

ISLAY SUSTAINABLE GOOSE MANAGEMENT STRATEGY

OCTOBER 2014 – APRIL 2024

STRATEGY DEVELOPED BY RAE MCKENZIE (ISLAY SUSTAINABLE GOOSE PROJECT MANAGER)

**ON BEHALF OF A STEERING GROUP WITH REPRESENTATION FROM SCOTTISH NATURAL HERITAGE,
SCOTTISH GOVERNMENT RURAL PAYMENTS & INSPECTIONS DIVISION AND THE NATIONAL
FARMERS UNION OF SCOTLAND (ISLAY BRANCH)**



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OCTOBER 2014 – APRIL 2024

1. Executive Summary

- 1.1 This strategy has been developed on behalf of a Steering Group made up of representatives from Scottish Natural Heritage (SNH), the Scottish Government (SG) and the National Farmers Union of Scotland (NFUS), Islay Branch.
- 1.2 It is a 10 year strategy, running from October 2014 to April 2024, which will cover goose management on the island of Islay, in Argyll. It will focus particularly on Greenland barnacle geese (*Branta leucopsis*) and Greenland white-fronted geese (*Anser albifrons flavirostris*). It will be subject to review every two years.
- 1.3 The aim of the strategy is to deliver long term sustainable goose management on Islay using an adaptive management approach to wildlife management. The strategy will meet the national policy objectives for goose management, which are:
 - Meet the UK's nature conservation obligations for geese, within the context of wider biodiversity objectives.
 - Minimise economic losses experienced by farmers and crofters as a result of the presence of geese.
 - Maximise the value for money of public expenditure.

To achieve these aims, the strategy will:

- Develop habitat management techniques to support feeding of white-fronted geese through provision of diversionary feeding and management of rush pasture.
- Ensure that large areas of suitable habitat on Islay are available to geese as undisturbed roosting and feeding areas.
- Ensure that there would be no adverse effect on site integrity of the Special Protection Areas listed in Tables 1 & 7.
- Maintain a viable population of barnacle geese at a level which meets our conservation obligations.
- Reduce damage to grass crops by scaring and reducing the number of barnacle geese, therefore reducing the impact of geese on the agricultural economy of Islay.

- Ensure that compensation payments to farmers for goose damage are targeted at the most appropriate management activities.
- 1.4 The strategy will provide a framework from which a new goose management scheme for Islay will be developed by the Islay Local Goose Management Group.
- 1.5 The strategy is required for two reasons;
- damage by barnacle geese on Islay is continuing at a level which causes serious agricultural damage. On-going high levels of damage threaten the viability of farming on Islay, which underpins economic and social viability as well as providing wider biodiversity benefits;
 - numbers of Greenland white-fronted geese have fallen to a very low level on Islay (as they have done across the species range);

Previous goose management schemes have not fully addressed these issues.

- 1.6 Both species of goose are classified as Annex I species under the EC Birds Directive. Annex I lists species and sub-species which are in danger of extinction, vulnerable to specific changes in their habitat, considered rare because of small populations or restricted local distribution or requiring particular attention for reasons of the specific nature of habitat. For these species Member States must conserve their most suitable territories as Special Protection Areas.
- 1.7 On Islay there are five Special Protection Areas classified for barnacle and/or Greenland white-fronted geese. These cover many of the key roosting and feeding areas for both species but do not cover all of the areas used by geese.
- 1.8 The effects of management on Islay on the overall populations across their ranges must be taken into account and liaison with other range states will take place.
- 1.9 Previous management schemes have had limited success in delivering the national policy objectives. Reductions in the available budget for goose management at a national level have meant that support for farmers experiencing significant levels of goose damage has decreased and as a result economic losses have not been minimised.
- 1.10 The strategy will develop trials of diversionary feeding and management of rush pasture habitat to provide increased feeding opportunities for Greenland white-fronted geese as alternatives to improved grassland.
- 1.11 The strategy will measure damage caused by geese through sward height measurements, reseeding frequency and other appropriate means. Baseline data will be gathered during the first year of the strategy. No population reduction of barnacle geese will begin until sufficient, scientifically robust, baseline data have been collected.

- 1.12 The strategy will measure economic losses by using the area payment calculation and the levels of compensation paid to farmers. It may also develop agricultural economic business models to assess the level of economic damage and measure the impacts on farm businesses of reducing goose damage.
- 1.13 The strategy will maintain international obligations for Annex I species but proposes to reduce damage by reducing numbers of barnacle geese.
- 1.14 The strategy proposes that the Islay barnacle goose population should be managed initially to ensure that it does not rise above the current 2013/14 level whilst baseline monitoring takes place. That level is 41250 geese (+/- 10%).
- 1.15 The UK Greenland barnacle goose population is fully protected under the EC Birds Directive but if necessary can be controlled, in limited circumstances, using the Derogation provided by Article 9 of the Directive. This allows the lethal control of Annex I species under licence to prevent serious agricultural damage. Any use of the Derogation must be reported to the EC.
- 1.16 The strategy then proposes that the extent of damage to crops is reduced by 25-35% across Islay. To achieve this it is proposed that the Islay barnacle population is lowered, in increments, to a minimum range of 28,000 to 31,000 geese and is then maintained at that level. This represents a maximum reduction of 25-30% of barnacle geese and it is thought that this, along with continued non-lethal scaring and development of new scaring techniques, will result in a comparable reduction in the current levels of damage to crops. The relationship between goose numbers and damage is not necessarily linear but will be monitored throughout the strategy period to examine that relationship.
- 1.17 If damage reduction targets are reached, i.e. a 25-35% reduction in damage, before the population is reduced to the lower range then population reduction will cease. Other management actions will continue to scare geese and to maintain the population within an agreed range.
- 1.18 The lower range proposed will maintain 8,000 – 11,000 more barnacle geese on Islay than were present at the time of the classification of Special Protection Areas for geese in 1988.
- 1.19 Significant areas of Islay (more than 70%) will remain as undisturbed feeding areas including large proportions of grassland on individual farms, RSPB reserves and rough grazings, dune grasslands, saltmarsh and roost areas.
- 1.20 The strategy will also continue to develop or trial new scaring or crop management techniques to reduce damage. If these are successful in preventing damage, the proposed reduction in the barnacle goose population may not need to be to the levels suggested within the plan.

- 1.21 Damage measurements will continue throughout the course of the strategy to ensure that we can demonstrate that management actions are achieving the expected outcomes.
- 1.22 The strategy will also consider future management of greylag geese (*Anser anser*), if necessary.
- 1.23 Goose counts will continue using the current methodology to ensure that an accurate record of the population numbers and trends is collected.
- 1.24 Our legal obligation to maintain populations of Annex I species means that damage may be reduced but will never be completely prevented. The strategy recognises that farmers require continued financial support for continuing to feed large numbers of protected geese. In some areas, especially close to roosts, it is anticipated that geese will continue to feed in high densities.
- 1.25 Whilst the strategy aims to reduce costs in the longer term, any initial savings will be made by the farmers who currently bear a significant proportion of the costs of supporting geese. It is unlikely that significant savings will be made on the public share of the costs initially, but significant savings are projected over a 15 year period.
- 1.26 The strategy will cost more to implement than the current scheme, initially, as it will introduce new costs for measuring damage, reducing barnacle goose numbers, developing new scaring techniques and trialling diversionary feeding.
- 1.27 Longer term savings to both farmers and the public purse may be possible if damage is reduced to the levels suggested and that reduction results in a reduced reseeded frequency. In addition, work done on Islay may inform approaches elsewhere in Scotland.
- 1.28 The first year of the strategy will overlap with the final year of the current management scheme. During that period work will take place to collect baseline data and to develop a new 5 year scheme to begin in 2015/16. Work in 2014/15 includes measurements of impacts, scaring trials and diversionary feeding trials whilst maintaining barnacle goose numbers at the 2013/14 level.
- 1.29 The delivery of goose management under this strategy will seek to ensure a neutral or positive effect on tourism interests and on the wider island economy through maintaining large areas of undisturbed feeding for geese, no disturbance at roost sites and incremental reduction of the barnacle goose population over a 10 year period to minimise disruption to sporting, bird-watching and other interests. Possibilities for sporting tourism may be considered during the period of the strategy.
- 1.30 If all relevant criteria are met and licences issued, any population reduction of barnacle geese below current levels will begin from winter 2015/16.

2. Introduction

2.1 Aims

The island of Islay supports a large number of wintering Greenland white-fronted geese (*Anser albifrons flavirostris*) and barnacle geese (*Branta leucopsis*) along with a small, but growing, population of breeding greylag geese (*Anser anser*). Geese have flourished on Islay due to the availability of high quality feeding, undisturbed roosts and the protection afforded to them under European and UK law. These geese generally feed on grassland which is grown to support beef and sheep production and large numbers of geese result in a high level of damage to the agricultural economy of the island (Percival & Houston 1992, Frame, 1996, & Bevan 2012).

This strategy aims to progress sustainable management of goose populations on Islay for the next 10 years in a way which delivers the national policy objectives for geese in Scotland. The strategy will follow an adaptive management process and will develop a range of actions to manage geese on Islay.

The strategy will aim to meet the national policy objectives for goose management (NGF, 2000) which are:

- Meet the UK's nature conservation obligations for geese, within the context of wider biodiversity objectives.
- Minimise economic losses experienced by farmers and crofters as a result of the presence of geese.
- Maximise the value for money of public expenditure.

To achieve these aims, the strategy will:

- Develop habitat management techniques to support feeding of white-fronted geese through provision of diversionary feeding and management of rush pasture.
- Ensure that large areas of suitable habitat on Islay are available to geese as undisturbed roosting and feeding areas.
- Maintain a viable population of barnacle geese at a level which meets our conservation obligations.
- Ensure that there would be no adverse effect on site integrity of the Special Protection Areas listed in Tables 1 and 7.
- Reduce damage to grass crops by reducing the number of barnacle geese, therefore reducing the impact of geese on the agricultural economy of Islay.
- Ensure that compensation payments to farmers for goose damage are targeted at the most appropriate management activities.

The presence of large numbers of rare geese on Islay attracts tourist to the island in winter. The delivery of goose management under this strategy will seek to ensure a neutral or positive effect on tourism interests and on the wider island economy through maintaining large areas of undisturbed feeding for geese, no disturbance at roost sites, targeted management for Greenland white-fronted geese and incremental reduction of the barnacle goose population over a 10 year period to minimise disruption to sporting, bird-watching and other interests. Possibilities for sporting tourism may be considered during the period of the strategy.

Discussions with local and national stakeholders including agricultural, environmental and tourism groups have taken place throughout the development of the strategy (Annex 1).

2.2 Adaptive management

Adaptive management is a tool which can be used to implement ecological management where a range of uncertainties exist over the outcome. The use of an adaptive management approach in this strategy will allow clear objectives to be set, and management actions to be developed. The actions we take will be monitored to assess their effectiveness and, at regular intervals throughout the course of the strategy, we will review the data collected. If necessary, we will adapt the strategy to take into account the results of the monitoring.

More details on how an adaptive management approach can be used are included in Section 7.

2.3 Goose species and numbers

There are three species of geese present on Islay which need to be considered within this strategy. These are the over-wintering populations of Greenland barnacle geese, Greenland white-fronted geese and a local population of breeding greylag geese. 2013/14 population counts indicate that Islay supports 41,250 Greenland barnacle geese, 5,500 Greenland white-fronted geese and c.2,000 – 2,500 greylag geese.¹

The average Greenland barnacle goose population wintering on Islay has risen from c.3,000 in 1952 to a peak of just under 50,000 in 2005-2006 (Figure 1) (Mitchell & Hall, 2013). That long term increase since the 1950s was due to a combination of breeding success, reduction in hunting following legal protection and changes in agricultural management providing good quality winter feeding. However, the numbers have fluctuated over recent years. There was no significant growth in the Islay population between the last two population censuses in 2008 and 2013 and there was a drop of just under 6,000 geese since winter 2012/13. Analysis by WWT suggests that the population trend has have levelled off (Hilton *et al.* 2014)

¹ Scottish Natural Heritage goose count data.

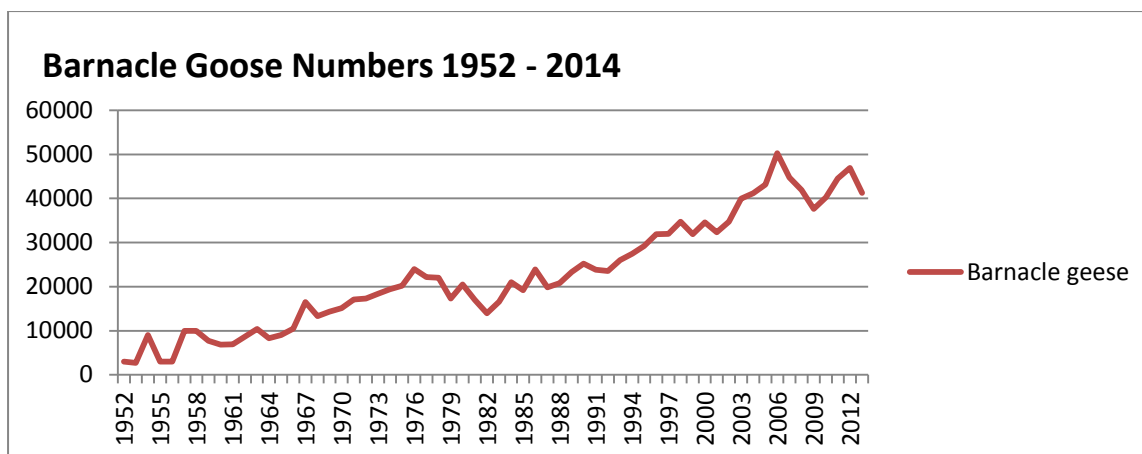


Figure 1. Barnacle Goose numbers on Islay (WWT and SNH count data)

The average Greenland white-fronted goose population wintering on Islay increased following the introduction of the Wildlife and Countryside Act in 1981. The population has since fallen from around 13,000 geese in the early 1990s (with just over 12,000 still present in 2000/2001) to a low of just over 4,500 geese in 2011/12². The decline on Islay has reflected a decline in numbers across the much of the range of the species. The population on Islay appears to have increased slightly over the past two winters with an average of 5,500 geese present in winter 2013/14 (Figure 2), perhaps suggesting that the population has stabilised.

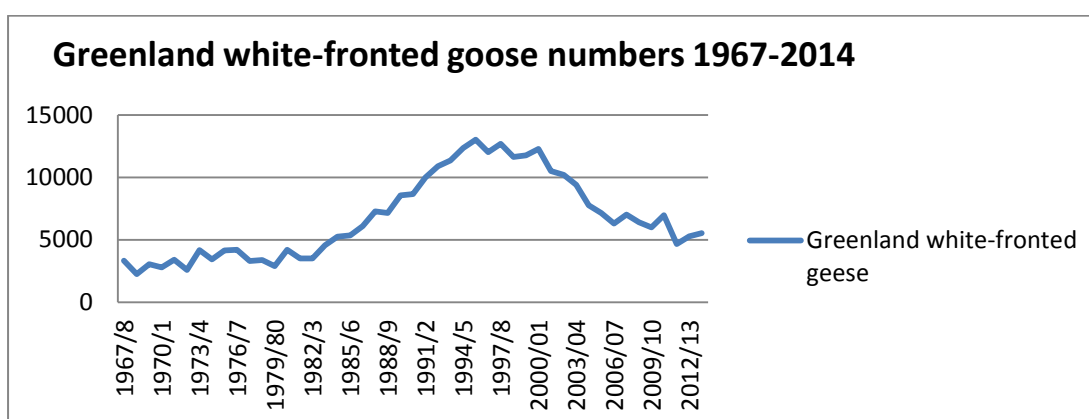


Figure 2. Greenland white-fronted goose numbers on Islay (WWT and SNH count data)

The breeding greylag population has grown from a handful of geese breeding on offshore islands in the early 1990s to the current peak autumn population of around 2,000- 2,500³. Around 1,000 of these geese remain on Islay throughout the winter. This population has been subject to a few years of intensive shooting by farmers in the open season and under licence to protect crops and, as a result, the population growth appears to have stalled. There are records of Icelandic greylag geese wintering on Islay from the 1950s to 1970s. Currently there are a very small number of records of Icelandic greylag geese being found on Islay but there is no apparent influx of greylags in winter (regular counts show that the greylag population generally decreases in winter) which suggests Islay does not support a significant population of migratory greylags.

² Scottish Natural Heritage goose count data.

³ Scottish Natural Heritage count data.

A more detailed biological assessment of each of these species is set out in Section 3 of this strategy.

The continuing high density of geese grazing on agricultural land has led to increasing conflict with farmers who rely on intensive grassland production to maintain high quality livestock herds. The total number of geese from these three species feeding on Islay in 2012/13 was around 55000. Farmers report that damage caused to grassland remains significant despite the reduction in white-front numbers and the active scaring of geese from the best quality grass. Damage is apparent in the reduced availability of grass which results in, amongst other things, increased reseeding frequencies, the loss of winter grazing for sheep, delayed turn-out of cattle in spring and later silage cutting dates.

Islay also supports small populations of light-bellied brent geese (*Branta. bernicla hrota*) which stop off on autumn migration, with only a handful remaining on the shores of the sea lochs throughout the winter. There are also occasional pink-footed goose (*Anser. brachyrhynchus*) flocks which pass through on migration. These species are present on Islay in very low numbers or generally pass through quickly. No management for these species is proposed.

2.4 History of goose management on Islay

Agriculture is a key industry on Islay. Much of the 55,000ha of farmed land, the majority of which is rough grazing, is used as grazing for cattle and sheep, although some arable cultivation is also carried out to supply barley to local distilleries. There are approximately 130 agricultural units, made up of full-time and part-time farmers and crofters supporting in excess of 100 full-time equivalent jobs. Just over 9,000ha of grassland is farmed, which currently supports over 5,000 suckler cows and over 20,000 breeding ewes. There is also one dairy farm on the island, which supplies milk locally.

A number of agricultural producers have taken advantage of the increase in tourism over the past 10 years and diversified into bed and breakfast and holiday let accommodation to supplement their farm income. Other forms of diversification include farm contracting and haulage. Land management has also shaped Islay's biodiversity with species such as chough (*Pyrrhocorax pyrrhocorax*) and corncrake (*Crex crex*) reliant on managed habitats.

The total income from farming and related activities on Islay is currently in the region of £10m -£11m per annum⁴.

Mention of geese causing damage to grass on Islay and other islands was made in the late 1800s (Harvie-Brown & Buckley 1892). Concerns about rising numbers of geese on Islay having a detrimental effect on agriculture were also documented in the 1960s when it was first reported that growing numbers of geese grazing on improved grassland were causing damage to valuable crops (Patton, D. date unknown). Whilst discussions took place between farmers and conservation organisations regarding limiting the population growth, no action was taken at that time.

⁴ Calculated using data from SFP and LFASS, livestock sales figures plus estimates from Islay NFUS based on their knowledge of individual business activities.

There was a downturn in barnacle goose numbers in the mid-1970s to the early 1980s, probably due to an increase in shooting for both crop protection and sport shooting combined with some poor breeding seasons.

The rise goose numbers from the 1980s until around 2007 has been attributed to protection of geese through the introduction of the Wildlife and Countryside Act 1981. There was also an increase in the area of improved grassland on Islay, some of which was supported by European funding programmes such as the Agricultural Development Programme. Whilst the aim of these programmes was to benefit agricultural production, they also provided increased feeding opportunities for geese.

In 1984, The Royal Society for the Protection of Birds (RSPB) purchased Gruinart Farm with the aim of maintaining a refuge for barnacle geese around the Loch Gruinart roost site and reducing the impacts of goose grazing on commercial farms in other parts of Islay. More information on RSPB's work on Islay can be found in Annex 2.

Five Special Protection Areas (SPAs) for geese (and other species) on Islay were classified in 1988 (Table 1). These cover just under 15,000ha. which is almost a quarter of the area of the island. However, large areas of grassland habitat used by geese as foraging areas are not included within the SPAs.

Table 1. Special Protection Areas designated for geese on Islay

Site	Goose species included in classification
Bridgend Flats, Islay	Barnacle geese
Laggan, Islay	Barnacle geese & white-fronted geese
Gruinart Flats, Islay	Barnacle geese, white-fronted geese & brent geese
Eilean na Muice Duibhe (Duich Moss), Islay	White-fronted geese
Rinns of Islay	White-fronted geese

The first management schemes set up involved farmers within barnacle SPA areas agreeing to maintain good quality grassland for grazing geese in return for management agreement payments. Out-with the SPA areas, a scaring scheme was set up which used human scaring to try to scare geese into the SPA areas.

As the goose population continued to increase into the early 1990s it became clear that the RSPB reserve and the SPA refuge areas were not supporting all of the geese over-wintering on Islay and that farmers out-with these areas were reporting economic damage to their businesses as a result of goose grazing. The numbers of geese recorded out-with the SPA and reserves had increased and farmers without management agreements argued that they were suffering similar economic impacts to some areas with management agreements. The scaring scheme was not proven to be effective in moving geese into the refuge areas and keeping them there.

The first whole island goose management scheme was set up in 1992. This scheme involved paying farmers to allow geese to feed on grass without disturbance. All farmers on Islay were eligible to join the scheme and payments were made on a per goose basis. The

scheme delivered mixed results. All farmers were able to claim payments for geese on their ground, but there was an on-going debate about levels of payments, which farmers felt did not cover the costs of feeding geese. This was essentially a feeding scheme and no management of geese was undertaken as part of this scheme. Populations of barnacle and white-fronted geese continued to grow throughout the 1990s.

In 1999, the Scottish Government set up the National Goose Forum (NGF) to review goose policy across Scotland and make recommendations on how goose management should be taken forward. The recommendations from the NGF included the setting up of goose schemes in specific parts of Scotland, including Islay. The NGF developed a framework for use by local goose management groups in designing new schemes. NGF subsequently became known as the National Goose Management Review Group (NGMRG) and is responsible for advising Government on goose policy. Co-ordination of all goose schemes takes place through NGMRG.

The framework led to a new scheme being developed by the Islay Local Goose Management Group (ILGGMG) which was launched in the autumn of 2000. This scheme recognised that farmers suffered economic losses as a result of geese grazing in high densities. It made compensation payments to farmers for allowing geese to graze on parts of their farm but, for the first time in an Islay scheme, farmers were able to protect some parts of their grassland through scaring geese, and in certain situations, licenced shooting of barnacle geese. The payments made were for losses attributed to goose grazing. These losses included costs of increased reseedling frequency and delayed turnout of livestock in the spring. The payments made to farmers at this stage were 100% of the calculated costs of goose damage.

Reviews of costs in 2005 and 2008 resulted in the payments to farmers increasing as a result of increasing goose densities and increasing farming costs (fertiliser, fodder and fuel). Following both of these reviews, it was decided by the Scottish Government that the costs could not be fully supported and so the budget offered was less than the calculated cost of supporting geese to reduce overall costs to the taxpayer.

Further cuts to payments were made following a review of all goose schemes in 2010. At this stage, the Scottish Government determined that scheme costs needed to be contained, and financial intervention should be targeted on the highest conservation species. Alternative mechanisms for managing protected species that are no longer of the highest conservation status were explored. In the case of Islay, this meant that Greenland white-fronted geese should be the focus of intervention and that alternative mechanisms for managing barnacle geese should be explored.

The overall budget for goose management in Scotland in 2011/12 was reduced by the Scottish Government, which meant a reduction in the Islay scheme budget from £903,000 to £710,000. The scheme was revised by the Local Goose Management Group to include, amongst other measures, weighted payments towards white-fronted geese. This revision to the scheme was not thought by farmers to be successful as it did not appear to reduce the amount of damage caused by barnacle geese (farmers still had to support large numbers of barnacle geese). Therefore it did not achieve one of the stated aims of minimising economic losses to farmers. There was also no evidence that the weighted payments improved the status of white-fronted geese.

NGMRG and local goose management groups then reviewed all of the payment calculations prior to a new three-year scheme set up from 2012- 2015. The review included updated costs for the individual elements of the payment calculation and rationalising the elements paid for in each scheme. The increase in costs of fuel, fertiliser and fodder since the 2008 payment review, along with using a seven-year average (which included years with very high counts in 2006/07) to calculate individual farm payments meant the calculated cost of the scheme rose to just under £1.6m.

Scottish Government could not commit that level of funding to goose management due to governmental budget constraints and so the level of funding offered for the 2012/13 scheme was £843,000. The Islay Local Goose Management Group accepted this level of funding on the condition that SNH and Scottish Government undertook to consider managing the barnacle goose population to a level which reduces damage on Islay farms. Concern remains that the level of damage is having a serious impact on farm businesses and that if the impacts continue there is a threat to the long term viability of many of these businesses.

Whilst scheme funding offsets some of the costs of goose damage it does not prevent the damage occurring (Figure 3). The short sward height and the high proportion of bare ground in the areas not protected by netting or scaring in these pictures are typical of fields affected by goose grazing.



Figure 3. The picture on the left shows the difference between grass on Cornabus Farm, Islay, which has been fully protected from goose grazing by crop protection netting from early February until early April 2014 and grass which has had no protection other than scaring by lethal and non-lethal shooting. It is likely that the grass protected by the netting benefits from the creation of a micro climate but the level of damage to the open sward is clear. The picture on the right shows (taken in late February 2014) is of a field near Bridgend which has only partially been grazed by geese. The foreground has not been grazed due to the scaring effects of the adjacent main road. The area grazed by geese can be seen clearly in the background.

2.5 Long term strategy development

SNH and Scottish Government agreed, in late 2012, to develop a long term sustainable management strategy for geese on Islay using an adaptive management approach. This commitment led to a Steering Group being set up which included representatives of Scottish Government, SNH and Islay National Farmers Union. A Project Manager was appointed in early 2013 and work began on the project in February 2013. There has been an ongoing

process of stakeholder engagement throughout the development of the strategy. Details are included at Annex 1.

The aim of the Islay Long term Sustainable Goose Management Project is to develop a 10 year strategy for management of all species of geese on Islay within two years of the start date.

The strategy, if approved, will form the basis of a new Islay Goose Management Scheme to be developed by the Islay Local Goose Management Group. Development of this scheme will begin in autumn 2014 with a view to the new scheme being launched in October 2015.

3. Biological Assessment

3.1 Greenland barnacle goose *Branta leucopsis*

3.1.1 Biogeographic population and conservation status

The barnacle goose (*Branta leucopsis*) breeds predominantly in the High Arctic and winters along the coasts of Britain, Ireland and the mainland of continental Europe. Three separate populations of barnacle geese occur in the Western Palearctic. These populations are not separated into sub-species and there are no morphological differences between them. However, they are geographically isolated and have been shown by ringing to have separate migration routes and breeding grounds with very limited exchange between the populations (Wernham *et al.* 2002). One population breeds on Novaya Zemlya in Arctic Russia (with a few on the Baltic islands) and winters primarily in the Netherlands. The second breeds in Svalbard and winters largely on the Solway Firth in southern Scotland. The third population breeds in north east Greenland and winters on the northern and western coasts of Scotland and Ireland, including Islay (Figure 4).

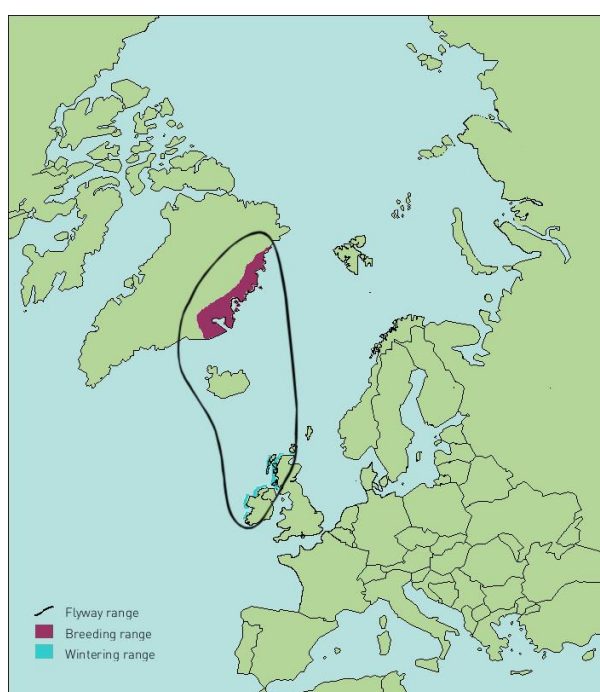


Figure 4. Range of Greenland barnacle goose (GSMP website)

Table 2. Conservation status of the Greenland barnacle goose

Global status (IUCN Red List of Threatened Species)	Least Concern
African-Eurasian Waterbird Agreement (AEWA)	B1
The Birds Directive (European Commission)	Annex I
UK status (Birds of Conservation Concern)	Amber

UK quarry species (Wildlife & Countryside Act 1981)	Not huntable
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3.1.2 Distribution

Breeding: Greenland barnacle geese breed along the coastal strip of north-east Greenland. Arriving in mid-May, geese breed in small colonies of a few to around 150 pairs, mainly on cliff ledges and outcrops above coastal plains or on the side of valleys. Some moulting areas have been identified within this breeding area, with numbers building up in these areas at the end of June. This suggests that a moult migration may occur within the breeding range (Ogilvie *et al.* 1999). Birds leave the breeding grounds in late August and September for staging areas in Iceland (Wernham *et al.* 2002).

Staging: Barnacle geese use two discrete staging areas in Iceland. During the autumn, staging occurs mainly in south-east Iceland, while in the spring barnacle geese largely concentrate in the valleys of northern Iceland.

Wintering: The wintering range of barnacle geese is maritime. All but a handful of wintering sites are on offshore islands confined to the northern and western coasts of Scotland and Ireland. In the March 2013 international census, barnacle geese were recorded at 69 wintering sites in Scotland and Ireland. Many of these sites were very small, holding a few hundred geese, with few sites holding more than 1,000 geese. Islay was by far the largest of these, holding approximately 45,000 geese, which was 56% of the population (Mitchell & Hall 2013). There have been only minor changes in the wintering distribution over recent decades; declines in goose numbers or abandonment of some island sites have resulted from reductions in sheep grazing affecting goose grazing quality. The birds tend to arrive in early October and have usually departed by early to mid-April.

Islay: Barnacle geese are widely distributed on areas of improved land on Islay. Analysis of marked birds in the 1980s indicated that there are five main feeding areas within Islay, each associated within a night-time roosting area. The majority of birds remain faithful to specific feeding areas both within the winter and between years (Percival 1991), and these areas have remained remarkably constant over recent decades despite changes to goose management on Islay (ap Rheinallt *et al.* 2007). Consequently, management should be undertaken at this flock level to ensure conservation obligations are met.

3.1.3 Habitat Requirements

The barnacle goose is primarily a grazer of short swards. During the breeding season, geese use wetland areas within the high arctic tundra, feeding on sedge and moss marshes and stands of *Eriophorum spp* (Ogilvie *et al.* 1999).

At other times of the year, barnacle geese have traditionally grazed short saltmarsh swards and areas where vegetation is restricted by exposure to wind and salt spray. As pastures have been improved, the species has increasingly moved to feed on intensively managed grassland, consequently moving further inland during both the winter (Percival 1993) and while staging (Black *et al.* 1991).

In spring, barnacle geese staging in Iceland feed largely on improved agricultural pastures and, to a lesser extent, wet river meadows. During the autumn passage, diet is more varied and includes berries and seeds in the uplands, and sedges on the lowlands as well as agricultural grasses (Ogilvie *et al.* 1999).

During the winter, some populations still feed on saltmarsh and salt-affected pasture, but most larger populations now use intensively managed grassland. On Islay, studies have shown that barnacle geese select for newly reseeded perennial ryegrass (*Lolium multiflorum*) pastures and for fields that have been fertilised. Barnacle geese on Islay also feed on barley and oat stubbles in autumn, taking both spilt and sprouting grain as well as undersown grass (Patton & Frame 1981, Percival 1993).

3.1.4 Population dynamics

Numbers of Greenland barnacle geese across the range have increased steadily since counts began in the 1950s. Due to the remote location of many of the wintering sites for Greenland barnacle geese, estimating the total population size is only practical from a combination of air and ground surveys. Between 1959 and 2013, 13 full surveys have been conducted at approximately five-year intervals. The total population has grown from 8,300 in 1959 to over 80,670 in 2013 (Figure 5).

This increase has been attributed to increased protection of roost sites through site designation, increased protection from shooting mortality and changes in agricultural practices resulting in the availability of higher quality winter grazing (e.g. Owen 1990).

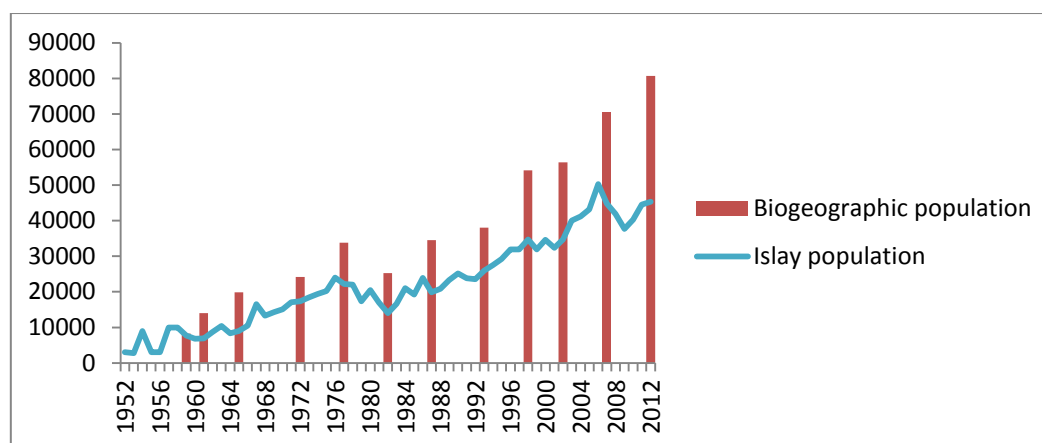


Figure 5. International census totals for Greenland Barnacle Geese, 1959 – 2013. (WWT)

Islay is the main wintering resort for this population, consistently holding well over 50% of the population. It showed a similar increase in population size until the past few years where it appears to have levelled off. While the proportion of the wintering population present on Islay has fluctuated over time there are no clear trends, although declines in the proportion of the population on Islay have been recorded in recent surveys (Figure 6).

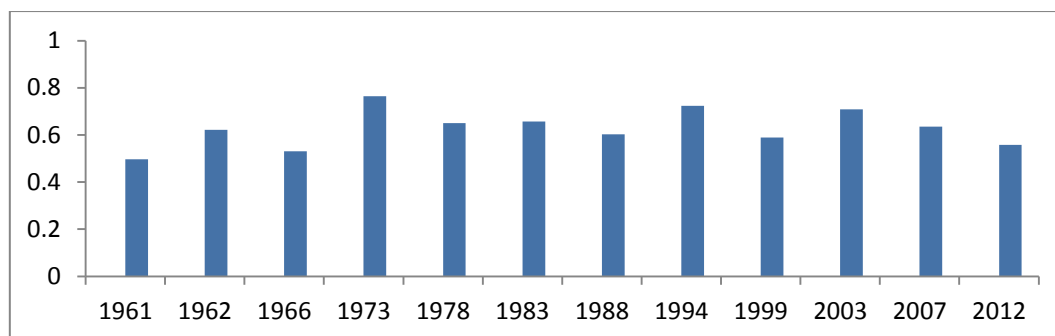


Figure 6. The proportion of the biogeographic population present on Islay 1961 – 2013 during the international census.

Breeding success of the Scottish population has been consistently measured on Islay, with the proportion of juveniles estimated annually since 1961. Estimates of reproduction based on observations made on Islay in the winter show quite wide inter-annual variation (Figure 7). This reflects variations in arctic conditions between years, with factors such as the timing of spring thaw having a marked impact on goose breeding success. The proportion of juveniles in the Islay population has declined significantly since 1961. The mean brood size has been collected annually on Islay since 1965 and has not shown any trend over this period. Similarly, crude survival rates, calculated from information on the numbers of geese and proportion of juveniles, have shown no discernible trends over time (Trinder 2014).

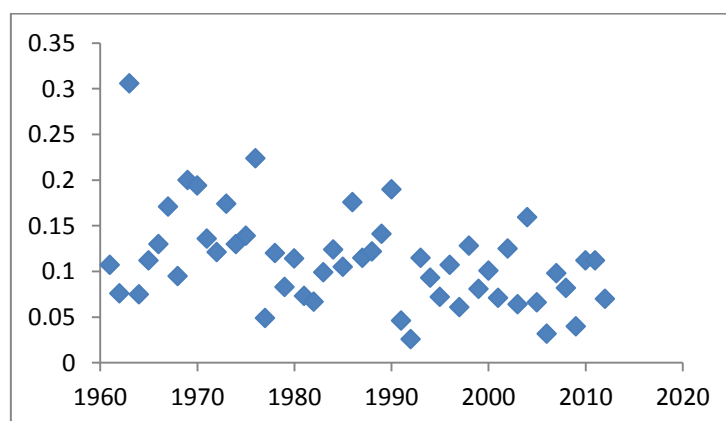


Figure 7. The proportion of young in Greenland barnacle goose flocks on Islay 1961-2012.

Population Viability Analyses (PVAs) have been undertaken three times for Greenland barnacle geese since 1999. In all cases the PVA was based on the Islay population rather than the Scottish population, as historical count and productivity data are more robust for this site than elsewhere in Scotland. The most recent of these (Trinder 2014) predicted that, with shooting levels remaining as they have been between 2000 – 2011, the Islay population would continue to increase by 2.6-3.0% per annum.

The Greenland barnacle goose, in common with many goose species, is most sensitive to changes in adult survival (Trinder *et al.* 2005). As such, changes in the shooting level will strongly affect population trajectories. Greenland barnacle geese are legal quarry in Iceland on autumn migration (bag data are available since 1995) and have also been subject to

shooting, under licence, on Islay since 2000 (between 2000 and 2011 this was licensed by the Scottish Government, since 2011 this has been licensed by SNH).

The number of Greenland barnacle geese shot on Islay and in Iceland between 2000 and 2011 has been reasonably constant, with the average number of geese shot over this period being 585 on Islay and 885 in Iceland (Trinder 2014). In 2012/13 the bag limit for barnacle geese on Islay was increased following a request by farmers and consequently approximately 2,000 were shot on Islay, equating to 4.45% of the Islay population. Continued shooting at this level is predicted to cause population decline (Trinder 2014) and the bag limit was reduced to 1,800 in 2013/14.

3.2 Greenland white-fronted geese *Anser albifrons flavirostris*

3.2.1 Biogeographic population and conservation status

Of the four currently recognised races of holarctic greater white-fronted goose (*Anser albifrons*), the Greenland-breeding race (*flavirostris*) is the most morphologically distinct (Ely *et al.* 2005), and the most recently described (Dalgety & Scott 1948).

Greenland white-fronted geese nest solely in west Greenland (Figure 8), wintering in north and west Scotland and Ireland. It is unusual among arctic-breeding geese in undertaking two separate long-distance migratory flights, each of over 1,000km, between its wintering and breeding areas.



Figure 8. Range of Greenland white-fronted goose (GSMP website)

Table 3. Conservation status of the Greenland white-fronted goose

Global status (IUCN Red List of Threatened Species)	Least Concern*†
African-Eurasian Waterbird Agreement (AEWA)	A2; International Single Species Action Plan

The Birds Directive (European Commission)	Annex I
UK status (Birds of Conservation Concern)	Red
UK quarry species (Wildlife & Countryside Act 1981)	Huntable in England and Wales during the open season

* Assessed at the species level *Anser albifrons*.

† Greater white-fronted goose *Anser albifrons* is listed as 'Least Concern' by IUCN. The Red List assessment of sub-species is not routinely undertaken, however, an assessment of Greenland white-fronted goose *Anser albifrons flavirostris* has been undertaken ([Boertmann 2007](#)); the sub-species was evaluated as 'Endangered'

3.2.2 Distribution

The Greenland white-fronted goose population nests solely in west Greenland, and crosses the extensive Greenland ice-cap on spring and autumn migration to stage in lowland agricultural areas and wetlands in west and south Iceland. The geese then migrate further south to wintering grounds in Britain and Ireland. There are also consistent records of small numbers wintering in Rogaland, southern Norway (Shimmings 2003).

Breeding: Greenland white-fronted geese breed on low arctic tundra on the relatively mild, oceanic west coast of Greenland. A range of low arctic wetland types are used during summer (May-September) for staging, nesting, brood-rearing and moult (Fox *et al.* 1983; Fox & Stroud 1988; Glahder 1999). In the southern part of the range, geese typically nest in large valleys with marshes, moving to moult in late summer on higher altitude lakes and wetlands on upland plateaux. In more northerly areas, nesting occurs in low, freshwater wetlands close to the coast.

Staging: Spring and autumn staging occurs on lowland farmland in the south and west of Iceland, with Scottish birds predominantly staging in southern areas and those from Ireland concentrating on staging areas to the west of Iceland.

Wintering: The extent of the wintering range, along the north and west fringes of Britain and Ireland, was originally restricted to the extent and distribution of lowland peatland areas (raised bogs or patterned blanket mires). These did not regularly freeze in winter, enabling the geese to feed on the underground parts of bog plants. During the 20th century, low intensity farmland within the traditional range became increasingly used as feeding grounds for geese, although many flocks continue to use peatlands as roost sites in most areas (Fox *et al.* 1999). Since flocks that feed in winter on intensively managed grasslands have had better reproductive success in recent decades (Fox *et al.* 2005), an increasing proportion of the population now occur on such grasslands (e.g. at Wexford, Kintyre and Islay). Geese tend to arrive on the wintering grounds from early to mid-October, departing for Iceland in mid-April.

Observations of individually marked birds have demonstrated high site fidelity at all times of the year, with individuals returning over many years to very small home ranges. On the wintering grounds this is manifest in the small number of regularly used sites; the entire global population of the Greenland white-fronted goose is currently confined to just c.80

regular sites in Ireland and Britain (including Islay as one site) (Fox *et al.* 1994, Stroud *et al.* 2012).

Islay: Greenland white-fronted geese are widely distributed on Islay, roosting on over 80 locations throughout the island and feeding widely on grassland, although concentrations of feeding geese can be seen in some areas, for example in the Kilmeny area (Ridgill *et al.* 2004).

Analysis of sightings of ringed birds on Islay indicates that Greenland white-fronted geese exhibit high levels of site fidelity both within and between seasons, and tend to remain within a very small area throughout the winter. Analysis of goose flight paths suggests that there are approximately 20 flocks on Islay with defined catchments. Consequently, conservation and management should be undertaken at this flock level to ensure the needs of individual flocks are addressed (Ridgill *et al.* 1994). Further studies of Greenland white-fronted geese on Islay which will provide more information on goose use of sites and catchment areas are currently being undertaken and a final report will be published in 2015.

3.2.3 Habitat requirements

In Greenland, geese select wetland habitats associated with favoured food plants. They feed on the underground organs of *Eriophorum* and *Triglochin* and berries initially, and switch to browsing on grasses and sedges later in the summer (Fox *et al.* 1983).

On staging areas in Iceland, geese feed on more intensively managed farmland, particularly on drained hay fields, waste potatoes and spilt grain when available and on natural wetlands including lakes, marshes, peatlands and saltmarshes (Fox *et al.* 1999).

On wintering areas, Greenland white-fronted geese appear to have traditionally fed on the overwintering pastures of *Eriophorum* and *Rhynchospora* on bogland areas, but no flocks are known to feed exclusively on this habitat now. Geese now feed on a range of agricultural grasslands, with some flocks also feeding on root crops and spilt cereal from stubble fields where available. Analysis of the habitat preferences of smaller wintering flocks in Scotland (excluding Islay) indicated that Greenland white-fronted geese appeared to select improved land, especially older improved pastures which were 'green-yellow' in appearance rather than bright green, with shorter swards and medium to high grazing intensities. Preferred fields had little or lower cover of *Juncus* rushes compared to those available to the geese generally (Francis *et al.* 2011). Previous studies on Islay indicate that Greenland white-fronted geese primarily feed on pasture, using all pasture earlier in the year but concentrating on recently improved pasture in the spring, with some use of arable land in the autumn. Geese also select fields with a higher proportion of *Juncus* and with a greener sward (Ridgill *et al.* 1994). Apparent differences between habitat selection on Islay and elsewhere may be because pasture on Islay is likely to be more intensively managed than many of the smaller flock feeding areas.

Greenland white-fronted geese roost on lochs, lochans, patterned mires and abandoned peat cuttings. Many flocks retain bogland roost sites where traditional feeding may take place at night (Fox *et al.*, 1999).

Greenland white-fronted geese demonstrate unusual social structuring with long lasting family relationships. Flocks typically comprise extended families of several generations.

Greenland white-fronted geese show strong fidelity to sites and use of limited home-ranges within sites over many years (Wilson *et al.* 1991). All these factors highlight a high cultural element of learnt behaviour in the selection and use of sites.

3.2.4 Population dynamics

Few data were collected prior to the initiation of the Greenland White-fronted Goose Study (GWGS) in 1982, although Ruttledge and Ogilvie (1979) estimated that the population had declined from around 17,500 - 23,000 in the 1950s to 14,300 - 16,600 in the 1970s. Protection from hunting on the wintering grounds in the early 1980s allowed the population to increase at c.4% per annum, reaching a peak of 35,600 in spring 1999. Since then however, numbers have declined rapidly, and the most recent assessment is of 22,403 in spring 2012 (Figure 9).

The hunting of Greenland White-fronted geese was banned in Iceland in 2006 and in Greenland in 2009, yielding complete protection throughout their annual cycle (other than in England and Wales) and helping to slow the decline.

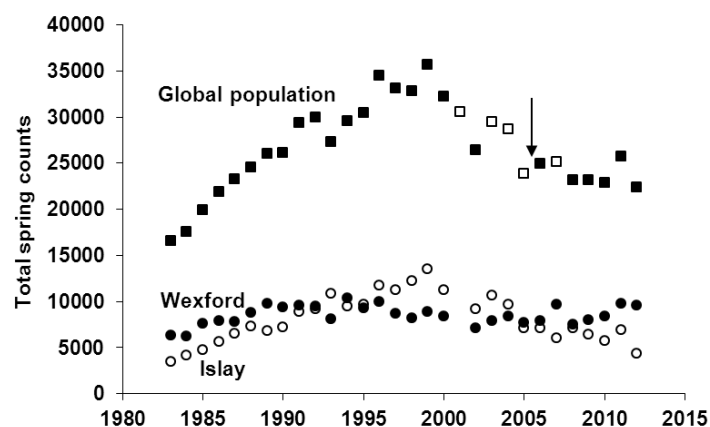


Figure 9. Spring counts of Greenland white-fronted geese from Wexford Slobs, Islay and the global population count, 1983-2012. The arrow marks the point at which autumn hunting in Iceland was stopped in 2006. (from Fox *et al.*, 2012)

Declines in productivity have been recorded since the mid-1990s (Figure 10). The recent chronic low productivity is known to be the immediate cause of the population decline. In most of the last ten years, productivity has not balanced mortality, causing a year-on-year reduction of numbers. These declines in productivity have been due to decreases in the proportion of geese breeding rather than declines in mean brood size (Fox *et al.* 2006)

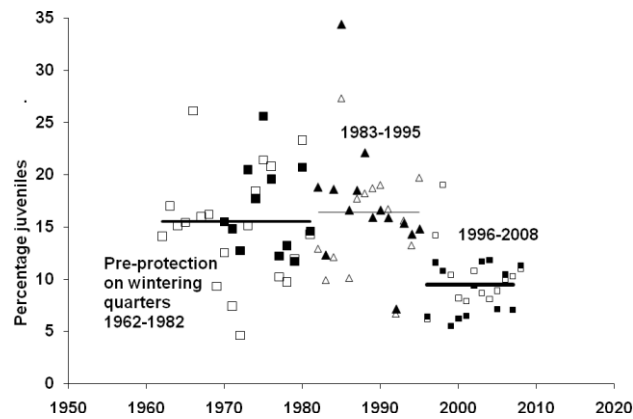


Figure 10. Changes in the proportions of young Greenland white-fronted geese sampled in winter from Wexford Slobs (triangular symbols) and Islay (square symbols) for the years 1962 – 2007. Year is summer of breeding. Data are shown from the period prior to the cessation of hunting on the wintering areas (up to winter 1981/82), the period immediately following protection until 1995 and since 1995, with mean values shown for each of the three periods. Data courtesy National Parks and Wildlife Service Ireland and GWGS/Dr Malcolm Ogilvie, respectively. (from Stroud *et al.* 2012)

The ultimate cause of the decrease in productivity remains unclear, although the two most likely issues (either independently or more likely in combination) are:

- i) A switch in the Atlantic Multi-decadal Oscillation which has had the consequence of greatly increasing precipitation in Greenland in April and May, constraining the availability of food for geese on arrival in Greenland and possibly also the availability of nest sites (Boyd & Fox 2008). This is supported by reports of an exceptionally successful breeding season following the snow-free spring and mild summer of 2010 (Fox *et al.* 2011); and
- ii) Competitive interactions with Canada geese *Branta canadensis* which have recently expanded their range and are now breeding widely in west Greenland (Stroud *et al.* 2012).

In recent years, it has been notable that trends in the biogeographic population have not necessarily been reflected at individual sites. At times when the biogeographic population was high a larger proportion of geese wintered on Islay, but in recent years the numbers of Greenland white-fronted geese on Islay has declined more rapidly than the international population (Figure 11). Conversely, at the other major wintering resort in Wexford in Ireland, numbers have been much more stable since the 1980s (Figure 10). The reasons for these recent declines on Islay are not yet clear. The Islay goose population may be in decline due to particularly low survival and productivity compared with other wintering birds, although there is no evidence of this from annual productivity estimates. Alternatively geese may be being pushed out of Islay due to unfavourable conditions on the island or may be being pulled into preferred feeding areas elsewhere. The cause of differing population trends at different wintering sites is part of an on-going PhD study at present.

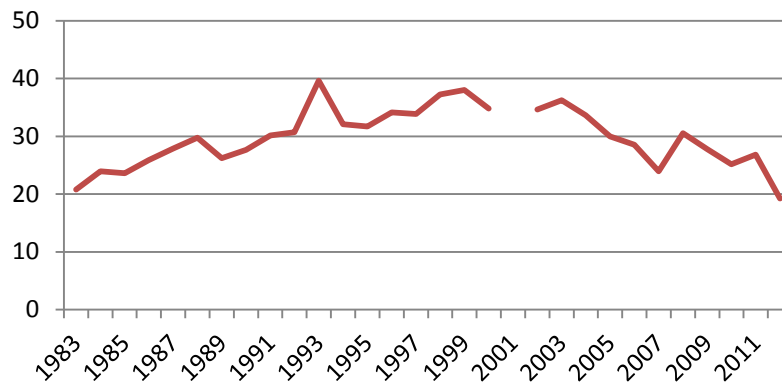


Figure 11. Changes in the percentage of Greenland white-fronted geese wintering on Islay 1983 – 2012.

A PVA for the Scottish population of Greenland white-fronted geese predicted that with the ban of shooting in both Iceland and Greenland, the Scottish population would make a slow recovery to a median population of 25,000 - 30,000 within 25 years (Trinder 2010). Although it is still relatively early as model predictions were made over a 25 year period, it seems this was rather optimistic in light of the continuing decline in the Scottish population since that time; there is on-going concern about the status of this species (e.g. Stroud *et al.* 2012). The discrepancy could be a result of the productivity estimates used in the PVA being higher than those recorded in more recent years. While the long term mean proportion of breeders from 1996-2005 was used in the PVA (average of 0.084), the mean proportion of breeders for 2003-2007 was lower at 0.06 (Trinder 2010). Additionally, other un-modelled factors such as competition and climate change may also be affecting the population trajectory. Such discrepancies between predicted and actual population trends highlight the uncertainties inherent in population modelling, especially over the shorter term for highly variable populations of Arctic-breeding geese.

3.3 British greylag geese *Anser anser*

3.3.1 Biogeographic population and conservation status

There are two races of the greylag goose (*Anser anser*), the nominate race (*anser*) breeds in Iceland, Scandinavia and around the Baltic, with a remnant population in northwest Scotland (Figure 12). The eastern race (*rubrirostris*) breeds across the former USSR, east of the Black Sea (Wernham *et al.* 2002). Birds from some populations winter within the breeding range, although the majority of birds are migratory.

Two populations of greylag goose occur in Britain. A migratory population breeds in Iceland and winters predominantly in northern Scotland, with smaller numbers in eastern Scotland, northern England, Ireland, southwest Norway and the Faeroe Islands. A largely sedentary population also exists: the British greylag goose occurs across much of Britain, particularly on the Hebrides, the north and west Scottish mainland, Orkney and throughout large parts of central and southern Scotland and south and east England. The British greylag goose has expanded its range greatly in recent years, and now overlaps with migratory Icelandic birds during the winter, particularly in Orkney.

While these two populations are not morphologically distinct and cannot be separated in the field, presence of geese throughout the year, the lack of influx of greylags in winter and

ringing recoveries suggest that the greylag geese present on Islay are largely from the British greylag goose population rather than the Icelandic population, although historically Icelandic greylag geese were thought to winter on Islay (ap Rheinallt *et al.* 2007). Recent collar re-sightings suggest that there may still be the occasional Icelandic bird present.

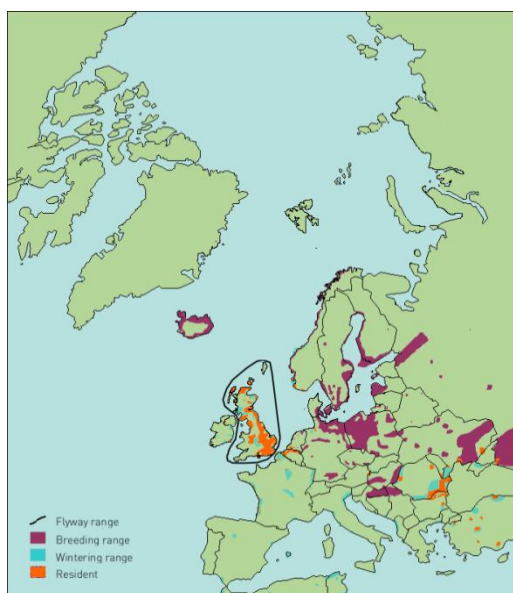


Figure 12. Range of British greylag goose (GSMP website)

Table 4. Conservation status of the greylag goose

Global status (IUCN Red List of Threatened Species)	Least concern
African-Eurasian Waterbird Agreement (AEWA)	n/a
The Birds Directive (European Commission)	Annex II (Part A)
UK status (Birds of Conservation Concern)	Amber
UK quarry species (Wildlife & Countryside Act 1981)	Hunttable in open season

3.3.2 Distribution

Greylag geese breeding in Britain were until recently considered to be from two separate populations. One of these bred in Scotland, primarily on the Outer Hebrides, Coll and Tiree, in parts of Caithness and Sutherland, other Hebridean islands (e.g. Mull), on coastal areas of Wester Ross and in Orkney and Shetland, and was the remnant of the native population that used to be more widespread (Mitchell *et al.* 2010). The second bred in many areas of Scotland to the south and east of the Great Glen and in England and Wales, and was largely

derived from re-established stock taken as eggs from sites in north and west Scotland, primarily Loch Druidibeg in the Outer Hebrides (Mitchell & Fox 1999).

Both segments of the population have recently increased greatly in number and range, now occurring over much of Scotland. In some parts of Scotland the populations overlap and are indistinguishable, so the two populations are now considered as one (Mitchell *et al.* 2012).

In a recent survey of British greylag geese in Scotland (Mitchell *et al.* 2010), the largest concentrations were found on Orkney, the Uists, Shetland, Tiree, Lewis & Harris and Islay.

Ringling data suggest that British greylag geese are relatively sedentary (Mitchell 1999). Most birds moult close to the breeding areas, although large numbers of non-breeders are known to gather at key moult sites. For example, Loch Loyal in Sutherland attracts non-breeding birds from a large part of northern Scotland and Loch Leven in Perth & Kinross attracts non-breeding birds from the Lothians and Fife.

3.3.3 Habitat requirements

The traditional winter habitat of British greylag geese is thought to have been saltmarsh and coastal *Scirpus* beds, but as little of this now remains in Britain, the geese switched to feeding on arable land and improved pastures centuries ago.

Most breeding areas include extensive open waters (coastal or inland) with dense vegetation, such as heather, that have ready access to suitable grazing pasture and wetlands. Moorland vegetation is particularly important in June/July during the moult period, but in the post-moult period geese tend to move onto managed grassland (Mitchell 1999). During the 2008/09 autumn survey, managed grazing habitats (both improved and unimproved grasslands) accounted for c.77% of the flocks encountered, while c.21% were found using natural wetlands (inland lochs, salt marshes and sea lochs) (Mitchell *et al.* 2010).

Greylag geese favour late growing crops such as barley for feeding during the autumn and grass is used throughout the winter when roosting on estuaries, coastal sandflats and freshwater lakes, lochs and mires (Mitchell 1999).

3.3.4 Population dynamics

From a low point of c. 500 birds in the 1930s, the population of British greylag geese has increased greatly to 47,400 birds in Scotland in 2008/09 (Figure 13). This conservation success story was due to a combination of direct conservation measures, favourable changes in agricultural systems and hunting mortality not keeping pace with recruitment. The re-establishment of populations in the south and east of Scotland in the 1930s and 1950/60s further enhanced both population size and range (Mitchell *et al.* 2010).

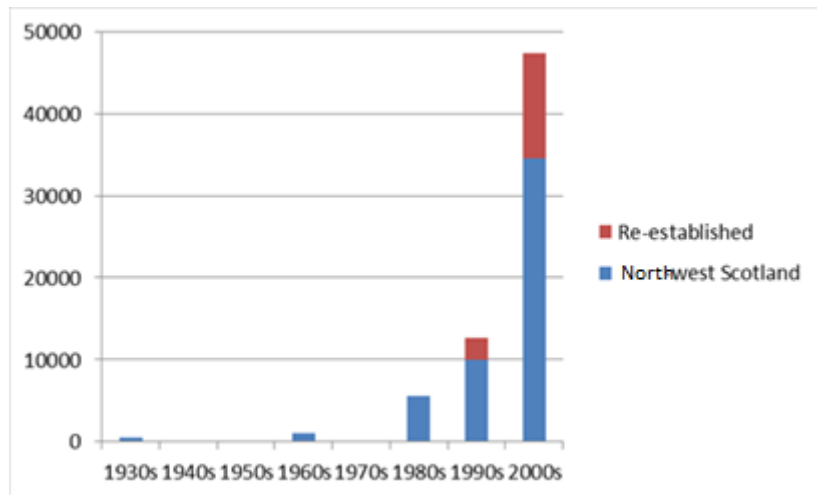


Figure 13. British greylag goose population trend over time, compiled from various sources.

British greylag geese exhibit high levels of natural survival and very high levels of productivity (typically 20-30% juveniles), with no clear trends over time. Consequently, with the availability of suitable habitat and in the absence of hunting, local populations can increase very rapidly (Trinder *et al.* 2009, Mitchell *et al.* 2010). Conflict with farmers has arisen in some areas due to grazing pressure from increasing goose populations. This has resulted in the development of local goose management schemes which support shooting of geese both in the open season and in the closed season under licence. Increased shooting pressure in some areas has led to a decline in local populations, for example on Tiree (see Figure 14). A PVA suggested that British greylag goose populations would start to decline with levels of shooting greater than 15-20% of the population per year (Trinder *et al.* 2009)

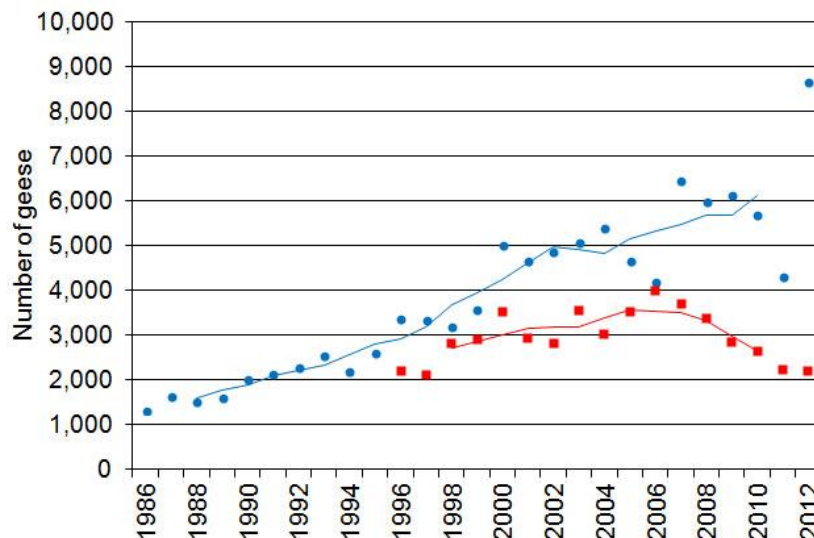


Figure 14. Late summer counts of British Greylag Geese on the Uists (blue circles) and Tiree (red squares). Five year running means shown as lines (from GSMP web-site)

On Islay, greylag geese appeared to be scarce during the breeding season throughout most of the 20th century. However, a wintering flock built up on the island from the 1950s, peaking at 665 birds in November 1964. A decline followed which saw only 200-300 birds in the late

1960s and early 1970s and no more than 100 birds through the 1980s, when a slow increase recommenced, associated with the establishment of a breeding population (ap Rheinallt *et al.*, 2007). Over the next few years, the species spread out to breed on wet flushes, moorland and, in particular, on islets off the north and south-east coasts, with numbers increasing to around 2,000 geese in recent years (Figure 15). Increased levels of shooting over the last 2-3 years are likely to have prevented a further increase in the number of greylags on Islay.

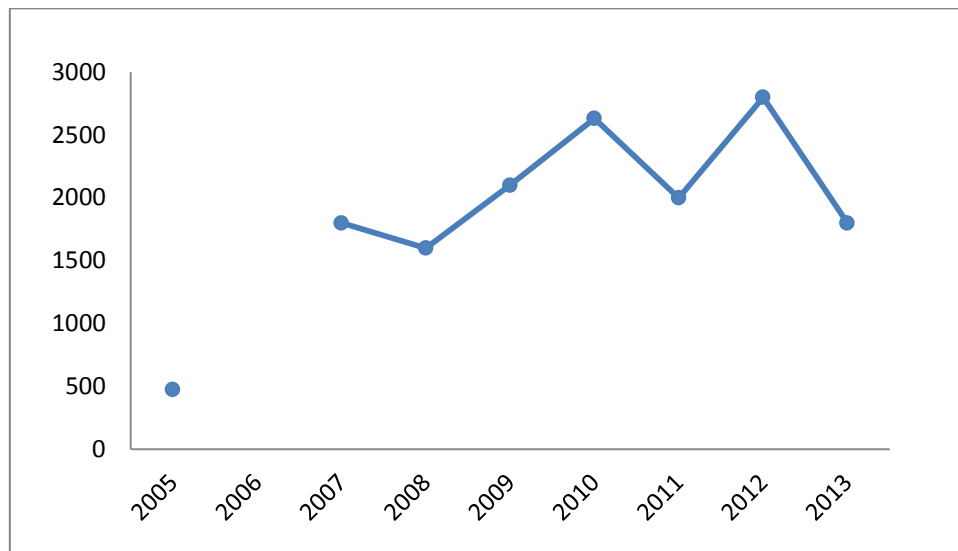


Figure 15. Trends in the population of British greylag geese on Islay 2005 – 2013 (Data from SNH).

3.4 Interactions between goose species on Islay

Madsen *et.al.* (1999) suggests that there are traditional differences in the preferred habitats of barnacle geese and Greenland white-fronted geese, with the former preferring the most intensively managed grassland and the latter preferring less intensively managed pasture and bog land. However, evidence from goose counts on Islay indicates that there is a very high level of spatial overlap between the feeding distributions of these goose species on Islay. Between 2005/6 and 2009/10 barnacle geese were recorded using 891 separate fields on Islay. The vast majority of these fields, 82.3%, were also used by Greenland white-fronted geese at some point during that period. Such data has not been analysed for greylag geese, but a similar pattern of overlap is anticipated.

These findings do not indicate that the two goose species are necessarily selecting exactly the same fields or habitats for feeding. It is possible that geese are feeding on different habitats within a single field, and that while there is overlap the two species do preferentially select habitat with different characteristics. Nevertheless it is clear that management for one goose species within the feeding areas on Islay will impact on the other goose species which are likely to use the same areas. This is likely to have significant implications for goose management on Islay as these goose species have differing conservation statuses.

There is no evidence that competition between goose species on Islay has a negative impact on any one species. There was however anecdotal evidence of a lack of grazing towards the end of the hard winter of 2011/12, resulting in geese in poor condition and

marksmen reporting that the weight of shot geese was low (Rae McKenzie *pers com*). It is possible that in such circumstances pressure for food will result in competition between livestock, geese of all species and other bird species present on Islay.

The roosting distribution of geese on Islay shows much lower levels of overlap. Barnacle geese roost at three main roost sites at Laggan, Bridgend and Gruinart, largely on saltmarsh. In contrast the Greenland white-fronted geese roost on over 80 lochs, lochans, patterned mires abandoned peat cuttings and even pools in fields (Ridgill *et al.* 1994). Consequently, any management actions on roosting areas are less likely to impact on other goose populations. However, no disturbance of geese on roosting areas is proposed under this strategy.

4. Legal framework

Article 5 of the European Birds Directive (Directive 2009/147/EC) requires Member States to establish a general system of protection for all species of bird referred to in Article 1 of that Directive (i.e. all species of naturally occurring birds in the wild state in the European territory of the Member States). This includes a requirement to prohibit the deliberate killing of birds, and the deliberate disturbance of birds particularly during the period of breeding and rearing (in so far as disturbance would be significant having regard to the objectives of that Directive). Derogations from these prohibitions may be granted under Article 9 where there is no other satisfactory solution for (amongst other things) the prevention of serious damage to crops. These prohibitions and Article 9 are transposed in Scots law by sections 1 and 16 of the Wildlife and Countryside Act 1981 respectively and (following delegation of licensing functions under section 16) SNH is now the licensing body.

In addition, both barnacle geese and Greenland white-fronted geese are listed on Annex I to the Directive, and as a result Special Protection Areas have been classified for them on Islay under Article 4(1) of the Directive.

The effect of Article 6(3) of the Habitats Directive (Directive 92/43/EEC) which is applied to Special Protection Areas classified under the Birds Directive) is that an Appropriate Assessment must be carried out for any plan or project which is likely to have a significant effect on a Special Protection Area, but which is not directly connected with or necessary to the management of that site. All the aspects of the plan or project which can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field.

The issuing of licences under Article 9/section 16 is considered to be a "plan or project" for these purposes. Regulation 48 of the Conservation (Natural Habitats, &c.) Regulations 1994 transposes Article 6(3) of the Habitats Directive in relation to devolved matters in Scotland. Before any licence is granted, it must be assessed in accordance with that provision, and (on the assumption that an Appropriate Assessment will be required) will only be issued if it can be ascertained that the actions to be licenced will not adversely affect the integrity of the site concerned.

Derogations under Article 9/section 16 are to be interpreted narrowly, and licences will be issued by SNH only if they have satisfied the relevant tests (including those in Article 6(3) of the Habitats Directive / Regulation 48 of the 1994 Regulations) are met in the circumstances prevailing at the time the licence applications are determined. Additionally, it will be important to ensure that numbers of barnacle geese are reduced only in proportion with the damage alleviation needed and that the proposed use of the derogations will not be incompatible with the overall requirements of the Directive (not just in relation to barnacle geese but also in relation to other species that may be affected).

5. Managing geese to protect crops

5.1 Scaring techniques used

These sections describe the types of management and scaring that have been deployed on Islay and sets out the reasons why the management techniques used to date have not been successful in preventing serious agricultural damage. To apply Article 9 of the Birds Directive to prevent serious damage to crops we must demonstrate that there is “no other satisfactory alternative”. One of the possible alternatives is to try to prevent geese from grazing on areas where serious damage is being caused by using scaring techniques and devices. The evidence presented here is a combination of experience of the use of scaring techniques on Islay, by farmers and Scottish Natural Heritage (SNH) as part of the goose management schemes which have been in place since 2000, and a review of research carried out into the effectiveness of bird scaring techniques on Islay and elsewhere (Bishop *et al.* 2003).

A number of different types of scaring techniques and devices have been used on Islay to scare wintering geese from grass crops. The effectiveness of these has never been fully monitored and evaluated on Islay but there is a significant amount of feedback from experienced farmers and goose scarers. Bishop *et al.* (2003) review literature regarding research into the effectiveness of bird scaring techniques and include a critique of some of the scaring methods used on Islay. That paper broadly supports the anecdotal evidence available on Islay.

The first attempts to scare geese from grass crops on Islay, in a co-ordinated manner, were in the late 1980s when groups of human scarers were used as part of a government-funded employment scheme. The scaring was poorly co-ordinated and, although some reduction in goose numbers was recorded in some areas, the scheme was not cost-effective and was discontinued. A second scheme involved paying farmers to do some of the scaring but this was perceived to be less effective than the first scheme as less scaring was carried out and it was similarly un-coordinated. Human scaring was judged to be relatively ineffective and costly. When these projects took place the island goose population was around 20,000 birds.

From 1992 until 2000, the goose management scheme was a feeding scheme and did not allow any scaring to take place within scheme areas. Most of the farms on the island affected by geese participated in the scheme so very little scaring took place during this period.

Scaring was re-introduced as an element of the new goose management scheme launched in 2000. Under that scheme farmers were able to protect newly reseeded grass by using a combination of scaring techniques. The scheme employed a goose scarer, who managed a range of scaring devices that were rotated around different farms, and a contract marksman.

The devices and techniques used by SNH staff and farmers, since 2000, are described in Table 5, along with a short description of how they operate and a summary of how effective they are thought to be based on experience on Islay.

Table 5. Goose scaring techniques used on Islay

Scaring device/technique	How it functions	Effectiveness	Likely to use in future
Gas guns/cannons	Gas operated bangers replicating the noise of a shotgun - fired periodically using a timer.	Partial: Can be reasonably effective for short periods of time. Geese become habituated to them. Cannot be used at night due to noise nuisance to neighbours. Effectiveness thought to increase if used in conjunction with shooting.	Yes
Canes and streamers	Bamboo canes or poles (c 1.5m in height) with lengths of coloured barrier tape tied to the top set out every 30m across a field. Tape flutters in the wind.	Partial: Until 2013 this was probably the most effective non-lethal scaring technique used on Islay. Geese could be prevented from using a sward until grass shortage elsewhere forced them to use protected grass. In the 2013/14 season it was observed that geese moved directly into fields with streamers in the autumn despite the availability of unprotected grass early in the season. (Figure 16). Goose counts regularly picked up barnacle geese within fields protected by streamers in 2013/14, with flock sizes ranging from 15 to 1750 geese.	Yes
Lethal scaring of barnacle geese (under licence)	Shooting by farmers or a contract marksman to scare or kill geese. Only used in conjunction with other scaring techniques.	Partial: Used to back up other scaring techniques. Research suggests it is difficult to quantify the impacts in relation to other techniques and human presence but farmers suggest that geese move further and stay off fields for longer if lethal scaring is used. Records kept by marksmen indicate that over the last 2 years lethal scaring has moved geese off the farm on which shooting has taken place on around 2/3 of the occasions when shots are fired. No details have been kept of the time geese have stayed away from the location of the shooting.	Yes
Quad bikes/vehicles	Used during normal farming operations	Partial: Work for short periods of time whilst vehicle is in field.	Yes
Scary Man	Gas inflated mannequin with lights and siren - inflates periodically	Ineffective: Geese became habituated to the device very quickly and it was not used regularly after 2-3 years of the 2000 scheme as geese were	No

	using a timer.	observed grazing close to the device. Possibly slightly more effective at night due to lights within the mannequin but this is difficult to quantify.	
Self-launching kites	15m poles with kites on strings attached to the pole. Imitates a bird of prey in flight.	Ineffective: Worked well initially but geese eventually became habituated to the kites. Completely ineffective by the end of the first few seasons of the 2000 scheme when grass was scarce. Geese were regularly observed grazing close to or under the kites. Not robust enough to withstand the severity of Islay's winter weather.	No
Flash Harry	Wind powered rotating device mounted on post	Ineffective: Birds became habituated to them.	No
Helium balloons	15m poles with small helium balloons attached by string. Similar to self-launching kites.	Ineffective: Less effective than kites. Geese observed regularly grazing under the balloons. Not robust enough to withstand the severity of Islay's winter weather.	No
Peace pyramids	Spinning pyramids mounted on fence posts which reflect light.	Ineffective: No reaction from geese at all. Geese observed grazing right up to device.	No
Squawkers	Electronic noises to replicate bird distress calls – set off periodically using a timer.	Partial: Can be reasonably effective for short periods of time, but less effective than gas guns. Geese became habituated to them and were observed grazing close to the device so they are no longer used. Cannot be used at night due to noise nuisance to neighbours.	No
Fireworks	Rockets set off close to fields geese are using.	Partial: Effective in scaring geese, especially at night on some farms where it has been tried. Impossible to target scaring to specific areas so geese can also be disturbed on feeding areas and roosts. Research suggests geese can also quickly become habituated to fireworks.	No
Verrey pistol (requires a firearms licence)	Hand held pistol firing blank cartridges into the air.	Partial: Used successfully on the airport runway areas alongside scaring by humans and vehicles. Not used outside of the airport due to possibility of scaring outwith designated fields, cost of buying equipment and the need for a licence to operate the pistol.	No

Scarecrows	Generally home-made figures or a collection of rags tied together and set out in fields	Ineffective: Geese ignore them and have been observed grazing right next to them.	No
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Figure 16. Barnacle geese using a field with canes and streamers scaring (Ballmartin Farm, February 2014)

5.2 Scaring techniques which have not been used or trialled on Islay

There are a number of scaring techniques listed in Bishop *et. al.* (2003), or a number of devices available on the market which have not been used on Islay (Table 6). Some have been proven not to be particularly effective elsewhere and some are prohibitively expensive but further trials on new devices or developing techniques will continue to be considered within the 10-year strategy.

Table 6. Goose scaring techniques that have not yet been used on Islay

Scaring device/technique	How it functions	Effectiveness	Likely to use in future
Lasers	Lasers are shone across fields (at night).	Some research suggests that birds may be laser resistant. Equipment can be expensive and needs to be operated manually. It is potentially only effective in darkness. Further trials with laser pens may be a cost effective means of testing effectiveness on Islay. Trials to be conducted in 2014-15 only after a literature review of the safety of lasers has been completed.	Yes
Robotic 4WD vehicles	Remote controlled or automatic vehicles moving around fields	Could be trialed initially with basic remote control vehicles moving through fields with geese present and may provide similar effects to remote controlled aircraft / drones, but with fewer constraints due to weather. Long term work could look at the development of automatic robotic vehicles to scare geese.	Possibly
Radio-controlled aircraft/drones	Operator flying remote controlled aircraft across feeding geese	This may be effective but requires a skilled operator so is labour-intensive and costly. Unlikely to work at all times in the exposed Islay climate due to the need for good weather to fly aircraft.	Possibly
Dogs	Well-trained dog which will chase, but not catch, geese controlled by a dog handler	Has been used in Kintyre to scare geese from protected fields to feeding areas. It requires a handler so therefore	Possibly

		labour-intensive and costly. It is a technique which can cover a wider area than a human but cannot be used where there are livestock present in a field. Islay has many fields where livestock is present so it may not be possible to use a dog efficiently but the technique could be trialled	
Raptor models	Kites or model raptors on fence posts.	Bishop <i>et.al.</i> (2003) reports that use elsewhere suggests that habituation to raptor models is relatively quick.	No
Falconry	Use of birds of prey controlled by handler to fly across feeding geese.	The technique has been successful around airports and landfill sites. Requires a handler therefore it is labour-intensive and costly. It may be difficult to fly the birds only on areas where scaring is permitted, so there is a high risk of geese being scared from feeding and roosting areas	No
Chemical deterrents	Liquid chemical solutions sprayed on grass. Taste deters birds.	Initial trials of a fertiliser based deterrent to be set up in 2014/15	Possibly
Habitat modification	Plough fields, reduce fertiliser inputs, change crops etc.	May be effective in discouraging geese / reducing goose damage but may have an impact on farming systems and may result in greater impacts on the farm economy than goose grazing alone.	Possibly

5.3 New scaring techniques being trialled during strategy period

As part of the work to develop the current strategy, trials have begun of scaring devices and management techniques that have not been used previously on Islay on a limited scale.

Sonic string has been used as a scaring device and crop protection netting as a means of preventing goose grazing. The trials have also begun to look at how white-fronted geese use fodder crops with a view to setting up longer term diversionary feeding trials.

Sonic string is a 5mm wide flat nylon tape suspended between fence posts. The tape vibrates in the wind creating a humming sound and a visual movement. Initial trials suggest the string does make a significant noise, but we have not yet found a way of making this type of scaring equipment robust enough to withstand the Islay climate. Trials are being developed to use reinforced tape to find out if that will create a similar noise and visual deterrent and will withstand the climate.

Crop protection netting involves using flea beetle and cabbage root fly netting to protect grass. Nets are laid over grass and pegged down to prevent geese gaining access to the sward. The nets should provide 100% protection from grazing and may create a micro-climate which improves the quality of the sward under the net. Trials will look at the durability of the net, how it stands up to Islay's climate, the effects on the grass under the net and the differences between protected and un-protected sward in the same field at the end of the season. Trials are limited to fields which do not hold livestock. Initial work indicates that nets will withstand the Islay climate and that grass will grow well underneath them for a short period of time. Further work is now planned to look at the benefits of the net, how cost effective their use might be in reducing goose damage, impacts on use of fields and impacts on other animals. The nets are very expensive to buy and the cost effectiveness of this option will depend on the availability of second-hand netting and the level of benefit gained by using it.

5.4 New management techniques being trialled during strategy period

Population management of barnacle geese involves reducing the population levels which reduce the density of goose grazing on grassland to try to reduce damage. To date, any lethal management of geese has been focussed on reducing damage to individual fields but, as geese move around the act of reducing damage on one field by scaring or preventing access to the sward is likely to result in damage elsewhere on Islay. Research in the United States (Nichols 2014) on damage caused by Canada geese on wild rice demonstrated that reducing goose numbers reduces damage to plants. The management plan for greater snow geese (*Chen caerulescens atlantica*) in the Atlantic flyway also advocates that reducing the population of snow geese will reduce damage to crops (Atlantic Flyway Gamebird Technical Section, 2009). It cites evidence from Delaware that the area and value of damage to crops was reduced, but variable, following liberalisation of hunting regulations. The Dutch also aim to develop sustainable management of the Dutch geese populations by finding a balance between the size of the naturally occurring populations and the associated risks (Wadden Sea Forum, 2013). Their approach includes reducing goose numbers to try to achieve a reduction of damage to the level of 2005 within a five year time frame.

Diversionary feeding / habitat management trials are planned with a view to attracting geese from the grass sward into crops such as fodder beet. Initial research suggests that this may work well for Greenland white-fronts and it is a practice that is carried out successfully in Wexford. Management of rush pasture is also being considered as a means of attracting Greenland white-fronts away from grass swards. As well as attracting birds into

crops, these areas may also provide refuges to birds scared from other areas, potentially increasing the effectiveness of scaring by providing suitable alternatives as refuge areas.

Laser pens may be effective in scaring geese for short periods of time. They are relatively inexpensive but need someone to operate them. Care needs to be taken when using these, particularly close to aircraft flight lines, airports, people and roads, but we will trial a limited number of these in 2014/15 to find out whether they can be an effective tool, particularly at night, to add to the range of scaring techniques. Trials will only take place after a literature review of safety issues is completed.

The density of geese is such that there are not enough alternative, less productive habitats onto which geese can be scared. Reducing the density of geese could achieve a direct reduction in damage across the island due to fewer geese grazing. More information on how these techniques will be included within an adaptive management strategy is included in Section 6.

5.5 Assessment of scaring and management techniques

Some management techniques may provide complete crop protection for the whole growing season, but have not yet been fully tested and evaluated (crop protection netting), and others offer temporary protection for several hours or until geese become habituated to the scaring technique.

To date, temporary scaring methods have principally been used on Islay (Table 5). Some work only in daylight hours, and some are more effective than others when geese aren't so quickly habituated to them. However, the effectiveness of all temporary methods may be affected by the availability of suitable forage elsewhere. The most effective techniques are likely to be those which exclude geese completely from the crop for the entire season or key parts of the season. That is why we are trialling crop netting. However these techniques can only be used in restricted areas due to cost, impacts on livestock or exposure to extreme weather.

Audible scaring devices can work in the short term but geese become habituated to them fairly quickly. Disturbance by humans, dogs and vehicles can also work to some extent, but needs to be co-ordinated across the island and is time-consuming and expensive. Effectiveness of audible and visual techniques often depends on how they are used in combination with other scaring techniques.

It is extremely difficult to protect grass at night. If geese are forced off crops during daylight hours, the pressure on them to continue to feed means that they are more likely to feed at night, particularly during full moon periods where visibility is increased. Therefore, the benefits of protecting grass during the day can be nullified. Reports from farmers on Islay suggest that, in recent years, geese are feeding more frequently at night as a result of scaring activities during daylight hours. Analysis of daytime goose counts around the roost areas may provide some evidence to demonstrate that geese spend more time not feeding around the roosts during daylight hours than they did previously.

Disturbance will move geese for periods of time but it is not totally effective because geese generally return after the disturbance event ceases. Geese must feed on a regular basis so, if scared from one location they are likely to feed, and cause similar levels of damage, in

another location. In the case of barnacle geese, these locations are likely to be on other good quality grass swards. All grass swards on Islay are required to support livestock either by grazing or by production of silage. Goose grazing occurs on the vast majority of these swards, with higher densities of geese recorded on the best quality grass.

As the winter period progresses, availability of grass reduces due to lack of growth, pressure from grazing livestock and grazing geese. The pressure on geese to feed coupled with the decline in available feeding results in scaring techniques possibly becoming less effective. Even if grass can be protected reasonably successfully until late in the season it becomes more attractive to geese when there is less available grass in other areas.

Not all scaring techniques have been tried on Islay, but the vast majority of available cost-effective measures have been used at some point in time. Since 2000, much of the scaring has been as part of a co-ordinated programme within the Islay Local Goose Management Scheme. The trials of new techniques this season are being extended into 2014/15. New techniques are needed on a regular basis to help combat habituation and will replace methods to which the geese have become habituated. Any new temporary scaring techniques will help to minimise damage in the short term but are unlikely to offer complete solutions to the problem as geese will likely habituate to new techniques.

Many scaring techniques have been used to scare geese on Islay and in other locations and to date, none have been seen to be completely successful in scaring geese to a level where serious damage to crops has been prevented over an entire season. Farmers report that if scaring is relatively successful at some point in the season, geese will make use of the protected grass at a later point in the season or at night when scaring activity is difficult. Since co-ordinated scaring was introduced in 2000, the barnacle goose population rose until 2006/07, and then levelled off, and damage to grass crops remains significant. The density of geese supported on Islay is such that scaring techniques can reduce goose damage on individual fields for a short time, but cannot prevent serious agricultural damage over a whole winter season as there is not enough suitable alternative habitats. Analysis of goose scheme data show that elements of the current compensation payment calculation, such as reseeding frequency, have increased in the past 14 years and instances of farmers reporting the need to regenerate swards through surface seeding is increasing.

For the reasons set out above, we do not consider scaring (including lethal scaring at current levels) to be a satisfactory alternative to reducing the barnacle goose population as it does not prevent serious agricultural damage.

It is possible that the development of new scaring techniques can play a part in reducing damage by geese and the strategy will implement research into the effectiveness of new techniques.

6. Long term adaptive management strategy for geese on Islay

6.1 Length of strategy

The strategy covers a 10 year period beginning in October 2014.

The actions taken as a result of the strategy will be monitored and its effectiveness reviewed every two years. If necessary, the strategy will be adapted to ensure that the objectives are met.

The strategy will overlap with the end of the current scheme as it includes baseline monitoring and management trials which will begin in 2014. There will be no change to the management scheme and regime that is in place for 2014/15, but the long term strategy will be the basis on which a future management scheme, beginning in October 2015, will be developed.

6.2 Aims

The established objectives for goose management schemes in Scotland are:

- Minimise economic losses experienced by farmers and crofters as a result of the presence of geese
- Meet the UK's nature conservation obligations for geese, within the context of wider biodiversity objectives
- Maximise the value for money of public expenditure.

The strategy will seek to address these objectives on Islay and will also consider how meeting these objectives will impact on other interests on Islay such as tourism, and sporting interests.

To achieve these aims, the strategy will:

- Develop habitat management techniques to support feeding of white-fronted geese through provision of diversionary feeding and management of rush pasture.
- Ensure that large areas of suitable habitat on Islay are available to geese as undisturbed roosting and feeding areas.
- Maintain a viable population of barnacle geese at a level which meets our conservation obligations.
- Ensure that there would be no adverse effect on site integrity of the Special Protection Areas listed in Tables 1 and 7.
- Reduce damage to grass crops by reducing the number of barnacle geese, therefore reducing the impact of geese on the agricultural economy of Islay.
- Ensure that compensation payments to farmers for goose damage are targeted at the most appropriate management activities.

6.3 Species

The strategy will include management actions aimed at Greenland white-fronted geese and Greenland barnacle geese. It will also take account of greylag geese and Canada geese, if necessary, over the 10 year period.

6.4 Basis of strategy

Barnacle goose numbers on Islay have increased over a long period, since the 1960s, but have begun to fluctuate over the past 10 years and current analysis suggests that numbers have stabilised. The average number of barnacle geese remains at a level (41,259⁵) which is causing serious agricultural damage on an annual basis. Over the last 10 years, Greenland white-fronted geese have decreased then appear to have levelled off at around 5,500 geese.

The strategy is two-fold. One part aims to significantly reduce agricultural damage on Islay by proposing a reduction in barnacle goose numbers feeding on grass crops and by continuing research into developing new crop protection and scaring methods. The population will be maintained at a level which continues to meet our conservation obligations on Islay and across the species international range. That level will also ensure that the spectacle of thousands of wintering geese, enjoyed by tourists to Islay, is maintained.

The second part aims to manage white-fronted geese to increase the population to a level which maintains their favourable condition on individual SPAs on Islay and which makes a positive contribution to bringing the species into favourable conservation status across its international range. This will be done by minimising disturbance to white-fronted geese and by developing trials to provide better feeding opportunities away from high agricultural value grass crops. This will be done through improving the condition of traditional feeding areas and introducing diversionary feeding if trials are successful.

If impacts by other species of geese (greylag and Canada), on crops or the delivery of the strategy, increase over the period of the strategy we will consider any management actions required for these species at each review period.

6.5 Licensed shooting of barnacle geese

Any reduction in barnacle goose numbers will require the issue of licences by SNH to kill birds to prevent serious agricultural damage. The licences would be issued for this purpose only if SNH are satisfied that there are no other satisfactory solutions. The assessment of any licence applications will take place at the time of application. Licences issued under these conditions will meet the provisions set out in the Derogation under Article 9 of the EC Birds Directive. More information on the legal framework has been provided in section 4.

The tests which need to be applied prior to licences being issued are:

1. Is serious damage being, or is likely to be, caused by geese at the site?
2. Have all other reasonable non-lethal scaring measures either been tried and found to be ineffective; or are impracticable; or are unlikely to work at the site?
3. Is it reasonable to consider that shooting geese will reduce, or prevent from increasing, the level of damage (whether through scaring or direct reduction of numbers)?

⁵ Average of 4 whole island counts in season 2013-14.

6.6 Serious damage to crops

The geese-farming conflicts are complex in that it can be difficult to define the perceived conflictive interaction in quantitative terms as to constitute a well-defined ecological problem, or a proven limiting factor for the viability of the businesses concerned. While the uncertainties mean that it is often difficult to provide unequivocal evidence that there is a real problem for farmers, the absence of clear quantitative evidence of serious damage does not mean that it is not occurring. Guidance issued by the EU on the use of the Derogation under Article 9 of the Birds Directive to manage Great Cormorants damaging fisheries provides details on how we might apply a pragmatic approach to the problem (European Commission, 2013).

In all cases, the concept of 'serious damage' as used in the Birds Directive, and interpreted on the basis of the above, involves the following:

- a) Firstly, it clearly relates to economic damage to fisheries and/or also economic damage to a fisheries-related recreational interests. The concept of 'damage to fisheries' is clearly related to the economy of turnovers and expected profits.
- b) Secondly, derogations issued under Article 9 of the Birds Directive are intended to prevent serious damage; therefore it is not only a response to already proven damage but also to the strong likelihood that this will take place in the absence of action. But, the chance that damage might occur does not suffice as, if damage is not yet evident, past experience should demonstrate a high probability of its future occurrence.
- c) Thirdly, there must be a basis for concluding that damage will be serious in the absence of action.

The following section attempts to outline the approaches used in demonstrating that serious damage by caused by geese occurs on Islay. Numerous studies have been commissioned by both farmers and nature conservation organisations to try to quantify the level of damage caused and reference to some of these is made below.

It has been shown that geese have a preference for perennial rye grass (*Lolium multiflorum*), one of the main components of grass swards grown for silage production on Islay (Patton & Frame. 1981). Goose counts carried out on Islay for goose scheme purposes since the early 1990s also show that geese prefer younger grass swards.

In the 1980s, a study was commissioned by the Nature Conservancy Council to try to determine appropriate levels of compensation for farmers feeding geese within designated sites on Islay (Tweddle. 1988). This study took place over three years comparing farms on Islay with similar farms in Kintyre and calculated the loss of profit due to goose damage. It concluded that, as a result of goose damage, the Islay farms carried a consistently lower level of stock than comparable farms in Kintyre, they had longer winter feeding periods, and they were later in applying fertiliser and thus in taking a first cut of silage.

Further work commissioned by Islay National Farmers Union (NFU) Branch in 1996 examined the Islay Goose Working Party Economic Model (Frame 1996). This work focussed on the model on which goose management scheme payments were calculated at the time and concluded that the model needed to include more flexibility to allow for changes

in agricultural practices and in numbers of geese. The paper included calculations on many of the elements which make up agricultural losses due to high levels of goose grazing and demonstrated a high level of economic damage caused by goose grazing.

Percival and Houston (1992) assessed the effect of goose grazing on silage yield on Islay and examined the relationship between goose grazing intensity and grassland yield. This study used exclosure cages to compare ungrazed plots with grazed plots. It found that, in all the study fields, geese caused a reduction in the grass standing crop and that, in the areas most heavily grazed by geese, up to 82% of the yield was lost. In heavily grazed areas a loss in yield was also recorded at the point of silage cutting in mid-June. It also showed that in less heavily grazed areas there were no significant losses of yield due to geese.

A literature review (Kirby, *et al* 1999), carried out to inform Scottish Government's goose management review process, looked at a large number of studies of damage caused by various species of geese, including some studies on Islay, which had been carried out between the mid-1960s and the late-1990s. This noted that geese can be responsible for crop damage, usually as a result of consumption of crops and subsequent loss of crop yields, but may also inflict physical damage to the crop, and sometimes to surface-soil structure, through trampling. The main problem with goose grazing in late winter and early spring is that grazing removes a significant proportion of the sward leaf area. This leads to a loss in photosynthetic ability and hence grass yield (either as early bite or silage) is significantly reduced. The review concluded that there is considerable evidence, including studies carried out on spring grass and silage production on Islay, that goose grazing sometimes causes a significant loss of yields. It does note some studies that have not detected yield loss, perhaps due to relatively mild winters, but suggests that there are weaknesses in these studies.

The current goose scheme payment calculation, originally set up in 2000, takes into account elements where goose damage can be most easily quantified and puts a financial cost on each element. These include an increased reseeding frequency, increased buying-in of supplements and fodder and delayed turnout of livestock in the spring. The density of geese present on individual farms is taken into account within the payment calculation so that farms which support most the highest densities of geese receive a higher level of compensation than farms with lower densities of geese. The goose scheme which has been in place since 2000 is paying for damage caused by geese to minimise economic losses to farmers. The current calculated cost of goose damage on Islay is c. £1.6 million.

This calculation was examined in a report commissioned by the Islay Branch of the NFUS in 2012 (Bevan. 2012). This report included case studies of how goose damage impacted upon individual farm businesses. Whilst it did not study a large sample size, it demonstrated significant financial losses as a result of goose grazing and concluded that existing levels of funding for farmers did not cover all of the lost farming income on the units studied.

A more recent study on the impacts of goose grazing was carried out in Flanders (Van Gils. *et al* 2012). The main findings were that grass production on grazed parcels is reduced significantly by the time silage is cut. The results have been used to lay the foundation for measuring grass yield losses due to grazing by protected wildlife species, which is now used in a compensation scheme for farmers.

6.7 Other satisfactory solutions

Scaring geese using a number of different techniques (Section 5) since 2000 has not effectively reduced the agricultural impacts. Compensation available to farmers for damage caused does not meet the costs of supporting the current goose population. Money does compensate to some extent, but it does not take into account the cumulative impact over many years on farm businesses and their ability to produce grass or carry profitable levels of stock. Therefore it cannot guarantee that agricultural activity in its current form will continue. Money does not minimise the damage and the use of compensation payments has not prevented either the goose population or the associated levels of damage increasing over the past 20 years. Therefore, scaring or compensation payments are not satisfactory alternatives to the proposed use of the derogation.

6.8 Liaison with range states

Scottish Government will discuss proposals to reduce barnacle goose numbers on Islay with other states which support the Greenland-breeding population of barnacle geese across their natural range; namely Greenland, Iceland and Ireland. These discussions will be aimed at ensuring that management on Islay will not have an unfavourable impact on the population across all range states.

6.9 Areas of undisturbed feeding and refuge

Both farmers and the RSPB will continue to support high numbers of barnacle geese on Islay.

In 2013/14, a total of 6,288ha of productive farm land were entered into the goose scheme. Of that, scaring is permitted on 1,120ha while the remaining 5,168ha is undisturbed feeding area. Provision will continue to be made for significant areas of undisturbed feeding and refuge areas for both barnacle and white-fronted geese on all farms. These refuge areas will continue to include improved and permanent pasture, dune grassland and saltmarsh and will add up to at least 70% of the available grassland habitats on Islay on which geese feed. As such, there will be an on-going requirement for payments to farmers for management of those areas where significant damage occurs. Provision of goose grazing on grass pastures will still be detrimental to farm businesses, but with fewer geese being supported damage levels should be concomitantly reduced.

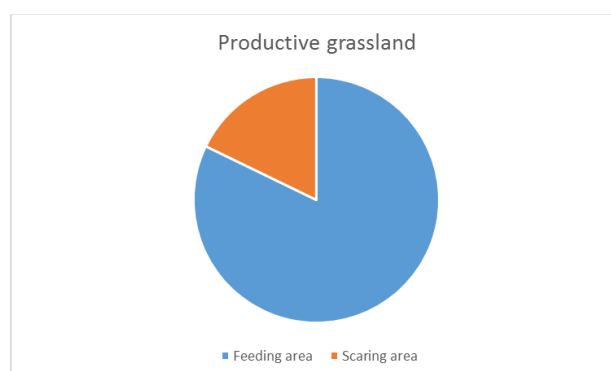


Figure 17. Chart showing the proportion of feeding area and scaring area within Islay Local Goose Management Scheme in 2013/14. This does not include productive grassland on RSPB reserves.

Figure 18 demonstrates an arrangement typical of the current scheme which ensures at least 60% of the improved and permanent grassland on individual farms is designated as undisturbed feeding area. No scaring of geese takes place on other habitats including rough grazing and saltmarsh.

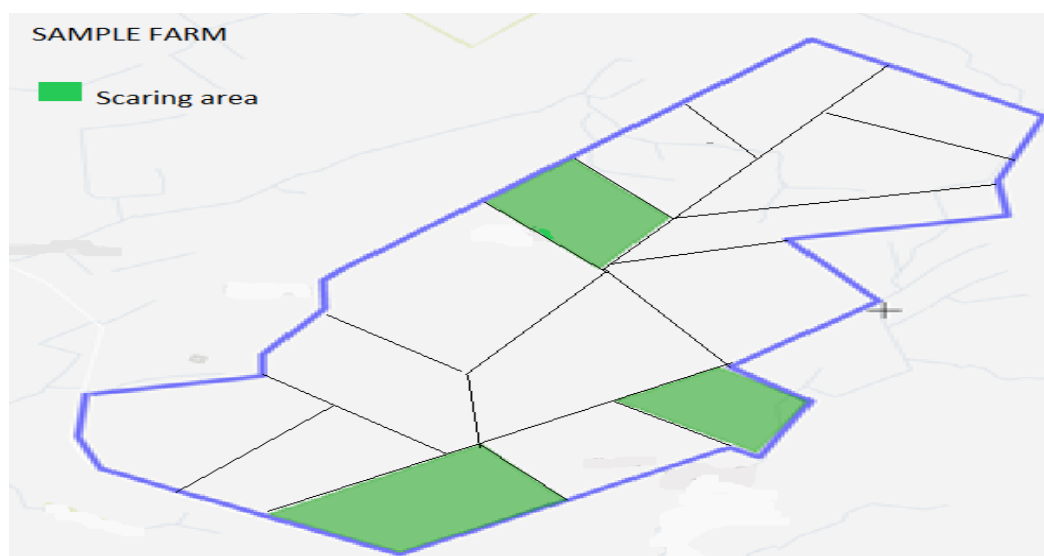


Figure 18. A sample farm where, within the blue boundary (productive grassland), 3 of the fields have been chosen for scaring management but a further 12 are designated as undisturbed feeding area.

The RSPB manages large areas of land which support goose grazing and roosting areas on Islay. The area used by geese within these approximates to 1075 ha of which just over 200ha is tidal mudflat. These reserves will continue to provide refuge areas for both white-fronted and barnacle geese. More details of the location and size of these reserves and of RSPB's management for geese are included in Annex 2.

6.10 Impacts on Annex I species and Special Protection Areas

Whilst the strategy proposes a reduction in the current barnacle goose population on Islay, it will ensure that the Greenland-breeding barnacle goose population will remain at a level which meets the requirements for favourable conservation status at the range level and favourable condition at individual SPA level. The reduction in barnacle goose numbers will be tightly controlled by licensing and will be fully monitored throughout the strategy. If a situation develops whereby numbers are predicted to, or do fall below an agreed level or range, licences can be reviewed at any time. The strategy has undergone a Habitat Regulations Appraisal (HRA) to ensure that there will be no adverse effects on the integrity of individual SPAs. The HRA considers effects on the Islay SPAs listed in Table 1 and on SPAs in other parts of Scotland and Ireland, which include Greenland barnacle geese as a classified species. These sites are listed in Table 7.

Table 7. Special Protection Areas designated for Greenland barnacle geese outwith Islay

Site	Country
Coll	Scotland
North Sutherland Coastal Islands	Scotland
North Uist Machair and Islands	Scotland

Switha	Scotland
Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast)	Scotland
Monach Isles	Scotland
Shiant Isles	Scotland
Treshnish Isles	Scotland
Inishkea Islands	Ireland
Trawbreaga Bay	Ireland
Inishmurray, Inishglora & Inishkeeragh	Ireland
Termoncarragh Lake & Annagh Machair	Ireland
Inishtrahull	Ireland
Duvillaun Islands	Ireland
Illaunonearaun	Ireland
Inishkeel	Ireland
Rathlin O'Birne Island	Ireland
Roaninish	Ireland
Illancrone & Inishkeeragh	Ireland
Ardbolin Island & Horse Island	Ireland
High Island, Inishshark & Davillaun	Ireland
Cruagh Island	Ireland
Mid-Clare Coast	Ireland
Horn Head to Fanad Head	Ireland
Inishbofin, Inishdooey & Inishbeg	Ireland
West Donegal Islands	Ireland
Ballintemple and Ballygiligan	Ireland
Magharee Islands	Ireland
Slyne Head to Ardmore Point Islands	Ireland

The HRA identified the risks to Natura sites and has proposed clear, firm mitigation to eliminate or mitigate such risks. The competent authorities have inserted appropriate policies, checks and monitoring into the Strategy which deal with the level of generality inherent in such a strategy while also meeting the degree of certainty required to allow a conclusion of no adverse effects on site integrity. The mitigation imposes limitations on the implementation of the Strategy, and constrains later decisions emanating from it so as to allow a conclusion of no adverse effects on Natura site integrity. This conclusion means that the Strategy can be consented to. The measures adopted within the strategy and to be incorporated into future goose management scheme design are listed below.

- If required, and following on from work carried out in 2013/14, further monitoring of barnacle geese will be undertaken (see Annex 4). This monitoring will gather further data on barnacle goose distribution, movement, and behaviour, and will provide more detail on movements between roost and foraging areas. In light of this improved evidence base, an analysis will be made about the allocation of increased bag limits, and how farm based bag limits can be linked to SPA populations. Further Habitats Regulations Appraisal will be carried out on the new Islay Local Goose Management Scheme before its implementation in 2015. Bags limits for 2015-16 will not be increased unless the HRA has concluded that there will be no adverse effect on SPA site integrity.
- In view of the use of Gruinart as a staging area for barnacle geese migrating onwards to other off-Islay SPAs, there will be no shooting of barnacle geese in this area during October and November. Existing data will be analysed and, if necessary, further monitoring data will be gathered on migratory movements (see Annex 4). Shooting at Gruinart in October and November will not recommence until a further HRA has

been carried out in light of this work and has concluded that there will be no adverse effect on SPA site integrity.

- As is carried out for the current Islay goose scheme, goose count data and bag limits/returns will continue to be collated and reviewed annually. At each scheduled two yearly review period, all available monitoring data for barnacle and white fronted geese on Islay (abdominal profile data, count data etc. – see Annex 4) will be reviewed along with count data from non-Islay SPAs. Appropriate assessment will be undertaken in order to determine that there are no adverse effects on site integrity for either the barnacle or white fronted goose SPA populations. HRA will be carried out in light of this information, and the scheme will be comprehensively reviewed, and if necessary adapted, if the HRA is unable to conclude that there will be no adverse effect on site integrity.
- There is currently good baseline information of Greenland-white fronted goose distribution, movement, and behaviour. As detailed above, monitoring is currently being undertaken to improve the baseline information for barnacle geese in 2013-15.
- Further detailed monitoring against the baseline information for both species will be undertaken in year five of the strategy (see Annex 4) to determine that there are no adverse effects on site integrity for either the barnacle or white fronted goose SPA populations. HRA will be carried out in light of this information, and the scheme will be comprehensively reviewed, and if necessary adapted, if the HRA is unable to conclude that there will be no adverse effect on site integrity.

The strategy recognises that management for barnacle geese may have impacts upon Greenland white-fronted geese in some locations. It will ensure that feeding opportunities for white-fronted geese are maximised and any disturbance as a result of management activities for barnacle geese is minimised. This will be done by exploring diversionary feeding and habitat management for white-fronts and by restrictions on scaring where white-fronts are present. Management proposals which impact upon SPAs will also undergo HRA to ensure that there will be no adverse effects on the integrity of individual SPAs which include Greenland white-fronted geese as a feature. HRA will also consider possible impacts on other species for which individual SPAs are classified.

To improve our understanding of how barnacle and white-fronted geese use their roosting and feeding locations, particularly in relation to SPAs, SNH has commissioned research to examine goose movements in more detail. The work on barnacle goose SPAs should be published in autumn 2014 and the work on white-fronted goose roosting and feeding sites should be published in summer 2015. If required, SNH will repeat this research in future as it may contribute towards long term monitoring of the behaviour and reactions to management actions of both species.

6.11 Reducing and measuring damage

One of the aims of the strategy is to reduce the level of damage suffered by farm businesses as a result of goose grazing. It is accepted that the level of geese grazing on Islay causes significant damage to agricultural land and has an economic impact on livestock producers (which is why goose schemes have been providing compensation for goose damage to farmers since 1992). It is for this reason that we consider that damage needs to be reduced. Whilst we do not know if goose numbers have a linear relationship with the level of damage caused we propose to take an adaptive management approach to test whether or not that is

the case. Barnacle goose numbers will be reduced in increments with defined targets set for the halfway point in the strategy and the final outcomes being reviewed as the strategy progresses. The effects of management will be carefully monitored and changes will be made to the strategy if required.

The Goose Science Advisory Group are currently considering the most appropriate methods to measure damage and will advise on this as soon as possible with a view to collecting the required baseline data in winter 2014/15. Damage is likely to be measured by sward height monitoring and by the frequency of reseeding. Sward height monitoring will look at damage on sample fields and reseeding frequency will look at levels of damage and associated costs across the whole island. Sward height monitoring can provide annual results but a reduction in the reseeding frequency is only likely to be measurable in the longer term. Reseeding data are available from 2001.

Economic losses can be monitored using the payment rate calculation and the payments to individual farmers. The payment rate calculation considers all of the elements where farmers incur additional costs as a result of goose damage and has been agreed by National Goose Management Review Group and the Local Goose Management Group. This rate is applied to the relevant habitat and goose density on the individual farm is used to calculate the compensation payment to each farm unit. A reduction in the reseeding frequency as a result of a reduction in goose damage will reduce the payment rates and a reduction in goose density on individual units will reduce the payments made to that unit.

The Local Goose Management Group is currently undertaking a review of payment rates to ensure that the correct level of payment is applied to each management system. It should be noted that any monitoring of payments to farmers should be done on total calculated costs not on the payments made after the total budget has been discounted.

6.12 Proposed methodology for the different indicators

6.12.1 Sward measurements

In the first year of the strategy (2014/15) the baseline level of damage caused by the current goose population under the current management regime will be measured. The intention is that this will be done by installing a number of enclosure cages on certain fields and measuring grass growth in protected and non-protected areas of these fields. There is a need to determine relative grazing by geese, rabbits, hares and deer so that comparisons can be made to measure the level of damage caused by geese. This monitoring will continue for the period of the strategy to ensure that the level of damage caused by geese is measured, and that the impacts of reducing goose numbers can be demonstrated. This monitoring should also allow us to set and agree outcomes in terms of the level of damage we are trying to prevent.

The aim is to reduce damage by 15-20% in the first half of the strategy by reducing the barnacle goose numbers by the same proportion. Measurements of sward height will be taken every year, but an assessment of how well the reduction in numbers meets the aims will be taken after several years monitoring (say 5 years). If the monitoring can demonstrate that the actions taken to reduce barnacle numbers are reducing the levels of damage by a similar level, then we aim to achieve a further reduction in damage of 10-15% by the end of

the strategy period (2024). The aim is that the total reduction in goose damage by the end of the strategy will be 25-35% of that of the baseline.

6.12.2 Reseeding frequency

Damage caused by high densities of geese grazing on grass crops results in farmers having to reseed more frequently. If we introduce management to reduce the impacts, we would aim to reduce the reseed frequency to levels across the island last experienced at a certain point in time. In 2001, the average reseed frequency across all scheme participants was 10% of the total rotational ground on Islay but this has risen to 15% in 2013, partly due to the impacts of goose grazing. This measurement can link a reduction in goose numbers to a real impact on the ability of farmers to produce more from their farms and a reduction in losses as a result of goose grazing. A phased reduction in the barnacle goose population will not have an immediate effect on reseed frequency, so this means of measuring damage will be used as a longer term indicator of achieving the strategy objectives. It also needs to use average frequencies across a period of time to reduce the impacts of variables such as weather, cost of reseed, etc.

6.12.3 Payment rates

A reduction in factors such as reseed frequency or turnout dates will have an impact on the payment rates, and a reduction in goose density will have an impact on the payment calculations for individual farms. This could be incorporated into an agricultural economic business model which would assess the level of economic losses as a result of goose damage.

Work to develop and agree the most appropriate means of measuring damage will continue as this strategy develops, with the aim that an agreed methodology is in place by winter 2014.

6.13 Management for Greenland white-fronted geese

In the first year of the strategy, trials of rush pasture management and diversionary feeding will be established. Initially this will be carried out experimentally on ground managed by RSPB and farmer volunteers. The detail of the trials is still being developed, but we are looking to work out standard techniques for managing land to support white-fronts. This is with a view to providing good quality feeding on traditional habitats and to provide supplementary feeding to off-set possible impacts of scaring of barnacle geese.

The trials will establish if land can be managed in a better way to support white-fronts, how long certain habitats can support white-fronts and whether management can be rotated and staggered around certain areas to support geese for longer periods of time. Management will be targeted at areas close to known feeding areas or roost sites as these are most likely to be utilised by white-fronts.

The trials will be complemented by research currently being undertaken by the Wildfowl & Wetlands Trust (WWT) in partnership with SNH to identify key areas for white-front feeding and roosting. This work is also looking at impacts of current goose management actions on white-fronts and it is hoped that this knowledge will help us to ensure that future

management actions for barnacle geese do not have a negative impact on white-fronts on Islay.

If we can establish standard management techniques which are proven to support white-fronts, we propose a roll out of this to certain areas of the island (identified with the help of current research work). Costs will be worked out and supported; in the longer term possibly by agri-environment scheme funding (perhaps through a partnership application from the Islay Local Goose Management Group).

In Years 2-10 of the strategy this management will be encouraged and supported in key areas either through further research (if required), a goose scheme or through agri-environment schemes.

If white-front numbers increase significantly and that increase begins to result in serious agricultural damage, e.g. if the diversionary feeding and habitat management does not reduce grazing impacts by white-fronts, then consideration may be given to the introduction of scaring management of white-fronts in future.

6.14 Reducing damage by management of barnacle goose numbers

6.14.1 Baseline numbers

In the 2013/14 season there was an average of 41,259 barnacle geese wintering on Islay, almost 6,000 fewer than were present the previous winter. Arctic-breeding goose populations can show substantial fluctuations from one year to the next, and whilst this drop is one of the largest changes we have recorded in the population, it is not beyond the expectations of normal variation.

Despite this fall in numbers, farmers report that geese continue to cause significant levels of agricultural damage. This was demonstrated visually in 2013/14 by the use of grazing exclosures and crop protection netting in a number of locations across the island. Further work to measure baseline levels of damage caused by geese using a robust scientific methodology will be carried out in 2014/15.

In the first year of the strategy, the population will be maintained at the current level of 41,259 barnacle geese (+/-10%; within a range of 37,133 – 45,385). If the population rises above this, the PVA (Trinder 2014) would be used to determine bag limits to bring the population within the agreed range. Bag limits may therefore be increased in 2014/15 if the population rises beyond the suggested range or decreased if the population falls.

In considering the reduction in damage and linking that to a reduction in the barnacle population, we have looked at a number of ways to set population levels which will ensure that all of the goose policy objectives are met. At the higher end of the scale, the barnacle population should not be allowed to increase beyond current numbers. At the lower end of the scale we have calculated a minimum safe population from a biological perspective, and we have also considered how many geese we might need to meet our legal obligations. In practice, we are considering a practical lower range that can be achieved using existing lethal scaring methods and similar levels of resources. These considerations are discussed further below:

6.14.2 Biological perspective

To inform discussion on a possible lower limit for the Islay barnacle goose population, SNH ornithologists have used the current PVA to calculate that the minimum safe population where the population is not at risk of serious decline is 23,100 (Urquhart 2014). Allowing 10% either side for count variation, this translates to a range of 20,790-25,410 birds). However, to meet our legal obligations and to consider what might be achievable with available resources, this biological lower limit is too low and should not be considered as the lower target for the barnacle goose population.

6.14.3 SPA perspective

We are obliged to consider our international obligations when setting a minimum population limit. The Islay barnacle goose population at the time of SPA classification on Islay was c. 20,000 in 1988. The expectation at the time of classification was that the numbers would be allowed to rise as a result of the additional protection afforded to geese. No guidance has been published which states the numbers of barnacle geese needed at individual SPA level, Islay level or international range level, but the range proposed within this strategy will ensure that barnacle goose numbers on Islay remain significantly higher (8,000 – 11,000 geese more) than 1988 levels.

Article 2 of the Birds Directive relates to the maintenance of bird populations across their natural range. While the Islay population growth appears to have levelled off, numbers across the rest of the winter range have continued to expand in recent years (Mitchell & Hall 2013). Monitoring of the barnacle range population will continue through the five yearly census, and consideration will be given to developing a ringing programme that will provide data on movements of barnacle geese across the range, including possible immigration and emigration to and from Islay.

6.14.4 Practical perspective

As the biological perspective suggests a lower population level which is close to the number of geese present on Islay at the point of SPA classifications we consider that use of that science to develop a lower population range would not comply with our legal obligations. Therefore we plan to set a number of population targets based on the level of damage reduction we might expect from a barnacle goose population of a certain level. We acknowledge that there may not be a linear relationship between goose numbers and damage caused but we plan to monitor the effects of management closely to establish what that relationship is.

Initially we plan to reduce the damage by c.15-20% over 3-5 years and to do this we propose an increase in the annual lethal shooting bag to a level which we estimate will achieve that reduction. If we can demonstrate that the actions we take reduce the damage by the expected levels we will continue working towards the aim of achieving c.25-35% reduction damage by the end of the strategy. If we cannot demonstrate this then the strategy and the management actions will be reviewed. This is similar to the approach advocated by other countries which are attempting to develop management plans for protected geese e.g. The Netherlands are setting targets based on population reduction to try to reduce damage to the level that it was in 2005 (Wadden Sea Forum Goose Management Group, 2013).

It is proposed, therefore, that the lower range on Islay will lie between 28,000 and 31,000 barnacle geese. We have modelled the impacts on the barnacle population of removing a certain proportion every year for 10 years, based on the current PVA (Trinder 2014). To achieve the proposed reduction in damage, the population would need to be reduced by up to 1,200 birds (over and above the bag limit estimated using the PVA for a stable population) per annum for eight years. To shoot that number of geese is thought to be achievable with additional resources and flexibility in the way shooting is organised. The increments do not need to be the same each year and could be front loaded provided that the agreed bag limits are achievable. Shooting will be carried out under licence and will only be carried out for the purpose of preventing serious damage to crops.

The plan is to reduce the population towards the lower range in increments beginning from Year 2 (2015/16), if all the necessary baseline data is gathered and legal tests are met. This will allow us to fully evaluate the impact of the management and begin developing the next 10 year strategy in advance of the end of this strategy.

At the same time as population reduction is taking place, current farmer scaring effort will continue using non-lethal methods. These will provide short term protection of crops in some locations. It is possible that non-lethal scaring may become more effective if the geese react more because of higher levels of shooting and there is reduced competition for grazing by a lower density of geese. For example, if there is sufficient grass resource in the feeding areas to support a certain level of goose grazing then there is perhaps less likelihood of geese trying to graze on scaring areas. Farmers may also be able to protect a larger proportion of their land than they can at present and trial new management techniques in combination with the proposed population reduction.

At all times, a significant area of undisturbed feeding will be available for all geese across the island (Figure 17). This will be more than 70% of the available improved and permanent grassland on the island. It will include all of RSPB's reserves and the areas designated by individual farmers as feeding areas. Roost areas on saltmarsh and rough ground will not be disturbed. The management of barnacle geese will continue to be monitored to ensure that it does not have a significant impact on the white-front population.

As we reduce the population the monitoring of the impact of that reduction will continue. If the monitoring demonstrates that we reach an agreed outcome (e.g. where measured damage is reduced and the actions we take reduce economic losses to farmers⁶), the population reduction on Islay will cease prior to reaching the suggested lower level. If we experience a sudden increase in the population on Islay which exceeds the acceptable upper limit and there is no evidence that these birds have come from other parts of the barnacle goose range, the bag limit could be adjusted upwards accordingly. If we were to experience a significantly higher than predicted fall in the population, we will reduce the bag limit or halt shooting until the population stabilises. We will also monitor the situation in other range states, and adjust the targets on Islay, if bag limits in Iceland change significantly, to ensure that our actions have only the intended impacts.

Monitoring of consequential disturbance of scaring and shooting of barnacle geese on white-fronts will be carried out and evaluated against baseline information being collected as part

⁶ Measured by monitoring of sward, reduction in reseed frequency and other indicators

of a current study. Possible impacts on other species within designated sites will be monitored through SNH's existing Site Condition Monitoring process.

Once a population level has been reached which minimises the damage to crops, there will be on-going shooting, to maintain the population at that agreed level to protect crops.

6.15 Management of other goose species

Increasing greylag numbers on Islay have resulted in increased agricultural damage, particularly in the autumn when feeding on grass and barley crops. There are also concerns that greylag geese will use up spilt barley in harvested fields, which has traditionally been used by barnacle geese. This could lead to barnacle geese moving on to grass crops sooner than expected, resulting in greater damage to grass crops. As a minimum aim, the Islay greylag population will be managed by shooting to prevent an increase beyond the current level (as at 2013).

There are concerns that Canada geese could establish breeding sites on Islay, as they have done in many other parts of the west coast of Scotland. An established and increasing Canada goose population would likely result in significant additional year round damage to crops. The aim within this strategy is to ensure that Canada geese do not establish breeding sites on Islay.

6.16 RSPB Reserves

RSPB manage a significant area of land (4,217 ha) on Islay, divided across three reserves. These reserves have played a key role in goose management; they support considerable numbers of geese and will continue to do so. The reserves all lie within designated sites and provide undisturbed refuge areas for all species of geese. The Loch Gruinart Reserve is one of the key areas on Islay for barnacle geese providing feeding and roosting sites for large numbers of geese. All three reserves are also important sites for feeding and roosting white-fronts.

The reserves are also areas where different management techniques have been tried in the past and RSPB have committed to taking forward work to look at the effects of diversionary feeding and rush pasture management.

A detailed description of RSPB management and proposals for future management trials are set out in Annex 2.

6.17 Tourism and sporting interests

Care will be taken in the design of the new goose management scheme to minimise impacts on tourism and sporting interests.

The strategy acknowledges that bird-watchers visit Islay in winter, partly to view the spectacle of geese feeding in large flocks and using the roost areas in their thousands throughout the winter. Islay will continue to support tens of thousands of geese, which will maintain that spectacle. Large parts of the island, including at least 70% of the productive grassland on which geese feed and all roost areas, including the saltmarshes at Gruinart

and Bridgend, will not be disturbed by management actions. RSPB will continue to provide visitor facilities on their reserves, including bird hides overlooking roost and feeding sites.

Proposed management to reduce the barnacle goose population will use methods similar to those used over the past 15 years (shooting using rifle and shotgun on limited fields) and management of greylag geese is likely to continue using methods similar to those used over the past 4-5 years. Any increases in annual bag limits for licensed shooting of barnacle geese will be carefully managed to ensure population reduction is carried out in small increments, i.e. the proposed population reduction will take place over the 10 year period of the strategy, and shooting will only take place on designated fields. Efforts will continue to be taken to minimise disturbance to other species, including Greenland white-fronted geese, as a result of management of the barnacle goose population. These efforts include restricting shooting whilst Greenland white-fronted geese are present within mixed flocks and habitat management to provide alternative feeding away from possible disturbance. Care will also be taken to minimise impacts on activities such as bird-watching by managing timing and location of shooting activities, where possible.

Islay Local Goose Management Group has issued an information leaflet via the local tourism group, the Islay & Jura Marketing Group, to inform tourists about goose management on Islay. This explains why management of geese is required on Islay and how that management is currently delivered. This leaflet will be updated with any changes required as a result of the implementation of this strategy. If concerns are raised by tourism interests about impacts of goose management activities these will be recorded by SNH and considered by the Islay Local Goose Management Group in the design of any scheme or at the review stages of this Strategy.

Liaison with sporting estates will continue to ensure that goose management activities do not disrupt existing management and sporting activities. If opportunities arise to develop sport shooting, for greylag geese, during the life of the plan, these will be examined. There may also be opportunities in future to involve estates in the management of barnacle geese.

6.18 Costs

The current overall cost of supporting geese on Islay has been calculated at c. £1.6m⁷. The costs cover all damage caused as a result of goose grazing and are derived using a number of elements on which goose grazing causes damage. These include an increased reseeding frequency, delayed turnout of livestock after winter, increased fertiliser application and increase in supplementary feeding. Payments are made for damage to permanent and rotational pasture and are adjusted according to the density of geese on each farm unit.

The current Local Goose management Scheme, launched in 2012, was given a budget for payments to farmers of £843,258 per annum. This was increased to £910,000 for 2013/14 only, following a request by farmers due to the fact that a long term management strategy, including a commitment to population reduction, had not yet been prepared. It is clear that the payments to farmers are significantly lower than the calculated cost of goose damage.

⁷ Cost calculated at last review carried out by NGMRG and Islay Local Goose Management Group in 2012

As part of the work to develop this long-term strategy the Islay Local Goose Management Group are currently reviewing payment rates for the current scheme and ensuring that specific elements of the payment calculation are targeted at the appropriate management. This may result in a reduction to the total calculated cost of supporting geese but it will still be in excess of the current budget for payments to farmers of £910,000. The outcome of this review may result in a redistribution of the current budget, in a future scheme, to target payments to the areas with the greatest levels of goose damage. It is likely that there will be more focus on payments for loss of grass production which supports livestock than there will be for crops or farming systems on which geese have less impact.

The costs of delivering an adaptive management strategy are difficult to predict accurately as both the payment rate review and the management scheme that will follow on from an agreed strategy have not yet been developed. The costs of monitoring, additional shooting and development and implementation of diversionary feeding added to the existing payments to farmers will increase actual scheme costs initially. However, if we can reduce damage by geese to a level which improves the sward and allows farmers to reduce their reseed frequency the longer term, real costs to farmers of supporting geese on Islay may begin to reduce within the strategy period.

Costs are likely to include:

- **Payments to farmers** for the cost of supporting significant numbers of geese. This is likely to require at least the current annual budget c. £910k per annum. It is likely that regular reviews will be necessary to ensure that this payment reflects increased costs as a result of inflation.
- **Operation of marksmen.** This is currently £25k per annum for 2 marksmen using existing vehicles but is likely to increase to include 1 additional employee plus costs to around £32k per annum.
- **Measurement of damage.** This is likely to cost c. £70k over ten years. Costs may include the construction of enclosure cages and the collection and analysis of data. There is also likely to be a cost associated with an agri-economic study to measure economic losses to farmers. This is estimated to cost c. £10k over 10 years.
- **Development of diversionary feeding techniques.** Costs less than £10k in year 1 but increasing to a possible £30k per annum by year 10 if trials are successful and diversionary feeding is rolled out. Long term funding for this may be possible through SRDP.
- **On-going trials of new scaring techniques.** Costs of (netting & sonic string) - £2k per annum for years 1-3 then if trials are successful wider support for scaring equipment might be £10k-£30k per annum.
- **Other costs.** There may be additional costs associated with research and monitoring work as this develops but these have not yet been identified.

Illustrations of possible costs relating to goose management payments and the operation of marksmen over a 15 year period have been prepared (Annex 3). These consider costs based on no change to goose numbers; goose numbers reducing as a result of management and goose numbers increasing as a result of stopping current lethal management. Figure 19 shows the possible total cost of each option over a 15 year period.

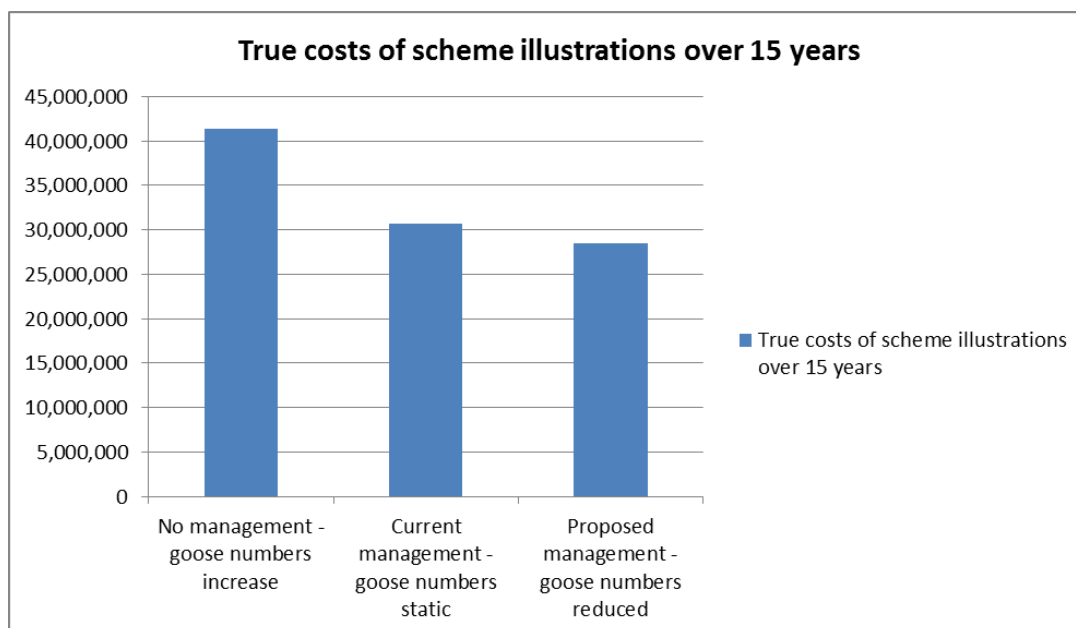


Figure 19. The estimated total costs of possible schemes over a 15 year period.

The illustrations indicate that continuing the current style of scheme, with no reduction in goose numbers, the costs of supporting geese will increase significantly. The illustration using a 2.5% inflation rate indicates that the true cost of supporting geese over the next 15 years could be c. £30.7m with the nominal excess costs borne by farmers c. £ 14.9m over 15 years. Annual true costs of supporting geese are predicted to increase, for both SNH and farmers, from the current c. £1.6m per annum to c £2.4m per annum, including inflation, in 15 years.

These illustrations also set out a scenario of costs if we can reduce costs of goose damage as a result of reducing barnacle goose numbers. They assume that costs can be reduced by 10% by year 10 and a further 10% by year 12 of the strategy. This assumes that there is a time lag before reductions in goose numbers have an impact on damage and associated costs. They predict that, using the same 2.5% inflation rate, that costs of supporting geese over the next 15 years will total c. £28.4m with the nominal excess costs borne by farmers of c. £14.2m over 15 years. This represents possible savings in excess of £2m over 15 years in the total costs of supporting geese.

A further illustration is included which sets out the scenario if goose management, with current bag limits ceases from 2014 onwards. The population growth estimates are taken from the PVA (Trinder 2014). They predict that, using the same 2.5% inflation rate, that costs of supporting geese over the next 15 years will total c. £41.4m with the nominal excess costs borne by farmers of c. £20m over 15 years.

6.19 Timescales and governance of strategy approval

The strategy has been developed through a partnership project by SNH, Scottish Government and the National Farmers Union of Scotland. Each body has representatives on the Steering Group: David MacLennan (SNH), Bill Dundas (SG), Jim McHarrie (NFUS) and Robert Epps (NFUS). The project has been managed by Rae McKenzie (SNH).

A draft strategy has been submitted to NGMRG and Islay Goose Management Group for comment and discussed at an open public meeting, held on Islay in June 2014.

The strategy was presented by the Steering Group to SNH Board in August 2014 for comment. A final strategy will be submitted to SNH Management Team in September 2014 for sign-off and then to the Minister for Environment and Climate Change for approval in September/October 2014. Approval will be sought by mid-October 2014.

If the strategy is approved, the Islay Local Goose Management Group will develop a scheme which will deliver the strategy objectives. NGMRG will comment on the scheme proposal and SG and SNH will provide approval and funding for the scheme. This scheme will begin in October 2015 and is likely to run for an initial five year period.

The scheme will be reviewed every two years and adapted according to the outcome of the review. A further scheme will be developed to follow on from the 1st five year scheme.

Consideration will be given to the development of a flyway plan across the Greenland barnacle goose range in the medium to long term.

7. Adaptive management

7.1 The process

This strategy will follow an adaptive management process. This means that it will set out objectives and the means by which it is thought these objectives can be achieved. However, the strategy, in this case, must deal with ecological uncertainty. It is not known with any certainty how geese will react to the measures proposed and how that reaction might lead to a reduction in damage to agriculture or an increase in numbers of white-fronted geese. This means that the process must be one which is closely monitored, evaluated and have the flexibility to make adjustments to the strategy, if required, to achieve the objectives (Figure 20⁸).

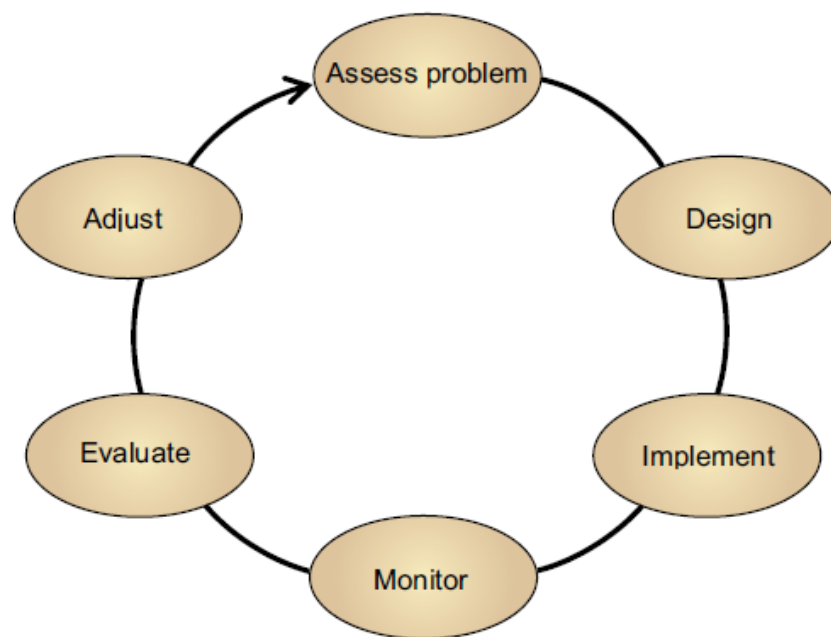


Figure 20. The adaptive management process

7.2 Research & Monitoring

The proposed monitoring required for this strategy is as follows:

- The collection of data which will provide information on goose numbers.
- The collection of data which will provide information on goose distribution and behaviours.
- The collection of data which will help indicate the response of geese to novel management

⁸ US Department of the Interior guide to adaptive management
<http://www.doi.gov/initiatives/AdaptiveManagement/whatis.html>

- The collection of data on the body condition of geese.
- The collection of data which will enable an assessment of the level of damage and associated levels of economic losses caused by geese.

Consideration will be given to the collection of other data which may help evaluate the impacts of goose damage and the effects of management.

A detailed research plan is included in Annex 4.

7.3 Review timetable

The strategy will be reviewed after the first year of baseline data collection in summer 2015 to ensure that the data collected are robust.

After that, the reviews will be every two years and will take place in the summer.

Reviews will be carried out by the Islay Local Goose Management Group. Any significant changes to the strategy or the scheme will require submission to NGMRG and the agreement of SNH/Scottish Government. Any proposed changes to monitoring regimes or research will be presented to GSAG for their advice.

It is possible that further formal appraisal of proposed management changes will be required to ensure that the strategy and the scheme remain compliant with Natura regulations.

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Annex 1 Stakeholder involvement

At the beginning of the project in mid-February 2013 a range of stakeholders and interested parties were identified and the Project Manager set up meetings to outline the aims of the project and seek as wide a range of views as possible on a way forward. Many of these stakeholders have been involved in on-going dialogue as the project has progressed and all have been given the opportunity to comment on a draft plan circulated in June 2014.

Stakeholder	Date of first meeting / discussion
Royal Society for the Protection of Birds (RSPB) (Islay staff)	15/2/13
Scottish Government Rural Payments and Inspections Division (SGRPID)	6/3/13
RSPB (national staff)	6/3/13
National Farmers Union of Scotland (NFUS) (policy staff)	7/3/13
Science and Advice for Scottish Agriculture (SASA)	7/3/13
Islay Local Goose Management Group (ILGMG)	12/3/13
Scottish Land & Estates (SL&E)	18/4/13
British Association for Shooting and Conservation (BASC)	18/4/13
Scottish Government (SG)	19/4/13
South Islay Development Co.	23/4/13
Islay & Jura Marketing Group	24/4/13
Islay Natural History Trust	22/5/13
National Goose Management Review Group (NGMRG)	6/8/13
Wildfowl & Wetlands Trust (WWT)	6/8/13
Islay NFUS Executive	7/11/13

In addition to meeting with organisations, discussions have also taken place with local bird experts throughout the development of the strategy. Interested parties were also invited to drop in sessions from 29 April to 2 May 2013 but interest in this was low (2 farmers requested meetings but there was no interest expressed by other groups).

Islay Local Goose Management Group held an open meeting on 27 May 2013 at which the development of the Strategy was discussed.

Islay NFUS organised a conference on Islay in March 2014 to which many of the key stakeholders in goose management were invited. A presentation outlining progress with the development of the Strategy followed by a Q&A session was presented to an audience of around 80 people.

An open meeting was held on 23 June 2014 to discuss the latest draft of the plan. All goose scheme members (c. 96 farmers) and the local stakeholder groups listed above were invited by letter and the meeting was advertised on posters across Islay. The letters and poster advertised the availability of the draft strategy. Approx. 20 people attended and they have been invited to provide comment on the draft Strategy. The availability of the draft for comment has also been advertised in the local newspaper.

The Project Manager attended Islay & Jura Agricultural Show on 14 August 2014 and spoke to a sample of people attending the show to seek their views on goose issues. They were

given a brief outline of the project and, if requested, information on where to obtain a copy of the draft strategy.

The Islay Local Goose Management Group was set up in 2000, at a public meeting. Stakeholders were invited to join the group at that meeting and representatives of following organisations make up the current group: Scottish Government (SG), Scottish Natural Heritage (SNH), Royal Society for the Protection of Birds (RSPB), National Farmers Union of Scotland (NFUS), Scottish Crofting Federation (SCF), Scottish Land and Estates (SL&E).

The National Goose Management Review Group (NGMRG) includes representation from SG, SNH, RSPB, NFUS, SCF, SL&E plus Wildfowl and Wetlands Trust (WWT) and British Association for Shooting and Conservation (BASC). This group was set up by Scottish Government.

The Goose Science Advisory Group, a sub-group of NGMRG includes representatives from SG, SNH, RSPB, WWT, BASC and Science and Advice for Scottish Agriculture (SASA).

Annex 2 Goose Management on RSPB's Islay Reserves

1.1 RSPB reserves on Islay

A key provision for goose management on Islay is the management of land by RSPB. The RSPB has three reserves on the island: Loch Gruinart, The Oa and Smaull Farm. These cover a total land holding of 4,217 hectares. These reserves all provide significant refuge areas for geese and goose management is the highest priority for management at Loch Gruinart.

The current management for geese is set out in this section along with the possibilities for future management to develop improved habitat and diversionary feeding opportunities for white-fronted geese.

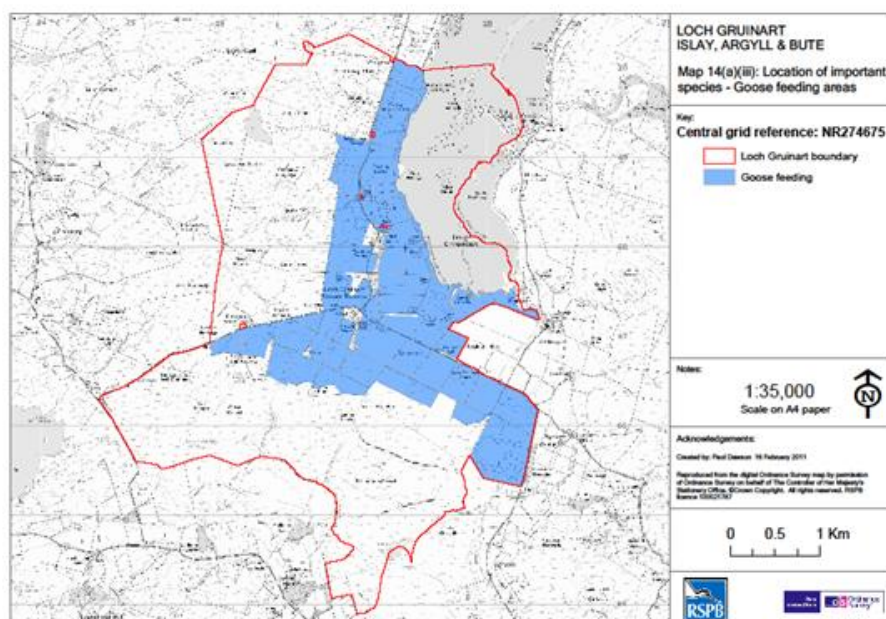
1.2 Current habitat management for geese on RSPB reserves

1.2.1 Loch Gruinart

The following habitats are managed for geese on Loch Gruinart Reserve:

- 95.66 ha of permanent pasture (sward height 5-10cm in October).
- 95.54ha of wet grassland (sward height 10cm on 1st Oct, <20% rush cover)
- 56.39 ha of rotational grassland (>5ha of spring sown arable, >3 ha of cover crop)
- 44.5 ha of herb rich neutral/ acid grassland
- 50.56 Ha of inundated grassland (winter flooding approx. 50%)
- 71.84 ha of fen mire mosaic
- 40.1 ha of salt marsh
- 216 ha of tidal mud

A total of 858.64 ha of the reserve are actively used by geese.



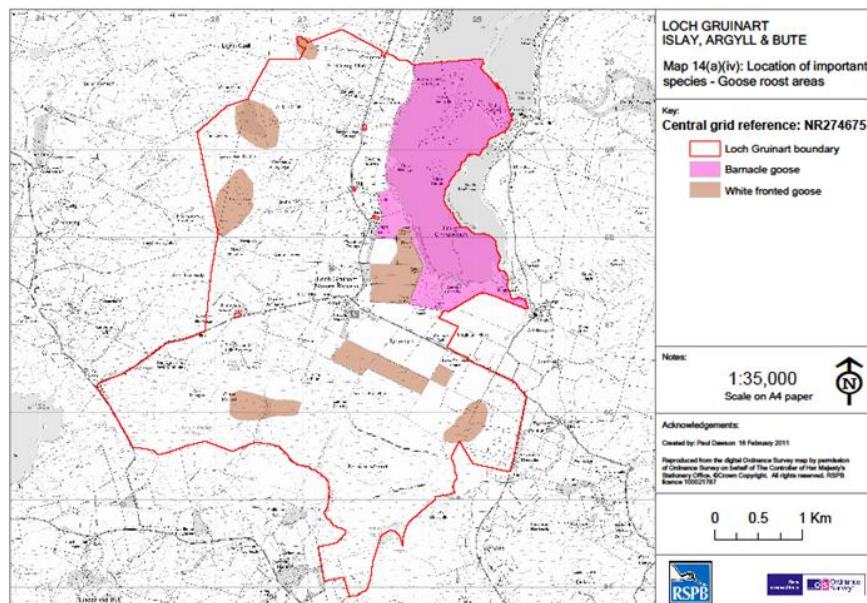


Figure A1. Loch Gruinart Reserve

- The grassland is maintained with 200 suckler cows and 200 sheep.
- Improved grassland is managed with fertiliser and lime application in accordance with management and soil analysis.
- 76.87 ha of wet grassland reseeded on a seven year cycle to maintain quality of sward and prevent *Juncus* encroachment.
- 56.39 ha reseeded as part of an arable rotation with at least 5 ha of spring arable planted annually
- *Juncus* management by grazing, topping and weed wiping, at least 50 ha of *Juncus* topped annually.
- Control of water levels by sluices and pipes – produces flooded areas during the winter for feeding and roosting white-fronted geese as well as allowing the reseeded grassland to free drain in the wettest months.
- All grazing of wet grassland area (Flats) finished by the 1st October to allow undisturbed goose feeding.
- Saltmarsh summer grazed by sheep to maintain salt marsh sward for wildfowl
- Estuarine roost and refuge maintained free of disturbance.

1.2.2 The Oa

The only habitat management currently carried out for geese on The Oa (Figure A2) is the topping of rush pasture during the autumn. Between 50ha and 75ha are topped annually dependent on staff capacity and ground conditions. The majority of accessible rush pasture is topped in a dry year. This management is also carried out for the benefit of foraging chough and improved grazing. The geese also regularly use areas of cut grass silage fields and improved grass.

The area of habitat regularly used by geese extends to around 150ha, of which 40ha is improved grass and grass silage, the remainder being semi improved grass and marshy rush pasture.

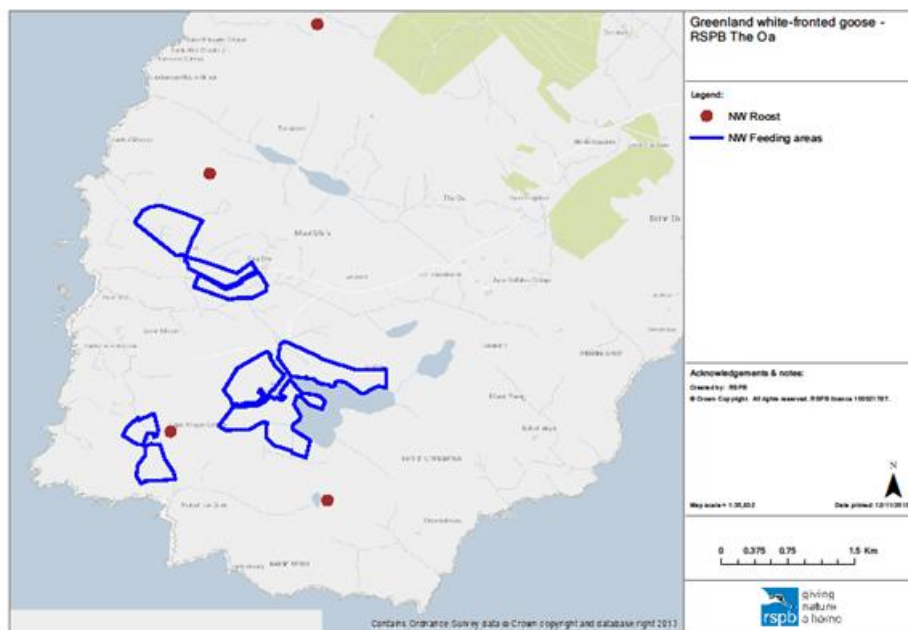


Figure A3. The Oa

The majority of rush pasture is topped each year in the autumn if conditions allow. Most of these areas are grazed with sheep and/or cattle throughout much the year. The improved and some of the semi-improved grasslands receive small amounts of fertilizer each year and again are grazed with sheep and/or cattle throughout much of the year. The grass silage is cut in late summer and is then grazed with predominantly sheep during the autumn and winter. These areas are fertilised.

1.2.3 Smaull Farm

Although management priorities at Smaull are for chough and corncrake, management activities do benefit the wintering geese. Management activities have changed very little over the last ten years. Smaull Farm (Figure A3) includes:

- 28.70 ha of in-bye including silage fields, herb rich meadows and a small oat crop.
- 39.01 ha of coastal grassland
- 8.89 ha of undisturbed inundated grassland
- 0.5 ha of rush is topped annually
- 4.6 ha of rush pasture

A total of 76.6 ha of the reserve are actively used by geese. Goose foraging take place mainly on the coastal grassland and the in bye. Occasionally Greenland white fronted geese have roosted in the cropped fields (Compartiment 17)

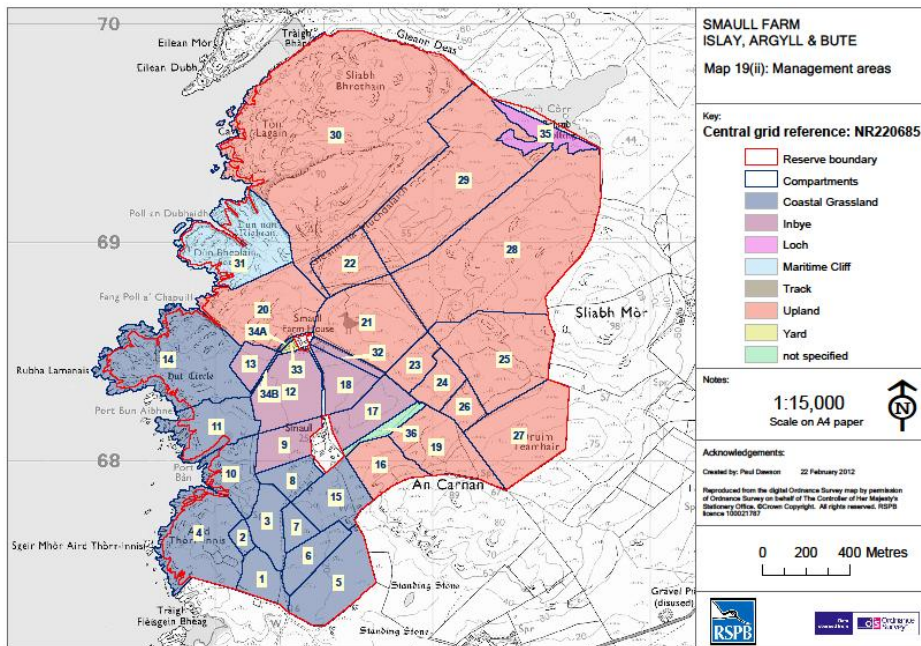


Figure A3. Smaull Farm

Although management priorities at Smaull are for chough and corncrake, management activities do benefit the wintering geese.

- 28.70 ha of in-by, cropped area and herb rich meadows are lightly grazed throughout the winter providing opportunities for foraging geese. These areas are lightly fertilised.
- 39.01 ha of coastal grassland is grazed all year with 25 cows and 100 sheep providing a short sward (<5cm on average) for foraging geese.
- 8.89 ha of undisturbed inundated grassland provide habitats suitable for geese. Water levels are not controlled.
- 0.5 ha of rush is topped annually.
- An additional 4.6 ha of rush pasture has been topped to provide opportunities for foraging geese
- Smaull farm is seen as a safe refuge in the north west of Islay.

1.3 Possible future management for geese on RSPB reserves

1.3.1 Loch Gruinart

Rush pasture: The existing rush management project at Loch Gruinart will continue. Opportunities to expand this will be examined, but this management technique has now been rolled out to most of the available habitat. The possibility of topping areas a second time in Feb/March is being trialled to open up the grassland again as the rush re-growth starts to dominate.

Diversionsary feeding: The reserve does not require diversionsary feeding, as the whole site is a feeding/refuge for geese. Trialling of techniques that will provide preferential feeding opportunities for white-fronted geese will be considered. The growing of beet crops however

is not possible at Loch Gruinart due to the wet shallow soils- beet crops when grown were unsuccessful.

Improved grassland management: An increase in the area and timing of reseeding may be possible in some areas; this would have a substantial financial cost.

Survey and monitoring: The current survey and monitoring programme will continue to inform management. The long term data set that exists for Loch Gruinart will be analysed to see if it shows any habitat use trends that can inform future management for white-fronted and barnacle geese.

1.3.2 The Oa

Rush pasture: A slight increase in topped rush pasture could be achieved with increased staff capacity and improved machinery, but would still be largely weather and ground condition dependent.

Diversionsary feeding: The trialling of diversionsary feeding will be considered as relevant techniques are proposed.

Improved grassland management: An increase in area of improved and semi-improved grassland for geese could be achieved through more intensive management of rush pastures/or increased reseeding, but this would have to be balanced against the loss of topped rush pasture in its own right as an important habitat for Greenland white-fronted geese.

1.3.4 Smaull Farm

Rush pasture: A slight increase in topped rush pasture could be achieved. The time of year this takes place will have to be examined to fit in with wader management. Opportunities to increase the wet flush area on the reserve will be sought. This will improve the feeding/roosting opportunities for white-fronted geese.

Diversionsary feeding: Trialling of diversionsary feeding techniques could be considered, although currently the relevant land parcels are within SRDP prescriptions.

Improved grassland management: There are no opportunities for increasing areas of improved grassland.

Surveying & monitoring: The current surveying programme will continue to inform management. More monitoring will take place to assess the impact of lethal scaring in the surrounding area.

Annex 3 Cost illustrations over 15 years

These figures are for illustrative purposes only. Budgets for longer term schemes will be decided following discussions between local group and NGMRG. Any reductions in budgets over time will be based on revising calculations during scheme reviews when agreed damage reduction targets are reached. There remains an expectation that payments to farmers at a minimum of 2014 levels will be required until significant reductions in damage are measured (See section 6.18 of plan).

Dated 11th July 2014	Example 1	Example 2	Example 3
ISLAY GOOSE STRATEGY	goose numbers & costs static with 2.5% inflation	goose numbers reduce	goose numbers increase
SUMMARY OF 15 YEAR Scheme and SNH Costs	apply 10% reductions at yrs 10 & 12 in Scheme & SNH costs with 2.5% inflation	apply 20% & 46% increases in Scheme and SNH costs with 2.5% inflation	
	£	£	£
True Cost of Schemes			
True Costs of Schemes (excluding Inflation)	25,057,770	23,454,073	33,009,436
True Costs of Schemes including Inflation	30,704,496	28,498,904	41,405,013
SNH Annual Budget Payments	15,795,404	14,267,349	21,339,741
Net Present Value of Goose Management Payments	11,941,411	10,887,622	15,617,467
The Nominal Excess Costs borne by Farmers	14,909,092	14,231,555	20,065,272
Net Present Value of Excess Costs borne by Farmers	11,264,176	10,902,539	14,670,831
Marksmen Contract Costs (not included in Management Costs)	472,237	391,513	0
Notes			
Example 1 - these 15 year costs comparisons partly address SNH Budget Affordability because they include the impact of Inflation on SNH MA costs on a 5-year cycle by allowing for a review of management payments at yrs 5 and 10			
Example 2 - The comparison highlights that if the goose numbers are reduced by 10% at the end of yrs 10 and 12 then the nominal and NPV real costs costs borne by Farmers will reduce as shown.			
Example 3 - Details the impact no shooting of geese would have on the overall costs of goose management to both SNH and the Farmers alike			

Annex 4 Research and monitoring plan

This plan sets out the framework for the monitoring work which is required to inform the adaptive management process which is being applied to the Islay Sustainable Goose Management Strategy. It covers work carried out at present to collect data to inform the management and administration of the current goose management scheme and future work required to collect baseline and ongoing monitoring data to inform regular reviews and decision making connected to future goose management.

What do we want to monitor	Type of monitoring	Reason for monitoring / outcomes	When	Lead	Where	Additional info.
1. To monitor goose numbers, distribution and behaviour	Goose counts (international) all wintering species	To calculate populations of Greenland white-fronts and barnacle geese on Islay and to calculate the white-front population across the range. There are 4 x 2 day counts per season in each of November, December, January and March. The data from these counts also contribute to the calculation of goose densities for the Islay Local Goose Management Scheme. It can also contribute to monitoring of goose usage of designated sites and to look at goose distribution across the island.	4 times annually	SNH/ GWFGS	winter range	Need to ensure that coverage of counts includes all possible areas where geese can be found on Islay (including areas geese are not currently found) to account for any movements as a result of changes in management.
2. To monitor goose numbers, distribution and behaviour	Goose counts (scheme) all wintering species	7 island-wide counts which contribute towards the calculation of goose densities on a farm by farm or field by field basis. The data are currently used to calculate management payments made to farmers under the Islay Local Goose Management Scheme. It can also contribute to monitoring of goose usage of designated sites and to look at goose distribution across the island.	7 times annually	SNH	Islay	As above. There is also a need to review the data over the course of the Strategy period to ensure the number of counts continue to provide robust data.

3. To monitor goose condition	Abdominal profiling	To measure body condition of all geese to assess the condition of geese prior to their return to Greenland in spring.	Annually, March - April	SNH	Islay	Established methodology; sample sizes will be confirmed in winter 2014/15.
4. To monitor population age structure	Age counts/breeding success	To collect age data of Greenland white-fronted geese, barnacle geese and greylag geese to inform future population viability analysis.	Annually, autumn / early winter	SNH/ Malcolm Ogilvie	Islay / Range	Established methodology sample sizes etc. will be re-confirmed for winter 2014/15
5. To monitor goose numbers	Goose counts (greylag) autumn & winter	To collect data on greylag numbers to monitor breeding and wintering population and to find out more about movements of greylag geese to and from Islay. The data will be used to inform decisions on future greylag management and the issuing of out-of-season licences to shoot greylags to prevent agricultural damage.	Annually, August / winter	SNH/ John Armitage	Islay / Jura	Established methods will be described /confirmed in winter 2014/15
6. To monitor goose numbers	Canada goose recording	To monitor presence of Canada geese on Islay and inform management to prevent colonisation. Canada goose data will be included within any organised goose count.	Annually	SNH	Islay / Jura	There is a need to raise awareness of Canada geese within farming and bird-watching community to ensure sightings are reported to SNH.
7. To collect data on potential goose movements across the range	BTO WeBS counts	Liaison with BTO to collect data on counts on goose roosts, especially away from Islay. This can potentially add to data already collected by scheme counts on Islay and may provide information on possible movements of geese in the rest	Annually	BTO	Range	There is a need to raise awareness amongst others collecting goose data that sightings of rings and collars may be important to the work on Islay.

		of the wintering range.				
8. To monitor goose numbers and distribution	International census	To monitor overall range population size of GWF and barnacle geese. Annual wintering range census of white-fronts is co-ordinated by the Greenland White-fronted Goose Study. The barnacle wintering range census is co-ordinated by WWT and takes place every 5 years.	Annually for GWF, 5 yearly for BA	GWFGS / WWT	Range	Follows accepted methodology
9. To monitor population structure and body condition	Collection of data from shot geese	Data collected from shot geese include location shot/ sex / weight/ age /rings. The data are used to inform PVA revisions.	Annually	SNH	Islay	Established methodology will be formally described / confirmed in winter 2014/15
10. To collect data on the effectiveness of new management techniques and to monitor behaviour	Diversionary feeding	To assess effectiveness of diversionary feeding trials, monitoring will take place of goose usage of individual trial fields. The data will be analysed to assess the usefulness of growing different crops or managing specific habitats.	2013 - 2016	SNH	Islay	Established methodology will be followed
11. To measure the level of damage caused by geese on a sample of fields	Damage measurement	To measure baseline level of damage prior to any management measures / population reduction and to measure reduction in damage as a result of these using enclosure cages and paired control plots. These will measure differences in sward height and dry matter between areas exposed to goose grazing and areas protected from goose grazing. Data relating to the current payment	Annually, spring	SNH	Islay	The methodology has been drawn up but will be confirmed in winter 2014/15. Further discussions to be held with farmers.

		calculation will also be collected, including reseeding cycles, turn-out dates and cutting dates.				
12. To measure the level of economic losses on a sample of fields	Measurement of economic losses	Data from the grass enclosure plots and farm management can be used in an off-the-shelf model that can calculate economic losses on a sample of individual fields.	May be looked at every second year	SNH	Islay	Methodology to be discussed by SASA and SRUC.
13. To measure the effectiveness of new management techniques	Effectiveness and cost-effectiveness of netting	To explore whether netting is a viable management option, monitoring of goose numbers in fields protected by netting will be carried out. Trials will also look at grass height and species composition, possibly in conjunction with the damage measurement and economic losses calculations.	2013 - 2016	SNH	Islay	The methodology will be confirmed in winter 2014/15
14. To measure the effectiveness of new management techniques and goose behaviour	Effectiveness of tape as a scaring device	To explore whether tape is an effective scaring option, monitoring of goose numbers in fields protected by tape will be carried out.	2013 - 2015	SNH	Islay	The methodology will be confirmed in winter 2014/15
15. To measure the effectiveness of new management techniques and goose behaviour	Effectiveness of laser pens	To explore whether laser pens are an effective scaring option, possibly also in conjunction with lethal scaring. Consideration will be given to the safety aspects of laser use and possible impacts on the health of geese through a literature review prior to any deployment	2014-15	SNH	Islay	The methodology will be confirmed in winter 2014/15. .

16. To measure the effectiveness of new management techniques and goose behaviour	Effectiveness of Grazers liquid deterrent	To explore effective scaring options using liquid fertiliser currently marketed as a deterrent. The distributor has offered to set up trials to examine effectiveness of the product on geese feeding on grass.	2014-15	SNH / Grazers	Islay	The methodology will be confirmed in winter 2014/15
17. To monitor movements of geese across the range, distribution and behaviour	Impacts of goose management on Islay across range	Ringling / colour ringling and re-sighting across barnacle goose range to monitor movements and detect any impacts of management on Islay in other parts of the range.	G	SNH & others	Range	Further discussion required by GSAG.
18. To monitor movements of geese across the range and to gain a better understanding of goose distribution and behaviour on Islay	White-front telemetry & roost work	This work is currently at the midway point of a 2 year project to gain a better understanding of white-front roosting and feeding behaviour on Islay. It will provide a baseline report against which we may be able to monitor any changes in goose behaviour and/or distribution as a result of management activities as well as informing decisions on future management.	2013-2015	SNH / WWT	Islay	Methodology is in place and the first year of work has been completed
19. To gain a better understanding of goose distribution and behaviour.	Barnacle telemetry	Work was done over the winter of 2013/14 looking at the use of roost sites by barnacle geese and movements between roosts and feeding areas. This was done to provide baseline data and to inform future management decisions.				Publication due by Autumn 2014.