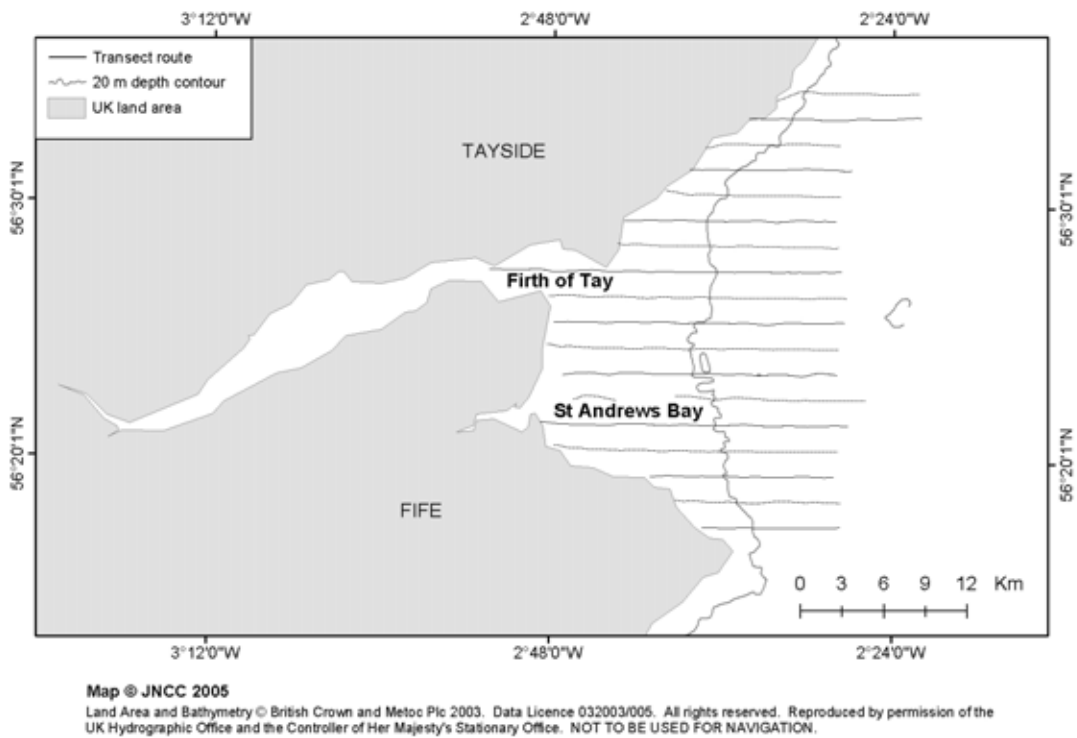


Figure 7. Locations of line-transects surveyed in the Firth of Tay on 2 February 2005.

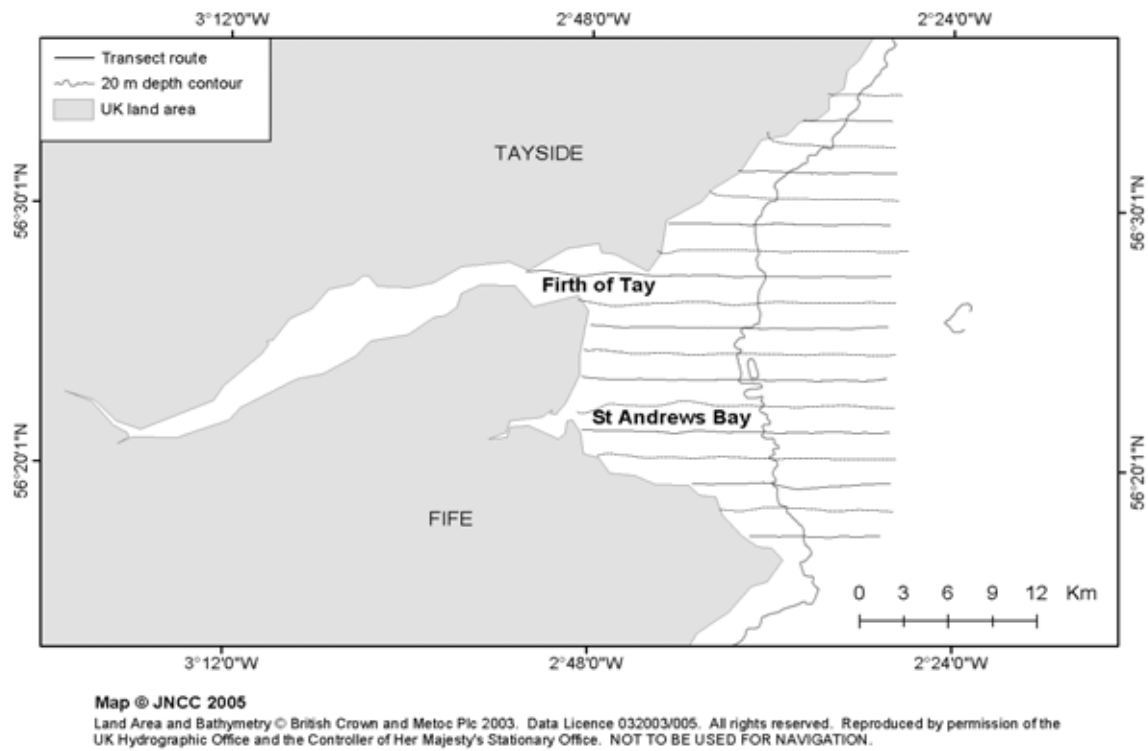


Figure 8. Locations of line-transects surveyed in the Firth of Tay on 18 March 2005.

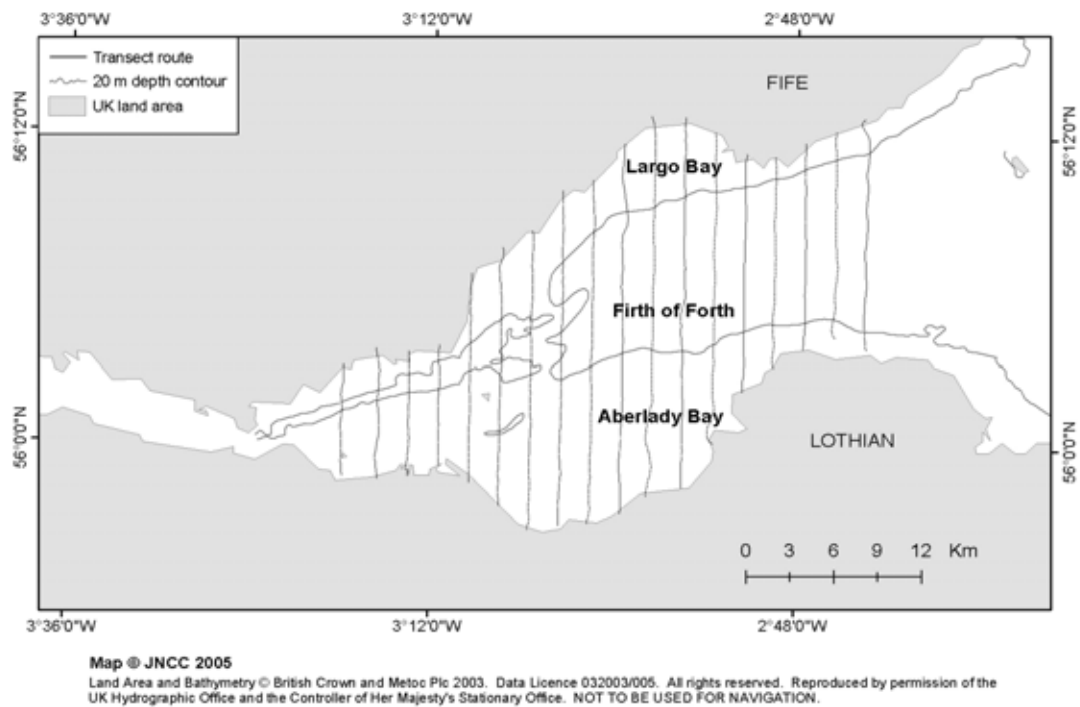


Figure 9. Locations of line-transects surveyed in the Firth of Forth on 12 December 2004.

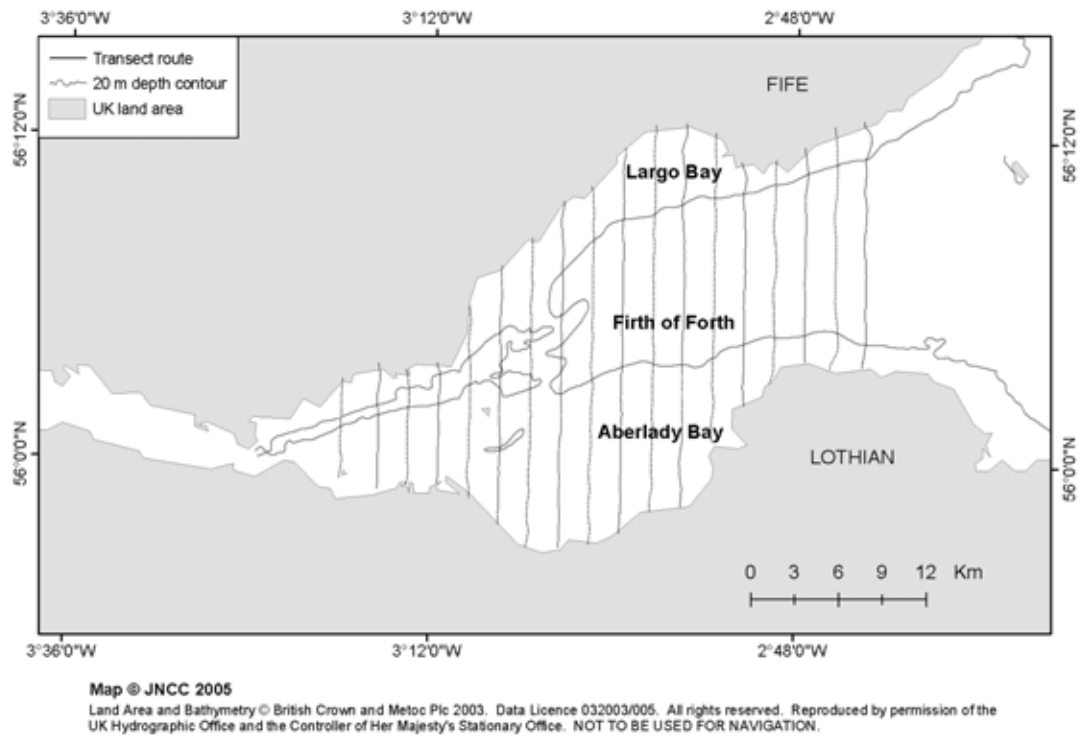


Figure 10. Locations of line-transects surveyed in the Firth of Forth on 3 February 2005.

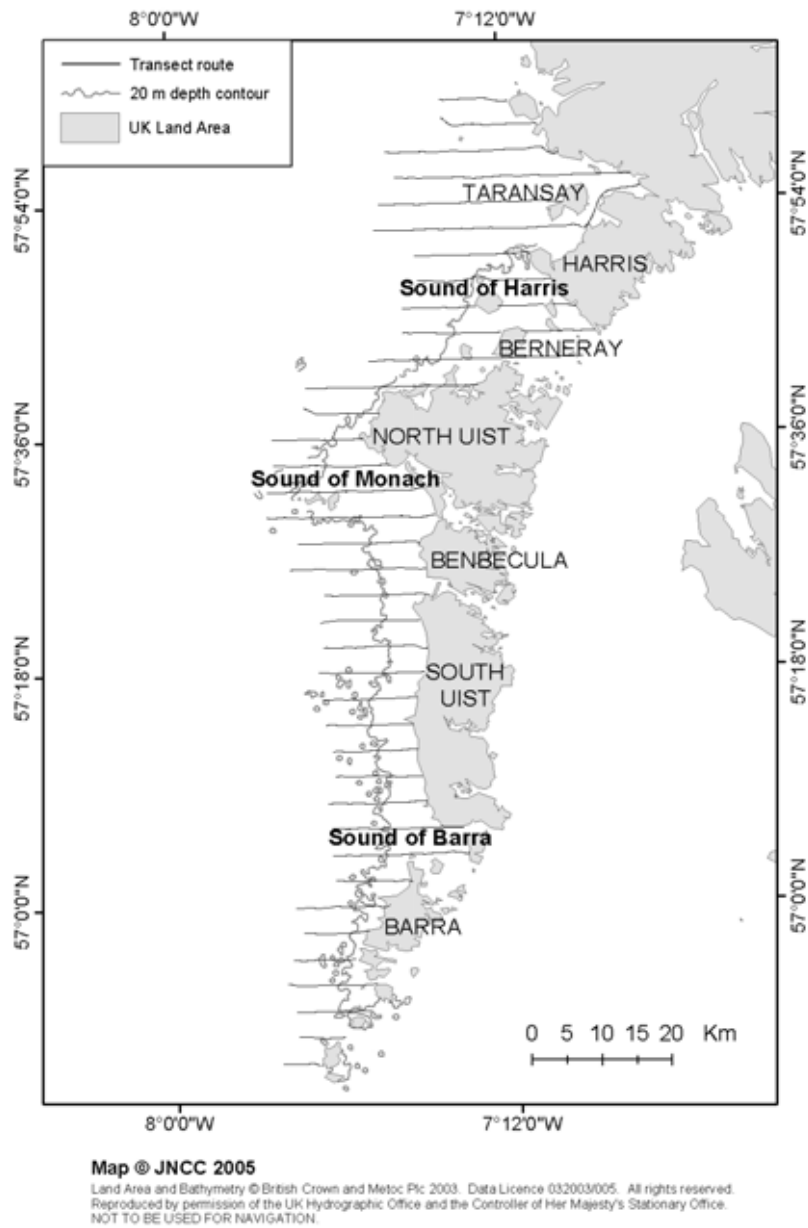


Figure 11. Locations of line-transects surveyed off the west coast of the Outer Hebrides on 7/8 March 2005.

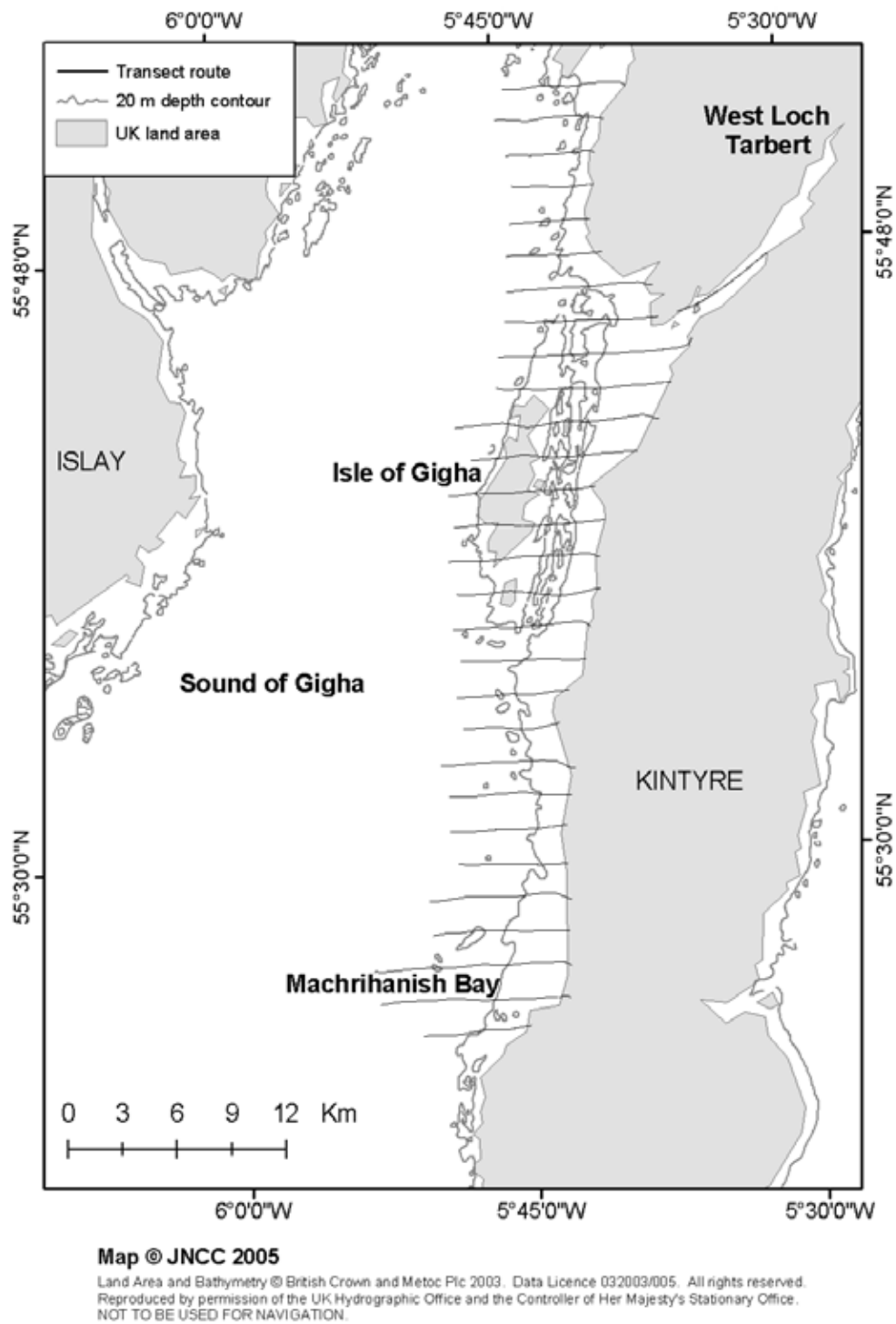


Figure 12. Locations of line-transects surveyed around the Sound of Gigha on 9 March 2005.

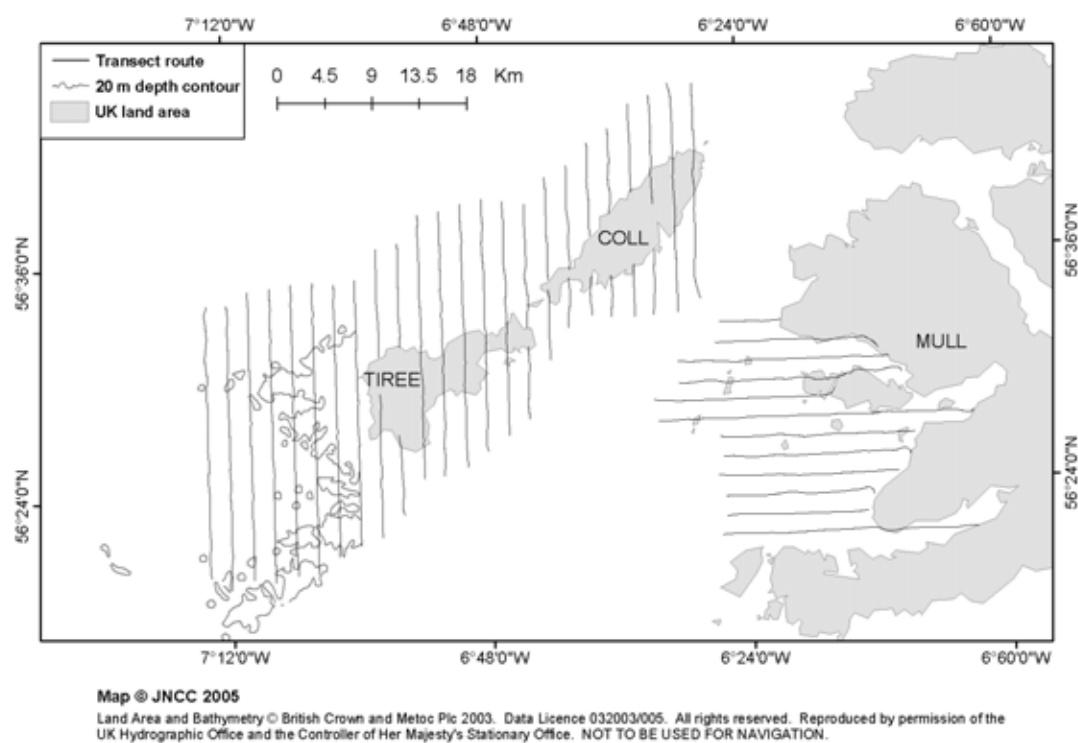


Figure 13. Locations of line-transects surveyed in the waters around Coll, Tiree and Mull on 25/26 March 2005. Note: bathymetry data only available for part of the area.

4.3 Weather conditions

Survey flights were undertaken during daylight hours (between 07:00 and 18:00 GMT) and in suitable weather conditions. Optimal conditions for survey flights were excellent visibility (to the horizon), calm seas of sea state 3 or less (wind \leq 10 knots, swell \leq 0.6 m), high altitude light cloud cover and little or no precipitation. Some surveys were conducted in sub-optimal conditions, but never in sea state exceeding 4 (wind $>$ 16 knots) or in low cloud (to 500 ft). One survey (Firth of Tay, 12/12/04) was abandoned because of deteriorating light conditions in the late afternoon.

4.4 Data recording

During each survey flight, time (to the nearest second) and navigation data (including the aircraft's position, altitude and speed) were automatically recorded from a Geographical Positioning System (GPS) (Garmin GPS III Plus) using the system described in Dean *et al.* (2004a).

Observations were made concurrently by one port observer and one starboard observer, each of whom recorded observation data directly onto a cassette voice recorder, using the protocols described in Dean *et al.* (2004a). In summary, each observer recorded the start and end times of each transect (to the nearest second). For all inshore waterbirds observed,

observers recorded the species, number, time and perpendicular distance from the transect line directly onto the voice recorders. Any cetaceans observed were also recorded in the same way. The time recorded was the time (to the nearest second) that the bird / flock passed abeam (at right angles to the length of the aircraft). The perpendicular distance of each observation from the transect line was recorded by assigning observations to one of four distance bands: band A, 44-162m; band B, 163-282; band C, 283-426; and band D, ≥ 427 . Observers determined these distances using fixed angles of declination from the visual horizon. In addition, visibility, cloud cover and wind speed were recorded at the beginning and end of each transect.

4.5 Analysis of survey data

4.5.1 Calculation of total transect length surveyed

The navigation and observation data were entered into separate tables in a Microsoft Access database, linked by a common time field. The position of the aircraft during small gaps in the navigation data (caused by poor GPS signal in some areas) was calculated by interpolation within the Access database, using a program written in Visual Basic for Applications (VBA) code. The approximate total lengths of transects covered during each survey of each area (Table 3), were calculated from the time and position data in the navigation database tables using a program written in VBA code.

4.5.2 Assigning locations to observations

Using the common time field in the Access database, each observation was assigned a location corresponding to the location of the aircraft at the time (to the nearest 1 second) that the observation was recorded abeam. The database containing the navigation and observation data was linked to a Geographical Information System (ESRI ArcMap v.8.2 GIS) via an ODBC (Open DataBase Connectivity) database connection, to generate the transect maps and distribution maps presented in Section 4.1 and Appendix 1 (Figures 1 -13 and A1.1 – A1.48).

5. SHORE-BASED COUNT METHODS

5.1 Survey area

Seven shore-based counts (including one incomplete count) of the target species were conducted between June 2004 and May 2005, from 11 count points, within eight sub-sections (between 1.7km and 6.7km in length), along the Aberdeen Bay area between Nigg Bay and Bay of Cruden (Figure 14). Locations of count points were chosen on the basis of having sufficient elevation and uninterrupted line of sight to give an optimal all-round view of the coastline to the north and south. Generally, each section was covered by two count points at either end and the observer used landmarks along the coast to determine the boundary of the area counted from each to ensure each section was fully covered. In some cases (sections 1 and 8), count points were located close together because of the nature of the coastline.

5.2 Weather conditions

Counts were undertaken only during daylight hours and in suitable weather conditions; good to excellent visibility (little or no glare, haze, or precipitation), calm seas (Beaufort Scale 3 or less, wind ≤ 10 knots), and high altitude light cloud cover.

5.3 Data recording and analysis

Counts were conducted over a single day during each month of June, August, September, October, November, December in 2004 and May in 2005. The dates and times of each survey are presented in Table 2.

Table 2. Dates and times of shore-based counts conducted within the Aberdeen Bay area (Nigg Bay to Bay of Cruden) June 2004 – May 2005.

Date	Start Time (GMT)	End Time (GMT)
27 June 04	06:25	13:55
22 August 04	10:25	16:15
28 September 04 (incomplete)	10:10 14:50	11:05 15:00
23 October 04	09:45	15:55
23 November 04	08:35	15:00
31 December 04	09:20	14:00
2 May 05	11:30	18:10

Counts were made using a tripod-mounted telescope with a $\times 30$ fixed eyepiece. Counts were made from each of the eleven count points, within each of the eight sub-sections of the coast

(Figure 14), generally working from south to north. The maximum distance from shore within which birds could be counted was estimated to be approximately 2km (R Schofield, pers. obs.).

All target species (section 3) observed on the water were counted and recorded. Except for eiders, all target species observed flying were also counted and recorded. Small numbers of eider (<10) were frequently observed flying both north and south and were excluded to avoid potential double counting. The direction of flight was recorded for all flying birds.

Count data from each count point were imported into a Microsoft Access database and used to calculate total counts for each species, in each sub-section, and in each month. Count totals within each sub-section were assigned a location equivalent to the centre of each sub-section and the database was linked to a GIS (ESRI ArcMap v. 8.2 GIS) via an ODBC database connection, to generate the count distribution maps presented in Appendix 2 (Figures A2.1 – A2.26). Total monthly counts for the whole of Aberdeen Bay were also calculated from the Microsoft Access database (Table 8).

To avoid double counting of birds flying between sub-sections, and to exclude birds flying through the Aberdeen Bay area without using it, flying birds are excluded from the sub-section totals and overall monthly totals are presented here.

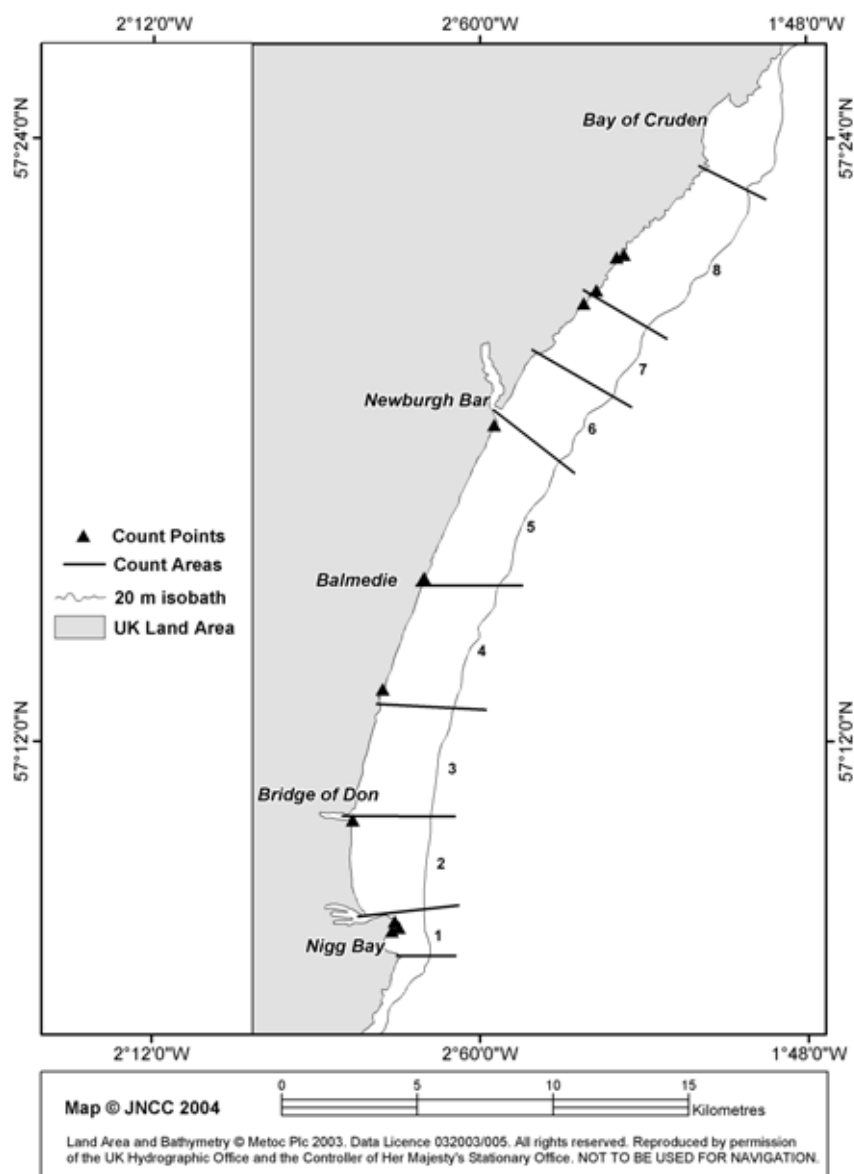


Figure 14. Locations of count points and count sub-sections for shore-based counts conducted within the Aberdeen Bay area (Nigg Bay to Bay of Cruden), June 2004 – May 2005.

6. AERIAL SURVEY RESULTS

6.1 Total transect length surveyed

The approximate total length of transect lines surveyed during the 2004/05 surveys was 4,222km; comprising 719km in December 2004, 808km in February 2004 and 2,695km in March 2005. The approximate total lengths of the transect lines flown during each survey of each area are presented in Table 3.

Table 3. Number of transects flown (TF) and approximate total transect lengths (Total km) in each survey area during aerial surveys. * denotes incomplete survey.

Area	Date	TF	Total km
Scapa Flow	07/03/05	18	222
Dornoch Firth	06/03/05	10	116
Moray Firth	06/03/05	45	425
Inverness Firth	06/03/05	5	25
Aberdeen Beach	11/12/04	16	178
Aberdeen Beach	17/02/05	17	199
Firth of Tay*	12/12/04	12	220
Firth of Tay	02/02/05	18	294
Firth of Tay	18/03/05	18	283
Firth of Forth	12/12/04	18	321
Firth of Forth	03/02/05	18	315
Outer Hebrides	07-08/03/05	39	651
Coll and Tiree	26/03/05	24	530
Mull	25/03/05	12	218
Sound of Gigha	09/03/05	29	225

6.2 Species recorded

Eleven of the 14 target species were recorded at least once during the 2004/05 aerial surveys. These comprised red-throated diver, black-throated diver, great northern diver, greater scaup, common eider, long-tailed duck, common scoter, velvet scoter, common goldeneye, red-breasted merganser and goosander. In addition, birds were recorded that could be identified only as diver species or scoter species. Little gulls were also recorded during these surveys. No grebe species were recorded.

6.3 Positional accuracy of observations from aerial surveys

An assessment of the accuracy of the locations assigned to bird observations using the method in 3.5.2 was made in Dean *et al.* (2004a). It resulted in the following conclusions:

1. Assuming a cruising speed of 51.38 m sec^{-1} , and a delay of up to five seconds between the time abeam of an observation and its recording on the cassette, most observations were assigned a position along the transect line within 257m (5×51.38) of their actual position. In a few cases, where visual encounter rates were very high, thereby increasing the delay between observation and recording to up to 10 seconds, observations may have been assigned a position along the transect line within 514m (10×51.38) of their actual position.
2. For the purposes of distribution mapping herein, all observations are assumed to be on the transect line and are therefore at least 44m and at most approximately 925 – 1000m from their true position either side of the transect line.

6.4 Numbers and distributions of species recorded during aerial surveys

Total numbers of each target species recorded in each survey area are presented in Table 4 (December 2004), Table 5 (February 2005), and Tables 6 and 7 (March 2005), along with the percentage of the Great Britain wintering population these represent (see Table 9). In considering these numbers it is important to note that:

1. The data are only sample counts (recorded along line-transects) of the total numbers present within each survey area. In order to produce total population estimates they must be analysed using distance sampling methods (Buckland *et al.* 2001);
2. One of the surveys was not completed. In this case, the data are only sample counts for part of the total survey area; and
3. Comparison of these raw data between different survey areas is not straightforward due to differences in the size of survey areas and sampling intensity.

Most inshore waterbird species observed during aerial surveys were recorded inshore of the 20m depth contour, this depth being the maximum typical diving depth for these species (Cramp & Simmons 1977) and corresponds with data collected in previous years (Dean *et al.* 2003, 2004a and 2004b). Maps showing the recorded diurnal distributions of the most important target species recorded in each area are presented in Appendix 1, Figures A1.1 – A1.48. In considering these distribution maps it is important to note that there is a degree of error associated with the positions assigned to observations, as discussed in section 6.3.

Table 4. Total numbers of each target species (as well as shelduck, little gulls and cetaceans) recorded in each survey area during the December 2004 aerial surveys. Numbers represent sample counts of all birds recorded along line-transects, with the percentage of the Great Britain wintering population these represent in brackets, where appropriate. Figures in bold denote nationally significant numbers (for Annex 1 species). * denotes incomplete survey.

	Aberdeen Bay 11/12/04	Firth of Tay 12/12/04*	Firth of Forth 12/12/04
Red-throated diver	31 (0.6)	20 (0.4)	57 (1.2)
Unidentified diver			1
Shelduck	15		
Eider	49 (<0.1)	4,378 (6.0)	2,033 (2.8)
Long-tailed Duck	5 (<0.1)	21 (0.1)	236 (1.5)
Common scoter	55 (0.1)	1085 (2.2)	34 (<0.1)
Velvet scoter	1 (<0.1)		13 (0.4)
Unidentified scoter		500	20
Red-breasted merganser		6 (<0.1)	105 (1.1)
Goldeneye			1
Little gull		4	
Bottlenose dolphin <i>Tursiops truncatus</i>	4		

Table 5. Total numbers of each target species (as well as cetaceans) recorded in each area surveyed during the February 2005 aerial surveys. Numbers represent sample counts of all birds recorded along line-transects, with the percentage of the Great Britain wintering population these represent in brackets, where appropriate.

	Aberdeen Bay 17/02/05	Firth of Tay 02/02/05	Firth of Forth 03/02/05
Red-throated diver	10 (0.2)	33 (0.7)	7 (0.1)
Eider	190 (0.3)	3,432 (4.7)	1,182 (1.6)
Long-tailed duck		32 (0.2)	52 (0.3)
Common scoter	258 (0.5)	305 (0.6)	70 (0.1)
Velvet scoter	1 (<0.1)		58 (1.9)
Unidentified scoter	6		16
Red-breasted merganser		6 (<0.1)	21 (0.2)
Goldeneye			5 (<0.1)
Bottlenose dolphin	1		
Harbour porpoise <i>Phocoena phocoena</i>			5

Table 6. Total numbers of each target species (and also Manx shearwaters *Puffinus puffinus*, great skuas *Stercorarius skua* and cetaceans) recorded in surveys of Scapa Flow, the Outer Hebrides, the Inner Hebrides and the Sound of Gigha, during the March 2005 aerial surveys. Numbers represent sample counts of all birds recorded along line-transects, with the percentage of the Great Britain wintering population these represent in brackets, where appropriate. Figures in bold denote nationally significant numbers (for Annex 1 species).

	Scapa Flow 07/03/05	Outer Hebrides 07- 08/03/05	Coll and Tiree 26/03/05	Mull 25/03/05	Sound of Gigha 09/03/05
Great northern diver	33 (1.1)	57 (1.9)	131 (4.4)	27 (0.9)	104 (3.5)
Red-throated diver	4 (<0.1)		2 (<0.1)	1	
Unidentified diver		1			
Manx shearwater			53		
Eider	599 (0.8)	621 (0.9)	220 (0.3)	67 (<0.1)	335 (0.5)
Long-tailed duck	146 (0.9)	54 (0.3)	17 (0.1)	1 (<0.1)	4 (<0.1)
Red-breasted merganser	11 (0.1)	8 (<0.1)	4 (<0.1)	1 (<0.1)	9 (<0.1)
Great skua				3	
Common dolphin			2		
Unidentified cetacean			2		

Table 7. Total numbers of each target species (as well as little gulls and cetaceans) recorded in surveys of the Dornoch, Moray and Inverness Firths and the Firth of Tay areas during the March 2005 aerial surveys. Numbers represent sample counts of all birds recorded along line-transects, with the percentage of the Great Britain wintering population these represent in brackets, where appropriate.

	Dornoch Firth 06/03/05	Moray Firth 06/03/05	Inverness Firth 06/03/05	Firth of Tay 18/03/05
Great northern diver	1 (<0.1)	5 (0.2)		1 (<0.1)
Black-throated diver		1 (0.1)		
Red-throated diver	1 (<0.1)	16 (0.3)	2 (<0.1)	20 (0.4)
Eider	5 (<0.1)	323 (0.4)	30 (<0.1)	992 (1.4)
Long-tailed duck		787 (4.9)	11 (<0.1)	27 (0.2)
Common scoter		693 (1.4)		448 (0.9)
Velvet scoter		6 (0.2)		3 (0.1)
Unidentified scoter		2		
Red-breasted merganser	4 (<0.1)			
Goosander			2 (<0.1)	
Scaup			70 (0.9)	
Goldeneye	1 (<0.1)	4 (<0.1)	3 (<0.1)	
Little gull				1
Bottlenose dolphin		15		
Harbour porpoise				1

7. SHORE BASED COUNTS RESULTS

7.1 Species recorded

Seven of the 14 target species were recorded on the water during shore-based counts of the Aberdeen Bay area (Nigg Bay to Bay of Cruden). These comprised red-throated diver, black-throated diver, common eider, long-tailed duck, common scoter, velvet scoter and red-breasted merganser. In addition, one immature male king eider *Sommateria spectabilis* was counted on 2 May 2005 at North Donmouth. No grebe species, greater scaup, common goldeneye or goosanders were recorded.

7.2 Numbers and distributions of species recorded during shore-based counts

Total numbers of each target species recorded on the water during each survey of the Aberdeen Bay area (Nigg Bay to Bay of Cruden) are presented Table 8, along with the percentage of the Great Britain wintering population that these represents (see Table 9). Maps representing the monthly sub-total counts of each target species observed, within each of the eight sub-sections are presented in Appendix 2, Figures A2.1 – A2.26. These maps are intended to summarise the broad scale distribution of each species recorded within the Aberdeen Bay area.

Table 8. Total numbers of target species recorded on the water during shore-based counts of the Aberdeen Bay area (Nigg Bay to Bay of Cruden), June 2004 – May 2005. The percentage of the Great Britain wintering population that each count represents is shown in brackets. Figures in bold denote nationally significant numbers (for Annex 1 species).

	27 June 2004	22 Aug 2004	28 Sept 2004	23 Oct 2004	23 Nov 2004	31 Dec 2004	02 May 2005
Red-throated diver	19 (0.4)	74 (1.5)	3 (<0.1)	118 (2.4)	69 (1.4)	129 (2.7)	423 (8.7)
Black-throated diver	1 (0.1)						
Common eider	1,756 (2.4)	6,003 (8.2)	163 (0.2)	444 (0.6)	250 (0.3)	363 (0.5)	208 (0.3)
Long-tailed duck				2 (<0.1)	52 (0.3)	17 (0.1)	22 (0.1)
Common scoter	2,992 (6.0)	3,475 (7.0)		395 (0.8)	508 (1.0)	493 (1.0)	655 (1.3)
Velvet scoter	17 (0.6)	2 (<0.1)		28 (0.9)	3 (0.1)		
Red-breasted merganser		12 (0.1)		5 (<0.1)	15 (0.2)	20 (0.2)	18 (0.2)

8. DISCUSSION

Complete aerial surveys of each of JNCC's core survey areas (the Dornoch, Moray and Inverness Firths, the Firth of Forth, and the Firth of Tay and St Andrews Bay), plus the Aberdeen Bay area were conducted between December 2004 and March 2005. Two surveys were carried out in Aberdeen Bay, the Firth of Forth and the Firth of Tay in December and February (although the Firth of Tay December aerial survey was incomplete), and a third survey of the Firth of Tay was carried out in March. The other core survey areas of the Dornoch, Moray and Inverness Firths were surveyed in March, along with Scapa Flow, the west coast of the Outer Hebrides, the waters around Coll and Tiree, the west coast of the Isle of Mull and the Sound of Gigha. In addition, seven shore-based counts (including one incomplete count) were conducted within the Aberdeen Bay area between June 2004 and May 2005.

8.1 Importance of areas for species recorded during aerial surveys

The data collected during these surveys may be used to inform the process of identifying inshore areas as possible marine Special Protection Areas (SPAs) (Johnston *et al.* 2002; McSorley *et al.* 2005; Webb *et al.* 2004; Webb *et al.* in prep.). Those sites holding qualifying numbers of birds may be considered for SPA designation according to the guidelines recommended by Stroud *et al.* (2001). These guidelines include:

- 1.1 An area is used regularly by 1% or more of the Great Britain (or in Northern Ireland, the all-Ireland) population of a species listed in Annex I of the Birds Directive (79/409/EEC as amended) in any season.
- 1.2 An area is used regularly by 1% or more of the biogeographical population of a regularly occurring migratory species (other than those listed in Annex I) in any season.
- 1.3 An area is used regularly by over 20,000 waterfowl (waterfowl as defined by the Ramsar Convention) or 20,000 seabirds in any season.

Therefore, a site may be considered to qualify as an SPA if the population estimate(s) within that site meet or exceed the thresholds stated above. (There is a fourth guideline which allows consideration (using Stage 2 judgements, not detailed here), to be given to cases where an adequate number of areas cannot be identified from Stages 1.1-1.3).

With this in mind, the following paragraphs outline the importance of each survey area for the recorded species. As stated in section 6.4, the numbers of birds recorded during aerial surveys (Tables 4 – 7) are only raw sample counts (as recorded along line-transects) of the total numbers present within each survey area. In order to produce population estimates within survey areas (to compare with national and biogeographic population estimates) JNCC recommends the data be analysed using distance sampling methods (Buckland *et al.* 2001). Such analyses (e.g. McSorley *et al.* 2005; Webb *et al.* 2004; Webb *et al.* in prep.) are outwith the scope of this report, but in considering the importance of areas for recorded species, it is vital to note that the recorded numbers are certainly underestimates of the true numbers present because of a reduction in detectability with increasing distance from the transect line, and that for some data, this underestimation may be considerable.

For the diver species (listed in Annex 1 of the EC Birds Directive), the raw sample counts alone were considered sufficient to identify those areas as nationally important (i.e. $\geq 1\%$ of the estimated GB wintering population). Thus, for diver species, where the raw sample counts alone were $\geq 1\%$ of the estimated GB wintering population prior to distance sampling analyses, these are referred to as ‘nationally important’. For the purposes of this report, for all other species, numbers were considered as ‘high’, where the raw sample counts recorded were $\geq 1\%$ of the estimated GB wintering population and ‘fairly high’ where these counts were 0.5-0.9 % of the estimated GB wintering population.

Table 9 shows the current national (GB) and biogeographic wintering population estimates for the recorded species, for comparison with the numbers recorded during these surveys. In the following sections, percentages quoted refer to the percentage of the GB wintering population that the raw counts represent.

Some tentative comparisons of the results of the aerial surveys of 2004 / 2005 with those from previous surveys (Dean 2003, 2004a and 2004b) can be made. It is important to note that in depth comparisons between these raw data are not possible at this stage because of the following reasons:

- In some areas, surveys between years were conducted during different months
- The area covered and the transect lengths flown vary between surveys within the same area
- Different weather conditions between surveys of the same area may affect counts

The latter two issues can be addressed by further analyses, which are outwith the scope of this report. For details of the coverage of previous surveys, see the relevant reports (Dean 2003, 2004a and 2004b).

Table 9. Wintering GB and biogeographic population estimates for each of the species recorded during 2004/05 surveys. Sources: (1) Lack (1986), (2) Danielsen *et al.* (1993), (3) Wetlands International (2002), (4) Kershaw & Cranswick (2003). * indicates species listed on Annex I of the EC Birds Directive.

Species	Wintering GB estimate	Biogeographic estimate
Red-throated diver*	4,850 ⁽²⁾	100,000 - 1,000,000 ⁽³⁾
Black-throated diver*	700 ⁽²⁾	100,000 – 1,000,000 ⁽³⁾
Great northern diver*	3,000 ⁽¹⁾	5,000 ⁽³⁾
Eurasian wigeon	406,000 ⁽⁴⁾	1,500,000 ⁽³⁾
Common eider	73,000 ⁽⁴⁾	1,248,400 - 1,858,400 ⁽³⁾
Long-tailed duck	16,000 ⁽⁴⁾	4,600,000 ⁽³⁾
Greater scaup	7,560 ⁽⁴⁾	310,000 ⁽³⁾
Common scoter	50,000 ⁽⁴⁾	1,600,000 ⁽³⁾
Velvet scoter	3,000 ⁽⁴⁾	1,000,000 ⁽³⁾
Common goldeneye	24,900 ⁽⁶⁾	400,000 ⁽⁵⁾
Red-breasted merganser	9,840 ⁽⁶⁾	170,000 ⁽⁵⁾
Goosander	16,100 ⁽⁶⁾	250,000 ⁽⁵⁾
Little gull*	300 - 700 ⁽¹⁾	66,000 – 102,000 ⁽⁵⁾

8.1.1 Scapa Flow

2004/05 surveys

During the survey of Scapa Flow (7 March 2005, Table 6), nationally important numbers of great northern divers were recorded (33, 1.1%). Fairly high numbers of common eider (599, 0.8%) and long-tailed duck (146, 0.9%) were also recorded. Divers were recorded throughout the area, but particularly in the deeper waters in the middle of Scapa Flow, whereas most seaducks were recorded in the inshore areas around the islands (Figures A1.1 – A1.4).

Previous surveys

The regularity of occurrence of these aggregations may be assessed against two previous aerial surveys of Scapa Flow (December 2002 and February 2004, Table 10), in which the same species were recorded (except for common scoter - not recorded in March 2005 and red-throated diver - not recorded in December 2002). Bird numbers recorded during the March 2005 survey were lower than those in February 2004, possibly due to wintering populations starting to disperse towards their breeding grounds. Bird numbers recorded in March 2005 were generally higher than those recorded during the December 2002 survey, but that survey covered less than half of the survey area, and was carried out in poor weather conditions. Bird distributions during the March 2005 survey showed a similar pattern to the February 2004 survey, in that most seaducks were recorded in the inshore areas, while divers were recorded mainly in deeper waters.

Table 10. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of Scapa Flow from 2002 - 2005.

Date	7 Mar 2005	12 Feb 2004	12 Dec 2002*
Total km surveyed	222	267	103
Red-throated diver	4	2	0
Great northern diver	33	156	9
Diver sp.	0	9	4
Common eider	599	832	153
Long-tailed duck	146	210	43
Common scoter	0	53	3
Red-breasted merganser	11	29	11

8.1.2 Dornoch Firth

2004/05 surveys

During the 6 March 2005 survey of the Dornoch Firth, only 12 birds were recorded, including five common eider and four red-breasted merganser (Table 7). These birds were all recorded within the southern half of the Dornoch Firth area, in waters less than 20 m deep (Figures A1.5 – A1.6).

Previous surveys

With so few birds recorded during the March 2005 survey, it is difficult to make any comparisons with previous surveys. Four complete surveys (December 2002, March 2003, December 2003 and 15 February 2004) and one incomplete survey (12 February 2004) have previously been carried out in the Dornoch Firth (Table 11). In addition, the Dornoch Firth was surveyed in January 2001, January 2002 and February 2002, but these count data were combined with those from the Moray Firth, Inverness Firth and Beaulieu Firth (see Table 13). During the 12 February 2004 survey, nationally important numbers of great northern divers were recorded, while high numbers of common scoter, velvet scoter and fairly high numbers of great northern divers were recorded during the 15 February 2004 survey. During the December 2002 survey of the Dornoch Firth, high numbers of common scoter and long-tailed duck were recorded. Most aggregations were recorded off Dornoch and within the southern half of the Dornoch Firth area and these aggregations appear to have been present fairly regularly over the 2002-04 winters.

Table 11. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the Dornoch Firth from 2002 - 2005. * denotes incomplete survey.

Date	6 Mar 2005	15 Feb 2004	12 Feb 2004*	6 Dec 2003	17 Mar 2003	11 Dec 2002*
Total km surveyed	116	142	105	140	154	62
Red-throated diver	1	4	3	6	18	2
Great northern diver	1	21	109	4	13	1
Diver sp.	0	10	2	6	22	1
Common eider	5	1	24	96	184	85
Long-tailed duck	0	93	48	0	42	181
Common scoter	0	547	153	154	0	626
Velvet scoter	0	43	0	0	0	0
Scoter sp.	0	8	100	0	825	0
Red-breasted merganser	4	2	0	7	4	0

8.1.3 Moray Firth

2004/05 surveys

During the 6 March 2005 survey of the Moray Firth, high numbers of long-tailed duck (787, 4.9%) and common scoter (693, 1.4%) were recorded, and almost all birds were recorded in the inshore areas with water less than 20 m deep (Table 7, Figures A1.7 and A1.8). Long-tailed ducks, common eiders and common scoter were concentrated along the southern Moray coast, between Lossiemouth and Nairn Bay, with fewer birds recorded along the coasts of the Black Isle and Easter Ross, while red-throated divers (16, 0.3%) showed a more dispersed distribution along the coasts (Figures A1.5 – A1.8).

Previous surveys

Four previous surveys have been carried out in the Moray Firth (December 2002 and 2003, March 2003 and February 2004, Table 12). In addition, three surveys were carried out in January 2001, January 2002 and February 2002 which included the Inverness, Beaulieu and Dornoch Firths, as well as the Moray Firth (Table 13). The most important areas for waterbird aggregations during all the surveys appears to be the southern coast of the Moray Firth, particularly Spey, Burghead and Nairn Bays and the inner firth. Aerial surveys during December 2002 and March 2003 only covered small parts of the Moray Firth area and did not record significant numbers of any of the target species. All of the other surveys recorded high numbers of long-tailed duck (3.5-7%) and common scoter (0.8-3.7%), while high numbers (1-2%) of velvet scoter were recorded in the January 2001, February 2002, December 2003 and February 2004 surveys. The February 2002 survey also recorded fairly high numbers of unidentified scoters (2630, most of which were likely to have been common scoters).

Both the January 2001 and January 2002 surveys recorded nationally important numbers of red-throated divers (3% and 1.5% respectively). Fairly high numbers of red-throated divers were recorded during the February 2002 survey (32, 0.7% in each) and fairly high numbers of unidentified divers (38, most of which were probably red-throated divers) were also recorded during the February 2002 survey. In addition, a high number (54, 1.8%) of great northern divers were recorded during the February 2002 survey.

High numbers (1455, 2%) of common eider were recorded during the January 2001 survey, with fairly high numbers recorded during January 2002 (559, 0.8%), February 2002 (548, 0.8%) and December 2003 (638, 0.9%). In addition, fairly high numbers of red-breasted mergansers (92, 0.9%) were recorded during the January 2001 survey.

Table 12. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the Moray Firth from 2002 - 2005.

Date	06 Mar 2005	15 Feb 2004	6-7 Dec 2003	11 Dec 2002*
Total km surveyed	425	424	439	192
Red-throated diver	16	19	32	8
Great northern diver	5	12	1	1
Black-throated diver	1	0	0	0
Diver sp.	0	10	20	11
Common eider	323	306	638	58
Long-tailed duck	787	634	1054	66
Common scoter	693	1362	581	60
Velvet scoter	6	139	47	0
Scoter sp.	2	70	0	0
Red-breasted merganser	0	4	31	0

Table 13. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the Moray Firth, including Inverness, Beaully and Dornoch Firths from 2001 - 2002.

Date	24-25 Feb 2002	8-9 Jan 2002	16-17 Jan 2001
Total km surveyed	716	716	828
Red-throated diver	32	74	150
Great northern diver	54	9	1
Diver sp.	38	114	2
Common eider	548	559	1455
Long-tailed duck	587	593	925
Common scoter	417	1861	1551
Velvet scoter	43	14	32
Scoter sp.	2630	0	891
Red-breasted merganser	23	12	92

8.1.4 Inverness Firth

2004/05 Surveys

During the 6 March 2005 survey of the Inverness Firth, a single group of 70 (0.9%) greater scaup were recorded between Alturlie Point and Longman Point. Only low numbers (<0.1% of the GB wintering population) of red-throated diver, common eider, long-tailed duck, goosander and goldeneye were recorded, all in the northern half of the firth (Table 7, Figures A1.5 – A1.7).

Previous surveys

Three previous surveys have been carried out in the Inverness Firth (December 2002 and 2003, and February 2004, Table 14). In addition, the Inverness Firth was surveyed in January 2001, January 2002 and February 2002, but these count data were combined with those from the Moray Firth, Dornoch Firth and Beaully Firth (see Table 13). High numbers (1.1%) of long-tailed ducks were recorded during the February 2004 survey with fairly high numbers (0.5%) recorded during the December 2003 survey. Red-throated diver, common eider, goldeneye and red-breasted merganser were recorded only in low numbers (<0.4%).

Table 14. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the Inverness Firth from 2002 - 2005.

Date	6 Mar 2005	15 Feb 2004	06 Dec 2003	11 Dec 2002
Total km surveyed	25	45	32	27
Red-throated diver	2	3	11	8
Goldeneye	3	49	0	2
Common eider	30	20	0	3
Long-tailed duck	11	177	80	20
Red-breasted merganser	0	1	38	9

8.1.5 Aberdeen Bay

2004/05 surveys

During the 11 December 2004 survey, fairly high numbers of red-throated divers (31, 0.6%) were recorded, but only 10 (0.2%) red-throated divers were recorded during the 17 February survey (Tables 4 and 5). Low numbers of common eider were recorded in December and February (49 and 190 respectively), whereas only five long-tailed duck were recorded during the December survey. Low numbers of common scoter (55, 0.1%) were recorded in December, but fairly high numbers were recorded in February (258, 0.5%). Both common eiders and common scoters were more dispersed along the coast during the February survey, when the higher numbers were recorded, whereas red-throated divers were recorded further offshore during the December survey (Figures A1.9 – A1.14).

Previous surveys

The only previous aerial surveys of this area were 3 December 2003 and 11 February 2004 (Table 15). Fairly high numbers of red-throated divers (0.9%) were recorded during the February 2004 survey, and were more dispersed than the December 2003 survey, which is the opposite pattern to that recorded during the 2004/05 surveys.

Table 15. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of Aberdeen Bay from 2003 - 2005.

Date	17 Feb 2005	11 Dec 2004	11 Feb 2004	03 Dec 2003
Total km surveyed	199	178	182	178
Red-throated diver	10	31	44	13
Common eider	190	49	171	40
Long-tailed duck	0	5	0	2
Common scoter	258	55	8	70
Velvet scoter	1	1	0	0
Scoter sp.	6	0	0	0
Red-breasted merganser	0	0	2	0

8.1.6 Firth of Tay and St Andrews Bay

2004/05 surveys

Two complete surveys (2 February and 18 March 2005) and one partially completed survey (12 December 2004) were carried out in the Firth of Tay and St Andrews Bay during 2004/05. Fairly high numbers of red-throated divers (33, 0.7%) were recorded during the February survey, and their distribution appeared to shift from being close to the coastline in December, to further offshore in February and March (Tables 4, 5 and 7, Figures A1.15, A1.20 and A.24). High numbers of common eider were recorded during the December (4378, 6%) and February (3432, 4.7%) surveys, with aggregations being concentrated at the mouth of the Firth of Tay (Tables 4 and 5, Figures A1.16, A1.21 and A1.25). High numbers

of common scoter (1085, 2.2%) were recorded during the December survey (Table 4), while low numbers (< 0.2%) of long-tailed duck were recorded in all three surveys (Tables 4, 5 and 7).

Previous surveys

Six previous surveys have been carried out in the Firth of Tay and St Andrews Bay areas (in December and February of 2000/2001, 2001/2002 and 2003/2004 winters, Table 16). No surveys of the Firth of Tay were conducted during the 2002/03 winter. Species composition and distribution of aggregations recorded in all surveys appear to have been fairly similar, although the numbers recorded have varied greatly. In all surveys, large aggregations of common eiders were recorded around the mouth of the Tay and this area was also favoured by red-breasted mergansers during the February 2004 survey.

Nationally important numbers of red-throated divers were recorded in the February 2001, December 2003 and February 2004 surveys. All previous surveys recorded high numbers of common scoter (1 – 3 % of the GB wintering population), while this was the case in only the December 2004 survey this winter. In addition, all previous surveys, including this winter's surveys but excluding the December 2001 survey, recorded high numbers of common eider (1 – 8%). High numbers of long-tailed duck were recorded in the February surveys during 2001 and 2004 (3.4% and 1% respectively)

Table 16. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the Firth of Tay and St Andrews Bay from 2000 - 2005. * denotes incomplete survey.

Date	18 Mar 2005	02 Feb 2005	12 Dec 2004*	29 Feb 2004	04 Dec 2003	26 Feb 2002	15 Dec 2001	15/16 Feb 2001	21 Dec 2000
Total km surveyed	283	294	220	281	304	248	129	213	167
Red-throated diver	20	33	20	137	57	9	7	98	1
Great northern diver	1	0	0	0	0	0	0	0	0
Common eider	992	3432	4378	3017	5974	3	211	1518	3861
Long-tailed duck	27	32	21	159	159	116	61	546	53
Common scoter	448	305	1085	487	717	865	506	1687	1416
Scoter sp.	0	0	500	0	105	295	0	16	36
Velvet scoter	3	0	0	0	69	6	3	4	0
Red-breasted merganser	0	6	6	38	12	4	27	5	0

8.1.7 Firth of Forth

2004/05 surveys

Nationally important numbers of red-throated diver (57, 1%), and high numbers of common eider (2,033, 2.8%), long-tailed duck (236, 1.5%) and red-breasted merganser (105, 1%) were recorded during the December 2004 survey (Table 4). High numbers of common eider (1,182, 1.6%) were recorded during the February 2005 survey (Table 5). Red-throated divers, common eiders and long tailed duck were largely dispersed throughout the area but mainly within waters less than 20m deep, while the scoters were largely aggregated in Largo Bay and Aberlady Bay (Figures A1.28 - A1.33 and A1.35-A1.39). Red-breasted mergansers were recorded largely in the western half of the Firth, and close inshore (Figures A1.34 and A1.40).

Previous surveys

Six complete surveys have previously been carried out in the Firth of Forth (December 2000, February 2001, December 2001, February 2002, 5 December 2003 and February 2004), as well as one incomplete survey on 4 December 2003 (Table 17). No surveys of the Firth of Forth were conducted during the 2002/03 winter. All of the complete surveys recorded high numbers of common eider (1.8 – 6.3%). High numbers of both common scoter (1.6-5.1%) and velvet scoter (4.4-14.3%) were recorded during the December 2000, February 2001 and December 2001 surveys, while the February 2002 survey recorded high numbers of velvet scoter (4.4%) and fairly high numbers of common scoter (0.8%). High numbers of common scoter (1.4%) were recorded in February 2004. Fairly high numbers of red-breasted mergansers (0.5%) were recorded during the December 2000 survey and fairly high numbers of common eider (0.8%) and velvet scoter (0.8%) were recorded during the incomplete survey of 4 December 2003. A high number of little gulls was recorded on 4 and 5 December 2003 (28, 75 respectively) and this has been the only winter in which any little gulls were recorded in the Firth of Forth (and similarly for the Firth of Tay).

The most important parts of the Firth of Forth for seabirds and divers appear to be the waters close inshore to the north and south coasts, particularly Largo Bay and the area of Gullane, Aberlady and Gosford Bays. Despite similarities in species composition and distribution, the numbers recorded have varied greatly during surveys, particularly for velvet scoters, which were recorded in much smaller numbers in 2003/04 and 2004/05 than in previous winters.

Table 17. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the Firth of Forth from 2000 - 2005. * denotes incomplete survey.

Date	03 Feb 2005	12 Dec 2004	16 Feb 2004	5 Dec 2003	4 Dec 2003*	26 Feb 2002	14 Dec 2001	15 Feb 2001	21-22 Dec 2000
Total km surveyed	315	321	309	380	136	359	359	309	394
Red-throated diver	7	57	14	10	4	16	12	3	14
Great northern diver	0	0	0	0	0	0	0	1	0
Diver sp.	0	1	1	0	3	0	1	0	0
Common eider	1182	2033	2419	1331	583	1582	2270	2267	4565
Long-tailed duck	52	236	142	62	54	48	64	45	19
Common scoter	70	34	718	24	104	379	2557	816	841
Velvet scoter	58	13	13	13	25	132	196	308	430
Scoter sp.	16	20	41	33	20	129	276	90	358
Red-breasted merganser	21	105	28	12	14	34	22	17	53

8.1.8 West coast of the Outer Hebrides

2004/05 surveys

A complete survey of the west coast of the Outer Hebrides was carried out 7 - 8 of March 2003. Nationally significant numbers of great-northern divers (57, 1.9%) were recorded, along with high numbers of common eider (621, 0.9%) (Table 6). Birds were dispersed along the coast, but common eiders were particularly aggregated east of Berneray and west of Eriskay (Figures A1.41-A1.43).

Previous surveys

Two previous surveys have been carried out along the coast of the Outer Hebrides during March 2003 and February 2004 (Table 18). Nationally significant numbers of great-northern divers were recorded in both surveys (3.4% and 8.9% during 2003 and 2004 respectively). Common eiders were recorded in fairly high numbers (0.9%) during the March 2003 survey and high numbers (1.5%) during the February 2004 survey. Long-tailed ducks were recorded in high numbers (183, 1.1%) during the March 2003 survey and fairly high numbers (84, 0.5%) during the February 2004. The most important sub-areas within the survey area were the Sounds of Harris, Monach and Barra, and the waters to the east of Berneray during February 2004 and the Sound of Barra and around Berneray during March 2003.

Table 18. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the west coast of the Outer Hebrides from 2003 - 2005.

Date	7-8 Mar 2005	17 Feb 2004	18 Mar 2003
Total km surveyed	651	514	459
Red-throated diver	0	13	0
Black-throated diver	0	0	0
Great northern diver	57	266	102
Diver sp.	1	0	12
Common eider	621	1078	634
Long-tailed duck	54	84	183
Common scoter	0	0	0
Red-breasted merganser	8	26	10

8.1.9 Coll and Tiree

2004/05 surveys

One survey was carried out around the waters of Coll and Tiree on 26 March 2005 (Table 6). Nationally significant numbers of great northern divers (131, 4.4%) were recorded, mainly around and west of Tiree, with a particularly concentrated number in the shallow waters to the south west of Tiree (Figure A1.44). Only low numbers of common eider (220, 0.3%) were recorded, and these were mainly close inshore to Tiree (Figure A1.45).

Previous surveys

Only one previous survey has been carried out (18 February 2004, Table 19). This recorded a nationally important number of great northern divers (175, 5.8%), which were distributed around both islands, and fairly high numbers of common eider (496, 0.7%), which were mainly distributed around Tiree.

Table 19. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of Coll and Tiree from 2004 - 2005.

Date	26 Mar 2005	18 Feb 2004
Total km surveyed	530	416
Red-throated diver	2	0
Great northern diver	131	175
Diver sp.	0	1
Common eider	220	496
Long-tailed duck	17	61
Red-breasted merganser	4	11

8.1.10 West coast of Mull

2004/05 surveys

One survey off the west coast of Mull was carried out on the 25 March 2005 and this recorded high numbers of great northern divers (27, 10.9%), but only low numbers of common eider (67, <0.1%) (Table 6). Great-northern divers, common eider and long-tailed duck were mainly distributed in the northern half of the survey area (Figures A1.44 – A1.46).

Previous surveys

Only one previous survey of the west coast of Mull has been carried out, during February 2004, but this did not survey the area as far south as the one covered in March 2005 (Table 20). Fairly high numbers of great northern divers (16) were recorded, but few other birds were recorded. This was probably due to the extreme sun glare and failing light during the survey.

Table 20. Total length of transects surveyed and count data for some of the species recorded in aerial surveys of the west coast of Mull from 2004 - 2005. * denotes incomplete survey.

Date	25 Mar 2005	18 Feb 2004*
Total km surveyed	218	138
Red-throated diver	1	0
Diver sp.	0	1
Great northern diver	27	16
Common eider	67	19
Long-tailed duck	1	11
Red-breasted merganser	1	0

8.1.11 Sound of Gigha

2004/05 surveys

This was the first winter that the Sound of Gigha had been surveyed. A single survey conducted on the 9 March 2005 recorded nationally important numbers of great-northern divers (104, 3.5%), which were dispersed around the coast of Kintyre, and fairly high numbers of common eider (335, 0.5%) (Table 6, Figure A1.47). Common eiders were also dispersed along the coast of Kintyre, but had aggregations around the north and south ends of the Isle of Gigha (Figure 1.48).

8.2 Importance of Aberdeen Bay for species recorded during shore-based counts

In contrast to the sample counts obtained from aerial surveys, the shore-based counts are intended to represent total numbers of birds present within the survey area. However, it is possible that a small proportion of the total numbers of some species present within the survey area were not detected during the counts because they were in locations that were obscured by the coastline.

In addition, the maximum offshore extent of the survey area was limited by the maximum distance offshore that birds could be viewed; approximately 2km. For this reason, and after consideration of the distributions observed during aerial surveys, it is also possible that a small proportion of the total numbers of some species wintering within Aberdeen Bay may have been located outwith the survey area.

For the purposes of this report, count data from shore-based surveys conducted during summer months (June and August 2004, and May 2005) are presented in Table 8, but are not discussed further here. Count data from the surveys conducted during winter months (September - December 2004), are compared to the GB wintering population for each species.

Red-throated divers were recorded in nationally important numbers ($\geq 1\%$ of the GB wintering population; (Table 9) during the shore-based counts of the Aberdeen Bay area conducted in October (118), November (69) and December (129) 2004 (Table 8). For red-throated divers, the most important sub-area within Aberdeen Bay was section six, from Newburgh Bar to Rockend (Figures A2.1, A2.4, A2.8, A2.12, A2.17 and A2.22). It should be noted that the count sub-sections were of variable length and therefore counts are not comparable between sub-sections. However, in section six alone, red-throated divers were recorded in nationally important numbers in October (59; Figure A2.8), and December 2004 (80; Figure A2.17).

Common eiders and common scoters were recorded in fairly high numbers during October and December 2004, while high numbers of common scoters were recorded in November 2004. Long-tailed ducks and red-breasted mergansers were only recorded in small numbers during the October, November and December 2004 counts. Wigeon were recorded only during the November 2004 survey, with a total of count of 130 birds. Only 1 black-throated diver was recorded (June 2004).

8.3 Comparison of shore-based counts with aerial survey data for Aberdeen Bay

December 2004 was the only month in which both an aerial survey and a shore-based count were conducted in Aberdeen Bay. The two surveys were conducted within twenty days of each other; the aerial survey was conducted on 11 December and the shore-based count was conducted on 31 December.

It is difficult to draw any meaningful conclusions based on this single comparison. Furthermore, the extents of the areas covered by each type of survey were different; the aerial surveys covered Bay of Cruden in the north, and extended approximately 10 km offshore (Figures 4 and 5), whereas the shore-based counts did not cover Bay of Cruden, and only extended approximately 2 km offshore (Figure 14).

The same species (red-throated diver, common eider, long-tailed duck, common scoter and red-breasted merganser) were recorded using both methods. In addition, one velvet scoter and 15 shelduck were recorded during the aerial surveys, but none were recorded during the shore-based counts.

As expected, the shore-based count (intended as a total count of all inshore waterbirds within the survey area) was higher than the aerial survey sample count (which records only a sample of all inshore waterbirds in the survey area) for all species recorded (Figure 15). The two methods also differed in the proportions contributed by each species to the total number of birds recorded, with the aerial surveys recording a higher proportion of red-throated diver, shelduck and long-tailed duck, and a lower proportion of common scoter compared to the shore-based counts (Figure 15). This is most likely due to differences in the distributions of these species. For example, red-throated divers may be dispersed over large areas, and long-tailed ducks are usually dispersed well offshore (Pollitt *et al.* 2003), thus being less likely to be detected by shore-based counts. A chi-squared test can be used to compare the frequencies of red-throated diver, eider and common scoter (but not the other species, as their low sample sizes produce observed frequencies of less than 5, see Fowler & Cohen (1990)). This shows that the two methods differ significantly in the proportions of each species recorded ($\chi^2=10.20$, $P<0.01$, 2df).

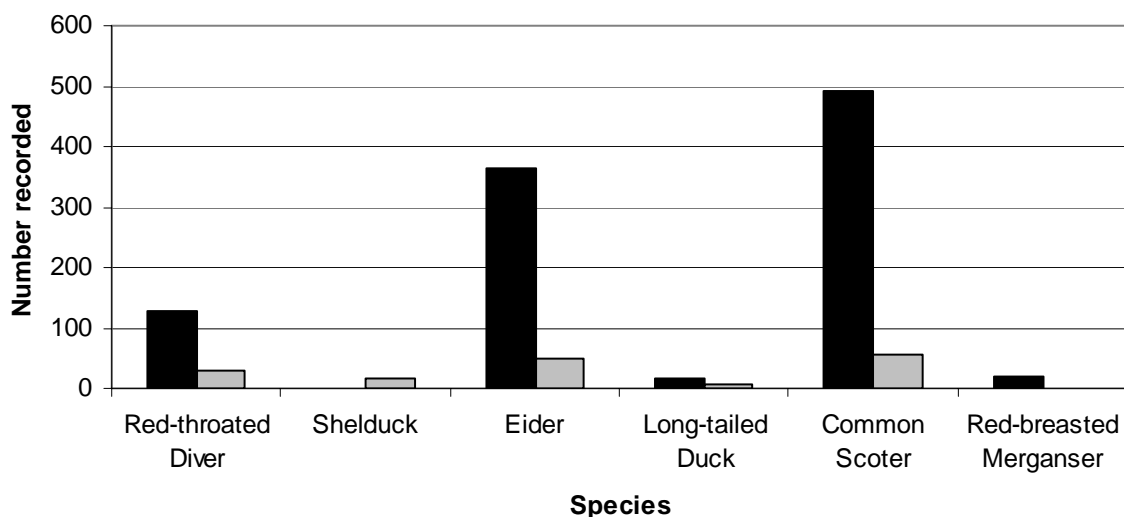


Figure 15. Comparison of the total numbers of each species recorded by the shore-based count (SBC, black bars) with the raw sample counts recorded by the aerial survey (AS, grey bars), December 2004.

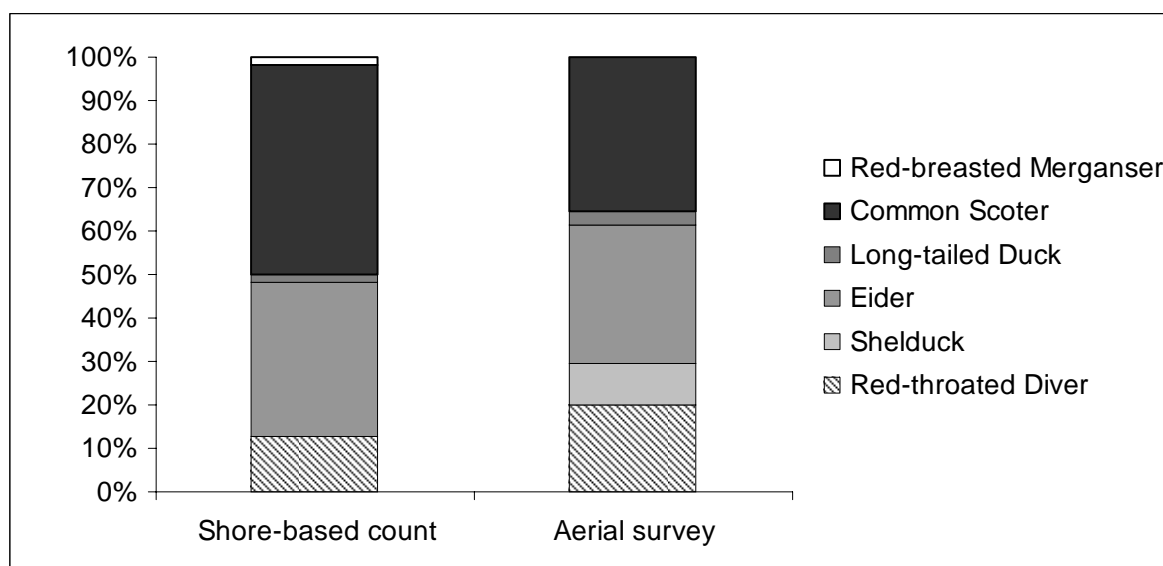


Figure 16. Comparison of the percentages contributed by each species to the total number of birds recorded, for the shore-based count and the aerial survey, December 2004.

8.4 Species not adequately surveyed

The following target species were not recorded during these and previous line-transect aerial surveys; great crested grebe, red-necked grebe and Slavonian grebe (Dean *et al.* 2003; Dean *et al.* 2004a and b). Based on land based counts, records of Slavonian grebes might have been expected from Scapa Flow and the Moray Firth, while red-necked grebes might have been expected in Scapa Flow (Pollitt *et al.* 2003). All three grebe species have also been recorded in large numbers in the Forth estuary from land based counts, but the Firth of Forth aerial survey does not cover this area. It is likely that grebe species were not recorded because they are not easily counted by aerial surveys, due to their tendency to be distributed close to shore, where they may be missed as the aircraft turns at the beginning and end of transects. In addition, the small wintering numbers of these species in the UK (Stone *et al.* 1997) reduces the likelihood of them being recorded using aerial surveys. Land-based counts or boat-based surveys may be more suitable methods for monitoring these species (Dean *et al.* 2003, 2004a and 2004b).

This was the first winter since 2000/2001 that aerial surveys recorded greater scaup (one aggregation of 70 birds in the Inverness Firth, during March). In land-based surveys, scaup are normally found in single, very dense flocks within 50 meters of the shore (A. Webb, *pers. obs.*). The probability of missing such flocks is likely to be quite high and consideration should be given to other survey methods for monitoring scaup populations. Land-based counts are likely to prove the most successful method, given the tendency for scaup to be distributed close inshore, as discussed by Dean (2003).

It is vital that adequate monitoring of those species and types of area for which line-transect and/or aerial survey methods are not suitable be included within any comprehensive inshore waterbird monitoring programme. As more aerial surveys are carried out, it should be

increasingly possible to make a rigorous assessment of these species and types of area and to develop appropriate additional surveillance techniques, if or when needed.

2003/04 was the first winter in which little gulls were recorded during aerial surveys. During the 2004/05 survey only 5 little gulls were recorded (compared to 120 in 2003/04). These surveys were designed and conducted to record seabirds, divers and grebes; prior to 2003/04, little gulls were neither targeted nor recorded (although they were probably present in the Firth of Tay/ St Andrews Bay and the Firth of Forth). The main reasons for beginning to record little gulls during the 2003/04 winter were that; (i) this was the first winter in which observers became sufficiently confident and experienced in detecting and identifying this species from aircraft; and (ii) on 1 May 2004, little gull was to be added to Annex 1 of the Birds Directive following the enlargement of the EU in February 2003 (European Economic Community 2003). On the basis of the 2003/04 JNCC and WWT aerial surveys, it appears that the method is suitable for collecting data on the numbers and distribution of little gulls wintering in inshore areas. However, based on the numbers recorded by the 2003/04 surveys, the most recent GB wintering population estimate of 300-700 (Lack 1986) may now prove to be a significant underestimate. This population estimate has been deemed inadequate by the Avian Population Estimates Panel (APEP; Baker *et al.* in press) because it is based on a small part of the population only.

8.5 Further analyses

The line-transect sample count data for the 2004/05 aerial surveys (the totals of which are presented in Tables 4 - 7) are suitable for distance sampling analyses (Buckland *et al.* 2001) to estimate total population sizes within each survey area.

The distribution data collected during the aerial surveys and presented as distribution maps in Appendix 1 (Figures A1.1 – A1.48), offer a good initial representation of the local diurnal distributions of the important species recorded within each survey area. In addition, these data have a high spatial precision and may be suitable for geostatistical interpolation (Cressie 1991) depending on their spatial (autocorrelative) structure. Geostatistical interpolation is capable of building fine-scale models of density (hence providing further estimates of population size) or presence/absence distributions (McSorley *et al.* 2005; Webb *et al.* 2004; Webb *et al.* in prep).

8.6 Conclusions

The 2004/05 surveys were successful in collecting data on the numbers and distribution of wintering inshore waterbirds in all of the core sites of the JNCC monitoring programme (Dornoch Firth, Moray Firth, Firth of Tay and St Andrews Bay, and the Firth of Forth), plus further important coastal areas (Scapa Flow, Aberdeen Bay, the west coast of the Outer Hebrides, Coll and Tiree, Sound of Gigha and the west coast of Mull). The 2004/05 monitoring programme also included shore-based counts of inshore waterbirds in Aberdeen Bay. Remaining gaps in species coverage and in other important coastal areas will be addressed by further aerial surveys over subsequent winters, and these will be complemented by additional shore-based and boat-based surveys for some species and areas.

Within the survey areas covered by these surveys, several sub-areas were particularly important for those waterbird species recorded, namely the coastline between Nairn and Lossiemouth in the Moray Firth, the inshore parts of St Andrews Bay, north into the mouth of the Firth of Tay, the inshore parts of the Firth of Forth, east of Berneray and west of Eriskay in the Outer Hebrides and the waters around Tiree. Repeat surveys of these areas in future years, allied to analyses to estimate the total numbers and density distributions or presence absence within the areas, should confirm their importance for inshore waterbirds.

9. ACKNOWLEDGEMENTS

The success of these surveys was due to the hard work and co-operation of those involved. Many thanks therefore to: Richard Schofield and Mark Lewis, who were the trained observers during these surveys; GeminAir for providing a pilot and aircraft at economical rates; and the pilot David McFerran for making the best use of the unpredictable winter weather, handling air traffic control and flying the surveys with the best possible precision and safety. Thanks to the Station Commanders at RAF Lossiemouth, RAF Kinloss, RAF Leuchars, and the Range Controller at Barry Buddon Range, for access into their airspace. Thanks also to the various Air Traffic Controllers who provided us with assistance.

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Appendix 1. Species distribution maps based on results of aerial surveys 2004/05.

Scapa Flow Survey, 7 March 2005

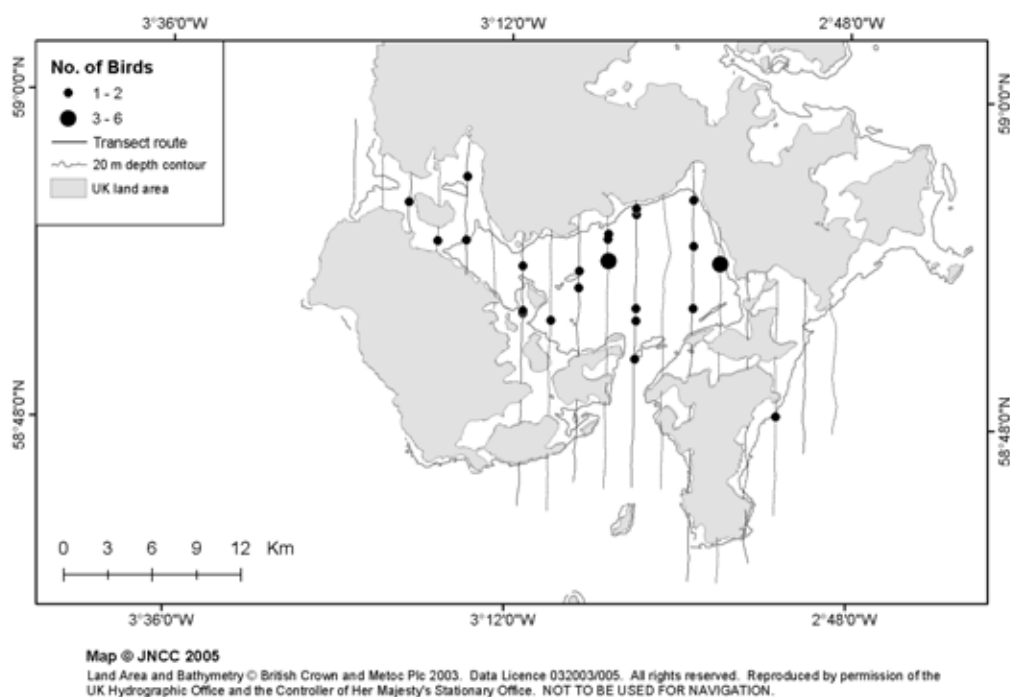


Figure A1.1. Distribution of great northern divers recorded in Scapa Flow on 7 March 2005.

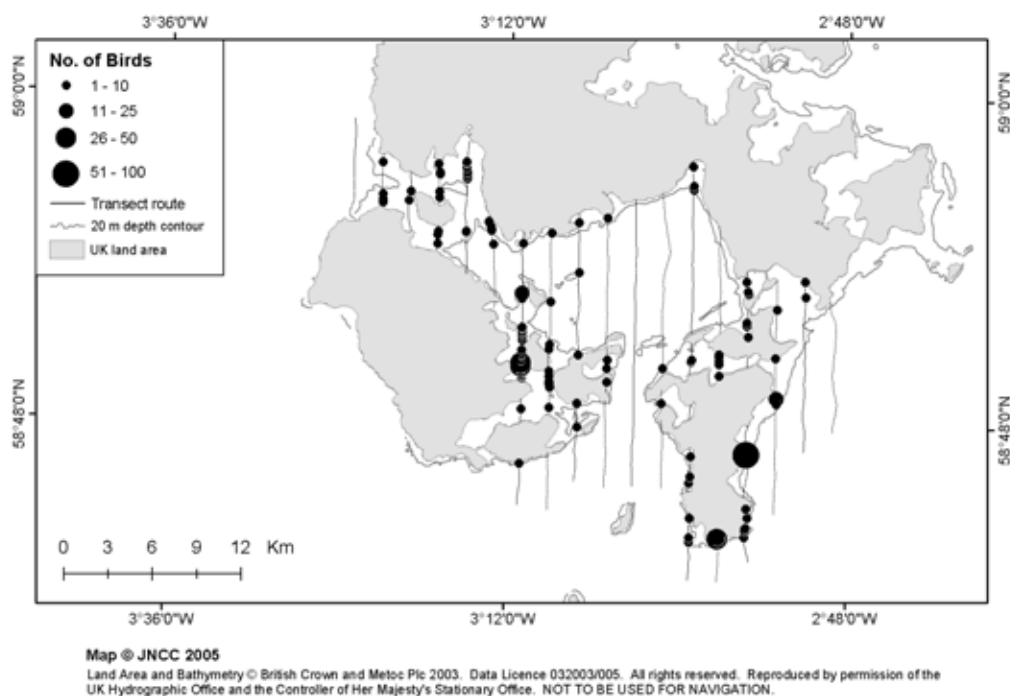


Figure A1.2. Distribution of common eiders recorded in Scapa Flow on 7 March 2005.

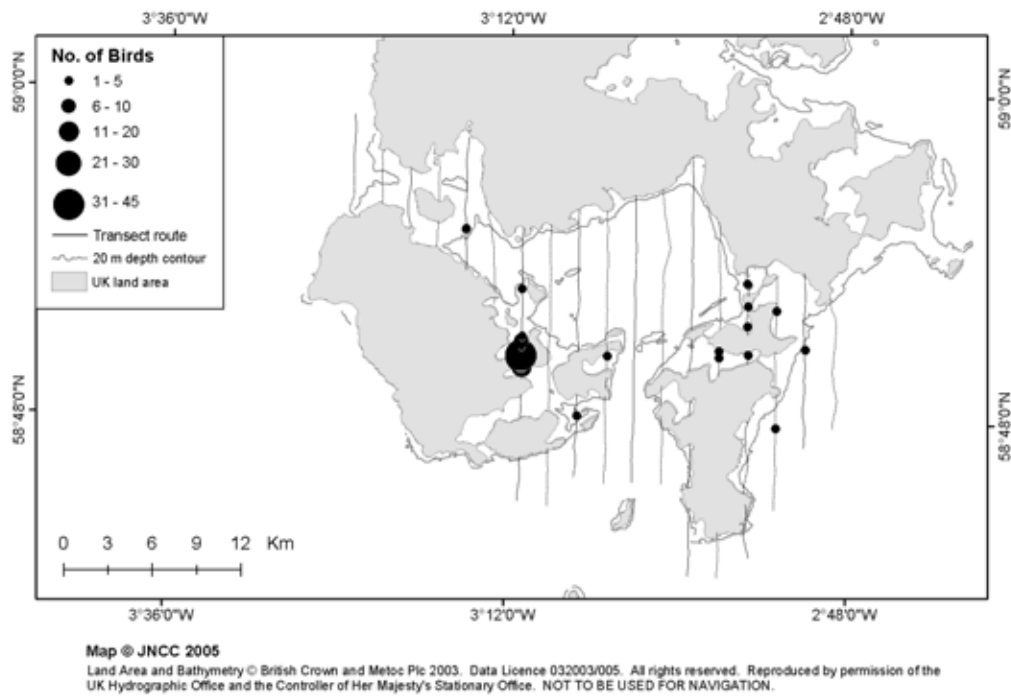


Figure A1.3. Distribution of long-tailed ducks recorded in Scapa Flow on 7 March 2005.

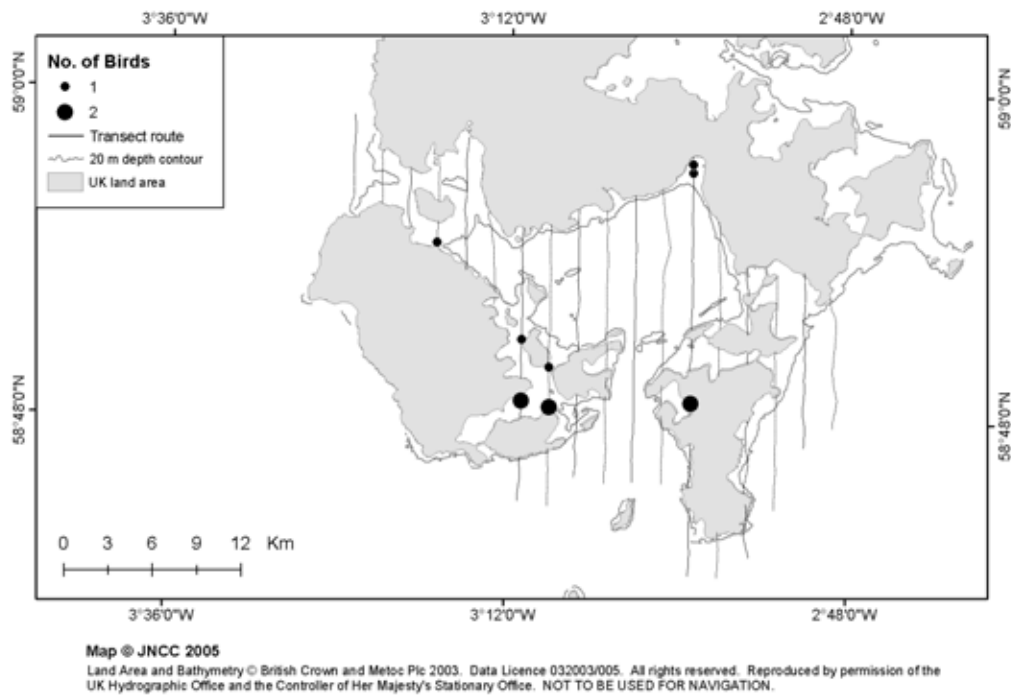


Figure A1.4. Distribution of red-breasted mergansers recorded in Scapa Flow on 7 March 2005.

Dornoch, Moray and Inverness Firths Survey, 6 March 2005

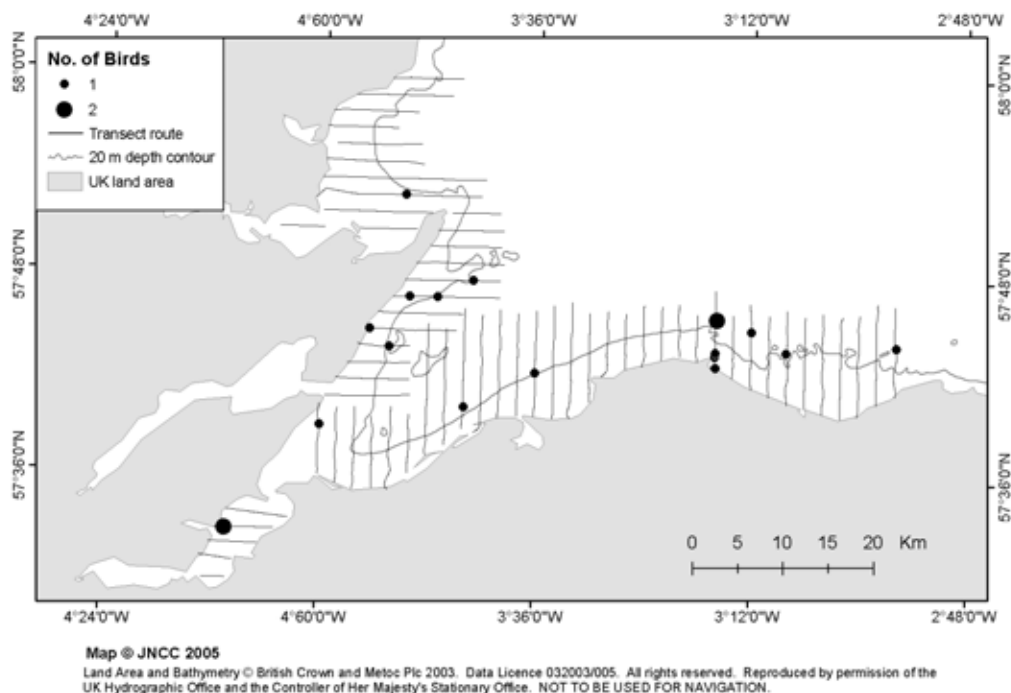


Figure A1.5. Distribution of red-throated divers recorded in the Dornoch, Moray and Inverness Firths on 6 March 2005.

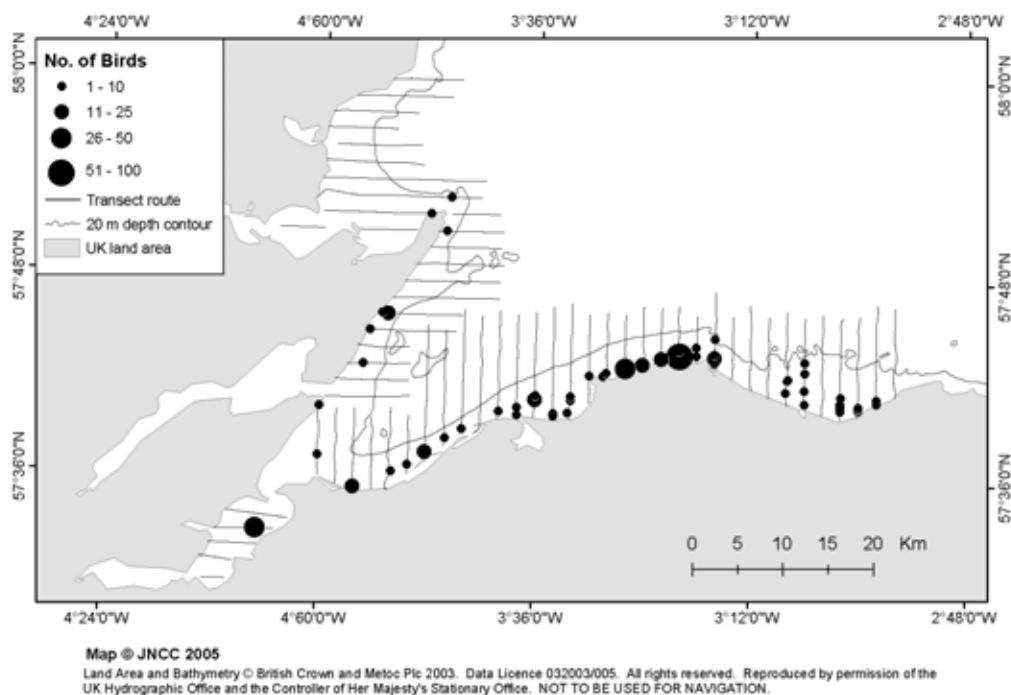


Figure A1.6. Distribution of common eiders recorded in the Dornoch, Moray and Inverness Firths on 6 March 2005.

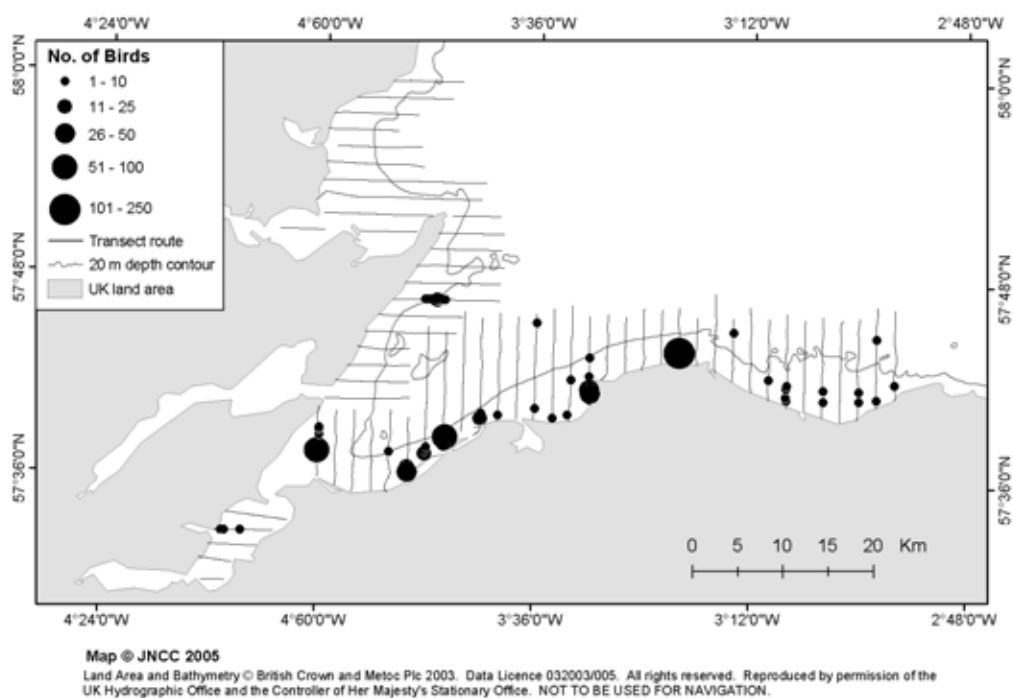


Figure A1.7. Distribution of long-tailed ducks recorded in the Dornoch, Moray and Inverness Firths on 6 March 2005.

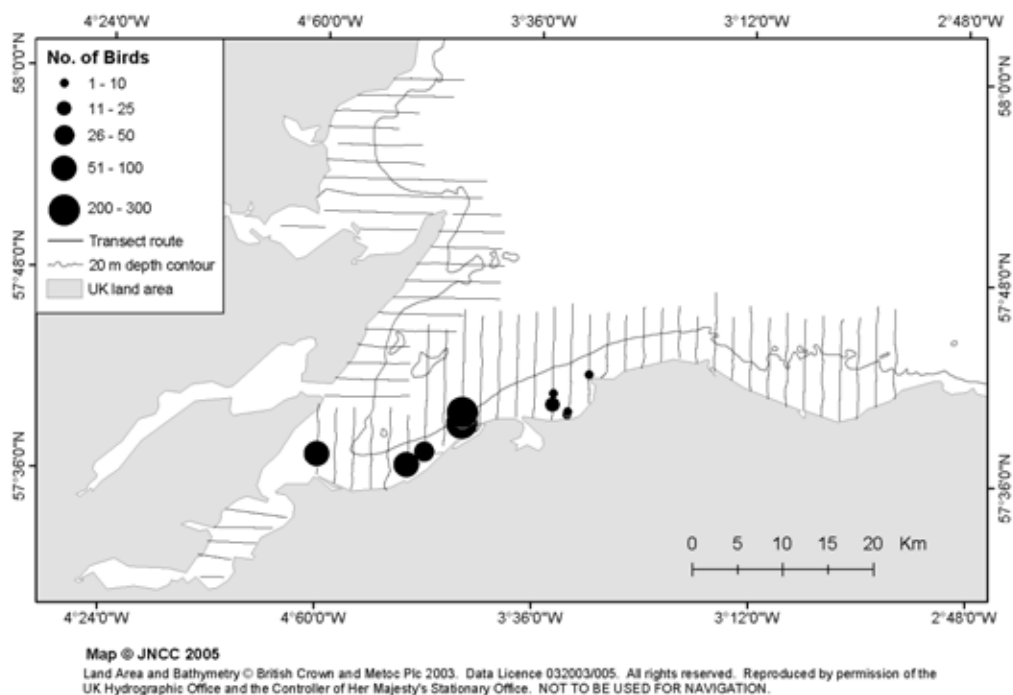


Figure A1.8. Distribution of common scoters recorded in the Dornoch, Moray and Inverness Firths on 6 March 2005.

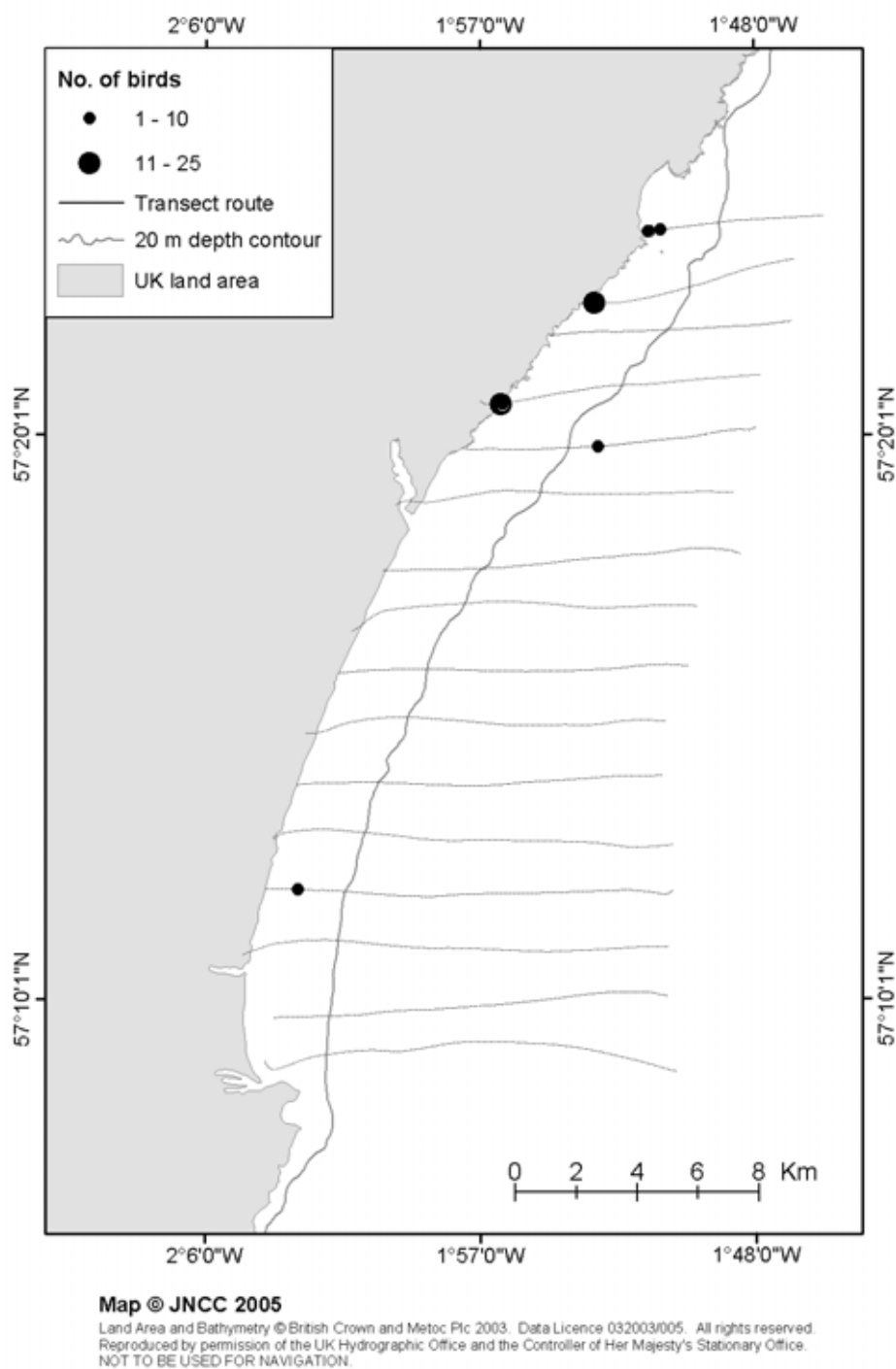


Figure A1.10. Distribution of common eider recorded in Aberdeen Bay on 11 December 2004.

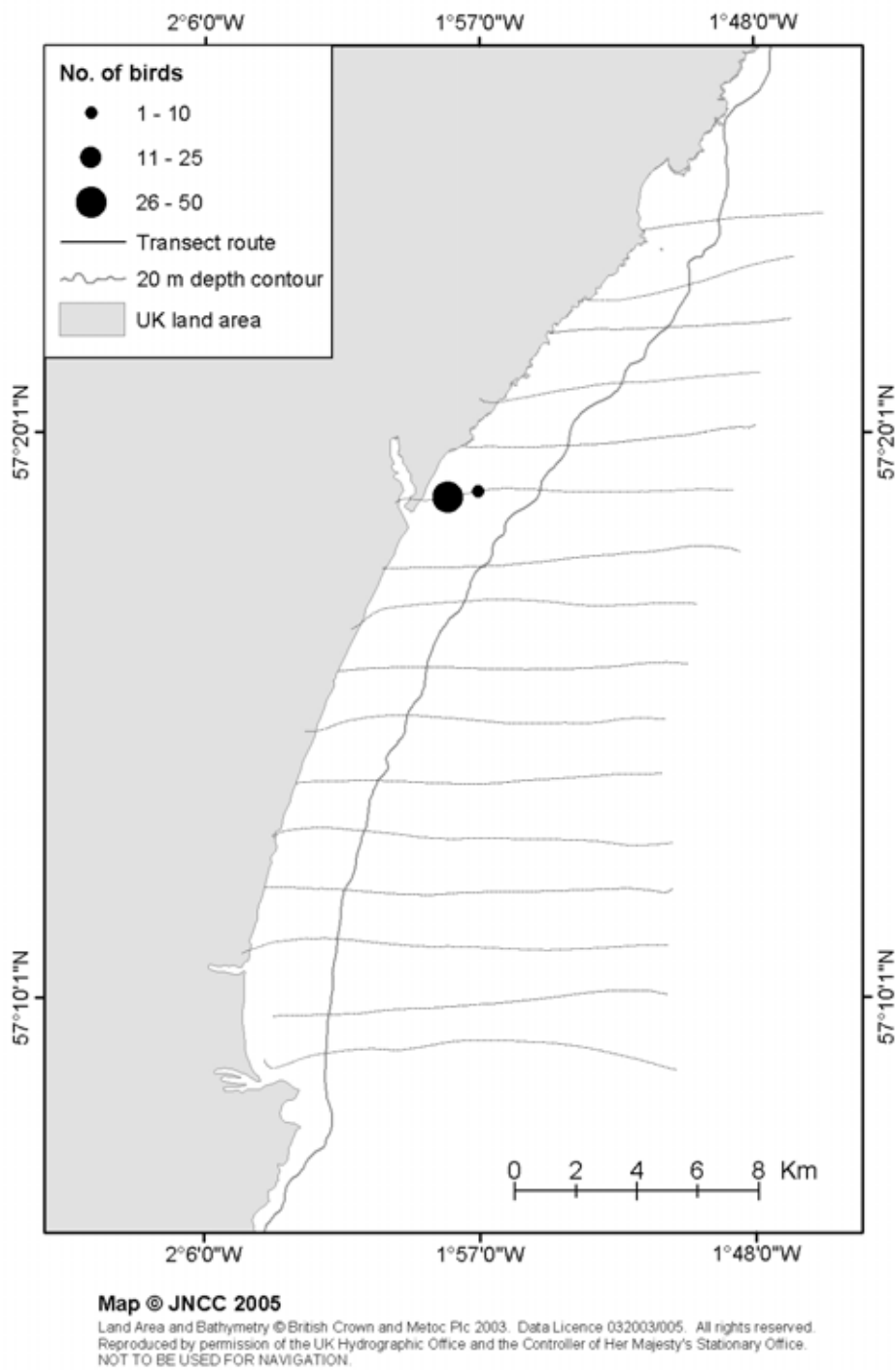


Figure A1.11. Distribution of common scoters recorded in Aberdeen Bay on 11 December 2004.

Aberdeen Bay Survey, 17 February 2005

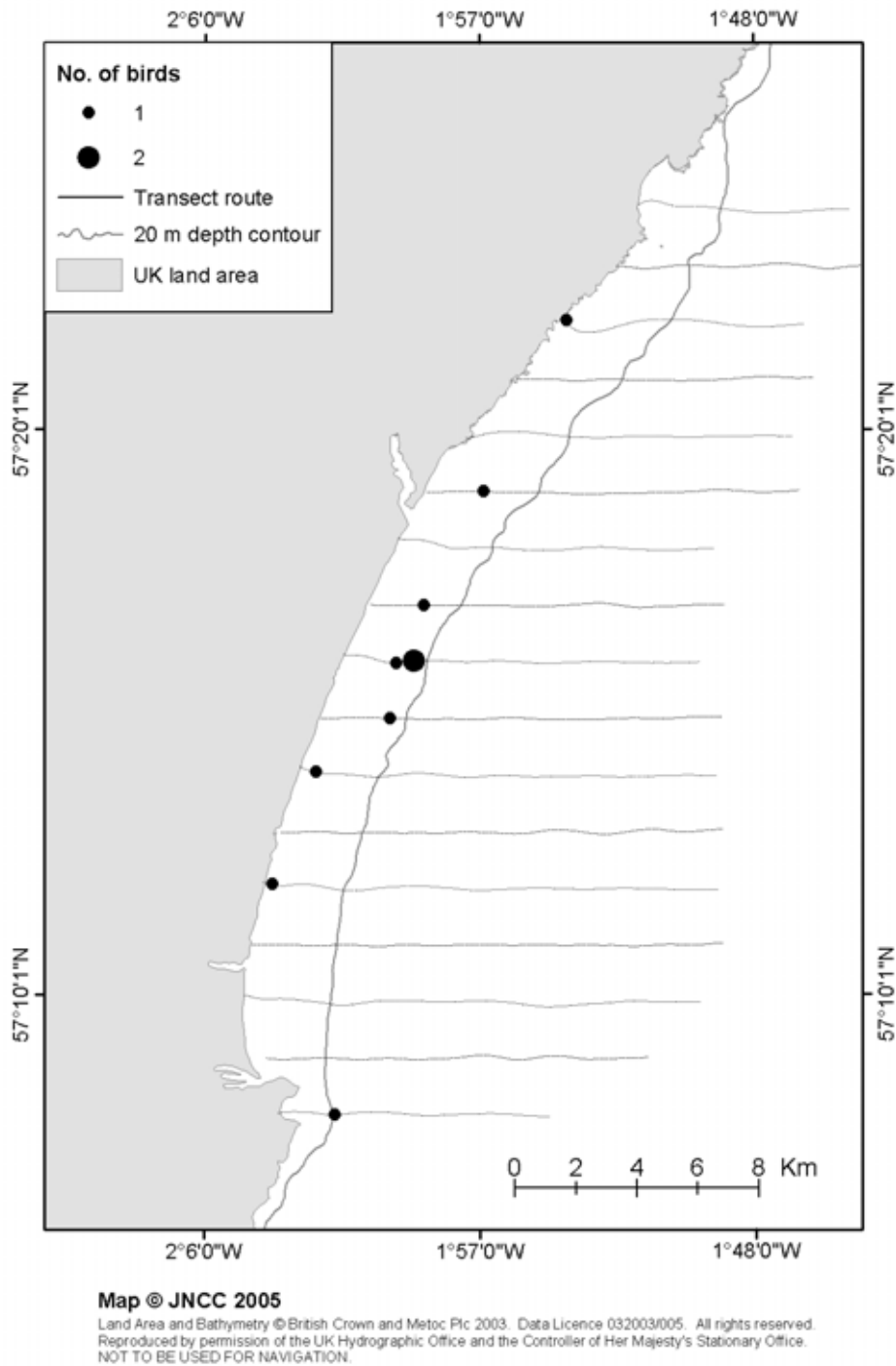


Figure A1.12. Distribution of red-throated divers recorded on Aberdeen Bay in 17 February 2005.

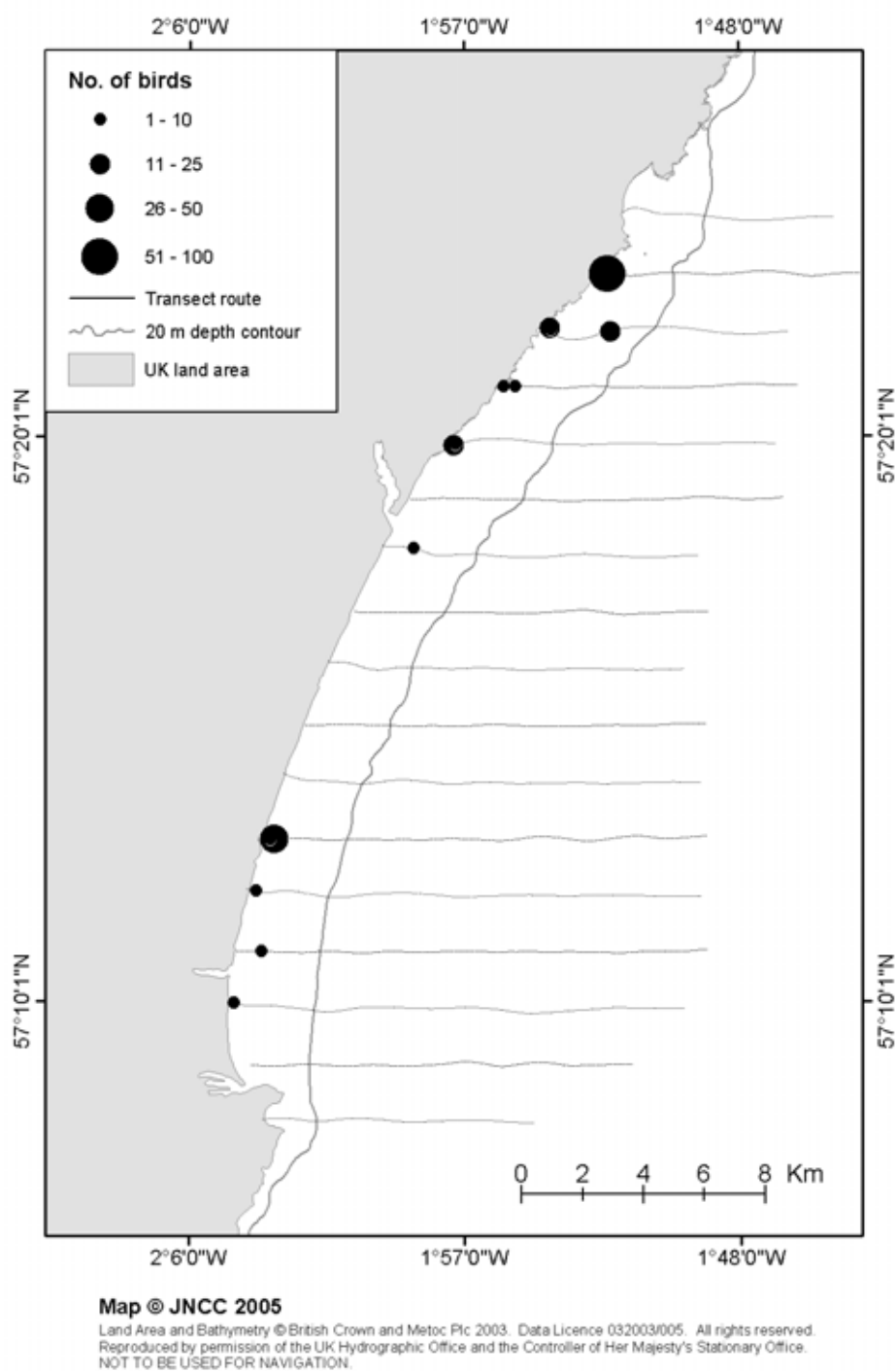


Figure A1.13. Distribution of common eiders recorded on Aberdeen Bay in 17 February 2005.

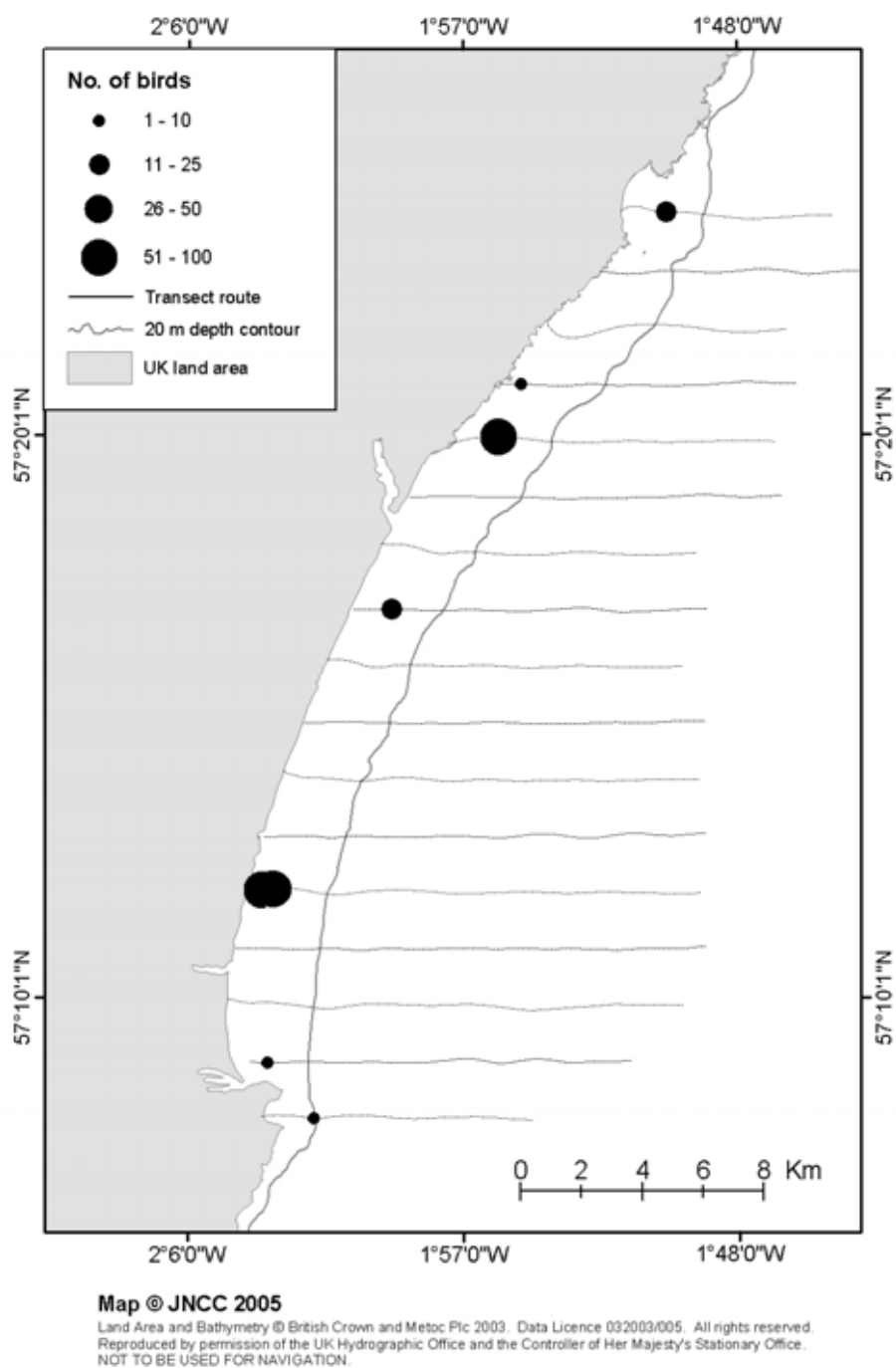


Figure A1.14. Distribution of common scoters recorded on Aberdeen Bay in 17 February 2005.

Firth of Tay and St Andrews Bay Survey, 12 December 2004

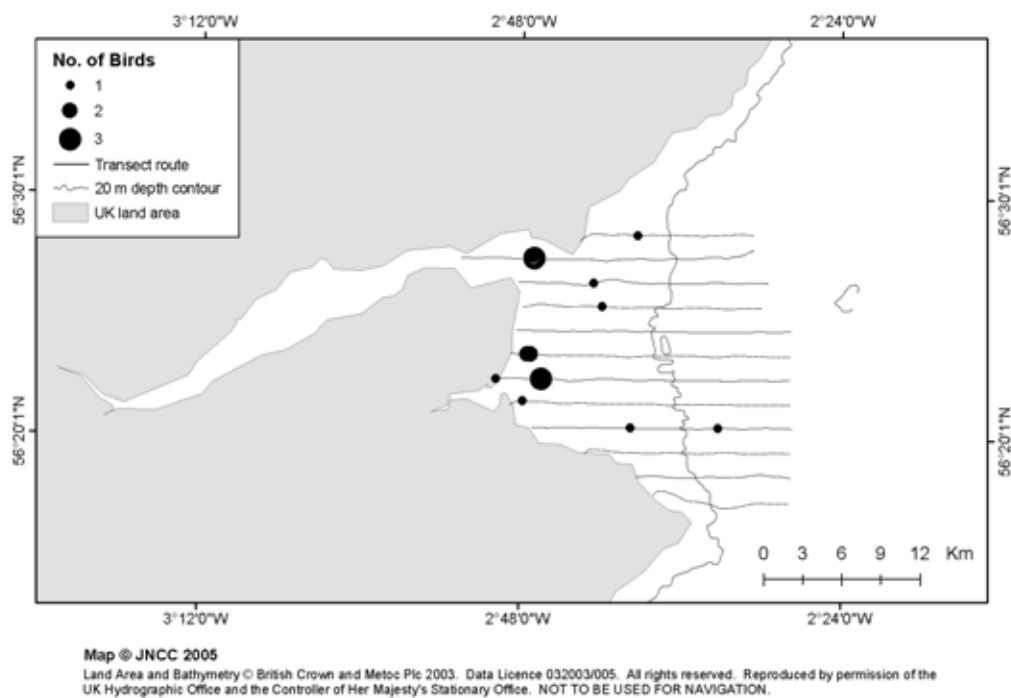


Figure A1.15. Distribution of red-throated divers recorded in the Firth of Tay and St Andrews Bay on 12 December 2004.

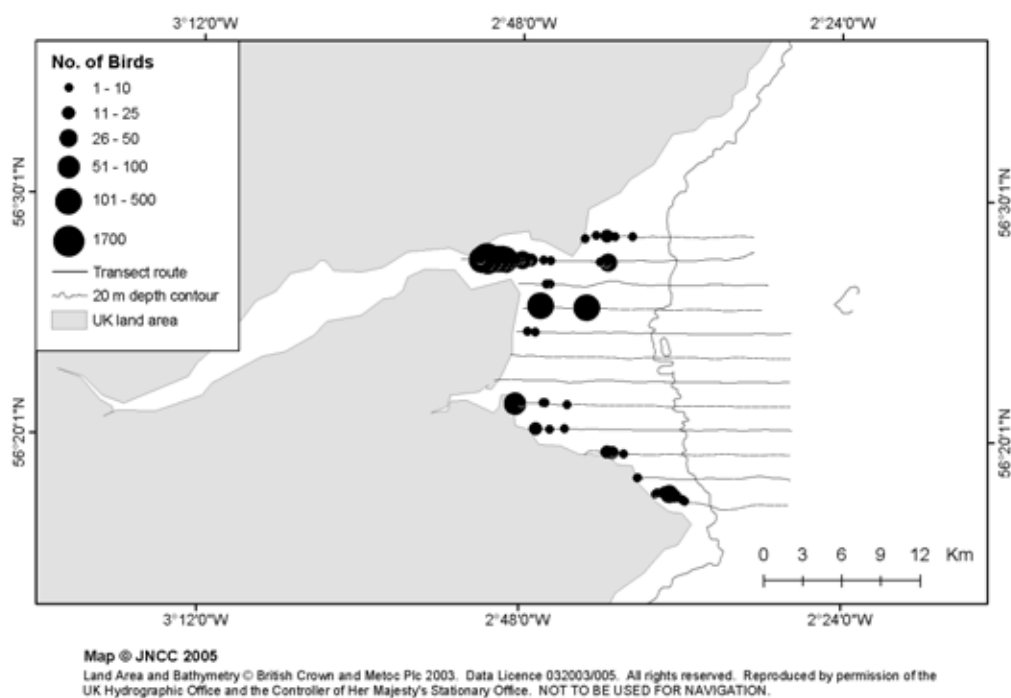


Figure A1.16. Distribution of common eiders recorded in the Firth of Tay and St Andrews Bay on 12 December 2004.

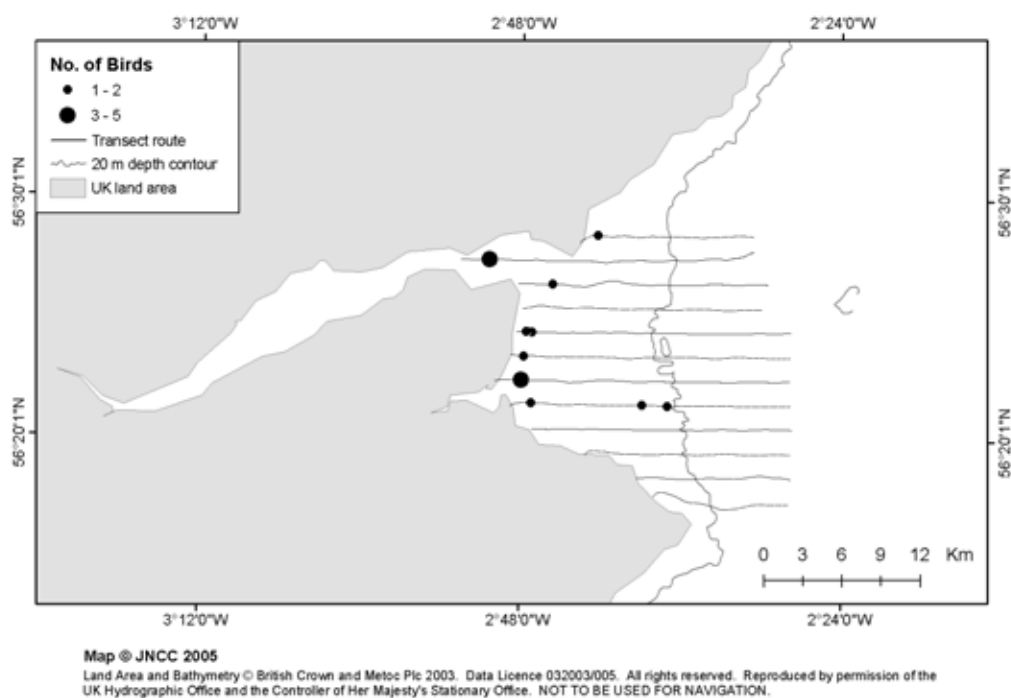


Figure A1.17. Distribution of long-tailed ducks recorded in the Firth of Tay and St Andrews Bay on 12 December 2004.

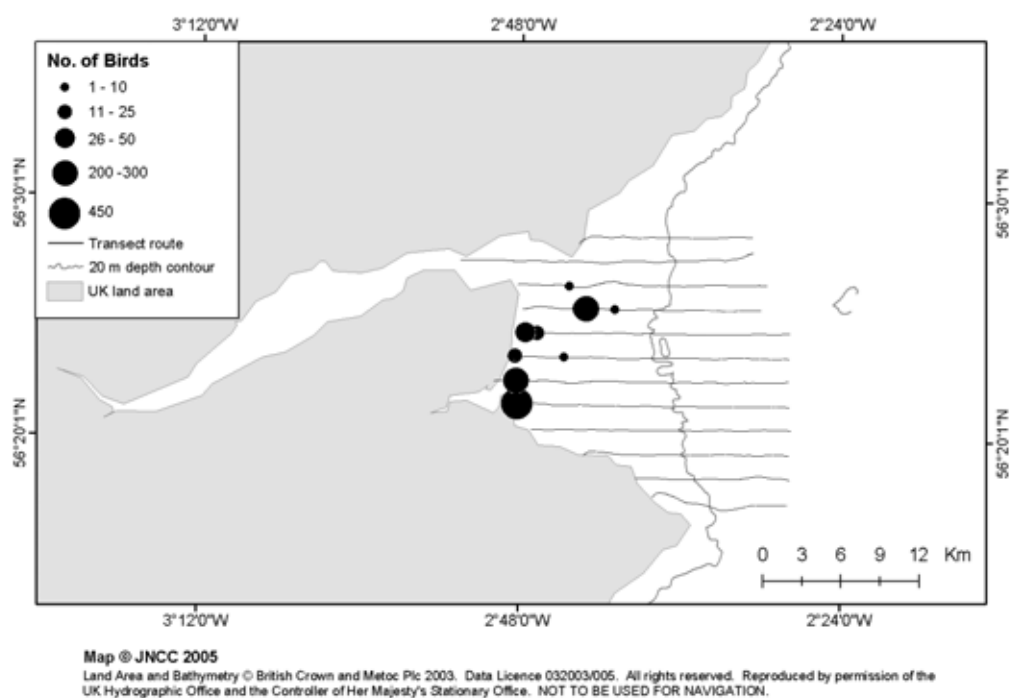


Figure A1.18. Distribution of common scoters recorded in the Firth of Tay and St Andrews Bay on 12 December 2004.

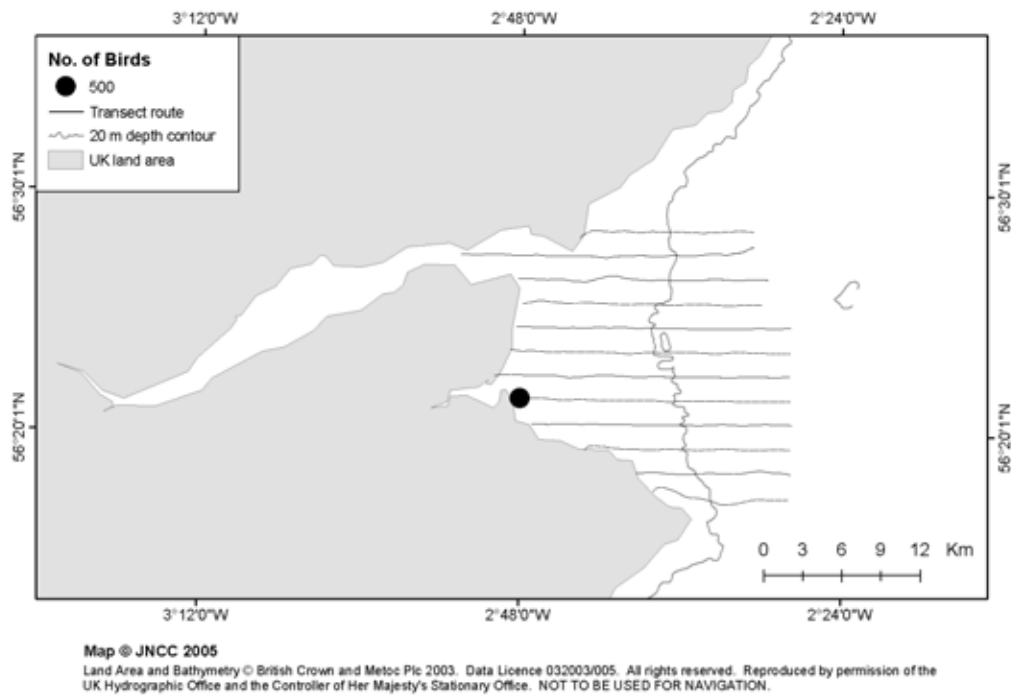


Figure A1.19. Distribution of unidentified scoters recorded in the Firth of Tay and St Andrews Bay on 12 December 2004.

Firth of Tay and St Andrews Bay Survey, 2 February 2005

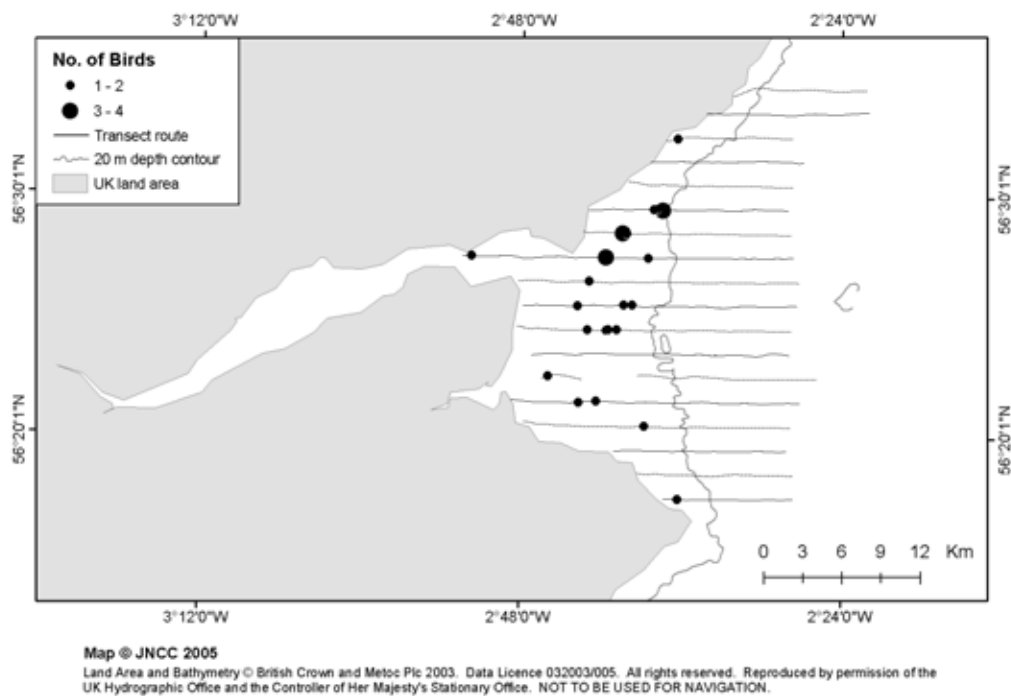


Figure A1.20. Distribution of red-throated divers recorded in the Firth of Tay and St Andrews Bay on 2 February 2005.

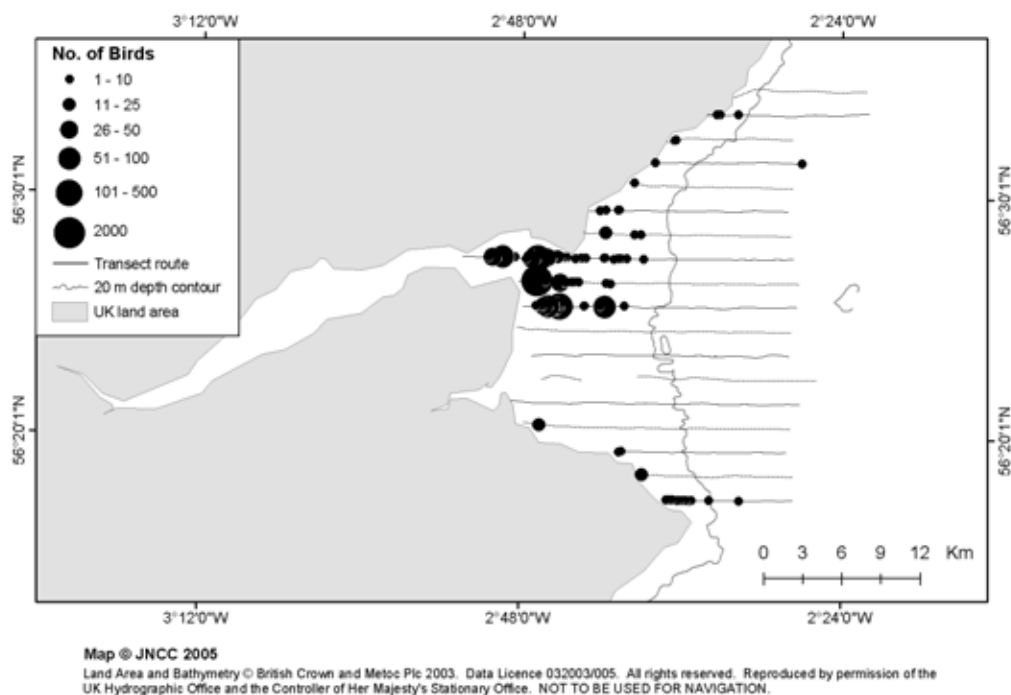


Figure A1.21. Distribution of eiders recorded in the Firth of Tay and St Andrews Bay on 2 February 2005.

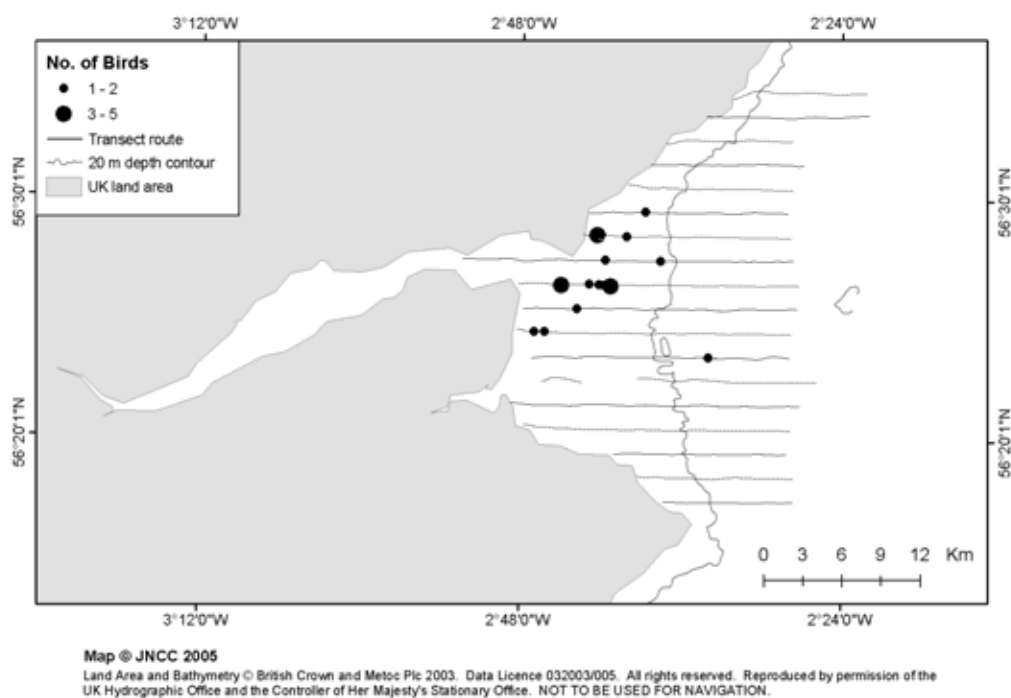


Figure A1.22. Distribution of long-tailed ducks recorded in the Firth of Tay and St Andrews Bay on 2 February 2005.

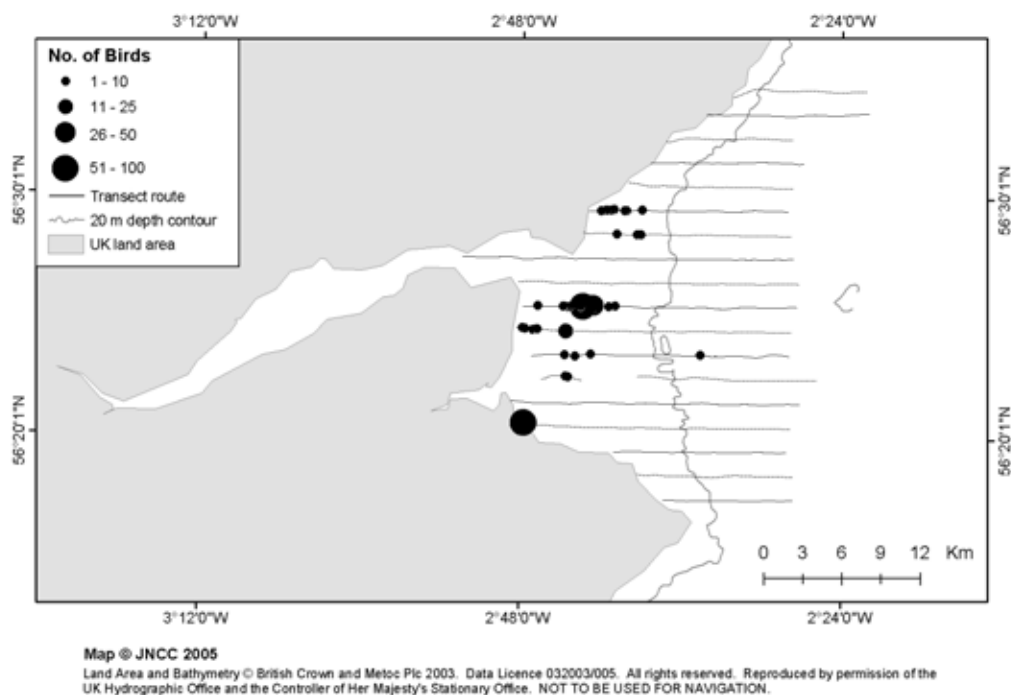


Figure A1.23. Distribution of common scoters recorded in the Firth of Tay and St Andrews Bay on 2 February 2005.

Firth of Tay and St Andrews Bay Survey, 18 March 2005

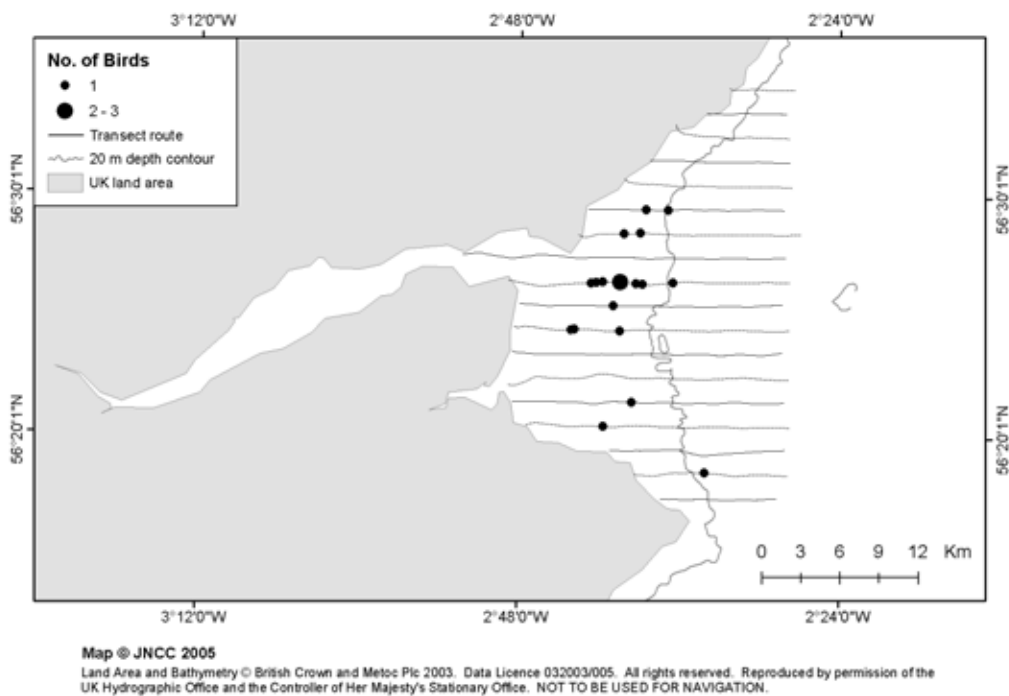


Figure A1.24. Distribution of red-throated divers recorded in the Firth of Tay and St Andrews Bay on 18 March 2005.

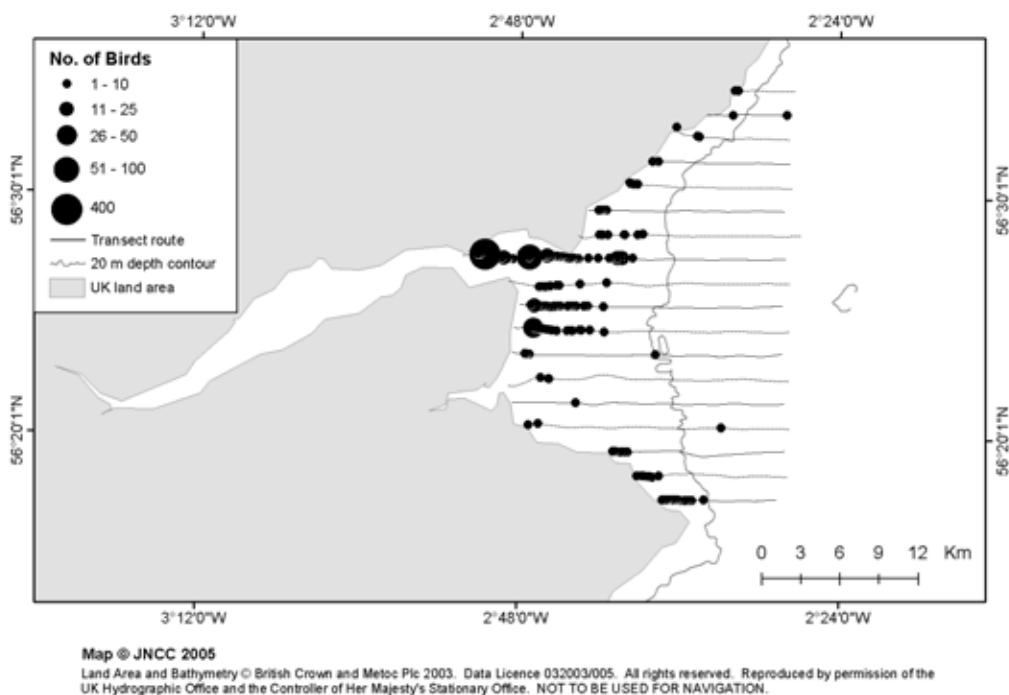


Figure A1.25. Distribution of eiders recorded in the Firth of Tay and St Andrews Bay on 18 March 2005.

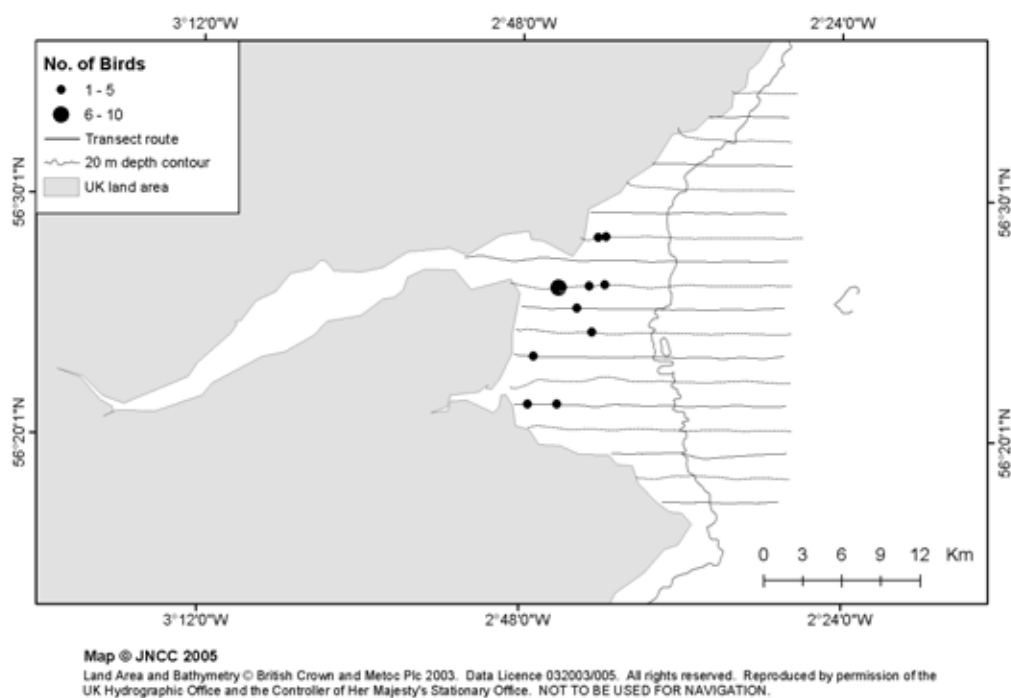


Figure A1.26. Distribution of long-tailed ducks recorded in the Firth of Tay and St Andrews Bay on 18 March 2005.

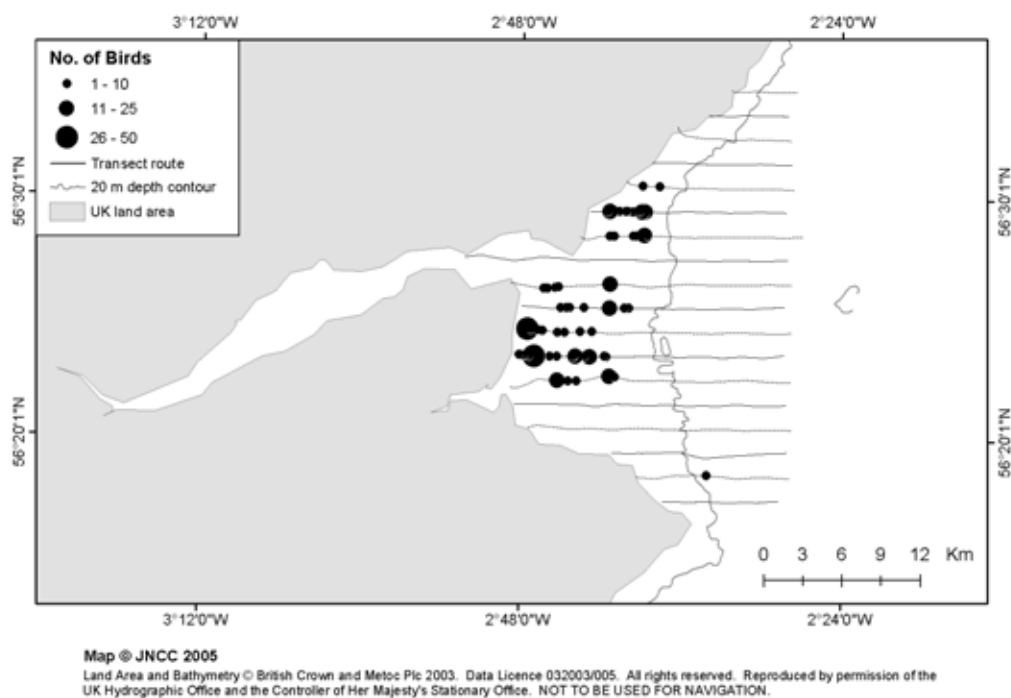


Figure A1.27. Distribution of common scoters recorded in the Firth of Tay and St Andrews Bay on 18 March 2005.

Firth of Forth Survey, 12 December 2004

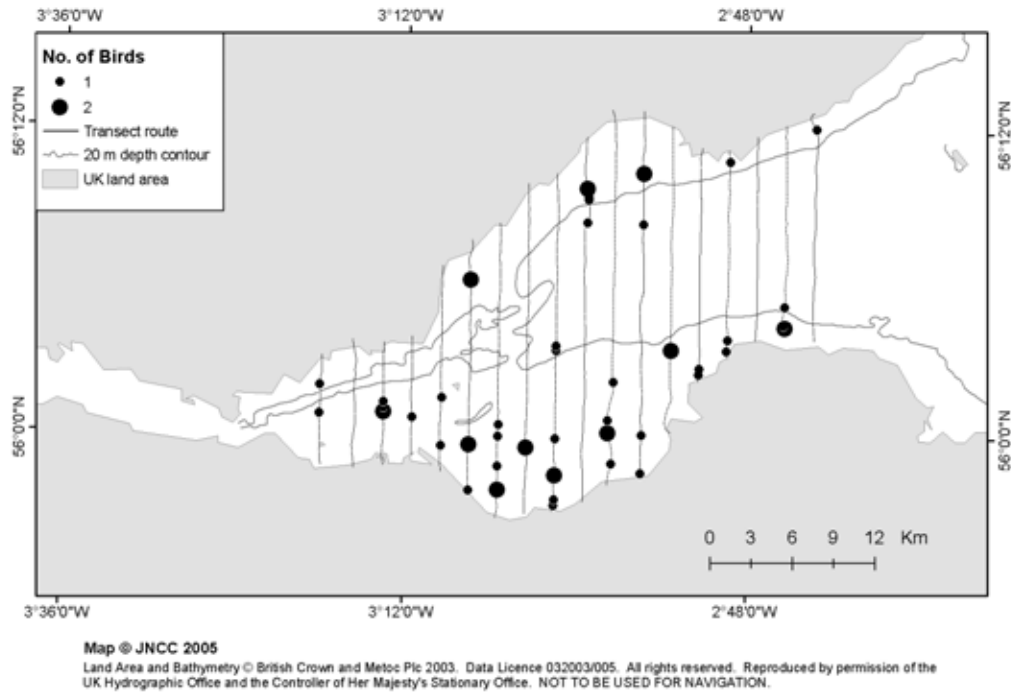


Figure A1.28. Distribution of red-throated divers recorded in the Firth of Forth on 12 December 2004.

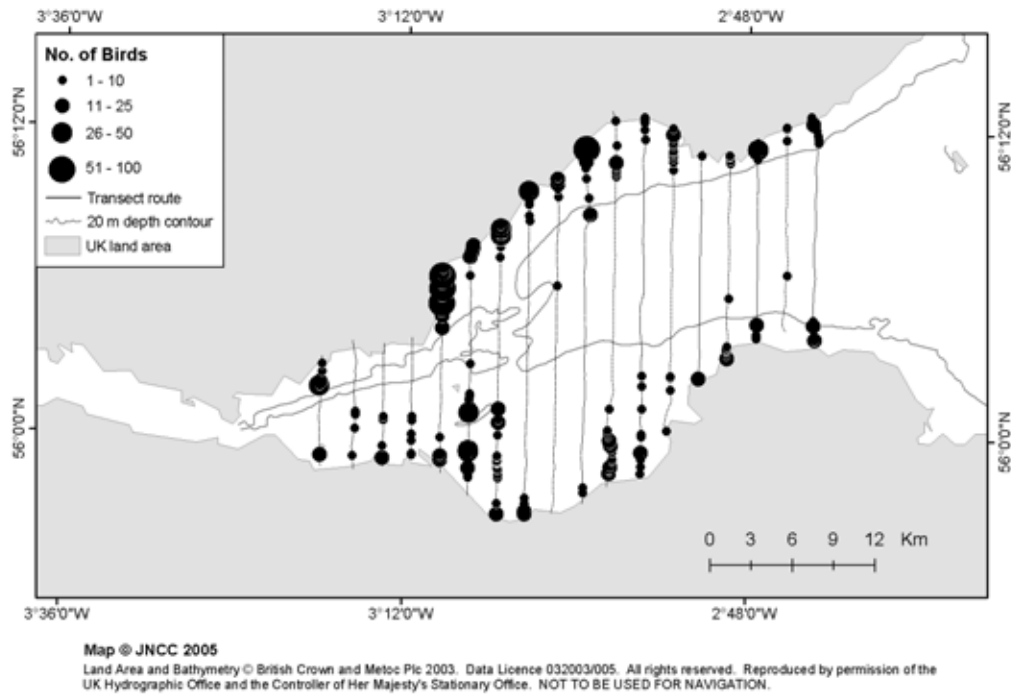


Figure A1.29. Distribution of eiders recorded in the Firth of Forth on 12 December 2004.

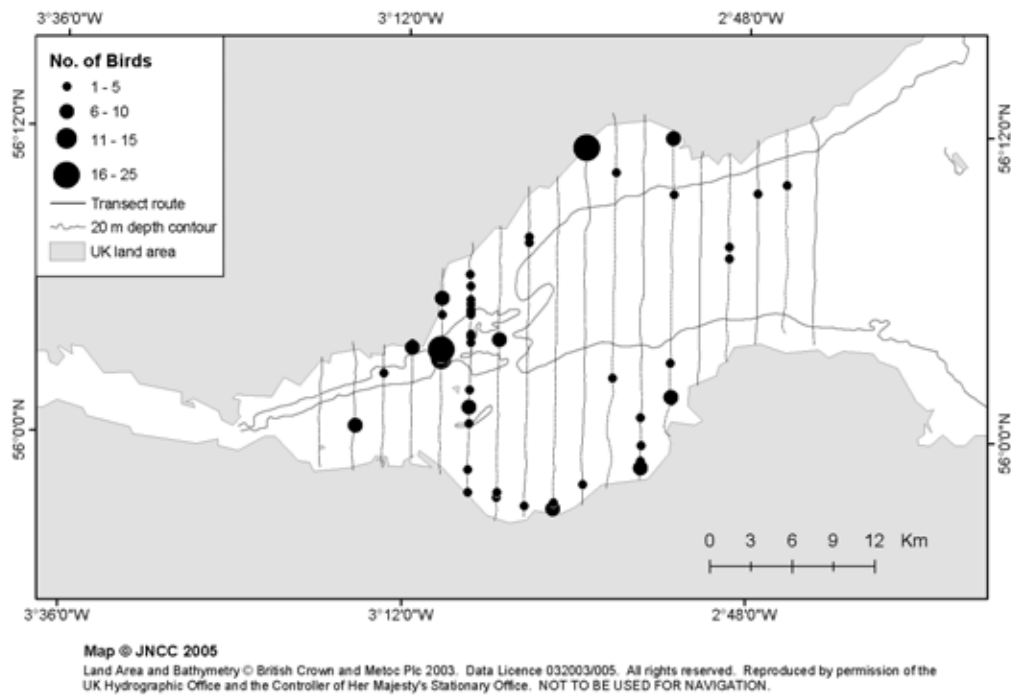


Figure A1.30. Distribution of long-tailed ducks recorded in the Firth of Forth on 12 December 2004.

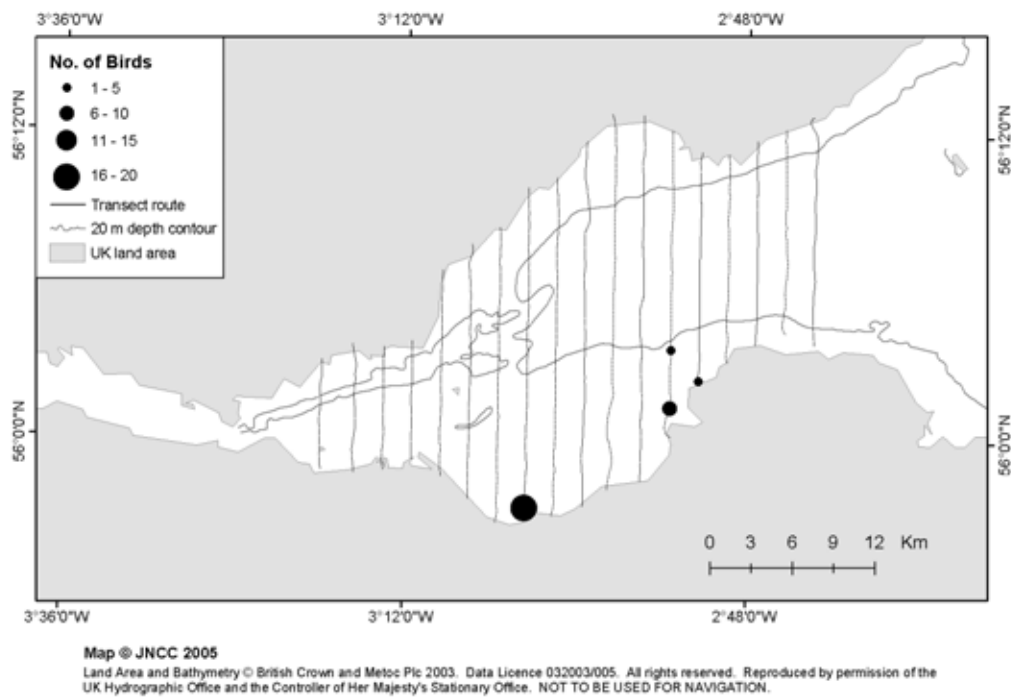


Figure A1.31. Distribution of common scoters recorded in the Firth of Forth on 12 December 2004.

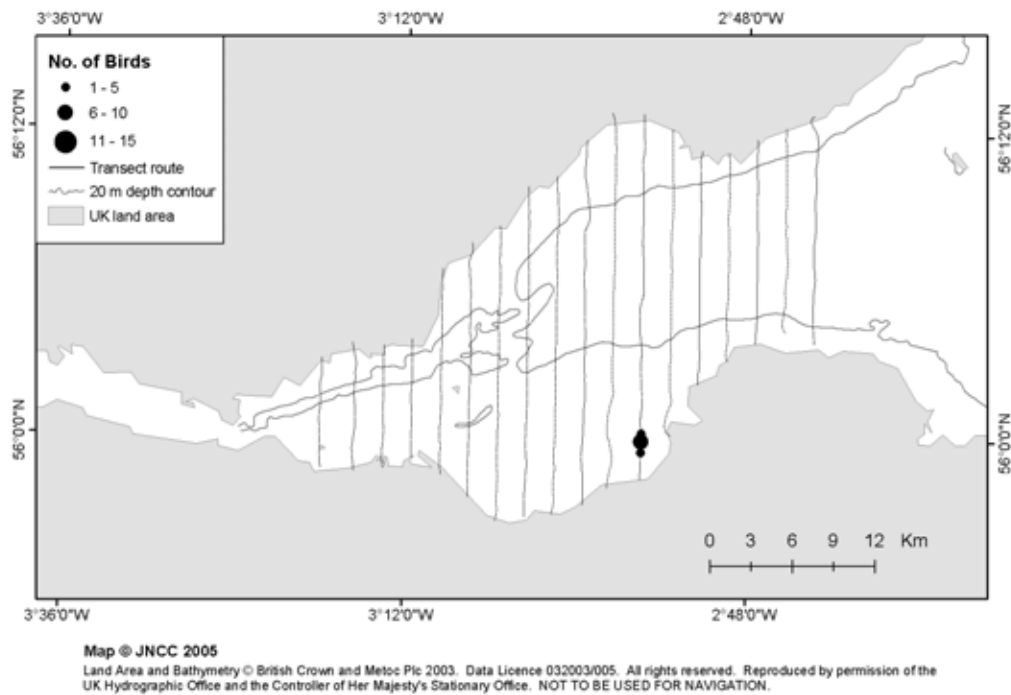


Figure A1.32. Distribution of velvet scoters recorded in the Firth of Forth on 12 December 2004.

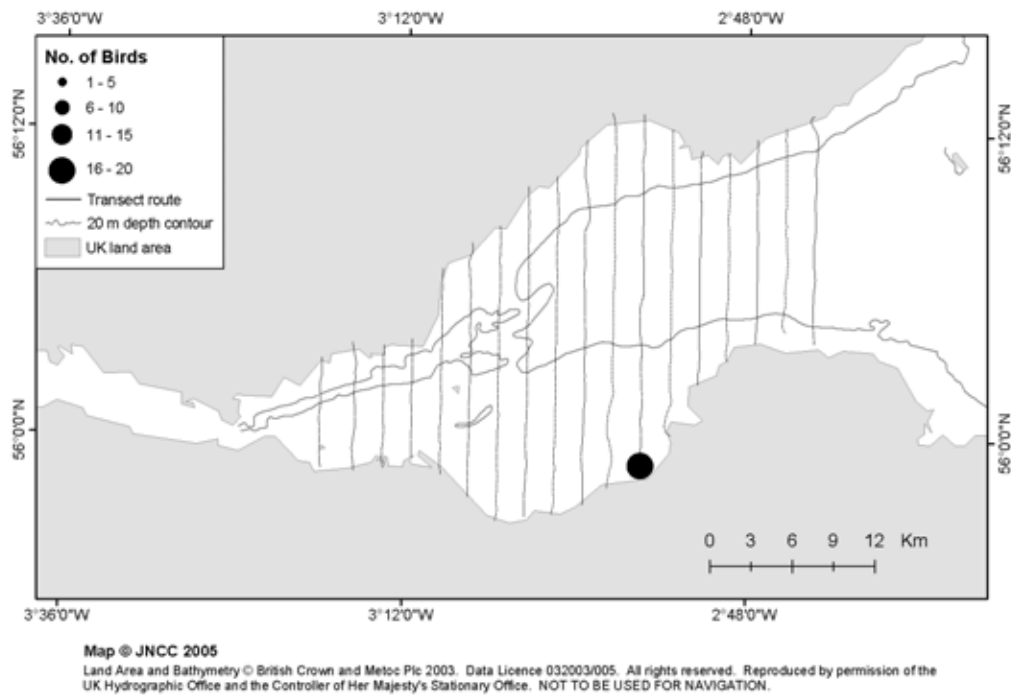


Figure A1.33. Distribution of unidentified scoters recorded in the Firth of Forth on 12 December 2004.

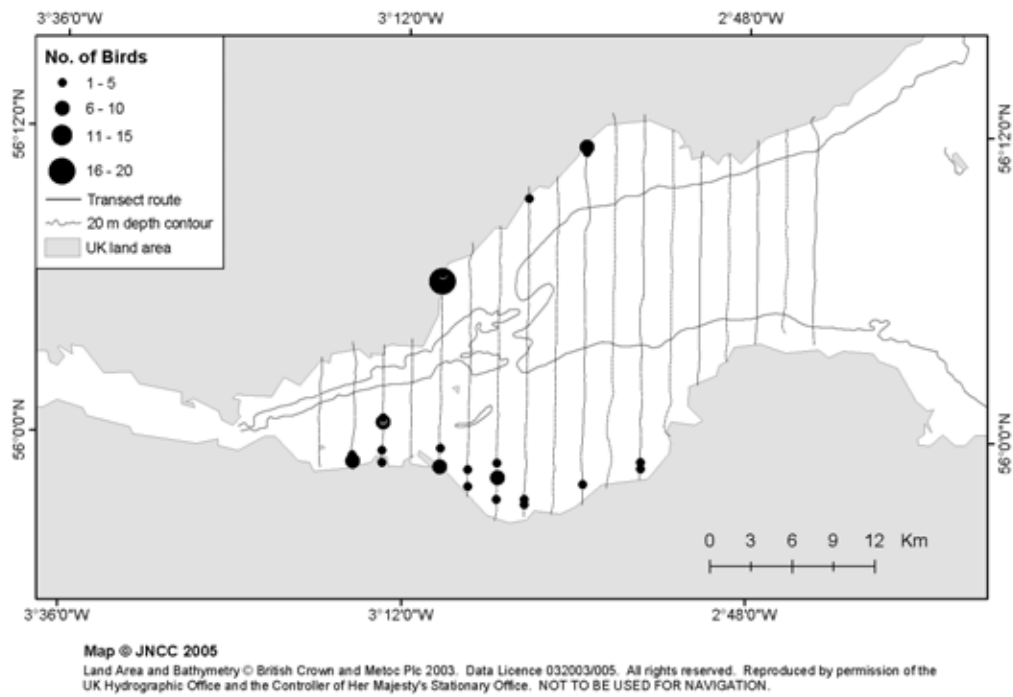


Figure A1.34. Distribution of red-breasted mergansers recorded in the Firth of Forth on 12 December 2004.

Firth of Forth Survey, 3 February 2005

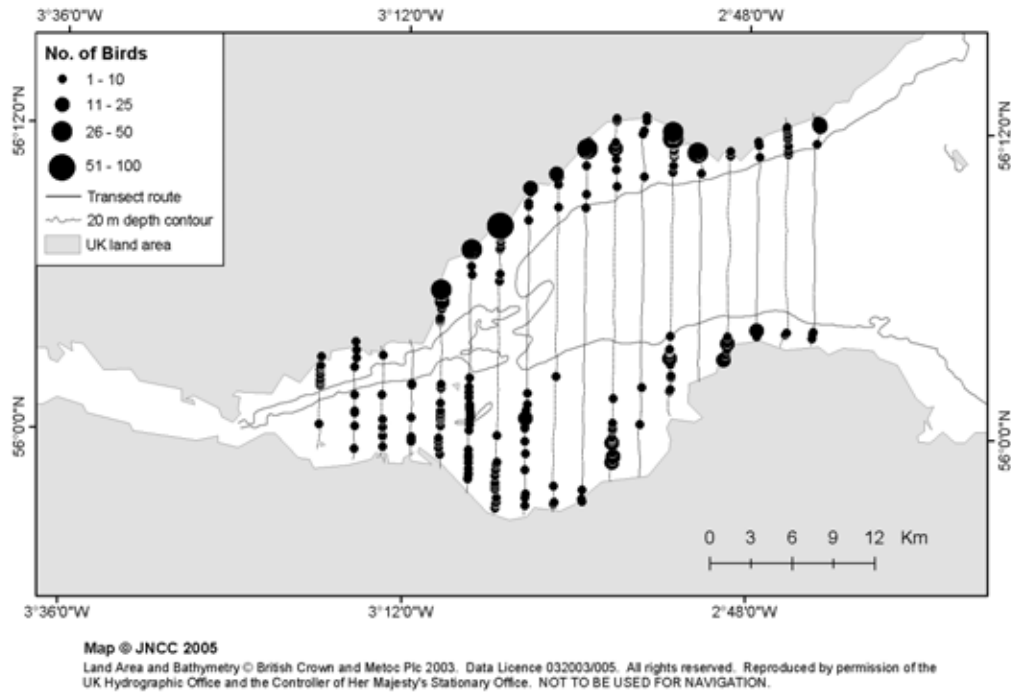


Figure A1.35. Distribution of common eiders recorded in the Firth of Forth on 3 February 2004.

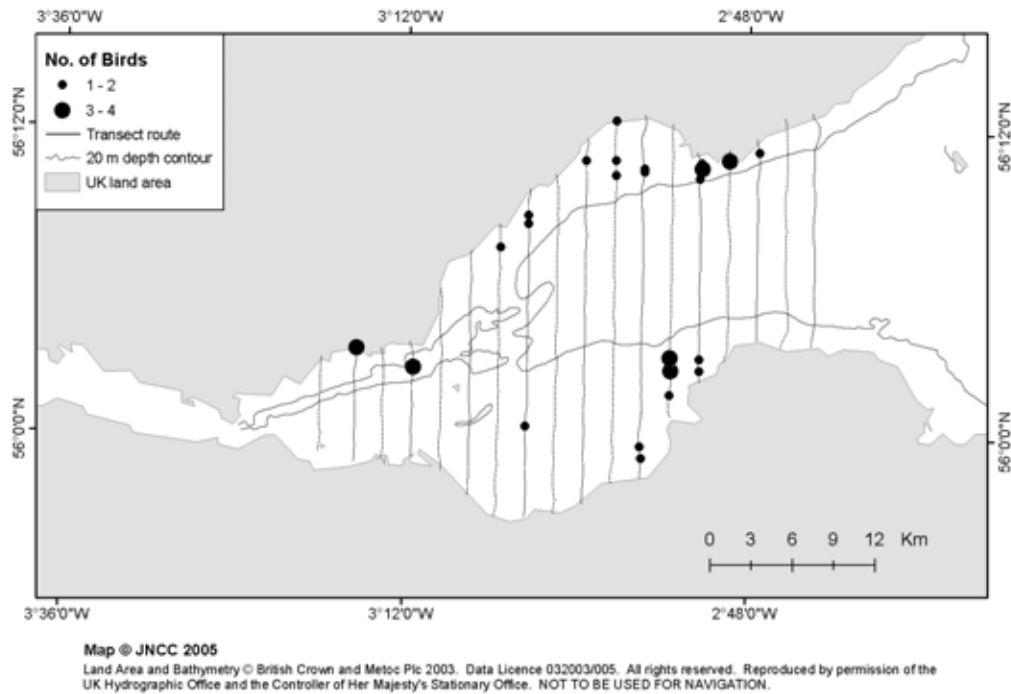


Figure A1.36. Distribution of long-tailed ducks recorded in the Firth of Forth on 3 February 2004.

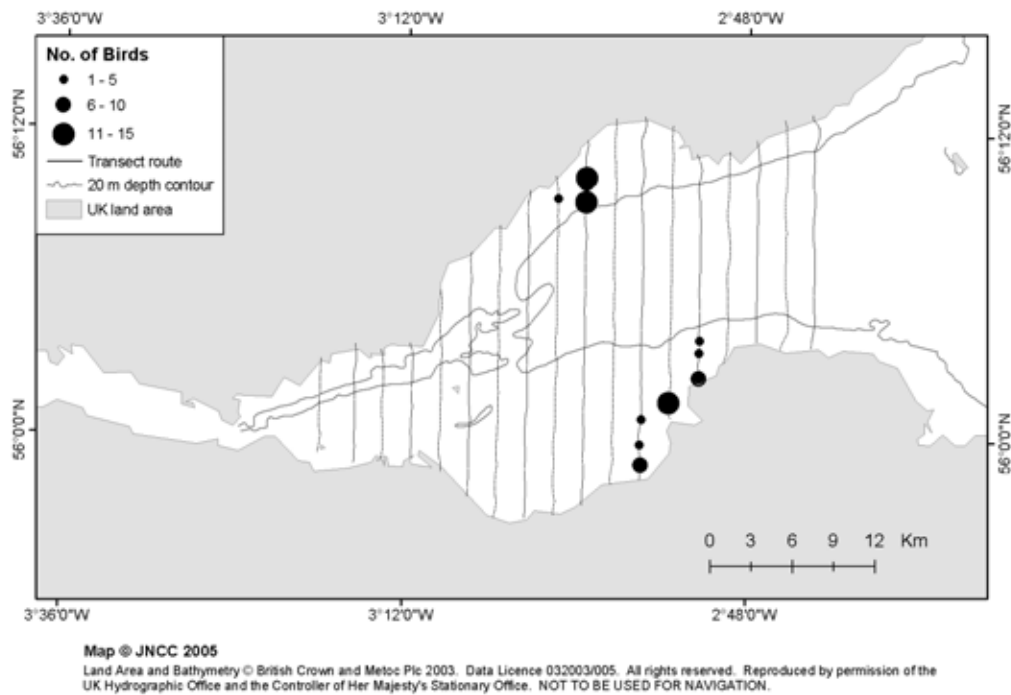


Figure A1.37. Distribution of common scoters recorded in the Firth of Forth on 3 February 2004.

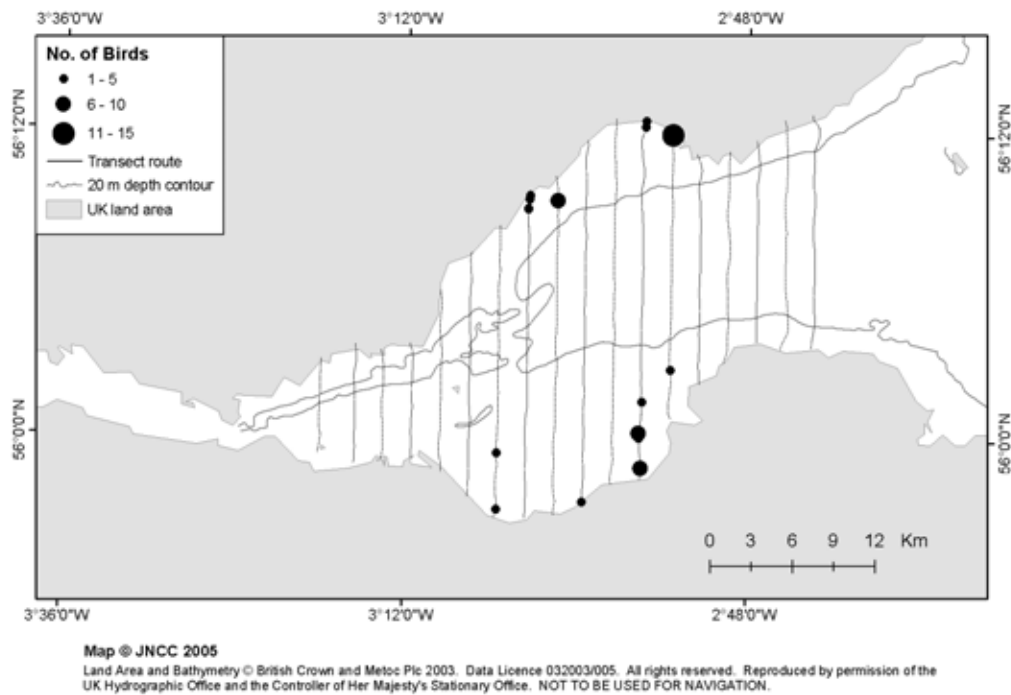


Figure A1.38. Distribution of velvet scoters recorded in the Firth of Forth on 3 February 2004.

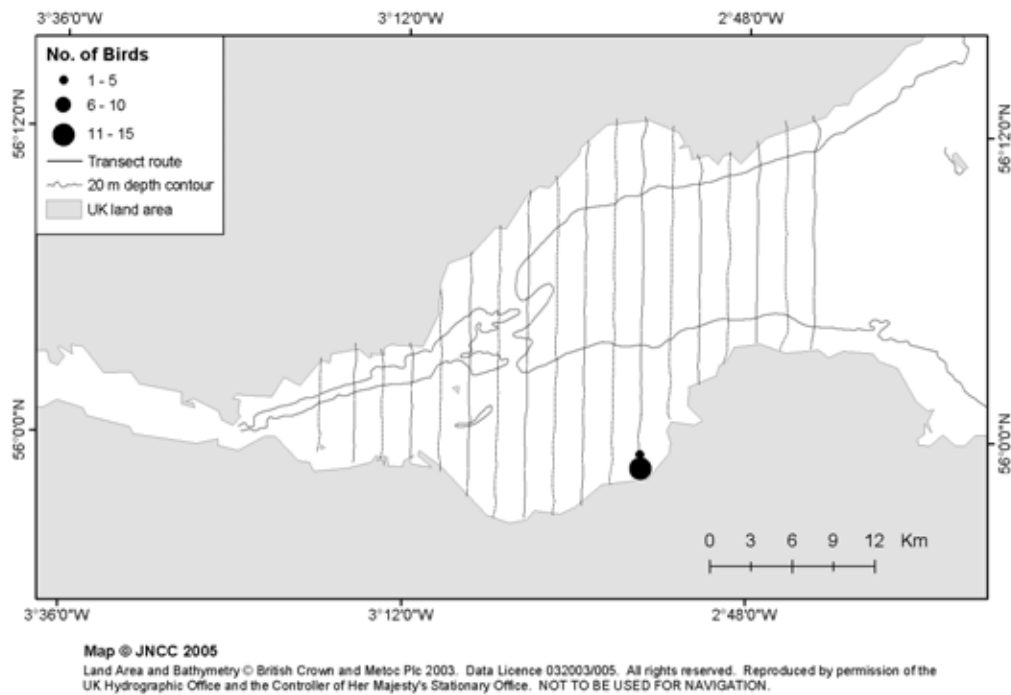


Figure A1.39. Distribution of unidentified scoters recorded in the Firth of Forth on 3 February 2004.

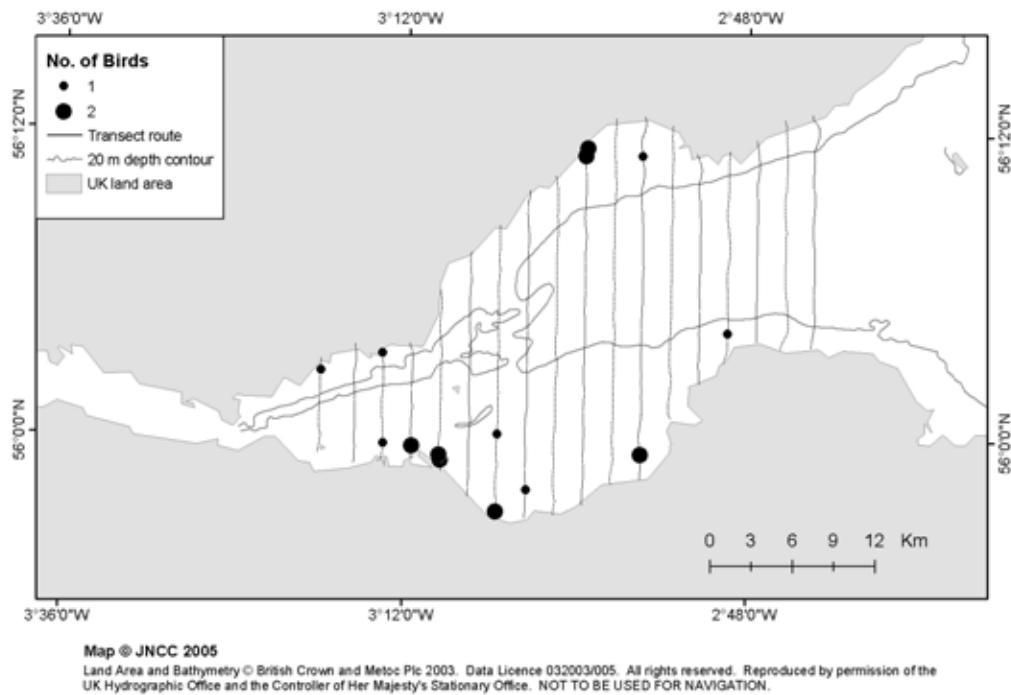


Figure A1.40. Distribution of red-breasted mergansers recorded in the Firth of Forth on 3 February 2004.

Outer Hebridean West coast Survey, 7 – 8 March 2005

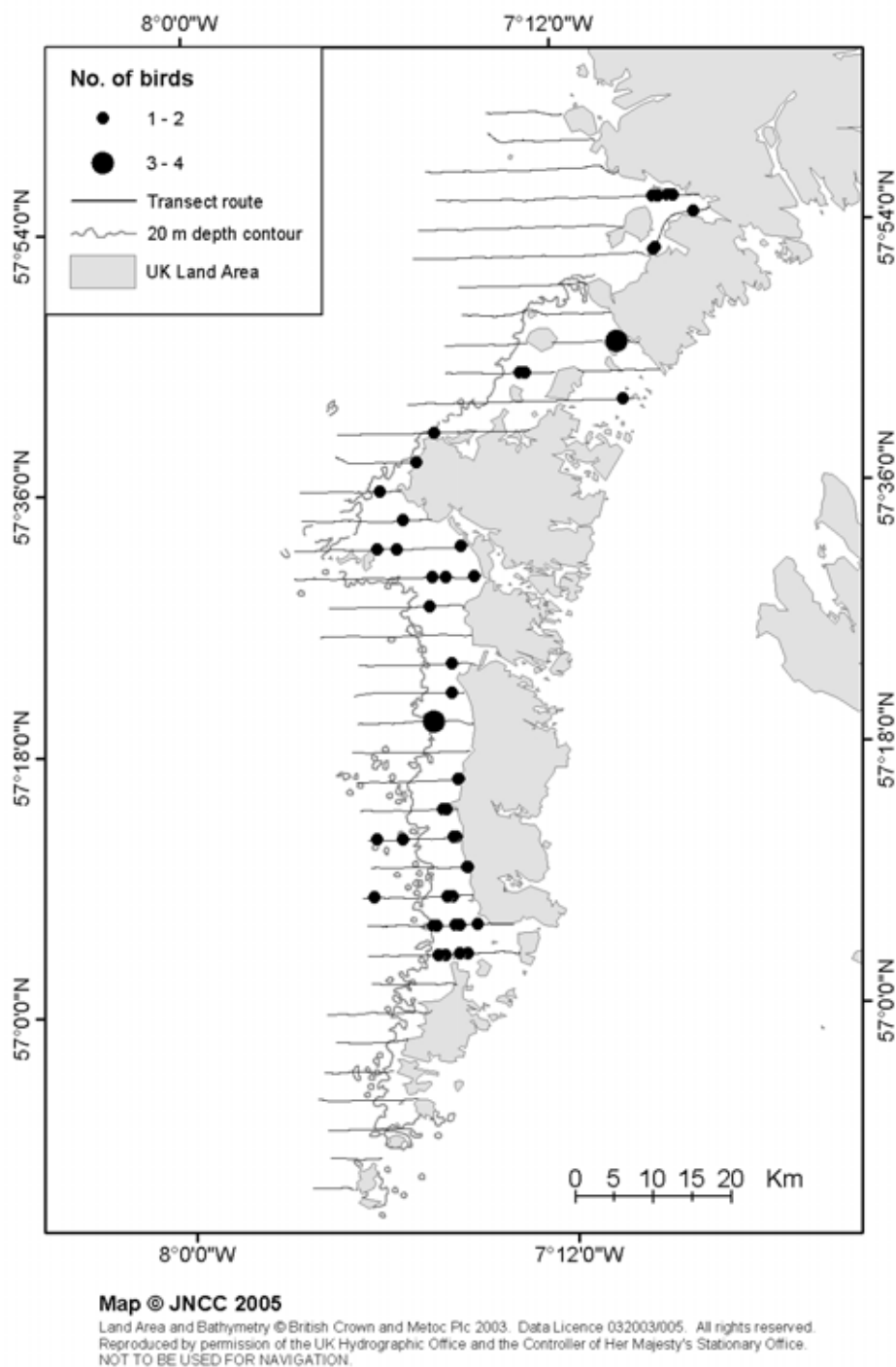
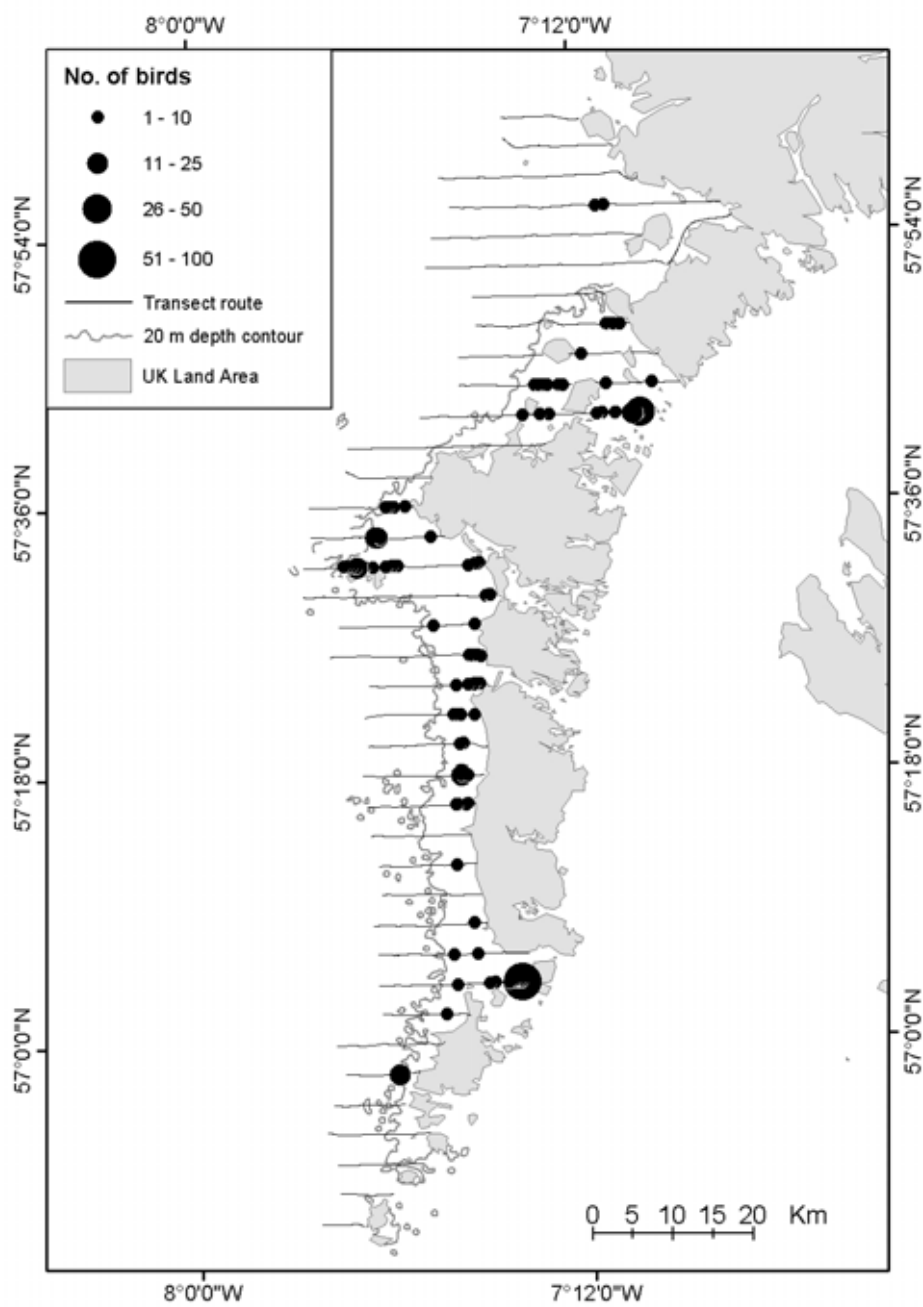


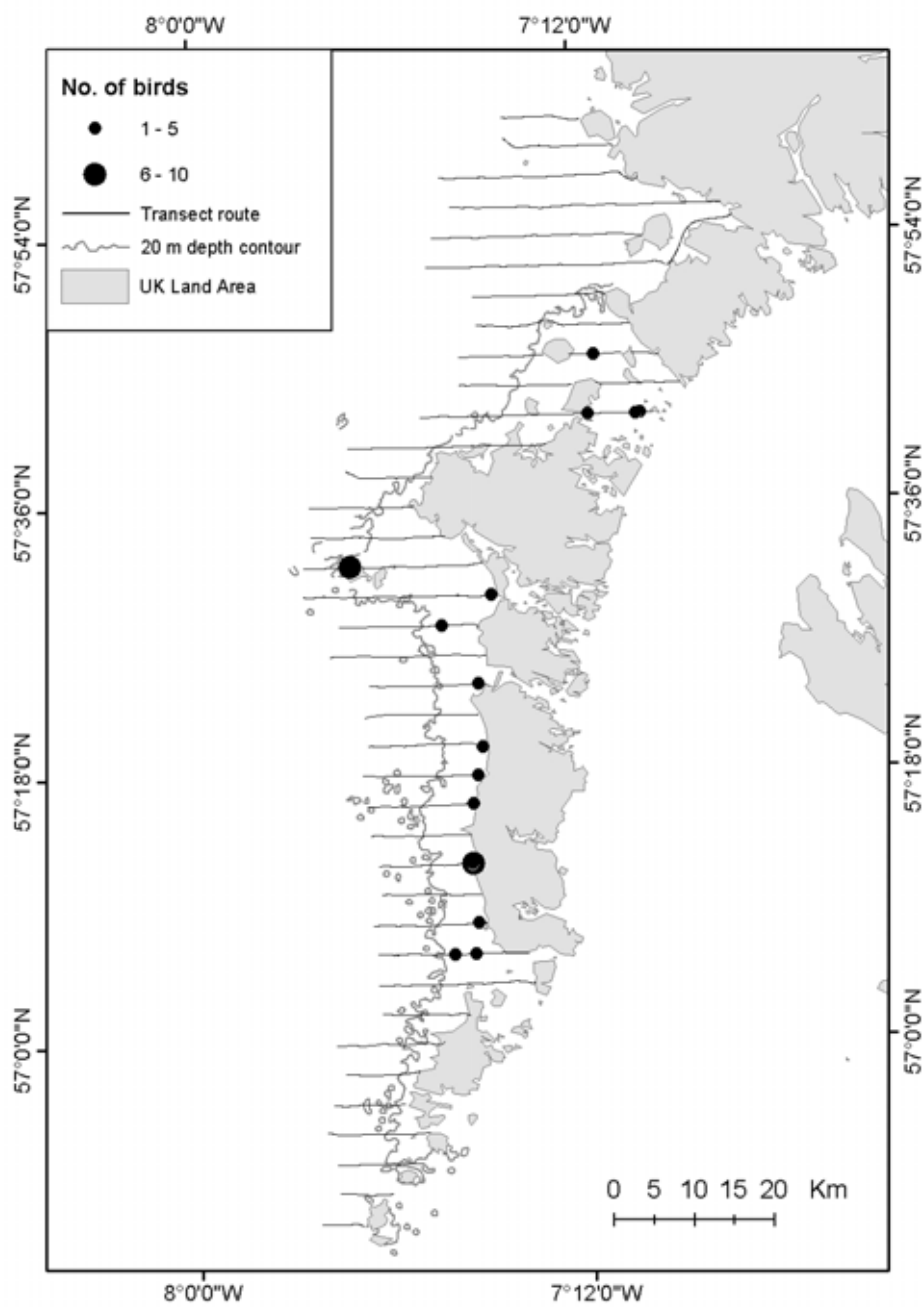
Figure A1.41. Distribution of great-northern divers recorded along the west coast of the Outer Hebrides on 7-8 March 2005.



Map © JNCC 2005

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Figure A1.42. Distribution of common eiders recorded along the west coast of the Outer Hebrides on 7-8 March 2005.



Map © JNCC 2005

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Figure A1.43. Distribution of long-tailed ducks recorded along the west coast of the Outer Hebrides on 7-8 March 2005.

Coll, Tiree and Mull Survey, 25 - 26 March 2005

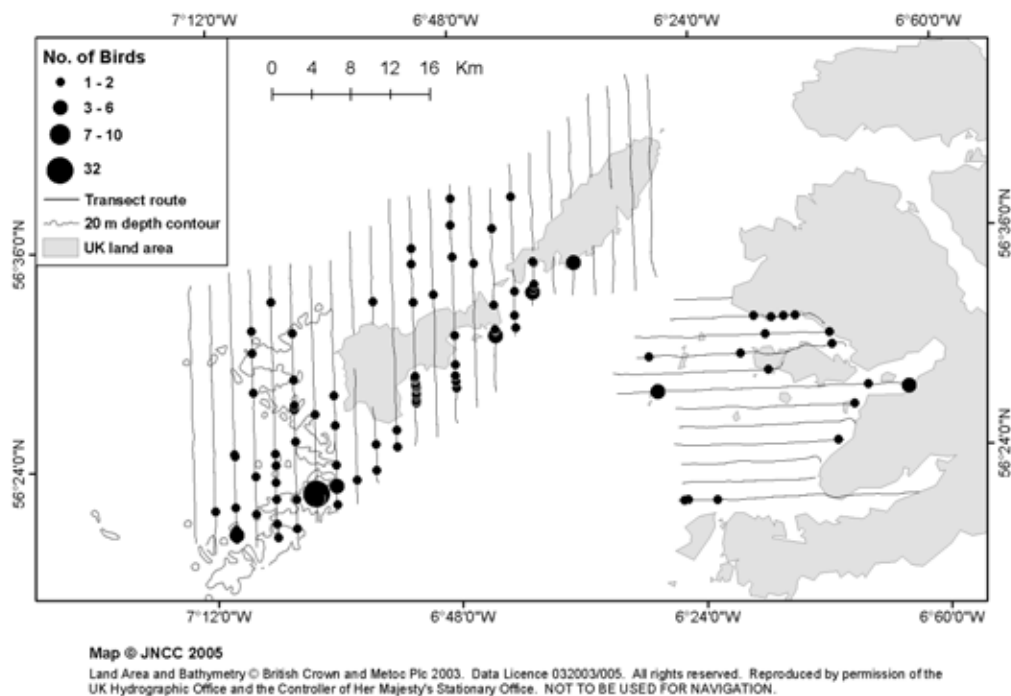


Figure A1.44. Distribution of great-northern divers recorded around Coll, Tiree and the west coast of Mull on 25-26 March 2005.

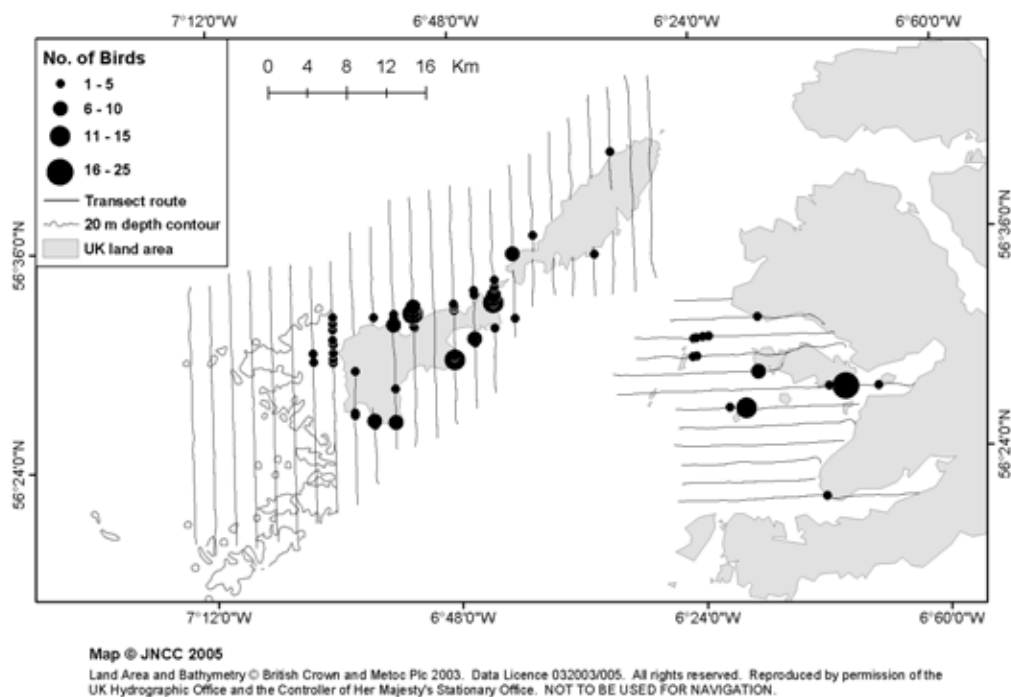


Figure A1.45. Distribution of common eiders recorded around Coll, Tiree and the west coast of Mull on 25-26 March 2005.

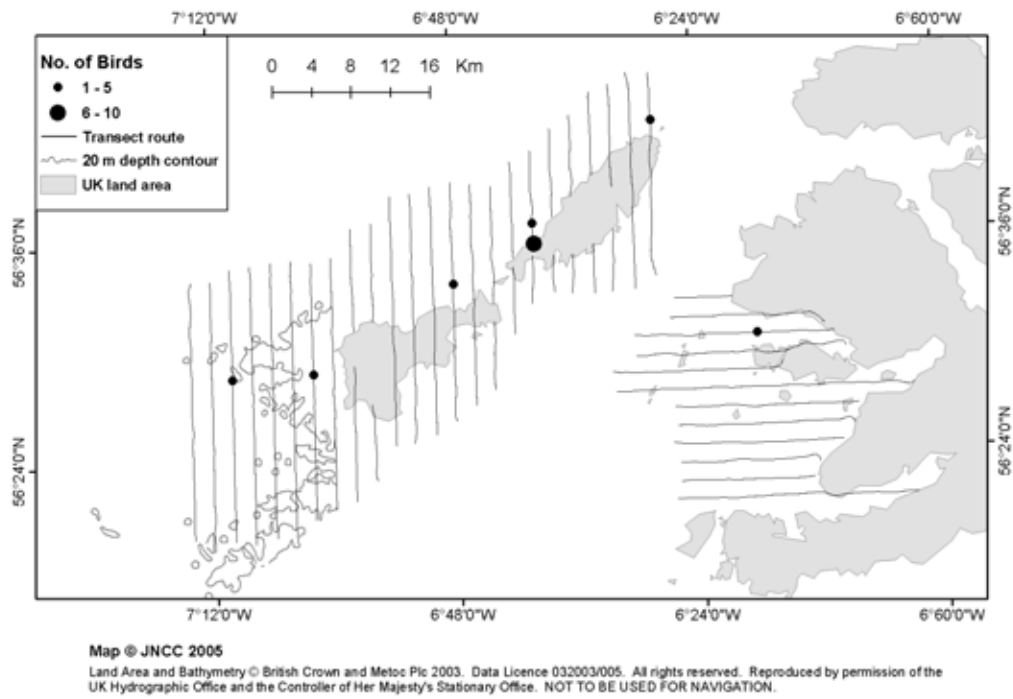


Figure A1.46. Distribution of long-tailed ducks recorded around Coll, Tiree and the west coast of Mull on 25-26 March 2005.

Sound of Gigha Survey, 9 March 2005

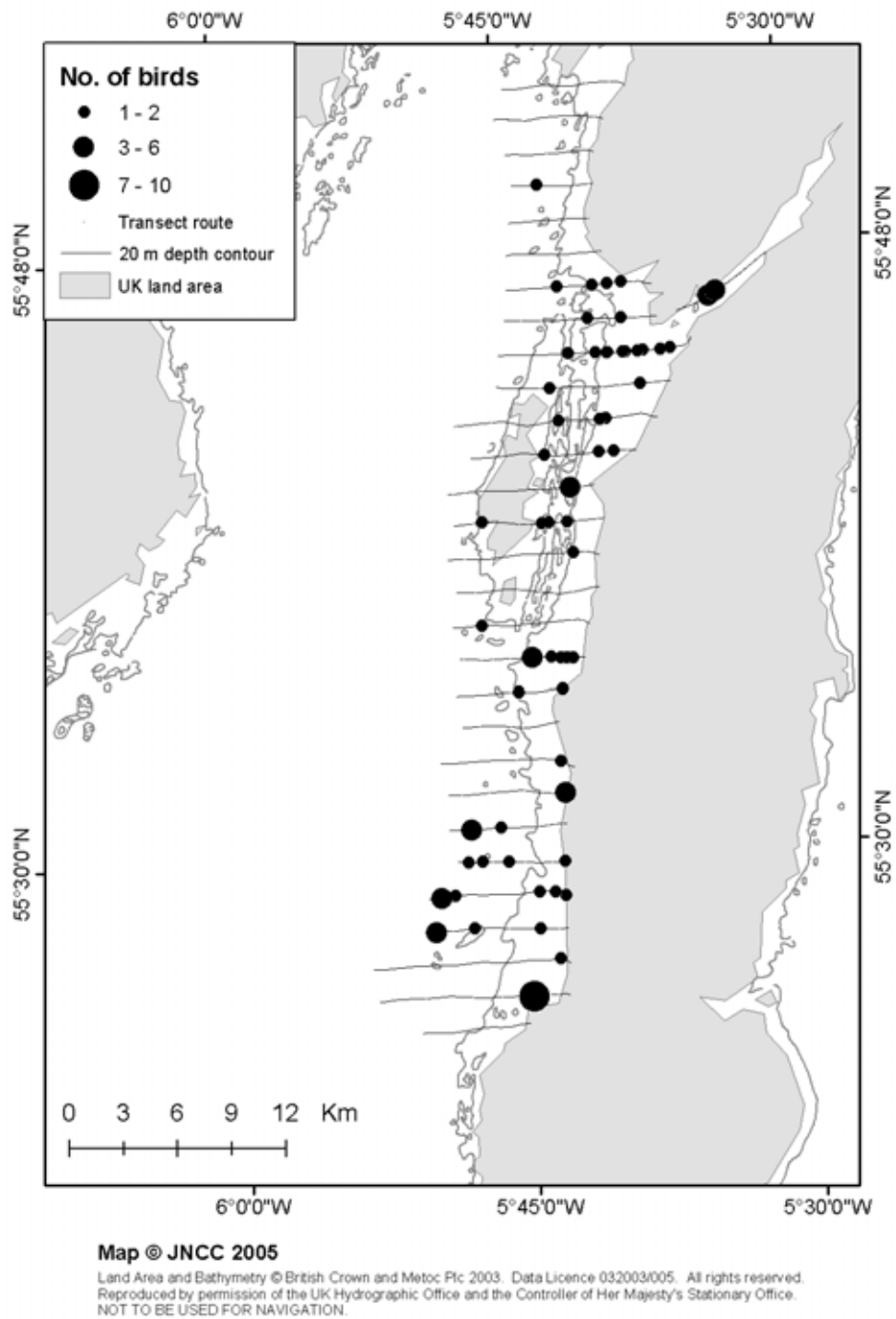


Figure A1.47. Distribution of great-northern divers recorded in the Sound of Gigha on 9 March 2005.

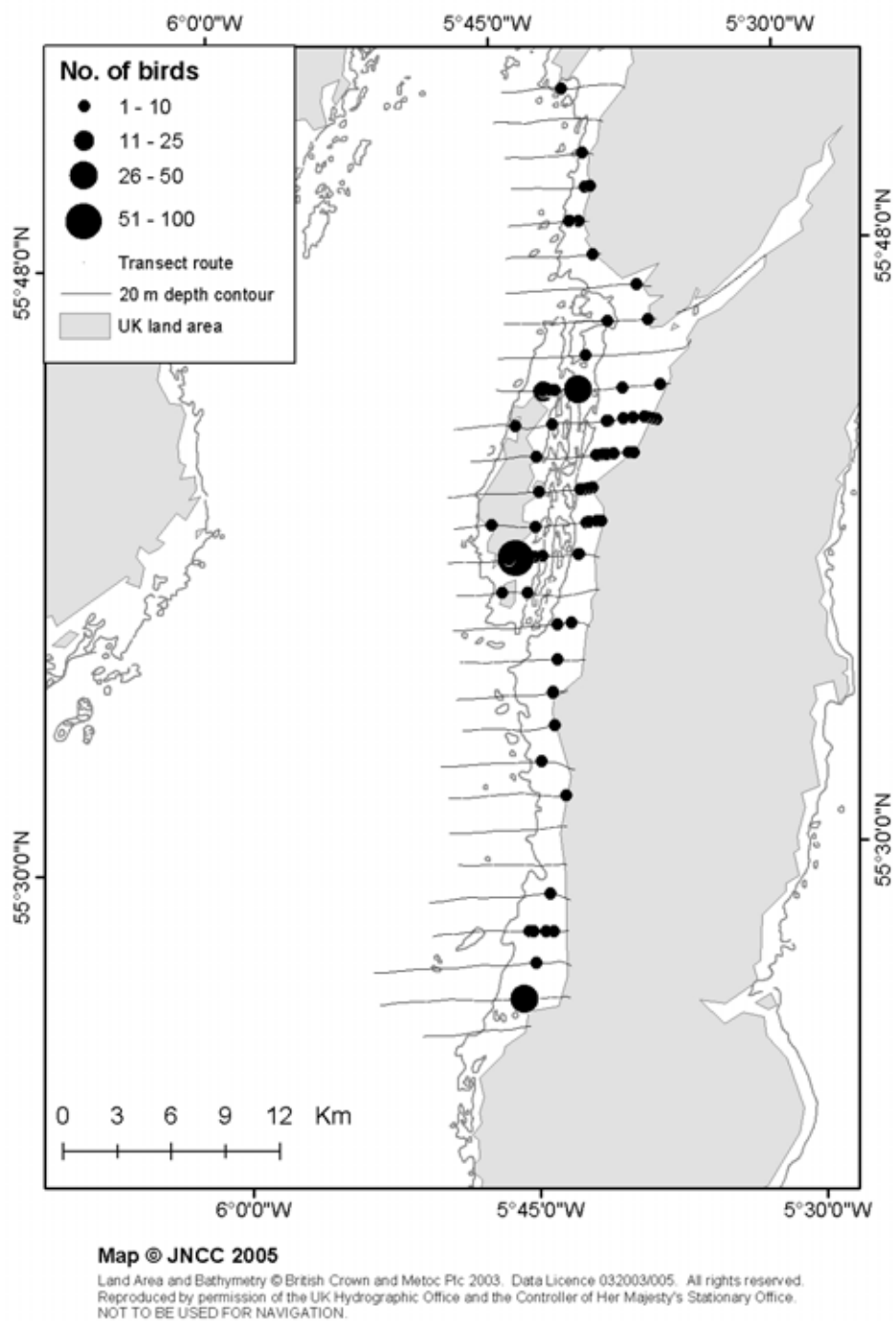


Figure A1.48. Distribution of common eiders recorded in the Sound of Gigha on 9 March 2005.

Appendix 2. Species count distribution maps based on results of shore-based counts in Aberdeen Bay June 2004 – May 2005.

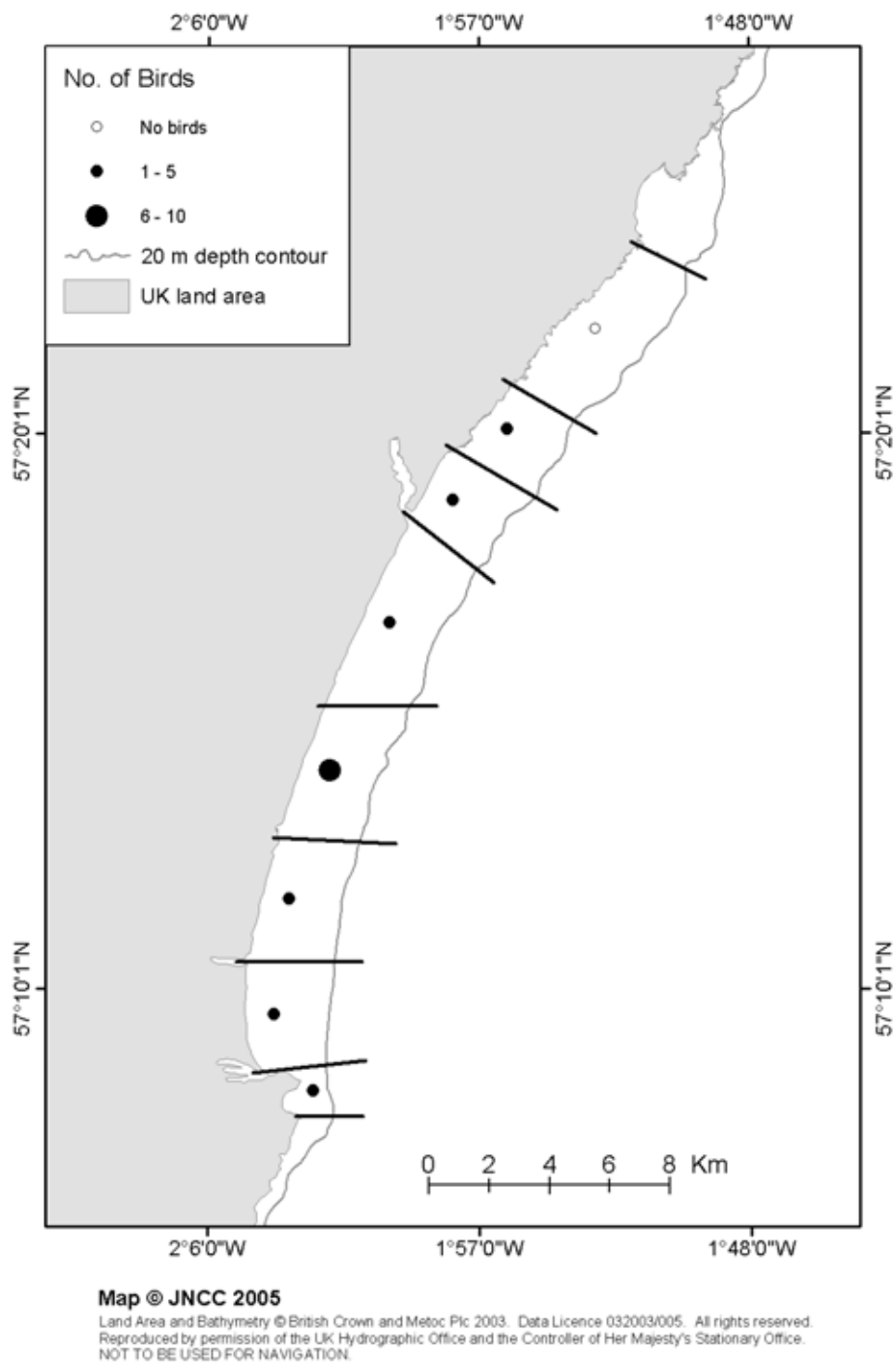


Figure A2.1. Numbers of red-throated divers observed, within each of the eight sub-sections in Aberdeen Bay, 27 June 2004.

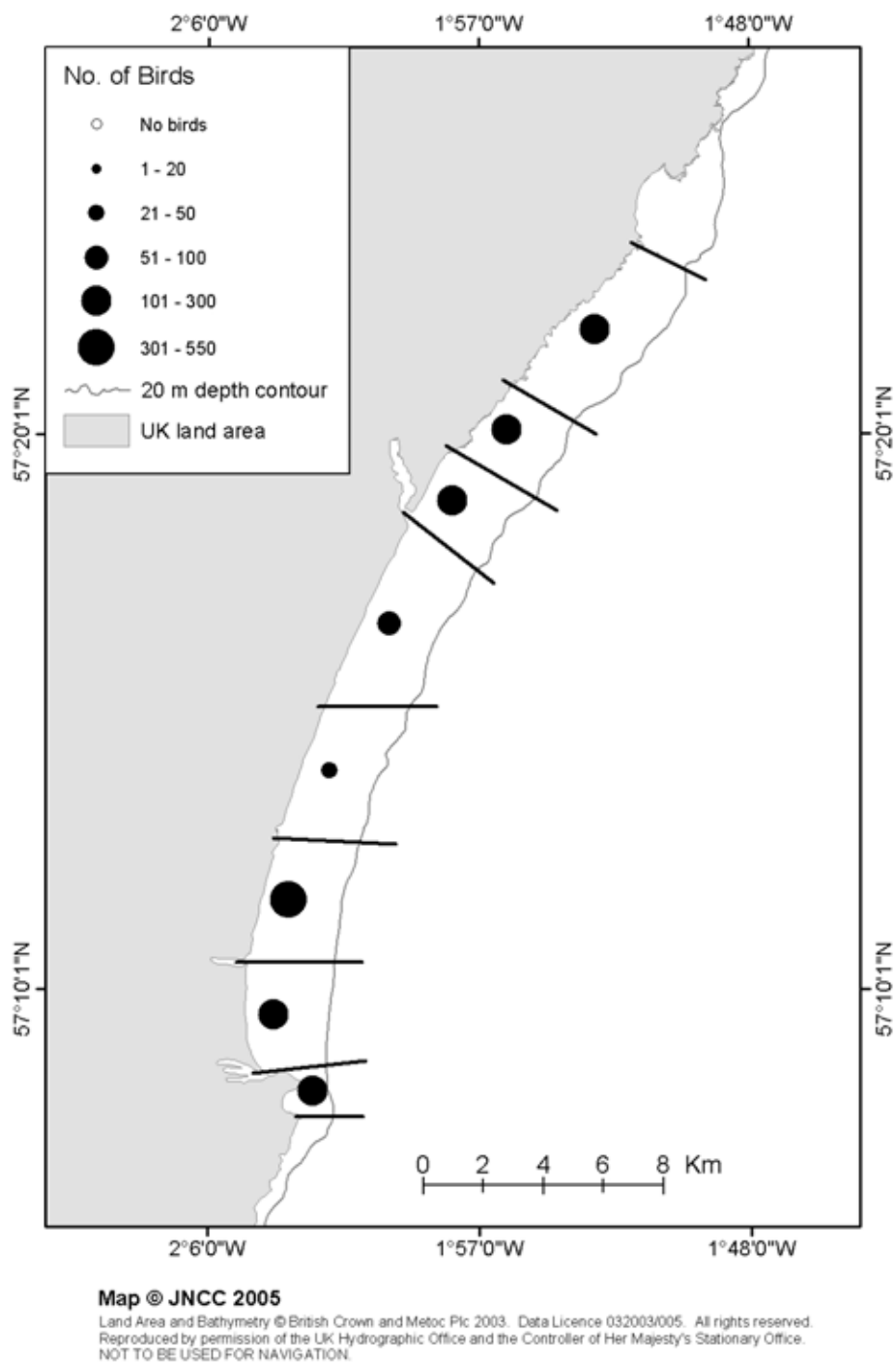


Figure A2.2. Numbers of common eiders observed, within each of the eight sub-sections in Aberdeen Bay, 27 June 2004.

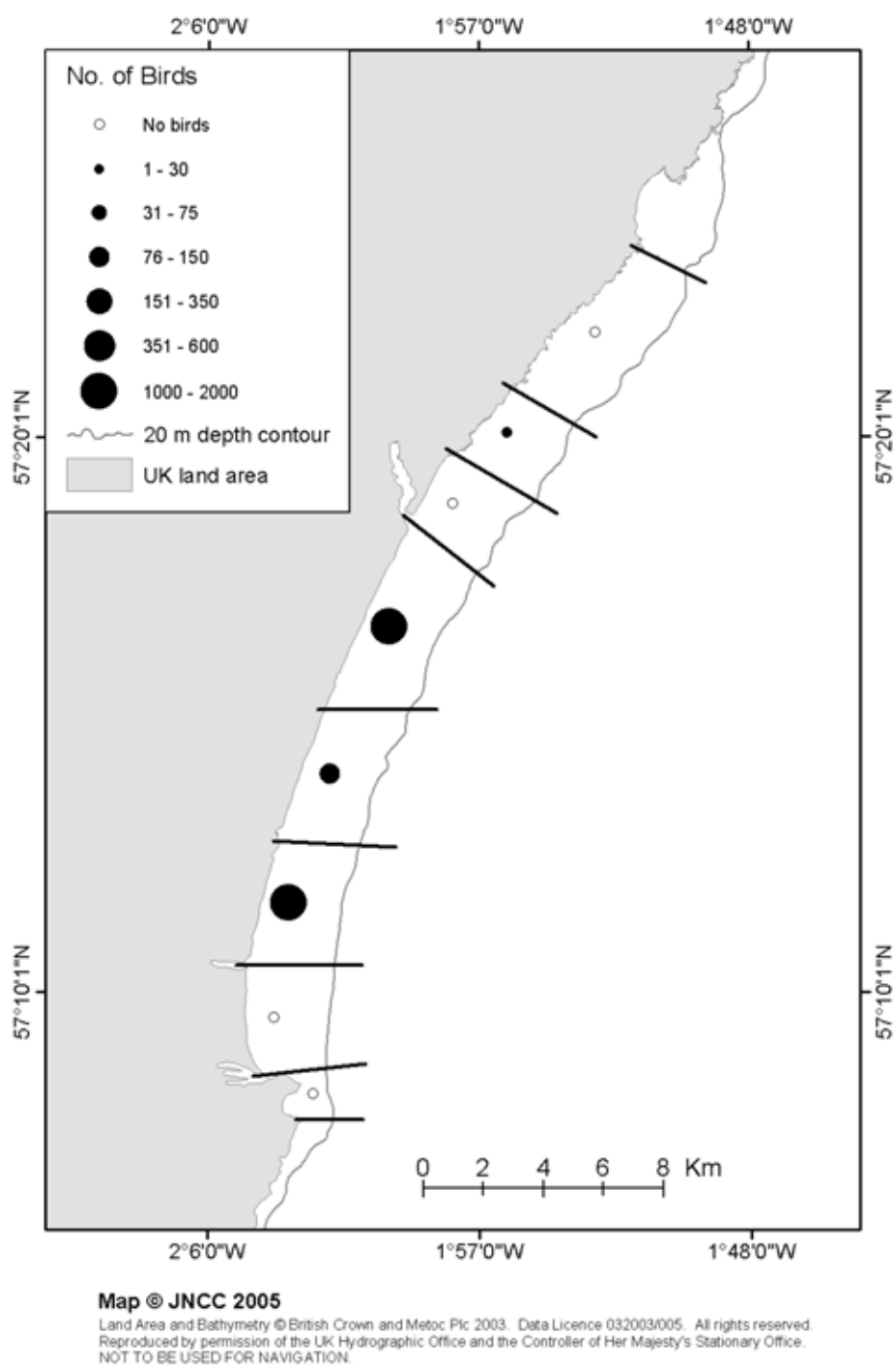


Figure A2.3. Numbers of common scoters observed, within each of the eight sub-sections in Aberdeen Bay, 27 June 2004.

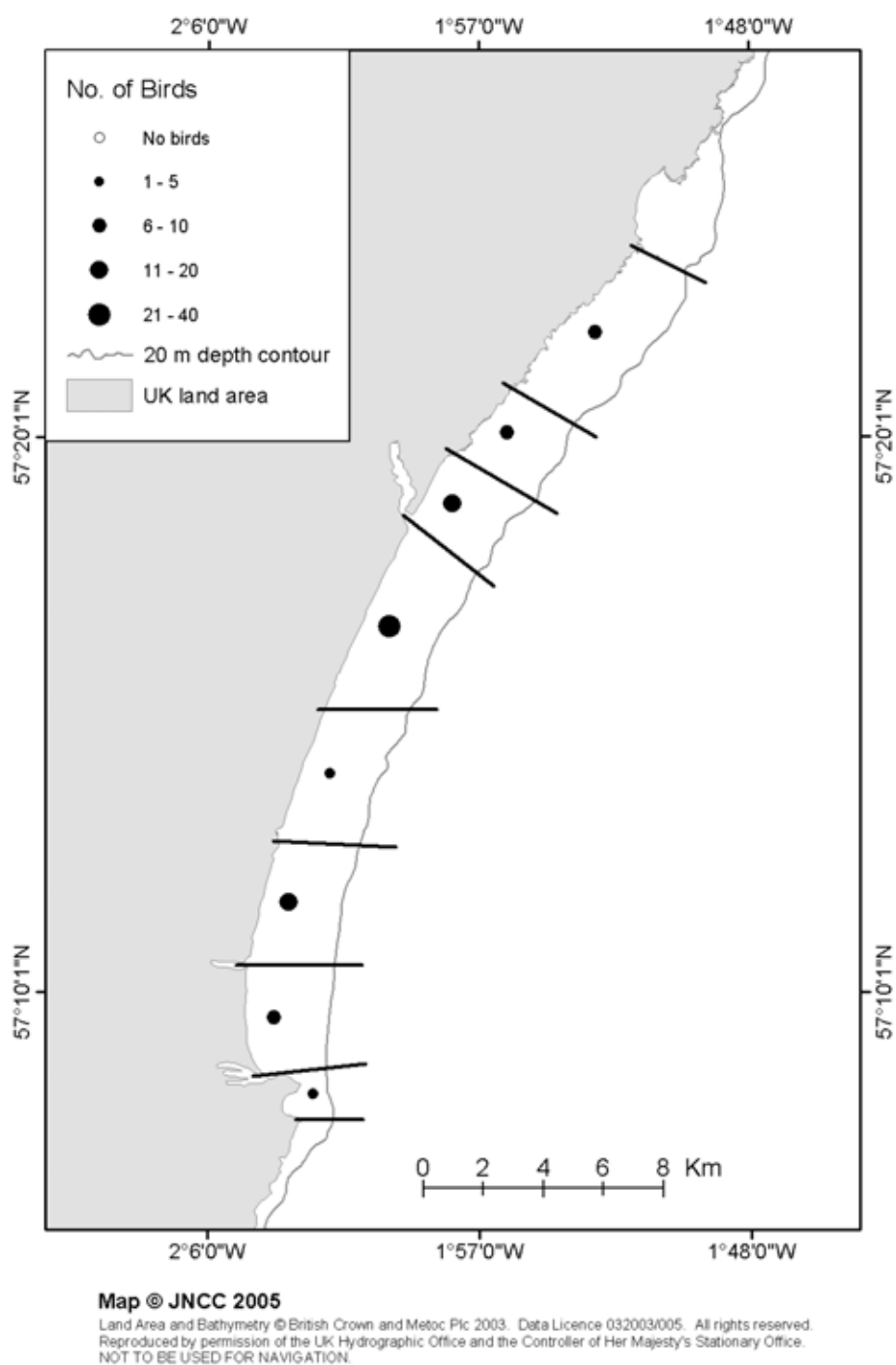


Figure A2.4. Numbers of red-throated divers observed, within each of the eight sub-sections in Aberdeen Bay, 22 August 2004.

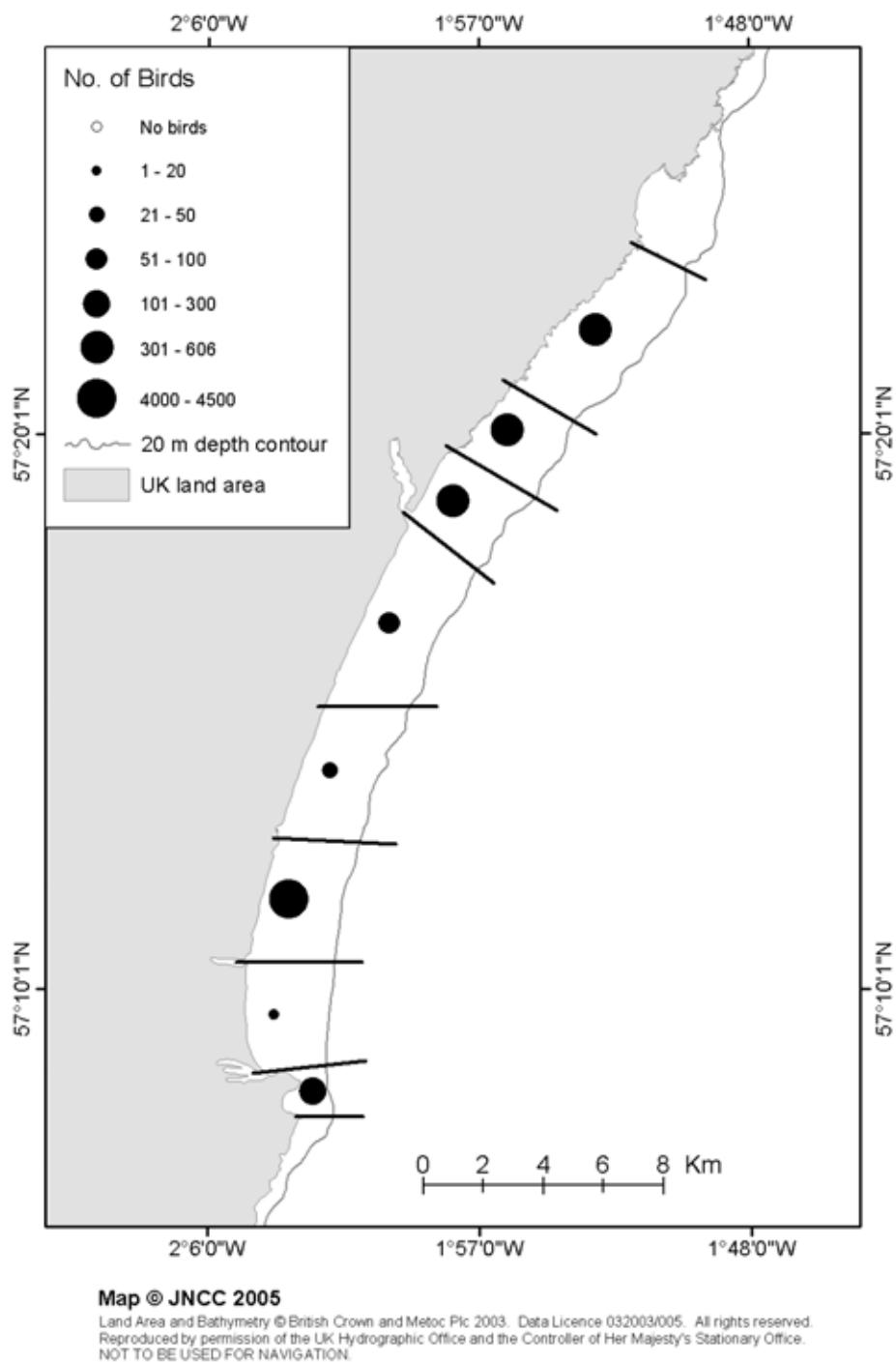


Figure A2.5. Numbers of common eiders observed, within each of the eight sub-sections in Aberdeen Bay, 22 August 2004.

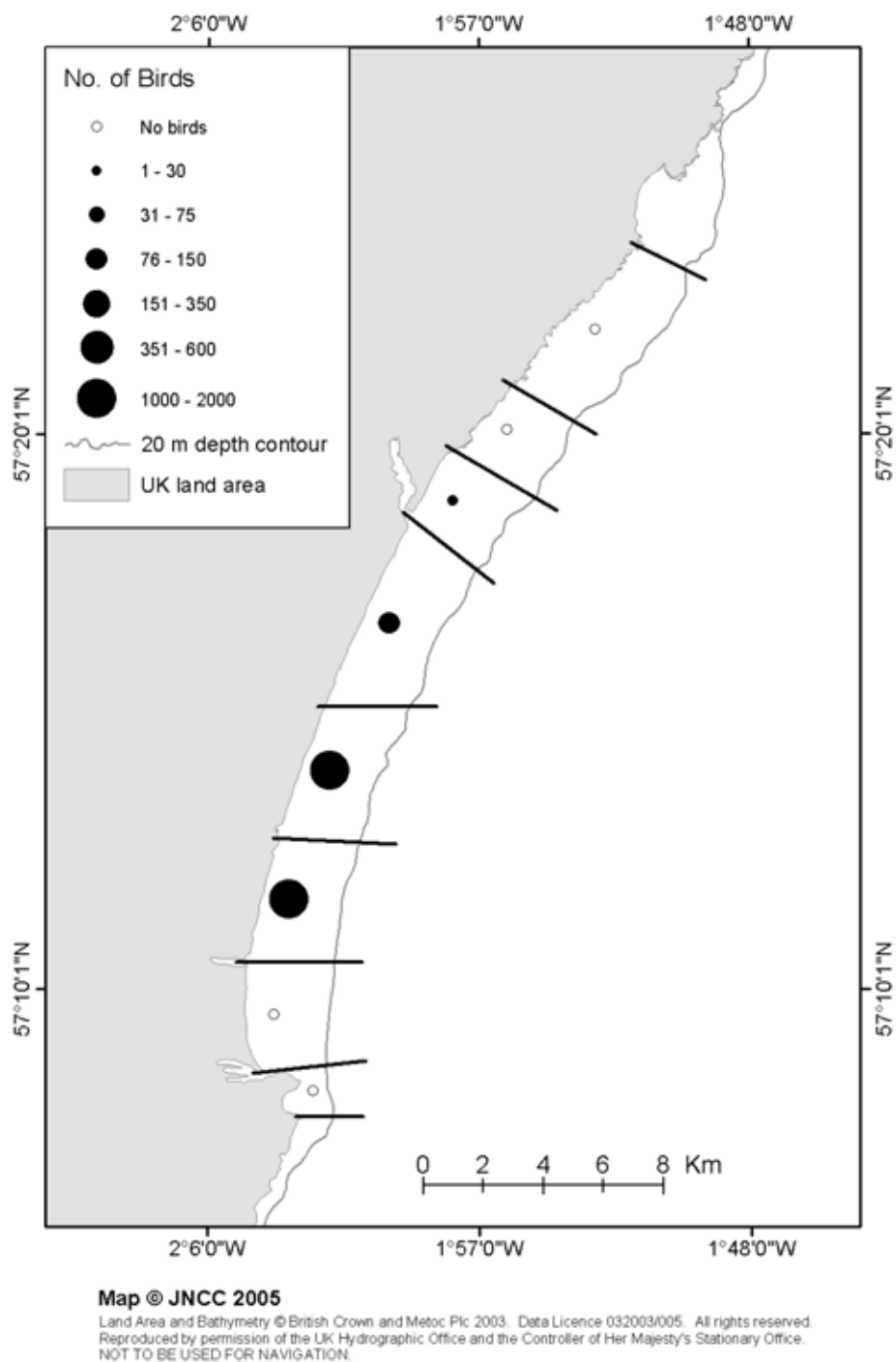


Figure A2.6. Numbers of common scoters observed, within each of the eight sub-sections in Aberdeen Bay, 22 August 2004.

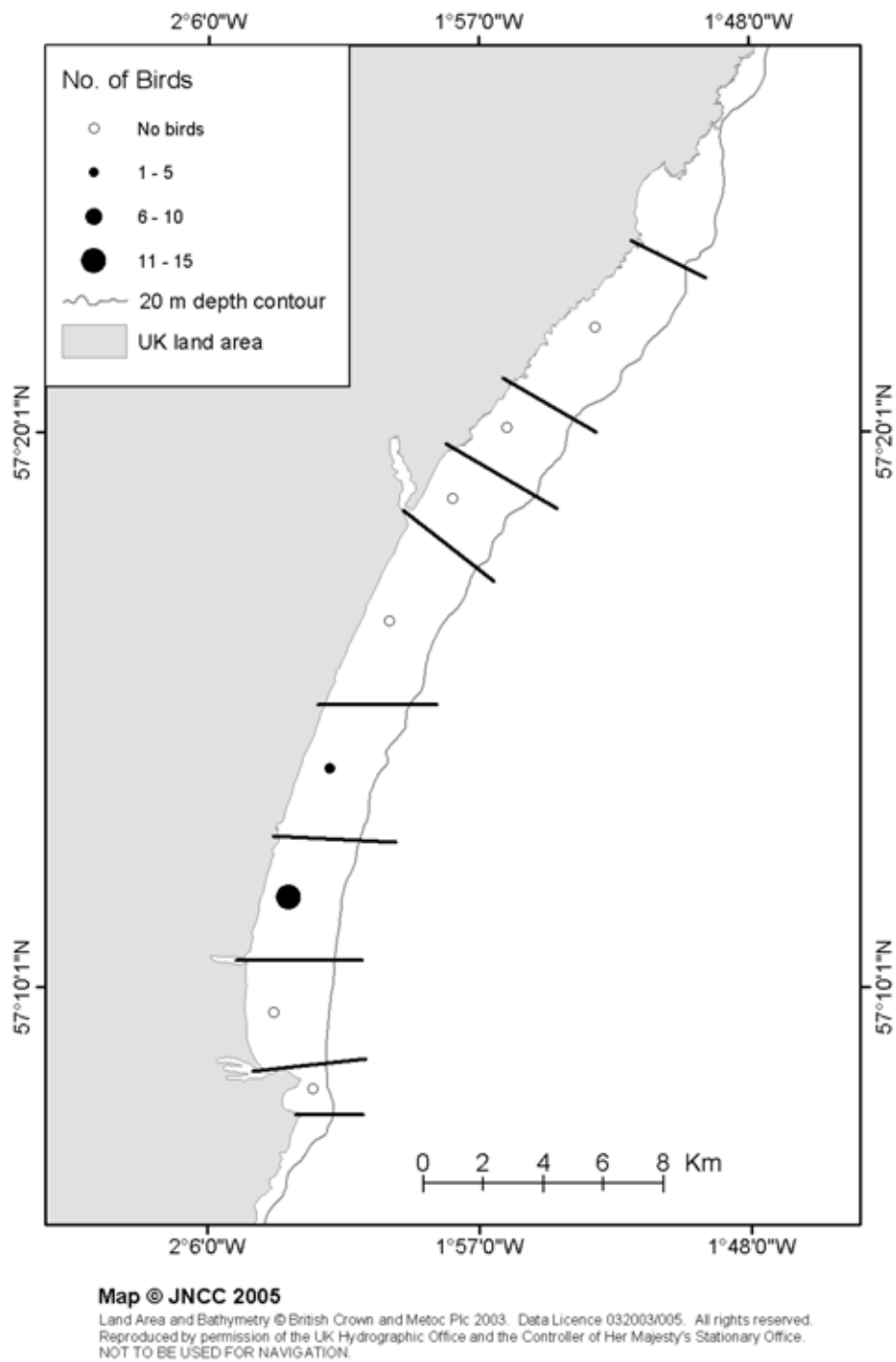


Figure A2.7. Numbers of red-breasted mergansers observed, within each of the eight sub-sections in Aberdeen Bay, 22 August 2004.

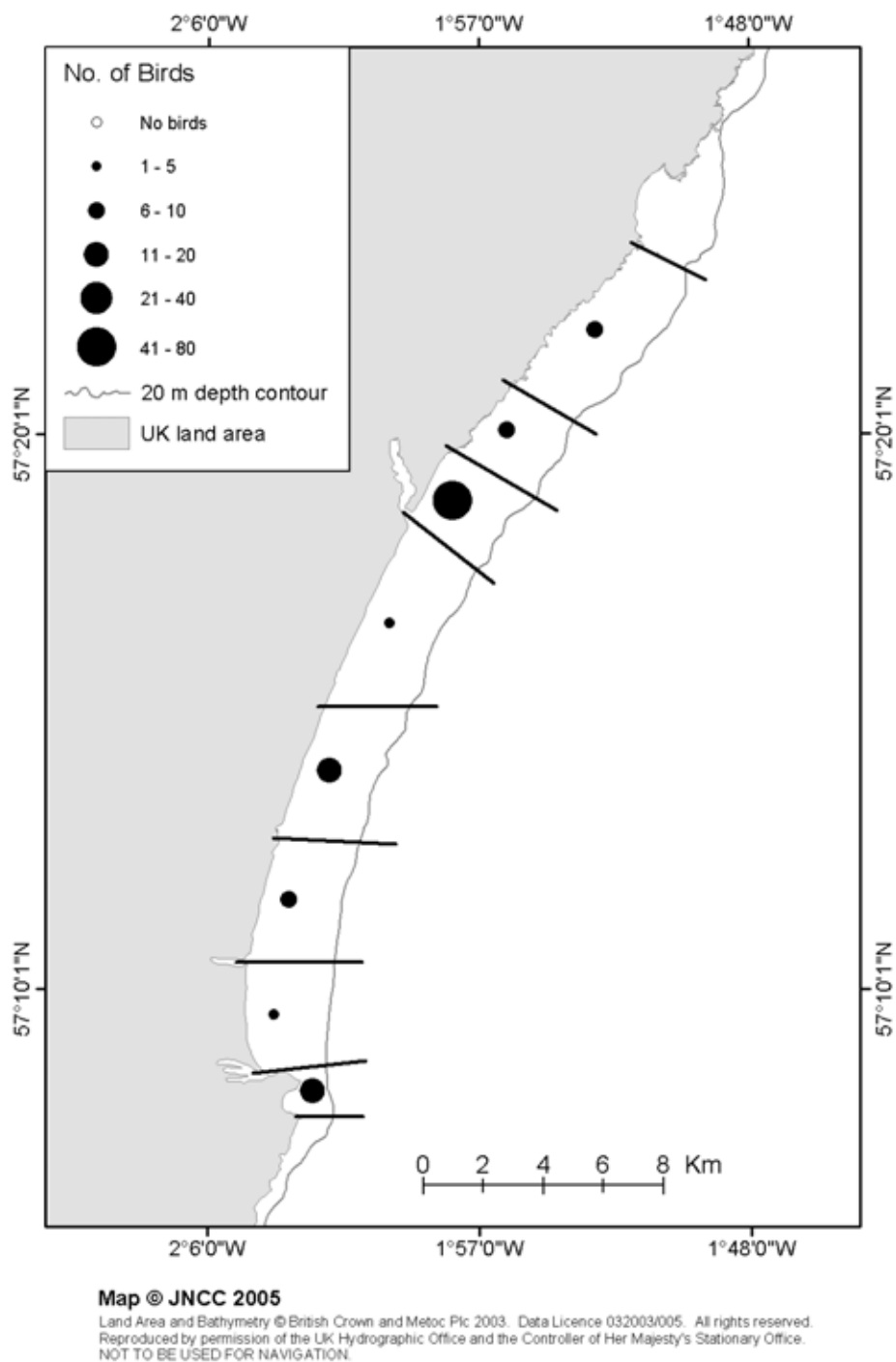


Figure A2.8. Numbers of red-throated divers observed, within each of the eight sub-sections in Aberdeen Bay, 23 October 2004.

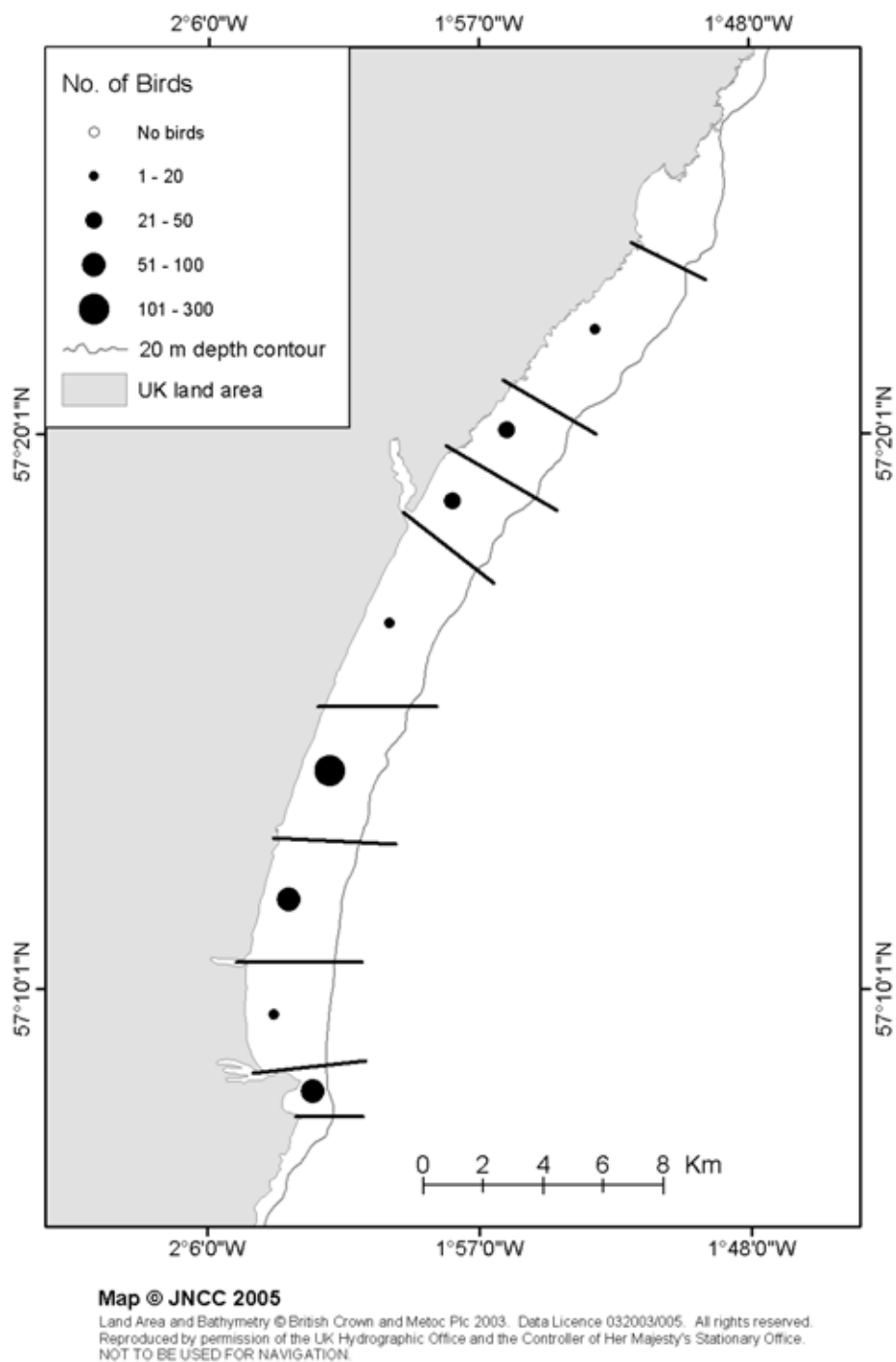


Figure A2.9. Numbers of common eiders observed, within each of the eight sub-sections in Aberdeen Bay, 23 October 2004.

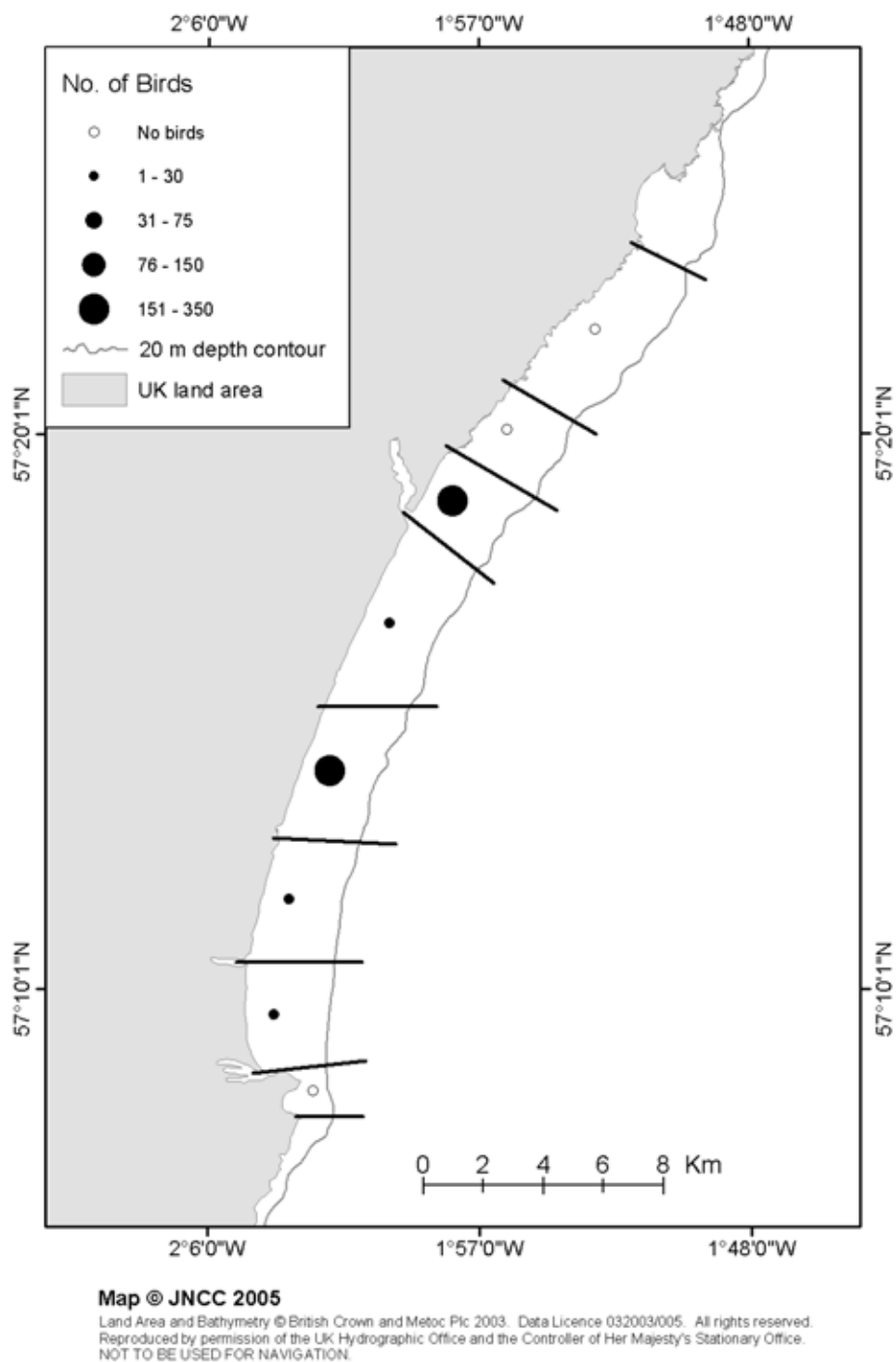


Figure A2.10. Numbers of common scoters observed, within each of the eight sub-sections in Aberdeen Bay, 23 October 2004.

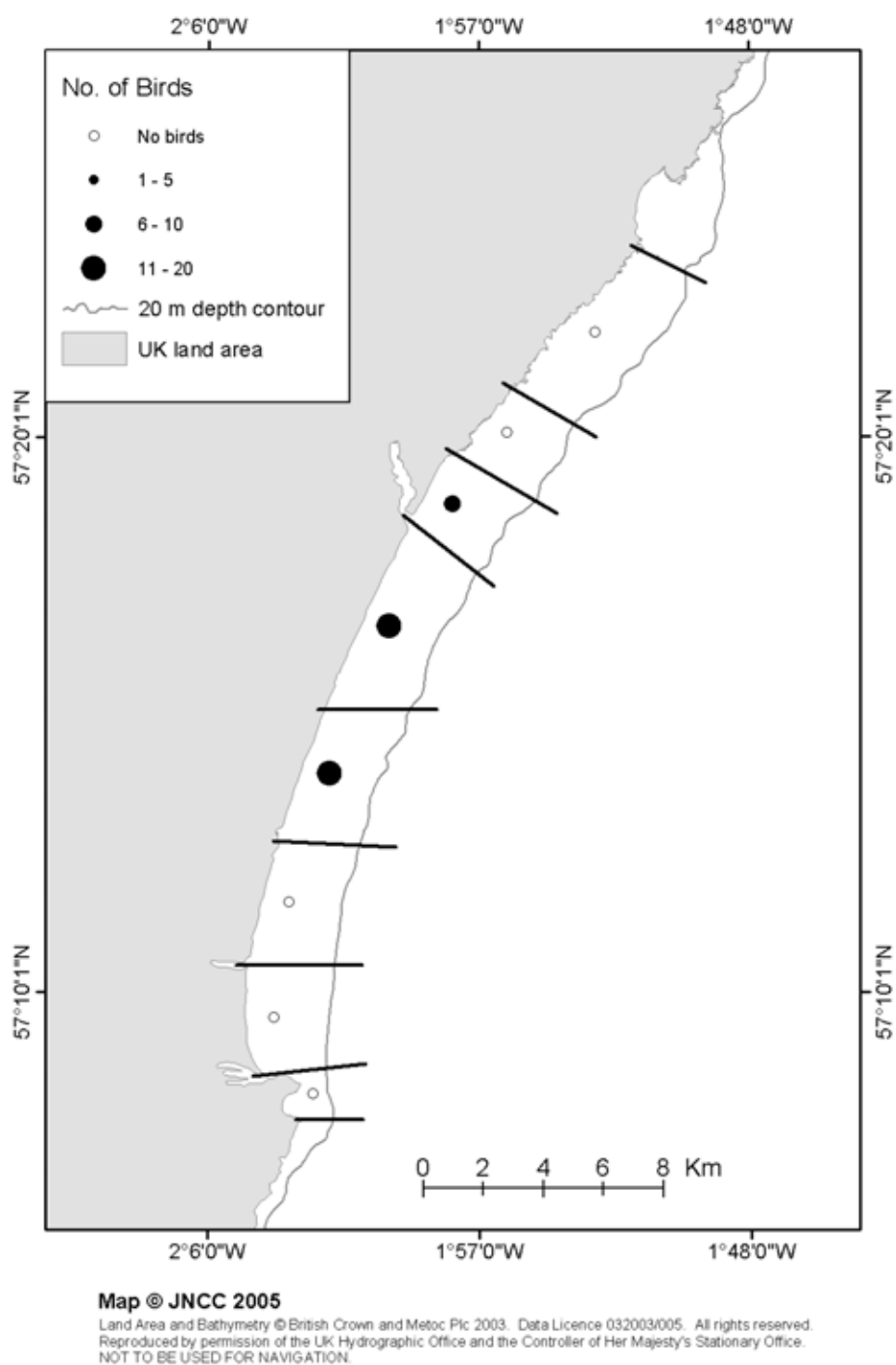


Figure A2.11. Numbers of velvet scoters observed, within each of the eight sub-sections in Aberdeen Bay, 23 October 2004.

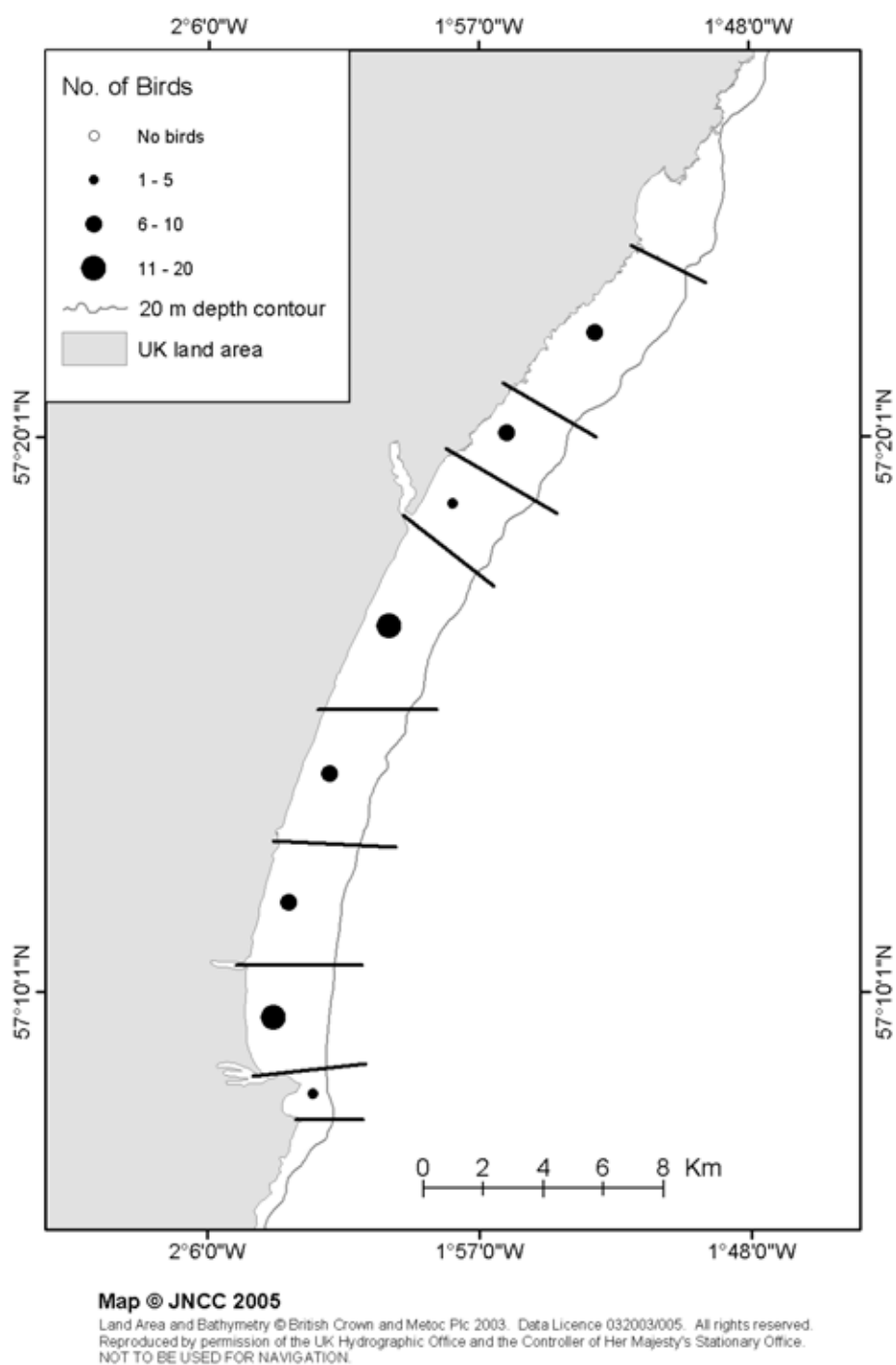
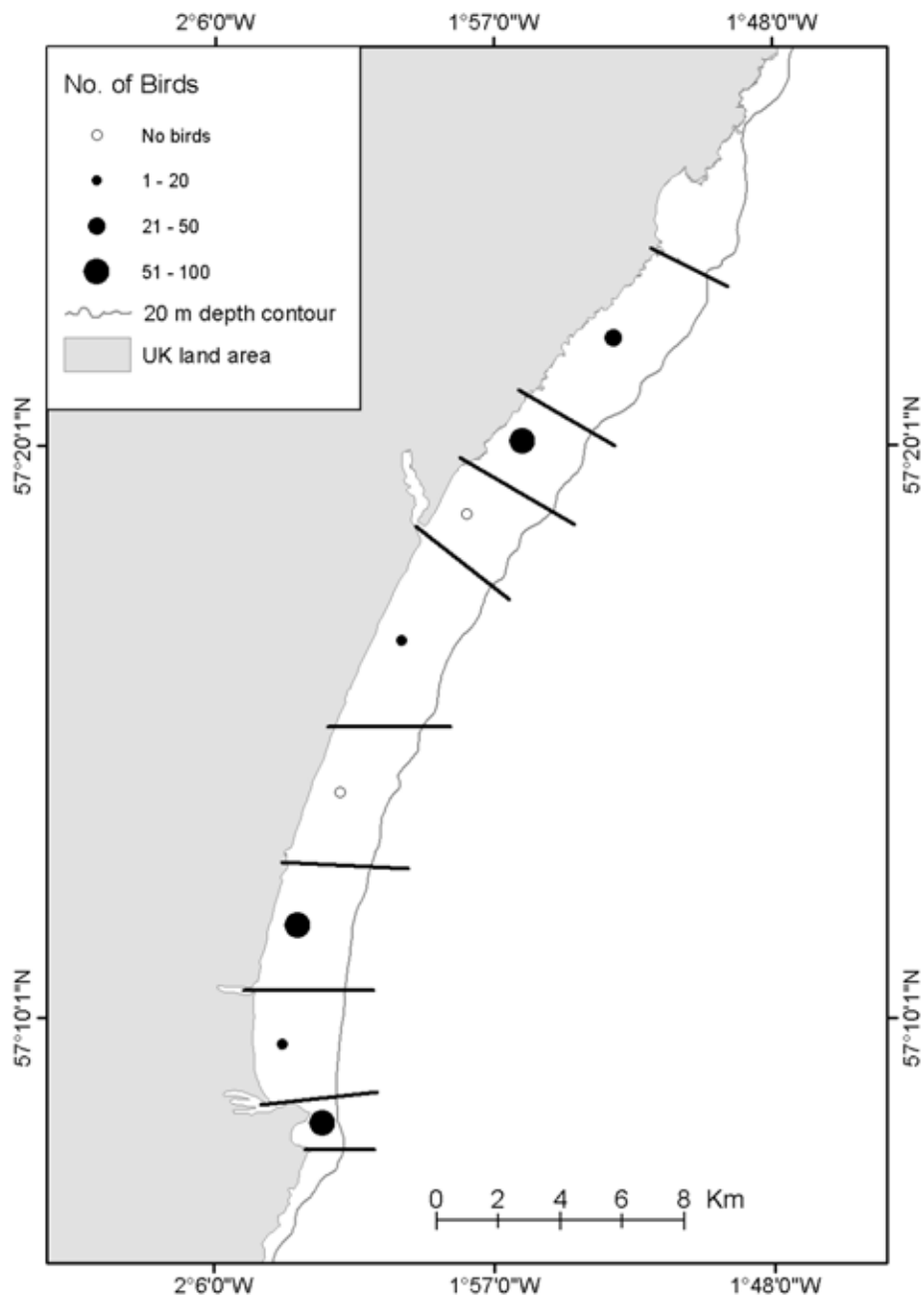


Figure A2.12. Numbers of red-throated divers observed, within each of the eight sub-sections in Aberdeen Bay, 23 November 2004.



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Figure A2.13. Numbers of common eiders observed, within each of the eight sub-sections in Aberdeen Bay, 23 November 2004.

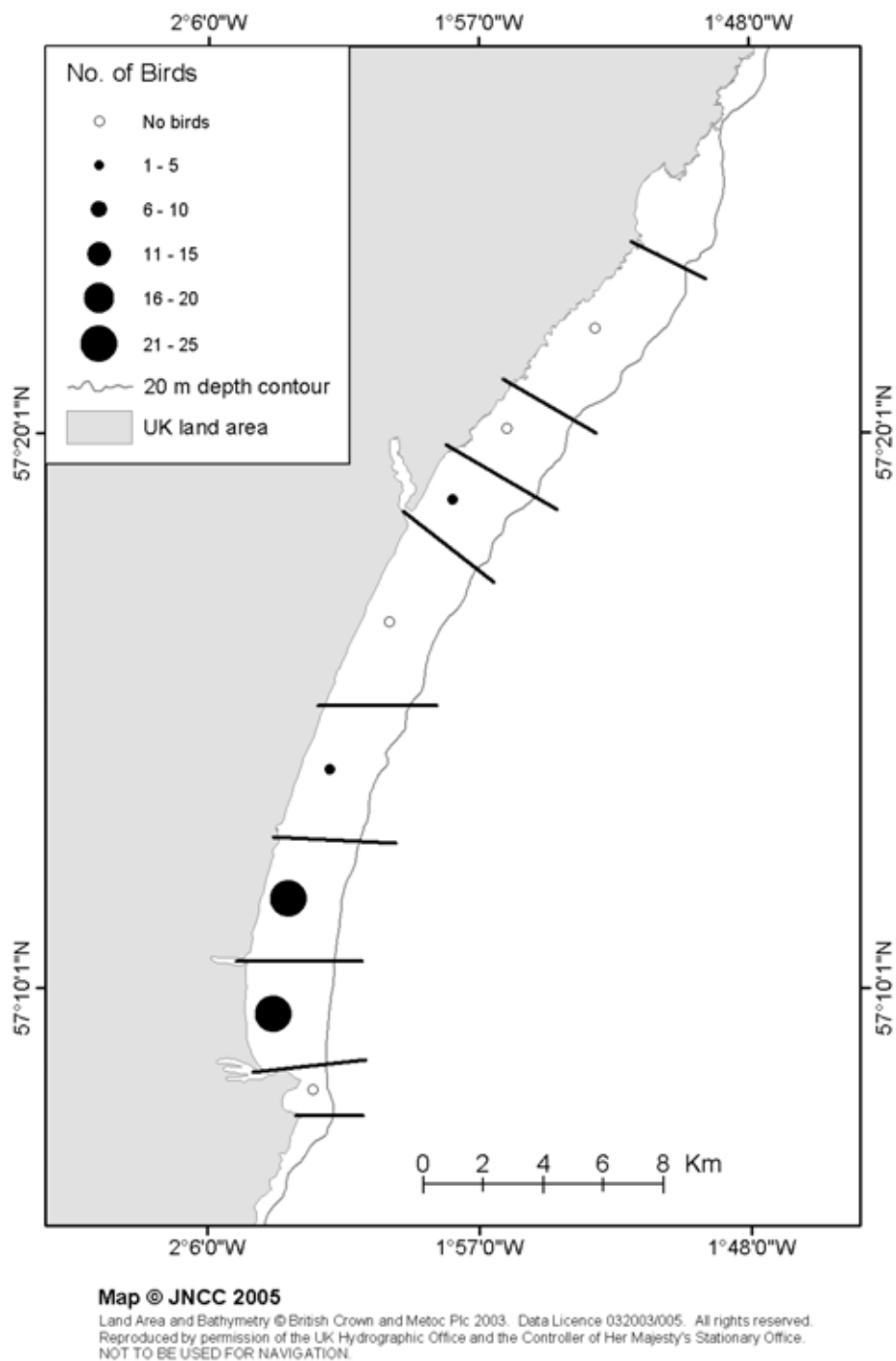


Figure A2.14. Numbers of long-tailed ducks observed, within each of the eight sub-sections in Aberdeen Bay, 23 November 2004.

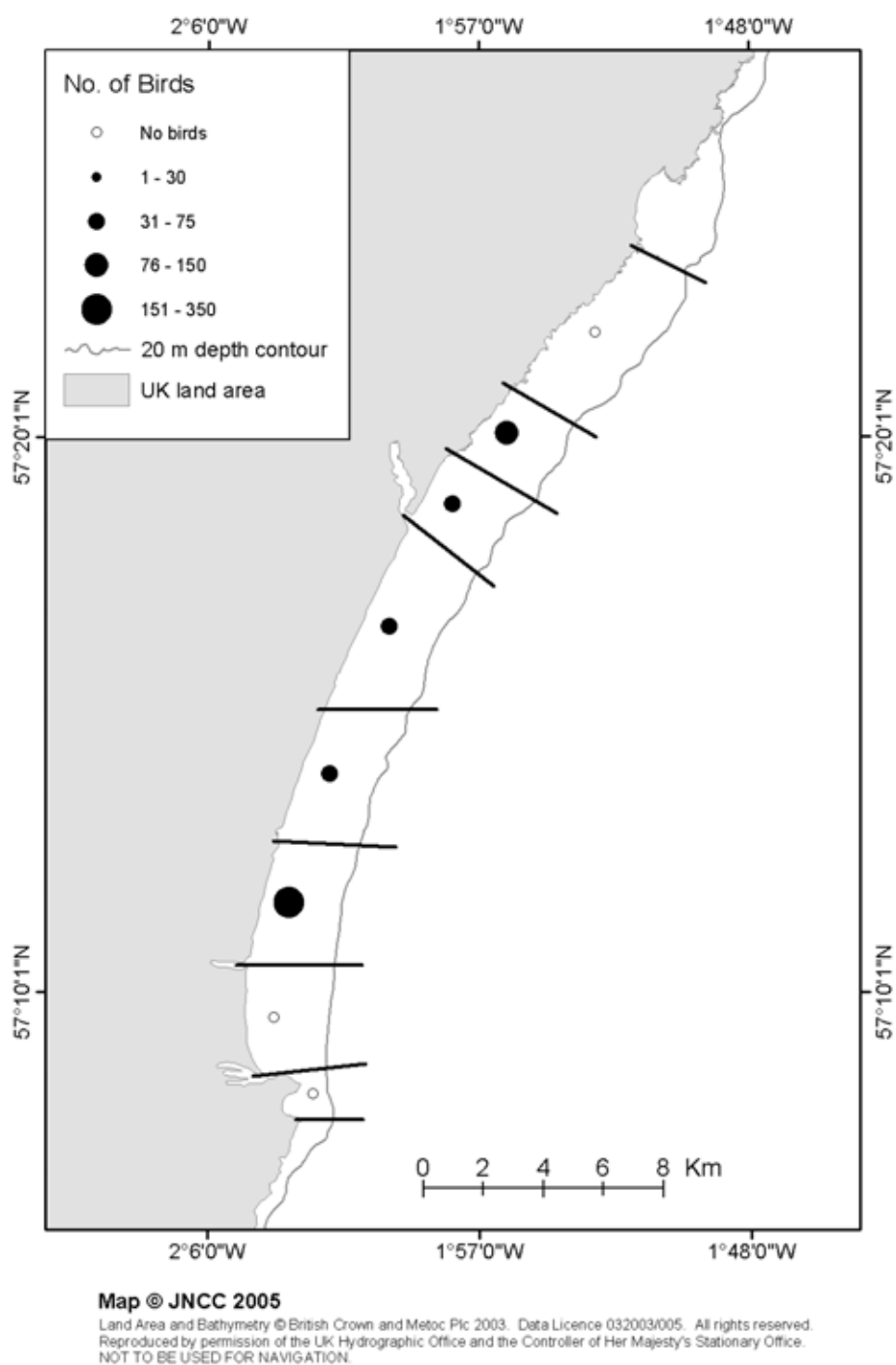


Figure A2.15. Numbers of common scoters observed, within each of the eight sub-sections in Aberdeen Bay, 23 November 2004.

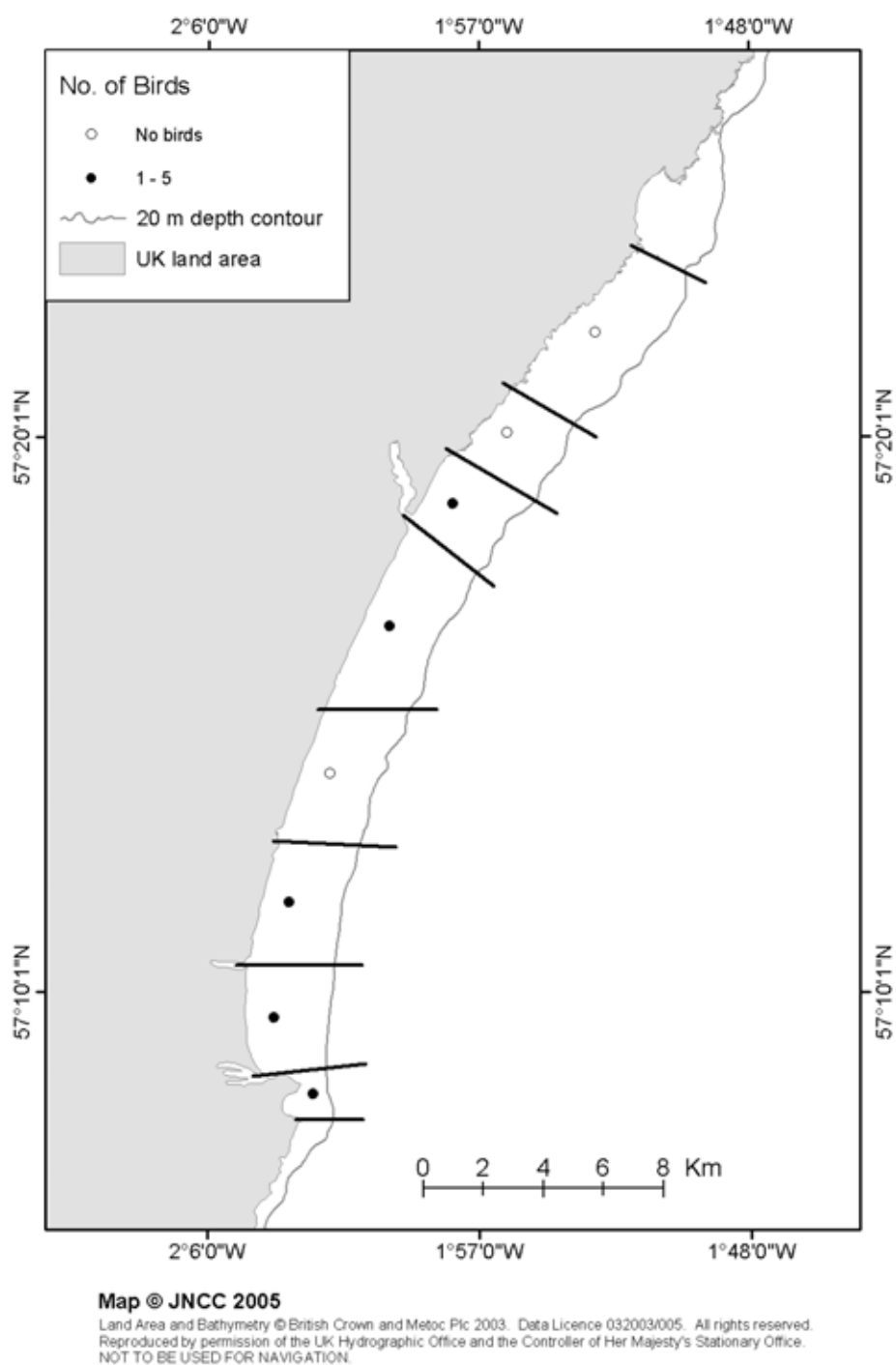


Figure A2.16. Numbers of red-breasted mergansers observed, within each of the eight sub-sections in Aberdeen Bay, 23 November 2004.

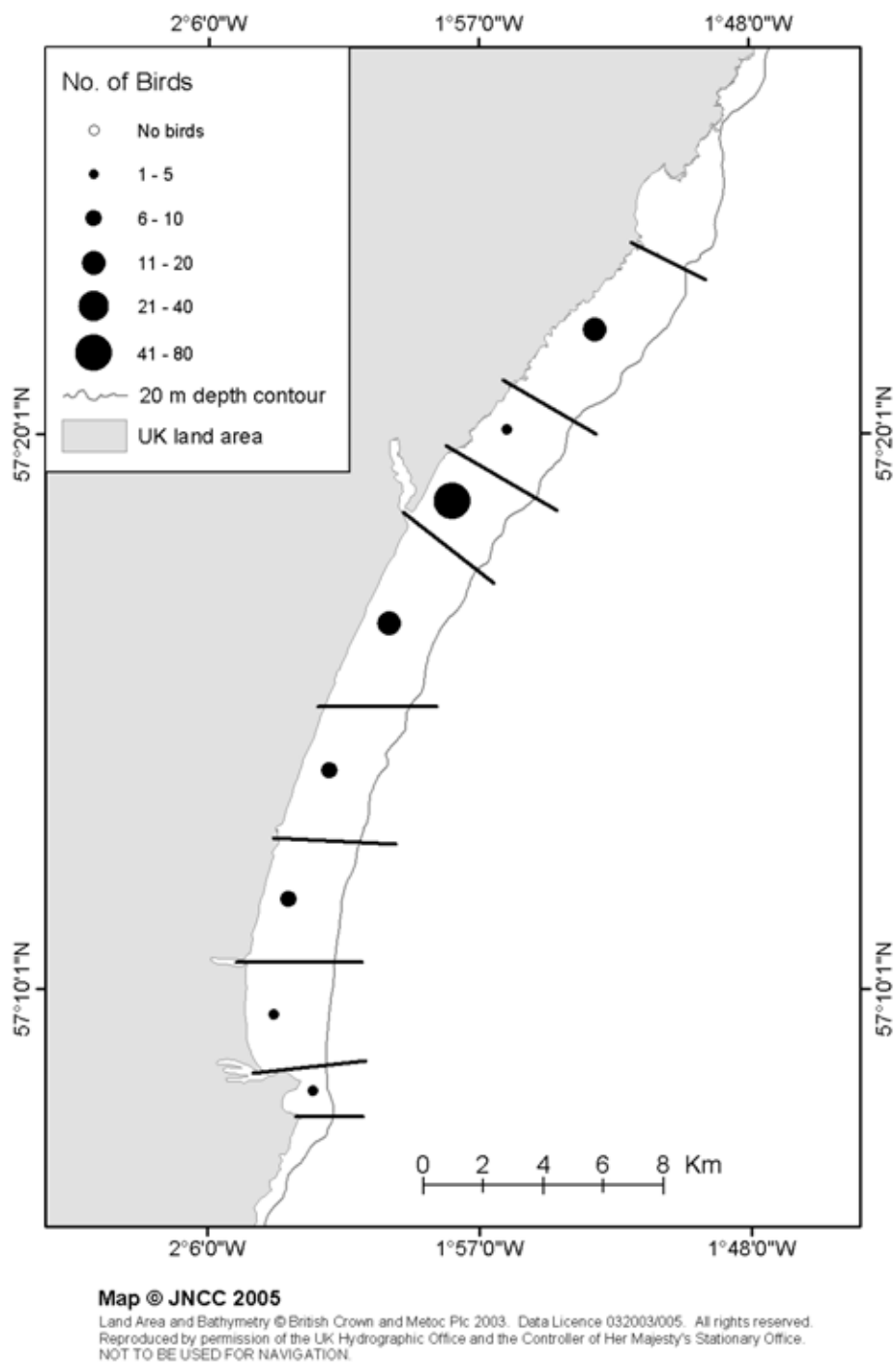
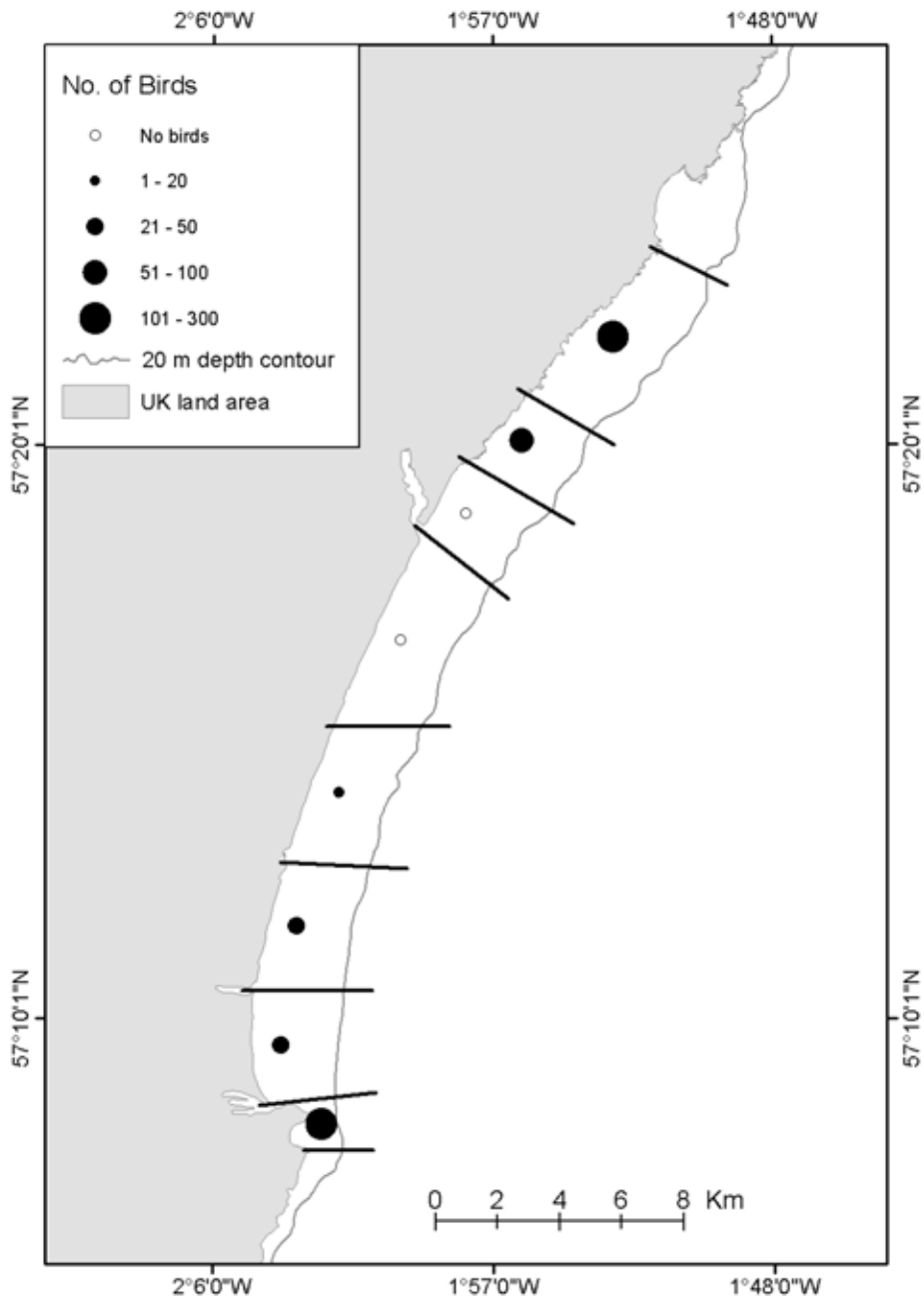


Figure A2.17. Numbers of red-throated divers observed, within each of the eight sub-sections in Aberdeen Bay, 31 December 2004.



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Figure A2.18. Numbers of common eiders observed, within each of the eight sub-sections in Aberdeen Bay, 31 December 2004.

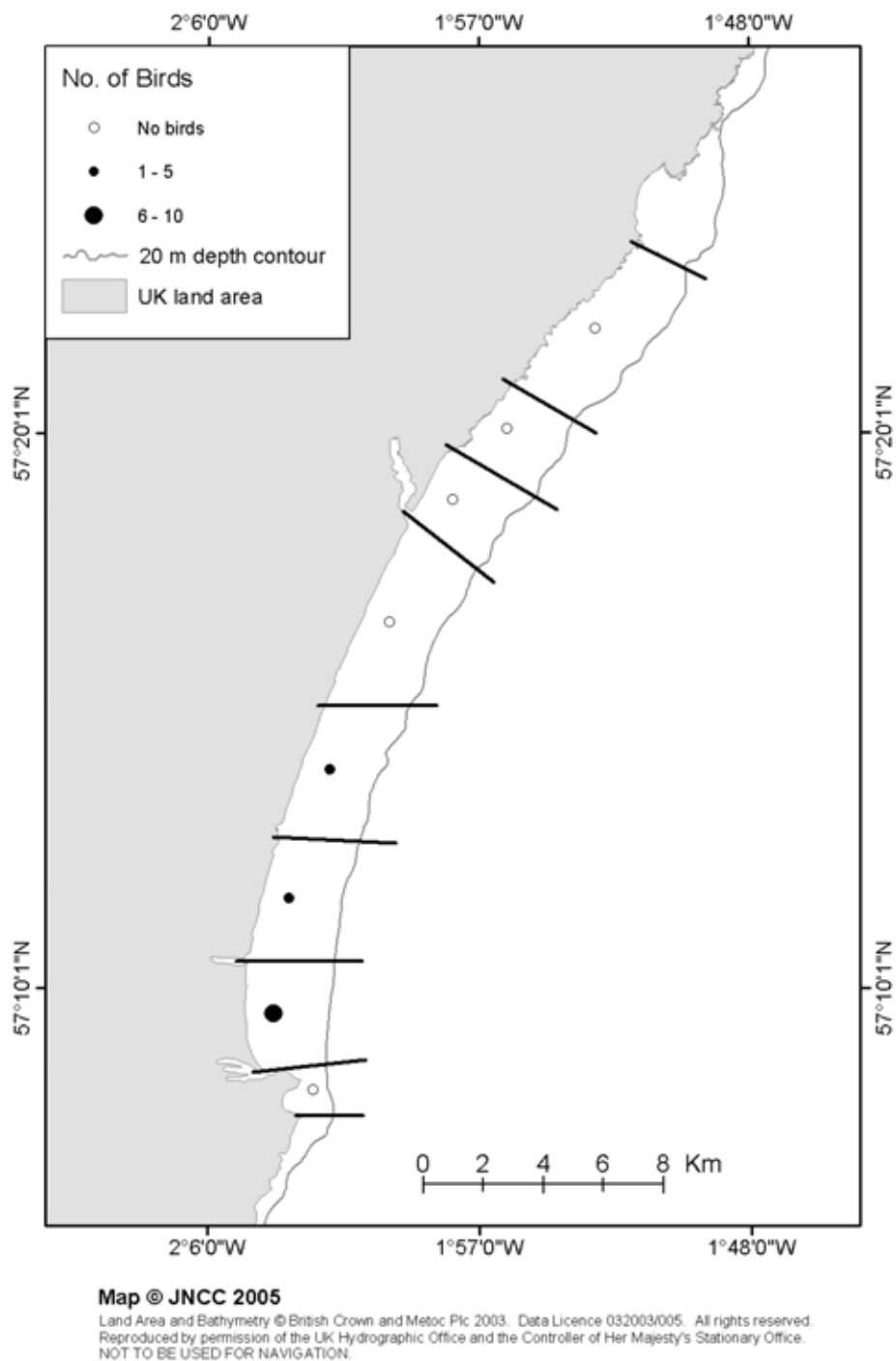


Figure A2.19. Numbers of long-tailed ducks observed, within each of the eight sub-sections in Aberdeen Bay, 31 December 2004.

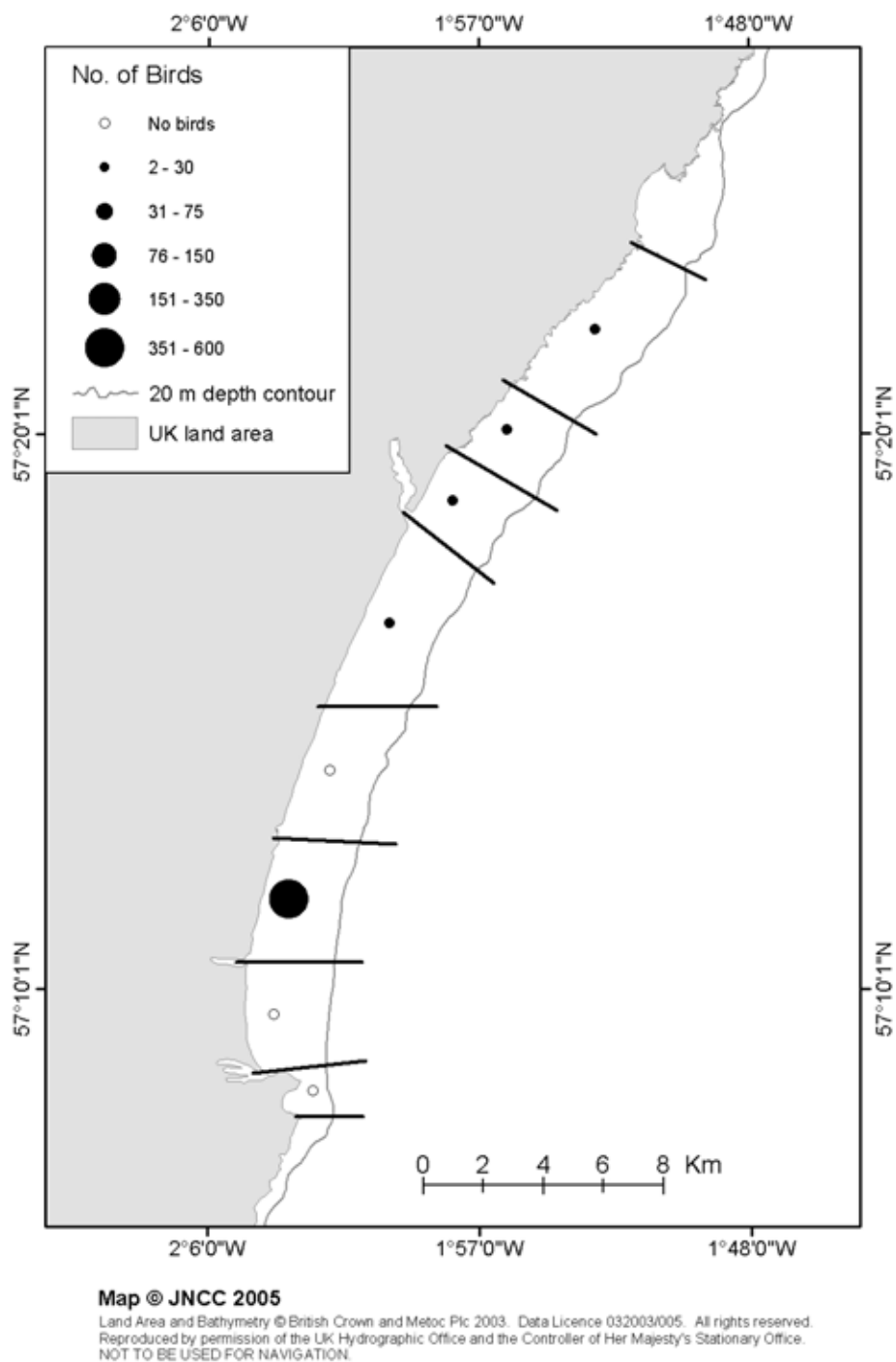


Figure A2.20. Numbers of common scoters observed, within each of the eight sub-sections in Aberdeen Bay, 31 December 2004.

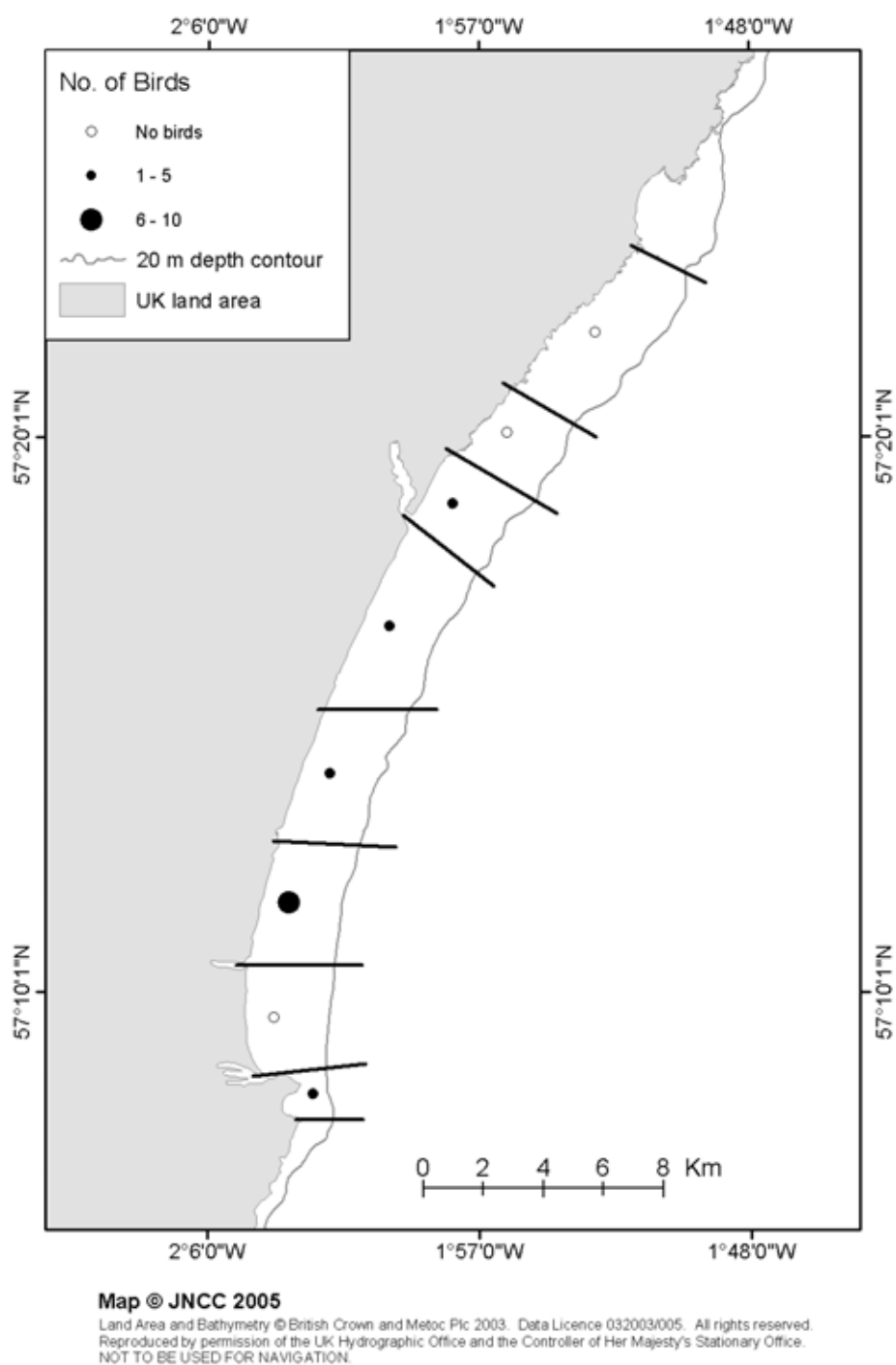


Figure A2.21. Numbers of red-breasted mergansers observed, within each of the eight sub-sections in Aberdeen Bay, 31 December 2004.

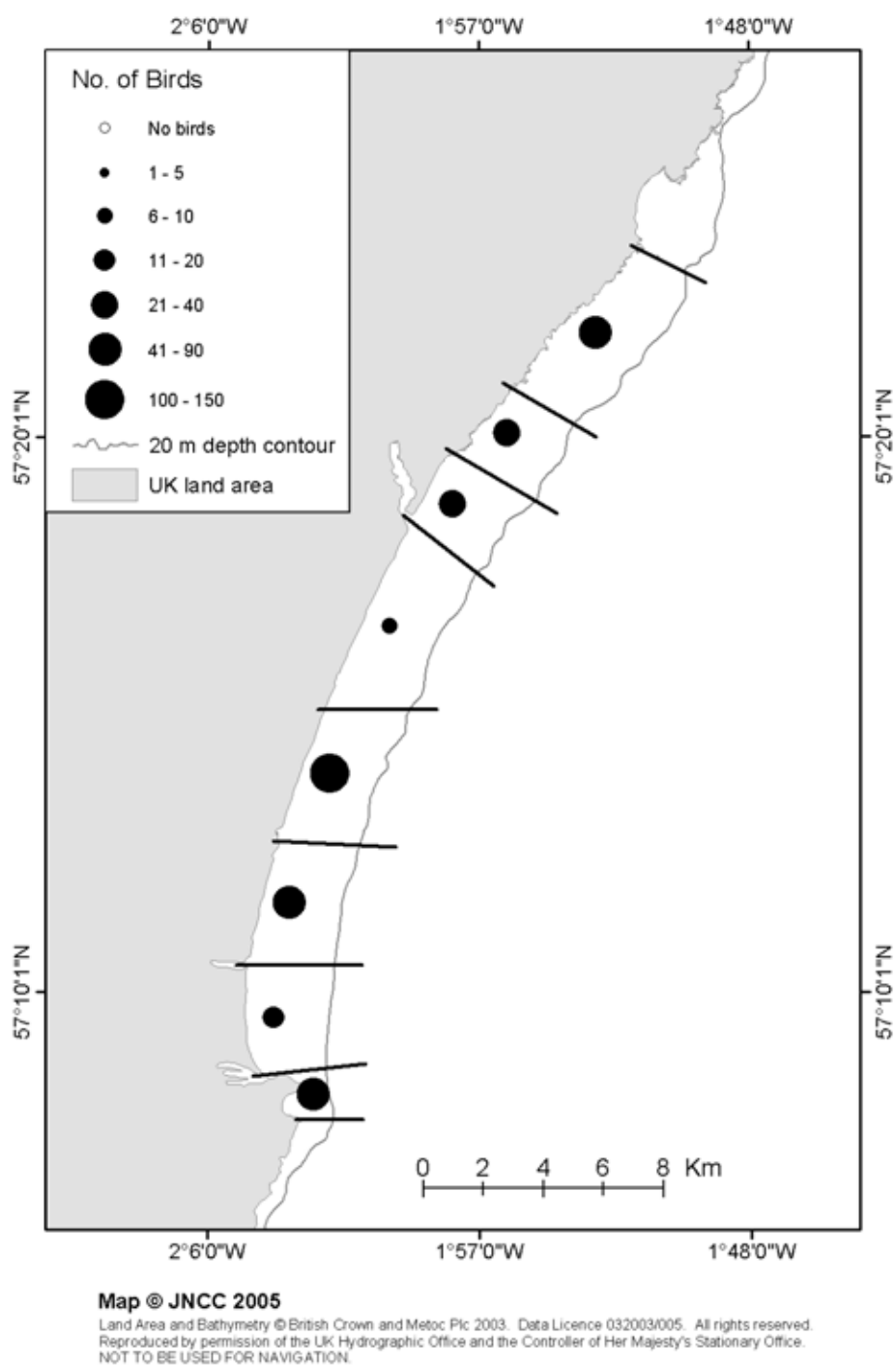


Figure A2.22. Numbers of red-throated divers observed, within each of the eight sub-sections in Aberdeen Bay, 2 May 2005.

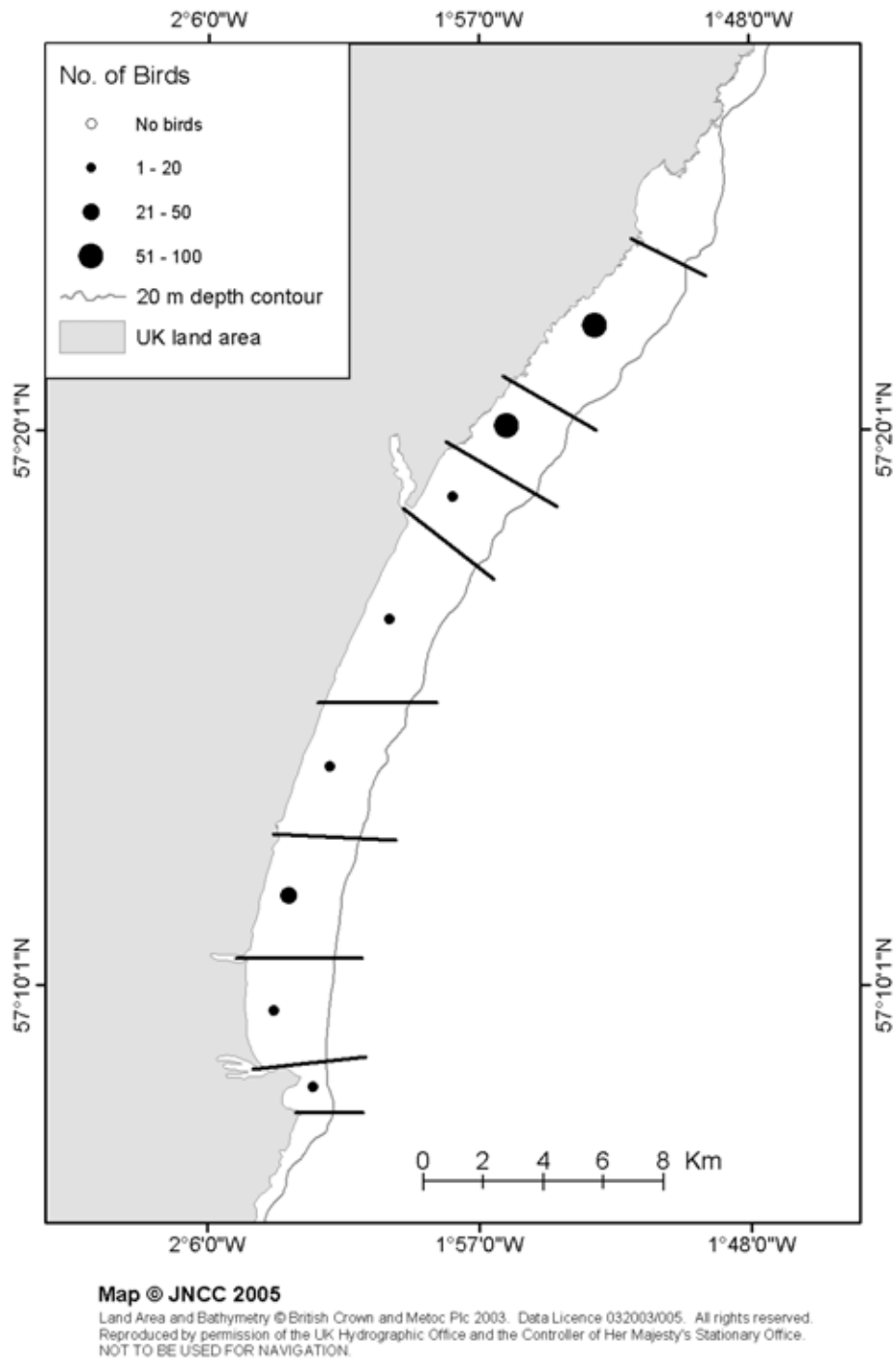


Figure A2.23. Numbers of common eiders observed, within each of the eight sub-sections in Aberdeen Bay, 2 May 2005.

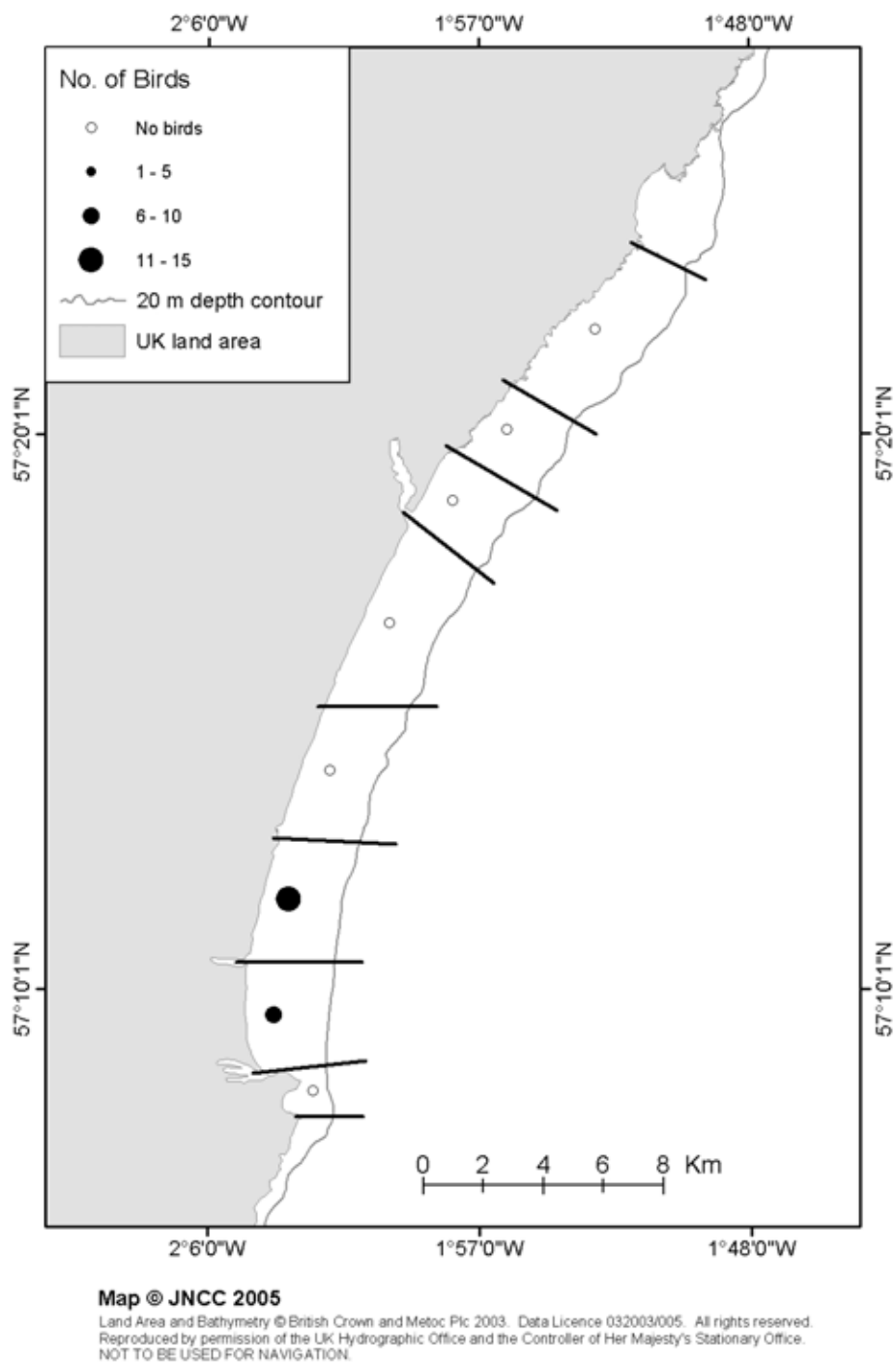


Figure A2.24. Numbers of long-tailed ducks observed, within each of the eight sub-sections in Aberdeen Bay, 2 May 2005.

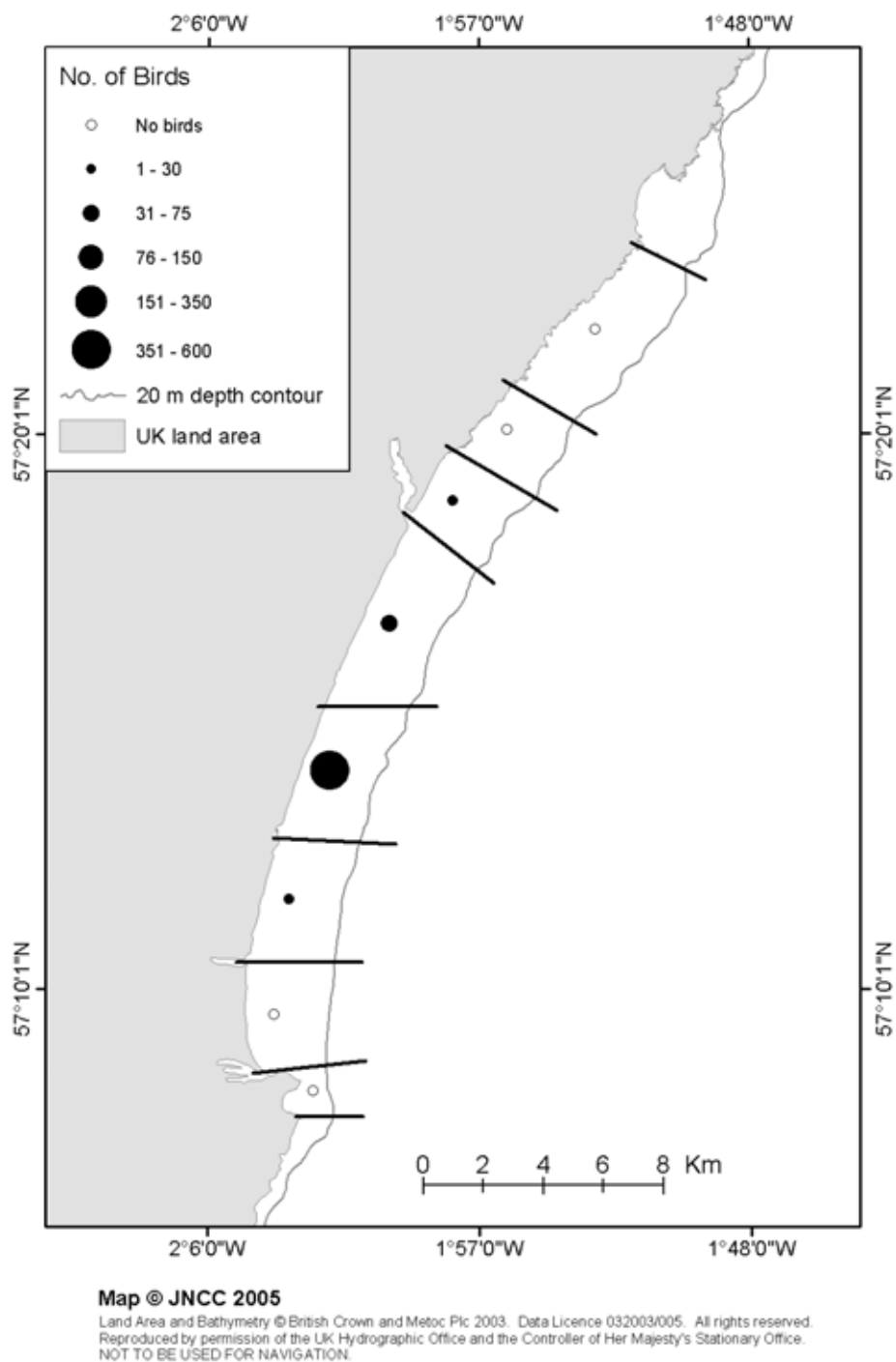


Figure A2.25. Numbers of common scoter observed, within each of the eight sub-sections in Aberdeen Bay, 2 May 2005.

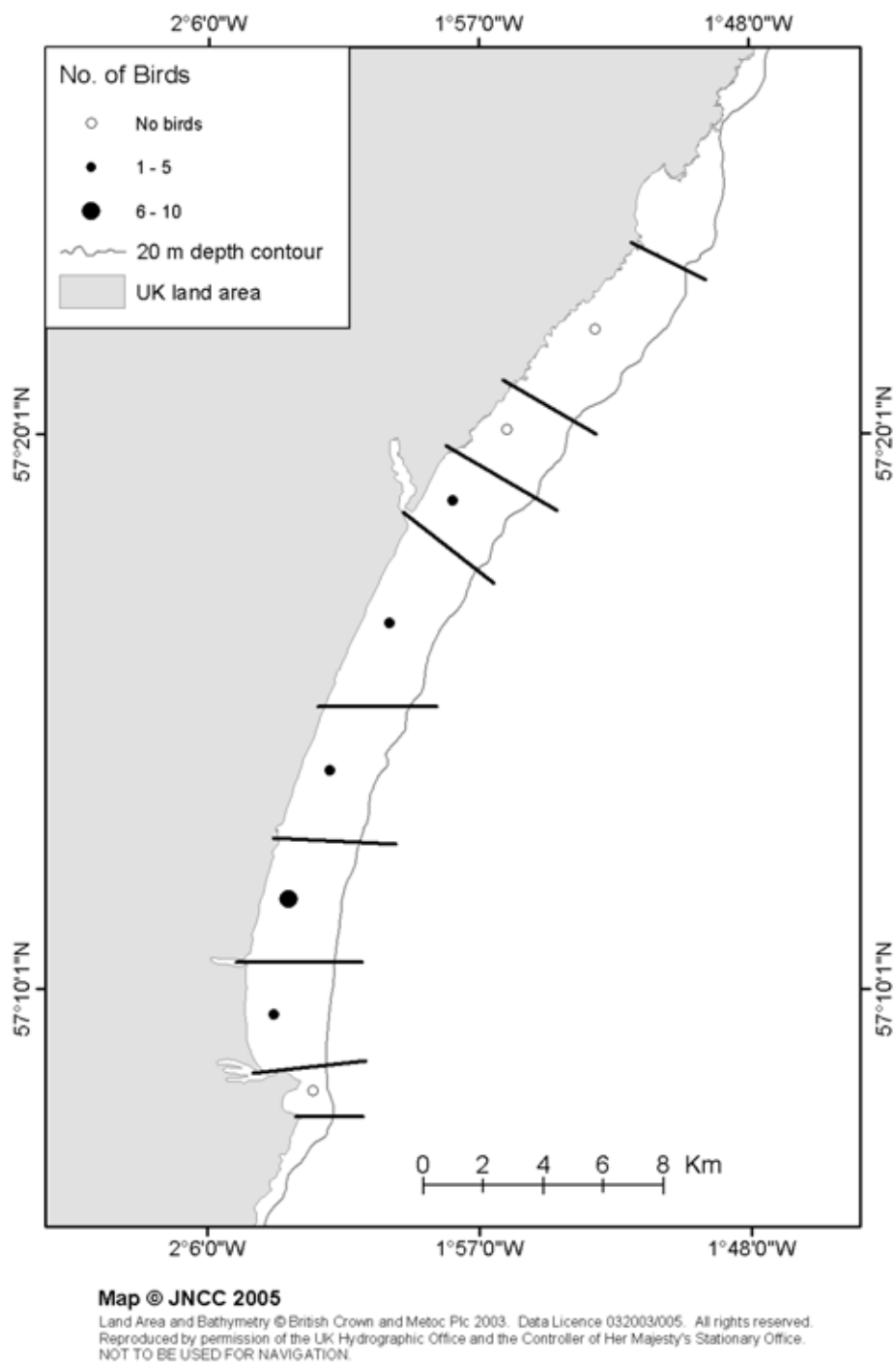


Figure A2.26. Numbers of red-breasted mergansers observed, within each of the eight sub-sections in Aberdeen Bay, 2 May 2005.

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