

Scottish Gamebird Releases: focusing on the Cairngorms National Park



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Contents

1.	SUMMARY.....	1
2.	PROJECT BACKGROUND.....	2
3.	DATA FROM NATIONAL GAMEBAG CENSUS (NGC).....	3
3.1.	NGC Methods	3
3.1.1.	NGC Data collection.....	3
3.1.2.	NGC Analysis.....	4
3.2.	NGC Results	5
3.2.1.	Density of birds released and shot.....	5
3.2.2.	Trends in the index of releasing and gamebag from the NGC	8
4.	SURVEYS UNDERTAKEN WITHIN CAIRNGORMS NATIONAL PARK.....	12
4.1.	Survey Methods.....	12
4.2.	Survey Results.....	14
4.2.1.	Summary of shoots interviewed	14
4.2.2.	Density of released gamebirds	14
4.2.3.	Return rates.....	16
4.2.4.	Number of shoot days	16
4.2.5.	Management associated with the shoots	17
5.	DISCUSSION	18
5.1.	Releasing densities.....	18
5.2.	Return rates.....	19
5.3.	Shoot management and possible effects of releasing on biodiversity	19
6.	CONCLUSION	20
7.	ACKNOWLEDGEMENTS.....	20
8.	REFERENCES.....	21
8.	APPENDIX.....	23

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1. SUMMARY

The release of pheasants *Phasianus colchicus* and red-legged partridges *Alectoris rufa* for game shooting is practised in many areas of the UK. The impacts, positive and negative, of releasing gamebirds are expected to be dependent on the density at which gamebirds are released. This project aims to collate data collected from two voluntary surveys at national and local scales to provide releasing density estimates for these two species.

Data from the Game & Wildlife Conservation Trust's National Gamebag Census was used to compare the reported number of birds released for the UK, and Scotland and England separately. The annual mean densities of released pheasants in Scotland ranged from 181 – 369 birds km⁻² (of estate area) between 2000 and 2023. This was about half the densities reported for England (455 - 673 birds km⁻²) over the same period. The density of pheasants being released has increased in the last 24 years by 88% in Scotland and 24% in England, however, there was no significant trend between 2013 – 2023. For red-legged partridges the release density in Scotland was considerably lower than in England until 2019, but release densities have since increased and are now similar to England (annual average released in Scotland was 333 partridges km⁻² between 2020 and 2023). This equates to an increase in Scotland of 107% from 2013 to 2023, compared to no change in England. Similar trends were found in the density of shot gamebirds.

Within the Cairngorms National Park (CNP) we interviewed managers from ten rear-and-release gamebird shoots, mainly located within the River Spey catchment. These ten shoots represented 45% of the 22 shoots identified within the CNP boundary. The combined area of the estates on which these shoots were located was 795 km² of which 96 km² (12%) was reportedly managed and used for released gamebird shoots. In the most recent three shoot seasons (since spring 2022) all ten shoots released pheasants, and five also released red-legged partridges. All participating shoots sourced birds from within the UK. Across all shoots the total number of birds released in seasons 2022/3, 2023/4 and 2024/5 were 50,900, 61,200 and 49,800 pheasants and 8,000, 36,000 and 29,240 red-legged partridges. These equate to the mean releasing densities of pheasants; 70 km⁻² and partridges; 73 km⁻², which are lower than those reported from Scotland as a whole. Release densities varied across the shoots interviewed with 70% of shoots releasing < 100 pheasants km⁻² and 20% of shoots releasing > 200 pheasants km⁻².

The estimated percentage of released birds shot was 32% on average for pheasants and 33% for red-legged partridges over an average of 24.2 shoot days per annum. These are similar to the 39.9% and 30.3% calculated from Scotland-wide NGC data for pheasant and red-legged partridge, respectively. This study was not able to assess whether the remainder of the birds died (or dispersed) before the shooting season, or what density of birds may remain the following spring. Generally, participants associated with the larger numbers of birds released reported more intensive predator management, woodland management, and game crop planting than those estates releasing lower numbers.

This study provides the first detailed assessment of gamebird releasing densities in the Cairngorms National Park, set in the context of national trends. The findings show that release densities in the CNP are generally lower than the Scottish average. However, further research is needed to better understand the positive and negative impacts of release and harvesting numbers. This would inform evidence-based management that reflects the Scottish landscape, habitats, wildlife, culture and regulatory framework to support both biodiversity and sustainable game management.

2. PROJECT BACKGROUND

The release of pheasants *Phasianus colchicus* and red-legged partridges *Alectoris rufa* to provide driven game shooting is practised in many areas of the UK, but especially in lowland areas of southern England (Tapper 1992, Madden and Sage 2020). Game bird releasing has been practiced since the 1800s but became more prevalent in the 1960s when wild gamebirds (mainly grey partridge *Perdix perdix*) populations declined due to agricultural intensification (Potts 1986) and could no longer support shooting demand. It is estimated that 47 million pheasants (95% CI 39 – 57 million) and 10 million red-legged partridges (95% CI 8.1 – 13 million) were released in the UK in 2016 (Aebischer 2019). However, a recent study using a wide range of data sources from 2016 - 2020, estimated that a lower annual mean of 43.2 million (95% CI 29.0 – 57.3 million) gamebirds (including mallard *Anas platyrhynchos*) were being released (Madden 2021).

The consultation on licensing gamebird release undertaken by the Welsh Government, highlighted the paucity of available evidence on the numbers of gamebirds released. The review commissioned by Natural Resources Wales stated “... *there is currently little reliable evidence about the scale, extent, history or methods of gamebird release and management in Wales. The estimates that I can calculate are subject to large errors, of around 2.5-fold and the extrapolations that I make are often based on restricted and perhaps skewed data*” (Madden 2023). Reliable and accurate data on gamebird releases are needed to allow devolved governments to make informed decisions on future regulations. The objective of this project is to gain a better understanding of gamebird release numbers and densities in Scotland and specifically within Cairngorm National Park with the aim to ensure that any future discussions are informed by evidence.

To address this knowledge shortfall, we considered the available information on the number of gamebirds released and shot in Scotland, submitted to the GWCT's National Gamebag Census (Tapper 1992), comparing this to the information available for England. This allowed us to put the trends in both the releasing and shooting bag in context with what happens in England. The Cairngorm National Park Authority (CNPA) supported this project, as their Partnership Plan 2022-27 (NPPP) includes a target to “*Establish a baseline for the number of gamebirds released in the National Park and assess their impact on native biodiversity*” (www.partnershipplan.cairngorms.co.uk). To support the NPPP objective, semi-structured interviews with sporting estates, within the Cairngorms National Park (CNP), were used to explore gamebird release densities and management at the estate level.

3. DATA FROM NATIONAL GAMEBAG CENSUS (NGC)

3.1. NGC Methods

3.1.1. NGC Data collection

The National Gamebag Census (NGC) is a voluntary scheme that collects bag statistics from up to 900 estates annually across the UK (Tapper 1992, Aebischer and Baines 2008). Contributing estates are well distributed across the whole of the UK and range from small family-run shoots to large commercial enterprises. Estates within the NGC include mainly driven, walked-up, and mixed shoots¹, but also deer-stalking estates and some wildfowling clubs. Accordingly, most NGC sites are inland rather than coastal, and their size varies widely, from under 1 to over 300 km², with an average area of 16 km²; overall they represent 19% of the area of land shot over in the UK (given as 160,000 km² in PACEC (2014), based on Piddington (1980)). Although some NGC estates rely on wild game, the proportion of estates releasing gamebirds and the numbers of gamebirds released for shooting have increased over time (Tapper 1992, Robertson *et al.* 2017).

NGC participants submit their records via an annual survey form, sent out at the end of the shooting season. The form requests numbers of each game species shot during the previous year, as well as additional information on the numbers of captive-reared birds released for shooting, and on numbers of legally controllable predators killed annually. It deliberately does not request further information on estate management or economics to keep the form brief and maximise return rate. Reminders are issued for nonreturned forms, and the annual return rate exceeds 85%.

For this study we use data collected since 1961 to report on trends at UK level but focus on data collected since 2000 for the comparison between Scotland and England. Before 2000 the releasing of red-legged partridges was uncommon in Scotland. The number of estates contributing data annually for both England and Scotland are detailed in Table 1. The number of estates reporting information to the NGC annually from within the CNP boundary was too low to allow analyses at this scale.

Table 1: The number of estates contributing data annually to the NGC, and the total number of records available from estates from 2000-2023 (mean with 95% confidence intervals in brackets).

	England		Scotland	
	Mean (95%CI)	Total records	Mean (95%CI)	Total records
Released:				
Pheasant	329 (300 – 359)	7,902	97 (88 – 105)	2,315
Red-legged partridge	182 (162 – 202)	4,371	37 (33 – 41)	887
Shot:				
Pheasant	400 (367 – 433)	9,598	126 (117 – 136)	3,032
Red-legged partridge	289 (262 – 316)	6,932	65 (60 – 71)	1,507

¹ Gamebird shooting can be categorised into either driven shooting, where gamebirds are flushed by beaters toward a stationary line of hunters, or walked-up or rough shooting, where hunters walk, often in line, using dogs to flush gamebird (e.g., Sotherton *et al.* 2009). Mixed shoots are estates doing both types.

3.1.2. NGC Analysis

For each year we calculated the simple mean of the number of birds released km⁻² (of estate area) and number of birds shot km⁻² (with 95% confidence intervals), for both pheasant and red-legged partridge in England and Scotland. An estimate of return rates (percentage of birds shot compared to number released), on those shoots that reported both the number released and the number shot was also calculated from the individual estate information for each species in Scotland and England. These annual data have been presented graphically for 2000 to 2023 (Figures 1 – 6). The mean area of estates releasing pheasants contributing to NGC in 2023 was 33.8 (95%CI ± 5.1) km² in Scotland and 12.5 (95%CI ± 1.5) km² in England.

To look at the long-term trend in numbers released and number shot (the bag) we follow Aebischer (2019) and calculate indices of change from 2000 for Scotland and England separately. To put these in context we also report on the UK-wide trends from 1961, using the same methods. The analysis of NGC data is complicated because not all estates return data in all years; some bag series have gaps, some estates disappear, new ones appear, and estate sizes vary spatially and temporally. In addition, game bags can vary from year to year, due to changes in the abundance of game species, both wild and released, and because of other factors that influence shooting effort and bag size such as changes in firearms, cartridges, numbers and experience of hunters, weather, and legislation (Tapper 1992, McDonald and Harris 1999). Despite variation in hunting effort, bag records have been found to be a reliable indicator of red grouse *Lagopus scotica* density (Cattadori *et al.* 2003), so numbers of pheasant and red-legged partridge shot have been considered here, as well as the numbers released.

A minimum of 2 years' data from the same site is needed to measure within-site change in numbers, so estates contributing only 1 year's data were omitted from analysis. For each species, release and bag analyses were based on annual returns where the number released, or shot, respectively, was greater than zero and covering the years 2000 to 2023. Data were analysed using a Generalised Linear Model (GLM) with a Poisson error distribution and logarithmic link function, with site and year as factors and the logarithm of site area as an offset variable, which standardised the numbers released or shot to unit area. The estimated coefficients were used to predict values for each combination of year and site; these values were then averaged across all sites to give annual indices of release or bag size on a log scale. The index series was exponentiated to give annual release or bag indices on the arithmetic scale. A Generalized Additive Model (GAM, Hastie and Tibshirani 1990) was then fitted to these, with one degree of freedom per decade or part-decade to smooth out annual variation. The smoothed indices of release or bag size were used to evaluate the percentage change in numbers released or shot; i) over 24 years (2000 – 2023) and ii) over 11 years (2013 – 2023). We obtained 95% confidence limits around the index values and measures of proportional change by bootstrapping at the shoot level (Efron and Tibshirani 1986). For each of 1,000 bootstrap runs, shoots were selected at random with replacement, a new set of indices obtained as described above, a new GAM fitted, and new measures of change calculated. For each year and measure of change, the 95% confidence limits were taken as the lower and upper 95th percentiles of the distribution generated through bootstrapping. A change in release or bag was deemed to differ significantly from zero when the 95% confidence interval of the change estimate did not overlap zero. Statistical analysis was carried out using the statistical computer package Genstat (23rd edition, Lawes Agricultural Trust, Rothamsted).

3.2. NGC Results

3.2.1. Density of birds released and shot

In the NGC, the mean annual density of pheasant release on Scottish estates ranged from 184 birds km^{-2} in 2000, up to 369 birds km^{-2} in 2018, with an average of 343 birds km^{-2} released in 2023. Pheasant releases on English NGC estates ranged from 455 km^{-2} in 2000 up to 673 km^{-2} in 2015, with an average of 629 birds km^{-2} released in 2023 (Figure 1).

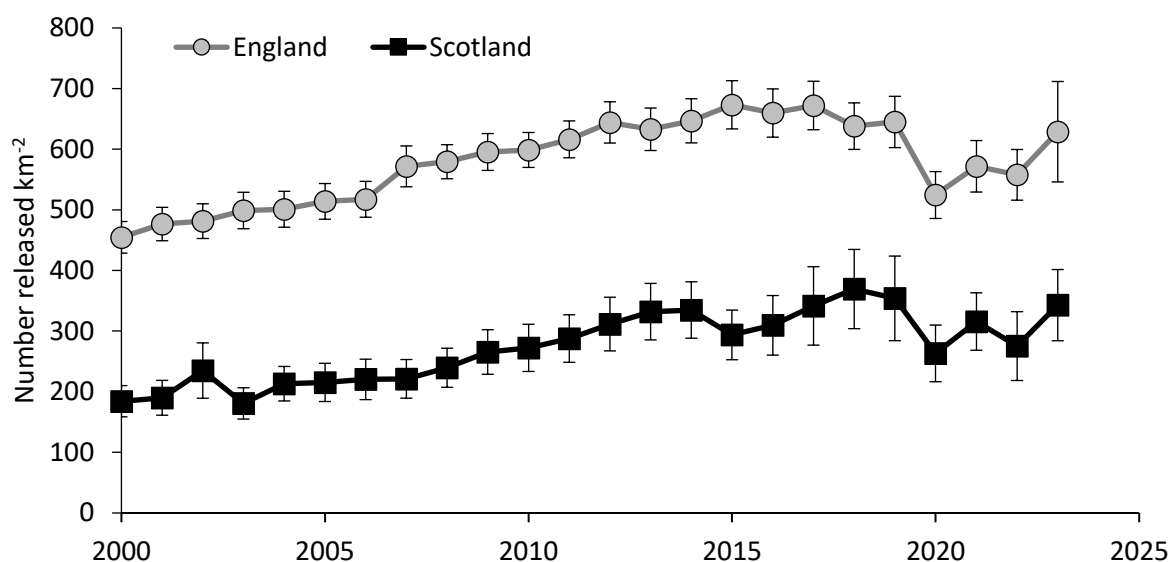


Figure 1: Mean ($\pm 95\%$ CI) annual numbers of pheasants released km^{-2} from NGC data submitted from shoots in England and Scotland.

The average annual density of red-legged partridges on Scottish estates ranged from 31 birds km^{-2} in 2000 up to 384 birds km^{-2} in 2021, with an average of 306 birds km^{-2} in 2023. Red-legged partridge releases on English NGC estates ranged from 216 km^{-2} in 2000 up to 588 km^{-2} in 2022, with an average of 434 birds km^{-2} released in 2023 (Figure 2).

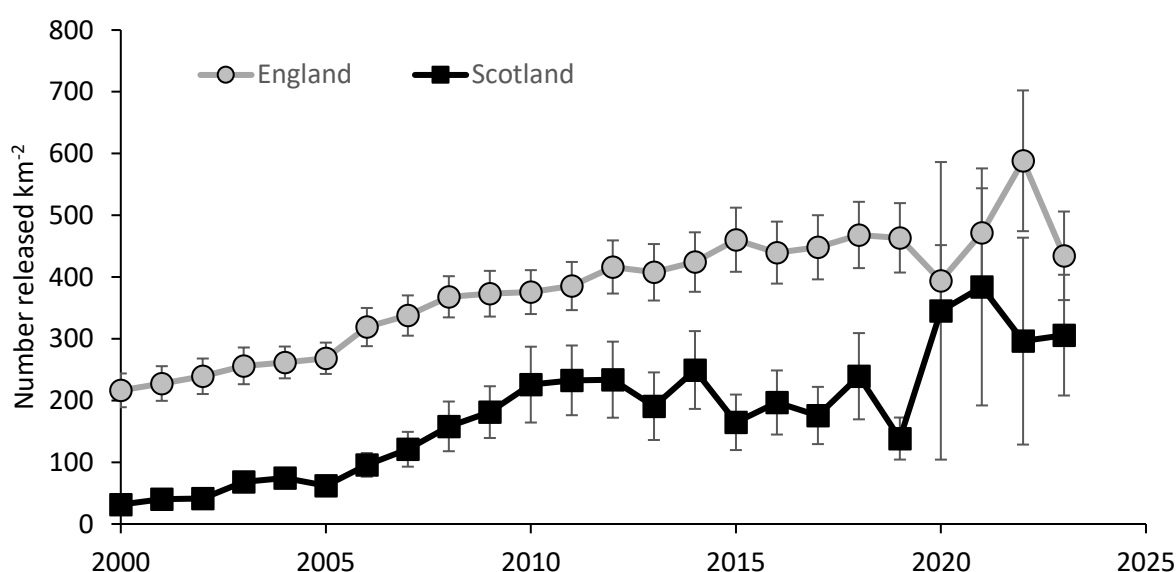


Figure 2: Mean ($\pm 95\%$ CI) annual numbers of red-legged partridge released km^{-2} from NGC data submitted from shoots in England and Scotland.

The average annual density of pheasant shot on Scottish estates ranged from 53 birds km⁻² in 2020, up to 97 birds km⁻² in 2018, with an average of 79 birds km⁻² shot in 2023. The average density of pheasants shot on English NGC estates ranged from 106 km⁻² in 2020 up to 237 km⁻² in 2014, with an average of 173 birds km⁻² shot in 2023 (Figure 3).

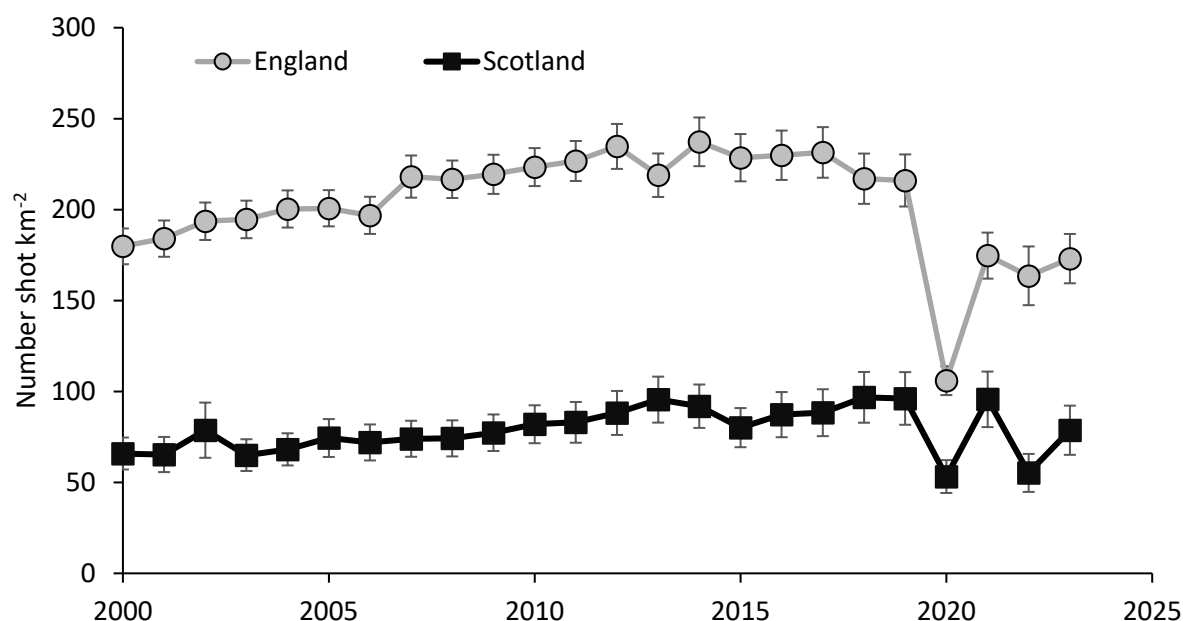


Figure 3: Mean ($\pm 95\%$ CI) annual numbers of pheasants shot km⁻² from NGC data submitted from shoots in England and Scotland.

The average annual density of red-legged partridges shot on Scottish estates ranged from 7 birds km⁻² in 2000, up to 103 birds km⁻² in 2021, with an average of 58 birds km⁻² shot in 2023. The average annual density of red-legged partridges shot on English NGC estates ranged from 65 km⁻² in 2000 up to 121 km⁻² in 2016, with an average of 103 birds km⁻² shot in 2023 (Figure 4).

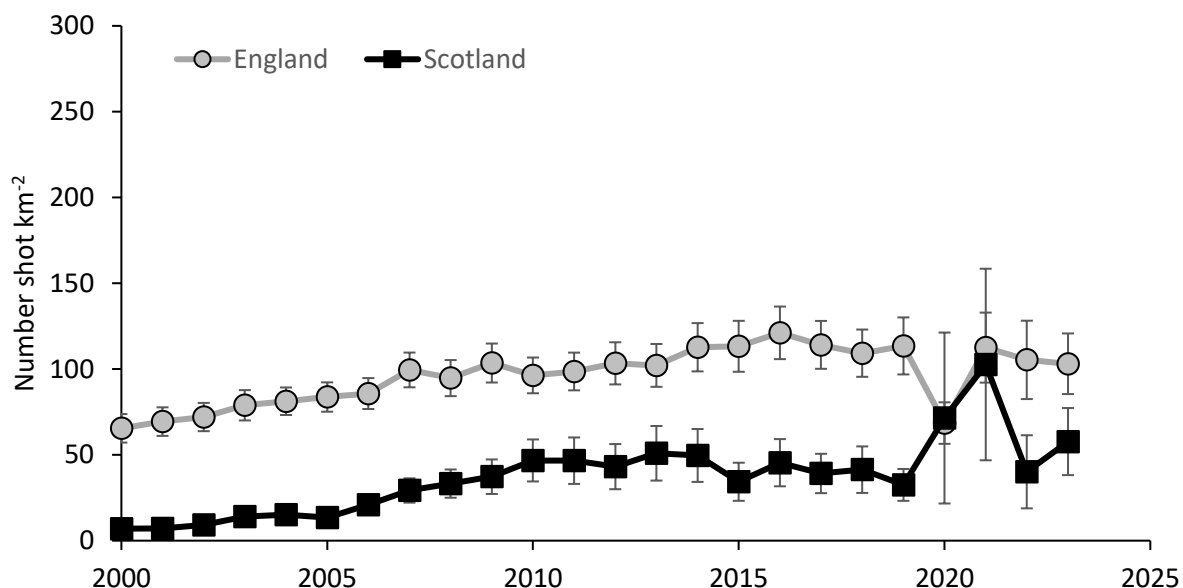


Figure 4: Mean ($\pm 95\%$ CI) annual numbers of red-legged partridges shot km⁻² from NGC data submitted from shoots in England and Scotland.

The return rates for pheasants in NGC Scottish estates ranged from 31% (in 2020) up to 48% (in 2000). In England return rates for pheasants ranged from 26% (in 2020) up to 51% (in 2003; Figure 5). The return rates for red-legged partridges in NGC Scottish estates ranged from 25% (in 2012) up to 39% (in 2022). In England return rates for red-legged partridges ranged from 32% (in 2008, 2015 and 2020) up to 45% (in 2013; Figure 5).

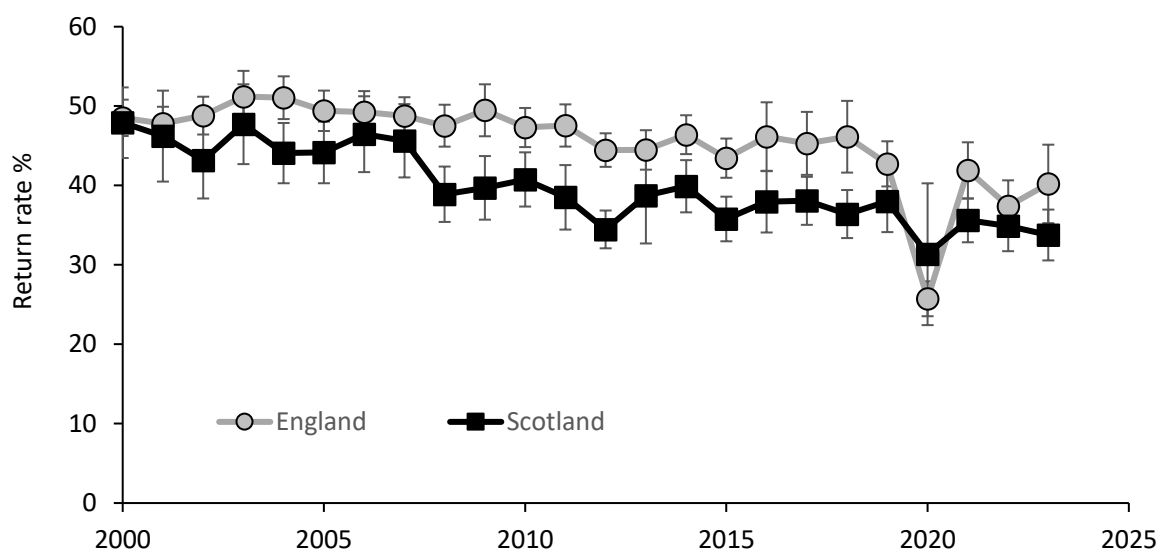


Figure 5: Mean ($\pm 95\%$ CI) annual return rates of pheasants from NGC data submitted from shoots in England and Scotland.

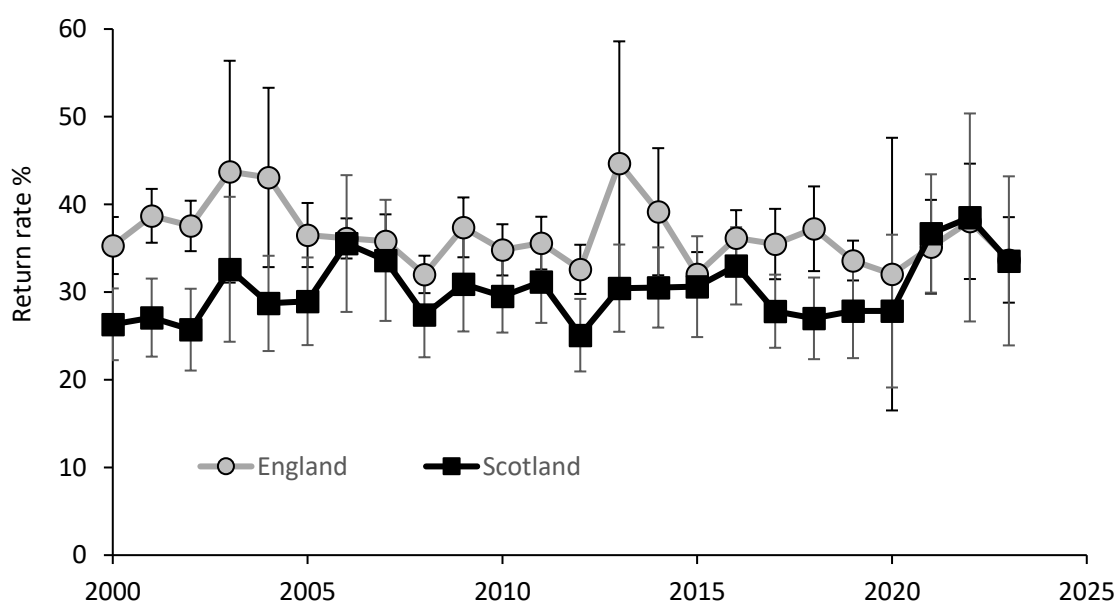


Figure 6: Mean ($\pm 95\%$ CI) annual return rates of red-legged partridges from NGC data submitted from shoots in England and Scotland.

3.2.2. Trends in the index of releasing and gamebag from the NGC

The UK-wide pheasant release index has been increasing since 1961 but appears to have stabilized in the most recent time period (2013 – 2023, Table 2). For red-legged partridges the index of releasing was still increasing between 2013 and 2023, but at a lower rate than the change reported between 2000 and 2023 (Table 2). The gamebag indices for both pheasant and red-legged partridges across the whole of the UK have been increasing since 1961 but shows a significant decrease from 2013 to 2023 for pheasants and no significant change for red-legged partridge (Table 2).

Table 2: Percentage change in the index of pheasants and red-legged partridges released and shot in the UK over periods of 1961-2023, 2000-2023, and 2013-2023 based in GWCT's National Gamebag Census returns: with 95% confidence intervals in brackets and * indicates where the trend is statistically significant at 5%.

	1961-2023	Time span 2000-2023	2013-2023
Released:			
Pheasant	+829* (+675 to +998)	+37* (+23 to +56)	+1 (-8 to +12)
Red-legged partridge	not available	+128* (+85 to +188)	+28* (+10 to +51)
Shot:			
Pheasant	+134* (+91 to +182)	-10 (-20 to +3)	-22* (-29 to -14)
Red-legged partridge	+1545* (+866 to +2691)	+87* (+36 to +153)	+7 (-14 to +29)

The index of pheasant release has not changed significantly from 2013-2023 in either Scotland or England (the 95% confidence intervals in Table 3 overlap with zero). However, over the longer period from 2000 to 2023, there had been an estimated 88% (95%CI 30 – 167%) increase in the index of pheasants released in Scotland compared to a 24% (95%CI 10 – 39%) increase in the English release index (Table 3; Figure 7). The index of red-legged partridge release has significantly increased over both time periods in Scotland, but in England the change from 2013 to 2023 was not significant (Table 3; Figure 8). The increases in the release indices were generally greater for red-legged partridges than for pheasants.

The index of the Scottish pheasant gamebags showed no change from 2013 to 2023, compared to significant declines in England (-30%). For both countries there was no significant change in the pheasant gamebag index from 2000 to 2023 (Table 3, Figure 7). Although the Scottish and the English red-legged partridge gamebag indices increased from 2000 to 2023, there is no significant change from 2013 to 2023 (Table 3, Figure 8).

Table 3: Percentage change in the gamebird release and gamebag indices from England and Scotland from 2000 to 2023, and 2013 to 2023, based on the GWCT's National Gamebag Census returns with 95% confidence intervals in brackets. * indicates where the trend is statistically significant at 5%.

	Time span			
	2000 to 2023		2013 to 2023	
	England	Scotland	England	Scotland
Released:				
Pheasant	+24* (+10 to +39)	+88* (+30 to +167)	-7 (-14 to +1)	+22 (-8 to +65)
Red-legged partridge	+90* (+56 to +132)	+676* (+229 to +1812)	+14 (0 to +27)	+107* (+8 to +192)
Shot:				
Pheasant	-17 (-27 to +6)	+34 (-12 to +101)	-30* (-36 to -23)	0 (-24 to +28)
Red-legged partridge	+49* (+9 to +3727)	+875* (+107 to +5104)	-8 (-23 to +5)	+89 (-16 to +206)

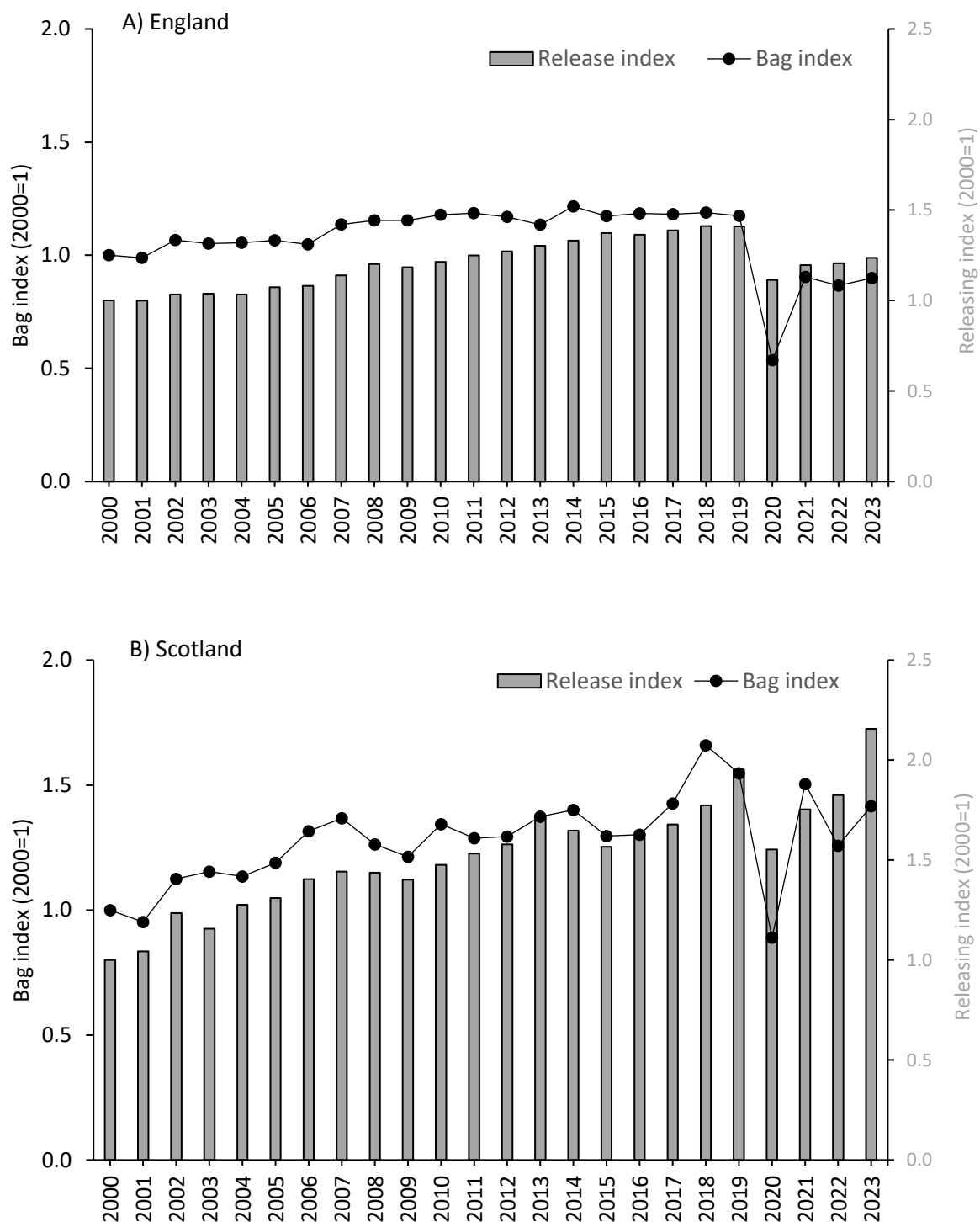


Figure 7: Pheasant: bag index (dots, left-hand scale) and releasing index (bars, right hand scale) for A) England and B) Scotland.

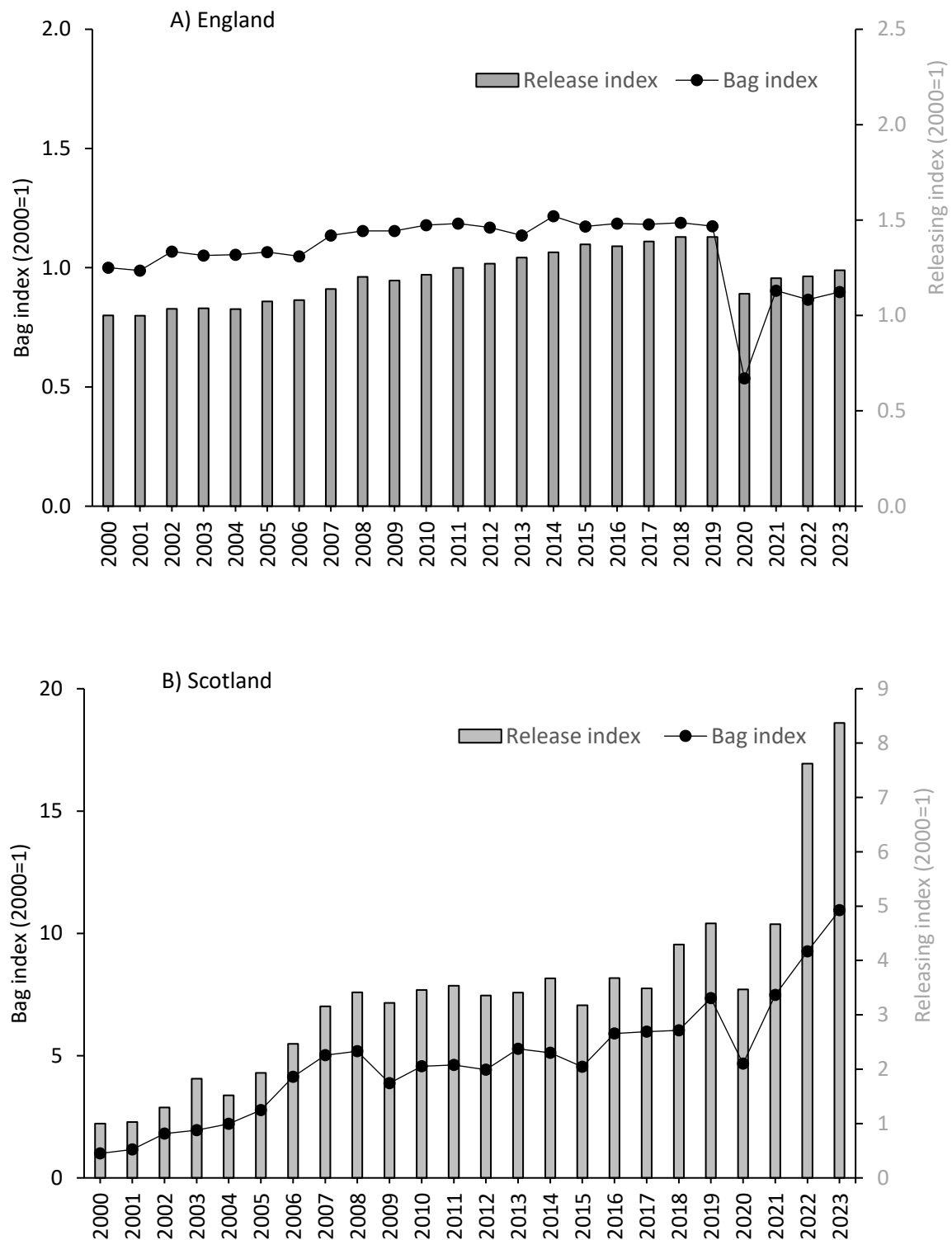


Figure 8: Red-legged partridge bag index (dots, left-hand scale) and releasing index (bars, right hand scale) for A) England and B) Scotland.

4. SURVEYS UNDERTAKEN WITHIN CAIRNGORMS NATIONAL PARK

4.1. Survey Methods

We used existing contacts and knowledge of estates in combination with “snowball” sampling (where participants suggest other potential participants), to identify potential participants within the CNP. The size of gamebird releases can vary greatly; small family-farm shoots or tenant syndicates may release a few thousand birds each year, and at the other end of the scale, some shoots release over 10,000 birds and may focus on paying guests attending shoot days to offset the costs. As there are differences in land ownership and business models we have referred to all as “shoots”. We identified 22 shoots within CNP, covering the range of sizes mentioned above.

All shoots were contacted by phone or email. Potential survey participants were emailed an information sheet with full details of the project. Ten shoots agreed and consented to participate in the study. We undertook face-to-face interviews with a representative of each of these shoots over March and April 2025. There were an additional three shoots in the process of changing management teams; they were not able to answer questions at this time. There were also two shoots that were willing to be interviewed but were too busy within the time period of this study. The remaining shoots that we approached (7) did not wish to participate in the survey.

To maintain the confidentiality of participants, data from individual shoots has been aggregated at river catchment (or sub catchment, hereafter all referred to as catchment) level where we have interviewed at least two participants. In the case of catchments with only one participant, catchments have been combined so there are at least two participants per combined catchment. For this study we adopted the same geographic areas as those used for the Cairngorms Nature Index and considered the catchments within the CNP as; Upper Spey, Lower Spey, Don, Dee, North & South Esk, and Tay (Table 4). The maps shown in this report are those used by the Cairngorms Nature Index, with the CNP split into 4 km-sided hexagons. We excluded those hexagons where landcover was considered unsuitable for released gamebirds (i.e. montane areas with < 20% tree cover; Figure 9). All mapping was done using ArcGIS Pro 3.4.0 © 2024 Esri Inc.

Table 4: Breakdown of shoots interviewed by catchment (also see Figure 9).

CNPA Catchments:	Number of shoots identified	Number shoots interviewed	% Interviewed
Upper Spey	7	4	57%
Lower Spey	8	5	63%
Donside	3	0	0%
Deeside	2	1	50%
North & South Esk and Tay	2	0	0%
All catchments	22	10	45%

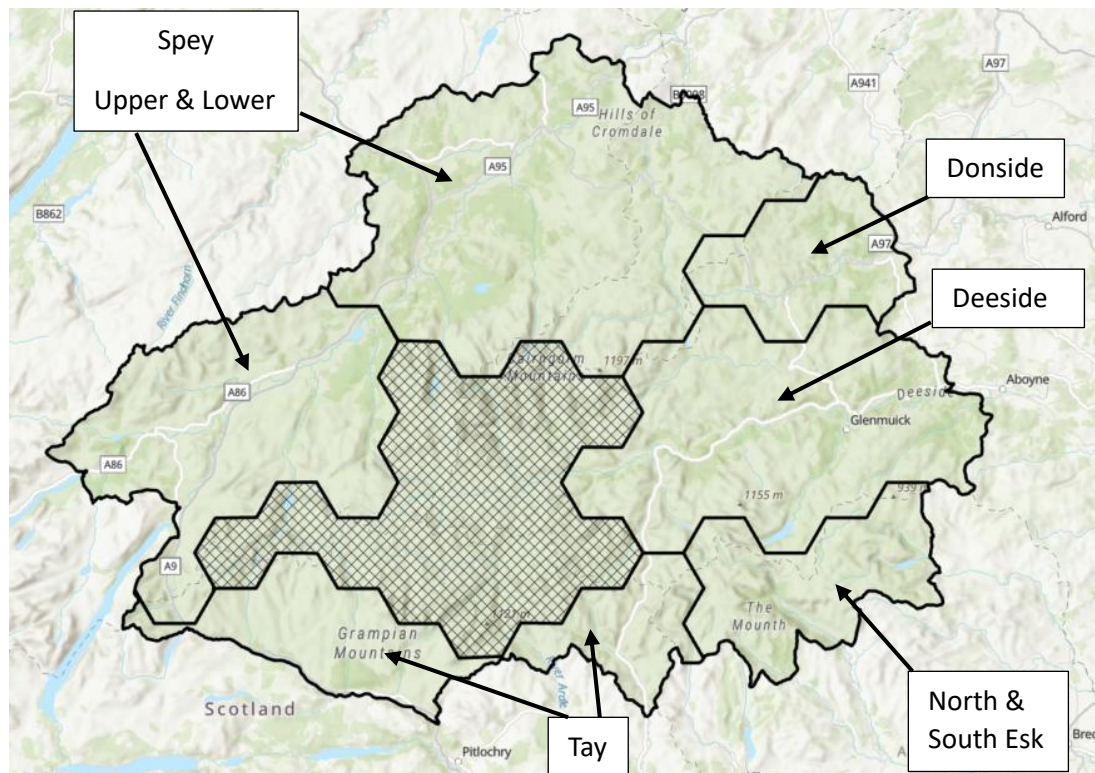


Figure 9: The Cairngorm National Park overlaid with 4 km-sided hexagons and then split into six “catchment” areas following the Cairngorms Nature Index mapping approach. The cross hatched area are hexagons likely to be unsuitable for released gamebirds (montane areas with <20% tree cover), source of map base layers: Esri 2024, Esri *et al.* 2024.

Participants were asked about the numbers of pheasants and red-legged partridge released in the last three years, i.e. shooting seasons 2022/3, 2023/4, and 2024/5. One shoot did not release pheasants in one of these seasons, the remainder released pheasants in all seasons. Five shoots (50%) did not release red-legged partridges in the three shoot seasons asked about here. One shoot released red-legged partridges in three seasons (10%), three shoots in two seasons (30%) and one shoot in one season (10%). In 2022/3 Highly Pathogenic Avian Influenza (HPAI) restrictions resulted in one shoot not releasing pheasants and two shoots not releasing red-legged partridge, due to the lack of availability or travel restrictions for the poults. Therefore, the mean number of birds released was calculated using the number released in an “active” season for each gamebird species.

We also asked for estimates of the area covered by the estate, the shoot itself, woodland, and release pens so release densities could be calculated across each of these areas. (Note that for the NGC figures, densities are calculated using the total area of the estate.) Shoots were also asked to provide the number of shoot days (for both gamebird species combined) and the return rates (percentage of birds shot compared to number released for each species). The last section of the survey focused on what aspects of shoot management were undertaken e.g., predator control, planting game crops, and supplementary feeding.

4.2. Survey Results

4.2.1. Summary of shoots interviewed

Participating shoots were located within estates that covered in total 795 km² (196,516 acres), with the mean area of individual estates being 79.5 (95%CI $\pm$ 38.3) km². The estimated total woodland area (including scrub) was 151 km² (37,370 acres). The area of each estate involved in gamebird release (i.e. the shoot area) averaged 12% of an estate's area (range 3% to 41%) with the total shoot area on the shoots surveyed estimated to be 96 km² (23,607 acres). The shoot areas were on average 63% of the woodland area on the estates (range 13% to 276%, i.e. shoot areas included arable, pasture, and moorland habitats in addition to woodland).

4.2.2. Density of released gamebirds

Across all catchments the total number released in seasons 2022/3, 2023/4 and 2024/5 were 50,900, 61,200 and 49,800 pheasants and 8,000, 36,000 and 29,240 red-legged partridges.

For pheasants, the release density was 582 pheasants km⁻² based on the shoot area, or 70 pheasants km⁻² based on the estate area. Six of the ten shoots (60%) were releasing below 5,000 pheasants per annum, and seven shoots (70%) were below 100 pheasants km⁻² of estate area. Two of the ten shoots were releasing > 200 pheasants km⁻² of estate area (comparable with the average Scotland-wide NGC values). Across all shoots the average release density per area of woodland pen (reported in hectares) was 477 pheasants ha⁻¹. Seven of the ten shoots (70%) released at densities below 1,000 pheasants ha⁻¹. Four of the shoots (40%) released at densities below 700 pheasants ha⁻¹.

For red-legged partridges the density of release was 772 partridges km⁻² based on the shoot area, or 73 partridges km⁻² based on the estate area. Four out of the five shoots releasing red-legged partridges did so at a density below 200 partridges km⁻² of estate area. Pens used to release red-legged partridges were more numerous than for pheasants, more mobile, and used for no more than a few days. Therefore, the density of red-legged partridges released per area of pen was not calculated.

The breakdown by catchment is shown in Table 5 and illustrated in Figure 10, showing that shoots within the Upper Spey were releasing pheasants and red-legged partridges at higher densities (based on shoot area) than the Lower Spey and Deeside catchments combined.

Of the nine shoots active before the UK-wide Covid-19 restrictions, six of the participants reported that they were now releasing similar numbers to before Covid-19, one was releasing fewer gamebirds, and two were releasing more.

Five shoots (50%) indicated that they plan to release similar numbers in 2025/6. Three shoots (30%) plan to release fewer gamebirds as they are responding to a decrease in the planned number of shoot days or potential clients and one shoot (10%) had not yet planned for next season due to staff changes. The final shoot will not operate in future as the shoot will cease due to the presence of wildcats within the area.

Table 5: Breakdown of number and density of pheasants (PH) and red-legged partridge (RL) released on shoots split by catchment (also see Figure 10).

	CNP Catchments			
	Upper Spey	Lower Spey and Deeside	Donside, North & South Esk and Tay	All catchments
<i>Releasing PH:</i>				
Number of shoots	4	6	0	10
Estate area (km ²)	252	543		795
Woodland area (km ²)	29	122		151
Shoot area (km ²)	20	75		95
Pen area (ha)	43	74		117
Total average PH release per year	18,167	37,467		55,633
<i>PH Release density:</i>				
Number per estate area (km ²)	72	69		70
Number per shoot area (km ²)	908	500		586
Number per pen area (ha)	422	506		475
<i>Releasing RL:</i>				
Number of shoots	3	2	0	5
Estate area (km ²)	183	243		426
Shoot area (km ²)	14	26		40
Total average RL release per year	26,583	4,440		31,023
<i>RL Release density:</i>				
Number per estate area (km ²)	145	18		73
Number per shoot area (km ²)	1,899	171		776

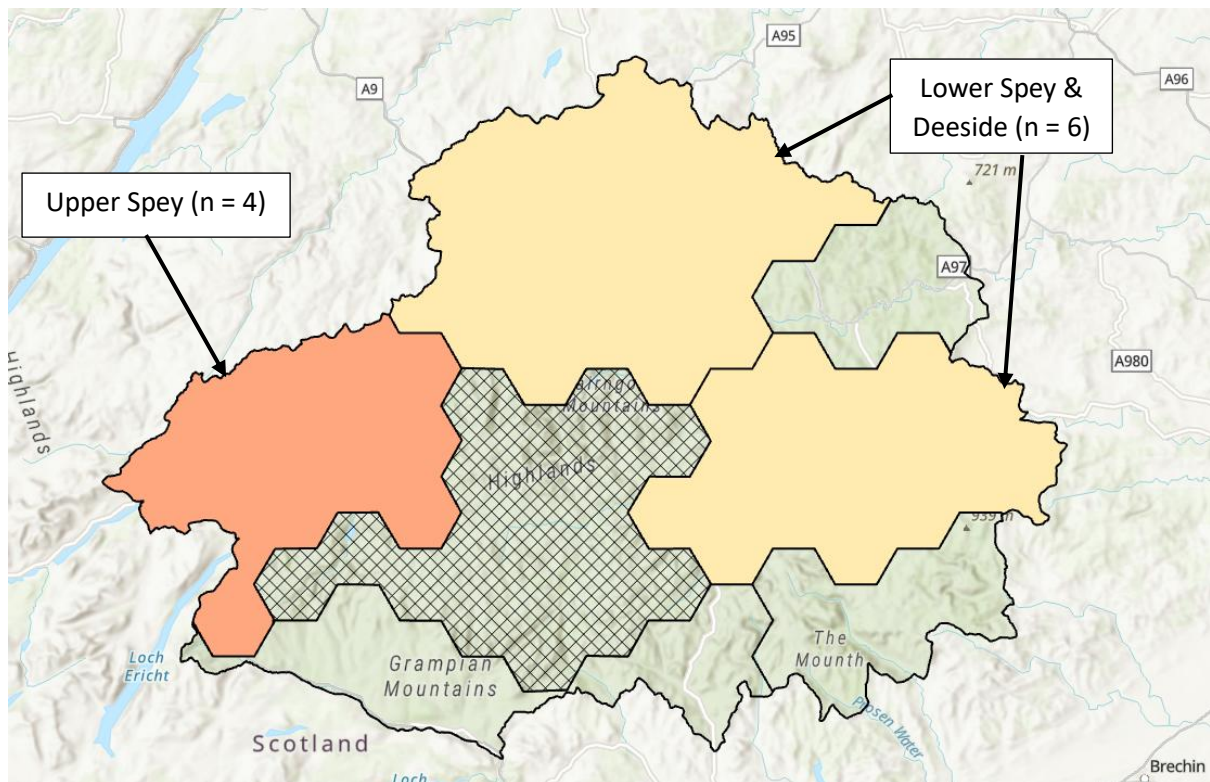


Figure 10: Mean annual density (bird km⁻² of shoot area) of released pheasants and red-legged partridges within the Cairngorm National Park. No data available for the three unfilled catchments (Donside, North & South Esk and Tay); higher release densities were reported in the Upper Spey catchment (orange, data from 4 shoots) than in the Lower Spey and Deeside catchments combined (yellow, data from 6 shoots) see Table 4). Cross hatch area are hexagons likely to be unsuitable for released gamebirds (montane areas with <20% tree cover), source of map base layers: Esri 2024, Esri *et al.* 2024.

4.2.3. Return rates

The return rate for pheasants (the percentage of released birds that were shot) was on average 32% across all shoots in the last three seasons. The highest return rate reported was 55% and the lowest was 20%, with six out of the ten shoots reporting > 30% average return rate.

The five shoots that released red-legged partridges reported similar return rates to those for pheasants with an average of 33% ranging from 2% to 40% and with two out of the five shoots reporting > 30% average return rates.

4.2.4. Number of shoot days

The average number of shoot days per year across the shoots interviewed was 24.2 (95%CI 16.6 – 31.7) days. This included an average of 18.3 (95%CI 12.4 – 24.2) driven days and 5.9 (95%CI 3.0 – 8.7) walked-up/rough days. The number of shoot days was highly variable, with commercial shoots running up to 40 days per year compared to non-commercial shoots with six days per year. Four out of the ten shoots (40%) interviewed described themselves as non-commercial shoots or as not-for-profit syndicates.

4.2.5. Management associated with the shoots

All ten shoots purchased poultts from game farms within the UK, of which eight (80%) purchased poultts from within Scotland. The area of pheasant pens used to house the poultts was estimated to be, on average, 1% of the woodland area on the estates (range 0.01 - 4%) and 1.2% of the shoot area (range 0.1 – 4.6%).

The number of gamekeepers (full time equivalent) employed on the whole estate varied from one to seven, with a total of 35.5 FTE across all ten estates which equated to an average density of 0.04 gamekeepers km⁻² (range 0.01 – 0.11 gamekeepers km⁻²). Five out of the ten shoots (50%) were undertaking predator management activities across the gamebird releasing area at a similar level to neighbouring driven grouse moor (see Sotherton *et al.* 2009), while the remainder (5) were operating predator management at a lower intensity.

Woodland management was undertaken in the last five years on five of the shoots but was less likely to have been done on the smaller scale syndicate shoots (one out of four syndicate shoots had undertaken woodland management). There had been trees or shrubs planted on three of the shoots, and natural regeneration of woodland within the shoot area on two other shoots. Woodland had also been thinned on four of the shoots. Game crops had been planted to provide cover on eight of the shoots (80%) over an average area of 0.6 km². All the shoots provided supplementary food after the end of the shoot season (Table 6).

Three out of ten shoots had received independent advice on the management of their shoot, and the same number were recording daily management activities on a mobile phone application. Half of the shoots contribute to the NGC, and a further four offered to be contacted to be future contributors. Seventy percent were aware of the GWCT Guidelines for sustainable gamebird release although this included two estates releasing densities higher than recommended.

Table 6: Responses to questions about shoot management activities from the ten shoots interviewed.

	Number shoots answering	
	YES	NO
Are game crops planted on the shoot?	8	2
Have any trees / shrubs been planted on the shoot in last five years?	3	7*
Has there been any thinning or rides cut within the shoot woodland in last 5 years?	4	6
Is supplementary food provided after the end of the shoot season?	10	0
Has the shoot had advice from an independent consultant?	3	7
Is a mobile phone application used to record daily management activities?	3	7
Do you contribute to the GWCT National Gamebag Census?	5	5
Are you aware of GWCT Sustainable Release Guidelines?	7	3

* Natural regeneration was mentioned by two shoots when asked about tree planting

5. DISCUSSION

5.1. Releasing densities

The long-term trends in the gamebird releasing indices across the UK have greatly increased. Since 2000, there has been a 37% increase (95% CI: 23 to 56%) in the pheasant releasing index and a 128% increase (95% CI: 85 to 188%) in the red-legged partridge releasing index. The number of estates submitting data to the NGC since 2000 was lower in Scotland (an average of 97 per year) than in England (329 on average per year). The numbers available for analysis still provide a sample sufficient to compare the releasing densities between the two countries and calculate trends. Within the CNP we interviewed ten shoots out of the 22 identified. The shoots varied in their releasing density and the scale of their management. Without further data from all the shoots within the CNP it is not possible to assess whether the ten shoots were fully representative or not.

The NGC data collected from Scotland suggest little change in pheasant releasing or gamebags from 2013 to 2023, which is also the case for the UK-wide and English trends. However, when considering pheasant releasing from 2000 to 2023, Scottish estates showed an 88% increase in releasing index compared to a 24% increase in England. Even with the trend for increasing pheasant release, release densities on NGC estates in Scotland since 2000 were on average half of those in England. The pheasant release densities reported from the sample of shoots within the CNP was lower than the NGC Scotland-wide values in the same years (309 pheasants km⁻²; Figure 1) at 70 pheasants km⁻².

The index of red-legged partridge release in the NGC is increasing much faster (+107% from 2013 - 2023) in Scotland, compared to no significant trend in England. The average release densities from the NGC over the last three years in the two countries are now very similar (Scotland 333 partridges km⁻², England 472 partridges km⁻²), although at the beginning of this century the average annual density of released red-legged partridges was much lower in Scotland. The release densities reported from our sample of shoots within the CNP was a quarter of the annual average releasing density reported by Scottish estates in the NGC in the most recent two years (i.e. 73 partridges km⁻² within CNP compared to 301 partridges km⁻² Scotland-wide, Figure 2).

As detailed in the methods section, the NGC releasing and bag density estimates use the whole estate area, rather than the releasing shoot area. On Scottish Highland estates, such as those within CNP, we found the shoot area was 12% of the estate area, with the primary sporting interest being grouse and deer. However, lowland estates in other parts of Scotland may use a greater proportion of the whole estate for releasing game. The area of the estates providing data in CNP were on average greater than those contributing to NGC in Scotland (and England). This could, at least in part, explain the lower density estimates within the CNP compared to the Scotland-wide values in the NGC. Any future surveys of gamebird releasing in Scotland should record both estate and shoot area, so local densities can be calculated more reliably.

The NGC reports trends in bag and releasing indices over time (Tapper 1992, Aebischer and Harradine 2007, Aebischer *et al.* 2011). Encouraging more estates to contribute to the NGC will help ensure calculations of the trends remain robust and can be used to inform conservation priorities (e.g., Stanbury *et al.* 2021). The NGC is not, however, able to evaluate the total number of birds and mammals hunted annually in the UK (or Scotland) because the total number of shoots is unknown, as is the proportion of NGC contributors among them. Since 2006 it has been compulsory to register when > 50 gamebirds are released with the Animal and Plant Health Authority Poultry Register (APHA) and since 2024 all birds kept outside must be registered with the Scottish Kept Bird Register. Seeking a data sharing agreement with APHA (as done by Madden 2021) and Scottish Kept Bird Register may

help determine estimates of number of shoots in Scotland (or regionally within Scotland) and allow NGC data to be extrapolated.

5.2. Return rates

The NGC data indicates similar return rates for pheasants in Scotland (39.9%) and England (45.5%). These were similar to the return rates reported in the CNP shoots interviewed for this report (32%). These values were comparable with previous published studies, which found that of the numbers released, around 35-40% of pheasants were shot (Robertson *et al.* 2017). Return rates have declined since 1960, with Robertson *et al.* (2017) suggesting that declining return rates may be due to a combination of loss of wild pheasants and an increase in shooting later in the season, though this remains to be explored for Scotland and warrants further research. The return rates for red-legged partridges for Scotland (36.5%), England (30.3%) and CNP shoots (33%) were all comparable.

Radio-tracking studies across sites in lowland England indicate that typically 90–95% of released pheasants and red-legged partridges remain within 1 km or so of the release point and by the end of the shooting season an average of 15% of the releases have survived (Turner 2007, Hesford 2012, Sage *et al.* 2018). This indicates that a small proportion of released birds are expected to spread into the wider countryside in spring. However, it was not within the scope of this study to quantify the mortality or dispersal rates of released gamebirds or the number remaining at the end of the shooting season within the CNP. Future studies could address this with springtime field surveys to accurately assess the density of released gamebirds present during the following breeding season, in conjunction with detailed information on location and numbers of gamebirds release in the previous shooting season (e.g. Sage *et al.* 2025).

5.3. Shoot management and possible effects of releasing on biodiversity

The releasing of gamebirds and their management have a range of potential effects on habitats and other wildlife. In general, negative effects are caused by the birds themselves while positive effects are a consequence of management activities to support them (Sage *et al.* 2021). Some of the negative effects such as damage to woodland floras or insects are localised, usually at the release site or feeding points while others, in particular disease issues and the effect of releasing on generalist predators, may occur across a wider area (landscape scale). Many of the positive effects of habitat management (e.g., woodland and game crops) occur at the scale of whole woodland or across an estate or farm.

Madden *et al.* (2023) reported on the results of a UK-wide study utilising National Biodiversity Network (NBN) Atlas data to compare animal species and diversity metrics from locations known to release gamebirds to locations with similar land cover but no gamebird releasing. Diverse effects of gamebird release and management were found at a national scale, some indicating an increase in non-game animal populations, while others showing a decrease. Similarly, a comprehensive review of studies looking at the impact of released gamebirds on a wide range of biodiversity measures found both positive and negative impacts of releasing gamebirds (Sage *et al.* 2020, see Appendix for summary figure).

A key recommendation in the GWCT guidelines for sustainable releasing (Sage 2007), is that release densities should be < 1,000 pheasants ha⁻¹ of woodland pen. When considering sensitive woodlands as a whole, the recommendations are that releases should be below 700 pheasants per ha of woodland pen to minimise any negative impacts of releasing (Sage 2007). Seven of the ten shoots we surveyed were releasing < 1,000 pheasants ha⁻¹ of woodland pen and four of them were < 700 pheasants ha⁻¹ of

woodland pen. However, we did not ask shoots to break down the woodland types on the estate nor did we ask if woodland within the shoot area or woodland pens contained sensitive plant groups such as lichens and bryophytes.

Furthermore, the habitats in shoot areas in the Cairngorms (and in neighbouring regions of Scotland) are likely to differ from those previously studied in Southern England. These areas of Scotland may include less favourable farmland/open hill, more coniferous woodland and occur at higher altitude and latitude (resulting in climatic differences) compared to Southern England. Further studies would be useful to assess impacts of releasing gamebirds at various densities on native biodiversity within Cairngorms National Park and other areas of Scotland. Such research would help determine the appropriateness of GWCT's recommended sustainable release densities in these settings and allow for the releasing guidelines to be refined accordingly.

6. CONCLUSION

Gamebird releasing remains an important part of the rural economy and land management in many parts of Scotland, including within the Cairngorms National Park. The data from the National Gamebag Census and this study suggest that releasing densities in Scotland are generally lower than those in England, with some shoots operating at considerably lower levels still. This, alongside existing management practices, may help to mitigate some of the environmental concerns associated with higher-density releases observed elsewhere.

However, the evidence base for understanding the full ecological consequences of gamebird releasing, particularly in upland Scotland, remains limited. Important questions persist around the effects on native biodiversity, disease transmission, predator dynamics, and the long-term sustainability of current practices. Given the distinct habitats, predator communities, and conservation priorities in the Scottish Highlands, further field-based research is needed to inform locally appropriate best practice guidelines.

Engaging more estates in voluntary data collection through data-sharing with the NGC and future studies focussing on released gamebirds, would help strengthen our understanding of gamebird releasing at both regional and national scales. Well-informed, evidence-based management will be essential to maintain the ecological integrity of important landscapes like the Cairngorms, while supporting ecologically and economically sustainable shooting in Scotland.

7. ACKNOWLEDGEMENTS

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8. APPENDIX

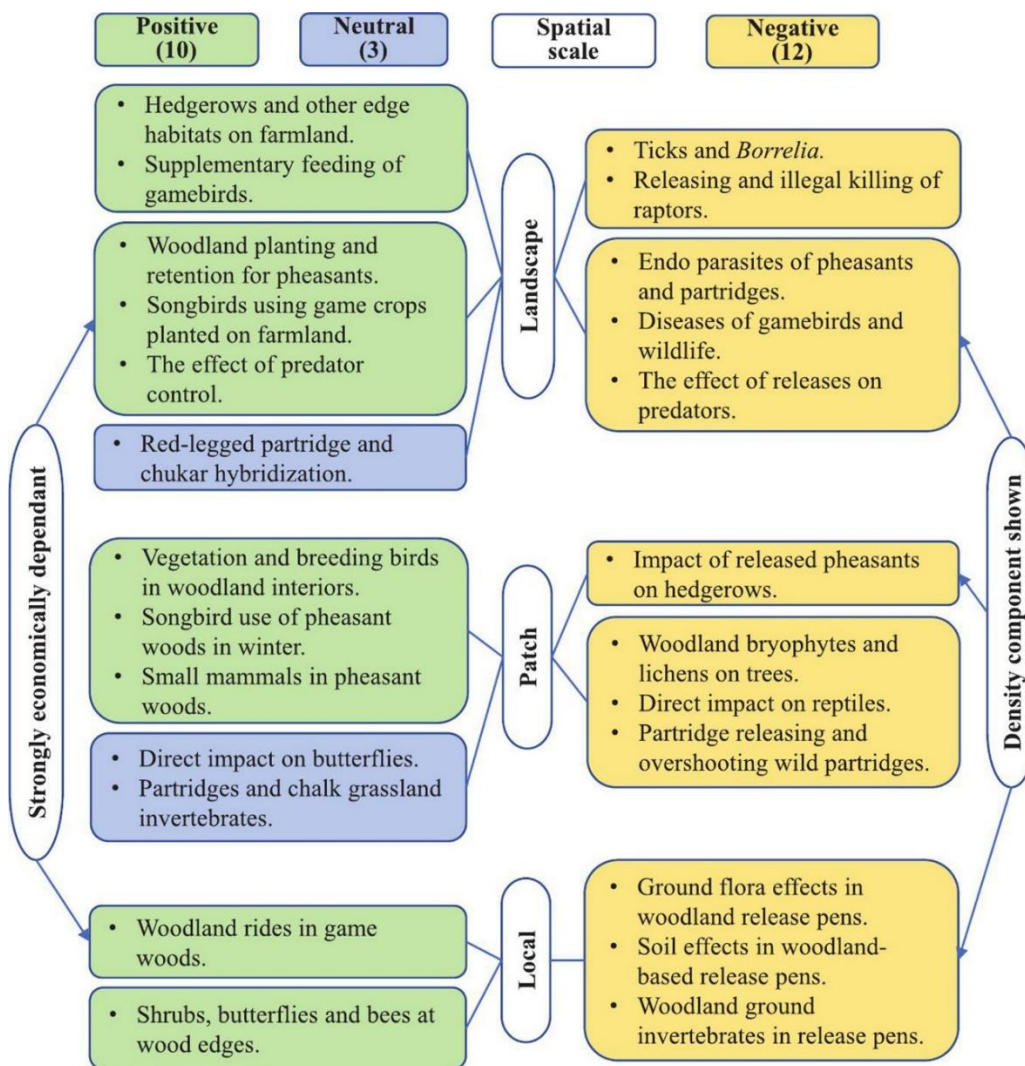


Figure 11: Twenty-five ecological consequences of gamebird releasing for shooting as identified by review and synthesis. There are 10 potentially positive, three neutral and 12 potentially negative effects that occur at one of three spatial scales as indicated. Positive effects that are dependent on economics (i.e. can be expensive) are also indicated and there are seven negative effects where there is evidence that they are reduced or eliminated when fewer birds are released. Economically dependent positives are more likely to be found at larger releases. However, as the density of release goes up some of the negative density related consequences may become more apparent. There is scope for some local or patch related negatives to be avoided by identifying sensitive sites. Taken from Sage *et al.* (2020).

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