Hen Harrier Brood Management Trial Project Plan

Context: In 2016 Defra published the Joint Hen Harrier Action Plan. The plan included a number of actions including trialling a brood management scheme. This trial delivers that that action.

This project plan is supplementary to the information set out in the rest of the licence application. As such it does not set out all the technical detail of the scheme rather it focuses on the governance and decision making elements. However for ease of reference information on the practicalities of the scheme, which is provided elsewhere in the application, has been included as Appendixes to this Project Plan.

Natural England reports annually to the Upland Stakeholder Forum on progress with all aspects of the plan including the Brood Management Trial.

Aim: The project will implement a field trial to test the design and help understand the practicalities of a brood management scheme and evaluate its contribution in delivering more hen harriers to the Northern uplands. Specifically the trial will test:

a) the practicalities of brood management: can eggs or chicks be taken from the wild and raised in captivity, can those chicks be released back into the wild and the implications for chick survival.

b) changes in social attitudes by those involved in upland land management to the presence of Hen Harriers on grouse moors with a brood management scheme in place.

The implications for chick survival will be tested by comparing chick and fledgling survival rates from the trial with those found in the literature and through the work of Natural England's hen harrier project.

Changes in social attitude will be measured through a study undertaken by the Universities of Aberdeen and Bangor which will ask a series of questions about attitudes and feelings towards Hen Harriers both before and after the advent of a trial (see Appendix 1).

The Trial area:

The trial will take place in the uplands of England within the area defined by the moorland line. Map 1 shows this area

Within the Trial area:

- nests can only be managed with the consent of the land owners and managers (see below),

- nests can only be managed where they have the potential to reduce the shootable surplus of grouse.
- broods managed from within an SPA with a conservation objective for breeding Hen Harriers will be released back into that SPA
- broods managed from outside of an SPA will be released back into suitable habitat within the trial area and where practical close to the area from where they were taken
- all birds released will be satellite tagged

Timescale:

The Trial will run for 5 years.

Governance

Roles and responsibilities

Project Role	Responsibilities	
Project Board	Ultimately accountable for all aspects of the trial. Responsible for signing off project design Responsible for decision making on which broods are managed and ensuring that proper liaison with NE local team is undertaken and that all the conditions of the licence are met. To meet as often as is necessary to fulfil this function and correspond between meetings where required. To ensure reporting from the project team is timely and acted upon. To act as the customer for the social science project and analysis of satellite tag data and to use the results to inform decisions about the trial outcome.	Rob Cooke/NE Chair Adrian Jowitt/NE Steve Redpath/Aberdeen University Jemima Parry-Jones/ICBP Adam Smith/GWCT Philip Merricks/HOT Amanda Anderson/MA Robert Benson/MA

	To undertake the necessary reporting to the Upland Stakeholder Forum and Defra at least on an annual basis. Review progress and improve operations where necessary. To oversee project external communications. To produce an annual report to be assessed by NE ornithologists, to assess the progress of the trial.	
Project Manager	Responsible for day to day coordination of trial design and rollout and providing secretariat for the Project Board. To lead on the funding, procurement and coordination of the social science survey To ensure that analysis of the satellite tag data is undertaken and written up. Note: This will be done by Natural England either in house or in partnership with academic bodies.	Principal Advisor Natural England 0.2 FTE *
Field Ecologist	Oversee the monitoring of Hen Harriers and nests. Work will be undertaken by both the ecologist and Natural England registered volunteers Responsibility for tagging chicks prior to release under supervision of Head of Bird Management Collation of satellite tag data on bird movements Liaising and working with estates for both nest monitoring and release site assessment and approval	Natural England Advisor 0.25 FTE *
Head of bird management	Responsibility for ensuring all aspects of bird husbandry, from the point eggs removed from nest to release back in to fledging area, are in place and undertaken to necessary standards. Provision of all equipment and personnel necessary to move eggs and chicks to and from the remote [redacted] rearing facility. Provision of	Jemima Parry-Jones/ICBP

	remote rearing facility and responsibility for ensuring it is managed to required hygiene levels. Ensuring that release aviaries are correctly set up and transporting birds to the release site Training of staff managing release aviaries This work will be carried out under contract to the Moorland Association.	
Project Board + Head of bird management	Responsibility for ensuring: <u>Tasks associated with releasing young HHs</u> Approved sites are agreed prior to any egg removal. Infrastructure is correct and in place in good time. Approved workers are sourced and trained in good time to carry out husbandry and monitoring of health and behaviour once birds have been transferred to release aviaries.** Source of food and storage facilities are in place. Satellite tags for each bird are resourced and ordered in good time.	Working with PB and JPJ: Field Ecologist NE advisor; Moorland Association & GWCT

* This is an estimate of average FTE requirement. Actual in year resource will vary depending on the number of nests and levels of intervention.

** For practical reasons exactly who undertakes this work will depend on the particular release site, its location and the staffing available in the area. Availability of suitable staff will be part of the Project Boards assessment of the release site.

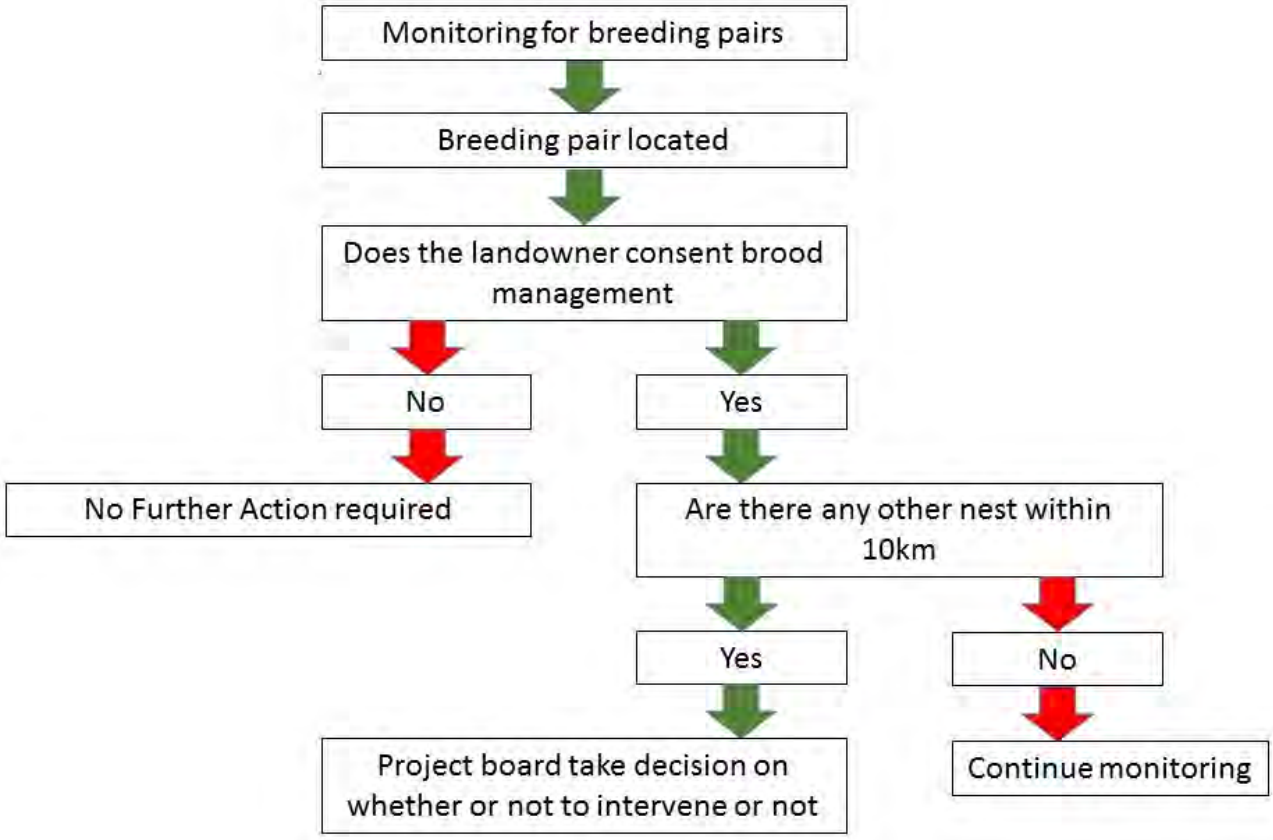
Resources

The Brood management trial is a joint project with resources provided by organisations represented on the Project Board and by Defra.

All elements of bird husbandry will be funded by the Moorland Association. A legal agreement between [redacted] has been drawn up to ensure that this agreement is maintained.

The first phase of the Social science, questionnaire design and pre-trial roll out has been funded by Natural England, Defra and GWCT.

Brood management process flow chart:



* The decision as to whether to intervene or not is based on the following criteria:

- The land owner wants to undertake BM on this nest
- There is another nest within 10km of the nest being considered
- There is 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 chick handling infrastructure is in place
- The release site is agreed and the aviary will be put in place with any necessary consents granted in time
- There are suitable personnel and resources in place to manage the birds until release

Exit Strategy

The Project Board, with information provided by project team members through regular reporting, will monitor the trial progress. The Project Board will compare the results of the trial to data from the Natural England Hen Harrier Study, literature and expert opinion. The Project Board will stop the trial at any stage if:

- The number of eggs failing to hatch is greater than expected in the wild and this cannot be explained by natural factors.
    - Time of Decision: Dependent on number of clutches brood managed to reach a conclusion.
    - Monitoring to inform decision: Each clutch hatching recorded. Annual review

- Mortality of chicks/fledglings whilst at [redacted] and in transport is greater than normally expected for captive reared birds.
    - Time of Decision: Dependent on number of eggs hatched to reach a conclusion.
    - Monitoring to inform decision: Fate of each egg hatched recorded continuously. Annual review

- Mortality of fledglings whilst in release pens is greater than normally expected for captive reared birds
    - Time of Decision: Dependent on number of fledglings released into pens to reach a conclusion.
    - Monitoring to inform decision: Each bird monitored twice daily. Weekly reporting to NE advisor but ill-health or death reported instantly.

- The behaviour of chicks post release is sufficiently unnatural that there are concerns that the birds will not integrate back into the wild population
    - Time of Decision: Dependant on number of birds fledging to reach a conclusion.
    - Monitoring to inform decision: Analysis of sat tag data in early dispersal period and dispersion period on an annual basis.

- Higher than expected mortality of birds post release
    - Time of Decision: Dependant on number of birds fledging and number of deaths to reach a conclusion.
    - Monitoring to inform decision: Continuous monitoring of birds' tag data, body recovery and by post mortem analysis following existing NE protocol. Annual review. If the trial is terminated, any birds still in captivity/release pens will continue to be cared for until release as per the trial protocol.

Risk Register

Risk	Title	Comment	Risk Owner	Prob	Impact	Level	Mitigation	Residual Prob	Residual Impact	Residual Level
1	Key staff project personal leave role or are unavailable	The project requires a few key people with particular skills to ensure all elements of the trial run according to plan. Loss of one of these staff would jeopardise the ability of the trial deliver its aim	Project Board	M	M	4	Identify organisational roles rather than individuals were possible. Use a range of staff so that knowledge is shared. Regular reporting for ease of hand over if required For release site always ensure that more than one staff member at the site is trained and available.	M	L	2
2	Birds are injured or become ill as a result of being in captivity	Although one of the aims of the trial is to test our ability to raise Hen Harriers in captivity and return them to the wild, if birds are injured or become ill as a result of holding them in captivity this would be detrimental to the conservation status of the species	Head of Bird management	M	H	6	Undertake a full disease risk assessment. Manage rearing and release facilities to a high stand of hygiene, following best practice. Exit strategy in place	L	H	3
3	Vandalism of release aviaries	It is possible that the release aviaries are targeted by vandals or people opposed to the trial	Project Board &	M	H	6	Put Security measures in place. These could include the following:	L	M	2

		resulting in either infrastructure not being ready in time or birds being released early.	Head of Bird Management				Keep the location confidential, but notify police. Ensure the location is not in an area visited by the public and where possible vehicle access is through private land. Ensure that estate's staff~~s~~ are alert to the risk. Identify back up release sites. Use of trail cameras at and on routes to site			
4	Necessary infrastructure is not in place in time	If necessary rearing facilities are not in place on time nests cannot be brood managed resulting in a loss of confidence in the trial by moorland managers	Head of Bird Management & Moorland Association	M	M	4	Ensure that relevant people are notified as soon as potential second pair of birds is identified to identify best release site options. Source or pre-purchase equipment for release aviaries. Hold pre-season planning meeting to ensure all actors are alert to necessary requirements. Ensure good communication with upland stakeholder so that in the event of unavoidable delays they are aware of the reasons	L	L	1

5	Funding	Funding short fall or unavailable for elements of the project	Social science: Project Manager Bird husbandry: Head of Bird Management & Moorland Association	M	M	4	Secure funding and trigger elements of work that can be commissioned ahead of licence application (social science). For bird husbandry and tracking, undertake no BM until funding available and have a legal contract in place to ensure all birds currently in captivity will be reared to release regardless.	M	L	2
6	Sat tags fail	The trial intends using a new type of tag with better real time tracking ability. There is a risk that these do not provide the data required	Project Board	L	M	2	Revert to tags used by NE tracking scheme.	L	L	1
7	Sat tag data	Risk that data, available to those taking part in the trial is used to either persecute birds or to undermine the trial	Moorland Association and Project Board	L	M	2	Ensure data access platform is secure and each user is password protected. Develop user protocol for security. Eyes and ears on the ground report any suspicious visitors to areas where know tagged birds are to police	L	M	2

Appendix 1:

Title: Hen harrier brood management and stakeholder preferences

Researchers:

Dr Freya St. John, Lecturer in Conservation Social Science, Durrell Institute of Conservation & Ecology (DICE), School of Anthropology & Conservation, University of Kent.

Professor Steve Redpath, Chair in Conservation Science, Institute of Biological & Environmental Sciences, University of Aberdeen

Issue: There is an ongoing conflict between grouse managers and conservation organisations over hen harriers. Harriers have virtually disappeared from England as a breeding bird. DEFRA published its Joint Action Plan to increase the English hen harrier population. One aspect of this plan deals with brood management, whereby an upper limit for hen harrier densities would be set and if densities increased beyond this level, excess broods would be reared in captivity to avoid the period of highest predation on grouse. These birds would then be released at fledging and allowed to re-join the wild population.

The perceived advantage of this approach is that it may give grouse managers the confidence to co-exist with breeding hen harriers, in the understanding that harriers will be removed before they reach densities at which they become too damaging for driven grouse shooting. However, we don't know whether this is the case, so the question we seek to explore is how do grouse managers "feel" about this approach compared to others in the Action Plan and would they be more likely to leave hen harriers to breed on their land if such a scheme was put in place? We can also explore how a brood management scheme changes perceptions by collecting the same data before and after the advent of the scheme

Proposed study

The proposed study will investigate the prevailing perceptions of English grouse keepers, grouse moor owners and conservationists towards 1) hen harriers and their presence as a breeding bird in the English uplands, 2) preference for alternative hen harrier management strategies in the DEFRA action plan (BMS / feeding / reintroduction / enforcement & do nothing), and 3) relationships between different groups of stakeholders

Beliefs underlie behavioural decision-making and are influenced by experiences and other developed emotions (Jochum *et al.* 2014). Recent work by St. John *et al.* (2015) identified the importance of descriptive and injunctive norms in people's conservation decision making. Building on such work, this project will also draw on cognitive psychology in order to capture the important role that immediate emotional responses to stimuli, such as conflict species, may have on the decisions that people make. Using a questionnaire, data on respondents' **experiences and perceptions** of hen harrier predation, **emotional response** to hen harriers, and **ratings of management options** will be measured. Coupled with data on estate characteristics, respondent demographics (e.g. profession, age and years of grouse management experience), this work will allow us to identify characteristics associated with levels of support for different management strategies with a special focus on brood management.

Experiences and perceptions: Open-ended questions will be used to explore respondents' experiences of hen harriers in general, and specifically on the estate where they are currently based (if appropriate). Further, Likert-style questions will be designed to measure current perceptions of hen harriers and their perceptions of other organisations.

Emotional response: Here we will draw on cognitive psychology, specifically work on dual process models which divide human thought processes into two intertwined systems, one which is fast-acting and automatic in nature, and another which operates at a slower speed and encompasses 'logical' thought processes (Evans 2003). It has been argued that the fast-acting emotion-based nature of this first system works as a heuristic or decision making short-cut by providing an initial assessment of a stimulus which the second system should then contradict or reinforce. This suggests that immediate emotional responses to stimuli, such as hen harriers, may dictate the extent to which additional information (e.g. scientific data on hen harrier predation behaviour) is evaluated, and ultimately the final decision made (Slagle *et al.* 2012). Resolving how respondents' emotional response to hen harriers, long associated with management-challenges, relates to their decisions to support or oppose management interventions, such as brood management, is crucial to designing effective conservation interventions.

Ratings of management options: Scenario-based questioning will be used to measure respondents' level of support for different management options (as outlined in DEFRA action plan) and hen harrier population levels including a baseline 'business as usual' scenario. For example, to measure levels of support for hen harrier brood management, respondents will be asked to score the following scenario *'An upper limit of one pair of hen harriers every 10Km^2 will be set and if densities increase beyond this level, excess broods will be removed from the estate and reared in captivity away from the moor in aviaries. This will reduce grouse predation by adult hen harriers foraging for their young. Birds raised in captivity will be released at fledging to re-join the wild population'* according to three criteria: intention to support suggested management regime; perceived benefits for grouse management; and perceived benefits for the hen harrier population.

Budget & timeline

This project will last for seven months and includes questionnaire preparation, data collection, data analysis and reporting phases:

	Project months						
Activitity	1	2	3	4	5	6	7
Initial meetings & questionnaire prep							
Pilot study							
Data collection							
Data analysis							
Report & paper writing							
Final meetings & submission of outputs							

Approach

We will use a combined approach involving meetings initially with DEFRA/NE to develop questionnaire. We will then pilot it, adapt it and circulate online with the help of stakeholder organsiations to get the views of land owners, keepers and conservationists. We hope that organsations will chase up their members to ensure a good return rate. Once we have the returns we will also run some follow up interviews with representatives from the organisations to ensure we understand answers given. We seek funding to support 4 months of research assistant time and support of St. John over 7 months. Redpath seeks to cover expenses.

Outputs

We will produce a report for funders and the hen harrier brood management trial group and submit the work to a peer reviewed open-access journal.

References

Bradley M.M. & Lang P.J. (1994). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25, 49-59.

Conner M. & Sparks P. (2008). Theory of planned behaviour. In: *Predicting Health Behaviour* (eds. Conner M & Norman P). Open University Press: Maidenhead, UK., pp. 170–222.

Cross P., St. John F.A.V., Khan S. & Petroczi A. (2013). Innovative techniques for estimating illegal activities in a human-wildlife-management conflict. *PLoS ONE*, 8, e53681.

Evans J.S.B.T. (2003). In two minds: Dual-process accounts of reasoning. *Trends in Cognitive Sciences*, 7, 454-459.

Jochum K.A., Kliskey A.A., Hundertmark K.J. & Alessa L. (2014). Integrating complexity in the management of human-wildlife encounters. *Global Environmental Change*, 26, 73-86.

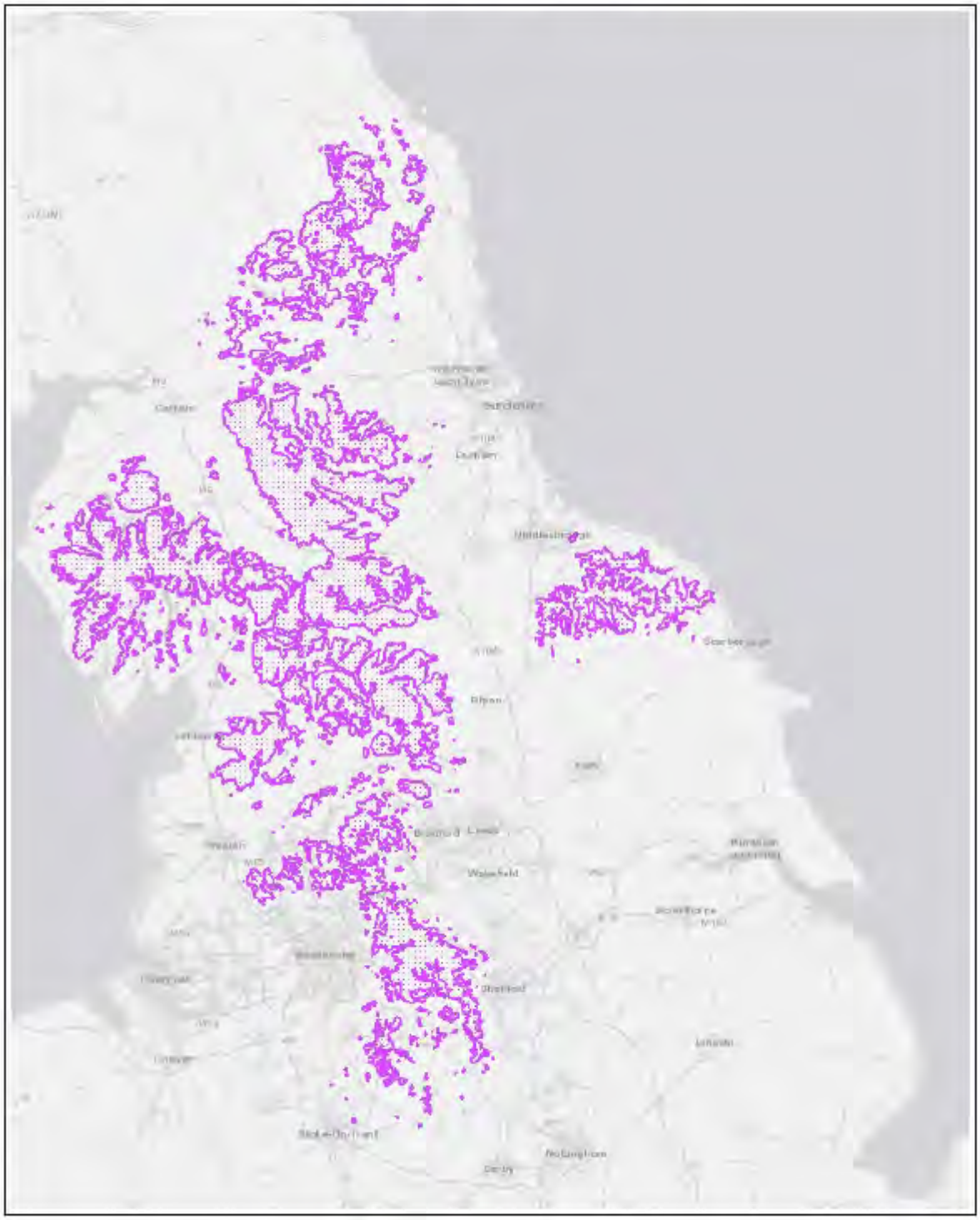
Nuno A. & St. John F.A.V. (2015). How to ask sensitive questions in conservation: A review of specialized questioning techniques. *Biological Conservation*, 189, 5-15.

Slagle K., Bruskotter J.T. & Wilson R.S. (2012). The role of affect in public support and opposition to wolf management. *Human Dimensions of Wildlife*, 17, 44-57.

St. John F.A.V., Mai C.-H. & Pei K.J.C. (2015). Evaluating deterrents of illegal behaviour in conservation: Carnivore killing in rural Taiwan. *Biological Conservation*, 189, 86-94.

Map 1.

Brood Management Trial Area



Map Produced from WebMap on 29/06/17	Map Projection: British National Grid	Map Scale at A4: 1:1,500,000

APPENDIX 1: Description of Brood Management Trial

Reason for the trial:

The Brood Management trial is one of 6 actions in the Governments Joint Hen Harrier recovery plan (Defra 2016). The trial will look to see if a scheme of this type would be likely to increase the numbers of hen harriers present in the uplands of England whilst also protecting the economic viability of grouse moors. In doing so the expectation is that the perceived conflict between Hen Harriers and Grouse management will be reduced leading to a cessation of illegal persecution and an improvement in the conservation status of the Hen harrier. Natural England's Science Advisory Group has endorsed the use of a trail to strengthen the evidence for informing a future decision about brood management. .

The trial will test:

- the ability to take eggs from the wild and rear the chicks in captivity;
- the survival of those chicks once they had fledged and are released back into the wild;
- the impact of brood management on perceptions and behaviour of the moorland community.

What action will be undertaken:

- If Harrier nests go above a density of 0.0125 nests/km (or 10km between nests)(see Note below) in England, in an area where high densities of Hen Harriers might have an have an impact on Grouse numbers available for driven shooting and where the landowner wishes the intervention to happen, the eggs or chicks from one of the nests at that site will be removed and reared *ex situ*. This would have the effect of reducing the density to below that which has been shown to impact upon the numbers of grouse chicks surviving to allow driven shooting (Elston 2014). Landowners may choose not to brood manage and to leave the broods to develop naturally or to undertake diversionary feeding.

- The density figure used as a trigger for intervention in the trial is 0.0125 nests/km^2. Elston 2014 showed that at harrier densities of or below 0.025 harrier impacts were predicted to reduce autumn grouse densities by <10%, suggesting that a quota scheme could theoretically support coexistence between grouse shooting and harrier conservation. The paper goes on to say that stakeholders will also need to recognize that a number of uncertainties remain about the impact of harriers on grouse and the design of a quota scheme. Because of those uncertainties the paper suggests it may be advisable initially to take a precautionary approach, as grouse managers are more likely to favour building up from low densities of harriers. For this reason the lower figure used in the model (0.0125) has been used as the basis for the trial.

- Eggs will be hatched and chicks reared in aviaries before being released back onto the moorland. The chicks would be managed under very strict biosecurity and husbandry conditions as set out in the Disease Risk Management document in Appendix 2.

- All chicks will be satellite tagged before being released.

- In parallel to the actual brood management work a social science study will be undertaken by Kent University in collaboration with Prof Steve Redpath from Aberdeen University to investigate the prevailing perceptions of English grouse keepers, grouse moor owners and conservationists towards 1) hen harriers and their presence as a breeding bird in the English uplands, 2) preference for alternative hen harrier management strategies in the DEFRA action plan (BMS / feeding / reintroduction / enforcement alone or in combination) in addition to a do nothing scenario, and 3) relationships between different groups of stakeholders.

Location of release sites

The release sites will be in the same general area, within or as close to as possible the SPA, from which the eggs were collected but for practical reasons will not be at the exact same location. These reasons include the need for easy access, security and avoidance of disturbance to shooting interests. The identified release sites are described at section A2 of the Draft HRA.

Release protocol

A detailed description of the release process provided in Appendix 3

Appendix 2 Disease Rick Assessment

Introduction to Hen Harrier (*Circus cyaneus*) DRA

Natural England is planning a programme brood management to mitigate the conflict between moorland owners and breeding hen harriers in Northern England. Brood management is a proposal whereby if Hen Harrier nests go above a pre-agreed density eggs or chicks from one of the nests are removed. The eggs will be transported to a suitable experienced facility, hatched, the young reared and then released back on suitable pre-agreed release sites in Northern England. This is a five year trial.

A first-stage feasibility assessment has already been considered, in which the suitability of potential release sites was assessed in terms of the following: habitat size and connectivity; accidental mortality risk; conflict with local economic interests; and conflict with other species. In addition the assessment will include a shortlist of potential release areas for more detailed surveys; the development of field survey protocols for prey/other food source availability in the shortlisted sites; a methodology for post-release long-term monitoring using satellite telemetry.

In compliance with IUCN and OIE guidelines (Jakob-Hoff et al., 2014), an essential component of translocation planning is to conduct a disease risk analysis (DRA). Risks are a combination of likelihood and consequences.

A comprehensive DRA is a step-wise and collaborative process. All methods have been based on guidance in the IUCN/OIE Manual of Procedures for Wildlife Disease Risk Analysis, in combination with the Disease Risk Assessment Tool (DRAT) specified in the IUCN/OIE Manual (Jakob-Hoff et al., 2014).

Whilst the IUCN/OIE Manual on Wildlife Disease Risk Analysis, advises where possible that a multi-disciplinary approach and involvement is applied to a DRA, it also accepts that this is not always possible or relevant. This DRA is created by a qualified Specialist in Avian Medicine [redacted] BVetMed DipECZM (avian) FRCVS, RCVS and EU Recognised Specialist in Avian Medicine), with reference to the IUCN/OIE Manual. In this case a small number of eggs will be retrieved from the wild, incubated and hand reared in a barrier nursing situation (with appropriate health screens and checks), prior to release as a group in a previously unused, purpose designed and managed aviary, which minimises any risk of human, fomite or wildlife derived infection. The young birds will then (following appropriate health screening), be released back to the moor, close to their site of origin.

There are three key objectives:

- ***Objective 1: Hazard identification***

To identify infectious and non-infectious hazards to which Hen Harriers are known to be, or are considered likely to be susceptible to:

a) Infection / contamination present when coming into captivity

The eggs that are removed from nests on the moor could be carrying infection.

The eggs will be candled at the nest site.

Any eggs that do not appear to be developing normally, will be removed and either destroyed, or placed in a quarantined transport box and subsequently quarantined incubator until the outcome is known.

At hatching, the shells from each egg, will be cultured for any indication of bacterial or fungal contamination, if found the chick will be treated appropriately. No chick would be considered for later release, unless screened and found to be healthy following treatment.

b) **Infected eggs could contaminate other eggs in the facility and vice versa**.
Incubation staff are extremely experienced, any suspect eggs will be separated from healthy hen harrier eggs and maintained in a 'quarantine' incubator, thereby reducing ay risk to healthy hen harrier eggs, or any other eggs in the incubation facility.

The hen harrier eggs will have a dedicated incubator that will be cleaned and disinfected prior to their arrival. The incubator/s will be disinfected every 2 weeks and between clutches.

c) The chicks could contract infection while being reared
Chicks will only remain on site at the incubation facility, until they are of sufficient age to feed and pull form themselves and travel safely to have rearing completed for release, back on the moor (approximately 3 - 5 weeks), i.e. this period of potential risk is minimised in duration.
Chicks will be trained to self-feed as early as possible, to minimise the risk of contamination during handling. Chicks will be crèche reared, to reduce risk of imprinting and subsequent reduced possibility of breeding naturally. Rearing staff will be fully trained and conversant in the principles and practices of 'isolation and barrier nursing', working under the direct supervision of a qualified Specialist in Avian Medicine. The chicks will benefit from barrier nursing throughout their time from hatch to removal from the rearing facility.

d) **The growing chicks could contract infections** [redacted]
The aviary to be used for initial rearing at the incubation site, is purpose designed and constructed, and will not have been used prior to the first batch of hen harrier chicks, (it would be emptied, cleaned and disinfected prior to any subsequent seasons). The aviary will have a covered roof (to reduce risk of faecal contamination by wild birds), mesh small enough to prevent access by any rodents, vermin or other pests. The base to each wall will be solid to prevent entry by ground dwelling vertebrates and invertebrates (potential pathogen fomites and parasitic intermediate hosts). The floor of the aviary will be solid and impervious, to prevent access by any relevant burrowing parasite intermediate hosts. The aviary is situated in an area separated from other aviaries at the facility, staff servicing the aviary will not be permitted to concurrently service any other birds at the facility. Separate outer clothing and footwear, will be used by any staff entering the aviary, and remain at the site of the aviary. If at the time of rearing, there is any perceived risk of insect vector born infections (e.g. avian pox or West Nile Virus), then the aviary will also be fitted with mosquito netting. Chicks being reared will only be fed on de-thawed, (previously frozen (rodents, i.e. by avoiding avian derived food, the risk of food born infection is reduced. A selection of the same batch of rodents will be submitted to laboratory based health screening, prior to being fed to the hen harrier chicks.

e) Risks in transportation
Transportation containers will be new or effectively disinfected prior to use, they will be IATA compliant. They will be clean, well ventilated, subdued lighting, all aspects of travelling will be based about the welfare needs of the eggs, neonates or chicks.

f) Prior to leaving the incubation facility, all chicks will be subjected to the following tests: Faecal direct microscopic and floatation examination of nematodes, trematodes, cestodes and protozoa. Faecal microbiology tests will be carried out by a quality controlled commercial avian diagnostic laboratory, with specific transport media and selective media as required, for any mammalian and avian pathogen, to include *Campylobacter* spp, *Salmonella* spp. Each bird will be checked in day and night time for ecto-parasites.

g) If any abnormalities are detected on any of the pre-release health screens, relevant treatment will be administered and the chicks only be released, if their 'clear health status' can be effectively assured.

h) Risk of infection, disease or injury in the release aviary on the moor

Once the young birds are in the release aviary, (at the release site) they will have no greater chance of infection, injury or disease than any wild hen harrier chick. Potentially less as the wholesomeness of the food will be assured. Onward development, behaviour and all welfare aspects will be monitored constantly by the trained and appointed staff.

i) Stress in catching up for tagging – wild hen harriers have been tagged for a considerable time now, the methods of catching, holding and tagging are designed to cause minimum stress

j) When released back to the wild

Non-infectious/disease hazards:

Hen Harriers, in line with almost all raptors have a high mortality rate in the first year. This is typically related to unsuccessfully hunting, flying accidents, such as collision with man-made objects, (e.g. barbed wire, other forms of fencing to vehicles). Severe weather conditions can impact birds, particularly in migratory raptors obliged to cross large areas of water or desert. All of these risks could be said to be natural.

The greatest anticipated risk: it is well reported (Molina et al 2011, Reche et al 2003, Anon 2008), that the greatest threat to hen harriers is illegal shooting or poisoning, which is reported to be conducted by members of shooting fraternity, in view of the longstanding conflict between hen harrier populations and managed grouse moors. Limitation of this risk is outside the control of these licensees. However one of the aims of the trial is to test the impact of brood management on perceptions and behaviour of the moorland community (as measured through social science) the expectation being that brood management will provide a mechanism to reduce the conflict between Grouse shooting and Hen Harriers.

k) Disease/Infectious hazards:

There is a paucity of data on the causes of death in free living hen harriers, other than those resulting from failed hunting, inclement weather and illegal shooting and other forms of raptor persecution. Harriers have been known to die through heavy worm loads typically ingested with food. Hen harriers are also be susceptible to infection with *Trichomonas gallinae*, contracted by eating fresh (warm) avian derived food. Salmonellosis through consumption of infected food, other bacteria such as *M avium*, and viruses such as paramyxovirus, avipox and avian influenza typically through eating infected birds (Klaphake & Clancy 2005).

All these risks are most likely to affect first year hen harriers before or subsequent to natural dispersal. In this trial, such diseases will be prevented at the incubation facility and in the pre-release aviary on the moor. The risk of young harriers being exposed to these pathogens prior to release is minimised by the feeding of 'health assured' thawed rodent food only.

Birds will be assessed for fitness for release, and will be supported nutritionally until hunting well and self-sufficient. Numbers of birds released at each site, conditions e.g. weather, time of day etc. for each release, will be planned and assessed in line with the welfare needs of the individuals being released.

The young birds released as part of this trial, would be subject to exactly the same natural wildlife risks following release. If birds are observed roosting or perching subsequent to release, attempts to collect faeces from under those perch or roost positions and monitor post release endo parasites will be made.

Transmitters placed on all released birds will allow capture of any birds which are sick for any period of time, or else wise recovery of carcases. All carcases will be submitted for post mortem examination with either APHA or will be conducted by [redacted] FRCVS with histology conducted by the International Zoo Vet Group (conducted by RCVS or ECVP Specialists in zoo/wildlife pathology).

Young birds will be supported during the period of learning to hunt. They will not be released until they are competent at flying. It is considered that the risks detailed above are acceptable and unavoidable, in respect that they are natural hazards, for young free living hen harriers, at this stage of development.

- ***Objective 2: Risks of hazard introduction arising from the translocation***
    - To identify and assess the likelihood of hazards being introduced and spreading or becoming established in the release areas, together with the likelihood and magnitude of any consequences for wildlife, domestic animals or humans as a result of the translocation.

  The likelihood of chicks being infected with bacterial, viral or parasitic pathogens is considered extremely remote, in view of the feeding regime, housing and health screening prior to release. The young harriers will undergo detailed faecal and blood health screening prior to release (as detailed above). The birds will be returned to moorland where their eggs were collected from, or as close as possible to it, in the interim they will not have come into contact with any other birds, they will have been barrier nursed and contact with fomites and parasitic intermediate hosts will have been prevented. It is the intention that all young harriers will be released, without any endo, ecto or haemoparasites, or pathogenic bacteria, yeast or viruses.

    - To outline mitigation options where applicable

  Extensive faecal and blood screening, will be used to assure the hygiene status of all chicks prior to release. All will be birds who originated from the area with the risks that would have been there had they been hatched and reared by parents in the wild.

- ***Objective 3: Risks of alterations to local disease ecology***
    - To identify and assess the likelihood of hen harriers affecting local disease ecology in the release areas of Northern England, together with the likelihood and magnitude of any consequences of a change in local disease ecology against the current background epidemiological picture
    - To outline mitigation options where applicable

  Great care will be taken to avoid exposure to any novel pathogen whilst in captivity, barrier nursing and feeding of a rodent based food supply are the greatest factors. Extensive health screening prior to release, is also considered a vital factor. The duration of captivity will be minimised (approximately 3 weeks between hatch and transfer to the release aviary), which in itself limits the potential for pathogen contamination. All released birds will have originated from the area of release.

In the event of any concern in respect of any infectious agent, the chicks will not be released.

Considerations of Disease Risk Analysis for hen harrier (*Circus cyaneus*) translocations

Objective

To transfer fertile, part incubated eggs, from free living moorland nest sites, close to other breeding pairs of, where there is a high risk of brood failure, persecution or predation, for completion of incubation in a bio secure and infection control situation. For the crèche rearing, in a manner to avoid exposure to any novel pathogen, then return to a pre-release aviary on the same or an adjacent moorland site, for acclimatisation and soft release back onto the moor.

The aim is to avoid excessive grouse chick predation by hen harrier parents feeding young, such that grouse populations are maintained, whilst facilitating hatching and return of hen harrier off spring back to the moorland situation.

In this trial the eggs are to be translocated to the [redacted] Whilst it may be considered that placing these chicks at this site creates an increased risk of infection, it is at the same time a requirement that highly skilled experienced incubation technicians are available to manage the part incubated eggs. [redacted]

As stated above the eggs will be incubated in a 'quarantine incubator', handled after hatch in line with the principles of 'barrier nursing', taught to self-feed as soon as possible, then transferred into a new, clean, disinfected rearing aviary on site, with all disease vectors excluded, managed by staff with no contact with other birds, wearing appropriate PPE.

Infectious risks

	Susceptibility Risk	**Exposure Risk**	**Severity of effect on release environment**	**Impact**
Adenovirus	5	0	1	0
PMV	5	1	1	5
AI	5	1	1	5
Herpesvirus	4	0	0	0
West Nile Virus	5	0	1	0
M avium	5	0	1	0

Aspergillus spp.	5	3	0	0
Chlamydia psittaci	1	1	0	0
Endo parasites	5	1	0	0
Ecto parasites	5	1	0	0
Haemoparasites	3	1	0	0
Campylobacter spp	1	1	2	2
Salmonella spp	5	1	1	5
Staph aureus	3	2	1	6

(Sainsbury et al 2010)

Consideration of the above disease risk

Risks of deleterious effects of translocation

It is believed that diligent screening will negate the risk of chicks leaving [redacted] with PMV, AI, *Campylobacter* spp, *Salmonella* spp or *Staph Areus*.

Consequences

In the event that this screen fails to detect a bird incubating such a disease, this is unimportant for the environment in the release aviary site, as all birds will be going into a quarantine situation in the release aviary, for an appropriate quarantine period (at least 21 days), prior to release.

It is however advised, that a minimum 21 day quarantine period is observed from the time when the last bird is added to a release aviary, before any birds are released from that aviary.

Objectivity

In all respects, the realistic anticipated and unanticipated risks have been considered.

Proportionality

The risks presented in this trial have been considered, in the light of the chances of them occurring and the quantum of effect on the environment if they did.

Acceptable Risk

It is the opinion of this reviewer, that the risks presented in this project have been considered, quantified, minimised and the end effect considered in respect of the overall risk to the environment and ecosystem. It is my conclusion that the risks are not excessive, so long as every aspect of the project is managed in line with the details listed above, and as such should go head.

Literature Review

This has been conducted, there is a severe paucity of data on causes of morbidity and mortality in free living hen harriers (*Circus cyaneus*), as detailed above, with persecution, predation (from larger raptors), and the rigours of dispersal, flight training and inclement weather being the only significant factors.

All infectious disease risks cited in literature have been considered in this risk assessment.

Hazard prioritisation criteria for each disease risk scenario.

Categorisation criteria	Priority level
Acceptable risk < risk estimate	First
Acceptable risk = risk estimate AND consequence assessment HIGH	Second
All other hazards for which mitigation was categorised as 'advisable'	Third
All remaining hazards	Low

References and Further Reading

Jakob-Hoff RM, MacDiarmid SC, Lees C, Miller PS, Travis D, Kock R. (2014) Manual of Procedures for Wildlife Disease Risk Analysis. Co-published by the OIE and IUCN, ISBN: 978-92-9044-957-7

Anon. A future for the Hen Harrier in England? (2008) Natural England. ISBN 978-1-84754-109-7 Catalogue Code: NE140 www.naturalengland.org.uk

Klaphake E, Clancy J (2005). Raptor Gastroenterology. Vet Clin Exot Anim. 8:2. Pp 307-327.

Molina-Lo´ pez RA, Casal J, Darwich L (2011) Causes of Morbidity in Wild Raptor Populations. Admitted at a Wildlife Rehabilitation Centre in Spain from 1995-2007: A Long Term Retrospective Study. PLoS ONE | www.plosone.org 10 September 2011 | Volume 6 | Issue 9 | e24603

Reche MP, Jiménez PA, Alvarez F, Garcia de los Ríos JE, Rojas AM, De Pedro P. (2003). Incidence of Salmonellae in Captive and Wild Free-Living Raptorial Birds in Central Spain Zoonoses and Public Health. Volume 50, Issue 1 February 2003 pp 42–44

Sainsbury A.W., Ewen J.G. & Armstrong D.P. (2012). Methods of disease risk analysis for reintroduction. In Reintroduction Biology: Integrating Science and Management (J.G. Ewen, D.P. Armstrong, K.A. Parker & P.J. Seddon, eds). Wiley-Blackwell, Oxford, United Kingdom.

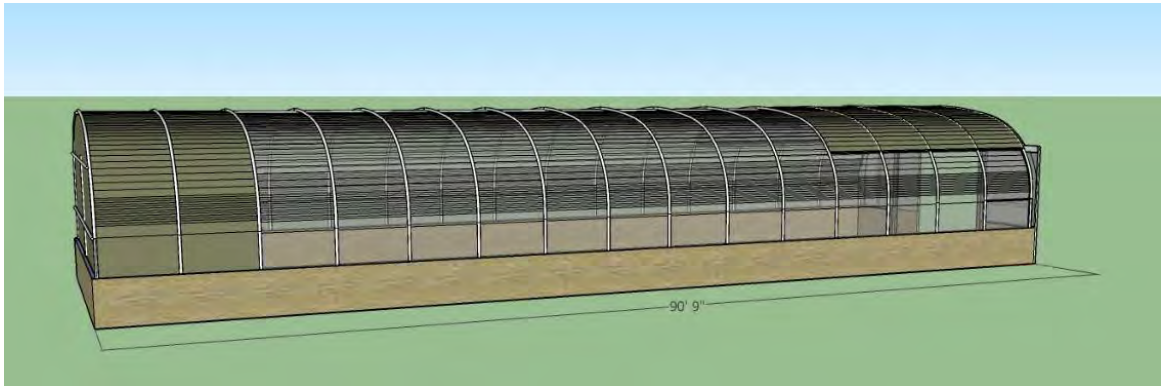
APPENDIX 3: Brood management Release Protocol

The following is a description of the prelease protocol provided by the International Bird of Prey Centre:

Release Enclosures

We have endeavoured to design something that is easy to erect, can be moved at a later date, is easy to manage and will suit the birds. It is really important to remember that fitness in terms of flying is crucial for the survival of predatory raptors (as opposed to scavenging raptors) so the size given here will give enough room to gain and maintain fitness. Poly Tunnels are very easy to move in kit form and can be put in the back of a pickup truck, they erect quickly and as a good part of the structure is going to be covered in netting, wind is less of a problem than if all covered in plastic. Please ignore the measurements, it will be a little smaller.

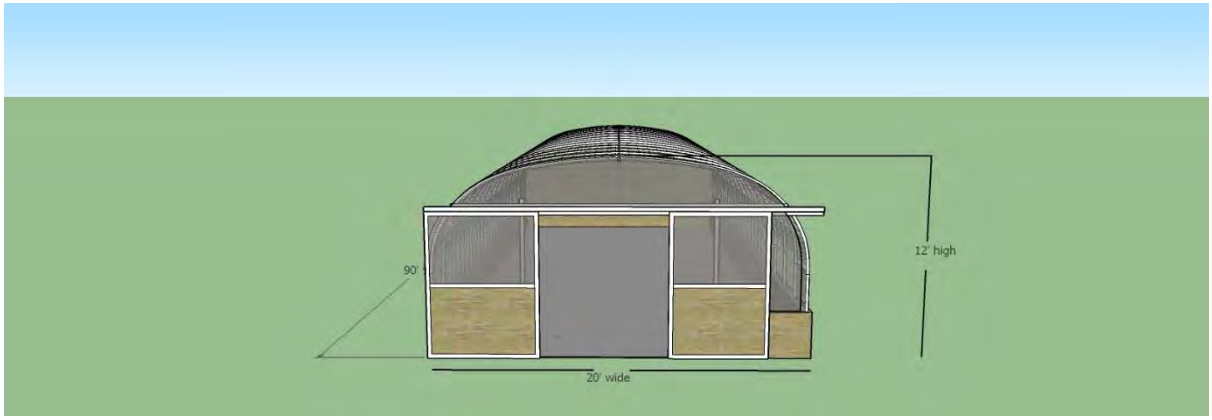
We use a soft terylene mesh – hole diameter of 1 inch (2.54 cms) which is small enough to keep most predators out, or Hen Harriers getting their heads through, the material is quite thick as fine mesh can injure birds. The end away from the door would be covered back and top in a weather proof lightweight material as would part of the roof the other end. It is important to give the young birds shelter. There would be two to three feeding stations inside accessible from the outside so that food can be placed without the birds seeing the keeper, with perches around the enclosure. The lower part of the enclosure needs to be clad in a material that discourages any wildlife from the outside. Timber or some other material to make a solid wall before the meshed area starts will work. There would be identical free standing perches and feeding stations outside the enclosure as well so that when the birds leave the release enclosure they have perches that they are used to and



comfortable with before getting adventurous and flying further afield.

There would be a bath placed in the pens for the birds to bath and drink, this can be slid out through a small door to be cleaned and refilled.

The two doors at the end would not be opened unless access is required into the aviary. We would plan to have a removable net over the outside of the doors to work as a double door system when access is needed. This would be taken down prior to the actual release. Access should only be needed if a bird is in trouble, or at the time when vetting and harnessing of the birds for health checks and satellite telemetry is to happen, otherwise the less disturbance the better.



The substrate of the release enclosures needs to be natural, rough grass may encourage wild rodents which would be very good for the young harriers. To achieve this erecting the release enclosure well before it is destined to be used would facilitate growth to return after building.

Feeding

Again depending on the age of the chicks when they are put in the release enclosures they will need feeding either once or twice a day. As soon as they are able they will manage to eat enough in a single feed and will reach their target weight. We propose feeding mainly mice – brown mice, and small rats to encourage the Harriers to know what to look for in terms of food and perhaps encourage them away from birds. These are reasonably available, and should this project get to a trial stage, we would suggest stock piling the brown ones so that enough food is available throughout the release to assist the young in the future.

Safety

While in the release enclosure, apart from foxes, badgers, stoats or mink the young should not be in any danger from predators. A fox proof fence will need to be put round the outside of the release enclosures to keep the young birds safe. It should to be 10 feet away from all sides except for the door end which needs to be 30 feet away. There should be an entry gate at both ends and no barbed wire anywhere – this could be an electric fence.

The length of time spent in the release aviary prior to release will depend very much on the age of the birds in the enclosure and the weather which plays a big part in the success of a release. Birds will require veterinary checks prior to release and we will satellite tag the birds to monitor survival rates, locations, winter survival and any potential movements. This should happen at least a week before the release to give the birds time to recover and settle after being caught up and handled. If required this could be a time to allow press coverage, because we strongly recommend that the press are not there when the doors are opened. A soft release relies on the birds returning to the release site to feed and that requires a very quiet release with no one around other than in the hide.

APPENDIX 5.

Ecological requirements and suitability of release sites and specification for release pen and management.

Purpose:

This short note describes the ecological requirements and criteria of sites required by young hen harriers in the English uplands. This is to help identify suitable and acceptable release sites for chicks raised in captivity as part of the trial brood management scheme.

NB: It is important to note that we are concerned with the landscape within which birds are released – rather than a site, which perhaps implies a more restricted area.

Location and habitat requirements:

The release sites will be in the same general area and habitat as that from which the eggs were collected in the uplands of northern England, but for practical reasons and for reasons of reducing conflict, may not be at the exact same location. If harriers are removed from an SPA notified for hen harriers, they will be returned to the same SPA or the immediate vicinity defined by available dispersal data.

A balance between easy access for construction of release pen and bird management and security as well as a site suitable for the species is important.

Availability of natural food is a vital consideration. In the English uplands important prey species include meadow pipits, sky larks, small mammals and grouse. The proportion of different prey in the diet is linked to availability. However most upland landscapes described below are likely to contain sufficient densities of the key prey species.

Stephen Murphy's work on tagged birds in the English uplands highlights the following requirements/habitats used:

Heather grass mosaic for hunting

Rushy (*Juncus sp*.) wet fields at lower altitude (150-250m contour) for roosting

Range of habitats and ecotones, transitional zones between open areas and forestry, physical structures and varied topography e.g. drystone walls, ridges, and gullies.

These habitats are typical of the semi natural habitats found within the SPAs and are loosely made up of the following NVC categories: H9 *Calluna vulgaris – Deschampsia flexuosa* heath; H12 *Calluna vulgaris – Vaccinium myrtillus* heath; M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire; M20 *Eriophorum vaginatum* blanket and raised mire and the species poor acid grasslands that border them.

Because female hen harriers can display natal philopatry, i.e. they imprint on the area where they fledge and can return to the same vicinity to nest, the immediate area of the release site should where possible contain suitable nesting habitat.

Stephen Murphy's research has shown that most birds in the English uplands nest in heather, only two of 133 recorded nests nest being in other habitat. The area around the nests is normally made up of a mix of heather and grass generally with heather making up 60-70% of the vegetation.

In the English uplands most Harrier nests are found at an altitude of between 350 & 450m and on slopes with a Northerly aspect.

Sites with a low risk of predation would be preferable.

Logistics:

Sites need full co-operation from landowner, tenants and immediate neighbours

Young chicks are planned to be brought to the release site by [redacted] or an experienced animal carrier with [redacted] staff at approximately three weeks old. (21 days). Timing will depend on the growth rate of the young birds. They should be able to 'pull' food for themselves but are unable to fly.

A pre-erected polytunnel type construction and fox proof fence are both required with a hide to watch progress. The birds should be checked twice a day.

Feeding will happen daily, early in the morning using suitable food for example dark coloured mice or small dark rats. The enclosure should be approached quietly from the sheltered end by one person only and food dropped through a shoot onto a food platform. An identical food platform will be erected outside the enclosure for feeding after the release.

The person feeding should then move back away from the enclosure and sit quietly with binoculars in a hide monitoring the birds for up to an hour after feeding and if possible another hour in the evening. Written records of the monitoring and behaviour should be taken.

Up to 8 mice per bird per day will be needed, depending on the size of the mice. Approx. 6 weeks feeding is required during the pre-release period and for a period of time after release until the birds either disperse or stop coming to the feeding platform. It is not possible to give an exact time frame as it will also depend on weather conditions and food availability in the wild.

Max 10 birds per enclosure/release site. All chicks will be satellite tagged at the outset of the trial.

Chicks should fledge and learn to fly in the enclosure between day 30 and 35 with the pen opened for release approximately two weeks after full fledging and a vets check one week prior to release.

About one week before release into the wild the birds should all be caught up, given a thorough veterinary check-up, and fitted with a Satellite Telemetry Tag for monitoring after the release. This could provide a publicity opportunity if wanted using an in-house photographer with stringent regulations applied.

On release, the door will be opened very early in the day and the enclosure be monitored by binoculars from a good distance in the hide and should not be on a cold, wet or windy day.

Initially continued daily feeding and monitoring, reducing to feeding every other day, until such point as the birds are rarely returning to the feed site, or have dispersed.

Release Enclosure Specification:

Release Enclosures should be easy to transport to release sites and assemble and consist of a polytunnel metal hooped frame of approximately least 5m wide x 20m long and 4m high at the highest point and covered by 2.5cm square soft thick terylene mesh (Bridport Gundry make suitable nets to order).

One end of the enclosure will be well sheltered with dense windbreak type material to protect the young from the elements, and to allow the person feeding the birds to approach without being seen.

Perching would be placed within and outside the enclosure at the release end, so that the birds can come back to feed until they can hunt for themselves. A food shelve should be placed outside the pen.

A bath should be placed at the release door end, and filled regularly from the outside.

A fox/badger proof fence surrounding the polytunnel at a distance of at least 3m around three of the sides and 10m at the end where the release door is situated is important.

Post fledging:

It is accepted that not all the birds will survive. Previous releases of Harriers in Europe have proved to be successful in terms of acceptable initial survival rates of young.

Tagged and monitored birds that appear to fail and be found still alive will be collected and rehabilitate prior to re-release.