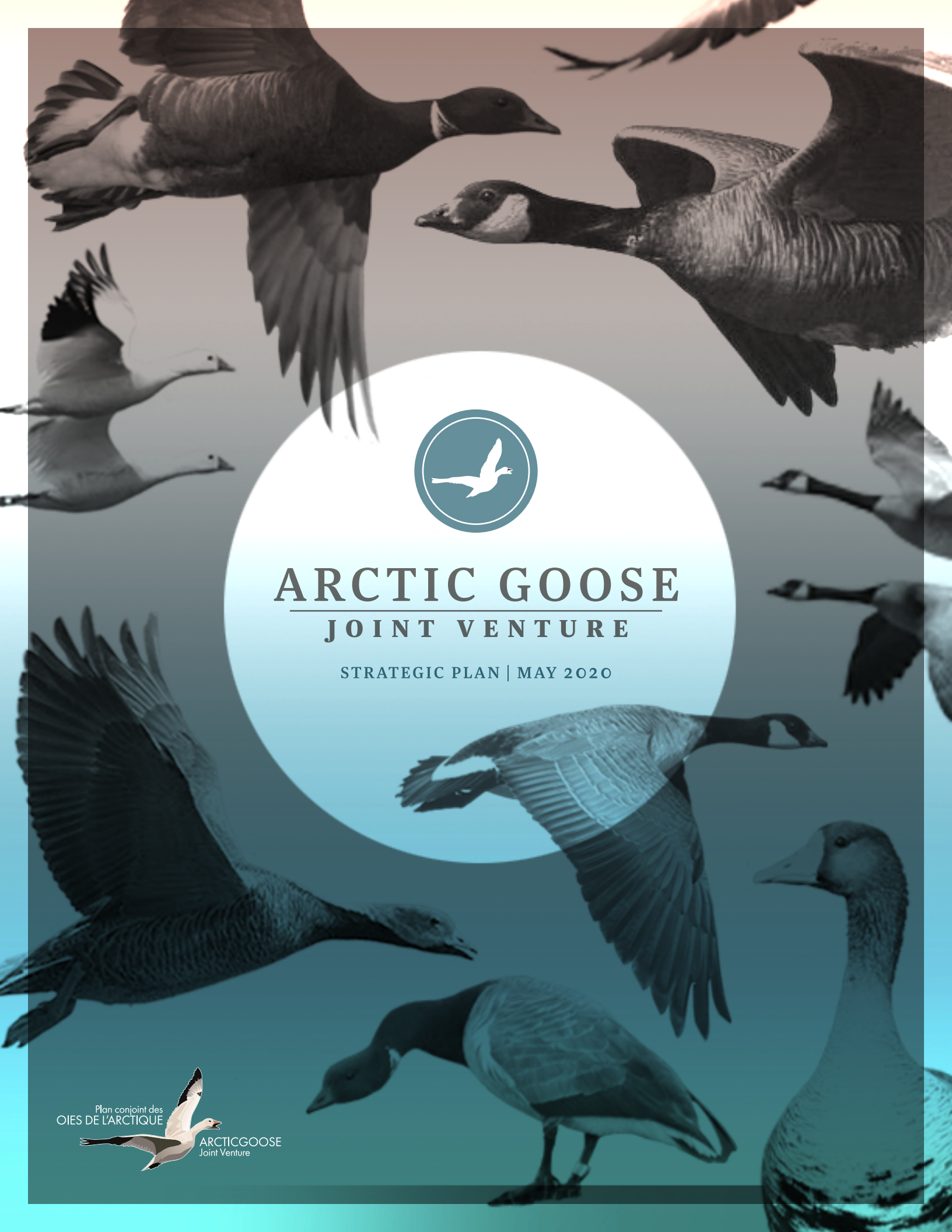

ARCTIC GOOSE
JOINT VENTURE

STRATEGIC PLAN | MAY 2020

Plan conjoint des OIES DE L'ARCTIQUE
ARCTICGOOSE Joint Venture

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ARCTICGOOSE
Joint Venture

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Shannon Badzinski, Chris Nicolai, Chris Nicolai, Shannon Badzinski,
Cameron Herschel, J. White, Chris Nicolai

ARCTIC GOOSE

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Introduction

The Arctic Goose Joint Venture (AGJV) is one of the original joint ventures, initiated by the North American Waterfowl Management Plan (NAWMP) Committee at their inaugural meeting held in August, 1986. The AGJV was established to improve scientific understanding and management of North America's geese. The continent's geese include individuals from two genera *(Anser and Branta)*, and seven species (greater white-fronted *[Anser albifrons]*, emperor *[A. canagica]*, snow *[A. caerulescens]*, Ross's *[A. rossii]*, brant *[Branta. bernicla]*, cackling *[B. hutchinsii]*, and Canada *[B. canadensis]* geese). Collectively, these populations constitute a natural resource of enormous social, economic, cultural, and recreational value.

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 became increasingly apparent that mixing of populations on wintering areas complicated assessment and management of some goose populations. Knowledge of breeding ground distribution, status, and demographics of some northern-nesting goose populations was limited. Although studies were being conducted, logistics were challenging, the costs were high, and the efforts lacked the coordination needed to make rapid progress in meeting basic information needs. Since its inception, the AGJV and its partners have set in motion a coordinated approach for meeting information needs for the management of northern-nesting geese in North America.

The AGJV detailed the populations, challenges, and opportunities that initially were to be addressed in its "Prospectus" in 1991. Since 1991, the scope of the NAWMP 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

ANDREANNE BEARDSELL

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.

has also expanded. The AGJV now encompasses 24 goose populations ranging from the Aleutian Islands to Labrador, including several subarctic-nesting populations.

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 emphasis on breeding grounds refers to the shift made in the late 1980s to monitor and delineate populations based on their breeding rather than wintering grounds, which has greatly simplified and improved management and monitoring. The AGJV was instrumental in this shift but has, and continues, to also support research in wintering and migration areas. The strategy of the Joint Venture is to achieve the AGJV goal by planning, facilitating, communicating, and coordinating 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 abundance and distribution, population trend, annual productivity, harvest, and survival rates. The amount of information available to management agencies varies widely among populations. In some cases, reliable indices of population size, trend, or distribution are still lacking. The purposes of this Strategic Plan are to: (1) identify the priority information needed to facilitate effective population management, (2) describe implementation strategies to meet the information needs, (3) develop procedures for ranking research and monitoring needs, and (4) 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, as necessary, as new information becomes available.

Accomplishments and Future Challenges

Past Accomplishments

The AGJV Strategic Plan has been updated approximately every five years since 1991 to reflect the continued progress this partnership has made to meet the high priority information needs for the continent's northern-nesting geese. To date, well over 100 projects have been endorsed and 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 through more appropriate population delineation, improved monitoring, and better assessment of population dynamics.

The AGJV has been instrumental in gathering, compiling, and communicating information regarding North American geese and their habitats. The list 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 publications (below), continental goose management regimes have been significantly influenced.

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

- AGJV. 1997. Arctic Ecosystems in Peril.
- AGJV. 1998. The Greater Snow Goose.
- AGJV. 1998. Science Needs for the Management of Increasing Lesser Snow Goose Populations.
- AGJV. 2001. The Status of Ross's Geese.
- AGJV. 2001. Science Needs for the Adaptive Management of the Greater Snow Goose.
- AGJV. 2003. Direct Control and Alternative Harvest Strategies for North American Light Geese.
- AGJV. 2007. Evaluation of the Special Conservation measures for Greater Snow Geese.
- AGJV. 2012. Evaluation of Special Management Measures for Midcontinent Lesser Snow Geese and Ross's Geese.
- AGJV. 2014. Surveys of Nesting Lesser Snow Geese and Ross's Geese in Arctic Canada, 2002-2009.

AGJV-supported projects and programs involve two main components: monitoring (banding and marking, surveys), and research. Following are a few examples of how AGJV supported projects improve capabilities for managing North America's goose populations.

Banding and Marking

The AGJV and partners support banding operations across the Arctic, from Baffin Island to Alaska. From 1989 to 2015, more than 1 million geese from AGJV populations were banded.

AGJV banding studies have provided information about timing of migration, recovery distributions, survival rates, population sizes, and harvest rates and derivations. Neck bands continue to be used in some cases to provide mark-resight estimates of population size or for answering specific research questions. However, several studies found that neck bands affected survival of geese, and as a result, most operational neck-banding was discontinued by 2007. A reward band study conducted by AGJV partners from 2003-2005 provided the first quantitative assessment of band-reporting rates among goose hunters in North America. The resultant estimates of reporting rates have improved our understanding of harvest rates in geese, and have also improved estimates of population size based on band recovery and harvest data. Improved knowledge of goose distribution during migration and winter has led to amalgamation of several populations of geese from breeding areas that were formerly divided into smaller regional components, including midcontinent greater white-fronted geese, midcontinent cackling geese, midcontinent lesser snow geese, and Southern Hudson Bay Canada geese. Banding data have also been used to monitor changes in distribution of species like Ross's geese, which have greatly expanded their range eastward over the past few decades.

Surveys

The AGJV has supported surveys conducted throughout northern Canada and the United States, including:

- Photo-inventory of snow and Ross's goose nesting colonies
- Greater snow goose spring staging survey
- White-fronted goose fall survey in prairie Canada
- Helicopter surveys of lesser snow goose colonies on southern Hudson Bay
- Videographic survey of Pacific brant nesting colonies
- Aerial surveys of migratory birds in the Arctic
- Evaluation of high resolution satellite imagery for surveying snow geese on Wrangel Island

Research

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

- Goose harvest in Mexico
- Lesser snow goose productivity on Wrangel Island, Russia
- Greater snow goose productivity on Bylot Island, Nunavut
- Ross's goose breeding ecology
- Vegetation characteristics, habitat alteration, and recovery in Arctic ecosystems
- Wintering habitat conditions (e.g., eelgrass availability)
- The role of snow and Ross's geese as carriers of avian cholera
- Impacts of habitat degradation caused by snow and Ross's geese on other species

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 agencies to appropriately manage goose populations through tailored harvest regulations.

Future Challenges

The NAWMP Continental Assessments (2006, 2011, and 2019) provided excellent opportunities for the AGJV to closely examine the focus and approach of the joint venture and review past accomplishments. Through those Assessments, the AGJV was commended for significant achievements with limited resources and several suggestions were made to the AGJV for consideration. Modifications based upon these reviews have helped to focus and refine the work of the AGJV to be more adept in meeting future challenges and priority information needs.

Information Needs and Strategies to Address Them

Species experts described and ranked the information gaps within each population, and the highest priority information needs for each population are identified in the Information Needs Matrix and further described in the subsequent sections of this plan. 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. Thus, the broader AGJV strategy is aimed at six priority focus areas derived from the Information Needs Matrix (Table 1) as a whole, which attempts to roll up the high priority information needs across populations. This allows for better identification of, and the possibility to address, the highest priority information needs collectively, or to make use of integrated studies with results applicable to a broader range of populations.

The AGJV has prioritized seven categories of "Information Needs" into high, medium and low designation for 24 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 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 NAWMP, 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 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 five populations (Table 1).

Population Status or Assessment refers to 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 16 populations (Table 1).

Population Dynamics refers to the measurement and understanding of how specific population parameters change. Of particular interest is the impact of management practices, especially harvest, on 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 need is identified as a high priority for five populations (Table 1).

Population Biology and/or Ecology refers to 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 ecological, climatological, temporal, geographical and other impacts (such as predation). This need is identified as a high priority for five populations (Table 1).

Harvest Assessment refers to the ability of management agencies to accurately measure the licensed and subsistence harvest of specific populations. This need is identified as a high priority for seven populations (Table 1).

Habitat Concerns refer to the capability of breeding, migration, and wintering habitats to support long-term health and sustainability of specific populations. Broad threats include: climate change, land-use conversion or loss, overabundant populations and their impacts on habitat, competition with other species, and resource exploitation. Specific habitat concerns are found in each population account. This need is identified as a high priority for 10 populations (Table 1).

Parasites, Disease, and/or Contaminants refer 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. This need is not identified as a high priority for any population. (Table 1).

Strategies for Meeting the Information Needs

The basic strategy of the AGJV is to plan, facilitate, communicate, and coordinate activities to improve information for management of goose populations identified in this Strategic Plan. As noted above, the AGJV addresses information needs by prioritizing and supporting two general categories of activities; (1) monitoring (banding and marking, surveys) and (2) research. Highest priority strategies include largescale studies or programs that encompass the entire range of a population, and studies or programs that encompass more than one population where possible.

Periodic changes to the Information Needs Matrix and focus areas account for improvements in our understanding as well as changing priorities from the management community represented by the AGJV.

TODD KEMPER

Information Needs Matrix

May 2020

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; and a low priority suggests that the information is relevant but other information needs should take precedence.

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	High	Med	High	Low
Emperor Goose *Anser canagica*	Low	Low	Med	High	High	Med	Low
Snow Goose *Anser caerulescens*							
Greater	Low	High	High	Low	Med	Med	Low
Midcontinent Lesser	Low	High	Med	Low	Med	High	Low
Western Arctic Lesser	Low	High	Med	Low	Med	High	Low
Wrangel Island Lesser	Med	High	Med	Low	Med	High	Low
Ross's Goose *Anser rossii*	Low	High	Med	Low	Med	High	Low
Branta							
Brant *Branta bernicla*							
Eastern High Arctic	High	Low	High	Med	Low	Med	Low
Atlantic	Low	Med	High	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	Med	High	Med	High	Low
Aleutian	Low	Med	Low	High	Med	High	Low
Midcontinent	Med	High	Med	Low	High	Low	Low
Canada Goose *Branta canadensis*							
North Atlantic	Med	High	High	Low	Med	Low	Low
Atlantic	Med	High	Med	Low	High	Low	Low
Southern Hudson Bay	Low	High	High	Low	Med	Med	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	Med	High	Med	High	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.)*

AGJV Focus Areas

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

Populations of snow geese and Ross's geese (light geese) have increased rapidly over the past few decades and remain at high levels. There is continuing concern about potential adverse impacts of these large populations on habitat and on other sympatric species, especially on Arctic and subarctic staging and nesting areas. Much of the evidence of habitat degradation caused by overabundant geese has come from coastal salt marsh habitats in staging areas along the James Bay and Hudson Bay coast and the St. Lawrence River, but increasing evidence has also come from more northern areas. Coastal salt marsh habitats are important to snow geese and other migratory birds, but represent only a small fraction of the habitats used by snow geese during the summer months. The proportion of available freshwater habitat across the Arctic that has been affected by foraging activities of large numbers of geese is difficult to quantify, and the ability of these habitats to recover over time requires further study. While the primary research focus remains assessing light goose impacts in subarctic and Arctic areas, additional research is needed to better understand light goose impacts to habitat and other species in areas used during winter and migration.

The strategy is aimed to:

1. Improve knowledge of habitat use by snow geese and Ross's geese in subarctic and Arctic breeding and staging areas, on wintering grounds, and during migration.
2. Evaluate habitat quality and availability and determine what proportion of available habitat has been negatively affected by geese, especially at Arctic staging areas and breeding colonies.
3. Monitor the nature and rate of recovery of impacted areas.
4. Assess the nature of impact on other populations of geese, other migratory birds, and other ecosystem components.

Evaluation and Improvement of Population Delineation

Most monitoring of goose populations in North America originally was based on surveys and banding conducted on migration and wintering areas. Over time, research and monitoring efforts on the breeding grounds have expanded, and our understanding of associations between breeding and wintering areas and distribution of various populations has greatly improved. Additionally, growth and expansion of some breeding populations has led to increasing geographic overlap among neighboring populations. Definition and delineation of breeding and wintering areas is a critical first step toward monitoring population status and trends in population size, and can help to ascertain the appropriate scale for management efforts aimed at maintaining breeding populations.

As information from breeding areas has improved and changed, traditional population definitions based on wintering distributions have been re-evaluated, and in some cases, this has led to changes in population descriptions or amalgamation of populations into larger geographic groups that facilitate and/or simplify population monitoring and management. Some examples of populations that have been recently re-defined include: (1) the Eastern Prairie, Mississippi Valley, and Southern James Bay Populations of Canada geese were amalgamated into one population, the Southern Hudson Bay Population of Canada geese, because separate management became unnecessary, and it was more efficient to monitor a single large population than three smaller ones; (2) the midcontinent and the western Central Flyway populations of lesser snow geese were amalgamated because of substantial overlap in nesting range; and (3) Short Grass Prairie and Tall Grass Prairie populations of cackling geese were amalgamated into a single population because of updated taxonomic information, and research indicated substantial overlap in nesting and wintering distributions. There are likely to be other cases where re-definition of populations can help to better align the geographic scale of monitoring and management.

Defining goose populations involves not only understanding their geographic distribution, but also their systematic relationships to other similar populations. This may be especially important in cases where breeding and/or wintering distributions overlap, and where there are conservation concerns or differing trends for one or more sympatric populations. For example, there are several


ROD BROOK

subspecies of Canada geese and cackling geese that nest in Alaska. Geographic distributions of some of these populations are incompletely known, and systematic relationships between adjacent populations remain unclear in many cases. There are questions about the status and extent of overlap between, for example, Tule and Pacific greater white-fronted geese, western high Arctic brant and Pacific Brant, eastern high Arctic and Atlantic brant, dusky and Vancouver Canada geese, Taverner's cackling geese and lesser Canada geese, North Atlantic Population Canada geese and Canada geese breeding in Greenland, among others.

Impacts of Climate Change and Resource Development on Arctic Geese

The Arctic is rapidly adjusting to climate warming, and these changes are influencing nearly every aspect of life in the Arctic. 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 Arctic habitats through decreasing sea ice, thawing of permafrost, coastal erosion and inundation, drying of wetlands, and altered phenology, distribution, abundance, and interactions of species. Mineral and energy resources in the Arctic are also becoming more accessible due to a reduction in sea ice and greater interest in northern economic development. Climate change and resource development may also affect habitats used by geese throughout their annual cycle. Importantly, not all changes are negative; some waterfowl species are benefitting from warmer temperatures in the Arctic. Changes in precipitation or temperature regimes, or broad-scale changes in resource development, can, for example, affect agricultural production and available forage in wintering and staging areas, or eelgrass productivity in marine environments, ultimately affecting goose distribution or demographic rates. Thus, there is increasing concern regarding how climate change and resource development will affect Arctic and subarctic goose populations.

Arctic and subarctic goose populations are valuable indicators of climate induced changes. Through the past work of the AGJV and its partners, long-term studies have greatly increased our knowledge of climatic effects on goose populations and other natural resources, and there are now a multitude of long-term datasets available to evaluate hypotheses about the impacts of climate change and predict future changes. Such undertakings were not possible just decades ago. The AGJV encourages and supports studies that quantify climate change and resource development effects on goose habitats and populations through monitoring of: (1) permafrost thawing, coastal erosion, sea levels, and changing phenology, distribution, abundance, and interactions of plant and animal species, (2) resource development/exploitation activities, and (3) the cumulative effects of climate change and resource development on goose breeding, molting, staging, and wintering habitats. The AGJV also encourages (4) modeling efforts that integrate multiple data sources to predict future climate-change related scenarios and (5) efforts to evaluate and identify habitat most essential to the future conservation of Arctic and subarctic geese. Additionally, the AGJV supports management agency efforts to review the status of habitats critical to migratory birds in Arctic and subarctic regions and, where appropriate, enact protections, such as inclusion into Environment and Climate Change Canada's Protected Areas Network or the U.S. Fish and Wildlife Service's National Wildlife Refuge System. Research efforts should focus on obtaining results and information that will prepare the goose management community on how to best manage, monitor, and sustain Arctic and subarctic goose populations now and in the coming decades.

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

Brant and emperor geese are maritime species that make little use of agricultural land or other human modified habitats compared to other Arctic-nesting geese. These species have specific habitat requirements, limited growth capacity, and are vulnerable to changes in marine coastal environments. Lower growth capacity and small population sizes of these species compared to many managed goose populations make brant and emperor geese more susceptible to overharvest. Brant populations have shown substantial changes in both breeding and wintering distribution during the past decades. Brant exhibit substantial annual fluctuations in productivity, and their abundance can change rapidly in response to changes in environmental conditions, such as harsh winter weather or eel grass die-offs. For example, a large proportion of black brant now reside in Alaska during the winter, and primary breeding colonies have been declining on the Yukon-Kuskokwim Delta (YKD) Alaska, with possible growth in other areas. Atlantic brant abundance crashed following eelgrass die-offs in the 1930s, prompting a two decade harvest closure. Atlantic brant have also shown a northward shift in wintering distribution (from New Jersey into New York), and recent declines in productivity are a concern. Emperor geese breed primarily on the YKD, and their abundance declined in the 1980s similar to other co-nesting goose populations. However, emperor geese did not recover as fast as other goose populations, prompting a three decade harvest closure that was recently re-opened in 2017.

Additional research and synthesis of existing information is needed to put management programs and harvest strategies for these species on sound footing. For both species, additional research is needed to better understand the ecology, demographic rates, and limiting factors of these species throughout their annual cycle and the factors that most impact population dynamics, distributions, and coastal habitats. Many research uncertainties remain regarding genetic structuring and population delineation (western high Arctic and eastern high Arctic brant), metapopulation dynamics and appropriate monitoring methods (black brant), information on breeding distribution, nesting biology, demographic rates, and drivers of productivity (Atlantic brant), and the effects of an open hunting season on demographic rates as well as non-harvest factors that limit population growth (emperor geese).

Evaluation and Improvement of Harvest Estimates

Harvest can be a significant source of mortality in some goose populations, and manipulation of harvest rate is usually an important component of population management plans for geese. Age-specific estimates of harvest increasingly are used to estimate population size and age structure of harvested species using Lincoln estimates. These population estimates are often considerably higher than indices of abundance that are based on count surveys, leading to concerns that harvest estimates may be biased high in some cases. Population-specific harvest estimates can also be difficult to obtain in cases where morphologically similar populations overlap during hunting seasons. Updated morphological or genetic criteria may be required to separate cackling geese from some Canada geese, or Ross's geese from snow geese in the harvest (see also Population Delineation above). Thorough assessments of these techniques need to be conducted to assess their reliability.

The lack of population-specific harvest information is sometimes confounded by unmeasured or incompletely measured harvest. For example, subsistence harvest is generally thought to represent a small portion of the total annual harvest in most goose populations, but it may constitute a large fraction of harvest for some populations, particularly in Alaska. In many areas of Canada, subsistence harvest surveys are only periodically conducted. In Alaska, annual, standardized subsistence harvest surveys are conducted, but accuracy and precision of estimates can vary greatly by species and location. In the case of some overabundant goose populations, spring harvests are not captured by harvest surveys, and species composition of spring harvests is not measured in either the U.S. Fish and Wildlife Service's or Canadian Wildlife Service's Parts Collection Surveys, which is focused only on regular season harvests. Additionally, federal, state, and provincial harvest surveys have many sources of potential bias that have received limited research focus. Further, systematic harvest estimates for Mexico are not regularly available. A coordinated harvest survey in Mexico should be encouraged.

Efforts should be made to evaluate harvest estimation procedures for potential sources of bias, and existing and new methodologies should be evaluated 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.

Development and Improvement of Population Monitoring

The development or improvement of techniques to obtain accurate indices and long-term trends of population abundance, habitat conditions, productivity, and other demographic parameters remains a priority for nearly all AGJV goose populations. There has been substantial effort and emphasis over the past decades to refocus monitoring efforts directed at Arctic and subarctic geese on their staging and wintering grounds to monitoring and assessment of breeding populations. The AGJV continues to emphasize this approach and its importance, and acknowledges that the vast geographic area and the difficult logistics entailed in subarctic and Arctic goose surveys and research efforts create a unique challenge and require an immense cooperative effort among partners. Some populations, such as lesser Canada geese, Taverner's cackling geese, Tule greater white-fronted geese, Vancouver Canada geese, and Aleutian cackling geese, have little to no monitoring or research being conducted on their breeding grounds, and such work is encouraged. Other populations, such as Ross's geese, western Arctic lesser snow geese, and black brant have been monitored or assessed through a variety and multitude of efforts, but an established population monitoring protocol or assessment metric has not been adopted or rigorously evaluated. Primary management indices or NAWMP objectives for some populations are based on fall and winter mark-resight efforts, such as for Tule white-fronted geese and Aleutian cackling geese, or still rely on winter monitoring efforts, such as for brant populations. Indices of some populations are still hindered by challenges in differentiating morphologically similar intermixed populations, such as Tule from Pacific greater white-fronted geese, Pacific from western high Arctic brant, lesser Canada geese from Taverner's cackling geese, and lesser snow geese and Ross's geese.

The AGJV supports cost-effective monitoring and assessment methods that provide the most rigorous and essential information to assess the status of populations and improve their management. To this end, the AGJV encourages research that evaluates bias of current monitoring and assessment methods, particularly those used to derive management indices or assess population status. This could include evaluating the effects of different marking methods or the effects of marking only within certain geographic areas, conducting replicate or alternative surveys within a given year, or quantifying and differentiating amalgamated populations included within indices. The synthesis and evaluation of monitoring programs that achieve a desired statistical power are also encouraged. The AGJV supports the use of new technologies, such as remote sensing methods and satellite imagery, that may improve monitoring and assessment of populations and habitats on both small and large-scales to augment more intensive ground and aerial efforts. Evaluation of banding and harvest data to assess demographic rates and abundance is encouraged, particularly studies designed to directly compare Lincoln estimates and those derived from alternative methods. Additional research is needed to determine and monitor age structure of populations, and to evaluate the magnitude of, and factors affecting, molt migration and its effect on breeding indices.

MANAGEMENT

ISSUES AND STRATEGIES

BY POPULATION


HEATHER WILSON

Greater White-Fronted Goose *(Anser albifrons)*

Midcontinent Population *(frontalis)*

Population Definition or Delineation: Greater white-fronted geese of the midcontinent population were formerly 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 since 1998.

Population Status or Assessment: An aerial count of staging birds in prairie Canada during late September provided an annual index to the population from 1992 to 2019. This fall index was based on counts of white-fronted geese at more than 600 wetland basins in Saskatchewan and Alberta each fall, and counts were not extrapolated to account for areas that were not surveyed. Accurately estimating large concentrations of mixed species flocks remained a challenge and increased numbers of light geese in the survey area during recent years exacerbated the problem. In late 2019, it was decided that Lincoln estimates would be used to monitor the population, though there remains interest in exploring alternative survey designs in fall staging areas. Lincoln estimates of population size based on banding data and harvest estimates suggest that population size is greater than suggested by fall and winter count indices.

1. Evaluate fall survey design and methods to improve ability to monitor trend in abundance.
2. Evaluate Lincoln estimates as a technique for monitoring population size.

Population Dynamics: Banding of adult white-fronted geese in the Queen Maud Gulf area and in Alaska provides the estimates of harvest rate and survival, and should be continued as operational. Annual production of young is evaluated based on age ratios in the harvest, because banding predominantly involves marking of only adult birds. 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, harvest surveys, and breeding grounds research to describe and evaluate factors influencing production (e.g., body condition, weather, habitat quality).
2. Expand and increase banding efforts among geographic areas and age classes to increase sample size and evaluate heterogeneity.

Population Biology and/or Ecology: Greater white-fronted geese of the midcontinent population use 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.

1. Where possible, collect information to evaluate factors that may influence annual productivity.

Harvest Assessment: A management plan approved during summer 2015 identified threshold levels of fall counts and harvest rates that would guide harvest strategies for midcontinent white-fronted geese. Criteria were modified from previous plans to incorporate banding data into the harvest management process, and to allow additional hunting opportunities when abundance and harvest rate criteria are met. Accurate harvest estimates are an important component of Lincoln estimates, and should be continued. Additional knowledge of subsistence harvests is needed.

1. Improve knowledge of subsistence harvests (size, distribution, factors affecting these) in Canada and the United States.
2. Maintain and evaluate methods of harvest estimation in Canada and the United States.
3. Expand and increase banding efforts to better evaluate harvest rates.

Habitat Concerns: The loss of wetlands in the Rainwater Basin and other spring-staging habitats is significant. Degradation of wintering habitat (loss of Gulf Coast marshes, detrimental agricultural practices, and urbanization) is of concern. Identification of important Arctic and subarctic staging and nesting areas is required in light of increasing resource development activities and potential impacts of increasing numbers of sympatric snow geese and Ross's 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 and nesting areas.
3. Improve understanding of habitat loss in important winter and migration areas and distributional changes of the population.

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

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

KIEL DRAKE


DOUG STEINKE

Greater White-Fronted Goose *(Anser albifrons)*

Tule Population *(elgasi)*

Population Definition or Delineation: Tule greater white-fronted geese are one of two subspecies of greater white-fronted geese that breed in Alaska and winter in California. The other subspecies is the Pacific greater white-fronted goose. Adults of these subspecies can be differentiated by morphological measurements reasonably well, but criteria for differentiation among juveniles and sub-adults are less certain. Tule greater white-fronted geese breed in the Cook Inlet and Susitna River basin in Alaska, predominantly in forested areas. The breeding range has not been fully delineated. The primary wintering areas are the Sacramento National Wildlife Refuge complex and surrounding agricultural lands, and to a lesser extent, the Suisun Marsh.

1. Continue efforts to fully delineate the breeding range.

Population Status or Assessment: Beginning in 2003, winter population estimates based on mark-re-sight methods have been used to assess the population. Tule greater white-fronted geese are radio-marked or neck-

collared on migration and wintering areas, and re-sighted throughout their wintering range. Prior assessments were based upon fall and winter abundance counts, but these methods were unreliable due to substantial intermixing with, and inability to differentiate, Pacific greater white-fronted geese. Challenges regarding differentiation of the two stocks still exist with fall-winter mark-resight methods, and efforts are underway to improve survey methodologies and estimation from this approach. Available data have suggested that the population is small (less than 10,000 geese), and trends have been relatively stable.

1. Continue and further develop mark-resight methods to provide an accurate and reliable winter population estimate.
2. Develop and implement a breeding population survey within the Cook Inlet and Susitna River basin.

Population Dynamics: There is little information about nesting biology and reproduction for this population. A few, limited studies have been conducted on the breeding grounds. Productivity is assessed by documenting the proportion of juveniles in the population on primary fall migration and winter areas. Individual marking data are used to assess survival.

1. Continue and expand marking efforts to assess survival and other demographic rates.
2. Continue collecting age-ratio data on staging and wintering areas and initiate studies on the breeding grounds to assess reproduction and productivity.

Population Biology and/or Ecology: Tule greater white-fronted goose nests have been found in diverse habitat types that include mixed forest, open bog meadows and riparian shrubs. In general, less is known about the breeding ecology of nesting geese in more forested landscapes compared to tundra habitats.

1. Initiate studies to evaluate nesting ecology.

Harvest Assessment: Estimation of Tule greater white-fronted goose harvest has not been possible under current Federal harvest surveys because there is no established method to separate tail fans of Tule and Pacific greater white-fronted geese. Limited harvest data have been obtained from check stations at public hunting areas. Issues with accurate measurements by personnel and the sporadic nature of when information was collected make an accurate assessment of harvest from these data difficult. The majority of greater white-fronted goose harvest in the Pacific Flyway occurs in California, and special harvest restrictions have been in place in the Sacramento Valley, the core Tule greater white-fronted goose wintering area, since 1979.

1. Continue harvest surveys and development of methods to differentiate harvested Tule and Pacific greater white-fronted geese.
2. Expand individual marking methods to assess harvest and harvest distribution.

Habitat Concerns: Many areas used by Tule greater white-fronted geese are public lands afforded Federal or state protection. In Alaska, the Redoubt Bay State Critical Habitat Area was established in 1989 to protect the only breeding and molting area known at the time. Primary nesting and molting areas of the Susitna and Kahiltna Valleys are composed almost entirely of general state lands and small private parcels, and these lands are subject to oil and gas leasing, mining, timber sales, and other development activities. On migration and winter areas, 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 and in the Klamath Basin. The continued decline in use of the Klamath Basin as a key autumn staging area by greater white-fronted geese and many other waterfowl species is a cause for concern.

1. Continue to ensure, develop, and implement protection of Tule greater white-fronted goose breeding and staging habitats in the Cook Inlet area, the Susitna and Kahiltna Valleys, and Gandil River area.
2. Identify Tule greater white-fronted goose use areas in Washington, Oregon, and California that are not currently under state or federal management; continue and develop land management strategies to protect these lands or make them more beneficial for migrant or wintering Tule greater white-fronted geese.

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

Greater White-Fronted Goose *(Anser albifrons)*

Pacific Population *(frontalis)*

Population Definition or Delineation: Pacific greater white-fronted geese are one of two subspecies of greater white-fronted geese that breed in Alaska and winter primarily in California. The other subspecies is the Tule greater white-fronted goose. Adults of these subspecies can be differentiated by morphological measurements reasonably well, but criteria for differentiation among juveniles and sub-adults are less certain. Pacific greater white-fronted geese breed from the Alaska Peninsula north to the Yukon River, with the majority of the population nesting on the Yukon-Kuskokwim Delta. The primary wintering areas are the Sacramento Valley and the Sacramento and San Joaquin River Deltas. A small percentage of the population, mostly from Bristol Bay, winters in the northern highlands of Mexico.

1. Continue development of methods to differentiate Tule and Pacific greater white-fronted geese throughout the annual cycle.

Population Status or Assessment: A predicted fall index is used to assess the population. The index is derived by expanding the number of indicated total birds from the Yukon-Kuskokwim Delta Coastal Zone Survey and the Alaska–Yukon Breeding Population and Habitat Survey near Bristol Bay by a factor derived from the correlation of these indices with past fall counts in Oregon and California.

1. Continue current breeding surveys and evaluate methods or initiate studies to improve breeding surveys or assess potential biases.
2. Continue and expand individual marking or other survey methods, with focus on methods to assess or update the current expansion factor.

Population Dynamics: Survival has been assessed periodically, mostly from neck collared individuals. Nesting and reproductive data are collected annually on the Yukon-

Kuskokwim Delta, but late nest, gosling, and fledgling survival are not assessed and few data are collected in other areas. Age ratios (immatures per adult) are obtained from survey and marking efforts on primary fall and winter areas and from the Parts Collection Survey. Age ratios of harvested white-fronted geese in the Pacific flyway have decreased since the 1960s.

1. Continue and expand banding efforts to estimate survival, with focus on estimating survival rates of different age classes.
2. Evaluate methods to assess productivity, with focus on integrating and comparing information from different data sources (i.e., Yukon-Kuskokwim Delta nest plot survey, harvest composition, family group size and age ratio data from surveys in the Klamath Basin and Sacramento Valley).

Population Biology and/or Ecology: Nest success and gosling survival can be variable among years depending upon environmental conditions and predation levels. During years of high fox abundance, Pacific greater white-fronted geese nesting success has been less affected than other sympatric nesting goose species because breeding distribution is more dispersed and extends farther inland. Additionally, Pacific white-fronted geese can better defend their nests from fox predation than smaller cackling geese. However, inter- and intra-specific density dependent effects and large-scale predator-prey dynamics on the breeding grounds are not well understood. Potential carrying capacity of the population, or factors that affect carrying capacity, are not well known.

1. Continue and expand research efforts on the Yukon-Kuskokwim Delta to evaluate predator-prey dynamics and inter- and intra-specific density dependent effects.
2. Initiate studies to evaluate carrying capacity and factors affecting carrying capacity.

Harvest Assessment: A harvest strategy approved in 2003 by the Pacific flyway guides general harvest levels for Pacific greater white-fronted geese. Harvest of greater white-fronted geese in the Pacific Flyway and Alaska is assessed through various state, federal, and subsistence harvest surveys. There is little information about greater white-fronted goose harvest in Mexico. Federal harvest surveys do not differentiate Tule and Pacific greater white-fronted geese because there is no established method to separate tail fans. Hunting restrictions to protect Tule greater white-fronted geese have complicated harvest management in the Pacific Flyway.

1. Continue licensed and subsistence harvest surveys.
2. Expand individual marking methods and analyse existing data to assess harvest and harvest distribution.
3. Initiate studies to assess harvest potential of the population and potential impacts to both Tule and Pacific white-fronted geese from changes in harvest regulations.

Habitat Concerns: Primary breeding areas have Federal or state protections; however, climate change, development, and other human activities affect, and will continue to affect, habitats and goose use in these areas. On migration and winter areas, 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 and in the Klamath Basin. The continued decline in use of the Klamath Basin as a key autumn staging area by greater white-fronted geese and many other waterfowl species is a cause for concern. In recent years, the increased abundance and earlier migrations of Pacific greater white-fronted geese northward, from the Sacramento Valley to the Klamath Basin, are increasing crop depredation complaints in these areas.

1. Continue to evaluate the effects of climate change, development, and other human activities on breeding habitats and goose use and distribution.
2. Provide sufficient wintering goose habitat to address crop depredation issues.
3. Establish priority areas for protection in the Klamath Basin, East Grasslands, and Sacramento-San Joaquin Delta areas of California.
4. Continue to assess distributional changes of the population and evaluate factors that may affect migration timing and winter distribution.

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

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


CHRIS NICOLAI

Emperor Goose *(Anser canagica)*

Population Delineation: Emperor geese are distributed in remote coastal habitats of Alaska and eastern Russia. Most emperor geese nest on the Yukon-Kuskokwim Delta, Alaska, but small numbers nest along the east and north coasts of Chukotka Peninsula, Russia, and other coastal areas of Alaska. The Chukotka Peninsula, Russia, is a primary molt migration site. Most emperor geese winter along the Aleutian Islands and Alaska Peninsula and stage along the Alaska Peninsula during the spring and fall.

Population Status or Assessment: The indicated total bird index from the Yukon-Kuskokwim Delta Coastal Zone Survey is the current population management index. Emperor geese are also monitored by a summer ground-based nest plot survey on the Yukon-Kuskokwim Delta. In the past, annual spring and fall staging surveys and fall age ratio surveys were also conducted on the Alaska Peninsula.

1. Continue annual population surveys to provide reliable population management indices.
2. Survey breeding areas in Russia, St. Lawrence Island, and the Seward Peninsula periodically.

Population Dynamics: Few demographic data exist for emperor geese, particularly for juveniles and sub-adults. Individual marking studies have primarily focused on adult females on the Yukon-Kuskokwim Delta. Early nesting and reproductive data were collected annually on the Yukon-Kuskokwim Delta in the past, but late nesting, gosling, and fledgling survival have only been periodically assessed. Productivity was also assessed during annual fall age ratio

surveys. Population growth and adult survival increased since harvest closures were established in the mid-1980s. Most documented mortality of radio-marked adult females occurred during May and August on the breeding grounds. Mortality among juveniles is high during brood rearing and over their first winter, with survival positively correlated with body condition during fledging.

1. Obtain survival estimates, particularly of juveniles and sub-adults, and identify time periods of high mortality within the annual cycle for different age classes.

Population Biology and/or Ecology: Compared to our understanding of breeding biology of emperor geese on the Yukon-Kuskokwim Delta, less is known about the ecology of emperor geese in wintering areas in Alaska and breeding and molting areas in Russia. The magnitude of, and factors affecting, summer molt migration and the proportion of adults that breed in a given year are not well known. Studies on the Yukon-Kuskokwim Delta have shown nest success and gosling survival is highly variable among years depending upon environmental conditions and predation levels. Other sympatric nesting goose species on the Yukon-Kuskokwim Delta, such as cackling geese and greater white-fronted geese, have greatly increased in abundance during the past decades while emperor geese have not. Improved understanding of inter- and intra-specific density dependent effects on the breeding grounds and limiting factors of emperor geese throughout the annual cycle are needed.

1. Continue to evaluate and determine limiting factors of emperor geese throughout the annual cycle.
2. Determine the magnitude of, and factors affecting, summer molt migration and the proportion of adults that breed in a given year.
3. Continue coordinated surveys and studies throughout coastal areas of northern Russia.

Harvest Assessment: In response to population decline and conservation concern, sport and subsistence harvest were closed in 1986 and 1987, respectively. In 2017, sport and subsistence harvest seasons were reopened after population abundance exceeded the established harvest closure threshold. New management plans and harvest strategies were adopted prior to reopening harvest. There is uncertainty regarding how much these new changes may impact the population. Subsistence harvest has been noted as one factor among many that may be limiting growth of this population. Subsistence harvest in Alaska is estimated from the Alaska Migratory Bird Co-management Council Harvest Assessment Program survey. There is uncertainty as to how accurately emperor goose harvest is estimated from this survey. Band reporting rates have generally been lower in rural Alaska compared to other areas of the U.S. and Canada.

1. Determine appropriate harvest levels and the impact of harvest on the emperor goose population or population parameters given changes in harvest regulations.
2. Continue annual harvest surveys in Alaska and initiate studies to obtain and evaluate information about the amount, distribution, timing, and composition of emperor goose harvest.
3. Continue and increase outreach efforts to increase band reporting rates in rural Alaska communities
4. Obtain harvest information from Russia.

Habitat Concerns: As a maritime, arctic-dependent species, impacts of climate change may be greater for emperor geese than other goose species; however, effects of climate change on emperor goose habitat usage, distribution, and migration are not fully known. Increased resource extraction, development, and vessel traffic in Alaska, Russia, and surrounding waters could degrade habitat important for emperor geese. While primary breeding and spring and fall staging areas of emperor geese in Alaska have some protected land status, primary wintering and summer molt migration areas in Russia have less secure protections.

1. Maintain adequate breeding, molting, staging, migration, and wintering areas for emperor geese.
2. Continue studies to determine the effects of climate change and development on emperor goose habitat usage, distribution, or migration.

Parasites, Disease, and/or Contaminants: Due to their range and migratory patterns, emperor geese may play an important role in the maintenance and dispersal of influenza A viruses between Asia and North America.

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


CHRISTIAN MARCOTTE

Snow Goose *(Anser caerulescens)*

Greater Snow Goose Population *(atlantica)*

Population Definition or Delineation: 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.

Population Status or Assessment: The population is monitored by an annual photographic survey in late April or early May when the population is concentrated in the southern Québec staging area. Recent research using VHF and satellite transmitters has helped refine the spring survey by accounting for a portion of geese staging outside the surveyed area. Further, a recently completed study has provided additional information regarding molting patterns on breeding grounds, and movements and habitat use patterns on wintering and staging areas. On the wintering grounds, distribution is monitored through the annual midwinter waterfowl survey. This population has increased dramatically from about 180,000 in 1980 (spring count) to approximately 1,000,000 since 1999. Since then, the population has stabilized.

1. Continue the expanded survey methodology implemented in 2004 on an annual basis.
2. Identify appropriate survey areas throughout the eastern Arctic to assess breeding ground expansion and contraction as well as potential effects on eastern high Arctic brant.
3. Evaluate the importance of staging areas in southern Quebec.

Population Dynamics: The banding program provides information on survival and harvest rates and should be continued. Productivity is measured by age ratio counts during fall in southern Québec. Detailed information on nesting effort, nesting success, and brood rearing success has been obtained annually from a field study on Bylot Island. There is a need to obtain accurate survival estimates of different age classes to better evaluate effects from special harvest regulations. Continue annual banding program on breeding grounds on Bylot Island to estimate age-specific harvest and survival.

1. Continue to assess annual productivity by conducting age ratio counts in fall in southern Quebec.
2. Continue breeding ecology project on Bylot Island through at least 2022 for a better understanding of the effects of weather, predation, and habitat conditions on recruitment.
3. Determine what factors may impact breeding activities in locations other than Bylot Island.

Population Biology and/or Ecology: 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 population and productivity monitoring programs in southern Quebec.
3. Develop and implement monitoring programs on staging and wintering areas to evaluate goose responses to changes in habitat conditions and hunting pressure.

Harvest Assessment: Harvest is assessed annually by CWS, USFWS, and individual states participating in the U.S. Snow Goose Conservation Order. Harvest from regular hunting seasons, the spring season in Québec and Ontario, and the U.S. Conservation Order has averaged nearly 150,000 birds annually since 2008. Trends in the spring population size indicate that the conservation actions implemented since 1999 have coincided with stabilized, or even reduced, population size. However, 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. Special harvest measures have been in place in Canada since 1999 and within the United States since 2009, and relative harvest between the two countries has proportionally increased during recent years.

1. Continue special harvest regulations for greater snow geese and evaluate the effect of these measures on population growth and demographic rates.
2. Promote local integrated management to increase harvest opportunity and reduce crop depredation by connecting hunters to farmers and alerting hunters to local hazing activities.

Habitat Concerns: The use of farmland by greater snow geese 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 staging and wintering habitats in many areas used by the greater snow goose have not changed significantly and no additional degradation has been observed. However, degradation of bulrush marshes on staging areas along the St. Lawrence River was documented through 2007. Current monitoring intensity indicates that ecological damage on the breeding grounds has not significantly increased in the last 18 years. Whether this is due to the stabilization of the population or favorable growing conditions in recent years is unknown. 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. This is the population objective that is currently in the Atlantic Flyway Greater Snow Goose Management Plan.

Although the special conservation measures have been successful in stabilizing 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. Evaluate the carrying capacity of natural habitats in breeding, staging, and wintering areas to refine the target population size.
2. Determine the best methods necessary for reducing damage to agricultural crops and to natural wetland habitats.
3. Reinstate monitoring of bulrush marshes on staging areas along the St. Lawrence River.

Parasites, Disease and/or Contaminants: No issues or concerns at this time. However, 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 geese on the breeding grounds are 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.


TIMOTHY HAAN

Snow Goose *(Anser caerulescens)*

Midcontinent Population *(caerulescens)*

Population Definition or Delineation: This population primarily breeds in the central and eastern Arctic and subarctic and winters in the Central and Mississippi Flyways. In the management plan updated in 2018, the former western Central Flyway wintering population was included within the midcontinent population. Approximately 90% 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. A portion (~20%) of the western Arctic population that nests on Banks Island, NWT winters in the midcontinent region, so they are also included in this population. The rest of the population nests along the south coast of Hudson Bay, mainly at Cape Henrietta Maria, Ontario, and La Perouse Bay and Cape Churchill, Manitoba. There is some evidence from banding data that migration routes have shifted westward in northern staging areas, while wintering distributions have expanded eastward and northward in the United States, especially along the Mississippi River in Arkansas.

1. Continue to monitor distribution of the population based on analyses of banding data. Adjust population management and monitoring of indicated units as needed.

Population Status or Assessment: Existing winter surveys provide coarse indices of abundance for midcontinent lesser snow geese. Winter surveys are not based on a statistical sampling framework and include an unknown proportion of the population each year and include an unknown number of Ross's geese. 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 analyse and cover an unknown proportion of the overall population. Despite weaknesses, these efforts have provided data for monitoring trends in specific portions of the population, which have generally increased over time. Recent analyses using Lincoln estimates based on harvest and banding data provide annual estimates of total population size, but require additional evaluation to determine potential sources and extent 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. Explore use of digital counting software to improve efficiency of photo analysis, and evaluate alternative methods, such as use of high resolution satellite imagery.
2. Continue to explore and evaluate use of banding and harvest data to estimate population size.

Population Dynamics: 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 suggested that while adult survival rates have declined among the 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 were

the declines in survival sufficient to result in stable or declining population size. Long term declines in age ratios suggest that density-dependent factors may be operating to reduce overall productivity, and continued monitoring of productivity is warranted.

1. Continue banding efforts to provide representative marking of the population in relation to their distribution on the breeding grounds.
2. Develop periodic reward banding studies to monitor changes in harvest rates and band-reporting rates for geese.
3. Evaluate fall age ratio counts on the Canadian prairies, harvest age ratios, and age-specific Lincoln estimates of population size for monitoring productivity.

Population Biology and/or Ecology: Midcontinent lesser snow geese exist in very large numbers, yet there is 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 climate change, 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. Maintain long-term monitoring of nesting birds at both northern and southern nesting colonies to explore factors affecting their productivity, including forage availability and quality, predation, climate change, and habitat alteration.

Harvest Assessment: Harvests of midcontinent lesser snow geese increased, at least initially, after measures to increase harvest 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 collection 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 species. 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.
2. Evaluate tail fan criteria used to separate Ross's geese and lesser snow geese in the harvest.

Habitat Concerns: Large numbers of staging and breeding geese have altered some areas of Hudson Bay and the central Arctic, and evidence suggests that the extent of habitat change caused by geese in coastal areas of James Bay and Hudson Bay 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 recent detailed habitat analyses at most northern nesting colonies have not been completed. Staging areas outside of coastal Hudson Bay are largely unknown, and the status of freshwater habitats used by most snow geese during summer in the Arctic is incompletely known.

1. Assess habitat quality and quantity throughout the breeding range.
2. Continue to investigate the impacts on other species and in freshwater habitats used by snow geese.
3. Refine knowledge of fall/spring migration routes, timing, and important staging and breeding sites used by midcontinent snow geese, particularly in northern Canada, through the use of satellite telemetry.
4. Protect and improve winter habitat quality and quantity through the NAWMP habitat joint ventures.

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

1. Conduct research and develop strategies for preventing disease epidemics through altered refuge management practices and other programs.


ANDRÉANNE BEARDSELL

Snow Goose *(Anser caerulescens)*

Western Arctic Population *(caerulescens)*

Population Definition or Delineation: Most (~95%) of the western Arctic population of snow geese nest on Banks Island, Northwest Territories, with smaller breeding colonies occurring on the mainland of the Northwest Territories and Alaska. Limited individual marking and genetic data indicate some exchange between the western Arctic population and the Wrangel Island and midcontinent populations. 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 proportion of western Arctic snow geese that winter in the midcontinent region of North America has increased over time.

1. Continue to refine population delineation based on analyses of 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. The abundance of nesting snow geese on Banks Island have generally increased over time based on photographic surveys, and there is recent evidence of nesting range expansion, especially on the north slope of Alaska. In parts of its range, the western Arctic population mixes with two other breeding populations of snow geese (Wrangel Island population and the overabundant midcontinent population) as well as increasing populations of Ross's geese, making traditional survey approaches difficult. Evaluations and further refinement of Lincoln estimates of population size based on harvest estimates and

banding data should be continued. Snow goose numbers and distribution in Mexico are not well documented.

1. Maintain regularly scheduled breeding area surveys to monitor breeding population trends and evaluate alternative methods, such as use of high resolution satellite imagery, to assess the population.
2. Implement an operational banding program to monitor survival, harvest, and distribution, and continue evaluation and refinement of Lincoln estimates of population size for use in monitoring and management.
3. Continue occasional monitoring of areas outside of traditional colonies for signs of continued breeding range expansion.

Population Dynamics: Available data indicate rapidly increasing abundance of snow geese in the western Arctic. Individual marking programs will provide information on survival and harvest rates (including the effects of liberalized harvest on population growth) and population growth rates, as well as information about in-situ growth versus immigration from other populations. Age ratios from harvest surveys in the Pacific Flyway and information from banding locations should be explored as an index of annual productivity.

1. Continue banding programs on Banks Island and the north slope of Alaska.
2. Better determine and monitor rates of in-situ growth versus immigration from other populations.
3. Examine trends in age ratios and factors influencing productivity.

Population Biology and/or Ecology: Snow geese nest earlier than other co-nesting goose species and climate change may continue to increase their competitive advantage. Nesting studies have been limited on Banks Island, where the majority of the population occurs. There is uncertainty in the carrying capacity of this population and predicting future changes in growth and distribution.

1. Continue research to understand the factors influencing population size, distribution, and productivity.
2. Continue and expand research to evaluate the impacts of snow geese on co-nesting goose species and other wildlife, particularly to understand potential large-scale effects under different population growth scenarios.

Harvest Assessment: Obtaining population-specific harvest estimates are complicated by overlapping distribution of Wrangel Island and midcontinent snow geese. There is uncertainty regarding how much harvest can be increased under existing or expanded harvest regulations and what the resulting effects may be on the population.

1. Continue to implement practices that increase harvest, evaluate feasibility or effects of other management actions, and assess the effects (or expected effects) of actions on population growth and abundance.
2. Design and test methods to estimate harvest for defined population units.

Habitat Concerns: With the growth of the western Arctic population, there is potential for snow geese to impact habitat, as has occurred near Hudson Bay and in the central Arctic. These impacts on habitat have ramifications for productivity and longterm viability of colonies, other geese, other birds, and overall ecosystem integrity. Breeding and staging areas are threatened by oil and gas development. Migration and wintering areas are threatened by development pressures. There is growing concern and research interest regarding the impacts that snow geese have on habitat and food resources during the winter and potential effects on other species, primarily ducks, as well as impacts to agricultural producers in some areas. Climate change will likely continue to alter distribution, which may cause or exacerbate habitat-related issues.

1. Assess habitat availability throughout the breeding range and investigate potential impacts to habitat from increasing numbers of geese.
2. Continue to investigate and assess the impacts of snow geese on other species.
3. Determine winter and staging habitat requirements, snow goose impacts to other species on the wintering and migration areas, and improve winter habitat quality and quantity.

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

1. Develop strategies for preventing disease epidemics through altered refuge management practices and other programs.


SHANNON BADZINSKI

Snow Goose *(Anser caerulescens)*

Wrangel Island Population *(caerulescens)*

Population Definition or Delineation: This population breeds on Wrangel Island, Russia, and winters primarily in British Columbia, Washington, Oregon, and California. Limited individual marking and genetic data indicate some exchange with the western Arctic population. During migration and winter, Wrangel Island lesser snow geese intermix substantially with western Arctic snow geese and Ross's geese on southern wintering grounds (i.e., California and Oregon), but little mixing is believed to occur on the northern wintering grounds (i.e., the Fraser and Skagit River deltas).

1. Continue and expand marking programs to refine knowledge about population delineation and interchange among populations, migration routes and primary winter use areas, and distributional changes.

Population Status or Assessment: The population is assessed by a ground-based breeding survey on Wrangel Island, which also provides information on nesting success and reproduction. Surveys have been conducted nearly annually since the 1970s. Recent studies were undertaken to assess the feasibility of using satellite imagery to enumerate the population. During winter, the population is indexed on the northern winter grounds in Washington and British Columbia by aerial photographic surveys. The size of the winter segment in California cannot be estimated because of mixing with western Arctic snow geese and Ross's geese. Snow goose abundance on Wrangel Island has increased during past decades from a low of 50,000 snow geese in the mid-1970s to more than 450,000 snow geese in 2019. Individual marking programs will provide information on survival and harvest rates (including the effects of liberalized harvest on population growth).

1. Continue breeding surveys on Wrangel Island and evaluate alternative methods, such as use of high-resolution satellite imagery to assess the population.
2. Continue or explore alternative methods, such as individual marking and Lincoln estimates, to assess abundance and changes in winter distribution.

Population Dynamics: Nesting success and productivity are assessed on the breeding grounds, and age ratio information is assessed from survey and harvest information in the Fraser-Skagit area. Survival rates have periodically been assessed from individual marking data, but there has not been a formal, comprehensive analysis of all available marking data.

1. Continue and expand survey and marking methods to assess survival and productivity.
2. Conduct comprehensive analyses using available data to assess population dynamics.

Population Biology and/or Ecology: Predation by Arctic foxes and disturbance by ungulates (reindeer and muskoxen) can negatively impact productivity in some years. Less is known about large-scale predator-prey dynamics, the factors affecting or limiting population growth, or potential population carrying capacity on Wrangel Island now or under future climate change scenarios. The northern and southern wintering segments of the population have experienced substantial distributional shifts in recent decades. The proportion of the population wintering on the Fraser and Skagit River deltas (the northern component) has increased from approximately 20-30% in the 1950-60s to >60% in recent years. There is still uncertainty about migration routes, timing, and important staging sites of this population, the extent of these changes compared to historical patterns, and the causative factors. The current level of immigration and inter-change among snow goose populations remains unclear.

1. Evaluate or develop models to assess predator-prey dynamics, factors affecting or limiting population growth, or carrying capacity, with focus on future climate change scenarios.
2. Continue and expand efforts to obtain information about fall/spring migration routes and timing and important staging and wintering areas.

Harvest Assessment: A harvest strategy approved in 2006 by the Pacific Flyway guides general harvest levels for Wrangel Island snow geese, with primary focus on the Fraser-Skagit area. Traditional state and federal harvest surveys do not provide information on the harvest of snow geese by population. Special surveys have been used since the late 1980s to determine harvest rates in the Fraser-Skagit area. Harvest and harvest distribution have been periodically assessed from banding and neck collaring data since the 1970s, but a comprehensive assessment of all available data has not been conducted.

1. Continue and expand individual marking efforts and complete analysis of existing data to compare harvest rates between the northern and southern winter population segments.
2. Continue to evaluate the effects of harvest regulations or changes in harvest regulation on the population or demographic rates.
3. Develop new methods to monitor effects of harvest regulations and their changes on the population or demographic rates.

Habitat Concerns: Most of Wrangel Island is a federally protected nature sanctuary administered by Russia's Ministry of Natural Resources and Environment. Expanded military presence on the island, development, and climate change could potentially impact breeding areas. Several protected areas have been established on the Fraser and Skagit deltas to provide refuge and foraging habitat. The increase of the Fraser-Skagit winter population has created 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. There is growing concern and research interest regarding the impacts that snow geese have on habitat and food resources during the winter and potential effects on other species, primarily ducks, as well as impacts to agricultural producers.

1. Continue to assess bulrush density and biomass and impacts from snow goose foraging.
2. Develop and evaluate management strategies to improve or provide sufficient wintering habitat and reduce conflicts with other public resources and users.
3. Determine winter and staging habitat requirements and snow goose impacts to other species on wintering and migration areas.

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.


KIEL DRAKE

Ross's Goose *(Anser rossii)*

Population Definition or Delineation: Ross's geese primarily breed in the central Arctic and winter in the three western flyways, and their breeding and wintering ranges have expanded eastward 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.

1. Mark Ross's geese within traditional and new breeding areas, and use recoveries of leg banded geese to evaluate associations among breeding, staging, and wintering areas.

Population Status or Assessment: Ross's geese have been 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, and both include an unknown proportion of the population in a given year. Likewise, winter counts are confounded by the presence of large numbers of sympatric snow geese. In recent years, Lincoln estimates based on harvest estimates and banding data have been used to estimate the population size of adult Ross's geese.

1. Continue leg banding of Ross's geese in Queen Maud Gulf Bird Sanctuary, and other colonies in the eastern Arctic, and continue collection of age-specific harvest estimates for estimation of population size.

Population Dynamics: Ongoing field work on nesting areas is providing information on factors influencing production in the Queen Maud Gulf region. Ongoing marking efforts will provide information on harvest and survival rates.

1. Continue annual ground surveys to assess trends in productivity of Ross's geese on breeding areas, and on fall staging areas in Saskatchewan.
2. Maintain programs to band 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. Ross's geese appear to be increasing in some areas in the eastern Arctic that were formerly occupied by snow geese.

1. Continue monitoring of Ross's geese on nesting colonies to explore factors affecting their habitat selection, productivity, and effects on habitat.

Harvest Assessment: Annual indices of harvest and production are derived, in part, from harvest questionnaire and parts collection surveys. Species-specific data could be biased if there is increasing overlap in morphological size of tail fans of snow geese and Ross's geese. This could be caused by declines in body size of snow geese over time, due to density dependent effects on gosling growth.

1. Evaluate and refine as necessary the tail fan criteria used to discriminate Ross's geese from snow geese in parts collection surveys.

Habitat Concerns: Increasing numbers of Ross's geese mix with lesser snow geese throughout their ranges. Continued range expansion and population growth raises concerns about the contribution Ross's geese are making to habitat alteration in the Arctic. Ross's geese contribute to habitat alteration through their foraging and nest building activities. The ability and habits of Ross's geese to forage on shorter vegetation than lesser snow geese may lead to further shifts in nesting distributions of the two species.

1. Continue studies to 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.

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. Continue to monitor and assess disease-related die-offs when they occur.

Brant
(Branta bernicla hrota)

Eastern High Arctic Population *(hrota)*

Population Definition or Delineation: Based on limited leg band data from the 1970s through 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.

1. Refine population delineation based on genetic, marking, and other information.

Population Status or Assessment: The abundance of eastern high Arctic brant has been evaluated annually since 1960 through surveys on the primary wintering grounds in Ireland. Before that, it was believed that the population had declined rapidly, mainly because of the disappearance of their primary food (Zostera spp.) 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 individuals. Current estimates are about 30,000–35,000 individuals.

1. Maintain winter surveys at present levels of geographical coverage and intensity.

Population Dynamics: Annual production rates are estimated through age ratio counts conducted at key autumn staging sites. Annual productivity has varied markedly from near zero to about 30% young in fall flocks. No data are currently available to estimate survival rates, and there is limited information on breeding ecology. In 2007, CWS collaborated in an international endeavour (Great Britain, Ireland and Iceland) led by the Wildfowl and Wetlands Trust to identify EHA breeding sites in the high Arctic. A total of 33 nests were found in June in the surroundings of Eureka (Ellesmere Island) and a total of 141 birds (adults and young) were banded in August.

1. Develop a breeding location banding program using colored tarsal bands which can be observed systematically at the relatively accessible staging and wintering areas to estimate annual survival rates.

Population Biology and/or Ecology: Only one study of nesting biology of eastern high Arctic brant has been conducted.

1. If feasible, conduct field studies at selected breeding locations to evaluate basic reproductive parameters, habitat use, and factors influencing annual productivity for the purpose of developing population models.

Harvest Assessment: Extremely small numbers of eastern high Arctic brant are harvested annually in the eastern Canadian Arctic. For example, the Nunavut Wildlife Management Board recently estimated about 15 brant taken annually in the relevant region. Indigenous harvest is not considered a threat to the population, but periodic harvest estimates are encouraged. 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, though a subsistence harvest of unknown magnitude occurs there.

1. Identify subsistence harvests at regular intervals, possibly through a Local Ecological Knowledge study.

Habitat Concerns: Understanding of habitat selection during the breeding season is poor, because of the remoteness of nesting and molting 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 spp.) due to a wasting disease. Subsequently the diets also included algal foods and grass species such as Festuca and Puccinellia, and since 1970, the birds have made increased use of managed grasslands.

1. Identify habitat requirements for nesting, brood-rearing, and molting.
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 climate change, and 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. Investigate breeding grounds die offs to determine cause of death.
2. Investigate possible occurrence of 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.

Brant
(Branta bernicla hrota)

Atlantic Population *(hrota)*

Population Definition or Delineation: A brant telemetry project completed during the 2000s confirmed that the breeding range of this stock is centered on the Foxe Basin in the eastern Arctic, with important colonies on Southampton, Baffin (Cape Dominion/Bowman Bay), Prince Charles, Air Force, and north Spicer Islands. Smaller breeding colonies were observed on Mansel and Coats Islands in northern Hudson Bay. The western boundary appears limited to the Melville Peninsula. Satellite and VHF telemetry data from the study conducted during the 2000s did not reveal any clearly separate affinities between wintering and breeding areas (i.e., the population is likely panmictic). Since the mid-2000s, a northward shift in the wintering range has been observed with similar numbers now observed in New York and New Jersey. Prior to the mid-2000s, New Jersey wintered 4-5 times more brant than New York. The reasons for this distribution shift are not known.

1. Improve understanding of Atlantic brant breeding areas and metapopulation dynamics.
2. Refine population delineation based on genetic, marking, and other information.

Population Status or Assessment: Midwinter surveys are the primary assessment index for this population and indicated an average population of about 145,500 from 2000-2020, with a slight declining trend over that period. Lincoln estimates of population size based on harvest and banding data were more variable than midwinter surveys and suggested an average population of 157,000 adults between 2001-2017, also with a slight declining trend.

1. Continue the current midwinter waterfowl survey at present levels of geographical coverage and intensity.
2. Evaluate Lincoln estimates and other model estimates of population size to measure abundance.

Population Dynamics: Productivity is monitored by age ratio counts in the fall flight, mainly in New Jersey and New York. Although long-term (1976-2019) productivity survey estimates have averaged 17.5% young, more recent (2010-2019) estimates have only averaged 12.2% young. Productivity surveys should be expanded throughout the wintering grounds to provide a better overall representation of brant productivity, and to account for changes in winter distribution. Survival and harvest rates are monitored using data from annual banding on the breeding grounds. Preliminary results from the 2000-2011 period indicate adult annual survival rates ranged from 75% to 90%, and averaged 84%. Juvenile annual survival rates from Baffin Island ranged from 32-66%, and averaged 44%. An Integrated Population Model (IPM) incorporating survey, banding, and weather data is being developed for Atlantic brant and may offer an effective means of predicting out-year population abundance which may be useful in guiding harvest management.

1. Continue breeding ground banding program on Southampton and Baffin Island, and expand to other breeding areas and continue other marking programs to allow continued estimation of harvest and survival rates.
2. Consider geographic expansion of fall productivity surveys, and improvements to protocols for fall age ratio data collection that allow estimates of precision to be calculated.
3. Continue to refine the IPM and explore its use for modeling population dynamics and factors affecting demographic rates.

Population Biology and/or Ecology: Recent research has been conducted on factors that influence breeding habitat quality and use, and how increasing snow goose, Ross's goose, and cackling goose populations affect brant breeding biology. This work should be expanded.

1. Evaluate basic reproductive parameters and factors influencing them at representative colonies.
2. Improve understanding and develop model(s) to evaluate and predict population response to habitat changes and other environmental factors.

Harvest Assessment: Since 1999, licensed harvest of Atlantic brant in the United States has been measured by the Harvest Information Program (HIP), an improvement over the earlier duck stamp-mail questionnaire survey. From 1999-2012, licensed harvest in the United States has ranged from 11,400-44,900 Atlantic brant. The Canadian licensed harvest rarely exceeds a few hundred individuals. However, subsistence harvest 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 licensed hunt, the Quebec Cree and Inuit reduced their harvests through the early 1980s, 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. The relationship between hunting regulations and harvest, and survival rates should be elucidated.

1. Estimate Canadian subsistence harvest.
2. Develop model(s) to predict population response to harvest and help guide harvest strategies.
3. Work with the USFWS and individual states to improve HIP registration and resulting harvest estimates. An opportunity exists to improve precision of harvest estimates with a move to online harvest surveys beginning in 2020, which would allow managers to identify brant hunters and more efficiently sample that group of hunters.

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 St. Lawrence estuary in the 1930s. Subsequently, eelgrass never regained its former abundance there. Further losses in feeding habitat have occurred through shoreline development, dredging, and pollution. In most areas, brant now rely primarily on sea lettuce. During the early 2000s, extensive growths of red algae (Gracilaria spp.) were observed in sea lettuce areas on the Atlantic coast. 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.

Important beds of eelgrass are believed to still occur in James Bay, making this area a critical staging area for brant. Despite changes in the freshwater flow of several rivers emptying 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. In western James Bay, various sedges and grasses are used extensively by spring staging brant. 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. Determine how changes to abundance of submerged aquatic vegetation, and probable shifts to other plants, particularly in lower James Bay will affect productivity and other vital rates.
3. 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.
4. Develop or improve remote sensing or other techniques necessary to evaluate the extent and quality of estuarine and terrestrial forage plants important to Atlantic brant in staging and wintering areas. Synthesize recently completed research to develop estimates of carrying capacity for wintering and spring-staging grounds.

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. During winter 2000-2001, at least 2,000 brant died in and around Forsythe National Wildlife Refuge in southern New Jersey. The U.S. Geological Survey was unable to determine a definitive cause of the mortality event; however, all of the necropsied birds were in good condition, indicative of an acute illness. Wintering brant may be susceptible to acute diseases in certain areas.

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

Brant *(Branta bernicla hrota)*

Western High Arctic Population *(hrota)*

Population Definition or Delineation: Western high Arctic brant are light-bellied birds that breed on the Parry and Queen Elizabeth Islands of the Northwest Territories, stage at Izembek Lagoon in Alaska, and primarily winter in northern Puget Sound of Washington and British Columbia. In the Pacific Flyway management plan adopted in 2018, western high Arctic brant are no longer managed as a stock separate from black brant.

1. Refine population delineation based on genetic, marking, and other information.

Population Status or Assessment: There are currently no surveys on the breeding grounds to monitor changes in abundance, production or distribution of western high Arctic brant. The locations of some areas used for nesting and molting are known, but there has never been a comprehensive survey for this stock. Primary surveys to assess brant within the Pacific Flyway include coordinated winter waterfowl surveys in the United States and Mexico and fall staging surveys near Izembek Lagoon. Ground-counts in Mexico have replaced aerial surveys. Survey techniques to distinguish western high Arctic and Pacific brant are either not conducted or may not accurately distinguish between the two stocks.

1. Institute periodic surveys to accurately assess population size and productivity on the Parry and Queen Elizabeth Islands.
2. Continue to refine and expand fall and winter surveys to accurately assess brant populations.
3. Evaluate methods to differentiate western high Arctic and black brant when possible.

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 banding data.

1. Institute banding programs on breeding and molting grounds to estimate survival rates.
2. Initiate research on the breeding and wintering grounds to assess recruitment and the factors affecting recruitment.

Population Biology and/or Ecology: The breeding biology of western high Arctic brant remains largely unstudied. Information is needed to understand the influence of migration and wintering area habitat status on survival and productivity rates, the impact of increasing snow goose populations on breeding grounds, and increasing bald eagle populations on wintering grounds.

1. Determine the effects of winter and spring food (e.g. eelgrass, algae, herring roe) quantity and quality on distribution, population dynamics, and reproduction.
2. Assess the interaction between brant and snow geese on breeding grounds and between brant and bald eagles during winter and spring migration.

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

1. Evaluate subsistence harvest of western high Arctic brant in Canada and Alaska.
2. Continue annual harvest surveys on wintering areas.

Habitat Concerns: Status and trends of breeding habitats are not known in great detail, because the area is not surveyed regularly. Western high Arctic brant migration

areas in northern Alaska may be affected by energy and mineral 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, Washington). Status and trends of eelgrass beds are not well known.

1. Strengthen and implement habitat protection programs on breeding, molting, staging, and wintering areas.
2. Map and determine status and trends of eelgrass beds in Izembek Lagoon, Puget Sound, and other staging and wintering areas.

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.

Black Brant *(Branta bernicla nigricans)*

Pacific Population *(nigricans)*

Population Definition or Delineation: Black brant breed over an extensive range in Alaska, Arctic Canada and Russia, stage primarily at Izembek Lagoon in Alaska, and winter primarily along the Pacific coast from Alaska to Mexico. Little information about breeding brant is available from Russia, and more information is needed on breeding distribution in the Canadian Arctic and delineation from western high Arctic brant. In the Pacific Flyway management plan adopted in 2018, black brant are no longer managed as a separate stock from western high Arctic brant.

1. Refine population delineation based on genetic, marking, and other information.

Population Status or Assessment: Primary surveys to assess brant within the Pacific Flyway include coordinated winter waterfowl surveys in the United States and Mexico and fall staging surveys near Izembek Lagoon. Ground-counts in Mexico have replaced aerial surveys. Additional surveys provide information about the status of brant: a summer breeding pair survey in western and northern Alaska, a colony photographic survey and random nest-plot survey in western Alaska, a molting goose survey in northern Alaska; and fall age ratio surveys in the Izembek Lagoon area. Survey techniques to distinguish western high Arctic and black brant are either not conducted at these areas or may not accurately distinguish between the two stocks. Lincoln estimates have also been used to estimate population size.

1. Continue winter surveys to assess the population.
2. Develop methods to improve and refine various brant surveys to provide statistically rigorous estimates of population abundance and trends.
3. Continue and improve methods to calculate Lincoln estimates of population size based on harvest and banding data.

Population Dynamics: Productivity of Pacific brant has been studied extensively on the primary breeding colonies on the Yukon-Kuskokwim Delta, but fewer data are available for other breeding areas, particularly in Russia. Annual production is estimated at the Izembek Lagoon, but these data represent aggregate productivity from all breeding areas. Long-term declines have been documented in the abundance and productivity at the primary breeding colonies on the Yukon-Kuskokwim Delta, survival rates among age cohorts throughout Alaska, and fall age ratios. Population growth has been observed on the Arctic Coastal Plain in northern Alaska, and fall and winter surveys indicate stable trends overall. Trends among all surveys, Lincoln estimates, and demographic rates do not all agree, and metapopulation dynamics remain unclear. Better understanding of population growth and distributional changes outside of the primary breeding colonies on the Yukon-Kuskokwim Delta is a central research need.

1. Maintain and expand banding programs.
2. Continue and expand studies to improve understanding of metapopulation dynamics.
3. Develop a population model that integrates available datasets and evaluates and quantifies potential biases.

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. Since the 1980s, declines in abundance have been documented on the primary breeding colonies on the Yukon-Kuskokwim Delta, and wintering distribution has shifted northward, with an increasing number of brant

wintering near Izembek Lagoon (i.e. a few thousands in the 1980s compared to more than 40,000 currently). Additionally, the molting distribution of brant near Teshekpuk Lake has shifted from the traditionally used inland lakes to coastal sites due to changing habitat conditions and disturbance regimes. Uncertainties remain regarding the influence of predator-prey dynamics, inter-specific competition, and habitat and other environmental changes on the declines in primary breeding colonies on the Yukon-Kuskokwim Delta, as well as breeding abundance and carrying capacity on the Yukon-Kuskokwim Delta outside of the primary breeding colonies. Future capacity for growth of brant in northern Alaska and Russia are uncertain. Snow goose populations are increasing in the western Arctic, and, although significant impacts to brant have not been documented to date, effects may increase with greater abundance of snow geese and could be exacerbated in the future due to climate change.

1. Continue to evaluate factors affecting breeding and wintering abundance and distributional changes and potential future changes under various climate change scenarios.

Harvest Assessment: Accurate harvest estimates are difficult to obtain for brant. 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 harvest surveys in Mexico and Russia are lacking or are not regularly conducted. Band reporting rates have generally been lower in rural Alaska compared to other areas of the U.S. and Canada.

1. Continue annual subsistence harvest surveys in Alaska and studies to obtain or evaluate information about the amount, distribution, timing, and composition of brant harvest.
2. Develop improvements to state, provincial, and federal harvest surveys to estimate fall licensed harvest of brant.
3. Continue to improve and refine harvest estimates, or alternative methodologies, in order to use banding and harvest data to estimate population size and continue outreach efforts to increase band reporting rates in rural Alaska communities.
4. Support the continuation and improvement of harvest data collection in Mexico and Russia.


CHRIS NICOLAI

Habitat Concerns: In Alaska, breeding habitat for Pacific brant is generally secure and in good condition, except in local areas of the Arctic where energy development has encroached on some colonies. Critical molting habitat near Teshekpuk Lake in northern Alaska continues to be the focus of prospective onshore and offshore energy exploration. Similar threats occur in the mainland of the western Canadian Arctic. Many brant nest coastally and are potentially subject to the effects of climate change. In the western Arctic, habitat used by breeding and molting 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 within the United States, Canada, and Mexico. Status and condition of eelgrass beds are generally known but future trends are uncertain. Unlike most other populations of geese, Pacific brant are a maritime species and make almost no use of agricultural land or other human modified habitats, making them particularly vulnerable to changes in marine coastal environments.

1. Strengthen and implement habitat protection programs on breeding, molting, and wintering areas.
2. Continue to assess eelgrass beds in Izembek Lagoon, Puget Sound, and other staging and wintering areas and develop and refine methods to predict conditions and trends under different climate change scenarios.
3. Continue studies to evaluate the effects of climate change, development, and increasing snow goose populations on Pacific brant habitat usage, distribution, and demographic rates.

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.


CHRIS NICOLAI

Cackling Goose *(Branta hutchinsii)*

Taverner's Cackling Geese *(taverneri)*

Population Definition or Delineation: Under the American Ornithologist's Union classification change in 2004, Taverner's cackling geese, along with Aleutian *(leucopareia)*, Cackling *(minima)*, and Hutchins' (hutchinsii) subspecies, were recognized as a taxonomic species called cackling geese *(Branta hutchinsii)*. There is overlap in morphological and genetic measures among subspecies of cackling geese and between Taverner's cackling geese and lesser Canada geese *(Branta canadensis parvipes)*, the smallest of the large-bodied Canada geese. The Taverner's cackling goose population has been partially defined through surveys, banding, and genetics studies, but the exact delineation and boundaries of the breeding range remain undetermined. Taverner's cackling geese nest on inland tundra habitats of northern and western Alaska, and this population's breeding range likely overlaps with lesser Canada geese within tundra-forest boundaries, hutchinsii on the eastern boundary, and minima within coastal areas near the Yukon-Kuskokwim Delta. Primary wintering areas are in Washington, Oregon, and California, predominantly west of the Cascade Mountains; however, winter distribution is based on limited data, and Taverner's cackling geese intermix with other cackling goose subspecies and populations of Canada geese.

1. Continue breeding ground genetic sample collection and analysis and improve delineation of population boundaries.

2. Evaluate taxonomy of cackling geese to determine degree of differentiation among subspecies

Population Status or Assessment: There is no current management plan for this population. A draft management plan was developed in 1994, but it included both Taverner's cackling geese and lesser Canada geese, which are now separate species under the American Ornithologist's Union classification. 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 during the winter. During winter, Taverner's cackling geese and lesser Canada geese have commonly been reported together. A breeding population index for Taverner's cackling geese is currently in development and combines indices from three breeding survey efforts: the Arctic Coastal Plain Breeding Pair Survey, the Yukon–Kuskokwim Delta Coastal Zone Survey, and strata of the Waterfowl Breeding Population and Habitat Survey. This index does not indicate a positive or negative trend; however, counts have been quite variable among years and the index likely represents only a small portion on the total population. Further refinement, evaluation, or development of a breeding ground survey to provide annual management indices for this population is needed.

1. Develop and implement a breeding ground survey to use as a population management index.

Population Dynamics: Little individual marking, productivity, or other demographic data exist for Taverner's cackling geese. Available information suggests a stable population. Decreased winter abundance in Oregon and Washington during recent years has been noted based on incidental and observation data.

1. Initiate studies to evaluate demographic parameters, including survival rates of adults and juveniles and nesting success and productivity.

Population Biology and/or Ecology: Little is known about breeding and migration ecology of Taverner's cackling geese. More information is available about wintering ecology, but data are primarily based on observational studies of multiple goose species.

1. Initiate studies to evaluate breeding and migration ecology.

Harvest Assessment: Taverner's cackling geese winter within the Pacific Flyway among six other populations of white-cheeked geese that are similar in appearance. Harvest of this population is not currently assessed, as traditional state and Federal harvest surveys do not provide information by subspecies. Morphological and genetic analyses indicate that Taverner's cackling geese can be distinguished from other goose populations in the Pacific Flyway. Goose harvest strategies within the Pacific Flyway have been primarily focused on other populations, and there are limited data available to assess population status of Taverner's cackling geese or effects of harvest regulations.

1. Continue licensed and subsistence harvest survey and evaluate morphological, genetic, or other criteria and methods to differentiate harvested Taverner's cackling geese from other populations, if warranted.
2. Expand individual marking methods to assess harvest and harvest distribution.

Habitat Concerns: Breeding areas, primarily coastal tundra, are relatively secure with the possible exception of the North Slope, where energy development is increasing. Effects of climate change on breeding habitats and distribution are uncertain. On the wintering grounds, increased goose foraging intensity on grain, turf, and pasture crops, which are predominantly private lands, has created conflicts with agricultural interests.

1. Continue studies to evaluate the effects of climate change or development on breeding habitats and distribution.
2. Evaluate winter foraging ecology, habitat capacity, and habitat use and develop cooperative goose and habitat management strategies to address crop depredation issues and provide sufficient wintering 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.

Cackling Goose *(Branta hutchinsii)*

Cackling *(minima)*

Population Definition or Delineation: Cackling geese (B. h. minima) nest on coastal areas of the Yukon–Kuskokwim Delta, Alaska, and winter in the Willamette and Lower Columbia River Valleys of Oregon and Washington. Prior to the early 1990s, the majority of this population wintered in the Central Valley of California. Questions about overlap in morphology, genetics, and geographic ranges among subspecies of cackling geese remain. Additional studies focused on the periphery or boundaries of population ranges on the breeding grounds would improve delineation.

1. Continue and expand genetic and morphological studies of cackling and Canada geese, with focus on delineating population boundaries.
2. Evaluate taxonomy of cackling geese to determine degree of differentiation among subspecies.

Population Status or Assessment: A fall population index is used to assess the population. The index is derived from the indicated total bird index during the summer Yukon–Kuskokwim Delta (YKD) Coastal Zone Survey expanded by a mark-resight ratio derived from neck collared individuals observed in the fall and winter. Nesting and reproduction data are collected annually from the YKD nest plot survey. Fall counts of cackling geese have increased in recent decades, from less than 26,000 in the mid-1980s to

greater than 300,000 in 2015.

1. Continue the spring YKD Coastal Zone Survey and mark-resight efforts to assess the population.
2. Evaluate methods to assess bias of indices or improve surveys.

Population Dynamics: Nesting and reproductive data were collected annually on the YKD in the past, but late nest, gosling, and fledgling survival and productivity are not assessed. Survival rates have been assessed primarily by neck-collaring and mark-resight methods. The population appears responsive to harvest regulations. Annual population growth rates greater than 15% were observed during restrictive harvest regulations, and population abundance or growth rates have correspondingly changed when harvest regulations have been more conservative or liberal.

1. Continue to develop methods to use or integrate various datasets to estimate demographic parameters.
2. Obtain additional information related to productivity and recruitment.

Population Biology and/or Ecology: On the breeding grounds of the YKD, large-scale predator-prey dynamics and inter- and intra-specific density dependent effects are not well understood. The ecological role that cackling geese play as a prey buffer for other goose and water bird species on the YKD has been posited but not well documented. The effects of migration and wintering area forage components on demographic rates or life-cycle processes are not well established. Further assessments of the past large-scale winter distributional shift northward from California to Oregon and Washington and potential future distributional shifts or factors affecting distributional shifts are needed.

1. Continue and expand research efforts on the YKD to evaluate predator-prey dynamics and inter- and intra-specific density dependent effects.
2. Assess the effects of winter forage quantity and quality on population dynamics and past and future distributional changes.

Harvest Assessment: A harvest strategy approved in 2016 by the Pacific Flyway guides harvest levels for cackling geese. Based upon observations during the past 30 years, harvest is a principal factor affecting abundance and growth of this population. Traditional state and Federal harvest surveys do not provide information on the harvest of geese by subspecies. Most historical data on the harvest of this population has come from analyses of individual marking data and geese classified at hunter check stations. With the closure of most hunter check stations in Oregon and Washington in 2015, the latter assessment tool will become limited in utility. Morphological and genetic analyses indicate that cackling geese from the YKD can be distinguished from other goose populations in the Pacific Flyway. Subsistence harvest data in Alaska have been collected under the Alaska Migratory Bird Co-management Council Harvest Assessment Program survey.

1. Continue licensed and subsistence harvest surveys and evaluate morphological, genetic, or other criteria and methods to differentiate subspecies of harvested cackling geese.
2. Expand banding and other individual marking efforts to assess harvest and harvest distribution.

Habitat Concerns: Cackling geese (B. h. minima) nest on the outer YKD and primary fall staging habitats are coastal wetlands on the north side of the Alaska Peninsula. Many lands within these areas have Federal or state protections. Climate change and development within these areas will continue to modify use and distribution. On the wintering grounds, increased goose foraging intensity on grain, turf, and pasture crops, which are predominantly private lands, has created conflicts with agricultural interests.

1. Continue to evaluate the effects of climate change and development on breeding and staging habitats, habitat usage, or distribution.
2. Evaluate winter foraging ecology, habitat capacity, and habitat use and develop cooperative goose and habitat management strategies to address crop depredation issues and provide sufficient wintering 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.

Cackling Goose *(Branta hutchinsii)*

Aleutian Population *(leucopareia)*

Population Definition or Delineation: Aleutian cackling geese nest primarily in the western Aleutian Islands, with lesser numbers in the central Aleutians and very small numbers (<200) in the Semidi Islands. Geese from the western and central Aleutians winter primarily in the San Joaquin Valley in California, and geese from the Semidi Islands winter in coastal Tillamook County, Oregon. The taxonomic species of cackling geese have some overlap in morphological and genetic measures among sub-species as well as overlap with smaller forms of Canada geese (i.e., lesser Canada geese). Additional studies focused on the periphery or boundaries of population ranges would improve delineation.

1. Continue and expand genetic and morphological studies of Aleutian cackling geese across their distributional range; continue and expand genetic and morphological studies of cackling and Canada geese, with focus on delineating population boundaries.
2. Evaluate special management considerations for the segment of the Aleutian cackling goose population that breeds in the Semidi Islands and winters along the Oregon coast.

Population Status or Assessment: The Aleutian cackling goose population is assessed by a winter population estimate derived from mark-resight data. Geese are neck-collared in California and resighted within the San Joaquin Valley, California and coastal areas in northwestern California and southwestern Oregon. Direct counts were conducted on the Oregon coast near Tillamook to assess geese breeding on Semidi Island. Since 2001, these counts became unreliable, as more geese from other population segments wintered in the same area. Aleutian cackling geese were listed as endangered under the Endangered Species Act in 1967 when abundance was less than 1,000 individuals. Abundance increased since the 1970s, and the population was downgraded to threatened status in 1990 and removed from protection under the Endangered Species Act in 2001. In 2015, the winter population estimate was approximately 190,000 geese. Survey and management efforts on the breeding grounds have substantially decreased since the population recovered and was delisted.

1. Continue mark-resight efforts to provide an annual winter population index.
2. Evaluate other population assessment methods and compare to current mark-resight methods.
3. Evaluate methods to differentiate or assess the population segment that breeds in the Semidi Islands.

Population Dynamics: Due to the remote nature of breeding islands and decreased breeding survey efforts since delisting, few data about productivity and recruitment are available. With past harvest closures and limited individual marking data, few data are available regarding survival rates, and survival rates have been assessed primarily by neck-collaring and mark-resight methods. The Aleutian cackling goose population increased substantially during the past decades due to management actions and protections implemented under the Endangered Species Act, including range-wide harvest closures/restrictions and fox eradication and translocation efforts on the breeding islands. Since delisting and instituting a limited harvest strategy, the population has continued to grow.

1. Continue to develop methods to use or integrate individual marking data to estimate demographic parameters.
2. Obtain information related to productivity and recruitment on the breeding grounds.

Population Biology and/or Ecology: Little is known about potential population carrying capacity. The factors or time periods during the annual cycle that most affect, or limit, population abundance and growth are uncertain. Despite large-scale harvest closures and similar recovery efforts on the breeding grounds, the Semidi Islands population segment did not respond similarly as other population segments. Observations indicate an increase of Aleutian cackling geese wintering in Oregon and Washington, but assessments of distributional changes have not been conducted.

1. Conduct research to determine population carrying capacity within breeding, staging, and wintering areas, and the factors affecting or limiting growth.
2. Assess distributional changes or potential future distributional changes of the population.

Harvest Assessment: A harvest strategy approved in 2006 by the Pacific Flyway guides harvest levels for Aleutian cackling geese. Harvest of this population is not currently assessed, as traditional state and Federal harvest surveys do not provide information by subspecies. Morphological and genetic analyses indicate that Aleutian cackling geese can be distinguished from other goose populations in the Pacific Flyway. Subsistence harvest surveys in Alaska do not differentiate among subspecies of cackling geese, nor has the Aleutian Islands been well surveyed. There is little prior direct observation to draw upon to assess how changes in harvest regulations may impact this population.

1. Continue licensed and subsistence harvest surveys.
2. Evaluate morphological, genetic, or other criteria and methods to differentiate subspecies of harvested cackling geese.
3. Continue and expand individual marking methods to assess harvest and harvest distribution.
4. Initiate studies to assess harvest potential of the population and potential impacts from changes in harvest regulations.

Habitat Concerns: Nesting islands occur within the Alaska Maritime National Wildlife Refuge, and these areas have, and will likely continue to have, protections. The effects of climate change or increased development within these areas are uncertain. On migration and wintering grounds, the capacity of public lands to support this rapidly growing population is limited, especially along the northwest coast of California. Changing agricultural practices and other land uses have reduced available habitat, and, accompanied with increased population abundance, have increased foraging on private lands, creating conflict with agricultural interests.

1. Continue to evaluate or conduct predator and rat removal on breeding islands, where warranted.
2. Determine the effects of climate change or development on breeding habitats, breeding distribution, and habitat use.
3. Evaluate migratory and winter foraging ecology, habitat capacity, and habitat use and develop cooperative goose and habitat management strategies to address crop depredation issues and provide sufficient migration and wintering habitat.

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

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

Cackling Goose *(Branta hutchinsii)*

Midcontinent Population *(hutchinsii)*

Population Definition or Delineation: Midcontinent cackling geese were formerly managed as the Short Grass Prairie and the Tall Grass Prairie populations, and some authorities included two former subspecies of Canada Geese in these populations *(parvipes and hutchinsii)*. In 2004, the American Ornithologists' Union recognized cackling geese *(Branta hutchinsii)* as a separate species from Canada geese *(Branta canadensis)*, making parvipes and hutchinsii members of different species. The two species are similar in appearance, but cackling geese are generally much smaller, nest only in Arctic tundra and coastal habitats (whereas Canada geese nest mainly below/within the tree line), and can be definitively distinguished from Canada geese based on mitochondrial DNA. The midcontinent population of cackling geese includes all cackling geese nesting north of the tree line in Canada, and wintering in the Central and Mississippi flyways.

According to band recovery data, geese banded in the westernmost nesting areas generally winter farther west than those from central Arctic nesting areas, which in turn winter farther west than those from eastern Arctic nesting areas. Cackling geese nesting in the central and western Arctic are most commonly recovered in eastern Alberta, western Saskatchewan, and western portions of the Central Flyway. Those nesting in the western Hudson Bay region between ~75-95oW longitude are mainly recovered in eastern Saskatchewan, southwestern Manitoba, and eastern portions of the Central Flyway, and cackling geese nesting on Baffin Island are recovered in southern Manitoba and in nearly equal proportions in the eastern Central Flyway and western Mississippi Flyway.

1. Continue genetic sampling across breeding areas to delineate the breeding range of cackling geese, and determine the extent of hybridization and/or range overlap with Canada geese.

Population Status or Assessment: Midcontinent cackling geese are counted during the Midwinter Survey in the United States, and Lincoln estimates of adult population size are based on band recovery and harvest data from the Central Flyway and the prairie provinces of Canada. Midwinter counts of cackling geese in the Central and Mississippi Flyways approximately doubled between the 1970s and the 2010s. Lincoln estimates of population size averaged 398,000 adult birds in the late 1970s, and 2.6 million adults between 2014 and 2018.

1. Maintain banding of representative samples of cackling geese from across the breeding range.
2. Maintain harvest surveys and continue to differentiate between Canada geese and cackling geese using tail fan criteria.

Population Dynamics: Estimates of adult survival and harvest rates are available for birds banded on nesting areas from 1988 to present. Analyses suggest that population size and adult survival rates have increased, while harvest rates have declined over the past 20 years.

1. Continue and increase representative banding of cackling geese on breeding areas.
2. Evaluate use of harvest age ratios as an annual index of recruitment.

Population Biology and/or Ecology: Environmental factors (e.g., snow cover, temperature) are likely to be the primary influence on productivity of midcontinent cackling geese, but there have been relatively few studies on nesting areas. Studies of cackling geese on Southampton Island indicate their increase in population is negatively affecting brant reproductive success.

1. Initiate studies to evaluate breeding and migration ecology.

Harvest Assessment: Cackling geese are differentiated from Canada geese in the Parts Collection Survey using tail fan criteria. However, specific criteria differ between the Central and Mississippi flyways, and in different parts of prairie Canada, and the criteria have not been evaluated for accuracy. Data collection has been inconsistent in the Mississippi Flyway until recently, but consistent estimates of cackling goose harvest in that flyway could improve overall harvest estimates as well as Lincoln estimates of population size.

1. Maintain data collection to obtain estimates of cackling goose harvests in prairie Canada, and in the Central and Mississippi Flyways.
2. Evaluate accuracy of tail fan criteria for estimating harvests of cackling geese in prairie Canada, and in the Central and Mississippi Flyways.

Habitat Concerns: Degradation of important habitats is a continuing problem and protection of wintering and staging areas needs attention (e.g., Louisiana and Texas coastal marshes, Rainwater Basin, Platte River). Spring staging habitats, particularly in northern Canada, are incompletely known, and the potential impact of increasing numbers of sympatric snow geese and Ross's geese on nesting areas is not well understood.

1. Promote protection and restoration of important wintering and migration habitats through the NAWMP habitat joint ventures.
2. Identify spring staging areas, and evaluate potential impacts of competition with snow geese and Ross's geese on nesting areas.

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

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


SHANNON BADZINSKI

Canada Goose *(Branta canadensis)*

North Atlantic Population *(canadensis)*

Population Definition or Delineation: North Atlantic population (NAP) Canada geese breed in Labrador, Newfoundland, and eastern Quebec and winter primarily in southern Atlantic Canada, New England and Long Island, with smaller numbers wintering south along the coast to North Carolina. Canada geese breeding in Greenland are also currently considered to be part of the NAP, but some genetic and population trend evidence suggests that Greenland-nesting geese actually may be more closely affiliated with the Atlantic population (AP). The staging and wintering areas of boreal breeding birds are not well known, and the western edge of the NAP range and overlap with Atlantic population Canada geese during the harvest season is not well defined. Some evidence suggests a disproportionate number of NAP Canada geese from Newfoundland winter exclusively in Nova Scotia.

1. Periodic spring and /or pre-season monitoring efforts should be undertaken in the Atlantic provinces and in the boreal forest of eastern Quebec to better define breeding, staging, and wintering areas, the western edge of the NAP range, and degree of overlap with Atlantic population Canada geese during the harvest season. Pilot projects are currently underway to evaluate effectiveness and cost-efficiency of leg bands and nanotags; use of satellite transmitters should also be investigated.
2. Evaluate efficacy of winter banding of geese in Nova Scotia. Determine what proportion of NAP geese over winter in Nova Scotia.
3. Telemetry studies and other research on Canada geese breeding in Greenland are needed to clarify their staging and wintering areas and migration timing, their relationships to NAP and AP as currently defined, and the implications of these distributions and definitions for management.

Population Status: Aerial fixed-wing and helicopter breeding surveys in the Eastern Survey area of Canada and the United States are the primary index to assess status of NAP Canada

geese. Determining the population status of NAP Canada geese in the winter is confounded by mixing with the Atlantic and Atlantic Flyway resident populations of Canada geese. Additionally, recent count surveys in Greenland indicate a 7-fold increase of Canada geese abundance.

1. Continue integration of fixed wing and helicopter components of the Eastern Waterfowl Survey to develop an operational breeding grounds survey for the NAP. There is a need to refine the visual correction factors for the integrated survey.
2. Conduct periodic surveys of the breeding population in Greenland.

Population Dynamics: Information about annual productivity is available from estimation of age ratios from tail fans in the harvest, but estimates are unreliable due to early molt of tail fans by juvenile temperate-nesting geese. Banding and neck-collaring have provided crude estimates of harvest and survival rates for adults, but estimates of harvest and survival for juvenile cohorts are lacking. Implementation of an annual banding program on the breeding grounds has proven to be difficult, and spring banding on Prince Edward Island was suspended from 2013-2018 due to shifting distributions and difficult access to birds; the resulting lack of robust sample sizes for properly delineating high- and low-harvest areas in the United States has created a significant challenge in harvest management. A pilot effort to re-initiate spring banding and nano-tagging on PEI began in 2019.

1. Develop a method to estimate annual productivity.
2. Pilot spring banding project should continue and, if successful, be converted to an operational program.
3. Feasibility of undertaking periodic banding of breeding cohorts in Newfoundland and Labrador should be evaluated.

Population Biology and/or Ecology: Little information is available about nest success, brood survival, and the effects of weather conditions on productivity. Population data for NAP Canada geese have been difficult and expensive to obtain.

1. Determine the feasibility of developing a program or index on the breeding grounds to monitor and evaluate the factors contributing to production rates.
2. Collaborate with European researchers working on Greenland to periodically mark breeding geese.
3. Development of a validated population model will result in better ability to reach and maintain population goals.

Harvest Assessment: Harvest estimates are confounded by other sympatric Canada goose populations (i.e., Atlantic and Atlantic Flyway resident populations). There is a need to improve the estimates of subsistence and other harvest. It is particularly important to develop a reliable method to distinguish between migrant and Atlantic Flyway resident population Canada geese in the harvest allowing managers to exert greater pressure on resident geese. Continued vigilance in monitoring the effects of harvest on population status and location of the majority of harvest in the United States needs to be a high priority for this population.

1. Refine harvest surveys in Canada and the United States to estimate Canada goose harvests for specific populations.
2. Periodically band or neck collar cohorts to obtain age-specific harvest information.
3. Develop a reliable system to monitor subsistence harvest.

Habitat Concerns: In winter and during staging, NAP 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, Newfoundland, and Labrador, large tracts of land are susceptible to development, either hydroelectric or for mineral extraction. The effects of development on these breeding areas appear minimal at the present time, but continued monitoring is warranted. The effect of molt migrant Canada geese on breeding and staging habitats is believed to be low, but effects may increase with increasing abundance of temperate breeding Canada geese.

1. Monitor the effects to NAP Canada geese from resource development on the breeding grounds.

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

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

Canada Goose *(Branta canadensis)*

Atlantic Population *(interior)*

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 50ºN. 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 on the Ungava Bay coast. This could be related to differential survival or productivity and / or emigration of Ungava Bay geese to different breeding areas (e.g. Greenland), but the potential for growth appears more limited for geese nesting along the Ungava Bay coast.

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 can be confounded by large numbers of molt migrant geese that enter the survey area, particularly the Hudson Bay coastal region, at about the same time the spring survey is conducted, and differences in survey timing and the abundance of molt migrants can introduce substantial variability and bias in the estimation of total population size. Thus, the Indicated Breeding Pair index from the Ungava Region is the primary metric used for assessing population status. However, the total

population size index does appear to reliably indicate multi-year periods of below-average productivity before these reductions become apparent in the breeding adult segment of the population, and therefore the total population index may provide a useful "early warning system" for managers to take into consideration for setting hunting regulations.

1. Continue spring breeding ground surveys as an operational program, with a focus on detecting change in the Indicated Breeding Pairs index. Continue to improve accuracy and precision of the survey.
2. Review options for including total population index as a secondary metric to inform management decisions.

Population Dynamics: Annual productivity is appraised using a mathematical model that incorporates weather variables on the Ungava Peninsula to predict age ratios at banding. Ground surveys at key nesting sites around Ungava Bay are conducted periodically to provide additional information on nesting effort and nest success.

Preseason banding is conducted annually within the major nesting areas, for example, along the northeastern coast of Hudson Bay and coast of Ungava Bay, and provides measures of survival, harvest, and distribution. Target samples have not been achieved in every year due to varying reproductive success, but, on average, about 5,500 juvenile and adult geese are banded each year, which have been adequate for assessment. An Integrated Population Model (IPM) incorporating survey, banding, and weather data has been developed and may offer an effective means of predicting out-year population abundance. The IPM has shown the ability to determine target harvest probabilities for desired population trajectories and predict expected harvest probabilities for various season length and bag limit combinations.


JOSH DOOLEY

1. The preseason banding program should continue as an operational program at current levels to provide harvest rate and survival estimates for all cohorts of geese.
2. Continue to use the productivity model to predict age ratio at banding and to analyze actual banding results to provide a direct assessment of annual production.
3. Continue to refine the IPM and explore its use for informing and evaluating harvest management decisions.

Population Biology and/or Ecology: Field studies on the Ungava Peninsula conducted in northern Quebec from 1996-2008 identified factors related to annual productivity such as nesting effort, nest success, brood survival, and the effects of weather conditions on productivity. The intensive nest work done along the Hudson Bay coast south of Puvirnituq ended in 2003. Nest surveys at key nesting sites were scaled back in 2006 to include only the nesting areas near Ungava Bay, and those surveys have been conducted periodically.

1. Continue the current breeding ground survey and banding programs 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 productivity model.

Harvest Assessment: Annual banding programs 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 derivation analysis during 2012–2017 indicated that Atlantic population Canada geese comprised about 30% of the harvest in Atlantic Flyway AP zones, with temperate breeding geese comprising the rest. Recoveries of banded

Atlantic population Canada geese during 1997–2017 showed that relative harvest proportions differ significantly among regions in the flyway, with most recoveries occurring in the Chesapeake region (40%; DE, MD and VA), followed by Quebec and Ontario (30%), the mid-Atlantic region (25%; NY, NJ and PA), New England region (2%; VT, CT, and MA) and other areas (<3%). 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. Continue leg banding of all Canada goose populations affiliated with the Atlantic Flyway for periodic assessment (e.g., every 3-5 years) of harvest distributions and derivations.
2. Develop a reliable system to monitor subsistence harvest.

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 molt 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 alteration of forage plant communities caused by the growing numbers of snow geese and molt migrant Canada geese.

1. Evaluated and monitor the effects and the extent of breeding and staging habitat change caused by snow geese and molt migrant Canada geese.

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

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

Canada Goose
Branta canadensis

Southern Hudson Bay Population *(interior)*

Population Definition or Delineation: The breeding range of this population includes the Hudson Bay Lowlands from southern and western James Bay mainland from 79°30' longitude to Cape Henrietta Maria and northwest to the Manitoba/Nunavut border, and includes Akimiski Island, Nunavut in James Bay. The breeding range extends from the James and Hudson Bay coasts inland to about the Lowland-Shield transition though this boundary remains uncertain because of the difficulty in working with surveying low densities of breeding pairs in remote locations. Canada geese originating from the Hudson Bay Lowlands in Ontario and Manitoba winter primarily in the Mississippi Flyway. Some Canada geese from the mainland southeast of James Bay winter in the Atlantic Flyway. Most birds breeding on Akimiski Island winter in the Mississippi Flyway, but a small proportion of them also winter in the Atlantic Flyway. Based on banding and other marking projects, migration appears to be essentially north-south and it is known that birds that breed in the eastern part of the breeding range tend to winter in the eastern Mississippi Flyway states, and similarly that birds that breeding in the western part of the breeding range mostly winter in western Mississippi Flyway states.

1. Banding and marking efforts should be maintained as harvest and survival rates are key metrics identified for monitoring the population. A recent analysis completed in 2014 identified the optimal sample size and banding distribution.

Population Status or Assessment: Status is assessed annually with a spring breeding ground survey. To improve efficiency, surveys were modified for 2016 to include only the higher density breeding area nearest the coast. This reduced the number of flight hours and improved the probability of detecting change on each transect. Complications due to inclusion of molt migrants in some spring surveys in the 1990s has been corrected by conducting surveys before molt migrants arrive and by basing the survey index on breeding pairs only.

1. Continue spring breeding ground surveys as an operational program, with a focus on detecting change in the Indicated Breeding Pairs index.
2. Monitor molt migrant Canada geese in the SHB population summer range (numbers, distribution, arrival and departure timing).

Population Dynamics: Survival and harvest rates were identified as the primary threshold metrics in the SHB management plan for triggering management action. Thus, the management plan focussed on providing optimal estimates for assessing the effects of harvest. Also, reproductive success and productivity were monitored historically through studies of nesting biology on Akimiski Island and at two locations on the Hudson Bay mainland (Burntpoint Creek in Ontario and at Cape Churchill in Manitoba). It was determined that age ratios at banding can provide a very good approximation of reproductive success which is now used exclusively as the productivity metric. With such a large range, productivity can vary geographically within a year. Productivity can be monitored at different geographic scales because banding is widely distributed across the range in coastal areas. Areas with particularly poor range like Akimiski Island, Cape Henrietta Maria and Cape Churchill that have suspected low gosling survival in some years can be monitored using age ratios at banding.

1. Harvest and survival rate estimation should be monitored and assessed through operational banding across SHB breeding range.
2. Continue to monitor annual productivity using age ratios during operational banding at meaningful geographic scales with periodic assessment at finer scale where data allow.
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 SHB population Canada geese is relatively well known due to long-term monitoring and research on the north shore of Akimiski Island, the Ontario north shore of Hudson Bay and at Cape Churchill in Manitoba. However, additional information is needed to understand the influence of temperate breeding Canada geese and overabundant lesser snow geese on their vital rates.

1. Develop and implement methods to assess the effects of competition from increasing numbers of Temperate Breeding Population molt migrants and lesser snow geese on brood rearing areas, the effects of variable spring forage quantity and quality, and effects of changing climate on population vital rates.

Harvest Assessment: Estimates of population specific harvest and subspecies composition of Canada goose harvest by state and province are usually not available. Banding-based derivations of population-specific 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). Subsistence harvest estimates have been made only periodically (1974-1976, 1981-1982, 1990, 2004-2005).

1. Enhance knowledge of geographic distribution of the harvest throughout the Mississippi and Atlantic Flyways.

Habitat Concerns: Coastal habitats (particularly brood rearing habitats) of the SHB population may be negatively impacted by one or more of the following factors: 1) growing numbers of molt migrants from temperate-nesting Canada goose populations, 2) spring staging lesser snow geese, 3) locally nesting lesser snow geese, 4) climate change, and 5) mineral extraction development.

1. Continue to monitor plant productivity and grazing pressure as indicators of habitat condition in coastal areas of Akimiski Island, at Cape Henrietta Maria and near Cape Churchill and in any other locations where brood rearing habitat might be negatively impacted.
2. Use habitat data in combination with vital rates in population models to assess effects of habitat change on population age structure and growth rates.
3. Determine carrying capacity to help estimate impacts of competition from Temperate Breeding Population molt migrants and lesser snow geese.

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

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

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Canada Goose *(Branta canadensis)*

Western Prairie Population *(interior)*

Population Definition or Delineation: This population includes Canada geese that nest in Manitoba west of 97oN longitude, in eastern Saskatchewan, and in the northern Great Plains of the United States. They mainly winter in the eastern states of the Central Flyway. Historically, these geese have been divided into the Western Prairie population (WPP) north of about 50o 30'N latitude, and the Great Plains population extending southward from there, but the populations have been treated as one group in recent years. There are relatively few banding data available from much of the range to assess population delineation.

1. Re-assess the breeding range boundaries for WPP Canada geese, and determine the appropriate geographic scale at which to manage these geese.

Population Status or Assessment: The distribution and abundance of WPP Canada geese were monitored by mid-December surveys in the Central flyway until 1999. Currently, counts obtained during the Midwinter Waterfowl Survey in January are used to provide the winter status and distribution of Canada geese in the Central Flyway. Breeding population estimates for the western Prairie population are also obtained from strata 21-25, 30-40, and 43-49 of the annual Waterfowl Breeding Population and Habitat Survey (WBPHS).

1. Evaluate use of the WBPHS in the United States and Canada to annually assess population status.

Population Dynamics: Harvest age ratios are unreliable as an index of annual productivity due to the early molt of juvenile tail feathers by temperate-nesting Canada geese. Wing feathers have also been collected to help appropriately age geese. The "keys" used to determine adult:immature ratios from harvest parts submitted during the annual National Species Composition Survey in Canada, and the Parts Collection Survey in the United States need to be assessed to ensure that Canada geese and cackling geese are accurately identified. A pre-season banding program was initiated in recent years, and should provide information about survival and harvest rates.

1. Evaluate pre-season banding data to determine age-specific survival and harvest rates of Canada geese in the Central Flyway.

2. Expand banding operations to increase spatial coverage of this population.

Population Biology and/or Ecology: There has been little work done on the breeding ecology of WPP Canada geese. Continued growth of the population suggests few limits to annual productivity. There is little information about molting areas used by these geese.

1. Update pre-season banding and/or marking efforts to examine fall and winter distribution, as well as harvest and survival rates of WPP Canada geese.

Harvest Assessment: Harvest estimates for Canada geese are available at the state, provincial, and flyway level from annual harvest questionnaire surveys in the United States and Canada, but estimates of population specific harvest and subspecies composition are not assessed from these surveys. Canada geese are differentiated from midcontinent cackling geese based on tail fan criteria, but different criteria are used to identify cackling geese in western Canada and states of the Central Flyway.

1. Continue to monitor harvest of Canada geese and cackling geese separately, and develop/evaluate consistent criteria for separating these species in the harvest.

Habitat Concerns: Increasing numbers of WPP Canada geese have created conflicts with people in both urban and rural settings, including degrading recreational areas and increasing depredation of crops. Expanded mineral exploration, forest industry activities and potential hydro-electric projects could influence the distribution, abundance and productivity of WPP geese in this region in the future.

1. Continue to mitigate against damage caused by WPP 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.

Canada Goose *(Branta canadensis)*

Vancouver Canada Geese *(fulva)*

Population Definition or Delineation: The Vancouver Canada goose population is centred in coastal areas of southeast Alaska and northern British Columbia. Vancouver Canada geese in southeast Alaska are largely non-migratory, but migratory behaviour of Vancouver Canada geese in British Columbia is unknown. About 2% of Vancouver Canada geese from Alaska winter as far south as Oregon. 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 molting Vancouver Canada geese have been observed along the northern coast of the Gulf of Alaska. Vancouver and dusky Canada geese have considerable overlap in morphological and genetic measures, and some taxonomic treatments have combined the two subspecies.

1. Conduct banding and telemetry studies in Alaska and British Columbia to better define distributional boundaries.
2. Conduct genetic studies to determine the genetic structure of geese from British Columbia and Alaska.

Population Status or Assessment: A draft management plan for this population was developed in 1979, but there have been no subsequent updates. There is no operational survey or other means to assess population status or productivity. During 1996–2001, approximately 24,000 Canada geese were estimated to winter in southeast Alaska. There are no reliable breeding or wintering estimates for British Columbia. Population assessment is difficult because Vancouver Canada geese are widely dispersed within forest habitats during the summer. During the winter, they are more visible along coastal areas, but some winter inland and as far south as Oregon.

1. Develop a survey to assess breeding or wintering Vancouver geese in southeast Alaska and British Columbia.

Population Dynamics: Survival has been assessed periodically by banding and telemetry studies, and high adult survival rates and evidence of long-term consistency have been observed. Little information exists about reproduction and recruitment and how these factors may affect population dynamics. Breeding studies have been spatially and temporally limited and showed considerable variation. There are no data on productivity, gosling or post-fledging survival, or recruitment.

1. Assess spatial and temporal variation in nest, gosling, and post-fledgling survival.

Population Biology and/or Ecology: Little is known about breeding ecology of Vancouver Canada geese, and, in general, less is known about the breeding ecology of geese nesting in more forested landscapes compared to tundra habitats. Genetic differences have been found among Vancouver Canada geese at different molting and nesting areas. Telemetry data indicated that Vancouver geese move short distances from wintering to nesting areas, and geese marked at different areas often remained separated during winter and nesting. Gene flow and demographic influences may operate at a relatively small scale.

1. Initiate studies to assess breeding ecology of Vancouver Canada geese.

Harvest Assessment: Harvest of this population is not currently assessed, as traditional state and federal harvest surveys do not provide information by subspecies. Harvest is presumed to be low, based on low rates of direct band recoveries (<3%) from limited banding.

- Expand banding across the breeding range to assess harvest levels and distribution.
- Evaluate morphological and genetic criteria to differentiate harvested Vancouver geese from other subspecies.

Habitat Concerns: Nesting and wintering habitat are generally stable. Forest road construction could potentially affect some nesting areas. Wintering habitat occurs in intertidal habitats. Coastal road and port development, oil spills, or other maritime-related activities could potentially affect some wintering areas. Brood-rearing habitats have been poorly studied.

1. Identify brood-rearing habitats and assess potential effects of resource development practices.
2. Evaluate 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.

Canada Goose *(Branta canadensis)*

Lesser Canada Geese *(parvipes)*

Population Definition or Delineation: Lesser Canada geese nest in forested river basins of southcentral and interior Alaska and western Alaska. This population has been partially defined through surveys, banding, and genetics studies, but the exact delineation and boundaries of the breeding range remain undetermined. The breeding range of lesser Canada geese likely overlaps the breeding range of the morphologically similar Taverner's cackling goose within tundra-forest boundaries. Primary wintering areas are in Washington, Oregon, and California, with small numbers wintering in Nevada, Arizona, and other interior states. During winter, lesser Canada geese intermix with other cackling and Canada goose subspecies.

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

Population Status or Assessment: There is no official or adopted survey to assess lesser Canada geese. Additionally, there is not a current management plan for this population. A draft management plan was developed in 1994, but it included both Taverner's cackling geese and lesser Canada geese, which are now separate species under the American Ornithologist's Union classification. The lesser Canada goose population historically has been monitored, albeit poorly, through breeding ground surveys directed primarily at other species, and through direct counts during the winter. During winter, Taverner's cackling geese and lesser Canada geese have commonly been reported together. A breeding population index for lesser Canada geese is currently in development using strata of the Waterfowl Breeding Population and Habitat Survey. This index does not indicate a positive or negative trend; however, counts have been quite variable among years and the index likely


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represents only a small portion on the total population. Further refinement, evaluation, or development of a breeding ground survey to provide annual management indices for this population is needed.

1. Refine and implement a breeding ground survey to use as a population management index.

Population Dynamics: Little individual marking, productivity, or other demographic information exists for lesser Canada geese. Best information available suggests a stable to slightly decreasing population. Decreased winter abundance in Oregon and Washington during recent years has been noted based on incidental and observation data.

1. Initiate studies to evaluate demographic parameters, including survival rates of adults and juveniles and nesting success and productivity.

Population Biology and/or Ecology: Little is known about breeding ecology of lesser Canada geese, and, in general, less is known about the breeding ecology of geese nesting in more forested landscapes compared to tundra habitats. There is more information about wintering ecology, but data are primarily based on observational studies of multiple goose species.

1. Initiate studies to evaluate breeding ecology of lesser Canada geese and other primarily forest nesting geese.

Harvest Assessment: Lesser Canada geese winter within the Pacific Flyway among six other populations of white-cheeked geese that are similar in appearance. Harvest of this population is not currently assessed, as traditional state and federal harvest surveys do not provided information by subspecies. Morphological and genetic analyses indicate that lesser Canada geese can be distinguished from other goose populations in the Pacific Flyway. Goose harvest strategies within the Pacific Flyway have been primarily focused on other populations, and there is limited data available to assess population status of lesser Canada geese or effects of harvest regulations.

1. Continue licensed and subsistence harvest surveys and evaluate morphological, genetic, or other criteria and methods to differentiate harvested lesser Canada geese from other populations.
2. Expand individual marking methods to assess harvest and harvest distribution.

Habitat Concerns: Breeding habitats, primarily interior forested wetlands, are relatively secure with the possible exceptions of south central Alaska and wetlands in the vicinity of Fairbanks, where urbanization is occurring and energy development is proposed. On the wintering grounds, increased goose foraging intensity on grain, turf, and pasture crops, which are predominantly private lands, has created conflicts with agricultural interests.

1. Determine the effects of climate change or development on breeding habitats and distribution.
2. Evaluate winter foraging ecology, habitat capacity, and habitat use and develop cooperative goose and habitat management strategies to address crop depredation issues and provide sufficient wintering 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.

Canada Goose *(Branta canadensis)*

Dusky Canada Geese *(occidentalis)*

Population Definition or Delineation: Dusky Canada geese predominantly nest on islands and mainland areas of the Copper River Delta of south eastern Alaska, and winter within the Willamette and Lower Columbia River valleys of Oregon and Washington. Dusky and Vancouver Canada geese have considerable overlap in morphological and genetic measures, and some taxonomic treatments have combined the two subspecies.

1. Assess seasonal ranges, overlap, and interchange of Canada geese breeding on the Copper River Delta and nearby islands in Prince William Sound.
2. Conduct genetic studies to better identify and describe overlapping genetic variation with Vancouver Canada geese

Population Status or Assessment: The dusky Canada goose population is assessed by an annual aerial and ground-based breeding population survey on the Copper River Delta and a biennial ground survey on Middleton Island. A productivity survey is also conducted annually on the Copper River Delta. Neck-collaring on the breeding grounds and mark-resight monitoring on the wintering grounds is used to assess annual survival rates. Approximately 600 dusky Canada geese are banded biennially on the Copper River Delta. Since 1986, the dusky Canada goose breeding population has ranged between 7,000 and 18,000 geese.

1. Continue annual breeding population and productivity surveys and individual marking and mark-resight efforts.

Population Dynamics: Since the 1980s, low productivity of the population has been a concern and the focus of management efforts. Productivity has increased in recent years. Since 2002, adult survival has been high, approximately 80%. Less information is known about post-fledging survival of juveniles or breeding productivity of different age geese.

1. Determine seasonal and annual survival rates for various age classes, particularly juveniles where few data exist.
2. Determine age-specific productivity.

Population Biology and/or Ecology: The 1964 Alaska Earthquake and uplift of the Copper River Delta triggered extensive habitat succession, which greatly increased predator access and predation rates. The Copper River Delta is a highly dynamic region continually influenced by tectonic, glacial, riverine and tidal forces. Continued research is needed to understand the effects of habitat succession on the suite of goose predators and predator-prey dynamics that affect nest success and gosling survival on the Copper River Delta.

1. Evaluate avian and mammalian predation and predatory-prey dynamics.
2. Evaluate current strategies and initiate new strategies to increase productivity.

Harvest Assessment: The management plan adopted in 2015 by the Pacific Flyway identifies monitoring criteria, actions, and thresholds that will be used to adjust management or harvest strategies of dusky Canada geese. Since 1985, harvest has been restricted in Washington and Oregon through establishment of limited harvest quotas and check stations. In 2015, dusky Canada goose harvest was completely closed, and check stations were no longer used. Direct assessment of harvest for this population is not possible. Potential changes in harvest or impacts of harvest will be assessed indirectly by assessment of annual breeding counts, productivity, and survival and knowledge about compliance with harvest closures. In Canada, there are no regulatory provisions specific to dusky Canada geese, although harvest is presumed to be low.


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1. Continue population monitoring to indirectly assess potential changes in harvest.
2. Evaluate additional methods to directly or indirectly assess harvest of dusky Canada geese or hunter compliance within the permit zone, and harvest of dusky Canada geese outside of the permit zone.

Habitat Concerns: On the breeding grounds, habitat succession from the 1964 Alaska Earthquake and uplift of the Copper River Delta is still on-going. On the wintering grounds, there are limited public lands available to manage specifically for dusky Canada geese, or geese in general. Substantial increases in other wintering goose populations have increased goose foraging intensity on grain, turf, and pasture crops, which are predominantly private lands, and this has created conflicts with agricultural interests. Effects to dusky Canada geese from the large increases in other goose populations on the winter grounds are uncertain.

1. Evaluate breeding habitat succession on the Copper River Delta, focusing on potential short- and long-term effects to dusky Canada goose productivity.
2. Evaluate winter foraging ecology, habitat capacity, and habitat use in relation to the large numbers of other wintering geese.
3. Develop cooperative goose and habitat management strategies to address crop depredation issues and provide sufficient wintering 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.

Funding

Introduction

The federal governments of the United States and Canada provide ongoing funds for the AGJV through the United States Fish and Wildlife Service and Environment and Climate Change Canada, Canadian Wildlife Service. These sources are essential to leverage funding from a wide variety of partners including federal, flyway, state, provincial, university, non-government, and private organizations. Funding is devoted almost exclusively for monitoring and research with only a small amount for staff, coordination, and communication costs.

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 of funding to more effectively meet the needs of the Joint Venture. The AGJV Strategic Plan identifies the research priorities for the various northern- nesting goose populations, and although much has been accomplished, several priority programs remain unfunded, thus preventing management agencies from making optimal decisions.

Principles

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

Mechanism

Fundraising 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 Management Board and Technical Committee 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.

Funding Sources

Government / Flyway Partnerships

The federal governments in both Canada and the United States, and the four flyway councils, made up of all state and provincial agencies, are the main contributors to AGJV projects.

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 of Natural Resources Canada. This support is critical to the delivery of many AGJV funded programs. Similarly, the Natural Sciences & Engineering Research Council and National Science Foundation have contributed significantly to AGJV programs.

Universities

One of the most efficient means of studying geese is through graduate students/research assistantships which are often supported through institutional research grants.

Co-Management Boards

Indigenous people 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 indigenous 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 Canadian Arctic, the Gwich'in and Sahtu Claims are settled, while the north and south Slave Claims are being negotiated. The Alaska Migratory Bird Co-Management Council, which represents the 10 subsistence regions in Alaska, works in close collaboration with the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game to establish subsistence harvest regulations, conduct surveys and research, and provide communications outreach. 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 needs.

Communications

The AGJV is a small joint venture, with limited human and financial resources available for communications, therefore efforts are focused to target audiences through regular communications activities and issue-driven products. Communications efforts provide:

a. information on progress and accomplishments of the AGJV to partners;

b. information on progress and accomplishments to co-management councils;

c. information and education about the status of goose populations, and key findings from AGJV supported projects;

d. information to current and potential partners to encourage additional funding to facilitate AGJV activities;

e. support to the North American Arctic Goose Conference, which 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 AGJV.


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AGJV Management Board and Technical Committee Representation

United States

- United States Fish and Wildlife Service
- United States Geological Survey
- Pacific Flyway Council
- Central Flyway Council
- Mississippi Flyway Council
- Atlantic Flyway Council
- Ducks Unlimited Inc.

Canada

- Environment and Climate Change Canada, Canadian Wildlife Service
- Western provincial representation
- Eastern provincial representation
- Northern government representation
- Ducks Unlimited Canada

Mexico

- Mexico representation (when capacity allows)

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 NAWMP 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; brief new members on AGJV structure and procedures.
8. Maintain a current directory of AGJV Projects.
9. Develop communications products with the Management Board and Technical Committee.
10. Develop and maintain AGJV website in English, French, Spanish, and other languages as deemed appropriate.
11. Develop and maintain the North American Arctic Goose Conference Website
12. 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.
1. Prepare annual and roll-up financial reports for the AGJV Management Board and Technical Committee.
2. Report AGJV contributions and expenditures annually to the U.S. Fish and Wildlife Service and the Canadian NAWMP National Tracking System.

Special Projects

1. 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.

2. 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 given full review by the AGJV Technical Committee with an endorsement recommendation and priority designation if required. Management Board generally reviews proposals once per year, but may act outside the regular meeting schedule to expedite support if necessary. When funding is available, requests for proposals by the AGJV, which outline highest priority information needs and submission deadlines, are posted to the AGJV website and other media. Proposals should be submitted to the AGJV Coordinator, if possible in electronic format at email address below.

AGJV Coordination Office

c/o Canadian Wildlife Service
9250-49 Street NW
Edmonton, Alberta
Canada T6B 1K5

Phone (780) 951-8652
Email Deanna.Dixon@canada.ca
agjv.ca / pcoa.ca / gansodelartico.com


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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 and background of each staff position in the study (<1 paragraph) and include a list of recent publications of the principal investigator(s). Maximum 2 page.
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:*** The amount of matching funds are considered when scoring proposals and need to be identified in the budget. At least a 1:1 match to AGJV funds is recommended, ideally from a non-federal source.
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 October 1 each year, in advance of the AGJV fall meetings, typically held in October or November..

Evaluation of Proposals

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

1. Does the proposal address an AGJV priority population?
2. Does the proposal meet the current RFP priority of the AGJV?
3. Does the proposal address one or more of the AGJV Information Needs?
4. Does the proposal address one or more of the AGJV Focus Areas?
5. What is the Strategic Plan Matrix rank? A low score on this question may lead to rejection, pending consideration of justification.
6. 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.


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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.*

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