

BTO Research Report No. 234

**Population Estimates &
Habitat Associations of
Breeding Waders in
Northern Ireland, 1999:
The Results of an Extensive Survey**

Authors

Ian Henderson, Andrew Wilson & David Steele

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1. EXECUTIVE SUMMARY

1. A re-survey of 106 tetrads (2 km x 2 km squares) in Northern Ireland, each previously surveyed in 1987 (then 146 tetrads in total), was conducted between April and June of 1999 to survey breeding populations of Snipe, Lapwing, Curlew and Redshank. Most observers (62%) surveyed their allocated tetrads on two occasions over this period, recording both birds and habitat information.
2. The survey revealed breeding population declines of over 50% for Lapwing, Curlew and possibly Redshank and over 30% for Snipe. Snipe densities may have been underestimated in 1999 compared to 1987, but a shallow decline in this species is still suspected over the interim period.
3. In general, few birds of any species were recorded on improved pastures or winter cereals. Lapwings, which were recorded on a wider range of habitats than other species, were recorded frequently on cultivated land, but only on late developing spring crops, stubbles or bare soil. Winter cereals and improved grasslands were avoided by this species. Breeding Lapwings were particularly scarce in the eastern counties of Northern Ireland.
4. Snipe were typically associated with bog/mire and marshy habitats, and their apparent decline may be linked to widespread losses of these habitats across Northern Ireland and particularly on farmland, since no clear range contraction was observed. Very few Snipe were recorded on improved grasslands.
5. Almost all Curlew were associated with bog/mire and unimproved grassland. Population declines, particularly in County Antrim, appear to represent a continuing range contraction from the eastern region of Northern Ireland. Previous studies have identified predation as possible proximate cause of the Curlew decline, but strong relationships with habitat composition, such as grassland mosaics are also emphasised in further studies within the UK. Curlew also avoided improved grasslands (relative to its availability). As with Snipe and Lapwing, marshy ground or surface water (including ponds or lakes) was a component of virtually all tetrads in which Curlew were found, but was present in less than half of the tetrads in which no waders were found.
6. Only five Redshank pairs (nine birds) were recorded in the survey and their scarcity and localised distribution restricts the power of the current large-scale, random tetrad design of survey to generate population estimates with any degree of precision. Consequently, a thorough census of known key wader sites in Northern Ireland is recommended for all species above but especially for Redshank.
7. The population declines of Lapwing, Curlew and Redshank in Northern Ireland exceed the alert level criteria for red listed species of conservation concern, that is, a greater than 50% decline in 25 years.

2. INTRODUCTION

There have been growing concerns about widespread loss of biodiversity particularly within farm landscapes, both in the UK, and more widely in mainland western Europe and the USA (Flade & Steiof 1990; Barr *et al.* 1993; Saris *et al.* 1994; Tucker & Heath 1994). Long-term monitoring programmes are showing substantial declines in the status of many groups of plants and animals (Firbank *et al.* 1991; Siriwardena *et al.* 1998; Donald *et al.* 1998). Among birds, waders (Charadriiformes) have attracted attention since some once common and widespread species, such as Curlew *Numenius arquata* and Lapwing *Vanellus vanellus*, are now considered threatened in both lowland farmland and upland grassland areas across many parts of western Europe (e.g. Wilson *et al.* 1999).

Within Europe, Northern Ireland is recognised as supporting important populations of breeding Curlew and Snipe *Gallinago gallinago* as well as significant populations of Lapwing within Britain and Ireland. In 1987, population estimates of 5,000 breeding pairs of Curlew and 5,725 breeding pairs of Snipe were considered to represent 10.6% (though less from recent estimates, e.g. Grant 1997) and 14.3% of the British and Irish Curlew and Snipe populations, and 8.2% and 9.9% of the European Union populations respectively (Partridge & Smith 1992). The same survey produced estimates of 5,000 breeding pairs of Lapwing across Northern Ireland (less than 1% of the British and Irish population). Northern Ireland is characterised as having a relatively small proportion of arable land (6%), but a high proportion of grassland (57%) and uncultivated land (25%; Cooper *et al.* 1997). Heavy, poorly drained peaty soils feature throughout much of the western Province from the lowlands of Fermanagh through marginal lowlands and uplands of Tyrone and the Derry Hills, and in the east on the approaches to the Mourne Mountains and Antrim Hills. In the pastoral lakelands of Co. Fermanagh, wet lowland areas take the form of species-rich grassland which have traditionally provided important breeding grounds for wading birds such as Lapwing in drier areas and in particular Snipe on swamp and fen habitats. Within the predominantly pastoral landscape of the marginal lowlands and marginal uplands, blanket bog becomes more apparent, though largely as drier 'cut-over' following generations of peat extraction (Cooper *et al.* 1997). These bogs together with the extensive upland blanket bogs of Counties Tyrone, Derry, Antrim and south Armagh have traditionally provided the major breeding areas for Curlew within the Province. Other significant wader concentrations in Northern Ireland include the Bann, Main and Blackwater river catchment areas and the drumlin farmlands of Co. Down and Co. Armagh. The former are characterised by productive farmland with remnants of cut-over bog, flood plains, leading to the shores on Lough Neagh and favoured habitat of breeding Redshank. Drumlin farmland is productive farmland which has, in the past, attracted breeding Lapwing on less intensively managed areas, and may also feature areas of marsh or fenland associated with lough fringes or drainage ditches on farmland.

Historically, blanket bogs and wetland complexes were integral in supporting Northern Ireland's outstanding wader populations, unimproved grassland was significant for Lapwing over much of the region. Damage to key wader habitats has nevertheless continued over a period of 60 years (Partridge & Smith 1992), with activities including: 1. mechanised peat cutting, 2. land reclamation on peatland, 3. the infilling of wetland sites for waste disposal and development, 4. flood-relief drainage schemes, and 5. increasingly intensive grassland management through re-seeding, the application of inorganic fertilisers and increased grazing pressure.

The study below was commissioned by the Environment and Heritage Service, to measure changes in breeding wader populations between 1987 and 1999, by re-surveying randomly selected tetrads (2 km x 2 km squares) last surveyed in 1987 by the Royal Society for the Protection of Birds (RSPB). The analysis also examines habitat associations of breeding wader

pairs.

3. METHODS

3.1 Survey Coverage

The initial target of the survey was to cover 146 tetrads (2 km by 2 km squares) across Northern Ireland, previously surveyed in 1987 in which each tetrad was randomly selected from within each land-based 10-km square in Northern Ireland (Partridge & Smith 1992). However, it was unlikely that all 146 tetrads would be covered given the combination of low volunteer density in the many rural areas and a relatively late start to the survey organisation. Hence our main priority was to establish representation across landscapes in order that realistic estimates of wader population size could be calculated. To achieve the appropriate distribution of tetrads, 39 tetrads located in remote areas of Co. Tyrone, Co. Fermanagh and Co. Armagh were covered by a professional ornithologist. Throughout the rest of Northern Ireland, volunteer ornithologists were recruited through the BTO's regional network including two regionally-advertised recruitment and training evenings organised jointly by the BTO and RSPB in Northern Ireland.

3.2 Survey Procedure

The procedure for surveying each tetrad was as follows (see Appendix): observers were asked to visit their allocated tetrad on two occasions, once between 9 April and 17 May and the second between 18 May and 21 of June 1999. This was directly comparable to the season covered during 1987. Most breeding waders would be on territory during the first visit, with the second visit aimed at increasing the detection rate of pairs, particularly where chicks and juveniles were present. On each visit (often lasting four or five hours), observers were asked to walk over as much of their tetrad as possible (the "field by field" method) recording all birds seen or heard, using binoculars to view inaccessible areas. In particular, and also comparable to the 1987 survey, observers were explicitly asked to search for areas of potential wader habitat (for example, wet flushes or unimproved grassland) and to cover these carefully in order to improve the detection rate of Snipe (Partridge & Smith 1992). Expansive areas of open moorland or grassland were covered by walking four transects per tetrad, at approximate 200 to 250 m intervals (c.f. Partridge & Smith 1992). Observers estimated the area of land within the tetrad that they were able to cover so that uncovered areas could be accounted for in the calculations of population size. Contacts with waders and their group size were recorded onto a 1:10,000 map of each tetrad, and each record allocated to a pre-determined habitat category (see below; c.f. Partridge & Smith 1992). Other than incubating females, breeding pairs of waders were taken to include any singles or pairs of birds encountered away from shorelines, beaches or estuaries, as well as individuals seen to display, mob, or assuming other territorial behaviours (c.f. Partridge & Smith 1992). The total number of pairs estimated per tetrad was equal to the maximum count for a single visit, unless it was clear from the observers that different birds had been seen on each of the two visits. Flocks of waders greater than four in number were recorded as individuals rather than breeding pairs and assumed to be non-breeding birds (occasionally two pairs can come together to forage on common ground, mob intruders or dispute boundaries). In practice, flocks were mainly encountered in coastal habitats and along lough shorelines.

3.3 Habitat Information

For each of the four 1-km squares within a tetrad, observers estimated the proportion of area that was occupied by habitat types from pre-determined categories. These categories included, for example, improved grassland, (grazed/ungrazed - with sheep, cattle or horses), unimproved grassland (grazed/ungrazed), upland heather moorland, water bodies, woodland etc. A full list of habitat categories and their definitions are presented in the Appendix. Each bird record was

associated with one of these categories in order that the abundance and distribution of a species might be linked to particular habitat features.

3.4 Analysis

For each species, abundance across tetrads in 1999 was essentially analysed by multiplying the sum total number of pairs by the relative proportion of land area of Northern Ireland surveyed (corrected for the mean proportion of area of each tetrad covered; as in 1987). Confidence limits for population estimates were calculated using a boot-strapping procedure that re-samples the count data randomly (999 times) to produce population estimates on each iteration, resulting in the calculation of a mean population estimate plus 95% confidence limits for each species.

A relative measure of preference for defined habitat types was calculated on combined categories in order to increase the sample sizes (see Figures 3-5), for Snipe, Lapwing and Curlew. The indices were calculated using the formula:

$$\text{Preference index} = 100 \times \log_{10} (\text{observed pairs} / \text{expected pairs}).$$

The index generated positive values (i.e. representing selection for a habitat) and negative values (i.e. representing avoidance of a habitat, although if no pairs were found on a habitat the index value is infinity). The expected values were calculated by assuming pairs were distributed randomly across habitats in direct proportion to the area of each habitat within the covered tetrads (assessed by fieldworkers). Redshank *Tringa totanus* were so few in number that such an analysis was not considered meaningful.

4. RESULTS

4.1 Tetrad Distribution and Coverage

All of the tetrads surveyed in the current survey were also surveyed in 1987; their distribution is presented in Figure 1. At the beginning of the survey, volunteers were found to cover 90 tetrads (i.e. 129 in all, including 39 tetrads covered by professional staff), leaving just 17 tetrads without coverage. Data was eventually received from 67 volunteers, mainly during September, but with two sets arriving in December 1999, so that the wader population estimates were based on 106 tetrads. All volunteers were contacted on at least two occasions by mail or by telephone in order to encourage the return of data (standard procedure for such surveys) but 23 volunteers failed to return tetrad information. Under represented areas were scattered but with concentrations across south-west Co. Down and south Armagh as well as part of the Antrim Hills. Otherwise, surveyed tetrads were fairly evenly distributed across the Province and representative of most landscape types. The tetrad area surveyed represented approximately 2.7% of the total land area of Northern Ireland (approximately 13600 km²). This percentage includes a mean area of coverage within tetrads of 87.0% (where coverage includes land not visited but known to be unsuitable as breeding wader habitat, such as continuous commercial forest or built up areas).

Figure 2 shows the distribution across tetrads of each wader species in the 106 tetrads covered in 1999, of which 62.5% were visited twice. The majority of tetrads in the 1987 survey were only visited once (Partridge & Smith 1992) so that in this respect, the likelihood of waders being found was potentially higher in 1999 than in 1987. No specific training was given to volunteers in 1987, whereas in 1999 two workshops were held, one in Belfast and one in Coleraine, in which the survey methods were explained to at least 30 volunteers. One of the presenters of the workshop, Clive Mellon (RSPB Belfast), had first-hand knowledge of the methods used in the 1987 survey, which he could divulge to the volunteers present, including a preference for morning work to improve wader detection rates. Some emphasis was placed on volunteers making morning visits in 1987 to increase the detection rate of waders such as Snipe, which are most active in display during the mornings or evenings. This aspect was not explicitly emphasised in the instructions for 1999 because priority was given to encouraging as many people as possible to take part. The prospect of early mornings can sometimes reduce volunteer uptake. The resulting reduction in detection rate of Snipe is unknown although it is likely that, with most tetrads taking around four hours to cover, a high proportion of volunteers would have included either mornings or evenings in their visits (see below). For other species, the detection rate of Curlew, Lapwing and Redshank should have been closely comparable with the survey of 1987. For Redshank, however, some relatively localised areas of high density may not have been fully represented by the random sampling procedure employed by the current survey (also mentioned for the 1987 random survey). This would have particularly affected the absolute population estimates of Redshank, a species that appears to be becoming increasingly patchy in breeding distribution in Northern Ireland.

4.2 Species Accounts

4.2.1 Lapwing

In 1987, breeding Lapwing were widespread across Northern Ireland (Figure 2), particularly in pastoral marginal uplands and lowlands, but also on arable land in the east of the Province. Lapwings were especially associated with close-grazed, slightly damp grassland, with concentrations around the Lough Erne and Lough Neagh basins (Partridge & Smith 1992). Current population estimates indicate a 66% decline since 1987 (Table 1), although possibly less

than 30% according to the 95% confidence limits in both surveys. The mean density of pairs was less than 0.5 pairs per tetrad (1.4 pairs per tetrad in 1987; Table 2). Lapwings were widely distributed west of Lough Neagh, with concentrations in Co. Tyrone and Co. Fermanagh. However, very few were located east of Lough Neagh, through Co. Antrim and the northern half of Co. Down (in contrast to the 1987 survey). Lapwings were recorded only infrequently during 1987 or during the 1988-91 breeding atlas period (Gibbons *et al.* 1993), within the southern halves of Counties Down and Armagh, or north-central Co. Londonderry. These data suggest that tetrads within these areas may not have contributed many pairs to the population total had they been included in 1999. In fact, their coverage may well have lowered the 1999 population estimate still further. Arguably, coverage of additional tetrads from the Antrim Hills, where Lapwings were found both in 1987 and during the 1988-91 atlas period, may have compensated for potential population deficiencies elsewhere. Our consensus, therefore, suggests that population values presented in Table 1 would probably approach estimates calculated from complete tetrad coverage of the Province.

Lapwings were found on a wider selection of habitats than other species (Figure 3). The highest ranked habitat preferences for Lapwing were stubble fields, late developing crops (non-cereals and spring cereals but not winter cereals) and bare soil on agricultural land (Figure 2; 13 pairs in all on these agricultural habitats). Birds also selected marshland and unimproved grassland but avoided improved grassland, especially where these were considered non-grazed (perhaps because the sward was too tall).

4.2.2 Snipe

Snipe is the commonest breeding wader in Northern Ireland which in 1987 occurred mainly in small *Juncus* wetlands and marginal habitats throughout the Province (Partridge & Smith 1992). The current survey still identified Snipe as the most abundant breeding wader and also as the most widespread wader species in Northern Ireland (Figure 2). Nevertheless, current population estimates suggest that Snipe have undergone a 30% decline since 1987 (Table 1) and currently breed at densities of 0.97 pairs per tetrad rather than 1.58 pairs per tetrad as in 1987. There may be some uncertainty in this conclusion given that 95% confidence limits overlap. Small, localised losses of breeding pairs from across Northern Ireland may have accounted for these apparent declines since few birds were recorded in either Co. Antrim or central Co. Down in 1987 (c.f. Partridge & Smith 1992) and there was no clear contraction of range. As with other species, the paucity of coverage in the Antrim Hills may have led to an underestimate of population size for Snipe. However, relatively few pairs were recorded in 1987 or later during the 1989-91 breeding atlas period, from southern Co. Down or from north-central Co. Londonderry in 1987 (areas of relatively poor coverage in 1999) implying that these tetrads may not have contributed many Snipe pairs to the population total. On balance, the population estimate given in Table 1 is probably close to that for complete coverage of Northern Ireland.

Bogs, fens and marshes were ranked highest amongst the habitat categories as those selected by Snipe (71 pairs on these habitats) with birds being recorded in few other habitats, except unimproved grassland (12 pairs) (Figure 4). These results indicated that wet and boggy areas are scarce in arable areas and on improved pastures since very few birds were discovered in these habitats or landscapes relative to their availability.

4.2.3 Curlew

In Northern Ireland, the Curlew is a species characteristic of expansive upland and marginal upland landscapes, blanket bogs and moorland, but may also occur on lowland agricultural land

including cereals and pasture (Partridge & Smith 1992). In 1987, the estimated Northern Irish population of Curlew was around 5,000 breeding pairs with clear range contractions identified at the time in areas of Co. Down and Co. Armagh. The current survey indicates further declines in overall population size estimated at around 58% (Table 1) with an average breeding density falling from 1.37 pairs per tetrad in 1987 to 0.53 pairs per tetrad (Table 2; Partridge & Smith 1992). Significant breeding concentrations were still present in Co. Tyrone and Co. Fermanagh (Figure 2), but only one record emerged from east of the River Bann, from previously identified areas of high density in central and south Co. Antrim (Partridge & Smith 1992). Previous surveys, in 1987 and during the 1988-91 breeding atlas period (Gibbons *et al.* 1993), indicate that low coverage of tetrads across the “drumlin belt” of Counties Down and south Armagh during 1999 was probably not significant in reducing the current population estimates of Curlew across Northern Ireland, at least relative to 1987. From this belt of land, in only two of the 12 tetrads that were not covered in 1999 were Curlew recorded in 1987 (see also the 1988-91 breeding atlas (Gibbons *et al.* 1993)). Furthermore, no Curlew were recorded in 1999, in the one tetrad in 1987 that was found to contain Curlew in south-west Co. Down (i.e. 10 km square J34, see Partridge & Smith 1992). Coverage of the “drumlin belt” tetrads, and tetrads from Co. Londonderry (10 km squares D 70,71,72 &73) could have reduced the mean population estimate of Curlew for 1999 still further than that presented in Table 1. Breeding Curlew may have been missed in 1999 from uncovered tetrads across the Antrim Hills (e.g. C21 to C30), or possibly from Co. Fermanagh near the border with Southern Ireland. In these locations, high densities of Curlew were recorded in both 1987 and the 1988-91 atlas period. Our consensus, however, is that coverage in Co. Fermanagh was largely complete and that our overall estimate of population decline would probably have approached 50% even had full coverage of Northern Ireland been achieved. Should the stronghold populations associated with the Antrim Hills also be depleted then the decline in this species would be even more severe than our current estimate suggests.

Virtually all Curlew were recorded on areas of bog or mires (37 pairs) or unimproved grassland (12 pairs) (Figure 5). In arable areas three pairs were recorded in non-cereals (such crops are relatively scarce). Two common and widespread habitats, improved grassland and upland grassland, were avoided by Curlews.

4.2.4 Redshank

As in 1987, the restricted distribution of Redshank meant that a random survey based on tetrads within the 10 km² grid was not suitable for providing precise estimates of population size for this species. Redshank have probably become too scarce to estimate their population size using this method and should require a more selective and intensive stratified re-survey of preferred habitats and known sites. The current population estimate probably reflects a large decrease in breeding population size (estimated at 65%), but flanked by wide confidence intervals (Table 1). Only five pairs were located from 106 tetrads compared to 21 from 146 tetrads in 1987, but records of breeding birds found by the western shores of Lough Neagh and by Lough Erne (one pair) are consistent with previously described concentrations (Figure 2; Partridge & Smith 1992). One pair of Redshank was found on heather moor, one in shoreline vegetation, one on unimproved grassland and two pairs on improved grassland (albeit with marshy, lake-shore vegetation nearby), and clearly few conclusions can be drawn with respect to habitat preferences. Four birds from the shoreline of Strangford Lough were not recorded as breeding birds and not included in the population estimates.

5. DAMAGE TO TETRADS

Most observers recorded no obvious damage to the habitats within the tetrads they visited, whether waders were present or not, although their ability to detect such damage, especially where the damage was not recent, was probably limited. The most striking result was that the majority of tetrads with breeding waders recorded in them also contained water (for Lapwing and Curlew as well as Snipe). This was in contrast to those tetrads in which no waders were recorded, and where standing water (pond, lake or bog) was detected in less than half of the tetrads (Table 3). Both extensive and piecemeal drainage of grasslands, peatlands and non arable patches of farmland could contribute to a removal of wetland breeding wader habitat.

6. DISCUSSION

The results of the present survey indicate a decline in population size exceeding 50% for Lapwing and Curlew, and potentially of the order of 30% for Snipe over the 12-year period between 1987 and 1999. Redshank may also have declined by over 50% in the same 12-year period, but the survey design was not ideal for the census of this species. Declining populations of all four species were previously identified during RSPB surveys of several key sites, most notably from Loughs Erne, Neagh, Beg, the Tyrone peat bogs and Blackwater catchment. Here declines of 39% for Lapwing, 22% for Curlew and around 15% for Snipe and Redshank were reported, between 1987 and 1992 (Donaghy & Mellon 1998). The present survey indicates that these species have continued to decline on a countryside-wide level through the 1990s and Lapwing and Curlew, in particular, have declined at a rate exceeding the threshold for red listed species of conservation concern; that is, a greater than 50% decline over 25 years (RSPB Conservation Review 10, 1996).

Some caution is recommended in interpreting the results for Snipe in 1999, due to overlapping confidence limits with 1987 population estimates and this species' inconspicuous behaviour. In both 1987 and 1999 population estimates for Snipe were probably underestimated since to estimate abundance accurately requires a series of repeated visits (ideally conducted in the evening), to account for the effects of varying weather conditions on display frequency (Fuller *et al.* 1983). Partridge & Smith (1992) agree that Snipe abundance was probably underestimated in 1987, and as with 1999, no correction factor was applied (see Green 1985). With respect to the relative differences between the two surveys, fewer early morning counts may have been carried out in 1999, although the proportion of visits that coincided with peak periods of Snipe activity in 1987 is essentially unknown. In either survey, for most tetrads, single visits will inevitably result in only a proportion of the area being surveyed at optimal times to coincide entirely with relatively narrow windows of peak activity (strictly, during the evening, and to a lesser extent, during the morning (Cramp & Simmons 1983). In 1999, approximately 10% of visits included some evening coverage that extended beyond 1700 hs (apparently there were no such visits in 1987). Almost 55% of visits were carried out partly or solely before 0900 hs. Two visits to over 60% of tetrads in 1999 may have increased the detection rate of Snipe in that year relative to 1987. Thus, we consider that the differences in survey methods between 1987 and 1999 were probably not so great as to mask a true, but relatively shallow population decline across Northern Ireland.

The average proportion of coverage of each tetrad in 1999 was around 87%. Around 75% of tetrads were counted either by professional fieldworkers or by volunteers who had received training in 1999. No such training was given in 1987. Twenty-nine percent fewer tetrads were covered in 1999, but the distribution of covered tetrads across Northern Ireland was comparable with 1987 except for a group of tetrads from south-west Co. Down and south Co. Armagh. Fewer tetrads in the sample would have reduced the level of precision attached to the population estimates, but there was no reason to suspect strong systematic biases in the data arising from this aspect of the survey (at least for the widely distributed species: Snipe, Lapwing and Curlew. As mentioned above, additional coverage of tetrads within the "drumlin belt" of Counties Down and south Armagh, would probably have added relatively few extra breeding pairs of Curlew, Lapwing or Redshank to the total, such that the population estimates for 1999 may well have been still lower. Even for Snipe, breeding pairs were relatively scarce in this region (as well as in north-central Co. Londonderry) during both the 1987 survey and the 1988-1991 breeding atlas survey. Potentially, greater coverage of tetrads in north-east Co. Antrim (Antrim Hills) and the border tetrads of Co. Fermanagh could have added further pairs of Snipe, Lapwing and Curlew to their respective population totals. In general, however, the missing tetrads would have needed to

support exceptional wader populations in 1999 to significantly alter the mean population estimates for the common three wader species for Northern Ireland as a whole.

6.1 Habitat Preferences

Large-scale changes to the rural landscape have taken place in Northern Ireland over several decades that are likely to have altered the quantity and quality of habitat available for breeding waders. With a climate more suited to growing grass, the area of arable land has declined and mixed farming has been replaced by increasingly intensive livestock production. The subsidy system of the Common Agricultural Policy has encouraged heavier stocking and livestock densities have risen by almost 50% in just over 30 years with sheep numbers alone increasing almost three-fold to 2.5 million animals (Donaghy & Mellon 1998). To support this number of animals, management of the pastoral ecosystem has become increasingly intensive through the re-seeding of rough pastures and the use of fertilisers to produce productive, uniform swards (Donaghy & Mellon 1998). Widespread, yet piecemeal reclamation of boggy hollows and corners in fields is likely to be associated with this level of grassland intensification. Thus, the loss of damp, “tussocky” pasture and its replacement with dry, uniform monoculture grassland is a process which threatens the existence of the two key features that attract breeding waders: 1. wet grassland (all species) and 2. tussocky or “rushy” grassland (not Lapwing). On a broad front across regions, such changes will potentially threaten as many pairs of waders as will high profile drainage and reclamation schemes as witnessed on flood plains such as that associated with the River Blackwater.

In our current survey, of 1999, wader registrations are simply associated with particular habitat types that could be identified from relatively brief visits to the countryside. There was no capability to analyse changes in wader density in relation to subtle alterations to the grassland ecosystem (from which to help identify cause and effect). Nevertheless, it was clear that none of the species was associated with improved grassland, despite this being a common and widespread habitat. Not all species responded to the same habitat criteria in the same way, however, and Lapwings for example, displayed a stronger association with arable landscapes than the other species. For Lapwing, increased intensification of both arable and pastoral farmland, and the loss of mixed farming practice is thought to have been significant in severe population declines in Wales (down 77%) and south-west England (down 64%) between 1987 and 1998 (Wilson *et al.* 1999). In particular, Lapwings are considered to have suffered from a long-term reduction in the area of spring tillage on arable land, and the mix of spring tillage and unimproved, grazing land with low stock density (Wilson *et al.* 1999). In Northern Ireland Lapwings showed an association with arable habitats where bare ground or short, sparse vegetation was available. These field types included stubbles, spring-sown crops and non-cereals but not winter cereals presumably because the crop is generally too tall or dense during April and May. Above all, however, the almost complete lack of association with improved grassland by Lapwings is probably the most profoundly significant land issue to affect this species' distribution and abundance in Northern Ireland. It is known that short, sparse swards are generally preferred by breeding Lapwings to densely vegetated improved pasture (e.g. Herbert *et al.* 1990). Suitable foraging habitat is also required to encourage invertebrates associated with old or damp grassland or soil (Cramp & Simmons 1983). The avoidance of improved grassland by Lapwings thus emphasises the likely impact of agricultural intensification within pastoral habitats on this species' status. Regionally, the impact of habitat degradation appears to have been most severe in the east, in Counties Antrim and Down, where Lapwing were recorded in 40 tetrads (27%) in 1987 but only four tetrads (4%) in 1999.

Very few breeding pairs of Curlew were associated with arable farmland or improved grassland in 1999. Instead, virtually all pairs were found on bog/mires and unimproved grassland, in

common with habitat preferences recorded in 1987 (Partridge & Smith 1992, Grant 1997). Curlew require a mosaic of nesting (rough grassland) and wet feeding habitat in preferred territories, so that both re-seeding and drainage processes are likely to reduce breeding densities. In Orkney, high breeding densities of Curlew occur on moorland/wetland complexes in total contrast to nearby improved grasslands (Gibbons *et al.* 1993). In other studies of Curlew in Britain and Ireland, high breeding densities were found to decline steeply in proportion to the area of available improved grassland (Baines 1989). It is widely recognised that the population of generalist predators (through reduced persecution) has increased in recent years in Northern Ireland, and it has been shown that Curlew in Co. Antrim and Co. Fermanagh may suffer directly from high levels of chick predation by Foxes *Vulpes vulpes* and Hooded Crows *Corvus corone* or Lesser Back-backed Gulls *Larus fuscus* (Grant *et al.* 1999). In the Pennines, on moorland where predators were controlled, clutch success was found to be higher than in Northern Ireland (Grant 1997). In Finland too, intensive studies revealed high predation rates on Curlew clutches, but this was particularly the case in areas of habitat fragmentation or in the proximity of forestry, roads or tracks which improve cover and access to predators (Valkama *et al.* 1999). Higher stock densities (providing carrion), habitat degradation or fragmentation, adjacent forestry, human activity (increasing disturbance and producing litter) and drier more uniform habitats (which allow improved access for ground predators) could all potentially facilitate higher predation rates in addition to reduced predator control (c.f. Grant *et al.* 1999) and contribute to a declining population. If the predation rates in Co. Antrim and Co. Fermanagh are typical of predation rates across Northern Ireland, then it is interesting, that the greatest contraction of range for Curlew has occurred in the east of the Province, from Co. Down and south Co. Armagh since the 1970s, (compare the two Breeding Atlases periods; c.f. Gibbons *et al.* 1993). This range contraction has continued into Co. Antrim, where Curlew were recorded from 27 tetrads in 1987 but from only one tetrad in 1999. Clearly, then, there are regional differences in key factors, such as predation rate, habitat/landscape composition and maybe exacerbated by climatic changes that contribute to this disparity. In the current study a damp substrate was an important factor (Cramp & Simmons 1983), since almost all tetrads from which Curlew were recorded in 1999 contained some element of standing water (lakes or wetlands), compared to only 46% of tetrads in which no waders were found.

Partridge & Smith (1992) emphasised the importance of small *Juncus* beds, wetlands and marginal habitats for Snipe and indeed the majority of records in 1999 were also associated with bog, marsh and unimproved grassland. For Snipe, their apparent decline was more likely to be a function of widespread but possibly localised losses of breeding habitat (perhaps through piecemeal drainage and land improvement operations) than a range contraction since there were few clearly defined centres of absence. The lack of association between Snipe and improved grassland implies that suitable damp ground may be a rare component of this habitat and may contribute to population change in this species.

For all species, but particularly for Redshank, some traditional areas of high wader density may not have been fully represented by the current survey (in 1987 key sites were also surveyed independently of the main survey). These areas include, for example, the Fairywater Valley in Co. Tyrone, the Lakelands of Co. Fermanagh and lake marginal habitats around Lough Neagh/Beg. As a rule, however, breeding Redshank are surveyed with reasonable accuracy, particularly when chicks are present, which is due to the parent's habit of mobbing intruders within the relatively discrete confines of the breeding territory (Fuller *et al.* 1983) such that neighbouring pairs can easily be distinguished from one another. Redshank, may, therefore, have undergone a severe population decline in Northern Ireland, possibly exceeding 50% over a 12-year period. This species has become so restricted in range that their numbers are difficult to assess with precision using large-scale randomised surveys and clearly Redshank would benefit

from a more intensive investigation.

The current survey was not designed to investigate the impact of grazing pressure in detail and this important aspect of breeding wader ecology would benefit from a more intensive field study. In both the 1987 and 1999 wader surveys, the identification of grazing on a field was largely dependent on the presence or absence of livestock at the time a tetrad was visited. However, the effects of grazing on the condition of a habitat could be carried over several weeks after livestock were removed. Moreover, the relationship between grazing and wader territory density may not be linear, such that, for example, light grazing may create a suitable sward for breeding or foraging birds, while heavy grazing may increase the risk of trampling, predation or ground compaction (e.g. Lapwings; Green 1987). The presence or absence of grazing measured at the tetrad level cannot determine whether these more subtle relationships exist, but intensive studies could determine this association.

In general, an analysis of the effects of habitat changes on wader densities would benefit from a more detailed, tetrad by tetrad, comparison of composition between 1987 and 1999. This approach would provide a more powerful and detailed assessment of the relationship between tetrad occupancy by waders and the presence or absence of habitat features than was available to the present study (which was limited to a combined analysis of tetrads for the whole of Northern Ireland). As in 1987, the identification of habitat damage was largely confined to current visible activities (e.g., land drainage, ditch clearance or peat extraction) with no potential to recognise historical changes that may still reduce the suitability of some habitats for waders. However, as mentioned above, tetrads that contained some standing water (ponds, lakes or flooded, marshy areas) were clearly associated with all breeding wader species, in contrast to tetrads in which no waders were recorded. It is conceivable that long-term changes in rainfall may alter the availability of suitable damp wader habitat which influence wader occupancy, mainly by exacerbating the effects of habitat changes caused by, for example, peat extraction or agricultural operations. Recent climate models, imply that higher mean temperatures associated with global warming (Parker & Horton 1999) may actually lead to increased rainfall in northern and western parts of the UK, especially in winter, but decreased rainfall in southern and eastern regions (Cannell *et al.* 1999). Overall, the relatively rapid rates of population decline for Lapwing and Curlew since 1987 suggest that profound changes in habitat composition, grazing density and predation pressure are more immediate sources of impact than climate change.

Acknowledgements

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Species	1987 population (95% confidence limits)	1999 population (95% confidence limits)	Population change 1987-1999
Lapwing	5,250 (3,750-6,820)	1,771 (942-2,599)	-66%
Snipe	5,725 (4,022-7,754)	3,993 (2,562-5,425)	-30%
Curlew	5,000 (3,800-6,250)	2,091 (1,243-2,938)	-58%
Redshank	550 (80-1,180)	188 (0-490)	-66%

Table 1 Population estimates for each species in 1987 (from Partridge & Smith 1992) and 1999 (current survey), with population change estimates for each species given in the final column.

Species	Number of pairs located in 1999	Number of tetrads occupied in 1999	% of tetrads occupied in 1999	Mean number of pairs per tetrad	
				1987	1999
Lapwing	47	20	19.2	1.40	0.44
Snipe	103	36	34.6	1.58	0.97
Curlew	55	28	26.9	1.37	0.52
Redshank	5	3	2.9	0.15	0.05

Table 2 Species sample sizes and their distribution within and between tetrads (1987 densities from Partridge & Smith 1992).

Species	% tetrads containing water	% tetrads apparently undamaged	N - tetrads
Lapwing	89	61	18
Snipe	100	65	34
Curlew	96	65	28
No waders	46	73	48

Table 3 The percentage of tetrads containing some water (standing water: bog/mire/fen/marsh/ponds) and the percentage of tetrads apparently undamaged (i.e. no sign of recent peat cuttings, drainage work or quarrying), for tetrads holding Lapwing, Snipe, Curlew and tetrads with no waders present. N = the number of tetrads per species for which the information above was available.

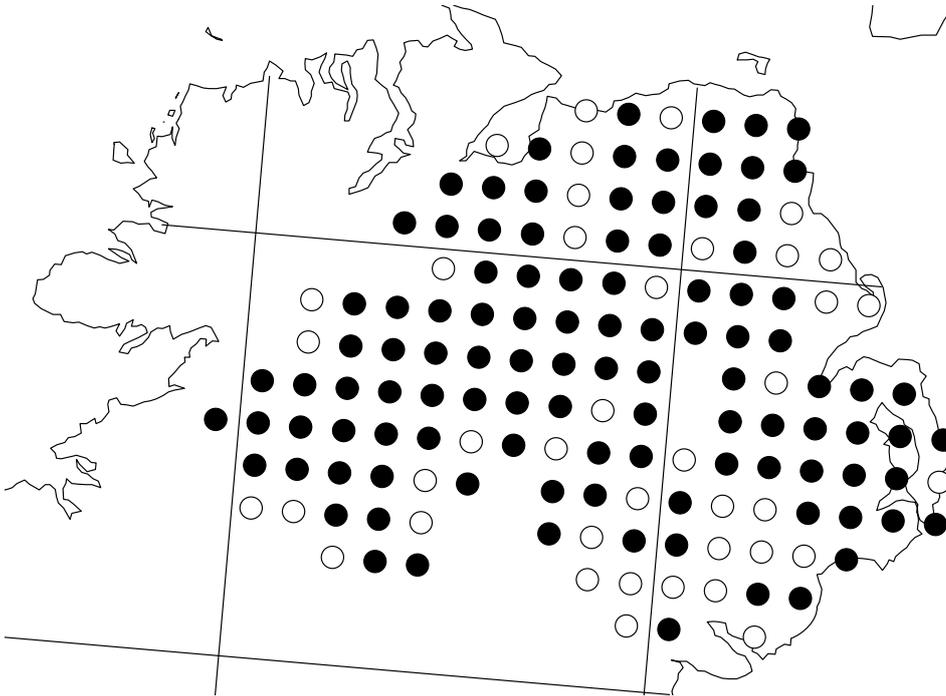
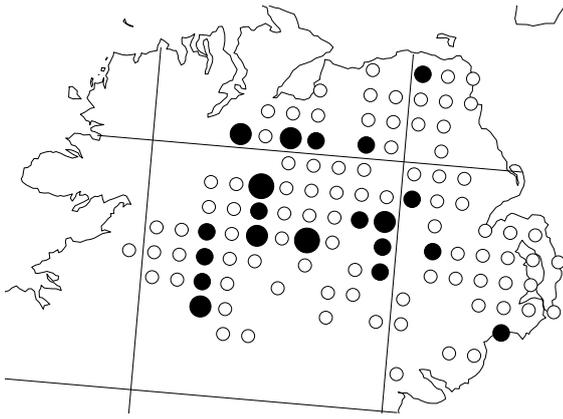
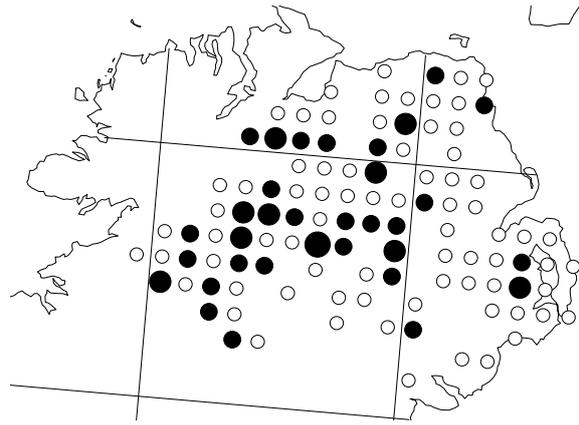


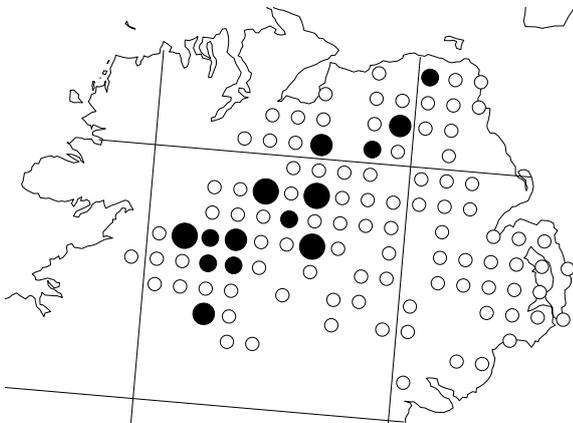
Figure 1 The distribution of survey tetrads in Northern Ireland. Filled circles represent the tetrads that were visited in 1999 and open circles represent the tetrads which were not visited in 1999 but which were visited in 1987.



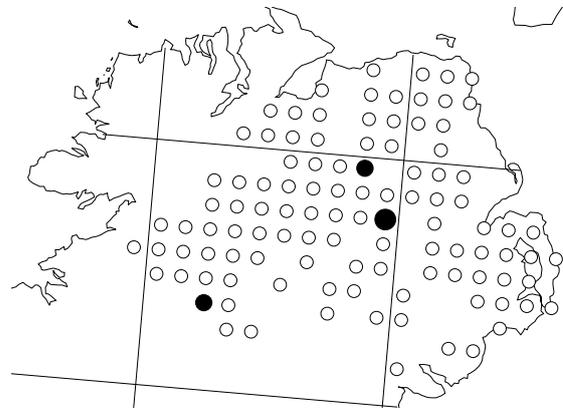
Lapwing



Snipe



Curlew



Redshank

Figure 2 The abundance and distribution of breeding wader species recorded across Northern Ireland in surveyed tetrads in 1999. Large black dot = >4 pairs in tetrad, medium black dot = 3-4 pairs, small black dot=1-2 pairs, open circle = no pairs in the tetrad.

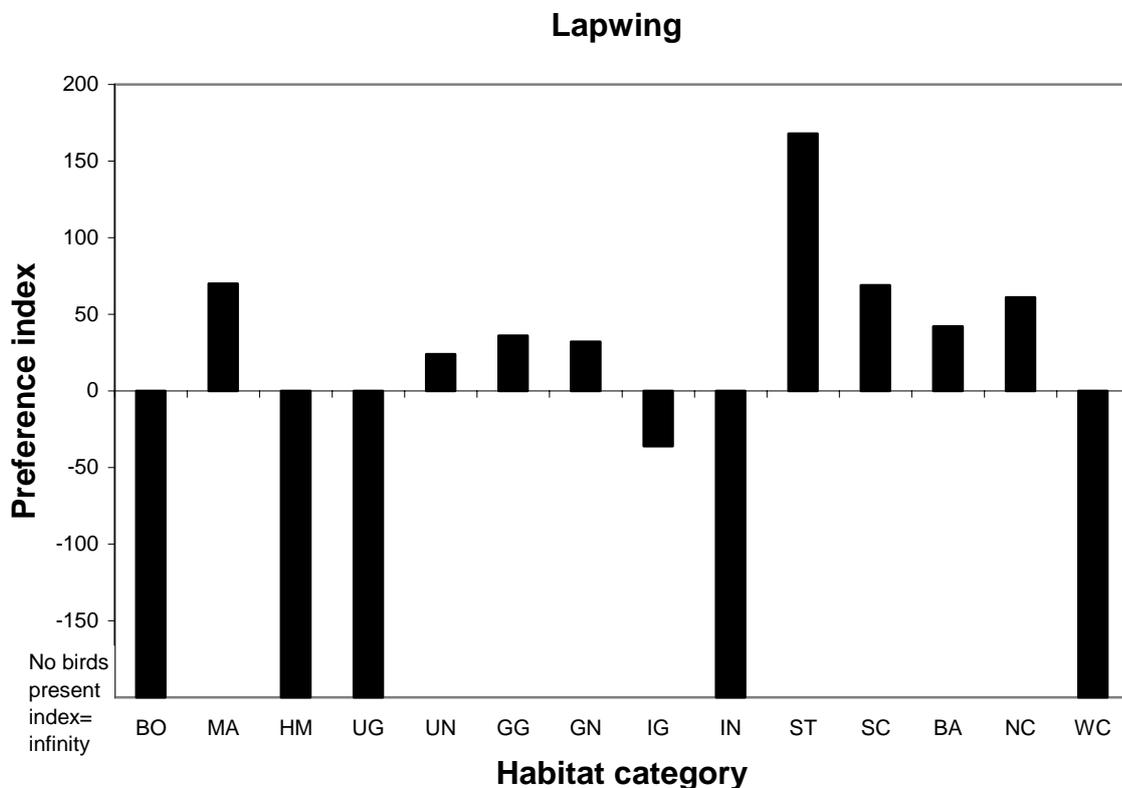


Figure 3. Relative habitat preferences by Lapwings based on the index: $100 \times \log_{10}$ (observed pairs/expected pairs). Habitat categories are as follows: BO = Bog/mire; MA=Marsh/fen; HM=Heather moor/heath; UG=Upland rough grazed land; UN=Ungrazed upland grassland; GG=Unimproved grazed grassland; GN=Unimproved non-grazed grassland; IG=Improved grazed grassland; IN=Improved non-grazed grassland; ST=Stubble fields; SC=Spring cereals ; BA=Bare soil; NC=Non cereals; WC=Winter cereals. Grassland grazed or non-grazed were classified according to whether observers recorded the presence or absence of stock at the time of their visit.

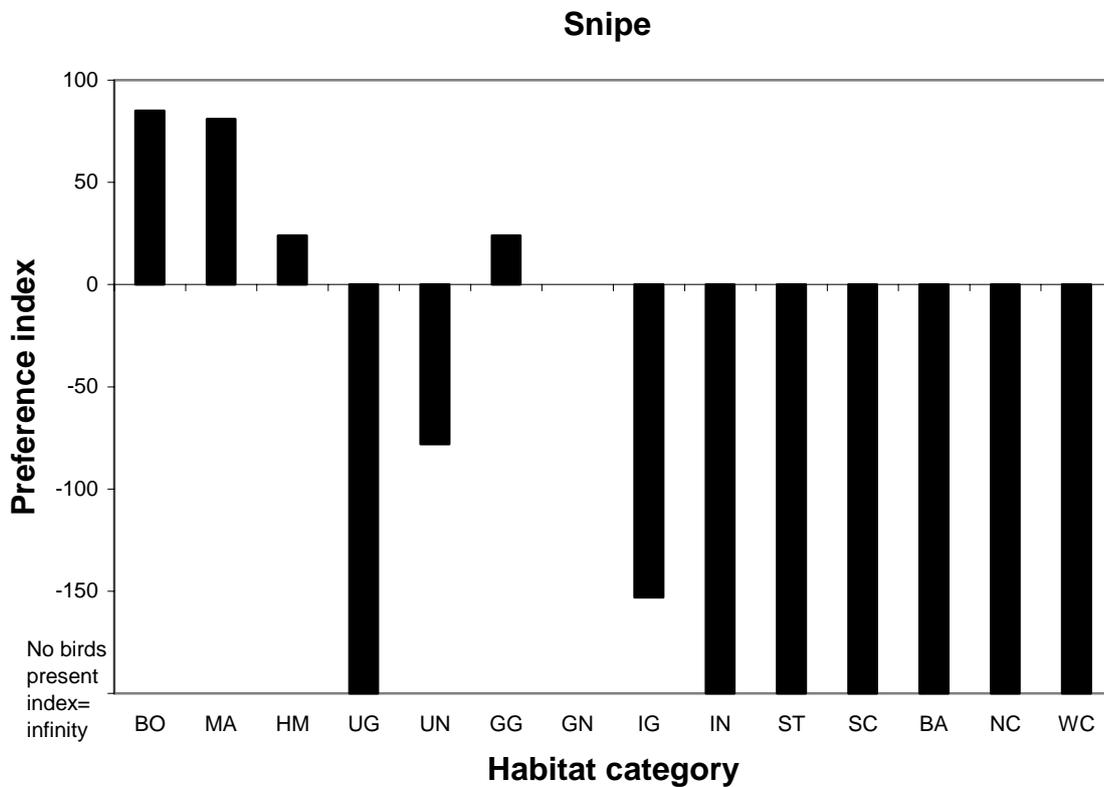


Figure 4. Relative habitat preferences by Snipe based on the index: $100 \times \log_{10}$ (observed pairs/expected pairs). Habitat categories are as follows: BO = Bog/mire; MA=Marsh/fen; HM=Heather moor/heath; UG=Upland rough grazed land; UN=Ungrazed upland grasland; GG=Unimproved grazed grassland; GN=Unimproved non-grazed grassland; IG=Improved grazed grassland; IN=Improved non-grazed grassland; ST=Stubble fields; SC=Spring cereals ; BA=Bare soil; NC=Non cereals; WC=Winter cereals. Grassland grazed or non-grazed were classified according to whether observers recorded the presence or absence of stock at the time of their visit.

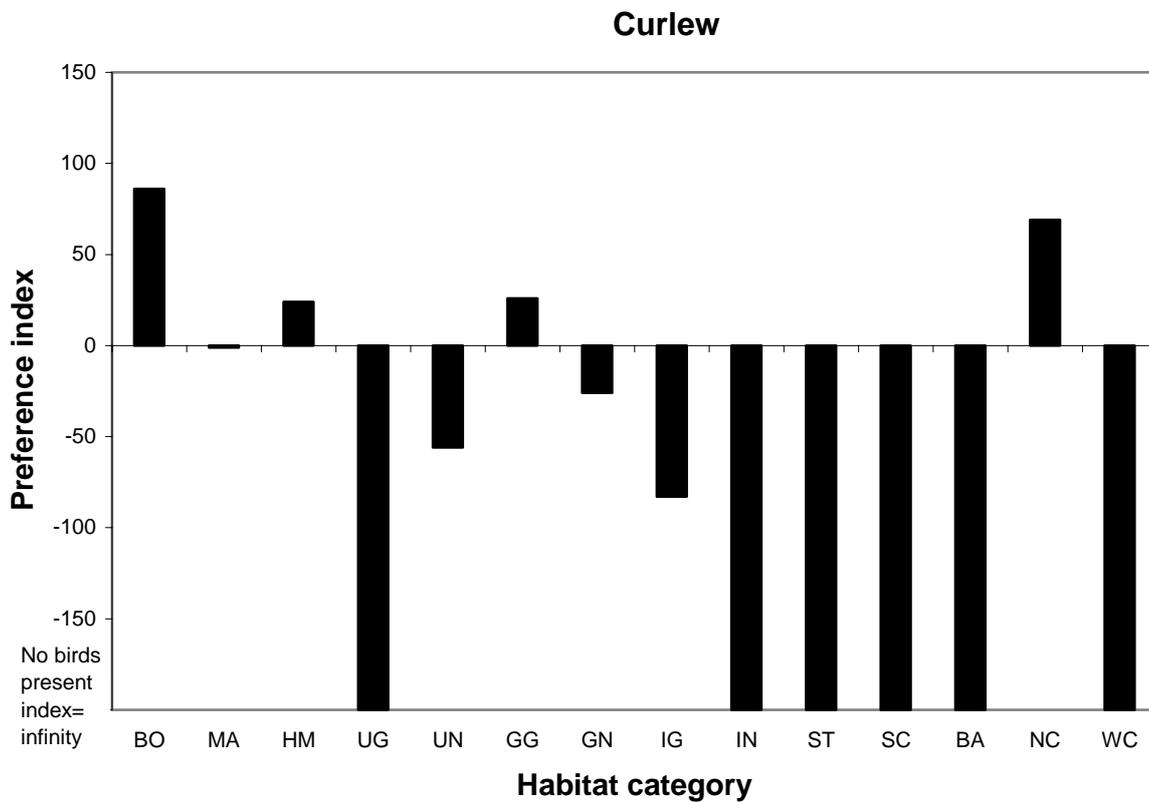


Figure 5. Relative habitat preferences by Curlew based on the index: $100 \times \log_{10}$ (observed pairs/expected pairs). Habitat categories are as follows: BO = Bog/mire; MA=Marsh/fen; HM=Heather moor/heath; UG=Upland rough grazed land; UN=Ungrazed upland grassland; GG=Unimproved grazed grassland; GN=Unimproved non-grazed grassland; IG=Improved grazed grassland; IN=Improved non-grazed grassland; ST=Stubble fields; SC=Spring cereals ; BA=Bare soil; NC=Non cereals; WC=Winter cereals. Grassland grazed or non-grazed were classified according to whether observers recorded the presence or absence of stock at the time of their visit.

APPENDIX 1

Fieldwork instructions and habitat definitions

Breeding Wader Survey of Northern Ireland, 1999

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Information for fieldworkers

Introduction

The 1999 Breeding Wader Study (BWS) is organised by the BTO in conjunction with the RSPB in Northern Ireland, and is funded by the Environment and Heritage Service (EHS). The aim of the survey is to repeat the 1987 RSPB Breeding Wader Survey of selected tetrads in order to calculate the change in breeding numbers of waders between the two survey periods. Northern Ireland is especially important within Britain and Ireland for Curlew, Snipe, Lapwing and Redshank, many of which breed on lowland wet grassland, sadly a rapidly disappearing habitat. A recent BTO survey of breeding Lapwings in England and Wales has revealed a 50% decline since 1987, and there are concerns that the number of breeding waders in Northern Ireland has also undergone a marked decline over this period.

The survey

The fieldwork for this survey involves the recording and mapping of singles, groups and breeding pairs of waders within 2 km x 2 km squares (tetrads). Tetrads have been selected from within every land-based 10 km square in Northern Ireland; they are the same tetrads as those covered in the 1987 wader survey. We envisage that most tetrads will take 5 to 6 hours to survey completely, depending on walking conditions and ease of access. However, you may find large areas are inaccessible or clearly unsuitable for breeding waders (e.g. forestry, housing or tall crops). Two visits to each tetrad are required, the first between 9 April and 17 May, the second between 18 May and 21 June 1999. If preferred, a single visit can be split across two different dates. We would also like volunteers to record habitat information from their tetrad(s) following the guidelines below.

The instructions on this sheet will help you complete the survey and fill in the recording maps and forms. The recording maps of the tetrad are intended for use in the field and should be used to record the location of bird sightings and habitat information. The recording form (yellow) is for summarising essential field details after each field visit. **Please study the contents of this form before your first visit to the field** or carry it with you so that you are aware of the details required.

Field visits

Preparation

If possible try to choose a clear, sunny day to carry out the survey. You will need binoculars but no other equipment (a telescope, if you have one, may help you view inaccessible areas). Each 1 km square within the tetrad is labelled as follows: A (top left), B (top right), C (bottom left) and D (bottom right). Please fill in the 'visit details' for date, visit number and start time in the appropriate spaces at the top of the field map.

Recording bird

Proceed around the tetrad, observing with binoculars as much of the area as you can whilst recording on the map the approximate location of every wader or group of waders you see. **Please use the appropriate two-letter species codes and activity codes given on the back of the map.** You do not have to visit areas of inappropriate wader habitat, such as forestry, buildings or tall crops, but please mark these areas on

the map and scan crops for Lapwings or Curlew. Where there are many small fields, try to concentrate your search in hollows and damp areas or areas of taller vegetation. Short grass on hill slopes can be viewed with binoculars, possibly from a road or track, but please make a special effort to search for Snipe, where dense rushes may make them difficult to detect. On areas of expansive moorland, survey the area using 'straight line' transects with approximately 250 m between them (i.e. four transects per 1 km²).

For the purposes of this survey displaying birds plus **all individuals or pairs are indicative of breeding birds**. However, exclude non-breeding flocks and obvious fledged (flying) juveniles - record any such sightings in brackets on the map but do not include them on the visit form later. Clearly a nest or young will also indicate a breeding pair.

At the end of the visit, please estimate the percentage area of the tetrad surveyed and mark uncovered areas on the map using diagonal hatched lines.

Specific indicators of breeding behaviour:

Lapwing

Perform an aerobatic display over their territory and are extremely vociferous in defence of their nest, mobbing predators and humans with equal vigour. Scanning with binoculars may reveal a single bird sitting on a nest and possibly another nearby standing quietly but alert.

Curlew

Perform a familiar bubbling display 'song' which is indicative of a breeding territory. Curlew have large territories so take care not to count the same bird twice, particularly if you are within 1 km of your last sighting.

Redshank

Perform an aerial display when breeding, where the male produces a clear piping call while flying in tight circles. Redshank are less conspicuous on the ground; care will be needed to detect them at a distance.

Snipe

Displaying ('drumming' and 'chipping') Snipe fly over their territory, a marshy or boggy area, towering and diving. Please check boggy areas carefully to find birds on the ground.

Recording habitat details

Note, there is space on the **visit map** to record activities that may cause damage to the tetrad and whether there is water present in the form of bogs, mires, marshes, ponds or lakes. Please indicate whether such features occurred on your tetrad (yes or no) and mark damaged areas on the visit map. Damage activities included major land management operations **other than cultivation**, such as drainage or peat workings, ditch cleaning, landfill sites or quarries. Please state whether areas not visited were unsuitable (e.g. forestry or buildings) or inaccessible (e.g. because of difficult terrain or because access was not granted).

Completing yellow visit forms

A hypothetical example of a visit form can be found on the back of the actual visit form. Please transfer to the visit form, your bird counts from the visit map in the appropriate habitat column for each species.

First complete the four columns labelled '% of each 1km square'. The headings A, B, C and D refer to the four 1km squares in your tetrad. For each 1km square, please estimate the approximate proportion of the area covered by each listed habitat category. **Use a tick for habitats that occupy a small proportion of each 1 km square (say less than 1%).** Habitat definitions are provided below. As a guide to help you estimate the percentage cover, the field marked 'x' to the west of Drummeny Big in square C on the hypothetical map covers approximately 3% of that 1km square.

Now, for each wader species, enter the number of pairs (in the column 'Pr.') and the total number of individuals (i.e. pairs x 2 plus individuals, in the column 'Tot.') for each habitat category. **There is no need to enter zero counts here.** 'Pairs' include paired individuals, displaying birds, nests or broods and other single birds **not** in flocks. After your final visit, please estimate the total number of pairs of each species that occurred in each tetrad **for the two visits combined** - taking care not to include duplicates. Duplicates are pairs that you strongly suspect were recorded on both visits, 1 and 2. Enter these totals in the boxes provided at the bottom of the visit form for the second visit. **Please return all data (maps and forms), including nil returns, to the BTO via your regional organiser where appropriate, by 1st July 1999.**

Habitat definitions

Unimproved lowland grassland: Fields of long-term grazing pasture or hay meadows in lowlands and on hillsides that have **not** been obviously improved. The sward may be short but uneven with occasional tussocks and may be both patchy and variable in colour.

Improved grassland: Pasture for grazing or silage mainly in lowland areas that has probably been cultivated within the last 5 years. The sward tends to look uniform and 'freshly' green due to high fertiliser inputs.

Upland rough grazing: Unimproved grassland on open hillsides, upland areas and moorland, often interspersed with heather or bracken and rarely confined to small fields.

Heather moorland and heath: Continuous expanses of open heather moorland or heathland, sometimes with sparse gorse scrub or other shrubs. Place dense areas of gorse in the 'woodland/scrub/...' category below.

Marsh swamp and fen: Permanently flooded ground in lowland areas by lakes pond or rivers, including marginal and emergent vegetation (iris beds or rushes).

Bog: Shallow but saturated ground including peat, blanket or raised bogs, possibly mixed with heather, usually with low vegetation such as cotton grass, sedges or sphagnum moss; in upland and lowland areas.

Saltmarsh: shoreline or estuary vegetation which periodically floods at high tide.

Water body: any expanse of water including a lake or large river.

Winter cereal: Autumn/winter-sown wheat, barley or oats, 20 to 30 cm (12") or more in height by mid-April.

Spring cereal: Late-sown wheat, barley or oats, probably less than 10 or 15 cm (6") in height by April.

Non cereals: Include potatoes, turnips, sugar beet, kale, vegetable crops and oilseed rape.

Bare soil: Caused by cultivation or vehicle disturbance for example.

Stubble: Stubble fields from a previous crop (cereals, linseed or oilseed rape), not yet ploughed in.

Woodland/scrub/forest/hedgerows: Deciduous or coniferous woodland, scrub, hedgerows and orchards.

Buildings: Include any part of a town, village or a group of farm buildings.

Observer:					Site name / Notes:																		
Tetrad (4-figure grid ref.):				Visit:																			
Habitats				% of each 1km square				Wader counts for whole tetrad															
								L		CU		RK		SN		Other species							
				A	B	C	D	P	T	P	T	P	T	P	T	P	T	P	T				
								r	o	r	o	r	o	r	o	r	o	r	o				
Unimproved Grassland	Grazed or	Sheep	US																				
	recently	Cattle	UC																				
	grazed	Horses	UH																				
		Unknown	UK																				
	Ungrazed		UG																				
Improved grassland	Grazed or	Sheep	IS																				
	recently	Cattle	IC																				
	grazed	Horses	IH																				
		Unknown	IK																				
	Ungrazed		IG																				
Upland rough grazing	stock present		RS																				
	no stock present		RN																				
Heather moorland/heathland			HM																				
Marsh/swamp/fen			MA																				
Bog/mire			BO																				
Saltmarsh			SA																				
Water body (lake, river)			WA																				
Woodland/scrub/forest/hedgerows			WO																				
Etc																							
Total wader counts								L.		CU		RK		SN		Other species							
Estimated total pairs for the tetrad (visits A + B):																							