WOLD ECOLOGY LTD

NORTH YORK MOORS

NATIONAL PARK

BREEDING WADER STUDY

REPORT 2019

	Staff Member	Position
Report prepared by	Richard Baines PGDip, MCIEEM, Director/Ecologist Mark Pearson BSc – Ornithologist Ana Cowie BSc – Ecologist	

EXECUTIVE SUMMARY

Between 1996 and 2019 five large scale breeding wader surveys have been carried out on open moorland within the North York Moors National Park (NYMNP). All five surveys; 1996, 2000, 2008, 2014 and 2019 - used the same generic methodology adapted from Brown and Shepherd (1993) as described within *Bird Monitoring Methods*, a manual of techniques for key UK species *(*Gilbert *et.al. RSPB 1998*). The principal aim of this method was the census of all upland breeding waders. The technique involved the random selection of 92 x 1 km squares of at least 75% open moorland. Each square was surveyed as a constant effort and visited twice.

Four species of wading bird were targeted: northern lapwing *Vanellus vanellus*, European golden plover *Pluvialis apricaria*, common snipe *Gallinago gallinago* and Eurasian curlew *Numenius arquatam*. Records of common redshank *Tringa totanus* (which historically bred in small numbers) were also sought along with a range of additional species (see page 36). Following data analysis, the golden plover, lapwing and curlew breeding populations were found to have decreased since 2014 with snipe rising slightly (see 5.3.3.2 for caveat). Over the five surveys since 1996 the golden plover 2019 total was the second highest, however 61% of survey squares held 0 or 1 pair. The lapwing mean breeding figure of 2019 was the lowest since the surveys began in 1996, declining on every survey since a peak in 2000. The curlew 2019 figures were the second lowest figures since the surveys began. Whilst the statistical variance was non-significant there is nevertheless an apparent declining trend since 2014 for all three species; golden plover, lapwing and curlew.

Regional differences across the National Park were detected with the highest population of waders in the central region. Year on year increases in the west and east since 1996 dropped for the first time in both regions in 2019. The northern region was the only area recording an increase in waders between 2014 and 2019. Peatland restoration was found to have provided habitat resilience over the three surveys years; 2008, 2014 and 2019. Using the survey results, regional examples of restoration projects and habitat suitability research are described. Future land management practices are recommended to manage habitats in order to maximise conditions for waders to attain breeding condition in early spring and throughout their breeding cycle. We also stress the importance of monitoring the populations using smaller studies in the years between the full surveys to evaluate the success of habitat management and restoration works.

Meadow pipit productivity fell in 2019. In 2014 87% of visit two results returned higher numbers than visit one, in 2019 this fell to 61%.

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1.0 INTRODUCTION

1.1 The North York Moors National Park (NYMNP) is located in the North-East of England and covers approximately 1200 square miles, including an area of almost 150,000 hectares of open moorland. Topography is that of mainly gentle to moderate slopes of heather moorland rising to 434 metres above sea level. There are some areas of steep-sided slopes and crags. The main altitudinal range lies between 50 and 200 metres above sea level but some forested regions can rise to 300 metres above sea level. Land use is split into 60,000 hectares of farmland, 50,000 hectares of heather moorland and 32,000 hectares of forest. This large-scale mosaic provides diverse habitats for wildlife (Rona Charles *pers. comm.*).

1.2 During 1997 and 1998 a comprehensive survey of upland vegetation was undertaken throughout all open moorland within the NYMNP. As a result, the total area of open moorland was estimated to be 460 km^2 (Jerram *et. al.* 1998, as cited in Shepherd 2000).

1.3 Over the five years 1996, 2000, 2008, 2014 and 2019, five large scale breeding wader surveys were commissioned by the North York Moors National Park Authority and carried out on open moorland within the National Park.

1.4 The first breeding wader survey in 1996 was conducted as part of the monitoring requirements of the Moorland Regeneration Programme. The survey involved the random selection and field survey of 92 x 1km squares of at least 75% open moorland. The following surveys in 2000, 2014 and 2019 also covered 92 x 1km squares, while the 2008 survey covered 84 x 1km squares.

1.5 The 1996 baseline survey showed that the North York Moors National Park held between 2.3% and 3.1% of the British breeding population of golden plover and between 0.3% and 0.6% of the European breeding population. Both estimates were considered to be nationally and internationally important. Numbers of breeding pairs of lapwings were found to be between 0.2% and 0.4% of the British population.

1.6 The survey method was found not to be suitable for snipe, largely due to their crepuscular display period, and only 244 (revised) breeding pairs were found. Estimated numbers of curlew were found to be between 0.7% and 1.4% of the British breeding population, and were considered to be nationally significant (Charlton and Archer 1996).

1.7 In 2000 the second survey of breeding waders was carried out as part of the continuation of the Moorland Regeneration Programme. A comparison of the two surveys revealed populations of golden plover and snipe to be stable, whilst curlew and lapwing showed a significant increase (Shepherd 2000).

1.8 In 2008, because of ongoing national conservation concern for the four wader species involved, they were included in the Local Biodiversity Action Plan (LBAP) of the NYMNP. The plans are reviewed every five years and fall under the auspice of the UK Biodiversity Action Plan (UK BAP), an ongoing strategy for conserving and enhancing wildlife and their habitats. Particular emphasis is placed on species and habitats that are internationally important or characteristic of local areas and also those that have declined significantly over recent decades (NYMNPA 2008). Two of the plan's targets were to maintain and enhance the current populations of waders within the National Park (NYMNPA 2008). Monitoring of this population therefore became essential. One of the main prescribed actions of the Species Plan was to undertake a wader survey every five years, hence the 2014 and 2019 surveys.

1.9 These surveys, their results and evaluation therefore satisfy several project and statutory requirements –

- In 1996 the surveys produced a baseline estimate of breeding waders as part of the Moorland Regeneration Programme
- Future trends based on the 1996 data could then be used to indicate the health of the upland environment
- The surveys assist and comply with the monitoring requirements of Local and National Biodiversity Action Plans.

1.10 In 2019 Wold Ecology R.B Ltd was commissioned to produce a report based on the findings of the five surveys with the following brief:

- Describe the results of the 2019 survey;
- Provide a comparative analysis of all five survey years;
- An evaluation of trends within the data both locally, regionally and nationally;
- Discussion of the findings with respect to local land management;
- How the results can be used to inform land use management, policy change, etc.; Further research and survey recommendations.

2.0 SURVEY METHODS

2.1 Field Survey Methodology

2.1.1 The method used in each of the five survey years was the generic survey methodology adapted from Brown & Shepherd (1993) as described within *Bird Monitoring Methods*, a manual of techniques for key UK species *(*Gilbert *et.al.* 1998*)*. The method was principally aimed at developing a census of all upland breeding waders including golden plover, snipe, lapwing, curlew and redshank. The field methods are aimed at collecting the following data:

- Estimated number of breeding pairs of each species
- Final visit maps indicating territories and showing all registrations and areas covered.

2.1.2 The standard method requires a minimum of two visits to each survey plot during early April – late June. The first visit undertaken between early April and mid-May and the second visit from mid-May to late June. The first visit is best at detecting species such as lapwing and curlew which breed relatively early and the second for species like golden plover which can breed later (Charlton & Archer 1996).

2.1.3 Within the standard method visits are carried out at any time between 0830 and 1800 BST depending on weather constraints. Survey work was not undertaken in mist, fog or other factors associated with poor visibility, continuous or heavy/medium precipitation and/or wind speeds greater than Beaufort Force five (see attached sheet for detailed definitions).

2.1.4 Within the pre-defined survey area, the following topographical and habitat areas were excluded from the survey:

- Human habitation
- Woodland/forest areas either natural or planted that have reached ticket stage or older.

2.1.5 The standard survey method is based on a timed total area search, with a constant search effort. Care was taken to keep to the specified time for each survey section. The standard method times are 25-30 minutes (20-25 if just recording waders) for each 500

x 500m quadrat of open land and 0.8-1.0 minutes for each Ha of enclosed fields. In practice the time taken for each plot was also determined by access, health and safety precautions and habitat. Care was taken to survey all areas equally and where possible the second visit was walked in the opposite direction to the first visit (Shepherd 2000).

2.1.6 Scanning with binoculars or telescopes was used to detect birds at approximate 100m intervals and close attention was paid for calls and songs. As each individual or pair was encountered, this was related to any previous registration to check for double counting.

2.1.7 On occasions nests may be found, but the main intention of the survey was for observers to focus their attention on adult birds and their behaviour which could indicate breeding or otherwise.

2.1.8 On completion of the fieldwork visits, all registrations were compiled onto individual master maps, with each visit registration given code A for the first visit and B for the second.

2.1.9 Cluster analysis was used to determine territory occupancy, and furthermore, birds can be identified as breeding if -

- They are recorded as displaying and/or singing
- Active nests, eggs or young are located
- Nest building activity is observed
- Adults engage in repeated alarm calling
- Distraction displays are recorded
- Territorial disputes are observed.

2.1.10 On occasions where several breeding individual birds were seen in one area and it had been difficult to estimate the numbers of breeding pairs then individuals were deemed to represent different pairs only if the distance between them was greater than 500m. This distance was chosen arbitrarily and reflects roughly the distance over which a breeding bird may travel during a single census visit (Shepherd 2000).

2.1.11 Pairs of breeding birds were only considered to be separate from each other if they were greater than 1000m apart. This distance again was chosen arbitrarily to roughly

reflect the distance birds may move between survey visits. Therefore, the identified locations of breeding waders in fact represented centres of breeding activity and not necessarily locations of nest sites or breeding territories (Shepherd 2000).

2.2 Constraints

2.2.1 Whilst every effort was made to cover each field and/or survey area, some fields/areas were recorded as difficult terrain with deep mud/water. Any areas noted as potentially unsafe were recorded to the nearest safe point. In practice, due to the dry weather over much of the spring and summer there were very few areas of this nature.

2.2.2 The survey method was unsuitable for accurate counts of snipe due to the timing of their peak display period being at dawn and/or at dusk. Counts and estimates made for snipe in this report are therefore made with the caveat they are likely to be higher than those figures quoted.

2.3 Estimation of Wader Populations

2.3.1 The total area of open moorland was estimated to be 460 km^2 (Jerram et al 1998). The minimum numbers of breeding waders within the area were estimated by extrapolation from the overall densities found in the 92, 1km squares surveyed. The actual total area of open moorland within these survey sites was 77.36km^2 (Shepherd 2000).

3.0 SPECIES DESCRIPTIONS AND STATUS

3.1 The following systematic species descriptions describe general habitat requirements and conservation status for each key species. Results of the 2014 surveys are described in order to produce a base line for comparison of the 2019 results described in section 4 page 13. The section includes species which are either notified Schedule 1 species, Wildlife and Countryside Act 1981 (as amended), breeding Red or Amber listed species (high conservation concern) as described in The Population Status of Birds in the UK BOCC4 (*Birds of Conservation Concern 4*: updated 2015), NYMNP SPA qualifying species EC Directive 79/409 on the Conservation of Wild Birds: Special Protection Area (SPA) or UK/LBAP Biodiversity Action Plan priority species (UKBAP species). *Nomenclature follows - Knox, A.G., Collinson, M., Helbig, A.J., Parkin, D.P. and Sangster, G. 2002. Taxonomic recommendations for British birds. Ibis 144: 707-710. English names are as in BOU Checklist of Birds of Britain and Ireland (7th Edition, July 2006, Ibis 148: 526-563).*

3.2 European Golden Plover *Pluvialis apricaria*

National and Regional Context; *NYMNP SPA qualifying species. Moved from Amber to Green List in BOCC4.*

3.2.1 Golden plovers breed in a wide range of upland habitats including wet heaths, blanket bogs, acidic grasslands and other sub-montane habitats. In the North of England these areas often overlap with areas that are managed as grouse moors.

3.2.2 The nest site is a shallow scrape on the ground in short vegetation (<15cm) such as on moorland burns, bare ground, short heath or cotton grass tussocks and is often well hidden by surrounding moorland vegetation. Eggs are generally laid from the end of March in Northern England through to mid-May with one clutch of four eggs per year, but this clutch size can vary between two and five.

3.2.3 Food consists of beetles, earthworms and other invertebrates and also some plant material, with cranefly larvae being of particular importance. Golden plovers in summer can range between two and seven kilometres from the nest site. Breeding sites are vacated from early July with the birds moving south and east for winter when they are more attracted to winter cereals, stubbles, close-grazed pastures and other lowland agricultural habitats (European Management Plan).

3.2.4 The survey of 2014 showed that golden plover within the National Park had a breeding density of 2.04 pairs/km^2. This density was substantially higher than that of 2008 which was 1.46 pairs/km^2. The extrapolated 2014 population for the whole moorland area was 938 pairs. This number is approximately 2.47% of the estimated UK breeding population of 38,000 pairs (Musgrove et al, 2013). The relative stability of the population within the National Park may be as a result of better heather moorland management. The estimated population is approximately 0.20% of the European breeding population estimated as 460,000 pairs (avibirds.com).

3.3 Northern Lapwing *Vanellus vanellus*

National and Regional Context; *Red List Species BOCC4, UK and regional long-term breeding population decline, regional indications of some increases since 1994 noted in the Yorkshire Bird Report 2014.*

3.3.1 Lapwings breed in areas with a mosaic of habitats surrounding the nest site, which is a scrape on the ground sometimes lined with plant vegetation, usually situated on wet grassland; in upland habitats this includes including heath and bog. Previous research has found that the birds prefer to nest in fields that are grazed throughout the breeding season where sward length is controlled to provide an abundance of invertebrates for the chicks. Breeding populations are often found in small colonies to aid in the defence of chicks and nests from predators.

3.3.2 Food consists mainly of earthworms, insects, beetles and other invertebrates including some plant species (Eglington 2009). The eggs are laid from late March to early May with a usual clutch size of four, but this can vary from two to five. The birds are single-brooded.

3.3.3 In winter lapwing populations tend to group together in lowland areas, sometimes around estuaries, and in areas with short permanent grassland.

3.3.4 The survey of 2014 showed that lapwings within the National Park had a breeding density of 1.30 pairs/km^2. The extrapolated population of lapwings across the entire moorland area was 598 pairs which is approximately 0.43% of the UK breeding population estimate of 140,000 pairs (Musgrove et al, 2013). This is approximately 0.04% of the European breeding population estimated at 1,590,000 pairs (Birdlife, 2015).

3.4 Common Snipe *Gallinago gallinago*

National and Regional Context; *Amber list species BOCC4, noted as scarce breeding resident in the Yorkshire Bird Report 2014. BBS data showing increase since 1994.*

3.4.1 Snipe are relatively widespread throughout Northern England, Wales, Scotland and Ireland, and are often found breeding on rough marshy pastures and moorland bogs with frequent clumps or patches of herbage or shrub cover affording good visibility of approaching danger. These areas are often lowland areas with fen, wet pastures and damp grassland (Sharrock 2010). These areas provide a rich source of food including earthworms and other invertebrates (Hoodless *et.al.* 2007).

3.4.2 Snipe nest in hummocks and tussocks in grass, heather and rushes lined with vegetation. Eggs are laid from early March to May with a usual clutch size of four, but this can vary from two to five.

3.4.3 The survey of 2014 showed that snipe within the National Park had a breeding density of 0.47 pairs/km^2. The extrapolated population of snipe for the whole moorland area was 216 pairs (see 2.2.2 page 8). This is 0.27% of the UK breeding population estimate of 80,000 pairs (RSPB) and is approximately 0.02% of the European breeding population estimate of 930,000 pairs (avibirds.com).

3.4.4 Snipe is protected under Annex II/2 and III/2 of the EC Birds Directive. The UK population has undergone moderate declines overall in the past twenty-five years, with particularly steep declines in lowland wet grassland. As a result, it is placed on the Amber List of conservation concern (BOCC4).

3.5 Eurasian Curlew *Numenius arquata*

National and Regional Context; *Red List Species BOCC4 and UK BAP species. Uncommon breeder, the Yorkshire population noted as continuing to decline in the Yorkshire Bird Report 2014.*

3.5.1 Curlews breeds in a variety of habitats including upland moors, peat bogs, swampy and dry heathlands and damp meadows and grasslands. In common with other wader species in such habitats, the next on the ground, often on a tussock for protection. Eggs are laid between late April and late June. The species is single-brooded with a usual clutch of four, but this can vary between two and five.

3.5.2 The diet of curlews in summer is primarily beetles and earthworms but other terrestrial invertebrates are also important. In winter, the population in the UK comprises both British and Scandinavian breeding birds with a majority wintering on estuaries and coastal areas (Musgrove *et.al.* 2011) with some birds moving as far as France or Spain.

3.5.3 The 2014 survey showed that the breeding density of curlew within the North York Moors National Park was 3.07 pairs/km^2. This is similar to previous densities found on open moorland in the UK (Marchant, 2008). The extrapolated population for Curlew across the whole moorland area was 1412 pairs. This is 2.08% of the UK breeding population estimated at 68,000 pairs (Musgrove *et al.*, 2013). The 1410 pairs

estimated to be found in the North York Moors is approximately 0.64% of the European breeding population which is estimated as 220,000 pairs (avibirds.com).

3.6 Common Redshank *Tringa totanus*

National and Regional Context; *Amber-listed species under BOCC4. Uncommon breeder after previous steep breeding population declines according to the Yorkshire Bird Report 2014.*

3.6.1 Redshank breed in damp areas including coastal saltmarshes, inland wet grasslands with short swards, swampy heathlands and grass marshes. Outside of the breeding period, Redshank can be found on flooded grasslands and along estuaries and coastal lagoons. The nest is a shallow scrape on a hummock or at the base of a tuft of vegetation that is often well hidden by overhanging vegetation. The species often nests in loose colonial groups near to the coast.

3.6.2 Redshank begin laying in March and the breeding season can last until August with breeding grounds departed between June and October. Redshank are single-brooded, laying four eggs per clutch but this can vary between three and five.

3.6.3 The diet includes a wide range of soil, terrestrial and aquatic invertebrates as well as estuarine invertebrates with the number of aquatic invertebrates increasing throughout the breeding period (Ausden 2003). During the non-breeding season, the species will also eat molluscs, crustaceans and occasionally small fish.

3..4 The UK breeding population of redshank is estimated to be 25,000 pairs (Musgrave *et.al* 2013). In the 2014 survey of the North York Moors National Park two pairs of redshank were found breeding in the same 1 km square. Because of local and national declines, the redshank has Amber Status (BoCC4) and is noted in the NYMNP SPA citation as part of the important bird assemblage (English Nature 2000).

4.0 RESULTS OF 2019 SURVEY

4.1 In 2019 the numbers of breeding waders recorded on the survey were as follows: 159 pairs of golden plover, 113 pairs of lapwing, 49 pairs of snipe and 271 pairs of curlew. A maximum of two pairs of redshank were on suitable breeding territory on the first visit but absent thereafter with no proof of breeding. Redshank is therefore omitted from the following results.

4.2 Distribution and Density of Target Species

4.2.1 The distribution and density of all four target species, as illustrated by the maps that follow in this section, can be summarised as follows:

4.2.2 Curlew

4.2.2.1 Fig. 1 shows a widely scattered distribution across the survey area, with a breeding presence recorded in the majority of squares surveyed. Of the few squares where no breeding was noted, all were in the south and east of the area; very few in the north and west lacked a breeding presence.

4.2.2.2 Densities were typically highest in the west, south-west and north, with squares hosting the highest numbers located in the latter two zones. Breeding densities were at their lowest in the central and eastern areas, with no squares holding similar densities to the most productive areas of the south-west and north.

4.2.3 Golden Plover

4.2.3.1 As can be seen in Fig. 2, the distribution of breeding golden plovers within the region can be described as widespread but patchy, this species being particularly thinly-distributed in central and eastern areas. Squares where no presence was found in 2019 are evident across the survey area, with a particular lack of registrations in the central and eastern regions.

4.2.3.2 By far the highest densities were found in the western third of the survey area, with further isolated squares of higher breeding densities in the far north and east. Areas with low breeding densities of golden plovers were apparent and across the eastern and central zones, where they constituted the norm across wide areas of these regions.

4.2.4 Lapwing

4.2.4.1 Fig. 3 shows breeding lapwings are absent from large tracts of heather moorland across the entirety of the region, with a slightly more widespread distribution in the north,

west, and central areas of the survey; squares where no evidence of breeding lapwings were recorded were most evident in the southern and eastern areas.

4.2.4.2 Breeding densities across the region were not clustered around specific areas, although were generally higher in the north and west and lower in the south and east. Squares where densities could be considered high were few and far between and followed no discernible geographical pattern.

4.2.5 Snipe

4.2.5.1 As can be seen in Fig. 4, snipe were thinly distributed across the surveyed region, with a lack of presence registered in many squares; of those squares where a presence was recorded, a slight bias towards the western survey area is evident.

4.2.5.2 Squares within which a breeding presence was noted generally hosted very low densities, with just a handful with medium to high densities recorded. As discussed, this is influenced by this species habitat preference with heather moorland not necessarily offering optimal breeding conditions and the survey timing being suboptimal (see 2.2.2 page 8).

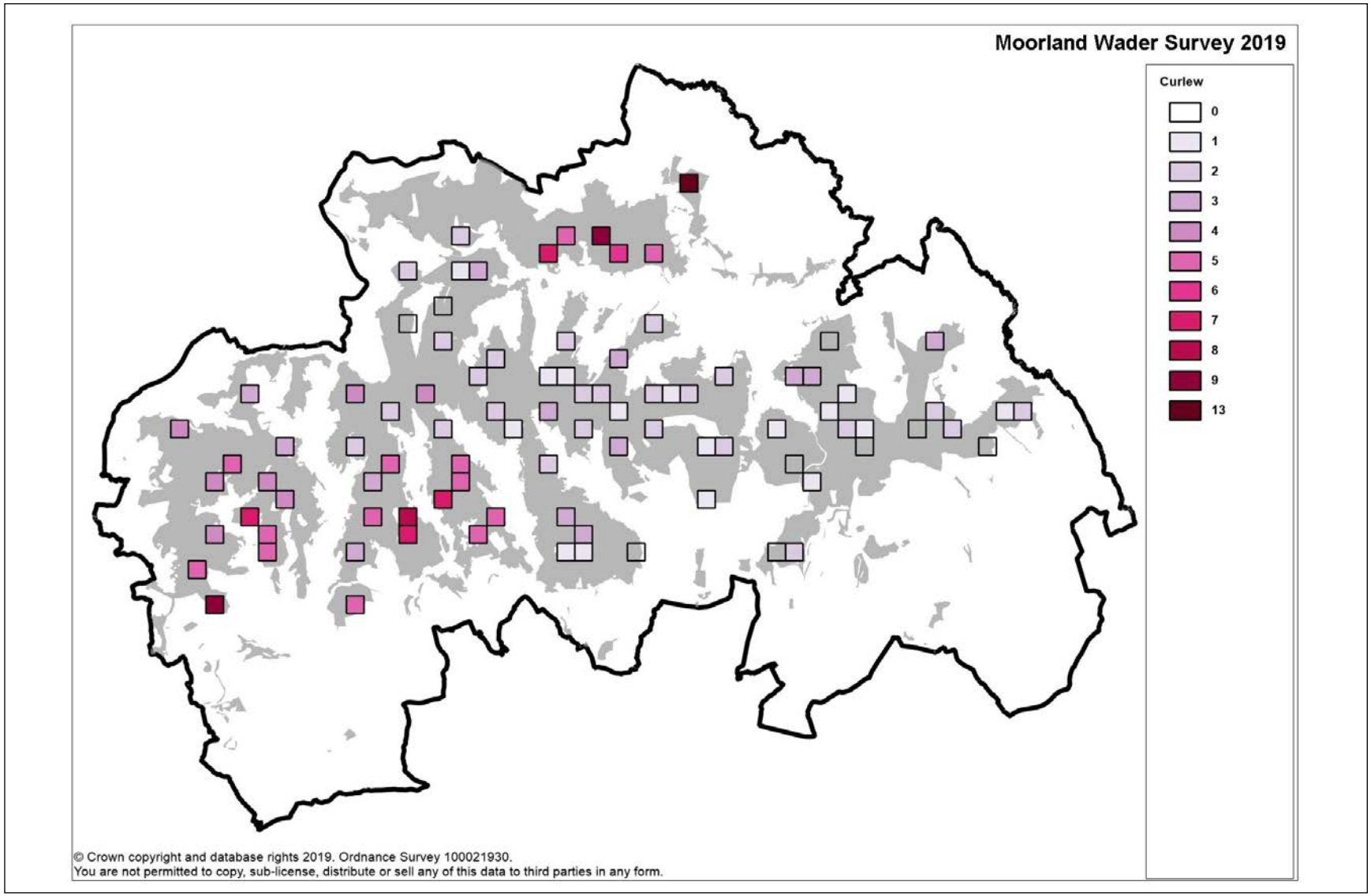


Figure 1 – Curlew Results 2019 Showing Distribution of Breeding Birds

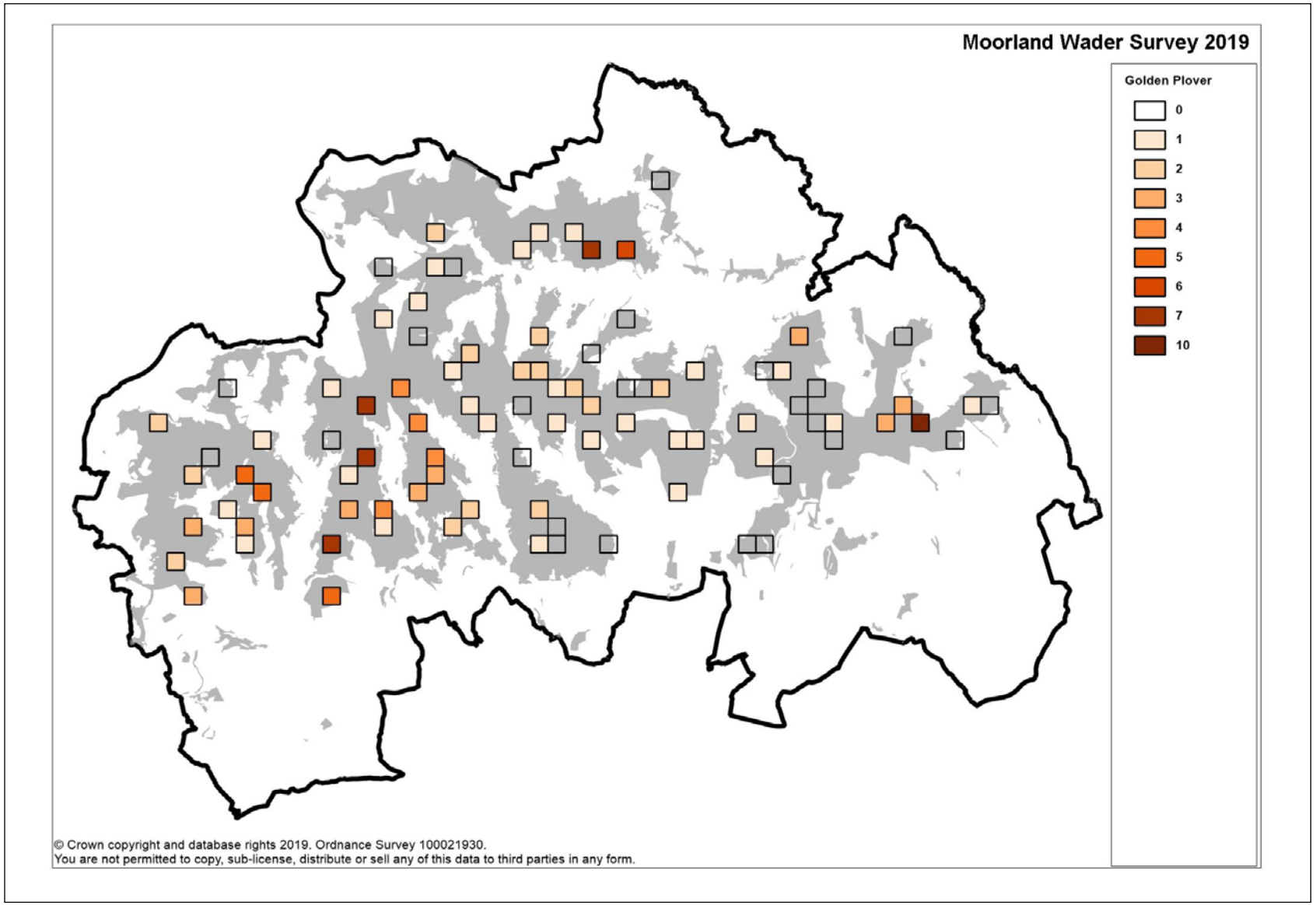


Figure 2 – Golden Plover Results 2019 Showing Distribution of Breeding Birds

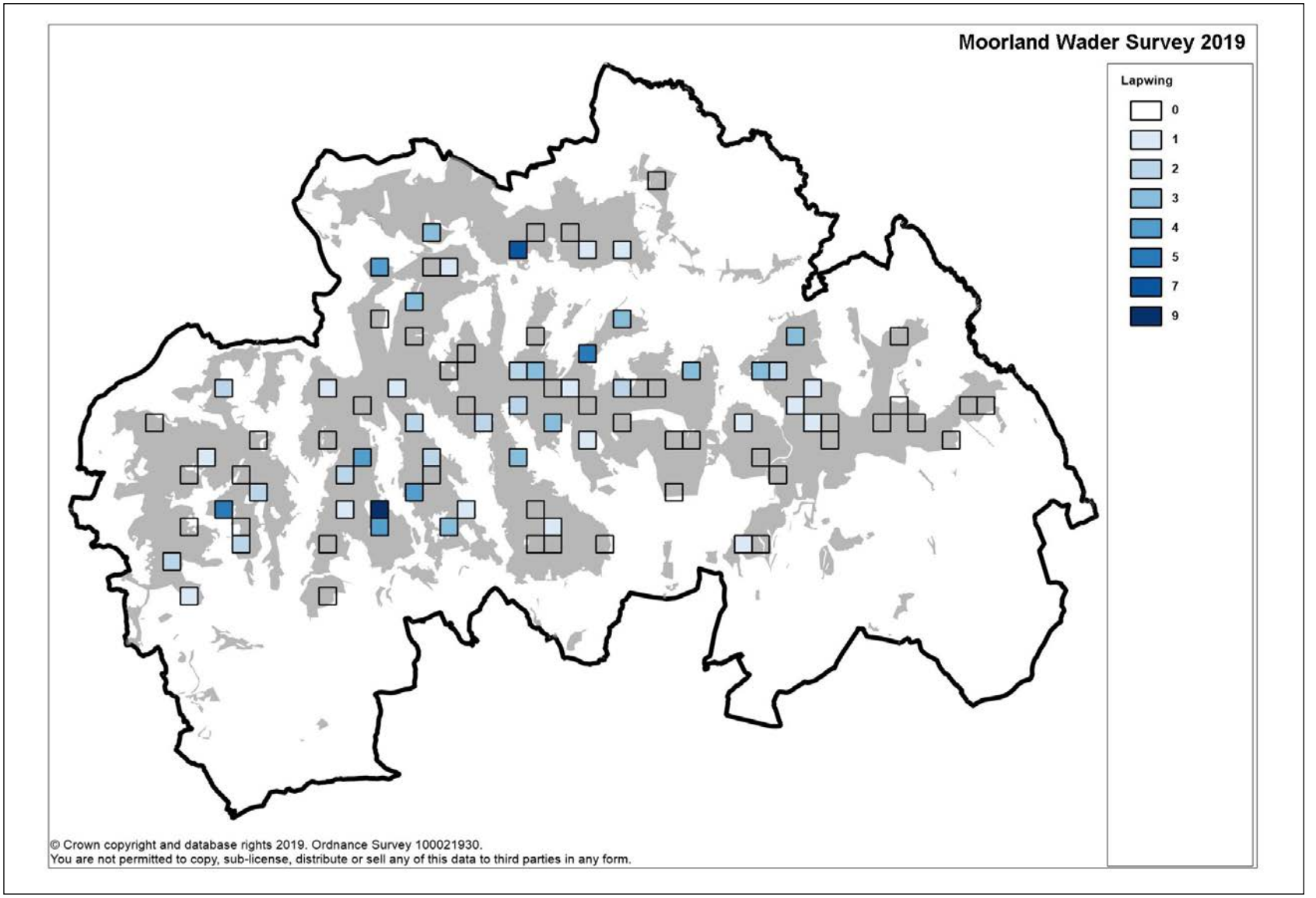


Figure 3 – Lapwing Results 2019 Showing Distribution of Breeding Birds

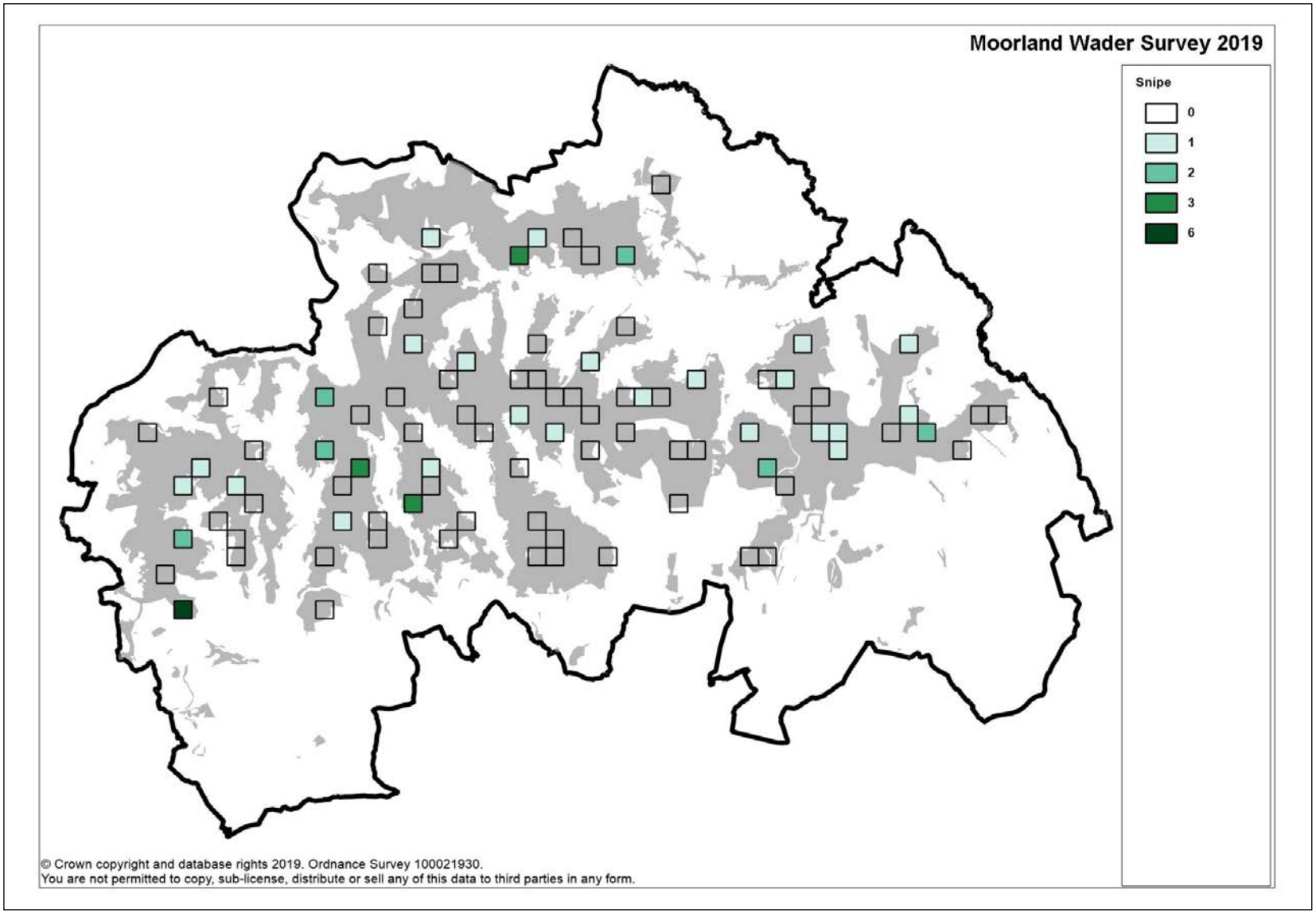


Figure 4 – Snipe Results 2019 Showing Distribution of Breeding Birds

4.3 Comparison of 2019 and 2014 Results

4.3.1 In 2019 a total of 159 breeding pairs of golden plover were recorded within the survey area, a decrease of 29 pairs from the survey of 2014. Statistical analysis showed there was a non-significant difference in recorded populations between 2014 and 2019 (t = 1.07, df.182, ns). Fig 1 illustrates the comparative numbers of breeding golden plovers recorded across the two surveys in 2014 and 2019.

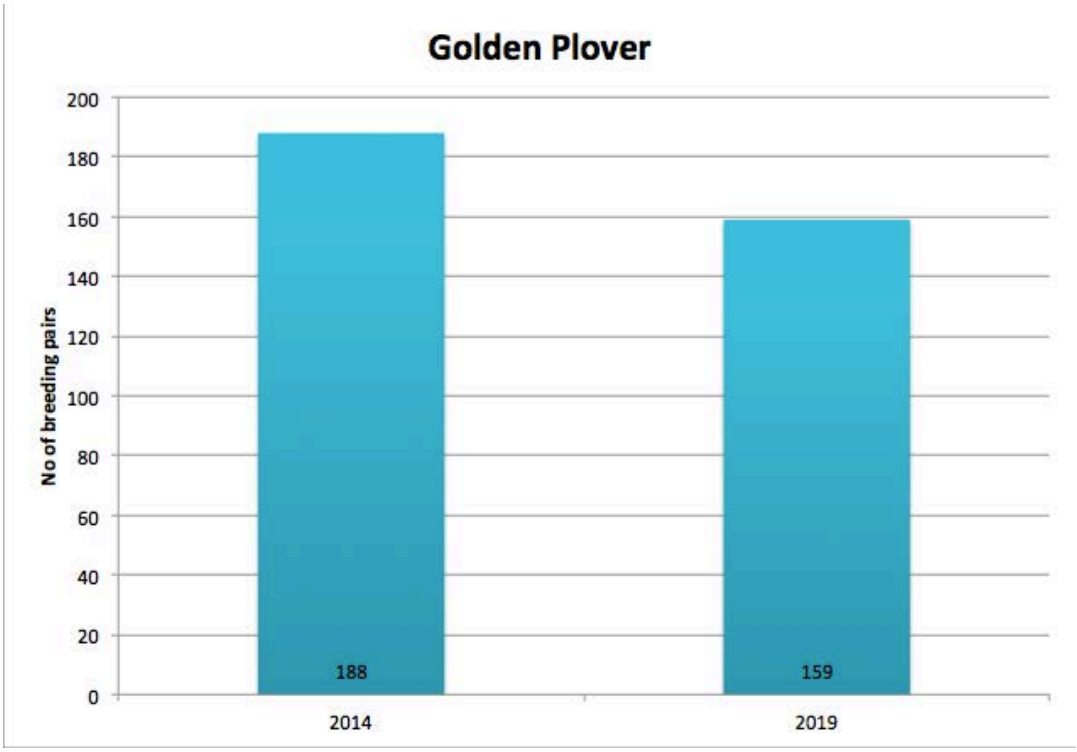


Fig 1 - Comparison of Golden Plover breeding pairs in the two surveys 2014 & 2019

4.3.2 In 2019, 113 pairs of lapwing were recorded as breeding in the survey area compared with 120 pairs in 2014, a decrease of seven pairs. Statistical analysis found this difference to be insignificant (t=-0.27, df.177, ns).

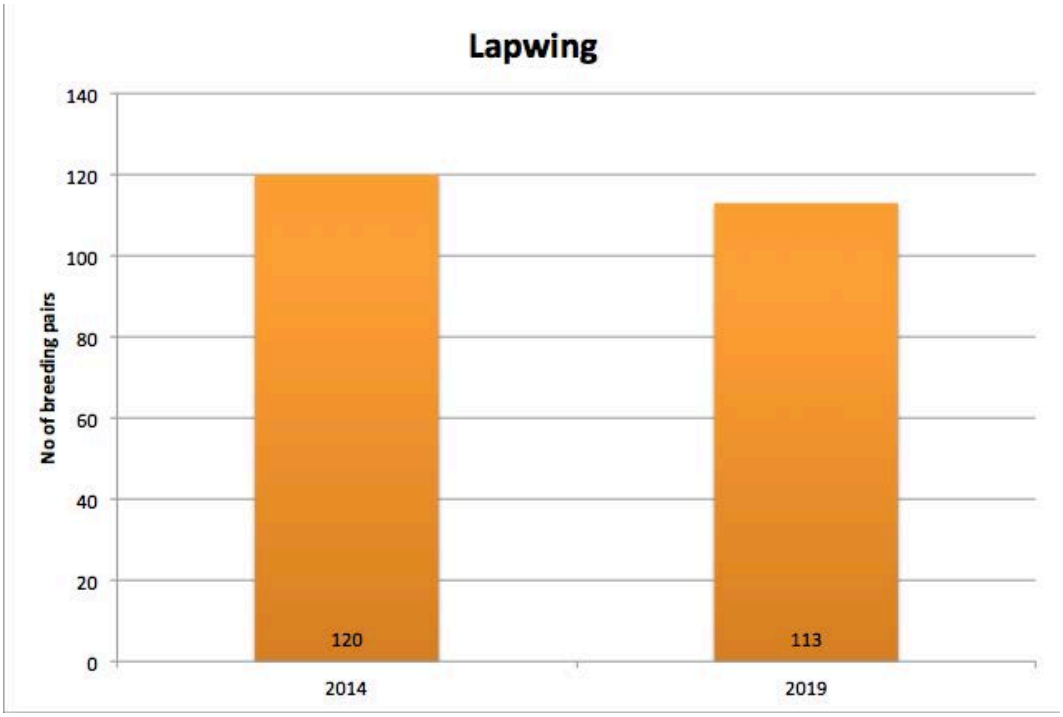


Fig 2 - Comparison of the numbers of Lapwing breeding pairs 2014 & 2019.

4.3.3 In 2019, 49 breeding pairs of snipe were recorded compared with 43 recorded in 2014, an increase of six breeding pairs. The results of t-test analysis found these numbers did not differ significantly from one another (t=0.49, df. 179, ns). Figure 3 compares the numbers of Snipe found in each of the surveys.

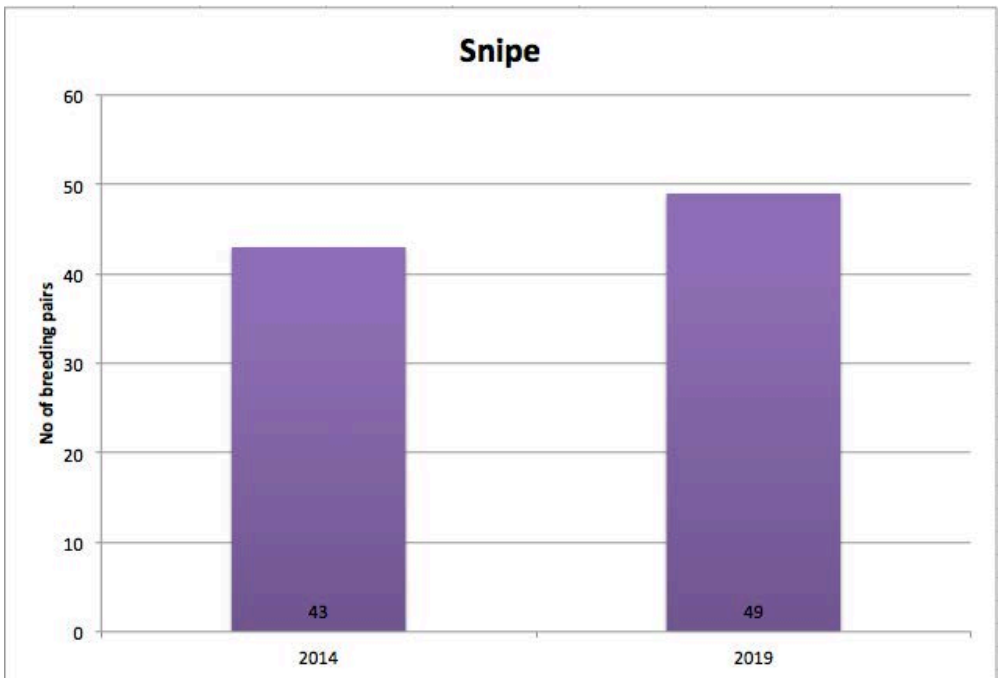


Fig 3 - Comparison of Snipe breeding populations recorded in 2014 & 2019.

4.3.4 In 2019 a total of 271 breeding pairs of curlew were recorded within the survey area, compared with 282 in 2014. Following statistical analysis, it was found the populations in the two surveys did not differ significantly from one another (t=-0.38, df. 173, ns). Figure 4 shows the comparison between the two surveys.

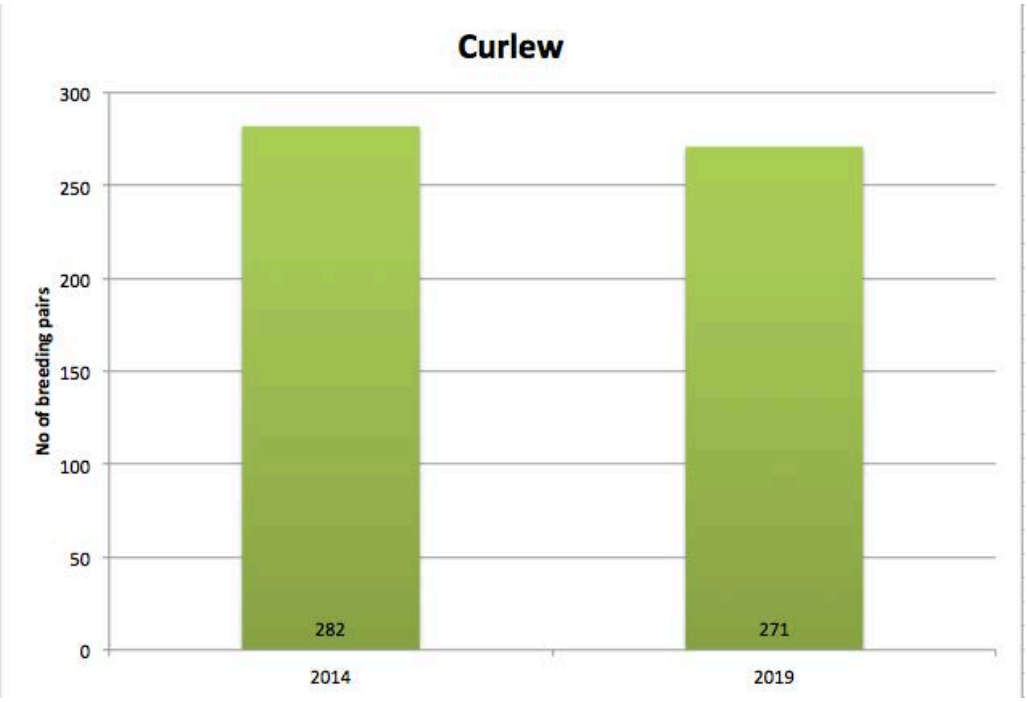


Fig 4 - Comparison between the two populations of Curlews recorded in the two surveys

4.4 Comparison of 2019 with Surveys Since 1996

4.4.1 Following these initial findings, comparisons were subsequently made between the numbers of different species of waders recorded in each of the four surveys since 1996 (Fig. 5). Table 1 on page 23 details the numbers of breeding pairs recorded in each of these survey years.

Table 1 – Comparison of numbers of breeding pairs of target species found in the survey area over the five surveys

Survey	Golden Plover	Lapwing	Snipe	Curlew	All Waders
1996	154	146	43	237	580
2000	143	182	33	328	686
2008	145	121	37	290	593
2014	188	120	43	282	633
2019	159	113	49	271	592

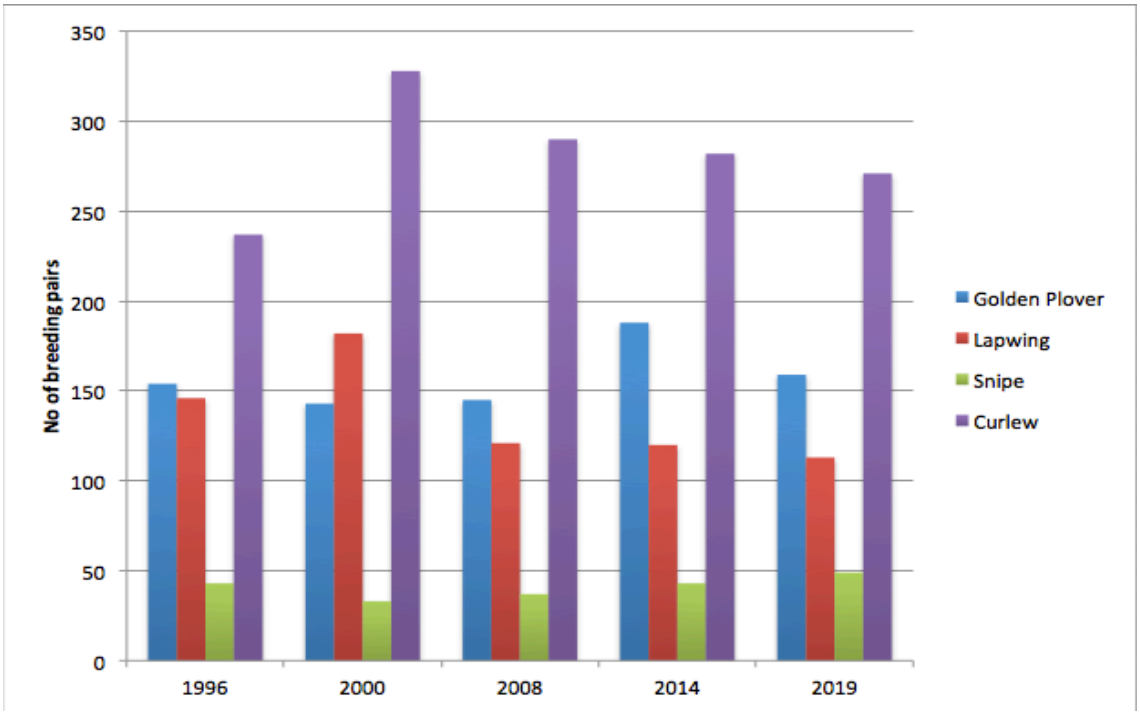


Fig 5 - Comparison of breeding wader totals recorded in each of the surveys within the NYMNP

4.4.2 The total number of breeding pairs of golden plovers recorded in the survey area in each year are shown in figure 6. There was some variation in number of pairs found in each survey since 1996, reaching the highest count in 2014. A comparative analysis of the results from each survey found that there was no statistically significant difference between them (X^2=8.31, df=4, X^2c=9.49, ns).

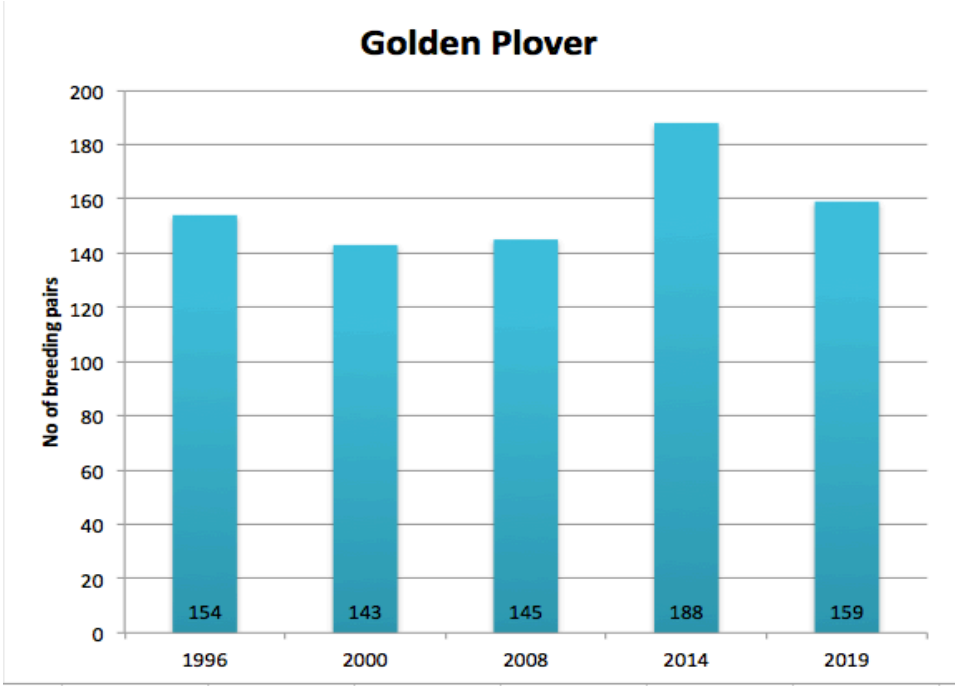


Fig 6 - Comparison of numbers of breeding pairs of Golden Plovers recorded during each survey

4.4.3 The numbers of lapwings recorded during each survey are displayed in Figure 7. A comparison across the surveys shows a downward trend in the numbers of breeding pairs; statistical analysis shows a significant difference between the numbers recorded over the surveys ($X^2=23.65$, df=4, $X^2c=9.49$, $p<0.05$).

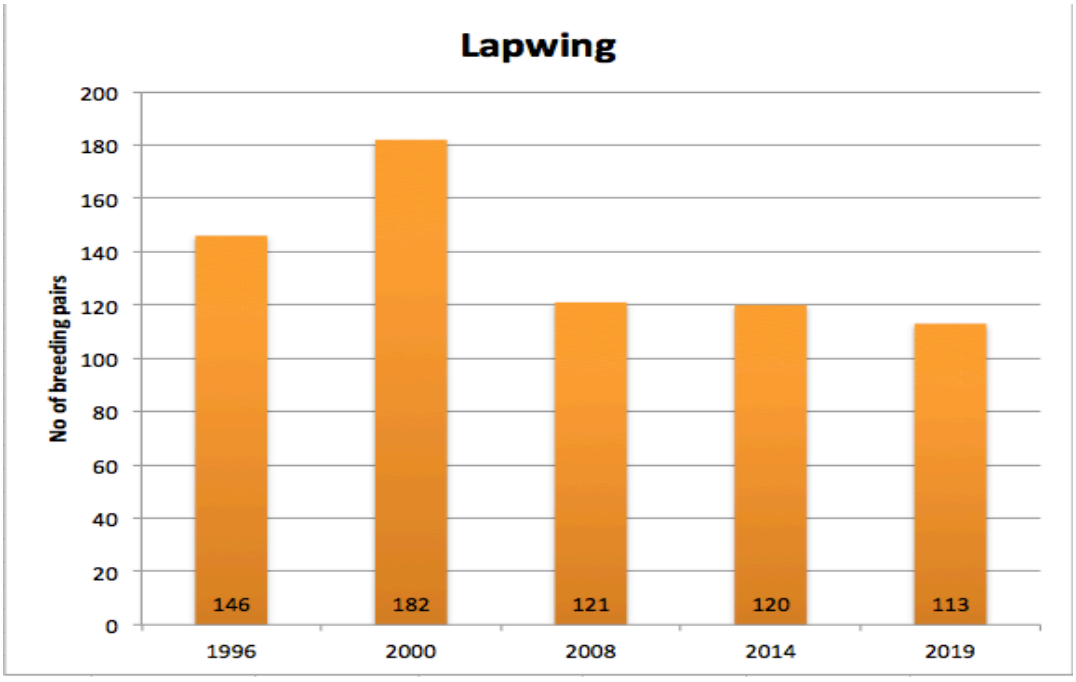


Fig 7 - A comparison of numbers of breeding pairs of Lapwings recorded during each survey.

4.4.4 The numbers of Snipe recorded during each survey are displayed in Figure 8. Statistical analysis of this slight variation in numbers showed that there were no significant differences across the surveys ($X^2=3.71$, df=4, $X^2c=9.49$, ns).

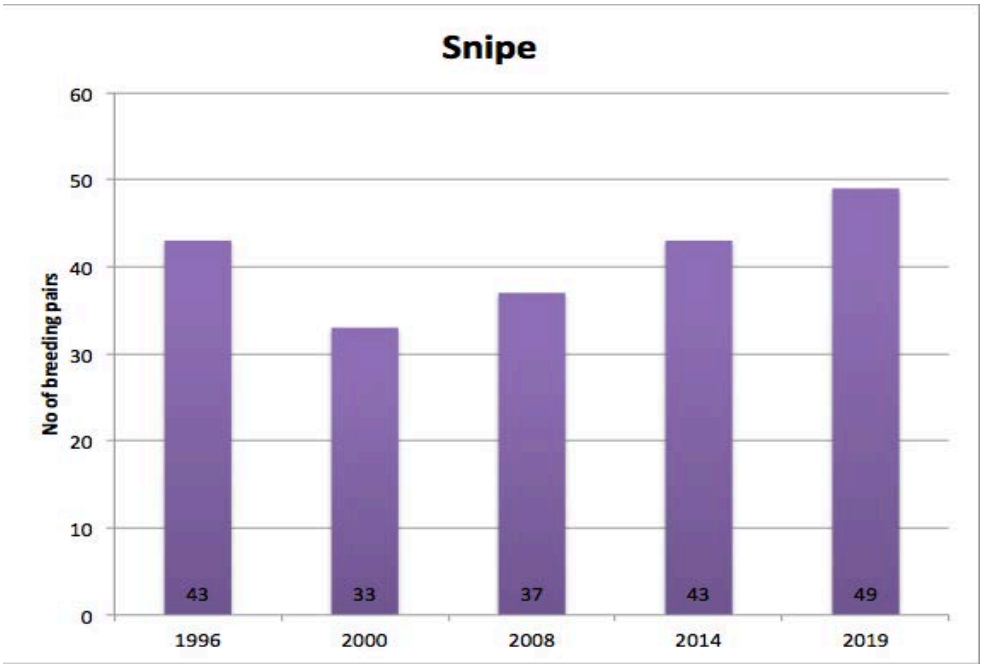


Fig 8 - A comparison of numbers of breeding pairs of Snipe recorded during each survey

4.4.5 A comparison of the numbers of breeding pairs of curlews recorded in the five surveys is shown in figure 9 page 26. A comparative analysis of the numbers recorded on each of the surveys showed that there were statistically significant differences between them ($X^2=15.36$, df=4, $X^2c=9.49$, $p<0.05$).

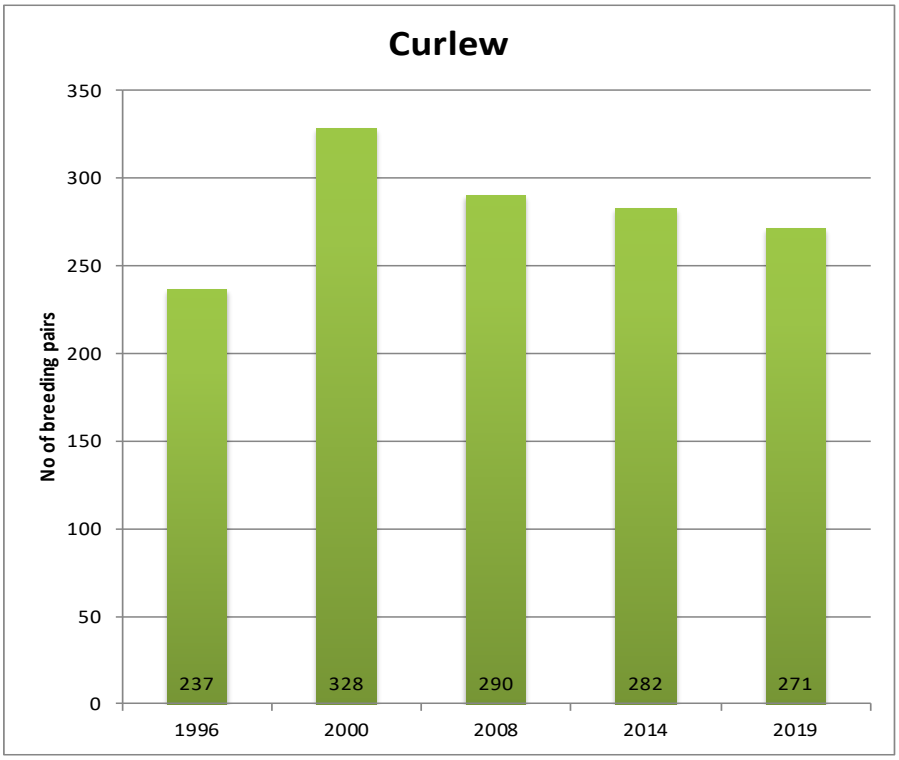


Fig 9 – A comparison of numbers of breeding pairs of Curlew recorded in each survey.

4.4.6 The breeding densities of the different species of waders from the five surveys are presented in Table 2. The densities show the mean number of birds breeding per 1km² in the survey area. The difference in densities between the species is interpreted visually in Figure 10.

Table 2 – Mean number of breeding pairs per 1km/sq. found in the survey area

Survey	Golden Plover	Lapwing	Snipe	Curlew
1996	1.67	1.58	0.46	2.58
2000	1.55	1.97	0.35	3.56
2008	1.57	1.31	0.40	3.15
2014	2.04	1.30	0.47	3.06
2019	1.73	1.23	0.53	2.94

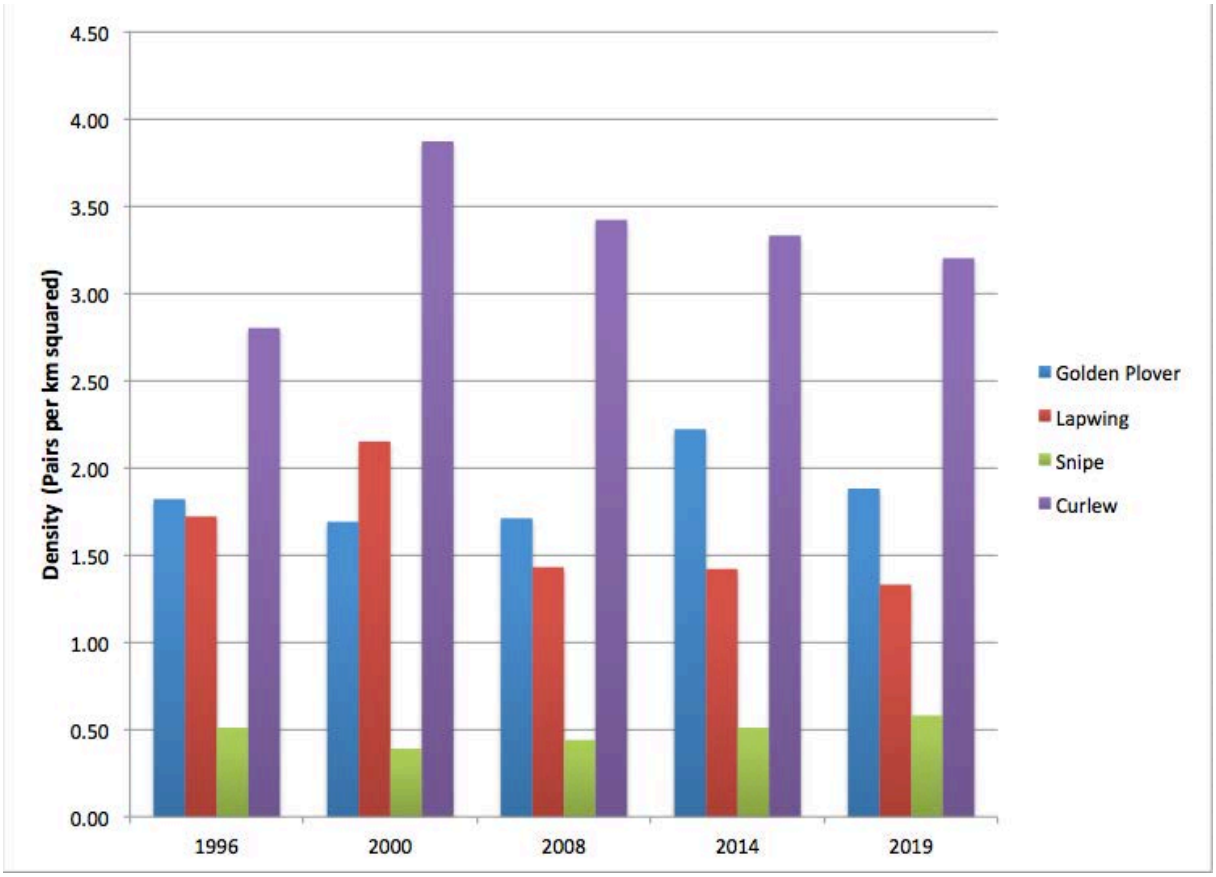


Fig 10 - comparison of breeding densities of the target species over all surveys in the NYMNP

4.4.7 A comparison of the location of breeding pairs of waders within the survey area is shown in Figure 11. Statistical analysis of these numbers recorded in different regions at each of the surveys showed that there were highly significant differences ($X^2=66.51$, $df=12$, $X^2c=21.03$, $p<0.001$).

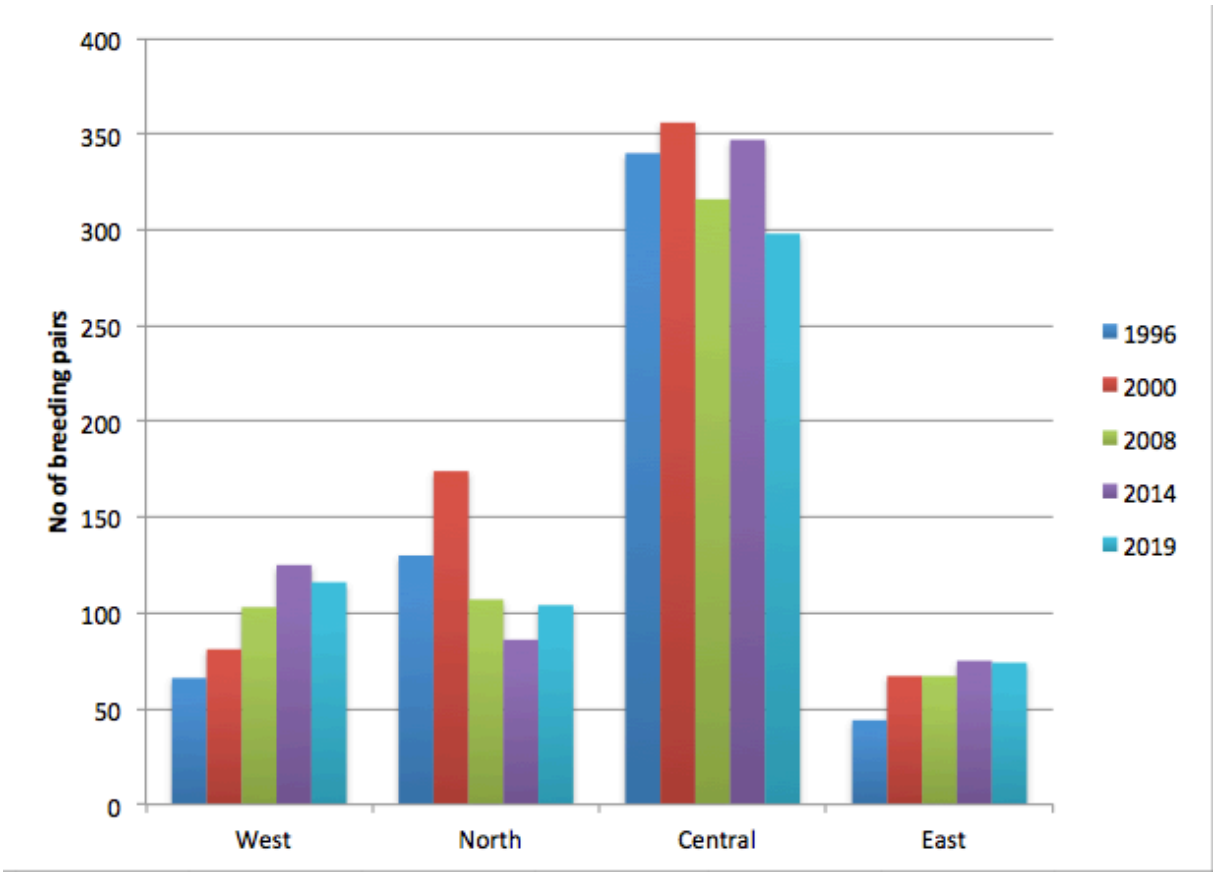


Fig 11 - comparison of overall numbers of wader breeding pairs (including Golden Plover, Curlew, Lapwing and Snipe) across the four different regions of the NYMNP over the five surveys.

4.4.8 Figure 11 illustrates the consistent trend of the largest numbers of all four species present in the central region. However, the total numbers in the central region were the lowest since surveys began. In the west and east numbers have been gradually increasing since 1996 with totals only slightly down in 2019 compared to 2014. The northern region was the only area to show an increase in 2019 from 2014.

4.4.9 These differences are most likely to relate to a combination of habitat, predation control, altitude, slope and climatic variables between the regions.

4.5 Peatland Restoration

4.5.1 The maps (Figures 12 and 13, pages 29-30 created by the NYMNP using Earthlight) provide a visual representation of the association between wader populations and the peatland restoration. They also show the difference in wader populations from 2014 to 2019 for each survey site. In both maps each square represents the km square that was surveyed with the colours of each square representing the difference in number of

birds between the two surveys. The red and orange are indicators of a loss in number of birds surveyed for that area, blue shows no change, green represents a rise in the number of birds surveyed.

4.5.2 The first map overlays the overall wader population alongside the peatland restoration areas (Figure 12, page 30). The second map shows the relationship between golden plover and the peatland restoration work (Figure 13 page 31).

4.5.3 The figures show a negative trend for all waders for the two years; 2014 and 2019 for squares within the restoration zones. Three squares increased, three stayed the same but five had lower numbers in 2019 compared to 2014. The trend was the same for golden plover.

4.5.4 The table below records the numbers of pairs of waders including golden plover and also golden plover separately which were recorded within each peatland restoration survey square for three years 2008, 2014 and 2019. These survey squares have at least some of their area within a peatland restoration zone. This three-year comparison gives a clearer reflection of trends than two years. Most peatland restoration work was carried out between 2009 and 2013.

Table 3 – Breeding wader numbers in peatland restoration survey squares

Square Number	2008 All Waders	2008 GP	2014 All Waders	2014 GP	2019 All Waders	2019 GP
45	5	0	4	1	9	3
55	8	5	14	10	19	7
50	7	3	8	5	8	1
51	6	4	12	6	9	7
18	3	0	3	0	3	1
28	2	1	6	2	3	1
31	5	2	6	2	7	1
23	2	1	3	1	3	1
24	5	4	8	3	5	2
30	3	2	5	2	3	2
32	7	3	4	1	3	1
Totals	**53**	**25**	**73**	**33**	**72**	**27**

4.5.5 The results show all 11 survey squares had breeding waders present in every one of the survey years 2008, 2014 and 2019. Over the three years the trend for all waders has been positive, increasing from 53 pairs in 2008 to 72 and 73 respectively in 2014 and 2019. The trend for golden plover has not shown any large fluctuations, remaining consistent throughout the three survey years from a low in 2008 of 25 pairs to a maximum population of 33 in 2014. 27 pairs were recorded in 2019.

4.5.6 Only two squares 45 and 18 returned zero golden plover, however both of these squares had golden plover breeding in 2019 with square 45 increasing from 0 in 2008 to three pairs in 2019. Six of the 11 squares returned only one pair of golden plovers in 2019, these low numbers in the peatland restoration areas were also reflected in the surveys as a whole.

4.5.7 These results show a clear benefit of peatland restoration to breeding waders. Trends over longer periods of time detect a clearer picture of value. It is highly likely the conservation of peat and its associated water levels, creates improved habitat resilience allowing breeding waders to return to larger numbers after excessively dry years.

Figure 12 – GIS Map Showing Difference in Breeding Waders across the Survey Plots between 2014 and 2019. The numbers in the legend refer to the difference in wader numbers between the two years of surveys

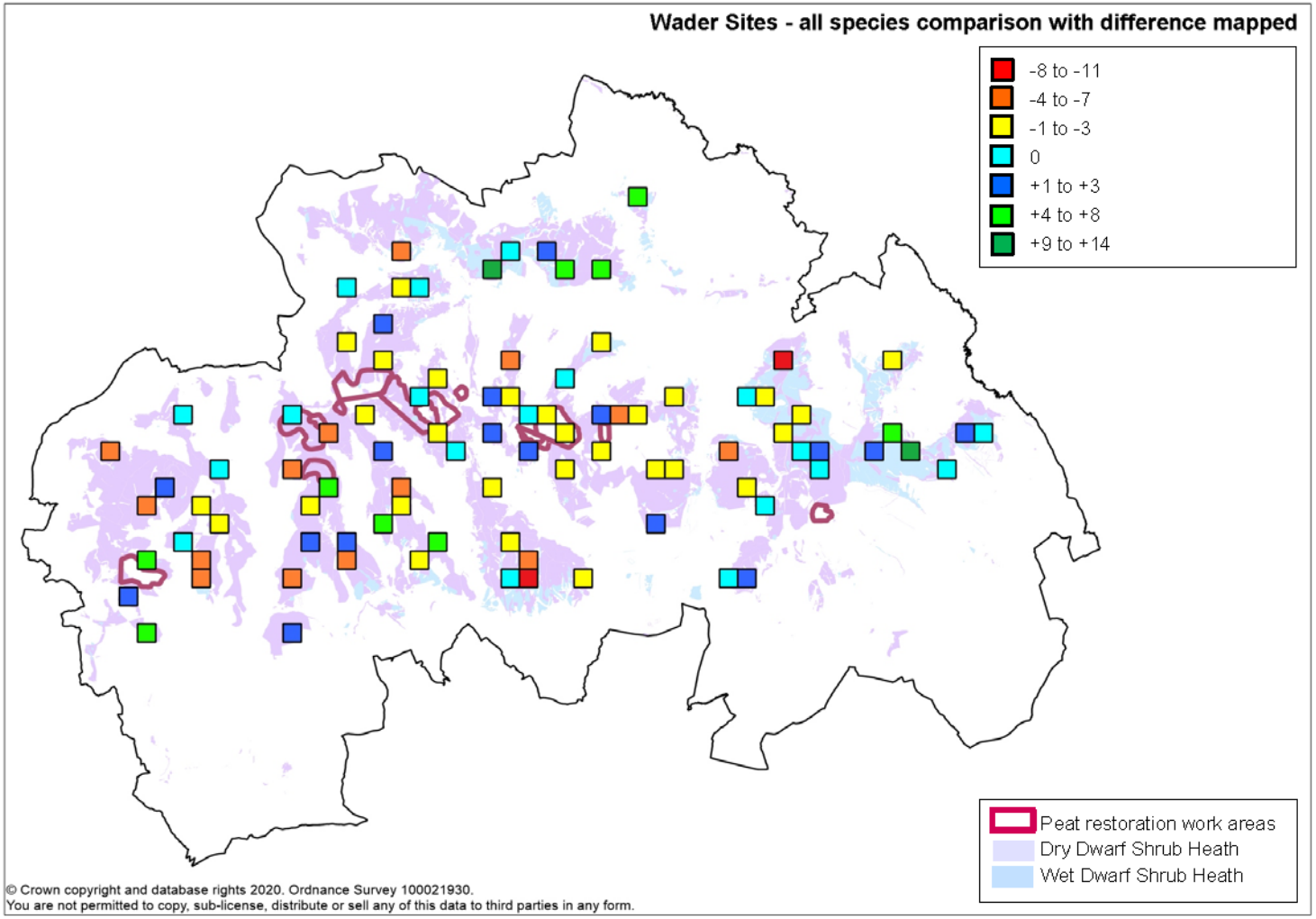
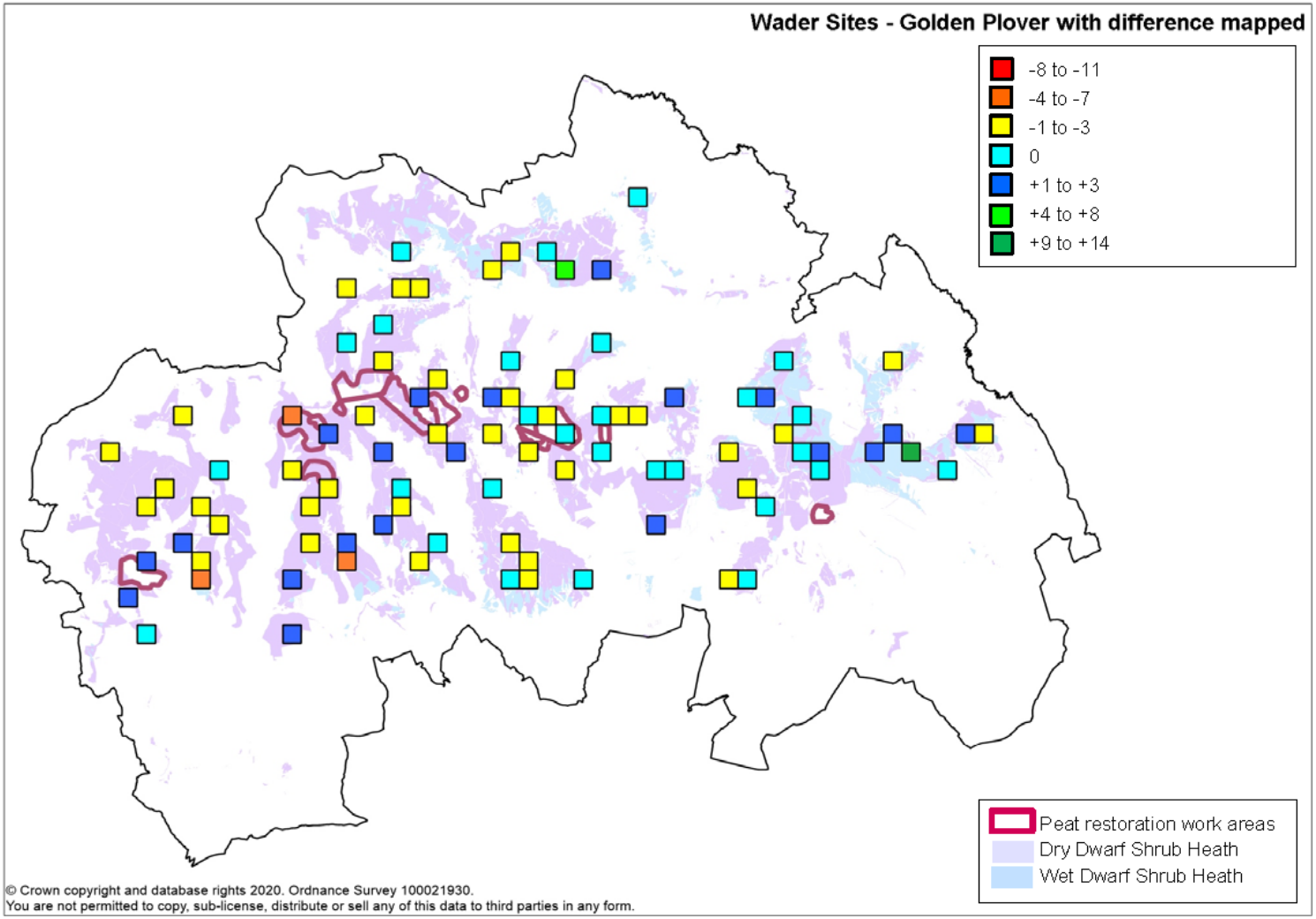


Figure 13 – GIS Map Showing Difference in Golden Plover Population across Two Survey years 2014 and 2019



5.0 EVALUATION OF TRENDS

5.1 The comparison of results of the 2019 wader survey with those of the 2014 survey show that there was only a small amount of change in the numbers of breeding pairs of the four key species. There is some fluctuation in populations of each species, but taken as a whole (i.e. as a suite of species), populations remain fairly stable across both surveys. Only golden plover showed a notable change, with 29 less pairs recorded in 2019 compared with 2014.

5.2 Survey Area

5.2.1 The survey area in this assessment is identical to that used in the previous four studies, with 92 x 1km squares being used. The innate randomness of sample sites chosen could affect the final results through exclusion of specific areas that are of high importance to some species, for example particularly wet/marshy areas or in-bye land close to agricultural areas with high invertebrate populations. It could also result in clustering of points around areas when spacing is not taken into account. This has the potential to produce some skew in the results or cause under-estimation in the number of waders when specific areas are not included.

5.2.2 Although using the same sites allows some level of continuity across the studies it does not take into account any habitat changes to the areas or fluctuations in climate. Within the National Park, the habitat is often altered for a number of reasons including management by burning, cutting and cropping as well as peatland restoration. These waders are not averse to moving to adjacent sites if an area becomes unsuitable and if their new location is an unmonitored square this bird will become a loss in the following survey records. Although this report has looked at some habitat change by incorporating peatland restoration whilst looking for trends there is still a large amount of change that can occur and alter wader numbers without being factored into the trends.

5.2.3 The results deal with relatively small population numbers which can be highly influenced by a number of factors therefore caution should be practised when evaluating any definitive trends. The whole sampling system allows for both growth

and reduction in numbers to go unrecorded as there are many locations that are not surveyed so all statistics and patterns found should be considered with this caveat.

5.3 Species Evaluation

5.3.1 Golden Plover

5.3.1.1 In 2019, 159 pairs of golden plovers were recorded breeding with the survey area of the North York Moors National Park, decreasing from 188 pairs in 2014. Statistical analysis showed that this difference between populations was not significant. However, these figures were biased by a small number of squares with large numbers of birds, it is important to recognise that 61% of squares returned either no pairs or one pair. The concentration of high numbers of golden plovers in a relatively small number of squares in 2019 appears to be consistent throughout the survey years. Yearly percentages of 0-1 return from squares; 1996=54%, 2000=60%, 2008=56%, 2014=48%, 2019=61%. These figures may illustrate a tendency for golden plovers to breed in higher numbers in the best habitat areas when the population is lower and/or suffers stress from adverse climatic pressure i.e. dry winter/spring.

5.3.1.2 The survey of 2019 showed that golden plover within the National Park had a breeding density of 1.73 pairs/km^2. This density was lower than that of 2014 which was 2.04 pairs/km^2.

5.3.1.3 The extrapolated population for the whole moorland area was 795 pairs. This number is approximately 2.1% of the estimated UK breeding population of 38,000 pairs (Musgrove *et.al.* 2013). The estimated population is approximately 0.17% of the European breeding population estimated as 460,000 pairs (avibirds.com).

5.3.1.4 Prior to 2008 the population remained relatively unchanged since the surveys began in 1996. In 1996, 154 pairs bred but dropped by 12 pairs in 2000 to 143, it then rose again to 145 by 2008. 2014 was the best year with 188 pairs. The relatively large fall to 159 pairs in 2019 should therefore be considered with caution as it relates to a fall from an exceptionally good year in 2014. A major constraint to numbers in 2019 is likely to have been the unusually dry early spring (see land management recommendations).

5.3.2 Lapwing

5.3.2.1 In 2019 a total of 113 breeding pairs of lapwing were recorded within the survey area of the North York Moors. This was seven less pairs than in the 2014 survey when 120 pairs were recorded. Statistical analysis showed the difference between 2014 and 2019 to be insignificant following the large decrease after 2000. In summary the trend in lapwing population remains relatively stable (but declining survey-on-survey) since 2008 after a peak year in 2000. It is important to recognise that 2019 was the lowest mean density of lapwings since the surveys started in 1996.

5.3.2.2 Nationally, lapwings have shown a decline since 1962 (Shrubb & Lack 1993). This trend appears to be continuing with the latest figures showing sharp declines between 2010 and 2011. It is thought that these declines were due to unfavourable weather conditions during these years aggravating long-term declines thought to be caused by habitat loss, land drainage and predation pressure (BTO, 2012).

5.3.2.3 In the 2008 survey evaluation there were statistically significant differences between the recorded numbers of lapwings found across the three surveys. However, by 2014 the population numbers appear to have stabilised resulting in no significant difference between the four surveys despite the variation of 25 more breeding pairs from 1996 to 2000 then a loss of 60 breeding pairs from 2000 to 2008. It is likely that these fluctuations are due to changes of habitat in the survey area throughout the years. The stability that appears in the latter years could be as a result of habitat management being more suitable for lapwings and therefore alleviating the effects on a local scale of the national trend of a decline in numbers. However, it is worth noting that the downward trend has continued during every survey since the peak in 2000.

5.3.2.4 The survey of 2019 showed that lapwings within the National Park had a breeding density of 1.23 pairs/km^2. The extrapolated population of lapwings across the entire moorland area was 566 pairs which is approximately 0.40% of the UK breeding population estimate of 140,000 pairs (Musgrove et al, 2013). This is approximately 0.04% of the European breeding population estimated at 1,590,000 pairs (Birdlife, 2015).

5.3.3 Snipe

5.3.3.1 In 2019 a total of 49 pairs of snipe were recorded breeding within the survey area of the North York Moors. This was six more than in the 2014 survey. Statistical analysis showed there were no significant differences between the two years, and between the numbers of breeding pairs recorded across the four survey years. In summary the trend in the population of Snipe within the North York Moors remained stable between 1996 and 2019.

5.3.3.2 Although the species appears to remain stable, with a breeding density of 0.51pairs/km^2 that has not varied much since the first survey in 1996, the numbers recorded are much smaller than that of golden plover, lapwing and curlew. It is likely that this is a reflection of the difficulty in surveying the species and the misrepresentation of suitable habitat for the Snipe.

5.3.3.3 The extrapolated population of snipe for the whole moorland area was 245 pairs. This is 0.3% of the UK breeding population estimate of 80,000 pairs (RSPB) and is approximately 0.03% of the European breeding population estimate of 930,000 pairs (avibirds.com).

5.3.3.2 This assessment is made with the caveat that snipe is generally considered to be under-recorded using the Brown & Shepherd methodology due to their peak activity time being highly specific, i.e. at dusk and during periods with low wind speeds (Hoodless *et.al* 2006). Additionally, snipe often have larger breeding densities on marshy grassland or acid flush rather than on heath (Hoodless *et.al.* 2007). Within the landscape of the NYMNP this habitat is far more likely to be found on in-by land (closer to the farm than on the high moor) and at lower altitudes than heather moorland and within upland farm holdings.

5.3.3.3 On the NYMNP surveys snipe were often flushed from locations that were wetter or uneven sward length where their favoured prey could be found. These sites often included wet drains or linear drainage ruts close to roads and tracks and were often outside of the survey plots (R. Baines *pers. comm.*). Therefore because of the access restriction and associated selection of the survey sites favouring higher elevations and heather moorland it is highly likely that this species has been under-estimated due to

the highly specific peak activity time for snipe and a large proportion of optimal habitat not being included (see Section 6, Recommendations).

5.3.4 Curlew

5.3.4.1 In 2019 a total of 271 breeding pairs of curlew were recorded within the survey area of the North York Moors. This was 11 less pairs than in 2014, when 282 pairs were recorded. This variation in populations was found to be statically insignificant.

5.3.4.2 Statistical analysis of the recorded numbers of breeding curlews collected since the beginning of the five surveys in 1996 shows that there were highly significant differences between the years. The survey in 2000 showed an increase of 91 pairs from 1996, followed by a decline of 40 breeding pairs by 2008. This decrease in numbers follows the current national trend in wader species.

5.3.4.3 The 2019 survey showed that the breeding density of curlew within the North York Moors National Park was 2.95 pairs/km^2. This is similar to previous densities found on open moorland in the UK (Marchant, 2008).

5.3.4.4 The extrapolated population for curlew across the whole moorland area was 1357 pairs. This is 2.0% of the UK breeding population estimated at 68,000 pairs (*Musgrove et al, 2013).* This represents an increase from the 1996 extrapolated population. The 1357 pairs estimated to be found in the North York Moors is approximately 0.62% of the European breeding population which is estimated as 220,000 pairs (avibirds.com).

5.3.4.5 Considering the apparently relatively stable population of curlew in the NYMNP since 2008, it is possible the previous population fluctuations were a result of natural trends or as a result of a change in population away from the site before the birds returned to the survey area. As a result, the changes in population on the moorland may not be as significant as first thought or as relevant to management on the moorland as could be implied.

5.3.4.5 Similar to the other wader bird species curlews are vulnerable to changes in habitat; such as improved drainage, extensive burning and unchecked growth of moorland vegetation. These factors can all cause the birds to move and breed elsewhere. However, despite the possibility of being affected by these factors they are also capable

of using grassy margins and pastures to find food and will frequently visit enclosed fields below moorlands particularly before and during incubation (Grant & Pearce-Higgins, 2012*).*

5.4 Regional Trends

5.4.1 The results from 2019 show an apparent strong difference in breeding numbers of waders in association with their location within the National Park. It appears from the results that waders are more likely to be recorded in the central region of the park compared with other regions and biased between east and west with more birds being found in the west than the east. It is possible this is due to subtle differences in habitats and/or climate across these regions of the NYMNP. These differences could include: possible higher levels of burning in some areas on the eastern side as opposed to the western areas, elevation and topography differences affecting vegetation.

5.4.2 It is possible that the location of survey sites could be responsible for some of the bias especially if there are more survey sites in one region than another. It is also possible that some areas are either over-represented or under-represented so this apparently significant difference between the regions should be approached with caution and may merit further study.

6.0 MEADOW PIPITS AND ADDITIONAL SPECIES

6.1 This section includes other key birds recorded on the survey. These include any Schedule 1 protected species (Wildlife and Countryside Act 1981 as amended) and/or key species identified by the NYMNP as significant due to their conservation status as UK BAP/LBAP species which are species of conservation concern as described in *The Population Status of Birds in the UK* (Birds of Conservation Concern: 2002-2007) and/or additional species deemed notable by the NYMNP.

6.2 Surveyors were required to record meadow pipits as a tally of actual numbers of birds counted during the survey with care not to over record birds. Meadow pipits were also counted on the 2014 survey but not on NYMNP wader surveys previously. Table 3 and 4 present the results of meadow pipits in the two years (both visits). Table 5 presents the results of each additional species (without meadow pipit) recorded in 2019

as cumulative over both visits. All other additional species were recorded consistently in 2019 for the first time on these surveys.

6.3 The following tables give an indication of the potential population and distribution of these additional species. However, the count results should be used with caution. Each species and/or suite of species require either a different generic survey or a species-specific survey to accurately survey their populations. Despite this constraint the results do show trends consistent with national survey results.

Table 4 – Meadow Pipit Counts 2014

2014 Total Birds	***Max Count from Each Square Total**	**Peak Visit Count & Square/s**
7395	4547	111 on visit 2 in NZ6902 & SE6194

Table 5 – Meadow Pipit Counts 2019

2019 Total Birds	***Max Count from Each Square Total**	**Peak Visit Count & Square/s**
5182	4480	88 on visit 2 in SE5089 & SE6097

* 'Max count from each square' takes the largest count from either visit as the accurate figure

Table 6 – Additional Species Counts

Species	**2019**	**Peak Count**	**Squares Recorded**	**Peak Grid Square/s**
Common Redstart	11	2	8	SE8392, SE8498 & SE9299
Whinchat	8	2	7	SE9299
Ring Ouzel	22	4	14	SE5996
Common Stonechat	2	2	1	NZ6909
Common Cuckoo	8	1	8	n/a
Northern Wheatear	3	2	2	NZ6909
Linnet	11		16	NZ9500
Reed Bunting	9	6	3	NZ5801
Eurasian Skylark	309	62	16	NZ 9104
Herring Gull *	8	4	2	NZ9500
Common Kestrel	25	1	25	n/a
Merlin	4	1	4	n/a
Peregrine	9	1	9	n/a
Red Kite	2	1	2	n/a
Common Buzzard	51	5	36	NZ9100

Eurasian Hobby	2	1	2	n/a

* Herring Gulls were only recorded in two squares when they were attempting to predate a curlew nest as a notable observation. Herring Gulls were not on the list of species requiring counts

6.4 Meadow Pipits and Additional Species Results and Discussion

6.4.1 The 2019 meadow pipit results provide the first opportunity to compare results with a previous year. The cumulative total for 2019 is 30% lower than 2014, however the total birds calculated as the maximum number recorded for each square over both visits is very similar with only a 1.5% decline since 2014. In 2014 the NYMNP surveys recorded a mean of 49 birds/square and in 2019 the mean was 48 birds/square.

6.4.2 Visit 2 counts should increase after successful breeding (fledged juveniles) compared to visit one. In 2014 this was a very clear trend with 80 squares of the 92 squares recording maximum numbers on visit 2. In 2019 the figure was much lower with only 56 of the 92 squares showing higher numbers on visit 2 than visit 1.

6.4.3 The fall in cumulative total numbers coupled with the large decline in visit 2 square max counts is highly likely to be caused by a poor breeding season in 2019. In 2014, 16 squares recorded counts of 80 birds or above on visit 2 compared to only three squares above 80 birds in 2019. 35% of squares in 2019 recorded a fall in numbers on visit 2.

6.4.4 The reasons for this fall in numbers in 2019 compared to 2014 are likely to relate to either or a combination of habitat change through land management changes coupled with climatic changes either cumulative or in 2018/19. The early spring of 2019 was notably dry with very little moisture in the ground noticed by all surveyors and land managers at the time of the surveys. This lack of moisture was highly likely to have greatly reduced the number and availability of invertebrates available to meadow pipits at that time. Early spring is a critical period when all birds in the northern hemisphere need to increase their energy and fat scores for the arrival of the breeding season. Lack of food in early spring may consequently drive birds away from their traditional breeding areas such as those in the National Park and reduce breeding success of those remaining. Land management changes on a large-scale influencing meadow pipit

numbers may have been due to the peak take up of agri-environment/stewardship schemes in 2015 giving a boost in optimum habitat conditions leading up to this in 2014.

6.4.5 The fall in meadow pipit productivity in 2019 based on the results from visit two is likely to have adversely affected the success and numbers of major predators of meadow pipits in these areas especially merlin *Falco columbarius*.

6.4.6 In the additional species table the most regularly recorded species was skylark *Alauda arvensis* with 309 individuals found but only present in 17% of survey squares. Common Buzzards were found in 39% of squares and common kestrels *Falco tinnunculus* in 27%. Other less well observed species were noteworthy; A total of 22 ring ouzels *Turdus torquatus* were found in 15% of survey squares, 11 redstarts *Phoenicurus phoenicurus* in 9% of survey squares and eight whinchat *Saxicola rubetra* found in 8% of survey squares.

6.4.7 Regional increases in two raptors; red kite *Milvus milvus* and Eurasian hobby *Falco subbuteo* was likely to be the driver for both species to be recorded on these surveys. Surprisingly few stonechats *Saxicola rubicola* were recorded. Three northern wheatear was a typical result when bearing in mind this species is a scarce breeding bird in the NYMNP when compared to upland areas to the west such as the Yorkshire Dales National Park where it is far more common.

7.0 LAND MANAGEMENT

7.1 This section aims to combine findings and discussion from the NYMNP surveys with both regional (north of England) and national (UK) habitat preferences for each species within the study. A final bullet point list of land management recommendations is then given for each species based on these local, regional and national results. The focus of this section is on habitat priorities and management. The role of predator control is discussed but, in less detail, as it lies outside of the brief of this study.

7.2 UK Factors Causing Declines in Upland Wader Populations (Upland Waders Species Action Plan Northumberland 2008).

- Overgrazing and trampling

- Predation
- Spring machinery operations
- Visual obstructions e.g. conifer shelter belts
- Drainage
- Disturbance
- Under grazing resulting in rush infestation

7.3 Golden Plover

7.3.1 The importance of a range of suitable feeding habitats including both moorland and enclosed fields for adult golden plover within a locally diverse habitat network has been established in previous studies. Whittingham M.J (2000) found that during incubation adult birds mainly fed in enclosed grassland fields between 1.1 and 3.7 km from the nest. Only 5% of their feeding time during incubation was spent on the moorland. After the eggs had hatched there was a dramatic change to 85% of their time spent feeding on the moorland.

7.3.2 The diet of golden plover chicks focuses on Beetles and Tipula (Crane Fly). Feeding habitat selection of the chicks matches habitat of their prey. Favoured vegetation structure includes Hare's-tail Cottongrass (Eriophorum vaginatum) mire and Soft Rush (Juncus effusus) grassland (Whittingham M.J 2001).

7.3.3 Creating this diverse vegetation structure on moorland through a grazing and/or burning regime is an important aspect of land management for golden plover chick rearing post incubation. A study assessing 85 moorland sites in southern Scotland found a correlation between areas of short, open grassland/vegetation swards and this type of land management. (Pearce-Higgins & Grant 2006).

7.3.4 Water table restoration combined with reduced grazing intensity followed by peatland restoration re-vegetating the sward has been carried out at Dove Stone in the Peak District National Park since 2010. The project has been managed by RSPB and United Utilities. Carr and O'Hara 2015 surveyed the population size and breeding productivity of Golden Plovers in this area between 2011 and 2013. The study found an increase in breeding populations across all three years of surveying within areas under targeted management. During this three-year period revegetation of bare peat was attempted

through reseeding techniques as part of a Sustainable Catchment Management Programme (SCaMP). The overall aim of this work was to restore a *Sphagnum* dominated blanket bog. To raise the water levels gullies were blocked using stone and heather bales to produce wetter areas.

7.3.5 Numbers of Golden Plover within this Dove Stone 2km² study area peaked at 25 pairs. In comparison the largest number of pairs per km² within the NYMNP 2014 survey was 10 in survey square 55 Grid reference SE6496 in central Bransdale. In 2019 the largest number recorded in one square was again 10 this time in survey square 88 Grid reference SE9299 in the Fylingdales estate.

7.3.6 Although this appears to compare favourably with the Dove Stone site, this high total was a rare exception in both 2014 and 2019 rather than a common finding across the whole of the NYMNP study. In the NYMNP study 2019 only eight squares had five or more pairs per 1km². 61% of squares returned either no pairs or one pair and the overall mean total of pairs per km² was only 1.73 pairs/km².

7.3.7 A mosaic of low vegetation as is described above is also critical relation to predator detection during the breeding season.

7.3.8 Land Management Priorities for Golden Plover

- **Incubation Period**: Create and/or manage short sward intensively grazed unimproved grassland rich in invertebrates relatively close i.e. within a few kilometers of the breeding area.

- **Chick-rearing**: Create and/or manage a moorland water table level which encourages a diverse mosaic of blanket bog vegetation containing Hare's-tail Cottongrass, low growing Heather (Calluna vulgaris) and *Sphagnum* moss.

7.4 Lapwing

7.4.1 Lapwings have been traditionally thought of as predominantly a breeding wader of lowland England once fairly common in the lowland arable landscape. The vast majority of academic studies of breeding lapwings have consequently concentrated on lowland wet grassland habitat. The relatively stable population in the NYMNP study

(since 2008) becomes regionally important when considered against the context of larger declines in the lowland.

7.4.2 The challenges facing lapwings in the uplands however are very similar to the lowlands. Agricultural intensification has been noted as a likely cause of decline in upland areas (Taylor et.al 2004) this can adversely affect lapwings when considering the importance of the wider local landscape for foraging away from the nest.

7.4.3 Lapwings feed on a variety of invertebrates. Habitats such as unimproved rough grazing with a high density of leatherjackets and earthworms are particularly important pre-breeding immediately after lapwings have arrived on the breeding grounds (Galbraith H 1989).

7.4.4 During the breeding cycle, nesting habitat choice has been found to depend to a greater extent on the cryptic colour and structure of the surrounding vegetation rather than the quality of the feeding close to the nest. (Galbraith H 1989).

7.4.5 A study on an upland farm in Stirlingshire in 2012 which had high numbers of breeding lapwings found the in-bye fodder crop management system being used on the farm supported 60% more Lapwings than the control site. A system of forage brassica for 2 years followed by grass reseeding was used and produced the highest yield of lapwings in the year after the brassica was sown. The availability of bare ground was found to be critical to nesting site choice (McCallum H.M 2012).

7.4.6 Vegetation management is critical for breeding lapwings whether through grazing or land management such as grouse moors where burning has an effect on the sward length and composition. An association between lapwing declines and vegetation cover was found in a study by Amar et al. 2012. The reduction of breeding birds was found to be greatest on heather-dominated plots and a link between declines and proximity to forest edge was also discovered.

7.4.7 Land Management Priorities Lapwing

- **Pre-breeding and Breeding Feeding:** Create and/or manage short sward intensively grazed unimproved grassland rich in invertebrates especially

leatherjackets and worms relatively close i.e. within a few kilometers of the breeding area.

- **Breeding:** Ensure the availability of a diverse open vegetation mosaic dominated by wet grassland pasture with a low or short structure and/or areas of open bare ground created by shallow disk ploughing to create a soil crumb which is relatively small.

7.5 Curlew

7.5.1 During the breeding cycle curlews have a diverse diet the most important invertebrates being earthworms, beetles and grasshoppers although many other insects such as snails and ants are also taken. However, worms are often absent from peaty soils but abundant on mineral soils, especially pasture close to the moorland edge. (Buchanan 2006).

7.5.2 A study in Sweden in 1992 found a very similar change in feeding patterns occurs with Curlew to Lapwing and Golden Plover. Grassland (in this case agricultural sown fields) was found to be significant for feeding during pre-breeding. Later in the breeding season foraging occurred closer to the nest site at the best fields for food rather than lower value fields further away. The link in this study was made between the preference for closer feeding areas and reduced risk of nest predation. (Berg A. 1992).

7.5.3 Risk of nest predation on breeding waders has been studied by many authors. One interesting study on curlew nesting risk and breeding habitat selection was researched in relation to the presence of kestrels on a site in western Finland. The study found that curlew nests were closer to kestrel nests than expected. The loss of chicks through kestrel predation was less than corvid predation and the conclusion was made that the association was a positive one guarding against higher predation by other predators such as corvids (Hemminki et.al. 1995).

7.5.4 Curlews prefer a taller vegetation structure during breeding than lapwing and golden plover. Typical sward often includes tussocks formed by species such as Purple moor-grass *Molinia caerulea* on damp soils (Haworth & Thompson 1990).

7.5.5 Challenges for curlews in the uplands include fragmentation of habitat often caused by a reduction in natural unimproved grassland loss, fragmentation, loss of vegetation diversity and structure and excessive drainage.

7.5.6 Land Management Priorities for Curlew

- **Pre-breeding:** Create and/or manage unimproved grassland rich in invertebrates relatively close i.e. within a few kilometers of the breeding area.

- **Breeding:** Create and/or manage habitats on or close to the open moorland on damp soils which contain a mosaic of vegetation communities and structures from taller grassland and Heather *Calluna vulgaris* through to shorter unimproved grassland rich in soil invertebrates.

7.6 Snipe

7.6.1 Snipe have traditionally been associated with marginal land containing wet grassland and many research papers have shown the link between these specialist habitat requirements and breeding success. A particularly valuable study was undertaken on an upland moor near Barnard Castle in Teesdale on behalf of the Game Conservancy Trust between 2000 and 2002. The results showed a strong association with marshy grassland or acid flush habitat with flush rates 3-4 times higher than on drier heath. (Hoodles S. et.al. 2007).

7.6.2 The proximity of small areas of wetland such as small pools and runnels or ditches is also an important factor in Snipe habitat choice. In the Teesdale study vegetation with an uneven structure was also found to be favored. Preference for types of vegetation was found to favor rushes (Juncus) and grasses (Hoodles S. et.al. 2007).

7.6.3 High water levels providing surface moisture to allow snipe to probe the soil with their long bill for food is critically important for breeding success. The longer this wet/soft ground is available throughout the spring and summer the better Snipe can cope with pressures such as predation and trampling of nests by stock. Moist soils allow the breeding season to continue for longer which in turn allows replacement clutches to be laid by breeding females and a subsequent higher breeding productivity (Green R.E 1988).

7.6.4 Snipe diet consists of a wide variety of invertebrate prey. The Teesdale study found that 85% of the food taken during the breeding season was earthworms and tipulid larvae. Differences in seasonal diet were found to be significant and included a higher percentage of aquatic and surface invertebrates taken earlier in the spring changing to a higher tipulid content later in spring. However, throughout the breeding season earthworms remained the strongly favoured food item (Hoodles S. et.al. 2007). Traditionally higher water levels early in the spring may lead to a preference for aquatic and surface food types.

7.6.3 Land Management Priorities for Snipe

- **Breeding:** Create and/or manage habitats on the open moorland or on in-bye land on damp soils to favor marshy grassland and acid flush habitat in a mosaic of unimproved land rich in soil invertebrates.

- **Water Levels:** Manage water levels to ensure a higher water table throughout the spring and summer periods thereby prolonging the period during which snipe can probe the soil and cope with additional pressures such as nest trampling by stock and predation.

7.7 Land Management Summary

7.7.1 All 4 species of breeding waders have a combination of species-specific habitat requirements combined with generalist requirements which are a common factor in breeding habitat choice.

7.7.2 One critical habitat requirement which is common to all 4 species is the importance of optimum feeding habitat prior to breeding. This critical time when waders arrive back from their long migration is a time when enclosed grassland fields, in-bye land and/or moorland edge areas with high numbers of invertebrates are essential to enable females to get into egg laying condition and males to defend a breeding territory.

7.7.3 This requirement for nearby areas of high food productivity away from nesting sites underlines the importance of applying all land management options for breeding waders within a landscape approach system. Habitat network planning should

therefore incorporate both moorland nesting habitat within a larger landscape area encompassing several kilometres surrounding the nest sites where the availability of unimproved land is critical to breeding wader productivity. Traditional sites are often used by waders in the NYMNP pre-breeding. A range of grazed grassland fields across the area regularly contain flocks of golden plover in early spring. A good example are the fields at Turnhill Rigg on Hamer Moor above Rosedale Abbey. Appropriate management of these and other similar fields to ensure a continued supply of short sward grassland with a high population of soil invertebrates is critical to ensuring the local population of golden plover and other waders are conserved.

7.7.4 Land management options such as stocking density control to ensure tight winter and early spring grazing to produce short sward grassland should be combined with incentives to ensure these fields are managed in an unimproved system with a view to creating invertebrate rich soils.

7.7.5 Many waders arrive in early March to breed on the North York Moors. A fledged golden plover chick was photographed on the 2nd May 2014 by R. Baines whilst conducting the NYMNP wader surveys in the Kildale area. Incubation normally takes up to 31 days in golden plover. Allowing for egg-laying (2-3 days) and time to develop a pair bond and nest site prior to this, the start of breeding for this pair is likely to have been mid-March. Disturbance to breeding areas from early March is therefore likely to have a negative effect on wader numbers.

7.7.6 Water level control or restoration to restore wet blanket bog habitat and/or manage in-bye land is critically important to all waders especially golden plover and snipe. The Dove Stone project proved the value of revegetating bare peat within the SCaMP project, combining this with raised water levels, gullies blocked and stone and heather bales used to restore *Sphagnum* dominated blanket bog.

7.7.7 The excessively dry end of winter 2018/19 and early spring of 2019 undoubtedly led to challenging times for breeding waders in the NYMNP. Several gamekeepers/land managers mentioned the strangely quiet moors during conversations held between keepers and surveyors in April (R. Baines and M. pearson pers. comms). With increasingly unpredictable climate ahead of us it is even more important than ever to ensure a sustainable source of water is held within the uplands. Land management strategies to hold water on the hills during wet weather will help ensure habitat is

available for returning waders in early spring and alleviate any dry periods such as those in the spring of 2019. The peatland restoration results (see 4.5 page 27) show clear evidence of the benefits to waders of this habitat enhancement strategy.

7.7.8 A small number of squares within this study have traditionally returned poor results for waders. In many cases this is due to a combination of excessive slope, proximity to forest (enclosure) and/or the unsuitability of vegetation structure for waders. In these where a change in constraints to waders are unlikely to change, it may be wise to reconsider alternative management strategies. A change to management for other declining species e.g. songbirds such as whinchat, redstart and ring ouzel would be a logical approach.

8.0 SURVEY RECOMMENDATIONS

8.1 The results and evaluation of the 2019 survey show varying trends across the four species of breeding waders since the surveys first began in 1996. Long-term studies provide the best source of producing reliable data on changes in bird populations. The value of this survey therefore increases the longer it is carried out. There has been some variation in timing of the surveys through the 18 years with the intention to survey every 4-5 years often depending on funding opportunities but overall, the surveys have taken place at an average of a survey every 4.5 years. To enable consistency of timing the next survey should be carried out in 2023 or 2024.

8.2 More detailed studies looking at the relationship between habitat differences have the potential to be extremely valuable in relation to the success of restoration projects such as the NYMNP peatland restoration program. An additional specific study on the spatial distribution, productivity and population of breeding waders on the peatland restoration areas compared with control plots within the same area would be a valuable research tool to evaluate the success of habitat improvement works.

8.3 The habitat condition of each square surveyed influences the bird populations in that immediate area. The evaluation and recommendations on land management would therefore be stronger if a habitat survey had been conducted either alongside this study or in a more limited annual wader population study (see below).

8.4 Monitoring a smaller number of survey squares annually would be a good way to track trends and create a mechanism where conservation action could be taken quickly based on results over several consecutive years. This may be a good way to tackle adverse effects of climate change on wader populations happening on a rapid scale. An annual survey of a statistically relevant number of wader squares may provide a better understanding of longer-term trends and allow speedy conservation action to reverse any decline detected.

8.5 Recording additional species has proved to be very productive especially in relation to meadow pipits. The fall in productivity detected in 2019 should be monitored closely. It is fairly straightforward to include meadow pipits in this survey therefore they could also be included in regular smaller scale wader studies between the full survey years.

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10.0 APPENDICIES

Appendix 1 – Plan of the 92 x 1km squares covering the moorland area of the NYMNP (provided by NYMNP Authority)