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Population size, breeding success and habitat use of Whooper Swan *Cygnus cygnus* and Bewick's Swan *Cygnus columbianus bewickii* in Ireland: results of the 2020 International Swan Census

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Plate 26. Whooper Swans (Brian Burke).

Keywords: Whooper Swan, Bewick's Swan, census, waterfowl, wintering waterbirds, *Cygnus columbianus bewickii*, *Cygnus cygnus*, habitat use, trends.

Each winter Ireland hosts internationally important numbers of Whooper Swans *Cygnus cygnus* from the Icelandic breeding population and what has diminished to small numbers of Bewick's Swans *C. columbianus bewickii* from the north-west European wintering population. The 8th International Swan Census took place in January 2020 to update the population estimates of these species and gather data concerning their distribution, breeding success and habitat use. A total of 19,111 Whooper Swans were recorded in Ireland – 14,467 in the Republic of Ireland (RoI) and 4,644 in Northern Ireland (NI). This represents an increase of 26.5% (24.9% in RoI, 32.0% in NI) since the 2015 census and follows on from a period of relative all-Ireland stability in

numbers. The number of flocks had increased by 11% to 550, despite modest rainfall levels which were expected to limit habitat availability. Shifts in distribution away from the west and north-midlands towards the south-midlands and north coast were evident. Whooper Swan showed a strong preference for pasture-based habitats, with some regional variation in the use of other habitats depending on local availability. The percentage of juveniles was relatively high (19.1%), although the mean brood size (2.0) was slightly below that of previous censuses. Fourteen sites each supported numbers of international and national importance. The number of Bewick's Swans in Ireland showed a continued decline, with only 12 individuals recorded at two sites in separate counties in RoI. Bewick's are expected to cease being a regular wintering species on the island of Ireland in the coming years.

Introduction

Each winter Ireland plays host to two species of migratory swan – the Whooper Swan *Cygnus cygnus* from the Icelandic-breeding population, and the Bewick's Swan *C. columbianus bewickii* from the population that breeds in northern Russia and winters in north-west Europe. Both species are listed on Annex I of the EU Birds Directive (2009/147/EC), requiring special conservation measures including where appropriate the designation of Special Protection Areas (SPAs). Whooper Swan is listed as a special conservation interest for 21 SPAs in the Republic of Ireland (RoI) and for three in Northern Ireland (NI), both including Lough Foyle. Bewick's Swan is a special conservation interest for three SPAs in RoI and two in NI, again both including Lough Foyle. The core count methodology of Ireland's annual wintering waterbird monitoring schemes, namely the Irish Wetland Bird Survey (I-WeBS) in RoI and the Wetland Bird Survey (WeBS) in NI, does not fully account for several species that feed regularly on non-wetland sites during the day (Burke *et al.* 2018), including each of the migratory swan and goose species. Targeted surveys have been established to better monitor their numbers. Since the mid-1980s, coordinated censuses of Whooper and Bewick's Swans have been carried out across their respective wintering ranges, typically on a five-year basis. These censuses aim to monitor the numbers and distribution of these species, as well as to assess breeding success and habitat usage, enabling comparisons between regions and assessment of changes over time (Crowe *et al.* 2015, Hall *et al.* 2016).

Ussher and Warren (1900) found Bewick's Swans more numerous and widespread than Whooper Swans in Ireland, but by 1950 the reverse was the case (Ruttledge 1974) and the relative status of the two populations has diverged even further since then. The increase in Whooper Swans in Ireland has coincided with a rise in the overall Icelandic-breeding population. The first international census in 1986 recorded 10,320 Whooper Swan in Ireland, representing 62% of the flyway population (Merne & Murphy 1986). By January 2000 (4th census) Ireland held 12,730 Whooper Swan (61% of the 20,856 flyway total; Cranswick *et al.* 2002) and numbers had increased to 15,370 in Ireland by 2015 (7th census). This represented a reduction to 45% of the flyway population (34,004), however, as a numerical shift to the south-east within the swan's overall winter distribution in Ireland and Britain was becoming increasingly evident (Hall *et al.* 2016), with numbers continuing to increase in Britain, particularly in England. Breeding success within the Irish-wintering population (22.3% juveniles, mean brood size 2.4) was higher than that in the British-wintering population (17.4%, 2.0), and in England in particular (16%, 2.0) suggesting that individuals may be changing their wintering locations rather than changes being attributable to better productivity. These regular, coordinated censuses have also highlighted the differences in habitat usage by Whooper Swan in different parts of their wintering range, with most birds in RoI and NI recorded on pasture (69.4% and 81.2% respectively in 2015), compared to only 12.8% of birds in Britain and none of the wintering birds in Iceland (Hall *et al.* 2016).

Bewick's Swans, by contrast, have declined to the point that they are expected to cease being a regularly-occurring species in Ireland in the near future, as a result of a contraction in wintering range ('short-stopping') and compounded by a decline in the flyway population (Beekman *et al.* 2019). In 1984 there were 1,244 Bewick's wintering in Ireland, representing 7.6% of the flyway population. Numbers increased in 1990 but fell to 580 in 1995 (Worden *et al.* 2006), 101 in 2010 (Boland *et al.* 2010) and by 2015 only 21 individuals were recorded in two counties in Ireland (Crowe *et al.* 2015).

This paper presents the results of the 8th International Swan Census in Ireland, which took place around the weekend of 11 and 12 January 2020.

Methods

The census followed the same methodology as previous International Swan Censuses in Ireland (Crowe *et al.* 2015, Boland *et al*. 2010). Counts were scheduled for the weekend of 11 and 12 January 2020, with counters asked to count on these days or as close as possible in the three days either side of the weekend to minimise potential double-counting of birds moving between sites. Swan counts from outside this

Plate 27. Bewick's Swan (Pawel Ryszawa).

period in January were also collated and utilised where the risk of double-counting flocks was deemed minimal (generally where a flock was counted a large distance away from other flocks and/or where anecdotal evidence indicates a flock was present but not counted around the exact census dates). Every attempt was made to ensure that all areas which held birds during previous swan censuses and regular I-WeBS and WeBS core counts were covered during the current census period. Counts of large sites, and elsewhere where movements of swans between nearby locations could occur, were coordinated and carried out on the same date, where possible. Coverage in RoI was organised through the I-WeBS office at BirdWatch Ireland; in NI through the Irish Whooper Swan Study Group (IWSSG) and the census was coordinated internationally by the Wildfowl and Wetlands Trust (WWT). Most coverage was by volunteer birdwatchers and professional staff involved in I-WeBS or WeBS, including staff from the National Parks and Wildlife Service (NPWS), BirdWatch Ireland, Northern Ireland Environment Agency, Royal Society for the Protection of Birds, and Armagh City, Banbridge and Craigavon Borough Council as well as IWSSG members. In addition, a small number of records were sourced via eBird (Cornell Lab of Ornithology) for consideration. An aerial census was carried out of the Shannon and Fergus Estuary, River Shannon, Lough Derg, Shannon Callows, Little Brosna and River Suck, by NPWS staff. Data for the census was mostly submitted on standardised paper forms or via the WWT website. Counters were asked to record date, time, location, number of swans, number of juveniles and size of broods, and note the habitat use of the swans (from 30 pre-defined habitat categories).

Once data were compiled, an assessment of the extent of coverage was made for each site complex (and region, where there may potentially be movement between sites), and aerial census results were used where ground-based coverage was considered incomplete. For the most part, aerial and ground censuses of certain sites took place on the same day, allowing for the most representative count for a large distinct area (e.g. long stretch of river, single side of a large lake, which may include multiple subsites) to be taken. Most of the totals in this paper are presented at county-level based on where an individual flock was recorded i.e. based on location of the count unit (subsite). Site totals are expressed as an amalgamation of totals from those subsites which form part of the same wetland complex and include the aggregation of roosting and feeding areas used by the same flock(s) of swans. Note that some sites consist of subsites that overlap with more than one county.

Results

Coverage

A minimum of 1,573 count units (1,144 in RoI and 429 in NI) were covered by 296 observers, representing an increase in coverage of 18.5% from the 2015 census. A small number of other count units were covered but no swans were found, and no record was submitted as a result (in addition to those covered and for which a record of zero birds was submitted). Of the 550 counts used to derive the Whooper Swan census total (421 in RoI, 129 in NI), 96.7% were from within three days either side of the target weekend (i.e. 08 to 15 January 2020). Some later counts were included where they were deemed unlikely to constitute double-counting of swans previously recorded in the surrounding area. These included 17 records amounting to 315 Whooper Swans from the period 16 to 19 January and a further 76 individuals included from two counts to 29 January 2020.

Rain in January was below the long-term average in most areas (Met Éireann 2020), following on from a December where rainfall varied considerably across the regions. This is likely to have influenced habitat availability in certain areas, particularly in the west and parts of the midlands where birds move to turloughs, flooded river callows and neighbouring grasslands once water levels are sufficiently high. Temperatures were mild during the census window, so possible redistribution due to ice formation at water bodies was not an issue. Despite some unsettled weather due to Storm Brendan, conditions did not significantly affect survey coverage or swan detectability.

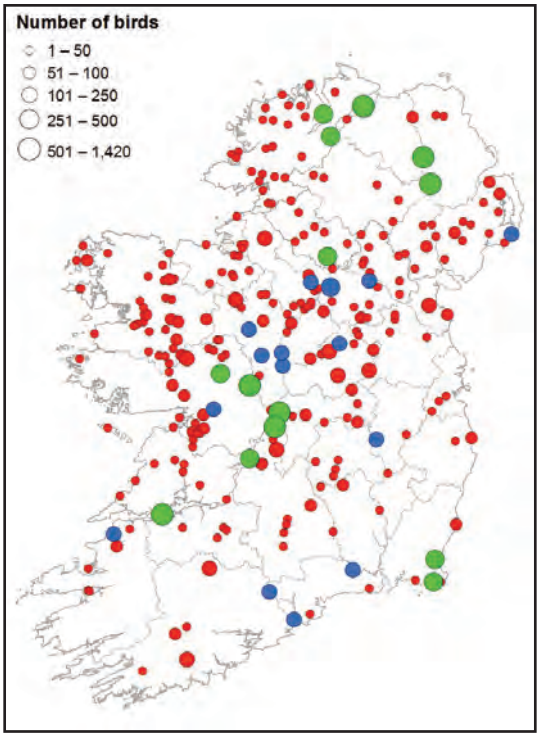

Figure 1. Distribution of Whooper Swans *Cygnus cygnus* in Ireland for the January 2020 census, at site level. Sites exceeding the international 1% threshold are illustrated in green, those exceeding the national 1% threshold are in blue and other sites are shown in red.

Whooper Swan

In total, 19,111 Whooper Swans were counted in 550 flocks during the census period, with birds recorded in every county (Table 1). This represents an increase of 26.5% compared to the 2015 census (Crowe *et al.* 2015) and is the highest total recorded for the species in Ireland to date. There was a 24.9% increase to 14,467 Whooper Swans in RoI and an increase of 32.0% in NI, bringing the latter to a total of 4,644 individuals (Table 1). The number of flocks recorded was 11.1% higher than in 2015 and higher than any previous census.

The distribution of Whooper Swans during this census is shown in Figure 1. Counties Offaly, Galway and Londonderry held the highest numbers of swans, while Roscommon, Donegal and Antrim also hosted > 1,000 individuals. There was considerable variation in almost all counties when compared with the 2015 census (Figure 2a, 2b), with 29 counties changing by >10% since January 2015 (including Carlow and Dublin which held no swans during the 2015 census). Increases were noted in 22 counties, most notably in Offaly (+1,017 birds), Londonderry (+830), Donegal (+660) and Westmeath (+593). The biggest decreases amongst the remaining 10 counties were in Monaghan (-324 birds), Galway (-308), Fermanagh (-292) and Mayo (-275).

The 1% international (flyway) and national (all-Ireland) importance thresholds for Whooper Swan are currently estimated at 340 and 150 birds respectively (Burke *et al.* 2018; Wetlands International 2020), based on the 2015 census. Whooper Swan numbers of international importance were recorded at 14 sites in total (10 sites in RoI; four in NI; Table 2) during the 2020 census, four more than in the 2015 census despite the increase in threshold. Numbers of national importance were recorded at a further 15 sites (14 in RoI; one in NI; Table 2) in January 2020, the same number as in 2015. Lough Neagh continues to support the highest number of Whooper Swans, showing an increase of over 500 birds since 2015 (Table 2). At nearby Lough Beg, and at Lough Foyle, very large numbers were recorded compared to other sites in NI, and both showed substantial increases from the previous census (Table 2). In particular, the dramatic drop in numbers experienced at Lough Foyle between the 2010 and 2015

Table 1. The county, total, number of flocks, age structure and brood sizes of Whooper Swans *Cygnus cygnus* in the January 2020 census, with All-Ireland totals from previous censuses. Note that original census figures have been updated in subsequent publications when counts submitted late are subsequently included and not all relevant revised figures (e.g. flock numbers) are subsequently published.

County	Total	Flocks	Aged	% Juv	Broods	1y	2y	3y	4y	5y	6y	7y	Mean Brood Size
Antrim	1,146 (+49.0)	32	974	18.4	71	29	25	9	6	2			2.0
Armagh	490 (+5.4)	16	490	17.1	42	15	15	9	3				2.0
Down	788 (+53.0)	17	718	25.3	93	42	27	13	8	3			2.0
Fermanagh	492 (-37.2)	23	451	13.7	18	9	4	3	1	1			1.9
Londonderry	1,478 (+128.1)	27	1,253	22.6	126	51	34	22	9	8	2		2.2
Tyrone	250 (-25.8)	14	239	14.6	23	14	6	3					1.5
NI Total	**4,644 (+32.0)**	**129**	**4,125**	**20.0**	**373**	**160**	**111**	**59**	**27**	**14**	**2**	**0**	**2.0**
Carlow	27 (↑)	2	24	-	0								
Cavan	813 (-22.8)	37	633	23.2	59	15	23	16	3	2			2.2
Clare	875 (+38.4)	20	319	17.9	14	8	5		1				1.6
Cork	488 (+100.0)	9	480	12.7	34	20	7	6	1				1.7
Donegal	1,159 (+132.3)	48	1,058	26.4	136	55	50	21	7	3			1.9
Dublin	40 (↑)	3	40	20.0	4	4							1.0
Galway	1,485 (-17.2)	38	1,261	12.8	62	28	20	8	6				1.9
Kerry	419 (-10.9)	16	312	9.0	15	8	4	3					1.7
Kildare	175 (+8.0)	3	175	8.6	1	1							1.0
Kilkenny	81 (+268.2)	2	81	22.2	0								-
Laois	197 (+64.2)	8	185	27.6	19	8	3	3	3	2			2.4
Leitrim	386 (+27.8)	20	289	24.9	41	18	17	5	1				1.7
Limerick	493 (+270.7)	8	98	10.2	8	7		1					1.3
Longford	394 (+85.0)	13	208	16.8	13	4	5	3	1				2.1
Louth	208 (+123.7)	2	0	-	0								-
Mayo	973 (-22.0)	55	823	20.3	52	16	27	8	1				1.9
Meath	119 (-43.1)	8	119	24.4	12	3	3	5	1				2.3
Monaghan	172 (-65.3)	12	127	11.0	1	1							1.0
Offaly	1,506 (+208.0)	15	714	16.2	19	5	9	2	3				2.2
Roscommon	1,322 (-3.3)	39	683	20.1	60	20	18	13	6	2	1		2.3
Sligo	273 (+52.5)	15	190	20.0	14	8	4	1	1				1.6
Tipperary	441 (+79.3)	11	351	25.4	13	2	7	3	1				2.2
Waterford	432 (+35.0)	12	382	20.4	41	21	9	5	6				1.9
Westmeath	982 (+152.4)	13	627	21.7	47	11	17	14	2	2	1		2.4
Wexford	928 (+17.3)	9	900	14.4	49	7	21	13	3	5			2.56
Wicklow	79 (-31.9)	3	79	26.6	6	2	2	2					2.0
RoI Total	**14,467 (+24.9)**	**421**	**10,158**	**18.7**	**720**	**272**	**251**	**132**	**47**	**16**	**2**	**0**	**2.0**
All Ireland Total 2020	**19,111 (+26.5)**	**550**	**14,283**	**19.1**	**1,093**	**432**	**362**	**191**	**74**	**30**	**4**	**0**	**2.0**
2015 [1, 2]	15,370 (+1.5)	495+	12,257	22.3	681	187	216	156	85	29	7	1	2.4
2010 [2,3]	15,136 (+7.5)	386+	11,969	17.6	695	240	210	146	67	24	8		2.2
2005 [4, 5]	14,079 (+10.6)	391	10,799	18.6	645	191	240	132	61	20	1		2.2
2000 [6]	12,730 (+29.2)	414	9,789	17.1	491	157	161	104	55	10	4		2.2
1995 [7]	9,855 (-17.7)	310	6,451	17.2	421	135	122	105	46	12	1		2.2
1991 [8]	11,974 (+16.0)	308	8,189	7.9	411	106	165	89	47	4			2.2
1986 [9]	10,320	361	7,609	23.1	230	63	76	46	29	13	2	1	2.4

[1] Hall *et al.* 2016, [2] Crowe *et al.* 2015, [3] Hall *et al.* 2012, [4] Worden *et al.* 2009, [5] Crowe *et al.* 2005, [6] Colhoun *et al.* 2000, [7] Cranswick *et al.* 1996, [8] Kirby *et al.* 1992, [9] Merne & Murphy 1986.

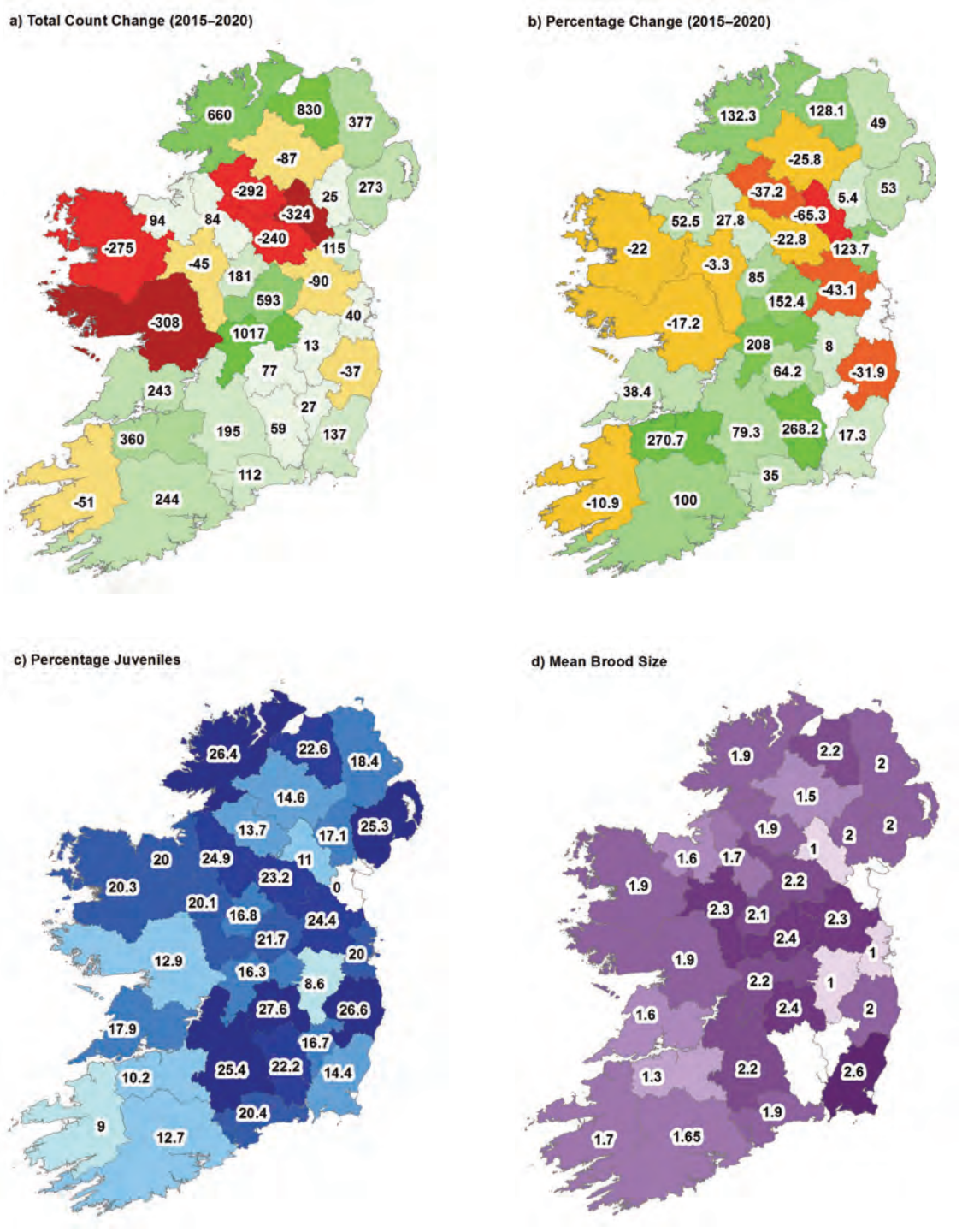

Figure 2. County breakdown of change in numbers from 2015 census (a), percentage change from 2015 census (b), percentage juveniles (c) and mean brood size (d) of Whooper Swans *Cygnus cygnus* in Ireland for the January 2020 census.

Table 2. Sites supporting internationally and nationally important numbers of Whooper Swans *Cygnus cygnus* during the January 2020 census. Importance thresholds after Burke *et al.* (2018) and Wetlands International (2020). Asterisks denote where status has changed since 2015 census.

Site	County	2020 Census	% Change (2015)
Internationally Important (1% flyway threshold = 340)			
Lough Neagh	Antrim, Londonderry, Tyrone, Armagh, Down	1,420	+56.4
Shannon Callows (Ground & Aerial)	Roscommon, Galway, Offaly, Westmeath	942	+102.6
Shannon & Fergus Estuary (Ground & Aerial) *	Clare, Limerick, Kerry	899	+265.4
Lough Foyle *	Londonderry, Donegal	890	+466.9
Lough Beg	Antrim, Londonderry	868	+27.8
River Suck (Ground & Aerial)	Roscommon, Galway	557	+46.2
Little Brosna Callows (aerial) ***	Offaly, Tipperary	542	+295.6
Lough Swilly *	Donegal	487	+118.4
Wexford Harbour & Slobs	Wexford	480	+25.7
North East Galway Lakes *	Galway	442	+181.5
River Foyle	Donegal, Tyrone, Londonderry	416	+25.3
Upper Lough Erne	Fermanagh	410	-40.5
Lough Derg (Shannon) Aerial ***	Galway, Tipperary, Clare	377	-
Tacumshin Lake	Wexford	342	+8.2
Nationally Important (1% all-Ireland threshold = 150)			
Lough Oughter Complex	Cavan	261	+48.3
Castleplunket Turloughs	Roscommon	239	+22.6
Blackwater Callows **	Cork, Waterford	218	+67.7
Cashen River & Estuary **	Kerry	210	-38.4
Lower Blackwater River	Waterford	198	+13.1
Southern Roscommon Lakes ***	Roscommon	198	+4,850.0
Lough Ree ***	Roscommon, Longford, Westmeath	195	+4,775.0
West Longford Wetlands ***	Longford	195	-
River Barrow (Monasterevin-Athy) ***	Laois, Kildare	184	+32.0
River Suir Lower ***	Waterford	171	+180.0
Ballinamore Lakes ***	Leitrim	165	+75.5
Lough Derravaragh ***	Westmeath	159	-
Bishopscourt/Ringawaddy ***	Down	157	-
Annalee River ***	Cavan	154	+3.0
Dooyertha River ***	Galway	154	-

*Numbers of national importance in 2015 census.

** Numbers of international importance in 2015 census.

*** Did not have numbers of national or international importance in 2015 census.

censuses (883 in 2010, to 157 in 2015), which contributed significantly to the drop in total NI numbers in the latter, was nearly precisely reversed, with numbers in 2020 (890) almost identical to those in 2010. The River Shannon system and its tributaries supported very large numbers, with the Shannon Callows, Shannon & Fergus Estuary, River Suck and Little Brosna Callows making up the top four sites in RoI, and Lough Derg also supported numbers of international importance, all having increased since 2015 (Table 2). Of those sites listed in Table 2, all but Upper Lough Erne and Cashen River Estuary had increased their totals since 2015. Kilmacshane (Galway) held internationally important numbers of Whooper Swans in 2015 but only 29 birds in 2020. Similarly, eight sites where nationally important numbers were recorded in 2015 did not meet that threshold in January 2020. It should be noted that counts during a limited census window mid-winter may not reflect the importance of sites in other months, especially during arrival in October and November and prior to

departure in spring, or when rainfall or frost levels have changed the availability of suitable feeding and roosting habitat.

In RoI, 45.3% of individuals (6,514) were associated with SPA's during the census (i.e. using subsites that overlap with SPAs). Given the caveats noted above, and the fact that birds recorded feeding away from wetland sites will have returned to nearby wetlands (including SPAs) to roost at night, this is undoubtedly an underestimate of the number of Whooper Swan using SPAs over the course of the winter.

The percentage of juveniles and mean brood sizes at county level are illustrated in Figure 2c and 2d. In total, 14,283 individuals (74.7% of all Whooper Swans recorded) were aged, of which 19.1% were juvenile (Table 1). This includes 18.7% juveniles in RoI and 20.0% in NI. A total of 1,093 broods were recorded, ranging between broods of one and six young, resulting in a mean brood size of 2.0 young for both RoI and NI separately, and combined. For the 24 counties where more than ten families were observed, mean brood sizes ranged between a low of 1.5 (Tyrone) and a peak of 2.6 (Wexford). Brood sizes were lowest in western and north-western parts of Ireland and higher in the midlands, south-east and north-east, suggesting a differential spatial distribution of juveniles and family groups.

Bewick's Swan

A total of just 12 Bewick's Swans was recorded, representing a decline of 47.6% since the 2015 census. The two sites where Bewick's Swans were recorded were both used during the last census: one adult bird at Brideswell (Roscommon) and a flock of seven adults and four juveniles (broods of 3y and 1y) at Wexford Harbour & Slobs. The latter site is a SPA. This is the second consecutive census in which this species was not recorded in NI.

Habitat

The habitat utilised was recorded for 87.2% of Whooper Swans (Table 3). Whooper Swans were recorded in 23 out of the 30 categorised habitat types (Appendix 1), with 165 birds recorded under the additional 'other (counter asked to specify)' habitat category, predominantly relating to cutaway bog (136 birds) and machair (27). If specific listed habitats are grouped into the categories used by Hall *et al.* (2016) (Appendix 1), then 57.8% of Whooper Swans used improved pasture (dry), with permanent standing water the second most frequently used habitat (11.9%) and arable waste used by 7.7% of birds during the census (Table 3). Overall, grassland habitats were clearly the most favoured, accounting for 73.5% of individuals (Table 3). At provincial level, grassland was still the most-used habitat, particularly improved pasture (dry), though there are clear regional differences in the use of different pasture types, as well as arable and permanent waterbody habitats that likely reflect the availability of those habitats in different parts of the country.

The 11 Bewick's Swans recorded in Wexford were seen feeding on fodder beet (categorised as 'Arable: Sugar Beet'/'Arable Waste'), while the lone bird in Roscommon was on unimproved wet pasture.

Table 3. Percentage habitat use by Whooper Swans *Cygnus cygnus* during the 2020 census, at All-Ireland and provincial level, based on habitat groupings according to Hall *et al.* 2015.

Habitat Group	All-Ireland	Ulster	Leinster	Munster	Connacht
Permanent Waterbodies	**16.5**	**12.1**	**24.4**	**2.4**	**22.3**
Permanent Standing Water	11.9	10.9	9.3	1.6	21.0
River	4.4	1.2	15.1	0.3	0.9
Coastal	0.2	< 0.1	0	0.5	0.4
All Pasture	**73.6**	**76.1**	**56.6**	**97.7**	**74.4**
Improved pasture (dry)	57.8	70.3	38.4	91.6	40.4
Improved pasture (wet)	9.0	1.4	11.7	2.5	21.7
Rough/Unimproved Pasture (wet)	5.8	3.5	5.6	1.9	11.5
Rough/Unimproved Pasture (dry)	1.0	0.9	0.9	1.7	0.8
All Arable	**8.7**	**11.8**	**16.6**	**0.0**	**0.0**
Arable growing	1.0	0	4.2	0	0
Arable waste	7.7	11.8	12.4	0	0
Other	1.3	0	2.5	0	3.0
Number of Swans (individuals)	**16,663**	**6,633**	**4,039**	**1,932**	**4,059**

Plate 28. Whooper Swans (Brian Burke).

Discussion

Whooper Swan – Distribution and abundance

Whooper Swans in Ireland have increased in number substantially (26.5%) since 2015, with numbers in both RoI and NI increasing to a similar extent (24.9% and 32.0% respectively). Results in 2015 (Crowe *et al.* 2015) found the all-Ireland Whooper Swan population to be stable, given that there had been little change in total numbers since 2010 (+1.5%; Crowe *et al.* 2015, Hall *et al.* 2016) and slowing growth since 2005 (+7.5%; Boland *et al.* 2010). This stability in Ireland was occurring at a time when the overall Icelandic breeding population was still growing (Hall *et al.* 2016), meaning the relative proportion of the flyway population in Ireland was decreasing. From the 2015 census, the result has been a significant shift in the Irish and Great British wintering population's centre of distribution, and it was suggested that individual birds may be changing their wintering grounds and migrating further to south-east England (Hall *et al.* 2016). The within-Ireland trend in 2015 also reflected this shift, with a reduction in numbers of 1,098 birds (26.1%) in NI being compensated for by an increase of 1,400 (13.4%) in RoI. As the incidence of marked swans within the population visiting Ireland has declined in recent years, further colour-ringing and ring-resighting efforts in Ireland would prove invaluable to determining to what degree individual birds are changing their wintering areas. The large increase in Whooper Swans in 2020 represents a departure from the trend of recent census results in Ireland and will be put further into context when the census results from the rest of the flyway wintering grounds (Iceland and Britain) are compiled.

For the first time during a census, Whooper Swans during January 2020 were recorded in all 32 counties. There was significant change in numbers at county-level since 2015, with 22 counties showing changes of > 25% and birds recorded once more in both Dublin and Carlow. The changes illustrated in Figure 2a and 2b show a shift away from the west and north-midlands. Many counties in the midlands and south, particularly Offaly and Westmeath, recorded population increases much greater than the overall rate of increase at

national and all-Ireland level. They perhaps benefitted from a southwards shift in birds from the west (Galway, Mayo), and north-midlands (Cavan, Monaghan, Fermanagh and Meath). Counties along the north coast, particularly Donegal and Londonderry, may have benefitted from reduced totals in the north-midlands, but their proximity to Scottish wintering grounds as well as Iceland may explain these increases to some extent. The presence of large and important sites including Loughs Foyle and Swilly in these counties, with noted increases in census totals of 467% and 118% respectively, will also have been important. Modest rainfall in December and early January, including the census period, may have reduced habitat availability for Whooper Swan in the west and north-midlands during the census, where turloughs and wet grasslands are commonly used when they become available. These changes in distribution should be examined in conjunction with annual site monitoring data to determine whether they are short-lived or part of a longer-term shift.

The number of flocks recorded was the highest ever, 11.1% higher than 2015 despite very wet conditions increasing the number of sites available that year (Crowe *et al.* 2015). In RoI, the River Shannon, its estuary, lakes and tributaries were amongst the most important Whooper Swan sites (Figure 1, Table 2), each showing large increases in numbers since 2015 and accounting for much of the increases in counties Clare, Limerick, Offaly and Westmeath. In NI, Lough Neagh held 7.4% of the all-Ireland census total and neighbouring Lough Beg supported an additional 4.5%, with the numbers at these sites having increased by 56.4% and 27.8% respectively since 2015. There were 42 flocks of ≥ 100 individuals in 2020, compared to 23 in 2015 and 35 in 2010. The extent of dispersal of the Irish population is notable in its contrast to those wintering in Britain and England in particular, where the flocks are concentrated at considerably fewer sites despite consisting of greater numbers of birds (Hall *et al.* 2016). Counter participation and site/subsite coverage were at their highest ever level for this census and this has added significantly to the accuracy of and confidence in the results presented here.

Coverage in NI was similar to that of 2015 (+6 count units in 2020) but increased by 240 count units in RoI. Swans are discovered at previously unknown locations (count units) during every census, which are then added to the I-WeBS and IWSSG databases to ensure they are surveyed in the future. Thus, the increased coverage in subsequent censuses is correlated with increased dispersal of swan flocks over time and as such should not be construed as simply the recording of swans that may have gone unrecorded during previous censuses, though that may be the case to a limited extent. If we compare the swan counts at the 25 sites supporting numbers of international and national importance during the 2015 census (Crowe *et al.* 2015) with the numbers at the same sites in January 2020, there was an increase of 1,823 birds (23.5%), similar to the overall rate of increase at all-Ireland level. With this in mind, we believe the increases reported are largely the result of genuine population increases. Further comparison of census results in combination with annual I-WeBS and WeBS monitoring data is recommended to determine more robust trends at site level.

Whooper Swan – Breeding Success

The percentage of juveniles was 19.1% overall, which was lower than in 2015 (22.3%) but otherwise slightly higher than previous censuses (Table 1). Many counties that showed decreases in total bird numbers also had relatively low numbers of juveniles (Figure 2), including Galway, Fermanagh, Monaghan and Kerry. However others, such as Mayo, Cavan and Meath all supported smaller numbers but high numbers of juveniles. Offaly and Wexford were amongst the most important counties for Whooper Swans in January 2020 and yet showed low numbers of juveniles. This may simply be an artefact of flock dynamics, with Brazil (2003) suggesting that the higher proportion of smaller flocks in central Scotland in the latter half of the winter may be indicative of family parties and pairs leaving larger flocks earlier than non-breeders. Airey (1955) noted a 'readiness of family parties to split off temporarily from big herds'. There may be a link, therefore, between the percentage juveniles and number of flocks, at county level, particularly those counties with large numbers of birds in few flocks. Mean brood sizes were lower than previous censuses (Table 1). They showed some correlation with the percentage juveniles at county level, particularly the low brood sizes in the west and south-west, though conversely Wexford had the highest brood sizes on the island at 2.6 (Figure 2d).

Between the 2015 and 2020 censuses, annual all-Ireland Whooper Swan productivity surveys have been carried out by IWSSG in mid-January each year. Sample sizes have been high relative to the size of the entire all-Ireland population, and have been improving year on year, from 3,378 swans aged in 2016 to 8,290 swans aged in 2019. During this period the percentage of juveniles varied between 15.8% and 21.5% (mean 18.3%) and average brood sizes varied between 2.04 and 2.28 (mean 2.14); these values are similar to those recorded in this census (see Table 1).

Whooper Swan – Habitat

The vast majority of Whooper Swans (73.6%) were recorded on grassland habitats (Table 3), which is consistent with previous years (72.6% in 2015, 79.2% in 2010). By comparison, only 11.5–20.6% of Whooper Swan in Britain were using pasture habitats in the last three censuses and almost no Whooper Swan in Iceland are found on pasture over winter (Hall *et al.* 2016, 2012; Worden *et al.* 2009). The use of pasture

varied somewhat between provinces (Table 3), with permanent waterbodies and arable habitats used to a greater extent in Leinster. The patterns of habitat use between provinces likely represent their local availability, with arable farmland largely absent from Munster and Connacht, pasture dominating in Munster, and a larger number of permanent waterbodies (mostly lakes) in Connacht and parts of Ulster. The vast majority of records received were of birds feeding and so the importance of permanent waterbodies as roost sites, near to suitable feeding habitat, should not be underestimated.

Bewick's Swans

Only 12 Bewick's Swans were found in Ireland in 2020, at two sites in counties in RoI where they have persisted in recent years. In the period 2011/12 to 2015/16 they were recorded at just seven sites during I-WeBS counts (Lewis *et al.* 2019) and at four sites in the 2015 census (Crowe *et al.* 2015). Given the decline of the species at flyway level (though some partial recovery noted; Beekman *et al.* 2019) and the shift to both short-stopping and short-staying on the wintering grounds in Britain, the Netherlands and Germany (Nuijten *et al.* 2020), numbers of Bewick's Swans are not expected to recover in Ireland. It seems, therefore, to be a case of when, not if, they are lost from Ireland as a regular wintering species.

Conclusion

The results from the 8th International Swan Census in Ireland showed a substantial increase in Whooper Swan in Ireland, despite relative numerical stability in the population between the previous three censuses dating back to 2005. The all-Ireland wintering population of Whooper Swans now exceeds that of the flyway total from the first three censuses between 1986 and 1995. Bewick's Swans continued their decline, with small numbers persisting mostly in Wexford. Whooper Swans were more dispersed than in previous years and this, combined with the strong preference for pasture-based non-wetland feeding habitats, underlines the importance of targeted and coordinated censuses to accurately account for the distribution and total numbers of our migratory swans. It is important to acknowledge that censuses carried out over a narrow time period at intervals of several years provide a brief snapshot of where our migratory swans are and what they are doing and that they are intended to complement data gathered annually through national monitoring schemes such as I-WeBS and WeBS. Similarly, the annual collection of age ratio and brood-size data through the Irish Whooper Swan Study Group plays a valuable role in filling in the gaps and providing context to the census results.

Plate 29. Whooper Swans (Brian Burke).

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Appendix 1

Habitats provided on standardised recording sheets for counters during the 2020 International Swan Census, and their relevant grouping according to Hall *et al.* 2015. Note that only those habitats recorded as used by Whooper *Cygnus cygnus* and Bewick's Swans *C. columbianus bewickii* during the January 2020 census are included here.

Habitat	Habitat Grouping
01 Natural permanent lake	Permanent standing water
02 Artificial lake/reservoir	Permanent standing water
04 Non-tidal river	River
06 Freshmarsh	River
07 Tidal river/estuary (on water)	Coastal
08 Saltmarsh/merse	Coastal
10 Brackish Lake	Coastal
12 Open coast	Coastal
13 Improved pasture (dry)	Improved pasture (dry & reseeded)
15 Reseeded pasture (dry)	Improved pasture (dry & reseeded)
14 Rough/unimproved pasture (dry)	Rough/unimproved pasture (dry)
22 Improved pasture (flooded)	Improved pasture (wet)
24 Reseeded pasture (flooded)	Improved pasture (wet)
25 Turlough – improved pasture	Improved pasture (wet)
27 Callow – improved pasture	Improved pasture (wet)
23 Rough/unimproved pasture (flooded)	Rough/unimproved pasture (wet)
26 Turlough – rough/unimproved pasture	Rough/unimproved pasture (wet)
28 Callow – rough/unimproved pasture	Rough/unimproved pasture (wet)
16 Arable: stubble	Arable waste
19 Arable: potatoes	Arable waste
21 Arable: sugar beet	Arable waste
17 Arable: winter cereal	Arable growing
29 Raised bog	Other
Other (counter asked to specify)	Other

Appendix 2

Per cent-usage of habitats of the four overarching categories by Whooper Swans *Cygnus cygnus* at county-level, based on records during the 2020 International Swan Census. Highest percentage given in bold.

	County	Number of Swans (individuals)	Permanent Waterbodies	All Pasture	All Arable	Other
Ulster	Antrim	1,146	1.7	**98.3**	-	-
	Armagh	490	6.5	**93.5**	-	-
	Cavan	792	22.1	**77.9**	-	-
	Donegal	1,117	15.6	**80.6**	3.8	-
	Down	741	15.0	**52.6**	32.4	-
	Fermanagh	492	17.5	**82.5**	-	-
	Londonderry	1,478	3.0	**63.2**	33.8	-
	Monaghan	127	**87.4**	12.6	-	-
	Tyrone	250	19.2	**80.8**	-	-
Leinster	Carlow	27	11.1	**88.9**	-	-
	Dublin	40	-	**95.0**	-	5.0
	Kildare	173	-	4.0	**96.0**	-
	Kilkenny	81	-	**100.0**	-	-
	Laois	197	20.8	**79.2**	-	-
	Longford	324	13.0	**85.2**	-	1.9
	Louth	208	-	**100.0**	-	-
	Meath	119	13.4	**68.1**	18.5	-
	Offaly	881	**47.4**	42.1	-	10.4
	Westmeath	982	41.2	**58.8**	-	-
	Wexford	928	5.4	42.9	**51.7**	-
	Wicklow	79	12.7	**87.3**	-	-
Munster	Clare	236	10.6	**89.4**	-	-
	Cork	466	-	**100.0**	-	-
	Kerry	323	3.1	**96.9**	-	-
	Limerick	98	3.1	**96.9**	-	-
	Tipperary	355	1.1	**98.8**	-	-
	Waterford	432	0.7	**99.3**	-	-
Connacht	Galway	1,453	5.0	**89.3**	-	5.8
	Leitrim	396	**78.0**	22.0	-	-
	Mayo	928	35.3	**64.7**	-	-
	Roscommon	982	4.5	**94.4**	-	1.1
	Sligo	273	**56.8**	43.2	-	-