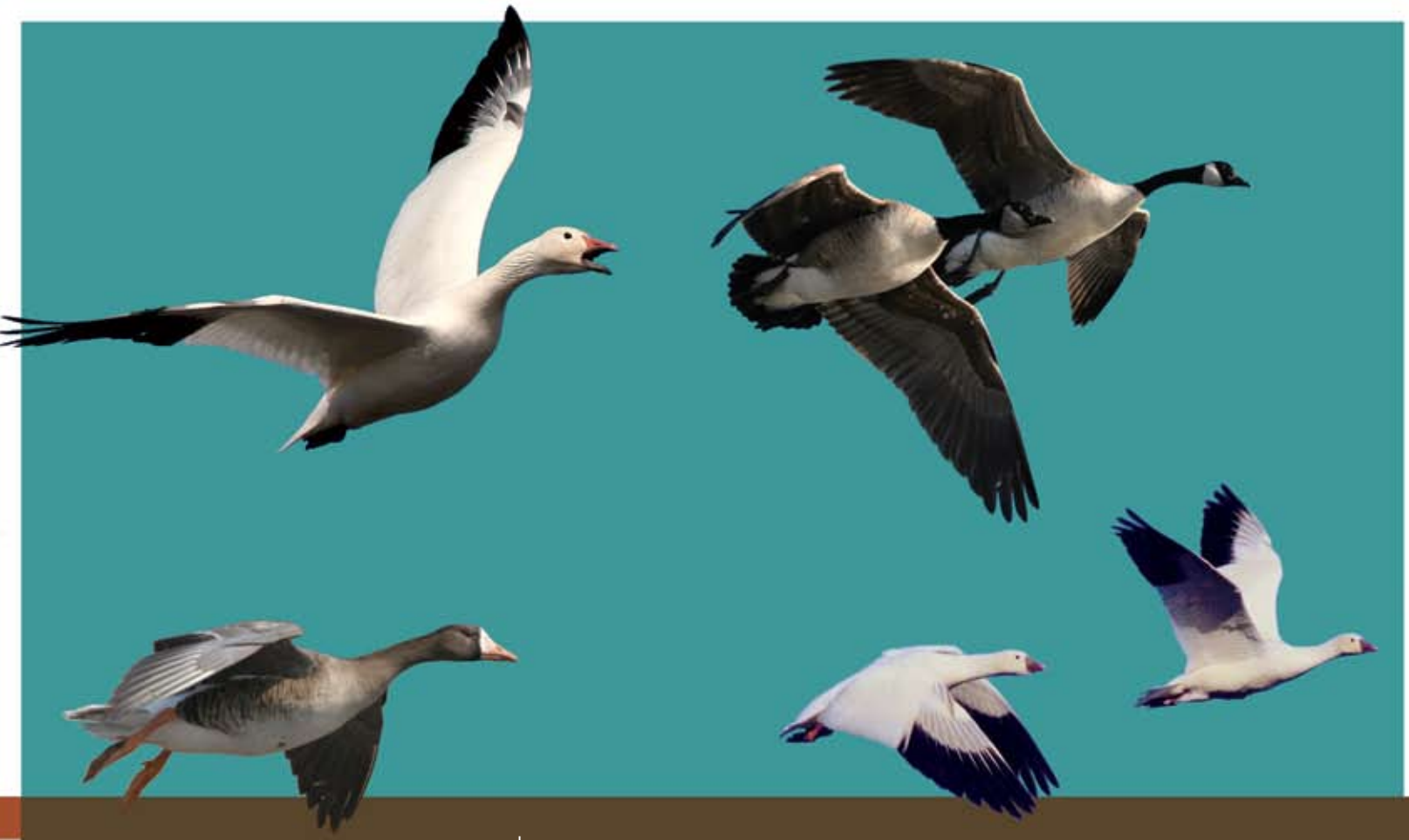
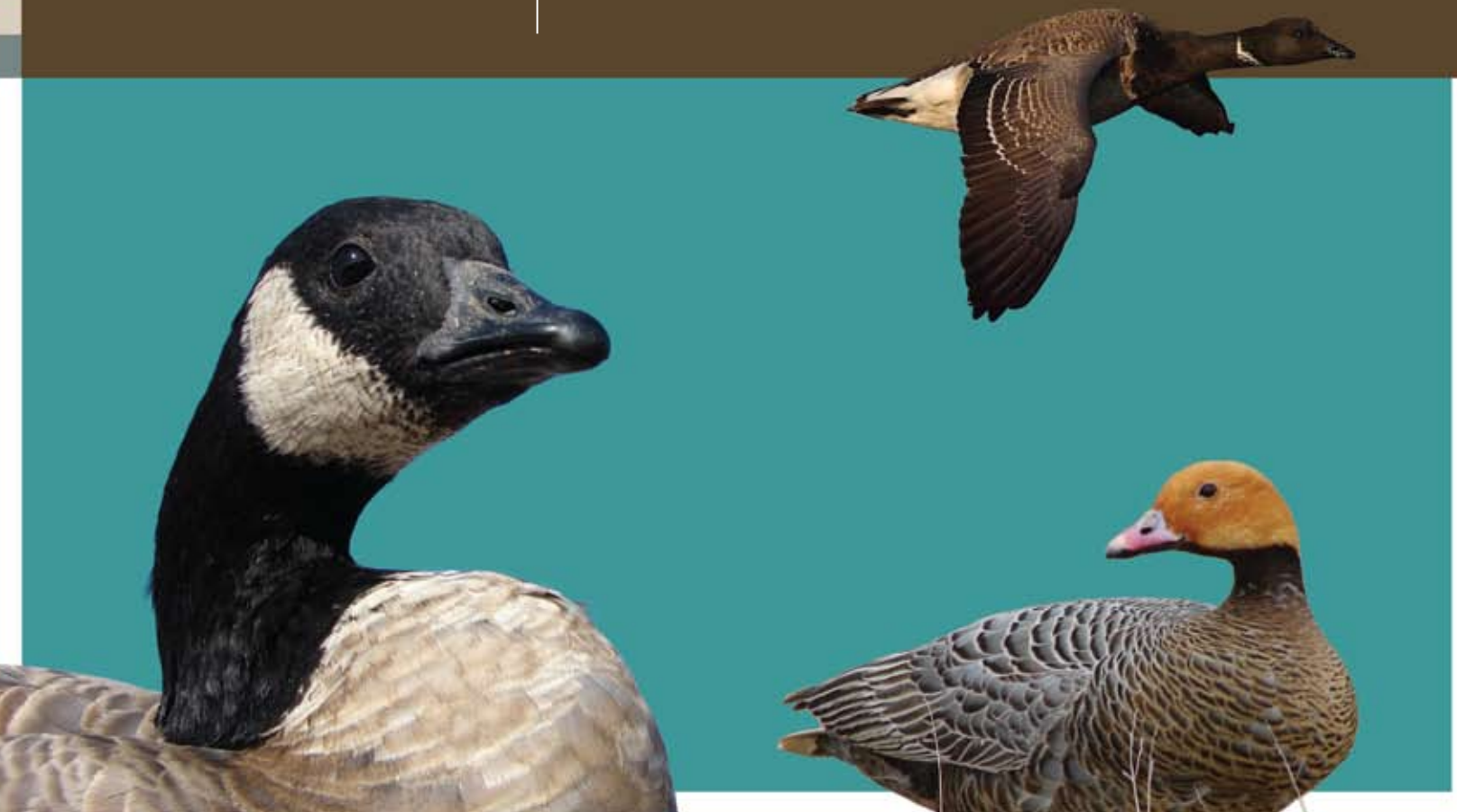


North American Waterfowl Management Plan

Plan nord-américain de gestion de la sauvagine

Plan de Manejo de Aves Acuáticas de Norteamérica

Arctic Goose Joint Venture
STRATEGIC PLAN
2008 – 2012



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Cover Photos (clockwise from top left): Doug Steinke, Doug Steinke, John Conkin, Jeff Coats, Tim Moser, Tim Moser, Doug Steinke

Arctic Goose Joint Venture Technical Committee. 2008. *Arctic Goose Joint Venture Strategic Plan: 2008 - 2012*. Unpubl. Rept. [c/o AGJV Coordination Office, CWS, Edmonton, Alberta]. 112pp.

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TIM MOSER

Introduction

THE ARCTIC GOOSE JOINT VENTURE (AGJV) WAS ESTABLISHED IN 1989 TO FURTHER THE SCIENTIFIC UNDERSTANDING AND THE MANAGEMENT OF NORTH AMERICA'S GEESE. THE CONTINENT'S GEESE INCLUDE INDIVIDUALS FROM THREE GENERA (*ANSER*, *CHEN*, AND *BRANTA*), SEVEN SPECIES (WHITE-FRONTED GEESE, EMPEROR, SNOW, ROSS'S, BRANT, CACKLING, AND CANADA GEESE), AND 34 RECOGNIZED POPULATIONS. COLLECTIVELY, THESE POPULATIONS CONSTITUTE A NATURAL RESOURCE OF ENORMOUS SOCIAL, ECONOMIC, CULTURAL, AND RECREATIONAL VALUE TO THE PEOPLE OF CANADA, THE UNITED STATES, MEXICO, AND BEYOND.

Prior to the formation of the AGJV, goose management in North America was primarily based on information gathered on goose migration and wintering grounds. However, over time it had become increasingly apparent that wintering ground mixing of northern-nesting geese and temperate-nesting geese

greatly complicated population assessment and management of all goose populations. Unfortunately, knowledge regarding the breeding ground population distribution, status and demographics of northern-nesting goose populations was limited. Although studies were being conducted, the costs were extremely high, and the efforts lacked the coordination needed to make rapid progress in meeting the basic information needs. Since AGJV inception, Joint Venture partners have set in motion a coordinated approach for meeting information needs for the management of northern-nesting geese in North America.

The founders of the AGJV recognized that a coordinated and integrated approach to identification, promotion, and the accelerated collection of important biological data was needed, especially for remote northern-nesting goose populations for which the logistics and costs of study were problematic. The AGJV detailed the populations, challenges, and opportunities that initially were to be addressed in their "Prospectus" in 1991. Since 1991, the scope of the North American Waterfowl Management Plan has expanded from inclusion of only those waterfowl shared among signatory countries to inclusion of all native waterfowl of the signatory countries. Consistent with that change and the need for cooperative study of northern-nesting populations, the umbrella of the AGJV has also expanded. The AGJV now encompasses 28 northern-nesting goose populations ranging from the Aleutian Islands to Labrador.

The goal of the AGJV is to foster greater research and monitoring of northern-nesting geese for the purpose of improving and refining population management from a breeding ground perspective. The strategy of the AGJV is to achieve the general goal by planning, facilitation, communication, and coordination of activities directed at improving the information base for northern-nesting populations of geese.

The activities of the AGJV include both short-term and long-term information gathering programs directed at determining basic population parameters such as population growth, production, harvest, and survival rates. In some cases, reliable indices of population abundance, trend, or distribution are still lacking. The amount of information available to management agencies varies widely among populations. The purposes of this Strategic Plan are to: (1) identify priority information needed to facilitate effective population management, (2) describe implementation strategies to meet the information needs, (3) identify the funding required to accomplish these tasks, (4) develop procedures for ranking research and monitoring needs, and (5) implement the communications strategy to increase awareness of the AGJV goals and accomplishments. It is intended that the major goals and objectives presented in this strategic plan be reviewed and revised, if necessary, at five-year intervals.

TIM MOSER

Accomplishments and Future Challenges

Past Accomplishments

Several iterations of the AGJV Strategic Plan reflect the continued progress this partnership has made on meeting the high priority information needs for the continent's northern-nesting geese.

To date, 84 projects have been endorsed, and 74 of those have been funded with AGJV designated contributions (see Summary of AGJV Funded Projects). The efforts of the AGJV and its cooperators have significantly improved management of North American goose populations. Management agencies are now more effectively maintaining populations near objectives, due, in part to more appropriate delineation, improved monitoring, and better assessment of population dynamics. All of the goose populations included in the 2000-2006 AGJV plan exhibited stable or increasing abundance over the last 10 years 1998-2007.

The AGJV has been instrumental in gathering, compiling, and communicating information regarding North American geese and their habitats. A listing of publications resulting from AGJV efforts and AGJV supported projects is substantial, with well over 400 publications identified. The AGJV has been especially active in addressing colony-nesting snow and Ross's geese, an initial NAWMP mandate, including issues of overabundance. Through a series of AGJV working groups and their publications (below), continental goose management regimes have been significantly influenced.

Following is a list of special reports initiated and prepared by the AGJV:

- Arctic Ecosystems in Peril. AGJV. 1997.
- The Greater Snow Goose. AGJV. 1998.
- The Status of Ross's Geese. AGJV. 2001.
- Direct Control and Alternative Harvest Strategies for North American Light Geese. AGJV. 2003.
- Science Needs for the Management of Increasing Lesser Snow Goose Populations. AGJV. 1998.
- Science Needs for the Adaptive Management of the Greater Snow Goose. AGJV. 2001.
- Evaluation of the Special Conservation measures for Greater Snow Geese. AGJV. 2007.

AGJV supported projects and programs involve three main components: banding, surveys and research. Following are a few examples of how AGJV supported projects improve capabilities for managing AGJV goose populations.

Banding

The AGJV supports banding operations across the Arctic, from Baffin Island to Alaska. From 1989 to 2007, over 960,000 geese have been banded under these projects.

Legbanding programs help determine recovery and survival rates of AGJV geese. Recent increases in banding efforts are significantly improving the estimation of survival rates for snow and Ross's geese. Colour-marking programs help delineate populations. This has been very important in the delineation of North American white-fronted, Canada, and cackling geese. In 2003, AGJV partners initiated a large banding study to provide the first quantitative assessment of band-reporting rates among goose hunters in North America. The resultant estimates of reporting rates, as well as results of other AGJV facilitated banding efforts, will greatly improve abilities to assess harvest and other vital rates for many goose populations.


KIEL DRAKE

Surveys

Surveys are another important component, assisting in determining the status and range of populations. The AGJV supports several surveys conducted on many of the AGJV sponsored populations throughout northern Canada and the United States. These include:

- Canada goose breeding population surveys
- Photo-inventory of snow and Ross's goose nesting colonies
- Greater snow geese spring staging survey
- White-fronted goose fall survey in prairie Canada
- Helicopter surveys of lesser snow goose colonies on southern Hudson Bay
- Surveys of post-breeding brant, snow, Ross's and cackling geese on Baffin Island
- Videographic survey of Pacific brant nesting colonies
- Initiation of fixed-wing aircraft surveys for migratory birds in the central Canadian Arctic

Research

AGJV provides support for goose research that is important for improving the management of goose populations. Some examples of supported research include evaluation of:

- goose harvest in Mexico
- snow goose productivity on Wrangel Island, Russia
- greater snow goose productivity on Bylot Island, Nunavut
- Ross's goose breeding ecology
- vegetation characteristics, degradation, and recovery in Arctic ecosystems
- wintering ground habitat condition (e.g., eelgrass availability)
- the role of snow and Ross's geese as carriers of avian cholera

AGJV supported activities have resulted in refined population definitions, increased precision of monitoring efforts, and increased monitoring capacity, and therefore have improved the ability of management agencies to maintain desired population status through tailored harvest regulations.

Future Challenges

The NAWMP Continental Assessment provided an excellent opportunity for the AGJV to closely examine the focus and approach of the joint venture and review past accomplishments. Through the Assessment, the AGJV was commended for significant achievements with limited resources. However, the AGJV and the Assessment identified several aspects that would benefit from increased attention. The priorities are captured in detail throughout this Strategic Plan. However a few challenges are highlighted below:

- The expansion of the joint venture is critically important to understanding and managing the full span of northern-nesting populations and properly addressing continental issues. This expansion to 7 species and 28 populations requires significant effort by AGJV partners to increase funding and human resources to adequately address the information requirements.
- The continental scope of this JV requires meaningful involvement from a wide range of partners and stakeholders. Diminishing human and financial support of key partners needs to be addressed. Also, increased effort to engage Mexico, northern aboriginal groups and circumpolar countries (e.g., Russia, Ireland, and Iceland) is needed.
- More emphasis should be placed on the short and long term outlook for geese, particularly with respect to impacts of changing agriculture practices, climate change, exploration and mining and other Arctic breeding ground disturbances. With assistance from the North American Waterfowl Management Plan International Committee, the AGJV will attempt to facilitate work, (e.g., through universities) to address these broad-scale issues.
- The AGJV is currently assessing the effectiveness of the light goose management strategies and determining potential next steps.
- Genetics is playing an increasingly important role in the management of populations and more emphasis should be placed on this research tool.


JOEL SCHMUTZ


TIM MOSER


MARK MALLORY


JERRY HUPP

Information Needs and Strategies to Address Them

The AGJV has prioritised seven categories of "Information Needs" into high, medium and low designation for 28 goose populations (Table 1, hereafter the Information Needs Matrix). A high priority indicates an immediate need for information; a medium priority recognizes a demonstrated need for the information, but other information is required first; and a low priority suggests that the information is relevant but other information is presently deemed more important. This approach ranks issues within each population; it does not prioritize among populations. While the current listings in the Short Term Information Needs Matrix (Table 1) are considered to be most important, the dynamic nature of goose populations and the knowledge base dictates that issue rankings may also change. It is the intent of the AGJV to be flexible in its approach to identifying and addressing the information needs of goose managers in North America. The present rankings were evaluated based on the North American Waterfowl Management Plan, national and flyway management plans, and the broad regional expertise of committee members who coordinated views among the agencies they represent. Following are definitions of each of the Information Needs categories and the number of populations where each of the Information Needs was ranked as high priority.

Definitions of Information Needs

Population Definition or Delineation refers to the need for an adequate definition for geographic limits of specific populations and the degree to which presently recognized populations actually represent groups distinct enough to be managed separately. This need is identified as a high priority for eight populations (Table 1).

Population Status or Assessment refers to the availability of a reliable annual or periodic population index that enables managers to monitor the status of the population and detect significant changes over time. This need is identified as a high priority for sixteen populations (Table 1).

Population Dynamics refers to the measurement and understanding of how specific population parameters change. Of particular interest is the impact of various management practices, especially harvest, on various population parameters such as survival, recovery, productivity and recruitment rates, and the relationships among these various parameters. This issue is confined to parameters directly measured on the population of interest and the relationship of these parameters. This category is identified as a high priority for nine populations (Table 1).

Population Biology and/or Ecology involves the relationship between the population of interest and its biotic and abiotic environment. The category is broader in scope than population dynamics and integrates an understanding of population dynamics with a wider range of climatological, temporal, geographical and other impacts (such as predation). This information need is identified as a high priority for two populations (Table 1).

Harvest Assessment refers to the ability of management agencies to accurately measure the sport and subsistence harvest of specific goose populations. Fifteen populations identify harvest assessment as a high priority issue (Table 1).

Habitat Concerns refer to the capability of breeding, migration, and wintering habitats to support long-term health and sustainability of specific goose populations. Broad threats include: climate change, land-use conversion, overabundant goose populations, and resource exploitation. Respective specific examples include: inundation of coastal goose breeding areas due to sea level increase, increased agricultural crop harvest efficiency, denuding of brood-rearing area vegetation, disturbance from hydroelectric and petroleum extraction activities. Habitat concerns are considered a high priority for six populations (Table 1).

Parasites, Disease, and/or Contaminants refers to factors that influence the health of the populations either through direct mortality or indirect impacts, such as lowered reproductive potential or synergistic effects with other diseases. There are no populations that currently identify parasites, disease and/or contaminants as a high priority information need (Table 1).

Strategies for Meeting the Information Needs

The Arctic Goose Joint Venture addresses the information needs by employing three general categories of activities; (1) banding and marking, (2) surveys, and (3) research. Priorities favour large-scale studies or programs that encompass the entire range of a population and programs that encompass more than one population.

The basic strategy of the AGJV is to develop and maintain the information base for management of breeding populations of geese identified in the AGJV. The strategy is aimed at eight immediate focus areas derived from the Short Term Information Needs Matrix (Table 1). These categories are related in a variety of ways. Several deal with population status or delineation of specific groups of geese. All breeding ground surveys are dependent upon knowledge of the distribution of the populations at the time of the survey. Therefore, delineation programs are necessary prerequisites to development of the breeding ground surveys. Likewise, status determination will be accomplished primarily by development or improvement of breeding ground surveys.

The most urgent information needs for each population addressed through the AGJV are described in the subsequent sections of this Plan, where species experts described and ranked the information gaps within each population. Stepping back, it becomes clear that many important issues are shared among several populations; for example, the need for improved harvest estimates or concerns about habitat. The following focus areas attempt to roll up the high priority information needs across populations, for which it may be possible to address them collectively, or to make use of integrated studies with results applicable to a broader range.

The information needs matrix is a result of progress during the last five years and changing priorities from the management community represented by the Arctic Goose Joint Venture.

Recent revisions of the Strategic Plan do not include existing breeding ground survey efforts or long-term operational legbanding programs in the information needs matrix even though this may be a higher priority need for some populations, because these needs have been addressed. The Joint Venture will continue working with the respective Flyway committees during the next several years to better document those operational programs directly related to Arctic Goose Joint Venture populations.

Information Needs Matrix

Table 1. Short-term information needs for goose populations included in the Arctic Goose Joint Venture. A high priority indicates an immediate need for information; a medium priority indicates a demonstrated need for the information, but other information is required first.

Genera, Species, Populations	Information Need						
	Population Definition or Delineation	Population Status or Assessment	Population Dynamics	Population Biology and/or Ecology	Harvest Assessment	Habitat Concerns	Parasites, Disease, and/or Contaminants
Anser							
Greater White-Fronted Goose *Anser albifrons*							
Midcontinent	Med	High	Med	Low	High	Low	Low
Tule	Med	High	Med	Low	High	Low	Low
Pacific	Low	Low	Med	Med	High	High	Low
Chen							
Emperor Goose *Chen canagica*	Low	Low	Med	High	High	Med	Low
Snow Goose *Chen caerulescens*							
Greater	Low	High	High	Low	Med	Med	Low
Midcontinent Lesser	Low	Med	Med	Low	High	High	Low
Western Central Flyway	Low	Med	High	Low	Med	High	Low
Western Arctic Lesser	High	Low	High	Low	Low	Med	Med
Wrangel Island Lesser	Med	High	High	Low	Med	Low	Low
Ross's Goose *Chen rossii*	Low	High	Med	Med	High	Low	Low
Branta							
Brant *Branta bernicla*							
Eastern High Arctic	High	Low	High	Med	Low	Med	Low
Atlantic	Low	High	Med	Med	Low	High	Low
Western High Arctic	High	High	Low	Low	Med	Med	Low
Pacific	Low	Low	Med	Med	High	High	Low
Cackling Goose *Branta hutchinsii*							
Taverner's	High	High	Med	Low	Med	Low	Low
Cackling	Low	Low	High	Med	High	Med	Low
Aleutian	Low	High	Low	Med	High	Med	Low
Canada Goose *Branta canadensis*							
North Atlantic	Med	High	Med	Low	High	Low	Low
Atlantic	Med	High	Med	Low	High	Low	Low
Southern James Bay	Low	Med	High	Low	High	Med	Low
Mississippi Valley	Low	Med	High	Low	High	Med	Low
Eastern Prairie	Med	Low	Low	Med	High	High	Low
Western Prairie	Med	High	Med	Low	High	Low	Low
Vancouver	High	High	Med	Med	Low	Low	Low
Lesser	High	High	Med	Low	Med	Low	Low
Dusky	Low	Low	High	High	Med	Med	Low
Cackling/Canada Goose* *Branta*							
Tall grass Prairie	High	High	Med	Low	Med	Low	Low
Short grass Prairie	High	High	Med	Low	Med	Low	Low

* In 2004, the American Ornithologist's Union declared that geese previously classified as 4 subspecies of Canada geese (*Branta canadensis minima*, *hutchinsii*, *leucopareia*, and *Taverneri*) would now be considered a new species of goose, the "cackling goose" (*B. hutchinsii*). (editor's note - Readers should be aware that prior to this change, the common name for the Alaska-nesting subspecies *B. c. minima* was "cackling goose," a name now adopted for this new group of 4 subspecies.) Three AGJV populations include only cackling goose subspecies (cackling, Aleutian, and Taverner's geese), and two populations (short grass prairie and tall grass prairie) include one subspecies from each of the two species (*B. c. parvipes* and *B. h. hutchinsii*).

ALL: ROD BROOK

Focus Areas

Habitat Degradation Caused by Populations of Snow and Ross's Geese

There is continuing concern about the adverse habitat impacts of large populations of snow and Ross's geese. Several populations of these species have increased rapidly over the past few decades and remain at high levels. During the last five years, additional evidence of the extent and severity of the problem has been obtained (e.g., in Wapusk National Park, Manitoba and in Queen Maud Gulf, Nunavut). Conversely, no evidence of habitat recovery on the subarctic and Arctic breeding grounds has emerged. Obtaining a more comprehensive knowledge of the geographic distribution of the impacts throughout the northern migration and breeding areas is considered a high priority. This includes the range of these populations that contains the majority of breeding birds in the eastern (e.g., Baffin Island, Southampton Island), central and western Arctic (e.g., recent evidence suggests that the Banks Island colony in the western Canadian Arctic has grown steadily and may soon cause habitat problems). Concern about the impacts of the observed habitat damage on other species and other ecosystem components also remains high, and the impact of these large populations on habitats and other species in southern migration and wintering areas is another concern.

The strategy is to expand the studies to:

1. Evaluate the geographic extent of habitat degradation, especially at the more northern staging areas and colonies.
2. Evaluate the nature and intensity of habitat changes.
3. Monitor the nature and rate of recovery of previously damaged areas.
4. Assess the nature of impact on other populations of geese, other migratory birds, and other ecosystem components.

KIEL DRAKE


KIEL DRAKE

Population Status and Assessment of Midcontinent and Tule White-fronted Geese

The midcontinent population of greater white-fronted geese nests across a broad region of the Arctic from Alaska to the west coast of Hudson Bay. The status of midcontinent white-fronted geese is determined during fall migration when birds are concentrated in southwestern Saskatchewan and southeastern Alberta. However, it has been difficult to obtain accurate aerial estimates of white-fronted geese among mixed species concentrations of waterfowl which often exceed one million birds in a relatively small area. A ground count is used to supplement the aerial portion of the survey, but both ground and aerial counts have been compromised during some years by large numbers of snow, Canada, and cackling geese that intermingle with white-fronted geese.

Although fall surveys have been useful, the development of a breeding population survey is needed to provide population estimates that are consistent with AGJV and Flyway objectives and to provide trend information on a regional basis. Portions of the breeding grounds are already surveyed; either on continental duck surveys or special surveys, therefore, efforts have been made in recent years to survey "uncovered" portions of the breeding grounds. After several years of small scale pilot surveys, a comprehensive experimental fixed-wing survey was initiated during 2007 to survey previously uncovered areas, especially in western and central Canadian Arctic, for multiple waterbird species, including midcontinent population white-fronted geese. Results indicate that an annual survey is feasible if reliable results are obtained and long-term funding can be secured.

Temporal and spatial differences among subpopulations of the midcontinent population are apparent. These differences provide some opportunity for subpopulation specific management, the pros and cons of which should be explicitly evaluated, with the need for such management dependent on trend differences among subpopulations.

Tule white-fronted geese are one of the least abundant of any goose subspecies, and obtaining accurate estimates of population size has proven quite challenging. The breeding grounds for the tule goose population were only partially delineated in the late 1990s, and aerial surveys have not been feasible because detection was very poor in boreal forest and muskeg habitats. On the wintering grounds, the scarce tule population intermingles with over a half-million Pacific white-fronted geese. Thus, inventory efforts in the 1980s and 1990s were focused on ground surveys during early fall migration when the tule population was mostly segregated from the Pacific population. In recent years, Pacific white-fronted geese did not stop in the Klamath Basin and mixed earlier with the tule population, complicating the ground surveys. Since 2003, surveys of radio-marked tule geese and ground surveys of marked and unmarked birds have been used to develop population estimates. This approach shows promise in assessing the status of the population. Continued telemetry work may help delineate seasonal ranges for survey purposes, as well as provide an operational means to produce indirect population estimates during winter.


TIM MOSER

Population Delineation and Population Assessment of Short Grass Prairie, Tall Grass Prairie, Lesser, and Taverner's Geese

In 2004, the American Ornithologist's Union (AOU) reclassified 4 subspecies of Canada geese (cackling, Richardson's, Aleutian, and Taverner's: *Branta canadensis minima*, *hutchinsii*, *leucopareia*, and *taverneri*, respectively) as a separate species of goose, the "cackling goose" (*B. hutchinsii*).[1] The decision was based on genetic sampling (mitochondrial DNA) which indicated low genetic interchange between the Canada and cackling species.

With this taxonomic change, the short grass prairie and tall grass prairie populations now contain individuals of both species, whereas the lesser and Taverner's populations are intended to include only one subspecies/species in each population (*B. canadensis parvipes*, and *B. hutchinsii taverneri*, respectively). A difficulty for management agencies is that there are no existing criteria to reliably discriminate individuals of these subspecies/species from each other.

The AGJV strategy is to improve information regarding the frequency of hybridization or introgression among Canada and cackling geese (using bi-parentally inherited DNA sampling) and improve the ability to genetically and morphologically discriminate between individuals of involved subspecies by increasing quantity and quality of genetic and morphological samples. Work could then proceed to refine delineation of breeding ranges, pursue methods to obtain population abundance indices within each subspecies' range, and attain improved knowledge regarding their annual distribution.

1 Readers should be aware that prior to this change, the common name for the Alaska-nesting subspecies, *B. c. minima*, was the "cackling goose," a name now adopted for this new group of 4 subspecies.

Assessing Impacts of Climate Change and Resource Development on Arctic Geese

The impacts of climate change could influence nearly every aspect of life in the Arctic and other northern climates. The Arctic, in particular, is extremely vulnerable. In the past few decades, average temperatures in the Arctic have increased at twice the rate observed in the rest of the world. Climate change has had a significant influence on the melting of glaciers, decreasing thickness of sea ice, thawing of permafrost, coastal erosion, drying of wetlands, and altered distribution and abundance of species. The Arctic region's resources are also becoming more accessible due to a reduction in sea ice that may increase shipping and resource extraction activities and further exacerbate environmental damages in the Arctic. Thus, concern regarding how climate change and resource development will affect Arctic and subarctic goose populations is growing.

TIM MOSER

The AGJV encourages studies that quantify climate change and resource development effects on northern habitats and geese through monitoring: (1) permafrost thawing, coastal erosion, sea levels, and changing distribution of plant and animal species, (2) resource development/exploitation activities, and (3) the cumulative effects of climate change and resource development on goose breeding, moulting, and staging areas.

In addition to monitoring, we encourage management agencies to review the status of habitats critical to migratory birds in Arctic and subarctic regions and, where appropriate, to propose inclusion into Environment Canada's Protected Areas Network, or the U.S. National Wildlife Refuge System.


NORM NORTH

Population Status, Population Dynamics, and Ecology of Brant and Emperor Geese

Brant exhibit great year-to-year fluctuations in productivity as their breeding success is more susceptible to annual weather conditions than most goose populations. Historically, Atlantic brant have been greatly diminished by loss of forage during eelgrass die-offs. Pacific brant have undergone a major shift in wintering grounds from the United States to Mexico, and the number of pairs at the largest colonies in western Alaska declined by 75% during the 1980s, but rebounded by the 1990s. The breeding distribution and status of the two smallest brant populations, eastern and western high Arctic brant, is not well documented.

Given the history of major population changes and erratic patterns of annual abundance, population dynamics work is needed to put management programs on a sound footing. For all brant, the mechanisms and history of colony growth, disappearance, and movement are unknown. There is a lack of long-term documentation about nesting conditions and relative productivity among the major breeding areas. Harvest rates appear to be low under long-standing conservative hunting regulations, but trends in survival and total mortality rates are poorly known.

Strategies to address brant population dynamics have primarily involved long term monitoring of breeding pairs and success at larger colonies, tarsal-banding and observation programs, and/or radio-telemetry. The major goals of marking are to provide annual and periodic estimates of survival by sex/age cohort and to understand the year-round distribution of brant from different breeding areas. Banding programs have been conducted in conjunction with site-specific studies in breeding colonies and projects on moulting areas. The amount of monitoring and research on brant has varied greatly among breeding areas. A breeding

BOTH: NAOMI BARGMANN

ground focus on western high Arctic brant will provide critical information on the taxonomy, morphology, migration, and range of this stock.

Brant and emperor geese may be considered "marine geese" because they are strongly dependent on coastal lowland habitats and marine waters most of the year. Accordingly, these species share many ecological traits, including susceptibility to the effects of climate change—changes in sea level, coastal erosion, plant succession, and predator dynamics. Of all the species considered by the AGJV, brant and emperor geese are probably more dependent on natural wintering habitats and thus have not benefited from agriculture and other human activities like many other species. General patterns of low reproductive success and recruitment in both species suggest that ecological limitations are in play and could become more critical with long-term changes in climate. Additional factors contributing to low recruitment on the breeding grounds include succession and alteration of habitats, and predation. Flooding has direct effects on nesting emperor geese and brant colonies. Shifts in important plant communities appear to be occurring in some areas and are probably due to climate influences (temperature, flooding, evapotranspiration, precipitation). Frequency of years of high fox predation on geese may be linked to coastal flooding, which affects the primary prey of foxes (small mammals). In some areas of the western Canadian Arctic, sea-level rise, coastal erosion, reductions in sea ice cover, increased amplitude of storm surges, and salt water inundation of coastal lowlands could all influence the habitat and numbers of brant.

Winter conditions may also limit recruitment and population size in these marine geese. Loss or deterioration of winter habitat is one of the greatest threats faced by brant. Eelgrass habitats are spatially more limited than in the past and some are now being impacted by invasive species. Some brant have changed to using alternate habitats, such as algal communities and pastures, but the functional availability of algal communities is made unpredictable by red tide issues. Reproduction in Pacific brant has been hypothesized to be linked to eelgrass habitats in traditional winter areas and the role of climate cycles (e.g., el Nino). It is unclear if or how this has contributed to the growing numbers of Pacific brant that are wintering much farther north than traditionally, at Izembek Lagoon. Similar constraints may affect emperor geese which winter in intertidal habitats of the remote Aleutian Islands, but specific factors are largely unknown.

Strategies to address population ecology and dynamics should include integrated studies of how demography is affected by climate variation, through impacts on habitats or on alternate prey of arctic foxes. Some telemetry approaches, as well as tarsal banding, may be useful quantifying breeding activity and use of particular habitats.


TED LAGRANGE

Status Assessment and Population Dynamics of Snow and Ross's Geese

Assessing the numerical status of Ross's and snow geese is difficult for a variety of reasons. In the midcontinent, their current population sizes and expanding range make comprehensive surveys expensive and difficult to design. Although success has been achieved with greater snow geese and to some extent with certain colonies of midcontinent lesser snow geese, a comprehensive and precise program to estimate numbers is elusive. Winter population assessment as an alternative has been criticized and is currently limited to midwinter indices. Winter monitoring programs have been threatened by diminishing agency budgets in recent years. Populations of these species in other parts of the continent have unique assessment problems. For example, assessing the status of Ross's geese or Wrangel Island snow geese on the wintering grounds remains difficult. Both populations mix with large numbers of western Arctic snow geese in California's Central Valley and the western Central flyway, and the abundance of Ross's geese wintering in the eastern Central flyway and Mississippi flyway continues to increase.

Wrangel Island snow geese winter in two different areas. A northern segment of the population winters at the Skagit and Fraser River deltas of Washington and British Columbia and the southern component migrates to California. Numbers of the northern segment are adequately assessed each year but enumeration of the southern-wintering group continues to be the crux of the assessment problem. Exchanges of personnel and information with Russian agencies continues to provide most breeding ground data and appropriate harvest management strategies for both wintering areas.

Midcontinent lesser snow geese are surveyed annually in only a small portion of their vast breeding range, and periodically in most of their breeding range. The latter air photo survey takes place over several years due to costs, logistic difficulties and unpredictable weather. Likewise, Ross's geese are surveyed annually in only a small, single portion of their breeding range and periodically on a larger but incomplete portion of their

expanding eastern Arctic breeding range. Because Ross's and snow geese cannot be discriminated during winter aerial surveys, distribution and trends in Ross's goose abundance requires additional ground counts (conducted in portions of the wintering range). Evaluation of population composition based on harvest tail fan collections is potentially biased (i.e., it may be overestimating Ross's goose harvest) due to reductions in snow goose body size and/or hybridization of the two species.


TIM MOSER

To augment the existing surveys, more specific information about the population dynamics of snow and Ross's geese is required. In particular, there is a need for a thorough analysis of data on production, recruitment, and survival rates of Wrangel Island snow geese (in cooperation with Russian agencies) to better formulate management strategies in the Pacific Flyway. Progress has been made with the establishment of a cooperative agreement between the U.S. Fish and Wildlife Service and the Wrangel Island Reserve for implementation of an annual banding program over the past 15 years as well as analysis of data on production, recruitment, and survival rates of Wrangel Island snow geese to better formulate management strategies in the Pacific Flyway. For western Arctic snow geese, scientifically informed decisions need to be made about the most appropriate numerical goal for the population and population dynamics of this population needs to be evaluated. Snow and Ross's goose populations that use the midcontinent and Atlantic regions should continue to be monitored during implementation of liberalized harvest programs aimed at population reduction.


ROD BROOK

The strategy to address these information needs is to establish new, or improve existing surveys to determine the size of these populations. The surveys would be cooperative ventures involving the principal agencies concerned with each population. In some cases, marking and telemetry programs would be initiated to help describe the temporal and geographic distribution of these geese to facilitate survey development. Site specific investigations on individual breeding areas would be conducted to determine other related population parameters. Banding programs for all populations should continue to evaluate the effects of liberalized harvest programs or other management efforts on total harvest, harvest rates, and survival rates, and in some case, to better define the year round distribution of different population components. Finally, continued investigation of responses to management actions, and the most effective means of population control is needed.

Population Specific Harvest Estimates

Harvest estimates at the population level improve the capacity of management actions to meet recreational, ecological, and abundance objectives for each goose population. Unfortunately, the availability of harvest estimates at the population level is currently very limited. The high prevalence of temperate-nesting Canada geese in major harvest areas of northern-nesting Canada goose populations continues to confound harvest estimation specific to these populations. Traditionally, federal governments in Canada and the United States have assessed goose harvest at the species level by collecting the tail and wing feathers of harvested geese from random samples of hunters (parts-collection surveys).

While waterfowl managers have worked to maintain and improve the precision of this harvest assessment, some recent developments have reduced the ability to apportion harvest among goose populations, or even among species: 1) The American Ornithologist's Union recently divided Canada geese into two species. Unfortunately, the substantial morphological overlap and similar geographical distributions of these two species likely makes differentiation from feathers impossible, at least without genetic or chemical analysis. 2) The rapid expansion of Ross's goose breeding, migration, and winter range and the apparent trend of decreasing body size of some snow geese have reduced the ability to differentiate harvest of these species by traditional survey methods. 3) Similarly, changes in the distributions and potentially the body sizes of Canada and cackling geese suggest traditional feather morphology criteria for apportioning harvest to species/subspecies/populations should be re-evaluated.

Population-specific harvest estimates can also be based on recovery of marked birds. Care must be taken to obtain representative samples of the entire population of interest, unbiased by the inclusion of individuals of other populations/subspecies/species. The continued increase of temperate-nesting Canada geese and their moult migrations to AGJV goose population nesting areas complicates that sampling.

The lack of population-specific harvest information is confounded by unmeasured or incompletely measured subsistence harvest. Although subsistence harvest is presently thought to represent a small portion of the total annual harvest in most goose populations, it may constitute a large fraction of harvest for some populations, particularly in Alaska. Reliability of subsistence harvest information is currently uncertain. Operational survey programs to measure and incorporate such harvest into overall management plans are lacking.

The strategy is to evaluate existing methodology and new methodologies for their ability to differentiate whole birds, and feathers (collected during parts collection surveys) of various goose stocks and populations. Resulting morphological, genetic, isotopic, or other methodology should be compatible with existing harvest survey programs conducted in Canada and the United States. The development of reliable periodic estimates of subsistence harvest for all goose populations should be undertaken as part of overall harvest assessment improvement programs in both countries. Further, systematic harvest estimates for Mexico are not regularly available. A coordinated harvest survey in Mexico should be encouraged.

Development/Improvement of Breeding Ground Surveys

The development or improvement of operational breeding ground surveys to obtain annual indices and long-term trends of population abundance, nesting habitat conditions, and productivity remains a priority for nearly all AGJV goose populations. Surveys should provide the information required to improve population management by targeting the most biologically meaningful time periods and be conducted in the most cost-effective manner. Determination of reliable forecasts of goose population fall flight prior to annual promulgation of harvest regulations is an important objective. In recent years surveys have been established and refined for many AGJV goose populations, however, reliable indices are still lacking for several populations. The vast geographic area and the difficult logistics entailed in northern-nesting goose surveys require efficient and cooperative efforts. Surveys may need to rely on remote-sensing methods to augment more intensive ground and aerial work. This information will also serve to track long-term variation in habitats and the distribution of geese in relation to indices of climate change. The establishment of operational surveys to accomplish these tasks is viewed as broadly applicable to all goose populations identified in the North American Waterfowl Management Plan.

The strategy will be to develop, evaluate, and improve population-specific breeding ground surveys, and to combine such surveys with more intensive site-specific work, remote sensing, and other monitoring efforts. The Joint Venture encourages the integration of regional and site specific studies into an overall program whenever possible.

SEAN BOYD

Management Issues and Strategies By Population


KIEL DRAKE

Greater White-Fronted Goose *Anser albifrons*

Midcontinent Population

Population Definition or Delineation: Prior to 2000, greater white-fronted geese of the midcontinent population were managed as two segments, the eastern and western. However, results of extensive banding and marking during the mid-1980s to mid-1990s indicated that eastern and western segments were not distinct during the non-breeding period. Therefore greater white-fronted geese of the midcontinent population have been managed as one group in recent years.

1. Investigate morphological and genetic variability, and cross-population interchange to determine degree of heterogeneity and existing demes.

Population Status or Assessment: An aerial census of staging birds in prairie Canada during late September, supplemented by simultaneous minor reports of birds elsewhere on the continent, provides an annual index to the population. However, accurately estimating large concentrations of mixed species flocks remains a challenge and increased numbers of light geese in the survey area during recent years has exacerbated the problem. The development of a breeding population survey would provide more consistency in estimating numbers of white-fronted geese plus it would provide information for comparing status among regions. Opportunistic counts in southern Texas and Louisiana during late October provide backup indices.

1. Continue annual fall staging counts in prairie Canada and southern United States.
2. Explore the development of a breeding population survey for white-fronted geese.

Population Dynamics: Banding of midcontinent white-fronted geese in the Queen Maud Gulf area and in Alaska provide the opportunity for recent adult mortality and survival estimates and should be continued as operational. However, annual production is only indicated from age ratios in the harvest without reliable vulnerability corrections. Age-related parameters have not been determined, and general understanding of population dynamics in relation to ecology of the species remains unknown.

1. Continue banding and breeding grounds research to describe and evaluate factors influencing production (age structure, body condition, weather, predation, habitat constraints).
2. Develop a program of systematic age ratio counts on fall staging areas (prairie Canada). Continue to estimate trends in annual production and relative vulnerability rates of adults and young.
3. Provide periodic updates of annual survival rates.

Population Biology and/or Ecology: Greater white-fronted geese of the midcontinent population utilize a wide range of nesting habitat, from open tundra to taiga and boreal forest and nest across a broad region of the Arctic. Understanding the effects of habitat and environmental factors on vital rates over such a broad area is a challenge. Recent efforts, however, of monitoring breeding populations across much of their range, and of assessing age ratios during fall staging should provide information on these relationships.

1. Use data from breeding ground surveys and regional climatic information, with fall age ratios to model white-front breeding effort and productivity.

Harvest Assessment: A management plan approved during summer 2005, identified population threshold levels which would guide general harvest strategies for midcontinent white-fronted geese. Criteria were modified from the previous plan to provide moderate opportunity over a broader range of population fluctuation, and to reverse a population decline that had occurred under the previous harvest strategy. The plan provides guidelines which link harvest strategies for the Mississippi flyway and the eastern tier of the central flyway, and the west tier central flyway, Alaska and Canada. This was considered appropriate because midcontinent white-fronted goose is now managed as one population but there was also a desire to recognize and consider historical distribution of harvest, particularly international, when regulatory adjustments are made. Harvest measurement is sufficient in Canada, being improved in the United States, and though harvest may be minimal, is still not well known for Mexico. Additional knowledge of subsistence harvests is needed for all countries.

1. Improve knowledge of subsistence harvests (size, distribution, factors affecting these) in Canada and the United States.
2. The current harvest strategy is designed to allow the population to fluctuate while allowing moderate, but consistent harvest opportunity.

Habitat Concerns: The loss of wetlands in the Rainwater Basin is significant. Degradation of wintering habitat (loss of Gulf Coast marshes, detrimental agricultural practices, and urbanization) is of concern. Identification of northern staging areas, and protection of breeding grounds, is required in light of northern development and potential loss of habitat to overabundant snow geese.

1. Promote protection and restoration of important staging and wintering areas in conjunction with the NAWMP habitat joint ventures when applicable.
2. Identify and document the importance of northern staging areas.
3. Develop cooperative conservation land programs for northern breeding geese.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events.


TIM MOSER

Greater White-Fronted Goose *Anser albifrons*

Tule Population

Population Definition or Delineation: Tule greater white-fronted geese are one of two subspecies of white-fronted geese that breed in Alaska and winter in California. The other subspecies is the Pacific greater white-fronted goose, which is differentiated by morphological measurements. Tule white-fronted geese breed in the Cook Inlet and upper associated drainages in Alaska. The breeding range has not been fully delineated, and additional nesting areas likely exist. The primary wintering areas for the tule population are the Sacramento National Wildlife Refuge complex surrounding agricultural lands, and to a lesser extent, the Suisun Marsh. The Sacramento National Wildlife Refuge complex receives the majority of fall migrants by November.

1. Define delineation of nesting and moulting areas through aerial surveys, telemetry, and habitat classification. Telemetry studies may require winter/spring capture and marking.

Population Status or Assessment: Not until the late 1960s and early 1970s did biologists begin to summarize more recent information regarding the winter abundance of the tule population. Flyway-wide, coordinated counts were conducted during the fall beginning in the late 1980s to the mid-1990s. During that period, Pacific white-fronted geese were less abundant overall or were staging in the Klamath Basin, making it feasible to examine a large proportion of the white-fronted geese and determine the number of tule geese present, especially in the Sacramento Valley. However, no protocols existed to characterize the relative reliability of the annual counts. By the mid-1990s, an increase in overall Pacific population numbers and a higher proportion of Pacific geese migrating earlier into the Sacramento Valley limited the ability of observers to classify and count tule geese. There were no coordinated inventories of tule geese attempted between 1996 and 2001 due to the earlier migrations of the much more numerous Pacific population which prevented reliable classification and enumeration of the tule population. From 2002 through 2007, a coordinated survey was conducted in the major fall migration and wintering areas similar to those conducted during the early 1990s. New survey protocols were instituted to establish a measure of reliability.

In combination with other research, estimates using an open population mark:resight model were made using both radio-marked and neck-collared tule geese from 1995-1997. Modeled estimates were higher than the direct fall counts for the same period. In 1999, due to the difficulties encountered with the fall coordinated surveys, the U.S. Geological Survey was asked by the Pacific Flyway Study Committee to review pertinent methods and propose alternative methods to measure the population size and trend for tule geese. Based on the work conducted in the mid-1990s, the USGS recommended a triennial survey using both neck-collared and radio-marked birds. Subsequent pseudo-replication of the fall 1995 and fall 1997 neck banding data indicated that radio telemetry may be more efficient as a means to provide population estimates. Beginning in 2003, California Department of Fish and Game and Oregon Department of Fish and Wildlife radio-marked and collared geese to continue the mark:resight population estimates.

1. Continue to radio-mark tule white-fronted geese to estimate population size and other population parameters.

Population Dynamics: The nesting biology and survival of tule white-fronted geese is not well documented. Based on unpublished data, nest success averaged 65% during 1994 – 1997 and brood success in 1997 was 67%. Age ratios at Redoubt Bay in 1980 and 1981 were 29 and 34% young, respectively. On the fall migration and wintering areas, age ratio data has been taken which have ranged from 9-39% young since 1978. Based on re-sightings of neck-collared tule geese in the early 1980s, and making assumptions regarding collar loss, it has been concluded that population survival was 80% for the first year after banding. Direct band recovery rates were about 12%. An analysis of radio-marked birds during 1994-1997 concluded that over-winter survival of adults was about 89%.

1. Conduct aerial surveys of Cook Inlet and Susitna Valley breeding areas to assess the feasibility of an operation breeding population survey.
2. Determine survival rates based on more current data.
3. Continue annual collection of age ratio data and family group size on staging and wintering areas.
4. Continue to band a sample of tule white-fronted geese while radio-marking birds at Summer Lake Wildlife Management Area or institute banding at known moulting lakes in Alaska.
5. Conduct surveys of primary moulting areas to assess the number and distribution of moulting birds.

Population Biology and/or Ecology: Unlike some other Arctic-nesting geese, tule white-fronted geese do not nest in colonies. Tule nests have been found in diverse habitat types that include mixed forest, open bog meadows and riparian shrubs. In general, nest sites were not near lakes or ponds. Given their nest site selection and apparent small population size, nest losses due to predation may be high.

1. Assess nest success/failure.

Harvest Assessment: Estimation of tule goose harvest has not been possible through the Parts Collection Survey because there is currently no method to separate tail fans of tule geese from those of Pacific white-fronted geese. The majority of white-fronted goose harvest in the Pacific Flyway occurs in California, and special harvest restrictions on white-fronted geese have been in place in the Sacramento Valley, the core tule goose wintering area, since 1979. The composition of tule geese in the white-fronted goose harvest from public hunting areas (where hunters' bags are checked in the field) in key migration and wintering areas has been obtained in some years through in-hand examination of harvested geese. Early estimates were made using a combination of weight and measurements of culmen and tarsus, and include estimates for both age classes. However, there were problems with consistent and accurate measurement by check station personnel. The various methods used to estimate tule goose harvest and the generally sporadic nature of the estimates limit the ability to describe long-term trends or assess the relative importance of harvest. In general, the

available information suggests that tule goose harvest may have increased in Oregon since 1996, is reduced in the Suisun Marsh in California, and appears somewhat similar in the Sacramento Valley of California. There are currently no estimates of the tule goose harvest from areas other than the public hunting areas.


DOUG STEINKE

1. Continue to collect measurement data from harvested white-fronted geese on the managed public hunting areas in the key migration and wintering areas.
2. Develop methodology to separate tule goose tail feathers from Pacific white-fronted goose tail feathers during the annual Parts Collection Survey.

Habitat Concerns: Habitat conversion, drought or other water shortages, and changes in agricultural practices may adversely affect the quantity and distribution of foraging or roosting habitat, especially in the Sacramento Valley during winter and in the Klamath Basin during spring. The continued decline in use of the Klamath Basin as a key autumn staging area by white-fronts and many other waterfowl species is a cause for concern.

Many areas used by tule geese are public lands afforded protection through classification as state and federal wildlife areas. In Alaska, the Redoubt Bay State Critical Habitat Area was established in 1989 to protect the only tule goose breeding and moulting area known at the time. Although most tule goose habitat in Alaska is on designated fish and wildlife lands, the current primary nesting and moulting area of the Susitna and Kahiltna Valleys is composed almost entirely of general state lands and small private parcels. Because tule geese were not known as a resource issue in these areas prior to 1994, the lands are subject to oil and gas leasing, mining, timber sales, and a variety of other development activities. Identification of tule goose use areas and establishment of protective stipulations has become a high priority.

1. Management programs and land use policies for state special areas in Cook Inlet should emphasize protection of tule geese and their habitats, as well as collection of data for tule goose management.
2. Measures to ensure protection of tule goose habitats and prevent impacts from disturbance should be developed and implemented for the Susitna and Kahiltna Valleys. A proposal for legislative designation of a wildlife special area should be considered to better ensure protection of core breeding and moulting areas.
3. Land management plans and policies for the Gandil River area should emphasize protection of tule goose staging habitat.
4. Identify preferred tule goose use areas in Washington, Oregon, and California that are not currently under state or federal management. Determine the desirability and feasibility of protecting (fee title acquisition, easement) such lands.
5. Continue to practice and encourage those land management strategies resulting in maintenance of habitat types identified as beneficial to migrant and wintering tule geese. Such efforts should include not only publicly managed areas, but also privately owned duck clubs and farms.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on national wildlife refuges and state-managed wildlife areas.

Greater White-Fronted Goose *Anser albifrons*

Pacific Population


DOUG STEINKE

Population Definition or Delineation: Pacific white-fronted geese are one of two subspecies of white-fronted geese that breed in Alaska and winter primarily in California. The other subspecies is the tule greater white-fronted goose, which is differentiated by morphological differences. Nearly all Pacific white-fronted geese breed from the Alaska Peninsula north to the Yukon River, with the majority nesting on the Yukon-Kuskokwim Delta. The primary wintering areas for Pacific white-fronts are the Sacramento Valley and the Sacramento/San Joaquin River Delta. These areas receive the majority of fall migrants, beginning in late September with peak numbers occurring by early to mid-November. A small percentage of the population, mostly from Bristol Bay, migrates early through the Klamath Basin in September, over-flies the Sacramento Valley, and winters in the northern highlands of Mexico.

Population Status or Assessment: Between 1965 and 1978 an index to the Pacific population was derived from peak fall counts in the Klamath Basin. A coordinated survey was initiated throughout the Flyway in 1979. This was due partly to changes in fall distribution as fewer birds staged in fall in the Klamath Basin. In 1985, a special aerial transect survey was initiated to quantify the number and distribution of breeding geese in the coastal region of the Yukon-Kuskokwim Delta, which covers nearly all of the high-density Pacific white-front nesting range. In addition, Pacific white-fronted geese are annually surveyed as part of the Alaska-Yukon Waterfowl Breeding Population Survey for the Bristol Bay area and interior portions of the Yukon-Kuskokwim Delta. The current population index for the Pacific population is a projected fall population derived by expanding the total indicated birds on the Yukon-Kuskokwim Delta and Bristol Bay breeding areas by the historic relationship between breeding ground and fall survey data sets. The annual index to the Pacific white-fronted goose population is increasing and is about 165% of the objective established in the Pacific Flyway Management Plan.

1. Conduct the annual Yukon-Kuskokwim Delta Coastal Zone Survey and Alaska-Yukon Waterfowl Breeding Population Survey.
2. Continue and expand annual coordinated fall surveys for dark geese and the Pacific Flyway midwinter survey to monitor seasonal distribution.

Population Dynamics: Survival rates have generally improved for Pacific white-fronted geese over the past 30 years, and are reflected in population growth during the late 1980s and early 1990s. Estimated annual survival was 0.68 during 1967-1969, 0.75 during 1979-1982, and 0.85 during 1985-1996. Immature Pacific white-fronted geese were observed to be particularly vulnerable to hunting as they were 2.8 times as likely to be harvested as adults. Flooding, predation, and timing of nest initiation can influence productivity. From the early to mid-1980s, the Arctic fox population reached a cyclic high and nest predation was significant on the diminished population of Pacific white-fronted geese. However, intense fox predation affected the Pacific population less than other goose species because white-fronted goose breeding distribution was more dispersed and extended farther inland. As well, nesting success for white-fronted geese is typically 20-40% higher than for cackling geese in years of high fox predation due to the white-fronted goose abilities to defend nests against terrestrial predators.

1. Annually band during pre-season 500-1,000 Pacific white-fronted geese on the Yukon-Kuskokwim Delta, Klamath Basin and/or Sacramento Valley.
2. Continue the random nest plot survey and air-ground comparison on the Yukon-Kuskokwim Delta to monitor density and distribution of breeding birds. (No actual production data are collected on Yukon-Kuskokwim Delta.)
3. Continue annual collection of family group size and age ratio data from field surveys in the Klamath Basin and Sacramento Valley.

Population Biology and/or Ecology: Rapid increase in sympatric nesting geese in the Yukon-Kuskokwim Delta coastal area may be creating inter-specific competition and degradation of foraging habitat used by Pacific white-fronted geese that could affect gosling growth rates and ultimately, survival.

1. Assess the effects of higher densities of breeding Pacific white-fronted geese and competition with other geese on quality of pre-nesting, nesting, and brood rearing habitats.

Harvest Assessment: A harvest strategy approved during summer 2003, identified population thresholds which guide general harvest levels for Pacific white-fronted geese. The plan recognizes the need to support and maintain a long-term harvest strategy that ensures equitable harvests among users, monitored through continuation of the breeding ground population surveys, state and federal harvest surveys, and subsistence harvest surveys. However, estimates of subsistence harvest are not obtained annually from some areas, particularly in the Bristol Bay and Alaska Peninsula regions and estimates of fall harvest in low harvest areas may not be reliable. Additionally, hunting restrictions to protect tule white-fronted geese have complicated harvest management.

1. Continue operational harvest surveys, parts collection, and state and federal check stations to provide more accurate estimates of the size and distribution of fall harvest.
2. Continue village harvest surveys on the Yukon-Kuskokwim Delta and improve survey consistency in other areas of Alaska to annually estimate seasonal subsistence harvest on breeding and staging areas.

Habitat Concerns: Habitat conversion, drought or other water shortages, and changes in agricultural practices may adversely affect the quantity and distribution of foraging or roosting habitat, especially in the Sacramento Valley during winter and in the Klamath Basin during spring. The continued decline in use of the Klamath Basin as a key fall staging area by white-fronts and many other waterfowl species is a major cause for concern. In recent years, earlier migrations of the increasing Pacific population northward, from the Sacramento Valley to the Klamath Basin, are creating increased crop depredation complaints. The earlier migration may be related to changes in forage abundance in the Central Valley of California.

1. Identify preferred white-fronted goose use areas not currently being protected and determine desirability and feasibility of protecting those important areas through purchase or easement programs. Priority areas for preservation are the Klamath Basin, East Grasslands, and Sacramento-San Joaquin Delta areas of California.
2. Determine the factors that may be causing the earlier migration of geese from the Central Valley to the Klamath Basin.
3. Encourage beneficial land use and management practices on public and private lands, and cooperatively managed private lands in wintering areas.
4. Develop cooperative strategies to address crop depredation where large numbers of Pacific white-fronted geese stage in spring (e.g., Klamath Basin)

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on national wildlife refuges and state-managed wildlife areas.

Emperor Goose *Chen canagica*

Population Delineation: Emperor geese are distributed in remote coastal habitats of Alaska and eastern Russia. Most emperor geese winter along the Alaska Peninsula and in the eastern Aleutian Islands. Spring and fall migrants use staging areas along the Alaska Peninsula. Emperor geese nest in western and southwestern Alaska and along the east and north coasts of Chukotka with the majority on the Yukon-Kuskokwim Delta, Alaska. Russian and Alaskan breeding emperor geese mix during migration and winter, based on observations of marked birds and band recoveries. The historical breeding range on the Alaska mainland extended from the north side of the Seward Peninsula to south of Kuskokwim River near Carter Bay. Nesting distribution is presently constricted as emperor geese are uncommon nesters on the Seward Peninsula and they are no longer known to breed south of the Yukon-Kuskokwim Delta. No subspecies or separate populations are currently recognized.

Population Status or Assessment: An aerial census of spring staging birds in coastal areas from the southern Yukon-Kuskokwim Delta through the Bristol Bay coastline to the south side of the Alaska Peninsula provides an annual estimate of population size. Eisenhauer and Kirkpatrick (1977) summarized available survey data to the 1970's suggesting a fall population between 175,000 and 200,000 geese and estimated 140,000 - 160,000 survived to spring. The population declined from the late 1970s through the early 1980s and has continued to be depressed to the present. The current (2004-2006) 3-year running average of the spring population estimate is 59,142 geese. Uspenskii reported as early as 1969 that the nesting population in Chukotka Peninsula was decreasing rapidly. Historic population estimates are 12,000 - 15,000 emperors breeding and moulting in Chukotka, with 200 wintering in the Commander Islands.

1. Continue annual spring aerial population survey of migratory staging areas to produce the primary population management index.

Population Dynamics: Since 1985, intensive random ground plot surveys have been conducted on the Yukon-Kuskokwim Delta in conjunction with aerial surveys to provide annual estimates of population size and production. Data indicate low, positive annual growth rates of +2.4% for total birds and +1.2% for active nests while the total population estimate from spring surveys indicates a very low annual decline of -0.4%/year. Natural mortality among juveniles is high during brood rearing and over their first winter, with survival positively correlated with body condition during fledging. Comprehensive photographic age ratio surveys in estuaries on the north side of the Alaska Peninsula provided a 20 year average of 18.3% young. After 1985, the proportion of juvenile birds declined by an average of 4.3% per year. Estimates of fall age ratio and family group size at the Izembek NWR since 1966 indicate averages of 23.2% juveniles and family group size of 2.8 juveniles per family. Juvenile age ratios at Izembek NWR have declined at 1.7% per year since 1966. Winter age ratio estimates in the Aleutian Islands averaged 14.5% juveniles, an average of 37.8% below corresponding fall estimates; this may provide an index of juvenile mortality. Byrd suggested that there is proportionally more mortality among juveniles than adults and suggested eagle predation and oiling were among possible causes. Seasonal and annual survival estimates of emperor geese, based on mark resightings, were found to be low compared to other goose species. Adult monthly winter survival rate was 0.940, whereas monthly over-summer survival varied among years from 0.940 to 0.980. Estimates of monthly survival of juveniles during their first winter period averaged 0.710. Subsequent monthly survival of juveniles was 0.943, similar to adults. Annual adult survival, estimated at 0.631 after adjustment for collar loss, was similar to the 0.587 reported by Petersen.

1. Continue annual fall aerial population survey of migratory staging areas. These data are used in conjunction with photographic age ratio surveys (B.3) to estimate the proportion of juveniles in the fall population.
2. Continue fall aerial photographic survey to determine the proportion of juveniles at staging sites. Continue ground sampling to estimate age ratios and average family group size at Izembek National Wildlife Refuge to maintain historic database.
3. Continue aerial breeding population survey in the coastal zone of the Yukon-Kuskokwim Delta. Use in conjunction with random nest plot survey to estimate total nests and potential production.
4. Continue annual random nest plot survey on the Yukon-Kuskokwim Delta coastal zone to index productivity.
5. Conduct an aerial photographic survey of brood flocks on the Yukon-Kuskokwim Delta to compare family size during late brood rearing to family group sizes during migration on the Alaska Peninsula and to assess the effects of potential predator management procedures.
6. Initiate studies to determine the effects of predator management designed to reduce emperor goose egg and gosling mortality on the Yukon-Kuskokwim Delta. Evaluate the effectiveness of these actions by estimating juvenile survival rates in relation to other factors influencing gosling mortality. Determine the effect of increased juvenile recruitment on population size.
7. Communicate with Russians to obtain breeding, moulting and migrating information throughout the Russian Far East. Arrange opportunities for cooperative aerial and ground surveys.
8. Complete population model using best available information to estimate how survival and reproduction effect population change and how manipulations might affect these changes.

Population Biology and/or Ecology: Emperor geese nest as dispersed pairs in coastal tundra areas, preferring slough borders, pond shorelines, peninsulas, moist meadows, ericaceous tundra, and small islands as nesting sites. Adults move broods from nesting areas to coastal salt marshes and estuarine habitats within one week of hatching, partially to find refuge from predators. Goslings spend over 80% of their feeding time in vegetated mudflats in coastal salt marsh where they consume nitrogen-rich salt marsh plants. During fall they also consume crowberries (*Empetrum nigrum)*.

Harvest Assessment: The Pacific Flyway Management Plan identified population thresholds which would help manage the harvest of emperor geese. After the decline of the population through the early 1980s, all legal hunting of emperor geese was closed in 1986. Subsistence harvest surveys have demonstrated that, despite the closure, subsistence hunting has continued primarily during spring and fall. Recent analyses of survival data suggest that subsistence harvest is contributing to the failure of the population to recover.

1. Continue to implement and enforce federal regulations for harvest of emperor geese and their eggs.
2. Conduct annual subsistence harvest surveys throughout habitats used by emperor geese to determine trends, magnitude, and timing of emperor goose subsistence harvest in Alaska.
3. Continue education and outreach programs designed to increase awareness of emperor goose management and biology with the goal of reducing both deliberate and incidental harvest.

Habitat Concerns: The impacts of long-term environmental changes in emperor goose habitats, such as warming Bering Sea temperatures, reduced sea ice, increased rates and impacts of storm surges, and vegetation changes are likely negative. Marine oil spills from vessels and spills and other habitat degradations resulting from oil developments in Bristol Bay are threats.

1. Initiate a winter study of emperor goose ecology to determine habitat requirements, physiological and nutritional requirements, and mortality factors.
2. Support existing and establish new protective measures to maintain adequate breeding, moulting, staging, migration, and wintering areas. Develop cooperative management agreements and public use plans with landowners to protect emperor goose habitat.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on national wildlife refuges and state-managed wildlife areas.

Snow Goose *Chen caerulescens*

Greater Snow Goose Population

Population Definition or Delineation: This subspecies does not appear to have recognizable, distinct affiliations on the breeding grounds. Recent range expansion has brought them into closer contact with some eastern flocks of lesser snow geese. On the wintering grounds, distribution is monitored through the annual midwinter waterfowl survey.

- A better understanding of the degree of intermixing with lesser snow geese on migration and breeding areas would be useful.
- Little is known about population affiliation in wintering areas.
- Research is needed to understand the importance of secondary staging areas (Ungava Peninsula, Lake Champlain, etc.) in the migratory ecology of the geese. A satellite telemetry project would best identify key staging areas in these remote regions and winter distribution, and should thus be carried through to completion.

Population Status or Assessment: This stock breeds from northern Foxe Basin and central Baffin Island northward to Ellesmere Island and northwest Greenland. The major staging area is located in southern Québec in the marshes and agricultural lands, from Lake Champlain to Lake St-Jean and from Québec-Ontario border to Baie-des-Chaleurs. The wintering area extends from New Jersey to North Carolina and is mostly confined to the coast. This population has increased dramatically from about 180,000 in 1980

(spring count) to more than 1,000,000 in 2007. The population is monitored by an annual photographic survey in late April or early May when the flock is concentrated in southern Québec staging area.

1. The spring photo survey in southern Québec remains the most effective means of monitoring population change, even though increasing numbers of geese, a wider geographical spread to their staging areas, and more frequent dispersal to inland farm fields make the task more difficult. For these reasons, it is critical that the expanded survey conducted in 2004 be maintained on an annual basis.
2. Considering the recent eastward and northward changes in the distribution of geese staging in southern Québec, monitoring the distribution and movements of geese fitted with satellite telemetry transmitters should be supported. This monitoring will allow more accurate annual estimates of the spring population size by assessing the proportion of geese that are missed during spring fixed-wing photographic surveys and also lead to a better understanding of distribution of greater snow geese on their breeding and wintering grounds since the recent population increase.
3. A method for counting the number of geese in flocks using digital imagery analysed with specialized software to obtain a complete and accurate measure of the spring population should be developed. This would also eliminate the labour cost associated with counting geese from photos.
4. The breeding survey, conducted every five years since 1983 at the largest nesting colony (Bylot Island, Northwest Territories), should be continued (next due 2008).
5. Given the demonstrated ability of large snow goose populations to affect habitat, surveys of appropriate areas throughout the eastern Arctic should be implemented at intervals to clarify range expansions or contractions on the breeding grounds, not only to evaluate the status of greater snow geese, but also to examine their potential effect on the much smaller population of eastern high Arctic brant.

Population Dynamics: The banding program provides up to date information on survival and harvest rates and should be continued. These geese have bred successfully (>10% young in fall flight) in 27 of the past 32 years (1976-2007), maintaining an average rate of approximately 24% young in the fall flight. Productivity is appraised by age ratio counts during fall in southern Québec.

Detailed information on nesting effort, nesting success, and rearing success has been obtained annually from a field study on Bylot Island (1989-2007, to continue through 2012). Because of evidence of density dependent declines in body condition, there is a need to obtain statistically sound estimates of survival rates of juvenile and adult cohorts.

1. Continue annual banding program on breeding grounds on Bylot Island and Ellesmere Island.
2. Productivity is best monitored by age ratio counts in fall in southern Quebec.
3. The field study on breeding ecology on Bylot Island should be carried through to completion (2012) to allow a better understanding of the effects of weather, predation, and habitat conditions on recruitment.
4. Although data recorded on Bylot Island is considered to be highly representative of the situation occurring throughout the main breeding area which includes much of northern Baffin Island, some geese breed at considerable distances from this core area and may therefore be subject to different conditions (e.g., effects of weather on reproduction; longer migratory distances [affecting survival rates]; effects of grazing pressure on habitat integrity). Additional studies outside the core area, surveys, banding and neck collaring efforts in parts of eastern Axel Heiberg and western Ellesmere islands should be conducted to obtain data for evaluation of survival rates.


TIM MOSER


GUSTAF SAMELIUS

Population Biology and/or Ecology: Similar to other Arctic nesting species, it is imperative to continue to evaluate factors related to annual productivity such as nest success, brood survival, and the effects of weather conditions. Current work on Bylot Island has contributed greatly to our knowledge of the breeding biology of greater snow geese. Similar work should be conducted on other important satellite colonies to ensure that Bylot Island continues to constitute a representative sample. Additionally, with changing global climate patterns and changes in agricultural policy throughout the range, it is increasingly important to understand how these changes along migratory paths and the wintering grounds affect demography and population vital rates.

1. Maintain and enhance breeding survey and banding program, to include important satellite colonies.
2. Maintain current monitoring programs on staging grounds.
3. Develop and implement monitoring programs on staging and wintering areas that track changing habitat conditions and goose response.

Harvest Assessment: Trends in the spring population size over the last few years indicate that the conservation actions implemented between 1999 and 2007 have been successful in halting the growth of the population, which now numbers between 800,000 and about 1,000,000 individuals. But the environmental conditions (e.g., milder summers on the Arctic breeding grounds, increasing acreages of corn fields near staging and wintering grounds) that have led to the overabundance of geese are still present and may even be increasing in eastern North America. The spring conservation harvest in Québec was the most effective special measure at reducing population growth through its direct (survival) and indirect (fecundity) effects on adult breeders. However, recent harvest surveys indicate that both the number of hunters and the total number of geese harvested in spring in Québec are declining, suggesting that the effectiveness of the spring harvest to control population size is decreasing. Moreover, attenuation of the indirect effects of disturbance on the fecundity of geese is now becoming evident. Recent data indicate that the total Canadian harvest (spring conservation and fall sport harvests combined) cannot be substantially increased. Therefore, the only sustainable management solution to control the size of this population in North America in the medium and long-term is to substantially increase harvest in the United States.

1. Develop a cooperative harvest management strategy to optimize harvest opportunity, while maintaining population health.

Habitat Concerns: The use of farmland has increased the carrying capacity of the range and led to conflict with agricultural interests, and with the rapid increase of the population, grazing pressure on many natural staging and wintering marshes remains high. Since 1998, the conditions of natural habitats used by the greater snow goose have not changed significantly and no additional degradation has been observed. However, it is difficult to determine if this situation is associated with the stabilization of the population size, the effect of

possibly more favorable weather conditions in the past years (especially in the Arctic region), or to an increased use of farmland during the migration and wintering periods.


JOSÉE LEFEBVRE

With the aim of determining a suitable target population size based on ecological and social considerations, a recent study showed that a spring population ranging from 500,000 to 750,000 would result in optimal benefits to the society.

Although the special conservation measures have been successful in stopping population growth, perhaps a greater challenge remains to determine the carrying capacity of the habitats used throughout the year, so that an ultimate population goal can be determined.

1. There is a need to evaluate the carrying capacity of natural habitats in breeding, staging, and wintering areas so that an appropriate target population size can be determined and refined.
2. There is a need to develop more effective means of achieving a more ecologically balanced distribution over the available habitat. This requires a better understanding of goose-habitat relationships on staging, wintering, and breeding areas, and can only be gained by intensified research.
3. Research is needed to develop and implement methods of reducing damage to agricultural crops and to natural wetland habitats.

The greater snow goose population objective should be reviewed through an analysis of recent ecological and socio-economic data on their staging and wintering grounds. This analysis must be taken into account in the development of a sustainable resource development framework.

Parasites, Disease and/or Contaminants: Although there is currently no indication of any unusual or extraordinary disease effects in the greater snow goose population, monitoring should be conducted and appropriate action taken if the situation warranted. It is imperative to any population model or harvest strategy to identify and understand the dynamics of any source of significant non-hunting mortality.

One possible transmission route of highly pathogenic Asian H5N1 avian influenza (HPAI) to North America is the eastern Canadian Arctic to which trans-Atlantic migrant birds might carry the virus from wintering grounds. Greater snow goose population on the breeding grounds is very close to the eastern high Arctic brant, which winter primarily in Ireland, and stage in Iceland and Greenland.

1. Maintain adequate surveillance on the high Arctic breeding group to detect the presence of HPAI or die-offs.


JEFF COATS

Snow Goose *Chen caerulescens*

Midcontinent Lesser Population

Population Definition or Delineation: Delineation of the midcontinent population of lesser snow geese is based on the common distribution of recoveries of birds banded on all nesting colonies east of 110W longitude in Canada. Ninety per cent of midcontinent snow geese nest north of 60°N latitude in Nunavut with important known colonies that include Colonies 3, 9, 10, and 46 in the Queen Maud Gulf region of the central arctic, the west coast of Hudson Bay, Southampton Island, and Baffin Island in the eastern Arctic. The rest of the population (10%), nests along the south coast of Hudson Bay, mainly at Cape Henrietta Maria, Ontario, and La Perouse Bay, Manitoba. There is anecdotal evidence that migration routes have shifted westward in northern staging areas, while wintering distributions have expanded eastward and northward in the United States.

1. Delineate population based on analyses of recent and ongoing marking program. Adjust population management and monitoring of indicated units as needed.
2. A better understanding of the degree of intermixing with greater snow geese and other populations of lesser snow geese on migration and breeding areas would be useful.

Population Status or Assessment: Existing winter surveys provide coarse indices of abundance for midcontinent lesser snow geese, because they are not based on a statistical sampling framework, count an unknown proportion of the population each year, and include an unknown number of Ross's geese and young of the year. Spring photographic surveys of arctic colonies have been used to monitor trends in numbers of nesting adults at all known nesting colonies, but are time-consuming to analyze, and also cover an unknown

proportion of the overall population. Despite weaknesses, these efforts have provided representative data for monitoring trends in specific portions of the population, which have generally increased over time. Recent analyses suggest that use of harvest estimates and banding data can provide annual estimates of total population size, but require additional evaluation to determine potential sources of error or bias. This error or bias relates directly to the reliability of harvest estimates of geese in both Canada and the United States.

1. Continue photographic surveys of nesting colonies unless/until alternative methods are developed.
2. Explore use of digital counting software to improve efficiency of photo analysis.
3. Continue to explore use of banding and harvest data to estimate population size.

Population Dynamics: Recent analyses suggest important differences in migration chronology and vital rates among northern and southern-nesting segments of the midcontinent population. Southern colonies tend to have earlier migrations, higher recovery rates, and lower survival rates than do northern colonies, where most snow geese currently nest. Representative marking programs are required to adequately monitor changes in vital rates in response to ongoing harvest management actions aimed at increasing harvests and lowering adult survival rates in this population. Preliminary analyses suggest that while adult survival rates have declined among 10% of snow geese that nest south of 60°N latitude, there has been no change in survival among the 90% of the midcontinent population that nests north of 60°N latitude. In neither stratum are the declines in survival sufficient to result in stable or declining population size. Long term declines in harvest age ratios suggest that density-dependent factors may be operating to reduce overall productivity, and continued monitoring of productivity is warranted.

1. Re-allocate banding effort to provide more representative marking of the population in relation to their distribution on the breeding grounds, i.e., proportionately more effort in the north, and proportionately less in the southern portions of the range.
2. Periodic reward banding studies to monitor changes in harvest rates and band-reporting rates for geese.
3. Maintain long-term monitoring of nesting birds at both northern and southern nesting colonies.
4. Evaluate fall age ratio counts on the Canadian prairies as a means of monitoring productivity.

Population Biology and/or Ecology: Midcontinent lesser snow geese exist in very large numbers, yet we have relatively little information on factors influencing their productivity. A long term decline in age ratios suggests that density-dependent factors may be operating to reduce productivity of the population, but the mechanism is unknown. In addition, Arctic climate is expected to ameliorate due to the effects of global warming, and the effects on snow goose dynamics are difficult to predict. Relatively little is known about what staging habitats are used by snow geese in the northern portions of their range, and the impacts that the geese may be having on those areas.

1. Refine knowledge of fall/spring migration routes, timing, and important staging sites used by midcontinent snow geese, particularly in northern Canada, through the use of satellite telemetry.
2. Maintain long-term monitoring of nesting birds at both northern and southern nesting colonies to explore factors affecting their productivity, including predation, global warming, and habitat alteration.

Harvest Assessment: Harvests of midcontinent lesser snow geese increased, at least initially, after measures to increase harvest (i.e., increased bag limits, spring conservation seasons) were implemented. An ongoing challenge in assessment of harvest is the lack of a consistent survey design among harvest states for spring conservation order harvest. In addition, there is no parts survey associated with the spring conservation order, so harvest estimates include both Ross's geese and snow geese, and both juvenile and adult birds of each


FRANCIS ST. PIERRE


DOUG STEINKE


ROD BROOK

species. Increasing overlap among some populations on staging and wintering areas has further complicated the attainment of population-specific harvest estimates. There is potential to estimate conservation order harvest by using both band recoveries and estimates of regular season harvest.

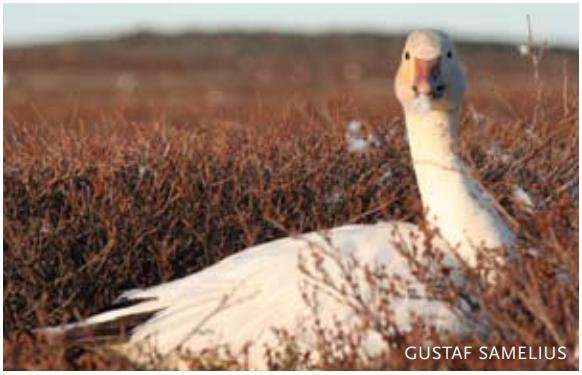
1. Design a consistent harvest survey approach across harvest states and provinces to better estimate harvest of midcontinent snow geese during spring conservation seasons.

Habitat Concerns: Some areas of Hudson Bay and the central Arctic have been heavily damaged by the large numbers of staging and breeding geese, and evidence suggests that the extent of damage in southern areas continues to expand. These impacts on habitat have ramifications for productivity of some population units, and long-term viability of colony locations. There is evidence of localized dispersal from some traditional colony sites, and expansion into new areas. Damage to habitats can also impact other geese, other birds, and overall ecosystem integrity. Most habitat assessments have focused on staging areas and southern colony locations, and detailed habitat analyses at some northern nesting colonies have not been completed. Staging areas outside of coastal Hudson Bay are largely unknown, so the extent of damage may go beyond what has been assessed to date.

1. Assess habitat damage throughout the breeding range and investigate impacts to health, population productivity and colony dynamics of lesser snow geese. Continue to investigate the impacts on other species and on coastal ecosystem processes.
2. Develop a population goal that is sustainable and consistent, over the long term, with reducing damage to breeding areas and managing the population by conventional harvest methods.
3. Improve understanding of staging habitats used during migration, their importance to lesser snow geese, and possible impacts to these habitats, particularly those north of the prairies, through satellite telemetry studies of migrant snow geese.

Parasites, Disease and/or Contaminants: Large concentrations of snow geese on migration and wintering areas provide opportunities for disease outbreaks that may also impact other species.

1. Conduct research and develop strategies for preventing disease epidemics through altered refuge management practices and other programs.
2. Protect and improve winter habitat quality and quantity through the NAWMP habitat joint ventures.


GUSTAF SAMELIUS


ROD BROOK

Snow and Ross's Goose

Western Central Flyway Population of Lesser Snow Geese and Ross's Geese

Population Definition or Delineation: Unlike most populations considered by the AGJV, the western central flyway population is defined by its wintering ground affinities rather than by breeding ground origins. When last evaluated, this somewhat artificial amalgam was comprised primarily of snow geese from the western Arctic population (75%), with smaller numbers midcontinent snow geese (15%), and Ross's geese from the central Canadian Arctic (10%). The number of western Arctic snow geese wintering in the western central flyway has increased historically and a smaller proportion of that population winters in the Pacific flyway than formerly. The recent winter distribution of western Arctic snow geese needs to be better documented and the overall species and breeding population composition of the western central flyway population needs to be updated.

1. Delineation of population based on analyses of recent and ongoing marking program. Adjust population management and monitoring of indicated units as needed.
2. Update delineation of population based on more recent breeding ground surveys, wintering ground counts, and banding information.

Population Status or Assessment: Existing winter surveys provide only indices of total lesser snow and Ross's geese and it is difficult to ascribe a breeding ground origin to the wintering geese. All the breeding populations which contribute to the western central flyway population seem to be increasing steadily. Survey results are confounded by the mixing of populations. Snow and Ross's goose numbers and distribution in Mexico are not well documented in some locations and are only periodically assessed in other areas.

1. Develop regularly scheduled breeding area surveys to monitor breeding population trends in all units.
2. Implement an operational banding program to monitor distribution and harvest of defined population units.
3. Develop and apply survey techniques to separate Ross's geese from white phase snow geese during migration periods, winter, and the breeding season.

Population Dynamics: The marking program will provide substantial new information on survival and harvest rates (including the effects of liberalized harvest on population growth). Similarly, breeding numbers can be adequately addressed by regular surveys. Overall production estimates from age ratio surveys lack consistency.

1. Continue or initiate banding programs on Banks Island, at the smaller mainland colonies in the western Arctic, and at Queen Maud Gulf.
2. Conduct regular age ratio surveys on fall staging areas and wintering grounds (if possible, related to defined sub-populations).


KIEL DRAKE

Population Biology and/or Ecology: Basic studies on factors influencing production should be updated on Banks Island and the small mainland colonies in western Arctic. In the western Arctic, the smaller mainland colonies are threatened by oil and gas development, habitat change, and other factors. The risks associated with these threats should be evaluated and appropriate mitigation procedures developed and implemented.

1. Initiate, expand, or update research on factors influencing production on Banks Island and the smaller mainland colonies in the western Arctic.

Harvest Assessment: The harvest of lesser snow geese cannot be currently apportioned by population units. Mixing of populations with different harvest goals further complicates harvest management. Population growth in some breeding areas may necessitate the development of strategies to increase population specific harvest.

1. Continue to implement and evaluate practices for expanded harvest of population units with undesirably high numbers and/or concentrations.
2. Design and test methods to estimate harvest for defined population units.
3. Develop and apply enhanced harvest estimates under the expanded harvest regime.

Habitat Concerns: With the growth of the western Arctic population, there is potential for snow geese to impact breeding areas on Banks Island as has been witnessed near Hudson Bay and in central Arctic. These impacts on habitat have ramifications for productivity of population units and long-term viability of colonies. The damage can impact other geese, other birds, and overall ecosystem integrity. Migration and wintering areas for western Arctic populations are threatened by development pressures. In the western Arctic, mainland breeding and staging areas are threatened by gas and oil development.

1. Assess habitat damage throughout the breeding range of lesser snow geese and investigate impacts to health, population productivity, and colony dynamics. Investigate the impacts on other species and on coastal ecosystem processes.
2. Develop a population goal that is sustainable and consistent, over the long-term, with reducing damage to breeding areas and managing populations by conventional harvest methods.
3. Delineate winter and staging habitat requirements for the population and develop securement or protection strategies in cooperation with NAWMP habitat joint ventures.

Parasites, Disease, and/or Contaminants: Large concentrations of snow geese on migration and winter areas provide opportunities for disease epidemics (e.g., cholera).

1. Conduct research and develop strategies for preventing disease epidemics through altered refuge management practices and other programs.
2. Protect and improve winter habitat quality and quantity through the NAWMP habitat joint ventures.

Snow Goose *Chen caerulescens*

Western Arctic Lesser Population

Population Definition or Delineation: Most (>95%) of the western Arctic population geese breed on Banks Island, Northwest Territories, with four smaller breeding colonies occurring on the mainland of the Northwest Territories and Alaska. Banding and marking efforts have provided information on the distribution of lesser snow geese from each area. Historically the population wintered primarily in the Central Valley of California but there has been a gradual and significant shift eastward in wintering distribution over the past several decades. The recent winter distribution of western Arctic snow geese needs to be better documented and the number of geese moving to each wintering area needs to be better quantified. The management implications of changing distributions should be carefully evaluated and the year round distribution of geese from the smaller colonies should be evaluated as well.

1. Delineate population based on analyses of recent and ongoing marking program. Adjust population management and monitoring of indicated units as needed.

Population Status or Assessment: Existing winter surveys provide only approximate estimates of total lesser snow geese and it is difficult to ascribe a breeding ground origin to the wintering geese. In parts of its range, the western Arctic population mixes with two other breeding populations of snow geese with highly different conservation status (the relatively small Wrangel Island population and the overabundant midcontinent population) as well as increasing populations of Ross's geese. Survey results are confounded by the mixing of populations, but it is clear that management efforts directed at other populations will influence the western Arctic geese. Snow goose numbers and distribution in Mexico are not well documented in some locations or regularly determined in other areas.

1. Develop regularly scheduled breeding area surveys to monitor breeding population trends in all units.
2. Implement an operational banding program to monitor distribution and harvest of defined population units.
3. Develop and apply survey techniques to separate Ross's geese from white phase snow geese during migration periods, winter, and the breeding season.


TIM MOSER


MICHAEL A. JOHNSON

Population Dynamics: The marking program will provide substantial new information on survival and harvest rates (including the effects of liberalized harvest on population growth). Similarly, breeding numbers can be adequately addressed by regular surveys. Overall production estimates from age ratio surveys lack consistency.

1. Continue or initiate banding programs on Banks Island and the smaller mainland colonies in the western Arctic.
2. Conduct regular age ratio surveys on fall staging areas and wintering grounds (if possible, related to defined sub-populations).

Population Biology and/or Ecology: Basic studies on factors influencing production should be updated on Banks Island and the small mainland colonies in the western Arctic. These smaller mainland colonies are threatened by oil and gas development, habitat change, and other factors. The risks associated with these threats should be evaluated and appropriate mitigation procedures developed and implemented.

1. Initiate, expand, or update research on factors influencing population size, distribution, and production on Banks Island and the smaller mainland colonies in the western Arctic.

Harvest Assessment: The harvest of lesser snow geese cannot be currently apportioned by population units. Mixing of western Arctic geese with other populations with different harvest goals further complicates harvest management. Population growth in some breeding areas may necessitate the development of strategies to increase population specific harvest.

1. Continue to implement and evaluate practices for expanded harvest of population units with undesirably high numbers and/or concentrations.
2. Design and test methods to estimate harvest for defined population units.
3. Develop and apply enhanced harvest estimates under the expanded harvest regime.

Habitat Concerns: With the growth of the western Arctic population, there is potential for snow geese to impact breeding areas on Banks Island as has been witnessed near Hudson Bay and in the central Arctic. These impacts on habitat have ramifications for productivity of population units and long-term viability of colonies. The damage can impact other geese, other birds, and overall ecosystem integrity. Migration and wintering areas for western Arctic populations are threatened by development pressures. Mainland breeding and staging areas are threatened by gas and oil development.

1. Assess habitat damage throughout the breeding range of lesser snow geese and investigate impacts to health, population productivity, and colony dynamics. Investigate the impacts on other species and on coastal ecosystem processes.
2. Develop a population goal that is sustainable and consistent, over the long-term, with reducing damage to breeding areas and managing populations by conventional harvest methods.
3. Delineate winter and staging habitat requirements for Wrangel Island and western Arctic and develop securement or protection strategies in cooperation with NAWMP habitat joint ventures.

Parasites, Disease, and/or Contaminants: Large concentrations of snow geese on migration and winter areas provide opportunities for disease epidemics (e.g., cholera).

1. Conduct research and develop strategies for preventing disease epidemics through altered refuge management practices and other programs.
2. Protect and improve winter habitat quality and quantity through the NAWMP habitat joint ventures.

Snow Goose *Chen caerulescens*

Wrangel Island Lesser Population

Population Definition or Delineation: Lesser snow geese are managed by four geographical population units: midcontinent, western central flyway, western Arctic, and Wrangel Island. In the 1980s, intensive cooperative marking efforts were undertaken on several major breeding colonies, including Wrangel Island, to delineate population units and document interchange rates. Collar sightings, and results from limited VHF/satellite transmitter projects, suggest that Wrangel Island snow geese are relatively distinct from all other populations, especially on the northern winter grounds (i.e., the Fraser and Skagit River deltas) where virtually no mixing occurs with other populations. On the California winter grounds, Wrangel Island geese mix with snow geese breeding in the low western Canadian Arctic (e.g., Banks Island, McKenzie River delta).

- Continue operational banding and refine knowledge of fall/spring migration routes, timing, and important staging sites used by Wrangel Island snow geese in Canada, Alaska, and Siberia through the use of satellite telemetry.

Population Status or Assessment: Russian biologists estimated that Wrangel Island supported >250,000 snow geese in the 1950s and 1960s. Since 1970, Russian biologists have been conducting spring population estimates on Wrangel Island and collecting data on breeding success, clutch size, family size, etc. annually. The breeding population decreased from approximately 150,000 in 1970 to only 50,000 in 1975 due to several consecutive years of breeding failures caused primarily by poor weather conditions. Since that time, the population fluctuated but has gradually increased to ca. 140,000–150,000 in 2008. Aerial surveys to

monitor population size and trends post-hatch on Wrangel Island were attempted in the early 1990s but abandoned due to the high cost and uncertainty of aircraft availability.

In winter, the Wrangel Island segment on the northern winter grounds in Washington and British Columbia are measured accurately by air-photo counts. The size of the winter segment in California cannot be estimated because the geese mix with a larger number of western Arctic birds. The northern and southern wintering segments have experienced important shifts in recent decades: the proportion of the Wrangel population wintering on the Fraser and Skagit River deltas (the northern component) has increased steadily from approximately 20-30% in the 1950-60s to >60% in recent years. This has been accompanied by a large increase in the absolute size of the northern segment, from approximately 15,000 in the mid-1970s, to 30-40,000 in the early 1990s, to approximately 90,000 in 2007-08. Past hypotheses for the proportional shift have included habitat/disease problems in California, differential survival (harvest) rates, and/or short-stopping of birds on the Fraser-Skagit deltas in fall. The population increase on the Fraser and Skagit deltas is suspected to be due primarily to high reproductive rates in recent years which, in turn, are being caused by unusually good weather conditions on Wrangel Island (possibly associated with warming of the Arctic). As has been the case with the midcontinent population of lesser snow geese, the following factors also likely contributed to the population increase: establishment of protected areas, foraging on agricultural crops, and relatively high adult survival rates associated with reduced harvest rates. The Fraser-Skagit winter population has grown to the point where the geese are now causing problems with crop depredation on local farms, air traffic safety issues at the Vancouver International Airport, nuisance concerns in urban areas, and over-consumption of bulrush rhizomes on the foreshore marshes.

1. Annually, collect data on population status (abundance and colony size) on Wrangel Island.
2. Annually, conduct White Goose Survey and Midwinter Survey air-photo counts to track abundance, recruitment, and distribution on the Fraser and Skagit River deltas.
3. Reassess hypothesis of changes in wintering termini using available marking data.

Population Biology and/or Ecology: For management purposes and to understand population dynamics, it is important to continue to collect data on specific vital rates at both Wrangel Island and on the winter grounds. Vital rates are influenced by a variety of factors. In some years, predation by Arctic foxes and disturbance by ungulates (reindeer and muskoxen) on the Wrangel Island colony have negatively impacted breeding birds and recruitment. Despite some preliminary satellite telemetry work undertaken in 1991-92, there is still very little known about the migration routes, timing, and important staging sites used by Wrangel Island snow geese in Canada, Alaska, and Siberia. This is especially true for spring migration when the Fraser/Skagit wintering birds join with the California wintering component somewhere in northern Canada or Alaska.

1. Annually, collect data on factors influencing production (breeding success, clutch size, family size, weather conditions, predation rates, etc) on Wrangel Island.
2. Develop a rigorous population model to determine which factors are most important in contributing to population change (recruitment, harvest, natural factors) and predict population trends under different climate change scenarios.
3. Assess the role of predation and reindeer/muskoxen trampling on survival and reproduction, periods of vulnerability, interaction of weather and predation, and annual variation in these factors.
4. Refine knowledge of fall/spring migration routes, timing, and important staging sites used by Wrangel Island snow geese in Canada, Alaska, and Siberia through the use of satellite telemetry.

Harvest Assessment: Special mail and road-side surveys have been used since the late 1980s to determine harvest rates on the Fraser and Skagit River deltas. Results suggest a mean annual harvest rate of 7-8%

(as a proportion of the mid-winter population), which has increased to 10-11% in 2005-06 and to even higher levels in 2007-08. United States, Canadian, and Russian biologists have been banding snow geese on Wrangel Island since the 1970s. Banding typically included neck collars but a recent effort between the United States and Russian biologists investigated hunter bias and marker loss problems associated with neck collars. A thorough analysis of these data should be completed to more fully compare harvest rates between the northern and southern wintering segments using current information. Based on a cooperative harvest strategy developed among management agencies (including Russia) and adopted by the Pacific Flyway Council in 2006, hunting regulations on the Fraser and Skagit River deltas are being altered to regulate harvest and maintain the population within acceptable levels.

1. Continue annual operational banding and complete analysis of legband data to compare harvest rates between the northern and southern winter population segments.
2. Implement 2006-2010 Pacific Flyway Management Plan Harvest Strategy and refine the strategy as required by 2011. Develop new rigorous population models to refine target harvest rates at various population levels.
3. Annually, conduct special annual harvest surveys on the deltas and evaluate the effects of more liberal regulations on population dynamics.

Habitat Concerns: Several protected areas have been established on the Fraser and Skagit deltas (Reifel MBS Alaksen NWA, Fraser River delta, and the Fir Island/Hayton Reserve on the Skagit River delta). These protected areas are off-limits to hunters and portions are managed to produce high quality foods such as cover crops and pasture grasses that are of higher quality than the traditional diet of bulrush rhizomes. Over the years, foraging on these agricultural foods has likely improved body condition and survival rates of the geese. Snow geese started to forage on farm crops on the Skagit River delta in the 1950s and on the Fraser River delta beginning in 1980. Cover crop programs initiated with farmers on both deltas in the early 1990s increased the amount of high quality food available to the geese. The large number of geese in recent years has resulted in elevated grubbing rates in the marsh to the point where bulrush density on the Fraser River delta has been reduced by about 50% since the early 1990s and is predicted to go functionally extinct within the next 25 years. The resulting damage will impact snow geese, other birds and important estuarine functions (e.g., the detrital food web). In addition, to avoid conflicts between snow geese and aircraft, Vancouver International Airport personnel have been actively scaring geese in recent years; this is especially critical now that both the goose population and air traffic have increased. The scaring program has resulted in a net loss estuarine habitat and reduced the carrying capacity of the Fraser River delta. Compensation funds from Transport Canada and Vancouver International Airport are being used to more intensively manage upland (farm) habitats to support the displaced geese.

1. Continue to assess bulrush density and biomass in permanent plots on the Fraser River delta and expand this to the Skagit delta.
2. Continue to improve management prescriptions on upland habitat to support wintering snow geese.

Parasites, Disease, and/or Contaminants: Large concentrations of snow geese on migration and winter areas provide opportunities for disease epidemics (e.g. cholera). The northern wintering component of the Wrangel population appears to be healthy but disease may play a role in California. In addition, avian influenza may be a concern because these birds move between Asia and North America in large numbers.

1. Continue to monitor for disease mortality on federal, provincial and state-managed wildlife areas.
2. Conduct research and develop strategies for preventing disease epidemics through altered refuge management practices and other programs.

Ross's Goose *Chen Rossii*

Population Definition or Delineation: Ross's geese have expanded their breeding and wintering ranges eastward dramatically in the last 40 years. Monitoring range expansion on breeding and wintering areas will facilitate assessment of population status, delineation, and presence of manageable geographic groups. Hybridization between Ross's geese and snow geese is likely increasing.

1. Estimate species composition during banding/survey operations at light goose colonies.
2. Conduct annual surveys to determine species composition and productivity of light goose flocks in the Pacific, Central, and Mississippi Flyways.
3. Mark Ross's geese within traditional and new breeding range, and use recoveries of legbanded geese to evaluate associations among breeding, staging, and wintering areas.

Population Status or Assessment: Ross's geese are monitored periodically through counts derived from aerial photography of certain breeding colonies, and from annual ground-based sampling at some major colonies in the Queen Maud Gulf (1993-present). Both assessments require on-ground verification to determine proportions of Ross's and sympatric lesser snow geese present at time of sampling. Continued expansion of Ross's goose breeding range, primarily into the eastern Arctic, is incompletely monitored. Similarly, the winter distribution of Ross's geese has expanded eastward and is inadequately documented. Continued and improved monitoring is needed to track changes in abundance.

1. Conduct periodic photo-counts with ground verification on the breeding grounds. Implement research to address issues related to methodological assumptions and detection bias.
2. Continue and expand periodic or annual assessments on breeding colonies in traditional and new range.
3. Continue to conduct annual ground surveys to track trends in species composition and productivity of Ross's Geese on fall staging areas in Saskatchewan.
4. Continue legbanding of Ross's geese in Queen Maud Gulf Bird Sanctuary (priority), and west coast Hudson Bay (secondary), in conjunction with harvest estimates, for estimation of population size.
5. Conduct research for estimation of population size (using band recovery and harvest data).

Population Dynamics: All populations of light geese in the midcontinent region, including Ross's geese are far above NAWMP population goals. Monitoring production, recovery, and survival rates of Ross's geese during periods of high light goose harvest is needed. Ongoing work is providing information on factors influencing production in the Queen Maud Gulf. Ongoing marking efforts will provide information on recovery and survival rates.

1. Continue and expand monitoring of Ross's goose production. Obtaining age ratios in Saskatchewan is a priority.
2. Maintain programs to legband Ross's geese on breeding areas, and expand where necessary.

Population Biology and/or Ecology: Ross's geese are expanding rapidly, numerically and geographically. Ross's goose abundance appears to be increasing at a faster rate than lesser snow geese and the limits of this expansion are unknown. Population growth and limits have strong implications regarding habitat degradation on their breeding (see below) and wintering habitats, as well as impacts on sympatric species.

1. Improve monitoring of Ross's geese on nesting colonies to explore factors affecting their habitat selection, productivity, and habitat alteration.
2. Create a population model using input from AGJV programs including estimation on limits to Ross's goose geographic and numerical growth.

Harvest Assessment: Annual indices of harvest and production derived from harvest parts collection surveys may be biased by reduced body size of lesser snow geese in late phenology years or due to habitat degradation.

1. Refine methods to discriminate Ross's geese from snow geese in parts collection surveys.

Habitat Concerns: Increasing numbers of Ross's geese intermix with midcontinent lesser snow geese throughout their range. Continued range expansion and population growth raises concerns about the contribution Ross's geese are making to habitat degradation in the Arctic. Ross's geese degrade tundra habitats during grubbing associated with nest building and other periods. The ability and habit of Ross's geese to forage on shorter vegetation than lesser snow geese suggests they may contribute to increased exploitation and a prolonged recovery period for tundra habitats above and beyond that which would occur in the presence of lesser snow geese only.

1. Encourage studies to better determine the impact of Ross's geese on Arctic habitats.
2. Encourage research aimed at expanding knowledge of Arctic-wide carrying capacity for light geese. Current viewpoint on carrying capacity does not give adequate consideration to freshwater habitats, especially in the central Arctic.

ALL: GUSTAF SAMELIUS

Parasites, Disease, and/or Contaminants: Large concentrations of light geese face a high likelihood of disease events. Snow and Ross's geese appear to serve similar functions in the etiology of avian cholera, which is a substantial mortality factor for many North American waterfowl species.

1. Conduct research on the etiology of avian cholera.
2. Develop and implement strategies to reduce disease frequency and severity through habitat management.


TIM MOSER

Brant *Branta bernicla*

Eastern High Arctic Population

Population Definition or Delineation: Based on limited legband data from the 1970s through to the 2000s, and recent satellite telemetry, the breeding range of the eastern high Arctic brant is thought to include locations throughout the eastern Queen Elizabeth Islands, from eastern Melville Island in the west to Devon Island in the east, as well as the areas to their north, including Axel-Heiberg and Ellesmere islands. They are not thought to breed in northwestern Greenland, although they were believed to do so a century ago, and there are very recent suggestions of breeding activity there. The geese winter primarily in Ireland, and stage in Iceland and Greenland. The population is believed to be distinct from the morphologically similar Atlantic brant nesting to the south and western high Arctic brant (WHA brant) to their west. Geographic delineation from the western high Arctic brant is less certain than from Atlantic brant. The number of wintering geese is much higher than can be accounted for at known breeding locations.

1. Use satellite transmitters to mark birds on the breeding grounds throughout the high arctic, and particularly in the central high Arctic where eastern high Arctic brant may overlap with western high Arctic brant to increase confidence and precision of the population delineation.
2. Continue to mark birds in Ireland and Iceland with satellite transmitters. With sufficient sample sizes, with birds captured throughout the winter population, the extent of the breeding range should eventually be well described.
3. Complete analysis of genetic structuring among global brant populations.

Population Status or Assessment: The abundance of eastern high Arctic brant has been evaluated annually since 1960/61 through surveys on the primary wintering grounds in Ireland. Before that, experts believed that the population had declined rapidly, mainly because of the disappearance of their primary food (*Zostera*) from a wasting disease, but also partially due to hunting. Counts made through the 1960s and 1970s indicated abundance varied between 11,000 and 17,000 birds. By the late 1990s, the counts increased to about 20,000 birds as a result of better survey coverage and several years of good breeding seasons. In 2005-2006, the number of eastern high Arctic brant was estimated at about 30,000 individuals. Like all Arctic geese, annual productivity of eastern high Arctic brant varies from near 0 to about 30%.

1. The early winter survey appears to provide good indices of long-term population change and production rates, and should be maintained at least at present levels of geographical coverage and intensity.
2. There are currently no studies on the breeding grounds in Canada to monitor changes in abundance, production or distributions. The locations of some areas used for nesting and moulting are known, but there has never been a comprehensive survey for this species. Aerial surveys during the moulting period along coastal areas of the high Arctic islands to periodically estimate abundance, recruitment (including family size), and distribution could be done concurrently for all waterfowl species. (See *Habitat* for an objective to assist in addressing this gap).
3. Gather information from the communities of the eastern Canadian high Arctic, through a Local Ecological Knowledge study regarding distribution, abundance and trends of eastern high Arctic brant.

Population Dynamics: Annual production rates are estimated through age ratio counts conducted at key autumn staging sites. No data are currently available to estimate survival rates, but with the recent initiation of a banding/re-sighting program in 2001 on staging and wintering areas in Iceland and Ireland respectively, survival estimates may be possible in the near future. All of the limited information on breeding ecology comes from studies in the late 1960s and mid 1980s. In the latter case, characteristics of breeding habitats and nesting success were based on observations of about 25 nests at two breeding locations.

1. Institute a banding program at breeding areas, using coloured tarsal bands which can be observed systematically at the relatively accessible staging and wintering areas to estimate annual survival rates.
2. Gather information from the communities of the eastern Canadian high Arctic, through a Local Ecological Knowledge study regarding distribution, abundance and trends of eastern high Arctic brant.

Population Biology and/or Ecology:

1. Determine the feasibility of developing a program on the breeding grounds to monitor and evaluate the factors contributing to production rates.
2. If feasible, conduct field studies at selected breeding locations to evaluate basic reproductive parameters and factors influencing annual productivity. The purpose is to estimate parameters, and their variance for use in population models.

Harvest Assessment: Extremely small numbers of eastern high Arctic brant are harvested annually in the eastern Canadian Arctic (the Nunavut Wildlife Management Board recently estimated about 15 brant taken annually in the relevant region). Hunting is prohibited throughout the wintering grounds in Great Britain, the Republic of Ireland, and France and at the staging grounds in Iceland. Hunting is also prohibited in Greenland, a subsistence harvest of unknown magnitude occurs there.

1. Estimates of subsistence harvests should be made at regular intervals, possibly through a Local Ecological Knowledge study as referenced above.


NORM NORTH

Habitat Concerns: Understanding of habitat selection during the breeding season is poor, because of the remoteness of the nesting and moulting locations. The staging areas in Iceland are well known and partially protected, whereas very little is known about those in Greenland. On the wintering grounds, anecdotal evidence suggests that between 1850 and 1950 the population declined rapidly, possibly because of the near disappearance of its preferred food (*Zostera*) due to a wasting disease. Subsequently the diets also included algal foods and salt marsh species such as *Festuca* and *Puccinellia*, and since 1970, the birds have made increased use of inland managed grasslands.

1. Identify habitat requirements for nesting, brood-rearing, and moulting.
2. Develop clearer understanding of availability and distribution of preferred habitats, to focus efforts to periodically survey breeding "colonies", leading to development and testing of a Habitat Suitability model. This understanding would also contribute to models forecasting potential effects of climate change on breeding brant.
3. Examine the status of Arctic wetlands used by brant and greater snow geese for staging and breeding, and determine impacts of grazing and grubbing by greater snow geese on those habitats.
4. Develop a method to monitor intertidal food resources at the important wintering and staging areas in Ireland, Iceland and Greenland.
5. Support research to evaluate the effects of encroachment by *Spartina* into the feeding areas of wintering eastern high Arctic brant.

Parasites, Disease, and/or Contaminants: Neither disease nor contaminants have been implicated as affecting this brant population. During winter, eastern high Arctic brant are increasingly feeding in agricultural lands, primarily improved grasslands and cereals, which may bring the birds in contact with agricultural chemicals. Occasional outbreaks of avian cholera kill numbers of geese on breeding grounds in the Canadian Arctic, but this has not been reported for this population.

1. Maintain adequate surveillance of wintering flocks to quickly detect die-offs and diagnose the causative agents. Should numbers of dead birds be observed on the breeding grounds, they should be collected for necropsy.
2. Complete a study of the influenza viruses present in live, apparently healthy eastern high Arctic brant, collected at the main staging location in Iceland, and on the Canadian breeding grounds.


TIM MOSER

Brant *Branta bernicla*

Atlantic Population

Population Definition or Delineation: The breeding range of this stock is centered on the Foxe Basin in the eastern Arctic, with important colonies on Southampton, Baffin (Cape Dominion), Prince Charles, Air Force and North Spicer Islands. Smaller numbers of Atlantic brant have been previously observed on northern Baffin Island, in Committee Bay, and westward to Queen Maud Gulf, but the bulk of the population is believed to nest in the Foxe Basin. The recently completed brant telemetry project confirmed key breeding colonies of Atlantic brant within the Foxe Basin, with smaller numbers on Coats and Mansel Islands in northern Hudson Bay.

1. Finalize data analysis of telemetry project to determine whether specific affinities exist among specific breeding and wintering areas.
2. Complete data analysis to compare relative abundances among the major colonies in the Foxe Basin in the early 2000's to those observed in the early 1980's.
3. Determine the northward and westward boundaries of the breeding range.

Population Status or Assessment: Midwinter surveys indicate a population fluctuating around a mean of about 150,000 brant over the period 1955-1968. A combination of poor breeding success and a large harvest brought the population to less than 50,000 in 1972, but it recovered to 125,000 in the fall of 1976. Severe cold on the wintering grounds in 1976-1977 again caused a decline to less than 50,000 but the population has subsequently recovered to maintain an average population of greater than 145,000 over the period 1992-2007.

1. The midwinter waterfowl survey appears to serve as a good index of long-term population change and should be maintained at least at present levels of geographical coverage and intensity. Options should be left open to conduct additional population surveys when conditions are poor during the midwinter survey or when special situations such as winter die-offs or excessive harvests occur.
2. Presently, no ongoing studies occur in most breeding areas to provide annual within-season evaluations of breeding success.

Population Dynamics: Productivity is monitored by age ratio counts in the fall flight, mainly in New Jersey and New York. Productivity surveys should be initiated throughout the wintering grounds to provide a better overall representation of brant productivity. A recent assessment of the fall productivity data indicated some problems with the collection and subsequent reporting methods. Recommendations were made to rectify these discrepancies. Information about annual productivity from the breeding grounds is not available prior to the regulations setting process in the United States. This population is a relatively small one with a history of sensitivity to the influences of both harvest and the environment. Therefore there is a continued need to develop a predictive model based on early season data (e.g. snow cover, temperature, etc.) that will alleviate the reliance on timely annual productivity data.

Prior to 2000, banding of Atlantic brant on the breeding grounds occurred opportunistically. In 1998, funding was secured to establish an operational banding program on the Great Plain of the Koukdjuak on Baffin Island. This effort was extended in 2001 to Southampton Island, Nunavut. This banding program has been very successful and has resulted in the banding of 8,087 adult and juvenile Atlantic brant from 2000-2006. This banding program has allowed for estimation of recovery and survival rates for Atlantic brant. In an effort to supplement the breeding ground data, and serve as a potential surrogate to breeding ground banding, several Atlantic Flyway wintering states have begun to conduct post-season banding operations.

Survival rates of adult brant were estimated to be about 79% from band recovery data for selected years between 1956 and 1977. Recent preliminary results from the 2001-2005 period indicate adult survival rates of 81% for Southampton Island and 73% for Baffin Island. Juvenile survival rates from Baffin Island were estimated at 37%.

1. An assessment of annual brant production must be available to managers during July of each year. Development of a predictive model will ease the urgency to have these data before the promulgation of regulations in the United States.
2. Improve fall estimates of productivity by implementing recommendations regarding the survey methods; such as, ensuring better coverage of all wintering flocks during annual age ratio surveys, establishing a set survey end date, and replicating data submission for independent review.
3. Continue breeding ground banding program. Recent increases in band reporting rates should improve recovery and survival rate estimates. Assess the utility of post-season banding programs in the estimation of survival rates utilizing developing techniques for band recovery analysis that may permit combination of more numerous winter bandings with a smaller summer banded sample.
4. Field studies at selected colonies to evaluate basic reproductive parameters and factors influencing them would provide estimated parameters (and their variance) for use in predictive functions.
5. Determine causes of low juvenile survival rates.

Population Biology and/or Ecology: Recent research has provided much needed information on the basic breeding biology of Atlantic brant as well as information on migratory pathways and movements on the wintering grounds. Work needs to be initiated on what factors influence breeding habitat quality and use, and how increasing snow goose populations affect brant breeding biology. Additionally, more work is needed to delineate the northward and westward extent of the breeding range. There continues to be a paucity of

data on the carrying capacities of staging and wintering grounds, and how changes to submerged aquatic vegetation abundance, particularly in the lower James Bay, will affect productivity and other vital rates.

1. Determine factors that affect quality and use of breeding habitats. Any effects of snow goose population on brant breeding habitats should be assessed.
2. Develop research to assess carrying capacity of staging and wintering grounds.

Harvest Assessment: Atlantic brant sport harvest in the United States, as measured by the duck stamp-based harvest survey, had the worst precision of any species. The new Harvest Information Program-based survey has improved the precision of harvest estimates in the United States. The relationship between hunting regulations and estimated survival rates needs to be elucidated. The Canadian sport harvest rarely exceeds a few hundred individuals because brant do not stop during the fall migration in southeastern Canada. However, subsistence hunting by Aboriginal peoples, occurring in spring and fall, principally in eastern James Bay, can be substantial. The average annual subsistence harvest was estimated at about 8,800 annually during the period 1974-1979. Alerted to the winter die-offs in 1976-1978 and of the closure of the sport hunt, the Quebec Cree and Inuit reduced their harvests through the early 1980's, and apparently have maintained a reduced harvest ever since. Unfortunately, the Aboriginal harvest survey in Quebec was not continued beyond 1979, so the magnitude of the current Canadian harvest cannot be determined.

- Estimates of Canadian subsistence harvest are needed.
- Develop model(s) to predict population response to harvest, habitat, and other factors known to influence the brant population.

Habitat Concerns: Brant rely heavily on subtidal and intertidal marine plants, especially eelgrass (*Zostera marina*), sea lettuce (*Ulva sp.*), and alkali grasses (*Puccinellia sp.*) during staging and wintering. A wasting disease caused a severe reduction in eelgrass along the Atlantic coast and in the gulf and estuary of the St. Lawrence in the 1930's. Subsequently, the plant never regained its former abundance there. Further losses in

KATHY DICKSON

feeding habitat have occurred through shoreline development, dredging, and pollution. In most areas, brant now rely primarily on sea lettuce. The U.S. Fish & Wildlife Service periodically conducts a photo assessment of Atlantic coast sea lettuce beds. During 1999-2000, extensive growths of red algae (*Gracilaria sp.*) were observed in sea lettuce areas. It is not known if sea lettuce is being replaced, or if brant use Gracilaria as a food item. During the winters of 1977-1978, brant significantly increased their use of lawn grasses, a trend that continues to the present time.

Important beds of eelgrass still occur in James Bay, making this area a critical staging area for these geese. Despite changes in the freshwater flow of several rivers feeding into James Bay due to hydroelectric development, these eelgrass beds remained abundant and productive through the mid-1990s. However, in 1999, a massive die-off of eelgrass occurred along much of the James Bay coast. No cause has yet been determined, and Hydro-Québec is continuing to monitor the situation. The potential for negative impact on the condition of brant before breeding appears considerable. During breeding, well-vegetated coastal wetlands are used extensively. Various sedges and grasses form the bulk of the brant diet during the breeding season. These Arctic habitats appear reasonably secure from damage by development, but increasing lesser snow goose populations could be having a detrimental impact on some marshes used by brant.

1. Determine the cause and extent of the decline of eelgrass beds in James Bay and examine possible effects on brant condition, staging duration, and feeding ecology at this important staging area.
2. Evaluate the status of subarctic and Arctic marshes used by both brant and snow geese for staging and/or breeding, and determine impacts on brant condition, reproduction, and survival.
3. Develop a cost effective survey to index wintering habitat (e.g., submerged aquatic vegetation, sea lettuce) conditions.
4. Determine if a spring body condition index of brant could serve as an indicator of reproductive potential.
5. Develop estimates of carrying capacity for wintering brant habitats.
6. Investigate winter condition and habitat use of Atlantic brant.
7. Develop time and energy budget model for wintering brant.

Parasites, Disease, and/or Contaminants: In the 1970s and 1980s there were spring die-offs from Diazinon poisoning resulting from grazing on golf courses in Long Island, New York. A national ban on the use of that pesticide on golf courses and sod farms was passed in the late 1980s. Despite the ban, another die-off of brant due to Diazinon poisoning occurred in New Jersey in April and May 2001. Wintering brant may be susceptible to acute diseases in certain areas. During November 2000 and January 2001, at least 2,000 brant died in and around Forsythe NWR in southern New Jersey. The U.S. Geological Survey was unable to determine a definitive cause of the 2 separate mortality events, however, all of the necropsied birds were in good condition, indicative of an acute illness. In late summer of 2006, 122 Atlantic brant were tested on the breeding grounds in late summer for the presence of avian influenza viruses. An additional 868 Atlantic brant were sampled on wintering areas during 2006-07. No viruses were detected.

1. Maintain adequate surveillance of wintering flocks to quickly detect die-offs and diagnose the causative agents.
2. Improve and enforce legislation controlling the use of harmful turf insecticides near brant concentrations.


JEFF COATS


SEAN BOYD

Brant *Branta bernicla*

Western High Arctic Population

Population Definition or Delineation: Western high Arctic brant breed on the Parry and Queen Elizabeth Islands of the Northwest Territories, stage with Pacific brant at Izembek Lagoon in Alaska, and winter in northern Puget Sound of Washington and British Columbia. Western high Arctic brant are currently regarded as a stock separate from Pacific and Atlantic brant, with no subspecies designation. Plumage characteristics of this stock range from the light gray breast and belly feathers of Atlantic brant to the black breast and belly feathers of Pacific black brant. The stock was defined based on marking and observation studies in the 1970's and 1980's on the breeding and wintering grounds, as well as limited genetic sampling on the breeding grounds. Recent banding efforts at Arctic moulting areas and samples from birds harvested on winter grounds have generated additional samples to help determine the genetic uniqueness of western high Arctic brant. These samples are currently being analyzed by the United States Geological Service Alaska Science Center.

1. Complete work on brant genetics to determine heterogeneity and stock separation. One area of focus for management purposes should be on differences between Pacific black brant and western high Arctic brant.
2. Complete current work on satellite telemetry to document migration routes, important staging areas, and habitat use patterns on winter grounds. Identify data/geographic gaps and deploy additional transmitters if necessary.

Population Status or Assessment: Western high Arctic brant status is assessed annually though the coordinated winter waterfowl survey. There are currently no studies on the breeding grounds in Canada to monitor changes in abundance, production or distribution. The locations of some areas used for nesting and moulting are known, but there has never been a comprehensive survey for this stock. Western high Arctic brant are known to stage in a separate area of Izembek Lagoon, but surveys to distinguish these birds from Pacific brant are not conducted there. On the wintering grounds, western high Arctic brant mix with Pacific brant in northern Puget Sound, but current survey techniques may not accurately distinguish between the two stocks.

1. Institute periodic surveys to accurately assess population size on the Parry and Queen Elizabeth Islands. Aerial surveys during the moulting period along coastal areas of these high Arctic islands to periodically estimate abundance, recruitment (including family size), and distribution could be done concurrently for all waterfowl species.
2. Continue to refine and expand winter waterfowl surveys to estimate western high Arctic brant in all potential wintering locations, and refine estimates of western high Arctic and Pacific brant in concurrent wintering areas.

Population Dynamics: Western high Arctic brant productivity is monitored annually through population and harvest surveys in northern Puget Sound. Recovery and survival rates have not been estimated because of the paucity of historic banding data.

1. Institute banding programs on Arctic breeding/moulting grounds and use VHF telemetry methods to measure survival rates and where possible, compare these to historic information.
2. Initiate research on the breeding grounds to assess factors (e.g. predation, food, weather cycles) affecting recruitment.
3. Develop a population model that integrates productivity, age structure, harvest, and survival rates.

Population Biology and/or Ecology: The basic breeding biology of Pacific brant is fairly well known due to long-term monitoring and research on the Yukon-Kuskokwim Delta, but the breeding biology of western high Arctic brant remains unstudied. Recruitment is estimated on the wintering grounds. Information is needed to understand the influence of migration and wintering area habitat status on survival and productivity rates. The bald eagle population in the Pacific Northwest has increased rapidly in recent years and is now the most important cause of disturbance to waterfowl in southwest British Columbia. High levels of disturbance are causing unknown effects on the habitat use patterns, body condition, and energetics of many bird species including western high Arctic brant.

1. Continue surveys to estimate annual recruitment of western high Arctic brant on wintering areas.
2. Develop research to assess the effects of winter and spring food (e.g. eelgrass, algae, herring roe) quantity and quality on distribution, population dynamics, and reproductive performance.
3. Assess the interaction between bald eagles and brant during winter and spring migration, and determine the negative effects on habitat use patterns, body condition, energetics, survival and reproductive rates.

Harvest Assessment: Subsistence harvest of western high Arctic brant is currently unknown. Harvest in northern Puget Sound is monitored through mandatory harvest reporting and intensive bag checks.

1. Design and conduct surveys to measure and describe subsistence harvest of western high Arctic brant in Canada and Alaska.
2. Continue special annual harvest surveys on wintering areas.

Habitat Concerns: Status and trends of breeding habitat are not known in great detail, because the area is not surveyed regularly. Western high Arctic brant migration areas in northern Alaska are threatened by petroleum exploration. Oil refineries in northern Puget Sound pose an ongoing threat to staging and wintering habitat due to potential for spills. Substantial habitat degradation and disturbance from commercial and recreational activity has affected staging and wintering areas in northern Puget Sound (e.g. Padilla Bay, WA). Status and trends of eelgrass beds are not known.

1. Strengthen and implement habitat protection programs on breeding, moulting, staging, and wintering areas through land use planning, regulatory constraints, effective mitigation of impacts.
2. Pursue habitat acquisitions and enhancement options through Pacific Coast Joint Venture.
3. Periodically, map and determine density/biomass of eelgrass beds in Puget Sound and Izembek Lagoon.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on federal, provincial, and state-managed wildlife areas.

Brant *Branta bernicla*


JEFF COATS

Pacific Population

Population Definition or Delineation: Pacific brant breed over an extensive range in Alaska, Arctic Canada and Russia. Little information on breeding birds is available from Russia, and more information is needed on breeding distribution in the Canadian Arctic. Mass aggregations of brant at Izembek Lagoon in fall and spring and on major wintering areas of Mexico preclude the detection and monitoring of discrete population units.

1. Conduct and expand banding and marking efforts throughout the Pacific brant range to describe breeding and wintering associations.

Population Status or Assessment: Pacific brant status is assessed annually through a coordinated midwinter survey. There are no regular surveys, however, to document the status of birds on all major breeding areas. The apparent decline at major colonies of western Alaska during the early 1980's, were reversed by the early 1990s, partly resulting from redistribution of brant. Knowledge of all breeding areas is thus needed to determine status of the entire population.

1. Institute operational surveys to accurately assess breeding pairs on major nesting colonies other than western Alaska (operational videography survey).
2. Initiate breeding bird inventories in the Canadian Arctic and acquire information on Russian breeding birds.

Population Dynamics: Productivity of Pacific brant has been studied intensively in recent years on Alaska's Yukon-Kuskokwim Delta, but data are not regularly obtained in other breeding areas. There are likely substantial differences in productivity between western Alaska, the Canadian Arctic, and Russia. Annual production is estimated at the Izembek Lagoon, Alaska fall staging area. Adult:young ratios and family group size have been recorded here over the long term, but these data represent aggregate productivity from all breeding areas. Mortality rates have not been adequately estimated, and harvest data for some areas are non-existent or unreliable.

1. Initiate periodic surveys of production on Canadian breeding areas and obtain data from Russian brant colonies on an annual basis.
2. Conduct research on colony dynamics to determine causes for any changes in colony sizes and distribution.
3. Maintain and expand banding programs to adequately measure survival rates.
4. Initiate research on factors affecting production, especially in northern Arctic areas, including potential impacts of fox predation on colonies.
5. Develop a population model that integrates productivity, age and density-related effects, harvest effects, and survival rates for western Alaska subarctic and Arctic population components.

Population Biology and/or Ecology: The basic breeding biology of Pacific brant is fairly well known due to long-term monitoring and research on the Yukon-Kuskokwim Delta. However, additional information is needed to understand the influence of migration and wintering area food supplies on distribution and breeding population vital rates.

1. Develop research to assess the effects of winter and spring forage quantity and quality on distribution, population dynamics, and reproductive performance.

Harvest Assessment: Currently, the most significant harvests of Pacific brant are by subsistence hunters in Alaska, and by United States hunters in Mexico. Harvest estimates are difficult to obtain because some spring hunting occurs in areas outside the scope of ongoing subsistence harvest surveys, State and Federal harvest surveys rely on very small sample sizes, and field surveys in Mexico have required international contributions of funds and technical assistance. Concerns about impacts on sub-populations and the decline of western Alaska breeders have necessitated restrictive hunting regulations in Pacific coast states. A long-term harvest strategy is needed that is based on population structure and productivity modelling.

1. Design and conduct surveys to measure and describe subsistence harvests of brant in Alaska.
2. Develop improvements to State, Provincial, and Federal methods of estimating fall harvest.
3. Support the continuation and improvement of harvest data collection in Mexico.


GUSTAF SAMELIUS

Habitat Concerns: In Alaska, breeding habitat for Pacific brant is generally secure and in good condition except in local areas of the Arctic where oil and gas development have encroached on some colonies. Critical moulting habitat near Teshekpuk Lake in northern Alaska continues to be the focus of prospective onshore and offshore petroleum exploration. Similar threats occur in the mainland of the western Canadian Arctic as well. In Canada, many brant nest near the Beaufort Sea coast, an area potentially subject to degradation by rising sea levels, melting of permafrost, coastal erosion, and increased salt water flooding. On Banks Island, habitat used by breeding and moulting brant is potentially threatened by the growing population of snow geese. Substantial habitat degradation and disturbance from commercial and recreational activity has affected staging and wintering areas of the U.S. and Canada. Recreational facilities and activity are increasing markedly on the coast of Baja, Mexico. This has the potential to adversely affect most of the brant population during winter. Brant have highly specialized habitat requirements and are less adaptable than other species. Unlike some other populations of brant, and most other populations of geese, Pacific brant make almost no use of agricultural land or other human modified habitats. As such, they are much more vulnerable to displacement and losses of winter habitat.

1. Strengthen and implement habitat protection programs on breeding and moulting areas through land use planning, regulatory constraints, and effective mitigation of impacts.
2. Strengthen and implement habitat protection programs on staging and wintering areas, in conjunction with the Pacific Coast Joint Venture.
3. Develop habitat objectives and protection strategies for wintering areas in Mexico through cooperative joint ventures.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on NWRs and state-managed wildlife areas.

Cackling Goose *Branta hutchinsii*

Taverner's Population

Population Definition or Delineation: This population has been partially defined through surveys, banding, and genetics studies; but full definition depends upon accurate delineation of breeding grounds. The exact boundaries of the breeding range remain undetermined due to the close proximity, and possible overlap, of the breeding range of the similar-appearing lesser Canada goose. Efforts are under way to determine the geographic boundaries between breeding areas of these two species after which an appropriate breeding ground survey will be established to provide annual management indices. Farther east it is not known where distribution of Taverner's geese ends and that of Richardson's goose begins.

1. Complete breeding ground genetic sample collection and analysis and delineate boundaries of breeding areas.

Population Status or Assessment: The Taverner's cackling goose population historically has been monitored, albeit poorly, through breeding ground surveys directed primarily at other species, and through direct counts and photo composition surveys of other geese in winter. Current trend analyses based on long-term aerial surveys of geese observed in suspected breeding areas indicate a relatively stable population.

1. Design and implement appropriate breeding ground survey to be used as an annual population index.

Population Dynamics: Little recent work has been done on the population dynamics of Taverner's Canada Geese. Best information available suggests a stable population.

1. Initiate studies of vital rates, including survival rates of adults and juveniles and studies of nesting success and productivity.

Population Biology and/or Ecology: Taverner's cackling geese nest as dispersed pairs in coastal tundra but with less association with low lying areas and water bodies than observed for cackling cackling geese (i.e., *B. h. minima*).

Habitat Concerns: Breeding areas, primarily coastal tundra, is relatively secure with the possible exception of the North Slope where extensive petroleum development is advancing rapidly across the coastal plain. On the wintering grounds, conversion of grasslands and croplands to uses not favorable to geese is increasing. Urban expansion, conversion to fruit/vegetable and vineyard crops, and pulpwood plantations have reduced habitat and increased goose foraging intensity on grain, turf, and pasture crops.

1. Monitor land use conversion on the wintering grounds to assess impacts on availability of suitable foraging habitats.
2. Continue to develop cooperative goose and habitat management strategies with agricultural producers to address crop depredation issues.
3. Continue to pursue opportunities to provide secure long-term winter grazing range through easements and acquisitions of habitat.

Harvest Assessment: Taverner's cackling geese winter with six other populations of white-cheeked geese that are similar in appearance. Population levels of some of these geese are such that severe restrictions are placed upon harvest opportunities, and hunter check stations are used in western Oregon and southwestern Washington to closely monitor harvest of certain populations. As a result, potential exists to monitor the harvest of Taverner's geese in part of the western portion of its winter range. Current information suggesting that this population of geese is stable would indicate that current harvest management, while directed primarily at other populations, is adequate for now. Improved harvest assessment would better ensure the security of this population and would seem prudent.

1. Improve the assessment of harvest through collection of morphological and genetic data at check stations.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on national wildlife refuges and state-managed wildlife areas.


TIM MOSER

Cackling Goose *Branta hutchinsii*

Cackling Population

Population Definition or Delineation: Historically, the cackling goose (*Branta canadensis minima*) has been considered the smallest subspecies of Canada goose. Johnson et al. (1979) demonstrated that cackling geese can be classified accurately among Pacific Flyway geese from morphological measurements. Early attempts to genetically distinguish Canada goose subspecies indicated that cackling Canada geese were different from others. Mitochondrial DNA studies have shown that cackling geese are associated with a group of small-bodied forms of Canada geese that developed west and north of the Alaska Range. Further work demonstrated a clear distinction between cackling geese and the adjacent Aleutian Canada goose (*B.c. leucopareia*). Taxonomic and management relationships of cackling and other small geese have recently become more complex with the differentiation of small bodied (cackling) geese from large bodied white-cheeked (Canada) geese. Small geese formerly comprising the cackling, Aleutian, Taverner's, and Richardson's subspecies of Canada geese have been lumped into the taxonomic species of cackling geese (*Branta hutchinsii*). However, the management issues and activities of these goose populations remain population specific.

For the purposes of this summary, cackling geese are defined as the management population of small-bodied geese nesting entirely on the Yukon-Kuskokwim Delta of Alaska. Historically, nearly all cacklers staged in the Klamath Basin during spring and fall, and wintered in the Central Valley of California. Since the early 1990s, the majority of cacklers have wintered in western Oregon and southwestern Washington.

1. The highest priority need in population definition is continued genetic comparisons with other small bodied cackling geese.

Population Status or Assessment: The population status of the cackling goose has been of concern to wildlife managers in the Pacific Flyway for many years. Peak counts of cackling geese from fall aerial surveys of the Klamath Basin documented a decline from over 400,000 birds in the late 1960s to less than 50,000 by the late 1970s. Coordinated fall surveys in California and Oregon indicated a record low count of less than 26,000 cacklers in 1984.

The steady decline of the population from the late 1960s to mid-1980s likely resulted from the combined effects of spring subsistence hunting in Alaska and sport harvest, primarily in California. Although harvest restrictions were implemented to protect Aleutian geese in the mid-1970s, and specifically for cacklers in 1979, concerted flyway-wide restoration efforts were not implemented until 1983. Representatives of management agencies, conservation groups, and hunters from Alaska to California began meeting in late 1983 to determine critical problems of geese nesting in western Alaska, agree on harvest restrictions, and to develop an intensive, broad-based conservation program. The Hooper Bay Plan, signed in January 1984, was the progenitor of the Yukon-Kuskokwim Delta Goose Management Plan which has guided harvest strategies and conservation efforts for cackling Canada geese for the past 23 years. By necessity and desire, annual coordination among interested parties has ensured consistency between Pacific Flyway management plans and the Yukon-Kuskokwim Delta plan. Cooperative conservation efforts have restored the cackling goose population to about 200,000 birds.

Coordinated counts of fall staging birds were eliminated in 1998 in favor of an aerial survey on the breeding grounds after comparison of 14 years of fall counts and breeding ground estimates. The Division of Migratory Bird Management in Region 7 of the USFWS conducts this survey on an annual basis.

Current Pacific Flyway management plan population objectives are to:

1. Achieve a population of 250,000 as measured by a 3-year average index of indicated breeding pairs (27,660) from the Yukon-Kuskokwim Delta aerial breeding goose survey.
2. Promote an average annual increase of 5-10% toward the population objective.

The highest priority survey is maintaining the breeding population survey since it provides the primary population management metric.

Population Dynamics: Cackler survival rates have been monitored with neck-collars and legbanding since the early 1980's. Raveling et al. (1992) estimated annual survival rates of cackling Canada geese at 81% from population and production data for the period 1985-1986. This estimate was derived from an annual neck band re-observation rate of 61% and inference that neck band loss rates were approximately 25%.

Annual and periodic survival rates from neckband observations have continued to be estimated. Recent data do not suggest differences in survival rates between adult males and females, nor have annual differences been detected during 1990-1997. The average estimated survival rate for the 1990-1997, as indexed by neckband observations, was 73%. If an annual neck band loss rate of 1.9%, measured from breeding ground recaptures, is applied to these estimates, average annual survival has been approximately 75%.

These recent survival estimates are significantly higher than those of the mid-1980s. When re-observation rates are adjusted for 2% neck band loss, survival rates may have been only 62%. However, numerous factors such as potential changes in neckband loss rates, differing observational efforts between the two studies, the effects of collars on survival, and the accuracy with which all of the parameters can be estimated make rigorous conclusions difficult.

Population Biology and/or Ecology: The basic breeding biology of cacklers is fairly well known due to long-term monitoring and research on the Yukon-Kuskokwim Delta. However, additional information is needed to understand the influence of migration and wintering area forage components on distribution and breeding population vital rates.

Develop research to assess the effects of winter and spring forage quantity and quality on distribution, population dynamics, and reproductive performance.

Harvest Assessment: Experience over the past 30 years has illustrated that harvest (adult mortality) is the most important factor regulating the size of the cackling goose population. Excessive harvest from the 1960s to the 1980s throughout their range caused a serious population decline that necessitated 15 years of restoration effort. Beginning in1984, the Pacific Flyway wildlife agencies, Alaska Natives, and other public interest groups have cooperatively developed flyway-wide harvest guidelines and strategies in the Yukon-Kuskokwim Delta Goose Management Plan.

Given the importance of harvest management in regulating the cackling goose population, the Pacific Flyway Council has established the following harvest guidelines, in cooperation with resource users throughout the flyway:

1. Harvest strategies should allow the population to increase to a preseason level of 250,000 geese, based on a 3-year moving average of the breeding population index. Thereafter, regulations should promote a stable population.
2. If the population index drops below objective levels after attaining the objective of 250,000, then necessary restrictions should be applied to regain the objective.
3. If the 3-year average population index drops below 80,000 geese (about 1/3 of the objective), all hunting should be suspended throughout the flyway.
4. After a closure and when the population increases above a 3-year average index of 110,000, limited hunting may be considered.

Traditional state and federal harvest surveys of hunters have not provided information on the harvest of geese by subspecies. Most historical data on the harvest of cacklers has come from analyses of band recoveries and numbers and trends of Canada geese classified at check stations on public hunting areas in California. Intensive harvest monitoring under special Canada goose restrictions in Washington and Oregon since 1984 has yielded increasingly valuable check station data on harvest of cacklers in their current primary winter range.

Recent analyses of goose tail fans from the Waterfowl Parts Collection Survey indicate that cackling geese can be distinguished by tail feather measurements from other races of geese in the Pacific Flyway with reasonable accuracy. Combined with the operational harvest survey, these data provide rough estimates of fall and winter cackler harvest in the flyway.

Cackling geese are an important food source for subsistence users on the Yukon-Kuskokwim Delta. Systematic, stratified household surveys were initiated in sample villages in 1985. Results of these surveys from 1985-2005 are summarized by USFWS annually. Subsistence harvest of cacklers on the Yukon-Kuskokwim Delta averaged 8,787 birds from 1985-2005, with a peak harvest of 15,000 in 1998. About half of the Yukon-Kuskokwim Delta subsistence harvest occurs in spring. Supplemental village surveys of the Bristol Bay-Alaska Peninsula region have indicated harvests of 900 cacklers in 1996 and 1,100 cacklers in 1998.

Habitat Concerns: Cackling geese prefer to nest in the extensive pond and meadow mosaic habitats of the outer Yukon-Kuskokwim Delta. Nest densities are somewhat clumped, and most nests are established on small islands. During brood-rearing, cackler families utilize pond edges with *Carex mackenziei* and *C. subspathacea*, *Triglochin palustris*, and *Puccinellia phryganodes*. Cacklers also make extensive use of wet tundra and river/slough bank meadows of *C. ramenskii* and *C. rariflora*. These areas are maintained by grazing year-to-year.

The intertidal marshes and coastal wetlands on the north side of the Alaska Peninsula are vital fall staging habitats where cackling geese add substantial body mass for migration. Cacklers feed intensively on pond shorelines with *Puccinellia* and *Triglochin*, as well as tide flats where Puccinellia and Hippuris dominate. Exposed intertidal bars are used extensively for roosting. Most of the primary use area at Ugashik Bay is protected in the Pilot Point State Critical Habitat Area, and portions of cackler habitats are within Cinder River State Critical Habitat Area.

Most cacklers currently winter in Oregon, and can be found throughout the Willamette Valley and along the lower Columbia River. Cacklers tend to shift southward in the Willamette Valley during late fall and early winter, and then move northward to the lower Columbia as winter progresses. Cacklers and other Canada geese make extensive use of agricultural crops, including ryegrass and other grass seed production varieties in the Willamette Valley. Winter wheat, pasture (clover, alfalfa, perennial grasses), and specialty crops such as carrots are used in the lower Columbia River areas. Winter habitat use by cacklers in the Willamette Valley has not been studied in detail, but cacklers tend to feed in stubble fields (e.g. wheat, corn, barley, oats) after arrival and then shift to grass seed farms (e.g. perennial rye, fescue, annual rye) as the winter progresses. Permanent natural wetlands (e.g. rivers, lakes, and ponds) and temporary field sheetwater areas produced by abundant rainfall provide important habitat components for geese throughout the wintering area.

Current Pacific Flyway Management Plan population objectives are to:

1. Manage for a winter distribution that includes no more than 20% of the current population in the lower Columbia River and Willamette Valley.
2. Maintain, manage, and enhance where feasible, nesting, migration and wintering habitats in sufficient quantity and quality to meet population objectives and public use goals.
3. Manage habitats and harvest to minimize agricultural depredation complaints, consistent with Pacific Flyway plans and policies.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on national wildlife refuges and state-managed wildlife areas.


TIM MOSER

Cackling Goose *Branta hutchinsii*

Aleutian Population

Population Definition or Delineation: The majority of the Aleutian cackling goose population nests in the western Aleutian Islands, with lesser numbers in the central Aleutians and very small numbers (<200) in the Semidi Islands. Periodic surveys are conducted to assess expansion of breeding birds on suitable islands. Banding and winter surveys have indicated that there are at least two distinct segments of Aleutian geese. Geese from the western and central Aleutians winter primarily in the San Joaquin Valley in California, while geese from the Semidi Islands winter in coastal Tillamook County, Oregon

1. Continue to provide special management consideration to that segment of the Aleutian goose population that breeds in the Semidi Islands and winters along the Oregon coast.

Population Status or Assessment: An indirect estimate based on observations of marked Aleutian geese during two separate periods in the San Joaquin Valley and north western California and south western Oregon coastal areas, provides an annual population index for the geese breeding in the western and central Aleutian Islands. Exponential growth has been observed in this segment of the population when it grew by 14% per year from 1974-2004. Direct counts of Semidi Islands Aleutian geese have become confounded as more geese from the Aleutian Islands segment winter sympatricly with the Semidi Islands geese; direct counts have been unreliable since 2001.

1. Continue field surveys to acquire collar resight data and other information to provide an annual indirect population index.
2. Design and implement aerial surveys of spring staging areas to evaluate this technique.

3. Continue direct counts of Aleutian geese on the Oregon Coast during winter.
4. Design and test surveys to provide an operational index of geese in the Semidi Islands

Population Dynamics: Little is known about harvest and survival rates as harvest on this formerly ESA-listed population only recently resumed in 2001, making band return data sparse.

1. Where possible, mark a sample of 200 birds with legbands only to evaluate harvest distribution and survival rates.
2. Assess the merits of post-season banding.

Population Biology and/or Ecology: Despite the elimination of harvest mortality, the population of Semidi Islands Aleutian geese has not responded, as have the Aleutians from the western Aleutian Islands.

1. Conduct research projects to determine what factors are preventing Semidi Islands geese from increasing.

Harvest Assessment: A management plan, approved during summer 2006, identifies a harvest strategy to be used through 2010 to manage the harvest of Aleutian geese to maintain a population objective of 60,000 geese. The population exceeded this number in 2002 and continues to increase. Currently, there is no direct measure of harvest from Harvest Information Program and Parts Collection Surveys.

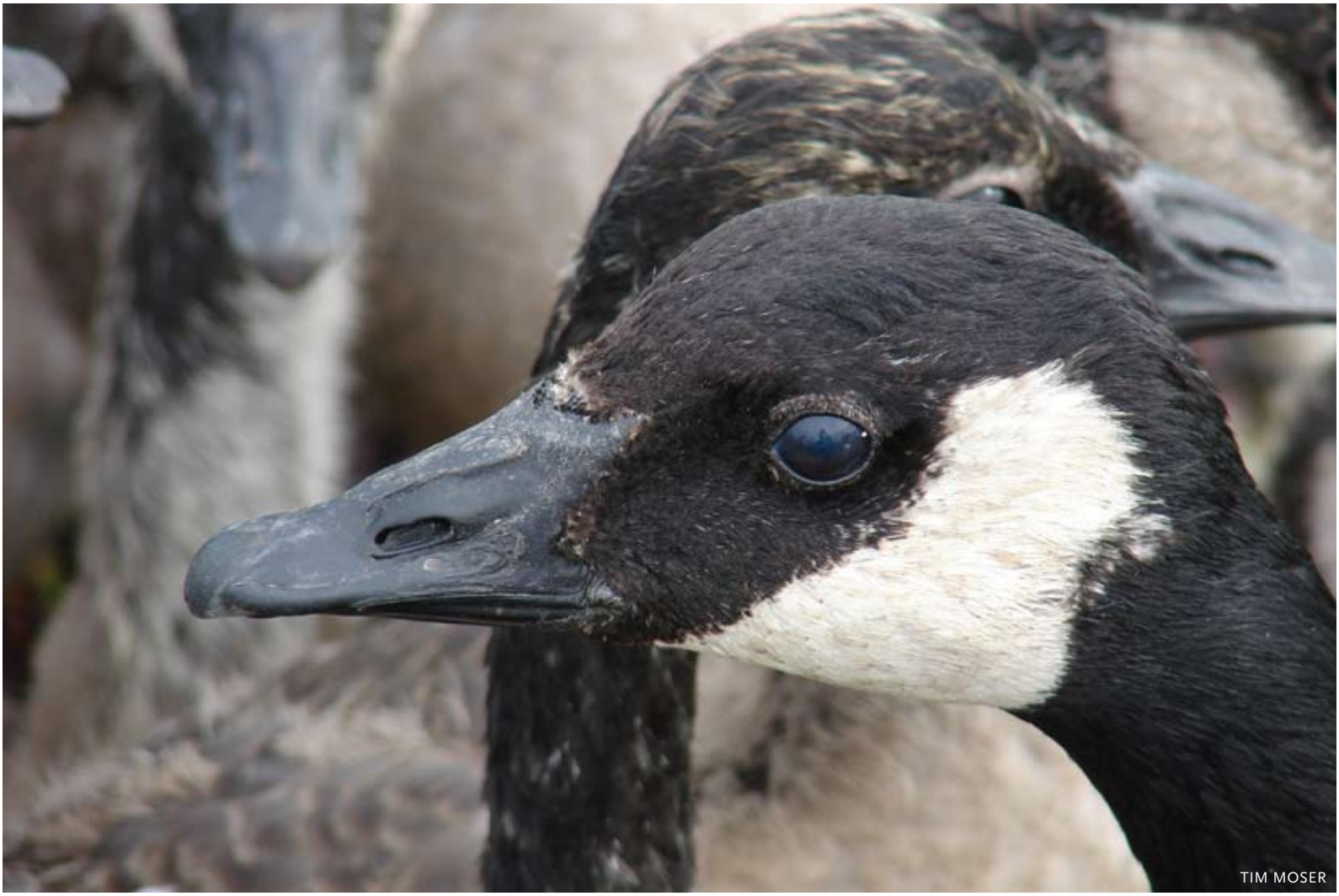
1. Maintain hunting closures in areas used by Semidi Islands geese until their status improves.
2. Implement the harvest strategy described above through 2010, modifying where necessary in response to distributional changes of Aleutian geese.

Habitat Concerns: There is current and potential unoccupied breeding habitat because of ongoing fox removal programs. It is not known whether there is habitat degradation on traditional, high-density breeding islands. The capacity of public lands in migration and wintering areas to support this large and rapidly growing population is limited, especially along the northwest coast of California. This places extra emphasis on the effects of goose foraging on private lands where geese conflict with agricultural interests. While there are numerous government support programs available to improve fish and wildlife habitat on private lands, there are no such programs to maintain preferred habitats as they currently exist. Also, changing agricultural practices and other land uses have the potential to negatively affect current migration and wintering areas.

1. Continue to remove introduced foxes and other predators (e.g., ground squirrels) from additional islands within the former breeding range and prevent accidental introductions of rats to existing or potential nesting islands by activating a ship-wreck response plan.
2. Provide adequate funding to protect and manage goose use areas that constitute migration and wintering habitat.
3. Conduct surveys to determine the amount and timing of use on staging areas to detect significant shifts in distribution, changes in foraging patterns, and responses to habitat management efforts.
4. Encourage optimal management of public lands for goose forage, with consideration of other management objectives and statutory requirements, to help relieve agricultural damage on private lands.

Parasites, Disease, and/or Contaminants: Avian cholera remains a potential source of mortality of Aleutian geese.

1. Conduct regular surveillance to detect outbreaks on major wintering and migration areas. At the onset of outbreaks, implement disease control activities.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Canada Goose *Branta canadensis*

North Atlantic Population

Population Definition or Delineation: The North Atlantic Population breeds in Labrador, Newfoundland, and eastern Quebec and winters in southern Atlantic Canada and New England.

Additional banding effort should be undertaken in the Atlantic provinces and in the boreal forest of Quebec. In particular the staging and wintering areas of boreal breeding birds are unknown.

1. Evaluate efficacy of winter banding of geese in Nova Scotia. Determine what proportion of north Atlantic geese over winter in Nova Scotia. Hypotheses have been forwarded that a disproportionate number of north Atlantic population geese from Newfoundland winter exclusively in Nova Scotia.
2. Banding is necessary to determine the ranges and degree of overlap between the north Atlantic population and Atlantic population during the harvest period. Such programs should be coordinated throughout the ranges of the two populations and focus on breeding birds.

Population Status or Assessment: Determining the population status of north Atlantic population Canada geese is confounded by mixing in winter of migrant birds from three populations (north Atlantic, Atlantic and southern James Bay populations) and Atlantic Flyway resident population Canada geese. The best method of evaluating the north Atlantic population status is to count breeding pairs on the nesting grounds.

1. Continue to refine the integration of the Eastern Waterfowl Survey to develop an operational breeding grounds survey for the north Atlantic population. Current surveys conducted through two different survey platforms (fixed wing and helicopter) indicate different population trends.
2. Conduct occasional periodic counts of the breeding population in Greenland. Recent counts indicate 7-fold increase in geese in Greenland.

Population Dynamics: Currently, information about annual productivity is available only from estimation of age ratios from tail fans in the harvest, which may be contaminated by growing numbers of temperate-breeding Canada geese. This is an important gap in our understanding of the population dynamics of north Atlantic Canada geese. Banding and neck-collaring have provided crude estimates of harvest and survival rates for adults. Estimates of harvest and survival for juvenile cohorts of the north Atlantic population are lacking.

- A method to estimate annual productivity should be developed.
- The operational spring banding program on Prince Edward Island should continue, but the banded sample should be increased to provide a reliable measure of harvest rate and survival. Banding should be expanded to areas within the breeding range. Without representative banding of family groups, no estimates of juvenile survival are possible.

Population Biology and/or Ecology: Experience with other Canada goose populations indicates the importance of evaluating factors related to annual productivity such as nest success, brood survival, and the effects of weather conditions.

1. Determine the feasibility of developing a program on the breeding grounds to monitor and evaluate the factors contributing to production rates.
2. Population data for the north Atlantic population are relatively expensive to gather. Development of a validated population model will result in better ability to reach and maintain population goals.

Harvest Assessment: Harvest estimates are confounded by unknown proportions of other Canada goose populations (southern James Bay population, Atlantic population and locally breeding Canada geese) in the harvest estimates in both the United States and Canada. The size of the subsistence harvest by Aboriginal people in Labrador has not been well estimated - a study in the early 1980s estimated that geese are relatively unimportant in the subsistence harvest there even in comparison to other kinds of birds. There is a need to improve the estimates of subsistence and other harvest.

1. Refinements are required in the Canadian and United States harvest surveys to estimate Canada goose harvests for specific populations. It is particularly important to develop a reliable method to distinguish between migrant and Atlantic Flyway resident population Canada geese in the harvest.
2. Continued vigilance in monitoring the effects of harvest on population status and location of the majority of harvest in the U.S. needs to be a high priority for this population.
3. In Canada there is a need to develop a reliable system to monitor subsistence harvest.

Habitat Concerns: In winter and during staging, north Atlantic population Canada geese make extensive use of agricultural land where they feed on various grains and green foliage as well as residential and commercial lands. The habitat is abundant, and any expected changes in acreage or crop composition will not likely reduce overall staging or wintering populations through the foreseeable future. On the breeding grounds in eastern Quebec and Newfoundland and Labrador, large tracts of land are susceptible to development, either hydroelectric or for mineral extraction. The effects of development on Canada goose breeding areas appear

minimal at the present time however, continued monitoring is warranted. The importance of moult migrant Canada geese on breeding and staging habitats is felt to be low, but may increase along with increasing abundance of temperate breeding Canada geese.

1. Monitor the effect on north Atlantic population Canada geese resulting from resource development on the breeding grounds.
2. Determine the extent of moult migration of Atlantic Flyway resident population Canada geese into northern portions of the Atlantic Flyway.

Parasites, Disease, and/or Contaminants: Although there is currently no indication of any unusual or extraordinary disease effects in the north Atlantic population, monitoring should be conducted and appropriate action taken if the situation warrants. It is imperative to any north Atlantic population model or harvest strategy to identify and understand the dynamics of any source of significant non-hunting mortality.


DOUG STEINKE


TIM MOSER


TIM MOSER

Canada Goose *Branta canadensis*

Atlantic Population

Population Definition or Delineation: Atlantic population Canada geese nest throughout northern Quebec, especially along Ungava Bay, the eastern shore of Hudson Bay, and the interior of the Ungava Peninsula mainly north of 50°N. This population winters from New England to South Carolina, with the largest concentration on the Delmarva Peninsula. The spring breeding pair index from the Ungava peninsula accounts for roughly 90% of the total estimated number of breeding Atlantic geese throughout their range. The highest densities are found along the coastal regions of Hudson Bay and Ungava Bay. However, the Hudson Bay coast now supports more than three times the density of breeding pairs of the Ungava Bay coast. This could be related to differential survival or productivity, but the potential for growth appears more limited for geese nesting along the Ungava Bay coast.

Preseason banding is conducted annually within the major nesting areas, for example, along the northeastern coast of Hudson Bay and coast of Ungava Bay. Since 1997, more than 69,000 geese have been banded with annual banding samples averaging about 6,300 birds (juveniles and adults combined). Although target samples have not been achieved in every year due to varying reproductive success, recent analyses of band recovery data indicated that adequate samples of Atlantic geese were banded to provide reliable measures of survival and harvest rates.

1. The preseason banding program should continue as an operational program to provide harvest rate and survival estimates for all cohorts of geese. If possible banding should be expanded to the boreal parts of the breeding range.
2. Genetic and stable isotope analysis currently underway should be completed to compliment harvest derivation determined from band recoveries.

Population Status or Assessment: Status of Atlantic population Canada geese is assessed annually with a spring breeding ground survey conducted in mid to late June in the Ungava Region of northern Quebec. The southern portion of the Atlantic population breeding range is surveyed as part of the integrated Eastern Waterfowl Survey. The density of breeding pairs in the taiga is low (<0.1 pair/km2) and relatively constant compared to the Ungava Peninsula. The total population estimate is confounded by large numbers of moult migrant geese that enter the survey area, particularly the Hudson Bay coastal region; at about the same time the spring survey is conducted. Differences in survey timing and the abundance of moult migrants can introduce substantial variability and bias in the estimation of total population size. Therefore, the estimated total number of geese is not considered a reliable measure of population status and, thus, is not used for management and setting hunting regulations. Rather, the Indicated Breeding Pair (IBP) index from the Ungava Region is the metric used for determining population status. Growth of the Atlantic population has averaged 11.7% since sport harvest resumed throughout the flyway in 2000. However, growth of the Atlantic population has slowed since 2002 as sport harvest has increased. Nevertheless, the growth of the Atlantic Population and modest harvest rates suggest that the desired population objective of 225,000 pairs is attainable. The objective of 225,000 breeding pairs in the Ungava Region of northern Quebec represents a crude estimate of what size breeding population it would take to produce a fall flight that can support a liberal hunting season with a total sport harvest of about 300,000 Atlantic population birds.

1. Continue spring breeding ground surveys as an operational program, with a focus on detecting change in the Indicated Breeding Pairs index.
2. Continue to estimate spring population size of resident Canada geese in Atlantic population harvest states.
3. Explore means of improving accuracy and precision of population estimates for the Atlantic population.

Population Dynamics: After several years of intensive study to determine the factors affecting nest effort and success, annual productivity is appraised using a mathematical model that incorporates weather variables on the Ungava Peninsula to predict age ratios at banding. Annual ground surveys at key nesting sites around Ungava Bay provide additional information on nesting effort and nest success. These sources of information are used to determine the level of annual productivity.

Three years of reward banding has provided an estimate of band reporting rates for this population. The current level of banding will provide reliable estimates of harvest and survival rates. Recent band analyses suggest that juvenile survival rates are lower than expected under current harvest rates. Adaptive Harvest Management population modeling of the Atlantic population has been completed and will be considered for regulation setting in the near future.

1. Continue to use the productivity model to predict age ratio at banding and to supplement its use by continuing the ground surveys at Ungava Bay to provide a direct assessment of annual production.
2. Best available vital rate data should be included in Adaptive Harvest Management population models as a tool to monitor population growth rates (status).

Population Biology and/or Ecology: Field studies on the Ungava Peninsula conducted in northern Quebec since 1996 have identified factors related to annual productivity such as nesting effort, nest success, brood survival, and the effects of weather conditions on gosling production. The intensive nest work done along the Hudson Bay coast south of Purvirnituq ended in 2003. Annual nest surveys at key nesting sites have continued, but were scaled back in 2006 to include only the nesting areas near Ungava Bay.

TIM MOSER

1. Continue the current breeding ground monitoring program to track changes in population size and annual productivity for setting annual harvest regulations.
2. Periodically (e.g., every 5 years) monitor annual productivity along the Hudson Bay coast to allow for correction of the AP Canada goose productivity model.

Harvest Assessment: Annual banding programs currently provide information that can be used with harvest surveys and spring population surveys to estimate the distribution of harvest and the size and composition of regional, state, and provincial harvests. Canada geese banded north of 57° latitude are used for harvest distribution and derivation analysis for Atlantic population Canada geese. Harvest estimates are confounded by unknown proportions of other Canada goose populations (North Atlantic, Southern James Bay, and resident Canada geese) in the harvest estimates in both the United States and Canada. Aboriginal subsistence harvest during spring and fall in James Bay and northern Quebec totaled about 80,000 Canada geese in the late 1970s when the most recent surveys were conducted. However, no comprehensive estimates of subsistence harvest have been made since that time. In 2005-2006, a subsistence harvest survey was conducted of the James Bay Cree First Nation, in central Quebec, by the Canadian Wildlife Service and the Cree Regional Authority.

1. Refinements are required in the Canadian and United States harvest surveys to estimate Canada goose harvest for each population. It is particularly important to develop a reliable method to distinguish between migrant and resident Canada geese in the harvest.
2. Operational legbanding of geese should continue for all Canada goose populations affiliated with the Atlantic Flyway for periodic assessment (e.g., every 3 years) of harvest distributions and derivations. Failure to continue this program will constrain effective harvest management efforts for Atlantic Flyway Canada goose populations.
3. In Canada there is a need to develop and implement a reliable system to monitor Aboriginal subsistence harvest (e.g., repeat the Cree subsistence survey every 3-5 years).

Habitat Concerns: In winter and during staging, Atlantic population Canada geese make extensive use of agricultural land where they feed on various grains and green foliage as well as residential and commercial lands. The habitat is abundant, and any expected changes in acreage or crop composition will not likely reduce overall staging or wintering populations through the foreseeable future. Atlantic population Canada geese breed and moult in Quebec, mainly north of 50°N. Large tracts of land are under hydroelectric development, involving massive diversion and the creation of large reservoirs. The effects of this development on Canada geese appear minimal at the present time; however, continued monitoring is warranted. Another threat to breeding and staging habitats may be the destruction caused by the growing numbers of snow geese and moult migrant Canada geese.

1. Determine the extent of moult migration of resident Canada geese from northern interior portions of the Atlantic Flyway.
2. The effects and the extent of habitat deterioration caused by snow geese and moult migrant Canada geese should be evaluated and monitored.

Parasites, Disease, and/or Contaminants: The importance of disease and other forms of non-hunting mortality in the population dynamics of Atlantic population Canada geese is not known. Subsistence harvest and forms of non-hunting mortality (e.g., predation, disease, lead poisoning, accidents, etc.) account for about 10-15% mortality among adult Atlantic geese in the absence of sport hunting, and it is believed to be higher for juveniles. Although there is currently no indication of any unusual or extraordinary disease effects in the Atlantic population, monitoring should be conducted and appropriate action taken if the situation warrants. It is imperative to any Atlantic population model or harvest strategy to identify and understand the dynamics of any source of significant non-hunting mortality.

Canada Goose *Branta canadensis*


DOUG STEINKE

Southern James Bay Population

Population Definition or Delineation: The breeding range of this population includes Akimiski Island and the southwestern James Bay mainland south of the Attawapiskat River. Approximately one-fifth of the breeding pairs occur on Akimiski Island, which accounts for only 3% of the breeding range. Banding efforts have concentrated on the high density brood rearing range on Akimiski Island. Inland boundaries on the mainland remain uncertain because banding data are lacking for inland sites. Migration and winter range has been determined from band recoveries. Approximately 85% of the southern James Bay population of Canada geese winter in the Mississippi flyway and 15% in the Atlantic flyway. Geese from the southwest mainland winter primarily in the Mississippi Flyway, those from the southeast mainland winter primarily in the Atlantic flyway, and those on Akimiski Island go to both flyways (~85% Mississippi flyway).

1. Banding and marking efforts on Akimiski Island and the mainland should continue as an operational program.
2. Banding and marking efforts on the mainland should be expanded wherever possible.
3. Radio marking and/or genetic sampling of this unmarked interior mainland segment of the southern James Bay population are required to assist harvest derivation.
4. Genetic analysis should be pursued to help validate banding distribution analysis through comparison with recovered banded birds and to help validate band recovery distribution and flyway proportions of the harvest by banding area.

Population Status or Assessment: Status is assessed annually with a spring breeding ground survey. Mid-January Canada goose distribution surveys are also conducted in southern James Bay population winter range. Complications due to inclusion of moult migrants in some spring surveys in the 1990s has been corrected by conducting surveys before moult migrants arrive.

1. Continue spring breeding ground surveys as an operational program, with a focus on detecting change in the Indicated Breeding Pairs index rather than total spring population, and improvements in survey design to permit detection of annual changes of 15%.
2. Continue to estimate spring population size of giant Canada geese in southern James Bay population harvest states.
3. Monitor moult migrant Canada geese in the southern James Bay population summer range (numbers, distribution, arrival and departure timing).

Population Dynamics: Reproductive success and productivity is determined annually through studies of nesting biology and gosling survival on Akimiski Island and from banding data. Age ratios at banding declined between 1985 and 1992, but have generally increased since then. Direct recovery rates of banded juveniles declined markedly beginning in 1987, and remain low until 2000. Juvenile direct recovery rates have been higher since with the exception of 2003. Reproductive success and productivity through late summer has been monitored from 1993-2007. Gosling mortality in the last 4 weeks of brood rearing is variable but high (30-60%) on the north shore of Akimiski, providing evidence to support the suggestion that the productivity declines (and Akimiski population segment declines) were related to reduced per capita food availability caused by habitat deterioration, and that summer mortality is limiting recruitment in some years.

1. Direct recovery rates should be monitored through operational banding to estimate and monitor harvest rates.
2. Continue to monitor annual reproductive success, productivity and gosling growth rates through late summer.
3. Best available vital rate data should be included in population models as a tool to monitor population growth rates (status). Population modelling will also help identify vital rate data gaps.

Population Biology and/or Ecology: The basic breeding biology for southern James Bay population Canada geese is relatively well known due to long-term monitoring and research on the north shore of Akimiski Island. However, additional information is needed to understand the influence of temperate breeding Canada geese on their vital rates. Further, factors affecting gosling survival to fledge are not well understood.

1. Develop research to assess the effects of changing spring forage quantity and quality and of climate on the population vital rates, particularly for gosling survival.

Harvest Assessment: Estimates of population specific harvest and subspecies composition of Canada goose harvest by state and province are useful for assessing harvest strategy. Banding-based derivations of population harvest depend on accurate estimates of population size and numbers of banded birds alive in each population, and representative banding of all populations in the harvest (i.e., they are subject to several estimation errors). However, recently developed genetic discrimination methods show high capability to estimate harvest composition by population at a state or regional level and to subspecies at an individual level. Subsistence harvest estimates are made only periodically (1974-1976, 1981-1982, 1990, 2004-2005),

1. Expand use of both the microsatellite technique and the combined mtDNA and microsatellite technique to estimate Canada goose harvests by population and subspecies (as required to assess harvest at various scales). Enhance knowledge of geographic distribution of the harvest throughout the Mississippi and Atlantic flyways. Use genetic techniques to validate banding distribution analysis.
2. Improve methods for and continue to monitor subsistence harvest in Canada.

Habitat Concerns: Coastal habitats (particularly brood rearing habitats) of the southern James Bay population in the Hudson Bay Lowlands may be negatively impacted by one or more of the following factors: 1) growing numbers of moult migrants from temperate-nesting Canada goose populations, 2) spring staging lesser snow geese, 3) locally nesting lesser snow geese, 4) climate change, and 4) mineral extraction development. Annual monitoring of plant productivity, grazing, and gosling growth rates occurs on Akimiski Island.

1. Continue to monitor plant productivity, grazing pressure, and gosling growth rates as indicators of habitat conditions in coastal areas of Akimiski Island, and initiate monitoring on mainland brood rearing areas.
2. Use habitat data in combination with vital rates in population models to estimate the effects of habitat changes on population age structure and growth rates.
3. Determine densities and distribution trends of moult migrant Canada geese and migrating and nesting snow geese in southern James Bay population summer range.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events, especially on public lands.

Canada Goose *Branta canadensis*

Mississippi Valley Population

Population Definition or Delineation: The Mississippi Valley population of Canada geese breeding and wintering ranges are fairly well known from intensive banding, marking, and radio-tracking. However, the delineation problems remain. The major issue is separation of both temperate breeding geese and southern James Bay geese during fall and winter population and harvest assessments although genetic techniques will help improve at least harvest surveys. The second issue is the separation of Mississippi Valley geese from moult migrant geese from temperate breeding populations during banding and marking in summer.

1. Continue geographically well-dispersed banding and marking of Mississippi Valley population on the breeding range.
2. Continue to use genetic techniques to help differentiate Canada goose subspecies from harvest surveys to validate results of band returns.

Population Status or Assessment: Mississippi Valley population status is assessed annually by a spring breeding range survey. Mid-January Canada goose distribution surveys are also conducted in Mississippi Valley population winter range. Winter surveys cover most concentration areas but are confounded by the presence of many giant Canada geese. Moult migrant temperate breeding Canada geese may confound spring population estimates to varying degrees, depending on survey timing in relation to that of the moult migration.

1. Continue a spring breeding range survey as the primary metric of population status with a refocus on change detection using transect level modelling techniques that control for survey timing and other covariates.
2. Monitor timing of the moult migration with regard to survey timing.
3. Estimate the numbers of temperate breeding geese in spring in the traditional Mississippi Valley population wintering states. Under a buffered harvest management paradigm, monitoring the population status of temperate breeding Canada geese becomes as important as monitoring Mississippi Valley population status.

TIM MOSER

Population Dynamics: Age ratios for Canada geese harvested in the Mississippi flyway are unreliable indicators of annual productivity because immature temperate breeding Canada geese moult their tail feathers in late fall, causing many to be incorrectly aged as adults.

1. Develop a reliable non-harvest measure of annual variation in productivity; monitor nesting biology and gosling survival on the breeding grounds.
2. Improve understanding of production indices such as age ratios in harvest samples by combining with genetic techniques to identify Mississippi Valley population geese in harvest samples, and continue collecting banding age ratio data, eliminating potential error from temperate breeding moult migrants using morphology and genetic methods.
3. Incorporate current available vital rate data into a population model to identify data needs and estimate growth rates and their range for a variety of harvest rates.

Populations Biology and/or Ecology: The basic breeding biology for Mississippi Valley population Canada geese is relatively well known due to long-term monitoring and research on the Hudson Bay coast. However, additional information is needed to understand the influence of changing habitat and climate on breeding vital rates and migration timing. Further, the influence of temperate breeding Canada geese on Mississippi Valley population vital rates is not known.

1. Develop research to assess the effects of changing spring forage quantity and quality and of climate on the population vital rates.

Harvest Assessment: Harvest estimated for each jurisdiction confounds subspecies and populations of Canada geese. Subsistence harvest of Mississippi Valley population Canada geese is not estimated annually or with standard methods in all areas.

1. Employ genetic techniques to estimate Canada goose harvest distributions by population and to validate band return derivations.
2. Estimate aboriginal subsistence harvest in Ontario and northern states periodically to monitor current levels and change. Promote the standardization of methods and implement a harvest survey "operationally" at regular multi-year intervals.

Habitat Concerns: Coastal nesting and brood rearing habitats of Mississippi Valley population in the Hudson Bay Lowlands may be impacted by increased populations of both Canada geese, snow geese and moult migrant temperate breeding Canada geese in the range and interactions of these increased populations with climate changes (e.g., late cold springs that stall large numbers of migrating geese on brood range). Further, mineral exploration and extraction activities may impact habitats directly and indirectly (e.g., impacting water levels in the Hudson Bay Lowlands, disturbance, power generation impacts [hydro-electric, wind farm]).

1. Assess habitat conditions in coastal areas regularly to identify potential changes.
2. Examine impact of large snow goose populations on Mississippi Valley population range.
3. Assess number and impact of temperate breeding Canada goose moult migrants in the area.
4. Model breeding density-habitat associations to help predict potential impacts when large scale development or changes are imminent.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events, especially on public lands.


TIM MOSER

Canada Goose *Branta canadensis*

Eastern Prairie Population

Population Definition or Delineation: Much of the annual variation in breeding population size estimates derived from aerial breeding grounds surveys results from variation in breeding density estimates from interior areas of the breeding range. Furthermore, generally increasing breeding population size estimates over the past 15-20 years are a result of estimated increased breeding density in interior areas of the eastern prairie population breeding range. In addition, these areas are currently proportionately allocated the lowest survey effort in annual breeding population surveys. Estimates of harvest derivation and geographic distribution of harvest come largely from birds banded annually in coastal areas. Understanding of the eastern prairie population breeding range and whether birds nesting in and near coastal areas are representative of the eastern prairie population as a whole is necessary to provide a better basis for management of the eastern prairie population.

1. Re-assess the breeding range boundaries for eastern prairie population Canada geese, especially the western limit of the breeding range.
2. Banding and marking should continue on the breeding range.

Population Status or Assessment: Eastern prairie population status is assessed annually by a spring breeding range survey. Mid-January Canada goose distribution surveys are conducted in the eastern prairie population winter range.

Affiliation of groups of Canada geese on the eastern prairie population breeding grounds is largely unknown. In recent years, large-bodied geese have been observed arriving from the south during late May and early June, and are likely moult-migrant giant Canada geese. However, groups of non-breeding geese on the eastern prairie population breeding grounds were present well before the current increase in moult migrants. Incorporation of these groups into breeding population surveys and in harvest derivation (based on summer banding on the eastern prairie population breeding grounds), has clouded interpretation of survey and banding data.

1. The winter and breeding season surveys should be continued to annually assess population status.
2. Assess the derivation of groups of Canada geese observed on the breeding grounds during the eastern prairie population breeding season, especially during spring (breeding surveys) and when adults are flightless (mid-late summer).

Population Dynamics: Productivity is assessed from the breeding season survey and on-the-ground monitoring of a sample site near Cape Churchill. Fall flights are predicted from these data and a spring weather-population size model. Survival is estimated from band recoveries and observations of marked geese. Brood-survival is a major unknown. It may be declining due to habitat deterioration or changes in distribution of broods.

1. Fall flight predictions from surveys, on-the-ground monitoring and modeling should continue.
2. Brood survival should be studied.

Harvest Assessment: Harvest strategies for eastern prairie population were revised in 2006. Previous strategies managed for average eastern prairie population under average conditions. Harvest goals are now focused on both eastern prairie population and temperate-nesting Canada goose populations. It is hypothesized that growing temperate-nesting Canada goose populations have and will continue to increasingly buffer the harvest of eastern prairie population geese, although the extent of this buffering effect is uncertain. In order to test the potential buffering effect, the eastern prairie population object was lowered from an average of 145,000 geese represented as singles and pairs to a minimum of a two-year average of 75,000 singles and pairs, which corresponds to the lowest breeding grounds estimate for the eastern prairie population from 1972-2006.

As eastern prairie population states/provinces move forward with the new harvest strategy, it will be increasingly important to monitor the spatial and temporal distribution of Canada goose harvest. The utility of traditional harvest derivation methods based on banding data are limited. Genetic techniques offer an alternative method that should be explored to estimate harvest composition by population in traditional eastern prairie population harvest states/provinces. More reliable information on harvest composition will facilitate the assessment of the hypothesis that the harvest of temperate-nesting Canada geese will buffer eastern prairie population harvest.

1. Consider genetic techniques to determine the spatial and temporal distribution of Canada goose harvest by population in eastern prairie population harvest states/provinces.
2. Continue to use band recovery data to monitor changes in harvest rates.

Habitat Concerns: Breeding ground habitat may be adversely affected by the midcontinent population of lesser snow geese, mining activities, hydro-electric development, and climate change. The midcontinent population of lesser snow geese has increased in size three-fold over the last 30 years. This dramatic increase in numbers of lesser snow geese has been accompanied by significant habitat degradation as a result of grazing and grubbing by geese. In recent years, mining companies have increased exploration and planning of diamond mines. Development of infrastructure, increased shipment of materials through Hudson Bay, and other landscape alterations could negatively impact eastern prairie population Canada geese. Demand for electricity could lead to additional hydro-electric developments; however, these developments would likely occur in the low density portion of the eastern prairie population range.

1. Monitor the direct and indirect effects of increasing numbers of snow geese on eastern prairies population Canada geese.
2. Be prepared to monitor potential impacts from mining or hydro-electric developments.
3. Establish monitoring protocol to measure broad scale changes in habitat within the eastern prairie population range.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events, especially on public lands.


RICHARD COTTER

Canada Goose *Branta canadensis*

Western Prairie Population

Population Definition or Delineation: In 1979 the Central Flyway Council approved a management plan for western prairie population Canada Geese. This plan addressed large Canada geese breeding in southwestern Manitoba and southeastern Saskatchewan. The eastern tier states of the central flyway desired separate guidelines for taxonomically similar large Canada geese which originated from restoration efforts, and a management plan was drafted for "Great Plains" (GP) Canada geese, which included geese restored into southeastern Saskatchewan and southwestern Manitoba, over-lapping the southern breeding range of western prairie population. The Trans-Canada Highway was accepted as the boundary between the two populations. By the late 1980's, however, available data were no longer adequate to separate western prairie population and Great Plains Population for management purposes, especially on the wintering grounds. The result was a revision and amalgamation of the two plans, resulting in the "Management Plan for Large Canada Geese Wintering in the Western Tier States of the Central Flyway (1988)". Banding data (1980-85) indicated that the western prairie population was composed of two components: a) a northern "group", nesting primarily in the boreal forest region of Saskatchewan and Manitoba, extending east to the range of the eastern prairie population, and composed of *B. c. interior* geese, and b) a more southerly, parkland breeding population of *B. c. maxima* extending south to the range of the Great Plains population. Preliminary band analyses indicated that within these two regions existed distinct sub flocks with discrete wintering areas within the central flyway. However, available data are inadequate to enable reasonable identification of manageable subpopulations.

Current estimates of harvest distribution and derivation are not available; there has been no significant banding of western prairie population geese on the breeding grounds in over two decades. Although management of the western prairie and Great Plains populations from a wintering ground perspective dictates that the two must be treated as one group, there may be a need to continue to manage the western

prairie population – nesting exclusively in Canada – as a separate entity. An improved understanding of the western prairie population breeding range and its winter distribution is necessary to provide a better basis for management of this population.

1. Re-assess the breeding range boundaries for western prairie population Canada geese, especially the eastern limit of the population which may over-lap with the eastern prairie population, and the southern limit, which over-laps with the Great Plains population.
2. Detailed analyses of current banding information will provide information on harvest distribution and derivation, and indicate if there is a need for banding within the ranges of the boreal forest and parkland components of the western prairie population.


TIM MOSER

Population Status or Assessment: The distribution and abundance of western prairie population Canada geese were monitored by mid-December surveys in the central flyway until 1999, when the survey was discontinued by the U.S. Fish & Wildlife Service. Additionally, the Canadian Wildlife Service conducted breeding population surveys in the parklands of eastern Saskatchewan from 1972-1978, and in northern Saskatchewan and Manitoba to determine breeding pair density within the boreal forest. Currently, counts obtained during the Midwinter Waterfowl Survey are used to provide the winter status and distribution of geese. Breeding population estimates for the western prairie population are also obtained from the annual Waterfowl Breeding Population and Habitat Survey conducted by the U.S. Fish & Wildlife Service (USFWS) and the Canadian Wildlife Service (CWS). Previous analyses indicated a strong relationship between the CWS western prairie population breeding population surveys and the Waterfowl Breeding Population and Habitat Survey.

The 1988 Management Plan, which includes the western prairie population (see Population Definition/ Delineation below), stated an objective of a "stable" breeding population, based on the Waterfowl Breeding Population and Habitat Survey. The plan also established a winter objective of 275,000 to 300,000 (three year average) birds based on the mid-December surveys, which were discontinued in 1999. Since then, the western prairie breeding population objective has been set at 17,000 pairs, with January winter survey regulatory thresholds of 150,000 to 285,000 (western prairie and Great Plains populations combined).

In, 2007, the estimated spring population in the portion of western prairie/Great Plains populations range included in the Waterfowl Breeding Population and Habitat Survey was 907,900 (+ 66,300) geese, 24% more than last year (P=0.050) The latest three year running average (2005-2007) population estimate of the western prairie/Great Plains populations from the Midwinter Survey is 435,167 or 53% greater than the current upper regulatory threshold of 285,000 as specified in the combined plan for western prairie population and Great Plains population.

There is a need to continue to manage large Canada geese wintering in the eastern tier states of the central flyway based on both breeding and wintering ground affiliations. Additionally, there is a need to better assess the distribution and abundance of the various sub flocks of western prairie geese within wintering areas.

1. Continue to monitor the combined western prairie/Great Plains populations through the January midwinter surveys in the central flyway, and the Waterfowl Breeding Population and Habitat Survey in Canada to annually assess population status.
2. Review the boreal forest surveys of breeding western prairie population (Canadian Wildlife Service survey and Waterfowl Breeding Population and Habitat Survey) to determine if sampling distribution and intensity is adequate to monitor the northern (*B. c.* interior) component of this population west of the range of the eastern prairie population of Canada geese.
3. Consider repeating the CWS breeding pair surveys (1972-1978) to determine if the Waterfowl Breeding Population and Habitat Survey continues to accurately represent the status of the western prairie population in eastern Saskatchewan.

Population Dynamics: Productivity is assessed by age ratios in the harvest, however there are issues with respect to variation in moult patterns of the two components of the western prairie population (boreal forest and parkland), further compromised by range over-lap and inability to separate western prairie from Great Plains in the harvested sample. The "keys" used to determine adult:immature ratios from tail fans submitted during the annual National Species Composition Survey in Canada, and the Waterfowl Parts Collection Survey in the United States need to be further refined and verified to ensure that appropriate and consistent decisions guide the age assessment of western prairie population tail fans.

Survival of adults and broods are not assessed on a regular basis due to the absence of operational banding and brood survey programs.

1. The keys used to determine the age of tail fans submitted to the national harvest surveys in Canada and the United States should be further refined and verified, and a consistent approach taken in their application at the central flyway and Canadian wing bees. Discriminant function analyses of tail feather measurements may facilitate separation of western prairie and Great Plains geese in the harvest.
2. Fall flight predictions from breeding pair surveys and on-the-ground monitoring, where available, would benefit the management of western prairie population Canada geese.

Population Biology and/or Ecology: There has been little work done on the breeding ecology of western prairie population geese or their boreal breeding habitats. Additionally, fall and winter behavior and ecology are not well documented. An unknown portion of western prairie population geese are believed to moult migrate to Arctic and subarctic areas where they may compete with other geese for resources. With construction of mainstem reservoirs on the Missouri River beginning in the early 1950's, late fall and winter distribution of these birds has shifted from mid-latitude states to South Dakota and more recently North Dakota. Additionally, fall migration is progressively occurring later due to warm fall weather and high energy waste grains and other crops such as peas and beans become more abundant in Saskatchewan

and North Dakota. These delayed and shortened migrations have resulted in reduced harvest of these birds which has likely allowed the large population growth that this population has experienced.

1. Design and conduct studies of the breeding ecology of western prairie population, especially in boreal habitats.
2. Conduct banding, marking or telemetry studies to investigate moult migration behaviour and determine the potential impacts of western prairie population on other species.
3. Conduct banding and/or marking studies to examine migrational behaviour and harvest and survival rates.

Harvest Assessment: Harvest strategies for the western prairie population are currently different than what was out-lined in the 1988 management plan, because the previous agreement was based on population status from the mid-December surveys which have been discontinued. The regulatory thresholds currently in place are 150,000 to 285,000 geese, based on the January winter survey (western prairie and Great Plains combined).

Estimates of band reporting rates are necessary for estimating distribution of western prairie population Canada goose harvest, yet currently, no estimates of band reporting rates exist specific for Canada geese. Furthermore, band reporting rates for western prairie population Canada geese likely vary spatially – and perhaps temporally – due to the large range encompassed by this population and variations in the abundance, distribution and migration chronology of the boreal and parkland components. This may bias harvest estimates.

1. If an operational banding program is initiated, the band reporting rates for western prairie population Canada geese should be estimated, and the spatial and temporal variation in band reporting rates investigated.
2. Continue to monitor harvest of western prairie/Great Plains Canada geese, with the objective of developing the ability to clearly distinguish between the two populations with respect to annual harvest.

Habitat Concerns: Populations of western prairie Canada geese have increased significantly over the past two decades. In some parts of the range, primarily in the parklands of southeastern Saskatchewan and southwestern Manitoba, Canada geese now occupy sub-optimal nesting habitat, due to the increased population density. This has impacted both brood and adult survival. Also, the increased population has created a number of conflicts in both urban and rural settings, with respect to negative impacts on recreational areas and increased depredation of cereal and forage crops.

Breeding habitat within the boreal forest range of western prairie geese is more secure and prone to fewer conflicts. Expanded mineral exploration, forest industry activities and potential hydro-electric projects on the Churchill River system may influence the distribution, abundance and productivity of western prairie geese in this region in the future.

1. Monitor industrial and forestry development within the boreal forest, and ensure that western prairie geese are recognized within environmental assessment studies conducted during the approval process for such activities.
2. Continue to work with municipal governments and agricultural organizations in mitigating against damage caused by western prairie population geese in both rural and urban settings.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events.


TIM MOSER

Canada Goose *Branta canadensis*

Vancouver Population

Population Definition or Delineation: This population largely has been defined by very limited banding and several morphological studies of Canada geese. There is considerable overlap in morphological measures with dusky Canada geese, stimulating historical debate on whether they constitute separate subspecies. Recent genetic analyses of Canada geese along the north Pacific coast also indicate overlapping variation in the two populations.

Banding and telemetry studies have confirmed that Vancouver Canada geese in Southeast Alaska are largely non-migratory. However, migration habits of birds in British Columbia are unknown. Birds with genetic characteristics of Vancouver Canada geese have been found on winter areas of dusky Canada geese. The population is centred in coastal areas of Southeast Alaska and northern British Columbia. The southern extent of their distribution is poorly defined and genetic distinctions may have been obscured by introductions of Canada geese from other populations in southern British Columbia. The northern extent of their distribution is also poorly defined, although moulting groups of Vancouver Canada geese have been observed along the northern coast of the Gulf of Alaska to the vicinity of Bering Glacier.

1. Expand and increase banding and telemetry studies in Alaska and British Columbia to better define seasonal and annual ranges.
2. Expand genetic studies to determine similarity of British Columbia birds to Alaskan birds, and to delineate the southern boundary of the population.

Population Status or Assessment: Currently, there is no management plan that addresses this population. There is no operational survey or other means to develop annual or periodic information on population status or productivity. Historical statements about population size and trends have been intuitive, based on

a few surveys of part of the range in southeast Alaska. During aerial surveys from 1996-2001, the U.S. Fish and Wildlife Service estimated that approximately 24,000 Canada geese wintered in Southeast Alaska. There are no estimates of breeding or wintering Vancouver geese in British Columbia. Population assessment is difficult because the geese are dispersed widely and use forest habitats in summer; in winter, birds are more visible on coastal areas, but some winter inland and as far south as Oregon.

1. Develop a survey design to assess the number of Vancouver geese wintering in Southeast Alaska and British Columbia.
2. Evaluate means to estimate he number of Vancouver geese wintering in western Oregon and Southwest Washington.

Population Dynamics: Banding and recent telemetry studies indicate that adult survival may be high. Although studies of nests have been quite limited, showing considerable variation in nest success, recent studies indicate relatively high nest survival. Nest survival may vary spatially across the range and among islands with different habitats and predators. There are no data on productivity, survival of goslings, post-fledging survival, or recruitment.

1. Assess spatial and temporal variation in nest survival.
2. Estimate gosling and post-fledging juvenile survival.

Population Biology and/or Ecology: Genetic differences have been found among Vancouver Canada geese at different moulting and nesting areas in southeast Alaska. Thus gene flow may be limited across relatively small geographic distances. Telemetry data confirm that birds often moved short distances from wintering to nesting areas, and that birds marked at different areas often remained separated during winter and nesting. Demographic influences may thus operate at a relatively small scale. Events that affect birds on nesting areas may affect local winter populations, and vice versa.

1. Further evaluate genetic variation among Vancouver Canada geese that nest in different areas.

Harvest Assessment: Current harvest surveys and the Parts Collection Survey do not produce estimates of harvest from this population. Harvest is presumed to be low, based on low rates of direct band recoveries (<3%) from limited banding. Most recoveries from Alaska bandings were from Southeast Alaska (84%), with 13% from Oregon or Washington, and the remainder from British Columbia. Recovery rates in Oregon and Washington may be elevated because of higher reporting rates at check stations.

1. Expand banding across the breeding range to assess harvest distribution.
2. Examine parts collection data to ascertain whether Vancouver goose harvest reliably can be estimated from tail fan samples.

Habitat Concerns: Nesting habitat is stable and primarily occurs in forest sites that have little commercial timber value. Forest road construction could potentially affect some nesting areas. Brood-rearing habitats have been poorly studied. Wintering occurs in intertidal habitats that are relatively stable, but that can be affected by coastal road development, port construction, oil spills or other accidental maritime releases.

1. Identify brood-rearing habitats and assess potential effects of forest management practices.
2. Conduct regional evaluations of winter habitat distribution and availability.

Parasites, Disease, and/or Contaminants: No issues or concerns.

1. Continue to monitor for disease mortality on national wildlife refuges and state-managed wildlife areas.


TIM MOSER


DOUG STEINKE

Canada Goose *Branta canadensis*

Lesser Canada Population

Population Definition or Delineation: This population has been partially defined through surveys, banding, and genetics studies; but full definition depends upon accurate delineation of breeding grounds. The exact boundaries of the breeding range remain undetermined due to the close proximity, and possible overlap, of the breeding range of the similar-appearing Taverner's cackling goose. Efforts are under way to determine the geographic boundaries between breeding areas of these two species after which an appropriate breeding ground survey will be established to provide annual management indices.

1. Complete breeding ground genetic sample collection and analysis and delineate boundaries of breeding areas.

Population Status or Assessment: The lesser Canada goose population historically has been inadequately monitored through breeding ground surveys directed primarily at other species, and through direct counts and photo composition surveys of other geese in winter. Current trend analyses based on long-term aerial surveys of geese observed in suspected breeding areas indicate a slightly declining population.

1. Design and implement appropriate breeding ground survey to be used as an annual population index.

Population Dynamics: Little recent work has been done on the population dynamics of lesser Canada geese. Best information available suggests a slightly declining population.

1. Initiate studies of vital rates, including survival rates of adults and juveniles and studies of nesting success and productivity.

Population Biology and/or Ecology: Lesser Canada geese nest in association with streams and rivers in interior Alaska. Flocks of goslings with attendant adults are typically seen on gravel and sand bars along rivers in interior Alaska during the summer. To the north and east, these birds may also nest in tundra habitats.

Harvest Assessment: Lesser Canada geese winter range partially overlaps with that of six other populations of white-cheeked geese that are similar in appearance. Population levels of some of these geese are such that severe restrictions are placed upon harvest opportunities, and hunter check stations are used in western Oregon and south western Washington to closely monitor harvest of certain populations. As a result, potential exists to monitor the harvest of lesser Canada geese in part of the western portion of its winter range. Current information suggesting that this population of geese is declining slightly and would indicate

that current harvest management may need to be reviewed soon. Improved harvest assessment would better ensure the security of this population and would seem prudent.

1. Improve the assessment of harvest through collection of morphological and genetic data at check stations.

Habitat Concerns: Breeding grounds habitat, primarily interior forested wetlands, is relatively secure with the possible exceptions of south central Alaska, where urban sprawl is occurring, and wetlands in the vicinity of Fairbanks, where urbanization is occurring and petroleum development is proposed. On the wintering grounds, conversion of grasslands and croplands to uses that are not favorable to geese is increasing. Urban expansion, conversion to fruit/vegetable and vineyard crops, and pulpwood plantations have reduced habitat and increased goose foraging intensity on grain, turf, and pasture crops.

1. Monitor land use conversion on the wintering grounds to assess impacts on availability of suitable foraging habitats.
2. Continue to develop cooperative goose and habitat management strategies with agricultural producers to address crop depredation issues.
3. Continue to pursue opportunities to provide secure long-term winter grazing range through easements and acquisitions.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease mortality on national wildlife refuges and state-managed wildlife areas.

TIM MOSER

Canada Goose *Branta canadensis*

Dusky Population

Population Definition or Delineation: This population of geese has been well defined and delineated historically through surveys and banding. Its range is relatively compact on both breeding and wintering grounds. Genetic studies over the past 20 years have established that dusky geese are distinct from other subspecies, as part of the large-bodied *Branta canadensis* group, although there is considerable genetic variability within the population. The primary definition issue is determining the degree of affiliation between the primary Copper River Delta breeders and several thousand closely related "island geese" that breed on Middleton Island and Prince William Sound islands. These birds coincide with dusky geese on the wintering grounds, along with similar Vancouver Canada geese.

1. Develop methods to mark and track geese breeding on Middleton Island and in Prince William Sound to determine seasonal ranges.

Population Status or Assessment: The dusky goose population historically has been monitored through breeding ground surveys, direct counts and photo composition surveys in winter, and development of indirect estimates from mark-recapture surveys. A modified breeding ground survey was recently adopted as the means to develop annual management indices.

1. Continue aerial spring breeding population surveys and periodic ground plot surveys.
2. Conduct biannual surveys of geese on Middleton Island.

Population Dynamics: Since the 1980s, the primary concern with the population has been high rates of nest and goose predation on the breeding grounds, resulting in low production. Recent studies indicate that adult survival remains high, but little is know about post-fledging survival of juveniles.

1. Continue July aerial production surveys.
2. Continue banding and maintain a sample of neck-collard birds.
3. Complete analyses to estimate seasonal and annual survival rates, and juvenile survival rates.
4. Pursue studies to determine age-related productivity in the population.

Population Biology and/or Ecology: The basic biology of dusky geese is fairly well known, but significant ecological changes on breeding and wintering grounds warrants further research and ongoing monitoring of environmental conditions. More research is needed to fully understand the effects of habitat succession on the suite of goose predators and predator-prey dynamics on Copper River Delta, especially on bald eagles that are currently the most significant predator.

1. Initiate studies to determine bald eagle foraging ecology and prey selection in relation to dusky goose production.
2. Continue monitoring of mammalian predation on nests and geese.
3. Initiate research to develop nest predator aversion and management strategies.

Harvest Assessment: Management of Canada goose hunting within the range of dusky geese has been very restrictive since the mid-1980s. A complex regulatory regime in Washington and Oregon is designed to provide harvest opportunity on stable and abundant Canada goose subspecies, ameliorate crop damage, and minimize harvest of dusky geese. Harvest assessment in the special permit quota zone is vital to track levels of dusky goose harvest, which may trigger closures of Canada goose seasons.

1. Continue conservative management through application of special regulations; monitor harvest with check stations, and collect morphological and genetic data to track size and distribution of subspecies harvests.
2. Investigate the composition of large dark geese in fall and winter harvests to assess the presence of Vancouver Canada geese or other non-dusky components.

Habitat Concerns: The 1964 Alaska Earthquake and uplift of the Copper River Delta triggered extensive habitat succession, including release of shrub and forest communities, alteration of coastal features and marshes, and desalination of wetlands. On the wintering grounds, conversion of grasslands and croplands to uses that are not favorable to geese is increasing. Urban expansion, conversion to fruit/vegetable and vineyard crops, and pulpwood plantations have reduced habitat and increased goose foraging intensity on grain, turf, and pasture crops.

1. Continue studies of breeding habitat succession on Copper River Delta, focusing on expansion of shrub and forest communities, changes in coastal and intertidal habitats, and changes in wetland characteristics.
2. Continue and expand studies of winter foraging ecology, habitat capacity, and habitat use in relation to the large collective of other wintering goose populations.
3. Monitor land use conversion on the wintering grounds to assess impacts on availability of suitable foraging habitats.
4. Continue to develop cooperative goose and habitat management strategies with agricultural producers to address crop depredation issues.

Parasites, Disease,and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events, especially on public lands.

RICHARD COTTER

Cackling/Canada Geese *Branta*

Tall Grass Prairie Population

Population Definition or Delineation: The delineation of the more northerly breeding midcontinent Canada goose/cackling goose population units is confounded by a relatively low density dispersed breeding distribution, mixing during migration, and plastic winter distribution. Further, discrimination of the subspecies (now species) of the birds that make up this population is virtually impossible in the field, in the hand, and from parts collected for harvest assessment. Historically, two breeding populations have been recognized, the tall grass prairie population and the short grass prairie population. Both populations were considered to be a complex of two subspecies of Canada geese, *B.c. parvipes* (lesser Canada goose) and *B.c. hutchinsii* (Richardson's Canada goose). In 2004, the American Ornithologist's Union split subspecies of Canada geese into two species – Canada geese (large-bodied white-cheeked geese) and cackling geese (small-bodied white-cheeked geese). Thus, *B.c. parvipes* is considered a Canada goose and *B.c. hutchinsii* is a cackling goose. This nomenclature issue is a serious impediment to even the most routine discussions of the status and management of this population as traditionally defined. The breeding range of tall grass prairie Canada/cackling geese was designated primarily on the basis of historical banding on wintering grounds and staging areas. More recent neckbanding on the breeding ground has generally confirmed the population delineation. There is an obvious need to better define tall grass prairie population migration and wintering areas from a breeding ground perspective.

1. Better define the tall grass prairie population in relation to breeding range, migration routes, and wintering areas. Improve knowledge of variation in distribution and its environmental correlates. Employ DNA techniques as well as traditional methods.
2. Develop a cooperative banding program across the breeding range to help identify populations and to guide population monitoring programs.
3. Develop and implement an operational breeding ground population monitoring program.
4. Determine the potential to continue effective management of this population separate from short grass prairie population.

Population Status or Assessment: Current procedures for assessing the status of tall grass prairie geese involves surveys that generate a large:small (*maxima/interior:parvipes/hutchinsii*) white-cheeked goose ratio. Estimates of small white-cheeked goose (*parvipes/hutchinsii*) numbers are estimated from counts of small white-cheeked geese in counties of each state designated as either tall grass prairie or short grass prairie traditional use areas. Accurate large:small white-cheeked goose ratios are difficult to estimate because of insufficient sampling, and apparent shifts in composition within the winter range of both tall grass prairie and short grass prairie. Additionally, surveys are conducted on Baffin Island in late summer to estimate population trends in the far eastern portion of breeding grounds. Surveys across the tall grass prairie and short grass prairie breeding grounds are being designed and implemented.

- Develop operational breeding ground surveys to provide accurate information on the status of breeding Canada/cackling geese with sufficient accuracy to monitor population change at a desired level.
- Use population delineation information to better define breeding populations, to design status assessment surveys, and to institute operational banding.
- Design and institute breeding area trend surveys across the tall grass prairie/short grass prairie range and refine with delineation information.


TIM MOSER

Population Dynamics: Problems with defining and monitoring populations based on breeding result in inadequate information on population specific productivity and mortality. Little is known of the trends or relevant factors affecting production. Mortality information is only available from recreational harvests, and that is obscured by lack of reliable discrimination of Canada/cackling geese from different populations.

1. Design and implement breeding grounds research to improve estimates of productivity vital rates and determine the important factors influencing those vital rates with a focus on comparison with short grass prairie.
2. Design and initiate a cooperative banding program (in conjunction with delineation projects) to derive survival estimates for identifiable population segments.

Population Biology and/or Ecology: Environmental factors (snow cover, temperature, etc.) appear to be the primary influence on the annual production of tall grass prairie geese. Band recovery information suggests a recent shift to the east of migration and wintering areas, although the reasons are not known.

1. Continue banding and surveys on northern breeding areas to monitor and better understand shifts in migration and wintering areas.
2. Monitor harvest and habitat use on migration and wintering areas.
3. Use data from recent breeding ground surveys and regional climatic information, with fall harvest age ratios to model tall grass prairie and short grass prairie goose breeding effort and productivity.

Harvest Assessment: Estimating harvest for tall grass prairie geese is hampered by weakly defined population definitions, mixing and shifting of subspecies during fall and winter, and poor methods used to identify and enumerate harvested birds.

1. Develop and test improved methods of assigning harvested Canada geese to breeding populations using practical morphological parameters or DNA analysis techniques.

Habitat Concerns: Degradation of important habitats is continuing problem and protection of wintering and staging areas need attention (e.g., Louisiana and Texas coastal marshes, Rainwater Basins, Platte River).

1. Promote protection and restoration of important wintering and migration habitats through the NAWMP habitat joint ventures.
2. Identify and protect spring staging areas.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events.


DOUG STEINKE


TIM MOSER

Cackling/Canada Geese *Branta*

Short Grass Prairie Population

Population Delineation: The delineation of the more northerly breeding midcontinent Canada goose/cackling goose population units is confounded by broad, dispersed breeding distribution, mixing during migration, and variable winter distribution. Further, discrimination of the subspecies (now species) of the birds that make up these populations is virtually impossible in the field, in the hand and from parts collected for harvest assessment. Historically, two populations have been recognized, the short grass prairie population and the tall grass prairie population. Both populations were considered to be a complex of two subspecies of Canada geese, *B.c. parvipes* (Lesser Canada goose) and *B.c. hutchinsii* (Richardson's Canada goose). In 2004, the AOU split subspecies of Canada geese into two species – Canada geese (large-bodied white-cheeked geese) and cackling geese (small-bodied white-cheeked geese). Thus, *B.c. parvipes* are now considered to be a Canada goose and *B.c. hutchinsii* are now considered to be a cackling goose. These nomenclature issues are a serious impediment to even the most routine discussions of the status and management of these birds. The breeding range of short grass prairie Canada/cackling geese, considered to be west of the 100th meridian, has been designated primarily on the basis of historical banding on wintering grounds and staging areas. More recent neck-banding work on the breeding grounds has generally confirmed this delineation. However, there is a need to better define short grass prairie migration and wintering areas from a breeding ground perspective.

1. Better define the short grass prairie population in relation to breeding range, migration routes, and wintering areas, including variation in distribution over time and environmental correlates to distribution.
2. Develop a cooperative banding program across the breeding range to identify biological population units and recommend population monitoring programs.
3. Develop and implement an operational breeding ground population monitoring program.
4. Determine the potential to continue effective management of this population separate from tall grass prairie.

Population Status or Assessment: Current procedures for assessing the status of short grass prairie geese involves surveys that generate a large:small (*maxima/interior:parvipes/hutchinsii*) white-cheeked goose ratio, estimation of small white-cheeked goose (*parvipes/hutchinsii*) numbers and monitoring numbers of small white-cheeked geese in counties of each state designated as either short grass prairie or tall grass prairie traditional use areas. This process suffers from difficulty in obtaining accurate large:small white-cheeked goose ratios, from insufficient sampling, and apparent shifts in composition within the winter range of both short grass and tall grass prairie population units. Surveys are being conducted on Baffin Island in

late summer as an index to population trends in the far eastern portion of breeding grounds. Additionally, surveys across the short grass and tall grass breeding grounds are being designed and implemented.

1. Develop operational breeding ground surveys to provide accurate information on the status of northerly breeding Canada/cackling geese.
2. Use information from population delineation projects to define population units, to design status assessment surveys, and to institute operational banding.
3. Design and institute breeding area trend surveys across the short grass prairie/tall grass prairie range and refine with delineation information.

Population Dynamics: Problems in defining and monitoring population units result in inadequate information on productivity and mortality. Little is known of relevant factors and trends in production. Mortality information is only available from recreational harvests, and that is obscured by lack of reliable discrimination of Canada/cackling geese from different populations.

1. Design and implement breeding grounds research to describe and evaluate factors influencing production, with emphasis on new work in the short grass prairie portion of the range.
2. Design and initiate a cooperative banding program (in conjunction with delineation projects) to derive survival estimates for identifiable population segments.

Population Biology and/or Ecology: Work on the breeding ecology of short grass prairie geese has been very limited. The potential impact of mineral extraction activities in Arctic and subarctic areas and climate change on these birds is not well understood. Biological work on the breeding grounds of these birds is difficult and expensive, thus cooperative efforts with other research projects may be an appropriate way to acquire information. Similarly, little work has been done on the ecology of these birds in the fall, winter and spring. Ecological issues that affect short grass prairie geese during the non-breeding period are the same that affect other Arctic and subarctic breeding geese.

1. Conduct studies to examine factors that affect nesting success and brood survival, especially those factors that could be related to mineral extraction and climate change.

Harvest Assessment: Estimating harvest for short grass prairie geese is hampered by weakly defined population units, mixing and shifting of subspecies during fall and winter, and poor methods of identifying and enumerating harvested birds.

1. Develop and test improved methods of discerning identity of harvested Canada geese from tail fans or other practical morphological parameters.

Habitat Concerns: Although breeding ground habitats are largely intact and in good condition, degradation of some important habitats (e.g., Playa Lakes, Rio Grande Valley) and protection of staging areas need attention.

1. Promote protection and restoration of important habitats through the NAWMP habitat joint ventures.
2. Identify and protect spring staging areas.

Parasites, Disease, and/or Contaminants: No issues or concerns at this time.

1. Continue to monitor for disease outbreaks and other mortality events.

Projected Annual Costs

Table 2. Projected initial annual costs ($1,000) by category of activity to address the focus areas of the Arctic Goose Joint Venture.

AGJV Focus Area	Banding	Surveys	Research
Habitat Degradation Caused by Populations of Snow and Ross's Geese	750	750	750
Population Status or Assessment of Midcontinent and Tule white-fronted Geese	300	600	500
Population Delineation and Population Assessment of Short Grass Prairie, Tall Grass Prairie, Lesser and Taverner's Geese	350	350	350
Assessing Impacts of Climate Change and Resource Development on Arctic Geese	0	150	250
Population Status, Dynamics and Ecology of Brant and Emperor Geese	350	200	550
Status Assessment and Population Dynamics of Snow and Ross's Geese	500	500	600
Population Specific Harvest Estimates	0	400	350
Development/Improvement of Breeding Ground Surveys	0	300	300
Totals	**2250**	**3250**	**3650**

Note: Projected annual costs change over time, as Information Needs are met and previous focus areas are supplanted by new focus areas. The projected costs for 2008-2012 focus areas are considerably lower than those of the 2002-2007 Plan, primarily due to the AGJV's previous progress regarding *Population Status and Harvest Assessment of Eastern Canada Geese*. However, costs of meeting that previous focus area are still being incurred and the apparent reduction in this table should not be interpreted as a reduction in the costs of meeting all AGJV important Information Needs.

Funding Strategy

Annual designated funding from the United States Fish & Wildlife Service and the Canadian Wildlife Service is critically important to leverage required support from federal, flyway, state, provincial, and university, non-government and private organizations.

Introduction

Many of the ongoing research and monitoring activities associated with the Arctic Goose Joint Venture are funded by federal, state and provincial/territorial wildlife agencies along with important non-governmental partners. The effort is under-funded for the challenges ahead, given the complex ecological issues. Additional sources are required to ensure that priority information needs are met. The AGJV Strategic Plan identifies the research priorities for the various Arctic nesting goose populations, and although much has been accomplished, several priority programs remain unfunded, thus preventing management agencies from making optimum decisions.

The federal governments of the United States and Canada provide ongoing funds for the AGJV through the United States Fish & Wildlife Service and Environment Canada, Canadian Wildlife Service. These sources are required to lever funding from a wide variety of partners. However, these limited annual sources, stretched across an increasing demand of scientific needs, restrict the AGJVs ability to address science and management requirements in a timely and effective manner. AGJV partners continue to seek out and encourage new sources to more effectively meet the needs of the Joint Venture.

Principles

a) Funding and fund-raising efforts are focused on priorities included in the Short Term Information Needs Matrix (Table 1), as well as maintaining operational banding and survey efforts identified as integral to goose management.
b) The AGJV will support research and monitoring efforts for valuable scientific efforts, noting that other sources are available to scientists as well.

Funding Sources

Government Partnerships

The federal governments in both Canada and the United States, and individual state and provincial members of the various flyways will be encouraged to take on additional fund raising for priority populations not currently funded, but of significance to the continental conservation of these populations of geese.

Polar Continental Shelf Project and Natural Sciences & Engineering Research Council

Considerable logistical support for many AGJV programs has been provided by the Polar Continental Shelf Project (PCSP) of Natural Resources Canada. This support is critical to the delivery of many AGJV funded programs. The PCSP support has been significantly reduced in recent years and continues to be under threat. AGJV partners should continue to encourage the Federal Government of Canada

to maintain and increase the PCSP funding. Similarly, the Natural Sciences & Engineering Research Council contributes significantly to AGJV programs. It is important to encourage continued support through on-going communications efforts.

Universities

One of the most efficient means of studying geese is through graduate students/research assistantships so increased cooperation with universities is an important component of this strategy.

Corporations and Foundations

Corporations with special interests in geese and their range of habitats should be targeted for solicitation of support for AGJV projects. These would include oil, mining, forestry and transportation companies, both inland and coastal. Foundations will be approached for support of research and educational programs. A list of those foundations offering the best potential for this should be prepared and interests matched with the research programs requiring funds. In addition, there is a need to prepare a list of key individuals who can provide liaison assistance with the corporation or foundation targeted. These individuals will either have the necessary contacts themselves, or will be able to contact those who do.

Co-Management Boards

Aboriginal peoples in the Arctic are involved with all aspects of wildlife management through co-management structures set up during land claims. The Inuvialuit have shown that aboriginal stakeholders can provide significant funding to AGJV projects that mesh with their own priorities for research. The Nunavut Wildlife Management Board is the main instrument of wildlife management in the Nunavut Territory, encompassing the eastern and central Arctic. In the western Arctic, the Gwich'in and Sahtu Claims are settled, while the north and south Slave Claims are being negotiated. All co-management boards formed under these claims must be linked into the research planning and fund raising process.

Conservation Organizations (NGOs)

Organizations such as Wildlife Habitat Canada, National Audubon Society, Wildlife Federations, Nature Conservancy, World Wildlife Fund, Ducks Unlimited's Institute for Wetland and Waterfowl Research, and others, some of which have already provided support for AGJV projects, will continue to be sources of future support for research efforts on priority problems. Again, a well coordinated point of contact would be instrumental in soliciting such support.

Individuals and Families with Interest in the Arctic

A large proportion of financial support for conservation and other charitable causes is derived from concerned individuals or families. There is a great deal of interest in the Arctic and waterfowl and other wildlife which live there. A list of these individuals and key contacts that might facilitate proposal presentation should be put together for use in AGJV fund raising. Many of these individuals are affiliated with conservation organizations already, and may be readily contacted. The appeal of the Arctic, solid research proposals, and key information gaps for Arctic nesting geese may be extremely attractive to such people.

Funding Processes

Grants

Grants in aid of specific research proposals could be sought from corporations and foundations. A focus on long-term programs, and perhaps specific researchers, may be appealing to such supporters. Clear objectives aimed at specific populations, and specific questions related to problems faced by those goose populations, will be required.

Special Items

Specific items such as radios for telemetry work or other capital equipment may be good fund raising vehicles. As well, special items such as goose collars might be "sold" to individuals as a way of involving outdoor enthusiasts or wildlife supporters. A variety of methods including raffles and auctions might be useful to target such individuals. Items for fund raising options can often be sponsored or provided by corporations and other major donors.

Special studentships where senior undergraduate students are provided an opportunity to work under scientists conducting AGJV research might be very attractive to major sponsors and some corporations who support research for its value as an educational opportunity.

Mechanism

Fund-raising is primarily carried out by individual project officers for their own projects. Once most funding is in place, requests are made to the AGJV for additional resources. AGJV MB and TC partners work together to ensure high priority projects are funded. This is done through a variety of methods including soliciting funds from the AGJV Canadian Wildlife Service and United States Fish and Wildlife Service sources, as well as encouragement of Flyway Councils and other partners to cost-share high priority needs.

Special AGJV funding needs are generally coordinated by the AGJV TC Co-Chairs and the AGJV Coordinator.

Communications Strategy

Communications for the AGJV include regular communications activities and issue-driven products. Several important components of the communications effort include:

a) Provide information on progress and accomplishments of the Arctic Goose Joint Venture to all joint venture partners, the waterfowl community including wildlife refuges.
b) Inform and educate specific target audiences about the purpose and activities of the AGJV and its impact on goose populations.
c) Provide information to current and potential partners to encourage additional funding to facilitate AGJV activities.
d) With assistance from the NAWMP Plan Committee, bolster communications and outreach efforts, particularly with external audiences and countries beyond the United States and Canada.
e) The North American Arctic Goose Conference is an important communication/education tool to raise the importance of northern-nesting geese.

Target audiences include: wildlife management agencies, flyway councils and technical groups, co-management boards, government leaders, conservation organizations, universities, and other organizations that can help further the objectives of the Arctic Goose Joint Venture.

Implementation

The AGJV Communications Committee is a committee of the Management Board to coordinate and implement communication and outreach functions. The Communications Committee will receive guidance and endorsement from the Management Board and Technical Committee regarding specific products. The Technical Committee of the AGJV will be responsible for monitoring and evaluating the utilization and impact of AGJV communications and outreach products.

Members of the committee include the AGJV Coordinator and communications representatives from the U.S. Fish & Wildlife Service and Environment Canada, Canadian Wildlife Service, with input from the AGJV Technical Committee Co-Chairs. As specific issues arise, input from other MB and TC representatives will be sought.


DEANNA DIXON

AGJV Management Board and Technical Committee Representation

United States

United States Fish & Wildlife Service

United States Geological Survey

Pacific Flyway Council

Central Flyway Council

Mississippi Flyway Council

Atlantic Flyway Council

Ducks Unlimited

Canada

Canadian Wildlife Service

Western provincial representation

Eastern provincial representation

Northern government representation

Ducks Unlimited Canada

Mexico

Mexico representation

Coordination Office – Functions and Services

Coordination and Communication of AGJV Activities

1. Coordinate meeting agenda development and distribution with Technical Committee and Management Board Chairs.
2. Coordinate and implement meeting arrangements, associated facilities and services, and timely notice to members.
3. Record and distribute minutes of all meetings. Follow up on progress towards all actions.
4. Track, coordinate and assist in the writing of AGJV plans, guidelines and reports.
5. Coordinate the review of project proposals by the AGJV Technical Committee, endorsement by the AGJV Management Board and AGJV response to project officers.
6. Coordinate communications between the Management Board/Technical Committee and the North American Waterfowl Management Plan Committee, the NAWMP Science Support Team, the NABCI Canada Council, NAWCC Canada Council, the United States NAWCC Council, species joint ventures and other joint ventures, goose representatives of Mexico.
7. Maintain a current directory of AGJV members, project officers and cooperators; brief new members on AGJV structure and procedures.
8. Maintain a current directory of AGJV Projects.
9. Develop, produce, and distribute presentations and public information products on the purpose and progress of the AGJV; answer or refer public inquiries.
10. Develop and maintain AGJV website.
11. Respond to general inquiries.

Document Handling and Archiving

1. Maintain files of all Joint Venture documents including minutes of meetings, proposals, project reports, financial reports, special reports, communications products and correspondence.
2. Receive and distribute proposals and other business items to the Technical Committee, Management Board, and/or other assigned ad-hoc committees and members; track document disposition.

Funding Coordination

1. Develop and maintain a current record of identified AGJV funding needs, funds committed to AGJV projects by source and amount, and active budget requests for AGJV programs.
2. Facilitate transfers of funds across jurisdictional borders.
3. Provide information to members and cooperators on mutual project interests, potential sources of funding and logistical support, and fiscal year/deadline schedules.
4. Prepare annual and roll-up financial reports for the AGJV Management Board and Technical Committee.
5. Report AGJV contributions and expenditures annually to the U.S. Fish and Wildlife Service and the Canadian NAWMP National Tracking System.

Special Projects

1. Develop and maintain a compendium of ongoing projects and activities on AGJV goose populations, as required.
2. Assist in developing and disseminating media items, technical papers, and other materials that highlight significant developments in biological sciences, government policy, and public interests, pertinent to the AGJV goals and activities.
3. Special projects as assigned by the Management Board and Technical Committee.

Guidelines for Proposal Submissions and Evaluations

The Joint Venture's role is to encourage and facilitate international and cross-flyway studies focusing on high-priority information needs for northern-nesting goose populations, as described in the Prospectus, Strategic Plan, and other guidance documents available from the AGJV Coordination Office. Consequently, the AGJV will receive proposals in three categories:

1. ***Informational*** - those requesting only technical review, advice on operations, or coordination with other related projects, and for inclusion in AGJV compendia;
2. ***Endorsement*** - those that are seeking endorsement as an AGJV project, but not specifically requesting AGJV funds;
3. ***Endorsement and Funding*** - those partially-funded or unfunded projects seeking endorsement as an AGJV priority and seeking AGJV assistance in locating financial cooperators.

Proposals will be accepted at any time, and given full review by the AGJV Technical Committee with an endorsement recommendation and priority designation if required. Management Board generally reviews proposals twice per year, but may act outside the regular meeting schedule to expedite support if necessary. ***Proposals should be submitted to the AGJV Coordinator, if possible in electronic format at email address below.***

In order for proposals to be considered for AGJV funding in an upcoming year, proposals need to be submitted at least one month prior to regular Management Board meetings. Contact the AGJV Coordinator (below) for meeting times.

AGJV Coordination Office
c/o Canadian Wildlife Service
2nd Floor, 4999-98 Avenue NW
Edmonton, Alberta
Canada T6B 2X3
Phone (780) 951-8652; Fax (780) 495-2615
Email agjv@ec.gc.ca
agjv.ca / pcoa.ca / gansodelartico.com

Format

Proposals should be no more than 10 pages in length and should include the following:

1. ***Cover Page:*** Title, Principal Investigator name(s) and affiliation, proposal category, key words, date.
2. ***Problem/Issue Statement:*** What is the problem or issue addressed by the proposed work, in relation to the AGJV priorities - 50 words.
3. ***Arctic Goose Population(s) Targeted***
4. ***Justification:*** Combine more information and literature review here. What is the pertinence of the proposal range-wide? What new information will be generated? Maximum 1 page.
5. ***Objectives or Hypotheses:*** Be clear and concise.
6. ***Study Area:*** Provide a description of proposed study area boundaries, proposed camp locations, and staging locations.

7. ***Experimental Design:*** Planned methods including statistical treatments. This section is critical to determining scientific soundness.
8. ***Anticipated Output:*** List expected products or data sets.
9. ***Management Implications:*** What is the significance of the work to management of the populations concerned?
10. ***Literature Cited as appropriate.***
11. ***Personnel:*** Briefly describe the role of each staff position in the study and append current curriculum vitae for the principal investigator(s).
12. ***Logistical Requirements:*** State needs for camp facilities, aircraft support, or other special resources, including dates needed (for assessment of potential cooperative efforts and shared support).
13. ***Timing*:** Beginning and completion dates, milestones.
14. ***Budget:*** One page (attached form) including personnel requirements, operating expenses, capital costs, annual costs, total project costs (multi-year). List all funds currently held for the project, funds applied for, and cooperators.
15. ***Matching Funds*:** Match requirements are a minimum of 1:1 and need to be identified in the proposal.
16. ***Letters of Commitment:*** Attach any letters of commitment from funding cooperators, endorsements or other documentation in support of the proposal.

Progress and Final Reports

Annual progress reports are required for all projects endorsed by the AGJV and should be sent to the AGJV Coordination Office. The progress information can be provided in any format suitable for inclusion in a comprehensive report to the Management Board and Technical Committee. Therefore it is preferable if the individual progress reports are brief. For ongoing projects, be sure to describe accomplishments to date (including publications), confirm the need for continuing support, and explain changes in the project since the endorsement. Serious problems with project implementation should be identified. The following questions should be answered by the report:

1. Was the work carried out as planned? Explain variances.
2. Is the work on schedule? Explain variances.
3. Are the results being used in management?
4. Is partner support still committed?

A final completion report is required for each endorsed project.

Send progress and final reports to the AGJV Coordination Office by 1 October each year. The Coordinator will send a reminder. A list of publications arising from the endorsed publication would be welcomed.

Contribution and Expenditure Reports

Contribution and expenditure reports are required annually for all projects endorsed by the AGJV. A form with the required information is available from the AGJV Coordination Office. The Coordinator will distribute the form each fall.

Send contribution and expenditure reports, and requests for consideration of continuing support, to the AGJV Coordination Office by 1 October each year.

Evaluation of Proposals

The Technical Committee's review of the proposal will focus on the following questions:

- Does the proposal address an AGJV priority population?
- Does the proposal address one or more of the AGJV Information Needs?
- Does the proposal address one or more of the AGJV Focus Areas?
- What is the Strategic Plan Matrix rank? A low score on this question may lead to rejection, pending consideration of justification.
- Is the proposal scientifically sound? (good design, investigator's track record, clear objectives, realistic timing, etc.) A low score on this question will lead to rejection.

Low scores on any of the above may lead to a request for resubmission, or rejection.

Summary of AGJV Funded Projects

AGJV #1. Distribution, Abundance and Key Habitats of White-fronted Geese in the Inuvialuit Settlement Region. Hines, J.

AGJV #2. Distribution and Survival of Geese, Kerbes, D.

AGJV #3. Tall Grass Prairie Canada Geese; Eastern Arctic Banding & Survey Program (Baffin Island, Southampton and West Hudson Bay), Caswell, D.

AGJV #5. Annual Distribution & Survival of White-fronted Geese and Canada Geese from West Central Arctic, Bromley, R.

AGJV #7. Coordination & Monitoring of Marked Geese in North America, Kerbes, R.

AGJV #8. Fall-Winter Distribution and Survival of White-fronted & Canada Geese from the Inuvialuit Settlement Region, Hines, J.

AGJV #11. Population Assessment of the Wrangel Island Snow Geese (Wrangel Island & Fraser/Skagit River), Boyd, S.

AGJV #12. Distribution & Abundance of Dark Geese in Queen Maud Gulf Migratory Bird Sanctuary, Alisauskas, R.

AGJV #13. Greater Snow Geese on Bylot Island; Feeding Ecology, Habitat Relationships & Reproductive Output, Reed, A.

AGJV #14. Greater Snow Geese in St. Lawrence Estuary; Population Monitoring & Habitat Relationships, Reed, A.

AGJV #15. Quality and Quantity of Habitat Use by Snow Geese Wintering on the Fraser River Delta, McKelvey, R.

AGJV #16. Ecological Requirements of Brant, Canada and Lesser Snow Geese in James Bay, Quebec; Impacts of Hydro-Electric Development, Reed, A.

AGJV #17. Wrangel Island Snow Harvest Survey, Fraser River Delta, Goudie, I.

AGJV #18. Population Turnover Rates & Critical Habitats for Brant Migrating Along the B.C. Coast, Goudie, I.

AGJV #19. AGJV Coordination, Dixon, D.

AGJV #20. Effect of Habitat Degradation on Growth & Survival of Ross's & Lesser Snow Geese Goslings at Karrak Lake, Queen Maud Gulf Migratory Bird Sanctuary, Alisauskas, R.

AGJV #21. Effects of Neckbands on Survival of Dark Geese from Queen Maud Gulf Migratory Bird Sanctuary, Alisauskas, R.

AGJV #22. Habitat mapping & Inventory of Queen Maud Gulf MBS, Alisauskas, R.

AGJV #23. Spring Nutritional Ecology of White-fronted & Small Canada Geese Nesting in Queen Maud Gulf MBS, Alisauskas, R.

AGJV #24. Marking White-fronted and Canada Geese at Inglis River, Kerbes, R.

AGJV #26. Habitats and Populations of Pacific Brant in the Canadian Western Arctic, Hines, J., Stenhouse, R.

AGJV #27. Aerial Surveys for Geese & Swans and Banding of Greater White-fronted Geese on Old Crow Flats, Yukon, Hawkings, J.

AGJV #28. Movements of Greater Snow Geese in Spring, Giroux, J.F.

AGJV #29. La Perouse Bay Snow Goose Banding, Cooke, F.

AGJV #30. Assessment of Habitat Use and Movements of Wrangel Island Lesser Snow Geese, Boyd, H.

AGJV #32. Survival of Canada Goose Goslings in Northern Manitoba, Rusch, D.

AGJV #33. Field Manual for Measuring Geese, Cooch, E.

AGJV #34. Effects of Predation on Productivity in Black Brant & Lesser Snow Geese at Anderson River Delta, Armstrong, D.

AGJV #35. Effects of Habitat Change and Flock Organization on the Feeding Efficiency of Geese in Southeastern Texas, Slack, R.D.

AGJV #36. Population Delineation & Affiliation of Small Canada Geese Including Delineation of Populations from the Parts Survey, Smith, L.

AGJV #37. Proposed Spring Goose Survey in the Northern Nesting Areas of Canada, Trost, R.

AGJV #39. Genetic Variation Among Sub-populations of Greater White-fronted Geese, Ely, C.

AGJV #40. Destruction of Arctic Coastal Wetlands by Lesser Snow Geese, Jefferies, R.

AGJV #44. Nutritional Ecology and Habitat Requirements of Wrangel Island Snow Geese During Winter & Spring Migration, Hupp, J., Ratti, J., Boyd, S.

AGJV #45. Population Dynamics, Population Structure and Demography of Pacific Brant, Sedinger, J.

AGJV #48. Distribution and abundance of White-fronted and Canada Geese in Areas of Post Glacial Marine Transgression in the Central Canadian Arctic, Alisauskas, R.

AGJV #49. Nutritional Ecology & Population Biology of Ross's Geese in Queen Maud Gulf Migratory Bird Sanctuary, Alisauskas, R.

AGJV #50. Interactions with Habitat Use & Distribution in Pacific Black Brant in B.C., Goudie, I.

AGJV #51. Annual Distribution & Abundance of Dark Geese in Queen Maud Gulf Migratory Bird Sanctuary, Alisauskas, R.

AGJV #54. White-fronted Goose Neck Collar Observations in Mexico, Nieman, D.

AGJV #55. Demography and Management of the Wrangel Island-Banks Island Metapopulation of Lesser Snow Geese, Cooch, E.

AGJV #56. Breeding Population Size and Distribution of Atlantic Population Canada Geese in Northern Quebec, Rodrigue, J.

AGJV #57. Distribution and Harvest of the Southern James Bay Population of Canada Geese, Rusch, D.

AGJV #58. The Hudson Bay Project, Jefferies, R.

AGJV #59. Program to Address Information Needs for the Management of Atlantic Canada Geese, Cotter, R.

AGJV #60. Habitat Use and Integrity of a Pacific Black Brant Wintering Population in Boundary Bay, British Columbia, Goudie, I., Boyd, S., Cooke, F., Cooch, E.

AGJV #61. Inventory of Snow & Ross's Geese in Arctic Canada by Vertical Air Photography, Caswell, D.

AGJV #62. Monitoring of Eastern Arctic Goose Populations: A Multi-Species and Multi-Purpose Approach to the Evaluation of the Snow Goose Habitat Working Group Report, Canadian Wildlife Service

AGJV #63. Canada Goose Brood Movements and Habitat Use in Relation to Snow Geese at Cape Churchill, Anderson, D., Gillespie, M.

AGJV #64. Vulnerability of White Geese to Electronic Calling Devices, Afton, A.

AGJV #65. Interior-Northwest Alaska White-fronted Goose Study, Ely, C., Spindler, M., Nieman, D., Hines, J.

AGJV #66. Population Dynamics of Greater Snow Geese: Demographic and Habitat Monitoring During a Period of Increased Harvest, Gauthier, G.

AGJV #67. The Role of Lesser Snow Geese as Carriers of Avian Cholera, Samuel, M., Wobeser, G. Rocke, T.

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North American Waterfowl Management Plan

Plan nord-américain de gestion de la sauvagine

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