Scottish Natural Heritage
Research Report No. 1075

Scapa Flow proposed Special Protection Area (pSPA) – inshore wintering waterfowl survey 2017/18

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RESEARCH REPORT

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Scapa Flow proposed Special Protection Area (pSPA) – inshore wintering waterfowl survey 2017/18

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This report should be quoted as:

Jackson, D. 2018. Scapa Flow proposed Special Protection Area (pSPA) – inshore wintering waterfowl survey 2017/18. *Scottish Natural Heritage Research Report No. 1075.*

RESEARCH REPORT

Summary

Scapa Flow proposed Special Protection Area (pSPA) – inshore wintering waterfowl survey 2017/18

Research Report No: 1075
Project No. 016870
Contractor: Atlantic Ecology
Year of publication: 2018

Keywords

Scapa Flow pSPA, wintering waterfowl survey, great northern diver, black-throated diver, Slavonian grebe, European shag, red-breasted merganser, common eider, long-tailed duck, Orkney

Background

The Birds Directive (EC Directive on the conservation of wild birds (2009/147)) requires EU Member States to identify and classify Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species. In 2016, following an extensive programme of marine bird survey and analysis, the public were consulted (SNH *et al*, 2018) on the case for classifying ten proposed Special Protection Areas (pSPAs) within Scottish territorial waters (out to 12 nm). These included the Scapa Flow pSPA (SNH, 2016) identified to safeguard areas used by non-breeding great northern divers, black-throated divers, Slavonian grebes, common eiders, long-tailed ducks, red-breasted mergansers, common goldeneyes and European shags together with foraging areas used by breeding red-throated divers.

The identification of the Scapa Flow pSPA was underpinned by visual aerial and shore and boat-based surveys of non-breeding wintering birds carried out between 1998/99 and 2006/07. The survey work detailed in this report was commissioned in order to provide systematic counts across the winter of 2017/18 for all eight species identified as qualifying wintering interests of the Scapa Flow pSPA.

The surveys covered the whole of the marine extent of Scapa Flow using a combination of shore-based vantage point counts and boat-based line-transect surveys. These methods are comparable to those used on previous surveys of the same area. The pSPA also includes inshore waters to the south and east of Scapa Flow which were surveyed for the first time using the shore-based count method. Four count rounds were conducted corresponding to the following periods: Round 1, November to early December; Round 2, mid-December to early January; Round 3, mid-January to mid–February; and Round 4, March. Counts were restricted to favourable weather and sea conditions.

Main findings

- The peak 2017/18 winter counts (number of individuals) for the eight qualifying wintering species of the Scapa Flow pSPA, and equivalent percentages of GB wintering populations (Musgrove *et al.*, 2013), are as follows:

    - Great northern diver (non-breeding), 1,016 birds (≤40.6% GB);
    - Black-throated diver (non-breeding), 39 birds (7.0% GB);
    - Slavonian grebe (non-breeding), 161 birds (14.6% GB);
    - European shag (non-breeding), 3,726 birds (3.4% GB, 1.9% biogeographic);
    - Common eider (non-breeding), 2,324 birds (3.9% GB);
    - Long-tailed duck (non-breeding), 1,996 birds (18.1% GB);
    - Red-breasted merganser (non-breeding), 370 birds (4.4% GB);
    - Common goldeneye (non-breeding), 51 birds (0.26% GB).

- With the exception of common goldeneye, both the peak and mean counts in 2017/18 exceeded 1% of the relevant GB wintering populations. For great northern diver, black-throated diver, Slavonian grebe, common eider, long-tailed duck and red-breasted merganser the counts in all four rounds also exceeded these thresholds. For European shag, three of the four counts exceeded 1% of the GB wintering population and one count exceeded 1% of the biogeographic population.
- Within the count sectors in Scapa Flow, comparison of the 2017/18 count totals with corresponding shore and boat-based counts in 1998/99 and 2000/01 suggest a large increase in the number of great northern divers, moderate declines in numbers of black-throated divers, European shags and red-breasted mergansers and a large decline in common goldeneyes over this period. Numbers of the other qualifying species have remained relatively stable. No valid comparisons could be made of changes in numbers in the other parts of the pSPA (around South Ronaldsay and east of Burray and southeast Mainland), which were previously surveyed from the air.
- The distributions of all eight of the wintering qualifying interest species of the Scapa Flow pSPA are mapped and changes in numbers over the winter are also described.
- Count data for other waterfowl species wintering in the pSPA were also collected and are summarised in an Annex to the report.

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Acknowledgements

The great majority of 2017/18 shore counts were undertaken by Simon Pinder. Simon was also lead surveyor for the boat survey work. Simon's huge contribution to the survey, his field skills, weather, patience and dedication to completing the work on time are gratefully acknowledged.

Karen Yearsley, Nigel Harding, David Lambie (and the author) assisted with boat surveys and shore counts and are thanked for their help and good company. John Thornton the skipper of the MV Karin and his crew are thanked for their help with the boat surveys and the much appreciated hot soup and pizza brought out at regular intervals to revive cold surveyors.

Throughout the project Kate Thompson, the nominated SNH project officer, enthusiastically gave advice, clear direction and encouragement. Jim and Stewart Williams are thanked for general advice on the practicalities of undertaking counts in Scapa Flow.

The landowners and managers in Orkney who freely allowed the survey team to access shorelines and park vehicles are also gratefully thanked.

1. INTRODUCTION

1.1 Background

The Birds Directive (EC Directive on the conservation of wild birds (2009/147)) requires EU Member States to identify and classify Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species. There are 44 such species of marine birds, including breeding and wintering seabirds and wintering waterfowl, that occur in notable numbers in UK waters every year. Scotland is of particular importance to a range of inshore wintering waterfowl, including Slavonian grebe, great northern, black-throated and red-throated divers, all of which are Annex 1 species, together with eight migratory duck species and European shag.

In 2016, following an extensive programme of marine bird survey and analysis by JNCC throughout the UK[1], SNH ran a public consultation (SNH *et al.*, 2018) on behalf of Scottish Government on the case for classifying ten proposed Special Protection Areas (pSPAs) within Scottish territorial waters (out to 12 nm). In Orkney, these included the Scapa Flow pSPA (SNH, 2016) and North Orkney pSPA which were identified to safeguard areas used by non-breeding divers, Slavonian grebes, seaduck and European shags and foraging areas used by breeding red-throated divers.

The Scapa Flow proposed Special Protection Area (pSPA) covers the waters of Scapa Flow and adjacent coastal waters around South Ronaldsay, Burray and southeast Mainland (Figure 1). The qualifying features are non-breeding great northern diver (*Gavia immer*), black-throated diver (*Gavia arctica*), Slavonian grebe (*Podiceps auritus)*, common eider (*Somateria mollissima*), long-tailed duck (*Clangula hyemalis*), red-breasted merganser (*Mergus serrator*) common goldeneye (*Bucephala clangula*) and European shag (*Phalacrocorax aristotelis*) plus red-throated diver (*Gavia stellata*) in the breeding season.

The bird count data used to underpin selection of the Scapa Flow pSPA were derived from a combination of visual aerial surveys in the winters of 2002/03-2005/06 and shore/boat-based surveys in the winters of 1998/99, 2000/01 and 2006/07 (see section 1.3 for details). Together, these covered the entire pSPA, but the shore and boat-based counts were confined to the waters of Scapa Flow itself. The areas covered and the survey results are summarised in a JNCC report (Lawson *et al.*, 2015).

The survey work detailed in this report was commissioned in order to provide systematic shore-based counts across the winter of 2017/18 for all eight species identified as qualifying wintering interests of the Scapa Flow pSPA. The surveys covered the whole of the marine extent of Scapa Flow using a combination of shore-based vantage point counts and boat-based line-transect surveys. These methods are comparable to those used on previous surveys and additionally include the areas of the pSPA to the south and east of Scapa Flow previously only covered by visual aerial survey. Four count rounds were conducted corresponding to the following periods: Round 1, November to early December; Round 2, mid-December to early January; Round 3, mid-January to mid–February; and Round 4, March. Counts were restricted to favourable weather and sea conditions.

The results of a survey of inshore wintering waterfowl interests in the North Orkney pSPA over the same winter (2017/18) are reported elsewhere (Upton *et al*., 2018).

[1] For further information see http://jncc.defra.gov.uk/page-4184

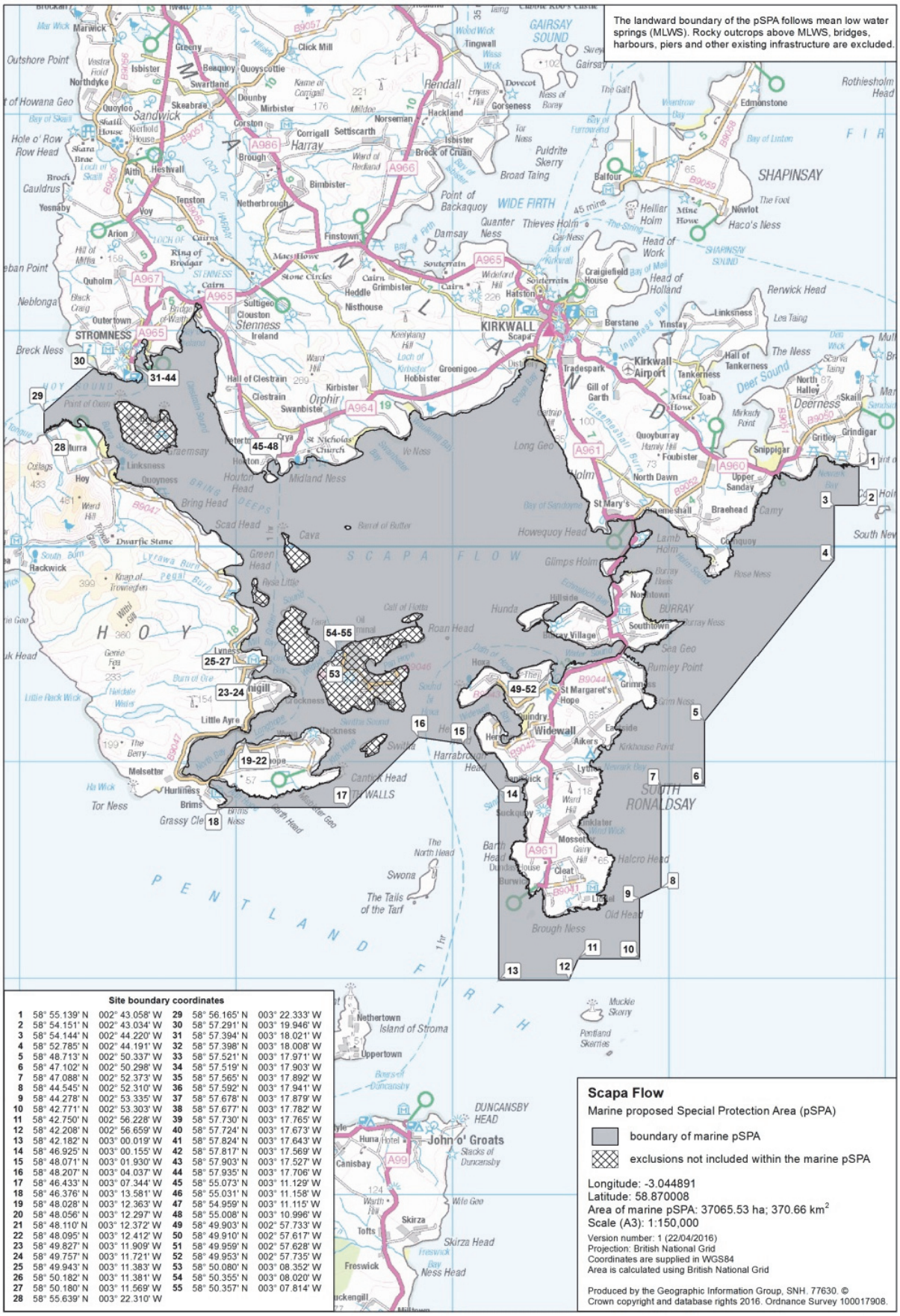

Figure 1. Proposed boundary of Scapa Flow pSPA.

1.2 Species of interest

The proposed SPA non-breeding qualifying species that were the focus of the surveys reported here are: great northern diver, black-throated diver, Slavonian grebe, common eider, long-tailed duck, red-breasted merganser, common goldeneye and European shag.

Red-throated diver is proposed as a qualifying species in the breeding season only, and was therefore not treated as a priority species for the winter surveys.

A wide range of other wintering waterfowl species occur alongside the qualifying species. These include red-throated diver, great cormorant, black guillemot, velvet scoter and several other seabirds and wildfowl species. Counts of these are of interest for wider ornithological monitoring of Orkney birds and to the understanding the conservation importance and ecological processes of the survey area.

1.3 Previous surveys

1.3.1 Shore-based surveys

There have been previous systematic shore-based surveys of wintering water birds in Scapa Flow as follows:

- 1974-1978, multiple counts (Lea, 1980)
- October 1988 to March 1989, monthly (Christer, 1989)
- October 1998 to March 1999, monthly (Williams, 1999)
- November 2000, January and March 2001 (Williams, 2001)
- November 2006 and January 2007 (Williams, 2007)

All of these surveys undertook a series of repeat counts of all water-bird species over the winter period from around the perimeter of Scapa Flow. The three surveys by Williams also undertook monthly boat-based counts of the central part of Scapa Flow.

There have been no previous shore-based surveys of the proposed East Coast and Southern Approaches parts of the pSPA (i.e. the parts outside Scapa Flow) (see section 2.2).

1.3.2 Visual aerial surveys

JNCC conducted visual aerial line-transect surveys of Scapa Flow and nearby coastlines as follows (Lawson *et al*., 2015):

- December 2002, partial coverage of Scapa Flow
- February 2004, all Scapa Flow, East Coast and Southern Approaches
- March 2005, all Scapa Flow, most of East Coast and Southern Approaches
- January and February 2006, all Scapa Flow, most of East Coast and Southern Approaches

Visual aerial surveys are ineffective at recording some species (notably grebe species and common goldeneye) and are not able to differentiate similar looking species (e.g. black-throated diver from great northern diver). Furthermore, they are based on sampling transects and so do not record all the birds present. Thus the raw data will under-record the true numbers present at the time of survey, but estimates can be corrected by *Distance* sampling and other methods (Dawson *et al*., 2009). Despite their limitations, visual aerial surveys are very effective at establishing the relative importance of areas to a species/species groups and allow large areas to be surveyed rapidly and at relatively low cost.

1.4 Survey aims

The primary aims of the 2017/18 survey were to collect four rounds of count data in the winter period between November 2017 and March 2018 of the eight proposed qualifying species wintering in the Scapa Flow pSPA, using shore-based and boat-based survey methods comparable to those used on previous surveys, and to collate and report on the count data.

Secondary aims were to record and map distributions of the proposed qualifying species to a fine level of spatial resolution, and, subject to the constraints imposed by available fieldwork time, to count other waterfowl and seabird species.

2. METHODS

2.1 Overall survey design

The survey design concerns the boundaries of the survey area, the timing and number of counts made, and the field methods deployed to count birds. The survey area was defined by the extent of the Scapa Flow pSPA (SNH, 2016) (Figure 1).

The approach to counting was to undertake four repeat counts (count rounds) over the 2017/18 winter using a combination of shore-based and boat-based counts that, together, as far as was practically possible, gave complete coverage of the survey area without duplication. A shore-based survey method was used for counting all 'inshore' parts of the survey area; defined as those parts that lie within approximately 2km of an accessible coastline. The coasts of uninhabited islands were considered to be inaccessible unless joined to an inhabited island by a bridge or causeway. A boat-based survey method was used to survey the large 'offshore' area in the centre of Scapa Flow that could not be counted from land.

Each count round was planned to be completed in as short a time as feasible but within the constraints imposed by weather, short winter day lengths and the number of surveyors available. Given the size of the area it was anticipated from the start that it was likely to take 12-18 person-days of fieldwork (not including time lost to bad weather) to complete each round of shore-based counts and a single day to undertake each boat-based count.

2.2 Survey area divisions

The boundaries of the 44 Scapa Flow count sectors first defined in the 1998/99 survey (Williams, 1999) were adopted. Fifteen new count sectors were defined and digitised for the 'East Coast' and 'Southern Approaches' i.e. those parts not included in the previous shore-based surveys (Figure 2).

For the purposes of the survey, the pSPA was considered as four component parts (Table 1). For purposes of summarising the survey results, the survey area was divided into 15 sub-areas, each of which (with the exception of the Scapa Flow 'offshore' sub-area) corresponded to a number of shore count sectors (Table 1, Figure 2).

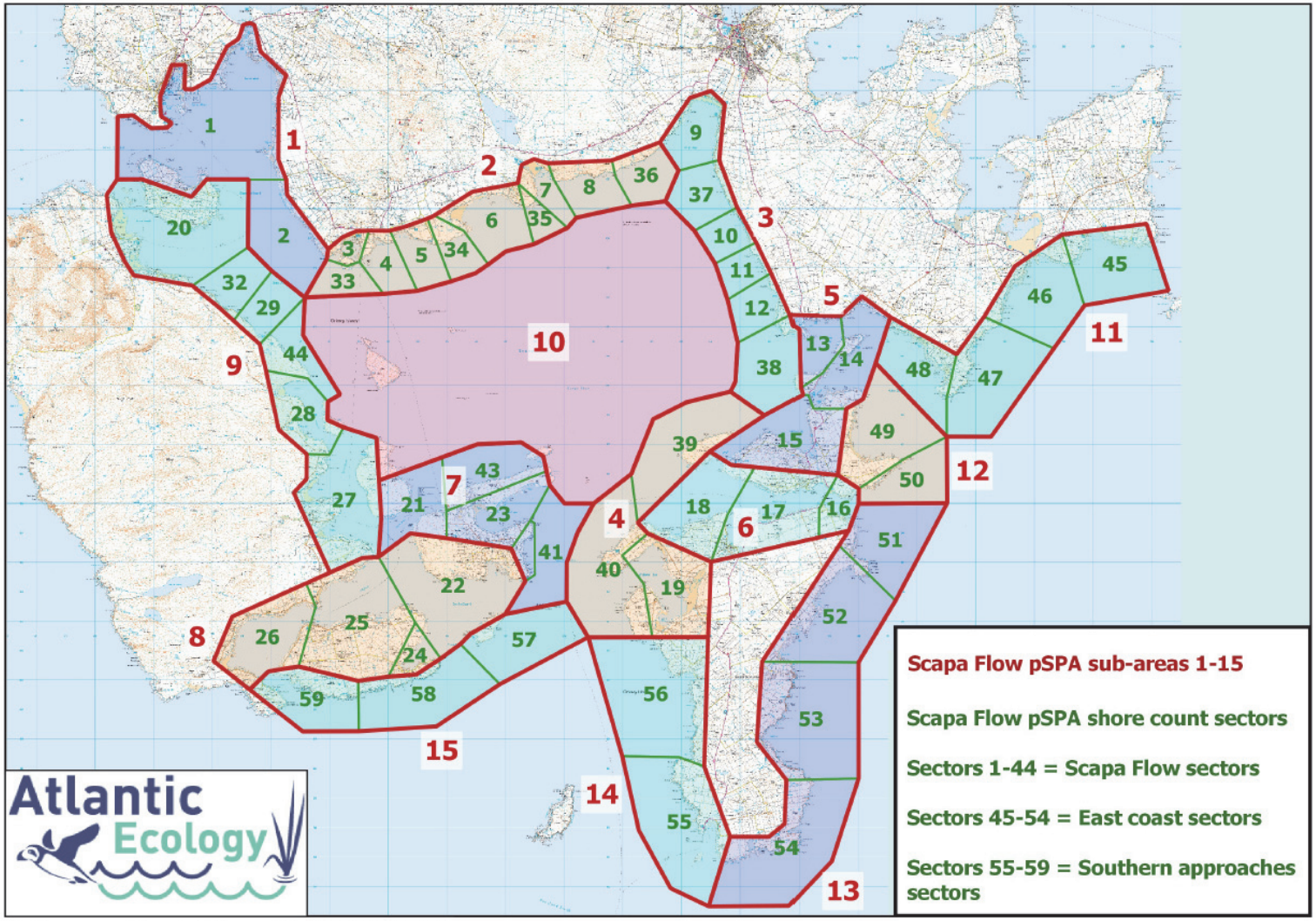

Figure 1. Scapa Flow pSPA 2017/18 winter waterfowl survey sub-area and count sectors.

Table 1. Spatial divisions of the pSPA used in the 2017/18 winter waterfowl survey

Part	Description	Sub-areas	Shore count sectors
Scapa Flow 'inshore'	The coast and inshore waters of Scapa Flow	1 to 9	1 to 44
Scapa Flow 'offshore'	The central offshore part of Scapa Flow, approximating to the areas more than 2km from accessible shorelines.	10	(surveyed by boat)
East Coast	The coast and inshore waters from Point of Ayre in eastern Mainland Orkney southwards to the south end of South Ronaldsay.	11 to 13	45 to 54
Southern Approaches	The coast and inshore waters off the west coast of South Ronaldsay, the south and east coasts of Flotta and to the south of South Walls	14 & 15	55 to 59

Four small brackish lochans (Loch of Ayre, Dam of Hoxa, Echna Loch and Liddel Loch) that are located very close to the Scapa Flow shoreline and which were clearly an integral part of the Scapa Flow inshore habitat system (as far as birds are concerned) were also included in the survey area for completeness. Birds counted at these lochans were totalled separately to the counts from the marine areas as these sites fall outside the boundary of the pSPA. It is not clear if these lochans were counted during previous shore-based surveys.

2.3 Shore-based survey methods

2.3.1 Vantage point selection

The shore-based counts were undertaken from a series of carefully selected vantage points that between them gave complete visual coverage of the inshore count area (Figure 3). Shore vantage points were selected on the basis of ease of access and the view they afford of the count sections. Many of the VPs used to count Scapa Flow were the same as those used for the 1998/99 survey.

Based on experience of undertaking shore-based counts of marine birds at other sites in Scotland, survey work was planned on the assumption that, provided sea conditions were reasonably calm and that the surveyor was at an elevation of at least 5 m, birds on the sea could be detected, identified and accurately counted at distances of up to 2km from a vantage point (VP) with the aid of a spotting scope.

The same VPs were largely used for every count round, but in some cases (about 20% of VPs) it was advantageous to vary the VP used according to prevailing conditions. For example, the best counting location for an area could change due to differences in sun glare, sea state and wind direction. In addition, some of the VPs chosen for Round 1 (many of which were the same as were used for the 1999 counts) were found to be unnecessarily close together and alternative VPs that allowed for more efficient coverage of the survey area were used on subsequent count rounds.

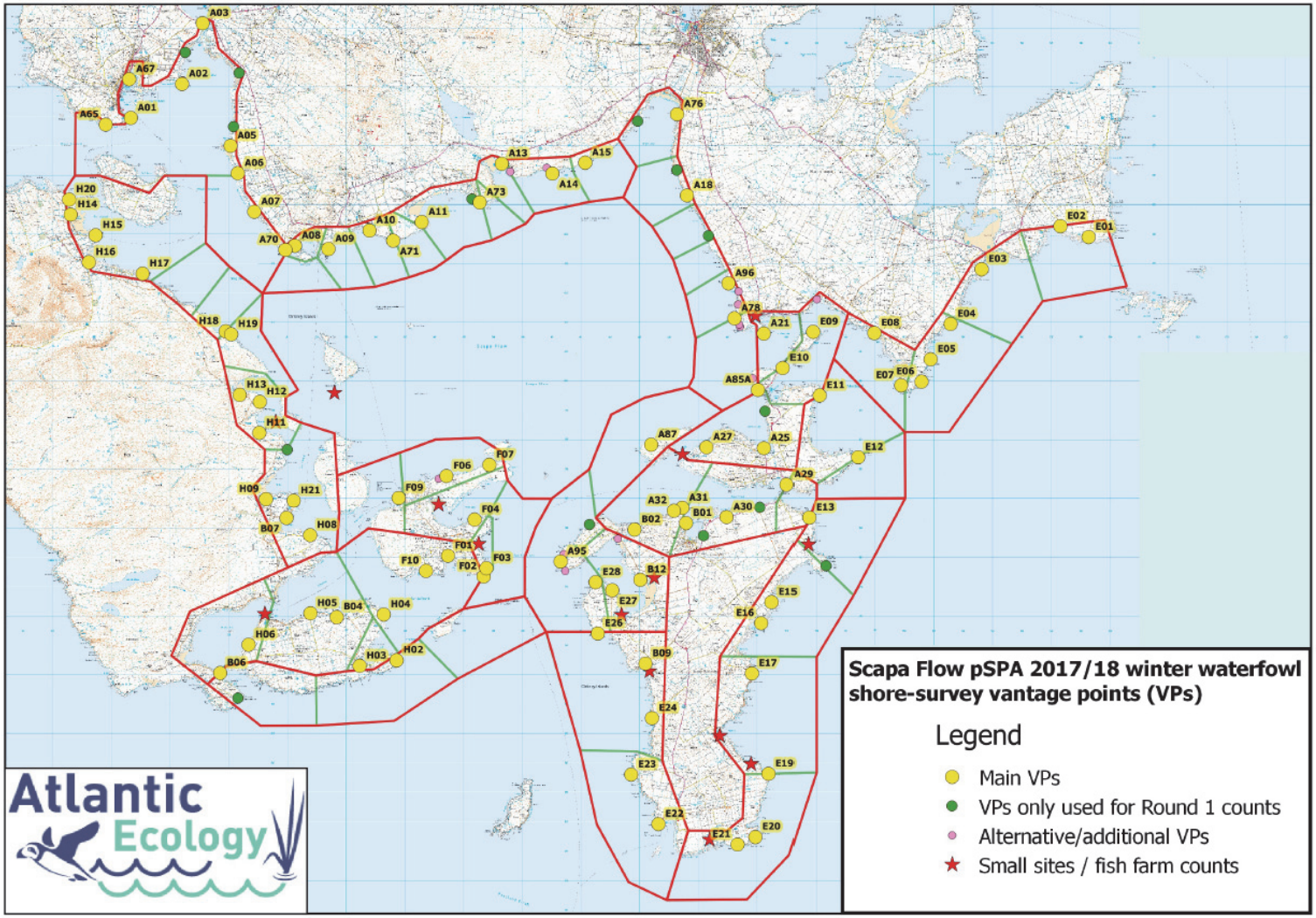

Figure 2. Scapa Flow pSPA 2017/18 winter waterfowl survey shore vantage points.

2.3.2 Counting and data recording

Shore-based survey work was undertaken by experienced ornithologists working alone. Binoculars (10x) and a zoom spotting scope (20-60x) were used to locate and identify birds in the count sections.

On arrival at a VP the surveyor first decided and noted the limits of the area to be counted, bearing in mind that some parts of the visible area, within 2km, may be better seen and counted from one of the other VPs. Typically, a VP's defined count area comprised the great majority of the visible coast and waters within 2km of the VP. The surveyor then systematically searched this defined area with the aid of their binoculars and telescope. To increase search efficiency and reduce the potential for double recording, the area was searched from one side to the other (e.g. from the right hand limit to the left hand limit). Typically it took 15-20 minutes to search the area and record the data. The actual time required depended on the size of the area, the number of birds present, sea state and light conditions. For example, counting in conditions of sea state 3 or greater increased the time taken, due to the reduced detectability of birds. In light of the many variables that could affect how long it took to search the count area, no time limit was set. Essentially the surveyor took as long as was required to obtain a single accurate count of the birds present. Start and end times, weather and sea conditions, were recorded for each VP count and the VP grid reference was recorded using a hand-held Garmin GPS unit.

All waterfowl species were searched for and recorded. Searches included roosting birds on the shorelines, cliffs, islets etc. even though many of these roost sites were above the tide line and thus located just outside the pSPA boundary. Nevertheless, as these species all depend on marine habitats for feeding, there was no doubt that these 'on-land' individuals were part of the populations wintering in the Scapa Flow pSPA. Amongst the qualifying species, only common eider, European shag and great cormorant commonly roosted on land. Previous shore-based surveys have included records of these species roosting on land. Flying birds were not recorded unless they landed in the count area or it was considered to be a notable record on account of the number of birds or the species' rarity.

For each individual/group located, the following information was recorded on a bespoke recording form (Annex 1: Form 1): species; number; plumage; behaviour; and location.

Plumage and behaviour were recorded according to standard plumage (e.g., summer, winter, transition, immature) and behaviour codes (Annex 1: List of Codes). The most commonly noted behaviours were resting on water (OW), diving (DV), feeding (FE), roosting on water (RW), and roosting on land (RL).

For flocks of up to approximately 200 birds, flock size was determined by counting birds individually. A mechanical tally counter was used when it was considered helpful to do so. For larger flocks (in practice this was only a few common eider and long-tailed duck flocks), flock size was determined by counting in units of five or ten birds at a time. All flocks of more than 30 birds of SPA qualifying species were counted at least twice to ensure accuracy, the surveyor recording the count they considered to be most accurate. If there was uncertainty about the precise size of a flock (for example because some birds were always out of sight diving) the surveyor recorded the count range they considered the true flock size lay within. In practice this situation occurred rarely; at the analysis stage the count value for these records was assumed to be the mid-point of the range recorded.

2.3.3 Recording location

For the eight pSPA qualifying species, plus black guillemot and great cormorant, bird location was usually recorded in terms of a compass bearing and an estimated distance from

the VP. With this information and grid reference of the VP, a bird location can be estimated using simple trigonometry. Compass bearings were measured to the nearest degree with a Type 54 Silva sighting compass. The distance to a bird was usually estimated to the nearest 100m. Distance was estimated with the aid of bespoke 1:25000 scale field maps on which were marked concentric circles at 200m intervals centred on the VP. The complex nature of the coastline in the survey area greatly facilitated the estimation of distance, as it meant there were nearly always recognisable landscape features at known distances from the VP e.g. opposing shoreline, islets and headlands. These known-distance landmarks also meant that surveyors obtained feedback on the true distance to features and thus were able to constantly improve their ability to estimate distance generally. In the case of European shags and great cormorants roosting on land, the location was usually recorded directly as the grid reference of the location read from the OS map or with reference to a precise landmark named on the OS map, whose grid reference could be determined later. To save time, no bird location information was recorded for other species.

2.3.4 Survey coverage and minimising the potential for double recording

Care was taken to minimise the potential for recording the same birds on multiple occasions within a survey round (double recording). Double recording is undesirable as it could lead to upward bias in population estimates, particularly for species that congregate in large flocks, such as common eider and long-tailed duck.

In the field the potential for double recording was minimised in several ways. The main way was to avoid spatial overlap (i.e. not to count an area more than once during a count round). By taking careful note of the effective boundary of the area counted from a particular VP it was relatively easy to ensure that the no part of that area was counted again from another nearby VP. Accurate delineation of areas of coverage from individual VPs was aided by high quality field maps, reference to distinctive landmarks and the use of a sighting compass.

The potential for confusion over whether or not an area had already been covered in a given count round was greatly reduced by having VPs that were generally spaced well apart (i.e. reducing overlap of the areas visible from VPs) and by recording data to a high degree of spatial accuracy.

To minimise the potential for birds to redistribute (and thereby be at risk of being recorded more than once in a survey round) fieldwork was organised to minimise the time between counting adjacent areas. This was achieved by the surveyor(s) systematically working along a section of coast and, within the limits of daylight and weather constraints, counting as large a stretch as possible in a single field day. Thus for areas counted on the same day there was typically less than an hour between counts from one VP and the next VP and thus little opportunity for birds to redistribute. When weather conditions allowed, counting within a round followed on from one day to the next, with a day's counting starting at the next VP along the coast from where counting had ended the day before.

On the first and second count rounds two surveyors were available on some days, and this allowed for simultaneous counting at adjacent areas. The relatively high proportion of good weather days and the longer day length during Round 3 and, particularly, Round 4 allowed for longer stretches of coast to be covered in a single day and reduced weather delays. Thus for these rounds, there were fewer opportunities for between-day redistribution of birds to affect counts.

It was often the case that an area could potentially be counted from two (or sometimes more) VPs, in which case the count was made from the VP that afforded the best view of the area. Occasionally a surveyor deliberately counted the same area more than once during a count round. For example, if it turned out that an area counted from one VP could

subsequently be counted again more accurately from an adjacent VP visited later in the same round (e.g. because conditions were better than previously), then the opportunity was taken to count that area again. On these occasions the surveyor tagged the records in the overlap area so that any potential duplicate counts could be excluded from count totals.

Additional checks of the shore-based survey data were made at the analysis stage to identify and remove potential duplicates (see section 3.1.2).

2.3.5 Additional black-throated diver survey work

Additional fieldwork was conducted on the 21st February 2018, a day with unusually calm conditions, aimed solely at obtaining an accurate count of black-throated divers wintering along the northern coast of Scapa Flow. The standard VP counts in this area recorded several small flocks and there was uncertainty regarding whether these were different or the same birds moving around over a wide area. These data were kept separate from those obtained during the standard count rounds and were excluded from the count totals.

2.3.6 Weather constraints

In the winter months Orkney typically experiences a relatively high proportion of days with strong winds and rain, and sometimes snow. It is undesirable to count birds in poor weather and sea conditions because it takes longer to complete counts and the accuracy of counts is likely to reduce as birds at distance become harder to detect and identify. For these reasons shore-based survey work was restricted to times when the sea state across the majority of a VP count area was below sea state 4 (i.e. sea states 0 to 3), when it was not raining heavily and when there was at least good visibility to a distance of 3km away.

The constraints imposed by poor weather could be managed to some extent through choice of where to count. The complex coastline of the survey area meant that on days with moderate wind strength, sea conditions along lee shore coast sections often remained acceptable for counting. For example, low sea states (0-2) prevailed in the most sheltered parts of the Scapa Flow survey (e.g. near the Churchill Barriers and the waters between South Walls, Flotta and Hoy), even when sea states in the more exposed parts were unsuitable for counting (sea states >4).

2.4 Boat-based survey method

2.4.1 Boat-based survey design considerations

The European Seabirds At Sea (ESAS) survey method (Camphuysen *et al*., 2004) was used for counting birds in the central 'offshore' part of the Scapa Flow part of the site (Table 1). This method was developed for determining the at-sea abundance of seabirds and is the method adopted by JNCC for boat-based offshore seabird surveys and is designed to meet the guidelines for *Distance* sampling (Buckland *et al*., 2001). It is also the method recommended by COWRIE and SNH for baseline surveys of offshore development sites (Jackson and Whitfield, 2011).

The boat survey design concerns the extent of the area of interest for boat survey and the number, spacing and orientation of transect lines covering this area. The area of interest was considered to be all 'offshore' parts of central Scapa Flow that were too far from the shore to be surveyed from readily accessible vantage points. The area of interest for the boat survey work did not include waters in the East Coast or Southern Approaches parts of the pSPA (Table 1).

The key survey design guidelines and considerations were as follows:

- At least ten transects (a minimum of 10-20 transect are recommended for *Distance* sampling).
- Transect lines at least 4km in length (short transects inflate confidence limits).
- Complete coverage of area of interest, assuming recording to 500m from either side of the vessel.
- Transect intervals of at least 0.9km (disturbance and double counting can occur if intervals are less than 0.9km).
- A survey design that can be comfortably completed during a single winter day.
- A transect orientation at right angles to major environmental gradients - these are considered to be bathymetry and distance from coast. As Scapa Flow is surrounded by coastlines, it was not possible to fully comply with these criteria as all transect orientations resulted is some transects being parallel to one or more of the coastlines. The chosen survey design minimised this problem as far as possible; only one transect, transect 12 (eastern most), was parallel to the coast.
- To promote vessel stability, the transect orientation was not at right angles to the predominant north-west wave and swell direction.
- The design also had to avoid various areas of Scapa Flow which imposed restrictions to navigation, for example various islands, rocks and shallow areas, moored tankers and oil platforms, fish farms and the two Single Point Mooring (SPM) 500m exclusion zones associated with the Flotta Oil terminal.

The practical considerations and cost effectiveness of boat charter, navigation and surveyor time were also taken into consideration.

2.4.2 Chosen boat-based survey design

The survey design was based on 12 approximately parallel transect lines nominally spaced 1km apart and designed to give approximately even coverage of the 91.2km^2 'offshore' area (Sub-area 10) (Figures 2 and 4). This area value was determined using GIS software and is for the area of sea only; the areas of terrestrial habitat shown within the boundary of this sub-area are excluded (Figure 2). In Figure 4, the transect lines are labelled '1' to '12' and the route to and from the survey area from Stromness is labelled '0'.

Transect ends were positioned approximately 1,750m from the adjacent coast. This distance reflects shore-based counting experience, which showed that in low sea states target bird species could be accurately counted from the shore out to at least 1,750m. The southern ends of transect lines 7 and 8 terminate further from the coast, due to the need to avoid an area known as The Grinds, that is too shallow for safe navigation.

To avoid various islands and the SPM exclusion zones, it was necessary for there to be minor deviations from parallel transect in some parts of the design (e.g., T4, T5 and T6), whilst in other parts (e.g., T1, T2 and T3) it was necessary for transects to make more marked deviations from straight lines.

The cumulative length of the twelve transects was 72.2km and the total port-to-port sailing distance was 115km (Table 2). Based on an average vessel speed of 8 knots and working out of the port of Stromness, it was predicted that the time from starting the first transect to finishing the last transect would be 5 hours 37 minutes, and the port-to-port time would be 7 hours 46 minutes. On this basis it was concluded there would be sufficient time to complete a survey in a single mid-winter daylight period. These time predictions proved to be broadly accurate.

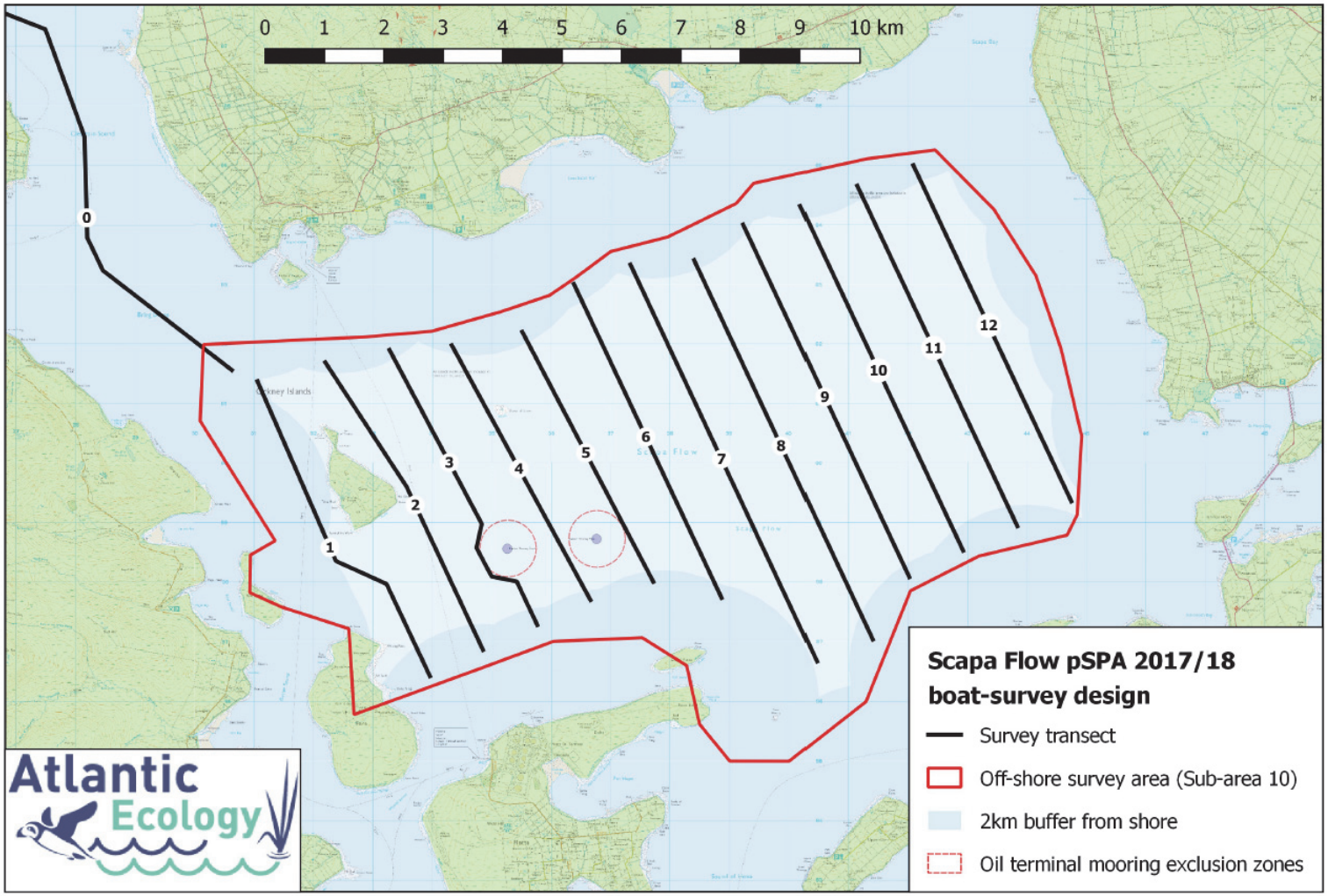

Figure 4. Scapa Flow pSPA 2017/18 winter waterfowl survey boat survey design.

The survey vessel was based in Stromness and, on all occasions, surveys were timed so that survey work commenced early in the morning, typically as soon as the light was bright enough to detect and identify birds (Table 4). On survey Rounds 1, 2 and 3 the full length of all transects was surveyed. On Round 4, two transects had to be cut short due to the navigational restrictions caused by moored oil tankers and this meant that the total transect length surveyed was reduced to 68.2km.

Table 2. Designed transect length for boat survey

Section	Length (km)
Transect 1	5.9
Transect 2	5.5
Transect 3	5.5
Transect 4	4.9
Transect 5	5.0
Transect 6	5.8
Transect 7	7.2
Transect 8	7.0
Transect 9	6.5
Transect 10	6.4
Transect 11	6.3
Transect 12	6.2
All transects	72.2
Transect tails	11.1
To /from survey area	31.7
Total	115.0

2.4.3 Boat-based survey field methods

Boat-based surveys were conducted from the MV Karin, a 24m long dive boat with a large forward-facing deck area, giving surveyors 6 metres eye height (Photo 1).

Surveys were undertaken using ESAS methods by a team of experienced ornithological surveyors, recording from both the port side and starboard side of the vessel. On most surveys, one surveyor focussed on spotting and identifying birds on one side of the vessel another surveyor did the same for the other side, and a third acted as scribe for the two spotters. The scribe also participated in searching for birds when not writing. On two occasions (Rounds 2 and 3) there were four surveyors on board. On these occasions they worked as two teams of two (a spotter and a scribe) on either side of the vessel. Between successive transects the surveyors had a break from surveying of approximately 5 minutes whilst the survey vessel travelled between transect lines.

All birds seen were recorded, with the exception of fulmars and gull species. For each record, the species, number in the group, age, plumage, activity, flight direction and distance from the boat were recorded. Where it was not possible to identify a bird to species level, sightings were recorded to the appropriate level of certainty (e.g. ‘diver sp.’). Survey data were recorded on specially designed forms, detailing species seen, weather conditions and other survey details (Annex 1: Forms 2, 3 and 4).

Photo 1 . MV Karin moored in Stromness

The vessel's position was recorded every minute using a Garmin GPS unit and the one-minute period in which each bird record was made was read from the same unit. This avoided risk of an asynchrony in time information and allowed accurate matching of bird records to vessel position using the time as recorded by the GPS unit.

Information describing sea state, swell (height and direction), wind force and direction, and sun glare intensity were recorded at the start of each transect line, and again during a transect line if there was a change in the conditions. Distance to birds sitting on the sea was recorded as one of five distance bands: band A, 0-50m; band B, 50-100m; band C, 100-200m; band D, 200-300m and band E, 300-500m. Surveyors used a ranging stick to assist accurate determination of distance bands. In some places the lack of a clear sea horizon meant that the ranging stick method could only give an approximate indication of where distance-band boundaries lay. In these cases the surveyor used a combination of experience and reference marks on the boat's mast (viewed from a fixed location) to estimate distance.

Flying birds were recorded that passed through the survey corridor. Flying birds were assigned as being 'in-transect' or 'not-in-transect' according to whether, at the moment of taking a regular snapshot of flying-bird distribution, they were inside or outside a 300m section of the survey corridor forward of the surveyor (i.e., a 300 x 300m box) (full details in Camphuysen *et al*., 2004). The interval between successive flying-bird snapshots was one minute.

2.5 Fieldwork timetable and effort

The four rounds of counting between the start of November 2017 and the end of March 2018 are hereafter referred to as Round 1, Round 2 etc. The planned and actual periods for each round are defined in Table 3. The number of days in these periods lost to poor weather is also detailed in Table 3.

Table 3. The planned and actual periods for each shore-based count round, and the number of days lost to poor weather

Count round	Planned period	Actual period	Shore survey days	Days lost to poor weather
Round 1	November and early December	01 November to 04 December	15	19
Round 2	Mid December to mid January	06 to 19 December, & 01 to 07 January	14	5
Round 3	Late January and February	19 January to 16 February	13	15
Round 4	March	07 to 26 March	11	8

Conditions in the Round 1 and Round 3 count periods were particularly stormy, with only 45% of days in these periods having conditions suitable for shore-based surveys.

The boat surveys targeted days with particularly favourable weather forecasts (settled wind speeds of force two or less, and no precipitation) and the first boat survey had to be postponed until 12 December (Table 4). All four boat surveys were conducted in close to ideal conditions (Table 4).

Table 4. Boat survey dates, timings and environmental conditions

Count Round	Date	Start time	End time	Rain	Visibility	Sea state (% of survey time)			
						1	2	3	4
1	12-Dec	08:44	15:04	None	Excellent	5%	53%	42%	0%
2	03-Jan	08:47	14:20	None	Excellent	33%	67%	0%	0%
3	04-Feb	08:18	13:14	None	Excellent	42%	58%	0%	0%
4	22-Mar	08:42	13:44	None	Excellent	8%	92%	0%	0%

3. ANALYSES

3.1 Analysis of shore-based survey data

3.1.1 Processing of shore-based survey data

The shore-based survey data were entered into an Excel spreadsheet, in which each row corresponded to one record (i.e., a sighting of an individual or a flock of birds of a given species). In total, the shore-based survey data set comprises 7,643 records.

The records were quality checked to ensure that: entered records accurately corresponded to the field sheets and were complete, and that values for a given field were within credible limits or corresponded to predefined codes and were correctly formatted.

The grid reference of those birds (the majority) for which location was recorded in terms of a compass bearing and distance from VP, was calculated in Excel using trigonometry functions from the bearing (corrected for magnetic deviation), distance and VP grid reference. For birds up to a distance of 1000m from a VP, the estimated location accuracy was approximately +/- 50m, and for those 1-2km away the accuracy was approximately +/- 100m.

The records were then imported into GIS software (QGIS) and subjected to further checking routines to identify and remove potential cases of double recording, as described in the next section. GIS software was then used to join information on the sub-area and count sector to each record, based on whether the record's location was inside a sub-area or count sector boundary. The data were then imported back into Excel and pivot table routines used to create summary tables of the total number of birds in each sub-area and count sector on each survey round.

In producing the count summaries, great care was taken to ensure that count totals were not biased high due to double recording using the procedures described below.

3.1.2 Removal of potential duplicate records

GIS software was used to identify potential cases of double recording on the basis of close proximity of similar records seen from adjacent VPs, with positions established in the Excel database as described above. The data were then imported into GIS software (QGIS) and displayed on screen against a background of the 1:25,000 OS map raster image. The records for each round, for each species were displayed on screen, with records from different VPs set to show as dots of a different colour, such that each VP's records showed as a cluster of dots of a certain colour. This process showed that there was very little spatial overlap in the cluster of records from adjacent VPs, as would be expected.

Pairs of similar records (i.e. in terms of species, count and plumage characteristics) that were seen from different VPs and that mapped to within 300m proximity (or thereabouts) were critically examined and the most parsimonious interpretation adopted. When it was considered likely that one of the records was a second record of the same individual or flock, that record was identified as a potential duplicate record and tagged accordingly. These duplicate records were excluded from count totals.

All shore-based survey records that when mapped were within the limits the Scapa Flow 'offshore' area covered by the boat-survey (sub-area 10) (Figure 2) were considered as potential duplicates and excluded. In practice, this was limited to a low number of records of great northern diver.

The numbers of records and individuals identified by the above procedures as being likely to be instances of double recording are summarised in Table 5.

It is inevitable that some redistribution of birds took place between counting one area and the next, irrespective of the time elapsed. However, on average, this would be expected to result in an equal number of gains and losses to a particular count area and therefore it is unlikely that redistribution significantly affects the count totals for the whole survey area or causes either high or low bias to the totals.

Table 5. The number of records/birds considered to be cases of double recording and therefore excluded from count totals.

Species	Round 1		Round 2		Round 3		Round 4	
	No. records	No. birds	No. records	No. birds	No. records	No. birds	No. records	No. birds
Black-throated diver	0	0	0	0	1	22	0	0
Great northern diver	4	11	3	3	13	16	11	14
Slavonian grebe	0	0	0	0	0	0	0	0
Shag	11	175	11	38	3	20	3	6
Red-br. merganser	0	0	4	5	1	1	0	0
Eider	9	792	5	42	8	526	4	498
Long-tailed duck	2	24	1	4	6	85	5	574
Goldeneye	0	0	0	0	0	0	0	0

3.2 Analysis of boat-based survey data

3.2.1 Processing of boat-based survey data

In total there were 1,610 records of individuals or flocks of a species seen during the four boat-based surveys. The data entered from field sheets were subject to the same quality control checks as described earlier for the shore-based survey data.

The vessel's GPS track was also downloaded into an Excel worksheet and through the time field, the vessel's position half way through each 1-minute time period was joined to each record. For each record, bird location was calculated from the vessel's position, the distance from the transect line to the bird (distance band), travel direction and whether it was seen from the port or starboard side of boat. This information allowed bird location to be estimated to an accuracy of approximately +/- 100m (the vessel typically travelled 200 - 250m per minute). The calculated bird locations were imported into GIS software (QGIS) initially to identify potential cases of double recording (see above) and also for the production of distribution maps.

The only pSPA qualifying species recorded in large numbers in the boat-based surveys were great northern diver and European shag. The remaining six pSPA qualifying inshore wintering waterfowl species all show a strong preference for the near-shore parts of the study area and the pSPA count totals are little affected by analytical approach to the boat-survey data.

3.2.2 Removal of potential duplicate records

The same procedure as used for shore-based records was used to identify potential duplicate records in the boat-based data set. There was only limited potential for double recording in the boat-based data as the effective survey corridors corresponding to each transect line were designed not to overlap (in practice there was occasionally minor overlap between adjacent transects). This process identified a number of small flocks of great

northern diver that were likely to be cases of double recording, and these were excluded from the analysis.

3.2.3 Derivation of estimates from boat-based survey data

Although the data were collected in a format suitable for *Distance* analysis, this analytical method has not been used. The methods and rationale used for analysing the boat-based survey data differed between species and are described below.

Great northern diver

Examination of the great northern diver records shows that there was a very high detection rate up to 500m from the vessel. This is not surprising given the size of this species and the very favourable sea conditions prevailing throughout most of the surveys. However, great northern divers responded to the approaching vessel by swimming away from it (but they were never seen to take flight; as also noted by Jarrett *et al* (2018)) such that by the time birds were perpendicular to vessel (when it is possible to measure distance with a ranging stick), those that had originally been within approximately 150m of the transect line, had often moved further away. This behavioural response skews the distance-detection relationship by reducing the number of records in distance bands A (0-50m) and B (50-100m) and inflating the numbers in C (100-200m) and perhaps D (200-300m); numbers in band E (300-500m) are unlikely to be affected. Consequently it is not possible to model a reliable detection function for application of *Distance* analysis.

The number of great northern divers present was therefore estimated by assuming that all birds within 500m of the survey vessel were detected. This is in line with the approach taken in previous boat-based surveys (Williams, 1999) and is likely to somewhat underestimate actual totals. This is because some birds were not detected, either because they were actively diving or due to reduced detection in the outer distance bands. Judging the outer limit of band E (300-500m) was difficult, especially when there was no horizon and there was thus some potential to misclassify whether a bird fell in band E or was further way (in which case it was excluded). Although it is possible that a few birds that were slightly more than 500m away were recorded as being in band E, it is considered likely that this is more than offset by a tendency for under-detection in band E due to distance.

The numbers of great northern diver in those parts of the offshore count area (sub-area 10), not covered by the boat survey (i.e. more than 500m from the transect lines), were estimated by extrapolation. It was assumed that the density in the unsurveyed parts was the same as the mean density within 500m either side of the transect lines. The density along the transect lines for each count round was calculated from the total count of birds, divided by the area surveyed (transect length multiplied by 1000m).

Duck species

The same assumption, (i.e., all birds within 500m of the vessel were detected) was adopted for common eider, long-tailed-duck, red-breasted merganser and common goldeneye. Common eider and long-tailed duck were relatively easy to detect even at distances up to 500m, on account of their tendency to associate in flocks. The boat survey count total for each round was extrapolated to give an estimate for the whole of the offshore area, using the same method for great northern diver.

European shag, Slavonian grebe and auk species

For European shag and auk species, there was a strong tendency for lower detection rates of birds on the water in distance bands D and E, which is in line with experience of surveying these species elsewhere using the same method. There was also little evidence that these

species showed a behavioural response to the approaching survey vessel. The data for these species are therefore considered to be well suited for *Distance* analysis.

For the purpose of this report, it was assumed that all individuals of these species in Bands A to D, up to 300m from the vessel, were seen. On-sea records in distance band E (300-500m) were excluded from the analysis as the detection rate in this band was very low compared to the closer bands. The assumption that all birds within 300m of the vessel were seen is a highly conservative assumption as the evidence indicated lower detection in bands C (100-200m) and D (200-300m) than in bands A and B (e.g. by some 16% for European shag and 35% for black guillemot). The same assumption was adopted for Slavonian grebe as, despite the paucity of boat records for this species, it was clear that birds in distance band E would be unlikely to be detected due to this species' diminutive size.

For European shag, Slavonian grebe and auk species the boat survey count total for bands A-D for each round were extrapolated to give estimates for the whole of the offshore area, using the same approach used for great northern diver, except that for these species the effective survey corridor was 600m.

Records of European shag (and great cormorant) on the land seen during the boat surveys were excluded from the above calculation of density. The on-land records were summed and added to the final count. All the roost sites that were counted during the boat-based surveys were different to the sites counted during the shore-based surveys.

3.3 Combining shore and boat datasets

The total estimated counts for the pSPA for each survey round were derived by adding together the sum of birds seen in shore-based surveys for Sub-areas 1 to 9 and 11 to 15, to the numbers estimated from the boat-based surveys for Sub-area 10 (Table 1).

The birds seen on the four small lochans just outside the pSPA boundary were totalled separately and excluded from the total count for the pSPA.

Count totals will be subject to potential error arising from a range of factors including: inherent detectability of each species (associated with size, plumage colour and pattern, and behaviour); mobility of birds within and between count sectors; distribution with respect to distance from shore-based vantage points or boat-based transects; and, count conditions (weather and sea state). In the species accounts (section 4.4), count error rates are estimated based on the surveyors' expert knowledge of the target species, quantitative detection rate data from the boat transect surveys (section 3.2.3) and recorded survey conditions. These are expressed as approximate percentages.

4. RESULTS

The original data are tabulated in two spreadsheets, one for the shore-based survey data and the other for boat-based survey data, attached at Annex 2.

Annex 3 includes round-specific totals for the pSPA qualifying species for each of the 59 count sectors and the 12 boat-based survey transects. Summary results tables are in sections 4.2 and 4.3, below. Survey results for the pSPA non-qualifying waterfowl species are presented in Annex 4.

4.1 Survey coverage

The 2017/18 winter surveys achieved a very high degree of coverage; for each of the four count rounds, survey work was undertaken from a complete series of VPs around the pSPA coast and for all 12 of the boat-based survey transects. Equal coverage was achieved for each survey round, thus between-round differences in species totals cannot be explained by differences in coverage.

Although overall coverage was very high, small parts of the pSPA either received no coverage or were prone to under recording due to the relatively large distance from the nearest VP. In particular, the East Coast part of the pSPA generally extends considerably further from the coast than could be effectively counted from the shore. Furthermore, the East Coast count sections are relatively exposed and commonly had sea-states of 3 - 5 more than 1km from the coast at the time of counting. For these reasons it is considered likely that the East Coast count sector totals for European shag, great northern diver and common eider are likely to be under-estimates.

Other areas where under detection was likely due to the distance from the nearest VP exceeding 1.5km are most of count sector 57 (to the east of the island of Switha) and the eastern half of count sector 59. Again, these are relatively exposed areas where under recording is most likely to affect counts of European shag.

Section 3.2.3 details how boat-based counts in central Scapa Flow were analysed to take account of incomplete coverage of some parts of the Scapa Flow offshore area (Sub-area 10). Section 3.2.3 also explains why the boat-survey derived estimates for the offshore area for European Shag and black guillemot are likely to be under-estimates.

4.2 Count totals

The pSPA total counts for each round are summarised in Table 6 for all the qualifying waterfowl species.

The 2017/18 peak and mean counts for qualifying species in the 44 Scapa Flow shore-based count sectors and the boat-based survey area are compared with the corresponding figures for the 1998/99 (Williams, 1999) and 2000/01 (Williams, 2001) winter surveys in Table 7.

Table 6. Waterfowl count totals for the Scapa Flow pSPA qualifying species for each count round of the 2017/18 winter survey. The peak count is shown in bold type.

Species	pSPA qualifying species	Round 1	Round 2	Round 3	Round 4	Mean
Great northern diver	Yes	572	**1016**	887	831	827
Black-throated diver	Yes	27	27	**39**	9	26
Slavonian grebe	Yes	**161**	102	**161**	67	123
European shag	Yes	**3726**	1169	1322	582	1700
Common eider	Yes	**2324**	1741	1696	2271	2008
Long-tailed duck	Yes	1286	893	1383	**1996**	1390
Red-br. merganser	Yes	**370**	266	229	200	266
Common goldeneye	Yes	25	41	**51**	32	37

Table 7. Comparison of pSPA qualifying species count totals for the 44 Scapa Flow shore- and boat-based survey sections counted in 1998/99, 2000/01 and 2017/18.

Species	1998/99 winter		2000/01 winter		2017/18 winter	
	Peak	Mean	Peak	Mean	Peak	Mean
Great northern diver	644	478	438	403	991	783
Black-throated diver	57	43	58	43	39	27
Slavonian grebe	124	89	141	91	161	122
European shag	3393	1977	3161	1794	2020	1096
Common eider	2308	1831	1980	1808	2101	1742
Long-tailed duck	1582	1157	1474	1217	1916	1288
Red-br. merganser	628	448	488	389	352	250
Common goldeneye	282	179	254	164	45	35

4.3 pSPA qualifying species accounts

Results for each of the pSPA qualifying species are summarised in the following sections. These include two count summary tables; the first breaks the pSPA total down according to each of the four major pSPA parts (i.e. Scapa Flow inshore, Scapa Flow offshore, East Coast and Southern Approaches) (Tables 8, 10, 12, 14, 16, 18, 20 and 22) and the second breaks down the pSPA count totals according to each of the 15 defined sub-areas (Tables 9, 11, 13, 15, 17, 19, 21 and 23). These tables also give the mean percentage (across the four count rounds) of the total for each pSPA part and sub-area. A third table for each qualifying species is presented in Annex 3 (Tables A3.1 to A3.8) that gives round-specific totals for each of the 66 count sectors and the 12 boat-based-survey transects.

Maps showing the distribution of records across the pSPA for each qualifying species are in Annex 5 (Figures 5 to 13). In these maps, each record is represented by a coloured dot of varying size, depending on the number of individuals. Different count rounds are shown in different colours.

4.4 Species accounts

4.4.1 Great northern diver

The numbers (peak 1,016 individuals, mean 826 individuals) of great northern divers counted in all four rounds of the 2017-18 shore/boat-based surveys of Scapa Flow pSPA substantially exceeded the UK SPA site selection guidelines stage 1.1 numerical threshold (50 birds) for inclusion of this Annex 1 species within the Scapa Flow pSPA. The current estimate for the GB wintering population of great northern diver (2,500 birds; Musgrove *et al*, 2013) is awaiting systematic review in light of recent evidence that the GB wintering population exceeds 4,000 birds (e.g. Austin *et al.,* 2017; Furness, 2015; Lawson *et al.,* 2015). The peak count of 1,016 individuals in the Scapa Flow pSPA in 2017/18 is believed to be the highest number of this species ever recorded for a single site in the UK and represents in the order of 25 to 40% of the GB wintering population.

The total estimated number recorded on Round 1 (572 individuals) was substantially lower than recorded on subsequent rounds (Tables 8 and 9). This suggests that birds were continuing to arrive through November and into December. Numbers recorded in Rounds 3 and 4 were slightly lower than the peak, suggesting that from February onwards, some birds start to move to other sites.

Great northern divers are relatively easily to detect and count. Therefore it is unlikely that many individuals were missed even when survey conditions were sub-ideal. It is also considered very unlikely that day-to-day redistribution of birds within a count round had more than a negligible effect on count totals due to the rigorous and precautionary approach taken to dealing with birds potentially seen on more than one occasion (see section 2.3.4). The count totals for great northern diver are judged to be within approximately 5% of the true figures.

The distribution of great northern diver is illustrated in Figure 5. Great northern divers were commonly encountered in all parts of the pSPA except the 'Southern Approaches' count sectors, where only a single individual was recorded (Table 9). Approximately 95% of the birds were in the Scapa Flow count sections, with nearly 55% in the central 'offshore' area. The 'East Coast' count sectors only accounted for around 5% of the birds seen and most of these were off Mainland and Burray.

Great northern divers were frequently encountered as flocks of over 10 birds, particularly in the offshore part of Scapa Flow. The largest flock encountered was 76 birds, though it was unusual for flocks to exceed 50 birds.

Great northern divers were occasionally seen with prey. The following prey items were recorded:

- 15-20 cm flatfish, 6 occasions
- 'Pelagic' fish, 1 occasion
- Probable 'clupeid' fish, 1 occasion
- Unidentified fish, 1 occasion
- Crab, 5 occasions

The high incidence of crab and flatfish is strong evidence that this species frequently forages on the seabed.

An apparent association between feeding great northern divers and a fish farm was noted only once when four birds were seen diving in the close vicinity of salmon cages off Hoy on the 10th March 2018.

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors and the boat-based survey area are approximately 80% higher than the corresponding totals for the 1998/99 and 2000/01 surveys (Table 7). It is not known to what extent this large increase reflects a genuine increase in numbers or is a consequence of improvements to survey methods (see Discussion). However, given the scale of the increase it is considered highly likely that this species has undergone a large increase over the past two decades.

Table 8. Great northern diver count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	256	407	335	328	40.1%
Scapa Flow offshore	10	249	584	519	454	54.6%
East coast	11-13	67	25	32	49	5.2%
Southern approaches	14-15	0	0	1	0	0.0%
Whole pSPA	1-15	572	**1016**	887	831	100%

Table 9. Great northern diver count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	54	32	52	38	5.3%
Scapa Flow inshore N: Houton Head - Greenigoe	2	75	119	111	78	11.6%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	13	26	71	37	4.4%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	35	83	28	39	5.6%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	16	16	14	23	2.1%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	13	21	13	14	1.8%
Scapa Flow inshore S: Flotta N & E coasts	7	18	33	13	65	3.9%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	16	6	4	21	1.4%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	16	71	29	13	3.9%
Scapa Flow offshore: (boat survey area)	10	249	584	519	454	54.6%
East coast: Mainland east coast	11	11	8	7	27	1.6%
East coast: Burray east coast	12	30	16	12	16	2.2%
East coast: South Ronaldsay E coast	13	26	1	13	6	1.4%
Southern approaches: South Ronaldsay W coast	14	0	0	0	0	0.0%
Southern approaches: S. Walls & Switha S coasts	15	0	0	1	0	0.0%
Whole pSPA	1-15	572	1016	887	831	100%

4.4.2 Black-throated diver

The numbers (peak 39 individuals, mean 27 individuals) of black-throated divers counted in all four rounds of the 2017-18 shore/boat-based surveys of Scapa Flow pSPA exceeded 1% of the GB population (6 individuals). The peak count of 39 individuals is equivalent to 7.0% of the GB wintering population (Musgrove *et al*, 2013 but is below the default level of 50 birds for Stage 1.1 selection of Annex 1 species (JNCC, 1999).

Black-throated diver proved more difficult to count than had been expected. They often occurred well off the coast (>1km) and needed to be seen well to distinguish them from the much more common great northern diver. The additional day of survey work dedicated to this species showed that flocks are relatively mobile, moving up to several kilometres in a period of a few hours. The high mobility of this species and consequent increased potential for double-recording was also noted in previous surveys (Williams, 1999). The estimated peak of 39 wintering birds in Scapa Flow was based on the most parsimonious interpretation of the records, and it is possible that some birds were overlooked, due to the difficulty of distinguishing this species at distance from great northern diver. However, it is considered unlikely that numbers exceeded 50 individuals. The Round 4 count includes six birds seen in count sectors 2 and 20 from the survey vessel as it returned to port on the day of the boat-based survey as these were clearly different to the few other birds seen in Round 4.

Black-throated divers were patchily distributed (Figure 6). None were recorded in the 'East Coast' and 'Southern Approaches' parts of the pSPA (Tables 10 and 11). Within Scapa Flow this species favoured the north coast, from Houton Head to Greenigoe (Sub-area 2) (Table 11). On average, this stretch accounted for 64% of the birds seen. The 'offshore' part of Scapa Flow (Sub-area 10), on average, accounted for 28% of the birds. Within this offshore area, all records of black-throated diver were near the periphery, either close to the northern or western edges or between the islands of Cava and Rysa Little.

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors and the boat-based survey area are approximately 35% lower than the corresponding totals for the 1998/99 and 2000/01 surveys (Table 7). It is not known to what extent this decline reflects a genuine decrease in numbers or is a consequence of improvements to survey methods (see Discussion), or a combination of both. However, it is considered likely that there has been a genuine decline in the numbers of black-throated diver wintering in Scapa Flow pSPA.

Table 10. Black-throated diver count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	23	27	28	7	78.5%
Scapa Flow offshore	10	4	0	11	8	21.5%
East coast	11-13	0	0	0	0	0.0%
Southern approaches	14-15	0	0	0	0	0.0%
Whole pSPA	1-15	27	27	**39**	15	100%

Table 11. Black-throated diver count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	0	0	0	1[a]	0.9%
Scapa Flow inshore N: Houton Head - Greenigoe	2	20	27	22	1	64.6%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	3	0	3	0	5.5%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	0	0	0	0	0.0%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	0	0	3	0	2.8%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	0	0	0	0	0.0%
Scapa Flow inshore S: Flotta N & E coasts	7	0	0	0	0	0.0%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	0	0	0	0	0.0%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	0	0	0	5[a]	4.6%
Scapa Flow offshore: (boat survey area)	10	4	0	11	8	21.5%
East coast: Mainland east coast	11	0	0	0	0	0.0%
East coast: Burray east coast	12	0	0	0	0	0.0%
East coast: South Ronaldsay E coast	13	0	0	0	0	0.0%
Southern approaches: South Ronaldsay W coast	14	0	0	0	0	0.0%
Southern approaches: S. Walls & Switha S coasts	15	0	0	0	0	0.0%
Whole pSPA	1-15	27	27	39	15	100%

a: birds seen from survey vessel as it returned to port on the day of the boat-based survey and not included in table A2.2

4.4.3 Slavonian grebe

The numbers (peak 161 individuals, mean 123 individuals) of Slavonian grebes counted in all four rounds of the 2017-18 shore/boat-based surveys of Scapa Flow pSPA substantially exceeded the UK SPA site selection guidelines stage 1.1 numerical threshold (1% GB, 11 individuals) for inclusion of this Annex 1 species within the Scapa Flow pSPA. The peak count of 161 individuals is equivalent to 14.6% of the GB wintering population (Musgrove *et al.*, 2013).

The Round 1 (161 individuals) and Round 3 (161 individuals) totals are remarkably consistent. It is unclear why the Round 2 count was lower (by about a third) but this may be, in part, due to reduced detectability as average sea states were higher during this count round. This species is particularly easy to overlook in sea state 3+ on account of its small size. The relatively low Round 4 count probably reflects that many individuals had departed by this time.

Apart from the Round 2 count, which may be an under estimate (due to on average lower detection rate in this count round), count totals for Slavonian grebe are judged to be within approximately 5% of the true figures.

Slavonian grebes showed a strong preference for sheltered, relatively shallow parts of the survey area (Figure 7). Only seven birds were seen in all the boat-based surveys, underlining the lack of importance of the central part of Scapa Flow. The 'East Coast' part of the pSPA also had low numbers of this species and none were recorded in the 'Southern Approaches' count sections (Tables 12 and 13). The distribution of records in Scapa Flow shows that there was some noticeable redistribution throughout the winter (Fig 7). In particular moderate numbers were seen in Round 1 between Hoy and South Walls (count sectors 26 and 25) but these had largely moved away in later count rounds. In contrast, relatively few birds were seen between South Ronaldsay and Burray (count sectors 17 and 18) in Round 1, but they were commonly seen in here in later count rounds.

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors and the boat-based survey area are approximately 36% and 22% higher, respectively, than the corresponding figures for the 1998/99 and 2000/01 surveys (Table 7). It is not known whether this increase reflects a genuine increase in numbers or is a consequence of improvements to survey methods (see Discussion), or a combination of both. The better quality spotting scopes used in the 2017/18 survey may have led to higher detection rates of Slavonian grebes that were more than approximately 1km from VPs.

Table 12. Slavonian grebe count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	155	94	161	65	96.6%
Scapa Flow offshore	10	6	8	0	0	3.0%
East coast	11-13	0	0	0	2	0.4%
Southern approaches	14-15	0	0	0	0	0.0%
Whole pSPA	1-15	**161**	102	**161**	67	100%

Table 13. Slavonian grebe count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	17	8	11	5	8.3%
Scapa Flow inshore N: Houton Head - Greenigoe	2	45	33	57	13	30.1%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	5	5	25	6	8.3%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	2	2	4	0	1.6%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	30	20	39	10	20.1%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	5	12	14	12	8.7%
Scapa Flow inshore S: Flotta N & E coasts	7	0	2	5	9	3.3%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	43	3	4	4	11.0%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	8	9	2	6	5.1%
Scapa Flow offshore: (boat survey area)	10	6	8	0	0	3.0%
East coast: Mainland east coast	11	0	0	0	0	0.0%
East coast: Burray east coast	12	0	0	0	2	0.4%
East coast: South Ronaldsay E coast	13	0	0	0	0	0.0%
Southern approaches: South Ronaldsay W coast	14	0	0	0	0	0.0%
Southern approaches: S. Walls & Switha S coasts	15	0	0	0	0	0.0%
Whole pSPA	1-15	161	102	161	67	100%

4.4.4 European shag

The numbers of European shag recorded in three of the four counts during the 2017/18 survey of Scapa Flow pSPA (Table 6) exceeded the UK SPA site selection guidelines stage 1.4 numerical threshold (1% GB, 1,100 individuals) and the peak count (3,726 birds) also exceeded the stage 1.2 numerical threshold (1% biogeographic, 2,000 individuals). The peak count is equivalent to 3.4% of the GB wintering population and to 1.9% of the biogeographic population (Musgrove *et al*, 2013; Wetlands International 2012).

The counts of European shag include birds roosting on land. Some of these roost sites were located a little outside (in all case <100m) the MLWS boundary of the pSPA. This species only forages in marine habitats and therefore there was no doubt that all the 'on-land' individuals were part of the populations wintering in the Scapa Flow pSPA. Birds at roost sites accounted for 19% of all the European shags seen.

The Round 1 count totals were nearly three times higher than those for Rounds 2 and 3, indicating that the pSPA has particular importance for this species in the early part of the winter. The count totals for Rounds 2 and 3 were similar (1,169 and 1,322 individuals, respectively) suggesting that numbers in mid-winter (December, January and February) are relatively constant. However, the number recorded in Round 4 (582 individuals) was down by approximately a half. It is likely that this large early spring reduction reflects breeding birds leaving Scapa Flow for breeding colonies.

Separate distribution maps are presented for records of European shags on the sea (this will reflect foraging areas) and records of European shags roosting on land (Figures 8 and 9). It should be noted that European shags often roost on navigation buoys and other man-made structures and this accounts for the records of birds roosting away from land shown in Figure 9.

Shags on the sea were very widely distributed across the pSPA (Figures 8 and 9); indeed the only part where they were infrequently seen was the central part of Scapa Flow, where presumably the seabed lies too deep for profitable foraging. The majority of European shags (on average 58%) were recorded in the Scapa Flow inshore count sectors (Tables 14 and 15). The 'East Coast' count sectors also had particular importance for this species, accounting, on average, for nearly 28% of the birds seen (Table 14). The offshore part of Scapa Flow accounted, on average, for only 7% of the birds and most of these were in the shallow western third. The 'Southern Approaches' count sectors also accounted, on average, for 7% of the birds seen. European shag was the only proposed pSPA qualifying species that occurred in reasonably high numbers in this part of the pSPA.

Shags are relatively easily overlooked because of their dark plumage and high proportion of at-sea-time spent underwater (shags roost on land). This is especially so at distances exceeding 1km and when sea state is 3 or greater. Unlike other pSPA qualifying species, European shags frequented the more exposed coasts of the pSPA, such as the 'Southern Approaches' and 'East Coast' parts, where sea states, away from the immediate shelter of the coast, were frequently between 3 and 5. Therefore, it is considered likely that European shag numbers, along the more exposed count sectors, were underestimated. The extent of this underestimation is unknown but it is judged to be approximately between 10 and 30%.

The estimated numbers, derived from the boat survey data for the offshore section of Scapa Flow, are also undoubtedly underestimates, because the analysis assumption that all birds up to 300m from the survey vessel were detected was clearly not met. The frequency distribution of records between the recording distance bands A to D would suggest that actually about 85% of birds within 300m of the vessel were detected. Thus, the extrapolated

estimates for the offshore part of the Scapa Flow are likely to be underestimated by around 17%.

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors and the boat-based survey area are approximately 40% lower than the corresponding totals for the 1998/99 and 2000/01 surveys (Table 7). It is not known to what extent this decline reflects a genuine decrease in numbers or is a consequence of improvements to survey methods (see Discussion), or a combination of both. However, monitoring of European shag breeding colonies has shown that numbers at Scottish breeding colonies are in long-term decline, decreasing by approximately 33% since 1998 (JNCC, 2016) and the birds wintering in Scapa Flow are known to mainly come from breeding colonies in northern Scotland (Wernham *et al.*, 2002). Shag populations are also subject to mass mortality events ("wrecks") associated with prolonged periods of stormy weather, resulting in fluctuations in wintering populations.

Table 14. European shag count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	1920	801	889	379	58.7%
Scapa Flow offshore	10	100	103	119	72	5.8%
East coast	11-13	1386	214	194	90	27.7%
Southern approaches	14-15	320	51	120	41	7.8%
Whole pSPA	1-15	**3726**	1169	1322	582	100%

Table 15. European shag count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	706	194	391	120	20.8%
Scapa Flow inshore N: Houton Head - Greenigoe	2	115	47	76	45	4.2%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	141	30	62	24	3.8%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	275	44	144	10	7.0%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	304	55	32	13	5.9%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	89	55	38	34	3.2%
Scapa Flow inshore S: Flotta N & E coasts	7	46	79	30	56	3.1%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	185	98	66	35	5.6%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	59	199	50	42	5.1%
Scapa Flow offshore: (boat survey area)	10	100	103	119	72	5.8%
East coast: Mainland east coast	11	417	128	46	46	9.4%
East coast: Burray east coast	12	185	34	7	8	3.4%
East coast: South Ronaldsay E coast	13	784	52	141	36	14.9%
Southern approaches: South Ronaldsay W coast	14	177	24	93	32	4.8%
Southern approaches: S. Walls & Switha S coasts	15	143	27	27	9	3.0%
Whole pSPA	1-15	3726	1169	1322	582	100%

4.4.5 Common eider

The numbers (peak 2,324 individuals, mean 2,008 individuals) of common eider counted in all four rounds of the 2017-18 shore/boat-based surveys of Scapa Flow pSPA substantially exceeded the UK SPA site selection guidelines stage 1.4 numerical threshold (1% GB, 600 individuals) for inclusion of this migratory species within the Scapa Flow pSPA. The peak count of 2,324 individuals is equivalent to 3.9% of the GB wintering population (Musgrove *et al.*, 2013).

Eiders were easy to detect and count and due to the rigorous and precautionary approach taken to dealing with birds potentially seen on more than one occasion (see section 2.3.4) it is also considered very unlikely that day-to-day redistribution of birds within a count round had more than a negligible effect on count totals. The count totals for eider are therefore judged to be within approximately 10% or less of the true figures.

The Round 1 and Round 4 count totals were remarkably similar (2,324 and 2,271 individuals respectively), as were the Round 2 and Round 3 counts (1,741 and 1,696 individuals respectively). It is not known why there were approximately 500 fewer birds present in the mid-winter counts but this is most likely to reflect a movement of birds out of the pSPA rather than counting error.

Apart from the 'Southern Approaches' sectors where they were scarce (<2% of the birds on average), common eiders were distributed all around the coast of the pSPA (Figure 10). Particularly large numbers were present along the east coast of Hoy, where they were commonly found in relatively large numbers around fish farms. These fish-farm aggregations were usually in association with flocks of long-tailed ducks. Similar observations have been reported within the North Orkney pSPA (Upton *et al*, 2018) but it was not within the scope of either survey to analyse the spatial distribution of marine birds in relation to salmon farms. On average, the inshore count sections of Scapa Flow accounted for 80% of the pSPA total, with the count sectors along the east coast of Hoy, between Ore Bay and Burra Sound (Sub-area 9), alone accounting for 55% of the total (Tables 16 and 17).

The offshore part of Scapa Flow on average accounted for just 4% of the total, with most of these birds occurring around the fish farm at the south end of the island of Rysa Little (Tables 16 and 17). There were few records in the eastern two thirds of the offshore area, presumably because this is mostly too deep to be attractive for foraging. The East Coast and Southern Approaches parts of the pSPA on average had approximately 12% and approximately 2% respectively of the whole pSPA mean total (Table 16).

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors and the boat-based survey area are approximately 3% lower than the corresponding totals for the 1998/99 and 2000/01 surveys (Table 7). It is not known to what extent this decline reflects a genuine decrease in numbers or is a consequence of improvements to survey methods (see Discussion), or a combination of both. Such a small change is strong evidence that the population of common eider wintering in Scapa Flow has been approximately stable over the past two decades.

Table 16. Common eider count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	2000	1336	1273	2038	82.7%
Scapa Flow offshore	10	43	184	32	63	4.0%
East coast	11-13	277	190	300	154	11.5%
Southern approaches	14-15	4	31	91	16	1.8%
Whole pSPA	1-15	**2324**	1741	1696	2271	100%

Table 17. Common eider count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	81	60	89	121	4.4%
Scapa Flow inshore N: Houton Head - Greenigoe	2	51	35	29	19	1.7%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	39	32	27	35	1.7%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	28	28	23	29	1.3%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	53	51	62	68	2.9%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	87	187	190	100	7.0%
Scapa Flow inshore S: Flotta N & E coasts	7	7	41	75	161	3.5%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	124	70	57	41	3.6%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	1530	832	721	1464	56.6%
Scapa Flow offshore: (boat survey area)	10	43	184	32	63	4.0%
East coast: Mainland east coast	11	118	97	212	100	6.6%
East coast: Burray east coast	12	13	24	26	19	1.0%
East coast: South Ronaldsay E coast	13	146	69	62	35	3.9%
Southern approaches: South Ronaldsay W coast	14	4	30	86	14	1.7%
Southern approaches: S. Walls & Switha S coasts	15	0	1	5	2	0.1%
Whole pSPA	1-15	2324	1741	1696	2271	100%

4.4.6 Long-tailed duck

The numbers (peak 1,996 individuals, mean 1,389 individuals) of long-tailed ducks counted in all four rounds of the 2017-18 shore/boat-based surveys of Scapa Flow pSPA substantially exceeded the UK SPA site selection guidelines stage 1.4 numerical threshold (1% GB, 110 individuals) for inclusion of this migratory species within the Scapa Flow pSPA. The peak count of 1,996 individuals is equivalent to 18.1% of the GB wintering population (Musgrove *et al.*, 2013).

Within Scapa Flow, long-tailed ducks were generally easy to detect over the count ranges required, however it was common for some birds to fly off whilst being counted (usually they alighted again only a few 100s of metres away, but sometimes they moved further) and this could make it difficult to obtain accurate counts. Nevertheless the count totals are judged to be within approximately 20% of the true figures.

The Round 1 and Round 3 counts were similar in magnitude (1,286 and 1,383 individuals respectively) and probably give an accurate indication of numbers overwintering. The Round 2 count was only 893 birds. It is not known if this low count was caused by some birds moving out of the area, or if it reflects undercounting, due to birds moving around within the pSPA. The Round 4 count (1,996 individuals) was the highest of the counts. It is quite likely that the increase at this time of year reflects an influx of birds, perhaps from more southerly wintering sites, as birds start to move back to their sub-Arctic/Arctic breeding grounds.

The distribution of long-tailed ducks within the pSPA was broadly similar to that of common eider; indeed the two species often fed in association. As for common eider, there were few records in the eastern two thirds of the offshore area, presumably because this is mostly too deep to be attractive for foraging.

Apart from the 'Southern Approaches' sectors, where they were scarce (<1% of the birds on average), long-tailed ducks were distributed all around the coast of the pSPA (Figure 11, Tables 18 and 19). On average the inshore count sections of Scapa Flow accounted for 72% of the pSPA total, with the count sectors along the east coast of Hoy, between Ore Bay and Burra Sound (Sub-area 9), alone accounting for 39% of the total. The East Coast part of the pSPA on average held approximately 7% of the whole pSPA mean total (Table 18).

The offshore part of Scapa Flow on average accounted for 19% of the total, with most of these birds occurring around the fish farms close to Cava and Rysa Little (Table 19). The large numbers present along the east coast of Hoy and Fara were also commonly found around fish farms, and usually in association with flocks of common eider. Similar observations have been reported within the North Orkney pSPA (Upton *et al*, 2018) but it was not within the scope of either survey to analyse the spatial distribution of marine birds in relation to salmon farms.

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors and the boat-based survey area are approximately 9% and 25% higher, respectively, than the corresponding totals for the 1998/99 and 2000/01 surveys (Table 7). It is not known to what extent this increase reflects a genuine increase in numbers or is a consequence of improvements to survey methods (see Discussion), or a combination of both. Given the inherent challenges in accurately counting long-tailed duck (see above) the small change observed suggests that the population of this species wintering in Scapa Flow has been approximately stable over the past two decades.

Table 18. Long-tailed duck count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	1152	572	1118	1244	73.5%
Scapa Flow offshore	10	27	231	136	672	19.2%
East coast	11-13	107	82	115	80	6.9%
Southern approaches	14-15	0	8	14	0	0.4%
Whole pSPA	1-15	1286	893	1383	**1996**	100%

Table 19. Long-tailed duck count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	38	7	33	31	2.0%
Scapa Flow inshore N: Houton Head - Greenigoe	2	82	44	161	61	6.3%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	44	27	162	112	6.2%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	14	11	34	18	1.4%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	63	123	77	111	6.7%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	75	57	115	119	6.6%
Scapa Flow inshore S: Flotta N & E coasts	7	7	14	34	50	1.9%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	55	27	32	54	3.0%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	774	262	470	688	39.5%
Scapa Flow offshore: (boat survey area)	10	27	231	136	672	19.2%
East coast: Mainland east coast	11	32	21	38	37	2.3%
East coast: Burray east coast	12	52	39	14	19	2.2%
East coast: South Ronaldsay E coast	13	23	22	63	24	2.4%
Southern approaches: South Ronaldsay W coast	14	0	5	4	0	0.2%
Southern approaches: S. Walls & Switha S coasts	15	0	3	10	0	0.2%
Whole pSPA	1-15	1286	893	1383	1996	100%

4.4.7 Red-breasted merganser

The numbers (peak 370 individuals, mean 266 individuals) of red-breasted merganser counted in all four rounds of the 2017-18 shore/boat-based surveys of Scapa Flow pSPA substantially exceeded the UK SPA site selection guidelines stage 1.4 numerical threshold (84 individuals) for inclusion of this migratory species within the Scapa Flow pSPA. The peak count of 370 individuals is equivalent to 4.4% of the GB wintering population (Musgrove *et al*, 2013).

The highest numbers were recorded on Round 1 (370 individuals). The count totals steadily reduced for subsequent rounds, the total for Round 4 (200 individuals) being only 54% of the Round 1 total. The reason for this decline is unknown but it is likely that it reflects a combination of birds leaving the pSPA and mortality (particularly of first-winter birds).

Red-breasted mergansers occurred almost exclusively along the most sheltered coastlines (Figure 12) and typically were close inshore, in pairs or small groups. These traits made them easy to detect and count and it is judged that count totals are within approximately 5% of the true figures.

The Scapa Flow inshore count sectors, on average, accounted for 92% of the pSPA total count (Table 20 and 21). The remainder of birds were spread between the other parts of the pSPA.

Additional birds on the four brackish lochans were: Round 1, not counted, Round 2, 3 birds; Round 3, 6 birds; and Round 4, 1 bird. These birds are equivalent to <2% of the birds seen within the pSPA boundary.

Red-breasted mergansers breed in moderate numbers in Orkney. It is unknown if the birds wintering in Scapa Flow are of local breeding origin or from breeding grounds outside Orkney, or a mixture of both.

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors and the boat-based survey area are approximately 40% lower than the corresponding totals for the 1998/99 and 2000/01 surveys (Table 7). It is not known to what extent this decline may in part reflect improvements in survey methods (see Discussion), but red-breasted mergansers are relatively easy to count accurately (see above) and it would therefore appear that the population wintering in Scapa Flow has undergone a moderate to large decline over the past two decades.

Table 20. Red-breasted merganser count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	349	250	205	180	92.5%
Scapa Flow offshore	10	3	3	5	7	1.6%
East coast	11-13	15	8	12	8	4.0%
Southern approaches	14-15	3	5	7	5	1.9%
Whole pSPA	1-15	**370**	266	229	200	100%

Table 21. Red-breasted merganser count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	64	36	38	46	17.3%
Scapa Flow inshore N: Houton Head - Greenigoe	2	36	20	21	11	8.3%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	1	3	7	2	1.2%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	4	4	6	7	2.0%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	51	31	42	26	14.1%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	44	55	32	33	15.4%
Scapa Flow inshore S: Flotta N & E coasts	7	6	21	14	20	5.7%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	96	50	28	32	19.4%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	47	30	17	3	9.1%
Scapa Flow offshore: (boat survey area)	10	3	3	5	7	1.6%
East coast: Mainland east coast	11	7	3	4	6	1.9%
East coast: Burray east coast	12	0	0	1	0	0.1%
East coast: South Ronaldsay E coast	13	8	5	7	2	2.1%
Southern approaches: South Ronaldsay W coast	14	1	3	0	1	0.5%
Southern approaches: S. Walls & Switha S coasts	15	2	2	7	4	1.4%
Whole pSPA	1-15	370	266	229	200	100%

4.4.8 Goldeneye

The numbers (peak 51 individuals, mean 37 individuals) of common goldeneye counted in the 2017-18 shore/boat-based surveys of Scapa Flow pSPA did not exceed the UK SPA site selection guidelines stage 1.4 numerical threshold (1% GB; 200 individuals) in any of the four count rounds. The peak count of 51 individuals is equivalent to 0.26% of the GB wintering population (Musgrove *et al.*, 2013).

The count totals for common goldeneye excluded the birds counted on the four brackish lochans just above the high tide levels. The numbers of additional birds counted on these lochans were: Round 1, not counted, Round 2, 17 birds; Round 3, 15 birds; and Round 4, 11 birds. These birds are equivalent to 35% of the birds seen within the pSPA boundary. Even if these birds were to be included in the count for the pSPA, the total count would not have exceeded 1% of the GB wintering population for any count round. It is not clear whether previous surveys included counts for these lochans but if they were counted this would partly explain the decline in this species.

The highest numbers were recorded on Round 3 (51 individuals). The round 2 count (41 individuals) was only slightly lower.

Goldeneye occurred exclusively along the most sheltered parts of coast, either close inshore, or on the small brackish or freshwater lochans discussed above (Figure 13). These traits made them easy to detect and count and it is judged that count totals are within approximately 5% of the true figures.

The winter counts made in the mid-1970s (Lea, 1980) reported that the majority of the 'Scapa Flow' birds were on Loch of Stenness SAC, a large saline lagoon connected to Scapa Flow. This site was not included in all subsequent Scapa Flow winter counts.

The Scapa Flow inshore count sectors accounted for 95% of the pSPA total count (Table 22 and 23). The remainder of birds were spread between the other parts of the pSPA.

The 2017/18 mean and peak count totals for the 44 Scapa Flow shore-based count sectors are approximately 80% lower than the corresponding totals for the 1998/99 and 2000/01 surveys (Table 7). It is not known to what extent this decline reflects a genuine decrease in numbers or is a consequence of improvements to survey methods (see Discussion), or a combination of both. However, given that goldeneye are relatively easy to count accurately (see above) it is apparent that numbers of goldeneye in Scapa Flow in 2017/18 were substantially lower than in 1998/99 or 2000/01. It is unclear to what extent this may be indicative of a long-term trend, potentially linked to wider declines in numbers of goldeneye wintering in the UK (Frost *et al*., 2017). The changes could potentially also arise from redistribution of goldeneye between marine, brackish and freshwater wintering sites in Orkney and beyond within and between winters, but it is beyond the scope of this report to examine this.

Table 22. Common goldeneye count totals and mean percentage for major divisions of pSPA for 2017-2018 winter count rounds. The peak count is shown in bold type.

Division of pSPA	Sub-areas	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore	1-9	25	40	45	31	94.6%
Scapa Flow offshore	10	0	0	0	0	0.0%
East coast	11-13	0	1	3	1	3.4%
Southern approaches	14-15	0	0	3	0	2.0%
Whole pSPA	1-15	25	41	**51**	32	100%

Table 23. Common goldeneye count totals and mean percentage for defined sub-areas of pSPA (Figure 2) for 2017-2018 winter count rounds.

SPA sub-area description	Sub-area	Round 1	Round 2	Round 3	Round 4	Mean %
Scapa Flow inshore NW: Stromness - Houton Head	1	0	2	0	1	2.0%
Scapa Flow inshore N: Houton Head - Greenigoe	2	0	2	5	4	7.4%
Scapa Flow inshore NE: Scapa Bay - Glimps Holm	3	0	0	0	1	0.7%
Scapa Flow inshore SE: Hunda (W) to Widewall Bay	4	3	6	8	5	14.8%
Scapa Flow inshore E1: Churchill Barriers 1, 2 & 3	5	11	10	15	6	28.2%
Scapa Flow inshore E2: Churchill Barrier 4 & Hunda (E)	6	3	12	12	10	24.8%
Scapa Flow inshore S: Flotta N & E coasts	7	0	2	3	1	4.0%
Scapa Flow inshore SW: S. Walls N+E & Hoy SE	8	8	6	2	3	12.8%
Scapa Flow inshore W: Hoy E, Ore Bay - Burray Sound	9	0	0	0	0	0.0%
Scapa Flow offshore: (boat survey area)	10	0	0	0	0	0.0%
East coast: Mainland east coast	11	0	1	0	1	1.3%
East coast: Burray east coast	12	0	0	0	0	0.0%
East coast: South Ronaldsay E coast	13	0	0	3	0	2.0%
Southern approaches: South Ronaldsay W coast	14	0	0	3	0	2.0%
Southern approaches: S. Walls & Switha S coasts	15	0	0	0	0	0.0%
Whole pSPA	1-15	25	41	51	32	100%

5. DISCUSSION

5.1 Survey method and coverage

The shore-based and boat-based methods used for the 2017/18 winter counts and described in this report proved to be robust and achieved a very high level of coverage of the pSPA. The method of recording the location of birds using a compass bearing and an estimated distance allowed bird distributions to be accurately mapped and provided a sound basis for identifying (and excluding from count totals) likely cases of double recording.

The shore-based count method was unable to reliably count birds in the East Coast count sectors that were more than approximately 1.5-2km (depending on species and sea state) from the shore. In places in the East Coast part of the pSPA the site boundary, identified from visual aerial surveys of common eider, lies up to 3.5km from the shore.

5.2 Comparison to previous survey results and confidence in counts

Over the past four decades since monitoring of Scapa Flow first began, there have been important advances in bird survey methods, all of which are likely to improve population estimates. These advances include: better binoculars and spotting scopes, ready access to accurate location information from the global positioning system (GPS) technology, standardised boat survey methods (e.g. the ESAS methodology), methods for accurately estimating a bird's location, improved knowledge on how to identify 'difficult' species in the field and the use of computer software to aid the analysis of data. As a consequence of these changes, the quality of survey data and the overall accuracy of counts are likely to have improved over this period. In addition, the area covered by previous surveys has not been entirely uniform and this also needs to be borne in mind when making between-survey comparisons.

The comparisons of the 2017/18 mean and peak numbers of the pSPA qualifying species in the 44 Scapa Flow shore-based count sectors and the boat-based survey area with the corresponding counts from the 1998/99 and 2000/01 winter surveys give an indication of pSPA population trends. For the reasons described, the apparent changes in numbers over the past two decades are likely to give only an approximate indication of the true changes that have occurred over this time. Nevertheless, they suggest a large increase in the numbers of great northern diver and moderate to large declines in the numbers of black-throated diver, European shag, red-breasted merganser and common goldeneye.

The apparent changes in the other three qualifying species (Slavonian grebe, common eider and long-tailed duck) are more modest.

5.3 Future monitoring

It is recommended that the same shore-based and boat-based methods are used for future monitoring to establish population trends and changes in bird distribution. A few additional VPs in the Southern Approaches count sectors would enable more accurate counts of the numbers of European shag using this part of the pSPA. Monitoring surveys conducted at approximately five-year intervals would enable long-term trends to be established.

The strong association with fish-farms observed for long-tailed duck and common eider, which was also observed within the North Orkney pSPA (Upton *et al*, 2018), merits further study, in particular to better understand what prey these birds are targeting and how fish farm management may affect this. There is also potential for these birds to become trapped in fish farm nets and be disturbed by fish farm operations and this too merits further study.

The regular occurrence of white-billed diver (at least two individuals were present through the 2017/18 winter) in the pSPA is of interest. This is a very rare wintering bird in the UK, with a small biogeographic population size, and has an IUCN global conservation status of 'Near Threatened'. For these reasons it is recommended that white-billed diver is a target species of future monitoring.

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ANNEX 1: RECORDING FORMS AND CODES

Form 1. Species recording form used for shore-based surveys (blank rows from lower half of form not shown)

SCAPA FLOW COUNTS
2017/18

Sheet _____

Date	Times	VP	Easting	Northing	Location

Obs.	Wind	Sea state	Rain	Visibility	Comments

Sp. code	Number	Behav. code	Plumage	Bearing	Distance	Map ref.	Overlap zone?	Dup.	Notes /accuracy

Form 2. Species recording form used for boat-based surveys (blank rows from lower half of form not shown)

Species Data

Date: _____ **Site:** *Scapa Flow* **Sheet: / __**

Trip Key	Tran-sect	Port or Stbd?	Time GMT	Sp.	Age	Plum	No.	Dist. Band	Dir.	Behav	In tran?	Notes
			:									
			:									
			:									
			:									
			:									
			:									
			:									
			:									
			:									
			:									

Form 3. Trip data form used for boat-based surveys (blank rows from lower half of form not shown)

Trip Data

Date: _____ **Site:** *Scapa Flow* **Sheet:** /

Vessel: _____ **Eye height:** ____ **Transect width:** ____

Time interval: _____ **Angle of view:** ____ **Surveyors:** _____

Trip Key (TK _)	Transct (T _)	TimeSt. (GMT)	TimeEnd (GMT)	Obs	Scribe	No. Obs	Method	Directn. View	Species counted	Notes
		:	:							
		:	:							
		:	:							
		:	:							
		:	:							
		:	:							
		:	:							
		:	:							

Form 4. Environmental conditions form used for boat-based surveys (blank rows from lower half of form not shown)

Environmental Data

Date: _____ **Site:** **Sheet:** /

Trip Key (TK _)	Transct (T _)	TimeSt. (GMT)	Wind dirn.	Wind force	Sea state	Swell dirn.	Swell ht. m	Vis.	Glare	Rain

List of Codes: Waterfowl species, behaviour and plumage codes used when recording survey data

BTO code	Species
RH	Red-throated diver
BV	Black-throated diver
ND	Great northern diver
div	diver sp.
WV	White-billed diver
LG	Little grebe
SZ	Slavonian grebe
F.	Fulmar
GX	Gannet
CA	Cormorant
SA	Shag
MS	Mute swan
SU	Shelduck
WN	Wigeon
GA	Gadwall
T.	Teal
MA	Mallard
SV	Shoveler
PO	Pochard
TU	Tufted duck
SP	Scaup
E.	Eider
LN	Long-tailed duck
CX	Common scoter
VS	Velvet scoter
GN	Goldeneye
RM	Red-breasted merganser
IG	Iceland gull
GZ	Glaucous gull
GB	Great black-backed gull
KI	Kittiwake
GU	Guillemot
RA	Razorbill
TY	Black guillemot
LK	Little Auk
PU	Puffin

Behaviour code	Description
AS	active searching for food
CD	courtship/display
DF	dip-feeding (e.g. terns, gulls)
DV	diving from surface
ED	escape dive from vessel
EF	escape flight
FE	feeding (method not noted)
FY	flying
LA	flying birds lands
OL	on land
OW	on water
PD	plunge diving (e.g. gannet, terns)
PR	preening/bathing
RL	roosting/resting on land
RS	roosting/resting on sea
SN	Snorkelling
TO	take off
Plumage/Age code	**Description**
1	1st cal. year (e.g. year hatched)
2	2nd cal. year, (e.g. 2 = 1st-sum)
3	3rd calendar year
4	4th calendar year
5	5th calendar year
A	Adult
I	Immature
J	Juvenile
U	Unaged (or unrecorded)
S	Summer
W	Winter
DL	Dark-Light category for fulmar
LL	Light-Light category for fulmar
DD	Dark-Dark category for fulmar
M	Male plumage (e.g. for ducks)
F	Female plumage (e.g. for ducks)
T	Transition (summer / winter)

ANNEX 2: ORIGINAL DATA

This Annex can be downloaded as two separate spreadsheets, one for the shore-based survey data and the other for boat-based survey data.

These spreadsheets each have a ‘Records’ worksheet which contains all the individual records of the birds seen (one row for each record). The files also include a ‘Read-me’ worksheet that explains the structure and format of the data. The boat-based survey spreadsheet also has a worksheet containing the survey vessel GPS tracks for each survey round.

ANNEX 3: SHORE SURVEY COUNT SECTOR AND BOAT SURVEY TRANSECT TOTALS FOR EACH ROUND OF 2017/18 WINTER WATERFOWL SURVEY

Table A3.1. Great northern diver totals by count sector/boat transect for each count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	16	10	35	27		
	2	38	22	17	11		
	All	*54*	*32*	*52*	*38*	*44*	*54*
2	3	0	0	1	0		
	4	1	2	7	7		
	5	6	26	10	25		
	6	8	18	27	6		
	7	7	1	4	4		
	8	29	36	2	10		
	33	1	1	2	10		
	34	3	16	11	4		
	35	3	0	32	1		
	36	17	19	15	11		
	All	*75*	*119*	*111*	*78*	*96*	*119*
3	9	1	2	4	1		
	10	6	0	6	0		
	11	0	0	6	6		
	12	3	8	6	20		
	37	1	5	13	2		
	38	2	11	36	8		
	All	*13*	*26*	*71*	*37*	*37*	*71*
4	19	2	2	3	1		
	39	27	38	19	21		
	40	6	43	6	17		
	All	*35*	*83*	*28*	*39*	*46*	*83*
5	13	0	4	3	1		
	14	11	5	6	17		
	15	5	7	5	5		
	All	*16*	*16*	*14*	*23*	*17*	*23*
6	16	0	1	1	1		
	17	3	7	2	2		
	18	10	13	10	11		
	All	*13*	*21*	*13*	*14*	*15*	*21*
7	21	0	4	2	21		
	23	1	3	1	6		
	30	1	1	1	6		
	41	0	5	6	20		
	43	16	20	3	12		
	All	*18*	*33*	*13*	*65*	*32*	*65*
8	22	13	5	2	16		
	24	1	0	0	1		
	25	1	1	1	2		
	26	1	0	1	2		
	All	*16*	*6*	*4*	*21*	*12*	*21*
9	20	4	29	7	6		
	27	6	7	1	2		
	28	2	18	1	0		
	29	0	2	12	0		
	32	4	13	7	2		
	44	0	2	1	3		
	All	*16*	*71*	*29*	*13*	*32*	*71*
1-9	***All***	**256**	**407**	**335**	**328**	***332***	***407***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	0	0	0	4		
	46	1	0	5	7		
	47	4	2	2	11		
	48	6	6	0	5		
	All	*11*	*8*	*7*	*27*	*13*	*27*
12	49	15	12	8	12		
	50	15	4	4	4		
	All	*30*	*16*	*12*	*16*	*19*	*30*
13	51	11	1	4	3		
	52	5	0	9	3		
	53	10	0	0	0		
	54	0	0	0	0		
	All	*26*	*1*	*13*	*6*	*12*	*26*
11-13	***All***	***67***	***25***	***32***	***49***	***43***	***67***
SPA Southern Approaches shore-based counts							
14	55	0	0	0	0		
	56	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
15	57	0	0	0	0		
	58	0	0	0	0		
	59	0	0	1	0		
	All	*0*	*0*	*1*	*0*	*0*	*1*
14-15	***All***	***0***	***0***	***1***	***0***	***0***	***1***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <500m from boat)							
10	T01	25	21	31	28		
	T02	21	16	35	47		
	T03	10	60	22	21		
	T04	2	33	13	2		
	T05	46	114	120	15		
	T06	32	6	17	10		
	T07	20	81	45	7		
	T08	7	34	25	16		
	T09	0	24	24	30		
	T10	3	32	18	24		
	T11	0	24	22	27		
	T12	30	14	36	50		
	off	0	0	0	60		
	All	*196*	*459*	*408*	*337*	*350*	*459*
Scapa Flow offshore - extrapolated counts							
10	***All***	***249***	***584***	***519***	***454***	*451*	*584*
Whole of Scapa Flow SPA							
All	***All***	***572***	***1016***	***887***	***831***	***826***	***1016***

Table A3.2. Black-throated diver totals by count sector/boat transect for each count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	0	0	0	0		
	2	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
2	3	0	0	0	0		
	4	0	0	0	0		
	5	0	0	0	1		
	6	3	3	0	0		
	7	6	0	0	0		
	8	11	24	0	0		
	33	0	0	0	0		
	34	0	0	0	0		
	35	0	0	22	0		
	36	0	0	0	0		
	All	*20*	*27*	*22*	*1*	*18*	*27*
3	9	0	0	0	0		
	10	3	0	0	0		
	11	0	0	0	0		
	12	0	0	0	0		
	37	0	0	3	0		
	38	0	0	0	0		
	All	*3*	*0*	*3*	*0*	*2*	*3*
4	19	0	0	0	0		
	39	0	0	0	0		
	40	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
5	13	0	0	0	0		
	14	0	0	0	0		
	15	0	0	3	0		
	All	*0*	*0*	*3*	*0*	*1*	*3*
6	16	0	0	0	0		
	17	0	0	0	0		
	18	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
7	21	0	0	0	0		
	23	0	0	0	0		
	30	0	0	0	0		
	41	0	0	0	0		
	43	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
8	22	0	0	0	0		
	24	0	0	0	0		
	25	0	0	0	0		
	26	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
9	20	0	0	0	0		
	27	0	0	0	0		
	28	0	0	0	0		
	29	0	0	0	0		
	32	0	0	0	0		
	44	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
1-9	***All***	**23**	**27**	**28**	**1**	***20***	***28***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	0	0	0	0		
	46	0	0	0	0		
	47	0	0	0	0		
	48	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
12	49	0	0	0	0		
	50	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
13	51	0	0	0	0		
	52	0	0	0	0		
	53	0	0	0	0		
	54	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
11-13	***All***	***0***	***0***	***0***	***0***	***0***	***0***
SPA Southern Approaches shore-based counts							
14	55	0	0	0	0		
	56	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
15	57	0	0	0	0		
	58	0	0	0	0		
	59	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
14-15	***All***	***0***	***0***	***0***	***0***	***0***	***0***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <500m from boat)							
10	T01	2	0	9	5		
	T02	1	0	0	0		
	T03	0	0	0	0		
	T04	0	0	0	0		
	T05	0	0	0	0		
	T06	0	0	0	0		
	T07	0	0	0	0		
	T08	0	0	(3)	0		
	T09	0	0	0	0		
	T10	0	0	0	0		
	T11	0	0	0	0		
	T12	0	0	0	1		
	off	0	0	0	6		
	All	*3*	*0*	*9*	*6*	*5*	*9*
Scapa Flow offshore - extrapolated counts							
10	***All***	***4***	***0***	***11***	***8***	*6*	*11*
(excludes 3 birds that likely duplicate shore-based counts)							
Whole of Scapa Flow SPA							
All	***All***	***27***	***27***	***39***	***9***	***26***	***39***

Table A3.3. Slavonian grebe totals by count sector for each 2017/18 winter count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	17	7	9	5		
	2	0	1	2	0		
	All	*17*	*8*	*11*	*5*	*10*	*17*
2	3	1	2	1	3		
	4	0	3	5	0		
	5	3	6	8	2		
	6	20	11	35	5		
	7	21	5	5	3		
	8	0	6	1	0		
	33	0	0	2	0		
	34	0	0	0	0		
	35	0	0	0	0		
	36	0	0	0	0		
	All	*45*	*33*	*57*	*13*	*37*	*57*
3	9	5	2	11	2		
	10	0	0	3	0		
	11	0	0	0	1		
	12	0	0	3	1		
	37	0	0	0	1		
	38	0	3	8	1		
	All	*5*	*5*	*25*	*6*	*10*	*25*
4	19	2	2	4	0		
	39	0	0	0	0		
	40	0	0	0	0		
	All	*2*	*2*	*4*	*0*	*2*	*4*
5	13	2	3	5	2		
	14	2	0	0	0		
	15	26	17	34	8		
	All	*30*	*20*	*39*	*10*	*25*	*39*
6	16	0	0	0	0		
	17	1	2	0	7		
	18	4	10	14	5		
	All	*5*	*12*	*14*	*12*	*11*	*14*
7	21	0	0	2	5		
	23	0	0	1	4		
	30	0	0	0	0		
	41	0	0	0	0		
	43	0	2	2	0		
	All	*0*	*2*	*5*	*9*	*4*	*9*
8	22	0	0	0	0		
	24	0	0	0	0		
	25	9	2	2	3		
	26	34	1	2	1		
	All	*43*	*3*	*4*	*4*	*14*	*43*
9	20	0	0	0	5		
	27	6	3	1	1		
	28	1	6	1	0		
	29	0	0	0	0		
	32	0	0	0	0		
	44	1	0	0	0		
	All	*8*	*9*	*2*	*6*	*6*	*9*
1-9	***All***	**155**	**94**	**161**	**65**	***119***	***161***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	0	0	0	0		
	46	0	0	0	0		
	47	0	0	0	0		
	48	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
12	49	0	0	0	2		
	50	0	0	0	0		
	All	*0*	*0*	*0*	*2*	*1*	*2*
13	51	0	0	0	0		
	52	0	0	0	0		
	53	0	0	0	0		
	54	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
11-13	***All***	***0***	***0***	***0***	***2***	***1***	***2***
SPA Southern Approaches shore-based counts							
14	55	0	0	0	0		
	56	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
15	57	0	0	0	0		
	58	0	0	0	0		
	59	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
14-15	***All***	***0***	***0***	***0***	***0***	***0***	***0***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <300m from boat)							
10	T01	3	4	0	0		
	T02	0	0	0	0		
	T03	0	0	0	0		
	T04	0	0	0	0		
	T05	0	0	0	0		
	T06	0	0	0	0		
	T07	0	0	0	0		
	T08	0	0	0	0		
	T09	0	0	0	0		
	T10	0	0	0	0		
	T11	0	0	0	0		
	T12	0	0	0	0		
	off	0	0	0	0		
	All	*3*	*4*	*0*	*0*	*2*	*4*
Scapa Flow offshore - extrapolated counts							
10	***All***	***6***	***8***	***0***	***0***	*4*	*8*
Whole of Scapa Flow SPA							
All	***All***	***161***	***102***	***161***	***67***	***123***	***161***

Table A3.4. European shag totals by count sector for each 2017/18 winter count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	673	154	359	118		
	2	33	40	32	2		
	All	*706*	*194*	*391*	*120*	*353*	*706*
2	3	13	7	2	3		
	4	1	8	7	4		
	5	2	4	9	29		
	6	53	15	26	5		
	7	12	3	2	1		
	8	21	2	8	0		
	33	2	1	9	0		
	34	2	5	7	1		
	35	5	0	2	1		
	36	4	2	4	1		
	All	*115*	*47*	*76*	*45*	*71*	*115*
3	9	46	16	29	2		
	10	3	4	3	0		
	11	2	0	6	2		
	12	7	5	8	5		
	37	2	3	2	2		
	38	81	2	14	13		
	All	*141*	*30*	*62*	*24*	*64*	*141*
4	19	80	11	14	1		
	39	26	12	13	0		
	40	169	21	117	9		
	All	*275*	*44*	*144*	*10*	*118*	*275*
5	13	198	6	7	2		
	14	21	23	8	7		
	15	85	26	17	4		
	All	*304*	*55*	*32*	*13*	*101*	*304*
6	16	1	6	9	0		
	17	12	10	6	9		
	18	76	39	23	25		
	All	*89*	*55*	*38*	*34*	*54*	*89*
7	21	0	7	2	4		
	23	7	15	4	3		
	30	2	5	5	4		
	41	18	37	14	43		
	43	19	15	5	2		
	All	*46*	*79*	*30*	*56*	*53*	*79*
8	22	142	44	46	23		
	24	7	6	0	3		
	25	34	28	11	7		
	26	2	20	9	2		
	All	*185*	*98*	*66*	*35*	*96*	*185*
9	20	26	136	32	22		
	27	19	31	9	11		
	28	13	18	3	4		
	29	0	3	2	3		
	32	1	8	0	0		
	44	0	3	4	2		
	All	*59*	*199*	*50*	*42*	*88*	*199*
1-9	***All***	**1920**	**801**	**889**	**379**	***997***	***1920***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	380	81	11	10		
	46	15	13	11	10		
	47	11	9	18	20		
	48	11	25	6	6		
	All	*417*	*128*	*46*	*46*	*159*	*417*
12	49	37	26	5	3		
	50	148	8	2	5		
	All	*185*	*34*	*7*	*8*	*59*	*185*
13	51	334	8	12	0		
	52	330	20	41	7		
	53	40	11	65	9		
	54	80	13	23	20		
	All	*784*	*52*	*141*	*36*	*253*	*784*
11-13	***All***	***1386***	***214***	***194***	***90***	***471***	***1386***
SPA Southern Approaches shore-based counts							
14	55	52	2	53	8		
	56	125	22	40	24		
	All	*177*	*24*	*93*	*32*	*82*	*177*
15	57	23	5	20	1		
	58	43	15	2	3		
	59	77	7	5	5		
	All	*143*	*27*	*27*	*9*	*52*	*143*
14-15	***All***	***320***	***51***	***120***	***41***	***133***	***320***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <300m from boat)							
10	T01	10	8	4	10		
	T02	10	8	12	2		
	T03	20	9	24	3		
	T04	1	10	12	3		
	T05	0	0	0	0		
	T06	0	0	0	0		
	T07	2	4	0	0		
	T08	0	0	0	0		
	T09	0	0	1	1		
	T10	0	3	0	0		
	T11	0	0	0	0		
	T12	0	0	0	0		
	off	0	0	0	0		
	All	*43*	*42*	*53*	*19*	*39*	*53*
Birds on land		9	14	7	29		
Scapa Flow offshore - extrapolated counts							
10	***All***	***100***	***103***	***119***	***72***	*99*	*119*
Whole of Scapa Flow SPA							
All	***All***	***3726***	***1169***	***1322***	***582***	***1700***	***3726***

Table 24. Common eider totals by count sector for each 2017/18 winter count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	34	13	38	75		
	2	47	47	51	46		
	All	*81*	*60*	*89*	*121*	*88*	*121*
2	3	0	1	5	1		
	4	13	5	2	2		
	5	10	11	5	4		
	6	9	5	12	7		
	7	4	2	0	1		
	8	5	4	0	0		
	33	6	3	0	4		
	34	1	4	5	0		
	35	0	0	0	0		
	36	3	0	0	0		
	All	*51*	*35*	*29*	*19*	*34*	*51*
3	9	13	18	17	18		
	10	6	0	0	0		
	11	6	0	0	9		
	12	6	8	5	4		
	37	0	0	0	0		
	38	8	6	5	4		
	All	*39*	*32*	*27*	*35*	*33*	*39*
4	19	22	18	23	21		
	39	2	2	0	0		
	40	4	8	0	8		
	All	*28*	*28*	*23*	*29*	*27*	*29*
5	13	9	13	6	1		
	14	22	24	42	45		
	15	22	14	14	22		
	All	*53*	*51*	*62*	*68*	*59*	*68*
6	16	5	48	75	8		
	17	32	68	43	31		
	18	50	71	72	61		
	All	*87*	*187*	*190*	*100*	*141*	*190*
7	21	0	35	63	136		
	23	3	3	8	23		
	30	0	0	0	2		
	41	0	0	0	0		
	43	4	3	4	0		
	All	*7*	*41*	*75*	*161*	*71*	*161*
8	22	11	6	3	1		
	24	2	2	3	4		
	25	27	17	20	25		
	26	84	45	31	11		
	All	*124*	*70*	*57*	*41*	*73*	*124*
9	20	216	162	8	22		
	27	24	217	96	2		
	28	1290	453	614	1421		
	29	0	0	3	19		
	32	0	0	0	0		
	44	0	0	0	0		
	All	*1530*	*832*	*721*	*1464*	*1137*	*1530*
1-9	***All***	**2000**	**1336**	**1273**	**2038**	***1662***	***2038***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	63	51	128	47		
	46	35	34	55	41		
	47	7	6	22	3		
	48	13	6	7	9		
	All	*118*	*97*	*212*	*100*	*132*	*212*
12	49	9	11	26	12		
	50	4	13	0	7		
	All	*13*	*24*	*26*	*19*	*21*	*26*
13	51	14	0	6	5		
	52	32	69	51	22		
	53	10	0	1	2		
	54	90	0	4	6		
	All	*146*	*69*	*62*	*35*	*78*	*146*
11-13	***All***	***277***	***190***	***300***	***154***	***230***	***300***
SPA Southern Approaches shore-based counts							
14	55	3	10	81	10		
	56	1	20	5	4		
	All	*4*	*30*	*86*	*14*	*34*	*86*
15	57	0	0	0	0		
	58	0	0	4	0		
	59	0	1	1	2		
	All	*0*	*1*	*5*	*2*	*2*	*5*
14-15	***All***	***4***	***31***	***91***	***16***	***36***	***91***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <500m from boat)							
10	T01	25	134	19	43		
	T02	0	3	2	2		
	T03	3	1	0	2		
	T04	0	2	0	0		
	T05	2	0	4	0		
	T06	0	0	0	0		
	T07	0	5	0	0		
	T08	4	0	0	0		
	T09	0	0	0	0		
	T10	0	0	0	0		
	T11	0	0	0	0		
	T12	0	0	0	0		
	off	0	0	0	0		
	All	*34*	*145*	*25*	*47*	*63*	*145*
Scapa Flow offshore - extrapolated counts							
10	***All***	***43***	***184***	***32***	***63***	*81*	*184*
Whole of Scapa Flow SPA							
All	***All***	***2324***	***1741***	***1696***	***2271***	***2008***	***2324***

Table 25. Long-tailed duck totals by count sector for each 2017/18 winter count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	38	4	20	29		
	2	0	3	13	2		
	All	*38*	*7*	*33*	*31*	*27*	*38*
2	3	0	5	2	0		
	4	9	0	0	0		
	5	1	0	5	0		
	6	47	25	138	48		
	7	16	14	16	11		
	8	0	0	0	0		
	33	0	0	0	0		
	34	9	0	0	2		
	35	0	0	0	0		
	36	0	0	0	0		
	All	*82*	*44*	*161*	*61*	*87*	*161*
3	9	17	17	33	7		
	10	13	0	0	0		
	11	6	0	16	48		
	12	2	3	68	57		
	37	0	0	0	0		
	38	6	7	45	0		
	All	*44*	*27*	*162*	*112*	*86*	*162*
4	19	14	11	26	18		
	39	0	0	8	0		
	40	0	0	0	0		
	All	*14*	*11*	*34*	*18*	*19*	*34*
5	13	4	21	35	14		
	14	26	59	14	87		
	15	33	43	28	10		
	All	*63*	*123*	*77*	*111*	*94*	*123*
6	16	22	8	63	49		
	17	19	17	36	26		
	18	34	32	16	44		
	All	*75*	*57*	*115*	*119*	*92*	*119*
7	21	0	4	3	6		
	23	7	10	29	44		
	30	0	0	0	0		
	41	0	0	0	0		
	43	0	0	2	0		
	All	*7*	*14*	*34*	*50*	*26*	*50*
8	22	0	6	8	15		
	24	0	0	0	0		
	25	32	15	22	31		
	26	23	6	2	8		
	All	*55*	*27*	*32*	*54*	*42*	*55*
9	20	12	27	89	13		
	27	220	163	235	603		
	28	542	67	104	69		
	29	0	5	30	2		
	32	0	0	0	0		
	44	0	0	12	1		
	All	*774*	*262*	*470*	*688*	*549*	*774*
1-9	***All***	**1152**	**572**	**1118**	**1244**	***1022***	***1244***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	6	5	16	13		
	46	2	9	15	13		
	47	0	0	1	5		
	48	24	7	6	6		
	All	*32*	*21*	*38*	*37*	*32*	*38*
12	49	52	28	14	9		
	50	0	11	0	10		
	All	*52*	*39*	*14*	*19*	*31*	*52*
13	51	2	4	34	5		
	52	21	18	29	19		
	53	0	0	0	0		
	54	0	0	0	0		
	All	*23*	*22*	*63*	*24*	*33*	*63*
11-13	***All***	***107***	***82***	***115***	***80***	***96***	***115***
SPA Southern Approaches shore-based counts							
14	55	0	1	0	0		
	56	0	4	4	0		
	All	*0*	*5*	*4*	*0*	*2*	*5*
15	57	0	0	0	0		
	58	0	0	0	0		
	59	0	3	10	0		
	All	*0*	*3*	*10*	*0*	*3*	*10*
14-15	***All***	***0***	***8***	***14***	***0***	***6***	***14***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <500m from boat)							
10	T01	13	139	51	496		
	T02	4	33	50	3		
	T03	0	0	0	0		
	T04	0	4	0	0		
	T05	0	0	0	0		
	T06	0	0	4	0		
	T07	0	6	0	0		
	T08	0	0	0	0		
	T09	0	0	0	0		
	T10	0	0	2	0		
	T11	4	0	0	0		
	T12	0	0	0	0		
	off	0	0	0	0		
	All	*21*	*182*	*107*	*499*	*202*	*499*
Scapa Flow offshore - extrapolated counts							
10	***All***	***27***	***231***	***136***	***672***	*266*	*672*
Whole of Scapa Flow SPA							
All	***All***	***1286***	***893***	***1383***	***1996***	***1389***	***1996***

Table A3.7. Red-breasted merganser totals by count sector for each 2017/18 winter count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	63	36	37	45		
	2	1	0	1	1		
	All	*64*	*36*	*38*	*46*	*46*	*64*
2	3	9	12	7	4		
	4	2	0	2	0		
	5	1	3	0	2		
	6	13	3	5	4	adjusted	
	7	9	2	0	1		
	8	0	0	0	0		
	33	0	0	7	0		
	34	0	0	0	0		
	35	2	0	0	0		
	36	0	0	0	0		
	All	*36*	*20*	*21*	*11*	*22*	*36*
3	9	1	3	7	1		
	10	0	0	0	0		
	11	0	0	0	0		
	12	0	0	0	0		
	37	0	0	0	1		
	38	0	0	0	0		
	All	*1*	*3*	*7*	*2*	*3*	*7*
4	19	4	4	6	7		
	39	0	0	0	0		
	40	0	0	0	0		
	All	*4*	*4*	*6*	*7*	*5*	*7*
5	13	2	14	12	5		
	14	28	8	11	5		
	15	21	9	19	16		
	All	*51*	*31*	*42*	*26*	*38*	*51*
6	16	7	1	5	3		
	17	33	44	23	22		
	18	4	10	4	8		
	All	*44*	*55*	*32*	*33*	*41*	*55*
7	21	0	4	3	10		
	23	3	17	11	10		
	30	0	0	0	0		
	41	0	0	0	0		
	43	3	0	0	0		
	All	*6*	*21*	*14*	*20*	*15*	*21*
8	22	0	0	2	0		
	24	3	3	0	0		
	25	31	23	8	18		
	26	62	24	18	14		
	All	*96*	*50*	*28*	*32*	*52*	*96*
9	20	3	6	6	0		
	27	27	13	4	3		
	28	17	11	3	0		
	29	0	0	4	0		
	32	0	0	0	0		
	44	0	0	0	0		
	All	*47*	*30*	*17*	*3*	*24*	*47*
1-9	***All***	**349**	**250**	**205**	**180**	***246***	***349***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	1	0	3	3		
	46	5	2	1	0		
	47	0	0	0	0		
	48	1	1	0	3		
	All	*7*	*3*	*4*	*6*	*5*	*7*
12	49	0	0	1	0		
	50	0	0	0	0		
	All	*0*	*0*	*1*	*0*	*0*	*1*
13	51	2	0	0	2		
	52	6	5	5	0		
	53	0	0	2	0		
	54	0	0	0	0		
	All	*8*	*5*	*7*	*2*	*6*	*8*
11-13	***All***	***15***	***8***	***12***	***8***	***11***	***15***
SPA Southern Approaches shore-based counts							
14	55	1	1	0	1		
	56	0	2	0	0		
	All	*1*	*3*	*0*	*1*	*1*	*3*
15	57	0	0	0	0		
	58	0	0	0	0		
	59	2	2	7	4		
	All	*2*	*2*	*7*	*4*	*4*	*7*
14-15	***All***	***3***	***5***	***7***	***5***	***5***	***7***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <500m from boat)							
10	T01	2	2	4	5		
	T02	0	0	0	0		
	T03	0	0	0	0		
	T04	0	0	0	0		
	T05	0	0	0	0		
	T06	0	0	0	0		
	T07	0	0	0	0		
	T08	0	0	0	0		
	T09	0	0	0	0		
	T10	0	0	0	0		
	T11	0	0	0	0		
	T12	0	0	0	0		
	off	0	0	0	0		
	All	*2*	*2*	*4*	*5*	*3*	*5*
Scapa Flow offshore - extrapolated counts							
10	***All***	***3***	***3***	***5***	***7***	*4*	*7*
Whole of Scapa Flow SPA							
All	***All***	***370***	***266***	***229***	***200***	***266***	***370***

Table A3.8. Common goldeneye totals by count sector for each 2017/18 winter count round (R1, R2, etc.)

Area	Sector	R1	R2	R3	R4	Mean	Max
Scapa Flow inshore areas shore-based counts							
1	1	0	0	0	1		
	2	0	2	0	0		
	All	*0*	*2*	*0*	*1*	*1*	*2*
2	3	0	1	0	0		
	4	0	0	1	0		
	5	0	1	3	0		
	6	0	0	0	3		
	7	0	0	1	1		
	8	0	0	0	0		
	33	0	0	0	0		
	34	0	0	0	0		
	35	0	0	0	0		
	36	0	0	0	0		
	All	*0*	*2*	*5*	*4*	*3*	*5*
3	9	0	0	0	0		
	10	0	0	0	0		
	11	0	0	0	1		
	12	0	0	0	0		
	37	0	0	0	0		
	38	0	0	0	0		
	All	*0*	*0*	*0*	*1*	*0*	*1*
4	19	3	6	8	5		
	39	0	0	0	0		
	40	0	0	0	0		
	All	*3*	*6*	*8*	*5*	*6*	*8*
5	13	1	5	4	1		
	14	0	2	4	5		
	15	10	3	7	0		
	All	*11*	*10*	*15*	*6*	*11*	*15*
6	16	0	7	9	9		
	17	3	3	3	1		
	18	0	2	0	0		
	All	*3*	*12*	*12*	*10*	*9*	*12*
7	21	0	0	3	1		
	23	0	2	0	0		
	30	0	0	0	0		
	41	0	0	0	0		
	43	0	0	0	0		
	All	*0*	*2*	*3*	*1*	*2*	*3*
8	22	0	0	0	2		
	24	0	0	0	1		
	25	2	4	0	0		
	26	6	2	2	0		
	All	*8*	*6*	*2*	*3*	*5*	*8*
9	20	0	0	0	0		
	27	0	0	0	0		
	28	0	0	0	0		
	29	0	0	0	0		
	32	0	0	0	0		
	44	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
1-9	***All***	**25**	**40**	**45**	**31**	***35***	***45***

Area	Sector	R1	R2	R3	R4	Mean	Max
SPA East Coast shore-based counts							
11	45	0	0	0	0		
	46	0	0	0	1		
	47	0	0	0	0		
	48	0	1	0	0		
	All	*0*	*1*	*0*	*1*	*1*	*1*
12	49	0	0	0	0		
	50	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
13	51	0	0	1	0		
	52	0	0	0	0		
	53	0	0	2	0		
	54	0	0	0	0		
	All	*0*	*0*	*3*	*0*	*1*	*3*
11-13	***All***	***0***	***1***	***3***	***1***	***1***	***3***
SPA Southern Approaches shore-based counts							
14	55	0	0	3	0		
	56	0	0	0	0		
	All	*0*	*0*	*3*	*0*	*1*	*3*
15	57	0	0	0	0		
	58	0	0	0	0		
	59	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
14-15	***All***	***0***	***0***	***3***	***0***	***1***	***3***
Scapa Flow offshore - raw boat-based counts (records selected: on sea <500m from boat)							
10	T01	0	0	0	0		
	T02	0	0	0	0		
	T03	0	0	0	0		
	T04	0	0	0	0		
	T05	0	0	0	0		
	T06	0	0	0	0		
	T07	0	0	0	0		
	T08	0	0	0	0		
	T09	0	0	0	0		
	T10	0	0	0	0		
	T11	0	0	0	0		
	T12	0	0	0	0		
	off	0	0	0	0		
	All	*0*	*0*	*0*	*0*	*0*	*0*
Scapa Flow offshore - extrapolated counts							
10	***All***	***0***	***0***	***0***	***0***	*0*	*0*
Whole of Scapa Flow SPA							
All	***All***	***25***	***41***	***51***	***32***	***37***	***51***

ANNEX 4: SURVEY RESULTS FOR NON-QUALIFYING WATERFOWL AND SEABIRD SPECIES

The total numbers of non-qualifying waterfowl and seabird species seen in each count round of the 2017/18 winter survey are summarised in Table A4.1.

The numbers of these species seen in each of the 15 survey sub-areas in each count round is summarised in Table A4.2

In Tables A4.1 and A4.2 the numbers of black guillemots seen in the offshore survey area (Sub-area 10) is the numbers seen within 300m of the survey vessel adjusted for proportion of the sub-area covered, as explained in Section 3.2.3. For all other species the numbers reported for the offshore survey area are the raw totals seen on the boat-based surveys.

The survey results showed that the pSPA is an important wintering site for black guillemot. The numbers of black guillemot increased through the winter and by Round 4 (March) approximately 800 birds were present in the pSPA, a number that exceeds 1% of the estimated UK wintering population. Black guillemot is not eligible to qualify for consideration as a qualifying SPA species (it is a non-migratory species).

White-billed diver was recorded on every survey round. The records of this species suggest there were at least two individuals wintering in Scapa Flow in the 2017/18 winter. Single birds (most likely the same bird) were seen on five occasions between Houton Head and the northern tip of Cava. There were also records of single birds in the eastern part of Scapa Flow (count sectors 39 and 40 respectively) on the 1st and 2nd of January 2018. One of these birds was in the outer part of Widewall Bay (count sector 40) and the other was approximately 6km away to the west of Hunda (count sector 39). It is not known if these records refer to one or two individuals. Given the difficulty of distinguishing white-billed diver from great northern diver in all except very favourable conditions, it is considered likely that that this species was sometimes overlooked. White-billed diver is a very rare wintering bird in UK and there is increasing evidence that Scapa Flow is one of the few regularly used inshore sites.

There were no records of red-necked grebe in the 2017/18 survey. The 1998/99 and 2000/01 surveys recorded low numbers of this species (peak of 23 individuals in March 2001).

Table 26. Waterfowl count totals for the Scapa Flow pSPA non-qualifying species for each count round of the 2017/18 winter survey. The peak count is shown in bold type.

Species	pSPA qualifying species	Round 1	Round 2	Round 3	Round 4
White-billed diver	No	1	**2**	0	**2**
Red-throated diver	No	**65**	16	8	15
Little grebe	No	5	**10**	**10**	5
Great cormorant	No	**171**	142	87	130
Velvet scoter	No	2	**8**	**8**	1
Common scoter	No	2	0	3	0
Tufted duck	No	11	27	**42**	29
Greater scaup	No	0	0	2	**3**
Common pochard	No	0	4	7	**22**
Eurasian wigeon	No	2330	2205	**3312**	1637
Eurasian teal	No	575	296	**779**	287
Mallard	No	380	432	**449**	129
Gadwall	No	2	0	3	**14**
Northern shoveler	No	3	12	12	**40**
Common shelduck	No	2	2	35	**61**
Black guillemot	No	299	540	674	**784**
Common guillemot	No	74	**151**	150	**223**
Razorbill	No	17	5	20	**120**
Guillemot/razorbill	No	2	0	3	**14**
Atlantic puffin	No	4	**11**	7	**12**
Little Auk	No	2	5	**7**	0

Table A4.2. Waterfowl count totals for the Scapa Flow pSPA non-qualifying species broken down by survey sub-area for each count round of the 2017/18 winter survey.

Species	Sub-area	Round 1	Round 2	Round 3	Round 4
Red-throated diver	1	7	3	2	3
	2	5	0	0	0
	3	3	0	0	1
	4	8	2	0	0
	5	7	0	0	1
	6	2	0	1	0
	7	4	3	1	0
	8	2	1	1	0
	10	2	4	0	6
	11	22	2	0	2
	12	2	0	0	0
	13	0	1	1	0
	14	1	0	1	1
	15	0	0	1	1
	All	65	16	8	15
White-billed diver	1	1	0	0	1
	4	0	2	0	0
	10	0	0	0	1
	All	1	2	0	3
Little grebe	1	2	4	10	5
	5	0	3	0	0
	6	1	1	0	0
	9	1	2	0	0
	13	1	0	0	0
	All	5	10	10	5
Northern gannet	1	12	0	0	0
	2	31	0	0	0
	3	55	0	0	0
	4	4	0	0	0
	5	46	0	0	0
	7	1	0	0	0
	10	0	0	0	0
	11	8	0	0	0
	12	7	0	0	0
	13	7	0	0	0
	14	22	0	0	0
	15	5	0	0	1
	All	198	0	0	1
Great cormorant	1	16	1	16	7
	2	33	91	22	86
	3	7	11	3	1
	4	20	5	5	0
	5	23	6	2	3
	6	5	2	0	0
	7	0	2	0	0
	8	3	2	0	0
	9	10	12	1	26
	11	6	4	7	1
	13	2	1	1	0
	14	7	1	0	1
	15	8	2	1	0
	All	140	140	58	125
Mute swan	1	0	0	1	3
	2	1	0	0	0
	3	0	0	1	0

Species	Sub-area	Round 1	Round 2	Round 3	Round 4
	5	0	7	6	8
	6	0	2	11	2
	13	5	0	1	0
	All	6	9	20	13
Common shelduck	1	0	0	0	9
	2	0	0	0	2
	4	2	0	26	28
	5	0	0	4	8
	6	0	0	2	4
	7	0	2	0	0
	8	0	0	2	1
	11	0	0	0	3
	13	0	0	1	4
	14	0	0	0	2
	All	2	2	35	61
Mallard	1	10	49	21	20
	2	77	43	54	13
	4	59	12	39	4
	5	16	122	109	17
	6	36	12	38	15
	7	22	20	6	6
	8	28	82	48	3
	9	24	43	35	13
	11	26	12	37	5
	12	0	0	0	2
	13	55	15	42	22
	14	27	20	16	9
	15	0	2	4	0
	All	380	432	449	129
Gadwall	2	4	0	0	0
	5	0	9	7	3
	6	3	2	6	7
	11	0	0	0	2
	All	2	0	3	14
Eurasian teal	1	88	50	34	20
	2	214	43	246	7
	4	14	10	70	24
	5	107	48	201	89
	6	5	3	13	20
	7	0	22	23	8
	8	8	0	20	0
	9	0	6	0	0
	11	79	104	19	15
	12	0	0	12	0
	13	60	10	131	101
	14	0	0	0	3
	15	0	0	10	0
	All	575	296	779	287
Eurasian wigeon	1	166	96	349	172
	2	336	145	121	143
	3	87	35	287	25
	4	314	105	481	200
	5	80	338	695	158
	6	321	200	489	72
	7	2	25	145	38
	8	89	139	135	63
	9	83	96	137	37
	11	139	385	307	66
	12	0	4	0	0

Species	Sub-area	Round 1	Round 2	Round 3	Round 4
	13	595	434	124	532
	14	97	203	29	131
	15	21	0	13	0
		2330	2205	3312	1637
	All	0	0	2	3
Common scoter	1	0	0	2	0
	5	1	0	0	0
	6	1	0	0	0
	9	0	1	0	0
	All	2	0	3	0
Velvet scoter	4	1	1	1	1
	6	1	7	7	0
	All	2	8	8	1
Common guillemot	1	0	0	3	5
	2	10	2	23	3
	3	6	0	7	6
	4	0	12	18	3
	5	3	0	4	1
	6	0	0	2	1
	7	0	3	9	22
	8	2	3	1	0
	9	0	1	0	0
	10	16	121	68	59
	11	7	0	0	20
	12	5	2	1	0
	13	17	0	3	103
	14	5	2	10	0
	15	3	5	1	0
	All	74	151	150	223
Guillemot/razorbill	2	6	0	0	1
	10	0	1	2	3
	11	0	0	0	4
	12	1	0	0	0
	13	3	0	0	0
	All	2	0	3	14
Razorbill	2	2	0	1	1
	3	1	0	2	2
	4	0	0	3	3
	5	0	0	3	4
	6	0	0	0	1
	7	0	0	0	4
	8	1	0	0	1
	10	4	5	6	69
	9	0	0	2	0
	11	5	0	0	6
	12	1	0	0	15
	13	3	0	3	12
	14	0	0	0	1
	15	0	0	0	1
	All	17	5	20	120
Little Auk	1	0	1	0	0
	3	0	3	1	0
	5	1	0	3	0
	10	0	1	3	0
	12	1	0	0	0
	All	2	5	7	0
Black guillemot	1	63	14	42	48
	2	16	42	87	25

Species	Sub-area	Round 1	Round 2	Round 3	Round 4
	3	6	10	63	10
	4	5	9	13	38
	5	6	26	36	13
	6	17	26	9	9
	7	3	16	14	46
	8	13	10	18	51
	9	17	38	26	25
	10	81	331	239	334
	11	12	3	65	105
	12	22	6	6	5
	13	34	8	29	10
	14	2	1	23	41
	15	2	0	4	24
	All	299	540	674	784
Atlantic puffin	3	0	0	1	0
	4	0	2	0	0
	5	0	0	1	0
	10	4	9	4	12
	13	0	0	1	0
	All	4	11	7	12

ANNEX 5: DISTRIBUTION MAPS

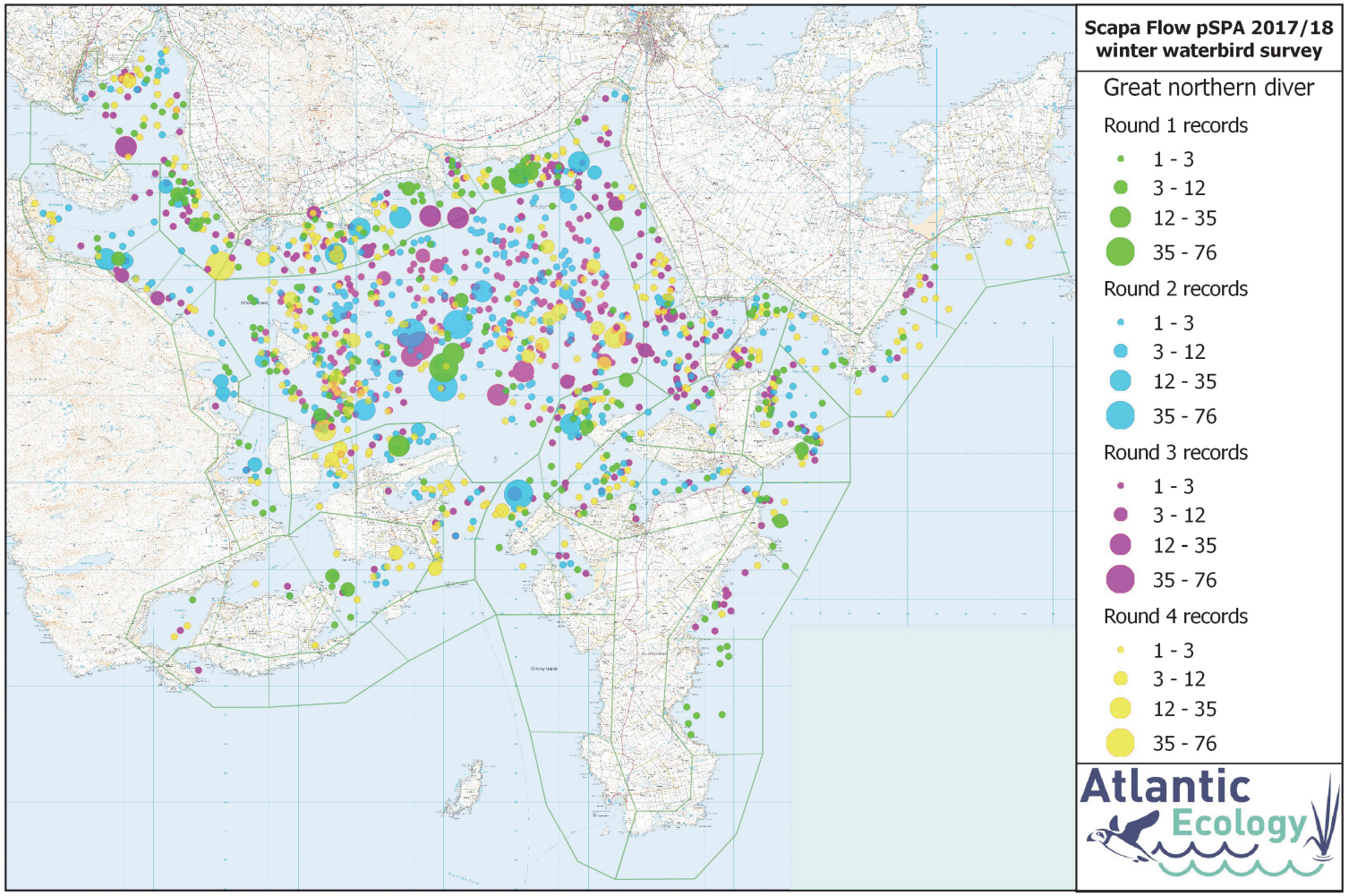

Figure 5. The distribution of records of great northern diver seen in the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

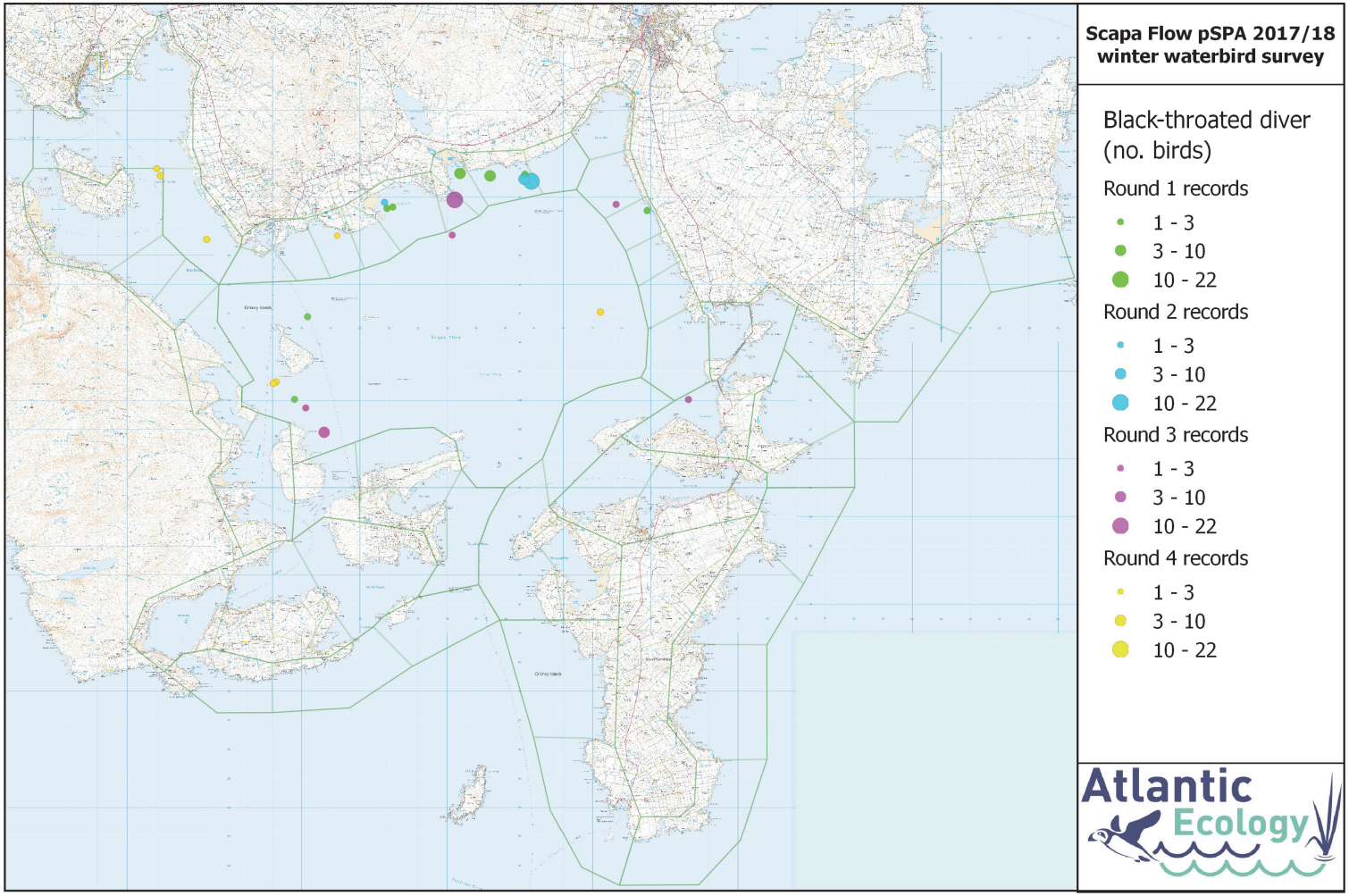

Figure 6. The distribution of records of black-throated diver seen in the 2017/18 winter waterfowl survey of Scapa Flow pSPA

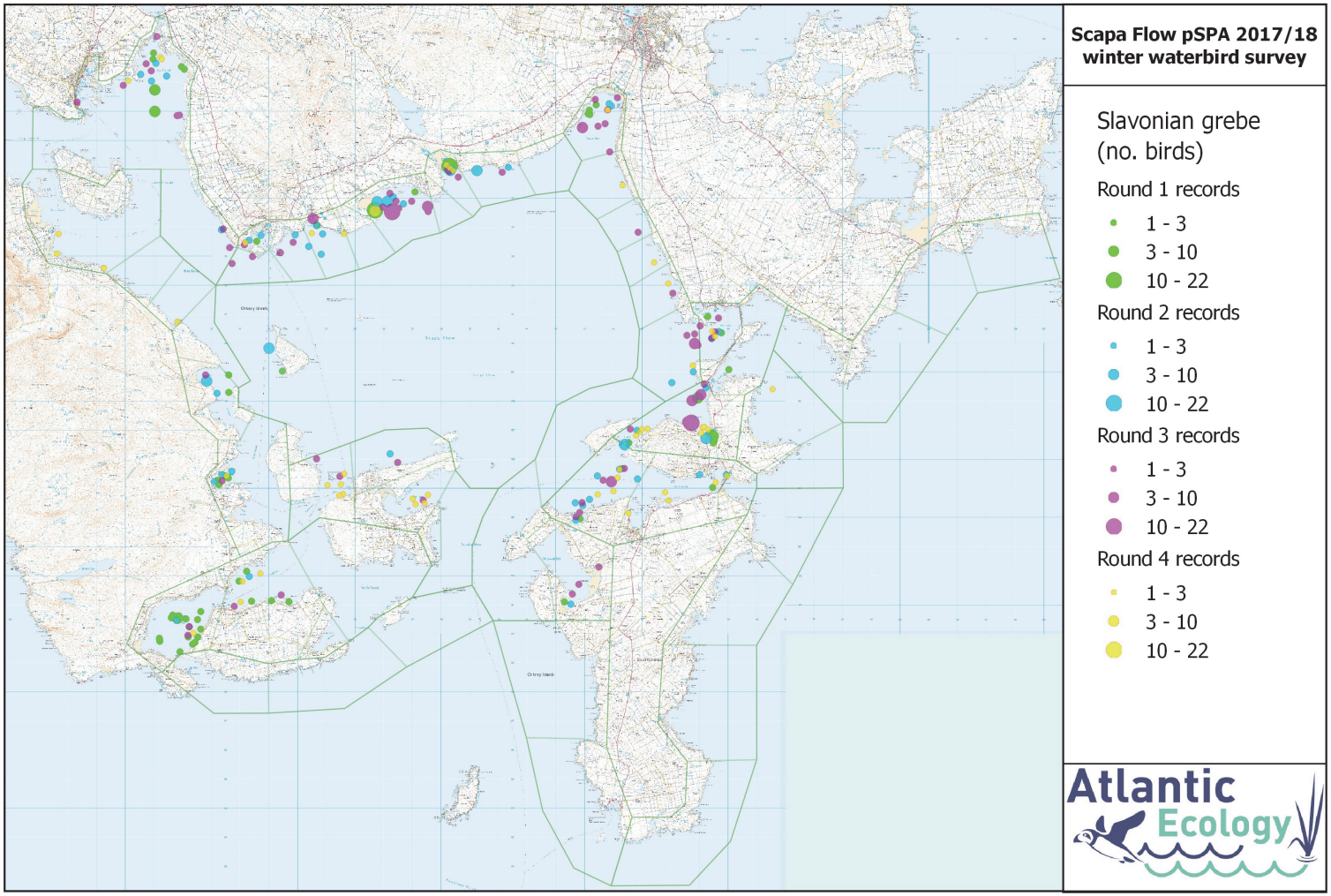

Figure 7. The distribution of records of Slavonian grebe seen in the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

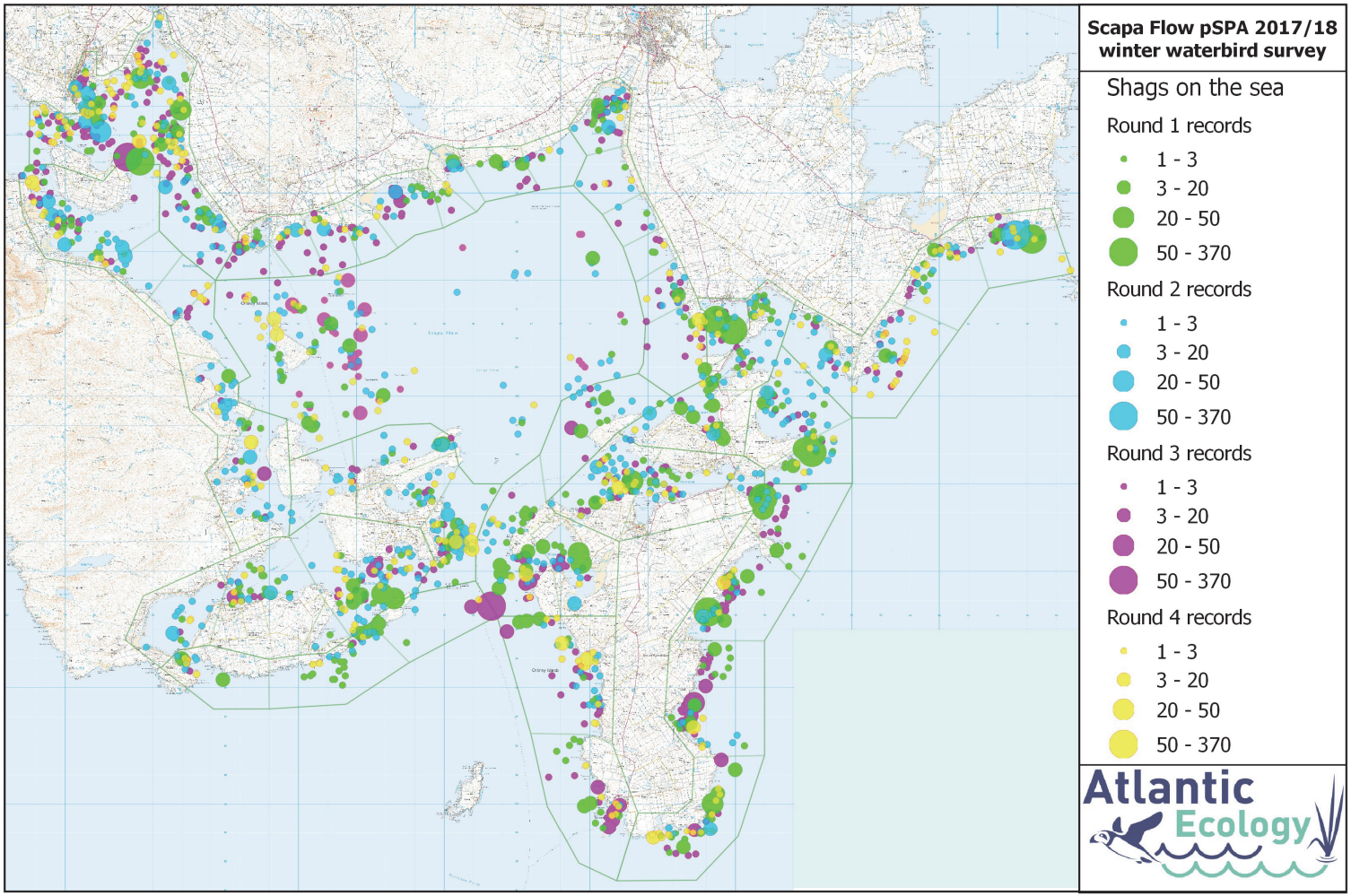

Figure 8. The distribution of records of European shag seen on the sea during the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

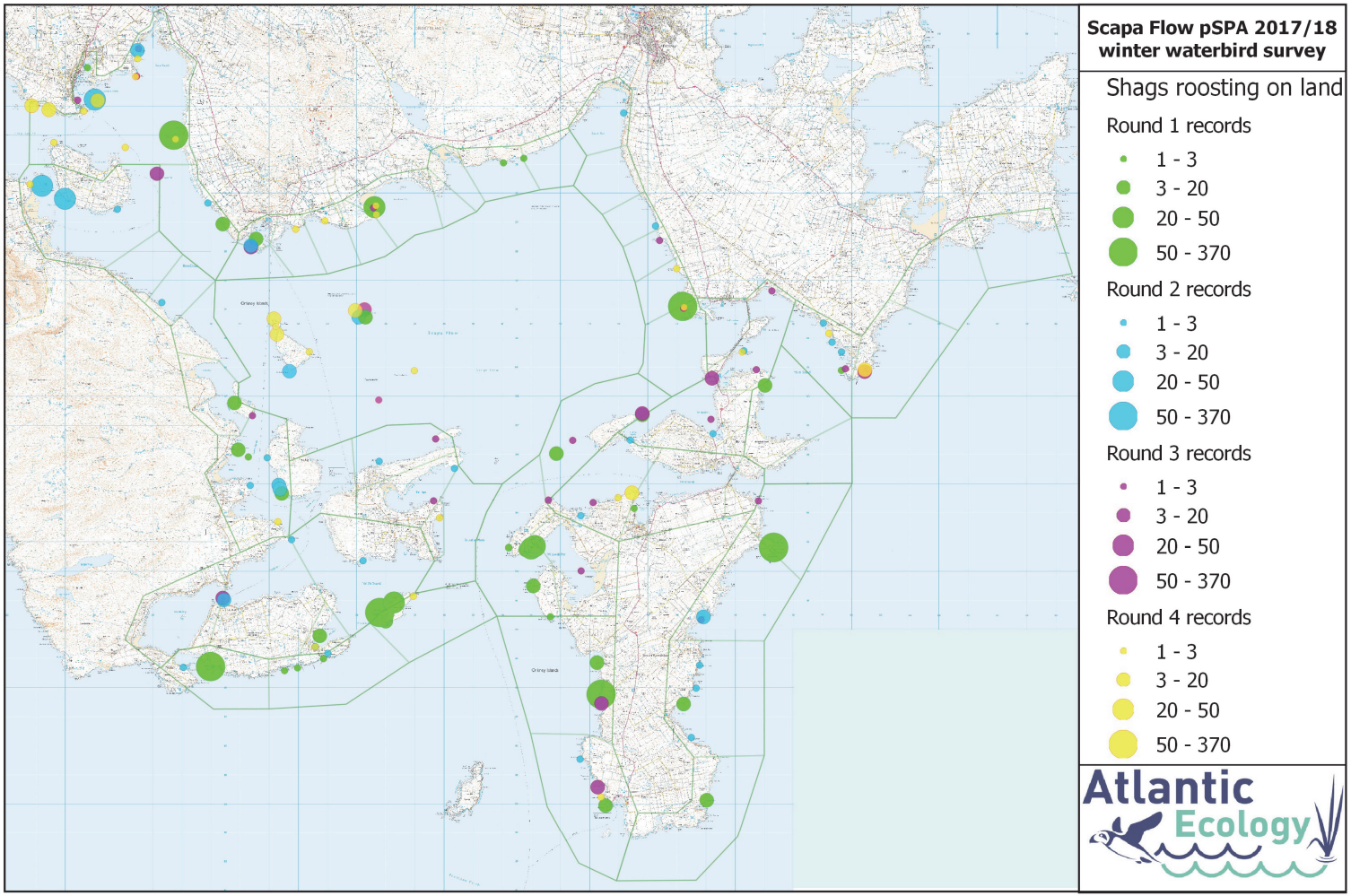

Figure 9. The distribution of records of European shag seen at roost sites during the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

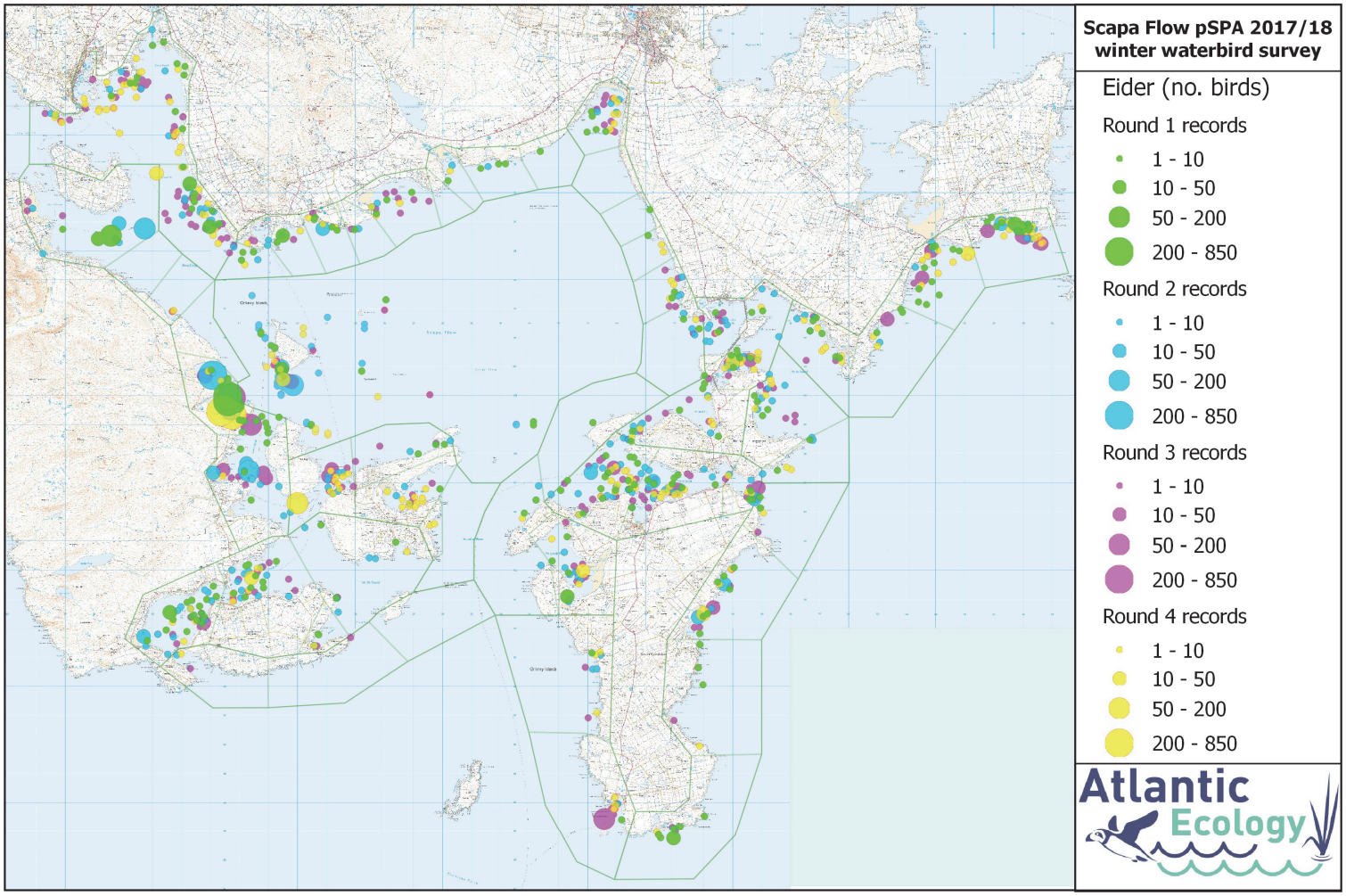

Figure 10. The distribution of records of common eider seen in the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

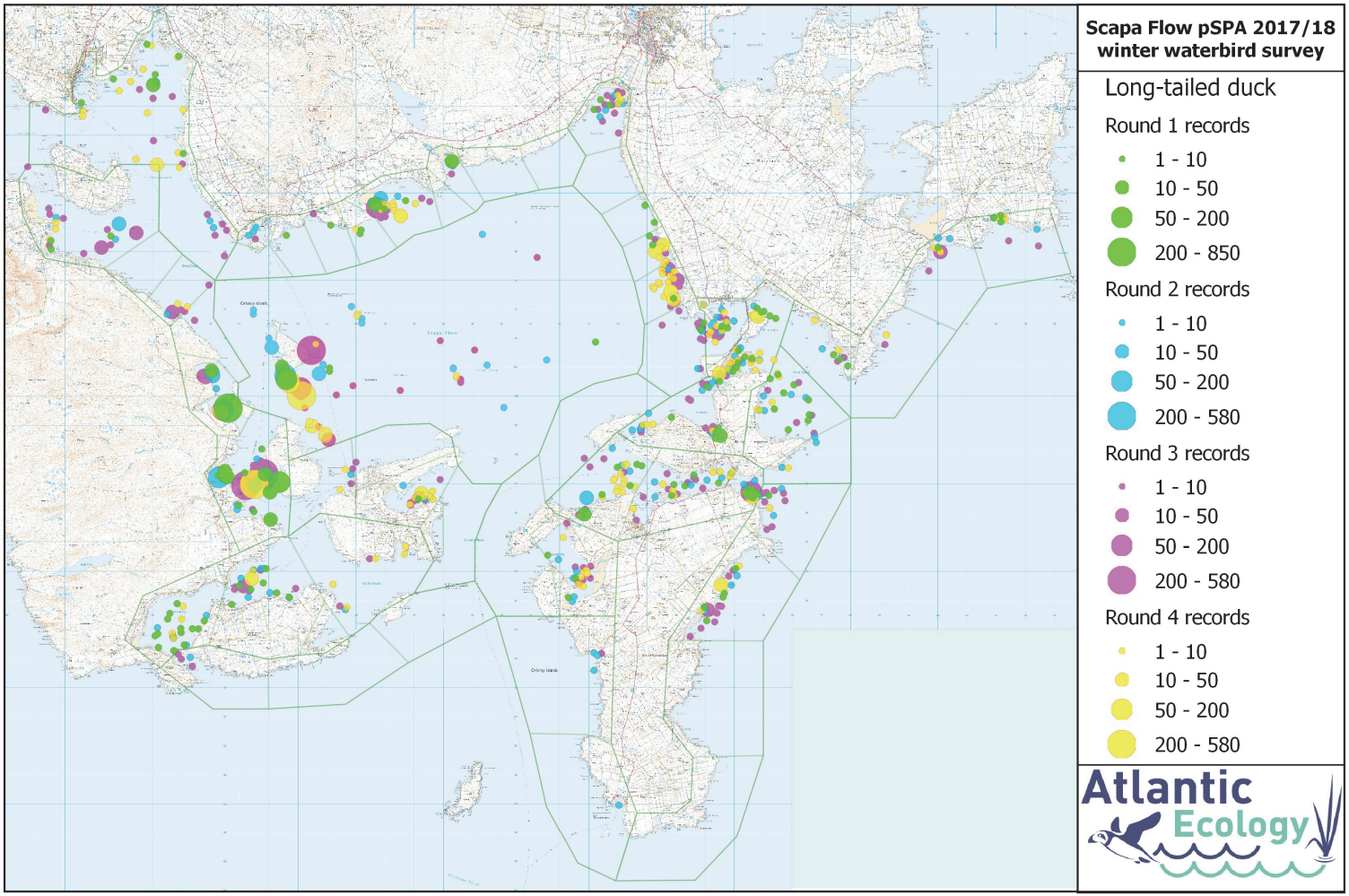

Figure 11. The distribution of records of long-tailed duck seen in the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

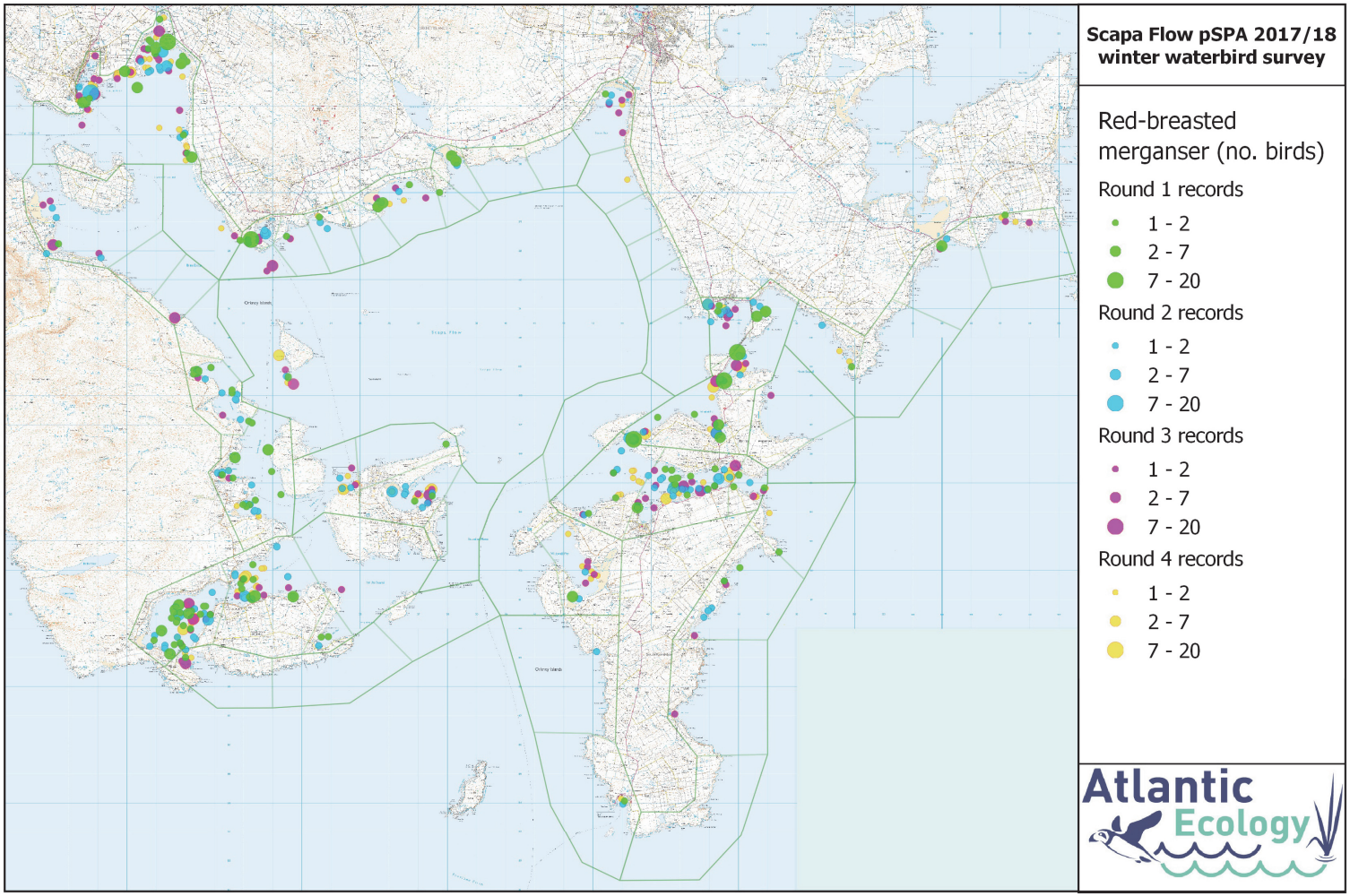

Figure 12. The distribution of records of red-breasted merganser seen in the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

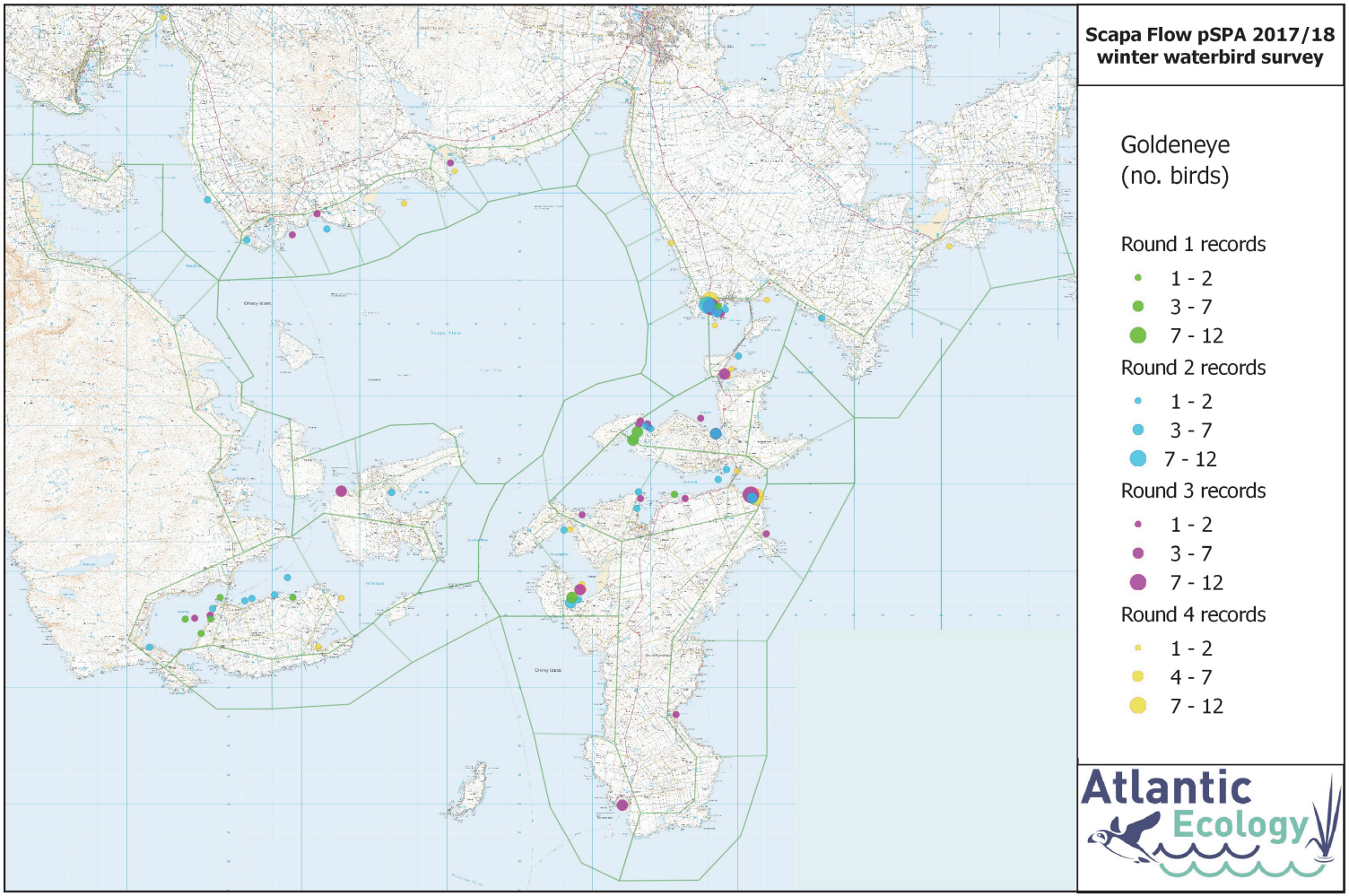

Figure 13. The distribution of records of common goldeneye seen in the 2017/18 winter waterfowl survey of Scapa Flow pSPA.

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