Icelandic-British workshop on grey geese, Hvanneyri, Iceland, 28 – 30 September 2001

Proceedings and recommendations

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NÁTTÚRUFRÆÐISTOFNUN ÍSLANDS

ÁGRIP Á ÍSLENSKU

Í Landbúnaðarháskólanum á Hvanneyri var haldinn vinnufundur í samvinnu íslenskra og breskra aðila dagana 28.–30. september 2001 þar sem fjallað var um sameiginlega stofna grárra gæsa. Vinnufundinn sóttu gæsasérfræðingar frá Íslandi, Bretlandi, Kanada, Írlandi og Danmörku ásamt fulltrúum stjórnsýslu í Bretlandi og Íslandi, en undirbúning annaðist Náttúrufræðistofnun Íslands.

Að minnsta kosti tvær ástæður lágu til þess að ákveðið var að efna til þessa vinnufundar. Annars vegar þótti tilefni til að bera saman bækur sínar um árangur litmerkinga á grágæsum og heiðagæsum, en það verkefni var framkvæmt á Íslandi á árunum 1996–2000. Hins vegar var talin ástæða til að ræða alvarlegt ástand grágæsastofnsins, en samkvæmt hausttalningu hefur orðið mikil fækkun í honum á síðastliðnum áratug, eða úr 100.000 fuglum í 80.000. Sérfræðingar, einkum frá Náttúrufræðistofnun Íslands (NÍ) og Wildfowl and Wetlands Trust (WWT) í Bretlandi, kynntu niðurstöður nýjustu rannsókna á ástandi, stofnvistfræði og veiðiálagi gæsastofnanna.

Helsta markmið vinnufundarins var að setja fram tillögur um framhald vöktunar, rannsókna og veiðistjórnar sameiginlegra stofna grágæsa og heiðagæsa í framtíðinni og skyldu tillögurnar byggðar á þeim gögnum sem kynnt yrðu á fundinum.

WWT hefur staðið að vöktun grágæsa og heiðagæsa í Bretlandi allt frá árinu 1960. Í október og nóvember ár hvert eru gæsir taldar á náttstöðum og sýni tekin úr stofninum til aldursgreiningar. Árið 1987 var farið að litmerkja heiðagæsir og síðan grágæsir árið 1992. Á Íslandi hafa gæsir einungis verið taldar á afmörkuðum svæðum og NÍ stóð fyrir litmerkingum 1996–2000. Veiðiskýrslur komu til sögunnar á Íslandi árið 1995, en sambærilegt kerfi er ekki til í Bretlandi.

Talningar í Bretlandi sýna að samfelld fjölgun hefur verið í heiðagæsa-stofninum allt frá því að talningar hófust, en stofninn hefur nú náð stöðugleika og er um 230.000 fuglar að hausti. Grágæsum fjölgaði einnig til ársins 1990 eða þar um bil en hefur síðan fækkað úr um 100.000 niður í 80.000. Ungfuglar eru um 15–20% stofnsins hjá báðum tegundum. Á Íslandi var að jafnaði sami fjöldi gæsa veiddur árlega á árunum 1995–2000, eða um 37.000 grágæsir og 13.000 heiðagæsir. Samkvæmt könnun á vængjum, sem NÍ lét gera, eru um 40% veiddra grágæsa og um 30% heiðagæsa ungfuglar. Með því að bera saman fjölda merktra gæsa sem fellur fyrir skotum veiðimanna í löndunum tveim má áætla gróflega hversu margar gæsir eru veiddar í Bretlandi: 26.000 grágæsir og 30.000 heiðagæsir.

Lífslíkur[1] þessara tveggja gæsategunda hafa verið metnar út frá því hversu margar merktar gæsir hafa sést aftur og hversu margir merktir fuglar hafa verið endurheimtir. Gæsir merktar með hálshring reyndust gefa bestar upplýsingar. Almennt má segja að lífslíkur heiðagæsa séu meiri en grágæsa (árlegar lífslíkur fullorðinna fugla: 82% á móti 72%), en lífslíkur á fyrsta ári voru meiri hjá ungviði grágæsa en heiðagæsa (45% á móti 39%).

[1] Með lífslíkum er átt við hversu stórt hlutfall stofnsins lifir frá ári til árs.

Þegar bornar voru saman upplýsingar úr ýmsum áttum um stærð grágæsastofnsins kom í ljós að þeim ber ekki saman. Væru bæði tölur úr hausttalningum og veiðiskýrslum réttar ætti stofninn að deyja út innan örfárra ára. Tölur hljóta því að vera rangar í öðru eða báðum tilvikum; annaðhvort eru grágæsir miklum mun fleiri en talningar sýna eða talsvert færri eru veiddar en skýrslur gefa til kynna, nema hvort tveggja sé. Hugsanlega er eitthvað um að gæsir séu tvítaldar í veiðiskýrslum, en þó var talið ólíklegt að miklar skekkjur gætu verið í þeim. Þátttakendur á vinnufundinum beindu sjónum sínum því mun frekar að haust-talningunum, enda þótt ekki sé augljóst að rekja megi meiriháttar skekkjur til þeirra heldur. Þá kom fram að hlutfall ungfugla í hauststofni verður að vera um það bil helmingi hærra en það er samkvæmt skráningum frá Bretlandi til þess að stofninn haldist í þokkalegu jafnvægi (eins og hann virðist hafa verið síðustu fimm ár). Af þessu má ljóst vera að taka þarf núverandi vöktunarverkefni til gagngerrar endurskoðunar og að öllum líkindum er einnig nauðsynlegt að afla viðbótargagna.

Þátttakendur ræddu þessi mál ítarlega og í lok fundarins komu þeir sér saman um nokkrar tillögur. Þær helstu eru raktar stuttlega hér á eftir:

- Halda á núverandi vöktun áfram og yfirfara niðurstöður sérstaklega með mögulegar skekkjur í huga.
- Hausttalningar á grágæsum, sem fara fram á Bretlandi í nóvember, ættu að ná yfir allar vetrarstöðvar grágæsar (þar á meðal Ísland).
- Litmerkingum ætti að halda áfram í báðum löndunum og merkja að minnsta kosti 200 fugla af hvorri tegund árlega.
- Mælt er með að talningar verði auknar í báðum löndum. Leitað yrði gaumgæfilega á talningarstöðum sem valdir væru af handahófi og dreifðir sem víðast yfir þau svæði þar sem vitað er að gæsir halda sig (lagskiptingarúrtak). Bæði ætti að skrá heildarfjölda gæsa og hlutfall ungfugla. Rannsóknin á Íslandi yrði meginheimild um aldursdreifingu og ætti að framkvæma hana um miðjan ágústmánuð, áður en veiðitímabilið gengur í garð.
- Auka þarf gildi og vægi þeirra upplýsinga sem afla má þegar merktar gæsir sjást aftur, með því að hvetja fuglaskoðendur til að leggja megináherslu á tiltekinn tíma í athugunum sínum og að safna meiri upplýsingum um hvern fugl, til dæmis um fjölskyldustærð.
- Bresk stjórnvöld eru hvött til þess að koma á fót veiðiskýrslukerfi til þess að afla megi áreiðanlegra upplýsinga um fjölda gæsa sem veiddar eru í Bretlandi árlega.
- Að því er varðar veiðistjórnun lögðu þátttakendur til að reynt verði að komast hjá auknum grágæsadauða af völdum veiða, enda telja þeir veiðiálag á stofninn mjög mikið auk þess sem lífslíkur tegundarinnar séu litlar og hætta á að stofninn minnki ef árlegur fugladauði eykst frá því sem nú er.
- Eindregið er hvatt til þess að sérfræðingar á Íslandi og Bretlandi hafi með sér frekara samstarf í framtíðinni, jafnt í fræðilegum efnum sem á sviði stjórnsýslu. Samningurinn um verndun afríska og evrópskra vatnafugla (African-Eurasian Waterbird Agreement) kann að vera gagnlegt tæki til að greiða fyrir slíku samstarfi.

LIST OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

An Icelandic-British workshop on shared populations of grey geese was held at Hvanneyri Agricultural University from Friday 28 September to Sunday 30 September 2001. The workshop, arranged by the Icelandic Institute of Natural History, was attended by goose specialists from Iceland, UK, Canada, Ireland and Denmark. A total of 25 people, both researchers and managers, attended the workshop. On Friday evening, the Ministry for the Environment in Iceland hosted a reception.

The workshop coincided with a white-fronted goose field study project organised by the Greenland White-fronted Goose Study, and thus benefited from the presence of both geese and goose experts at Hvanneyri. The opportunity to watch, catch and handle geese provided extra inspiration for most workshop participants.

There were at least two motives for arranging the workshop. The first was to review the findings of the colour-ringing programme of greylag and pink-footed geese that has been carried out in Iceland 1996-2000, and the second was the alarming situation for the greylag goose population, which according to autumn censuses in the UK has declined from more than 100,000 to around 80,000 over the last ten years. Researchers, mainly from the Icelandic Institute of Natural History (IINH) and the Wildfowl and Wetlands Trust (WWT), presented the most recent results on status, population dynamics and hunting pressure of the two goose populations. The main aim of the workshop was, in the light of the evidence presented, to make informed recommendations about future monitoring, research and management of grey goose populations shared by Iceland and Britain.

In this report, I briefly summarise what happened at the workshop. Summaries are given of both presentations and the ensuing discussion; in this context, I wish to thank Guðmundur A. Guðmundsson, Kristinn H. Skarphéðinsson and Ólafur Einarsson for taking notes during the workshop. Also included here are the recommendations drafted Sunday afternoon; special thanks to Tony Fox and David Stroud for their efficient contribution to this process. Finally, I include a list of participants.

2 WORKSHOP SUMMARY

The workshop was opened officially by Sigurður Á. Þráinsson on behalf of the Ministry for the Environment in Iceland; he stressed that the ministry considered the meeting very important. The ministry has spent considerable funds on the research programme to establish background data for population modelling, and recently a committee to evaluate hunting pressure on geese and other birds has been set up. The ministry therefore awaited the results of the workshop with great interest.

2.1 Abstracts of presentations

Richard Hearn: Monitoring and research of Icelandic-breeding grey geese in the UK. The monitoring programme has been coordinated by WWT since 1954, with full roost censuses since 1960. About 100 volunteer observers census some 120 roosting and feeding sites on two weekends in October (primarily pinkfeet) and November (primarily greylags); in some years, counts are also carried out in mid-winter and spring. Techniques for assessing the proportion of juveniles and mean brood size in the populations were developed in the 1950s and 1960s; currently, about 5% of the population is sampled, mainly by professional observers. A task force has been set up under the Wetlands International Goose Specialist Group in order to review the collection of such productivity data. Large numbers of geese were ringed in Britain in the 1950s, but the current colour-ringing programmes were initiated in 1987 (pinkfeet) and 1992 (greylags). About 2376 pinkfeet and 1912 greylags have been ringed, mostly at very few locations, and at present the databases contain about 30,000 and 13,000 re-encounters, respectively. Amateur observers collect most resightings, and only basic information is generally recorded. Since the mid-1980s, some research has been carried out on e.g. feeding ecology, habitat choice and winter movements, mostly on pinkfeet.

Morten Frederiksen: Current monitoring and research of grey geese in Iceland. The colour-ringing programme 1996-2000 has resulted in ringing of 3245 pinkfeet and 1274 greylags. Resighting activity in Iceland has been low. Some counts of breeding and moulting pinkfeet have been carried out, as have spring counts and local breeding counts of greylags. However, no comprehensive surveys exist for either species. Brood size data have been collected at ringing and in late summer/autumn in recent years. Survival analyses based on the colour-ringing data set and subsequent population modelling are in progress.

Richard Hearn: The population status of Icelandic-breeding grey geese. Both species increased at roughly the same rate until ca. 1980, when they numbered around 80,000. At this point the pinkfeet started to increase faster whereas the greylags peaked around 1990 at 100,000 and then started to decline (Figure 1). Current autumn population levels, based on the British censuses, are ca. 230,000 for pinkfeet and ca. 80,000 for greylags. A few thousand greylags are known to winter in Ireland. The distribution of greylags has shifted northward in recent years, with around 20,000 now in Orkney. At the same time, the number of pinkfeet wintering in England, particularly Norfolk, has increased. In Britain, the hunting season for both species extends from 1 September to 31 January.

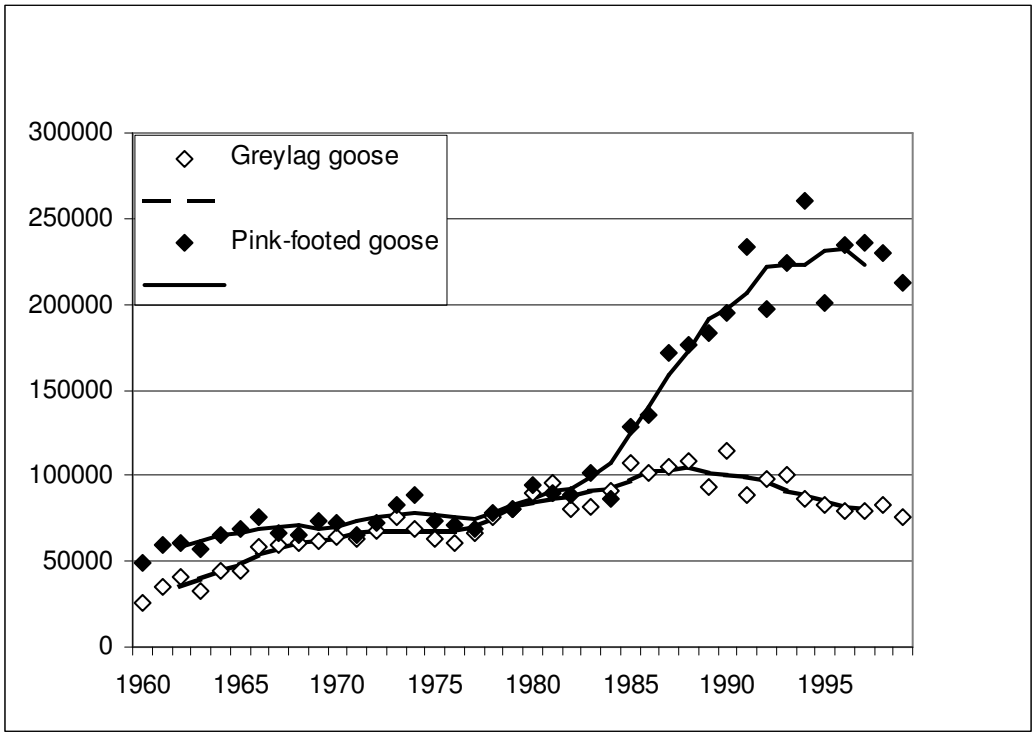

Figure 1. *Results of the WWT autumn goose surveys in Britain, with five-year running means.*

Tony Fox: Status of the Greenland white-fronted goose population. Following protection in Britain and Ireland in 1983, the population increased at 6.6%/year until 1991/92, to reach the present level of 32,000, since when, the numbers have been more or less stable. This stabilisation appears linked to a long-term decline in measures of productivity in the population, since survival appears constant over the period since 1983. Although whitefronts now make use of agricultural habitat, their winter distribution is still limited to areas which contained the traditional "patterned bog" wintering habitat. The increase in numbers has levelled off at one important wintering site (Wexford), but continued to increase at another (Islay). Marked birds staging at Hvanneyri primarily winter at Wexford and are therefore most likely to breed in the northern part of west Greenland. Crude annual survival was highly negatively correlated with hunting bag at Wexford, suggesting an additive effect of hunting mortality. The mean age of first breeding (based on observations of birds returning with at least one young to the wintering areas) increased during the 1990s compared to the 1980s. This, together with a long-term decline in the proportion of known cohorts surviving to breed at all, suggest restrictions on recruitment to the breeding population is the likely mechanism causing the population to stabilise.

Arnór Sigfússon: Goose hunting in Iceland. The season for pinkfoot and greylag hunting goes from 20 August to 15 March. A compulsory bag reporting system was established in 1995; hunters are required to report their bag (anonymously) to the Wildlife Management Institute when renewing their annual license. The number of active goose hunters has been stable at ca. 3500. The number of geese shot has also been relatively stable: mean 37,000 greylags (35,000 – 41,000) and 13,000 pinkfeet (10,000 – 15,000) (Figure 2). The proportion of juveniles in the bag has been assessed by a wing survey by IINH; it has been quite stable at around 40% for greylags and more variable around 30% for pinkfeet. Although the mean is much higher, annual

fluctuations are parallel with the ones found in Britain. There is little direct evidence for the accuracy of the bag statistics; correct identification is unlikely to be a problem, but some over-reporting may occur because hunting in groups is common. Indirect evidence from other species (ptarmigan) indicates that the reported number shot is quite accurate. In 1998, more than half the greylag hunters shot only 1-5 geese, whereas 50-60% of the total bag was accounted for by the 15% of hunters shooting more than 20 geese. The maximum number of greylags reported by one hunter was more than 900.

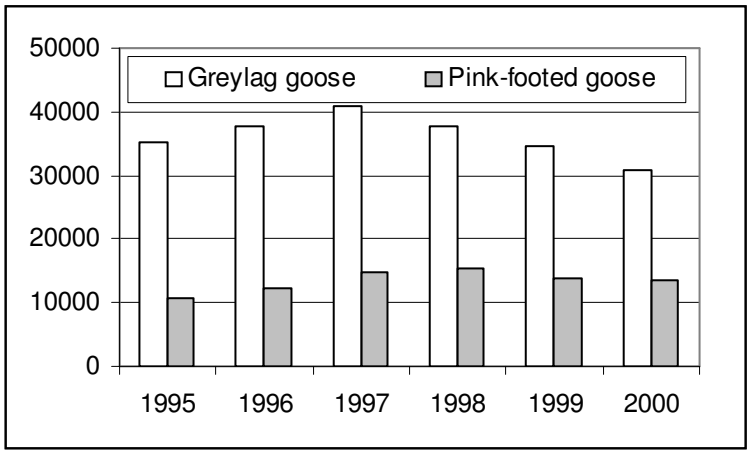

Figure 2. *Numbers of geese reported shot in Iceland. Numbers for 2000 are preliminary.*

Ian Bainbridge: Monitoring hunting mortality of geese in Scotland. The National Goose Forum, which reviewed activities relating to goose management in Scotland, stressed the need for information about the number of geese shot in Britain. About 75,000 persons hold shotgun licenses in Scotland alone, whereas BASC (British Association for Shooting and Conservation) has about 10,000 members in Scotland. No bag reporting system is in place, and there is no legislation which permits government to introduce a legal requirement for reporting. A pilot project for voluntary reporting, consisting of a sample survey of shotgun license holders (in collaboration with local police authorities) as well as of BASC members in Scotland, is being developed and tested during the ongoing (2001/02) hunting season by the Scottish Executive in collaboration with BASC (Nicola Reynolds). However, this system needs to be tested carefully for biases, and goose shooting by hunters from other parts of Britain as well as by foreign visitors must also be accounted for.

Morten Frederiksen: Survival of greylag and pink-footed geese. A study based on resightings and recoveries of colour-ringed birds. Traditional "crude survival rates" rely on accurate counts and age ratios and thus do not provide independent input to population modelling. Furthermore, individual annual estimates are unreliable. A combined approach, using both dead recoveries and live resightings, overcomes both these problems and several well-known concerns about capture-recapture survival estimates (loss of markers, emigration etc.). Because geese have been ringed at three times of the year, a detailed approach was used that estimates survival on a seasonal basis. Resightings during two-months periods in spring and autumn were used. Results (Figure 3) showed that pinkfoot goslings had lower survival from ringing until arrival in Britain than greylags (0.51 vs. 0.61), but otherwise pinkfeet survived better

than greylags (summer to autumn, adults: 0.94 vs. 0.84; autumn to spring, adults: 0.89 vs. 0.87; autumn to spring, juveniles: 0.78 vs. 0.74). Mortality from spring to summer was negligible. Mean annual survival of adults was 0.82 for pinkfeet and 0.72 for greylags; mean first-year survival (summer to summer) was 0.39 and 0.45, respectively, and mean juvenile survival (autumn to autumn) 0.72 and 0.62, respectively. For comparison, mean crude annual survival rate was 0.83 for pinkfeet and 0.80 for greylags. Year-to-year variation in survival was more pronounced for greylags than for pinkfeet. Resighting probabilities for neck-collared birds were around 50% in recent years. During periods when hunting was the main mortality factor, about 30% of all dead ringed geese were reported back to the ringing centres. Lower reporting probabilities of goslings of both species and of adult pinkfeet in Iceland indicated substantial non-hunting mortality. The annual rate of loss of colour rings was about 10% for pinkfeet and neck-collared greylags, whereas leg-ringed greylags showed negligible ring loss.

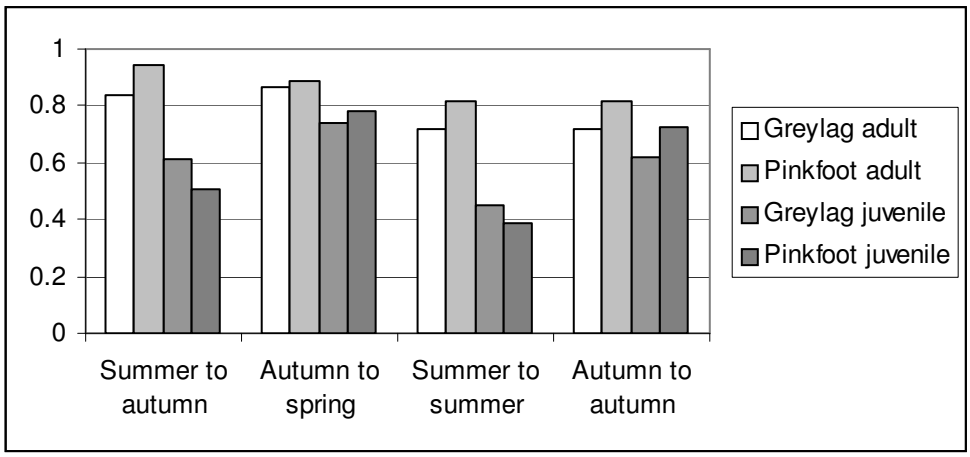

Figure 3. *Seasonal and annual survival of greylag and pink-footed geese.*

Richard Hearn: The productivity of Icelandic-breeding grey geese – what we know and what we don't. The proportion of juveniles, as recorded in Britain in autumn, has varied considerably over the years for both species, but has shown no consistent trend. Annual variation in the two species is highly correlated. Mean values 1970-2000 are 17% for pinkfeet and 18% for greylags. Mean brood size measured in Britain over the same period is 2.1 and 2.3, respectively. The few data from Iceland on greylag brood size suggest high annual variation, with mean values at least in some years considerably higher than in Britain.

Morten Frederiksen: What we don't know ... Gaps and weaknesses in our understanding of Icelandic goose population dynamics. The key missing data point is: how many pairs breed. This is related to the question of what proportion of the population breeds at various ages. The most direct estimates can be achieved if age ratios, brood sizes and total population size are known or reliably estimated. In the absence of such data, a matrix population model can provide some predictions if the population is assumed to be constant. For instance, assuming that survival and brood size at fledging are known, it can be estimated that 40% of three-year-old greylags and 75% of older birds must breed successfully each year to keep the population constant. In general, if the pre-breeding population of greylags is 130,000, 22,000 pairs must breed successfully. For pinkfeet, the corresponding numbers are 200,000

and 32,000 pairs. The proportion of yearlings at the start of the breeding season can also be predicted: 27% for greylags and 18% for pinkfeet. However, it is important that these predictions are checked against field data, specifically age ratios.

Andy Douse: The use of population models in the management of wintering grey goose populations, especially the Icelandic greylag goose. In recent years, a series of population viability analyses (PVAs) have been carried out on behalf of Scottish Natural Heritage (SNH). These modelling efforts were motivated by the considerable conflicts between geese and agriculture in Scotland. In the case of Icelandic greylags, crude survival and productivity were estimated from annual counts and age ratios. Means and standard deviations were calculated, and after suitable transformation, random values were drawn from these distributions. These values were then used as input for 1000 runs of a stochastic two-age-class matrix model, which predicted population growth over the next 25 years. The mean predicted growth rate of the greylag population was ca. 1% per year, with rather wide confidence limits. If density-dependence was included in the model, the population stabilised slightly above the present level, with much narrower confidence limits. Sensitivity analyses showed that lowering the mean annual mortality by ca. 5% could practically eliminate the risk of serious declines in population size, and equivalently that small increases in mortality would strongly increase the risk of such declines. It is important that the predictions of the model are viewed with caution, since mean population parameters may not remain constant in the future.

Morten Frederiksen: How many greylags? Conflicting evidence. If both autumn censuses, bag statistics in Iceland and their associated age ratios were correct, the greylag population should decline very rapidly (ca. 22,000 adults shot in Iceland, ca. 13,000 juveniles alive in UK in autumn to replace them), even without considering the hunt in Scotland. Including the third source of evidence, survival estimates, is not sufficient to solve the quandary.

a) If the autumn census is correct, there is only "room" for a hunting bag in Iceland of max. 27,000, of which most should be juveniles (max. 10,800 adults or half the estimated number).

b) On the other hand, if the bag statistics are correct, the autumn population size should be 158,000 or twice the observed number.

In any case, the population can only be in balance if the proportion of juveniles in autumn is about twice as high as observed (ca. 31-34%); such a high proportion of juveniles could also explain the discrepancy between crude survival rates and capture-recapture survival estimates in greylags. The bag size in Scotland can be estimated from the ration of shot recoveries in the two countries as ca. 26,000; this is consistent with the total over-winter mortality estimated in b) above. These simple modelling exercises clearly call for a review of all data collection procedures, particularly the autumn count.

Morten Frederiksen: How are the greylags doing? Evidence from Iceland. Very few Icelandic data are available on what trend the greylag population is following. Counts of breeding pairs in three areas and of spring-staging birds in two areas mostly show stable or increasing populations, although declines are known from anecdotal evidence in other areas.

2.2 Brief summary of discussion

Brief discussions followed each presentation, and several hours were spent on a longer discussion of general issues on Saturday and Sunday. The subjects that attracted most attention were the reliability of the data at hand, and how to improve their quality. Participants agreed that the most important concerns involved the greylag population, both because the existing data are incompatible with regard to the present population size and composition, and because the best available data show that it has been declining in recent years. No obvious solutions to where the apparently missing geese can be were arrived at; it is thought that all areas holding large numbers of greylags are covered by the existing surveys. Ways were therefore sought to improve data collection with regard to how many greylags there are and how large a proportion of these are juveniles. As a first measure, the existing November counts in Britain should be extended to cover the entire range, i.e. Ireland, Norway, the Faeroe Islands and Iceland.

An important issue here was what is the optimal time of the year to collect this information, and where it best can be collected. One of the concerns about the age ratio data collected in Britain is that by October/November, greylag juveniles are difficult to distinguish from adults. Furthermore, the *ad hoc* manner in which these data have been collected can easily lead to biases associated with flock size, habitat and phenology. It was suggested that the best way to address these problems would be to set up a stratified sampling survey, in which randomly selected study plots are thoroughly searched for all geese present. In order to collect the best information on age composition of the population, such a survey should be carried out in Iceland in mid August, just before the start of the hunting season. A similar survey in Britain later in autumn could be used as a check on the existing goose counts and provide an independent estimate of population size for both species. In both countries, knowledge of land cover and goose habitat use, as well as expert statistical advice, would be needed to set up the survey. A lively discussion of the practical aspects of such a survey followed.

Regarding ringing, participants agreed that this should viewed as a monitoring activity and should therefore be resumed and/or continued indefinitely. It was debated whether ringing only in Britain might give more “value for money”, but the consensus was that ringing in Iceland wouldn’t be very costly at the level envisaged, and that it could contribute information relevant to estimating effects of hunting that could not be achieved by ringing only in Britain.

Participants also debated whether the Icelandic hunting bag statistics could be biased in such a way that the reported number of geese shot was higher than the actual number. The possibility of such a bias was acknowledged, because it is thought that groups of hunters sometimes all report the total number of geese shot during a hunting trip; however, it was considered unlikely that such a bias would be important. Several participants expressed regret that a similar bag reporting system doesn’t exist in Britain.

At the end of the discussion, the workshop participants agreed on a set of recommendations for future monitoring, research and management of the shared goose populations (see Chapter 3).

3 RECOMMENDATIONS

The Icelandic-British workshop on grey geese met at Hvanneyri Agricultural University in Iceland from 28-30 September 2001. It was attended by specialists from Iceland, Britain, Canada, Ireland and Denmark and reviewed current knowledge of the populations and monitoring of the Icelandic population of greylag geese, the Iceland/Greenland population of pink-footed geese, and noted the results of long-term monitoring of Greenland white-fronted geese.

Workshop participants focused on the effectiveness of current research and monitoring activity to provide essential data and information for the conservation management of greylag and pink-footed geese. They strongly stressed the essential need to maintain current activity at existing levels. Many desirable enhancements to current activity were noted and these are listed below.

Participants strongly thanked the Icelandic Institute of Natural History for organising the workshop, Hvanneyri Agricultural University for providing the outstanding venue and the Icelandic Ministry of the Environment for hosting the workshop reception.

3.1 Counts & surveys

1. The seasonal timing of population estimation is critical; it should be undertaken at a time when the most accurate estimate (i.e. the smallest confidence intervals and minimal bias) can be made. If both considerations cannot be met at the same time, minimising bias is the most important factor to consider.
2. The Wildfowl and Wetlands Trust (WWT) should maintain current monitoring activities and develop regular international co-ordination of the UK autumn census with annual inputs from Norway, Iceland, Faeroes and Ireland.
3. WWT, Joint Nature Conservation Committee (JNCC) and others should plan for and undertake a survey of stratified sample squares in UK (particularly for greylag geese) with the aim of generating a comprehensive autumn total which includes numbers on small wetlands, not regularly included in current census.
4. WWT, Scottish Natural Heritage (SNH) and others should pursue a range of minor improvements to counting procedures, which could enhance regular UK autumn census coverage.
5. The Icelandic Institute of Natural History (IINH) should design a stratified sample survey of greylag geese in Iceland during August, initially to assess resource requirements of such a survey. A survey close to the onset of the hunting season would be useful. This could be supplemented by additional survey of moulting non-breeders earlier in the summer.
6. A comprehensive pre-breeding census of greylag geese in Iceland would be valuable and might be considered, but has a wide range of, possibly intractable, methodological problems.
7. It is essential that comprehensive surveys in Iceland and UK are co-ordinated (with any follow-up activity), i.e. that they occur in the same year.

3.2 Age ratios

1. The Wetlands International Goose Specialist Group Task Force should be encouraged to finalise and widely disseminate international common standards for productivity estimation of geese in the non-breeding season.
2. There is a need for both UK and Iceland to review the statistical basis of age ratio estimation for both species with respect to within-flock sampling, geographical sampling and seasonal timing and implement the recommendations. In particular, there is a need to better understand the relationship between age ratios in the field, in the hunting bag, and in the ringing catch samples.
3. There may be a need for greater formal geographical stratification of age ratio estimates throughout the present winter range. In particular, there is a need for greylag goose data from Orkney.
4. A stratified sampling procedure for assessing age ratios in Iceland in August should be developed and implemented, in conjunction with the sample count suggested under point I.5 above.
5. More detailed regular information on breeding success (numbers of pairs attempting to breed and brood size at or around fledging) would aid refinement of population models for both greylag and pink-footed geese. The logistic difficulties of collecting such data are significant, especially for pink-footed geese.
6. Collection of wing sample data from hunting bags in the UK would be desirable and collection of such data should be continued in Iceland.

3.3 Ringing

1. Ringing activity plays an important role in monitoring as well as providing research insights. It should be continued on this basis.
2. Population parameters change over time, and there is an important need for long-term commitment to collect relevant data on a continuing basis. The importance of long-term funding for such ringing (and other research) activity should be highly stressed with governments and other funding agencies.
3. A greater geographic spread of ringing activity within UK and possibly Iceland is desirable.
4. In using ringing for monitoring purposes, there is a need to review optimal numbers (and distribution) of different age classes of geese ringed and then seek to implement these targets in a regular programme that complements other methods of monitoring population dynamics.
5. Important insights into population dynamic processes can be gained from the collection of higher quality information from future resightings of marked geese. There is a need for dialogue with observers to encourage such better quality data collection (e.g. family relationships).
6. There is a specific need to collect data that will help assess the numbers of individuals recruiting into the breeding population and hence enable assessment of the effective population size of greylag geese. Collection of such data on the breeding grounds in Iceland should be encouraged
7. In order to aid the analysis of survival from resighting data, observers in UK should be encouraged to focus effort during specific periods. These are October and March for pink-footed goose and November and March for

greylag goose. However, it is important to maintain collection of observations outside of these periods for other purposes.

3.4 Bag statistics

1. Noting obligations under the African-Eurasian Waterbird Agreement to report harvest statistics for hunted waterbirds, and aware of the significant need for these data for the modelling of population processes, the workshop noted the value of the data collected in Iceland since the inception of the hunting bag legislation in 1995, and urged the UK government to investigate best statistical means to collect similar data.

3.5 Resources

1. Population monitoring through census, ringing and the annual assessment of mortality and productivity provides essential information for the sound management of goose populations, securely founded upon scientific principles. There are governmental responsibilities under international conventions to ensure the favourable conservation status of these shared migratory populations. Accordingly, governments and their agencies have responsibilities to provide the necessary resources so as to enable effective monitoring. Governments and their agencies in the UK and Iceland are urged to consider these recommendations so as to ensure provision of necessary resources.

3.6 Management issues

1. The population of Icelandic greylag geese is already subject to high shooting pressure throughout their migratory range. Best available data and information suggests a current population decline. In response, existing programmes enhanced through the recommendations outlined above will provide better data on this trend and its causes.
2. The workshop noted that in Scotland, government has recommended that there be no further increase in shooting mortality, and on a similar basis, the workshop urged that any increase in shooting pressure on greylag geese in Iceland should similarly be avoided. The situation should be reviewed again once research and monitoring clarifies the role of hunting mortality in determining current population trends.
3. For pink-footed geese, the rapid population increase of the 1980s and early 1990s appears to have ceased and numbers have now stabilized. In the context of this changing situation it is essential that existing monitoring activity be continued in order to provide necessary surveillance of status.

3.7 Future collaboration

1. Co-ordination and co-operation between Iceland and the UK on the conservation management of shared migratory goose populations should continue to be furthered, both at governmental levels as well as at a technical level. Workshop participants recommended a meeting at the technical level in

late 2002 in order to exchange information about new sampling schemes being set up in the two countries (see points I.3 and I.5 above).

2. The possible development of a flyway plan to consider conservation management of waterbird populations breeding and wintering within the Canada / Greenland / Iceland / UK / Ireland flyway was noted. There was support for investigation as to how international co-operation within this flyway can be taken forward. Such co-operation could and should occur both at governmental and at technical levels. The African-Eurasian Waterbird Agreement may help to assist such co-ordination.

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