Current research on Arctic Geese

A Symposium held at Voksenåsen, Oslo, 24–26 October 1983

We feel that the wider 'Wildfowl' readership would welcome information on this important Symposium, and therefore are reprinting here the abstracts of the 18 papers delivered, together with, in full, the Preface and the Summary and Conclusions. As these reveal, the Symposium was a most rewarding meeting both for the participants and as an example of international cooperation in research and conservation of geese.

The papers are available in full in the Proceedings of the Symposium, which have been published by the Norsk Polarinstitutt in their *Skrifter* series, or as reprints from the authors concerned.

The full title of the Proceedings is:

Mehlum, F. & Ogilvie, M. A. (Eds.) 1984. Current research on Arctic Geese. *Norsk Polarinstitutt Skrifter* Nr. 181.

The Proceedings are obtainable (Price 130 Kr) through booksellers, or from the accredited agents: Universitetsforlag, Boks 2977, Tøyen, Oslo 6, Norway; Oxford University Press, Walton St., Oxford, OX2 6DP, U.K.; Columbia University Press, 136 South Broadway, Irvington-on-Hudson, New York 10533, U.S.A.

Preface

FRIDTJOF MEHLUM

In 1596 two Dutch ships sailed into the Barents Sea in an attempt to find the northern route to China. Because of difficult sea-ice conditions the Dutchmen chose to sail north of Novaja Zemlja, but they failed in navigation and reached Svalbard. They went ashore on the north-western coast of Spitsbergen on 21 June. The earliest records of birds in Svalbard originated from this visit. The first bird species they saw was a Brent Goose breeding on a small islet.

The conspicuous arctic geese are still an important part of the bird fauna of Svalbard. Three species breed there, the Pink-footed Goose *Anser brachyrhynchus*, the Barnacle Goose *Branta leucopsis*, and the light-bellied subspecies of the Brent Goose *Branta bernicla hrota*. Today the Pink-footed Goose is the most numerous and the Brent Goose the least abundant species, but this may not always have been the case. Historical data indicate that the Brent Goose may have been the most abundant species in earlier times.

Management of the Svalbard goose populations is an international task, since the birds visit several north-western European countries during their yearly cycle. It is therefore necessary to focus not only on the situation at the breeding grounds, but also on the migration staging areas and the winter quarters.

The Svalbard geese have been studied by scientists from several countries. Since these goose populations seem to gather in small, discrete staging and wintering areas, they are well suited for population dynamics studies. In this respect the comprehensive individual ringing programme conducted on the Svalbard Barnacle Goose, by the Wildfowl Trust and others, is an excellent example.

Norsk Polarinstitutt is responsible for Norwegian research concerning the management of the wildlife in Svalbard. For management of the Svalbard geese it is essential to have a close cooperation between the research groups and the authorities in the countries visited by the birds during this year. The main purpose of the Arctic Geese symposium in Oslo, 24–26 October 1983, was to consolidate existing knowledge of the biology and population status of the Svalbard geese in order to give

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priority to future investigations for the best possible management of the populations. We therefore invited goose researchers from Denmark, Great Britain, the Federal Republic of Germany, the Netherlands and Norway to present the results of their studies and discuss the need for future work.

In order to compile the present knowledge of the Svalbard geese and to make it more widely available it was decided to publish the presented papers in the *Norsk Polarinstitutt Skrifter* series. We hope that the Symposium and the proceedings will encourage more research on these arctic goose populations.

The Svalbard geese: an introductory review of research and conservation

MAGNAR NORDERHAUG

This introductory paper summarizes the history of geese research in Svalbard. The present conservation status for the three Svalbard geese species in territories used during various stages of their life cycles are given in an Annex.
Nor. Polarinst. Skr. 181: 7–10.
Magnar Norderhaug. Ministry of the Environment, Oslo-Dep., Norway.

Changes in winter distribution and population size of Pink-footed Geese breeding in Svalbard

BARWOLT S. EBBINGE, HENK T. van der MEULEN and JOHAN J. SMIT

Ringing of the Svalbard population of the Pink-footed Goose in its Netherlands wintering grounds has provided 204 recoveries of dead birds. These show changes in winter distribution since the 1950s, with many fewer in Germany than formerly. The population has increased considerably in recent years, but more birds are counted in Denmark in autumn and spring than in the entire winter range in mid-winter. Possible causes of the increase include spring feeding to prevent agricultural damage, cessation of spring shooting in Svalbard, and full protection in the Netherlands. Ringing recoveries reveal a slight interchange with the Iceland-British population of Pinkfeet, but no net immigration or emigration. Recruitment has not changed significantly in the period of study, but mortality has fallen.
Nor. Polarinst. Skr. 181: 11–17.
Barwolt S. Ebbinge, Henk T. van der Meulen and Johan J. Smit, Research Institute for Nature Management, P.O. Box 46, 3956 ZR Leersum, Netherlands.

Numbers, distribution, and habitat utilization of Pink-footed Geese in Denmark 1980–1983

JESPER MADSEN

Data of population size, breeding success, distribution and habitat utilization of the Svalbard population of Pink-footed Geese wintering and staging in Denmark during the years 1980 to 1983 are presented. Since the peak count of 28,500 individuals in autumn 1979 the population has apparently stabilized around 25–27,000 individuals, but problems in

estimating the annual population level and breeding success exist. The Pink-footed Geese make use of 14 sites in seasonal succession with a close connection to habitat selection. In autumn feeding on stubble predominates, in winter and early spring most feeding takes place on pastures, and in spring most geese feed on new-sown cereal fields. The shift from grassland to new-sown fields has accelerated during the last decades, and conflicts with agriculture will probably increase in the near future. The possible reasons for the population increase since the 1950s are discussed.
Nor. Polarinst. Skr. 181: 19–23.
Jesper Madsen, Institut for Zoologi og Zoofysiologi, Zoologisk Laboratorium, Universitetsparken, B 10 3, DK-8000 Aarhus C, Denmark.

The wintering sites of Svalbard Pink-footed Geese in Germany – present situation

PETER PROKOSCH

Short histories of the former important Pink-footed Goose haunts in Germany are given: Emsland (max. figures 2000–3000), Föhr (8000–1000), Jadebusen (10,000), and Rodenäs-Vorland (12,000). After the reclamation of Rodenäs–Vorland (1981–82), the geese have given up the last important site in Germany. Today less than 1000 Pink-footed Geese stay in Germany at any time in winter.
Nor. Polarinst. Skr. 181: 25–28.
Peter Prokosch, WWF – Wattenmeerstelle Schleswig-Holstein, Olshausenstraße 40–60, D-2300 Kiel, Federal Republic of Germany.

The status of the Pink-footed Goose in Southwest Friesland (the Netherlands) and the movements over western Europe.

LEO J. SCHILPEROORD

From autumn 1979 to spring 1983 regular counts were made of the Pink-footed Geese wintering in Southwest Friesland. Compared with the period before 1976 some local shifts in the distribution were noted and described. In the four seasons considered here most geese arrived in Friesland by the end of October or the beginning of November, except in 1982 when they arrived about two weeks earlier. The autumn maximum was reached during the first half of November and the numbers remained almost constant until December, when several thousands of Pinkfeet flew southwards to Belgium. The migration back to northerly feeding grouds started as early as January and it seems to be normal that nearly all geese have left Friesland after the first week of February. However, in three of the four seasons they returned under the influence of frost and snow in the second half of February. They moved northward for the second time in late February or early March. Southwest Friesland held 23% to 28% of the total number of Pink-footed Goose-days spent in Western Europe in 1980–81 to 1982–83. From the information of the occurrence in Denmark, Friesland and Belgium it appears that during the whole winter period considerable numbers of Pinkfeet must be in unknown places. The missing numbers are much higher than those found in Germany.
Nor. Polarinst. Skr. 181: 29–36.
Leo J. Schilperoord, Department of Zoology, State University at Groningen, P.O. Box 14, 9750 AA Haren, The Netherlands.

Dynamics and age structure of an increasing goose population – the Svalbard Barnacle Goose

MYRFYN OWEN

This paper describes the dynamics of the Svalbard-Solway population of Barnacle Geese from 1970 to 1983 and examines influences on mortality and breeding performance which explain the observed changes in numbers. Despite a period of stability in the 1960s, the population grew steadily from just over 3000 in 1970 to 8000–9000 in the 1980s. The increase was due to a lowering of the mortality rate rather than better breeding. It was concluded that this decrease in death rate was enabled by the extension of a winter refuge which made geese less accessible to illegal shooting. Mortality rate of adults varied from 8.7% to 13.7% annually. Juveniles had a higher mortality rate only in some years. Birds in their second year of life had consistently lower mortality rates than older birds. The recruitment rate, expressed as the proportion of mature geese that bred, fell as the population grew, from 40–50% at 2–3000 potential breeders, to 10–20% at 6–7000. Young geese bred significantly less well than adults and the difference did not disappear until the birds were in their 6th year of life. At present population levels breeding success was limited by factors operating on the breeding grounds. The low birth rate and death rate led to an increasing surplus of unproductive mature geese and in increase in the average age, from 2.5 years in 1972 to 5.9 years in 1983. The density-dependent depression of recruitment rate would set a limit on future population growth. Given average weather conditions and continued low mortality the population is likely to stabilise at about 12,000 birds.
Nor. Polarinst. Skr. 181: 37–47.
Myrfy Owen, Wildfowl Trust, Slimbridge, Gloucester GL2 7BT, United Kingdom.

Some results from the ringing of Barnacle Geese in Svalbard and Britain

MALCOLM A. OGILVIE and MYRFYN OWEN

A total of 4,522 different Barnacle Geese of the Svalbard breeding population has been ringed since 1954, and another 1,732 recaptured. Details are given of the number and location of all the different catches. Nearly all the birds have been rounded up while flightless on the breeding grounds, or caught with rocket nets on the wintering grounds. Brief details are give of the different types of rings put on the geese. The use of individually coded plastic rings has brought great advances in the study of this population. Losses of these rings are shown to be negligible. The majority of the recoveries of dead birds have come from within the known range of the population. Those from outside the range are probably mostly drifted or over-shooting migrants. Shooting is the single major cause of death, and this still continues despite total protection throughout the range. Mortality calculations based on the recoveries suggest a higher mortality in the 1960s than since, fitting with estimates from counts and sightings of individually ringed birds.
Nor. Polarinst. Skr. 181: 49–55.
Malcolm A. Ogilvie and Myrfyn Owen, Wildfowl Trust, Slimbridge, Gloucester GL2 7BT, United Kingdom.

Numbers and distribution of Barnacle Geese on Norwegian staging islands and the importance of the staging area to the Svalbard population

NILS GULLESTAD, MYRFYN OWEN and M. J. NUGENT

Barnacle Geese breeding in Svalbard and wintering in northern Britain perform a non-stop migration in late April and early May to a staging area in Helgeland (65° 40′ N, 11° 40′ E), Norway. This paper describes the area and studies carried out between 1975 and 1982. Counts from the staging area, together with information from Britain, other parts of Norway, and from Svalbard, indicate that the whole of the Svalbard population can be found in Helgeland in the first half of May. Departure from the Solway depends on wind conditions but mass movements are usually between 20 April and 7 May. The length of the staging period is 2–3 weeks depending on arrival time in Helgeland. Departure from Helgeland during the years of study has been largely between 15 and 20 May. Individual geese are loyal to their staging archipelago and the majority of adults return to the same part of the area year after year. A decline in numbers of geese on Lånan-Flovaer in recent years, traditionally the most important archipelago for geese, has coincided with the absences of grazing animals and other changes in the forms of traditional management of the area. In considering the status and future management of the Helgeland archipelagos, it is stressed that

(a) the area is of vital importance to the Svalbard population,
(b) depopulation and cessation of stock grazing and traditional management practices is deleterious to the geese,
(c) steps should be take to give the main areas protection and to encourage the continuation or reintroduction of traditional management practices.

Nor. Polarinst. Skr. 181: 57–65.

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Myrfyn Owen and M. J. Nugent, Wildfowl Trust, Slimbridge, Gloucester GL2 7BT, United Kingdom.

Migration routes of Svalbard Barnacle Geese with a preliminary report on the importance of the Bjørnøya staging area

MYRFYN OWEN and NILS GULLESTAD

The paper describes the migration route of Barnacle Geese between their Svalbard breeding area and their wintering grounds on the Solway Firth in northern Britain, established from observations of migrating birds and from the sighting and recovery of ringed individuals. The geese keep to well defined routes which differ slightly in autumn and spring. Lateral drifting causes a scatter of observations in Britain in autumn, but most displaced birds eventually reach the wintering grounds. Movements occur over a very narrow time span, especially in spring. Mass movements both in autumn and spring are almost always on strong following winds and periods without such conditions can cause delays in migration. Preliminary observations from the newly-discovered autumn staging area Bjørnøya are presented. The geese travel non-stop from there, taking 36–48 hours for the journey. The area of suitable vegetation for geese is small but provides a vital extension to the pre-migratory fattening period, especially in years of early snowfall in the Spitsbergen breeding and staging areas.

Nor. Polarinst. Skr. 181: 67–77.

Myrfyn Owen, Wildfowl Trust, Slimbridge, Gloucester GL2 7BT, United Kingdom.
Nils Gullestad, Nordland Regional College, P.O. Box 309, 8001 Bodφ, Norway.

Importance of the family unit to Barnacle Goose offspring – a progress report

JEFFREY M. BLACK and MYRFYN OWEN

The families of geese and swans are maintained throughout winter and it has long been supposed that being in a family confers advantages to the young. This study investigates those advantages and examines ways in which family membership might enhance juvenile survival. The performance in encounters and daily activities of juvenile Barnacle Geese within different sized families and of orphaned juveniles were recorded on the wintering grounds. Family juveniles were dominant over single goslings and fed and rested for longer uninterrupted periods while their vigilance burden and aggressive activities increased. Because of the dominance of large families within the flock, their goslings were probably offered better feeding conditions than other goslings. Orphaned young attempted to join large families but were repelled. The fact that parents did not increase their family size by adopting stray juveniles may mean that the optimum brood size as far as winter performance is concerned is not the largest.
Nor. Polarinst. Skr. 181: 79–85.
Jeffrey M. Black and Myrfyn Owen, Wildfowl Trust, Slimbridge, Gloucester GL2 7BT, United Kingdom.

Reproductive success of the Barnacle Goose in relation to food exploitation on the breeding grounds, western Spitsbergen

J. PROP, M.R. van EERDEN and R. H. DRENT

Reproductive success was determined for a colony of the Barnacle Goose on the west coast of Spitsbergen during four consecutive years (1978–81), following upon an expedition (1977) when the majority of the local population were caught and provided with leg rings with individual code inscriptions. Telescope observation revealed 120 pairs (where one or both of the parents were recognizable from afar) associated with the colony, and these pairs were followed through until arrival at the wintering grounds in Scotland. Nest-site selection was found to influence success, both the substrate (food around the nest minimizes absence of the gander) and location (potential information interchange regarding feeding opportunities on the tundra) being implicated. Nesting birds travelled up to 4 km from the colony to feed on the adjacent tundra, but most visits were restricted to within 1 km where mosses and monocots (50% of the diet as revealed by droppings analysis) as well as herbs and horsetails were gathered. On a 4-ha intensive study plot on the foraging grounds a 25 × 25 m grid was staked out and individual search paths mapped in relation to the snow cover (the birds tending to follow the retreating snow carpet). Utilization of plants was quantified by sampling subplots and taking photographic close-ups of the vegetation before and after goose visitation. Depending on site and plant species, 40–90% of food items were cropped, and even a single visit exerted a measurable impact on the food supply. *Salix* buds formed the main food source on the plot, and a plateau of exploitation for the season was already reached after 10–20 seconds of feeding time per m^2 had accumulated, a combined effect of depletion by removal and by plant phenology (opening of the buds after which they are no longer taken). Individuals differed in the intake rates achieved, and birds falling below the median for that date invariably failed to complete incubation. Time-budget studies from a tower overlooking the colony showed that individual females with extended foraging bouts were most liable to fail, and it is argued that these birds were attempting to cope with a lowered state of body reserves, a low intake rate, or a combination of both. Birds from the colony moult on adjoining tundra lake systems, where a mossy vegetation (the protruding

Dupontia and *Carex* being important foods) reaches capacity at about 100 geese/10 ha. Individual families families differ in foraging opportunities at this stage, and the rate of recruitment of goslings to the winter flock in Scotland can be related to feeding condition experienced during the moult. Overall, date of snowmelt is a reliable predictor of gosling production. Late years are characterized by a higher level of non-breeding (one quarter of the parents failing to lay, as opposed to only ten percent in early years) and by a high failure rate during incubation (80% versus 30% in early seasons). Immediate posthatch losses on the island (due to gull predation) are heavy in late seasons, but no effects of season on gosling survival during the tundra stage could be detected. About half of the goslings hatched reached the winter quarters.

Nor. Polarinst. Skr. 181: 87–117.

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M. R. van Eerden, Rijksdienst voor de IJsselmeerpolders, Smedinghuis, 8200 AP Lelystad, Netherlands.

Status of the Svalbard population of Light-bellied Brent Geese wintering in Denmark 1980-1983

JESPER MADSEN

The present knowledge of the size of the Svalbard population of Light-bellied Brent Geese is summarized together with a description of the migration pattern and habitat utilization in its Danish wintering grounds. During the period 1970 to 1980–83 the population has increased from 1600–2000 to 3500–4000 individuals. The population has five regular haunts in Denmark and one in England. The size of the wintering population in Lindisfarne, England, is negatively correlated to winter temperatures in Denmark. The Brents have a narrow feeding habitat spectrum ranging from shallow waters/mud flats to salt marshes, and to a lesser degree pastures. A shift from shallow waters to saltings takes place in spring.

Nor. Polarinst. Skr. 181: 119–24.

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The occurrence of Light-bellied Brent in Brent Goose flocks in the German Wattenmeer

PETER PROKOSCH

The German Wattenmeer holds about 100,000 Brent Geese (autumn and spring). They belong almost totally to the Siberian population of the Dark-bellied Brent. Only negligible numbers of Light-bellied Brent Geese, which may belong to the Svalbard population, are present every year. During systematic checks of 145 flocks, including 275,000 individuals, only 79 Light-bellied Brent were found (1975–1983). The figures indicate an annual spring occurrence of some 30 of this race on the German North Sea coast.

Nor. Polarinst. Skr. 181: 125–7.

Peter Prokosch, WWF – Wattenmeerstelle Schleswig-Holstein, Olshausenstrasse 40–60, D-2300 Kiel, Federal Republic of Germany.

Status of the goose populations in the bird sanctuaries in Svalbard

PÅL PRESTRUD and ASBJORN BORSET

Between 1300 and 1600 pairs of Barnacle Geese were breeding in the sanctuaries in 1982. This is about 70% of the Barnacle population that attempts breeding each year in Svalbard. There has been a marked increase in the breeding Barnacle Goose population since the last counts in the 1960s. The Barnacle population will probably be limited by available breeding habitats, if it does not start breeding in steep cliffs in the inland or along the coast, as it did earlier. The Barnacle and the Eider seem to compete for good breeding habitats. The breeding Brent population in the sanctuaries has remained low and nearly constant since the last counts took place in the 1960's. In accordance with earlier observations the breeding Pink-footed Goose population in the sanctuaries is small.
Nor. Polarinst. Skr. 181: 129–33.
Pål Prestrud, The Governor's office, 9170 Longyearbyen, Norway.
Asbjorn Børset, Fylkesmannen, Julsundv, 1B, 6400 Molde, Norway.

Breeding sites and distribution of geese in the northwest Isfjord area, Svalbard, 1982

PETER PROKOSCH

In June/July 1982 the total number of geese in the lowlands of Daudmannsøyra, Alkhornet, Vermlandryggen, Erdmannflya, and Bohemanflya was surveyed. 690 Pink-footed Geese (including 221 breeding pairs), 640 Barnacle Geese (including 262 breeding pairs), and 13 Brent Geese (no breeding pairs) were found. These figures of a formerly poorly investigated area represent significant proportions of the Svalbard goose populations.
Nor. Polarinst. Skr. 181: 135–9.
Peter Prokosch, WWF-Wattenmeerstelle Schleswig-Holstein, Olshausenstraße 40–60, D-2300 Kiel, Federal Republic of Germany.

Study of the possible impact of oil exploration on goose populations in Jameson Land, East Greenland: a progress report

JESPER MADSEN

An extensive oil exploration in Jameson Land, East Greenland, is under preparation, and the Ministry of Greenland has brought about an environmental research programme in order to map and determine biological interests. Goose studies have been carried out since 1982. Aerial surveys and ground counts have revealed that up to 11,800 geese stay the summer and moult in the area (5600 Pink-footed Geese and 6200 Barnacle Geese). This report presents the approach to the goose studies and gives some preliminary results on behavioural and ecological investigations. A map of sensitive areas for moulting geese, where oil exploration should be avoided, is presented.
Nor. Polarinst. Skr. 181: 141–51.
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Protection and management of arctic goose populations in Denmark

PALLE UHD JEPSEN

This report deals with the protection of the populations of Pink-footed Goose and Light-bellied Brent Goose in Danish haunts in relation to damage to field crops caused by Pink-footed Goose, shooting, nature conservation, and establishment of reserves for geese. It is suggested that the arctic goose populations which during migration and the winter stay in haunts in north-west Europe should be managed in such a way that the mortality factors which may contribute to the fact that the populations cannot achieve a high survival rate are reduced to a minimum. These factors are primarily shooting, disturbances in the haunts, and reduced food resources.
Nor. Polarinst. Skr. 181: 153–60.
Palle Uhd Jepsen, Wildlife Administration of the Ministry of Agriculture, Wildlife Reserve Bureau, Strandvejen 4, DK-8410 Rønde, Denmark.

Captive breeding and reintroduction of northern geese

MAGNAR NORDERHAUG

Experience from two different reintroduction programmes related to the Svalbard population of the Light-bellied Brent Goose and the Fennoscandian population of the Lesser White-fronted Goose is summarized. The Light-bellied Brent Goose project was a pilot study conducted in 1974 to investigate possibilities for captive breeding and reintroduction in Svalbard to prevent further population decline. The project on the Lesser White-fronted Goose was initiated in Sweden in 1979. Reintroduction started in 1981 with the release of 14–37 young birds per year in Lappland 1981–1983. Manipulation with the traditional migratory route is a part of this conservation programme. Details are further described.
Nor. Polarinst. Skr. 181: 161–4.
Magnar Norderhaug, Norwegian Ministry of the Environment, Oslo 1, Norway.

Summary and conclusions at Arctic Geese Symposium in Oslo, Norway, 24–26 October 1983

MALCOLM A. OGILVIE

Nor. Polarinst. Skr. 181: 165–8.
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The Symposium has clearly demonstrated the great value of international cooperation in scientific research. The work carried out on the three species of geese breeding in Svalbard has involved ever closer links between biologists in different countries. It has also highlighted the need for international cooperation in conservation and management. While the three populations of geese currently have at least a reasonably satisfactory status and prospects, until very recently this has come about mainly through uncoordinated actions in the different countries which they visit, and not through concerted international action. The future well-being of all three will be best served by the greatest possible coordination of effort in conservation and management, as well as in research.

The most useful basic information for any understanding of one of the goose populations must be knowledge of their numbers and distribution. The potential for instability in arctic-breeding goose populations, with the relatively large natural influences on their annual breeding cycle coupled with the capability of man to make massive changes to their wintering grounds, demands that there must be regular (i.e. at least annual) monitoring of their population size, breeding success, and where possible, their use of the many different haunts throughout the range. With this regularly augmented store of information available it is possible to plan detailed research programmes, realistic conservation measures, and where necessary active management. Ideally all three of these should be as closely integrated as possible.

With the benefit of this collection of papers reviewing the current state of our knowledge of the three species of Svalbard geese, we can now briefly consider each species to see how closely the ideal monitoring is being achieved, what research is currently being undertaken, while highlighting gaps which need to be filled.

Pink-footed Goose
Anser brachyrhynchus

Whilst the status of this population is undoubtedly healthy, having shown substantial increases in recent years, it is nevertheless apparent that knowledge of the species' distribution through the year is very patchy. The population counts come from brief periods in autumn and spring when the birds are all gathered in Denmark. The Symposium papers have shown only too well how incomplete is our knowledge of the whereabouts of the birds at other times of the year. Mid-winter surveys are producing two-thirds or less of the known total. The very full cooperation between workers in the recognised winter range is so far failing to locate all the birds, with a consequent loss in ability to provide any needed protection or management. The recent increase in numbers does, however, suggest that the present level of hunting throughout the range is not excessive. Indeed a drop in mortality is one of the main reasons suggested for the population increase. On the other hand there are some wintering areas which are being under-used, or have lost their birds altogether, probably through excessive hunting and disturbance.

The species is very widespread in Svalbard and for this reason alone may not require any special conservation measures there. However, as important breeding and/or moulting areas are identified, their conservation status should be reviewed. There are no known important autumn staging areas between Svalbard and Denmark, but this probably requires further checking. Similarly, there is not yet a complete picture available for the vital spring staging areas, though recent work suggests that for some at least of the geese these lie in Denmark.

A recognition of the need for continued cooperative surveys on the winter numbers and, particularly, distribution of the Pinkfeet is one of the more obvious conclusions to be drawn from the Symposium. It is certainly planned that they should continue, while routine monitoring of breeding success, only started relatively recently, is an essential part of this work.

In common with many other goose populations wintering in western Europe, there has been a growing conflict between the Svalbard Pinkfeet and agricultural interests on the wintering grounds. This is presently confined to Denmark where the problem has been exacerbated by changes in farming practice. Measures to alleviate it have included baiting the birds away from vulnerable crops, but increasingly the need is to provide feeding reserves for the geese where natural food is readily available, or crops can be specially grown. This is particularly necessary in the critical spring period.

Turning to research, the Pinkfoot presents a considerable number of opportunities. The only ringing being undertaken is relatively small in scale and confined to standard metal rings. Detailed work has taken place in the last few years on feeding habitat utilisation in Denmark, but almost all other aspects of Pinkfoot biology and behaviour throughout the range await study. Research in Svalbard has not extended beyond some ringing in the 1950s, and a more recent small-scale project on breeding biology.

While the Svalbard Pink-footed Goose population is larger and more widespread than the Barnacle Goose stock, it would nevertheless seem to offer great scope for detailed research along some of the same lines and based on similar individual marking.

Barnacle Goose
Branta leucopsis

The sheer breadth of research that has developed in recent years on this population almost makes it easier to point out the gaps in knowledge, rather than review what has been discovered and what is in progress. Taking full advantage of the circumscribed winter range it is possible to obtain extremely accurate population counts and measurements of breeding success every autumn. The present quite healthy size of the population compares with its parlous state just thirty years ago. Protection is now total throughout its range, if not entirely effective at least in winter, though this came about through national actions in each country, rather than through coordinated international effort.

The distribution within Svalbard breeding grounds is comparatively well known, perhaps 80–90% of the breeding pairs being located. The majority are on existing bird sanctuaries, whose effectiveness is in process of being monitored. There seems little doubt as to their value, nor to their ever-present vulnerability to disturbance. It is hoped that summer surveys will be possible at regular intervals. Spring staging areas have been identified off the coast of Helgeland, North Norway. Here, although the birds are adequately protected, recent changes in human land management practices threaten the habitat and therefore the well-being of the geese. Proposals were put forward in the Symposium to rectify this potentially very serious situation. The last gap in annual travels of these geese, knowledge of the autumn staging area, is in the course of being filled, by the very recent work on Bjørnøya.

Protection throughout the year, and management of the wintering grounds to improve the food supply and reduce disturbance, have resulted in the considerable population growth of recent years. The predicted upper level has yet to be reached, but it is considered that the ultimate limitation on numbers will be set on the breeding grounds.

The detailed knowledge already gained on breeding biology and behaviour, factors affecting individual and population performance, and food, feeding and energy budgets through the year, coupled with the ability to maintain the level of individually marked birds at around 1 in 5 or even better, make this goose population one of the best studied in the world, as well as one with the highest potential for rewarding further study. The answers emanating from the research have not only provided direct benefit for these geese but also many results with wider applications.

Just two of the particular aspects now under investigation are the distribution of mortality through the annual cycle, including losses of young between hatching and arrival on the wintering grounds, and

possible losses of adults on migration, and the long-term breeding performance of individual birds and thus the importance of individual contributions to the population. This latter aspect is of wide interest as several European goose populations share with the Svalbard Barnacle Goose the common factor of an increasing segment of mature yet non-productive birds. To what extent the same birds remain productive or non-productive over a period of years, and if so why, are questions of considerable importance, the answers to which are more likely to come from this study than any other currently in progress.

Light-Bellied Brent Goose
Branta bernicla hrota

This population, one of the smallest clearly identifiable goose populations in the world, has very recently shown some welcome signs of increase. There is no cause for complacency, however, as both our state of knowledge and the conservation prospects for the goose are a long way from being satisfactory.

The population total can be assessed reasonably well each winter, though there are problems related to the mobility of the birds and the size of some of their haunts. Except in periods of very severe weather it is believed that all their regular major haunts are known and counted. Breeding success has only been routinely monitored in the last few years, but this must certainly be continued. It is capable of providing a useful additional check on the apparent completeness of the population counts. The Light-bellied Brent Goose is protected throughout its range, with the exception of those few that stray into Germany. It seems highly probable that the recent increase has come about through reduced mortality following the cessation of Brent shooting in Denmark in 1972. That action was principally aimed at benefiting the Dark-bellied Brent Goose *B.b. bernicla* and undoubtedly contributed to that population's dramatic increase. It is now vital that any change in the latter's protection status, and there is much lobbying by hunters in several north-west European countries to be allowed to shoot it again, should take very full account of the continued need for total protection for the Light-bellied Brent. Even with total protection there is evidence that the disturbance from shooting of other species is having an adverse effect on the geese, as are other kinds of disturbance, from fishing and boating, as well as degradation of saltings. There is a considerable need for more reserves for this population of geese in addition to better management of those that exist already.

The breeding distribution of the Light-bellied Brent Goose in Svalbard has changed quite markedly in recent decades, though to what extent this has been associated with the earlier population decline, and how if at all the increasing Barnacle Goose population has competed for nest sites, is unknown. Rather few pairs seem to breed on the established bird sanctuaries, though such other colonies as are known are mostly safeguarded by their very remoteness and inaccessibility. There is an obvious need for more summer surveys, to be used as a basis for effective conservation measures when these seem required.

The timing of arrival and departure from Denmark would seem to preclude the existence of any other spring or autumn staging areas, making the Danish haunts of even greater importance to the geese than if they were just wintering sites.

There is even less available knowledge of other aspects of the Light-bellied Brent Goose than there is of the Pinkfoot, though the need for information is certainly no less. Experience with other goose populations suggests that the spring feeding sites are of critical importance and it is perhaps here that any study should commence, particularly as it has been suggested that the carrying capacity of one of the two sites may have been reached, with the saltings being cultivated and so denied to the geese. Marking with individually coded rings would quite quickly provide much useful information on movements between haunts as well as answers to some of the many outstanding questions concerning this highly vulnerable population.

Conclusions

There is little doubt that taking just the raw population data, the last ten years have provided a considerable success story for the three populations of geese breeding in Svalbard, all of which have roughly doubled their numbers. These, and the earlier increases of particularly the Barnacle Goose, have at least partly come about through

deliberate acts of man seeking to benefit the geese, even if, as already mentioned, these acts were mostly carried out unilaterally in different countries, and not through some coordinated international plan. Examples of such acts include the establishment of a reserve for the Barnacle Geese on the Solway, and its subsequent expansion and management, and the setting up of the breeding bird sanctuaries in Svalbard. However the geese have also benefited from changes brought about by man in ways which could not, or at any rate were not, foreseen. For example the shooting of Brent Geese in Denmark was primarily halted to benefit the Dark-bellied Brent, but undoubtedly helped the Light-bellied Brent too. And the changes in farming practices on the wintering grounds of the Pinkfeet provided the geese with more and better feeding, though this process may have begun to be reversed. It has to be constantly borne in mind that some apparently quite unrelated event, perhaps the alteration of a particular farming subsidy, can have profound effects on the well-being of these, and other, goose populations.

From a purely conservation stand-point it is indeed fortunate that efforts to find oil or other new minerals in Svalbard have so far proved unsuccessful, or at any rate uneconomic. The Symposium was very usefully able to look beyond Svalbard to East Greenland where a major oil exploration programme is about to begin. It was particularly welcome to learn of detailed environmental impact assessments being carried out before such a programme actually gets under way, a procedure that ought to be, but too often is not, followed universally. The detailed studies being done on the likely impact on the Pink-footed and Barnacle Goose populations of the area were of direct relevance to the main subject matter of the Symposium, as well as further afield.

The Arctic Goose Symposium in Oslo was not just a meeting at which these published papers were read and discussed. It was also, for the participants, a most stimulating three days of new and renewed contacts, which constantly served to emphasise the value of a cooperative approach to research and conservation. Our hope is that this will indeed be the main way forward as we seek to uncover the facts that will enable us properly to understand and conserve Svalbard's geese.