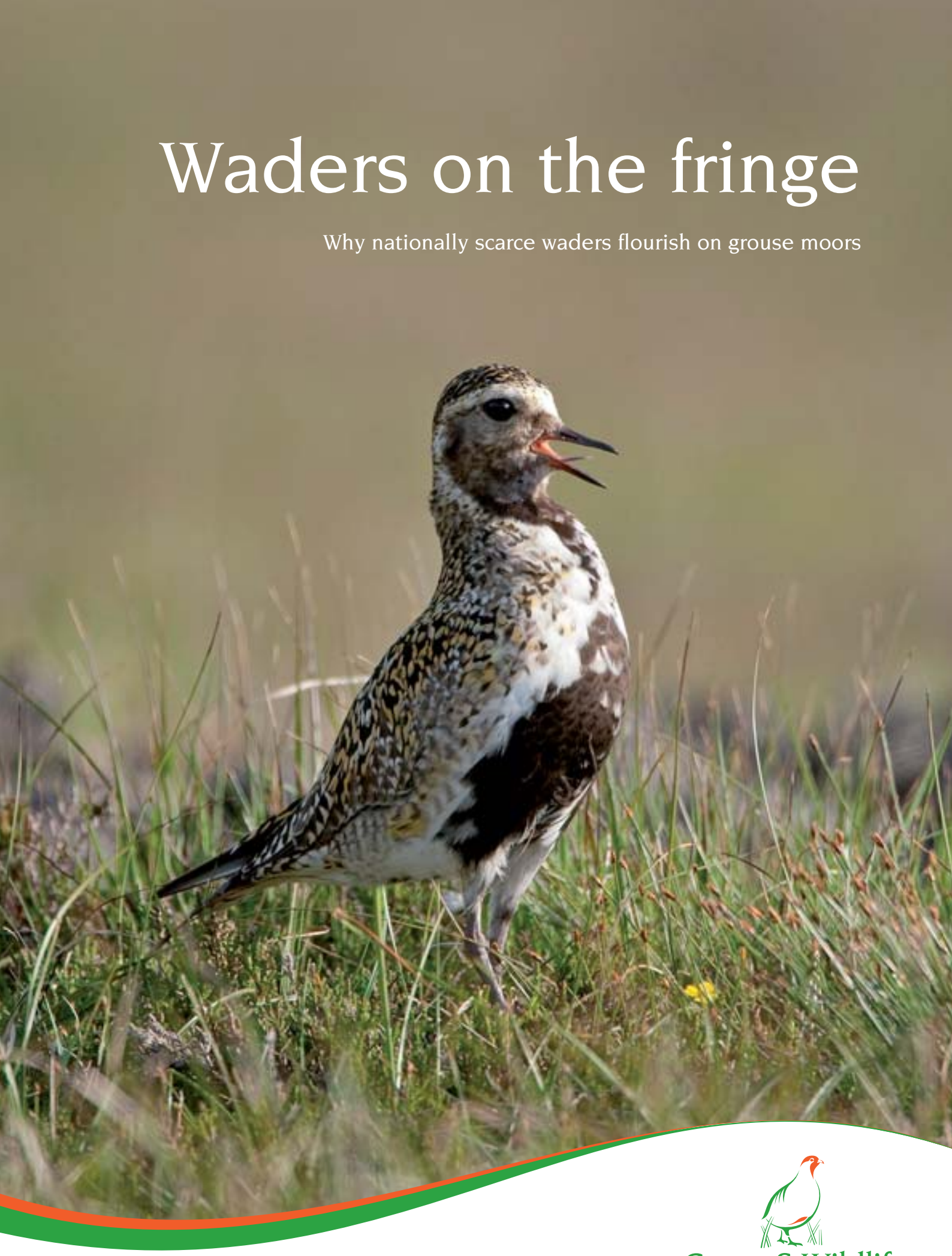
Waders on the fringe

Why nationally scarce waders flourish on grouse moors



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Contents

The full experimental results and analysis of this predation experiment can be found in: Fletcher K, Aebischer N J, Baines D, Foster R and Hoodless A N (2010). Changes in breeding success and abundance of ground-nesting moorland birds in relation to the experimental deployment of legal predator control. *Journal of Applied Ecology*. In press.

Acknowledgements

This publication reports the work of:
Nicholas Aebischer, David Baines, Julie Ewald, Craig Jones, Kathy Fletcher, Robin Foster, Andrew Hoodless, Nick Sotherton and Stephen Tapper.

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We also would like to thank a Scientific Advisory Committee, chaired by Dr John Coulson, for its work in guiding and appraising the experiment at Otterburn.

Front cover photograph: Golden plover. © David Mason
Page 2: Bellshiel study area.

Summary

Gamekeeping and predator control was widespread across Britain in the 19th century. Some now very common predators, like crows and magpies, were consequently comparatively rare a hundred years ago. Others like the fox were also substantially less common. If we are to restore some of today's vulnerable and declining birds we need to understand how this formerly widespread predator control for gamebirds affected other wildlife. The Upland Predation Experiment at Otterburn was designed to explore this.

Only on upland grouse moors is predator control now practised extensively to support wild game shooting, so our experiment was based on the type of predator control adopted by grouse keepers.

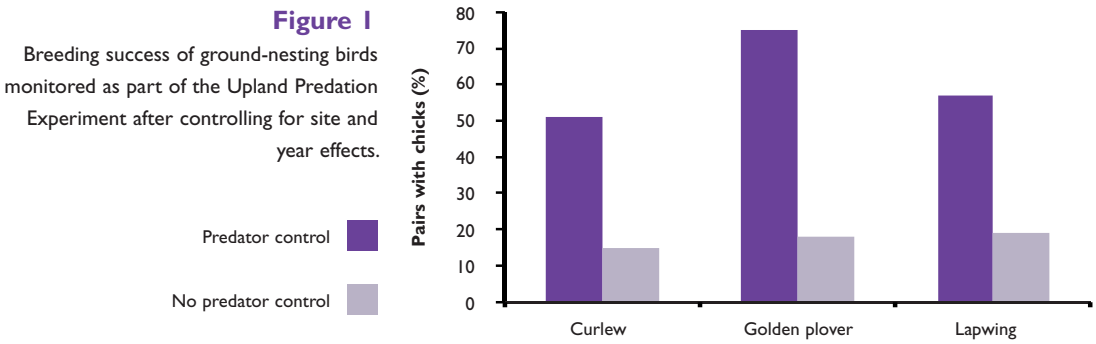
Part 1 - The Upland Predation Experiment

The experiment ran for nine years and included four sites – two with predator control and two without. The principal focus was the upland wader species; curlew, lapwing and golden plover - all species in national decline.

The key findings of the experiment were:

1. The breeding success of curlew, golden plover and lapwing was significantly improved by controlling the numbers of some of their predators. Waders were more than three times as likely to raise a chick on an area with predator control than on an area without.

Figure 1
Breeding success of ground-nesting birds monitored as part of the Upland Predation Experiment after controlling for site and year effects.



2. Breeding numbers of lapwing, golden plover and curlew increased in years following predator control, but declined in other years. Snipe numbers seemed unaffected by predator control.

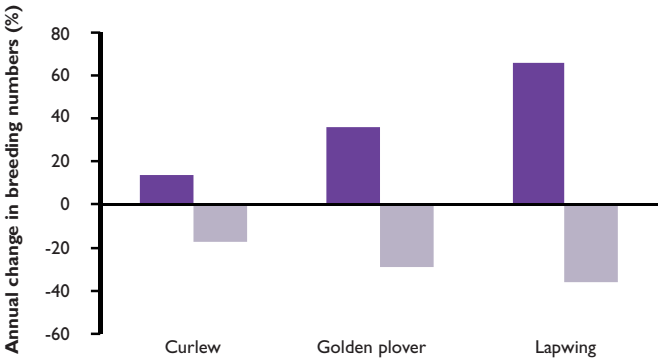


Figure 2
Changes in abundance of ground-nesting birds monitored as part of the Upland Predation Experiment after controlling for site and year effects.

Part 2 - What this means for conservation

These findings have an important bearing on bird conservation in the uplands. Taken with the results from other studies we make the following inferences:

- The concentration of moorland breeding waders in the North Pennines appears to be a direct result of grouse moor management including rotational burning and predator control by gamekeepers. This has led to its designation as a Special Protection Area (SPA) in the EU Natura 2000 programme. Agri-environment schemes on their own, without predator control, seem unable to give rise to an abundance of breeding waders or even bring about a significant improvement in sparse populations.

- The low breeding success on our areas without predator control suggest that predation is likely to be contributing to population declines of waders elsewhere.

- The contraction in breeding range of some waders, like lapwing and curlew may be being caused by, or at least aggravated by, predation during the breeding season.

To restore some of the wildlife we had in the 19th century, we need habitat programmes and environment schemes to help wildlife live alongside modern land-use, but we may also need to restore some lost wildlife management, such as predator control, if vulnerable species like waders are to recover their populations in areas away from the grouse moors.

Rationale – the historical context

Victorian and Edwardian Britain increasingly saw the countryside as a rural idyll where farming and nature were in harmony. Perhaps no better illustration of this is the published work of Edith Holden in her *Nature Notes and Country Diary*[1,2]. Although this appreciation of natural history also led to occasional passions for collecting things from butterflies and moths, to birds' eggs and even stuffed birds, it also led to systematic recording and scientific inquiry. Hence we have a pretty fair idea about the countryside wildlife in the 19th century and we can be sure its biodiversity was real – not imagined.

The later loss of wildlife, especially after the Second World War, has been well documented. It was also highly publicised in an American setting by Rachel Carson's *Silent Spring*[3]. Perhaps no other publication explained so vividly the tragedy that was unfolding across farmland as the drive to improve production brought in pesticides and artificial fertilisers. Not only farming but forestry too. Neglected woods, following the demise of wood industries like charcoal burning and hurdle making, were replanted with fast growing conifers which snuffed out the diverse shrubs and herbs found beneath native broad-leaved trees[4].

> "... tens of thousands of gamekeepers were employed to look after gamebirds and destroy predators..."

There is, however, another thread to this land-use history that is often over-looked – this is the one of game management and game shooting[5]. A hundred years ago shooting grouse, partridge and pheasant was part of a country gentleman's calendar, just as hunting, fishing, horse racing and boating was. Royal estates like Sandringham and Balmoral led the fashion, and across the land gamekeepers were employed in tens of thousands to look after gamebirds by feeding them, providing habitat for them, keeping away poachers, and most of all, by destroying the predators of these birds – the so called vermin.

Farming and forestry became more intensive over the 20th century, but predator control by gamekeepers less so. For some birds and mammals on the Edwardian gamekeeper's vermin list, like buzzards and polecats, this allowed them to recover their former range and population. This has rightly been welcomed

Illustrations from: Fur and Feather Series: The Grouse. *Macperson H A, Stuart-Wortley A J and Saintsbury G. (1894) Longmans, Green & Co London.* Letters to old shooters, *Payne-Gallwey R, (1902) Longmans, Green & Co London.*

as an improvement in biodiversity. Perhaps less welcome though, has been the resurgence of common opportunistic predators like the carrion crow, magpie and fox. In Simon Holloway's atlas of birds in Victorian Britain[6], the magpie is described as uncommon in south-east counties, most counties of the north and east, and most astonishingly of all, as rare in Essex, Suffolk, Cambridge and south Lincolnshire. Likewise the carrion crow was uncommon or rare in most southern counties, East Anglia and the whole of northern England. Holloway attributes this to gamekeeping.

So as we try to restore lost biodiversity to the countryside we need to understand the consequences of this overall reduction of predator control, as well as the effect of its persistence in some areas today. The research we describe in this publication goes to the heart of this; testing predator control experimentally on northern moorland. It looks primarily at vulnerable ground-nesting species like lapwing, curlew and golden plover, all of which are currently declining in geographic range and population.

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PART 1-
The Upland Predation Experiment, Otterburn

Testing the idea – Experimental design

The best evidence about the effect of an intervention comes from experimentation. The essence of any experiment is a comparison between something subject to a procedure – a treatment, with an identical thing not subject to the procedure – a control. In the natural environment experiments are a little more challenging because no two things are really identical. So if we compare localities with and without gamekeeping we cannot be certain that there isn't a difference between the two localities which confounds interpretation of the experiment. We can get round this by swapping the treatment and control areas after a period of time, but then there is always the possibility that the environment is changing with time. To reduce these possibilities and ensure a powerful experiment, the design can become elaborate. We ended up with a four way comparison:

- One site with eight years continuous predator control.
- One site without any predator control for eight years.
- One site with predator control for the first four years, but not for the second four years.
- One site with no predator control for the first four years, but with predator control for the second four years.

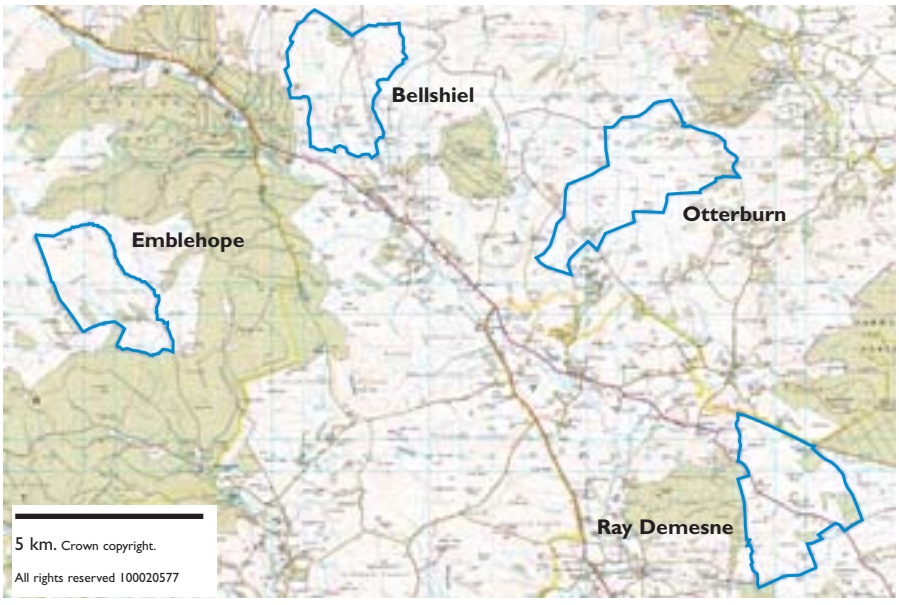

Figure 3
The four study sites used for the experiment. The irregular shapes were because it was convenient to draw boundaries along existing natural or man-made features. The study areas were between 930 hectares and 1,440 hectares (around 3,000 acres on average).

It is also important, quite naturally, that the activities on one site do not spill over on to one of the others. Thus in our experiment sites had to be separated by a substantial buffer zone.

Such an experiment requires an extensive area. Places like this are difficult to find in Britain, so we are indebted to Defence Estates (the land-owning arm of the Ministry of Defence) for allowing us access to the moorland of their Otterburn training ranges, and to the Duke of Northumberland, Lord Devonport and Martin Edgar for the use of nearby ground (see Figure 3). The four sites around the village of Otterburn, consist mostly of open heather-dominated moorland and grassland. Sheep grazing is the main farming use and there are small areas of improved grass and meadow (less than 8%) on the sites themselves. There has been some over-grazing of heather in the past as there has been on surrounding land. A lot of the nearby grassland has been reseeded and fertilised and there are substantial plantations of conifers for forestry. Figure 4 shows how each of these sites contributed to the experimental design.

We are grateful to the landowners and farmers who allowed us access to their land – particularly to the Ministry of Defence, Defence Estates. (L-R) Steve Johnson, Landmarc, Major Bertie Sexton, Otterburn Training Area and Mark Hudson, Chairman of the Game & Wildlife Conservation Trust.

The experimental design of the Upland Predation Experiment

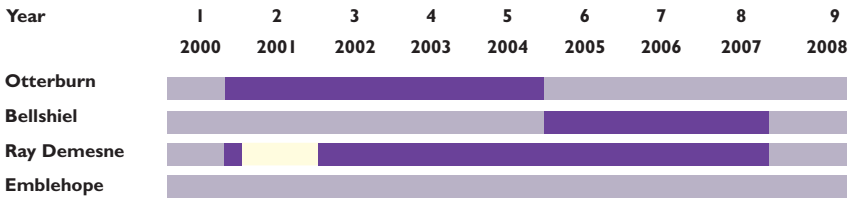

Figure 4

Experimental regimes on the four study sites between 2000 and 2008. The regimes on Ray Demesne and Emblehope remained constant from the start (autumn 2000) but the treatments on Otterburn and Bellshiel were switched at the end of 2004. 2001 is anomalous because of Government restrictions due to Foot and Mouth disease, curtailed some predator control and the ecological surveys.

Predator control

No predator control

Break in keepering in 2001 due to Foot and Mouth disease

Field work – the annual programme

The work was undertaken by two field teams:

- A gamekeeping team: Consisting of a head gamekeeper and an under-keeper, whose duties were to undertake the predator control on two of the sites and the necessary heather burning on all four.

- A research team: Comprised a senior scientist and research assistant working full-time, and four other seasonal assistants employed in the spring and summer to help with the bird counts.

Throughout, the experiment was overseen by an independent Scientific Advisory Committee.

Predator control: The gamekeepers shot or trapped the grouse predators on the two sites subject to predator control. The important species were carrion crow, fox and stoat, as well as others such as weasel and the occasional magpie. All these animals either kill grouse or their chicks, or steal grouse eggs. The intention was to keep numbers of these animals as low as possible, particularly during the grouse breeding season. All these species can be controlled without a special licence. We sought no permissions or licences to take any protected species so our gamekeepers' work was practically identical to what we advocate for grouse moor gamekeepers everywhere[7]. (See Appendix page 27.)

Crows were controlled using Larsen traps.

Heather burning: In October and March each year our keepers burnt out small patches of heather to maintain the patchwork habitat of different shrub heights; some to suit nesting grouse and others to provide foraging habitats for grouse broods. Heather burning was maintained on all four sites, irrespective of whether or not it was subject to predator control, and was consistent with the burning regime on the land prior to the experiment.

Wildlife surveys. These were conducted by the research team and concentrated on the following groups; the gamebirds – red grouse, black grouse and grey partridge; the waders – snipe, curlew, golden plover and lapwing; the common small birds such as meadow pipit and skylark; key predators such as carrion crow, fox, weasel and stoat; as well as the protected birds of prey. Some of these surveys were simply to monitor the effectiveness of the predator control.

Field work included heather burning, wildlife surveys and predator control.

The full results and the exact methodologies of these surveys will be reported elsewhere and we shall concentrate here on the waders; lapwing, curlew and golden plover, for which purpose the experiment was set-up.

Results – The upland breeding waders

Waders, unlike the grouse, are not generally year round residents and they come onto the moors only to breed and rear their young (see Figure 5). Some, like the lapwing and golden plover, winter on lowland farms, but curlew leave for the coasts and estuaries. Snipe do remain on the moor, but they also migrate towards low wetlands and are joined by others from northern Europe.

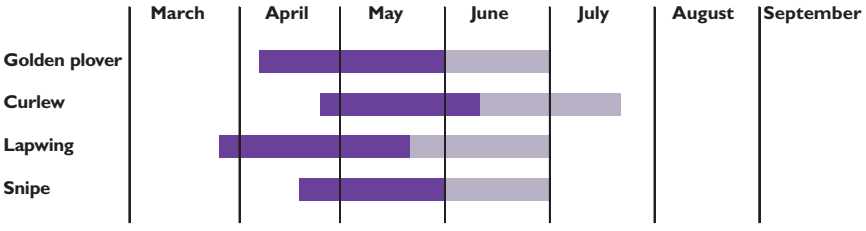

Figure 5
The main breeding seasons of the four principal waders on upland moors in England.

Egg laying and incubation period

Chick rearing period

On our study sites we conducted spring surveys each year marking every breeding pair on a map. Later we checked these pairs during the chick rearing period to monitor broods and assess which pairs fledged young.

Snipe were very secretive so it was impossible to find each pair. However, we did estimate their average abundance by the number of their display 'drumming' flights that we saw. It was, however, impossible to measure their breeding success.

Leaving aside the snipe, the numbers of the other three waders that were breeding on the sites are shown in Table 1 (see page 12). In comparison to the average Pennine grouse moor, and its adjacent in-bye land, the numbers of these waders is actually low.

Snipe were very secretive but we did estimate their average abundance by the number of drumming flights that we saw. It was, however, impossible to measure their breeding success.
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Table 1

The number of breeding waders during the course of the experiment. Percentages are an estimate of the proportion that bred successfully. Years highlighted in purple indicate years with predator control. *NB. Breeding success figures for lapwing at Otterburn are based only on a sample of pairs. This is because some pairs regularly nested in a chain-link fenced enclosure where their chicks became trapped – we excluded these pairs from the analysis.

TABLE 1

Number of breeding waders in the Upland Predation Experiment, 2000-2008

a. Otterburn plot (keepered autumn 2000-2004, unkeepered since)

Year	Curlew		Golden plover		Lapwing	
	Pairs	% success	Pairs	% success	Pairs	% success
2000	17	12%	5	40%	9	33%*
2001	No data collected owing to foot and mouth					
2002	14	64%	11	73%	23	67%*
2003	9	33%	11	91%	26	50%*
2004	11	73%	10	100%	30	83%*
2005	10	50%	13	62%	45	38%*
2006	16	0%	11	18%	35	0%*
2007	17	12%	10	0%	32	0%*
2008	17		6		29	

b. Bellshiel plot (unkeepered 2000-2004, keepered since)

Year	Curlew		Golden plover		Lapwing	
	Pairs	% success	Pairs	% success	Pairs	% success
2000	14	14%	4	0%	7	29%
2001	No data collected owing to foot and mouth					
2002	10	20%	2	0%	4	0%
2003	7	0%	0	0%	1	0%
2004	4	0%	1	0%	2	0%
2005	3	0%	0	0%	0	0%
2006	3	67%	3	67%	2	50%
2007	3	0%	1	100%	10	50%
2008	4		3		16	

c. Ray Demesne plot (keepered autumn 2000-2008)

Year	Curlew		Golden plover		Lapwing	
	Pairs	% success	Pairs	% success	Pairs	% success
2000	21	14%	6	33%	12	50%
2001	No data collected owing to foot and mouth					
2002	18	44%	9	56%	14	79%
2003	22	55%	8	63%	18	72%
2004	18	50%	7	86%	19	74%
2005	17	29%	7	71%	17	47%
2006	18	56%	8	63%	11	36%
2007	20	25%	8	25%	8	38%
2008	21		6		9	

d. Emblehope plot (unkeepered autumn 2000-2008)

Year	Curlew		Golden plover		Lapwing	
	Pairs	% success	Pairs	% success	Pairs	% success
2000	4	75%	7	14%	2	0%
2001	No data collected owing to foot and mouth					
2002	4	50%	7	29%	1	0%
2003	3	33%	4	25%	1	0%
2004	3	0%	3	0%	1	0%
2005	3	0%	4	25%	0	
2006	2	0%	2	0%	0	
2007	2	0%	3	33%	0	
2008	1		3		0	

The effect of predator control is best considered by looking first at the proportion of the breeding waders that successfully raise one or more chicks during the year. Accurate counts of all the chicks in a brood were difficult to obtain. However, there were marked changes in the behaviour of adult birds which clearly indicated whether they had chicks or not. By monitoring the period of alarm-calling behaviour of each pair of waders it was possible to judge which pairs raised chicks to fledging and many broods were seen close to fledging because the young were much larger at this time. The figure is shown as a percentage beside the number of breeding pairs in each year on each site in Table 1. There were marked differences between the sites and years with and without predator control. A statistical analysis, using all the data from all years and all four sites, showed that the difference was significant for all three species and it was large (see Figure 6) – the average bird was three and a half times as likely to be successful if it was in an area subject to predator control, than if it was not.

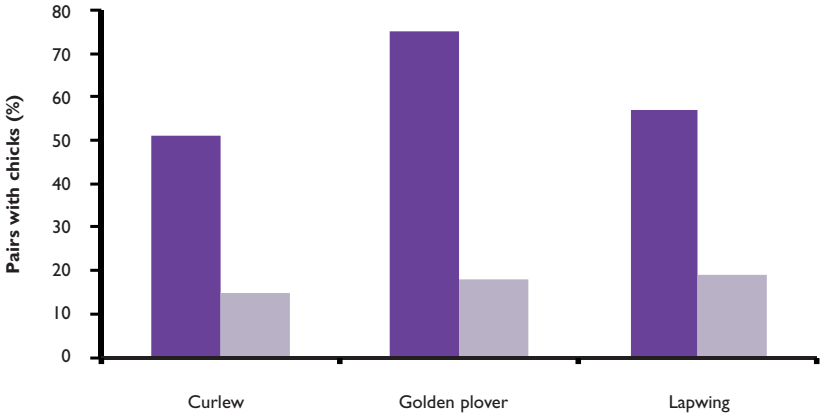


Figure 6
The percentage of waders that bred successfully on areas with and without predator control. A successful pair is one that rears at least one chick. Data taken from all years and all four study sites.

Inspecting a large cage trap for carrion crows.

This is an important new finding which is entirely in line with evidence from other vulnerable ground-nesting birds[8]. However, many birds produce large numbers of young that for one reason or another fail to survive to the next year and do not go on to breed themselves. Sometimes factors can impose an upper limit on numbers, therefore it matters very little whether a lot or only a few young are produced. This is often referred to as a 'doomed surplus' and is a well recognised concept in population ecology. Conversely if the population raises too few chicks there will be insufficient to maintain breeding stocks and the population will decline. So we have to address the question of whether or not these differences in production with and without predator control affect breeding numbers?

We already know from an RSPB-led survey of upland moors, that grouse moors support between three and five times as many breeding lapwing, curlew and golden plover than other areas[9]. So now we might strongly suspect that it is the improved breeding success associated with predator control that leads to the higher breeding numbers on such areas.

To a limited extent we can examine this using the results at Otterburn. We can do this by seeing whether or not breeding numbers improved after a season in which predators were controlled. This was a simple analysis for lapwing and golden plover, but not for curlew. This is because curlew usually do not breed until they are three years old, so we would not expect to see an improvement in a single year.

Figure 7 summarises the findings of this analysis. Lapwing breeding numbers on average improved by 66% following a season when predators were controlled, and declined by some 36% after a season when they were not. This was statistically significant. The differences were also large for golden plover (+36% after predator control, -29% without), but were not statistically significant. For the curlew the effect was smaller (+14% and -17%) and was only significant when we assumed they first bred at three years old. The number of snipe seemed unaffected by predator control.

Grouse moors support between three to five times as many breeding lapwing, curlew and golden plover than other areas. © David Mason

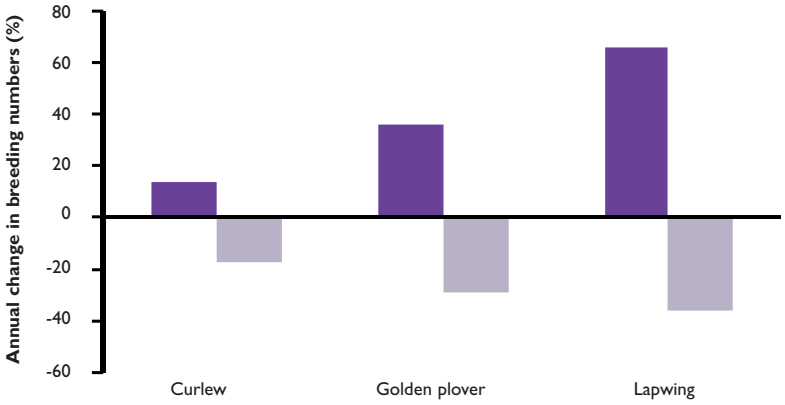


Figure 7
Changes in breeding numbers of waders following years with and without predator control.

Conclusions

1. The breeding success of curlew, golden plover and lapwing was significantly improved by controlling the numbers of some of their predators. Waders were more than three times as likely to raise a chick on an area with predator control than on an area without.

2. Breeding numbers of lapwing, golden plover and curlew increased in years following predator control but declined in other years. Snipe numbers seemed unaffected by predator control.

PART 2-

What this means for conservation

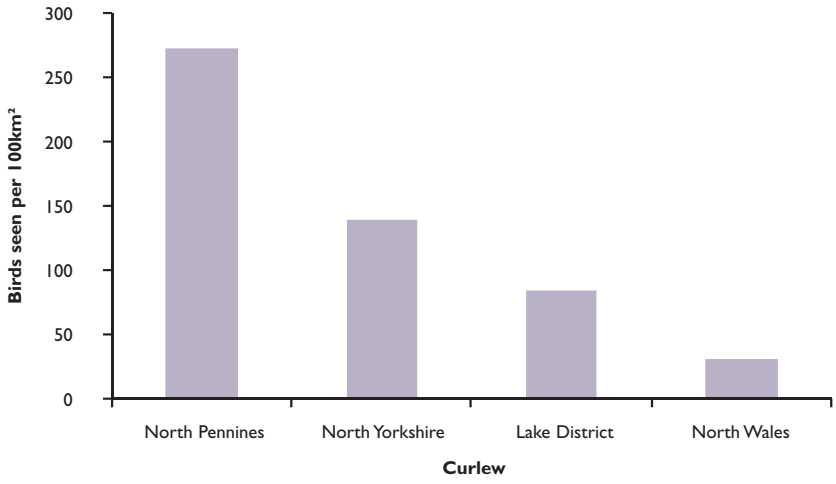
Golden plovers in flight. © Laurie Campbell

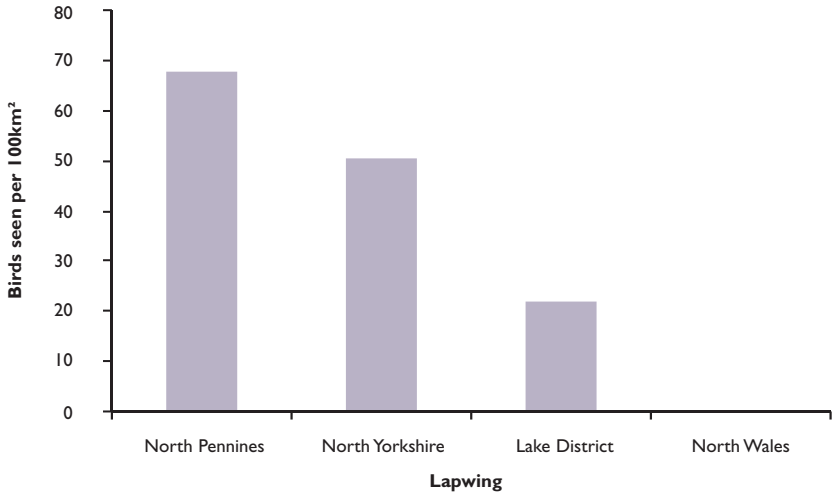
The two findings from our experiment contribute significantly to our knowledge of the importance of predation to the population dynamics of ground-nesting birds. This is because our results have come through experimentation and, as such, they carry more weight than conclusions based on correlation. We now need to consider how relevant this is for bird conservation.

The three waders; lapwing, curlew and golden plover are all species of conservation concern and have been either 'red' or 'amber' listed because of declining numbers or importance internationally[10]. Over-grazing by sheep, treatment of upland inbye pastures with fertilisers, encroachment of bracken and plantation forestry have all played a part in reducing both the extent and quality of habitat for these birds. Since 1987 some farm conservation programmes, such as the Environmentally Sensitive Areas (ESAs) scheme, deliberately targeted upland farms with grants to improve these habitats[11, 12]. More than 75% of payments under the ESA scheme were spent on payments to improve grass and moorland for conservation[12]. The big national parks like the Lake District and Dartmoor were major recipients of these funds, as well as the Yorkshire Dales. In some places the quality of the inbye pastures and hay meadows have improved and wader numbers in the Yorkshire Dales may have stabilised, but overall these schemes are doing better at halting landscape change than they are at maintaining or improving biodiversity[13]. Changes to the support for hill farmers, from 'headage' based to area based payments, as well as the consequences of the 2001 foot and a mouth disease outbreak, have caused the national sheep flock to drop by some 28% since the mid-1990s[14] thus taking some pressure off upland grazing. Waders prefer a short sward so too little grazing could now be a factor in some places. Even so, conditions for waders on moorland and adjacent inbye land should have improved.

Nationally the British Trust for Ornithology's (BTO) Breeding Bird Survey shows that all three waders declined during the period 1995-2007 (golden plover -8%; lapwing -14%; and curlew -38%) the declines in lapwing and curlew being statistically significant. Upland birds have also been the subject of special surveys between 1980-91 and recently again in 2000 and 2002. Over this 10-20 year gap many areas had shown significant drops in wader numbers – especially in England and Wales[15].

Whatever these trends, and it is difficult to exactly tease out what has caused them, there are nevertheless substantial differences in the abundance of these birds between regions which analyses of rates of change overlook. In the BTO's atlas of





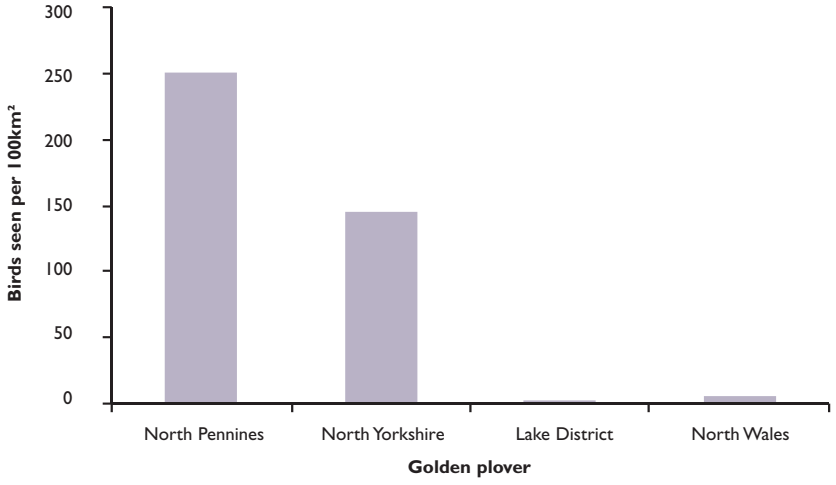


Figure 8

Abundance of three waders from selected upland survey plots in four different regions. Surveys were maximum counts of waders carried out along 200 metre transects in 2000 and 2002 and expressed as numbers seen per 100km^2. Calculated from Sim et al[15].

breeding birds[16], the Pennines shows up as a hot-spot for waders. The magnitude of the difference between the Pennines and the other regions is also illustrated by looking at the numbers of these birds seen in upland bird surveys (see Figure 8). We need to be cautious with this comparison because there were some habitat differences between the regions and the survey plots were not chosen at random. Nevertheless, comparing only areas where identical methods have been used, the North Pennines and North Yorkshire appear to have many times the number of waders as either the Lake District or North Wales[15], in spite of similar farm subsidies and comparable agri-environment schemes. In short, the Pennines standout as being the key stronghold for breeding waders in England and Wales.

To protect such strongholds, the European Union, under the Birds Directive (1979), requires member states to set up Special Protection Areas (SPAs) for birds as part a Natura 2000 network of protected sites. In Britain these SPAs have been set-up on areas with significant concentrations of birds of conservation concern. Legal protection of these sites comes from the Sites of Special Scientific Interest (SSSIs) which underlie them.

By far and away the largest of these SPAs is the North Pennines which extends from the River Tyne and Hexham in the north, to the River Wharfe and Harrogate in the south. The designation, set out in 1999, includes three upland waders; dunlin (330 pairs), golden plover (1,400 pairs) and curlew (3,930 pairs). A recent survey of this SPA puts the current status of these birds at; dunlin (186 pairs), golden plover (4,171 pairs) and curlew (5,454 pairs). The survey also found 4,389 pairs of lapwing and 1,786 pairs of snipe[17]. So in the North Pennines, the obligation to maintain the numbers of these birds for the Natura 2000 site is clearly being met.

Figure 9 shows the extent of the North Pennines SPA, and how it takes in much of the popular walking landscape of the North Pennines Area of Outstanding Natural Beauty (AONB), the Yorkshire Dales National Park and the Nidderdale AONB. Upland birds are an important and popular feature of these moors and are promoted by the park and the AONB authorities as a wildlife attraction.

There are 40 properties that shoot either walked-up or driven grouse within the boundaries of the North Pennines SPA and between them they employ more than 115 gamekeepers to improve grouse production.

These grouse moors were largely established as shooting estates in the 19th century and most have been managed continuously for grouse ever since. Many have annual grouse shooting records that go back well over a century. What is true for the North Pennines is also true for other upland SPAs designated for waders;

A reduction in sheep numbers has helped improve moorland habitats. © David Mason

the South Pennines SPA (designated for golden plover and dunlin) and the North York Moors SPA (designated for golden plover). Overall some 74% of English upland SPAs are managed as grouse moors.

This evidence, taken with our findings from Otterburn, suggests we can infer that:

- The concentration of moorland breeding waders in the North Pennines appears to be a direct result of grouse moor management including rotational burning and predator control by gamekeepers. This has led to its designation as a Special Protection Area (SPA) in the EU Natura 2000 programme. Agri-environment schemes on their own, without predator control, seem unable to give rise to an abundance of breeding waders or even bring about a significant improvement in sparse populations.

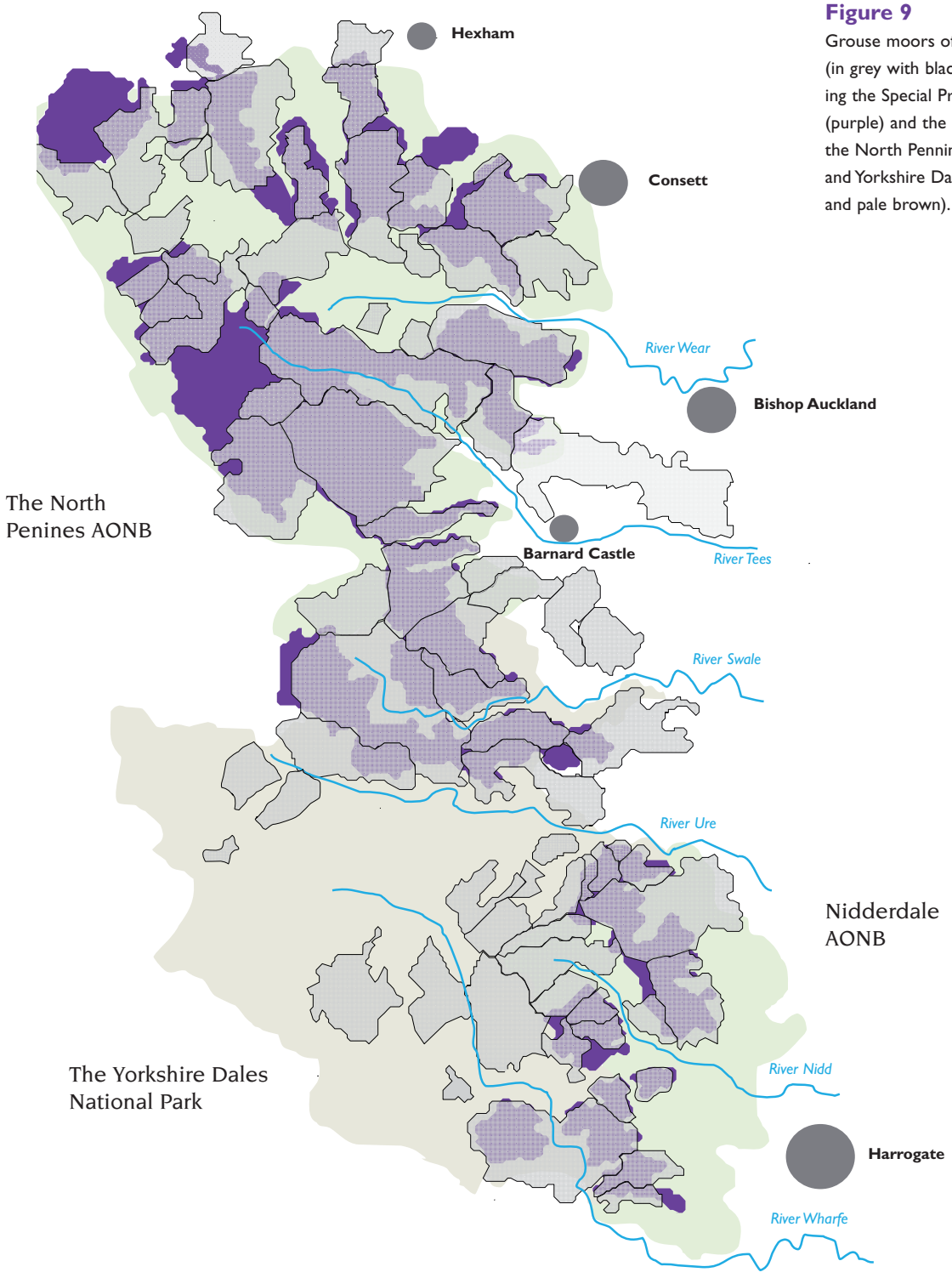
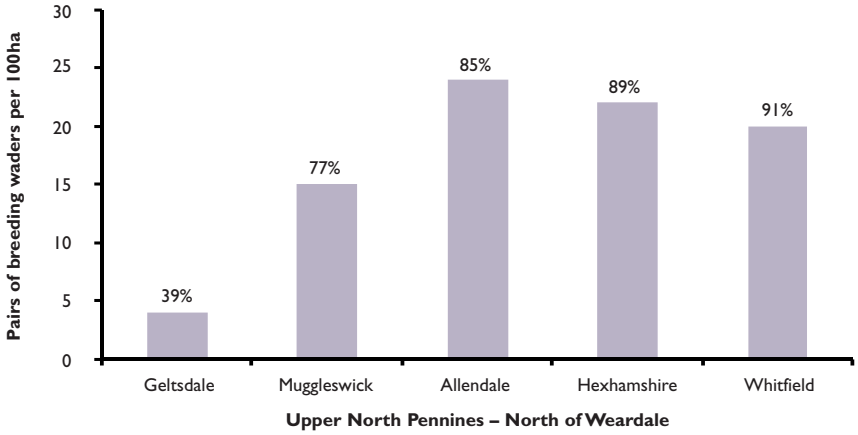
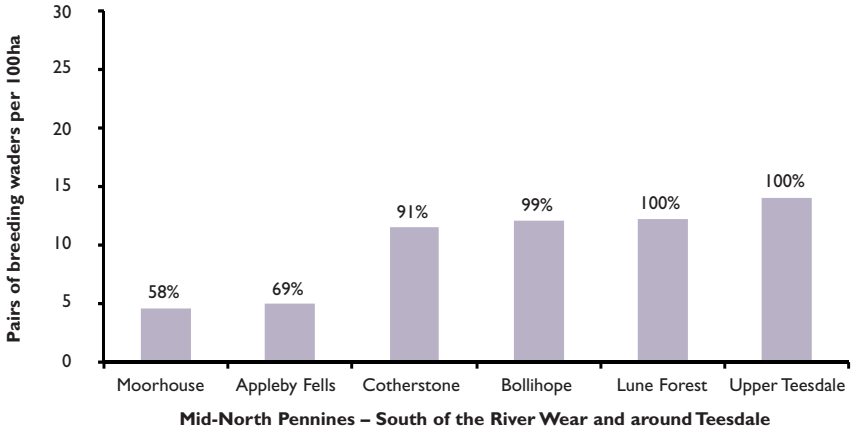


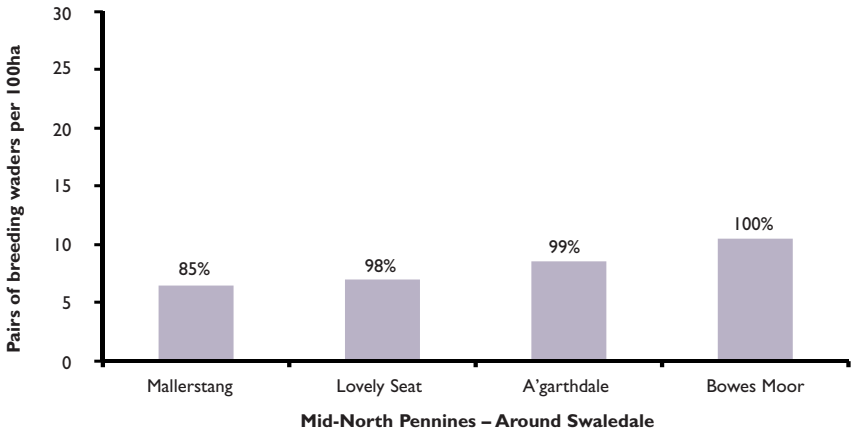
Figure 9
Grouse moors of the Northern Pennines (in grey with black outline) shown overlaying the Special Protection Area for birds (purple) and the landscapes designations of the North Pennines and Nidderdale AONBs and Yorkshire Dales National Park (pale green and pale brown).

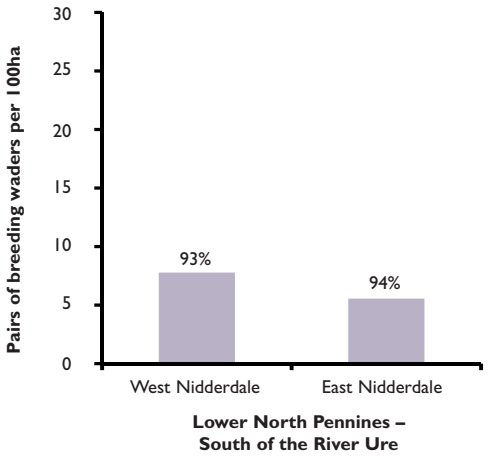
Figure 10

Density of breeding waders (pairs per 100ha) on all 17 Pennine SSSIs that make up the North Pennines SPA. The proportion of the SSSI in each that is managed for grouse is shown as a percentage above each bar. Data from a report to Natural England by Shepherd (2008)[17] and taken from an analysis by Aebischer et al. (in press)[18] – see text for details.









Within the North Pennines SPA there is a close association between wader breeding numbers and the proportion of each SSSI that is managed for grouse. This is illustrated in Figure 10. It also shows wader breeding numbers on the 17 SSSIs that make up the North Pennines. The bird surveys were carried out between 2005 and 2007 and comprised walked routes across the open moorland area, as well as field by field inspections of nearby ground[17]. Effectively they are complete counts of breeding pairs on the different SSSIs. The percentage of each SSSI that is managed for grouse was calculated by comparing the boundaries of the grouse moor properties illustrated in Figure 9, which were derived from a questionnaire circulated to the National Gamekeepers' Organisation and the Moorland Association[18]. For comparison the SSSIs were divided into five, roughly north to south, blocks which show a general trend from high to low numbers. It is clear that in four of the five blocks, where there are differences in the proportion of grouse moor in the SSSIs, this proportion is reflected in the number of waders.

This strong association between waders and grouse moor suggests that the high abundance of waders currently in the North Pennine SPA depends heavily on the management for grouse by the gamekeepers.

This sometimes provokes the suggestion that this high abundance may not matter in conservation terms. For bird lovers abundance surely does matter, but there is an argument that suggests that provided the full range of bird species are maintained, the so-called 'upland bird assemblage', then that is sufficient biodiversity. Perhaps without the gamekeepers, although there would certainly be fewer waders, the number of bird species would not be reduced. This is likely to be wishful thinking.

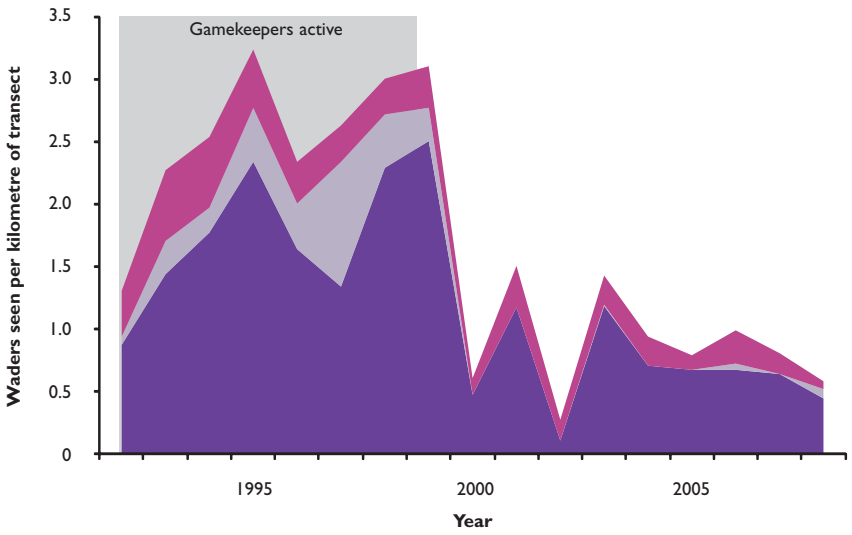
At Otterburn we found that the numbers of golden plover and curlew were quite low compared with grouse moors – yet, as we have seen, in the years without predator control their numbers declined. There was nothing to suggest that these birds could maintain their low density continuously. Indeed their breeding success was too low to sustain a stable breeding population. We calculate that these low rates of breeding success, combined with published estimates of adult and juvenile mortality, would cause lapwing and golden plover numbers to drop by 81% and curlew by 47% after 10 years.

There is at least one documented example where this type of loss has occurred. This was the well studied Langholm moor in Dumfriesshire owned by Buccleuch Estates. This moor of some 12,000 acres (4,858ha) was managed as a driven grouse moor until 1999, when the gamekeeping was stopped after the grouse population failed to recover from a cyclic decline. The failure of the grouse recovery was caused by heavy predation by hen harriers and, to a lesser extent, by peregrine falcons. This was well reported as part of the *Joint Raptor Study (1992–1997)*[19,20].

Grouse failed to recover on Langholm Moor.
© David Mason

The wader numbers at Langholm have been monitored since 1992 along a series of transects. Analysis of these wader counts shows that their numbers collapsed when the predator control finished in 1999[21]. Figure 11 shows that this amounts to about a 75% reduction in nine years. By 2008 there was no evidence that the decline had stopped.

Figure 11
Changes in numbers of breeding waders on Langholm moor since 1992. Gamekeepers were employed to control predators until 1999.



We infer:

- The low breeding success of waders on our areas without predator control suggest that predation is likely to be contributing to population declines of waders elsewhere.

If wader declines like these were to become widespread and commonplace they might certainly jeopardise the existence of the upland bird assemblage. We would not be left with local declines, we would be looking at local extinctions. Birds would simply disappear from significant parts of their breeding range. There is evidence that this is indeed happening.

Using information on the breeding distribution of waders published in the BTO's bird atlas[16], we show in Figure 12 (see page 24) how the breeding range of lapwing and curlew have contracted in different parts of Britain. It is clear in Wales and south-west England that there has been a very significant loss in breeding range of these two waders.

- The contraction in breeding range of some waders like lapwing and curlew may be being caused by, or at least aggravated by, predation during the breeding season.

This emphatically does not imply that predator control is the only factor that limits these waders – others factors like habitat, burning and grazing surely do too. This is

Fox, stoat, magpie and carrion crow numbers are all increasing or stable. © Laurie Campbell



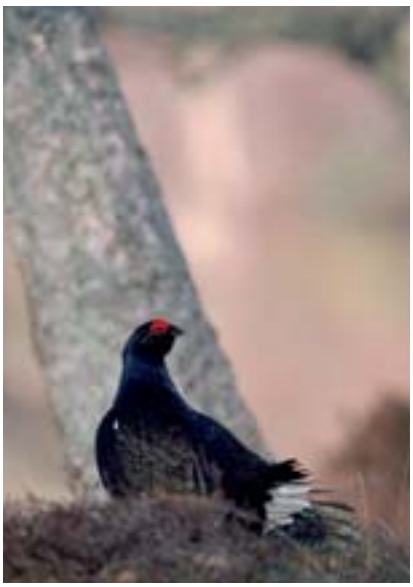

not a new insight though. In an RSPB report 14 years ago into the status of birds in Wales[22], the increase in common predators like foxes and crows, due to a reduction in gamekeeping, was considered just as significant as modern farming, over-grazing and plantation forestry to the decline of birds in Wales – a loss that was so severe that the authors did not mince their words:

> "Wales still appears as a fertile country of rolling hills and green valleys. However, in wildlife terms, this image is a sad illusion, for the veneer of wildlife that the countryside now supports has become paper thin." Foreword to *Silent Fields: Gwlad Tawel* in 1995[22].

One can hear echoes of these same concerns in more recent RSPB reports. With reference to the *Lake District in The Uplands; Time to change?*[23] the RSPB said (next to an illustration of a lapwing):

> "In wildlife terms, the Lake District is average, or below average, rather than exceptional."

It will be very sad if we lose a significant fraction of our bird life through want of a little wildlife management. The evidence from our research is that such losses are not inevitable and the North Pennines stands as a testament to the difference game management can make to conservation in the uplands.



Black grouse, a seriously threatened gamebird, is a major beneficiary of grouse moor management. © Laurie Campbell

TABLE 2

How common are these birds and mammals?

Species	Number	Range	Change
Fox	240,000	Ubiquitous	Increasing or stable
Stoat	462,000	Ubiquitous	Increased along with rabbits
Magpie	1,180,000	Ubiquitous in lowlands	Increased to 1985 – now stable
Carrion crow	1,580,000	Ubiquitous	Increasing since 1961
Lapwing	308,000	Widespread: range contracting	Declining
Curlew	210,000	Moorlands: range contracting	Declining
Golden plover	45,200	Uplands: range contracting	Stable or declining
Red grouse	309,000	Moorlands: range contracting	Declining
Black grouse	13,020	Moorland fringe: contracting	Declining

Numbers are estimates of breeding adults (males + females) in Great Britain. Based on Harris and Yalden[24] for the mammals and Baker et. al. [25] for birds. For the latter we have assumed two adults per territory and a 1:1 sex ratio for black grouse.

Curlew, golden plover, lapwing and red grouse are all in decline. © David Mason and Laurie Campbell

Figure 12

Disappearing waders. The average extent of the loss in breeding range of curlew and lapwing from different regions of Britain between 1970 and 1990 as recorded in the British Trust for Ornithology's bird atlas[16,18].

The North of England

11% **loss of breeding range**

The Scottish Mainland

17% **loss of breeding range**

Wales

32% **loss of breeding range**

South-West England

47% **loss of breeding range**

© Laurie Campbell

Looking to the future – learning from the past

Conservation, it seems, has always been a struggle. We seem to lose more than we gain in spite of ever widening streams of tax payers' money directed to it. Even though a lot of money gets absorbed in the regulatory infrastructure of conservation agencies, conservation programmes have never been better funded. Money alone is not enough and conservation needs allies. Perhaps largely unrecognised, the biggest natural ally of conservation may be the gamekeeper – it is a shame that he has so often been cast as the enemy.

The degree to which gamekeeping supports conservation has been over-looked for too long, but studies like our experiment at Otterburn reveal just how significant this is for birds like waders that share the same vulnerabilities as grouse. This is not to claim that grouse moors are good for all birds – we know that some, like the hen harrier and peregrine, if breeding in significant numbers will destroy the economic basis of the grouse enterprise.

> "...we want birds of prey in the sky just as much as we want to hear the calls of lapwing and curlew..."

If we want to restore some of the wildlife we had in the 19th century, certainly we need habitat programmes and environment schemes to help wildlife live alongside modern systems of agriculture. But we must not ignore the role of wildlife management – the Victorians and the Edwardians did not; neither did generations of country people before them[26]. It is true that we don't want to go back to doing everything the way they did – we want birds of prey in the sky just as much as we want to hear the calls of lapwing and curlew in the uplands every spring. But there are lessons from the past. We will manage the future better if we learn them.

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Appendix. Gamekeeping on grouse moors

Most grouse shooting in England is 'driven' – where grouse are flushed in large numbers over the shooting party who are spaced out and hidden in butts. There may be eight to 10 'guns' in a shooting party, but there will be some 40 odd casual workers employed for the day as 'beaters' who flush and drive the birds towards the line of guns. There can be four drives in a day and a large Pennine moor in a good year may organise over 30 days. In a poor year there may be no shooting at all. In Scotland some moors are 'driven' in this way, but many more rely on 'walked-up' shooting. Here the guns walk in a line with the gamekeepers and gundogs and shoot the grouse as they are flushed.

The shooting season legally extends from mid-August to December, but in practice most shooting usually finishes by the end of October. So although it is the high point of the year, managing the grouse shooting represents only a fraction of a grouse gamekeeper's job.

The bulk of the keeper's year is spent conserving the stock of wild grouse living on the moor. The habitat is improved by patchwork heather burning, grouse predators are trapped and shot to increase the survival of grouse and their chicks, and on some moors, 'medicated grit' is put out for the birds to reduce numbers of the debilitating gut worm *(Trichostrongylus tenuis)* which is a periodic problem on most Pennine moors. Most of the year the grouse moor gamekeeper is occupied with predator control.

Gamekeeping for grouse depends on going round all of the 'beat' using good field craft, keeping a lookout for signs of predation and predators, and checking traps at least daily.

Carrion crows are captured and killed in large walk-in cage traps and small moveable Larsen traps. The efficiency of these traps is considerably increased by keeping a decoy crow in the cage so that it attracts in other territorial crows. Magpies, where they occur, are also trapped in this way. Crows are also shot either with a shotgun or a rifle as opportunities arise.

Foxes can take grouse at any season. Being nocturnal they are generally not noticed by the public and they can move onto a grouse moor at any time of the year. Rifle shooting at night with a spotlight is a widely used method where access is good and heather is fairly short. The other important means of capture are snares which are designed to catch and hold a fox until it is shot by the keeper on his daily round.

Stoats and weasels. Stoats depend principally on rabbits, but they can take grouse too. Weasels go mostly for voles but do take nesting songbirds when voles are scarce – they also take game chicks. Both hunt in and out of holes as they go round their territories so gamekeepers trap them by placing lethal spring traps in tunnels and holes around the moor.

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