

**Svalbard Barnacle Goose distribution around the  
Solway Firth 2020-2021: Flock counts from the  
Solway Goose Management Scheme area**

**Author**

Larry Griffin of ECO-LG Ltd (prepared for WWT)

**July 2021**



Prepared for:

**Wildfowl & Wetlands Trust**  
Slimbridge  
Gloucestershire  
GL2 7BT

Tel 01453 891900  
Fax 01453 890827  
Email [conservation@wwt.org.uk](mailto:conservation@wwt.org.uk)

Reg. charity no. 1030884

This publication should be cited as:

Griffin, L. (ECO-LG Ltd.) 2021. Svalbard Barnacle Goose distribution around the Solway Firth 2020-2021: Flock counts from the Solway Goose Management Scheme area. Final Report to NS. Prepared on behalf of WWT, Slimbridge. 29 pp.

---

# Contents

<b>Executive Summary</b>	<b>v</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Objective	1
<b>2 Methods</b>	<b>2</b>
2.1 Management Scheme counts	2
2.2 Coordinated Svalbard Barnacle Goose total population counts	3
2.3 Brood sizes and juvenile productivity of the Svalbard Barnacle Goose	3
2.4 High tide heights, times and dates	4
<b>3 Results</b>	<b>7</b>
3.1 Barnacle Goose counts within the Management Scheme area	7
3.2 Pink-footed Goose counts for the Management Scheme area	17
3.3 Greylag Goose counts for the Management Scheme area	18
3.4 Canada Goose counts for the Management Scheme area	19
3.5 Whooper Swan counts for the Management Scheme area	19
3.6 Mute Swan counts for the Management Scheme area	19
3.7 Deliberate disturbance to geese in the Management Scheme area	20
3.8 Count section dates and times of coverage	20
3.9 Farmer liaisons regarding geese	20
3.10 Coordinated Svalbard Barnacle Goose population count totals	21
3.11 Brood size and juvenile productivity of the Svalbard Barnacle Goose	23
3.12 Leucistic Barnacle Geese	23
3.13 Other geese	24
3.14 Trail camera monitoring	24
3.15 Acknowledgements	26

## Executive Summary

A total of 16 counts were carried out in winter 2020-2021 within the Solway Barnacle Goose Management Scheme area. COVID-19 restrictions did not affect the NatureScot (NS) Scheme counts this winter and only some of the voluntary participation in the JNCC census counts of the Svalbard Barnacle Goose *Branta leucopsis*, but only for count sections out with the Scheme area. In a slight change to the tender specification, this report draws on the results of 16 counts overall, rather than the 14 specified in the contract, due to the supplementary data presented for October 2020 and April 2021.

For the NS Scheme counts, the times of day, the days of the week and the starting points at which the counts were conducted were varied as much as possible to avoid bias in terms of when a section was surveyed. With the coordinated JNCC census counts this was not possible as the volunteer count network is only typically available at a certain time and on a certain day and so all survey sections tend to be counted on a Wednesday from 10:00–12:00. For the NS counts, flock size assessments were made for all goose and swan species encountered, with flocks assigned to fields by code. Instances of direct disturbance clearly aimed at the geese and of conversations with farmers were also noted. Again for the JNCC counts, except where they were conducted by WWT, these extra data were not consistently noted across the count sectors, with barnacle goose flock counts being the focus of those surveys. Data collected under the JNCC contract on brood size and productivity estimates for this population are also presented.

The adopted total for the Barnacle Goose population wintering on the Solway Firth was 39,700 geese (the mean of the maximum count of 42,303 and two other counts within 10% of this, rounded up to the nearest 100). This represents an increase of 3,700 birds on last winter's adopted total of 36,000 geese, almost balancing the loss of 4,000 birds seen that winter.

COVID-19 restrictions and advice did not affect as many counts in winter 2020-2021 as it did in the latter months of winter 2019-2020 with only the December count and February count being affected to a small degree by some JNCC counters abstaining. The November JNCC count was cancelled due to poor weather – a replacement count was organised for the Scheme area – and from December onwards one JNCC count section at Boreland of Colvend, rarely used by the geese except in harsh winter conditions, was avoided out of respect for the landowner's wishes.

It is known from past years that ringed birds from small feral flocks at Loch Leven and the Highland Wildlife Park (HWP) can be present throughout the winter on the Solway and that birds over-summering in Cumbria can also be present. Further to this evidence of UK feral/naturalised birds wintering on the Solway Firth, in December 2020 a cohort of 11 geese were GPS collar tagged on the reserve, being part of a flock of 450 birds in the field at the time of the catch. These tagged birds stayed close together on the reserve fields and those of neighbouring farms throughout mid-winter and migrated north together to Loch Leven in the last week of February, breeding on St Serf's Island in April/May 2021. The tagged birds were observed at various points during the winter on the fields of the reserve and tended to be in a flock of 400-500 birds. No blue leg ringed birds from HWP were seen alongside the GPS tagged birds in such flocks so it could be that there are now over 500 feral/naturalised birds wintering on the Solway and perhaps as many as 1,000 if breeding populations in the Lake District and elsewhere also winter wholly or in part on the Solway. This means that any future population counts or assessments of juvenile productivity should more fully try and take account of this element within the Svalbard flyway population especially if AEWAs are using such monitoring data in its modelling for any adaptive management plans. Efforts to ring or tag birds across other feral populations of the UK would help elucidate the true number of UK "resident" birds (albeit some HWP birds have turned up in Iceland and in Norway) wintering on the Solway. Such knowledge would also be useful when considering Goose Management Scheme costs and the provenance of the birds it is supporting.

Significant numbers of birds again staged/wintered on the east coast at Budle Bay, Northumberland with an estimated 2,250 there on 14 October 2020 dropping to a more sustained 1,400 to 2,200 for the rest of the winter until at least the last week of February 2021. By the count of 24 March 2021, and on subsequent counts in April and May, no Barnacle Geese were recorded. This pattern of reduced numbers by March is similar to what has been recorded in previous years though it is still not clear if all of these birds are at that time moving southwest to the Solway or to other locations in the UK or elsewhere. An effort to ring or tag a cohort of birds at Budle Bay in late winter would help elucidate what happens to these birds and the extent to which they are short-stopping Svalbard birds.

---

The breeding success of Svalbard Barnacle Geese sampled on the Solway Firth from October 2020 to December 2020 ranged from 2.7% to 28.7% with a mean of 13.1% young derived from 19 flocks and 14,296 geese sampled. Across the same area, the total number of broods sampled was 250, with a mean family size of 2.2 young, ranging from 1-5 young. Both metrics were above the current ten year means of  $8.3 \pm 1.9$  S.E. and  $1.3 \pm 0.1$  S.E. respectively, with a mean of 1.6 goslings per family and 5.2% young the previous winter. This increased productivity largely accounts for the increase in the population present on the Solway after a period of decline.

The latter half of winter up until the end of the count period in April had been quite harsh, especially in January in terms of the number of frost days, though there was no laying snow of any significant depth or duration on the coastal marshes and fields of the Solway all winter and grass forage was always available to the geese. As such, as far as could be ascertained from local knowledge and also from remote monitoring of GPS tagged birds, the geese made little use of areas outside their usual range and were thus well covered by the counter network.

# 1 Introduction

The Solway Firth is an internationally important site for a number of wetland bird species being a key site for the wintering Svalbard Barnacle Goose *Branta leucopsis* population. By mid-winter, ~97% of this flyway population utilise five main sites around the Solway, with three of those being on the north side of the Firth, including Caerlaverock, Kirkconnell (Nith) and Southwick (since 2016, ~3-5% now stopover in the Budle Bay area, Northumberland, in the period from October-March to an increasing extent). This century with the growth of the Solway population to over 40,000 birds (though this had recently declined to 36,000), the distribution has spread west towards the Outer Solway with geese now visiting the areas around Colvend, Auchencairn and Rascarrel in most winters, with significant flocks at Wigtown typically from late February to early April.

The Cumbrian saltmarshes, and some inland fields, west of Rockcliffe Marsh also accommodate a larger number of this increased goose population for a longer duration. On Rockcliffe Marsh itself, gatherings of up to 30,000 barnacle geese have been recorded in late April/early May immediately prior to the spring departure north. Parts of this flock can utilise nearby fields and saltmarsh in the Gretna, Redkirk and Baurch area on the Scottish side of the Solway well into May.

During the winter, on the Scottish side of the Solway, the geese mainly feed within managed reserves or within the Solway Barnacle Goose Management Scheme area, often choosing stubbles in early autumn and improved pastures and saltmarsh throughout the rest of the winter. NS (formerly SNH) has run this management incentive scheme on the Solway since 1995 in order to integrate farming and goose grazing needs on areas of improved agricultural land. On land entered into the Scheme, tiered payments are made to help cover the extra costs of managing the land for Barnacle Geese. Fields are classified as 'Feeding', 'Buffer' (which receive a tiered payment) or 'Scaring' (non-payment) zones depending in large part on the typical level of winter goose use. Controlled scaring is encouraged in the non-payment zone during the winter to try to keep the geese within the feeding or buffer zones. Scaring is also permitted throughout April within the Scheme area, as due to budgetary constraints imposed since 2012 (though April payments reinstated briefly in 2013), fields within the Scheme area no longer receive goose management payments for April.

Since about 2010, there has been an increasing tendency for large numbers of Barnacle Geese to remain at the autumn staging site around Budle Bay/Lindisfarne, Northumberland, until later in the winter or into the following spring depending on the east coast weather. Based on ring sightings, data from GPS tagged birds and the timing of the initial increase in numbers at the site during the traditional migratory period in late September/early October it is assumed that the majority of these birds are of Svalbard origin.

## 1.1 Objective

The overall objective of the survey is to assess the distribution and abundance of the Svalbard Barnacle Goose and other goose and swan species on the fields and saltmarsh of the north side of the Solway Firth in relation to the Solway Barnacle Goose Management Scheme area.

## 2 Methods

### 2.1 Management Scheme counts

Eight “NS Route Counts” within the Goose Scheme area were carried out in addition to eight “JNCC Census Counts” on an approximately 14-day cycle between 7 October 2020 and 28 April 2021 (**Table 1**). For the NS route counts, the starting points were varied as much as possible to prevent counting any area at the same time of day, with count days spread evenly throughout the week including weekends. For the JNCC census counts, the use of volunteers meant that count sections were surveyed between 10:00-12:00, typically on Wednesdays.

COVID-19 restrictions and advice did not affect as many counts in winter 2020-2021 as it did in the latter months of winter 2019-2020 with only the December count and February count in Cumbria being affected to a small degree by some JNCC counters abstaining. The November JNCC count was cancelled due to poor weather – a replacement NS count was organised for the Scheme area - and from December onwards one JNCC count section at Boreland of Colvend, rarely used by the geese except in harsh winter conditions, was avoided out of respect for the landowner’s wishes.

**Table 1 – Summary of the sources of count data provided each month.**

Count source	October	November	December	January	February	March	April	Total
JNCC counts	3	0	1	0	1	1	2	8
NS counts	0	2	1	2	1	1	1	8

During NS route counts, geese and swans in larger flocks were counted in tens on a tally counter, while those in smaller flocks of <100 were counted individually; all flocks being mapped and coded according to the NS convention on the field maps provided. Each day was broken down into four counting periods to cover the four main count areas (**Table 2**), starting at first light with allowance made for weather conditions, e.g. geese tend to be slow to move off the roost during periods of frost/fog such as those geese flying off the Blackshaw Bank roost to utilise fields up the River Nith at Greenmerse and Kirkconnell. The time of observer arrival at each count section was recorded. Where significant numbers of geese moved during a count, the field the geese moved from and to was recorded with a “Comment” added within the Excel spreadsheet provided. Observations of leucistic geese and other goose species of note were also added.

**Table 2 – Count sections covered within the counting periods.**

Count Period 1	Count Period 2	Count Period 3	Count Period 4
Caerlaverock	Gretna	Nith	Southwick
Southwick	Nith	Caerlaverock	Gretna
Nith	Caerlaverock	Gretna	Southwick
Gretna	Caerlaverock	Nith	Southwick

The NS count route covered areas to the east as far as Gretna and to the west as far as Mersehead, with JNCC counts extending as far west as Wigtown on the Scottish side of the Solway (**Figure 1**). Use of any fields out with the NS Goose Management Scheme area was noted during the census counts.

Areas where there are difficulties observing the fields from the road are well known as are the high vantage points which can be utilised to count them from. Otherwise approach on foot was adopted with prior permission being sought for access. During the NS route counts and the JNCC census count routes covered by WWT staff, the presence and nature of any disturbance to the geese, intentional or otherwise, was noted using the NS field code system provided. Impromptu discussions with any landowners during the surveys was welcomed and a record of each conversation regarding the geese along with those had during arranged visits or calls to farmers were logged. Care was taken in relation to biosecurity and disease prevention, and where access to fields was required there was compliance with any precautions required by the landowners, with gates being left as they were found.

As with last winter it soon became clear that the Priestside/Hurkledale area was being used quite often by the Barnacle Geese whereas the section to the northeast of Ward Law covering the Quay Hill was rarely being used and was therefore not surveyed on a regular basis although it was covered during the census counts. In some previous years the Priestside/Hurkledale section has been dropped due to a lack of goose use but this winter it was again surveyed. During the co-ordinated counts of the Solway, Barnacle Geese were rarely recorded in the Auchencairn/Rascarrel area in mid-winter and from February onwards numbers of Barnacle Geese began using the Wigtown area in larger numbers but this could not be economically covered via the NS route count budget.



**Figure 1.** The Inner Solway Firth showing the main areas surveyed during the NS Solway Goose Management Scheme counts (black polygons – except Boreland of Colvend area which although surveyed in previous winters was replaced in winter 2017-2018 by a small area around Redkirk/Baurch near Gretna). Site names are referred to in the text and also cover those areas surveyed during the coordinated JNCC census counts. For mapping clarity, Wigtown Bay and RSPB Crook of Baldoon are not shown as they are 20km to the west of Borgue.

## 2.2 Coordinated Svalbard Barnacle Goose total population counts

Each winter, in part fulfilment of the JNCC GSMP work plan, WWT has conducted total population counts of the Svalbard Barnacle Geese present on the Solway from arrival to departure. This involves a network of staff and volunteers counting the geese in survey sections within a one- to two-hour time-period at the same time on the same day, typically 10:00-12:00 on Wednesdays. There are weekly counts during the arrival period in October and during the departure period in April/May, with monthly counts from November to March (except January) depending on the weather.

## 2.3 Brood sizes and juvenile productivity of the Svalbard Barnacle Goose

Each winter, in fulfilment of the JNCC GSMP work plan, WWT carefully assesses the brood sizes and juvenile productivity of a large proportion of the Barnacle Geese from as many sites as possible around the Solway. The dates, land use types, and flock sizes used for sampling are varied as much as possible to avoid any bias in the average estimate obtained. Also the sampling units within the flocks are varied as much as possible if whole flock estimates cannot be made as families with young tend to associate at the edges of a flock, particularly at the front. All observations were carried out by an experienced observer.

## 2.4 High tide heights, times and dates

**Table 3. Dates and times of high tides ( $\geq 9.5\text{m}$  as summarised from Laver's '*Liverpool and Irish Sea Tide Table 2020 & 2021*') for the period during which geese were present in the Barnacle Goose Management Scheme area.**

Month	Period 1: From date/time	Period 1: To date/time	Period 1: tidal height range (m)	Period 2: From date/time	Period 2: To date/time	Period 2: tidal height range (m)
September	22:24 16/09/20	01:57 22/09/20	9.5 - 10.2	-		
October	21:57 15/10/20	13:13 20/10/20	9.6 - 10.3	-		
November	21:30 13/11/20	12:54 18/11/20	9.6 - 10.1	-		
December	21:58 13/12/20	12:42 17/12/20	9.5 - 9.7	-		
January	11:48 14/01/21	12:30 15/01/21	9.5	12:51 31/01/21	13:30 01/02/21	9.5
February	12:15 13/02/21	-	9.5	11:52 28/02/21	13:51 03/03/21	9.6-9.8
March	10:47 28/03/21	13:30 01/04/21	9.5 - 10.0	-		
April	10:16 26/04/21	13:14 30/04/21	9.5 - 10.0	-		



Figure 2. Mean goose use (total geese/number of goose count days) per hectare in winter 2020/21 (shaded symbols) compared to the previous five-year period from 2015/16 to 2019/20 (shaded fields plus NS field codes) for the Priestsidge to Longbridgemuir area.



Figure 3. Mean goose use (total geese/number of goose count days) per hectare in winter 2020/21 (shaded symbols) compared to the previous five-year period from 2015/16 to 2019/20 (shaded fields plus NS field codes) for the Glencaple to Ladyhall area.

## 3 Results

### 3.1 Barnacle Goose counts within the Management Scheme area

A field code system has been used by NS to cover all of the fields within the Management Scheme area typically used by the geese (**Figures 2-5**), with new codes and field boundaries digitised for the Redkirk to Gretna area added to the NS count route in October 2017. These are the codes also used in the results tables (**Tables 4 - 9**). Over the past decade, where geese were recorded in an uncoded field, the coding was extended in a logical and consecutive manner. The first five figures covering the Goose Management Scheme area are ordered in a sequence from east (Priestside area; **Figure 2**) to west (Mersehead area; **Figure 5**), with the final figure showing the new field surveillance area near Gretna and the border with England (**Figure 6**). The field and marsh compartments have been shaded from light to dark blue depending on the average number of geese encountered on the count days over the previous five year period and the size of the field (as measured in the GIS). Those fields without shading but with a NS code have never had Barnacle Geese observed in them during the Scheme counts carried out in the previous five year period. Other fields shown on the BING imagery are not part of the Barnacle Goose Scheme survey area.

Field use in winter 2020-2021, up until the end of April 2021 was fairly similar to that recorded in the previous five winters with core use being focussed on the Caerlaverock area – but not at the WWT reserve, see below - with especially heavy use of farms at Newfield, Midtown and Newmains and in the Southernness area on the farms at Cowcorse, West Preston (those fields not managed by RSPB) and Newmains; some details include:

- The Powfoot and Barrasgate area seemed to have more Barnacle Goose use than usual albeit the fields are uncoded and outside of the “Scheme” area traditionally reported on (eastern part of **Figure 2**);
- The Priestside and Hurkledale areas probably had similar levels of use to usual if not slightly greater at Hurkledale (**Figure 2**);
- Thwaite was probably used slightly more heavily than usual possibly linked with the new grass leys that have replaced some of the stubble fields typically seen in that area in winter (**Figure 2**);
- The Stanhope fields had high use especially in early winter on the flooded stubble at SC20 (**Figure 2**);
- There was a continued long-term decline in use of the fields and merses at WWT Powhillon (**Figure 2**);
- Mid and Nether Locharwoods fields both south and north of the road were used at similar levels to usual albeit use tended to be patchy (**Figure 2**);
- Upper Locharwoods had less use than usual on the count dates whereas the Bankend to Shearington fields had higher use than expected especially at C40-C42 and S53 (**Figure 2**);
- The Newmains fields had fairly average use albeit C37 had much higher use and conversely C28 much lower use on the count dates than usual (**Figure 2**);
- The Lands/Hollands area had fairly typical levels of use across the count dates (**Figure 2**);
- Midtown farm possibly had lower levels of goose use than average north of the road (**Figure 2**);
- Newfield farm was heavily used as usual with some fields south of the road getting much higher use e.g. C07, while those north of the road were slightly lower use than normal e.g. C19a (**Figure 2**);
- WWT Eastpark reserve was noticeably quiet in terms of goose use all winter and numbers there on the fields and merses continue to be in long-term decline which could perhaps be putting more Barnacle Goose grazing pressure of the surrounding farm holdings (**Figure 2**). Visually, the fields of the reserve

were in the poorest condition since the Foot-and-Mouth (FMD) year in 2001 as the reserve manager had not been able to secure the use of outside stock due to COVID effects on movements of people and so the reserve fields and merses had gone completely ungrazed throughout 2020, and although cut to an extent, did not look evenly green and “fresh”. Unlike in the FMD year where all farms in the parish were equally affected in terms of sward condition and all fields looked roughly the same, this year the Eastpark fields were the odd ones out as other farms had their own stock and carried on farming as usual. Therefore the geese had a choice, and so it is perhaps understandable that numbers on the reserve massively declined compared to past winters. Whether or not this will further entrench the long-term decline at the reserve remains to be seen;

- As typically seen, the fields on Ward Law were hardly used during the counting periods but the coastal fields at Lantonside had fairly average use and S17/18a in particular had greater use (**Figure 3**);
- Use of fields up the River Nith closer to Dumfries was patchy as usual with the merses still being well used. Fields at Netherwood Mains, Flats of Cargen and Greenmerse farms were used slightly more than usual, others slightly less (**Figure 4**);
- Corbely/Overton and Drumburn did get some goose use, occasionally on the uncoded fields east of the main road though predominantly the flocks had spilled over from the merse (**Figure 4**);
- The Carsethorn fields were used mostly in line with expectation at fairly low levels with Powillimount little used (**Figure 4**);
- The Newmains area near Prestonmill was well used by some very big flocks continuing the trend of increasing numbers in that area of much improved and intensively managed grassland, and where the golf course has been converted to pasture this has similarly encouraged the geese (**Figure 5**);
- East and West Preston had high use as usual but especially at P23 and the group of fields north of the road at P09/12 to P13/18. Balancing that was lower goose use, probably due to the crop types planted, on the run of fields from P24-P32 including those in the middle of Southernness golf course (**Figure 5**);
- The fields at Cowcourse were probably used by the geese in line with the 5-year expectation although possibly a bit less than usual in some places across the set of count dates (**Figure 5**);
- Southwick Home Farm had heavier use of some fields such as M07a but reduced use of others compared to average (**Figure 5**);
- The RSPB fields at Mersehead and West Preston had fairly average low to medium use though some nearer to the dunes at West Preston appear to have declining use. Merse sections continue to be well used with improved use up the Southwick Burn (**Figure 5**);
- Again this winter there was no use of fields recorded north of the main road from D01-D59 (**Figure 5**);
- The Redkirk/Baurch/Gretna area had fairly average medium use of the usual set of fields and merses though the survey times and dates are not well suited to monitoring that area as early morning dog walkers and horse riders often disturb the geese, and use of the area continues well into May after the Scheme survey period has ended – as known from the JNCC counts and GPS tracking data (**Figure 6**).

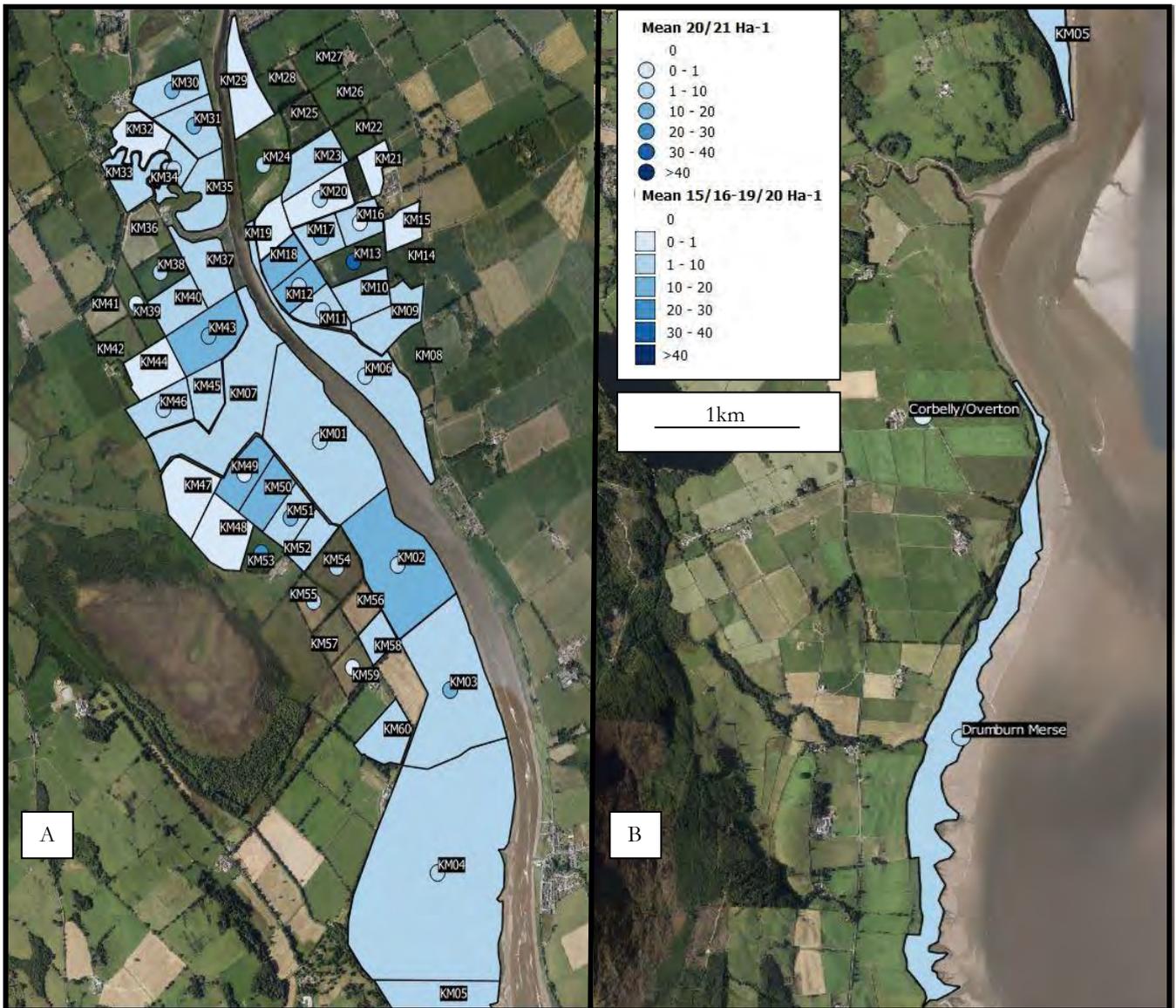


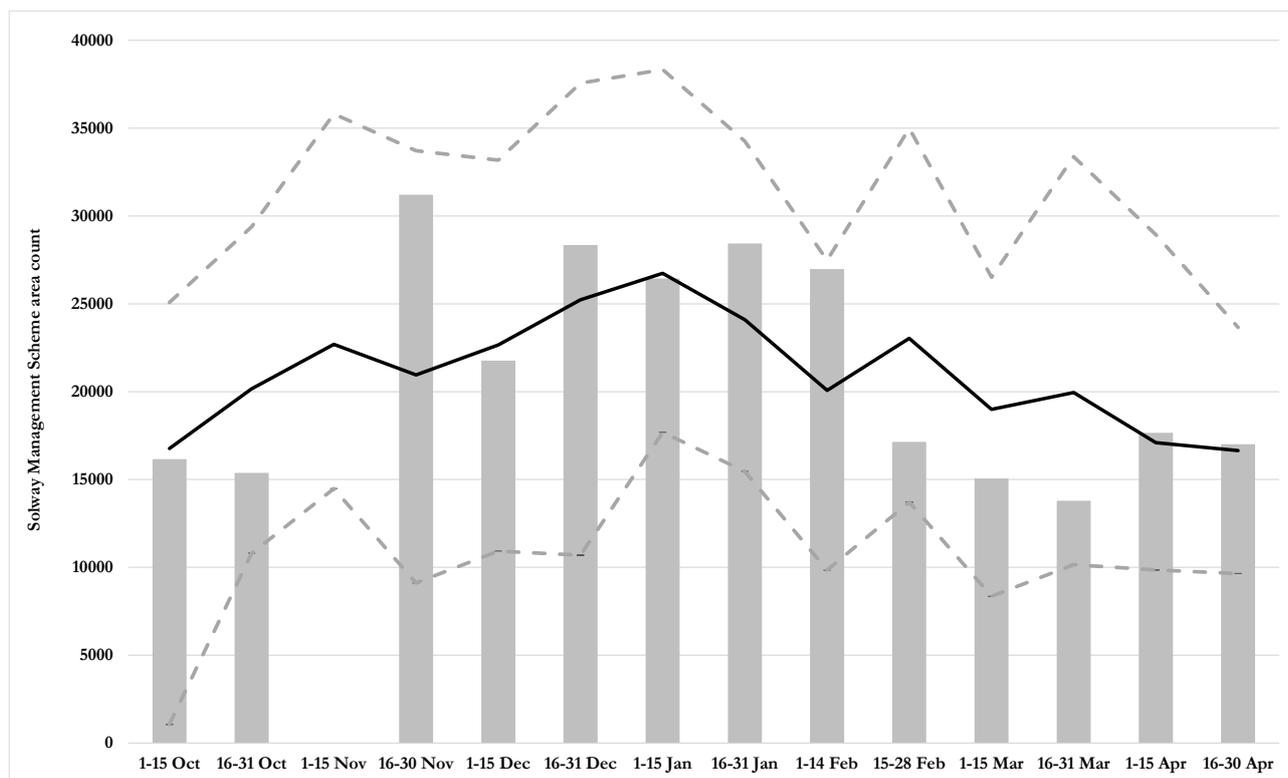
Figure 4. Mean goose use (total geese/number of goose count days) per hectare in winter 2020/21 (shaded symbols) compared to the previous five-year period from 2015/16 to 2019/20 (shaded fields plus NS field codes) for the Kirkconnell and River Nith (A) south to the Corbilly/Overton and Drumburn Merse area (B).



Figure 5. Mean goose use (total geese/number of goose count days) per hectare in winter 2020/21 (shaded symbols) compared to the previous five-year period from 2015/16 to 2019/20 (shaded fields plus NS field codes) for the Carsethorn to Southwick area.



**Figure 6. Mean goose use (total geese/number of goose count days) per hectare in winter 2020/21 (shaded symbols) for the Redkirk to Gretna area, which although not part of the Goose Management Scheme area, was added to the NS count surveillance route in October 2017 (hence the previous five-year data are not available for this area).**



**Figure 7.** Svalbard Barnacle Goose 2020/21 half-month flock count totals (grey bars) within the NS Solway Goose Management Scheme area compared to the mean (solid black line), minimum and maximum (dashed grey lines) counts for the period from 2008/09 to 2019/20 within the same area.

Some goose count totals for the Scheme area are greater than others because double counting of flocks that move between fields often occurs over the course of a route count. The methodology of the NS route counts does not seek to remove this bias as the aim is to record the numbers of geese using individual fields. In contrast, the co-ordinated count methodology of the JNCC census at a set time of day within a *ca.*1.5 hour period aims to remove this bias. Fluctuations in goose numbers within the Scheme area also occur due to the effect of high tides (see **Table 3**) combined with weather conditions which can push geese off low lying saltmarsh areas on the south side of the Solway, and due to geese dispersing mid-winter after peak arrival to foraging areas outside the Scheme area (**Figure 7**).

The mean number of geese recorded during the route counts was 21,151 for the period from October 2020 to April 2021 (23,700 for October 2019 to early March 2020 only - due to COVID restrictions; and 25,055 for October 2018 to April 2019) ranging from a minimum of 13,761 on 24 March 2021 (14,495 in 2019-2020) up to a maximum of 32,091 on 27 November 2020 (38,330 in 2019-2020). Spring departure from the Solway was not monitored in 2020 due to COVID restrictions but in 2021 it was possible to monitor the migratory period and by 28 April 7,736 geese were counted in the Scheme area and nearly 30,000 on Rockcliffe/Burgh Marsh, Cumbria. By 5 May just four birds were recorded in the Scheme area and nearly 12,000 at Rockcliffe with numbers dropping to nearly 5,000 by 12 May and just 450 by 20 May. One week later less than ten birds remained on Rockcliffe with the majority of departures having occurred fairly rapidly within a two week window at the start of May following a period of sustained north-easterly wind patterns and poor weather.

Overall within the Scheme area there tends to be a decline in goose use as food resources within the area are depleted by the end of January. This trend was very apparent this winter after a sustained cold period in January 2021, and winter 2020-2021, was somewhat harsher overall with 40 nights, compared to 21 in 2019-2020 (data to 30 April) on which ground frosts likely occurred (minimum temperature less than  $-1^{\circ}\text{C}$  recorded at the WWT Caerlaverock weather station); though the first ones were not until December 2020.

Flock sizes and field distribution of Barnacle Geese within the Management Scheme area are given in **Table 4**. Coded fields with zero counts have not been shown although these data are provided in the accompanying Excel file.







S67												1130	530				1660
S67a												7	14				21
S68												1130	240				1370
SC06									40			25					65
SC08														70			70
SC16					2200							540		1420			4160
SC17					640												640
SC20			2830	3	450												3283
SC22/23						3000											3000
SC24/31						120	950										1070
SC27							1750										1750
SC28/29												2160					2160
SC32/PR05						940											940
SC33											2300	290					2590
SC34					170										80		250
SC35				1350					400	800			390	165			3105
SC36							2400										2400
SC45	800	1840			260	790	160		2000			120	600		4250	590	11410
W02												6					6
W03/04													32				32
W06													8				8
W39/43							1270										1270
W52									2000								2000
Total	19233	13030	15340	30272	32091	21740	28317	26408	28397	26951	17109	15029	13761	17627	16973	7735	322278

### 3.2 Pink-footed Goose counts for the Management Scheme area

Pink-footed Goose *Anser brachyrhynchus* counts are very variable as the extent to which geese remain in the area tends to be very weather and crop dependent. Typical peak times include the autumn as geese arrive back from Iceland into the UK and early spring in February/March as the geese start to head north again through the UK as with the peak of 4,650 recorded in the last week of February 2021 (**Table 5**). In mid-winter counts were generally less than 1,000 in the Scheme area. Pink-footed geese were seen in the traditional wintering areas between Carsethorn and Powillimount, Kirkconnell Merse, Priestside and Hurkledale, with occasional flocks elsewhere at Lands, Shearington, Bankend and the Locharwoods area, with an increasing number of flocks through the winter.

**Table 5. Pink-footed Goose flock sizes recorded during the Management Scheme route counts.**

Field code	07/10/20	14/10/20	28/10/20	19/11/20	27/11/20	09/12/20	22/12/20	04/01/21	23/01/21	07/02/21	24/02/21	09/03/21	24/03/21	08/04/21	21/04/21	28/04/21	Total
A01/03							25					650					675
A04/05		850															850
A20b												820					820
A22												520					520
C41							30	160				210					400
C42				170				130				260					560
C43								45									45
C44							10						80				90
C45						240											240
D67									110								110
Drumburn Merse												600		600			1200
G07												60					60
G35/38												6					6
JP27								480									480
JP29								15									15
JP44				190													190
JP45														1			1
JP48										290							290
JP49							12							250			262
KM01									22								22
KM02											60	32			11		103
KM03															30		30
KM04	500									15				40			555
KM05														260			260
KM12							90										90
KM13							100		730		40			400			1270
KM16											560						560



### 3.4 Canada Goose counts for the Management Scheme area

Small numbers of Canada Geese *Branta canadensis* of typically 40-80 birds, were recorded within the Scheme area, most records occurring on the ponds and fields at WWT Caerlaverock (**Table 7**). As with the Greylag Geese with which they often associate in mixed flocks, post-moult flocks usually build up in this area during the late summer, with numbers declining from a few hundred to less than ten over the course of the winter. One small *hutchinsii* type Canada Goose was noted in a flock of Barnacle Geese at Northpark in mid-October 2020.

**Table 7. Canada Goose flock sizes recorded during the Management Scheme route counts.**

Field code	07/10/20	14/10/20	28/10/20	19/11/20	27/11/20	09/12/20	22/12/20	04/01/21	23/01/21	07/02/21	24/02/21	09/03/21	24/03/21	08/04/21	21/04/21	28/04/21	Total
C08					60			1		60			2	1			124
C16				40													40
C17		2	35	5		60	40	6	70		40	8	4				270
C40	10	1 Hutchinsii															10
M33				25													25
P37a					20												20
S60/64	100																100
SC28/29														1			1
Total	110	2	35	70	80	60	40	7	70	60	40	8	6	2	0	0	590

### 3.5 Whooper Swan counts for the Management Scheme area

The Scheme area and fields at its fringe, especially around WWT Caerlaverock, Kelton and Thwaite, generally hold up to 400 Whooper Swans *Cygnus cygnus* throughout the winter, with numbers increasing gradually up to the end of November and into December as the swans arrive from Iceland and decreasing rapidly during March as birds head north on migration. Some flocks occurring on fields outside the Scheme area are noted as comments on the Excel database provided with this report to NS but do not contribute to the totals given here (**Table 8**). The swan numbers this winter followed the usual arrival and departure pattern with birds using the traditional feeding areas around Kelton/Greenmerse, Caerlaverock/Locharwoods, and Thwaite/Ruthwell.

**Table 8. Whooper Swan flock sizes recorded during the Management Scheme route counts.**

Field code	07/10/20	14/10/20	28/10/20	19/11/20	27/11/20	09/12/20	20/12/20	04/01/21	23/01/21	07/02/21	24/02/21	09/03/21	24/03/21	08/04/21	21/04/21	28/04/21	Total
A01/03				11			2										13
A02						10							20				30
C08					98			2		125							225
C17		7	10	35		60	60	50	115		150	70					557
KM10		150															150
KM13				5		160											165
KM14			98														98
KM37				90													90
L07/08													11				11
L13									5								5
L14/15												15					15
N30				4	4												8
PR52			5														5
SC13				140													140
SC16			30		14												44
SC20			2														2
SC28/29													205	60			265
Total	0	157	145	285	116	230	62	52	120	125	150	85	216	80	0	0	1823

### 3.6 Mute Swan counts for the Management Scheme area

Mute Swans *Cygnus olor* mainly occur on the ponds at WWT Caerlaverock with scattered pairs elsewhere. This winter followed the usual pattern and after numbers built up at the Caerlaverock swan feeds to a peak in mid-winter, by early March the birds were dispersing to breeding territories elsewhere (**Table 9**).

**Table 9. Mute Swan flock sizes recorded during the Management Scheme route counts.**

Field code	07/10/20	14/10/20	28/10/20	19/11/20	27/11/20	09/12/20	20/12/20	04/01/21	23/01/21	07/02/21	24/02/21	09/03/21	24/03/21	08/04/21	21/04/21	28/04/21	Total
C16				2	2									2			6
C17	20	25	40	50	45	50	80	65	55	25	40	50	20				565
C52				3													3
M16					2												2
M32										2							2
SC06														4			4
Total	20	25	40	55	49	50	80	65	55	27	40	50	20	6	0	0	582

### 3.7 Deliberate disturbance to geese in the Management Scheme area

Disturbance activities thought to be directed towards geese were as follows (further details in Excel spreadsheet):

- From c. mid-November, blue barrels were deployed on hillside fields at D23 & D24 northwest of Prestonmill. No barnacle geese were seen on this field all winter so the devices were perhaps directed towards pigeons or pink-footed geese. Also an orange bag on a stick and a makeshift “scarecrow” with a yellow high viz jacket was deployed at fields N38 and N57 respectively though that at N38 was not maintained;
- From c. mid-December and then from c. mid-January, an increasing number of fields, 12 in all, prefixed “JP” in the Carsethorn to Powillimount area had an increasing density of yellow high viz jacket “scarecrows” deployed, probably in response to the increasing use of these intensively agriculturally improved fields by Pink-footed Geese and Barnacle Geese; these devices did not appear to be moved during the period of observation over the winter;
- From c. early March tapes on canes appeared on three fields in the Thwaite area at SC22/23, SC27 and SC28/29 in response to Barnacle Goose use of those fields and perhaps Whooper Swan use these being maintained into April;
- From c. mid-February, within the Scheme zonation, field S66 at Midtown had 10 tapes on canes deployed until April and C28 & C29 at Newmains had 10 bags on canes deployed during a similar period, with 15 bags on canes deployed on C27 by c. end March through to April;
- There was a late deployment of tapes on canes in the Hurkledale area PR68b and Redkirk area RK14 in c. early and late April respectively probably in response to Pink-footed Goose and Barnacle Goose use;
- Single sources of disturbance on 13 different fields due mainly to tractor or digger work or dog walkers will possibly have kept geese off of these fields and those in the surrounding area for the period during which they occurred - details are given in the Excel spreadsheet provided to NS alongside this report.

### 3.8 Count section dates and times of coverage

**Table 10. Survey dates, times and types for the NS Goose Management Scheme count sections.**

Type	JNCC	JNCC	JNCC	NS	NS	JNCC	NS	NS	NS	NS	JNCC	NS	JNCC	NS	JNCC	JNCC
Day	Wednesday	Wednesday	Wednesday	Thursday	Friday	Wednesday	Tuesday	Monday	Saturday	Sunday	Wednesday	Tuesday	Wednesday	Thursday	Wednesday	Wednesday
Date	07/10/20	14/10/20	28/10/20	19/11/20	27/11/20	09/12/20	20/12/20	04/01/21	23/01/21	07/02/21	24/02/21	09/03/21	24/03/21	08/04/21	21/04/21	28/04/21
Thwaite	10:00	11:15	10:20	14:05	10:40	10:30	10:35	15:00	10:05	16:00	10:50	13:15	10:10	16:35	10:05	09:30
Nith	09:00	08:45	08:50	11:45	15:15	09:15	12:30	13:15	12:00	14:30	09:10	10:15	08:30	14:00	08:30	08:15
Southernness	10:45	10:30	10:15	09:30	14:00	11:00	15:20	10:00	15:00	12:00	10:50	16:15	10:15	12:30	11:10	11:30
Gretna	11:00	11:35	11:15	14:45	11:20	11:30	11:20	15:40	08:30	17:10	12:10	14:15	10:50	17:30	11:10	10:05

There were eight Wednesday counts and two counts each on Tuesday and Thursday with one count on each of the other days of the week giving 16 counts in total (**Table 10**).

### 3.9 Farmer liaisons regarding geese

As counts were conducted within the Scheme area, any significant conversations with the farmers about goose numbers were noted. Sometimes these were on days on which a count was not being conducted. Farmers were also contacted by phone during the January/February period to discuss goose issues once they had received the field count data from NS. All conversations were about goose numbers and whether or not the counts being conducted gave a useful representation of what the farmers’ impressions of field use was like; generally the farmers felt that the counts probably gave a reasonable representation of what was happening on their land although many also felt that the reduced frequency of counts did not give a good representation of goose use but understood the limitations of the methodology. Farmers engaging in conversations about geese were noted (**Table 11**).

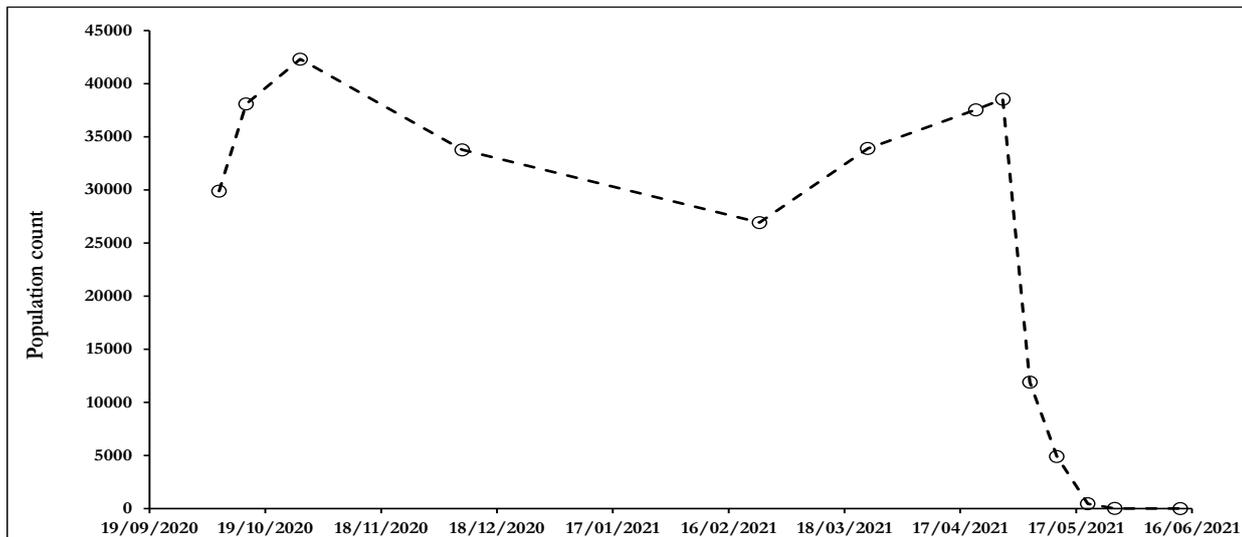
**Table 11. Records of conversations with farmers regarding goose activity in the Scheme area.**

20/12/20	JK said the fields around Cowcourse had been quiet last few days but fields had been "black with geese" at road end by West/East Preston a week or so ago.
c.23/01/21	AM said the barnacles had been on roadside fields a bit more, and especially the reseed under barley stubble early doors in big numbers so will have to see how the sward develops/recovers. Seems bigger numbers about more generally. Mr Swan's fields north of the road getting a lot of action, but otherwise similar to normal. No issues to raise.
	BO thought fairly similar use of roadside fields in Scheme as normal, no issues to raise in particular; said he had one lot of counts through from NatureScot.
	SB said Mossband fields used at night on moons and high tide; field by house taken out of Scheme which seems slightly odd as trail camera images showed reasonable goose use last winter (perhaps this was not raised as an issue due to lack of recent meeting and thus Scheme field changes due to COVID? LRG comment); SB said it was usually well used up to January. Field nearer shore we agreed was little used. Newfield had heavy use as usual on all fields except rushy bottom field down by shore which now not in Scheme anyway as in AECS scheme which makes up for lack of goose payments.
	JW said the geese had hammered the wheat two fields back from the road on Ward Law by Bowhouse and had used pastures above that due no doubt to lack of disturbance up there. Nothing major to report. No issues beyond these. JW also mentioned heavy use of Thwaite area and had noted geese on merses along the Nith and some fields at Lands.
	SF said rarely at the farm himself but his workers regularly reported to him about the goose damage and there was the usual level of complaints from them so nothing out of the ordinary. Winter barley in front of Torrorie seemed to have been used and more geese seemed to have moved along that way this winter. The pasture by the road just prior to Mersehead can get hammered; we both noted how the geese never used the pasture north of the road there. SF could not recall any use of the pastures north of the main road up on the hillside or on the rushy fields nearer Mersehead that they had tried to cut more. The Home Farm cannot get sheep on the pastures before end of April in any year.
	SM said it was just the usual but perhaps a bit more use north of the road; agreed the flocks seemed bigger in that area. SM thought they returned to crop the pastures about every two weeks. SM said they had been using the reseeds MB and Arbigland Estate put in and fields massively improved in those areas through investment. Had not seen use of fields in centre of golf course except for one occasion, but one of those fields in kale anyway. Thought Cowcourse and Mersehead get eaten out earlier in the season, and with this lower ground being poorer, the grass is slower to recover.
	AG similar to usual, nothing to report though will speak to JG and get back to LRG if there are any issues. The geese seem very tame at the moment and do not fly even close to the roads and there seem to be more about generally.
	AW agreed fields down towards Bankend had been used perhaps more than usual and some of those of JJ's especially just over the Lochar at Northpark where they like to hop across. Also felt there had been good use of field by RC's house due to it being big and open and thus perfect for geese and field next to JG's due to it being opened up through rush cutting.
	DF thought things were just as usual, and much as they had been for last 20 years! Not for a couple of weeks now, but before there were large numbers of geese heading to/from sort of Carrutherstown direction which were in V's and thus probably pink-footed geese and roosting perhaps more towards Rockcliffe. Did not think they were heading for Longbridge. When commenting about fields at Powhillon and their lack of goose use DF said they don't use fields that are not grazed so we'll see what happens at Stanhope if fields not grazed (e.g. due to WWT taking them back under their management).
	JJ said nothing too bad, grass maybe too long for them - they don't like our grass! No more use than usual and fields that are in the Scheme are still preferred to those outside of it and nothing out of the ordinary to report. Some small flocks of barnacle geese just starting to use the big field at the end of his farm driveway, possibly drawn in by the bigger flocks of pink-footed geese.
(MB – made no comment; LRG unable to contact direct so far and messages left on mobile to call LRG back if any issues with the geese that MB wanted to report).	

### 3.10 Coordinated Svalbard Barnacle Goose population count totals

**Table 12. Coordinated Svalbard Barnacle Goose population count totals for the Solway Estuary and Budle Bay.**

Count section	07- Oct	14- Oct	28- Oct	18- Nov	09- Dec	24- Feb	24- Mar	21- Apr	28- Apr	05- May	12- May	20- May	27- May	13- Jun
Annan to Gretna	30	0	560	n.c.	800	340	190	190	1400	0	0	0	0	0
Ruthwell to Cummertrees	0	0	2830	n.c.	4580	3497	525	0	0	0	0	0	0	0
Longbridgemuir	0	0	0	n.c.	0	0	0	0	0	0	0	0	0	0
Caerlaverock	7490	10010	5470	n.c.	5620	5444	3556	4565	4600	0	0	0	0	0
Kirkconnell & Ward Law	1900	3020	6780	n.c.	7490	2934	4395	4940	45	1	0	0	0	0
Mersehead to Airds Pt	9813	11160	9210	n.c.	4730	5689	6185	7778	1690	3	0	0	0	0
Caulkerbush to Rascarrel	n.c.	n.c.	n.c.	n.c.	0	0	0	0	0	0	0	0	0	0
Dundrennan to Wigtown	n.c.	n.c.	0	n.c.	0	2250	1245	2715	0	0	0	0	0	0
Rockcliffe Marsh	10650	8350	5400	n.c.	7300	5300	15350	11800	19500	9500	4900	450	8	0
Burgh Marsh	0	0	7650	n.c.	750	n.c.	0	5500	10300	2400	0	0	0	0
Bowness to Grunc	3	5550	4403	n.c.	2500	1466	2450	50	1000	0	0	0	0	0
<b>Solway total</b>	29886	38090	<b>42303</b>	n.c.	33770	26920	33896	37538	38535	11904	4900	450	8	0
Budle Bay	800	2250	1400	1400	1400	1800	0	0	0	0	0	0	0	0
<b>Overall total</b>	30686	40340	<b>43703</b>	n.c.	35170	28720	33896	37538	38535	11904	4900	450	8	0



**Figure 8. Total population of the Svalbard Barnacle Goose on the Inner Solway from October 2020 to June 2021 (November JNCC count cancelled due to very poor weather).**

The first arrival of Barnacle Geese thought to be genuine migrants from Svalbard was a flock of 28 recorded at WWT Caerlaverock on 16 September 2020, a date that is again joint earliest on record, with 140 by 20 September (albeit including a Snow Goose x Barnacle Goose hybrid which could indicate a feral Loch Leven origin for a percentage of these birds) and 2,000 by 27 September. Then there was a gradual build up in numbers to 6,590 on 8 October, with 5,000 being typical for the WWT reserve area from then until 9,086 recorded on 20 October. For the first time since 2006, no peak count above 10,000 was recorded for the reserve and counts remained noticeably low.

The census count on 7 October 2020 recorded 29,900 geese on the Solway and another 800 at Budle Bay, Northumberland, suggesting an early rapid mass exit from Svalbard. By 14 October numbers were already close to the maximum recorded for the winter at 38,100 on the Solway and 2,250 at Budle Bay and by 28 October, the maximum count for the season across the two sites of the Solway (42,303) and Budle Bay (1,400) was recorded with 6 leucistic Barnacle Geese also being noted – the maximum number seen in winter 2020/21 (**Table 12; Figure 8**).

COVID-19 restrictions and advice did not affect as many counts in winter 2020/21 with only the December count and February count being affected to a small degree by some counters abstaining. The November count was cancelled due to poor weather and from December onwards one count section at Boreland of Colvend, rarely used by the geese except in harsh winter conditions, was avoided out of respect for the landowner's wishes.

Significant numbers of geese again staged/wintered on the east coast at Budle Bay with an estimated 2,250 there on 14 October 2020 dropping to a more sustained 1,400 to 2,200 for the rest of the winter until at least the last week of February 2021. By the count of 24 March 2021, and on subsequent counts in April and May, no Barnacle Geese were recorded. This pattern of reduced numbers by March is similar to what has been recorded in previous years though it is still not clear if all of these birds are at that time moving southwest to the Solway or to other locations in the UK or elsewhere. An effort to ring or tag a cohort of birds at Budle Bay in late winter would help elucidate what happens to these birds and the extent to which they are short-stopping Svalbard birds.

It is known from past years that ringed birds from small feral flocks at Loch Leven and the Highland Wildlife Park (HWP) can be present throughout the winter on the Solway and that birds over-summering in Cumbria can also be present. Further to this evidence of UK feral/naturalised birds wintering on the Solway Firth, in December 2020 a cohort of 11 geese were GPS collar tagged on the reserve, being part of a flock of 450 birds in the field at the time of the catch. These tagged birds stayed close together on the reserve fields and those of neighbouring farms throughout mid-winter and migrated north together to Loch Leven in the last week of February, breeding on St Serf's Island in April/May 2021. The tagged birds were observed at various points during the winter on the fields of the reserve and tended to be in a flock of 4-500 birds. No blue leg ringed birds from HWP were seen alongside the tagged birds in such flocks so it could be that there are now over 500 feral/naturalised birds wintering on the Solway and perhaps as many as 1,000 if breeding populations in the Lake District and elsewhere also winter wholly or in part on the Solway. This means that any future population counts or assessments of juvenile productivity should more fully try and take account of this element within the Svalbard flyway population especially if AEWA is using such monitoring data in its modelling for any adaptive management plans. Efforts to ring or tag birds across other feral populations of the UK would help elucidate the true number of UK "resident" birds (albeit some HWP

birds have turned up in Iceland and in Norway) wintering on the Solway. Such knowledge would also be useful when considering Goose Management Scheme costs and the provenance of the birds it is supporting.

Due to count variation, with possible inaccuracies and the chance of double-counting, an adopted count total for the Solway population is derived by averaging those counts within 10% of the maximum recorded during the winter. In 2020/21, eight full census counts were completed from October-April (May counts are affected by spring migration and not included in the adopted count estimation process) and the counts of 38,090 on 14 October 2020, 42,303 on 28 October 2020 and 38,535 on 28 April 2021 fulfilled this criterion (albeit the late April count could have been affected by some earlier departing geese) and were thus averaged to produce **an adopted Solway population total of 39,700 Svalbard Barnacle Geese** (rounded up to the nearest 100; c.f. 36,000 in 2019/20). Therefore in terms of either the peak count or adopted count there has been an increase in the population total on the Solway in 2020/21. This increase on the Solway does not take account of birds at Budle Bay and does not account for the UK resident birds referred to above known to be wintering on the Solway.

### 3.11 Brood size and juvenile productivity of the Svalbard Barnacle Goose

The juvenile productivity of the Svalbard Barnacle Goose observed in flocks sampled on the Inner Solway from October 2020 to January 2021 in the Powfoot, Caerlaverock, Kirkconnell, Drumburn and Southernness areas varied between 2.7% to 28.7% (**Table 13**; 0.7% to 14.6% in 2019-2020) with a mean of 13.1% young for 19 flocks with 14,296 geese sampled (5.2%; n = 14 flocks; 10,111 geese sampled in 2019-2020). Across a subset of these areas, the total number of broods sampled was 250, with a mean family size of 2.2 young, range 1-5 young (1.6 young; n = 121 broods; range 1-4 young in 2019-2020). As usual flocks in fringing areas tended to have the highest percentages of young e.g. as seen at Budle Bay, Northumberland and the field near Powfoot (WWT field code AN278).

**Table 13. Brood size and juvenile (juv) productivity for Svalbard Barnacle Geese on the Solway in winter 2020/21.**

Date	Flock Size	Sample Size	Total Juvs	WWT-code	Crop	Brood of 1	Brood of 2	Brood of 3	Brood of 4	Brood of 5	Brood of 6	Single Juvs	% juvs	Obs
07/10/2020	109	109	6	OM1	merse	3		1					5.50	BRM
08/10/2020	410	410	11	A9/10	pasture		4	3					2.68	BRM
14/10/2020	1080	1080	59	A5	pasture								5.46	BRM
28/10/2020	210	210	48	H18/19	pasture	7	10	4	1	1			22.86	LRG
30/10/2020	589	589	75	V9b	pasture								12.73	V&B
10/11/2020	640	600	117	DR9	pasture	8	14	11	6				19.50	LRG
10/11/2020	1230	850	133	V9b	pasture	11	13	12	5	1			15.65	LRG
10/11/2020	4200	2190	331	V8	pasture	2	1	3					15.11	LRG
10/11/2020	1100	600	125	T13	pasture	7	9	6	6	1			20.83	LRG
19/11/2020	1650	1045	72	P5	pasture	13	9	8	3	1			6.89	LRG
21/11/2020	1160	640	128	Budle Bay	pasture								20.00	DF
23/11/2020	850	850	80	H14	pasture	13	15	7	4				9.41	LRG
23/11/2020	48	48	8	L4	stubble			1		1			16.67	LRG
23/11/2020	2860	1440	96	M1	pasture								6.67	LRG
23/11/2020	3100	1370	218	F8	pasture								15.91	LRG
27/11/2020	450	415	86	L4	stubble								20.72	LRG
28/11/2020	810	695	55	G13	pasture								7.91	LRG
29/11/2020	500	485	25	O5	pasture	3	4	2	2				5.15	LRG
09/12/2020	1400	670	192	AN278	pasture								28.66	LRG
04/01/2021	390			T12	pasture	6	5	3						LRG
Total		14296	1865											
<b>Overall juv%</b>			<b>13.05</b>											
						Brood size totals:								
						73	84	61	27	5	0	Total broods	250	
						Number of juveniles per brood size category:						Max %juvs	28.7	
						73	168	183	108	25	0	Total juvs	557	
												<b>Mean brood</b>	<b>2.23</b>	

### 3.12 Leucistic Barnacle Geese

A minimum of six leucistic Barnacle Geese was recorded on 28 October and 9 December 2020 and 28 April 2021, with one to three birds being recorded in most of the main count sections.

### 3.13 Other geese

At least one blue phase Ross's Goose *Anser rossii* x Barnacle Goose hybrid was often present at Caerlaverock – this bird is likely to be from Loch Leven where it associates with the naturalised Barnacle Geese that breed there. One small *hutchinsii* type Canada Goose was noted in a flock of Barnacle Geese at Northpark in mid-October 2020. On 21 April 2021 a juvenile European White-fronted Goose *Anser albifrons albifrons* was noted on the river near Kelton.

### 3.14 Trail camera monitoring

From the end of November 2020 to the start of May 2021, two Acorn LTL 6310MC trail cameras with 32GB SD cards and rechargeable batteries were deployed on trees, with landowner permission, at field 'S67a' on Midtown Farm within the Goose Management Scheme area (**Table 14**). The cameras were used in time lapse mode to take images every 20 minutes from dawn to dusk from 05:00-19:00 GMT (14 hours in total) until 9 March 2021 when batteries and SD cards were changed and the time lapse period was updated to 04:00-21:00 GMT (17 hours in total) with final retrieval on 12 May 2021 by which time the geese had left the Scheme area. In general, the images were unaffected by periods of poor weather except for some rare early morning mists and occasional rain on the camera lens. In some instances there were corrupted images but for all cases of poor image quality these totalled less than 0.5% of the total images collected by either camera. In all circumstances it was possible to discern goose flocks at all distances between the camera and the field boundaries, though this no doubt depended on flock size to an extent. The approximate surveillance polygons within which geese could readily be detected are depicted in **Figure 9**. A subjective assessment was made of the approximate percentage field visibility as the edges of fields closer to the camera are out of the line of site of the "cone" shaped field of view (**Table 14**). Such a limitation to the view field was not thought to be a problem in assessing whether or not a field was used by geese as the field of view covered the most improved sward areas within this field.

**Table 14. Trail camera deployment locations (Figure 9), field areas surveyed and the survey periods covered.**

Farm holding	Approximate percentage of field area visible	Deployment time & date	Final image time & date
Midtown	'S67a' (western upper improved part of field) ~85%	09:47 28/11/20	18:40 31/03/21
Midtown	'S67a' (eastern upper improved part of field) ~85%	09:55 28/11/20	10:47 12/05/21



**Figure 9. The two trail camera positions (star symbols) on the field compartment ‘S67a’ at Midtown Farm and their approximate surveillance polygons. Cameras were fitted on trees at ~1-2m height above the ground.**

The pictures from the cameras were viewed on Windows PhotoViewer on a 27 inch desktop screen at the rate of about one picture per 2-3 seconds, each picture being scanned from side to side by the viewer (LG) for signs of goose flocks. It is quite likely that small flocks of less than 10-20 birds will be missed on occasion at increasing distances from the camera. A subjective assessment of the flock size, based on 20 years’ experience of counting goose flocks, was made and noted on a spreadsheet along with the arrival and departure times of the geese to and from the field. These are probably minimum assessments of feeding times spent by the geese on the fields as sometimes a flock was seen to move into or out of the field of view of the camera and so it was not known if the flock had just arrived or just left the field. In some cases where a flock disappeared with a direction of travel into an area out of view, and then reappeared within the next hour from that direction, it was assumed that the flock had remained within the field during that whole time period. In the summary below it is presumed that the pictures taken every 20 minutes would have recorded any goose flocks using a field as goose flocks tend to use a field for 1-2 hours or more once settled (see below).

Each flock count recorded on the trail camera images was converted to “goose hours” (goosehrs) by multiplying the maximum estimated count recorded in a series of contiguous images by the period of time over which those images extended plus an allowance of 10 minutes either side of the first and last image for the flock to have been present but unobserved, for example 100 geese on a field for at least 40 minutes (present on two images) equates to  $100 \times 1.0 = 100$  goosehrs which is deemed equivalent to 200 geese being present for 30 minutes or 100 geese for an hour. All ‘goosehrs’ totals for a field probably represent a minimum because birds may have used areas of the field that were not within view of the camera and occasionally flocks may have visited a field for less than 20 minutes.

The trail camera observing the western upper section of improved grassland at ‘S67a’ recorded no geese in 2019-2020 winter when running for 11 hours per day from 07:00-18:00 from 15 November 2019 to 3 May 2020, whereas in 2020-2021 it recorded flocks of c. 3-320 geese on 16 different days during the period from 28 November 2020 to 31 March 2021 (when the camera unexpectedly stopped working), with 2,824 goosehrs recorded in total during that period over 124 days (**Table 14**). This is still very low goose use which can be envisaged as a flock of ~3,000 geese utilising the field for one hour during the whole winter period.

The camera observing the eastern upper section of improved grassland at ‘S67a’ recorded ~4,000 goosehrs in 2019-2020 during 14 hours of monitoring per day from 06:00-20:00 from 1 January to 3 May 2020, and in 2020-2021 a similar level of use of 4,223 goosehrs was recorded across 47 different days during the period from 28 November 2020 to 12 May 2021, spanning 166 days of continuous recording (**Table 14**). Again this represents very low goose use overall and in both the eastern and western sections of this field after the 1 April in the critical spring period prior to stock turn-out only ~130 goosehrs were recorded on the preferred eastern section with the western section having presumably receiving close to zero use. This is equivalent to 130 geese using the field for an hour during the whole of April.

The cameras at ‘S67a’ recorded disturbance of the goose flocks by walkers with or without dogs, and use of the field by roe deer *Capreolus capreolus* (with three or four present on most days).

A limited comparison of the data derived from the trail camera images with the count data collected for field ‘S67a’ was possible for 11 of the 16 NS/JNCC surveys covering the Goose Management Scheme area winter survey period (**Table 15**).

**Table 15. Ground counts for field ‘S67a’ in comparison with those derived from trail camera monitoring. Periods of potential overlap in monitoring are shown in grey; field S67a was monitored from 28 November 2020 to 12 May for the eastern part and to 30 March 2021 for the western part. Where geese were detected on the trail camera imagery, peak counts recorded during the 20 minute time lapse samples are given (in bold) with the approximate time periods the flocks were likely to be present.**

Field code	07/10/20	14/10/20	28/10/20	19/11/20	27/11/20	09/12/20	22/12/20	04/01/21	23/01/21	07/02/21	24/02/21	09/03/21	24/03/21	08/04/21	21/04/21	28/04/21
S67a	0	0	0	0	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (45 c.10:15-11:46)	0 (0)	7 (0)	14 (0)	0 (30 c.11:05-12:36)	0 (0)	0 (0)

Across the 11 “field days” on which both methods were operational (highlighted cells), there were two instances, on 7 February and 8 April 2021, where images of geese on the field was captured by the trail cameras but the ground counts recorded zero goose use. However, this was due to the ground counts being conducted in the Midtown area at c.15:00 on both dates (**Table 10**) by which time the trail camera imagery showed that the geese had left both of these fields. There were also two instances of ground counts of small flocks of 7 and 14 on field ‘S67a’ on 9 March and 24 March 2021 respectively which were not recorded on the camera imagery (**Table 15**). This is due to the

counts being conducted from the WWT Farmhouse Tower and only covering the visible southern half of the field (**Figure 9**).

The final version of the Excel spreadsheet of summary counts supplied with this final report to NS in fulfilment of the contract does not have the field counts for field 'S67a' amended in any way in line with the camera trap imagery records because of the time of day mismatch, as this would bias the ground count data in favour of field 'S67a' compared to other fields in the Scheme.

### 3.15 Acknowledgements

Thanks go to Bob Jones for conducting census counts in the Rockcliffe/Burgh Marsh area, Mhairi Maclaughlan for counts covering the Bowness to Grune route, Marian & Dave Rochester for covering the Borgue to Wigtown route, Paul Tarling for covering Crook of Baldoon, David Charnock for covering Rascarrel to Sandyhills and Rowena Flavelle and Colin Bartholomew for covering the Southwick area to Drumburn. Derek Forshaw kindly provided counts for Budle Bay, Northumberland.