

Estimates of waterbird numbers wintering in Ireland, 2011/12 – 2015/16

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Annual monitoring of wintering waterbirds is carried out under the I-WeBS and WeBS schemes in the Republic and Northern Ireland respectively. These surveys are carried out from September to March each year, largely by a dedicated volunteer network, and are the principal tools used in the conservation of Ireland's wintering waterbirds and their wetland habitats. This study presents population estimates and 1% thresholds for wintering waterbirds in Ireland for the period 2011/12 to 2015/16 inclusive. Estimates were generated based on annual peak counts with imputation and include the results of more targeted surveys (i.e. goose and swan species censuses, non-estuarine surveys) where these improve the accuracy of estimates for the species in question. Estimates were generated for a total of 44 waterbird species, using data from 684 wetland sites across the Republic of Ireland and Northern Ireland. The total number of waterbirds estimated was 757,910, comprising 38% wildfowl (21 species), 6% wildfowl allies (8 species) and 57% waders (15 species). Total numbers have declined by 138,160 (15%) since the 2006/07-2010/11 period, with waders experiencing the largest declines; the combined totals of 15 wader species having declined by over 19%. Golden Plover *Pluvialis apricaria* and Lapwing *Vanellus vanellus* were the most numerous wader species recorded and Wigeon *Mareca penelope* and Teal *Anas crecca* were the most numerous wildfowl. Eight of the 44 species have increased by more than 5% since the previous estimates for 2006/07 – 2010/11, whereas 29 species declined by 5% over the same period. Many species are undergoing similar declines at flyway level, although the impact of local pressures and threats at Irish wetland sites should not be overlooked. Ireland continues to hold internationally important numbers of several waterbird populations, most notably Icelandic Whooper Swan *Cygnus cygnus*, Greenland White-fronted Goose *Anser albifrons flavirostris*, Greenland Barnacle Goose *Branta leucopsis*, East Canadian High-Arctic Light-bellied Brent Goose *Branta bernicla hrota*, Europe-wintering Great Northern Diver *Gavia immer*, North European Ringed Plover *Charadrius hiaticula*, Icelandic Black-tailed Godwit *Limosa limosa islandica* and North European/North Russian Bar-tailed Godwit *Limosa lapponica*.

Introduction

Waterbirds provide a number of important ecosystem services by acting as predators, herbivores, and as vectors of seeds, invertebrates and nutrients. In these roles they help maintain the diversity of other organisms, control pests and serve as

effective bioindicators of the ecological condition of the wetlands they inhabit (Green & Elmberg 2013). These wetlands in turn provide hugely valuable services including

Plate 1. Black-tailed Godwit (Richard T. Mills).

water provision and purification, fixation of nutrient run-off, flood prevention, food production and carbon sequestration (Zedler & Kercher 2005). Conservative estimates of the value of these services from wetlands to the Irish economy run into the hundreds of millions (Bullock *et al.* 2008).

Ireland's location along the East Atlantic Flyway and proximity to major waterbird breeding areas in the Arctic, together with its mild climate and abundance of coastal and inland wetlands, make it a very important area for non-breeding wildfowl and waders during the winter months (Boland & Crowe 2012). Indeed, over 850,000 waterbirds were estimated to winter in Ireland during the last period assessed (Crowe & Holt 2013), and Ireland is important in a flyway context for several species including Light-bellied Brent Goose *Branta bernicla brota*, Greenland White-fronted Goose *Anser albifrons flavirostris* and Whooper Swan *Cygnus cygnus*, amongst others. Regular reassessment of the relative importance of Ireland in a flyway context for wintering waterbird species is important and allows for the evaluation of the current importance of individual sites in a national and international context, facilitating site protection and management (Crowe & Holt 2013). To date, more than 100 wetlands in Ireland are designated as Special Protection Areas (SPA) under the E.U. Birds Directive (2009/147/EC) and 33 of these are also designated as Ramsar sites (under the 1971 Ramsar Convention on Wetlands).

These important data are underpinned by monitoring of waterbirds at our wetland sites. Selected species groups at some of the larger wetlands were first counted systematically as far back as the 1940s, but it wasn't until the 1970s that a comprehensive baseline survey was carried out. The Wetlands Enquiry (1971/72-1974/75; Hutchinson 1979) allowed numbers of most wintering wildfowl and wader species to be estimated for the first time and helped create a register of wetlands and their relative importance to wintering waterbirds. The Winter Wetlands Survey (1984/85-1986/87; Sheppard 1993) repeated and improved on the efforts of the previous decade and for the first time provided a trend for wintering waterbird numbers in Ireland.

Annual monitoring of waterbirds in Northern Ireland continued from the Winter Wetlands Survey and became what is now the UK Wetland Bird Survey (WeBS) (Delany 1996). The Irish Wetland Bird Survey (I-WeBS), modelled on its UK counterpart, began in winter 1994/95 (Delany 1996). Together the two schemes aim to monitor the numbers and distribution of waterbird populations wintering in Ireland across the long-term, enabling population numbers and trends of individual species to be established and updated on an ongoing basis. Since these monitoring schemes began, they have been the principal tools used in the conservation of Ireland's wintering waterbirds and the wetland habitats upon which they rely. Results have been used to provide population estimates and

trends of waterbird species wintering on the island of Ireland during the periods 1994/95-1998/99, 1999/2000-2003/04 (Crowe *et al.* 2008) and 2006/07-2010/11 (Crowe & Holt 2013).

Here we present population estimates, population trends and 1% thresholds for regularly-occurring waterbird species wintering on the island of Ireland during the period 2011/12-2015/16. These updates are based on the results of annual I-WeBS and WeBS surveys, and additional surveys targeted at individual species and non-estuarine coastal sites.

Methods

Sources of data

Counts carried out under I-WeBS (Republic of Ireland) and WeBS (Northern Ireland), have been the primary source of data for wintering waterbirds on the island of Ireland since the mid-1990's. These surveys are carried out by a network of dedicated volunteer birdwatchers and professional staff of the schemes' partner organisations. Both surveys are based on scheduled monthly core counts each winter, from September to March inclusive. Counts are recommended in all seven months, although this is not often achieved. Emphasis is put on achieving monthly counts during the mid-winter period of November to February, when numbers of most species reach their peak. The importance of achieving good coverage in January in particular is stressed to counters, as these totals contribute to the International Waterbird Census (IWC) coordinated by Wetlands International (<https://www.wetlands.org/>). Counts are conducted on pre-determined dates to maximise synchrony and minimise any duplicate counts of flocks moving between or within sites.

The estimates of numbers and trends in relative abundance presented here were based largely on I-WeBS and WeBS core counts. The core count methodology is insufficient for surveying several species that feed regularly on grasslands away from wetland sites including swan and goose species, Golden Plover *Pluvialis apricaria*, Lapwing *Vanellus vanellus* and Curlew *Numenius arquata*. Furthermore, a large proportion of the populations of a variety of wader species, particularly Ringed Plover *Charadrius hiaticula*, Sanderling *Calidris alba*, Purple Sandpiper *Calidris maritima* and Turnstone *Arenaria interpres*, occur along non-estuarine coast which is not monitored during core counts. To better account for the numbers and relative abundance of these species, data from targeted surveys were integrated or used in place of core count data where available (Crowe *et al.* 2015, Fox *et al.* 2018, Hall *et al.* 2016, Lewis *et al.* 2017, Irish Brent Goose Research Group 2018, Doyle *et al.* 2018).

All waterbird species that are relatively widespread in Ireland were included in these analyses, and were grouped into wildfowl (29 species, including swans, geese and ducks,

and their allies, defined here as divers, grebes, Cormorant *Phalacrocorax carbo*, herons and rails) and waders (15 species, including Oystercatcher *Haematopus ostralegus*, plovers and sandpipers). Elusive species, such as Water Rail *Rallus aquaticus*, Moorhen *Gallinula chloropus*, Jack Snipe *Lymnocyptes minimus*, Snipe *Gallinago gallinago* and Woodcock *Scolopax rusticola* which have a secretive and retiring nature, and marine species such as Long-tailed Duck *Clangula hyemalis* and Black-throated Diver *Gavia arctica*, which are difficult to survey from land, were excluded from these analyses. Introduced species, including Canada Goose *Branta canadensis* and Greylag Goose *Anser anser* (the naturalised population) have been excluded as there is no conservation requirement to define 1% thresholds for site assessment under the EU Birds Directive. Gulls and terns are not considered as they are not routinely counted during core counts, and their distributions are generally too widespread for adequate monitoring by these methods alone. The scientific names of all species included in these analyses are presented in Table 1 and those for other species are given where first mentioned in the text.

Estimates of waterbird totals

Raw count data for the period under consideration (2011/12 – 2015/16) were first modelled using a multiplicative log-linear index model with site, year and month factors (after Underhill & Prŷs-Jones 1994 and using the UINDEX4 DOS executable programme). The resulting fitted values were then used to impute values where counts were missing (i.e. site not visited that month) or where a count was deemed to be ‘low quality’ (i.e. where the surveyor believed the count was markedly lower than the true number present).

Model considerations:

- In addition to data for the five-year period under consideration (2011/12-2015/16 inclusive), data from the two previous seasons (2009/10 and 2010/11) were included in the model to increase the pool of data and improve the model. These two years were then removed at the end to calculate the final five-year mean (for more detailed methodology please refer to Underhill & Prŷs-Jones 1994; Atkinson *et al.* 2006).
- The Underhill model was first run using all sites that had been surveyed in 50% or more of months during the seven-year period examined (Underhill & Prŷs-Jones 1994). This meant that the number of imputed counts in this first model was relatively low. The imputed values from this first run were then treated as actual counts during a second run of the model in which all sites were retained. This method ensured that sites with poor coverage did not impact on the imputed values for sites with good coverage (Crowe & Holt 2013).

- Counts were deemed to be of low quality where there was poor visibility, high disturbance levels, or because the site was only partially counted. For large wetland complexes with a number of count subsites, a count was identified as potentially incomplete if fewer than 75% of the subsites were surveyed, and less than 75% of the average number of birds present in previous years was recorded. Low quality counts were compared to fitted values for that month, and the larger of the two was used for analysis.

The resulting dataset was therefore complete for all months and seasons and comprised a combination of actual count data and imputed count data. All-Ireland estimates were then calculated using a five-year mean for the period 2011/12-2015/16 inclusive, consistent with the approach used previously in Ireland (Crowe & Holt 2013, Crowe *et al.* 2008) and the UK (Musgrove *et al.* 2011, Kershaw & Cranswick 2003, Rehfish *et al.* 2003). This approach minimises the potential confounding effects of cold-weather movements (causing large-scale displacement) and disturbance (causing ‘local’ survey under- and overestimation).

Many wader species that winter in Ireland also have populations that occur here on passage in early autumn and late spring, but winter elsewhere (mostly further south in Continental Europe and/or Africa). To minimise inclusion of counts of passage populations, wader estimates were based on data from November to February each season only. This does not apply to passage populations of wildfowl populations in Ireland. The month with the highest value was selected (so that the index was based on maximum bird numbers), and all months with overlapping 90% consistency intervals (Underhill & Prŷs-Jones 1994) were also included.

Where available, the results of other targeted censuses (outlined above) were used in preference to I-WeBS/WeBS counts, as the species-specific targeting of survey effort is likely to provide better estimates of wintering numbers of these species. For those species which occur on non-estuarine coast, which is not routinely counted during I-WeBS or WeBS core counts, a median bootstrapped estimate from the third Non-Estuarine Waterbird Survey (NEWS-III) (Lewis *et al.* 2017) was added to the modelled counts. The updated bootstrap approach used for NEWS-III (Austin *et al.* 2017; Lewis *et al.* 2017) was retrospectively applied to NEWS-II data (Crowe *et al.* 2012) and subsequently to the previous set of Irish waterbird population estimates (Crowe & Holt 2013) to facilitate accurate calculation of short-term changes between the 2006/07-2010/11 and current periods.

Table 1. Flyway population estimates and trends of wildfowl and waders wintering in Ireland. All data based on African-Eurasian Migratory Waterbird Agreement (AEWA) Conservation Status Review 7 (CSR7) (AEWA 2018) (and published on wpe.wetlands.org).

Species	Population name	Flyway estimate	1% Flyway Threshold	Flyway trend
Mute Swan <i>Cygnus olor</i>	Ireland	9,130 ¹	100	Stable
Tundra Swan (Bewick's) <i>Cygnus columbianus bewickii</i>	<i>bewickii</i> , Western Siberia & NE Europe/North-west Europe	21,000	220	Decrease
Whooper Swan <i>Cygnus cygnus</i>	Iceland/UK & Ireland	34,000	340	Increase
Greenland White-fronted Goose <i>Anser albifrons flavirostris</i>	<i>flavirostris</i> , Greenland/Ireland & UK	20,529 ²	190	Decrease
Greylag Goose <i>Anser anser</i>	<i>anser</i> , Iceland/UK & Ireland	93,720	980	Decrease
Barnacle Goose ³ <i>Branta leucopsis</i>	East Greenland/Scotland & Ireland	72,162	810	Decrease
Brent Goose (Light-bellied) <i>Branta bernicla hrota</i>	<i>hrota</i> , Canada & Greenland/Ireland	36,500	400	Decrease
Common Shelduck <i>Tadorna tadorna</i>	North-west Europe	250,000	2500	Stable
Wigeon <i>Mareca penelope</i>	Western Siberia & NE Europe/NW Europe	1,300,000-1,500,000	14000	Decrease?
Gadwall <i>Mareca strepera</i>	<i>strepera</i> , North-west Europe	110,000-138,000	1200	Increase
Eurasian Teal <i>Anas crecca</i>	<i>crecca</i> , North-west Europe	500,000	5000	Increase?
Mallard <i>Anas platyrhynchos</i>	<i>platyrhynchos</i> , North-west Europe	4,200,000-6,700,000	53000	Stable?
Northern Pintail <i>Anas acuta</i>	North-west Europe	65,000	600	Stable/ Fluctuating
Northern Shoveler <i>Spatula clypeata</i>	North-west & Central Europe (wintering)	60,000-70,000	650	Increase?
Common Pochard <i>Aythya ferina</i>	North-east Europe/ North-west Europe	200,000	2000	Increase
Tufted Duck <i>Aythya fuligula</i>	NW Europe (wintering)	800,000-1,000,000	8900	Decrease?
Greater Scaup <i>Aythya marila</i>	<i>marila</i> , Northern Europe/ Western Europe	150,000-275,000	3100	Decrease
Common Eider <i>Somateria mollissima</i>	<i>mollissima</i> , Baltic, Denmark & Netherlands	930,000	9,800	Stable/ Fluctuating
Common Scoter <i>Melanitta nigra</i>	<i>mollissima</i> , Norway & Russia W Siberia & N Europe/ W Europe & NW Africa	510,000-525,000 687,000-815,000	5,200 7500	Stable/ Stable/ Increase?
Common Goldeneye <i>Bucephala clangula</i>	<i>clangula</i> , NW & Central Europe (wintering)	1,000,000-1,300,000	11400	Stable/ Decrease
Red-breasted Merganser <i>Mergus serrator</i>	NW & Central Europe (wintering)	70,000-105,000	860	Stable/ Decrease?
Red-throated Diver <i>Gavia stellata</i>	North-west Europe (wintering)	216,000-429,000	3000	Stable?
Great Northern Diver <i>Gavia immer</i>	Europe (wintering)	5,100-6,300	50	Decrease?
Little Grebe <i>Tachybaptus ruficollis</i>	<i>ruficollis</i> , Europe & North-west Africa	375,000-597,000	4700	Stable/ Decrease?

Table 1 (Continued).

Species	Population name	Flyway estimate	1% Flyway Threshold	Flyway trend
Great Crested Grebe <i>Podiceps cristatus</i>	<i>cristatus</i> , North-west & Western Europe	513,000-764,000	6300	Stable/ Decrease?
Great Cormorant <i>Phalacrocorax carbo</i>	<i>carbo</i> , North-west Europe	127,500	1200	Decrease
Little Egret <i>Egretta garzetta</i>	<i>garzetta</i> , Western Europe, NW Africa	106,000-116,000	1100	Decrease
Grey Heron <i>Ardea cinerea</i>	<i>cinerea</i> , Northern & Western Europe	347,000-712,000	5000	Decrease
Common Coot <i>Fulica atra</i>	<i>atra</i> , North-west Europe (wintering)	1,200,000-2,000,000	15500	Stable/ Decrease?
Eurasian Oystercatcher <i>Haematopus ostralegus</i>	<i>ostralegus</i> , Europe/South & West Europe & NW Africa	850,000-950,000	8200	Stable/ Decrease?
Ringed Plover <i>Charadrius hiaticula</i>	<i>hiaticula</i> , Northern Europe/ Europe & North Africa	47,000-62,000	540	Decrease/ Stable
European Golden Plover <i>Pluvialis apricaria</i>	<i>altifrons</i> , Iceland & The Faroes/ East Atlantic coast	930,000	9300	Uncertain
Grey Plover <i>Pluvialis squatarola</i>	<i>squatarola</i> , W Siberia/W Europe & W Africa	200,000	2000	Decrease
Northern Lapwing <i>Vanellus vanellus</i>	Europe, W Asia/Europe, N Africa & SW Asia	5,500,000-9,500,000	72300	Decrease
Red Knot <i>Calidris canutus</i>	<i>islandica</i> , NE Canada & Greenland/Western Europe	500,000-56,5000	5300	Stable/ Fluctuating
Sanderling <i>Calidris alba</i>	<i>alba</i> , East Atlantic Europe, West & Southern Africa (wintering)	200,000	2000	Stable
Purple Sandpiper <i>Calidris maritima</i>	N Europe & W Siberia (breeding)	50,000-100,000	710	Increase
	NE Canada & N Greenland (breeding)	11,000	110	Decrease
Dunlin <i>Calidris alpina</i>	<i>alpina</i> , NE Europe & NW Siberia/ W Europe & NW Africa	1,330,000	13300	Stable/ Decrease?
Black-tailed Godwit <i>Limosa limosa</i>	<i>islandica</i> , Iceland/ Western Europe	98,000-134,000	1100	Increase
Bar-tailed Godwit <i>Limosa lapponica</i>	<i>lapponica</i> , Northern Europe/ Western Europe	150,000	1500	Increase
Eurasian Curlew <i>Numenius arquata</i>	<i>arquata</i> , Europe/Europe, North & West Africa	637,000-876,000	7600	Decrease?
Common Greenshank <i>Tringa nebularia</i>	Northern Europe/SW Europe, NW & West Africa	230,000-470,000	3300	Stable/ Increase?
Common Redshank <i>Tringa totanus</i>	<i>totanus</i> , Britain & Ireland/Britain, Ireland, France	76,500	760	Decrease
	<i>robusta</i> , Iceland & Faroes/ Western Europe	150,000-420,000	2400	Decrease?
Ruddy Turnstone <i>Arenaria interpres</i>	NE Canada & Greenland/ W Europe & NW Africa	100,000-200,000	1400	Increase

¹ Mute Swan flyway estimate based on current study.² Greenland White-fronted Goose flyway estimate from Fox *et al.* 2018.³ Barnacle Goose flyway estimate and trend from Mitchell & Hall 2018; 1% flyway threshold taken from AEWA 2018



Plate 2. Black-tailed Godwits, Dunlin, Redshank and Knot (John Fox).

Results

Coverage

In total, 631 wetland sites were visited in the Republic of Ireland in the five seasons between 2011/12 and 2015/16 inclusive. This total includes the majority of the key wetland sites that are of significant importance for birds (Burke *et al.* 2018) and is predominated by lakes and turloughs (58%), estuaries (11%), rivers and callows (13%) and non-estuarine coast (5%). The remaining 13% of sites include reservoirs, marshes and bogs, quarries and gravel pits, and grasslands. The number of sites covered in any one year ranged between 261 and 234, with between 78% and 89% of sites covered in January in any one season.

In Northern Ireland, 53 wetland sites were visited in the five seasons from 2011/12 to 2015/16. These were mostly lakes and turloughs (55%), estuaries (23%) and reservoirs (17%), with marshes, rivers and grasslands making up the remaining 5%. The number of sites covered in any one year ranged between 29 and 41, with between 71% and 90% of sites covered in January in any one season. The majority of key wetlands that are of significant importance for waterbirds (Frost *et al.* 2017) were counted during this period.

Estimates

Estimates were generated for a total of 44 species. The total number of waterbirds estimated was 757,910, comprising 38% wildfowl (21 species), 6% wildfowl allies (8 species) and 57% waders (15 species) (Table 2a, 2b). The estimates generated for 15 species must be treated as conservative as they are widely distributed in a variety of wetland and non-wetland habitats that are under-sampled during I-WeBS, WeBS and the targeted surveys. Golden Plover and Lapwing were the most abundant species recorded overall, estimated at 92,060 and 84,690 individuals respectively, collectively comprising 23%

of the total number of waterbirds estimated. Wigeon *Mareca penelope* (55,730), Teal *Anas crecca* (35,740) and Light-bellied Brent Goose *Branta bernicla brota* (35,150) were the most numerous wildfowl species, collectively comprising 17% of total waterbirds. Of the waders, Oystercatcher, Dunlin *Calidris alpina* and Curlew were also relatively numerous (>30,000 individuals).

Changes in estimates

The estimates for Bewick's Swan *Cygnus columbianus bewickii* and Scaup *Aythya marila* showed declines of greater than 50% since the previous estimate, at 74% and 58% respectively (Table 2a). The numbers of eight species declined by between 25% and 50% since the previous period: Red-throated Diver *Gavia stellata*, Knot *Calidris canutus*, Goldeneye *Bucephala clangula*, Common Scoter *Melanitta nigra*, Purple Sandpiper, Shoveler *Spatula clypeata*, Pochard *Aythya farina* and Great Crested Grebe *Podiceps cristatus* (Table 2a, 2b). The estimates for Common Scoter, Red-throated Diver and Great Crested Grebe should be treated with caution however, as these are conservative estimates for species that can be distributed a considerable distance offshore and therefore are under-recorded through core count methodology. In total, 27 waterbird species underwent declines of greater than 10% since the last period, including those mentioned above. In contrast, a total of seven species showed increases of greater than 10%: Eider *Somateria mollissima* (76%), Grey Heron *Ardea cinerea* (24%), Gadwall *Mareca strepera* (17%), Greenshank *Tringa nebularia* (17%), Great Northern Diver *Gavia immer* (15%), Whooper Swan (13%) and Sanderling (13%).

Table 2a. All-Ireland estimates and trends in relative abundance of wildfowl and their allies. The estimates given are based on mean of peak counts with imputation unless otherwise stated. The 1% thresholds are calculated (with roundings) as 1% of the respective all-Ireland totals. Percentage changes in estimates since the previous period (2006/07-2010/11; Crowe & Holt 2013, as revised) and the first set of I-WeBS/WeBS estimates (1994/95-1998/99; Crowe *et al.* 2008).

Species	Species code	Republic of Ireland ¹	Northern Ireland ¹	All-Ireland ¹	All-Ireland 1% threshold ¹	% NEWS	% Change Estimates	
							Short-term (2006/07-10/11)	Long-term (1994/95-98/99)
Mute Swan*	MS	7,032	2,094	9,130	90	2.0	-0.9	-24.9
Bewick's Swan ²	BS	21	0	20	20	-	-73.8	-98.6
Whooper Swan ²	WS	11,852	3,518	15,370	150	-	13.4	39.6
Greenland White-fronted Goose ²	NW	9,500	87	9,590	100	-	-14.5	-20.9
Greylag Goose	GJ	1,954	1,598	3,550	35	-	-20.8	-20.8
Barnacle Goose ²	BY	16,237	0	16,240	160	-	-7.2	101.1
Light-bellied Brent Goose ²	PB	-	-	35,150	350	-	-15.5	96.1
Shelduck	SU	6,378	3,783	10,160	100	1.2	-14.2	-30.4
Wigeon*	WN	50,452	5,282	55,730	560	3.3	-12.0	-37.6
Gadwall	GA	515	377	890	20	0.0	17.1	34.8
Teal*	T.	27,644	8,096	35,740	360	6.6	6.2	-21.6
Mallard*	MA	18,810	9,423	28,230	280	7.5	-4.6	-41.2
Pintail	PT	1,017	557	1,570	20	0.0	-12.8	-4.8
Shoveler	SV	1,865	150	2,020	20	0.1	-30.6	-32.9
Pochard	PO	4,729	6,422	11,150	110	0.0	-30.4	-77.3
Tufted Duck	TU	16,927	10,544	27,470	270	>0.0	-11.1	-34.0
Scaup	SP	167	2,485	2,650	25	>0.0	-57.9	-58.2
Eider*	E.	1,373	4,288	5,660	55	25.6	76.3	100.7
Common Scoter*	CX	10,607	34	10,640	110	22.6	-31.5	-42.8
Goldeneye	GN	1,256	2,559	3,820	40	0.3	-36.8	-67.8
Red-breasted Merganser	RM	1,913	519	2,430	25	31.7	1.3	-33.6
Red-throated Diver*	RH	657	109	770	20	53.1	-42.5	-38.6
Great Northern Diver*	ND	2,128	110	2,240	20	68.1	14.9	-
Little Grebe*	LG	1,594	601	2,200	20	4.9	-1.3	-16.3
Great Crested Grebe*	GG	1,734	1,195	2,930	30	3.6	-28.2	-42.9
Cormorant*	CA	7,967	2,907	10,870	110	33.5	-21.1	-15.3
Little Egret	ET	1,274	117	1,390	20	11.5	-2.8	-
Grey Heron*	H.	1,943	662	2,610	25	30.5	24.3	-5.1
Coot	CO	13,303	5,216	18,520	190	0.0	-16.7	-34.6
Total wildfowl				287,210				
Total wildfowl allies				41,530				

* These estimates must be treated as conservative on the basis that they are widely distributed in a variety of wetland and non-wetland habitats that are undersampled during I-WeBS, WeBS and the special surveys, such as on large, small and ephemeral wetlands, or considerable distances offshore and not detected during counts from land-based vantage points.

¹ Estimates were derived by summing the core counts with those from the 2015/16 Non-estuarine Waterbird Survey (NEWS III) (Lewis *et al.* 2017) and have been rounded up or down to the nearest '10'. A minimum 1% threshold of 20 has been applied to all species with totals less than 2000, and remaining thresholds have been rounded as follows: 21-100 to the nearest five; 101-1000 to the nearest ten.

² Estimates from targeted censuses apply, including for swans (Crowe *et al.* 2015, Hall *et al.* 2016), Greenland White-fronted Goose (Fox *et al.* 2018), Barnacle Goose (Doyle *et al.* 2018) and Light-bellied Brent Goose (Irish Brent Goose Research Group 2014, Colhoun *et al.* 2015, 2017, 2018). Data from Brent Goose census in October 2017 is not representative of distribution later in the winter when majority winter in ROI.

Table 2b. All-Ireland estimates and trends in relative abundance of waders. The estimates given are based on mean of peak counts with imputation unless otherwise stated. The 1% thresholds are calculated (with roundings) as 1% of the respective all-Ireland totals. The percentage change in estimates since the previous period (2006/07-2010/11; Crowe & Holt 2013 as revised) are given, together with the % change since 1994/95-1998/99 (Crowe *et al.* 2008).

Species	Species code	Republic of Ireland ¹	Northern Ireland ¹	All-Ireland ¹	All-Ireland 1% threshold ¹	% NEWS	% Change in Estimates	
							Short-term (2006/07-10/11)	Long-term (1994/95-98/99)
Oystercatcher	OC	42,875	17,665	60,540	610	30.0	-21.2	-7.9
Ringed Plover	RP	10,545	1,113	11,660	120	54.5	-16.5	-18.7
Golden Plover*	GP	80,707	11,357	92,060	920	4.5	-23.5	-43.6
Grey Plover	GV	2,812	131	2,940	30	7.0	-5.8	-54.3
Lapwing*	L.	69,823	14,863	84,690	850	6.4	-16.4	-67.2
Knot	KN	13,752	2,520	16,270	160	3.1	-42.2	-43.3
Sanderling	SS	7,572	849	8,420	85	44.4	13.2	34.9
Purple Sandpiper	PS	465	197	660	20	74.9	-31.3	-80.7
Dunlin	DN	37,409	8,350	45,760	460	13.3	-23.2	-61.6
Black-tailed Godwit	BW	17,862	1,933	19,800	200	0.6	4.2	44.9
Bar-tailed Godwit	BA	13,385	3,147	16,530	170	4.0	3.9	6.5
Curlew*	CU	28,300	6,938	35,240	350	30.3	-13.4	-42.3
Greenshank	GK	1,208	109	1,320	20	32.0	16.8	11.9
Redshank	RK	16,812	6,988	23,800	240	16.4	-23.6	-19.2
Turnstone	TT	6,296	3,180	9,480	95	49.0	-20.6	-28.0
Total waders				429,170				
Total waterbirds				757,910				

Footnotes are given under Table 2a.

Data from NEWS-III collected in the winter of 2015/16 (Lewis *et al.* 2017) accounted for over 11% of the waterbirds estimated overall. Over 50% of the Purple Sandpiper (75%), Great Northern Diver (68%), Ringed Plover (55%) and Red-throated Diver (53%) estimates were recorded during NEWS-III (Table 2a, 2b), as was 25-50% of the populations of nine species and 10-25% of another four species. Most of these were waders but also included wildfowl and ally species. The most numerous wader species recorded during NEWS-III was Oystercatcher, with 18,133 individuals estimated, which represents 30% of their all-Ireland population estimate (Table 2b). Declines along non-estuarine coast shown between NEWS-II in 2006/07 (Crowe *et al.* 2012) and NEWS-III in 2015/16 were responsible for a significant part of the decrease in estimates of Red-throated Diver, Common Scoter, Purple Sandpiper, Ringed Plover and Turnstone. Conversely, increases along non-estuarine coast between NEWS-II and NEWS-III were largely responsible for increases in estimates for Eider, Grey Heron, Greenshank and Great Northern Diver.

Discussion

Annual monitoring of waterbirds in Ireland through I-WeBS and WeBS, together with additional more targeted surveys, allow for the calculation of robust population estimates and trends for wintering waterbirds on the island of Ireland on a regular basis. The results presented here for the period 2011/12–2015/16 are the fourth such set of estimates published, updating those from 2006/07-2010/11 (Crowe & Holt 2013). The estimates for 44 species are given, resulting in a total of 757,910 waterbirds – a decline of 138,160 (15%) since the 2006/07-2010/11 period. The combined totals of the 15 wader species examined declined by over 102,310 birds (19%) since the previous period, while wildfowl and wildfowl ally numbers have declined by over 28,000 (9%) and 7,600 (16%) respectively. Total numbers of wildfowl and waders wintering in Ireland have shown a continued decrease through each set of estimates published (Crowe *et al.* 2008, Crowe & Holt 2013). The first such set of estimates published for the period 1994/95-1998/99 estimated 1,255,575 waterbirds across 42



Plate 3. Dunlin and Black-tailed Godwit
(Richard T. Mills).

species, meaning a decline of 40% of our total waterbird population has occurred in the intervening 17 years.

Ireland continues to host a very high proportion of the flyway populations of East Canadian High-Arctic breeding Light-bellied Brent Goose (98% of flyway population winters in Ireland), Greenland White-fronted Goose (47%), Icelandic Whooper Swan (45%), Europe-wintering Great Northern Diver (45%), Greenland Barnacle Goose *Branta leucopsis* (23%) and North European Ringed Plover (22%). Wintering numbers of Black-tailed Godwit *Limosa limosa* (18% of flyway population) and Bar-tailed Godwit *Limosa lapponica* (11%) were also highly important in a flyway context (>10% of flyway population), though the relative proportion of Black-tailed Godwits wintering here has declined by 13% (previously 31%, Crowe & Holt 2013). The island of Ireland has a closed population of Mute Swans *Cygnus olor*, and the current estimate is almost identical to that of the previous period, though that estimate itself represented a 20% decline since the late 1990's and early 2000's (Crowe *et al.* 2008).

The majority of wildfowl and ally species were present in lower numbers than in the previous period. Only four wildfowl species showed increases greater than 5%. The largest increase was for Eider (76%), although given the limitations of core count methodology in recording this coastal species and the fact that the populations are declining at flyway level, comparison of estimates here is almost certainly unreliable. Gadwall showed a 17% increase, although the Irish population is still relatively small at <900 birds. Whooper Swan numbers in Ireland increased between the 2010 and 2015 censuses (13%), though at a slower rate than elsewhere in their wintering range (Hall *et al.* 2016), with increases in the Republic of Ireland (13%) but a 24% reduction in Northern Ireland. Finally, Teal numbers increased by 6% on the previous period. Amongst the allies, both Grey Heron (24%) and Great Northern Diver (15%) increased by more than 5%, though as with Eider these species are not well covered by I-WeBS core counts.

By contrast, 18 species of wildfowl and allies underwent declines of over 5%. A lot of these species are also declining at flyway level. In many cases it is likely that climate change is a significant factor in the species returning to Ireland in reduced numbers, irrespective of flyway trends. For example,



Plate 4. Pintail (Michael Finn).

only 21 Bewick's Swan returned to Ireland (Wexford) in recent years, and this species has declined by 74% since the previous period. The decline of Bewick's Swans in Ireland pre-dates their decline at international level (Kennedy *et al.* 1954, Ruttledge 1966, Sheppard 1993) and has been attributed to milder conditions closer to the breeding grounds and the species 'short-stopping' elsewhere as a result (Crowe *et al.* 2005, Worden *et al.* 2006). It is likely that this species will cease to be a regular wintering species here in the near future. The same cause is probably a factor in other species wintering here in reduced numbers, as the migration as far as Ireland is becoming increasingly disadvantageous rather than necessary. Recent research by Pavón-Jordán *et al.* (2018), which included both I-WeBS and WeBS data, has provided evidence for a long-term north-eastwards shift of the centre of the wintering population of species preferring deep waters (e.g. Pochard, Tufted Duck *Aythya fuligula*, Goldeneye, Red-breasted Merganser *Mergus serrator*, Coot *Fulica atra*, Cormorant, Great Crested Grebe) and changing shifts in the centre of the wintering population of shallow-water species (e.g. Pintail *Anas acuta*, Shoveler, Teal, Wigeon, Mallard *Anas platyrhynchos*, Gadwall, Shelduck *Tadorna tadorna*) in response to large-scale changes in winter weather conditions (linked to NAO index values). Lehtikoinen *et al.* (2013) and Fox *et al.* (2016) found similar evidence for Tufted Duck and Goldeneye, and Wigeon, respectively.

The decline of the Greenland White-fronted Goose has been due to poor breeding productivity, with the population now standing at around half of what it was at its recent peak in 1999/2000. In Ireland, numbers in Wexford have remained relatively stable as birds abandon former sites around the country and the species becomes increasingly concentrated on the Slobbs and neighbouring sites (Fox *et al.* 2018, Weegman *et al.* 2016). Around 80% of the Irish population of Greenland White-fronts now winter at a small number of sites in Wexford (Fox *et al.* 2018). Although the North Slob is managed for these geese, their continual loss of range in the north and west of the country puts the Irish population at increased risk of any potential stochastic or longer-term threats at those few sites in Wexford.

Total wader numbers in Ireland have declined almost 20% since the previous estimates 5 years ago. Numbers of Greenshank (17%) and Sanderling (13%) have showed significant increases in the last 5 years and are either stable or increasing at flyway level. Black-tailed Godwits are increasing internationally and showed modest gains (4%) in Ireland. Declines of >20% are evident for Knot, Purple Sandpiper, Redshank, Golden Plover, Dunlin, Oystercatcher and Turnstone, with 10% declines for Ringed Plover, Lapwing and Curlew. Golden Plover, Lapwing, Oystercatcher and Dunlin have long been among the most numerous waterbird species in Ireland (Crowe *et al.* 2008, Crowe & Holt 2013), so these large and rapid declines will have a disproportionately negative effect on the total waterbird numbers at many sites. It is also worth noting that the number of wetlands regularly

supporting 20,000+ migratory waterbirds, one of the thresholds for international site importance under the Ramsar Convention, has fallen considerably since I-WeBS began. Fifteen sites in the Republic of Ireland supported over 20,000 wintering waterbirds in 2004/05, when the first set of population estimates were published (Boland & Crowe, 2006; Crowe *et al.* 2008), falling to nine in 2010/11 when the last set of estimates were published (Crowe *et al.* 2012; Crowe & Holt 2013), and only five sites met the criteria in the recent period from 2011/12 to 2015/16 (Burke *et al.* 2018).

As with wildfowl, there is an increasing body of evidence linking changes in temperature and climate to easterly shifts in wintering distribution for species such as Lapwing, Golden Plover (Gillings *et al.* 2016), Ringed Plover, Dunlin, Knot, Redshank, Grey Plover *Pluvialis squatarola* and Oystercatcher, amongst others (Austin & Rehfish 2005). Many of the wader species declining in Ireland are also decreasing at flyway level, suggesting causative factors further afield than Ireland. Kubelka *et al.* (2018) found that levels of predation of shorebird nests in the Arctic have increased threefold in the last 70 years, with 70% of total nests now being depredated. Higher rates of predation were associated with increased temperatures, indicating that climate change is affecting total numbers of wild bird populations as well as causing the shifts in range discussed above. However, this should not mask the many local pressures faced by wintering waterbirds. In Ireland, many waterbirds are vulnerable to recreational disturbance, habitat modification and loss, and potential impacts from increased aquaculture and renewable energy developments, each of which has the potential to lower survival rates and total numbers of their respective Irish and flyway populations as a result.

It is clear that there are a wide range of anthropogenic and environmental factors that are affecting waterbird populations; likely underpinning the observed declines at national and flyway level. Because waterbirds are largely migratory, there are considerable challenges in addressing these declines as many different factors may affect populations on the breeding grounds, along their migratory routes and in the wintering areas. An integrated temporal and spatial approach is required to address waterbird declines along the east Atlantic flyway and further afield, which will undoubtedly be confounded by differing economic jurisdictions and priorities. Despite calls for international, collaborative and strategic measures to address these declines for many years (e.g. Stroud *et al.* 2006) and various initiatives put in place, there are few signs of improving trends for many species. Continued monitoring is therefore important to keep track of our changing waterbird populations as well as to input into international programmes such as the International Waterbird Census and related research, to ultimately inform future conservation policies.

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