

Hen Harrier Brood Management Trial Evaluation

The effectiveness of brood management as a mechanism for supporting hen harrier recovery

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Executive summary

Introduction

1. The hen harrier is a red-listed bird of conservation concern which remains extremely rare in England. Hen harrier numbers have historically been suppressed by illegal killing associated with grouse moor management (Murgatroyd *et al.*, 2019). Illegal killing occurs because hen harriers can limit red grouse numbers and reduce numbers of grouse shot to the extent that 'driven' grouse shooting, a practice requiring high densities of red grouse, becomes economically unviable (Thompson *et al.*, 2009).
2. Law enforcement alone has, to date, failed to stop the illegal killing of hen harriers. As a result, cooperative ways of encouraging coexistence of hen harriers and grouse shooting have been explored, in partnership with game shooting organisations. These were published in the 2016 Hen Harrier Action Plan, and one of these six methods, brood management, is the subject of this report.
3. Brood management is based on the theory that the impact of hen harriers can be managed by maintaining the density of hen harrier nests on moorland at a pre-set level (Elston *et al.*, 2014), by removing the eggs and/or chicks from nests, rearing them in captivity, and releasing them back into the wild once able to fly and disperse. Thus, adults are taking fewer grouse to feed their young, and disturbing grouse less often. This was predicted in the 2016 plan to increase the confidence of moorland managers that these impacts of hen harriers could be legally managed at levels compatible with grouse shooting, and in turn lead to changes in attitudes and reduce illegal killing of hen harriers.
4. The government's 2016 Hen Harrier Action Plan set out plans for a trial of brood management in England, firstly, to understand whether this technique was practically possible, and, secondly, to understand whether the practice and availability of brood management could lead to a reduction in illegal killing, and ultimately an increased population of hen harriers.
5. Licences to take hen harriers into captivity for brood management, for the purpose of scientific research, were issued from 2018 to 2024, with brood management carried out during 2019 to 2023. Over that period, 15 broods were taken from the wild, with the young birds later released. Records were kept of numbers and land use of nesting hen harriers in England, survival rates of tagged birds (both wild and brood managed), and reported incidents of illegal killing. Two social science studies exploring attitudes of moorland managers to brood management and a population modelling analysis were carried out.

Results: hen harrier data

6. The technique of captive rearing and releasing hen harriers was found to be technically possible with no negative effects on birds detected (Section 4.1).
7. Illegal killing of hen harriers continued throughout the Brood Management Trial, but 'hotspot' areas for illegal killing did not overlap with areas where brood management has been used during the trial. Since the numbers and proportion of illegal killings that come to the attention of the police are relatively low it is not possible to directly

assess from police data the likelihood that they increased or decreased in number or rate during the trial; it is only possible to say they continued. It is also not possible to assess whether the apparent absence of illegal killing in brood managed areas was because of the brood management or because those less likely to be involved in illegal killing were more likely to take part in the trial (Section 4.5).

8. A substantial increase in nesting hen harriers in England was seen during the trial. In the initial years of the trial, the numbers of hen harriers nesting in areas managed for grouse shooting increased significantly. This increase was mainly seen in grouse shooting areas where brood management was available. (Section 4.2).
9. The possibility was considered that the act of captive-rearing and releasing broods of hen harriers (sometimes called 'headstarting') had directly caused this increase of nesting hen harriers on grouse moors, by increasing the numbers of chicks able to fledge successfully, compared to leaving them in the wild. However, population modelling carried out by the British Trust for Ornithology (BTO) did not support this; the modelling showed that the direct effects of captive rearing on population growth were relatively limited (Section 4.4).
10. The BTO modelling work indicated that the most parsimonious explanations for the population increase require improvements in one or both of survival rate and 'settlement' (whereby an existing population of birds available to breed becomes more likely to settle and nest). It is possible, but not likely, that survival change alone can explain the observed population growth (Section 4.4).
11. Data from satellite tagged hen harriers, both brood-managed and wild, show first-year survival below levels that would be expected in populations with no illegal killing (Section 4.3). However, this does not rule out some improvement in survival rates, potentially of specific age classes.
12. These inferred improvements in either or both of settlement and survival rates could theoretically have been caused by natural environmental drivers or a reduction in illegal killing and disturbance. However, increases have not occurred in the neighbouring populations of Wales or southern Scotland, making large-scale environmental drivers an unlikely explanation. It is considered likely that any improvements in survival rates or settlement rates could be attributed to changes in human activity (Section 6.1).

Results: social science data

13. The hen harrier data was triangulated with two social science studies where appropriate, to explore possible causes of changes in human activity. The first study was based on interviews of trial participants carried out by Natural England (NE) in 2021, and indicated support for the premise that the availability of brood management allays concerns about hen harriers increasing so much that they 'overrun' grouse moors, i.e. increasing to the extent that the grouse moor becomes unprofitable (Section 4.6).
14. A wider survey, online and anonymous, was carried out in 2024 by the National Centre for Social Research (NatCen). Respondents were grouse moor owners, agents, managers and gamekeepers. Taking part in the survey was optional and resulted in 63 respondents, a small, self-selected sample whose views are unlikely to be representative of the grouse shooting community as a whole (Section 4.7).

15. In this wider survey, respondents generally agreed that brood management contributed to the observed increase in numbers of hen harriers. Two broad and differing explanations were given for this increase. Many expressed beliefs that hen harrier numbers had increased due to direct benefits of captive rearing. However, as outlined previously, this was not supported by population modelling. The other explanation was that brood management had led to increased acceptance of hen harriers and confidence that their impacts on grouse were managed. This opinion would logically lead on to the idea that illegal killing and disturbance had therefore decreased. A later question asking about perceptions of illegal killing trends confirmed that many respondents thought illegal killing had decreased. However, in apparent contrast to the view that hen harriers were more accepted, around half of respondents thought that involvement in the trial increased both hen harrier predation and disturbance of grouse on participating estates. This held true for those involved in the trial and those who had not been involved. These results either suggest a very split community with very different opinions of the trial and of hen harriers, or suggest that increased acceptance of harriers was not due to decreased business impacts from hen harriers (Section 5).
16. Survey respondents reported that benefits of brood management included demonstrating support of grouse shooting as a sport and demonstrating commitment to wildlife conservation. However, just over half (54 percent) said that wider roll-out of brood management would be impractical (Section 5).
17. Those respondents who said they thought that illegal killing of hen harriers had declined were asked about what factors could have led to this. Many selected the availability of brood management increasing confidence that impacts on grouse were managed, increased feelings of positivity towards hen harriers, diversionary feeding and the presence of tags on birds as the key contributors. Free-text answers also referred to internal industry peer pressure or pressure from managers, a recognition that grouse shooting and hen harriers need to coexist, and tighter laws in Scotland (Section 5).

Conclusions

18. The scenario best supported by the available evidence is that the availability of brood management has led to more hen harriers successfully breeding on grouse moors.
19. These increases in hen harrier nesting numbers appear likely to be due to a reduction in illegal activity in some areas. The social science research suggests that this is unlikely to be due to confidence that the impacts of hen harriers on red grouse can be fully managed, and shows there are perceived costs of increased hen harriers. Instead, motivations to increase hen harrier numbers could be attributed to demonstrating a commitment to wildlife conservation and demonstrating that estates are working to support grouse shooting as a sport, despite the cost to business, with brood management working as a 'safety net' to allay concerns about hen harrier numbers increasing to levels at which grouse shooting would be uneconomical.
20. The trial has had mixed results, with increases in numbers of nesting hen harriers on some grouse moors seen alongside ongoing illegal killing. While it appears likely that illegal killing and disturbance of nesting hen harriers has reduced to some extent and in some areas, the trial did not show that illegal killing has declined generally.

21. It is likely that these observations reflect substantial variation in attitudes and behaviours across different shooting estates. Comparison of reports of hen harrier crime against hen harrier nest distributions indicate that nesting hen harriers remain absent from illegal killing 'hotspots' (and many other grouse moors), while on other grouse moors, away from illegal killing hotspots, numbers of nesting hen harriers have increased.
22. It follows that a range of approaches may be required to reduce illegal killing on grouse moors and increase hen harrier numbers in future, ranging from cooperative approaches to reduce impacts of hen harriers on grouse and recognise responsible practices, to enforcement action and surveillance, depending on location and situation.
23. The fact that key motivators for taking part in the trial include 'demonstrating commitment to wildlife conservation and demonstrating that estates are working to support grouse shooting as a sport', suggests that public and peer pressure to adhere to responsible practices have played a role in the motivation of some estates to increase hen harrier numbers.
24. Further analysis of age-specific survival rates and dispersal patterns of hen harriers, and predicted population trajectories and sizes under different scenarios, would build on these findings.

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1. Introduction

Hen harriers *Circus cyaneus* breed on moorland, moving to lowland and coastal regions during winter. Most of the UK population is found in Scotland, with smaller numbers in northern England, north Wales and Northern Ireland (Balmer *et al.*, 2013). Historically widespread, they declined due to agricultural change and direct killing, becoming virtually confined to Orkney in the 1900s, from where they recolonised mainland Scotland during the 20th century. The hen harrier is a red-listed bird of conservation concern in the UK (Stanbury *et al.*, 2021).

Hen harriers feed on small mammals and birds, and can limit red grouse (*Lagopus lagopus scotica*) numbers, reducing the numbers shot to the extent that 'driven' grouse shooting, a practice requiring high densities of red grouse, becomes economically unviable (Redpath & Thirgood, 1999, Thirgood *et al.*, 2000, New *et al.* 2011). Red grouse numbers on a moor are impacted if they are eaten by hen harriers, and if grouse flocks move around or scatter because they see harriers. Hen harrier populations have historically been suppressed by illegal killing and disturbance (Etheridge *et al.*, 1997) a risk associated with increased time spent on grouse moors (Murgatroyd *et al.*, 2019).

Law enforcement has, to date, failed to stop the illegal killing of hen harriers (Newton, 2020), and cooperative approaches to reduce the impact of hen harriers on red grouse, and thus the reason to illegally kill raptors, have been explored in recent decades, in partnership with game shooting organisations. One such method is 'diversionary feeding', where additional food is provided to nesting hen harriers to reduce predation on red grouse. While studies have shown that diversionary feeding can reduce the number of red grouse taken by hen harriers (Redpath *et al.*, 2001), stakeholder confidence that diversionary feeding alone can enable economically viable driven shooting has been limited (Ludwig *et al.*, 2018), and other ways of reducing conflict have been sought.

Brood management is based on the theory that reducing the density of hen harrier nests on moorland to a pre-set level, by removing the eggs and/or chicks from the nests, rearing them in captivity, and releasing them back into the wild once able to fly and disperse, will increase the confidence of land managers that impacts of nesting hen harriers can be legally managed (Thirgood & Redpath, 2008, Elston *et al.*, 2014, Sotherton *et al.*, 2009). Increased confidence in legal management methods is predicted to reduce illegal killing or disturbance of hen harriers.

The Brood Management Trial formed part of the Joint Action Plan to Increase the English Hen Harrier Population, also known as the Hen Harrier Action Plan, published by Defra in 2016. Brood management was trialled between 2018 and 2024 by a partnership group consisting of the Moorland Association, the International Centre for Birds of Prey, the Game and Wildlife Conservation Trust, the Hawk and Owl Trust and Natural England.

This report presents the activities carried out by the Brood Management Trial partnership, and the evidence gathered by Natural England during the Brood Management Trial, including:

- Changing numbers of hen harriers nesting in different habitats.
- Changes in the use of diversionary feeding licences.
- A summary of survival rates of tagged hen harriers.
- A summary of a population modelling analysis carried out by the British Trust for Ornithology (also published as a separate report).
- A summary of wildlife crime reports analysed by the National Wildlife Crime Unit.
- Summaries of two social science surveys that investigated the effects of availability of brood management on attitudes of moorland managers (both published as separate reports).

Section 5 of this report is an exploration of the social science results under an EMMIE realist evaluation framework, outlining the Effect, Mechanisms, Moderators, Implementation and perceptions of Economic and indirect costs of the Brood Management Trial.

Finally, this report outlines the potential outcomes of the Hen Harrier Action Plan and the Brood Management Trial, and discusses which outcomes are best supported by the available evidence.

2. Background and aims of the trial

This section gives the history leading up to the trial of brood management, the aims of the trial, and how operations were delivered. It also outlines the review of the trial that took place in 2022, when data collected up to that point was evaluated and the aims adjusted.

2.1 The overarching Hen Harrier Action Plan

The Joint Action Plan to Increase the English Hen Harrier Population, also known as the Hen Harrier Action Plan (HHAP) was drawn up by a sub-group of Defra's Upland Stakeholder Forum in 2016. This sub-group consisted of Defra, Game & Wildlife Conservation Trust (GWCT), the Moorland Association (MA), the National Gamekeepers' Organisation (NGO), National Parks UK, Natural England (NE) and the Royal Society for the Protection of Birds (RSPB). The RSPB later withdrew support for the HHAP due to disagreement over the plan to trial brood management.

The success criteria of the overarching HHAP were:

1. The hen harrier has a self-sustaining and well dispersed breeding population in England across a range of habitats including a viable population present in the Special Protected Areas designated for hen harrier.
2. The harrier population coexists with local business interests and its presence contributes to a thriving rural economy.

Many of the actions in the HHAP were designed to reduce the conflict with grouse shooting interests and the associated illegal killing of hen harriers. The measures set out in the HHAP were:

1. **Monitoring of populations in England and UK.** Nest monitoring and satellite tagging and tracking of hen harriers. Leads: Natural England (NE), Royal Society for the Protection of Birds (RSPB).
2. **Diversionsary feeding.** Gamekeepers and shoot managers encouraged to follow 'best practice' by providing carrion as supplementary feeding for hen harriers, to substitute for grouse. Leads: Game and Wildlife Conservation Trust (GWCT), The Moorland Association (MA), The National Gamekeepers' Organisation (NGO).
3. **Work with Raptor Persecution Priority Delivery Group (RPPDG) to analyse monitoring information and build intelligence picture.** Supply intelligence regarding reported incidents of persecution. Leads: All Upland Stakeholder Forum Hen Harrier Sub-group members who sit on RPPDG.
4. **Nest and winter roost protection.** Nests are monitored so that action can be taken where appropriate to protect them from disturbance and destruction, and to identify provisioning problems. Winter roosts are identified and monitored so that action can be taken where appropriate to protect them from persecution. Lead: Natural England (and partners, including volunteers, wildlife crime officers as appropriate).

5. **Southern reintroduction.** Reintroduce additional hen harriers to suitable upland or lowland habitat in southern England with the aim of securing a stable, self-sufficient population with the potential to expand its range. Lead: Natural England.
6. **Trial brood management scheme.** Testing of interventions made based on the modelling to remove harriers to rearing pens and later reintroduce them. Lead: Natural England with MA, GWCT and others.

The plans for a trial of brood management were further set out in the Hen Harrier Action Plan:

“Research has shown that high densities of breeding harriers can threaten the viability of driven grouse moors. The aim of a brood management scheme would be to remove harrier broods from driven grouse moors once breeding numbers had reached a density at which they would impact significantly on grouse numbers.

The trial would use the densities determined in Elston *et al.* (2014) to assess whether brood management is likely to improve the numbers of harriers present in the uplands while protecting the economic viability of the moor.

A trial scheme (licensed under Section 16(1)(a) of the Wildlife and Countryside Act 1981 for scientific, research or educational purposes) would be open to driven grouse moors that had brood numbers in excess of the modelled densities and would run for a minimum of five years. An agreed threshold, based on independently derived, objective criteria, and agreed by main stakeholders, would be set for contiguous groups of estates. When harrier numbers within estates increased above the density determined by Elston *et al.* (2014), their eggs or broods could be moved to a rearing facility away from managed moorland. Young would be reared in pens (in heather habitat) until fledging, whereupon they would re-join the wild population.

If the trial scheme is successful, it would be available as an ongoing tool for grouse moors to conserve hen harriers, to be used under licence from Natural England.”

The expected benefits of a brood management scheme set out in the Hen Harrier Action Plan included “*confidence for grouse moor managers to allow birds to settle in the knowledge that impacts can be managed, meaning that bird numbers could start to grow*”.

2.2 The Brood Management Trial aims

The original aims of the Brood Management Trial were set out in the Brood Management Trial Monitoring and Evaluation Plan:

1. To test whether eggs and chicks can be safely taken from the wild, raised in captivity and ultimately successfully released back into the wild (assessed as survival to one year).
2. To assess whether the practice and availability of brood management leads to a reduction in hen harrier persecution, ultimately leading to an increased population size of hen harriers.

This monitoring and evaluation plan set out five steps along the pathway to the first objective, from eggs being taken into captivity to released birds successfully dispersing and surviving up to one year of age:



In terms of delivering the second objective, the plan also set out five broad steps along the pathway to a successful outcome:



2.3 Brood management operations

A partnership was established to deliver brood management operations and collect data.

Partner	Roles
Natural England	Chaired partnership meetings, monitored nests in the field, fitted satellite tags under BTO permits and under supervision of the International Centre for Birds of Prey, monitored positions of tagged birds. Provided satellite tags for wild birds. Funded commissioned research.
The Moorland Association	Managed activities on the ground, liaised with landowners, found sites for and constructed release aviaries, funded the care and husbandry of the captive hen harriers while in the rearing aviaries at the International Centre for Birds of Prey and in the release aviaries. Provided satellite tags for captive-reared birds.

Partner	Roles
The International Centre for Birds of Prey	Responsible for all aspects of bird husbandry, from the point eggs/chicks removed from nest to release back in to fledging area, under contract to the Moorland Association. Provided and managed remote rearing facility, and equipment and personnel necessary to move eggs and chicks to and from the remote rearing facility. Trained staff managing release aviaries.
The Game and Wildlife Conservation Trust, the Hawk and Owl Trust	Sat on partnership board with overall responsibility for operations, advised on operations and research, assisted with management of satellite tag data.

An overview of the operational methods is set out in Annex 1. Brood management was carried out where 1) the landowner wished to undertake brood management on the nest, and 2) there was a grouse shoot on the land such that the hen harriers to be managed could have an impact on the shootable surplus of grouse.

2.4 Licensing of brood management

The act of brood management involves the taking and disturbance of a Schedule 1 species, licensed under Section 16(1)(a) of the Wildlife and Countryside Act 1981 for scientific, research or educational purposes, to answer the questions as set out in the Brood Management Trial Monitoring and Evaluation Plan.

A series of 1- and 2-year licences was issued (2018–2019, 2020–2021, 2022, after which the rationale for licences was reviewed, and then 2023–2024).

A set of conditions applied to each licence (see Annex 2 for conditions of the 2023–2024 licence). These conditions varied slightly between the different licences issued, reflecting lessons learned as the trial progressed and situations developed.

Key licence conditions relevant to interpretation of the results outlined in this report are noted here:

- Birds could only be taken into captivity if there was another active hen harrier nest within 10km of the intervention nest. This nest (the ‘trigger’ nest, i.e. it triggered the use of brood management at another nest) had to be active at the time of intervention. If the trigger nest had already failed at the point of the planned intervention, brood management could not take place at the intervention nest (unless a different, active, nest could be defined as the trigger nest). This was to ensure that the trial was testing the effects of a reduction to a set density, not elimination, of nesting hen harriers. As a practical outcome of this condition, trigger nests were necessarily more successful on average than other nests, because nests that failed early could not be trigger nests. Trigger nests were not intended to be compared with brood managed or other nests, as this would not compare like with like.

- Brood managed birds were satellite tagged and tracked after release. This was to ensure that the first aim of the original monitoring and evaluation plan could be tested, i.e. to test whether eggs and chicks could be safely raised in captivity and ultimately successfully released back into the wild, as well as to monitor longer-term movement and behaviour patterns and survival rates. In the initial five-year stage of the trial, all birds taken into captivity were tagged, except in a few exceptional cases where bird welfare took precedence. In Stage 2 of the trial (2023–2024, see Section 2.5), a representative sample were tagged.
- Birds taken into captivity were released into suitable habitat, to protect their welfare. The release area had to be above a set altitude, in habitat known to be suitable for hen harrier breeding and foraging, and away from known risks. In addition, birds taken from nests within a Special Protection Area designated for hen harriers had to be released back into that area.

The Natural England Wildlife Licensing Service (NEWLS) assessed licence applications and renewals sent in by the project team, determined whether licences could be issued, drew up licence conditions, reviewed reports and checked compliance with licence conditions. A strict internal division was maintained between staff working in NEWLS and Natural England staff working on the Brood Management Trial project, such that staff working on the project had no access to discussions or decisions related to licence assessment.

2.5 Stage 2 of the Brood Management Trial

In November 2022, five years after the first brood management research licence was issued, the Natural England Science Advisory Committee / Social Science Expert Panel (NESAC/SSEP) reviewed the evidence gathered under the first stage of the trial (2018–2022). At that time, brood management activities had been carried out in four years, from 2019 to 2022 (35 nestlings taken into captivity in total, of which 34 had survived to fledging and release, from nine broods, over the four years). No issues with the health or behaviour of the captive-reared birds had been detected. Over this period, the total number of wild nesting female hen harriers in England had risen from 14 in 2018 to 49 in 2022.

A midpoint social science study had been carried out by the NE Social Science team (see Results, section 4.6). People who took part in the study reported that availability of the technique improved trust and confidence in this method to manage conflict among those that participated in the trial. This supported continuation of the trial, but, by design, was not representative of the views of the wider community, i.e. those who were not part of the trial.

NESAC/SSEP was presented with the evidence gathered to that date, and asked for a view on whether the evidence gathered to date fully answered the questions posed in the original monitoring and evaluation plan. The conclusion was:

- The first objective of the original monitoring and evaluation plan (*“To test whether eggs and chicks can be safely taken from the wild, raised in captivity and ultimately*

successfully released back into the wild") had been met, and did not need further testing.

- The second objective ("*To assess whether the practice and availability of brood management leads to a reduction in hen harrier persecution, ultimately leading to an increased population size of hen harriers*") had not been met, as while hen harrier breeding numbers had increased, it had not been shown that this was due to the availability of brood management, and social science research had not been carried out into the views of the wider shooting community, only those involved in the trial.

NESAC/SSEP recommended that the trial be extended in 2023–2024, to maintain availability of the technique to allow wider social science research to be carried out into the effects of this availability.

In Stage 2 of the trial (2023–2024), the project therefore no longer had the specific aim of trialling hen harrier captive rearing methods, and it was no longer necessary to tag each individual bird to monitor health and behaviour. Instead, a representative sample were tagged in order to monitor survival rates.

Aims of Stage 2 of the Brood Management Trial (2023–2024):

1. Establish a causal link between the availability and practice of brood management and increases in the population size of hen harriers, via population modelling and social science.
2. Understand whether brood management can be effectively delivered under a scenario of increased hen harrier populations.

3 Methodology

This section sets out the methods of data collection and evaluation. The ten steps underpinning the aims of the trial (Section 2.2) formed the basis of the monitoring and evaluation of the project.

Step	Data collected	Hypothesis
1	The hatching success of eggs in captivity	Eggs taken from the wild and raised in captivity will not suffer lower hatching success compared to other similar captive rearing programmes.
2	The fledging success of chicks in captivity	Hen harrier chicks taken from the wild and raised in captivity will not suffer lower fledging success compared to similar captive rearing programmes.
3	Time to independence of released birds	The time chicks take to become independent will be similar in aviaries and the field.
4	The movements of juvenile harriers	The dispersal behaviour of released birds will be similar to that of birds raised by their parents.
5	The survival of captive-reared juveniles post-fledging	The survival rate of captive-reared juveniles will be no less than that of wild-reared birds.
6	Attitude of grouse moor owners and managers	As a result of the availability and practice of brood management, grouse moor owners and managers become more tolerant of hen harriers on their land.
7	Levels of persecution of hen harriers on grouse moors	Hen harriers will become less likely to be persecuted on grouse moors.
8	Survival of hen harriers	Hen harrier survival will improve.
9	Breeding success of hen harriers	There will be increased hen harrier breeding success on grouse moors.
10	Population size of breeding hen harriers	There will be an increase in the overall population size of hen harriers in England during the breeding season

Steps 1–5 related specifically to captive-reared individuals. Steps 6–10 related to all hen harriers. This evaluation only considers in detail the second aim of the trial (steps 6–10), since the first aim (steps 1–5) was considered to be satisfactorily established in 2022 (see Section 2.5).

3.1 Data collection methods

This section summarises how data was collected for the monitoring and evaluation of the trial. More detail is given in the relevant results sections where necessary.

Records of captive rearing activities

Natural England collated data recorded by Brood Management Trial partners relating to taking hen harriers from the wild and rearing them in captivity. This included numbers of eggs/chicks taken from the wild, their approximate age, diet, results of health screening, biometrics, and dates that birds were taken, moved and released.

This information underpinned the monitoring and evaluation of the hatching success in birds in captivity (Step 1) and the fledging success of birds in captivity (Step 2).

Satellite tagging

Solar-powered Microwave Telemetry satellite tags were fitted to captive-reared and wild hen harriers by Natural England Hen Harrier Team staff under appropriate licences. These tags transmitted bird locations and tag data to an online database, which was checked daily. When tags stopped transmitting, analysis and ground searches were carried out by NE field staff to establish whether the bird had died, and, if possible, determine a cause of death.

This information underpinned the monitoring and evaluation of the time to independence of released birds (Step 3), the movements of juvenile harriers (Step 4), the survival of captive-reared juveniles post-fledging (Step 5), levels of persecution of hen harriers on grouse moors (Step 7), and survival of hen harriers (Step 8).

Nest success and land use

Nesting hen harriers in England are monitored under licence by fieldworkers and volunteers, and at the end of each breeding season, the total numbers of nests and chicks fledged are collated by the Natural England Hen Harrier Team. Hen harrier breeding areas are well covered, and it is likely that these records are a near-complete count of all nests in England. Natural England also collected information about where diversionary feeding had been used or registered.

This information underpinned the monitoring and evaluation of breeding success of hen harriers (Step 9) and population size of breeding hen harriers (Step 10).

Social research

Interviews of participants and Natural England staff who were involved in the trial were carried out in 2021 by the Natural England Social Science team. A wider survey, open to all moorland managers, whether they participated in the trial or not, was carried out in 2024 by the National Centre for Social Research, commissioned by Natural England.

This information underpinned the monitoring and evaluation of the attitude of grouse moor owners and managers (Step 6).

3.2 Data analysis and evaluation methods

Further analysis and interpretation of the primary data was carried out throughout the trial, summarised here, and with more detail in the relevant results section where necessary.

- Changes in numbers of nests in different land use categories were analysed using log-linear Poisson regression by Natural England (Section 4.2).
- The British Trust for Ornithology was commissioned by Natural England to carry out population modelling to explore the effects of changes in rates of productivity, survival, and settlement on population change (Section 4.4).

- The National Wildlife Crime Unit reviewed disappearances of tagged hen harriers, and evidence of crime from other sources, to record and map incidences of confirmed and suspected wildlife crime involving hen harriers (Section 4.5).

The 2024 survey of moorland managers was designed to help populate an EMMIE realist evaluation framework (Johnson *et al.*, 2015). EMMIE, which stands for Effect, Mechanism, Moderators, Implementation and Economic cost, clarifies thinking about what in an intervention means it is working, or not, and in which contexts it works. It specifically aims to unpick why different mechanisms may or may not work in different contexts, as far as is possible. This is important for usefully informing possible ongoing implementation of interventions, and is widely advocated in the analysis of crime reduction efforts, such as those summarised on the What Works Centre for Crime Reduction website. The EMMIE evaluation of the social science was carried out by Natural England and is presented, and explained in more detail, in Section 5.

This evaluation applied the key findings from the results and analyses detailed here to a logic model adapted from the original Monitoring and Evaluation Plan to draw conclusions on whether, and how, the availability of brood management could be linked to numbers of nesting hen harriers. This logic model was slightly adapted because the original framework did not explicitly include the reason why attitudes of grouse moor managers might be expected to change (i.e. increased confidence that the impacts of hen harriers on grouse moors can be managed via brood management).

It is important to note that the Brood Management Trial was carried out alongside and concurrently with other initiatives set out in the Hen Harrier Action Plan designed to reduce human-wildlife conflict and illegal killing of hen harriers, such as diversionary feeding of hen harriers nesting on grouse moors, analysis of intelligence and data collection to support law enforcement. The discussion (Section 6) is structured to, first, consider whether the Hen Harrier Action Plan overall had achieved success in increasing hen harrier numbers, before considering the evaluation of the brood management trial specifically, and considering what results could be attributed to the availability of brood management rather than other simultaneous initiatives.

3.3 Limitations

The aim of this work was to assess the hypothesis that the availability of brood management can change the attitudes and behaviours of moorland managers, leading to a reduction in the illegal killing of hen harriers and ultimately an increase in hen harrier numbers. However, there are limitations to the evidence that can be used for this purpose:

- It is not possible to accurately measure numbers of hen harriers illegally killed, since this activity is by nature covert, occurs in remote areas, and methods may change and evolve in response to enforcement activities to avoid detection. While some incidents are detected directly, it is likely that this is an unknown fraction of the total number. This evaluation uses theoretical natural survival rates of hen

harriers, and numbers of nesting hen harriers, to draw conclusions about illegal activity, but there is necessarily some uncertainty inherent in these conclusions.

- Participants in social research related to illegal behaviour may not give accurate accounts of their attitudes and behaviours. In order to minimise this possible bias, the survey carried out and reported in Section 5 was anonymous, meaning that it was not possible to design experimental or quasi-experimental sampling to observe changes in individual people over time.
- For rare birds, such as hen harrier, it is possible to directly count the total number of nests each year with reasonable confidence, and this is generally accepted as a good measure of population size. However, observed nest numbers and success rates will be influenced by a range of demographic and environmental factors including immigration, productivity, illegal disturbance, and rates of illegal killing and natural mortality, as well as the total population size.

It follows that neither the rate of illegal killing, the attitudes of moorland managers, or the population size of hen harriers, could easily be measured using experimental methods, leaving the next best option as assessing the likelihood of different observations given different scenarios, to rule out some scenarios, and effectively leave a shortlist of scenarios which the evidence points towards.

Further analysis of demographic and spatial data available from satellite tags may have provided more detailed insights into factors such as immigration and survival rates, but due to time and resource constraints the commissioned analyses were restricted to those presented in this evaluation.

The results of the social science surveys were based on a small, self-selected sample of respondents and may not be representative of the wider community of moorland managers.

4. Results

This section presents the activities carried out by the Brood Management Trial partnership, and the evidence gathered, analysed and commissioned by Natural England during the Brood Management Trial, including changes in numbers of nesting hen harriers, use of diversionary feeding licences and survival rates of satellite tagged hen harriers. Also presented are summaries of other analyses commissioned by Natural England and carried out by the British Trust for Ornithology and the National Centre for Social Research.

4.1 Brood management activities

Table 1: Brood management activities

Metric	2018	2019	2020	2021	2022	2023	2024	TOTAL
Broods	0	1	2	2	4	6	0	15
Viable eggs collected	0	0	0	0	0	1	0	1
Eggs hatched	N/A	N/A	N/A	N/A	N/A	1	N/A	1
Chicks collected	0	5	9	8	13	23	0	58
Chicks fledged	N/A	5	8	8	13	24	N/A	58
Birds tagged	N/A	5	8	7	12	9	N/A	41
Survival from fledging to first breeding	N/A	No birds survived to 1 year	6 tagged birds survived to 1 year	3 tagged birds survived to 1 year	2 tagged birds survived to 1 year	1 tagged bird survived to 1 year	N/A	12

In total, 58 hen harrier chicks were collected, and one viable egg was collected and hatched in captivity (other unhatched eggs had been collected with other broods, but all were shown to have been unviable). One bird died in a release aviary in 2020, during poor weather. All 58 birds were released in good condition, and post-release monitoring via satellite tags did not show unexpectedly high mortality or abnormal behaviour.

Of the 58 birds released, 41 were fitted with satellite tags and monitored daily. Of these, 29 tags stopped transmitting during the first year, before the birds reached breeding age. Twelve birds reached breeding age, of which seven bred or attempted to breed. Three tagged birds were still alive as of December 2024. In total, 38 tags of brood managed birds stopped transmitting during the trial. When tags stopped transmitting, searches were made on the ground to try to recover the bird. Nine searches ended in recovery of a dead bird, all of which were sent for post-mortem examination. Seven of these were determined to be natural deaths, and two were thought to be due to illegal killing due to the presence of lead shot in the bodies. There were 29 cases where birds were not recovered after the tags stopped transmitting. In one case, evidence of natural death by predation was found at the scene. In three cases, the tags were thought to have malfunctioned. In the remaining 25

cases, the birds were not recovered despite searches at their last recorded location. See Annex 3 for a full list.

4.2 Nesting hen harriers in England during 2018–2024

4.2.1 Overall trends in numbers of nesting hen harriers

An increase in hen harrier nesting numbers was seen after the Brood Management Trial started in 2018. In the years 1986–2019 there were no more than 23 hen harrier nesting attempts in England in any one year. From 2020 to 2023 numbers of nesting attempts rose to 54, dropping back to 34 nesting attempts in 2024.

Results from *The status of breeding Hen Harriers Circus cyaneus in the UK and Isle of Man 2023* (Kelly *et al*, 2025), showed that since 2016 (the date of the last UK census), there was a substantial increase in England (a 1,150% increase from four territorial pairs in 2016), contrasting with moderate increases in Wales (14% recovery from 35 to 40 pairs) the Isle of Man (27% increase to 38 pairs) and Scotland (15% increase to an estimated 529 pairs). The Scottish trend included a non-significant 32% decline in the Southern Uplands, the region closest to England, since 2016.

Figure 1: Counts of hen harrier nesting attempts, successful nests, and chicks fledged, in England, 1986–2024.

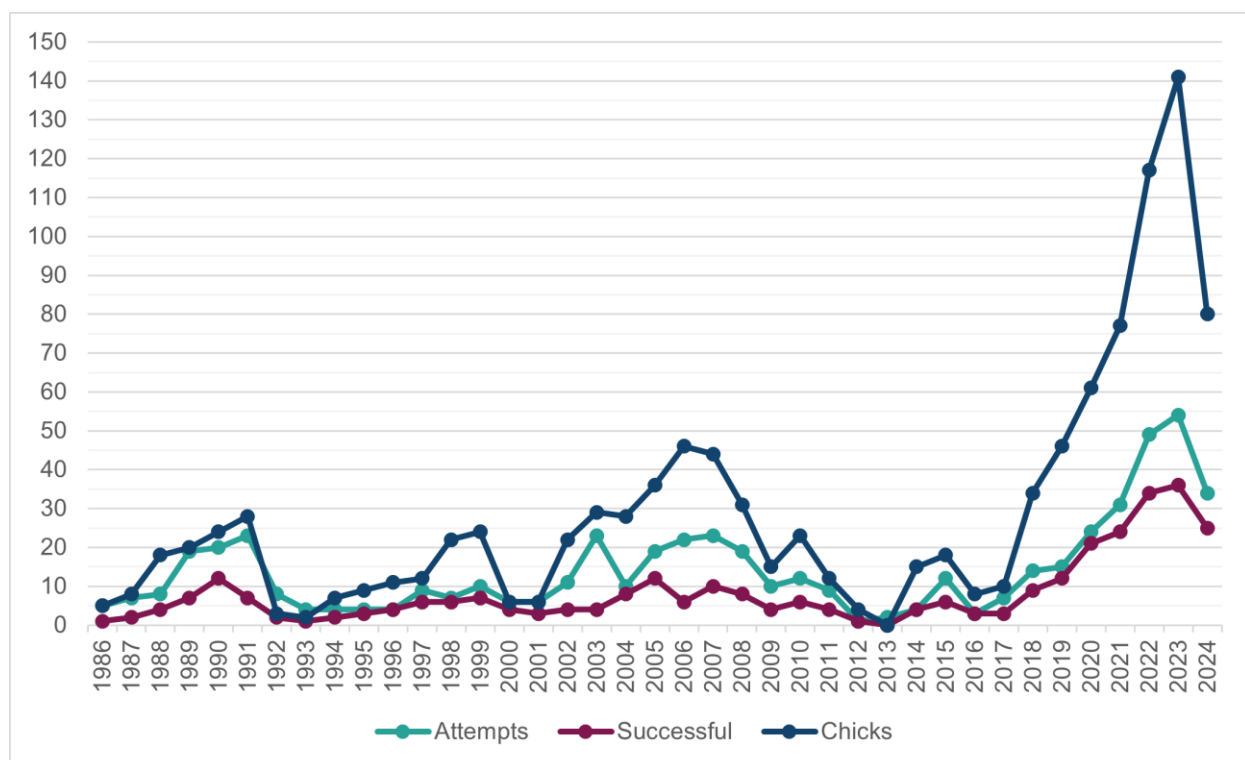
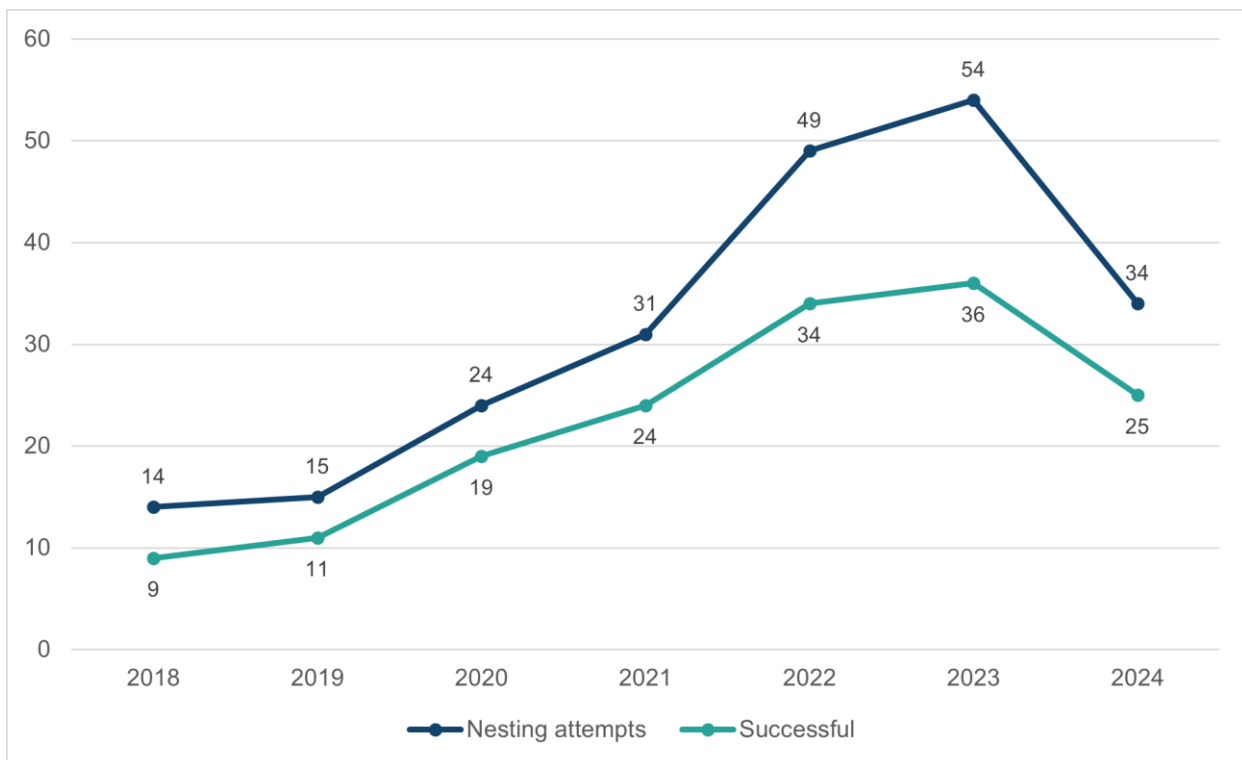


Figure 2: Counts of hen harrier nesting attempts, and successful nests, in England, during period of the Brood Management Trial, 2018–2024.



4.2.2 Land use categories

Hen harriers nest on land managed for a number of purposes, often in combination, including forestry, water catchment, carbon sequestration, amenity, nature conservation, driven grouse shooting and other game shooting. Land may be used for a number of these purposes (for example, land owned by a water utility company but leased for grouse shooting), and land use may change between years. As a result, identifying land where the availability of brood management might be expected to influence attitudes was not clear cut in all cases. The classifications shown in Table 2 were drawn up to define the likely relevance of brood management availability to each nest area, but it should be noted that the effect of the availability of brood management is likely to vary depending on the unique circumstances of each landholding.

The locations of hen harrier nests and details of land use were recorded by fieldworkers, and land use was defined by them as grouse moor, other moorland, forestry land, or water catchment. During an analysis carried out in 2023, a GIS layer of kept grouse moors (KGM) was provided by the Moorland Association, defining the areas where brood management was and was not available. The nest locations and land use details as recorded at the time were checked against this GIS layer, and a small number of discrepancies were corrected, generally in areas very close to land use boundaries where the GIS layer was found to be inaccurate. The final classifications were confirmed by fieldwork staff and used to assign nests to land use categories (Table 2).

Table 2: Nest land use categories

Nest land use category	Description of land use and brood management availability	Relevance of brood management
‘Other’ moorland (not KGM)	All nests that were not on kept driven grouse moors (KGM). These were primarily RSPB reserves and land owned by Forestry England, as well as some area of amenity moorland, mixed-used land, Ministry of Defence land, and land operated for other game shooting. Walked-up shooting for grouse, other game shooting and predator control may take place in some of these areas, but they were not defined as kept driven grouse moors.	Land managers in these areas were presumed to not be managing the land for high grouse stocks required for driven grouse shooting and were presumed to not consider brood management relevant.
KGM, BM not available	Nests on kept driven grouse moors where brood management (BM) was not available. These were areas with predator control and driven grouse shooting but were defined by the Moorland Association as ‘brood management not practically available’. These were two distinct areas: United Utilities water catchment land in Forest of Bowland, and National Trust land in the Peak District.	Brood management (as trialled) requires the consent of the landowner. Land managers in this category were presumed to not consider brood management as an available management option.
KGM, BM available, not used	Nests on kept driven grouse moors where brood management was theoretically available but had not in practice been taken up during the trial. These areas were primarily driven grouse moors owned by private individuals. None of these areas took up the option of brood management during the trial, which in some cases can be explained by the fact that the number of hen harrier nests had not reached the required threshold, but there were also cases where hen harrier nests had occurred at the required density, but brood management had not been chosen as an option.	Land managers in this category were presumed to be aware that brood management was an available option, when nests reached a density that would permit intervention.
KGM, BM used	Nests that were within 10km of nests where brood management was used at any stage during the trial. All these areas were driven grouse moors owned by private individuals. The category comprised four distinct clusters, each consisting of either a single estate, or a group of neighbouring estates that co-ordinated between them which nests would be brood managed in each year. The nests in each cluster were within 10km of each other (normally closer), the distance required to allow brood management. This category includes the brood managed nests themselves.	Land managers in this category are presumed to have felt positively towards brood management, as evidenced by its use at some stage during the trial and presumably would have been confident throughout the trial that brood management was available.

The changes in numbers of hen harrier nests in these different categories to 2024 are shown in Figures 3 and 4 (with the third and fourth categories grouped together in these graphs to combine all kept grouse moors where brood management was available, regardless of whether brood management was used or not).

Figure 3: Counts of nests by land use (kept grouse moors and land not managed for grouse shooting), 2018–2024

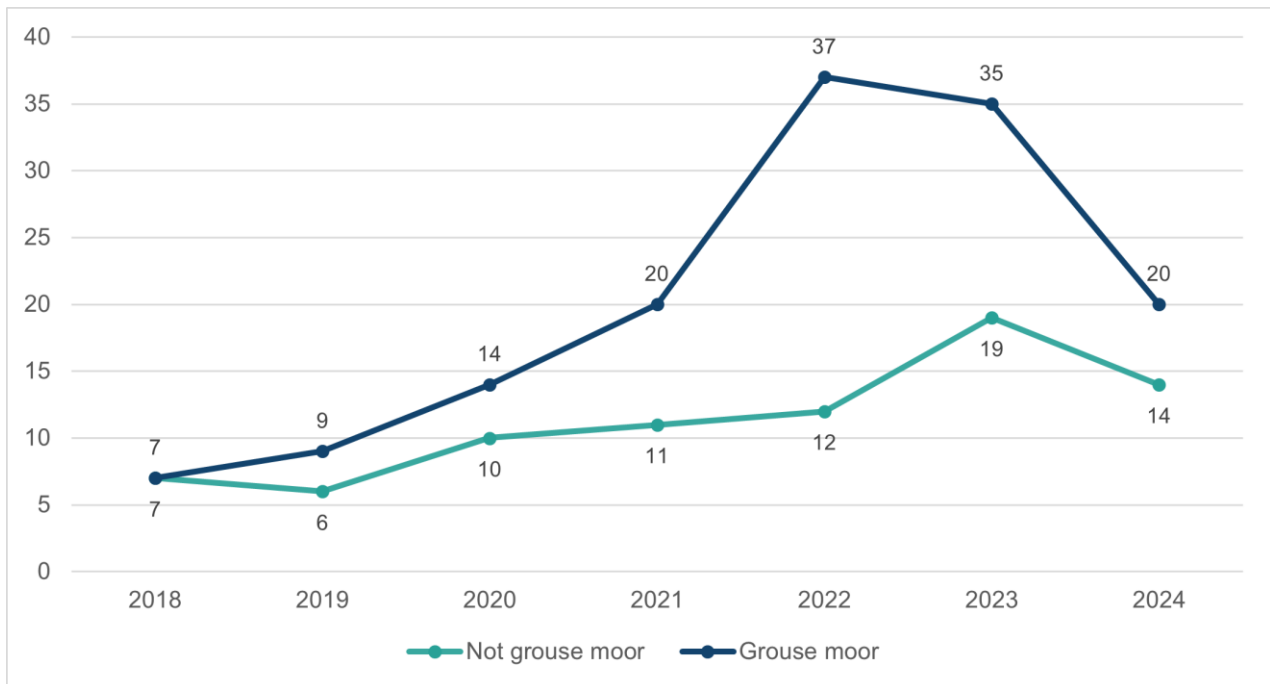


Figure 4: Counts of nests by land use (brood management availability), 2018–2024

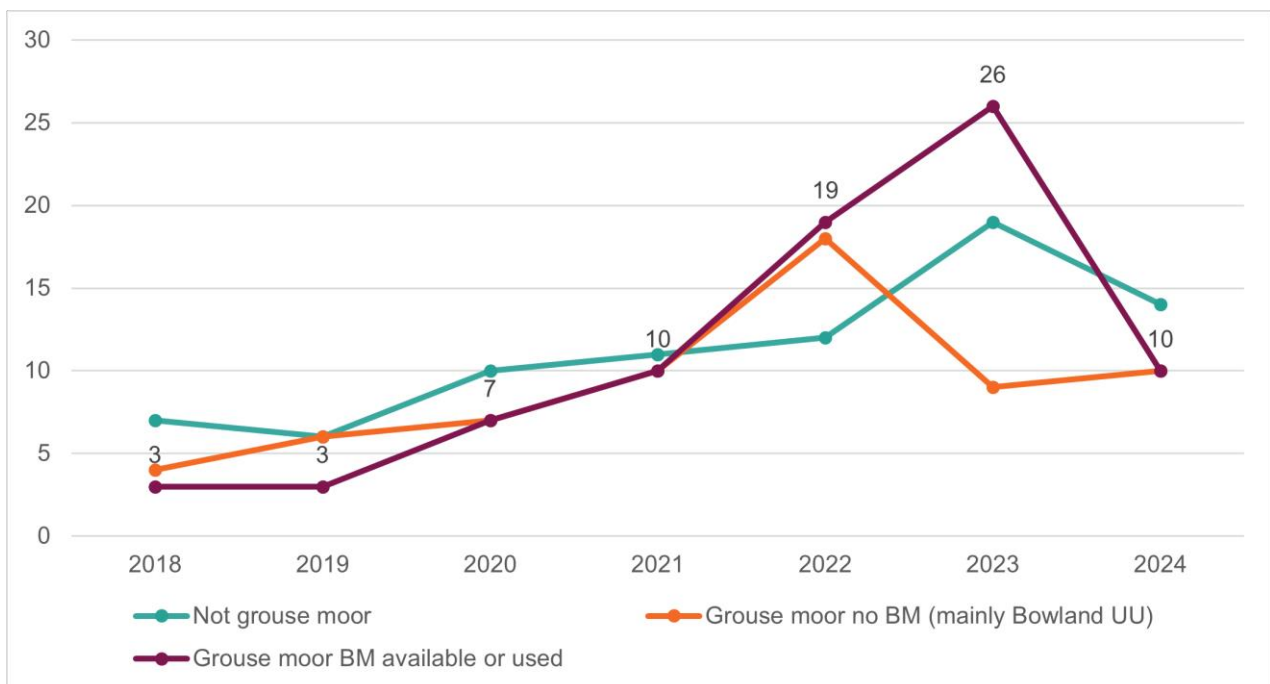


Figure 3 shows the increase in nests on kepteered grouse moors compared to land not managed for driven grouse shooting. Nests in these areas increased from seven to 37 between 2018 and 2022, dropping down to 20 in 2024.

For context, there are reported to be 175 grouse moors in England and Wales (Countryside Alliance, 2016), so necessarily this increase in nesting hen harriers (to a maximum of 37 nests in England) was not seen on all grouse moors, since most grouse moors had no nesting hen harriers.

Figure 4 shows how these nests were split between land where brood management was known to be available/used (purple line) and land where brood management was not practically available (green line, primarily water utility land in the Forest of Bowland). Numbers of nests on kepteered grouse moors where brood management was available/used rose from three in 2018 to 26 in 2023, dropping down to 10 in 2024.

The decline in nesting numbers in 2024 may be due to natural fluctuations, and has anecdotally been attributed to poor and wet weather conditions in early spring. However, it can be seen from Figure 4 that the decline has not been seen in all areas, and has primarily been in grouse moor areas where brood management is available/used.

4.2.3 Initial increase in areas managed for grouse shooting (2018–2023)

An analysis carried out following the 2023 breeding season found that the increase in numbers of nests on grouse moors between 2018 and 2023 (Fig 3) was significant, while the increase on land not managed for driven grouse shooting was not significant. See Figure 3 for graph.

The kepteered grouse moor category was further split into areas where brood management was available (including areas where it had been used in practice) and those where it was not practically available, such as grouse shoots where land is leased from entities such as United Utilities or the National Trust (see Table 2). The 2018–2023 increase in nests on grouse moors (Fig 4) was still significant when only considering areas where brood management was available/used. This indicates that the increase was primarily seen in grouse shooting areas where brood management was available and/or used, suggesting that the increase was related to brood management availability rather than another aspect of grouse moor management.

The analysis investigated whether the increase in nests in areas where brood management was available could have been due to increases solely on the small number of landholdings where brood management had been implemented ('brood management used'), potentially indicating an effect limited just to those individual estates. To investigate this, differences in increases in the 'available' and 'used' categories were investigated, but no significant differences were found. Instead, increases in numbers of nests were seen across both these categories, not only in those areas where brood management was used. This suggests a positive effect of the 'awareness of the availability' of brood management, as well as the actual use. See Annex 4 for details of this analysis.

4.2.4 Diversionary feeding use during the Brood Management Trial

Diversionary feeding is the practice of providing alternative food to hen harriers nesting on grouse moors, to reduce the impact of hen harrier predation on grouse. As with brood management, this technique was intended to reduce the illegal killing of hen harriers by increasing confidence in legal methods of reducing hen harrier impacts.

In an experimental study carried out between 2008 and 2015 at Langholm Moor, diversionary feeding reduced the number of grouse chicks fed to hen harrier broods by 64–94%. However, the combination of diversionary feeding and grouse moor management did not increase the grouse density enough to support driven grouse shooting, and recovery may have been limited by other factors, including other predators, bad weather, or insufficient habitat recovery (Ludwig *et al* 2018).

Provision and use of diversionary feeding in England was an action set out in the 2016 Hen Harrier Action Plan, and a class licence for diversionary feeding has been available throughout the period of the Brood Management Trial, permitting diversionary feeding to be used to reduce hen harrier predation of red grouse.

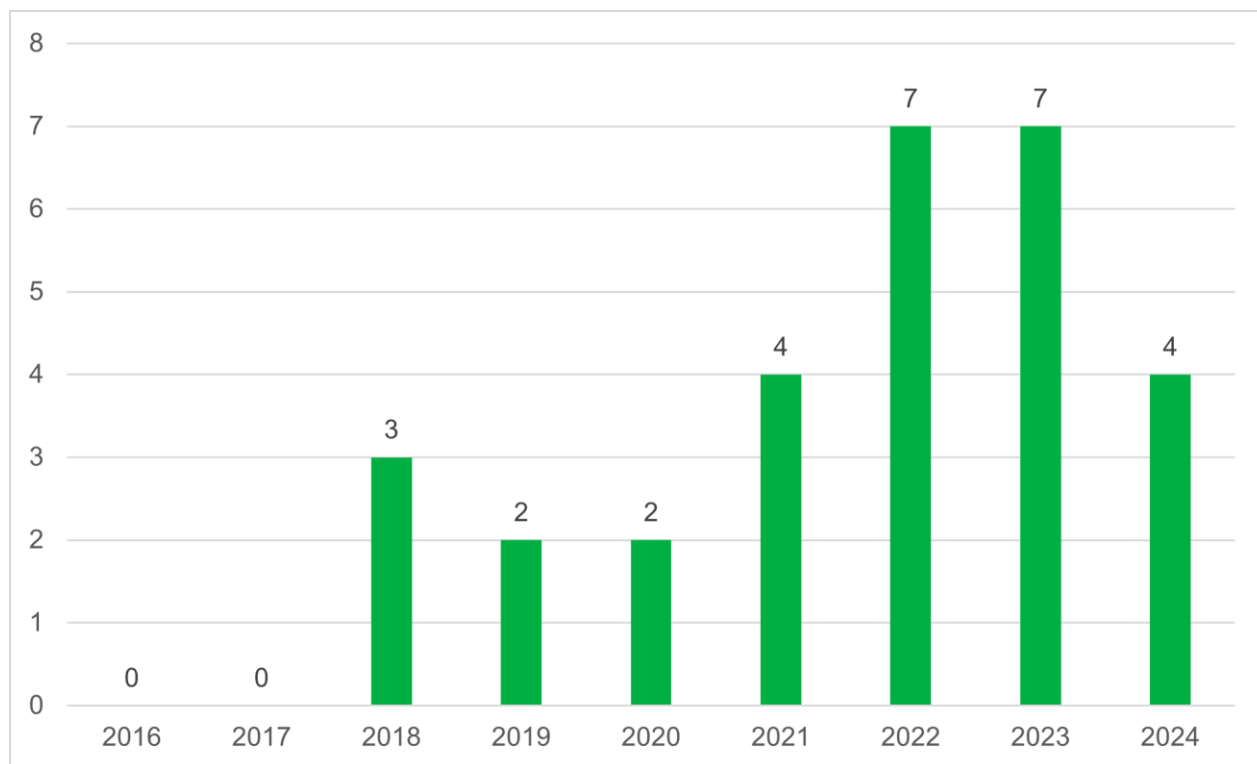
The number of registrations by shooting estates to use the diversionary feeding class licence (Figure 5) has increased in line with the increase of nesting hen harriers on grouse moors, with no registrations in 2016 and 2017, up to seven registrations per year in 2022 and 2023.

As both diversionary feeding and brood management are management methods that have been widely available to shooting estates during the Brood Management Trial, it is not straightforward to disentangle the effects of their availability on the attitudes and confidence of grouse moor managers.

It should be noted that diversionary feeding was available before 2018, but the increase in hen harriers nesting on grouse moors did not start until the start of the Brood Management Trial in 2018, whereafter the number of diversionary feeding registrations increased. This would support a view that the increase in diversionary feeding registrations is a result of increased numbers of hen harriers nesting on grouse moors, rather than a cause. If the availability of diversionary feeding had caused an increase in the numbers of hen harriers nesting on grouse moors, this increase would have been expected to have been seen before 2018.

The effects of diversionary feeding on hen harrier productivity were investigated in the population modelling study (see Section 4.4), and the effects of diversionary feeding on attitudes of moorland managers was included in the social science study (see Section 4.7).

Figure 5: Number of shooting estates registered to use CL25 diversionary feeding class licence.



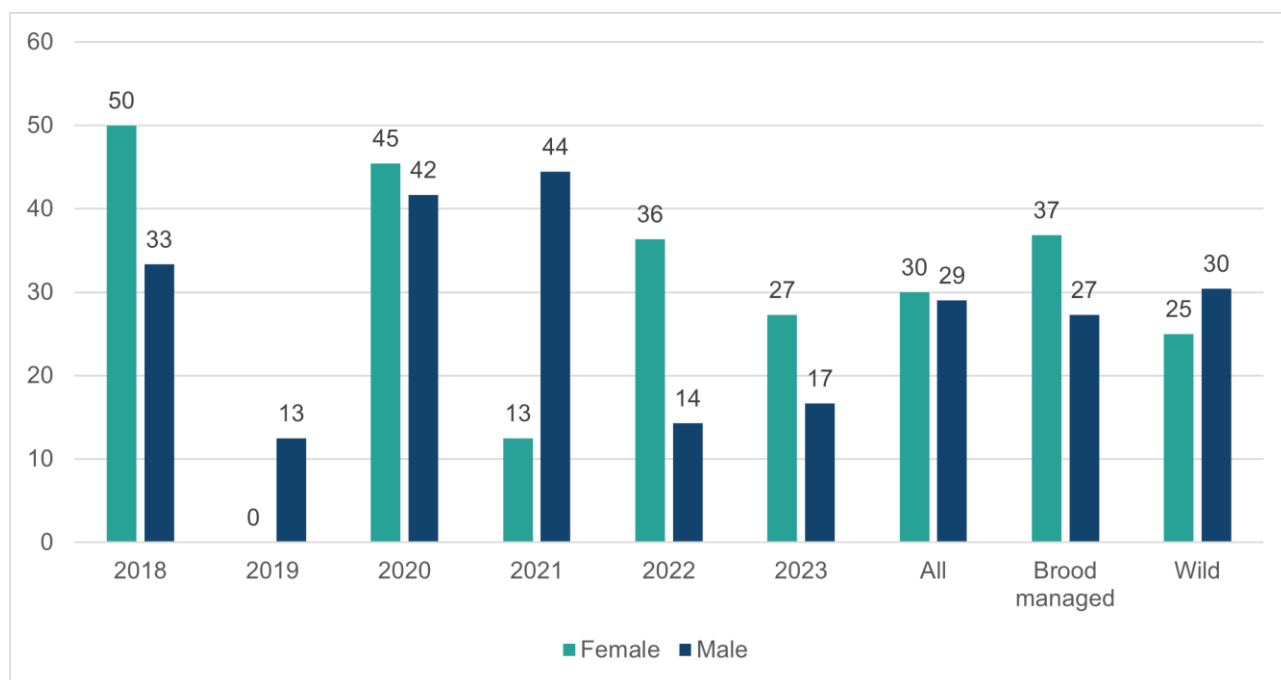
4.3 Observed survival of tagged hen harriers

There have been 92 hen harriers satellite tagged under licence by NE fieldworkers during the period covered by the Brood Management Trial (41 brood managed and 51 wild).

Of these 92 birds, 30% of females and 29% of males survived their first year (calculated as surviving to 1st June the following year).

- Of the 41 brood-managed hen harriers, 37% of females and 27% of males survived their first year (32% overall).
- Of the 51 wild-reared hen harriers, 25% of females and 30% of males survived their first year (27% overall).

Figure 6: Percentage of each annual cohort of tagged hen harriers surviving to 1st June the following year



Ewing *et al.* (2023) analysed annual first-year survival of tagged hen harriers from an RSPB dataset of hen harriers subject to illegal killing (n=148) and calculated that first-year annual survival rates should be 60% for females and 38% for males in the absence of illegal killing, assuming that causes of death act additively. These are similar to estimates from the Orkney islands, where rates of illegal killing were thought to be low, and where survival was c. 54% for females and c. 37% for males (Picozzi, 1984 and Amar, 2001). This indicates that survival rates of hen harriers in England during the Brood Management Trial were below those that would be expected in populations with no illegal killing.

Subadults and adults generally have higher survival rates than birds in their first year of life. There were 23 birds tagged between 2018 and 2022 that survived to one year old (to 1st June in the following year), and of these, 15 (or 65%) survived for at least one further year. Birds tagged in 2023 and 2024 were not included in this calculation, as at the time of publication birds from this cohort would not have reached two years of age. For comparison, Ewing *et al.* (2023) calculated that in a population with no illegal killing, subadult survival rates should be 89% and 90% for subadult males and females respectively. The mean estimated annual survival rates of males and females from 2–6 years old in the Orkney study were 72% and 90% for males and females respectively (Picozzi, 1984).

It is possible that satellite tags, visible in the field, may act as a deterrent to illegal killing of those individuals, and it is also possible that the locations of brood managed birds were of interest to and shared among the grouse shooting community, which may also have deterred illegal killing of those individuals. Therefore, survival rates of tagged hen harriers may be higher than the un-tagged population and should be treated with caution.

4.4 Hen harrier population modelling

The British Trust for Ornithology was commissioned to carry out population modelling to explore the effects of changes in rates of productivity, survival, and settlement on population growth in the English population of hen harriers. This work is detailed in Macgregor *et al.* (2025) and summarised in this section.

Model outcomes were compared to the observed population trend to assess the plausibility of a range of candidate mechanisms to explain the population increase, including productivity uplift from nest-level interventions including brood management and diversionary feeding, increased survival, and increased settlement rate. For the purpose of this study, 'settlement' effectively represents the rate at which breeding-age birds commence recorded breeding attempts, and therefore encompasses the potential for change both in the rate at which birds skip breeding entirely, and the rate at which breeding attempts fail prior to detection by surveyors (i.e. very soon after initiation).

Models were parameterised using several sources of evidence. Scenarios for productivity change were evidenced using nest record data for all recorded hen harrier breeding attempts in England during the period 2018–24, including those at which interventions had and had not been applied. Scenarios for survival change were based on a recent study of hen harrier survival in Britain (Ewing *et al.*, 2023). A lack of knowledge about settlement patterns both before and during the study period meant that scenarios for settlement change were harder to determine, and therefore largely exploratory.

Population models did not support productivity uplift from the nest-level interventions, brood management and diversionary feeding, as the sole explanation for the rapid increase in the population. Indeed, the direct effects of these interventions on population growth were relatively limited compared to the effects of change in survival or settlement rates.

The study concluded that the most parsimonious explanations for the population increase require improvements in one or both of survival rate and settlement rate. It is possible, but not likely, that survival change alone can explain the observed population growth. It is evident that some illegal killing has continued throughout the trial period; the question of whether it has reduced to some extent, and survival rates accordingly improved, cannot be addressed through this population modelling approach, but survival analysis for individuals tracked during the trial period may shed light on this.

It is plausible that increased settlement rates, perhaps linked to reduced disturbance immediately before and during the early part of the breeding season, could have contributed to the observed population increase. However, this possibility still requires some improvement in survival rates, as well as the pre-existence of a pool of non-breeding birds and/or supplementation by subadult breeding or immigration, to explain the sudden and rapid increase in the number of hen harrier breeding attempts in England. Within the context of this study, the modelled effect of increased settlement rates could also correspond to a real-world increase in the proportion of breeding attempts that persist for

sufficiently long to be detected by surveyors, as opposed to failing soon after initiation (whether due to human interference or otherwise) and going undetected.

Either of these rates could have responded positively to environmental drivers (e.g. increased prey availability), a reduction in removal and/or nest interference by humans coincident with the availability of brood management as a tool to alleviate conflict between hen harriers and grouse moor management, or both, to plausibly result in the observed rapid population increase. However, equivalent increases have not occurred in the neighbouring populations of Wales or southern Scotland, making large-scale environmental drivers an unlikely explanation.

A substantial decline in the total number of breeding attempts between 2023 and 2024 highlights that adverse conditions (whether natural or linked to illegal killing) still have the capacity to slow or reverse the ongoing recovery of the hen harrier population in England.

4.5 Wildlife crime reports

At the time of writing in December 2024, of the 92 hen harriers tagged by Natural England between 2018 and 2024, including wild and brood-managed birds, 61 were 'missing, fate unknown'; their tags had stopped transmitting, and they were likely to be dead. These deaths may have been natural, or they may have been due to illegal killing. There had been 21 birds recovered dead, of which five were either confirmed illegally killed or remained under police investigation. Ten birds were still alive and being tracked as of December 2024.

In 2024 the National Wildlife Crime Unit (NWCU) set up a Harrier Task Force to investigate disappearances of tagged birds and identify clusters of confirmed and suspected incidents of illegal killing of hen harriers. Under this initiative, the NWCU reviewed deaths and disappearances of hen harriers from 2022 (including birds tagged by NE and under other projects) and concluded that 43 of these incidents (up to October 2024) were confirmed or suspected criminal. Of these, 23 were categorised as 'hotspot' incidents, due to proximity to other incidents indicating a pattern.

- None of the six NWCU hotspot clusters of incidents overlapped with the clusters of hen harrier nests where brood management had been used during the trial.
- Two individual (non-hotspot) incidents, including the deliberate destruction of a hen harrier nest, were within a group of nests where brood management had been used.
- The other three areas where brood management had been used had had no suspected or confirmed criminal incidents, according to the NWCU analysis (2022–2024).

Since the numbers, and presumably the proportion, of illegal killings that come to the attention of the police are relatively low, it is not possible to directly assess from police data the likelihood that they increased or decreased in number or rate during the trial; it is only possible to say illegal killings have continued. It is also not possible to assess whether

the apparent absence of illegal killing in brood managed areas was because of the brood management or because those less likely to be involved in illegal killing were more likely to take part in the trial.

While the launch of the Harrier Task Force demonstrates a new approach to tackling bird of prey crime, this has been a National Wildlife Crime Priority since 2009, and long subject to enforcement action. The increase in nesting numbers dating from 2017 was not associated with a large-scale change in enforcement activity.

4.6 Midpoint social science evaluation 2022

A midpoint social science evaluation of Natural England's Hen Harrier Brood Management Trial was carried out between April 2021 and April 2022 by Natural England social researchers. A sample of seven staff from within Natural England who had direct involvement in the trial, and 12 individuals from outside Natural England who directly participated in the trial in some capacity, were interviewed between July and November 2021. This work is detailed in the Hen Harrier Brood Management Trial midpoint social science evaluation (Natural England, 2026) and summarised here.

This report provided evidence that moorland owners and managers were concerned that in high densities, hen harriers would 'overrun' grouse moors, making them unprofitable. Perceptions of hen harriers 'overrunning' grouse moors were (in part) driven by reference to the Langholm Moor Demonstration Project within which a similar process was perceived to have unfolded.

The report identified recognition of the need and desire for better coexistence with hen harriers on grouse moors and that brood management was perceived to be a tool that can enable this. Participants in this study acknowledged that change in attitudes and behaviours takes time. It was suggested that brood management had been able to tap into and harness a more general recognition of the need to change and coexist with hen harriers, but that different levels of support existed within the grouse shooting community. The analysis identified that the mechanism driving this change in attitudes and behaviours is that brood management creates a perceived 'safety valve' that is able to prevent hen harriers colonising a grouse moor.

This report concluded that the Brood Management Trial was improving moorland owners', managers' and gamekeepers' views that hen harrier predation of grouse is manageable, i.e. changing attitudes and behaviours among those grouse moor owners and keepers who participated in it.

This report presented evidence to suggest that the availability of brood management allays concerns about hen harriers overrunning grouse moors, and inferred that it is likely that brood management alleviates a driver of illegal killing of hen harriers. However, it was noted that this report did not provide evidence of changes in views beyond those who participated in the research.

4.7 Social science survey of moorland managers 2024

The midpoint social science study completed in 2022 (Section 4.6), indicated support for the premise that ‘brood management permits hen harrier predation on grouse to be managed’ among moorland managers who had participated in the Brood Management Trial. This midpoint study was based on in-person interviews of people involved in the Brood Management Trial. A wider survey, online, anonymous and aimed at all moorland managers, was carried out by the National Centre for Social Research (NatCen) in 2024, built in part on earlier work examining the lessons from the management of red grouse and hen harriers in England conducted by St John *et al.* (2018). This survey aimed to understand the wider views of moorland managers (grouse moor owners, agents, managers and gamekeepers) on the effects of brood management on their grouse shooting operations, and their views on illegal killing of hen harriers. This work is detailed in Marcinkiewicz *et al.* (2026) and summarised here.

The number of respondents to the 2024 online survey was relatively small (63), despite wide circulation within the grouse moor management community. The key findings from the survey are explored in Section 5.

5 EMMIE framework review

The social science survey aimed to help populate an EMMIE realist evaluation framework (Johnson *et al.*, 2015). This section summarises EMMIE (which stands for Effect, Mechanism, Moderators, Implementation and Economic cost), and how it informed the brief given to the National Centre for Social Research for survey design. The results from the survey are then presented. The discussion and conclusions organised in line with the EMMIE framework are shown in Section 6.2.

The EMMIE framework review was carried out to help evaluate Step 6 of the original brood management trial aims (shown in Section 2.2), i.e. to help assess whether the availability and practice of brood management affected how tolerant grouse moor owners and managers are of hen harriers. It also aimed to find out perceptions of some other steps relating to fledging, survival and illegal killing, as well as beliefs about feasibility of a wider roll-out of brood management.

5.1 How the EMMIE framework informed the social science survey

E=Effect, or the impact of an intervention

At the time of designing the social science survey, numbers of hen harriers nesting on grouse moors in northern England had increased significantly (see Section 4.2.3; Initial increase in areas managed for grouse shooting). The social science survey aimed to explore several different types of possible effect from the trial:

- (i) Opinions on the effect of the trial on hen harrier numbers.
- (ii) Opinions on whether the trial altered the business impacts of hen harriers (which can also be phrased as managing the impacts of hen harriers).
- (iii) The stated effects of the trial on attitudes towards hen harriers.
- (iv) Opinions on the effects of taking part in the trial on reputation.

MM=Mechanisms and Moderators

Mechanisms describe how an intervention has an effect, often being a chain of events, and moderators are factors which define circumstances which alter whether and how much an intervention has an effect.

Possible mechanisms at work in the Brood Management Trial and which the survey was designed to assess are described in the list below. For each, opinions were gathered as to how much of an effect the mechanisms were having, and in some cases why/why not:

- (i) Opinions on which mechanisms might be altering nesting levels on grouse moors.
- (ii) Opinions on which mechanisms might be altering overall hen harrier populations in the past five to ten years.
- (iii) Opinions on whether illegal killing had an impact on hen harrier populations.
- (iv) Opinions on whether illegal killing had changed in frequency in the past 5 to 10 years.
- (v) Opinions on which mechanisms might be altering illegal killing.

Possible moderators which the survey aimed to help uncover included possible subgroups which in the end were not often possible to analyse, due to small numbers in the sample. These subgroups are explained further here along with all moderators.

- (i) **The role of the respondent.** The survey collected information on the role of respondents within the grouse moor community and was designed so that analysis could help assess if there appears to be differences in perceptions, attitudes or stated behaviours between those working on the ground such as gamekeepers and those with less 'hands on' roles such as agents.
- (ii) **The business model of the moor.** Since hen harriers can impact the income of grouse moors, due to predation of grouse and disturbance of shooting days, the survey was designed to assign respondents according to how much their business model relied on grouse shooting alone as opposed to having other sources of income. In the final analysis, small numbers meant it was not possible to use this subgroup analysis in a sensible manner. The most it is possible to say is that it seems logical that those with a low profit margin and/or full reliance on income from shoots may have less room to accommodate more hen harriers if more harriers mean decreased profits.
- (iii) **Participation in the trial.** The survey asked whether people had taken part in the trial and so for some questions it is possible to assess if there appears to be differences between those who took part in the trial and those who did not. It is important to acknowledge that if there are differences between trial participants and non-participants it is not possible to assess from this survey if the

differences were caused by the trial. It is perfectly possible that those who opted to take part in the trial were already those with the most positive views of hen harriers, and it is also possible that taking part in the trial has altered the opinions of some of those involved.

- (iv) **Score on values held concerning wildlife.** One survey section asked participants about their views on wildlife, and on different aspects of country life. The aim of this was to help inform whether any differences in values were associated with different tolerances of hen harriers since this variation in a population is a typical factor which could lead to mixed implementation success of any further evolution of the trial or licensing. In other words, it aimed to help inform implementation considerations and was useful in a small number of questions where numbers were not too low.

I=Implementation

EMMIE recognises that the practicalities of implementation greatly impact whether an intervention is given a fair chance to work. Furthermore, feedback on what went well and what were the stumbling blocks to implementation can inform any future iterations of an intervention, or decisions about its continuation/desistance. Hence the survey asked about the following key aspects of implementation:

- (i) Reasons for taking part in the trial or not taking part,
- (ii) Willingness to take part in the trial in the future,
- (iii) Opinions on whether a larger scale version of the trial was practically feasible,
- (iv) Opinions on the importance of hen harriers to the upland ecosystem, and on whether more harriers were needed,
- (v) Opinions about whether brood management was worth the effort, whether it invited unwarranted scrutiny or interference from outside organisations, and
- (vi) Suggestions for improving the trial.

E= economic assessment

Often called a benefit-cost-analysis or similar assessment of value for money, many policy-relevant interventions include some measure of value-for-money. The social science work does not attempt to capture a cost-benefit analysis explicitly but the results from it would be helpful in any efforts to map out what constitutes costs and benefits to some key stakeholders. For example, while those involved in grouse moor management tended to say they appreciated hen harriers as birds of prey, meaning it could be inferred that increased harriers would bring intangible benefits, the overall message was that increased numbers did have financial impacts for the grouse shooting business model.

5.2 Fitting the social science responses to the EMMIE framework

A total of 63 respondents completed the survey, and had the following characteristics. These individuals will not fully represent the entire grouse shooting community, and it is not possible to ascertain how many shooting estates this sample represents since the survey was kept anonymous to maximise participation.

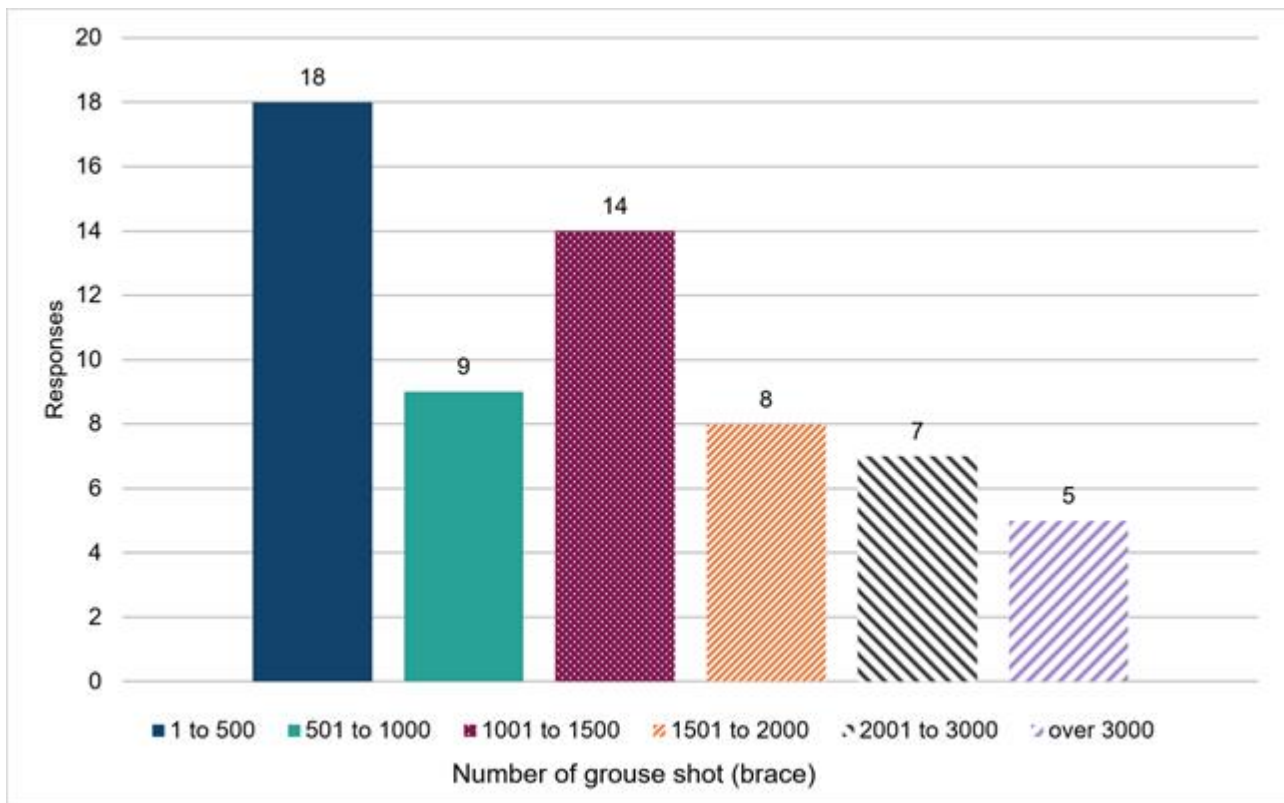
Respondent and estate characteristics

- Respondents were typically male (n=62 of the 63), employed (n=59) and living in the north of England as would be expected given the location of most grouse moors. Respondents held sometimes overlapping roles in the management of estates, including gamekeepers (n=20), agents (n=19), owners (n=17) and managers (n=11).
- Respondents were typically experienced in the active management of grouse moorland; most had more than 10 years' experience (n= 53), and none had less than three years' experience. All held memberships with professional and interest organisations including The Moorland Association, the Game and Wildlife Conservation Trust and the National Gamekeepers' Organisation. Many held multiple memberships.
- Most of the respondents (n=42) were only involved in grouse moor management on one estate. Only 12 were involved with more than five different estates.
- Most estates that respondents were involved with were owned and managed by the landowner (n=47), and most estates were either less than 5,000 acres or between 5 and 9,999 acres (n=20 and 21 respectively). Note that these numbers do not represent numbers of individual estates, but the responses given by respondents, and there is no way of knowing which, if any, of them are involved with the same estate.

Figure 7 displays the number of brace (pairs of grouse) estimated by respondents to have been shot per year in the past five years on their estate. It shows how the distribution implies fewer respondents from very large estates with large land areas and very high brace counts.

Finally, questions about participants/groups to whom shoot days were open revealed that respondents' estates were open to a mix of groups including most frequently family and friends, and buyers, with relatively few open to syndicates.

Figure 7: Average number of brace (pairs of grouse) shot per year on respondent's estate



5.2.1 Effects

Effect of brood management on hen harrier populations

Most survey respondents (57 of 63) either agreed or strongly agreed that brood management had increased harrier numbers.

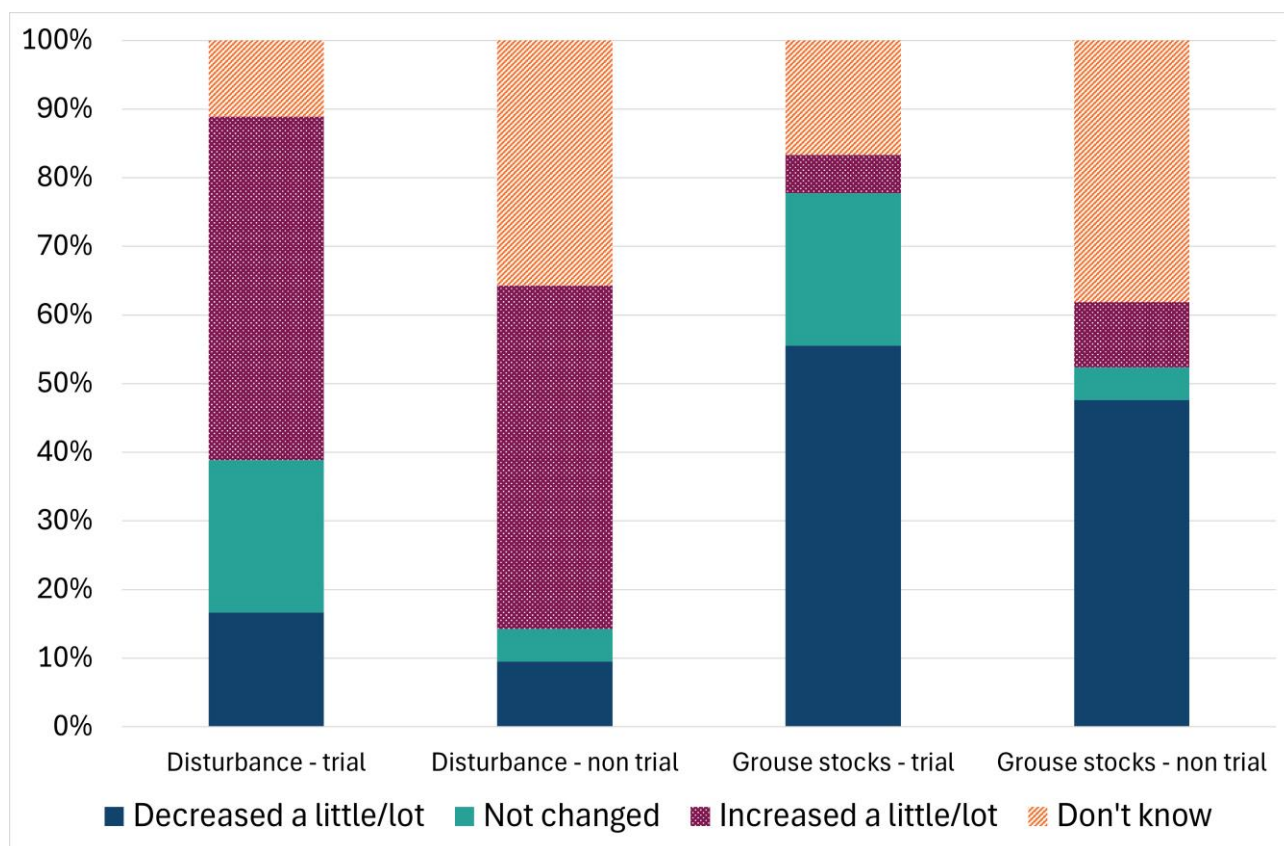
Effect of brood management on grouse businesses

Disturbance to shoot days and grouse stocks:

All respondents were asked their opinions on whether brood management had changed the number of shoot days disturbed by hen harriers on estates that took part in the trial, and whether they felt grouse stocks (the numbers of grouse on the land available to shoot) had changed on participating estates. Results are shown in Figure 8 with metrics displayed as the percentage of respondents to each question, which allows visual comparison between the opinions of trial participants (n=18) and of non-participants (n=42).

- Around half of all respondents in both trial and non-trial groups held the view that interruptions to shoot days had increased on participating estates, and similarly around a half of all participants thought grouse stocks had decreased a little or a lot on participating estates.
- These results highlight two aspects: first, that the Brood Management Trial is viewed as causing business impacts on estates, and secondly, that views about these impacts held by trial participants and non-participants who responded to the survey do not appear to differ.

Figure 8: Opinions on whether brood management altered the number of shoot days disturbed by hen harriers, and on whether it altered grouse stocks, on participating estates



Financial pressures from brood management

All respondents were asked how much they agreed or disagreed with the statement “Brood management adds undue financial pressures on participating estates”.

- Almost half (30 of 63) agreed or strongly agreed, a third (20 of 63) were neutral and only 10% (3 of 63) disagreed or strongly disagreed.
- This question was asked later in the survey than those about disturbance and changes in grouse stocks. It was designed in part to help check for consistency in responses. Both questions evoked similar levels of response, indicating (a) that respondents held consistent views about financial pressures and (b) that those undue financial pressures can sensibly be thought of as:
 - The increased interruptions of shoot days,
 - Decreased grouse stocks that were thought to be related to brood management,
 - In some cases, the direct costs of brood management operations.

Interference from public bodies

All respondents were asked how much they agreed or disagreed with the statement “There has been too much involvement from public bodies in estate activities due to brood management”.

- Over half of respondents (38 of 63, or 60%) felt there had been too much involvement, and a further third were neutral (20 of 63 or 30%).
- These responses suggest that involvement of public bodies in estate activities has generally been unwelcome, and further work would be useful to better assess how any future expansion of brood management could balance the requirements of public bodies and estates.

Effects of brood management on attitudes towards hen harriers

Willingness to coexist with hen harriers

Trial participants were asked whether brood management had increased their willingness to coexist with hen harriers, and non-participants were asked if the knowledge that brood management was available had changed their willingness.

All participants were later asked how much they agreed or disagreed with the statement that brood management had increased feelings of positivity towards hen harriers within the grouse shooting community.

The answers to both questions are presented here to allow comparison of slight differences in answers given to the two questions.

- Overall, 40 of the respondents (n=60) felt the trial had increased willingness to coexist with hen harriers with possibly slightly lower positive opinions within trial participants. Around a quarter of trial participants (5 of 18, or 28%) felt that brood management had increased their willingness to coexist with hen harriers, whereas a larger proportion of non-participants (19 of 42, or 45%) felt this. While the small numbers mean that little emphasis should be placed on these differences it is worth noting that there may be some differences in the groups. The groups were more similar when considering what proportion did not feel the trial had altered their willingness to coexist, with around a half of each group reporting no change giving an average of 45% for all respondents. Only two out of the 60 (3%) of all respondents felt the trial had decreased their willingness to coexist with hen harriers.
- There was some difference between the responses given by gamekeepers compared to respondents in other roles, with some indication that gamekeepers were less likely to report increased willingness to coexist than those in other roles. Two of the 12 gamekeepers who had not taken part in the trial reported an increase, whereas 17 of 30 in non-gamekeeper roles who did not take part reported an increase in willingness to coexist. Again, low numbers mean these results should be treated with caution but coupled with other results which suggest some differences according to roles, reported later, a picture builds that those who work on the front line of grouse and moorland management may hold slightly differing opinions than those in other roles. Similarly, there was some difference between business where grouse shooting is the main type of business and other models where other streams of income exist. Only five out of 22 respondents working

where grouse formed the main source of income reported increased willingness to coexist.

All respondents were asked how much they agreed or disagreed that brood management had increased feelings of positivity towards hen harriers in the overall grouse shooting community. This differed from the coexistence questions which asked about respondent's personal levels of willingness to coexist.

- Almost half (27 of 63, or 43%) reported the view that they agreed the technique had increased feelings of positivity. Only 14 (22%) disagreed or strongly disagreed which is a more negative response than the question about willingness to coexist. A third (20 of 63, or 32%) felt the trial had not altered feelings towards hen harriers.
- Table 3 summarises the results for both questions to allow easier comparison, with scales of agreement/disagreement and scales of increase/decrease altered to positive effects, neutral effects, and negative effects for ease of comparison. One explanation for the difference in negative results would be that willingness to coexist with hen harriers is not seen as the same as feelings of positivity towards the species, and that feelings of positivity only explain part of the willingness to coexist. However, confidence in this interpretation is low due in part to the low numbers of respondents and due to the existence of other explanations.

Table 3: Opinions on whether brood management changes a) willingness to coexist with hen harriers, and b) feelings of positivity towards hen harriers

	Willingness to coexist	Positivity towards hen harriers
Positive	40%	43%
Neutral	45%	32%
Negative	3%	22%

Effects of (taking part in) brood management on external perceptions of the estate

All respondents were asked how much they agreed/disagreed with three statements about what brood management demonstrated, to elicit more information about motivations for taking part or not.

The majority (49 of 63, or 78%) felt that brood management demonstrated the estate's commitment to wildlife conservation. A similar proportion (44 of 63, or 70%) felt that brood management demonstrated that the estate is working to support grouse shooting as a sport.

Respondents were slightly more divided on whether brood management demonstrated the estate's ability to responsibly manage the impacts of hen harriers. While 37 respondents agreed (59% of 63), 25 either disagreed or were neutral (40% of 63). Notably, a smaller proportion of gamekeepers agreed with this statement compared to those in other roles—

only eight out of 20 gamekeepers agreed, compared to 29 out of 43 respondents in other roles.

5.2.2 Mechanisms

Mechanisms that explained increased nesting attempts

Respondents were presented with information on increased nesting numbers of hen harriers between 2016 and 2023. They were then asked to select all the factors they thought had caused this increase, from a randomised list of factors which might alter numbers of nesting attempts on grouse moors. The list included four key mechanisms which might bring about increased nests, related to the scenarios listed in 'Table 6: Hen Harrier Action Plan scenarios', as well as the options 'another reason', 'none of these' and 'don't know'. Table 4 presents the numbers and percentage of respondents who chose each option. Multiple responses were possible.

Table 4: Number of respondents who thought different mechanisms contributed to the rise in hen harrier nesting attempts between 2016 and 2023

Mechanisms thought to contribute to increased numbers of nesting hen harriers on grouse moors	Count (n=63)	Percentage of respondents
Reduced illegal killing/disturbance	29	46%
Birds arriving from non-grouse-moor areas	24	38%
Environmental conditions	20	32%
Changes in moorland management, unrelated to brood management	9	14%
Another	8	13%
Don't know	7	11%
None of these	4	6%

When asked to specify, responses to 'another' included 'better tolerance' (presumably of people towards nests), withdrawal of chemicals, and natural causes e.g. food and water supply.

- The responses indicate that the most frequently chosen mechanisms thought to contribute to increased nests were reduced illegal killing and disturbance, and arrival of harriers from non-grouse moor areas, closely followed by environmental conditions. The option of 'changes in moorland management' was included to check for any unknown major changes in land use.

Mechanisms that explained rise in overall hen harrier population

Respondents who thought that brood management had led to an increase in the overall hen harrier population (n=57), were asked why brood management had led to that increase, in a free text answer. The most common answers given were consistent with those mechanisms most commonly chosen as increasing nesting attempts, and were focused on:

- (i) Captive rearing element of brood management creating better conditions, such as better food, less risk of predation, and
- (ii) Availability of brood management had increased acceptance of hen harriers and increased confidence that business impacts can be managed.

Illegal killing as a mechanism, whether it has decreased, and which mechanisms were thought to have decreased it (for those who thought it had decreased)

Three related questions aimed to increase understanding of participants' views on (a) the role of illegal killing on hen harrier numbers, (b) on whether illegal killing has decreased, and if so, (c) which mechanisms played a role in that decrease.

a) Views on the influence of illegal killing on hen harrier populations

All respondents were asked if they thought hen harrier numbers had changed because of illegal killing in the past 5 to 10 years. Sixty-one respondents answered and nine of these said they did not know, meaning that 52 had an opinion. Of those, nearly half (25 out of 52 or 48%) thought harrier numbers had been changed (including 'a lot' and 'a little') by illegal killings, while 21 (40%) said hen harrier numbers were changed 'not very much' by illegal killings. Only six respondents (12%) of those who expressed a view did not think illegal killing played a role at all.

b) Views on whether illegal killings have changed in the past 5 to 10 years

Respondents were asked whether they thought illegal killings had decreased in the past five to ten years. Fifty-seven responded, of which 12 said they did not know.

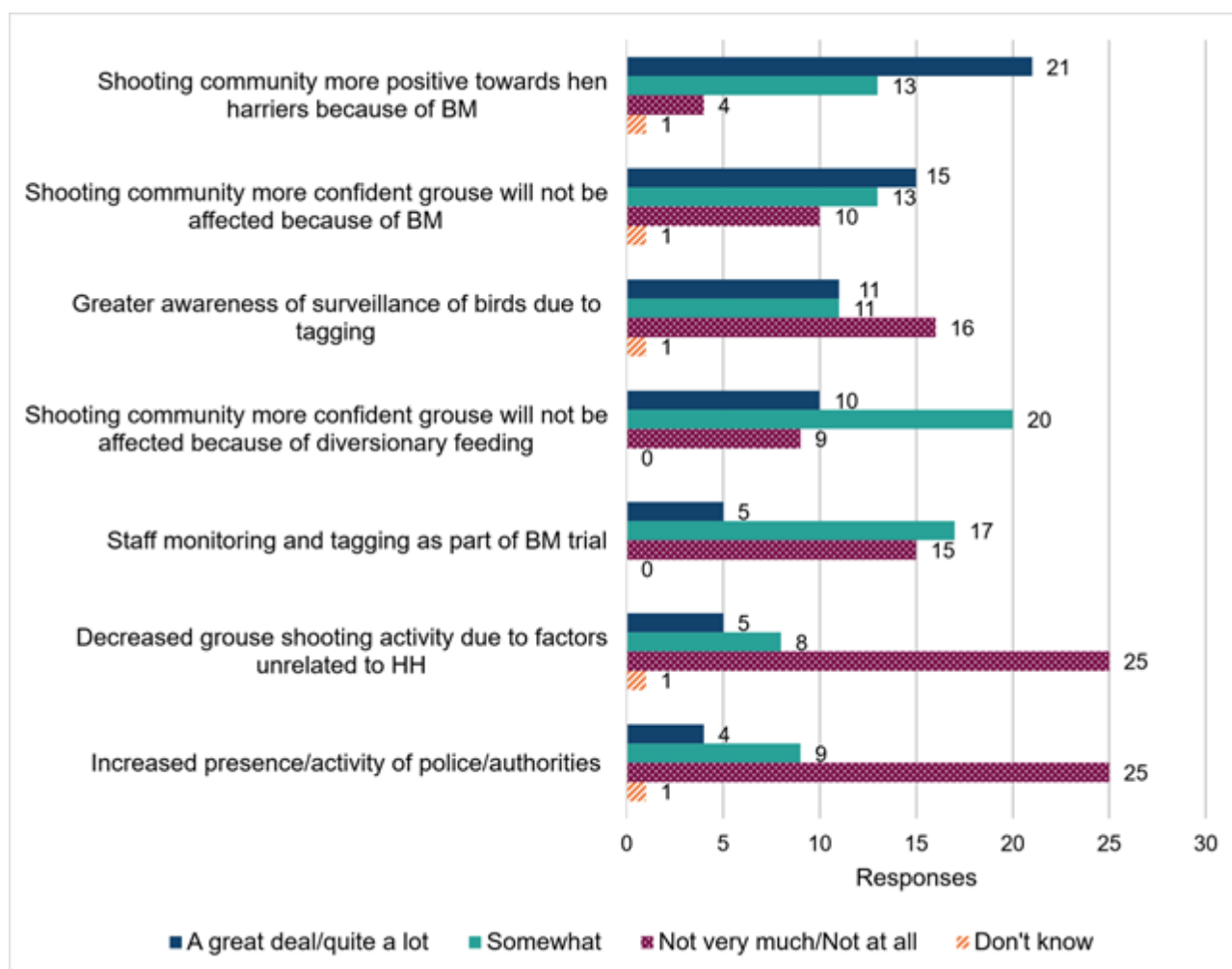
Half said illegal killings had decreased a lot (29 of 57 overall), and 10 said they had decreased a little, so over two thirds (39 of 57, or 68%) thought illegal killings had decreased. This represents 87% of those who expressed an opinion. No respondents thought that illegal killings had increased.

c) Mechanisms that alter illegal killing – asked of all who thought that illegal killings had decreased

- Respondents who thought that illegal killings had decreased in the past five to ten years (n=39) were asked to rate how they believed the following mechanisms had played a role in that decrease (Figure 9):
 - Increased feelings of positivity towards hen harriers.
 - Increased confidence that harrier impacts on businesses can be managed through brood management.
 - The presence of tags on birds creating a surveillance effect.

- Increased confidence grouse numbers will not be affected, due to diversionary feeding.
- The presence of staff involved in the trial e.g. those who tag birds.
- Decreased shooting activity unrelated to the Brood Management Trial, e.g. bad grouse years
- The presence of police and other authorities.
- Free-text answers also referred to internal industry peer pressure or pressure from managers, a recognition that grouse shooting and hen harriers need to coexist, and tighter laws in Scotland.
- The results are broadly consistent with answers given to previous questions about feelings of positivity increasing, and an increase in confidence that grouse stocks are not affected or are less affected because of brood management.
- They also suggest that respondents feel tags and associated perceptions of surveillance play a role, albeit a smaller one, and that the roles of diversionary feeding and presence of staff on the ground are similarly not believed to be negligible.
- The least impactful mechanisms reported were a decrease in grouse shooting activity due to factors unrelated to brood management, such as bad grouse years, and any increased activity by the police.
- Additional analysis was carried out to check for consistency of answers within respondents. Of the 15 respondents who attributed the decline in illegal killing “a great deal” or “quite a lot” to “Shooting community being more confident grouse will not be affected by hen harriers, because of brood management”, six had expressed views earlier in the survey that brood management had led to decreased grouse stocks on shooting estates. Possible explanations for this include:
 - Some respondents were being inconsistent in their answers because they were affected by some bias such as social desirability bias, or
 - That they believed a different mechanism was playing a role in decreasing illegal killing that was not related to business impacts.

Figure 9: Mechanisms chosen by respondents as causing the decrease they perceived in illegal killings of hen harriers



5.2.3 Moderators

Role: keepers, agents, owners, and managers

Overall, there appears to be some evidence that gamekeepers within this sample held some different views to those in other roles. These may reflect the reality of the everyday lived experience, being on the front line of managing land for grouse which includes predator control and balancing multiple demands in their roles. Overall, they were more likely to have slightly lower scores on wildlife values than those in other roles (for example, 11 of 20 scored low on hen harrier appreciation compared to six of 43 in other roles) and were less likely to say the hen harriers are important for the upland ecosystem. Gamekeepers also reported lower increases in increased willingness to coexist with harriers than those in other roles, and were more likely to agree that large scale brood management was impractical (16 of 20 keepers thought larger scale roll-out was impractical, compared to 34 of 61 in the overall sample).

Business model

Due to low sample numbers, it was not possible to carry out a full subgroup analysis based on business models, but one result is worth noting. Where grouse shooting was the main business model, there was a slightly lower increase in willingness to coexist than if other sources of income were available. Only five out of 22 respondents working where grouse formed the main source of income reported increased willingness to coexist. Given the belief that increased hen harriers decreased grouse stocks, this makes financial sense.

5.2.4 Implementation

This section describes various factors which might be helpful in designing-out potential barriers to successful implementation of any future scheme. Factors including the motivations for taking part or not, the variation in fundamental appreciation of hen harriers, whether respondents thought brood management conferred a cost to them, and suggestions for improvements to the trial are presented.

Views on the practicality of any larger scale roll-out: a reflection of a possible barrier

Opinions on whether a larger scale version of the trial was practically feasible were on aggregate more negative than positive.

- Over half (54%, or 34 of 63) of respondents thought it would be impractical, while 17 or 27% thought it would be practical. The remainder were either neutral or did not know.
- There was some indication that lower scores on wildlife values and those in gamekeeper roles were concentrated in the group who thought expansion was not practical.
- This negative view means that any larger scale roll-out of brood management or a similar scheme may benefit from engaging with the grouse shooting community to understand which factors in particular lead some to believe the scheme is not practical.

Motivations for taking part in the trial and not taking part, and willingness to take part in the future

- Key motivations for taking part were to help conservation efforts, help manage hen harrier numbers and be supportive of the aims of the trial.
- Forty-two respondents said that their estates did not participate in the trial, either because they could not (e.g. did not meet the eligibility criteria or did not have nesting hen harriers on their estate) or did not want to. Key reasons for not wanting to take part centred around concerns about impacts of hen harriers on grouse and concerns about potential interference in the estates from the outside.
- Of the 18 respondents whose estates had taken part in the trial, half (n=9) reported they would like to take part in the future. Of those who did not take part and expressed

an opinion about future participation (n=42), many (n=20) said they would not have liked to take part if given the opportunity. Reasons given for wanting to be involved, or not, in future, were broadly similar to reasons given for taking part, or not, in the trial.

The perceived cost of brood management to estates

Several questions together paint a picture of a relatively common view that while hen harriers were thought of as being important to the upland ecosystem (34 of 63 agreed this was the case), there is also a perception that brood management confers a cost.

- The perceptions of increased interruptions to shoot days and lower grouse stocks were reported earlier, and may well explain the fact that, when presented with the statement 'The English uplands would be worse off if there were more hen harriers,' over half (37 of 63 or 58%) agreed, and 13 disagreed.

Views on whether brood management was a lot of work for little benefit: a split opinion

- When presented with the statement 'Brood management is a lot of work for little benefit,' opinions were split with an almost equal number of respondents agreeing and disagreeing with this statement. A third agreed (22 of 63), and a third disagreed (23 of 63).
- This along with other answers indicate variation in views in the population of people who would be involved in implementing any future roll-out of brood management or a similar scheme. Hence if the design relied on voluntary uptake, then consideration of how to design out some of the barriers discussed here might improve the chances of successful and wider uptake.

Suggestions for changing the trial: opinions from those involved day to day

The 18 respondents who took part in the trial were asked for their suggestions to improve the trial. These are listed here and contain a mixture of practical suggestions, and several mentions of ways to theoretically decrease the impact on the estates taking part, by allowing bird releases to be further away from the originating moor, or by increasing the number of receptor sites available.

- Being able to release birds outside of the Special Protection Areas and into lowland habitats.
- Removing electric fencing around release aviaries.
- More involvement of keepers in the process (e.g. letting them keep information on the birds after they fledged, satellite tag information).
- More receptor sites [release sites].
- Introduce a single release site away from grouse moors.
- Less or no requirement for tags due to cost.
- Diversionary feeding at nest.

6. Discussion

This section firstly summarises the key findings relating to hen harrier populations (Section 6.1) and the key findings of the EMMIE framework review (Section 6.2).

It then outlines the potential outcomes of the original Hen Harrier Action Plan and the original Monitoring and Evaluation Plan in Tables 6 and 7. These have been slightly adapted from the theoretical framework set out in the original Monitoring and Evaluation Plan (Section 2.2). Firstly, to consider how changes in attitudes and behaviours towards nesting hen harriers might differ to those towards hen harriers at other times of year (for example, at winter roosts). Secondly, to incorporate the reasons behind any potential change in attitudes and behaviours, in order to understand how brood management specifically, as opposed to other factors, might cause any changes.

Finally, the key findings relating to hen harrier populations (Section 6.1) and the EMMIE framework review (Section 6.2), are compared to these potential outcomes (Tables 6 and 7) to draw conclusions on the scenario best supported by the available evidence.

6.1 Key findings related to hen harrier populations

Table 5: Key findings and sources

Finding	Source and limitations
A) Illegal killing of hen harriers has continued throughout the Brood Management Trial.	Section 4.5. National Wildlife Crime Unit intelligence reports. While individual incidents could potentially have been miscategorised, the overall conclusion that illegal killing has continued is supported by evidence from multiple incidents.
B) The areas where illegal killing has occurred in recent years tend to be away from areas where brood management has been used.	Section 4.5. National Wildlife Crime Unit intelligence reports and hotspot analysis. This finding is based on a simple analysis of the systematically categorised reports 2022–2024.
C) A substantial increase in nesting hen harrier numbers has been seen in England during the trial, compared to moderate increases in Wales, and a decline in southern Scotland.	Section 4.2. Direct surveys by hen harrier fieldworkers. Counts of nests in England are believed to be a near-complete census so this finding is likely to be accurate.
D) In the initial years of the trial, the numbers of hen harriers nesting in areas managed for grouse shooting increased significantly. This increase was mainly seen in grouse shooting areas where brood management was available. Smaller increases were seen in areas of England not managed for grouse shooting. Not all grouse moors saw increases in nesting hen harriers.	Section 4.2. Allocations of nests to land use categories were based on two sources of evidence: field reports and GIS mapping. Individual nests may have been miscategorised but the overall pattern is likely to be accurate.
E) Productivity increases from the act of captive-rearing and releasing broods of hen harriers, or from diversionary feeding, could not explain the increases in nesting numbers seen.	Section 4.4. British Trust for Ornithology population modelling using field data, including near complete counts of fledged chicks, gathered by NE and partner organisations.
F) Satellite tagged hen harriers, both brood-managed and wild, show first-year survival below levels that would be expected in populations with no illegal killing.	Section 4.3. Percentages of NE tagged wild birds and brood managed birds that survived one year. These survival rates may be higher than rates for untagged birds if tags influence survival. It can be concluded that survival rates are not at levels seen in populations with no illegal killing.

From the key findings in Table 5, the following can be inferred:

As the increase in nesting numbers (C) cannot be explained by productivity increases during the trial (including the productivity improvements caused by captive-rearing and diversionary feeding) (E), this increase must be attributed to either:

- i. improvements in survival, and/or

- ii. increased 'settlement', whereby an existing population of birds available to breed becomes more likely to settle and nest.

However, the fact that illegal killing has continued (A) means that the overall survival rates of wild birds cannot have improved to levels seen in populations with no illegal killing. This is supported by the observation of survival rates of satellite-tagged birds which, while not necessarily representative of untagged birds, indicate first-year survival rates below what would be expected of populations with no illegal killing (F).

This does not rule out some improvement in survival rates, potentially of specific age classes (for example, adult females have the potential for very high natural annual survival if they are able to settle in a favourable area). However, it does highlight improvements in settlement, potentially of birds immigrating from the larger Scottish population, as a potential explanation for the increase in nests observed.

As illegal activity is, by nature, covert, and measures to avoid detection evolve in response to enforcement practices, it is not possible to confidently measure trends or changes in illegal activity. However, since illegal killing and disturbance of nesting attempts are thought to be the key factor limiting hen harrier populations (Murgatroyd *et al.*, 2019, Ewing *et al.*, 2023), it is reasonable to infer that any improvements in survival rates or settlement rates are likely to be due to changes in levels of illegal human activity.

This is supported by the fact that substantial increases in hen harrier nesting attempts have been seen in grouse shooting areas where brood management has been available (D), and not in non-grouse-moor areas or in southern Scotland (C), suggesting that improvements in survival rates or settlement rates are more likely to be due to changes in illegal human activity than large-scale environmental drivers.

6.2 Key findings of the EMMIE framework review

The potential reasons behind any change in human influences inferred in Section 6.1 are explored in the EMMIE framework review, Section 5 of this report. The conclusions are shown below.

Perceived effects of the trial

Overall brood management was seen as being effective in increasing hen harrier numbers, but also increased costs to estates in the form of interruptions to shoot days and decreased grouse stocks, as well as potentially direct costs of taking part in brood management, though not all held this opinion. An additional cost seen by some was that of involvement from public bodies due to the trial.

Over a third of respondents (40%) reported the trial had increased their willingness to coexist with hen harriers, and a similar proportion believed the trial had increased feelings of positivity towards the birds in the wider grouse shooting community. Gamekeepers were less likely in this sample to report increased positivity or willingness to coexist, but the small sample numbers mean limited emphasis should be placed on this finding.

Motivations for taking part in the trial, despite the costs mentioned earlier, centred largely around demonstrating a commitment to wildlife conservation, demonstrating that the estate was working to support grouse shooting as a sport, and hoping to manage hen harrier impacts. Key reasons for not wanting to take part centred around concerns about impacts of hen harriers on grouse and concerns about potential interference in the estates from the outside.

Mechanisms believed to be at work

The mechanisms reported as contributing to increased nesting attempts, and increased overall hen harrier numbers, were focused around reduced illegal killing and disturbance; natural population immigration from other areas; diversionary feeding; environmental conditions; and 'headstarting', meaning the act of hand rearing chicks in captivity improving survival rates. The BTO analysis presented earlier in this report highlights how 'headstarting' does not seem likely to be having an effect and that there is some mismatch between beliefs held in the survey respondent community and other information.

Illegal killing was thought to play a role in hen harrier numbers by approximately half of respondents who held an opinion, and similarly around half of all respondents thought illegal killing had decreased in the past five to ten years. The most common reasons believed to contribute to that decrease in killings were increased positivity towards harriers; increased confidence that grouse will not be affected due to the availability of brood management; and for some, the surveillance effect of tags and the effect of diversionary feeding (which would in theory again decrease impacts on grouse stocks by decreasing predation on grouse). Unlikely mechanisms were believed to be less shooting activity over the trial years, and the presence of police or other authorities.

Possible moderators

Role: overall, there appears to be some evidence that gamekeepers within this sample held some different views to those in other roles. For example, they reported lower increases in willingness to coexist with harriers than those in other roles, and were more likely to agree that large scale brood management was impractical (16 of 20 keepers thought larger scale roll-out was impractical, compared to 34 of 61 in the overall sample).

A further moderator for which there was some evidence is that of the business model of the estates. Where grouse shooting was the main business model, there was a slightly lower increase in willingness to coexist than if other sources of income were available. Only five out of 22 respondents working where grouse formed the main source of income reported increased willingness to coexist. Given the belief that increased hen harriers decreased grouse stocks, this makes financial sense. Small sample numbers means both results should be treated as possibly indicative – larger samples would be needed for representative results.

Implementation issues

The population of grouse estate owners, agents and game keepers who would be implementing any future intervention based on brood management shows some variation

in opinions and how they perceive the effects of the trial. The design of any future intervention could be in part informed by these results.

Factors which might act as barriers to successful and effective implementation include the views that hen harriers carry a financial cost to estates, the view held by just over half of respondents that larger scale roll-out of brood management was impractical, and the fears of some who did not take part that the trial would bring interference from outside the estate on top of the costs of impacts on grouse and on shoot days.

However, despite these barriers, opinions were split about whether brood management was worth it, with a third thinking it was and a third thinking it was not. Furthermore, the trial was seen as an effective way to decrease illegal killing and to increase hen harrier numbers.

Several suggestions for improving the trial tended to centre around how to release birds further away from the estate on which they originated, by allowing release outside of a Special Protection Area (SPA) if that was relevant, or by increasing the number of receptor sites. This fits with the opinions that increased numbers of birds on or near an estate confer a cost to the business.

Overall assessment of the quality of the EMMIE framework results

In general, where there were questions that asked about similar mechanisms or opinions, which had been designed to check for consistency within individuals, that consistency was high. One notable exception to this is where some respondents (n=6) reported both an increase in confidence that brood management could help limit the impacts of hen harriers on grouse, but also expressed opinion that grouse numbers had been impacted by the Brood Management Trial. Other than this, the key consideration throughout and for all interpretation of results is the relatively small sample size meaning that subgroup analysis is very limited.

6.3 Hen Harrier Action Plan scenarios

In the year of the publication of the Hen Harrier Action Plan, 2016, there were just three hen harrier nests in England. A suite of actions set out in the plan aimed to reduce conflict with grouse shooting interests and associated illegal killing of hen harriers, and increase hen harrier numbers. A number of broad outcomes were possible in terms of changes in illegal killing and effects on hen harrier populations, outlined in Table 6.

Table 6: Hen Harrier Action Plan scenarios

	Potential outcome	Predicted observations
A	Illegal activity stops entirely ; no disturbance or illegal killing of hen harriers on nesting grounds or at other times of year.	Increasing numbers of nests on grouse moors, increasing overall population size. Survival rates increase to levels seen in populations with no illegal killing. No reports of illegal killing.
B	Illegal killing and disturbance of nesting hen harriers reduces or stops , but year-round illegal killing continues .	Increasing numbers of nests on grouse moors. Survival rates remain low. Continued reports of illegal killing.
C	Illegal killing and disturbance of nesting hen harriers continues , but year-round illegal killing reduces or stops .	No increase in nests on grouse moors. Survival rates improve. Reduced reports of illegal killing. Increasing numbers of nests in non-grouse-moor areas may be observed in this scenario.
D	Illegal killing and disturbance of nesting hen harriers continues , and year-round illegal killing continues .	No increase in nesting numbers in any regions. Survival rates remain low. Continued reports of illegal killing.
E	Illegal killing and disturbance of nesting hen harriers continues , and year-round illegal killing continues . However, a coincidental natural factor (e.g. improved weather conditions) causes improved survival and/or productivity away from grouse moors.	No increase in nests on grouse moors. Survival rates may improve. Increasing numbers nesting in non-grouse-moor areas. Continued reports of illegal killing.
F	Illegal killing and disturbance were not the limiting factor for hen harrier populations; low numbers on grouse moors were due to this being an unsuitable environment. Diversionary feeding and brood management directly improve hen harrier productivity in these areas via 'headstarting'.	Increased hen harrier populations on grouse moors (where these activities occur). Survival rates and reports of illegal killing remain unchanged.
G	Illegal killing and disturbance were not the limiting factor for hen harrier populations; low numbers on grouse moors were due to this being an unsuitable environment. However, a coincidental natural factor (e.g. improved weather conditions) causes improved survival and/or productivity.	Increasing hen harrier populations in all areas. Survival rates may improve, reports of illegal killing remain unchanged.
H	Illegal killing and disturbance were not the limiting factor for hen harrier populations; low numbers on grouse moors were due to this being an unsuitable environment. No actions in the action plan cause a population increase.	No increase in hen harrier populations. Survival rates and reports of illegal killing remain unchanged.

6.4 Brood Management Trial scenarios

The logic of brood management as presented in the Hen Harrier Action Plan (see Section 2.1) can be broken down into four 'steps'. These steps are shown in Table 7, along with the alternative scenarios possible for each step.

This logic model has been adapted from that in the original Brood Management Trial Monitoring and Evaluation Plan (Section 2.2) in order to incorporate the explanation set out in the Hen Harrier Action Plan of how the availability and practice of brood management might cause grouse moor owners and managers to become more tolerant of hen harriers on their land (i.e. that brood management leads to confidence that impacts of hen harriers can be managed).



Table 7: Brood Management Trial scenarios

Step	Step does not occur	Step occurs but for a different reason
1. Brood management increases confidence within moorland community that impacts of hen harriers on red grouse can be managed.	No increase in confidence within the moorland community that the impacts of hen harriers on red grouse can be managed.	Increase in confidence, but for a reason not attributable to brood management (e.g. diversionary feeding, or reduced impact on shoots for unconnected reason).
2. Confidence leads to more positive attitudes towards hen harriers (reduced conflict).	Attitudes towards hen harriers do not become more positive.	Attitudes do become more positive, but for a different reason (e.g. increased recognition of value of hen harriers / recognition of need to coexist with hen harriers).
3. Positive attitudes lead to reduced illegal killing and disturbance of hen harriers.	No reduced illegal killing or disturbance of hen harriers.	Reduced illegal killing of hen harriers, but due to increased enforcement activity rather than more positive attitudes.
4. Reduced illegal killing leads to increased hen harrier numbers and increased numbers of successful nests.	No increase in hen harrier nesting numbers or survival rates.	Increase in numbers, but for reason unconnected with illegal killing (e.g. 'headstarting' effect of captive-rearing, or a natural factor such as weather conditions).

6.4 Comparison of key findings with scenario outcomes

It can be concluded from the key findings relating to hen harrier populations set out in Section 6.1 that the period since the launch of the Hen Harrier Action Plan has seen:

- i. Significant increases in numbers of hen harriers nesting on grouse moors in England (although not on all grouse moors),
- ii. Smaller increases in non-grouse-moor areas,
- iii. Continued reports of illegal killing,
- iv. Survival rates below those that would be expected in populations with no illegal killing,
- v. No evidence that direct productivity gains from captive-rearing or diversionary feeding have caused observed increase, and
- vi. No evidence that a coincidental natural factor has caused observed increases.

These key findings indicate that the most likely outcome of the overarching Hen Harrier Action Plan, out of those outlined in Table 6, is “(B) Illegal killing and disturbance of nesting hen harriers reduces, but year-round illegal killing continues.”

It can be concluded from the key findings relating to hen harrier populations set out in Section 6.1, and the key findings of the EMMIE framework review (Section 6.2), that the Brood Management Trial has seen:

- i. Little evidence for an increase in confidence within the moorland community that the impacts of hen harriers on red grouse can be fully managed,
- ii. Motivations to increase hen harrier numbers attributable to demonstrating a commitment to wildlife conservation and demonstrating that estates are working to support grouse shooting as a sport, despite the cost to business,
- iii. Evidence from interviews to suggest that the availability of brood management allays concerns about hen harriers increasing so much that they ‘overrun’ grouse moors, causing shoots to become unprofitable,
- iv. Indirect evidence of reduced illegal killing and disturbance of nesting hen harriers on some grouse moors,
- v. Some indication of effects of surveillance activity and diversionary feeding on illegal killing, but survey results indicate these are seen as less significant than changes in attitudes due to brood management,
- vi. No evidence that factors other than changes in illegal activity (such as natural factors, or ‘headstarting’) have caused observed increases in nesting numbers on grouse moors.

These key findings suggest that steps 3–4 of the logic model in Table 7 are supported (“reduced illegal killing of hen harriers due to changes in human attitudes and behaviours, leading to increased numbers of nesting hen harriers”), but steps 1–2 are not supported (“brood management increases confidence within moorland community that impacts of hen harriers on red grouse can be managed, leading to more positive attitudes”).

Therefore, the scenario best supported by available evidence is that changes in attitudes have led to reductions in illegal activity (killing and disturbance) on some grouse moors, leading to an increase in nesting hen harriers. However, unlike in the logic model in Table 7, this is not likely to be due to confidence that the impacts of hen harriers on red grouse can be managed. Instead, motivations to increase hen harrier numbers can be attributed to 'demonstrating a commitment to wildlife conservation and demonstrating that estates are working to support grouse shooting as a sport', despite a cost to business, and with brood management working as a 'safety net' to allay concerns about hen harriers increasing so much that they 'overrun' grouse moors.

7 Conclusions

Brood Management Trial

The trial suggests that availability of brood management has led to more hen harriers successfully breeding on grouse moors. These increases in hen harrier nesting numbers appear likely to be due to a reduction in illegal activity in some areas. However, the social science research suggests that this is unlikely to be due to confidence that the impacts of hen harriers on red grouse can be fully managed, and shows there are perceived costs of increased hen harriers. Instead, motivations to increase hen harrier numbers could be attributed to 'demonstrating a commitment to wildlife conservation and demonstrating that estates are working to support grouse shooting as a sport', despite the cost to business, with brood management working as a 'safety net' to allay concerns about hen harrier numbers increasing to levels at which grouse shooting would be uneconomical.

The trial has had mixed results, with the aforementioned increases in numbers of nesting hen harriers on some grouse moors seen alongside ongoing illegal killing. While it appears likely that illegal killing and disturbance of nesting hen harriers reduced to some extent and in some areas, the trial did not see evidence of substantial reductions in year-round illegal killing of hen harriers.

It is likely that these observations reflect substantial variation in attitudes and behaviours across different shooting estates. Comparison of reports of hen harrier crime against hen harrier nest distributions indicate that nesting hen harriers remain absent from illegal killing 'hotspots' (and many other grouse moors), while on other grouse moors, away from illegal killing hotspots, numbers of nesting hen harriers have increased. This is further supported by the 2024 social science survey, which revealed considerable variation in views of respondents, presumably employed by different estates, regarding whether reductions in illegal killing had led to increased hen harrier numbers.

It follows that a range of approaches may be required to reduce illegal killing on grouse moors and increase hen harrier numbers in future, ranging from cooperative approaches to reduce impacts of hen harriers on grouse and recognise responsible practices, to enforcement action and surveillance, depending on location and situation.

The fact that key motivators for taking part in the trial include ‘demonstrating commitment to wildlife conservation and demonstrating that estates are working to support grouse shooting as a sport’, suggests that public and peer pressure to adhere to responsible practices have played a role in the motivation of some estates to increase hen harrier numbers.

Hen Harrier Action Plan

This report is not an evaluation of the Hen Harrier Action Plan, but relevant findings are summarised in this section. Many of the actions in the HHAP were designed to reduce the conflict with grouse shooting interests and the associated illegal killing of hen harriers.

- This report concludes the trial of brood management (Action 6).
- Monitoring of populations (Action 1) has been essential in gathering the data required to assess success of interventions, and there is some evidence that tagging of birds is perceived as having an effect of reducing illegal killing.
- Diversionary feeding (Action 2) appears to have a small positive effect on productivity of fed nests, but not enough to explain the population increases seen during the trial. Diversionary feeding may somewhat increase confidence that impacts of hen harriers on grouse can be managed, and reduce conflict with grouse shooting, but according to responses to the social science survey is seen as less effective in this regard than brood management. Furthermore, increases in numbers of nesting hen harriers did not begin until after the start of brood management (despite diversionary feeding being available before this date) so it seems unlikely that this intervention was the cause of the observed increase.
- There is little direct evidence in this report for the effects of cooperation with the RPPDG (Action 3) or nest and winter roost monitoring (Action 4), but the social science research suggests that measures such as presence of staff on the ground and presence of tagged birds are perceived by some members of the grouse moor management community as effective in reducing illegal killing, indirectly indicating impacts of surveillance and enforcement activities.
- The Southern Reintroduction (Action 5) is not one of the actions designed to reduce illegal killing of hen harriers and is not considered in this report.

Evidence gaps and areas for future research

Analysis of survival rates of tagged birds may provide clearer evidence on whether increases in numbers of nesting birds were due to improved survival and settlement rates, and further analysis of survival rates and dispersal patterns of tagged hen harriers, and predicted population trajectories and sizes under different scenarios, would build on these findings. Retrospective categorisation of historic losses of tagged birds into confirmed or suspected criminal may permit further analysis of if, and how, geographical patterns of illegal killing have changed over time. The EMMIE framework analysis indicates that views of grouse moor managers who responded to the survey are mixed on whether further roll-out of brood management as an intervention is workable as trialled. Further dialogue, informed by the findings contained in this report, may be required to reach agreement on management methods that motivate grouse moor managers to support increased hen harrier numbers. Key to this would be a common understanding of whether any densities of nesting hen harriers are compatible with both grouse moor management and species conservation targets.

8. References

- Amar, A. Determining the Cause of the Hen Harrier Decline on the Orkney Islands. PhD thesis (Aberdeen University, Aberdeen, 2001).
- Balmer, D. E., Gillings, S., & Caffrey, B. 2013. Bird Atlas 2007-11: The Breeding and Wintering Birds of Britain and Ireland.
- Countryside Alliance. 2016. Grouse Moors are a Conservation Success Story. Last modified March 2023. URL: <https://www.countryside-alliance.org/resources/news/grouse-moors-are-a-conservation-success-story> (Accessed: 01.12.2024).
- Elston, D. A., Spezia, L., Baines, D., & Redpath, S. M. 2014. Working with stakeholders to reduce conflict – modelling the impact of varying hen harrier *Circus cyaneus* densities on red grouse *Lagopus lagopus* populations. *Journal of Applied Ecology*, 51(5), 1236–1245. <https://doi.org/10.1111/1365-2664.12315>.
- Etheridge, B., Summers, R. W., & Green, R. E. 1997. The Effects of Illegal Killing and Destruction of Nests by Humans on the Population Dynamics of the Hen Harrier *Circus cyaneus* in Scotland. *Journal of Applied Ecology*, 34(4), 1081. <https://doi.org/10.2307/2405296>.
- Ewing, S. R., Thomas, C. E., Butcher, N., Denman, B., Douglas, D. J., Anderson, D. I., Anderson, G. Q., Bray, J., Downing, S., Dugan, R., Etheridge, B., Hayward, W., Howie, F., Roos, S., Thomas, M., Weston, J., Smart, J., & Wilson, J. D. 2023. Illegal killing associated with gamebird management accounts for up to three-quarters of annual mortality in Hen Harriers *Circus cyaneus*. *Biological Conservation*, 283, 110072. <https://doi.org/10.1016/j.biocon.2023.110072>.
- Johnson S.D., Tilley N. & Bowers K.J. 2015. Introducing EMMIE: an evidence rating scale to encourage mixed-method crime prevention synthesis reviews. *Journal of Experimental Criminology*. 11: 459–473.
- Kelly, L. A., Tománková, I., Downing, S., Lindley, P., Mattingley, W., Morris, N. G., Murphy, S., Orr-Ewing, D., Owens, R., Rooney, E., Ruddock, M., Stevenson, A., Thomas, M and Wotton, S. R. 2025. The status of breeding Hen Harriers *Circus cyaneus* in the UK and Isle of Man in 2023. *Bird Study*, 1–18. <https://doi.org/10.1080/00063657.2024.2446373>.
- Ludwig, S. C., Roos, S., Bubb, D., & Baines, D. 2017. Long-term trends in abundance and breeding success of red grouse and hen harriers in relation to changing management of a Scottish grouse moor. *Wildlife Biology*, 2017(SP1). <https://doi.org/10.2981/wlb.00246>.
- Macgregor, C.J., Pearce-Higgins, J.W., Siriwardena, G.M., Wilson, M.W., & Robinson, R.A. 2025. Assessment of recent Hen Harrier population trends in England through population modelling. Research Report 778. British Trust for Ornithology.

Marcinkiewicz, A., O'Shea, C., Furszyfer, D. 2026. Hen Harrier Brood Management Trial; Findings from the social science survey of moorland managers. *Natural England Commissioned Report* NECR615. Natural England.

Murgatroyd, M., Redpath, S. M., Murphy, S. G., Douglas, D. J. T., Saunders, R., & Amar, A. 2019. Patterns of satellite tagged hen harrier disappearances suggest widespread illegal killing on British grouse moors. *Nature Communications*, 10(1). <https://doi.org/10.1038/s41467-019-09044-w>.

Natural England. 2026. Hen Harrier Brood Management Trial; midpoint social science evaluation. *Natural England Research Report* NERR160. Natural England.

New, L. F., Buckland, S. T., Redpath, S., & Matthiopoulos, J. 2011. Modelling the impact of hen harrier management measures on a red grouse population in the UK. *Oikos*, 121(7), 1061–1072. <https://doi.org/10.1111/j.1600-0706.2011.19958.x>.

Newton, I. 2020. Killing of raptors on grouse moors: evidence and effects. *Ibis*, 163(1), 1–19. <https://doi.org/10.1111/ibi.12886>.

Picozzi, N. 1984. Sex ratio, survival and territorial behaviour of polygynous Hen Harriers *Circus c. cyaneus* in Orkney. *Ibis*, 126(3), 356–365. <https://doi.org/10.1111/j.1474-919x.1984.tb00256.x>.

Redpath, S. M., & Thirgood, S. J. 1999. Numerical and functional responses in generalist predators: hen harriers and peregrines on Scottish grouse moors. *Journal of Animal Ecology*, 68(5), 879–892. <https://doi.org/10.1046/j.1365-2656.1999.00340.x>.

Redpath, S. M., Thirgood, S. J., & Leckie, F. M. 2001. Does supplementary feeding reduce predation of red grouse by hen harriers? *Journal of Applied Ecology*, 38(6), 1157–1168. <https://doi.org/10.1046/j.0021-8901.2001.00683.x>.

Sotherton, N., Tapper, S., & Smith, A. 2009. Hen harriers and red grouse: economic aspects of red grouse shooting and the implications for moorland conservation. *Journal of Applied Ecology*, 46(5), 955–960. <https://doi.org/10.1111/j.1365-2664.2009.01688.x>.

St John, F. A. V., Steadman, J., Austen, G., & Redpath, S. M. 2018. Value diversity and conservation conflict: Lessons from the management of red grouse and hen harriers in England. *People and Nature*, 1(1), 6–17. <https://doi.org/10.1002/pan3.5>.

Stanbury, A., Eaton, M., Aebischer, N., Balmer, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D., and Win I. 2021. The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds* 114: 723-747.

Thirgood, S. J., Redpath, S. M., Rothery, P., & Aebischer, N. J. 2000. Raptor predation and population limitation in red grouse. *Journal of Animal Ecology*, 69(3), 504–516. <https://doi.org/10.1046/j.1365-2656.2000.00413.x>.

Thirgood, S., & Redpath, S. 2008. Hen harriers and red grouse: science, politics and human–wildlife conflict. *Journal of Applied Ecology*, 45(5), 1550–1554. <https://doi.org/10.1111/j.1365-2664.2008.01519.x>.

Thompson, P. S., Amar, A., Hoccom, D. G., Knott, J., & Wilson, J. D. 2009. Resolving the conflict between driven-grouse shooting and conservation of hen harriers. *Journal of Applied Ecology*, 46(5), 950–954. <https://doi.org/10.1111/j.1365-2664.2009.01687.x>.

9. Appendices

Annex 1: Practical delivery of brood management

Taking hen harriers into captivity

Nests could be taken into captivity once the project team had ascertained the following:

- The landowner wanted to undertake brood management on this nest. Landowners were able choose not to brood manage and to leave the broods to develop naturally, or to undertake diversionary feeding.
- There was another active nest within 10km of the nest being considered.
- There was a grouse shoot on the land such that the hen harriers to be managed could have an impact on the shootable surplus of grouse.
- The necessary remote egg and/or chick handling infrastructure was in place.
- The release site was agreed, and the release aviary would be put in place with any necessary protected site consents granted in time.
- There were suitable personnel and resources in place to manage the birds until release.

In addition, during the first stage of the trial (2018–2022), a rule was followed that no pairs would be subject to brood management in successive years. This was a precautionary measure due to the very low numbers of nesting hen harriers at the start of the trial, to enable normal breeding behaviour in alternate years. From 2023 onwards, following the increase in numbers of nesting pairs and in brood managed pairs, this was changed to state that no pair would be subject to brood management in three successive years.

Occasionally, hen harriers breed in polygynous groups (one male and multiple females, with the females each at their own nest). Procedures were followed to reduce risk that the brood management of one nest in a polygynous group would not indirectly affect other nests by influencing the activity of the male provisioning both nests.

Captive rearing

If all the above protocols were complied with, the eggs and/or chicks could be taken into captivity by the licensee or appropriate agent. Eggs and/or chicks were transferred to the rearing facility. Eggs were examined, and hatched if viable, and chicks reared in brooders and then aviaries for approximately three weeks before being transferred back to the moorland release aviaries.

Release protocol

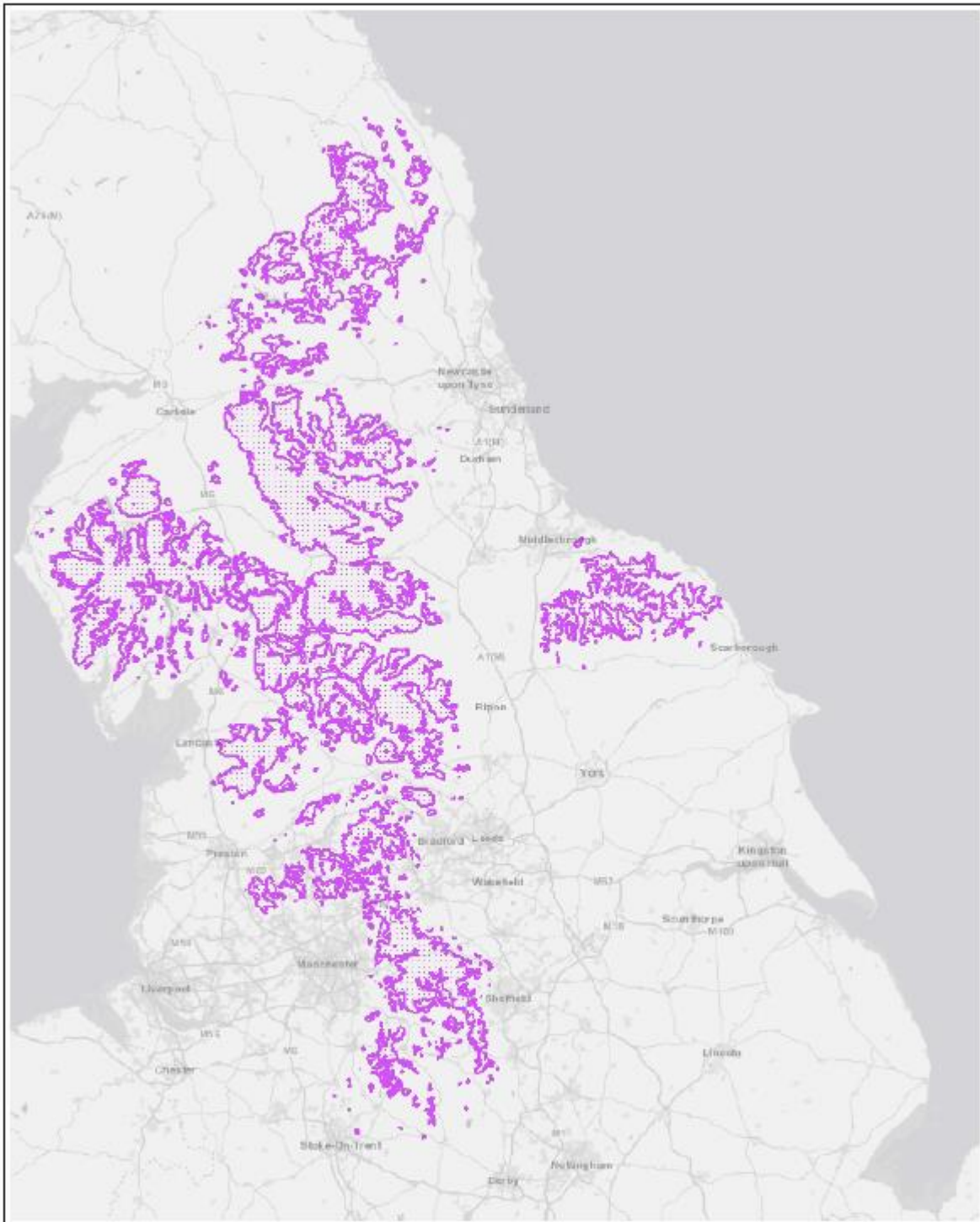
Locations were selected for release aviaries, within suitable hen harrier breeding habitat, within the trial area, and with cooperation of landowners and tenants. Release aviaries 13m x 5m in size were constructed of steel tubes and netting, covered at one end with tarpaulin material to provide a sunshade, rain protection, and as a screen to allow care

and handling personnel to approach without disturbing the birds. The release aviaries were protected by predator proof electric fences and security cameras. Local care and handling teams provided food daily, approaching the aviaries from the covered end to avoid disturbance. Once the birds were successfully flying around the aviaries, at about 4 to 5 weeks old, they were tagged and given a veterinary check. Approximately one week after tagging and this final veterinary check, the aviary doors were opened and the birds permitted to disperse. Food was provided on perches at the release sites for a few weeks after release, but in most cases was not used and the birds quickly dispersed away from the sites.

Disease Risk Assessment

A Disease Risk Analysis (DRA) was completed for the period that the eggs/chicks were planned to be in captivity. This identified and assessed infectious and non-infectious hazards that could identify the hen harrier eggs or chicks, risks of hazards arising from the translocation, and risks of alterations to local disease ecology. Strict biosecurity, veterinary and husbandry conditions were set out in the project's Disease Risk Assessment to mitigate the risks to acceptable levels.

Brood Management Trial Area



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Map Produced from WebMap on 29/06/17

Map Projection: British National Grid

Map Scale at A4: 1:1,500,000

Annex 2: Licence conditions and notes

This section shows the licence conditions and notes relating to the 2023–2024 licence to take and disturb a Schedule 1 bird species (in this case, hen harrier) for the purpose of science, research and education, under section 16(1)(a) of the Wildlife and Countryside Act 1981.

Licence conditions

1. These conditions apply to the licensee and any additional authorised person. The licensee and any additional authorised person(s) are responsible for ensuring that any licensed operations/ activities comply with all terms and conditions of the licence.
2. The licensee and any additional authorised person(s), shown on the licence, may act under the authority of this licence. The licensee or any additional authorised person(s) may also employ assistants provided they work under the direct personal supervision of the licensee or authorised person.
3. Whilst engaged in activities permitted by this licence, the licensee and/or any additional authorised person(s), must have access to a copy of this licence and produce it to any police officer or any Natural England officer on demand.
4. The Licensee and any additional authorised person(s) shall permit an officer of Natural England, accompanied by such persons as he/she considers necessary for the purpose, on production of his/her identification on demand, reasonable access to the site for monitoring purposes and to be present during any operations carried out under the authority of this licence for the purpose of ascertaining whether the conditions of this licence are being, or have been, complied with. The Licensee shall give all reasonable assistance to an officer of Natural England and any persons accompanying him/her.
5. This licence does not convey any right of entry upon land, and the landowner's/occupier's prior permission must be obtained, as necessary, before the licence is used.
6. No licensed activity shall be carried out under this licence on a National Nature Reserve or Marine Nature Reserve except with the prior written permission of Natural England.
7. A person authorised by the licensee shall provide him/her with such information as is within his/ her knowledge and is necessary for the Report, which the licensee is required to make to Natural England.
8. The 'Report by licensee of action taken under licence' must be completed, even if no licensed action is taken. It must be submitted online or sent to the Natural England office at the address shown on this licence, to arrive no later than 14 days (two weeks) after the expiry of the licence. Failure to make a report may result in the licence being revoked and/or any future applications being refused.
9. Natural England has the right to revoke or modify this licence at any time, if it is reasonable for it to do so. Reasons for revocation or modification could (without limitation) include developments relating to Avian Influenza or other diseases. We will notify you in writing if your licence is revoked or modified.

10. The licensee must notify Natural England in writing within 1 working day if any dead hen harriers are found by the licensee, authorised individuals or members of the care and handling teams, and within 5 working days if 3 or more dead cormorants, gulls or wild waterfowl (swans, geese and ducks) or 5 or more dead birds of any species (that have died other than by licensed action under a different licence) are found by the licensee, authorised individuals or members of the care and handling teams. You can notify Natural England by contacting Wildlife@NaturalEngland.org.uk and NEWLSSpeciesTeam@naturalengland.org.uk
11. This licence permits the licensee and authorised individuals to take only hen harrier eggs and/or unfledged juveniles by hand.
12. The following may be amended only with the written approval of Natural England:
 - a. The membership and terms of reference of the Scientific Advisory Group, approved by Natural England on 5 June 2019
 - b. The Monitoring and Evaluation plan, submitted to Natural England on 20 March 2023 (refer to Note 9)
13. No eggs or juvenile hen harriers may be taken into captivity under this licence unless the trial intervention threshold of two nests within 10km is surpassed. Where this is the case eggs or juvenile hen harriers may be taken from one of the two nests (and for the purposes of this licence the other nest shall be known as the “non-intervention” or “trigger” nest) provided all other conditions are met.
14. Whilst hen harriers are within the release pen, all release sites must have security measures which comply with Appendix 3 of the Project Plan dated 17 November 2021 and the responses to requests for further information submitted to Natural England on 20 December 2021 and 14 March 2022. Any amendment to these arrangements requires the prior written approval of Natural England. Any occurrences of unauthorised individuals approaching the pen (defined as reaching or attempting to reach the release pen) should be reported to Natural England within 24 hours of this occurring.
15. No eggs or juvenile hen harriers may be taken into captivity under this licence until the release site care and handling team have been identified and approved in writing by Natural England. Operatives fitting satellite tags must be approved by the British Trust for Ornithology
16. The licensee should ensure that all release sites are subject to thorough predator control of all species legally available and that there are no known occupied badger setts within 2km of the release pen. Any deviation from these proposed release site criteria and the below predator mitigation measures requires the prior written approval of Natural England. All release sites must have the following predator mitigation measures:
 - a. One of the following perimeter fences:
 - i. An electric perimeter fence around the release pen that meets the specifications submitted to Natural England on 26 April 2020. Ground preparation should ensure that the risk of short circuits is minimised and, whilst hen harriers are in the pen prior to release, the fence must be maintained intact and kept in proper working order at all times.
 - ii. A weldmesh perimeter fence around the release pen that meets the specifications and details most recently approved by Natural England

on 1 June 2021. Whilst hen harriers are in the pen prior to release the fence must be maintained intact at all times.

- b. Trail cameras which meet the specifications detailed within the response to a request for further information submitted to Natural England on 14 March 2022 must be installed to cover the release pen and perimeter fence. Any occurrences of badger or foxes approaching the pen (defined as reaching or attempting to reach the release pen) should be reported to Natural England within 24 hours of this occurring. WML-A27 (02/2022) Natural England Ref: 2022-62941-SCI-SCI
17. No eggs or juvenile hen harriers may be taken into captivity under this licence until:
- a. Natural England is notified of the location of the intervention nest, the non-intervention nest (see Condition 13) and the expected number of eggs/chicks to be taken, with details of landowners and confirmation of landowners' consent. The specific locations of the intervention and non-intervention nests must be provided (including 8 figure grid reference in the format 'XY 1234 5678'); and
 - b. Natural England is notified of the location of the release site that is intended to be used for the group of birds equivalent to the number taken from the intervention nest, with details of landowners and confirmation of landowners' consent (refer to Note 10). The specific location of the release site must be provided (including 8 figure grid reference in the format 'XY 1234 5678'); and
 - c. Natural England has confirmed in writing that it consents to the activity. To enable Natural England to process a request for consent, the licensee must give Natural England at least two weeks' notice of proposed activity, unless Natural England agree to a variation to this timing (refer to Note 11). For the avoidance of doubt, consent is required for all intervention nest and release sites regardless of whether they are located on a protected site.
18. Natural England reserves the right to require that hen harriers taken under this licence be released at a site other than that intended by the licensee. Reasons for exercising this right could (without limitation) include developments relating to Avian Influenza or other diseases. We will notify you in writing if this is the case.
19. No eggs or juvenile hen harriers may be taken into captivity under this licence until the licensee has confirmed to Natural England, they have in their possession sufficient satellite tags to allow the maximum number of individuals taken to be tagged as required by condition 20b. The licensee must review the number of tags available prior to each intervention and there must be sufficient tags of a range of sizes to allow for all sizes of birds.
20. The licensee must ensure that a representative sample of juveniles released as part of brood management are fitted with a satellite tag, in accordance with the Monitoring and Evaluation Plan submitted to Natural England on 20 March 2023 and the following sampling protocols:
- a. Excluding birds that are not eligible for welfare reasons a random male and random female bird from each intervention brood must be fitted with a satellite tag. If there are no eligible male birds in the brood, then two random female birds must be fitted with a satellite tag. If there are no eligible female birds, then two random male birds must be fitted with a satellite tag. If there

- are only two or one eligible birds in the brood, all must be fitted with a satellite tag.
- b. Once 16 birds have been fitted with satellite tags in accordance with condition 20a in any given year, any subsequent birds taken in that year may be released without a satellite tag in accordance with condition 20d.
 - c. Once it becomes clear that no further interventions are planned in a given year, the licensee must review the number of satellite tags fitted to brood managed birds in that year and the number of birds still in captivity that will be eligible to be fitted with a satellite tag under condition 20a. If the total number of birds fitted with a satellite tag in that year will be less than 10, then satellite tags must be fitted to additional brood managed birds still in captivity (once they are at the appropriate age) until either:
 - i. at least 10 brood managed birds have been fitted with satellite tags in that year; or
 - ii. all remaining birds that are not excluded for welfare reasons have been fitted with satellite tags.
 - d. Any birds that are not fitted with a satellite tag must be fitted with a colour ring combination or alphanumeric 'darvic' ring that allows identification of individual birds, unless it is determined by the Operative approved by the British Trust for Ornithology who is fitting the satellite tags and/or rings that to do so would be unacceptable for welfare reasons. If a hen harrier taken under this licence is not fitted with a satellite tag, colour ring combination or alphanumeric 'darvic' ring then the details of the bird affected and the reason for the decision should be provided to Natural England in writing within 24 hours of the decision to not fit a satellite tag or colour ring being made.
21. Captive rearing of eggs and/or chicks taken under this licence must be undertaken at [address of rearing facility]. The use of any other captive rearing facility requires the prior written approval of Natural England. For the avoidance of doubt, 'Captive rearing facility' in the context of this condition does not include rearing at release sites.
22. No other birds, except from hen harriers from this brood management trial, may be simultaneously held in the same captive rearing equipment and aviaries/pens as brood managed hen harriers.
23. The brooder enclosure to be used at the captive rearing facility at [address of rearing facility] must be the same as the one inspected by Natural England on 23 February 2022. Prior to occupation by hen harriers, the measures to improve the enclosure, agreed via email on 1 March 2022, must be implemented. Hen harriers must not be placed in a different brooder enclosure at this captive rearing facility without the prior written approval of Natural England. For the avoidance of doubt 'brooder enclosure' in the context of this condition does not refer to either the indoor facilities used to raise chicks until they are old enough to thermo-regulate, nor the release pens at the release sites.
24. Birds taken under this licence may be separated into age/size groups rather than remaining within intervention nest groups prior to being taken to the release site. Birds must not be mixed with birds from other broods until they have been through the quarantine and testing protocols detailed in the Addendum and Supplement to

- Appendix 2 of the Project Plan received by Natural England on 3 February 2023. The grouping of birds and allocation to release sites must follow the criteria detailed within Appendix 5 to the Project Plan received by Natural England on 3 February 2023. For the avoidance of doubt, the same number of birds taken from an SPA must be returned to the same SPA as per Condition 29 and Condition 30.
25. Hen harrier pairs must not be subject to brood management where they have been subject to brood management on their previous two nesting attempts, whether in the same year, or the previous year(s). If a third nesting attempt by the same pair is unsuccessful, then that pair must not be subject to brood management for subsequent attempts until either:
 - a. They successfully raise chicks in a subsequent nesting attempt; or
 - b. A non-intervention nest within 10km of the pair and within a SPA successfully raises chicks.
 26. Where proposed intervention nests are being provisioned by a polygynous male hen harrier the selection of the intervention nest shall follow the actions detailed within Appendix 6 of the Project Plan received by Natural England on 3 February 2023. Any deviation from these proposed actions requires the prior written approval of Natural England.
 27. Release pens must follow the specifications and maximum capacity detailed in Appendix 3 of the Project Plan received by Natural England on 3 February 2023. Hen harriers may not be placed in release pens with a revised specification without the prior written approval of Natural England. 'Release pens' under this condition only refers to the pen at the release site.
 28. Release pens must be located in landscape units that comply with the criteria in Appendix 4 to the Project Plan dated 17 November 2021, with the exception of altitude, which should be greater than 250m above sea level.
 29. The same number of hen harriers taken from a Special Protection Area (SPA) must be released back within the boundaries of the same SPA.
 30. See the map at Annex B to this licence. The same number of birds taken from the Northern Zone, North-Central Zone and South-Central Zone of the North Pennine Moors SPA must be released back into those same zones. In the case of intervention nests which are close to the border of contiguous zones, the licensee may, with the prior written permission of Natural England, return the birds to a neighbouring zone. If birds are taken from the Southern Zone of the North Pennine Moors SPA then the same number of birds must be released back into North Pennine Moors SPA according to the following:
 - a. If the non-intervention trigger nest is also within the Southern Zone and a hen harrier nest successfully raised chicks in the previous breeding season within the Southern Zone, then the birds may be released into any Zone.
 - b. If the non-intervention nest is not within the Southern Zone and/or there were no successful hen harrier nests within the Southern Zone in the previous breeding season, then the birds must be released within the Southern Zone. For the avoidance of doubt, in the context of this condition "successful hen harrier nests" are to be counted as either a natural nest successfully rearing chicks or a release of brood managed hen harriers within the Southern Zone.

31. In addition to the basic report of licensed action required by General Condition 8, the following detailed reports by the licensee, in consultation with the Project Board and the Scientific Advisory Group (SAG), must be submitted to Natural England:
- a. By no later than 14 October 2023: An interim report in respect of 2023 summarising the activities and research undertaken under the licence in 2023 (including the rearing success of the non-intervention nests) and provisionally updating the trial results to that date (i.e. to include 2018-2023).
 - b. By no later than 31 March 2024: A final annual report in respect of 2023 updating the trial results to that date (i.e. to include 2018-2023). This must include evaluation of post-release overwinter survival of the 2023 cohort of individuals, until mid-February 2024, and progress towards the goals of all three workstreams detailed in the Monitoring and Evaluation Plan.
 - c. By no later than 14 October 2024: An interim annual report in respect of 2024 summarising the activities and research undertaken during the licence in 2024 (including the rearing success of the non-intervention nests) and provisionally updating the trial results to that date (i.e. to include 2018-2024).
 - d. By no later than 31 March 2025: A final annual report in respect of 2024 updating the overall trial results to that date (i.e. to include 2018-2024). This must include evaluation of post-release overwinter survival of the 2024 cohort of individuals, until mid-February 2025, and progress towards the goals of all three workstreams detailed in the Monitoring and Evaluation Plan. A draft of this annual report must be considered at a meeting of the SAG. The finalised annual report must annex the minutes of the SAG meeting.

Notes:

1. Avian influenza (bird flu) is a notifiable animal disease and members of the public should use the new online reporting system or call the Defra helpline (03459 33 55 77) if they find one or more dead wild birds of any species. You should follow the additional guidance contained in Annex A: Avian influenza ('bird flu') and wildlife licensing.
2. This licence permits activities which will result in close contact with birds, bird faeces or eggs. In order to prevent the spread of avian influenza, care should be taken to dispose of any carcasses in line with Annex A and the current government guidance, which can be found at: <https://www.gov.uk/guidance/avian-influenza-bird-flu#public>. Persons operating under this licence should also abide by the latest Health and Safety Executive guidance on Avian Influenza to minimise risks to public health, which can be found at: <https://www.hse.gov.uk/biosafety/diseases/aisuspected.pdf>. You should regularly review these information sources to ensure you abide by the latest guidance.
3. Please read the details of your licence carefully to ensure that you comply with it paying particular attention to the number and species licensed as this may differ to what was requested in your application.
4. An additional authorised person is a suitably trained and experienced person who is able to carry out work under a licence without the personal supervision of the licensee. To carry out licensed activities their name will be on the licence. To comply with the

licence conditions, additional licensed persons should have a copy of the licence accessible when acting under the licence.

5. An assistant is a person assisting the licensee or the additional authorised person(s). Assistants are only authorised to act under a licence whilst they are under the direct supervision of either the licensee or the additional authorised person(s).
6. Please note the information of the 'Report by licensee of action taken under licence' may have changed from previous years. The data required in your report and the required format can be viewed on the Natural England website. Alternatively, you can request a copy from the Natural England address shown on your licence.
7. Wild birds, their eggs and nests (while in use or under construction) are protected under the Wildlife and Countryside Act 1981. Bird species listed under Schedule 1 of that Act have additional legal protection. It is an offence to intentionally or recklessly disturb any Schedule 1 wild bird while it is building a nest or is in, on or near a nest containing eggs or young, or to intentionally or recklessly disturb its dependent young. Only disturbance of hen harriers associated with the licensed taking of eggs or juvenile hen harriers is permitted under this licence; no other disturbance of other non-intervention hen harriers, or other Schedule 1 birds, is permitted. Care must be taken to avoid the disturbance of Schedule 1 birds during the breeding season.
8. If satellite tags are being fitted during warm weather, reasonable steps should be taken to keep birds cool, such as: fit harnesses in the cool of the day where possible, keep the bird on a cool surface rather than the operator's lap, minimise handling time, keep birds in the shade, and monitor temperature.
9. Natural England expect that the Scientific Advisory Group be consulted on any changes to the Monitoring and Evaluation Plan and a submission to change the Monitoring and Evaluation Plan should be accompanied by the minutes of the SAG meeting in which the changes were discussed.
10. It is acknowledged that the intended release site may differ from the actual release site used for any given brood/bird. This is acceptable provided all other conditions in relation to this licence are complied with, including prior approval of the actual release site used and numbers of birds returned to SPA.
11. The two-week notice period mentioned in Condition 17 (c) shall be counted from submission of all information necessary to satisfy Conditions 15 and 17 and, if relevant, information submitted to request amendments/deviation from the details in Conditions 14, 16 and 27.
12. Known goshawk territories should be avoided when selecting potential release sites. Release sites should also avoid proximity to waterfowl and gull colonies to minimise the risk from Avian Influenza.
13. The licensee should give due consideration to the capacity of the release pens when separating birds into age groups for transport to release sites.
14. Security arrangements at each release site should be determined on a site-by-site basis. However, at a minimum each release site security should include a roving human presence, appropriate security cameras with full coverage of the release pen and approaches and, if near public rights of way, appropriate signage.
15. Natural England expect that the protocols detailed within the Disease Risk Assessment to be complied with at all stages of the project.

16. Any documents or information requested by Natural England as a condition of this licence should be submitted by email to NEWLSSpeciesTeam@naturalengland.org.uk.

Annex 3: Details of tagged brood managed hen harriers

Code	Sex	Date tagged	Date last contact	Status December 2024
R1-F1-19	F	25/07/2019	01/04/2020	Missing Fate Unknown
R1-M1-19	M	25/07/2019	21/05/2020	Missing Fate Unknown
R1-M3-19	M	25/07/2019	05/05/2020	Missing Fate Unknown
R1-M4-19	M	25/07/2019	09/09/2019	Missing Fate Unknown
R1-M2-19	M	30/07/2019	19/09/2019	Missing Fate Unknown
R1-M1-20	M	11/07/2020	20/10/2020	Dead
R1-M2-20	M	11/07/2020	12/06/2023	Missing Fate Unknown
R1-M3-20	M	11/07/2020	04/10/2023	Missing Fate Unknown
R1-M4-20	M	11/07/2020	20/09/2020	Missing Fate Unknown
R2-F1-20	F	14/07/2020	15/11/2021	Missing Fate Unknown
R2-F2-20	F	14/07/2020	29/06/2023	Dead
R2-F3-20	F	14/07/2020	N/A	Alive December 2024
R2-M1-20	M	14/07/2020	07/12/2023	Missing Fate Unknown
R1-F1-21	F	08/07/2021	19/10/2022	Missing Fate Unknown
R1-M1-21	M	08/07/2021	01/12/2022	Missing Fate Unknown
R1-M2-21	M	08/07/2021	06/03/2022	Dead
R2-F1-21	F	20/07/2021	24/09/2021	Missing Fate Unknown
R2-M1-21	M	20/07/2021	11/06/2023	Missing Fate Unknown
R2-M2-21	M	20/07/2021	27/10/2021	Dead
R2-M3-21	M	20/07/2021	27/10/2021	Dead
R1-F1-22	F	14/07/2022	30/04/2023	Missing Fate Unknown
R1-F2-22	F	14/07/2022	29/04/2023	Missing Fate Unknown
R1-F3-22	F	14/07/2022	30/03/2023	Missing Fate Unknown
R1-F4-22	F	14/07/2022	25/09/2023	Missing Fate Unknown
R1-M1-22	M	14/07/2022	17/08/2022	Missing Fate Unknown
R2-F1-22	F	20/07/2022	15/12/2022	Missing Fate Unknown
R2-M1-22	M	20/07/2022	01/04/2023	Missing Fate Unknown
R2-M3-22	M	20/07/2022	31/05/2023	Missing Fate Unknown
R3-F1-22	F	04/08/2022	14/12/2022	Dead
R3-F2-22	F	04/08/2022	N/A	Alive December 2024
R3-M1-22	M	04/08/2022	23/08/2022	Dead
R3-M2-22	M	04/08/2022	05/10/2022	Missing Fate Unknown
R1-F1-23	F	08/07/2023	23/07/2023	Missing Fate Unknown
R1-F2-23	F	08/07/2023	24/08/2023	Missing Fate Unknown
R2-F2-23	F	19/07/2023	24/09/2023	Missing Fate Unknown
R2-F1-23	F	19/07/2023	25/06/2024	Missing Fate Unknown
R2-M1-23	M	19/07/2023	07/03/2024	Dead
R2-M2-23	M	19/07/2023	17/05/2024	Missing Fate Unknown
R3-F1-23	F	02/08/2023	11/08/2023	Missing Fate Unknown
R4-F1-23	F	08/08/2023	04/10/2023	Missing Fate Unknown
R4-M1-23	M	08/08/2023	N/A	Alive December 2024

Annex 4: Analysis of trends in numbers of nests by land use

A log-linear Poisson regression carried out after the 2023 breeding season was used to investigate the changes in numbers of hen harrier nests under different categories of land use (grouse moor or non-grouse moor) and brood management status (N/A, not available, available or used); see Table 2.

To check for differences in success rates between land use categories, the analysis was re-run including only nests that were successful (at least one chick fledged). The findings were the same as shown here, so these conclusions (an increase in numbers of nests on grouse moors where brood management was available) hold for successful nests as well as for all nesting attempts.

Model 1: comparing numbers on grouse moors to non grouse moors

The first model incorporated land use as a factor and year as an interaction term. This showed a significant increase in the number of hen harrier nests in England on land managed for grouse shooting during the Brood Management Trial (Fig. 3 and S1). In contrast, the increase in hen harrier nests on land not managed for grouse shooting during the same period was not significant (S1).

S1 Summary of Poisson regression model for the effect of land use on nest count during the Brood Management Trial. Significant results are highlighted in bold.

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-281.0022841	167.0751556	-1.681892	0.0925899
KGM – Yes	-456.0362411	202.5081301	-2.251940	0.0243260
Year	0.1401303	0.0826735	1.694986	0.0900781
KGM – Yes:Year	0.2260978	0.1001974	2.256524	0.0240379

Model 2: comparing numbers on grouse moors where brood management was available or used compared to those where brood management was not available.

For the second model, the nest habitat categories ‘KGM, BM available’ and ‘KGM, BM used’ were combined into one group, representing areas where brood management of nests was available to all land managers, whether it was implemented or not. This model incorporated brood management status as a factor and year as an interaction term. This showed that the significant increase still held when only considering the nests on moors where brood management was available (Fig. 4 and S2).

S2 Summary of Poisson regression model for the effect of brood management status on nest count during the Brood Management Trial. Significant results are highlighted in bold.

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-281.0022841	167.0751556	-1.6818915	0.0925899
BM unavailable	-138.2760796	236.5892786	-0.5844562	0.5589134
BM available or used	-706.4318338	231.6044623	-3.0501650	0.0022872
Year	0.1401303	0.0826735	1.6949857	0.0900781
BM unavailable:Year	0.0684383	0.1170655	0.5846158	0.5588061
BM available or used:Year	0.3497037	0.1145813	3.0520148	0.0022731

Model 3: comparing numbers on grouse moors where brood management was used compared to those where brood management was theoretically available.

The third model looked only at areas where brood management was available, using the separate categories 'KGM, BM available' and 'KGM, BM used'. Model 3 incorporated brood management status as a factor and year as an interaction term.

This found that the increase was also shown in areas where brood management was theoretically available but not in practice been used ('brood management available'). There was no significant difference between the increase in these two groups (S3).

S3 Summary of Poisson regression model for the effect of brood management status on nest count during the Brood Management Trial, within areas where brood management was available to all land managers. Significant results are highlighted in bold.

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-1195.6912101	252.0871380	-4.7431663	0.0000021
BM used	253.1207235	324.9422145	0.7789715	0.4359965
Year	0.5923724	0.1246834	4.7510142	0.0000020
BM used:Year	-0.1249879	0.1607213	-0.7776685	0.4367645

