

A review of Ireland's waterbirds, with emphasis on wintering migrants and reference to H5N1 avian influenza

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ABSTRACT

Ireland is characterised by its diversity and large abundance of wetlands, making it attractive to a wide variety of waterbirds throughout the year. This paper presents an overview of Ireland's waterbirds, including ecological factors relevant to the potential introduction, maintenance, transmission and spread of infectious agents, including the H5N1 avian influenza virus, in Ireland. Particular emphasis is placed on five groups of wintering migrants (dabbling and sieving wildfowl, grazing wildfowl, diving wildfowl, waders and gulls), noting that the H5N1 avian influenza virus has mainly been isolated from this subset of waterbirds. Ireland's wetlands are visited during the spring and summer months by hundreds of thousands of waterbirds which come to breed, predominantly from southern latitudes, and during the autumn and winter by waterbirds which come from a variety of origins (predominantly northern latitudes), and which are widely distributed and often congregate in mixed-species flocks. The distribution, feeding habits and social interactions of the five groups of wintering migrants are considered in detail. Throughout Ireland, there is interaction between different waterbird populations (breeding migrants, the wintering migrants and resident waterbird populations). There is also a regular and complex pattern of movement between feeding and roosting areas, and between wetlands and farmland. These interactions are likely to facilitate the rapid transmission and spread of the H5N1 avian influenza virus, if it were present in Ireland.

KEYWORDS: East Atlantic flyway, epidemiology, H5N1, Ireland, waterbirds, winter migration

Irish Veterinary Journal
Volume 62 Number 12 800-811 2009

INTRODUCTION

The wetlands of northwest Europe are internationally important for millions of waterbirds, both resident and migratory. During summer months, waterbirds migrate to these wetlands to breed, whereas in winter, northern and boreal-nesting species migrate to these wetlands, either to overwinter or on passage to wintering grounds further south. Other waterbirds are year-round residents. Ireland plays a critical role in the ecology of these waterbirds, given its strategic location (on a major flyway), its mild (generally ice-free) climate and abundance of wetlands (Crowe 2005). An understanding of waterbird ecology is important to disease epidemiology, noting the role of these birds in the maintenance and spread of low pathogenic avian influenza (LPAI) (Webster *et al.* 1992). As yet, however, the role of waterbirds in the epidemiology of highly pathogenic avian influenza (HPAI) H5N1 of Asian lineage remains unclear and developing. The current outbreak of HPAI H5N1 was first detected in China in 1996 (Webster *et al.* 2007a), and has subsequently appeared in many countries in Asia, Europe and Africa (Kilpatrick *et al.* 2006). Ongoing studies are

highlighting substantial differences in the behaviour of HPAI H5N1 and previous AI viruses, suggesting that the H5N1 virus is in rapid evolution (Webster *et al.* 2007b). These differences include direct transmission of H5N1 viruses from birds to humans, transmission predominantly via the respiratory route, increased thermal stability and varying pathogenicity in waterfowl.

Within the European Union, co-ordinated measures have been developed to prevent and control avian influenza in poultry. Influenza surveillance in both poultry and wild birds has been increased, and import bans are placed on susceptible imports from third countries with H5N1 outbreaks (European Commission 2007). Ireland has developed a range of relevant measures, including a contingency plan and ongoing risk assessments (DAFF 2009).

Detailed information has recently been prepared on Ireland's waterbirds (Crowe 2005). As yet, however, a review of this material has not been prepared, nor is information readily available of ecological factors that might be relevant to the introduction, maintenance, transmission

and spread of infectious agents, such as the H5N1 avian influenza virus, between and within waterbird populations in Ireland. This paper seeks to address this issue. Particular emphasis is placed on five groups of wintering migrants (dabbling and sieving wildfowl, grazing wildfowl, diving wildfowl, waders and gulls), noting that the H5N1 avian influenza virus has mainly been isolated from this subset of the broader waterbird population (EFSA 2006; EFSA 2008).

IRELAND'S WATERBIRDS

Overview

Ireland is characterised by a diverse and large abundance of wetlands (**Figure 1**), making it attractive to a wide variety of waterbirds throughout the year. Wetlands are defined by the Ramsar Convention as areas of water, marsh, fen or peatland, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including marine waters, the depth of which at low tide does not exceed six metres (Ramsar Convention Secretariat 2007).

Waterbirds are defined as all species which are ecologically dependent on such wetlands, and some 86 species are regularly recorded in Ireland (**Table 1**), many of which (34 species) occur year-round. However, very few of these are entirely resident. Few remain in Ireland throughout the year, with no immigration or emigration (the Mute Swan *Cygnus olor* is one.) Rather, the majority of the waterbirds which occur in Ireland are migratory, and are part of the East Atlantic Flyway (**Figure 2**), delimited by long-term studies of marked (ringed) birds (Wernham *et al.* 2002). This is a generalised picture of the distribution and movements of

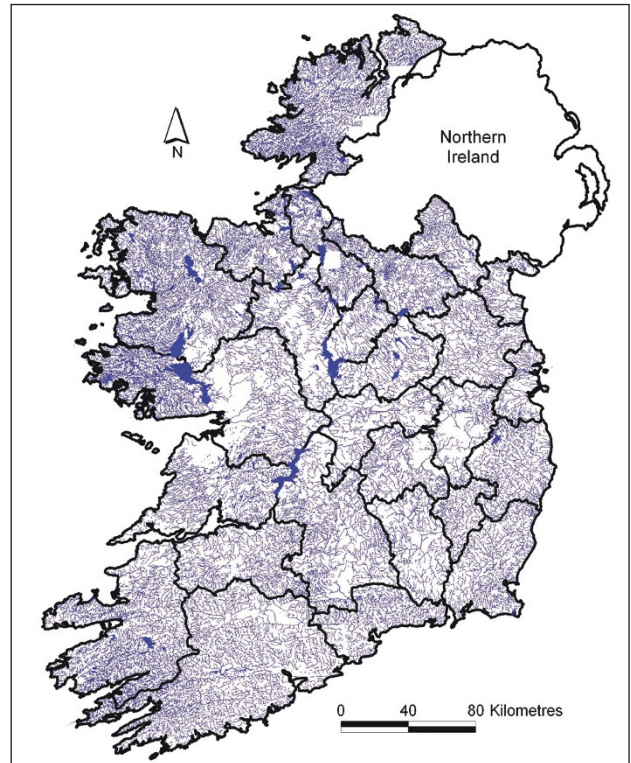


Figure 1: Ireland's wetlands, including rivers streams, reservoirs, ponds, lakes and canals.

migratory waterbirds and one which has particularly been derived from studies of waders. Details of international flyway delineation, as shown in **Figure 2**, are less applicable to other waterbird taxa (see Boere and Stroud 2006).

Migratory flyways

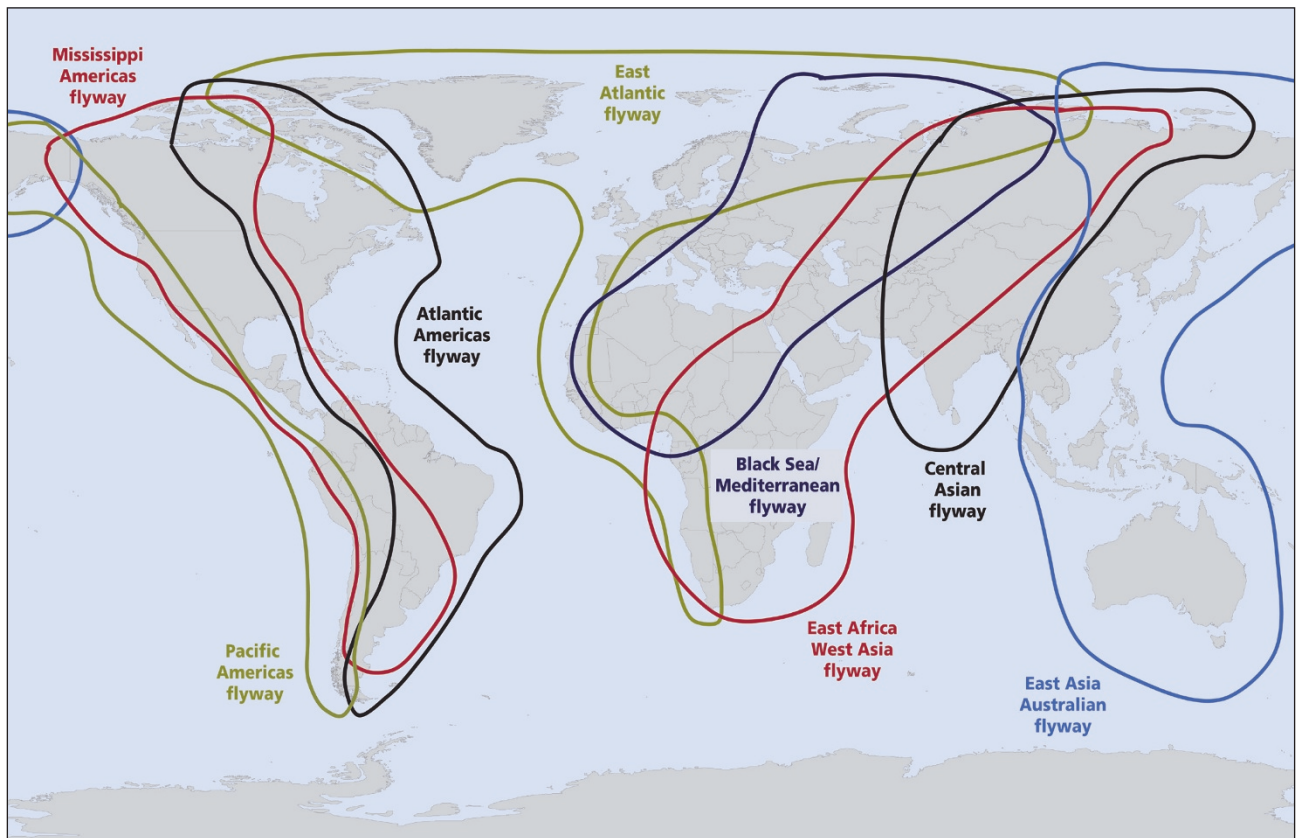


Figure 2: Wader flyways. Source: International Wader Study Group.

Table 1: Waterbird species occurring in Ireland

Species		Occurrence in Ireland
Divers and grebes		
Red-throated Diver	<i>Gavia stellata</i>	Wintering – September to April, small numbers (<10 pr) breed in Donegal
Black-throated Diver	<i>Gavia arctica</i>	Wintering – September to April (Scarce)
Great Northern Diver	<i>Gavia immer</i>	Wintering – September to April
Little Grebe	<i>Tachybaptus ruficollis</i>	Year-round
Great Crested Grebe	<i>Podiceps cristatus</i>	Year-round, numbers increase during the winter due to immigrating birds
Shearwaters and Petrels		
Manx Shearwater	<i>Puffinus puffinus</i>	Breeding – March to August
European Storm-petrel	<i>Hydrobates pelagicus</i>	Breeding – March to August
Leach's Storm-petrel	<i>Oceanodroma leucorhoa</i>	Breeding – March to August and passage September to October
Fulmar	<i>Fulmarus glacialis</i>	Year-round
Gannet		
Gannet	<i>Morus bassana</i>	Year-round
Cormorants		
European Shag	<i>Phalacrocorax aristotelis</i>	Year-round, few seen inshore outside the breeding season
Cormorant	<i>Phalacrocorax carbo</i>	Year-round, some immigration during the winter
Hérons		
Grey Heron	<i>Ardea cinerea</i>	Year-round
Little Egret	<i>Egretta garzetta</i>	Year-round
Wildfowl (swans, geese and ducks)		
Mute Swan	<i>Cygnus olor</i>	Year-round
Bewick's Swan	<i>Cygnus columbianus</i>	Wintering – October to April
Whooper Swan	<i>Cygnus cygnus</i>	Wintering – October to April
Greenland White-fronted Goose	<i>Anser anser flavirostris</i>	Wintering – October to April
Greylag Goose	<i>Anser anser</i>	Year-round (feral birds), augmented by wintering birds- October to April
Canada Goose	<i>Branta canadensis</i>	Year-round (feral birds)
Barnacle Goose	<i>Branta leucopsis</i>	Wintering – October to April
Light-bellied Brent Goose	<i>Branta branta hrota</i>	Wintering – October to April
Shelduck	<i>Tadorna tadorna</i>	Wintering – September to April
Wigeon	<i>Anas penelope</i>	Wintering – September to April
Gadwall	<i>Anas strepera</i>	Year-round, augmented by wintering birds – October to April (scarce)
Teal	<i>Anas crecca</i>	Year-round, augmented by wintering birds – September to April
Mallard	<i>Anas platyrhynchos</i>	Year-round, augmented by wintering birds – September to April
Pintail	<i>Anas acuta</i>	Wintering – September to April
Shoveler	<i>Anas clypeata</i>	Wintering – September to April
Pochard	<i>Aythya ferina</i>	Predominantly wintering – September to April, small numbers breed
Tufted Duck	<i>Aythya fuligula</i>	Predominantly wintering – September to April, small numbers breed
Scaup	<i>Anas marila</i>	Wintering – September to April
Eider	<i>Somateria mollissima</i>	Wintering – September to April
Long-tailed Duck	<i>Clangula hyemalis</i>	Wintering – September to April
Common Scoter	<i>Melanitta nigra</i>	Predominantly wintering – September to April, small numbers breed
Goldeneye	<i>Bucephala clangula</i>	Wintering – September to April

Species		Occurrence in Ireland
Red-breasted Merganser	<i>Mergus serrator</i>	Wintering – September to April , small numbers breed in West
Goosander	<i>Mergus merganser</i>	Year-round, small numbers breed (scarce)
Ruddy Duck	<i>Oxyura jamaicensis</i>	Year-round (feral birds)
Rail & Coots		
Water Rail	<i>Rallus aquaticus</i>	Year-round
Moorhen	<i>Gallinula chloropus</i>	Year-round, augmented by wintering birds – September to April
Coot	<i>Fulica atra</i>	Year-round, augmented by wintering birds – September to April
Waders		
Oystercatcher	<i>Haematopus ostralegus</i>	Year-round, augmented by wintering birds – September to April
Ringed Plover	<i>Charadrius hiaticula</i>	Year-round, augmented by wintering birds – September to April
Golden Plover	<i>Pluvialis apricaria</i>	Wintering birds – September to April, breeding birds – April to September, some overlap in populations
Grey Plover	<i>Pluvialis squatarola</i>	Wintering birds – September to April
Lapwing	<i>Vanellus vanellus</i>	Wintering birds – September to April, breeding birds – April to September, some overlap in populations
Knot	<i>Calidris canutus</i>	Wintering birds – September to April
Sanderling	<i>Calidris alba</i>	Wintering birds – September to April
Little Stint	<i>Calidris minuta</i>	Passage birds – August to October (scarce)
Curlew Sandpiper	<i>Calidris ferruginea</i>	Passage birds – August to October (scarce)
Purple Sandpiper	<i>Calidris maritima</i>	Wintering birds – September to April
Dunlin	<i>Calidris alpina</i>	Wintering birds – September to April, small numbers breed in west
Ruff	<i>Philomachus pugnax</i>	Spring and autumn passage (scarce)
Jack Snipe	<i>Lymnocyptes minimus</i>	Wintering birds – September to April
Snipe	<i>Gallinago gallinago</i>	Year round, augmented by wintering birds – September to April
Woodcock	<i>Scolopax rusticola</i>	Year round, augmented by wintering birds – September to April
Black-tailed Godwit	<i>Limosa limosa</i>	Wintering birds – August to April
Bar-tailed Godwit	<i>Limosa lapponica</i>	Wintering birds – September to April
Whimbrel	<i>Numenius phaeopus</i>	Passage birds – April to September
Curlew	<i>Numenius arquata</i>	Year round, augmented by wintering birds – September to April
Redshank	<i>Tringa totanus</i>	Year round, augmented by wintering birds – September to April
Greenshank	<i>Tringa nebularia</i>	Wintering birds – September to April
Common Sandpiper	<i>Actitis hypoleucos</i>	Summer visitor- breeding birds present April to September
Turnstone	<i>Arenaria interpres</i>	Wintering birds- September to April
Skuas, Gulls & Terns		
Great Skua	<i>Stercorarius skua</i>	Passage birds – April to October
Arctic Skua	<i>S. parasiticus</i>	Passage birds – April to October
Mediterranean Gull	<i>Larus melanocephalus</i>	Year-round, very small breeding numbers (scarce)
Black-headed Gull	<i>Larus ridibundus</i>	Year-round, some local migration to/from breeding areas
Common Gull	<i>Larus canus</i>	Year-round, some local migration to/from breeding areas in west.
Lesser Black-backed Gull	<i>Larus fuscus</i>	Occur during the breeding season, March/April to August/September
Herring Gull	<i>Larus argentatus</i>	Year-round, some local migration
Great Black-backed Gull	<i>Larus marinus</i>	Year-round, some local migration
Little Gull	<i>Larus minutus</i>	Wintering birds – September to April (scarce)

The concept of a flyway is based on the migratory behaviour of birds. Flyways in northwestern Europe are typically north-south in orientation, with migratory birds moving to warmer climes during the autumn, and then returning during the spring to more northerly breeding areas. Many species migrate along well-defined routes, and consistently use the same sites as stop-over and/or wintering sites.

Some eight general migratory flyways have been defined (Davidson and Pienkowski 1987). The East Atlantic Flyway (Figure 2) extends from east Canada, across northern Europe to west Siberia in the north, and also south along the east Atlantic shores of northwest Europe and west Africa. Most migratory waterbird species which occur in Ireland during the winter have originated from one or more of the following areas:

- North/ northwest: Canada, Greenland and Iceland;

- Northeast: the Netherlands, Denmark, Germany, Fennoscandia, the Baltic, western Russia (west of the Ural Mountains);
- Far-eastern: Russia east of the Ural Mountains and Siberia; and,
- Central/ east Europe: Europe east of and including Poland, Czech Republic and Austria.

The breeding origins of waterbird species occurring in Ireland during the winter are summarised in Table 2. Most migratory waterbird species which breed in Ireland winter further south, in Continental Europe or west Africa (i.e., they belong to the same principal flyway).

Migrants

a. Breeding migrants

During the spring and summer months, hundreds of thousands of waterbirds come to Ireland to breed,

Table 2: Flyway origins of species occurring in Ireland outside the breeding season

Species		Breeding ¹	Wintering ¹	Flyway estimate ²	All-Ireland estimate ³
Red-throated Diver	<i>Gavia stellata</i>	Arctic/ boreal W Eurasia, Greenland	Europe, Greenland	300,000	1,025+
Black-throated Diver	<i>Gavia arctica</i>	N Europe and W Siberia	NW Europe, Mediterranean, Black and Caspian Seas	375,000	<1,000
Great Northern Diver	<i>Gavia immer</i>	N America, Greenland, Iceland	NW Europe	5,000	<1,000
Little Grebe	<i>Tachybaptus ruficollis</i>	Europe, NW Africa	Europe, NW Africa	340,000	2,345+
Great Crested Grebe	<i>Podiceps cristatus</i>	NW Europe	NW Europe	475,000	5,385+
Great Cormorant	<i>Phalacrocorax carbo</i>	NW Europe	NW Europe	120,000	13,710+
Grey Heron	<i>Ardea cinerea</i>	W Europe, NW Africa	W Europe, NW Africa	274,500	2,960+
Little Egret	<i>Egretta garzetta</i>	Ireland, UK, Continent, N Africa	Ireland, UK, Continent, N Africa	134,000	<1,000
Mute Swan	<i>Cygnus olor</i>	Ireland	Ireland ^a	11,440a	11,440
Bewick's Swan	<i>Cygnus columbianus bewickii</i>	Arctic N Russia	NW Europe	29,000	380
Whooper Swan	<i>Cygnus cygnus</i>	Iceland	Ireland, UK, Iceland	20,900	12,730
Greenland White-fronted Goose	<i>Anser albifrons flavirostris</i>	W Greenland	Scotland, Ireland	33,000	11,340
Greylag Goose	<i>Anser anser</i>	Iceland	UK, Ireland	89,100	5,030 ^b
Canada Goose	<i>Branta canadensis</i>	Ireland	Ireland	1,050	1,050
Barnacle Goose	<i>Branta leucopsis</i>	Greenland	Scotland, Ireland	54,100	9,035
Light-bellied Brent Goose	<i>Branta bernicla hrota</i>	Canada, Greenland	Ireland	21,750	30,000
Common Shelduck	<i>Tadorna tadorna</i>	NW Europe	NW Europe	300,000	14,610
Eurasian Wigeon	<i>Anas penelope</i>	W Siberia, NW and NE Europe	NW Europe	1,500,000	82,370+
Gadwall	<i>Anas strepera</i>	NW Europe	W Europe	60,000	630
Eurasian Teal	<i>Anas crecca</i>	N and NW Europe	NW Europe	400,000	45,010+
Mallard	<i>Anas platyrhynchos</i>	N Europe	NW Europe	4,500,000	38,250+
Northern Pintail	<i>Anas acuta</i>	N Europe, W Siberia	NW Europe	60,000	1,235
Northern Shoveler	<i>Anas clypeata</i>	N, NW, Central Europe	NW, Central Europe	40,000	2,545
Common Pochard	<i>Aythya ferina</i>	Russia, NE and NW Europe	NE and NW Europe	350,000	37,780
Tufted Duck	<i>Aythya fuligula</i>	N and NW Europe	NW Europe	1,200,000	36,610
Greater Scaup	<i>Aythya marila</i>	W Siberia, N Europe	W Europe	310,000	4,430

Species		Breeding ¹	Wintering ¹	Flyway estimate ²	All-Ireland estimate ³
Common Eider	<i>Somateria mollissima</i>	see c below	see c below	1,548,000c	2,890
Long-tailed Duck	<i>Clangula hyemalis</i>	Iceland and Greenland	N Atlantic	125,000	<1,000
Common Scoter	<i>Melanitta nigra</i>	N and NW Europe, W Siberia	Baltic, E Atlantic	1,600,000	23,190
Common Goldeneye	<i>Bucephala clangula</i>	N, NW and Central Europe	NW and Central Europe	400,000	9,665
Red-breasted Merganser	<i>Mergus serrator</i>	NW and Central Europe, Iceland, E Greenland	NW and Central Europe, Iceland	170,000	3,390
Water Rail	<i>Rallus aquaticus</i>	Iceland	Faeroes, Scotland, Ireland	Unknown	Unknown
Common Moorhen	<i>Gallinula chloropus</i>	Europe and N Africa	Europe and N Africa	3,550,000	Unknown
Common Coot	<i>Fulica atra</i>	E, N, W Europe	NW Europe	1,750,000	33,160
Eurasian Oystercatcher	<i>Haematopus ostralegus</i>	N, C, W Europe	Europe, NW Africa	1,020,000	67,620
Ringed Plover	<i>Charadrius hiaticula</i>	Iceland, N and NW Europe	W Europe, N Africa, Mediterranean	73,000	14,580
European Golden Plover	<i>Pluvialis apricaria</i>	Iceland, the Faeroes, Greenland	Ireland, W Britain, Continent, NW Africa	930,000	166,700+
Grey Plover	<i>Pluvialis squatarola</i>	Arctic Russia, NE Canada	Wadden Sea, Ireland, UK, S and W Africa	247,000	6,315
Northern Lapwing	<i>Vanellus vanellus</i>	Europe	Europe, N Africa	6,750,000	207,700+
Red Knot	<i>Calidris canutus</i>	Canada, Greenland	W Europe	450,000	18,970
Sanderling	<i>Calidris alba</i>	NE Canada, Greenland, Svalbard	E Atlantic, W and S Africa	123,000	6,680
Purple Sandpiper	<i>Calidris maritima</i>	E Atlantic	E Atlantic	75,000	3,330
Dunlin	<i>Calidris alpina</i>	N Scandinavia, Russia, NW Siberia	W Europe, Mediterranean, N Africa	1,330,000	88,480
Jack Snipe	<i>Limnocyrtus minimus</i>	N Russia, S Sweden, N Poland, N Belarus, Baltic	W and S Europe, N and W Africa	>1,000,000	Unknown
Snipe	<i>Gallinago gallinago</i>	N Europe	S and W Europe, W Africa	>2,500,000	Unknown
Woodcock	<i>Scolopax rusticola</i>	Europe	W and S Europe, N Africa	17,500,000	Unknown
Black-tailed Godwit	<i>Limosa limosa</i>	Iceland, the Faeroes	Britain, Ireland, Continent, N Africa	47,000	13,880
Bar-tailed Godwit	<i>Limosa lapponica</i>	N Europe, N Russia	W Europe, NW Africa	120,000	16,280
Whimbrel	<i>Numenius phaeopus</i>	Iceland, the Faeroes, Scotland	W Africa	675,000	Unknown
Eurasian Curlew	<i>Numenius arquata</i>	W, N and Central Europe	W Europe, Mediterranean, NW Africa	850,000	54,650+
Common Redshank	<i>Tringa totanus</i>	see d below	see d below	400,000d	31,090
Common Greenshank	<i>Tringa nebularia</i>	Scotland, Scandinavia	W and SW Europe, NW, W and S Africa	420,000	1,265
Ruddy Turnstone	<i>Arenaria interpres</i>	NE Canada, Greenland	W Europe, NW Africa	150,000	11,810
Mediterranean Gull	<i>Larus melanocephalus</i>	Black Sea, C, S, W Europe	Black Sea, Mediterranean, NW Europe, NW Africa	660,000	<200
Black-headed Gull	<i>Larus ridibundus</i>	Greenland, N and W Europe	S and W Europe	4,250,000	Unknown
Common Gull	<i>Larus canus</i>	Iceland, Ireland, Britain	Europe, N Africa	1,725,000	Unknown
Lesser Black-backed Gull	<i>Larus fuscus</i>	Greenland, Iceland, Ireland, UK, Belgium, France	W Europe, W France	550,000	Unknown
Herring Gull	<i>Larus argentatus</i>	Iceland, Ireland, Britain, NW France, Germany	NW Europe	590,000	Unknown
Great Black-backed Gull	<i>Larus marinus</i>	NW France, Britain, Ireland, Iceland, N Europe	E Atlantic S to Iberia	440,000	Unknown

¹ From Wernham *et al.* (2002), also EURING's Migration Mapping Tool (<http://blx1.bto.org/ai-eu>)

² From Wetlands International (2002).

³ Crowe *et al.* (2008).

⁴ The Irish Mute Swan population has been elevated to biogeographic population (Wetlands International 2002), and the threshold is thus the same as that for all-Ireland.

⁵ Additional birds from feral population - c. 2,000 individuals.

^c The relevant population on which to base the 1% threshold for Common Eider has been taken as the NW European total which comprises the four populations in this region (Britain/Ireland 73,000, Baltic/Wadden Sea 850,000-1,200,000, Norway/NW Russia 300,000-550,000 and White Sea 20,000-30,000).

^d The relevant populations for Common Redshank include two populations, *robusta* (breed in Iceland and the Faeroes, winter Britain, Ireland, NW France) and *britannica* (breed in Britain and Ireland, winter Britain, Ireland, NW France).

predominantly from southern latitudes. These breeding migrants begin to arrive in Ireland in March, and are present in highest numbers between April and August, with some individuals remaining into early October. These waterbirds breed predominantly around Ireland's coastline, colonising the cliffs and islands. Some also nest inland, on lake islands and along the shorelines of lakes, rivers and streams. The breeding migrants include seabirds (petrels and shearwaters, Gannet *Morus bassana*, cormorants, gulls, terns and auks), as well as a number of other species/groups such as Red-throated Diver *Gavia stellata*, grebes, herons, swans, feral geese, ducks, rails, coots, waders, Great Skua, gulls, terns and auks.

b. Wintering migrants

During the autumn and winter, Ireland's mild winter climate, relative to most other European countries, together with its diversity of wetlands, make it attractive over a million northern and boreal-nesting migrant waterbirds. Therefore, most of the wintering, or non-breeding, migrants come from northern latitudes from Canada in the west to Taimyr in arctic Russia in the east. These birds begin to arrive from as early as July, with most occurring in Ireland between September and February, and some individuals remaining into early May. They occur in largest numbers of coastal estuaries, and on a selection of inland lakes, such as Lough Neagh in Northern Ireland and Lough Corrib in Co. Galway. Wintering waterbirds include fewer bird groups (divers, grebes, herons, swans, geese, ducks, rails, coots, waders and gulls), but a much broader diversity of species within these groups compared with breeding.

Residents

Many waterbirds remain in Ireland year-round. These include grebes, cormorants, herons, Mute Swan, some duck species and some gulls. However, as mentioned above, Mute Swan is one of very few examples of an entirely resident species, remaining in Ireland throughout the year with no immigration or emigration. Most other species are joined by additional birds during the autumn and winter months migrating from arctic and boreal-nesting areas (see section on migrants below).

Ireland also supports a number of introduced waterbirds, which remain relatively local throughout the year. These include:

Naturalised introductions: Some wildfowl species have escaped from collections, and are free-living (e.g. Greylag Goose *Anser anser* and Canada Goose *Branta canadensis*). While these birds are sedentary, and do not generally move large distances, they cannot be easily distinguished from their wild counterparts;

- Wildfowl bred for hunting: Large numbers of Mallard *Anas platyrhynchos* are farmed, and released during the autumn for hunting; and,
- Domestic wildfowl: This group includes farmyard geese and ducks, and birds from wildfowl collections. Some of the farmyard geese and ducks have interbred with naturalised Greylag and Mallard respectively, and are part of the feral populations described above.

Interactions between populations

Most waterbirds occurring in Ireland come from more than one population. For example, small numbers of Coot (almost 4,000 pairs) breed in Ireland (Gibbons *et al.* 1993), while wintering numbers exceed 33,000 individuals (Crowe *et al.* 2008). It is believed that the breeding birds are resident, and that during the winter, Britain and Ireland receive large numbers of immigrating birds from northern Europe, Scandinavia and the Baltic (Wernham *et al.* 2002). There are many other similar examples where numbers of resident breeding birds are augmented by winter migrants of the same species, e.g. Great Crested Grebe *Podiceps cristatus*, Teal *Anas crecca*, Moorhen *Gallinula chloropus* and Oystercatcher *Haematopus ostralegus* (**Table 1**).

Some breeding seabird species, such as Kittiwake *Rissa tridactyla*, become oceanic in nature outside the breeding season, when they are seldom recorded in inshore waters. Other species are entirely migratory; the five tern species and Common Sandpiper *Actitis hypoleucos* occur during the breeding period only, while most of the other wader species occur on passage and/or during the winter. For some species, many distinct groups have been recognised, and discrete populations have been defined, some of which have been split taxonomically into subspecies. For example, there are three populations of Dunlin *Calidris alpina* which occur in Ireland. *Calidris alpina schinzii* breeds in Ireland and winters further south in southwest Europe and northwest Africa, *C. a. arctica* breeds in Greenland and occurs in Ireland during spring and autumn on passage, while *C. a. alpina* breeds in Scandinavia and Siberia and winters in Ireland (Stroud *et al.* 2004). Other species, such as Golden Plover *Pluvialis apricaria*, breed and winter in Ireland, although the origins of the respective populations differ; Irish-breeding birds move south to winter, while the non-breeding birds come from the population breeding in Iceland and the Faeroes. Further details, including the latin names and the status, of all waterbirds occurring in Ireland are presented in **Table 1**.

Furthermore, there are periods (between March and early May and later between July and October) when there is considerable mixing of breeding and wintering (non-breeding) migrants (**Figure 3**). Waterbirds of varying origins regularly occur together. Examples include:

- Close to 10,000 post-breeding terns congregate in Dublin Bay in August and September prior to their southward migration and mix with thousands of migrant geese, waders and gulls arriving from faraway arctic breeding grounds; and,
- Large numbers of Icelandic-breeding Greylag Geese (roughly 2,000 birds) mix with a resident flock of 800 feral Greylag Geese at Lough Swilly each winter.

Interactions between species

Outside the breeding season, most waterbirds are highly gregarious, and generally assemble in large, and often mixed-species flocks. By doing so, they reduce their risk to predation, as a flock of birds is more likely to detect a predator than a single bird. Flocks of swans and geese

often include family parties which tend to remain intact for most of the first year. Although preferred wetlands among different waterbird groups (dabbling ducks, swans etc; see below) is to some extent exclusive, some of the larger wetland complexes include a variety of habitat types, and may support many different groups. For example, Lough Derg in counties Tipperary, Galway and Clare supports significant concentrations of a range of both dabbling and diving wildfowl, as well as waders and gulls. Further, waterbird species tend to gather together in mixed flocks where their favoured food is available. During the breeding period itself, most species tend to nest either solitarily, with many pairs holding and defending territories (e.g. Lapwing), or in dense colonies, where birds nest in close proximity, usually on cliffs and/ or on islands, where they afford greater protection from predation and disturbance. It is not unusual for colonial species to nest in mixed-species colonies.

IRELAND'S WINTERING WATERBIRDS

Wintering waterbird surveys

Wintering waterbirds in the Republic of Ireland have been monitored for almost 40 years as part of three main surveys, the *Wetlands Enquiry* (1971/72-1973/74) (Hutchinson 1979), the *Winter Wetlands Survey* (1984/85-1986/87) (Sheppard 1993) and the *Irish Wetland Bird Survey* (I-WeBS 1994/95-present) (Crowe 2005). In most cases, parallel surveys have been carried out in Northern Ireland, with the most recent, the *Wetland Bird Survey* (WeBS), in operation since 1993/94. An example of information generated from I-WeBS (specifically, the distribution and abundance of Mallard, *Anas platyrhynchos*) is presented in **Figure 4**. These surveys have served to highlight the importance of wetlands in Ireland for wintering waterbirds, and have defined a suite of wetlands which have proven of significance, many of which have since been designated as Special Protection Areas (SPAs) under the EU Birds Directive (EEC/79/409) (European Commission 2006). To this end, waterbird populations, and the wetlands upon which they rely, continue to be monitored in Ireland through I-WeBS and WeBS.

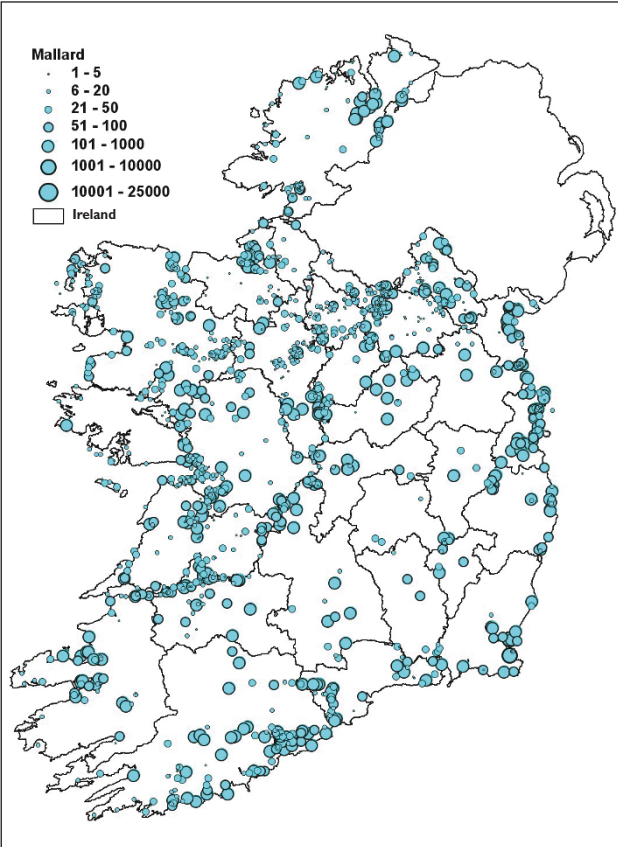


Figure 4: Distribution and abundance of mallard (*Anas platyrhynchos*) in Ireland. These data were collected by BirdWatch Ireland as part of the Irish Wetland Bird Survey. The counts were conducted over the last 10 years, mainly from September to March. At each sampling site, the circle represents the maximum number of mallard supported, based on the maximum number observed at each of the recording sites on a single occasion during the last 10 years.

Within-winter movements

Many waterbird species are highly site-faithful, returning to the same wintering areas each year. While most species are entirely dependent on wetland habitat, others can be found considerable distances from wetland sites. Swans, geese, and some wader species are regularly seen feeding on grassland and/or stubble, and use wetland habitats only for roosting.

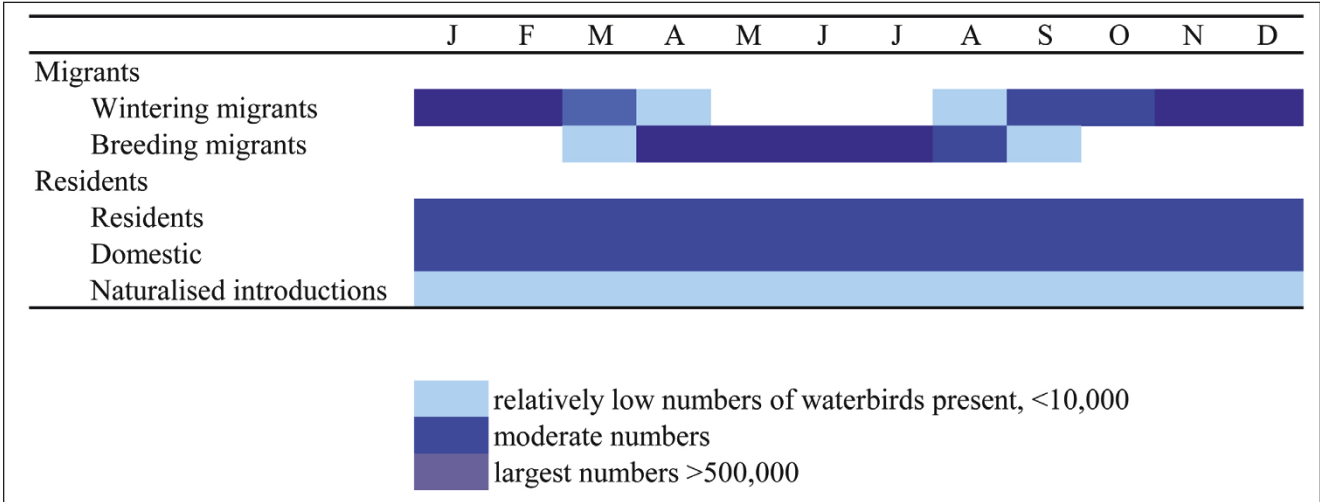


Figure 3: The number of migrant and resident waterbird present in Ireland throughout the year.

During the course of the winter, there is regular temporal and spatial movement of waterbird species. Along the coast, roosting and feeding is largely dictated by tide. Many swan and goose species feed by day, and often fly large distances (occasionally in excess of 20 km) to their wetland roosts at night. Many duck and wader species feed by night as well as by day. The roosting and feeding locations and patterns of movements of these waterbird species are less defined.

Large-scale movements of waterbirds between wetland sites have been directly related to weather conditions. There is a noticeable decline in some waterbirds during early autumn, particularly resident species such as Little Grebe, Cormorant and Mallard. It is thought that this reflects a shift in range of these species as they begin to disperse from coastal sites to exploit small inland wetlands that are replenished by increasing rainfall levels. In contrast, during cold weather periods, when such small wetlands are more likely to become frozen over, there is reversal of this movement, as species are forced at times to move large distances to larger waterbodies, riverine sites or to coastal sites, all which are less likely to become frozen.

During particularly cold weather periods in Europe, a number of species from northern Europe, and even Britain, are known to move west into Ireland, with its milder climate (Ridgill and Fox 1990). It is known that Lapwing and Golden Plover are particularly sensitive to such cold weather periods, when numbers in Ireland have been seen to increase dramatically. In extreme situations, Wigeon and Teal in Britain and Ireland move further south into France and Iberia. Here, it is known that there is some mixing with other populations breeding on the Black and Mediterranean Seas.

Waterbird species

Waterbirds are highly variable in size and shape, and have adopted a wide range of techniques that enable them to successfully exploit the variety of food types provided by wetland habitats. In general, wildfowl species feed by dabbling, sieving, diving (for example, to obtain benthic food items, or to prey on fish) and/or grazing, waders by probing or surface pecking, and gulls by surface pecking. Many species exhibit more than one method of feeding. For example, most dabbling ducks are also capable of diving, but do so for much shorter periods of time.

Wintering waterbirds can be divided into three main groups:

- Wildfowl include swans, geese and ducks, and are also often accompanied by their 'allies', the divers, grebes, rails, as well as Cormorant, Little Egret and Grey Heron;
- Waders frequent intertidal flats and shallow water, especially along coastal sites. This group comprises oystercatcher, plovers, lapwings, sandpipers, curlews and woodcocks; and,
- Gulls include the large family of seabirds that occupy a wide variety of wetland and non-wetland habitats. Some gull species have learned to co-exist successfully with man and have thrived in human habitats.

Terns are summer migrants, and mostly occur on passage during the autumn and spring months only, and are very seldom recorded during mid-winter.

Almost 140 waterbird species have been recorded during I-WeBS and WeBS. However, this total includes many vagrant species, which for a variety of reasons have strayed away from their

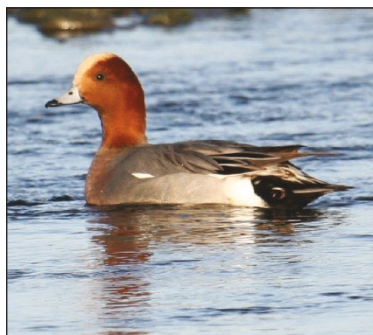


Figure 5: (Eurasian) Wigeon (*Anas penelope*). Photo: Ronnie Martin.

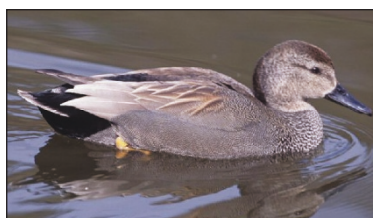


Figure 6: Gadwall (*Anas strepera*). Photo: Eddie Dunne.



Figure 7: Teal (*Anas crecca*). Photographer: John Carey.

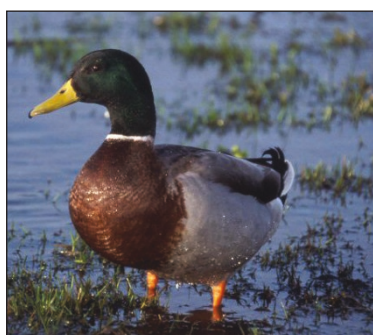


Figure 8: Mallard (*Anas platyrhynchos*). Photo: John Carey.



Figure 9: (Northern) Pintail (*Anas acuta*). Photo: Michael Finn.

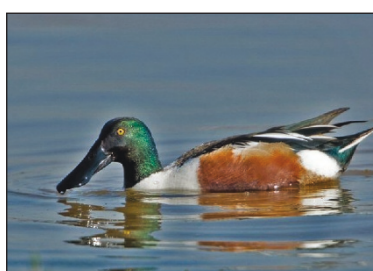


Figure 10: (Northern) Shoveler (*Anas clypeata*). Photo: Ken Kinsella.

usual flyways. More regularly, some 58 species occur in significant numbers at a variety of sites in Ireland, including 33 wildfowl, 20 wader and five gull species.

a. Dabbling and sieving wildfowl

Distribution and feeding habits

Dabbling is the preferred technique, which has given a large group of duck species their collective name. Dabbling ducks in Ireland include Shelduck, Wigeon, Gadwall, Teal, Mallard, Pintail and Shoveler (**Figure 5-10**). This technique is also employed by other species, particularly swans. Dabbling species feed mostly on seeds or invertebrate prey present on the surface of the water. They access food at slightly greater depths by dipping their heads and necks below the water. The long necks of swans allow them to access deeper food items than the ducks. These species can all extend their reach by up-ending into a vertical position, with their tails pointed in the air. Virtually all species which dabble feed by pecking at individual items. However, the dabbling ducks can also feed by sieving dense concentrations of smaller food, where they suck in water through a slightly open bill, and filter out the food items as the water is then expelled out at the sides. With the exception of Shelduck, which is exclusively coastally distributed, most dabbling species occur on a variety of relatively shallow wetlands, both inland and coastal. Dabbling species are often recorded on the lee shore, where the wind has blown seeds and invertebrates into a relatively narrow band. Temporary flooded fields are particularly attractive, where abundant food items surface from the soil or pasture. Wigeon, Gadwall, Teal and Mallard, in particular, are regularly seen taking advantage of such food resources. They are widely distributed throughout the country.

Social interactions

Dabbling species are regularly recorded feeding together in large, and usually mixed, flocks, each species exploiting different feeding niches. Some species gain added benefit by feeding communally. Shoveler are often recorded feeding closely to the tail of the bird in front. The combined action of paddling feet is particularly effective in stirring up the water and increasing the amount of food brought to the surface. Wigeon regularly feed alongside swans and Coot, and parasitise them as they return to the surface with food. Gadwall have also been recorded feeding on aquatic plants brought to the surface by diving Coot and Goldeneye.

b. Grazing wildfowl

Distribution and feeding habits

Whooper and Bewick's Swans, Greenland White-fronted, Greylag, Barnacle and Light-bellied Brent Geese and Wigeon (**Figure 5**) are all grazing species. The swans and first two species of goose listed also feed on stubble. Light-bellied Brent Goose and Wigeon spend the autumn and early part of the winter grazing coastal vegetation (particularly *Zostera* spp. (eelgrass), *Enteromorpha* spp. and *Ulva*

sp. [green algae]), and move to feed on grasslands once these coastal supplies have become depleted. Most swans and Wigeon, tend to remain close to water at all times, while the remaining species listed above may be found considerable distances from wetlands. All of these species return to roost by night on wetlands.

Whooper Swan and Wigeon are the most widely distributed species of this group, found grazing next to wetlands in almost all counties. Greenland White-fronted Geese are largely concentrated in Wexford Harbour, in particular on the Slobbs, though small numbers also occur at approximately 30 locations elsewhere in the country. The range of migratory (Icelandic) Greylag Goose is also quite restricted, and just six flocks are recognised in the Republic. However, the introduced population of this species is much more widespread, and small numbers occur throughout the country, and throughout the year. Barnacle and Light-bellied Brent Geese remain along the coast throughout the winter period. The former species is distributed mostly on the islands along the west and northwest coast of Ireland, where it feeds predominantly on grasslands. Light-bellied Brent Geese occur on estuaries along the east, south and southwest coasts, and increasingly use coastal grasslands as the winter progresses. Wigeon also feed on grassland, but are restricted to those adjoining wetlands, for security (**Figure 11**).

Social interactions

While these species tend to mix while in wetlands (as described in 'Dabbling species' above), the majority tend to assemble in single-species flocks while grazing. This is, most likely, due to differences in range, and also preferred feeding times during the day. However, mixed-species flocks do occur. For example, Wigeon and Light-bellied Brent Goose associate at some sites, though mostly when feeding on coastal vegetation. The diets of Light-bellied Brent Geese and Black-tailed Godwits (see 'Waders' below) are markedly different, though they are often seen feeding together.

c. Diving wildfowl

Distribution and feeding habits

Diving species forage by diving in an area, and seek food either visually, or by touch. They feed on submerged aquatic vegetation, or on animal prey, particularly molluscs and crustaceans and/or fish. The list of diving species in Ireland is quite extensive, and includes the divers, grebes, Cormorant, Pochard, Tufted Duck, Scaup, Eider, Long-tailed Duck, Common Scoter, Goldeneye, and Red-breasted Merganser, Moorhen and Coot. Some of the species listed above are largely marine, and are seldom seen close to shore during the winter. These include the divers, Eider, Long-tailed Duck, Common Scoter and Red-breasted Merganser. All remaining species, with the exception of Scaup, which occurs predominantly along the coast and on a few select inland sites, are widely distributed, especially on large deep wetlands. Great-crested Grebe, Little Grebe, Cormorant and Goldeneye are found on a variety of both



Figure 11: Pochard (*Aythya ferina*). Photo: Billy Clarke.

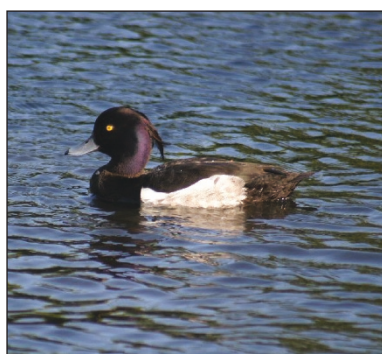


Figure 12: Tufted Duck (*Aythya fuligula*). Photo: Ronnie Martin.



Figure 13: (Northern) Lapwing (*Vanellus vanellus*). Photo: Billy Clarke.



Figure 14: Black-headed Gull (*Larus ridibundus*). Photo: John Carey.



Figure 15: Common Gull (*Larus canus*). Photo: Billy Clarke.

inland and coastal wetlands, while Pochard, Tufted Duck and Coot are mostly distributed on inland waterbodies (**Figure 11** and **Figure 12**).

Social interactions

The marine species listed above are usually found in discrete groups, and seldom interact with other species present inshore, or on inland wetlands. Inland, Little Grebe, Pochard, Tufted Duck and/or Coot are regularly seen feeding together, despite their different feeding habits. Pochard and Coot are primarily vegetarian, while Little Grebes and Tufted Ducks prey on animal material. Tufted Ducks, in particular, also occasionally feed in shallow waters, often alongside dabbling ducks, particularly on spilt grain.

d. Waders

Distribution and feeding habits

The majority of wader species wintering in Ireland are exclusively coastal throughout the winter period. Here, they prey largely on marine invertebrates present in sandy and muddy substrates of estuaries, open coast and along rocky shoreline.

A number of wader species, namely Oystercatcher, Golden Plover, Lapwing, Jack Snipe, Snipe, Woodcock, Black-tailed Godwit and Curlew, also forage on a variety of soil and surface-feeding invertebrates present in farmland. Oystercatchers and Black-tailed Godwits use mostly coastal grasslands, while Golden Plover, Lapwing, Jack Snipe, Snipe, Woodcock and Curlew are much more widely distributed on a variety of both coastal and inland sites. Both Golden Plover and Lapwing (**Figure 13**) are also known to forage on grassland sites at night, possibly to avoid Black-headed and Common Gulls (see below).

Social interactions

Waders are highly gregarious, and large numbers occur on coastal sites in Ireland. Inland, Lapwing and Golden Plover flocks often mix, and occasionally include other species, such as Black-headed Gull. Curlew are often also present, but in general tend to form more discrete flocks. Jack Snipe, Snipe and Woodcock are skulking species, are highly elusive, and are less likely to interact with the above species.

e. Gulls

Distribution and feeding habits

Gull species occurring in Ireland are predominantly coastal. Most tend to feed at sea, on fish and on offal discarded from fishing trawlers. Some, such as Herring Gull, scavenge close to human habitation, particularly on rubbish tips. Black-headed and Common Gulls (**Figure 14** and **15**) also occur on a variety of coastal and inland farmland sites throughout the country, where they forage for earthworms and other soil invertebrates.

Social interactions

The feeding and roosting habits of most gull species wintering in Ireland are broadly similar, and large numbers regularly assemble, particularly on coastal sites throughout the Irish coastline. Additionally, Black-headed Gull and Common Gull

occur, often together, on a variety of inland sites. Here, they are associated with wetlands, but also regularly occur on pasture. They are often recorded feeding alongside Golden Plover and Lapwing. Both gull species are known to parasitise Golden Plover and Lapwing.

CONCLUSION

Ireland is attractive to a wide variety of waterbirds, due to the variety and abundance of wetlands. During the winter, over 1m waterbirds, comprising mostly migrants from arctic and boreal breeding areas, spend the winter in Ireland, congregating predominantly on wetland sites, and occurring alongside resident waterbirds, often in large mixed-species flocks. There is very substantial mixing of waterbird populations in Ireland, throughout Europe and internationally. Throughout Ireland, there is interaction between different waterbird populations (breeding migrants, the wintering migrants and resident waterbird populations) and species. There is also a regular and complex pattern of movement between feeding and roosting areas, and between wetlands and farmland, which will each also increase the mixing of waterbird species and populations. These interactions are likely to facilitate the rapid transmission and spread of the H5N1 avian influenza virus, if it were present in Ireland.

ACKNOWLEDGEMENTS

I-WeBS is a joint project of BirdWatch Ireland and NPWS, and relies on hundreds of dedicated volunteers and staff of partner organisations.

REFERENCES

- Boere GC, Stroud DA (2006) The flyway concept: what it is and what it isn't. Waterbirds around the world. Eds G.C. Boere, C.A. Galbraith, D.A. Stroud. The Stationery Office, Edinburgh, UK. pp. 40-49.
- Crowe O (2005) Ireland's Wetlands and their Waterbirds: Status and Distribution. BirdWatch Ireland, Wicklow.
- Crowe O, Austin GE, Colhoun K et al. (2008) Estimates and trends of waterbird numbers wintering in Ireland 1994/95-2003/04. Bird Study 55, 66-77.
- Davidson NC, Pienkowski MW (eds). (1987) The conservation of international flyway populations of waders. Wader Study Group Bulletin 49 (Supplement), 1-151.
- DAFF (2009) Avian influenza information, Department of Agriculture and Food. Available from: http://www.agriculture.gov.ie/avian_influenza/ [Accessed 14 September 2009].
- EFSA (2006) Opinion on migratory birds and their possible role in the spread of highly pathogenic avian influenza. The European Food Safety Authority Journal 357, 1-46.
- EFSA (2008) Scientific Opinion of the Panel on Animal Health and Welfare on a request from The European Commission on Animal health and welfare aspects of avian influenza and the risk of its introduction into the EU poultry holdings. The European Food Safety Authority Journal 715, 1-161.
- European Commission (2006) Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds, and its amending acts. Available from: http://europa.eu/legislation_summaries/environment/nature_and_biodiversity/l28046_en.htm [Accessed 14 September 2009].
- European Commission (2007) Avian influenza, DG Health and Consumer Protection. Available from: http://ec.europa.eu/food/animal/diseases/controlmeasures/avian/index_en.htm#ai_response [Accessed 14 September 2009].
- Gibbons DW, Reid JB and Chapman RA (1993) The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991. T. & A. D. Poyser, London.
- Hutchinson CD (1979) Ireland's Wetlands and Their Birds. Irish Wildbird Conservancy, Dublin.
- Kilpatrick AM, Chmura AA, Gibbons DW, Fleischer RC, Marra PP, Daszak P (2006) Predicting the global spread of H5N1 avian influenza. Proc Natl Acad Sci USA 103, 19368-19373
- Ramsar Convention Secretariat (2007) Designating Ramsar sites: The Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance. Ramsar handbooks for the wise use of wetlands, 3rd edition, vol. 14. Ramsar Convention Secretariat, Gland, Switzerland. Available from: http://www.ramsar.org/pdf/lib/lib_handbooks2006_e14.pdf. [Accessed 14 September 2009].
- Ridgill SC, Fox AD (1990) Cold weather movements of waterfowl in Western Europe. International Waterfowl Research Bureau Special Publication No. 13. IWRB, Slimbridge.
- Sheppard R (1993) Ireland's Wetland Wealth. Irish Wildbird Conservancy, Dublin.
- Stroud DA, Davidson NC, West R et al. (compilers) on behalf of The International Wader Study Group (2004). Status of migratory wader populations in Africa and Western Eurasia in the 1990s. International Wader Studies 15, 1-259.
- Webster RG, Bean WJ, Gorman OT et al. (1992) Evolution and ecology of influenza A viruses. Microbiol Rev 56, 152-79.
- Webster RG, Hulse-Post DJ, Sturm-Ramirez KM et al. (2007a) Changing epidemiology and ecology of highly pathogenic avian H5N1 influenza viruses. Avian Dis 51, 269-272.
- Webster RG, Krauss S, Hulse-Post D et al. (2007b) Evolution of influenza A viruses in wild birds. J Wildl Dis 43, S1-S6
- Wernham CV, Toms MP, Marchant JH et al. (2002) The Migration Atlas: movements of the birds of Britain and Ireland. T. & A. D. Poyser, London.
- Wetlands International (2002) Waterfowl population estimates, 3rd Edition. Wetlands International Global Series No. 12, Wageningen, The Netherlands.