Estimating the breeding wader populations on farmland in northern England in 1993

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Populations of breeding waders on lowland areas of northern England in 1993 were estimated using a stratified random sample of sites. 205 km^2 of land were surveyed, finding 220 pairs of Oystercatchers, 1,836 pairs of Lapwing, 304 drumming Snipe, 630 pairs of Curlew and 295 pairs of Redshank. Estimated populations of waders on farmland in northern England are 11,750 pairs of Oystercatcher, 61,825 Lapwing, 6,035 pairs of Snipe, 20,375 to 34,000 Curlew (depending on calibration method used) and 4,800 pairs of Redshank.

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INTRODUCTION

Five species of breeding waders, Oystercatcher *Haematopus ostralegus*, Lapwing *Vanellus vanellus*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Redshank *Tringa totanus*, are associated with farmland habitats in the United Kingdom. Recent surveys have estimated populations in Wales (O'Brien *et al.* in press), Scotland (O'Brien 1996) and Northern Ireland (Partridge & Smith 1992). It is known that wader populations in parts of northern England are high (especially Lapwing and Curlew) (*e.g.* Day 1992; Smith 1983; Baines 1988) and that farmland in this region may support substantial populations of several species. In 1987, there were estimated to be 123,124 pairs of Lapwing in England and Wales, of which just over half (74,565 pairs) were recorded in an area similar to that covered by the present survey (Shrubb & Lack 1991).

A number of studies have shown that many populations of breeding waders have been declining. Trends in breeding wader populations are available for areas of lowland wet grassland in England and Wales, which recorded declines in numbers of Lapwings (O'Brien & Smith 1992), and Northern Ireland, where declines in all species were recorded (Partridge 1992). The New Breeding Bird Atlas (Gibbons *et al.* 1993) suggests that there has been a marked reduction in the range of Snipe and Redshank but an expansion in the range of Oystercatcher within the present study area.

The main aim of this project was to estimate the size of wader populations on farmland in northern England. This will provide a baseline for monitoring future trends in wader populations within the area, and will indicate the importance of northern England farmland for these species.

METHODS

For the purposes of this survey, northern England has been defined as all counties from Greater Manchester, North Humberside, West Yorkshire and Merseyside north to the Scottish Border (Figure 1). The only practical way of estimating breeding wader populations on farmland in northern England is to randomly select a number of sites for survey. A definition of 'lowland' and an estimate of its location and total area in northern England is required to determine the location of sites for survey. For the purposes of this survey, 'lowland' was defined as any land classified as agricultural land grade 1-4 (MAFF 1980). This includes all enclosed farmland, up to the moorland edge, excluding the unenclosed uplands, urban and afforested areas. The total area of such farmland within the survey area was 19,957 km^2.

A random sample of 100 1 km squares was selected from all 1 km squares present in northern England. These squares had to fulfil three criteria:

i) that the dominant land grade within the square covered at least 75% of that square;

ii) that the dominant land grade was between 1 and 4;

iii) that the square did not fall within a number of areas where more intensive surveys were being undertaken: the Pennine Dales environmentally sensitive area (ESA), the Lake District ESA, Baldersdale/Lunedale (Shepherd 1993) and the Forest of Bowland (Campbell *et al.* 1994).

Access was refused to one square, so 99 1 km squares were surveyed. 1 km squares for the surveys in the Pennine Dales and the Lake District ESAs were randomly selected using criteria i) and ii), (with the added proviso in the Dales that at least one square was surveyed in each of the main Dales). Twelve squares were selected to monitor breeding wader populations within the Lake District ESA (total area of farmland 720 km^2) and 29 squares in the Pennine Dales ESA (total area of farmland 223 km^2, 28 km^2 in Baldersdale/ Lunedale).

More detailed surveys were carried out in the Forest of Bowland and the Baldersdale/Lunedale area (Campbell *et al.* 1994; Shepherd 1993). Twenty-three randomly selected 1 km squares in the Forest of Bowland (plus eight sets of 1 km

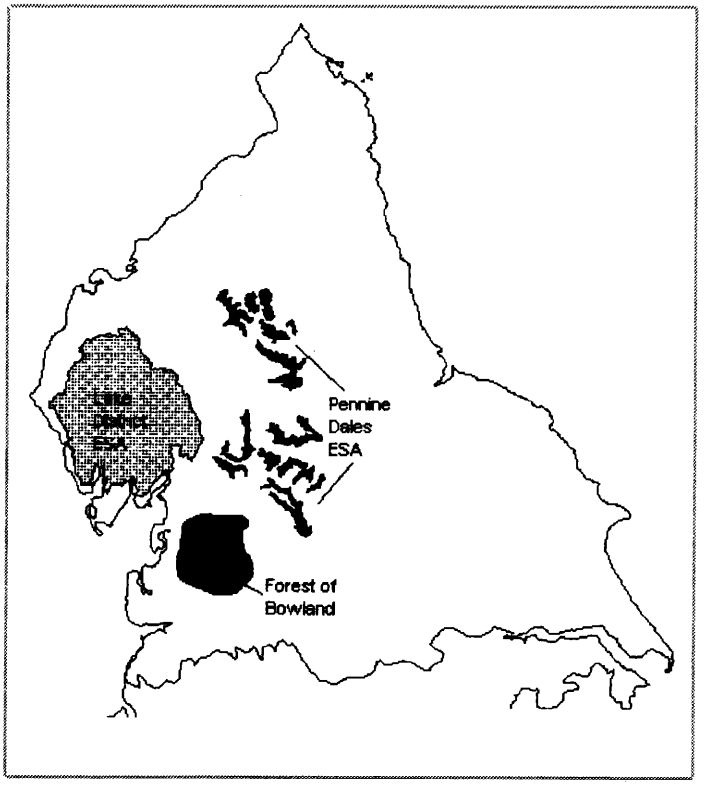

Figure 1. The study area, highlighting boundaries of the Environmentally Sensitive Area (ESA) sites and the Forest of Bowland.

squares that were identified as being good for breeding waders, total area of farmland 425 km^2), and the whole of the Baldersdale/Lunedale area (34 km^2) were surveyed. The Baldersdale/Lunedale survey included 28 km^2 of land within the Pennine Dales ESA as well as 6 km^2 outside.

The numbers of breeding waders recorded by these surveys were used to obtain population estimates for the area from which the squares were selected. These regional population estimates were then added to the estimate obtained from the main survey to obtain overall populations for breeding waders in northern England.

Methods used to survey breeding waders

We used the field by field method previously used to survey breeding waders of lowland wet grasslands in England and Wales (O'Brien & Smith 1992) and farmland sites in Northern Ireland (Partridge & Smith 1992). The main difference between our survey and the lowland wet grassland survey in England and Wales was the time of day that visits were made. The fieldwork reported here was undertaken within three hours of dawn or dusk. These are the times when highest counts of breeding waders are obtained (Reed *et al.* 1985) and it is known that these provide the best estimate of numbers of breeding Snipe on sites (Green 1985). The disadvantage of dawn and dusk surveys is that the area that can be surveyed in the time available is limited to about 2 km^2 per day.

All surveyors were provided with three copies of a map of the survey area together with three sets of recording forms. Each map was marked with the 1 km square boundary, within which all fields were numbered. Surveyors were asked to visit each square once during the following three periods: 18 April - 8 May; 9 May - 29 May and between 30 May and 19 June. On each visit, they were asked to walk through, and get to within 100 m of every point in, each field and to look 200-400 m. ahead, scanning with binoculars to note the distribution of all waders. All wader registrations were mapped although only birds considered to be breeding within the square were counted (see below).

Standard techniques were used to interpret the wader data and calculating the number of breeding pairs for each species at each site (Bibby *et al.* 1992, O'Brien 1996; Partridge & Smith 1992):

Oystercatcher: the maximum number of pairs on any one visit (Smith 1983).

Lapwing: half the maximum number of individuals recorded on the site between mid April and late May (Barrett & Barrett 1983).

Snipe: the maximum number of drumming plus chipping birds on any one visit multiplied by 1.74 (Green 1985).

Curlew: the maximum number of estimated pairs on any one visit (Smith 1983).

Redshank: the average number of birds (excluding flocks) counted on the site before the first nests hatch (about 20 May) (Cadbury *et al.* 1987).

Extrapolating the survey data to all remaining lowland areas within survey.

To estimate the total number of breeding waders on northern England farmland, we added

(i) the number estimated from the random survey

(ii) the numbers estimated through the random sites survey on the ESAs,

(iii) the numbers estimated on the survey on the Forest of Bowland (Campbell *et al.* 1994) and

(iv) the numbers recorded on the Baldersdale/Lunedale study area (Shepherd 1994).

We used the 'bootstrap' method (Greenwood 1991) to estimate 95% confidence limits around the first three of these population estimates (see Appendix for further details). These are presented in Table 3 as the minimum and maximum confidence limits.

RESULTS

Estimates of the number of breeding waders on farmland in northern England

a) Estimates from the random sites survey.

Estimates of numbers and densities of breeding waders on sites surveyed are presented in Table 1. Lapwing was the most commonly occurring species of wader, being recorded in approximately two-thirds of the squares. Curlew were recorded in just over half the squares and Oystercatcher in a third, whereas Redshank and Snipe were recorded in 10% or fewer of the squares. Overall wader populations within a site ranged

Table 1. Number of pairs of breeding waders estimated for the survey of randomly selected grid squares on farmland, in northern England in 1993.

	Lapwing	Oystercatcher	Snipe	Curlew	Redshank
Total no. registrations	590	54	14	167	42
Maximum no. in a square	49	5	3	10	4
% squares with birds	68	32	8	53	10
Calibrated no. pairs	295	54	24.36	167	21
Mean density (pairs km^{-2})	2.98	0.55	0.25	1.69	0.21
Estimated population	55370	10135	4572	31345	3942

from 0 to 35.5 pairs, with 15 out of 99 sites not recording any species of breeding wader.

b) Estimates from the ESA Sites.
Table 2 shows the density of waders within the ESAs. Overall wader density within the Lake District ESA was just a third of the density of waders in the Cumbrian wider countryside (Murray *et al.* 1995). No Redshank or Snipe were recorded on any of the 12 random squares within the Lake District ESA.

Table 2. Number of pairs of breeding waders within the Environmentally Sensitive Areas in northern England in 1993.

a) Lake District ESA.	**Lapwing**	**Oystercatcher**	**Snipe**	**Curlew**	**Redshank**
Total no. registrations	13	1	0	16	0
Maximum no. in a square	6	1	0	7	0
% squares with birds	25	8	0	67	0
Calibrated no. pairs	6.5	1	0	16	0
Mean density (pairs km^{-2})	0.54	0.08	0	1.33	0
Estimated population	390	60	0	960	0
b) Pennine Dales ESA.	**Lapwing**	**Oystercatcher**	**Snipe**	**Curlew**	**Redshank**
Total no. registrations	457	31	34	81	39
Maximum no. in a square	104	6	9	10	15
% squares with birds	97	52	52	97	41
Calibrated no. pairs	228.5	31	59.16	81	19.5
Mean density (pairs km^{-2})	7.88	1.07	2.04	2.79	0.67
Estimated population	1540	209	400	546	131

Some of the Pennine Dales ESA sites were not covered in their entirety (access to some of the fields where land had not been entered into the ESA was not obtained), so the numbers and densities recorded are minima. Despite this, for all five species the average density of waders recorded on Pennine Dales ESAs is substantially higher than anywhere else in the region.

c) Overall population estimates for farmland in northern England.
Overall population estimates for farmland in northern England have been calculated using data from Tables 1 and 2, as well as results from surveys in the Forest of Bowland (Campbell *et al.* 1994) and Baldersdale/Lunedale (Shepherd 1993). Table 3 shows the estimates together with 95% confidence intervals. Estimates range from 61,825 pairs of Lapwing down to just 4,800 pairs of Redshank. The size of the confidence intervals around the estimates indicates the patchy distribution of all the species surveyed.

Other recent surveys in northern England.
A number of surveys have been undertaken in the region. Table 4 compares wader densities on these surveys, and contrasts these with other areas of importance for breeding waders in northern England. It is apparent that wader densities on Baldersdale/Lunedale, and Upper Teesdale are comparable with other areas in the UK better known for their high wader densities, such as the Ouse and Nene Washes, Derwent Valley and the North Kent Marshes (O'Brien & Smith 1992).

DISCUSSION

The results indicate that there are substantial populations of both Curlew and Lapwing on farmland in northern England. A comparison with overall UK population estimates indicates that the area holds between 25 and 30 % of the total population in just 8% of the area (Grant in press; O'Brien in press). Maintaining suitable farmland habitat within this area is, therefore, of high conservation importance.

Information collected from two of the ESAs within the region provides a contrasting picture. The Lake District ESA appears, at present, to be unimportant for farmland waders with very low numbers in the areas surveyed. By contrast, the Pennine Dales ESA holds substantial populations at, in places, high densities. In the Pennine Dales, average densities for all waders combined are three times the average density on farmland in northern England, although parts of the Dales, especially Upper Teesdale and Baldersdale/Lunedale hold wader populations at densities equivalent to some of the best

Table 3. Population estimates of breeding waders on lowlands in northern England in 1993.

	Area (km²)	Lapwing	Oystercatcher	Snipe	Curlew	Redshank
Random sites*	18,582	55,370	10,135	4,572	31,345	3,942
Lake District ESA	720	390	60	0	960	0
Pennine Dales ESA	196	1,540	209	400	546	131
Baldersdale/Lunedale	34	957	80	392	280	213
Forest of Bowland	425	3,570	1,275	672	893	518
Overall Numbers	19,957	61,827	11,759	6,036	34,024	4,804
Minimum Confidence Limit	47,279	7,703	2,781	16,379	2,212	
Maximum Confidence Limit	78,442	15,130	9,549	43,830	7,646	

* Refers to random sites in northern England.

Table 4. Wader densities in recent surveys in northern England compared with 1993 random survey, ranked by overall density.

	Area (km²)	Lapwing	Oystercatcher	Snipe	Curlew	Redshank	Total
1990 Upper Teesdale[1]	16	46.38	0.56	5.88	3.44	4.69	60.95
1993 B'dale/Lunedale[2]	34	28.15	2.35	11.53	8.24	6.26	56.53
1992 Eden Valley[3]	14	11.32	7.48	3.68	8.60	4.87	35.95
1993 Forest of Bowland[4]	31	8.40	3.00	1.58	2.10	1.22	16.30
1993 Pennine Dales[6]	29	7.88	1.07	2.04	2.79	0.67	14.45
1992 N. Staffs Moors[5]	58	2.17	0.00	5.43	4.60	0.00	12.20
1993 Random Sites[6]	99	2.98	0.55	0.25	1.69	0.21	5.65
1993 Lake District[6]	12	0.54	0.08	0.00	1.33	0.00	1.95

Source of data
1 Barrett & Finlay pers comm.
2 Shepherd 1993
3 Day 1992
4 Campbell, Reid & O'Brien 1994
5 Brindley 1992
6 Present survey

known sites in the UK. Monitoring the wader populations in these areas to assess the effectiveness of the ESA prescriptions should be a high priority.

Wader densities on northern England lowlands can be compared with a number of other large scale surveys undertaken in the UK. The present survey is directly comparable with a survey of lowland breeding waders on mainland Scotland in 1992 (O'Brien 1996) (Table 5). Lapwing densities in northern England were higher than in Scotland, Curlew densities were similar and Oystercatcher densities were considerably lower. Snipe and Redshank densities in both surveys were rather low - both species being present in only a small proportion of squares in both surveys.

The only survey that provides a comparable estimate of populations of breeding waders within northern England is the 1987 survey of breeding Lapwing (Shrubb & Lack, 1991). In that survey, the estimated total number of Lapwing within the three regions most closely approximating to the northern England region selected for this survey came to 74,565 pairs, within the upper confidence limit for the present survey (Table 3). The total area covered by the term 'northern England' in the BTO survey extended further south than the present survey and included a sample of squares from the uplands, although low Lapwing densities would be expected in the uplands.

The density of breeding waders in Northern Ireland is an overall density for the province as a whole, and so includes the uplands (Partridge & Smith 1992). However, 88% of the randomly sampled sites surveyed fell on enclosed land, so the majority of the survey was on land comparable, in terms of land-use, with the northern England survey. Wader densities in the province appear to be considerably lower than in northern England, with the exception of Snipe (Table 5).

A comparison of wader densities with those recorded on the Breeding Waders of Wet Meadows Survey in 1989 (O'Brien & Smith 1992) indicates that densities of Lapwing, Curlew and Oystercatcher are considerably higher on farmland in northern England than on lowland wet grassland sites (Table 5). Only Snipe and Redshank were recorded at higher densities on lowland wet grassland sites. The BWWM survey sites were selected because they were thought to be suitable for breeding waders.

A detailed survey of breeding wader populations in the uplands of the South Pennines recorded wader densities similar to (Snipe and Redshank), or below (Lapwing and Curlew) densities on lowland areas in the region (Stillman & Brown 1994). Information on wader densities in other parts of the uplands in the region, and elsewhere in the UK, is now

Table 5. Comparison of wader densities on large scale surveys in the United Kingdom (pairs km^{-2}).

	Lapwing	Oystercatcher	Snipe	Curlew	Redshank
N. England lowland 1993	3.10	0.59	0.17	1.70	0.24
Wales 1993[1]	0.19	0.0	0.14	0.52	0.01
Scottish lowland 1992[2]	2.56	2.29	1.14	1.54	0.34
BWWM 1989[3]	1.74	0.27	0.98	0.19	1.17
Northern Ireland 1988[4]	0.36	-	0.40	0.34	0.04
Lapwing 1987 (England/Wales)[5]	0.70				
Lapwing 1987 (Northern England)[5]	1.70				

Source of data:
The N. England lowland 1993 data are from this paper. The densities are based on the overall population estimate when the ESA and Forest of Bowland data are added to the randomly selected squares estimate.
1 O'Brien *et al.* In press
2 O'Brien 1996
3 BWWM = Breeding Waders of Wet Meadows (OBrien & Smith 1992)
4 Partridge & Smith 1992
5 Shrubb & Lack 1991

required to obtain best estimates of overall breeding populations of breeding waders in the UK.

Concern has recently been expressed over the use of the maximum number of pairs present to estimate Curlew populations (Grant in press) It may be more appropriate to use the mean number of pairs recorded on visits in May and June. This would reduce the overall population estimate of lowland breeding Curlew in northern England from 34,024 pairs to 20,365 pairs (95% confidence limits of 16,379 to 28,265) - 60% of the original figure. It should be stressed that the method used throughout this report (the maximum number of pairs on any visit) is the method that has been used in all previous surveys of breeding Curlew in the British Isles. A separate study to determine the best method of estimating the number of pairs of Curlew is presently being undertaken (M. Grant, pers. comm.).

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APPENDIX

Calculating the confidence limits

Each of the 99 randomly selected 1 km squares can be considered to provide a local estimate of wader densities on farmland in northern England. Averaging the data across the 99 1 km squares provides the best estimate of overall wader densities. Confidence limits about the estimate can be calculated using the 'bootstrap' method. For this method, a set of 99 1 km squares is randomly selected from the 99 surveyed squares, with replacements. Some 1 km squares will be selected more than once in each set, whilst others will not be selected at all. The data from this set are used to calculate an estimate of 'pseudo density'. This process is carried out 999 times, the 'pseudo densities' are ranked and the 25th highest and 25th lowest values are used as the 95% confidence limits about the true population density.

For each of the areas surveyed (Forest of Bowland, Lake District ESA, Pennine Dales ESA, other farmland in northern England) a mean population estimate, and confidence intervals about the population estimate for each species was calculated. The area of land not surveyed was multiplied by the mean density and the upper and lower confidence limits. To each of these were then added the number of pairs of breeding waders recorded on the land that was surveyed. There are no confidence intervals for the Baldersdale/Lunedale study area because the population estimate was based on a complete survey.

The confidence limits about the total population estimates have been generated by calculating 'pseudo population' estimates for each of the survey areas and summing these to obtain an overall 'pseudo population estimate' for northern England on each of the 999 replications. These were then ranked and confidence limits calculated as before. The population estimate for the Baldersdale/Lunedale study area was added to the 'pseudo population estimate' on each of the 999 replications.