FINAL VERSION, as agreed at Project Group meeting on 22 March 2007

THE LANGHOLM MOOR DEMONSTRATION PROJECT

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1. Purpose

This paper outlines a project proposal to demonstrate an effective means of resolving the raptor-grouse moor controversy. The proposal is to restore grouse moor management on Langholm Moor SPA/SSSI as a way of meeting the conservation objectives of the site. This site would become a model for modern, sustainable grouse moorland management. The duration of the project is up to ten years, subject to review every three years.

The paper provides background detail on the Langholm Moor SPA/SSSI conservation objectives, previous work on raptors and grouse, and current proposals to enhance the moor. It outlines the proposal to restore grouse moor management, giving details of objectives, evaluation criteria, monitoring and costings. The project offers a key opportunity to demonstrate compatibility between grouse moor management and raptor conservation.

Given the totemic significance of Langholm as a former, successful grouse moor, many organisations now agree that it is important to put in place a management regime at Langholm which seeks to reconcile the grouse moor and raptor interests in a way which benefits moorland conservation objectives. A detailed Site Management Plan would be produced to underpin this work.

2. Background

2.1 Natural heritage context

Scotland's heather moorlands form one of Europe's most distinctive and important habitats – in terms of their beauty, economic value, wild plants and animals, and appeal to tourists. Scotland's moorland is special (Moorland Working Group, 2002; Anon, 2005). Over large areas of Scotland, indeed Britain, moorland has declined in extent and condition, in both the wider countryside (e.g. Moorland Working Group, 2002) and on designated nature conservation sites (Williams, 2006). The restoration of moorland habitats and associated

wildlife is an important challenge for nature conservation and other land-use interests in Scotland. Grouse moor habitat which is well managed has high biodiversity value. Grouse shooting interests are positively related to the retention of heather moorland, and land managed for red grouse shooting has been shown to support higher densities of some waders than occur in other moorland (Moorland Working Group, 2002).

Langholm-Newcastleton Hills SSSI and SPA comprises approximately 7,600 hectares of upland moorland between the towns of Langholm and Newcastleton. The site falls partly in the Scottish Borders and partly in Dumfries & Galloway (SNH Areas: Dumfries and Galloway and Forth & Borders). The boundaries of the SPA and SSSI are the same except for the exclusion from the SPA of a small area of woodland in the south and an area on the western edge of the site (see Figure 1 for the SPA boundary).

The vegetation is dominated by extensive blanket mire, heather moorland and species-poor acidic grasslands, and there are frequent small areas of broad-leaved woodland associated with streams. The hen harrier is the SPA qualifying feature. The notified features of the SSSI include the assemblage of upland habitats (including heather moorland, blanket bog, dwarf shrub heath, upland grassland, woodland and flushes), aggregations of breeding birds, and geology (Carboniferous-Permian igneous). The objectives for the SSSI and SPA are detailed in Annex A.

Since the 1940s, the extent and condition of the heather moorland has been reduced through heavy grazing pressure (Redpath and Thirgood 1997), though in recent years there has been a reduction in grazing pressure on some parts. This has led to an increase in the amount of white moor and grassy heath. The upland habitat assemblage currently remains in an unfavourable condition, and SNH and partners are seeking to return the habitat feature to favourable condition. Further details of the results of Site Condition Monitoring and other monitoring at Langholm are provided at Annex B. A heather condition survey was carried out by Averis & Averis in 1997/98. A full NVC survey was completed in 2002 by Central Environmental Heritage Surveys (2003). Table 1 provides a breakdown of the habitats on the site. About 90% of the habitats are mosaics of habitat types e.g. dry heath with grasslands, bracken or bog.

Table 1. Areas of habitats on Langholm – Newcastleton Hills SSSI (hectares) (CES Survey 2003)
Note that areas of habitat <100% indicate this is a mosaic with other broad habitat

Broad Habitat	National Vegetation Classification types	habitat cover > 20%	habitat cover > 50%	habitat cover > 100%
Dry heath	H10, H12	1240	924	156
Montane heath	H18, H21	187	184	47
Mires - Flying bent bog	M25	1949	1586	184
Mires - Blanket Bog	M18, M19, M20	2547	2375	822
Mires - Wet heath	M15	175		
Mires - flush	M6	24		
Rush pasture	M23	370		
Bracken	U20	407	375	118
Grasslands	U2, U5, U4, MG9	907	771	158
Improved (inbye)	IMP	62		
Calcareous grass	CG10	2		
Native woodland	W7, W9, W11, W4	114		
Plantation		4		
Tall herb	U16	1		

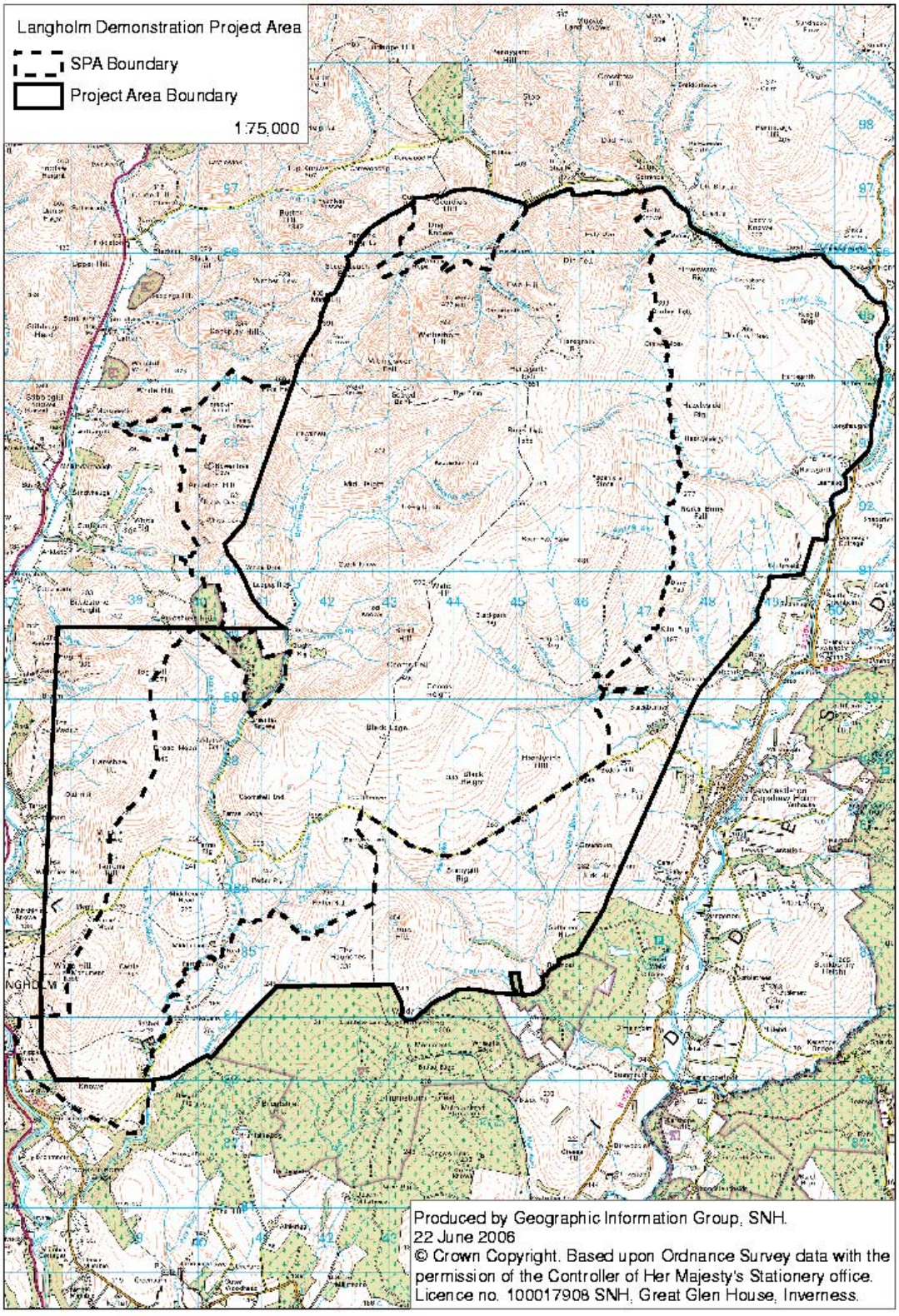


Figure 1: Langholm-Newcastleton Hills SSSI/ SPA and project area boundaries. Note that a small area at the west of the project area boundary is outwith Buccleuch Estates' ownership.

2.2 Langholm and the Joint Raptor Study

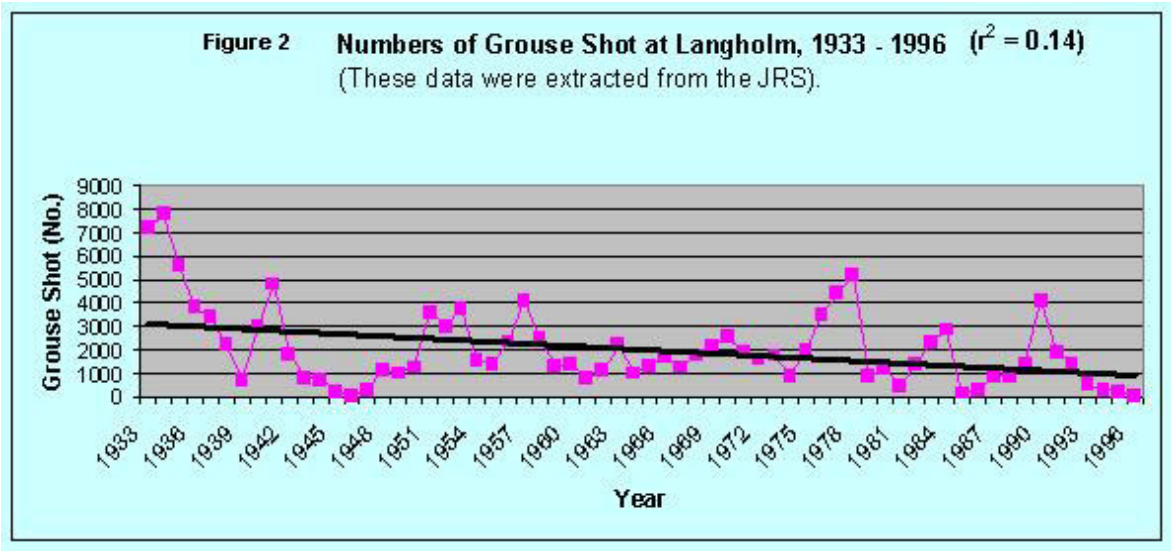
Langholm has a long history of management as a grouse moor and was the main study site (there were five other study areas) for the 'Joint Raptor Study' (Redpath & Thirgood 1997) which investigated the impact of hen harriers and peregrines on red grouse numbers. At the end of fieldwork for this project and subsequent trials of diversionary feeding for hen harriers, Buccleuch Estates, who own most of the land within the SSSI and SPA, announced that as a result of a marked reduction in red grouse numbers they were discontinuing grouse moor management, and laid off or re-deployed their gamekeeping staff.

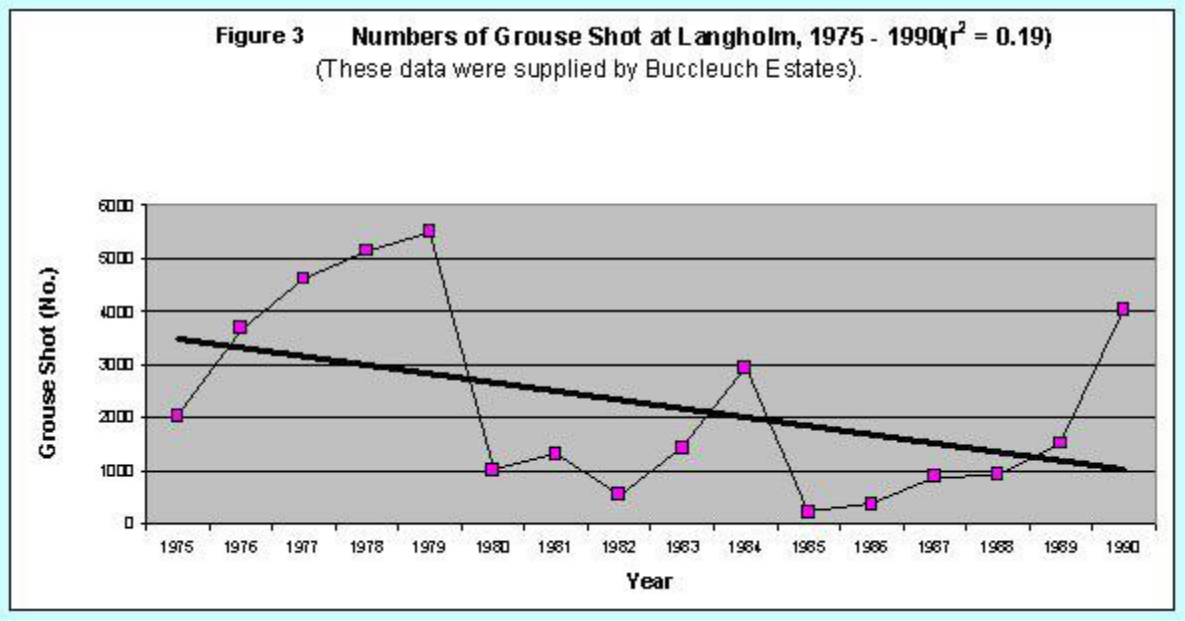
For decades it was a firmly held opinion by grouse managers that predation by breeding hen harriers reduced the shooting surplus of red grouse on managed heather moorland. As a result, raptor persecution on grouse moors was common to the extent that it reduced the range and abundance of this species of conservation concern; this is despite legal protection. Between 1992 and 1997 a research partnership (the Joint Raptor Study or JRS) set out to quantify the impact of raptors on red grouse. Over this period, the project concluded that raptor predation could limit red grouse populations and reduce shooting bags. In 1998 and 1999 research continued at Langholm to quantify the impacts of diversionary feeding of hen harriers on their take of red grouse. That research showed a marked reduction in predation on red grouse chicks by fed hen harriers (Redpath *et al*., 2001).

Since 1999 annual monitoring of raptors, grouse, voles and passerines has continued at Langholm to the present day. Following the JRS, red grouse densities continued to decline. In spring 2003, there were less than 8 red grouse per 100ha (in 1993 there were 29 birds per 100ha). Despite the site's designation as an SPA for hen harriers, numbers of breeding female hen harriers fell from a peak of 20 in 1997 to five females in 2006 (with only one pair producing fledged young) despite the most important prey base, the field vole, being at the peak of its population cycle. We note that at the time of notification, the site held 13 breeding females (the number used for classification of the site as an SPA).

2.3 Trends in red grouse numbers

The red grouse bag data published in the JRS showed a long-term decline from a peak in 1978, when 5200 birds were shot (Figures 2 and 3). The last year when driven grouse shooting occurred at Langholm was in 1996, when 265 birds were shot. Since 1949, 2000 or more brace of red grouse were shot in five years (1957, 1977, 1978, 1979 and 1990).





3. The need for a Langholm Demonstration Project

Since publication of the JRS report in 1997 there has been considerable debate about the interpretation of the JRS research, and the applicability of the raptor-grouse moor association at Langholm to other grouse moors (e.g. Anon, 2000; Redpath & Thirgood, 2003). The UK Government-established UK Raptor Working Group recommended research and demonstration studies involving habitat and species conservation and management measures to address the raptor-grouse moor conflict (Anon, 2000). This Group specifically mentioned Langholm as a suitable demonstration study (Recommendation 13; Anon, 2000).

Most organisations with an interest in moorland conservation and management agree that there is currently an impasse between grouse moor managers and raptor conservation interests as a result of the JRS. Scotland's Moorland Forum (which comprises 24 member organisations committed to improving Scotland's moorland habitat) has urged a small grouping of organisations connected with Langholm to develop a proposal to restore the grouse moor and conservation interests of the moor.

In the *Statement of Intent* (Scotland's Moorland Forum, 2002) giving rise to the Forum, the members committed to:

> "Continue the progress made at Langholm to reduce in the short-term the impact of birds of prey on red grouse … [to] further examine through research those management techniques which aim to reduce the impacts of birds of prey on red grouse numbers."

The Moorland Forum published a best practice guidance document (*Principles of Moorland Management,* 2003), which outlines detailed guidance and advice on moorland management, including the above issues.

4. Current management at Langholm

Approximately 92% of the SSSI is owned by Buccleuch Estates: at the moment, 40% is managed in-hand and 52% is let to five tenants. There are a further three owners of small parcels of land within the SSSI, which are included in the Project area.

Most of Langholm moor is currently managed for sheep, with active grouse moor management in abeyance since 1998 (Figure 4 shows the extent of the grouse beats).

A 30-year SSSI management agreement between SNH and Buccleuch Estates commenced on 8 June 1990. The Agreement covers 3,183 ha (just under half the site) of in-hand land managed by Buccleuch Estates Ltd.

SNH contracted the Macaulay Institute (MI) in 2002 to produce a Moorland Restoration Plan. This evaluated the vegetation condition and identified management prescriptions for grazing, muirburn, heather seeding etc (Milne & Pakeman, 2002).

Two of the tenants have entered Natural Care scheme agreements with SNH under the Forth and Borders Moorland Management Scheme which was launched in 2004. Prescriptions include muirburn, bracken control, fencing, stock off-wintering, stock reduction and shepherding.

5. The Demonstration Project

5.1 *Project proposal*

Buccleuch Estates, SNH, GCT, RSPB and NE (the Langholm Moor Demonstration **Project Group**, which would become the **Project Board** once the Project is established) wish to restore the grouse moor interests of Langholm moor to demonstrate the feasibility of sustaining **both** grouse moor and nature conservation interests (in particular a viable hen harrier population). Essentially, the proposal is to restore habitat and biodiversity interests of the SPA/SSSI through active management of the moor as a grouse moor.

5.2 *The Project Area*

The proposed Project Area covers 11,960 hectares, as shown in Figure 1 and, in more detail in Figure 4. This Area incorporates all of the SSSI/SPA owned by Buccleuch Estates, the areas previously managed as grouse beats, and surrounding buffer areas where legal predator control was undertaken to support the management of the grouse beats.

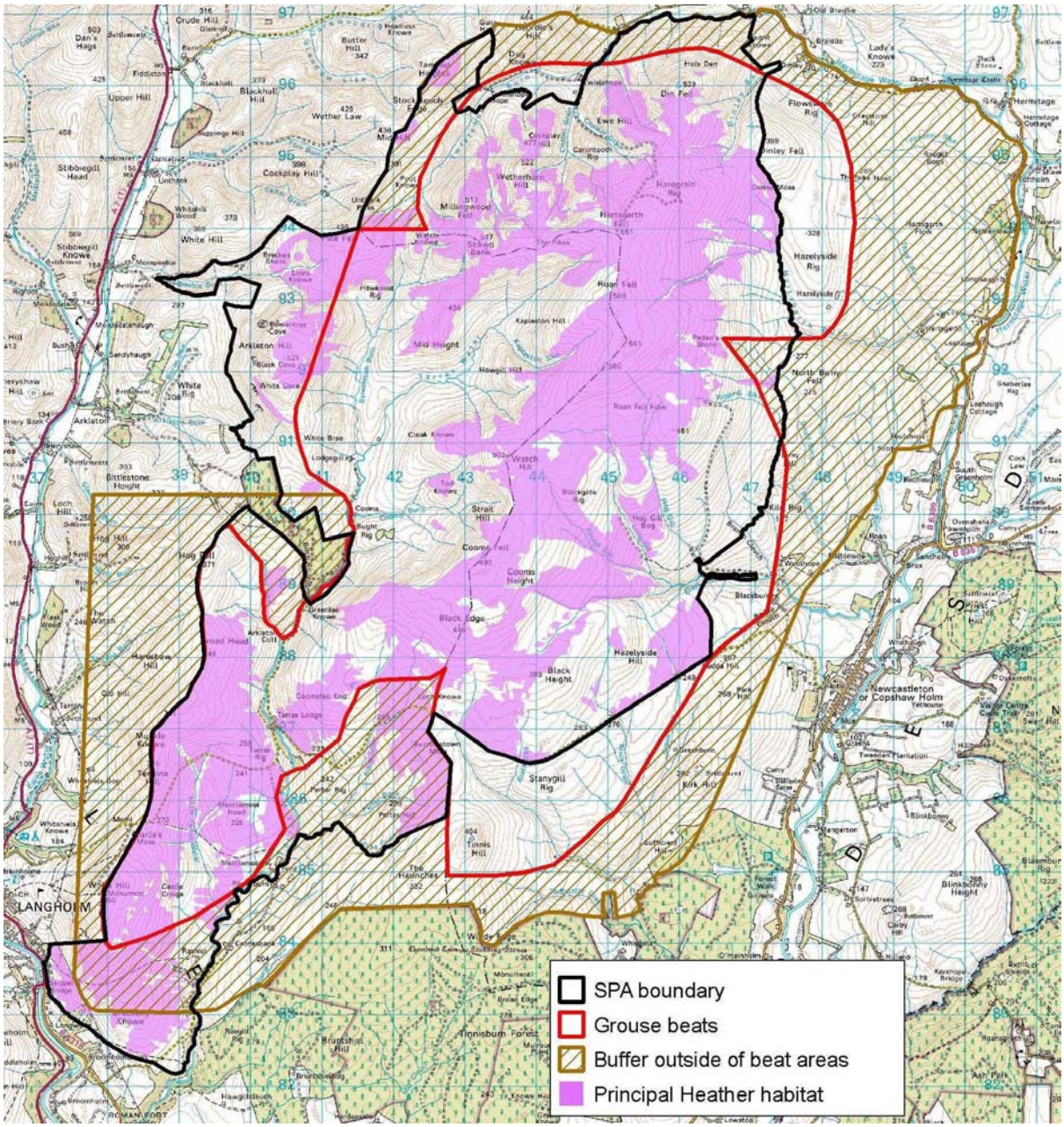


Figure 4: The Langholm Moor project area, embracing all areas enclosed by the mapped boundaries.

5.3 Objectives

The Project Group proposes the following core objective:

To establish Langholm Moor as a driven grouse moor to meet the nature conservation objectives for the SPA and SSSI.

Under this objective, the following elements would be delivered:

(a) Demonstration of how to resolve conflicts between moorland management for raptors and red grouse;

(b) The hen harrier population would be maintained as a viable component of the SPA;

(c) The heather moorland habitat would be extended and improved beyond its state in 2002; and

(d) The number of red grouse shot would be sufficient to ensure the moor reaches a financial viable state).

These elements would be reviewed every three years, guided by the evaluation criteria given in Section 5.5.

5.4 Scope of Project

The project seeks to address all of the above elements. Livestock management is essential to deliver the habitat management element in c) above, but it is proposed that this element is delivered through a separately resourced Management Agreement between SNH and Langholm Farms Ltd.

5.5 Project evaluation

Many factors influence numbers of raptors, red grouse, and other wildlife in moorland areas. The Project Group has been mindful of potential impacts of the vagaries of weather and disease on bird, and indeed habitat, interests. Five broad criteria have been devised to evaluate the success or otherwise of the project.

These criteria will be considered in detail by the Scientific and Technical Advisory Group (STAG), which will make recommendations to the Project Board (see later).

(a) Compatible management for raptors and red grouse

- The Project Group seeks compatibility between management for raptor and red grouse interests.

This project seeks to demonstrate if it is possible to manage an SPA for both raptor and red grouse interests. In judging the success of this component of the work, there should be agreement within the Project Board.

(b) Hen harriers and other raptors

- The project seeks a viable population of hen harrier in pursuance of the EC Birds Directive.

The Project Group seeks to avoid deterioration of the habitats of hen harriers or significant disturbance of them, thus ensuring the integrity of the Langholm SPA is maintained. All raptors will be protected during the course of this project. The SPA will hold a nationally important population of hen harriers when there is 1% of the UK population (currently, 7 breeding females). This project aims to restore moorland habitats, reduce conflicts, and create the other conditions which allow the SPA conservation status to be maintained, and to endeavour to meet a target of at least 1% of the UK population of female hen harriers.

In applying the results of this project to create a possible model for modern, sustainable grouse management it is acknowledged that some other moors will not be SPAs.

(c) Red Grouse numbers

- The Project Group seeks an economically viable number of red grouse for shooting.

By way of example, it is standard practice to shoot 30% of grouse on a moor. A total population of 6,000 birds would be needed in the autumn (equivalent to a density of 150 birds per km^2) in order to shoot 1,000 brace. In order to yield 150 birds per km^2 in the autumn, a spring density of 68 birds per km^2 should be present. In 2003, the spring density of red grouse at Langholm was 8 birds per km^2. At a 33% rate of increase, it would take about 8 years to reach 1,000 brace shot. The major cost of moor management should be covered by revenue generated by the grouse moor after ten years. At present economic rates for grouse moor management, a brace of grouse provides a revenue of £95. Accordingly, 1,000 brace would generate an income of £95,000 (at present day rates).

A target is set for 1,000 brace of grouse to be shot, or a mean density of 150 birds per 100 ha in July across the sample plots, in one year, with sustainable employment of keepers. Grouse moor management would be the economic driver, supporting the employment of at least five keepers but not necessarily making a financial surplus**.**

(d) Heather moorland

- The Project Group seeks to increase the extent and improve the condition of heather moorland (dry heath and blanket bog) at Langholm beyond the baseline of that recorded in 2002.

Milne & Pakeman's (2002) report gives detailed maps of heather cover in 1948 and 1988, areas suitable for burning, numbers of distribution of grazing sheep and goats, and the results of seedbank sampling. On the basis of this, a target is set of increasing heather cover by 20% beyond the 2002 baseline of 1240ha of dry heath, by the tenth year. Based on previous heather restoration work the project group seeks to restore and enhance up to 250ha of the heather moorland currently made up of areas of white ground and degraded heather moorland within the four grouse beats on Langholm moor. We also seek to attain an improvement in the condition assessment of the moor in accordance with SNH's Site Condition Monitoring principles.

(e) Passerines and waders

- There should be substantial populations of passerines and waders, including the full range of species within the breeding bird assemblage present at the time of SSSI notification.

Breeding waders (lapwing, curlew, golden plover) and meadow pipit have been monitored in sample 1km squares on the Langholm Estate since 1992. Snipe also breed on Langholm Moor, but abundance has not been accurately determined and detectability is subject to high between-year variation so this species is not considered further. In the period 2000-03, 14 species of bird were known to breed and/or feed on the site.

In the surveyed area, Lapwings have fallen to 1-2 pairs, and both curlews and golden plovers have declined in recent years. Meadow pipit numbers have fluctuated more than two fold over the same period.

The population response of these species to the combination of habitat and predator management which will take place during the project is difficult to predict. However, given the population maxima and minima since 1992, we suggest that achievement of the success criteria for red grouse, hen harriers and heather moorland habitats should be accomplished alongside achieving breeding densities of lapwing, curlew, golden plover and meadow pipit at or above the upper quartile of the following ranges by 2010:

Lapwing: 0-0.8 birds per km² (target: 0.6)
Curlew: 0.5-2.3 birds per km² (target: 1.9)
Golden Plover: 0.1-0.6 birds per km² (target: 0.5)
Meadow Pipit: 8.5-26.4 birds per km² (target: 21.9)

These figures are based on June counts along two 1 km transects in each of 15 1 km squares, using BBS methods. These targets will be more closely defined once annual count data for the species for 1992-2006 are made available to the Partnership.

5.6 **The Project will comprise three broad elements of work**:-

a) **Moorland management** – keepering, shepherding and associated activities;
b) **Monitoring** – survey, surveillance and monitoring of red grouse, raptors and other species and habitat interests; and
c) **Project management**, reporting and PR.

6. Moorland Management

6.1 *Outline proposals and staffing requirements*

The Project Group has identified five elements to be carried out:

a) Programme of measures to benefit the habitat, including heather burning, bracken control, heather restoration, blanket bog management, livestock management and goat control;
b) Legal predator control;
c) Programme of medication for disease control (notably to combat strongylosis);
d) Programme of diversionary feeding of hen harriers; and
e) If the recovery of the game population is slow by Year 3, red grouse may be taken from other moors to help 'kick start' the red grouse population.

We will also explore habitat creation measures to create alternative nesting and feeding habitat for hen harriers.

It is proposed that a team of five keepers is recruited to undertake this work, which will operate alongside shepherds and ecologists.

6.2 *Management Measures*

A detailed Management Plan will be agreed by the Project Group. However, the broad principles behind the above measures are outlined below. Such a Plan will take account of previous draft proposals for the in-hand land outlined in a draft Management Plan produced by Milne & Pakeman (2002). Not all the measures will be undertaken on the tenanted land.

Heather burning. In compliance with the Muirburn Code, the aim would be to create an intimate mosaic of different aged and small scale patches, with an average 15 year rotation for good dry heather habitats increasing to a 20-25 year rotation for some potentially burnable blanket bog habitats. Currently, there are 1,240 hectares of dry heath and 1490 hectares of blanket bog (excluding M18, which should not be burnt). Overall, around 2200 hectares of these moorland habitats could be burnt over a 15 year cycle, so that approximately 150 hectares would be burnt each year. These figures exclude Twislehope and Dinley tenanted farms as muirburn is covered under the SNH Natural Care agreements.

Bracken control. Priority areas for bracken treatment should be based on the threat to dwarf shrub habitats and vigour of bracken. This is not a significant area since a considerable percentage is under Natural Care agreements and the remainder is alongside water courses, amongst scrub or adjacent to white ground. Current mapped information indicates that around 42 hectares per annum should be treated.

Heather restoration. Eleven areas of 'white' grass-dominated moor have been identified as potential areas for heather restoration (Figure 5). A number of methods were suggested by MI (2002), including use of cattle and cutting strips in *Molinia*. Changes in stock management and bracken treatment as discussed in this section will also be beneficial.

It is proposed to trial the 'high intervention' heather restoration method (spraying with glyphosphate; preparing the heather seedbed, possibly involving burning and litter removal, and applying heather seed) in some areas, as recently carried out by Geoff Eyre successfully in northern England. It was identified in 2003 that there were substantial and suitable areas for heather restoration by his methods. Although costly, this is favoured, and £10,000 has been earmarked for a heather restoration trial. Further work will be required to thoroughly evaluate suitable areas for restoration, and set out a programme of work and resource requirements for initial treatment and follow-up remedial work.

Blanket bog management. Good practice management would be required as per the prescription within the Forth and Borders Moorland Management Scheme, over 540ha. In addition, there may be scope for ditch blocking on the east facing slopes of Roan Fell to Blackgate Rig.

Livestock management. Stock management to encourage heather recovery will be required and this could incorporate stock off-wintering, shepherding to rake sheep out onto the hills and move off vulnerable areas, and management of supplementary feeding sites. Exclusion of stock is likely to be required in "high intervention" heather restoration areas until the heather is well established. A Grazing Management Plan (developing Milne & Pakeman's 2002 report) will recommend the most appropriate action, which will be taken forward under a Management Agreement between SNH and Buccleuch Estate.

Other herbivore control. The goat population should be brought down to 200 animals over a 3 year period.

Legal predator control. Control of foxes, corvids and mustelids will be carried out throughout the year, with the main effort being concentrated in the spring for the benefit of ground nesting birds.

Disease control of grouse. Medicated grit will be put out all year (it would be withdrawn prior to the shooting season in years when grouse are shot). Birds may be caught and dosed with an anthelmintic (worming) drug.

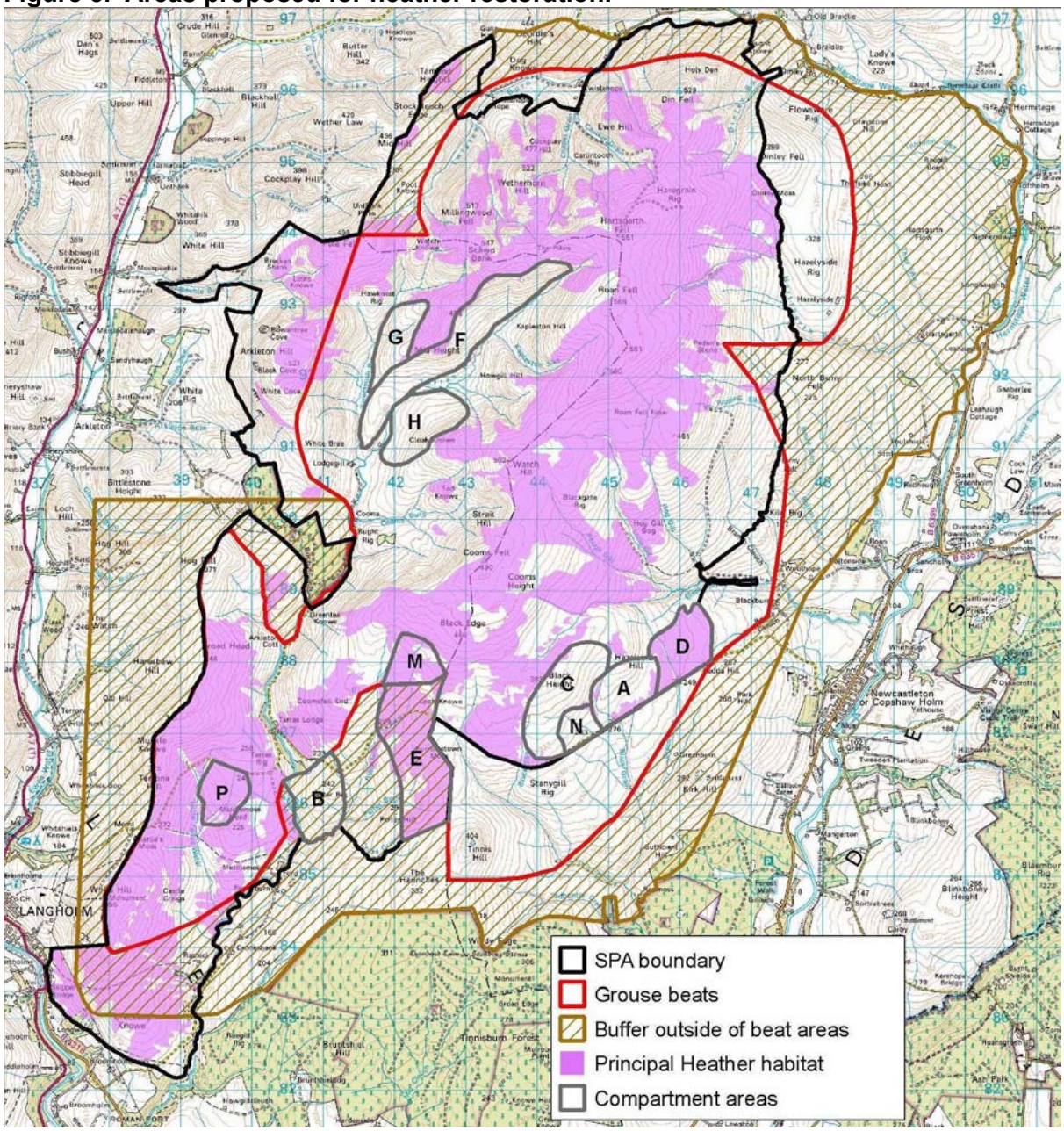
Diversionary feeding of hen harriers. Work would be carried out in accordance with the practice described in *'Substitute Feeding of Hen Harriers on Grouse Moors'* (Moorland Working Group 1999).

Habitat creation. This may include the creation of potential nesting habitat for hen harriers through very localised, small scale scrub creation. In some parts of the hen harrier range small forest plantations and brash have provided important nesting habitats.

Table 2 . Summary of monthly moorland management activities for Langholm moor

Management activity	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Comments
Muirburn	*	*						*	*	*	*	*	Should take place whenever conditions are suitable through the muirburn season. There would be no muirburn beyond 15 April.
Heather restoration - ground preparation	*	*			*			*					Spraying in July, litter reduction before March/April
Heather seeding			*	*	*								April, May, possibly June depending on conditions. Following years, check establishment success, may need remedial actions
Blanket bog restoration													Ditch blocking; general good practice elsewhere
Bracken control			*	*	*	*							Physical control should take place (cutting/brusing) should take place between May-June, but spraying best carried out after the end of July, when bracken reaches full height
Stock management and goat control		*	*					*	*	*	*	*	* All year but especially months marked: Shepherding Stock off-wintering Stock control in heather restoration areas
Legal predator control													
Fox control	*	*	*	*	*	*	*	*	*	*	*	*	Main effort during spring for foxes, mustelids and corvids
Corvid control	*	*	*	*	*								
Mustelid control	*	*	*	*	*								
Disease control of grouse	*	*	*	*	*	*	*	*	*	*	*	*	Medicated grit put out all year. Birds may be caught and dosed with anthelmintic (worming) drug.
Diversionary feeding	*	*		*	*								
Habitat creation							*	*	*	*	*	*	Young forestry creation. Winter activity to avoid disturbance

Figure 5. Areas proposed for heather restoration.



6.3 *Moorland management costs and potential revenue*

The majority of the moorland management work will be carried out by the land managers and shepherds and thus the major proportion of expenditure under this element will be made up of **salaries and associated staff costs, including equipment**. Additional costs for bracken control, heather restoration and stock off-wintering have been included as follows.

Bracken control estimates have been based on figures provided by The Heather Trust.

Table 3. Bracken control costs

Year	No. of hectares	Rate per ha	Total
		£	£
1	42	140	5880
2	42	36	1512
3	42	14	588
4	42	14	588
5	42	14	588
Total	42		9156
Average per year			1830

Intensive **heather restoration** is costly, and can amount to up to £250/ha. An amount of £10,000 towards the costs of intensive heather restoration work over 5 years has been included within the costs.

Stock management costs have not been factored in as they will be covered by the Management Agreement between SNH and Buccleuch Estate.

Other herbivore control would be carried out by the keepers but there would be a cost of approx. £30 per head for disposal of carcasses, and if 100 goats were culled per year, this would come to a total of £3,000 per year.

Annex C provides a breakdown of total expected costs. A summary is provided in Table 4. Capital items have been written down over a 5 year period.

Table 4. Summary of moorland management costs

Item	Amount per year (£)	%
Staff salaries	110,000	51
Other staff support costs	91,700	43
Equipment	6,200	3
Bracken control	1,830	1
Heather restoration	2,000	1
Herbivore control	3,000	1
Total	214,730	100

6.4 Potential revenue

Against these costs, there is the potential for revenue generation. Three scenarios are suggested:

Table 5. Potential revenue for shooting

	Year 1	Year 5	Year 10
a) No recovery in red grouse numbers	0	0	0
b) Modest recovery in red grouse numbers (10% annual rate of increase)	0	150 brace £14.3k	300 brace £28.5k
c) High recovery in red grouse numbers (33% annual rate of increase)	0	500 brace £47.5k	1,000 brace £95k

These figures assume an average of £95 per brace generated as revenue.

The net expenditure could be reduced through income generated from shooting. The overall annual expenditure could be reduced, at year 10, by £28K if there is a 10% increase in grouse numbers, and by £95K if there is a 30% increase in grouse numbers. However, the Project Group notes that the vagaries of weather, disease and predation could have a dramatic impact on this income generation.

No 'income generation' is attached to recovering heather and blanket bog habitat, and potential improvement in biodiversity and reductions in conflicts between raptor and grouse moor interests.

These potential savings have not been incorporated in the Project Plan. However, within the timeframe of the project, any income generated or additional funding secured, will be shared between the 3 main project funders (SNH, GCT and BE) until such time as their share of costs is reduced to the level of other project partners, beyond which point those other project partners will receive a pro-rata share of the balance.

7. Monitoring

Details of the scientific monitoring

7.1 Red grouse

Abundance & breeding success: Grouse will be counted twice per year. First in late March and early April to determine pre-breeding densities and again in the second half of July to assess breeding success, autumn densities and an index of adult mortality (difference between consecutive March and July counts of adults). Grouse will be counted within fifteen 50 ha plots, three in each of the five moorland beats comprising the study area. Two plots in each beat will be the long-term plots established within the Joint Raptor Study for which there are annual data since 1991. A third plot in each beat will be established to consider potential changes in grouse abundance within zones of intended habitat restoration.

Grouse mortality: Monthly searches will be made for signs of dead grouse within each of the 15 survey plots and probable sources of mortality assigned (raptor / fox / parasites). A sample of at least 20 hen grouse will be caught in late winter and radio-tagged. Monitoring of subsequent nests will permit hatching rates, mean brood size at hatching and thus grouse prey availability to harriers to be calculated. Chick survival rates would be calculated and compared to provisioning rates of grouse chicks to harrier nests (see 8.2). Given that the breeding harriers are currently distributed within a relatively confined area, it may be sensible to confine intensive radio-tracking studies to this zone. Low densities of breeding grouse may hamper sample sizes of tagged birds and for this reason, this aspect of the study may not begin until year 2 or 3.

***Parasite burdens*:** All autumn shoot days will be attended to estimate both the number of birds removed from each plot and to estimate parasite burdens (strongyle worms). To cover for the strong likelihood of no shooting days in some or indeed all of the plots, parasite burdens will also be estimated from worm eggs in caecal pats collected in March, August and December. Although currently not present in the grouse areas, sheep flocks should be sampled for the prevalence of louping ill before the project starts and repeat sampled at 5 and 10 years (10% sample of approximately 8,000 sheep at the outset); goats should also be sampled.

7.2 Hen harriers

The number of hen harriers breeding annually will be recorded by watching for displaying males from a series of vantage points in March (Redpath & Thirgood 1999). Checks will be

made regularly until June to ensure that no late breeders were overlooked. Females that are fed in spring deliver supplementary food to chicks at more than twice the rate of those females that were not fed in spring (Redpath *et al*. 2001). For this reason, supplementary food will be provided daily in all known territories from late-March until the start of incubation. Harrier nests will be found by watching and listening for food passes in those areas where displaying males have been observed. Nests will be monitored to determine hatching success and broods will be provided with further supplementary food from chick hatching to dispersal (Redpath & Thirgood 1997). The feeding protocol will follow that of Redpath *et al*. (2001).

To examine both harrier diet whilst rearing their chicks and the rate at which harriers took the supplementary food offered relative to other species such as crows, hides would, in turn, be erected at each nest. At least one 5-hour watch would be made at each nest per week over the 5 weeks from hatching. Prey brought to the nest would be classified into supplementary or natural food. Natural food would be either identified to species or categorized into passerine, small mammal, nidifugous young and lagomorph (Redpath & Thirgood 1997). Pellets would be collected from nest sites and analysed as part of the study of harrier diet. The Scientific and Technical Advisory Group will advise on wing tagging and telemetry of harriers.

7.3. Other raptors and ravens

Data on both the numbers of breeding pairs and the breeding success of other raptors and ravens at Langholm have in recent years been patchy. Annual surveys of all traditional peregrine eyries will be made and nesting success followed. Discussions will be held with the Dumfries and Galloway Raptor Study Group on monitoring birds of prey, although surveys of breeding hen harriers - as a focal species for the project – will primarily be the responsibility of monitoring staff employed by the Partners. If monitoring is undertaken by Raptor Study Groups their work would be subject to a formal agreement with the Project Board, and the Groups will adhere to an agreed protocol. All data on nest locations and success will be made available to the Project Board, as and when required by the Board, for analysis and reporting .

7.4 Other breeding birds and small mammals

Birds: The abundance of all birds, but predominantly passerines and waders will be estimated annually within 25 Breeding Bird Survey (BBS) plots, each comprising two parallel 1 km transects. Currently, there are 15 BBS plots, three in each of the five moorland beats, surveyed annually since 1992. This total will be extended by adding a further two survey plots into each beat. New plots will probably be placed relative to areas of planned habitat restoration.

Counts will be conducted twice per annum. The first count will take place between late April and late May, and be repeated in June. All counts will be conducted between 06.00 and 09.00. Passerines, together with all other birds, will be recorded and confined to three distance bands in line with both BBS methods.

Small mammals: Small mammal abundance will be estimated annually through snap-trapping in early March, using the same 10 transects (2 for each of the 5 beats) that have been used since 1992 (Redpath and Thirgood 1998). Fifty unbaited snap traps would be set over two nights, giving a total of 100 ‘trap nights’ per transect. The Scientific and Technical Advisory Group will be asked to advise further on the methods.

7.5 Predator abundance & management

Foxes: A relative estimate of red fox abundance will be derived through the use of scat transects. A fox scat transect will be surveyed on foot in March in each plot in each year as a

clear-up round, with subsequent monthly repeat surveys until June. Transects will run along obvious linear features such as walls and fences to facilitate repeat surveys in future years. Each transect will be around 10 km in length. Three such routes have been surveyed annually since 2002 and will be continued. A further two routes will be selected so that there is one route per beat.

Stoats & weasels: An index of small mustelid abundance will be obtained using footprint tracking tunnels set in locations likely to be used by stoats and weasels. Fifty tracking tunnels have been set annually for 14 days in late April / early May and again in September since 2002 and will be continued. Numbers of tunnels may be augmented to reflect the larger project area and tunnels apportioned so that broadly equal numbers are in each beat.

Corvids: Crows will be recorded within the 25 BBS plots (see 8.4).

Keeper trapping effort: Gamekeeper records of numbers of pest species killed per trapping effort will be maintained and collated monthly by the scientists. In addition, all animals killed will be logged and mapped and carcasses made available for analysis. Gamekeepers will be encouraged to keep a daily log of agreed observations.

7.6 Habitat condition assessments

Monitoring would be specifically targeted towards gauging changes in heather cover and blanket bog condition arising from modifications to existing grazing and burning regimes. Two approaches are proposed: a) Repeat the Averis & Averis (1998) to compare results with the 1997-98 baseline surveys (the method uses 240 twenty metre diameter sample plots, in which 12 condition attributes of heather and other dwarf shrubs are measured, after MacDonald *et al.,* 1998); b) Using the site condition monitoring attributes for dry heath, wet heath and blanket bog, the overall condition of these habitats would be assessed as part of the Site Condition Monitoring programme. In addition, aerial photographs would be analysed and compared with earlier photographs (Redpath & Thirgood 1997) to assess extent of dwarf shrub habitat.

7.7 Monitoring: Staffing and Management

The monitoring programme will be headed by a post-doctoral scientist (HSO grade with GCT) supported by additional seasonal staff (SO grade or equivalent), who will be employed by different organisations within the partnership. The HSO will manage the fieldwork programme of the seasonal research assistants. The primary responsibility of the SO staff employed by RSPB (one for 5 months and one for 3 months) will be to deliver monitoring under 7.4.-7.5, above, and to liase with the Raptor Study Group personnel to ensure delivery of monitoring under 7.3, subject to the outcome of discussions referred to above. A further SO (employed for 5 months by GCT) will assist the HSO in delivering monitoring under 7.1 and 7.6. All monitoring staff will take part in the intensive monitoring of hen harrier nests under 7.2. and the SO posts will have flexibility in their Job Descriptions to ensure that the monitoring effort makes the best use of staff resources on a day-to-day basis.

Any fieldwork gap periods during the employment of the HSO and assistants will be used for data entry, catching up on fieldwork back-log should weather restrict progress, ensuring up to date records are obtained from gamekeepers and staff taking some holiday. Further data entry, data checking, analyses and annual reporting will be undertaken by the HSO in the period October through December. Recruitment of assistants will occur annually in January, with training of new staff in early March.

The overall annual work programme is summarised below, and in Gantt chart format in Table 6.

Annual work programme:-

March
Grouse counts / kill search: Two plots per day
Grouse radio-tracking: Catching 5 days, tracking 10 days
Locate / feed displaying harriers One day per beat per fortnight
Fox scats (clear-up): One route per day
Voles: 1000 traps over two days

April
Grouse counts / kill search: Two plots per day
Grouse radio-tracking: Located weekly / nests
Caecal pats: Two plots per day (collection & lab.)
Locate / feed displaying harriers: One day per beat per fortnight
Visit raptor eyries, ravens etc twice / month
Bird counts: Three plots per morning (12 plots)
Fox scats: One route per day
Mustelid tunnels: Setting & collecting

May
Grouse kill search: Three plots per day
Grouse radio-tracking: Located weekly
Harriers: locate late pairs, nests
Visit raptor eyries, ravens etc twice / month
Bird counts: Three plots per morning (25 plots)
Fox scats: One route per day

June
Grouse kill search: Three plots per day
Grouse radio-tracking: Located weekly
Harriers: locate late pairs
Hide watches / feed harriers: 6 hours/nest/week @ 5 nests
Visit raptor eyries, ravens etc twice / month
Bird counts: Three plots per morning (13 plots)
Fox scats: One route per day

July
Grouse counts / kill search: Two plots per day
Grouse radio-tracking: Located weekly
Hide watches / feed harriers: 6 hours/nest/week @ 5 nests up to mid-month
Vegetation monitoring

August
Grouse kill search: Three plots per day
Grouse radio-tracking: Located fortnightly
Strongyle worm counts
Caecal pats: Two plots per day (collection & lab.)
Shoot attendance: Average of 3 days per year

September – March
Monthly: Grouse kill search: Three plots per day
Monthly: Grouse radio-tracking: Located fortnightly
Monthly: Keeper data: Collate trapping & burning data
October: Predator carcasses: Process, age and sex
December Caecal pats: Two plots per day (collection & lab.)

Table 6. Summary of monthly activities by HSO & SO assistants).

Activity	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Fieldwork												
Locate harriers	*	*	*									
Feed harriers	*	*		*	*							
Find hh nests			*	*								
Hide watches				*	*							
Grouse counts	*	*			*							
Grouse worms	*					*				*		
Bird counts		*	*	*								
Fox scats	*	*	*	*								
Voles etc	*											
Admin. etc												
Keeper records	*	*	*	*	*	*	*	*	*	*	*	*
Liaison meets	*											*
Data entry	*	*	*	*	*	*	*	*				
Annual Report									*	*		
Interview SOs											*	

Monitoring Costs

Detailed costs are provided in Annex D. A summary is provided in Table7.

Table 7. Costs of monitoring, including capital items, travel and subsistence (Annex D gives more detail).

Year	1	2	3	4	5	6	7	8	9	10	Totals
	£k										
Salaries for staff	**44.3**	**46.2**	**48.0**	**50.0**	**52.1**	**54.1**	**56.1**	**58.3**	**60.8**	**63.3**	**533.2**
Other staff costs	**22.7**	**17.2**	**18.0**	**18.7**	**19.5**	**23.9**	**19.9**	**20.8**	**21.4**	**22.1**	**204.2**
Habitat monitoring	**4.7**				**4.7**					**4.7**	**14.1**
Total	**71.7**	**63.4**	**66.0**	**68.7**	**76.3**	**78.0**	**76.0**	**79.1**	**82.2**	**90.1**	**751.5**

The average annual cost is therefore approximately **£75,150**.

8. Project management

8.1 Project management structure

The Project Group has discussed a number of possible models for managing this research. A Company would be formed to employ a Project Manager and five Keepers. Monitoring ecologists would be seconded into the Project from GCT and RSPB.. The following membership of committees/groups is proposed, as shown in Figure 5:-

Partnership Committee: The Committee provides the strategic direction for the work. It would comprise Chief Executive/Director level representation from Buccleuch Estates, SNH, GCT, RSPB and NE as funders. It might also include the Chair of Scotland's Moorland Forum.

Project Board: The Board manages the work, and comprises funding partners (Buccleuch Estates, SNH, GCT, NE, RSPB). Management of the Board should rotate every three years and initially shall be chaired by SNH. The Project Board shall meet quarterly to consider quarterly reports from the Project Manager and annual reports from the Scientific and Technical Advisory Group. The Project Board shall review progress after 3 years, noting the progress in meeting the five criteria devised to assess success.

Scientific and Technical Advisory Group (STAG): This group advises on all scientific and technical matters, notably the results of the monitoring of the grouse moor, habitat and other management. It would be drawn from Project Board members with some additional organisations represented, one of whom might be chair.

Project Manager: A person with responsibility for the day-to-day management of the staff and other resources. Manages the staff resources involved in moorland management and monitoring, and provides reports on the work. Manages the media relations governed by a Partnership Protocol.

8.2 Project Management Costs

The management costs for the project manager is equivalent to approximately 2½ days per week of an HSO, amounting to £13,800. The other costs for participation in Committees and Boards would be borne by partner bodies. However, a further £2,000 p.a. would be set aside to cover the expenses. The total annual cost is £15,800.

The STAG will report to the Project Board, and:

a) On formation be provided with a copy of the project proposal and copies of key scientific papers and other documents relating to hen harrier and red grouse conflict;

b) Meet before the project starts in order to:

i) discuss and agree the monitoring protocols in the project proposal, and

ii) Discuss and agree the moorland management/keepering activities, including alternative feeding of hen harriers, to ensure the techniques are of a standard commensurate with the moor achieving a financial viable state. In determining compatibility between management for raptor and red grouse interests, the STAG and Project Board should have regard to the practicality and affordability of diversionary feeding or any other measures tried to reduce impact[1];

c) Be responsible for advising the Project Board regarding any problems that may emerge with the monitoring protocols and advise on reviewing and adjusting them as appropriate; and

d) Meet annually (unless Project Board decides that more regular meetings are required) to review the project results and advise whether the project is meeting or is likely to meet its success criteria. It would review all published outputs for scientific and technical accuracy, and be entitled to claim reasonable travelling and subsistive expenses.

[1] It is suggested that the cost is benchmarked against the SNH Natural Care programme grants for diversionary feeding;

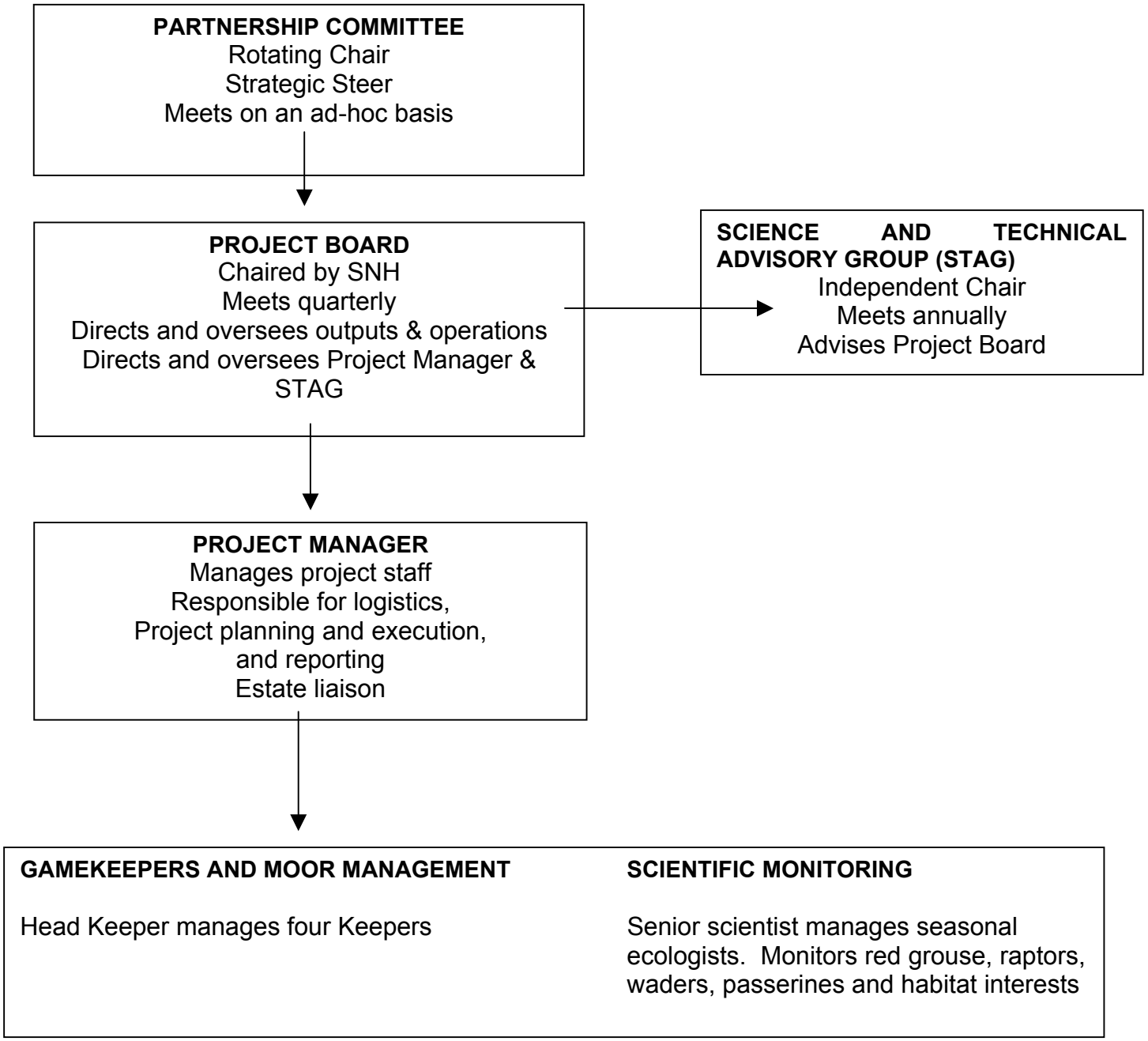


Figure 5. The proposed Project Management model

8.3 Liablity

The Agreement, establishing the Langholm Moor Demonstration Project, shall subsist so long as the parties hereto agree. If one or more parties withdraw then the Agreement will be dissolved and require re-negotiation. Staffing and other expenditure commitments as part of the Project, including forward commitments, would be honoured by all parties on a pro rata basis under which the Project was established.

9. Summary of Financial Implications

9.1 The three cost elements, and the total cost implications, can be summarised as follows (assuming 2.5% annual inflation):

Table 8: Total Costs.

Cost category	Annual Cost	Total cost over 10 years
Moorland management	£214,730	£2, 405,630
Monitoring	£75,150	£841, 920
Project management and support costs	£15,800	£177,071
Total	**£305,680**	**£3,424,621**

9.2 Table 9 indicates the levels of funding which the partners are currently proposing to contribute:

Table 9. Varying contributions per partner (assuming 2.5% annual inflation).

	Annual Cost	Total cost over 10 years
Total Cost	£305,680	£3,424,621
SNH	£86,893	£973,491
Buccleuch Estate	£86,893	£973,491
GCT	£86,893	£973,421
RSPB	£30,000	£336,096
Natural England	£15,000	£168,052

10. References

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Annex A
Objectives for Langholm – Newcastleton Hills SSSI and SPA

5.1 Conservation objectives for the SPA

When the SPA was classified, the hen harrier population numbered an average of 13 nesting females per annum over the previous three years.

There are two objectives for the SPA:

(a) To avoid deterioration of the habitats (heather and bog moorland) of the qualifying species (hen harrier *Circus cyaneus*) and avoid significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

(b) To ensure, for the qualifying species (hen harrier), that the following are maintained in the long term:

- Population of the species as a viable component of the site,
- Distribution of the species within the site,
- Distribution and extent of habitats supporting the species,
- Structure, function and supporting processes of habitats supporting the species, and
- No significant disturbance of the species.

5.2 Conservation objectives for the SSSI

The SSSI has a broad range of notified features. There are eight core objectives focused on these features:

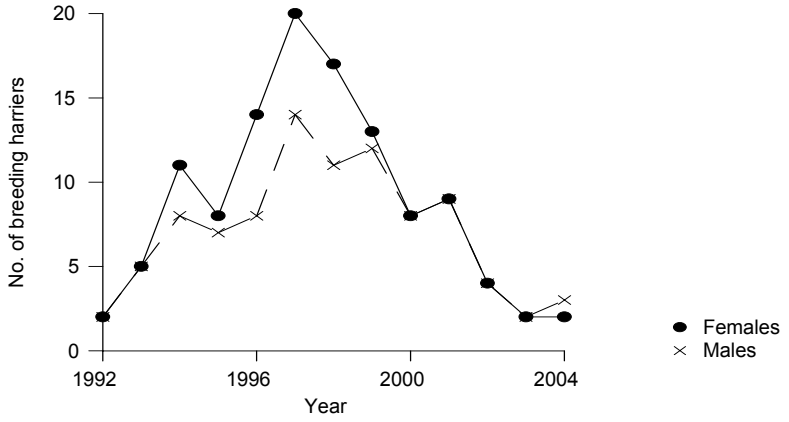
- Maintain the current area of good condition heather,
- Restore heather and dwarf shrub cover to areas which have lost heather cover over the last two decades,
- Avoid deterioration of the quality and extent of the current area of blanket bog,
- Increase the biodiversity of upland habitats,
- Increase the area of native scrub and tree development in appropriate areas,
- Reduce area of bracken dominated ground and replace this with grassland for improved grazing, burnable heather and woodland as appropriate,
- Maintain the assemblage of breeding birds, and
- Maintain geological interest of the site.

<u>ANNEX B</u>: Results of Site Condition Monitoring, and other monitoring at Langholm.

The Langholm and Newcastleton Hills SSSI and SPA were notified for three qualifying features: breeding hen harriers, vegetation mosaics and breeding bird assemblages. Site condition monitoring (SCM) was carried out during various periods between 2003-2004 and all three qualifying features failed the targets set. SCM will be repeated in May/June 2006 for all qualifying features.

a) **Hen harriers:** SCM was completed for both the SSSI and SPA in 2004. Only two pairs attempted to breed in 2004 and only three chicks fledged. The two breeding females which bred in 2004 were the same individuals which bred in 2003, indicating a lack of recruits (from birds bred at Langholm, but perhaps from elsewhere). In 2006 there were five breeding females.

   These numbers continue a downward trend in breeding numbers from a peak of 20 breeding females in 1997.

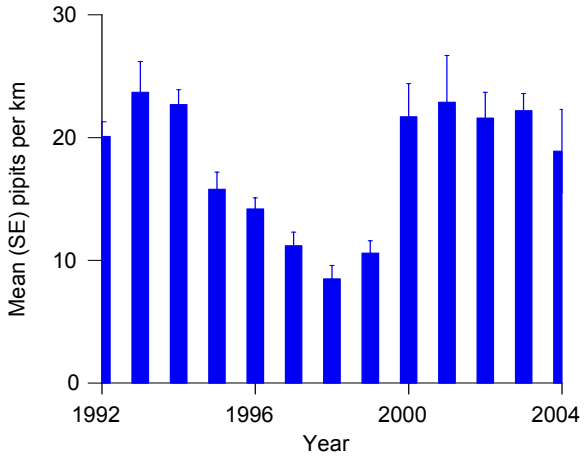


The number of breeding male and female harriers at Langholm 1992-2004

b) **Vegetation mosaic:** SCM was completed in 2004. Five component habitats were identified from the National Vegetation Classification. The site is known to have lost 45% of heather dominated dwarf shrub habitats since 1948, due to over grazing, poor burning management and extensive moor gripping. In total, dwarf shrub heath accounts for 1,380 ha but it occurs in mosaics with other habitats (grasslands, wet heath, bracken etc) varying between 30% and 100% cover. One notable aspect of this site is that the dry heath habitat has become much more fragmented or discontinuous over time.

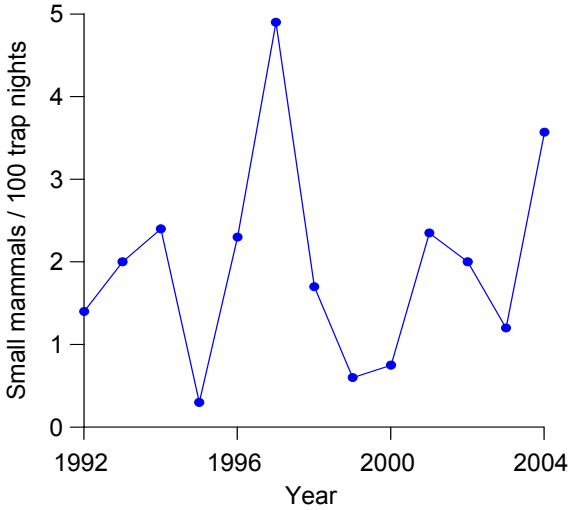
c) **Breeding bird assemblage:** SCM was completed in 2003. Fourteen species of bird were known to be breeding and/or feeding on the site between the period 2000-2003.

d) **Meadow pipit density:** The density of meadow pipits differed between years, with densities showing a decline over the period 1992-98, reaching a low of 8.6 birds per km in 1998. Since then, numbers have increased and over the last five years have been similar to the peak found in the first three years of the study.



Changes in Meadow Pipit abundance (mean birds + SE per Km) for six 1 km transects in each of five beats of Langholm Moor 1992-2004.

e) Voles: In 2004, 3.06 voles were trapped per 100 trap nights. Langholm seems to have a four year vole cycle, and in 2004 voles were in an increasing phase.



Numbers of small mammals trapped at Langholm in spring (per 100 trap nights). Note that in 2001, data were collected six weeks later than usual due to FMD.

ANNEX C: MOORLAND MANAGEMENT COSTS

a) Staff and running costs		Per keeper £	Total £	Total per year £
WAGES:				
1 Head Keeper	@	30,000	30,000	30,000
4 beat keepers	@	20,000	80,000	80,000
VEHICLES				
5 pick-up trucks	@	14,000	70,000	
5 ATV	@	5,000	25,000	
		5 year write down	-	19,000
1 Argocat	@	15,000		
		5 year write down		3,000
11 Repairs/tax/ins @ £1k			11,000	11,000
Fuel for 5 pick ups @ £2,500)			12,500	
Fuel for 5 ATVs @ £1,500)			7,500	
				20,000
DOGS ALLOWANCE				
5 keepers	@	1,400	7,000	7,000
HOUSING				
5 keepers	@	5,000	25,000	25,000*
MISCELLANEOUS (such as clothing, testing sheep for louping ill etc)			6,700	6,700
Sub-total				**201,700**

b) Equipment			£	
Heather burning equipment			5,000	
Butts			5,000	
Equipment				
guns	5	1,500	7,500	
rifles	5	1,500	7,500	
Binoculars	5	800	4,000	
Vermin control			2,000	
Sub-total			**31,000**	
	5 year write down			**6,200**

c) Additional Costs		
Bracken Control (Material Costs) per year	**1,831**	**1,831**
Heather reseeding over 5 years	**10,000**	**2,000**
Additional habitat/herbivore management per year	**3,000**	**3,000**
Total expenditure (a-c)		**214,730**

ANNEX D: COSTS OF BIRD AND HABITAT MONITORING

Costings for scientific and technical monitoring (£k).

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
STAFF COSTS										
HSO Post-doc										
Salary (£22k)	22	22.9	23.8	24.8	25.8	26.8	27.9	29	30.2	31.4
On costs (25%)	5.5	5.7	6	6.2	6.5	6.7	7	7.3	7.6	7.9
SO assistant s										
Salary (£16k)	13.4.	14	14.6.	15.2.	15.8.	16.4.	17	17.6	18.4	19.2
On costs (25%)	3.3	3.5	3.7	3.8	4	4.1	4.3	4.4	4.6	4.8
OTHER COSTS										
Vehicle purchase/lease	5.5	5.6	5.7	5.8	5.9	6	6.1	6.2	6.3	6.4
Insurance	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9
Fuel etc	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.9	5.1	5.3
Servicing / repairs	0.3	0.5	0.7	0.9	1.1	0.4	0.6	0.8	1	1.2
Accommodation (Mar-Jul)	3	3	3.1	3.1	3.2	3.3	3.3	3.4	3.4	3.5
Dog purchase/running costs	1.8	0.8	0.8	0.9	0.9	2	0.9	1	1	1
T&S	2	1	1	1.1	1.1	1.2	1.2	1.3	1.3	1.4
Telemetry	4.5	1.5	1.5	1.5	1.5	4	1.5	1.5	1.5	1.5
Office costs	1.5	0.5	0.6	0.6	0.7	1.7	0.8	0.8	0.9	0.9
Habitat Condition Assessments	4.7				4.7					4.7
TOTAL	**71.7**	**63.4**	**66**	**68.7**	**76.3**	**78**	**76**	**79.1**	**82.2**	**90.1**

Budget Notes

Vehicle purchase / lease - Purchase estate car 15k, depreciate over 5 years, lease 4WD Mar-July inclusive @ £500;
Accommodation - Estate cottage for period Mar-Jul inclusive, rent, council tax, water rates, heating;
Field costs - Clothing & boot allowance, gps, hides;
Telemetry- 20 radios per annum @ £150 each , refurbishing old radios, receivers etc in year 1 and 6
Office costs: 2 laptop computers in years 1& 6. Stationery, misc..