Wintering Great Northern Divers *Gavia immer* off the Mullet Peninsula, Co. Mayo, Ireland

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Abstract
The Irish wintering population of Great Northern Divers *Gavia immer* has been estimated at between 1,000 and 1,500 birds. Four sites qualify as internationally important, i.e. regularly supporting 50 or more birds (> 1% of the estimated west European wintering population), of which the shallow seas around the Mullet Peninsula, Co. Mayo is one, with a five-year mean of 54 birds between 1996/97 and 2000/01. From 2002–10, a single count in flat calm conditions was made each January or February of Great Northern Divers in Blacksod Bay, off the southeast coast of the Mullet Peninsula, and from 2005 similar counts were made in Broadhaven Bay, off the northeast coast; in total, these recorded an average of 98 birds. Additional counts suggested wintering numbers were augmented in spring by moulting birds, and that from late February over 250 may be present in the area. These counts, I-WeBs data, and other incidental records, all suggest that the Irish wintering population of Great Northern Divers exceeds 1,500 birds.

Introduction
Thompson (1851) wrote of the Great Northern Diver *Gavia immer* in Ireland that it "is a regular winter visitant to the coast, remaining from five to six months, and is occasionally met with in summer"; that statement is still relevant today. They are the most numerous species of diver in winter, being present from September to April, particularly off the south, west, and northwest coasts (Hutchinson 1989). The Irish wintering population has been estimated at between 1,000 and 1,500 birds (Lack 1986), although no systematic surveys have been conducted for the species, and this figure is considered an absolute minimum (Crowe 2005).

Recent estimates of local numbers are based on systematic counts of waterfowl under the Irish Wetland Bird Survey (I-WeBS), a joint project of the National Parks and Wildlife Service and BirdWatch Ireland initiated in 1994/95 (Boland *et al*. 2010). I-WeBS data found that three 'sites' qualified as internationally important for Great Northern Divers, i.e. regularly holding 50 or more birds, or 1% or more of the estimated west European wintering population of 5,000 individuals (Wetlands International 2006). These are Inner Galway Bay, the Mullet Peninsula, and Donegal Bay, which held five-year winter means of 105, 54 and 50 birds, respectively, between 1996/97 and 2000/01 (Crowe 2005). A more recent assessment found that these sites still qualified as of international importance, along with

Ballinskelligs Bay, Co. Kerry, on the basis of 70 birds recorded in 2003/04, while the five-year mean for the Mullet Peninsula increased to 91 birds between 2003/04 and 2007/08 (Boland 2010), possibly due to increased coverage and changes in observers (H. Boland pers. comm.).

However, wintering Great Northern Divers can be difficult to detect from land in all but the calmest sea conditions, and are not adequately monitored through the I-WeBS, since counts are conducted on predetermined dates irrespective of

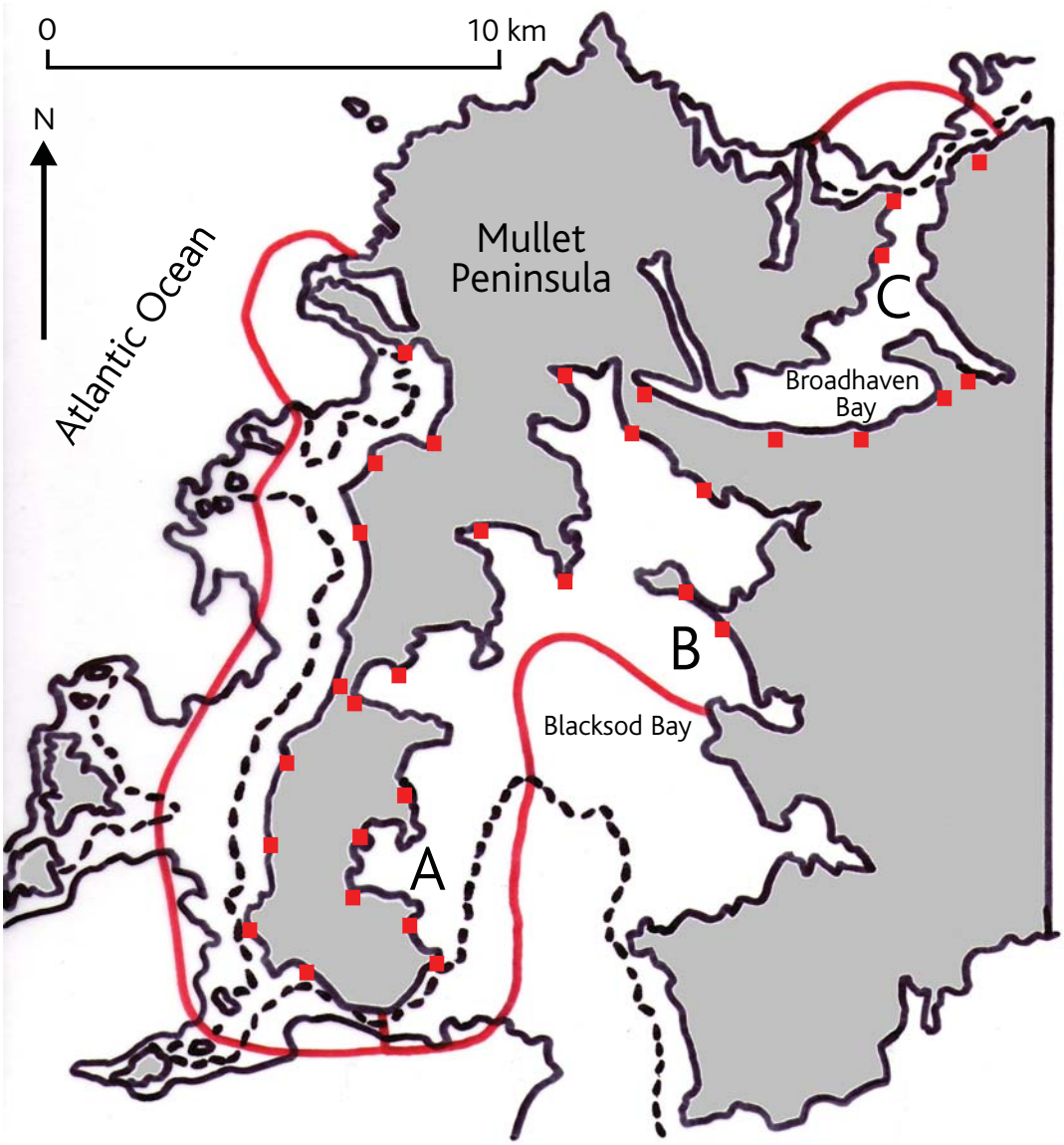

Figure 1. Location of count points (red squares) and limits of survey area (red line) for wintering Great Northern Divers *Gavia immer* around the Mullet Peninsula. The bays marked A - C on average held the highest numbers during January - February each winter. The dashed line depicts the 10m isobath and the solid line the 20m isobath.

weather conditions (Crowe 2005). The aim of this study was to achieve at least one count of Great Northern Divers in the relatively sheltered waters east of the Mullet Peninsula between late December and February during flat calm conditions. In addition, when conditions and time allowed, an effort was made to count the same area in spring (March to May).

Study area and methods

The Mullet Peninsula (54°05'N 10°05'W; 54°18'N 10°00'W) in Co. Mayo, northwest Ireland, is bordered by two large, sheltered bays to the east, and by the Atlantic Ocean to the west (Figure 1). The two bays, Blacksod and Broadhaven, are separated by an isthmus and extend over approximate sea areas of 160 km^2 and 44 km^2, respectively, and within them are various smaller sheltered bays and inlets. Both bays have weak tidal streams, average a depth of 10 m reaching a maximum of 19 m at their mouths, and support a range of littoral and sub-littoral sediment communities and infra-littoral reefs (NPWS 2001, 2003). Because of their sheltered nature, these bays are used for recreational purposes, mainly by local fishermen in small boats and by water sport enthusiasts, but such disturbance is limited in winter because of weather conditions. The 18 km long, low-lying west coast of the Mullet Peninsula comprises bays and long stretches of sandy beaches. This extensive sea area (c. 52 km^2) of waters up to 20 m deep has a strong tidal stream, and is afforded some protection from winter storms by various small islands situated up to 4 km offshore.

Counts were conducted each winter on at least one date between late December and February, in wind speeds of Beaufort Force 2 or less and a smooth sea state. These were considered optimal conditions, allowing divers to be identified up to at least 2 km offshore using the 'look-see' method (Bibby *et al*. 1992). From vantage points c. 10–15 m above sea level, pre-defined areas were scanned slowly using binoculars and a tripod-mounted 20–60x telescope. No divers were aged. Beginning in 2001/02, counts covered the smaller bays along the east coast of the Mullet Peninsula within Blacksod Bay, an approximate sea area of 44 km^2. In 2004/05 this was extended to include c. 22 km^2 of the inner section of Broadhaven Bay. Each pre-defined area was counted in sequential order, starting at the southern tip of the Mullet Peninsula in Blacksod Bay at c. 09.00 h and working north along its east coast so as to reduce the risk of double-counting birds, and completing the inner section of Broadhaven Bay by 17.00 h. If the wind speed increased then the count was considered as suboptimal, and only Blacksod Bay was counted. These same methods were used for some further counts in March to May.

These same areas were also covered by I-WeBS counts. In some winters, depending on observer availability, these I-WeBS counts included the west coast of the mainland within Blacksod Bay, an approximate sea area of 46 km^2. Because of its exposed nature, very few opportunities arose for counts along the west coast of the Mullet Peninsula; no full surveys were made in winter but three counts in calm sea conditions were completed in spring in different years.

Table 1. Counts of Great Northern Divers *Gavia immer* in January and February along the east coast of the Mullet Peninsula, in optimal and suboptimal sea conditions.

Winter	Blacksod Bay Optimal	Blacksod Bay Suboptimal	Broadhaven Bay Optimal	Total Optimal
2001/02	53	40	no count	-
2002/03	57	41	no count	-
2003/04	57	no count	no count	-
2004/05	56	29, 28	34	90
2005/06	57	23, 35	35	92
2006/07	58	no count	43	101
2007/08	84	no count	35	119
2008/09	66	43, 32	22	88
2009/10	54	no count	41	95
Mean ± SE	60.2 ± 3.2	33.9 ± 2.5	35.0 ± 3.0	97.5 ± 4.7

Results

A single count between 16 January and 23 February (median date: 5 February), in calm conditions, was achieved each winter over nine years for Blacksod Bay and six years for Broadhaven Bay (Table 1). In Blacksod Bay, numbers ranged from 53 to 66 birds in eight winters (mean = 57.3 ± 1.4 SE), with a higher count of 84 on 15 January 2008; this last count may have coincided with a movement of birds across the bay from the east side, where up to 30 birds are known to winter (I-WeBS data), although there is no direct evidence to support this. The distribution of birds within Blacksod Bay varied, but two small bays, each c. 4 km^2 (A & B, Figure 1) generally recorded the highest numbers with a mean count of 13 birds in each. The range and variation in counts (22–43 birds, mean = 35.0 ± 3.0 SE) was slightly higher in Broadhaven Bay, influenced by a relatively low count of 22 birds on 23 February 2009, for reasons unknown. Within Broadhaven Bay, birds generally frequented a sheltered area approximately 7 km^2 (C, Figure 1). The overall mean count of Great Northern Divers wintering in these bays was 97.5 ± 4.7 SE (Table 1).

Table 2. Counts of Great Northern Divers *Gavia immer* within Blacksod Bay in March, April and May, in optimal and suboptimal sea conditions.

Spring	Optimal	Suboptimal
2002	96 (9/5)	no count
2003	131 (26/3)	58 (11/4)
2004	no count	no count
2005	65 (9/3), 115 (11/5)	no count
2006	60 (14/3), 55 (30/4)	no count
2007	89 (6/4)	47 (12/3)
2008	no count	no count
2009	no count	no count
2010	91 (1/3)	no count

On the eight occasions when conditions became suboptimal, i.e. with a wind speed of up to Beaufort Force 4 and small waves, some breaking, counts within Blacksod Bay were completed but fewer divers were recorded, with a mean of 33.9 ± 2.5 SE birds as opposed 60.2 ± 3.2 SE (t = 6.342, P < 0.001) during optimum conditions (Table 1).

From late February, numbers within Blacksod Bay varied considerably (no systematic counts were made in Broadhaven Bay), with up to 131 birds in March, 89 in April, and 115 birds in May indicating increased numbers from those wintering (Table 2). Many of these birds were noted as in active primary wing moult. Whether these were birds that had wintered in more exposed locations

within the general area and moved into the more sheltered waters of Blacksod Bay to moult, or whether they were migrants from further south in the wintering range using the bay as a moult staging area is unknown.

Because of its exposed nature, the west coast of the Mullet Peninsula is difficult to survey and it is unknown how many birds winter there. Nevertheless, three counts in calm conditions, of 64 on 9 March 2005, 46 on 30 April 2006, and 132 on 1 March 2010 (when 91 were also counted in Blacksod Bay and 31 in Broadhaven Bay), indicate the area does, at least in the spring, hold appreciable numbers; this last count of 254 birds would represent c. 5% of the current estimate for the west European wintering population. Many of these birds were also in active primary moult, in groups of up to 25, and with adults calling frequently. Most were found in the 'mid channel', an area with a water depth of c. 15 m extending over 14 km^2. Beyond this, and beyond the offshore islands, no divers were recorded during systematic transects in calm sea conditions on 5 March and 13 April 2010 (pers. obs.), extending up to 15 km offshore and in water depths gently shelving to 100 m. In conjunction with those in Blacksod Bay, these counts suggest the wintering population around the Mullet Peninsula is augmented in spring by variable numbers of birds from elsewhere gathering to moult.

Discussion

Counting Great Northern Divers accurately in winter is not easy, and comparing numbers between winters, and estimating populations should be done with caution. Nevertheless, the data presented here suggest that (a) by conducting counts only in the most favourable sea conditions relatively consistent numbers can be recorded in successive winters, and (b) c. 100–120 birds winter within the two large bays on the east coast of the Mullet Peninsula, with an (as yet) unknown number wintering off the west coast, including around the offshore islands.

Given these rather consistent wintering numbers, it is tempting to speculate that the same adults return to these bays each autumn. There is little published evidence for winter site-fidelity in Great Northern Divers, but the case of a leucistic bird that returned to the same bay in Shetland for at least 19 successive winters suggests it may well occur (Suddaby 1992; Pennington *et al*. 2004). As with other wintering populations in Western Europe, their breeding origin, whether Iceland, Greenland or Arctic Canada (or a combination of these) remains largely a matter of speculation (Lack 1986; Heubeck *et al*. 1993; Weir *et al*. 1996).

As well as hosting numbers of international importance in winter, the waters around the Mullet Peninsula are a major spring moulting area for Great Northern Divers, when up to 250 may be present at any one time. This lends them susceptible to any environmental change in the area. Divers are highly vulnerable to the effects of large oil spills, which can have a long-term local impact on wintering numbers (Pennington *et al*. 2004). Fortunately, the Mullet Peninsula is remote from major inshore shipping routes and is therefore considered at low risk from oil pollution. However, the extraction of natural gas approximately 83 km to

the northwest, with a pipeline to shore running through Broadhaven Bay to a processing plant, presents one potential threat to the species' use of the area, another being a renewable wave-energy project currently proposed for the west coast of the Mullet Peninsula.

As off the Mullet Peninsula, there is increasing evidence that more Great Northern Divers winter at some Irish locations than has been suggested by the I-WeBS, and that wintering numbers are then exceeded by higher counts in late winter and early spring. Records submitted to www.irishbirding.com over the last two winters show that up to 280 birds (January 2009) can be present in Inner Galway Bay (D. Breen pers. comm), whereas the highest I-WeBS count for the area was 191 in January 2003, while off Achill Island, Co. Mayo numbers increased from 37 birds in December 2009 to 104 in April 2010 (M. O'Briain pers. comm). In the Irish Sea, numbers in Dundalk Bay, Co. Louth increased from 79 birds in mid November 2008 to 167 in January 2009, and 270 by mid February 2009 (H. Delaney pers. comm.). Similarly, in Ballyteigue Bay, Co. Wexford numbers increased from 43 birds in late November 2009 to 116 by 1 March 2010 (K. Mullarney pers. comm.). From such records, this study, and I-WeBS data, it is evident that the Irish wintering population of Great Northern Divers almost certainly exceeds 1,500 birds, while numbers would seem to be further enhanced by an influx of moulting birds in spring.

The west European wintering range of Great Northern Divers extends from western Norway south through the British Isles (mainly Atlantic coasts) and the Bay of Biscay to northern Iberia (Cramp & Simmons 1977). However, little is known about the speed of migration, the use of stopover sites, or turnover rates at particular sites. Along the west and north coasts of Scotland, peak numbers of Great Northern Divers at favoured locations tend to occur during autumn and (especially) spring migration (Pennington *et al*. 2004; ap Rheinallt *et al*. 2007; Forrester *et al*. 2007). However, it remains unclear to what extent higher counts in March, April and May represent (1) local wintering birds flocking more during the pre-nuptial moult, (2) birds from more southern wintering areas migrating north to moult closer to a departure point for an Atlantic crossing, or (3) birds that have completed their moult in southern wintering areas using northern locations as migratory stop-over sites, and at what turnover rate. Given its position in northwest Ireland (Figure 1), the Mullet Peninsula would seem a suitable location for the latter two options for birds that have wintered in the southern half of the west European range. Finally, although there would certainly be logistic difficulties, the application of remote tracking technology (Kenow *et al*. 2002) to Great Northern Divers that winter in Europe would provide a fascinating insight into the migratory habits of this enigmatic species.

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