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MISSISSIPPI FLYWAY COUNCIL

Management Plan for Ross's Geese in the Mississippi Flyway

Prepared by the Mississippi Flyway Council Technical Section
Arctic Goose Committee

August 2021

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Introduction and Purpose

Ross's geese (*Anser rossii*) are important migratory game birds whose management is a responsibility shared among federal, state, provincial, and territorial agencies, Indigenous Peoples, as well as non-governmental conservation organizations. This plan was drafted in cooperation with the Central and Pacific Flyway Councils, and the management objectives, harvest management strategy, and population monitoring components of the plan are consistent in each flyway. Although Ross's geese and snow geese (i.e., light geese) have primarily been managed collectively in North America, separate management plans have been developed for the five populations (i.e., Ross's geese, midcontinent, western Arctic, and Wrangel Island lesser snow geese [*A. caerulescens caerulescens*], and greater snow geese [*A. c. atlantica*]). The intent to is continue managing harvest of snow and Ross's geese collectively, due to similarities in their population status, harvest rate, migration and wintering locations, and because they are difficult for hunters to differentiate. The purpose of this plan is to promote and guide cooperative harvest management of Ross's geese migrating through the states, provinces, and territories that comprise the Mississippi Flyway (Figure 1). The Mississippi Flyway Council (MFC) was organized in 1952 to promote and help coordinate management of migratory game birds, and this plan was written under its direction and authority.

Figure 1. North American Flyway administrative boundaries defined for cooperatively managing migratory birds.

Population Delineation

For the purposes of this management plan, Ross's geese include all those that breed and winter in North America. Ross's geese occur sympatrically with lesser snow geese across most of their breeding, migration, and wintering range, and are collectively termed 'light geese' by managers and hunters. Where snow and Ross's geese co-occur, daily bag and possession limits for the two species have been managed in aggregate, with the exception of spring conservation seasons in Canada during 1999-2013. Ross's geese primarily nest in several discrete, dense colonies in the Queen Maud Gulf in the central Arctic of Canada (Figure 2), and until recently, had experienced rapid annual growth, increasing at a rate of about 11% per year (Alisauskas et al. 2012b). An eastward shift in their wintering and breeding range has occurred over the past few decades based on abundance surveys and first sighting records (Jónsson et al. 2020). The proportion of recoveries (of Ross's geese banded in the central Arctic) has declined in the U.S. portion of the Pacific Flyway, from about 80% in the 1980s to only 40% by the early 2000s, and similar eastward shifts in recoveries have also occurred in Canada (Alisauskas et al. 2006). However, this eastward shift in band recoveries also likely reflects more liberalized regulations and the resulting higher harvests in the three eastern Flyways relative to the Pacific Flyway during this time period (Moser and Duncan 2001, Alisauskas et al. 2012a). Ross's geese also nest throughout the eastern Arctic, including western Hudson Bay, Southampton Island, and Baffin Island (Figure 2), although their colonization of this area is relatively recent (*circa* 1980s). Ross's geese were not observed on Baffin Island during expeditions in 1928-29 and 1930-31 (Soper 1946), or during research by Kerbes in 1967-68 (Kerbes 1969). The first encounters of Ross's geese on Baffin Island occurred in 1992, when several Ross's geese were captured incidentally during banding drives for lesser snow geese (Kerbes et al. 2014). Although not an indication of relative abundance, in the last decade nearly 1,000 Ross's geese (adults and goslings) have been banded annually on Baffin Island, and they now represent 34% of all light geese banded there (CWS, unpubl. data). Similar expansions have occurred on Southampton Island (Kerbes et al. 2014, Nissley et al 2016), and at McConnell River, NU (Caswell 2009). The proportion of Ross's geese in light goose banding drives on Southampton Island has increased from 0.02% in the 1950-60s (Kerbes et al 2014) to an average of 8% in recent years (CWS unpublished data).

Similarly, Caswell (2009) estimated growth at the recently established (*circa 1990s*) colony at McConnell River was 11.4% between 2003 and 2007, and by 2009, the colony was estimated to contain 81,400 Ross's geese (compared to 23,500 in 1994; Kerbes et al. 2014). Small numbers of nesting Ross's geese also nest on Banks Island in the western Arctic (Eric Reed, pers. comm.), in northern Ontario (Abraham 2002, Abraham 2007), and also in northern Manitoba, where their population is reportedly expanding (R.F. Rockwell, pers. comm.).

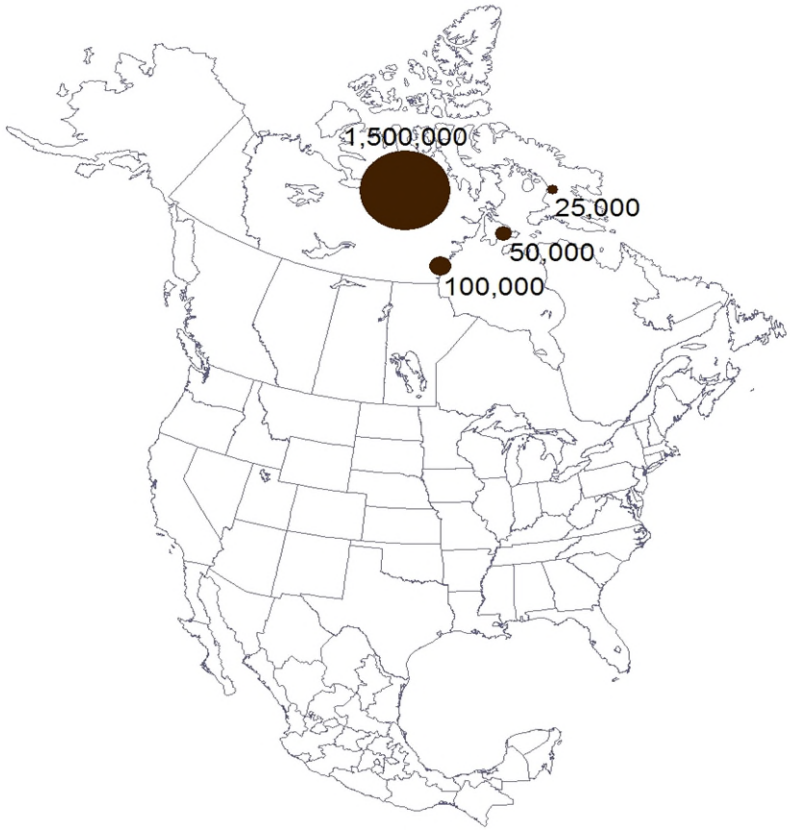

Figure 2. Approximate breeding distribution and abundance of Ross's geese in the Canadian Arctic, 2013. Small numbers of Ross's geese are found in northern MB and ON, and on Banks Island, NU, but are not shown. Figure J.1.1 in Fox and Leafloor 2018, used with permission.

Population Status and Trends

Ross's geese were thought to number only 2,000-3,000 in the early 1950s, but similar to other Arctic nesting geese, the combination of increased availability of

agricultural foods and refuges throughout the flyways improved survival (Abraham and Jefferies 1997) and led to rapid growth. During the 1980s, waterfowl managers became aware of the potential adverse impacts on subarctic habitats of increasing numbers of snow geese (Central Flyway Council and Mississippi Flyway Council 1982). Although over-abundance of snow geese was the primary focus at the time, Ross's geese were also increasing rapidly, but their contributions to habitat alteration were less well known.

Ground-truthed aerial photographic surveys (Kerbes et al. 2014) provided estimates of growth at colonies in the Queen Maud Gulf, but Ross's geese accounted for an unknown proportion of light geese counted on mid-winter surveys, and the continental Ross's goose population size was unknown at the time. Beginning in 1989, jurisdictions in the Mississippi Flyway began liberalizing hunting regulations, primarily in response to the growth of the lesser snow goose population. Bag and possession limits were gradually increased, and by 1996, hunting seasons were extended to the latest date (March 10) allowed under the Migratory Bird Treaty. By 1997, further growth of the snow goose population, increasing concern about damage to agricultural crops, and concerns about potential widespread degradation of Arctic and sub-Arctic habitats (Kerbes et al. 1990, Abraham and Jefferies 1997, Jano et al. 1998) resulted in recommendations to reduce the population. The goals at the time were specific to the lesser snow goose population; reduce the population by 50% by 2005, reduce the population growth rate to between 0.85 to 0.95, and triple the harvest rate (Batt 1997). Reducing adult survival rates through increased harvest mortality was considered the most efficient mechanism to reduce the population size and slow the population growth rate (Rockwell et al. 1997), and making use of harvested birds was thought to be the most socially accepted approach to achieving management goals (Johnson 1997:102). Recognizing such increases in harvest would not be possible under current regulatory constraints, the United States introduced new regulations for both Ross's and snow geese in 1999. These changes allowed hunting to occur after March 10 during the special conservation order (US), expanded or removed daily bag or possession limits, extended hunting hours, and permitted the use of additional hunting methods (i.e., electronic calls, and unplugged shotguns in the U.S). However, a successful court challenge in Canada by The Animal Alliance resulted in exclusion of Ross's geese from additional harvest measures in Canada at this time. The basis of the decision was that the evidence for

overabundance had not included Ross's geese. Ross's geese were eventually declared overabundant in Canada in 2014, by which time there was evidence that Ross's geese contributed to habitat alteration on northern staging and breeding grounds (Alisauskas et al. 2006, Abraham et al. 2012).

Similar to snow geese, overall harvest of Ross's geese increased substantially during the 1990s in both Canada and the US (Figure 3), but harvest has plateaued in recent years, perhaps due to behavioral adjustments by geese to increased hunting pressure, or due to satiation of hunters (Johnson et al. 2012).

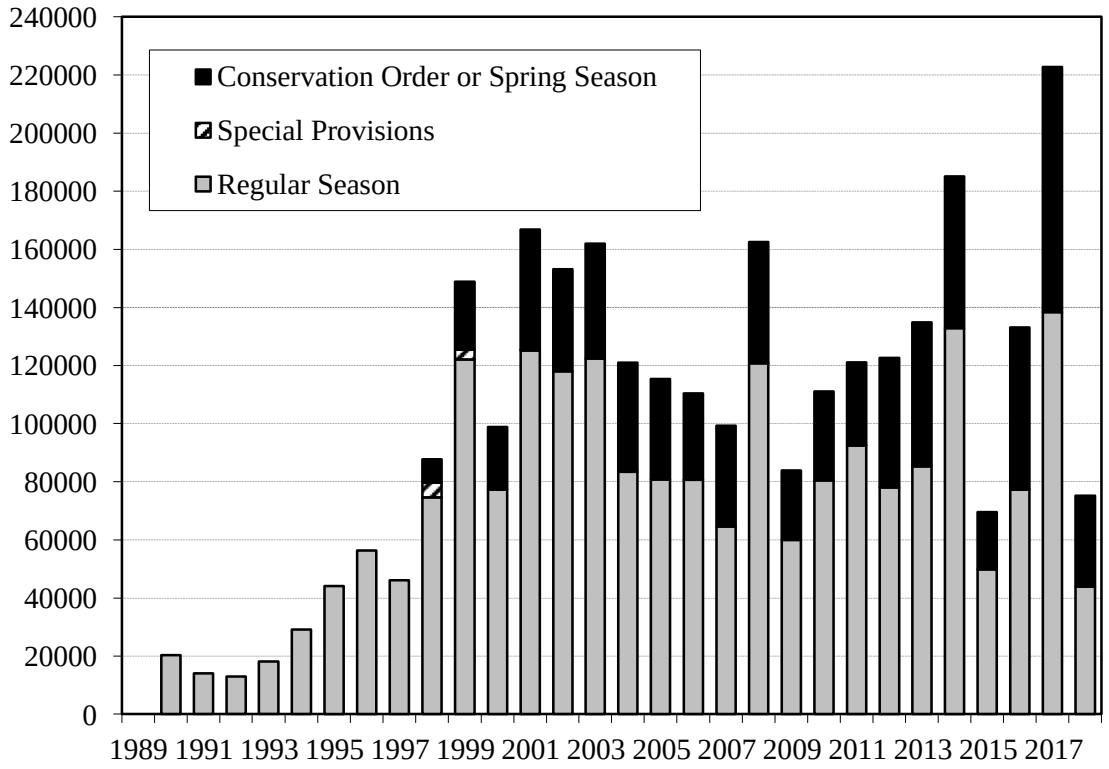

Figure 3. Annual harvest of Ross's geese (AHY and HY combined) during regular seasons, special provisions, and conservation orders (US) or spring seasons (Canada), 1990–2018. Harvest outside of regular seasons were estimated from regular season harvest and ratio of band recoveries (Alisauskas et al. 2011).

Variability in total harvest is partially related to numbers of juveniles in the fall flight, and in years of good production, large numbers of juveniles are harvested, and account for more than half the total harvest (Figure 4).

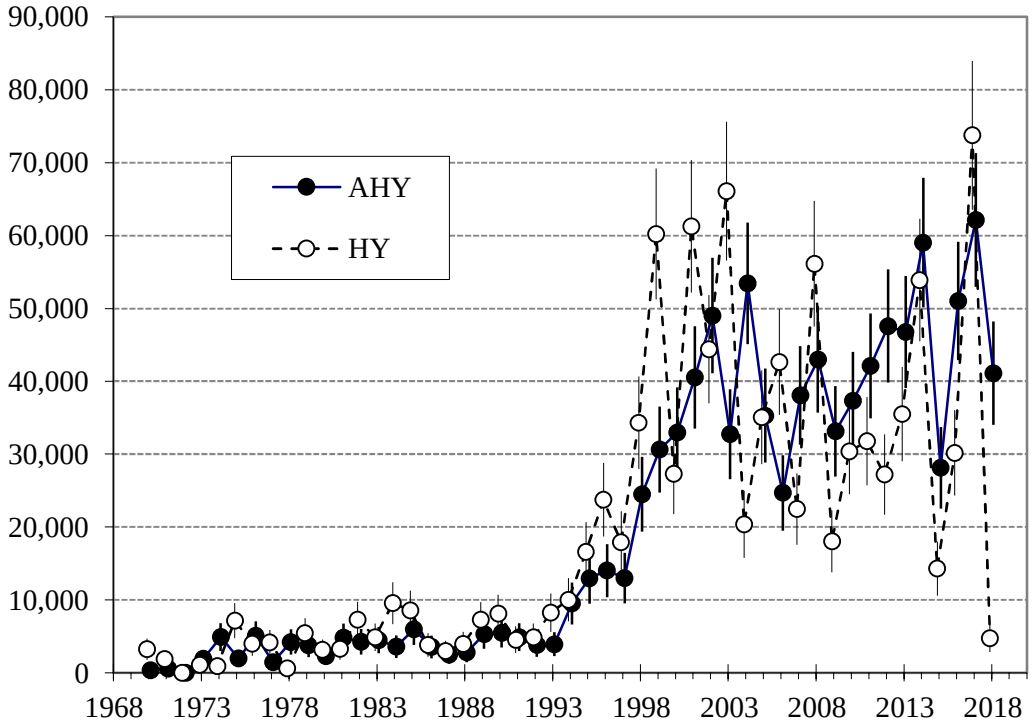

Figure 4. Age-specific annual harvest and 95% CL of Ross's geese during regular hunting seasons only (US and Canada), 1969-2018 (USFWS and CWS, unpublished data).

Most of the Ross's goose harvest occurs in the US (Figure 5), where the Central Flyway states account for the largest proportion (Figure 6).

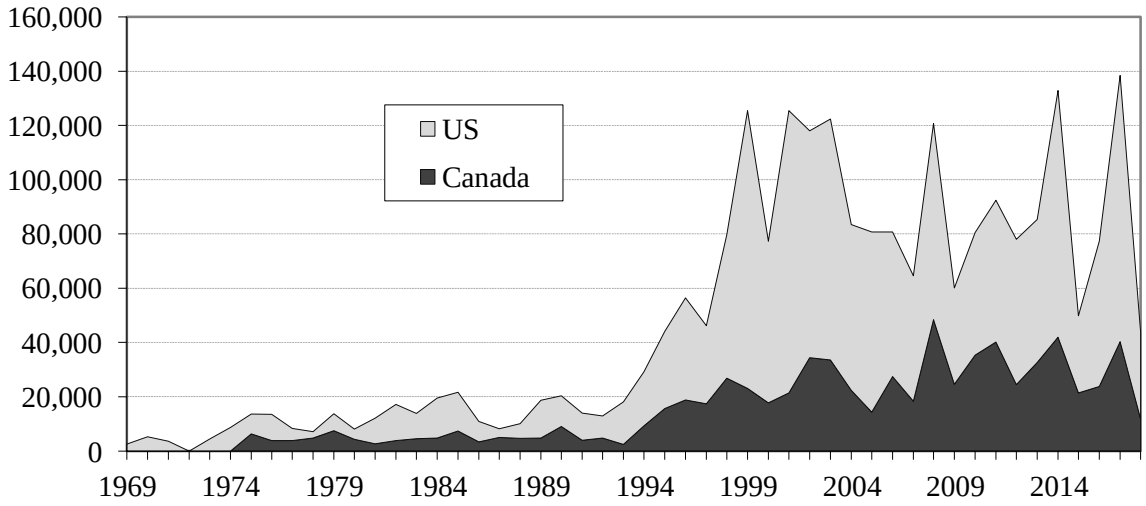

Figure 5. Annual harvest of Ross's geese during regular the season in Canada and the US, 1969-2018

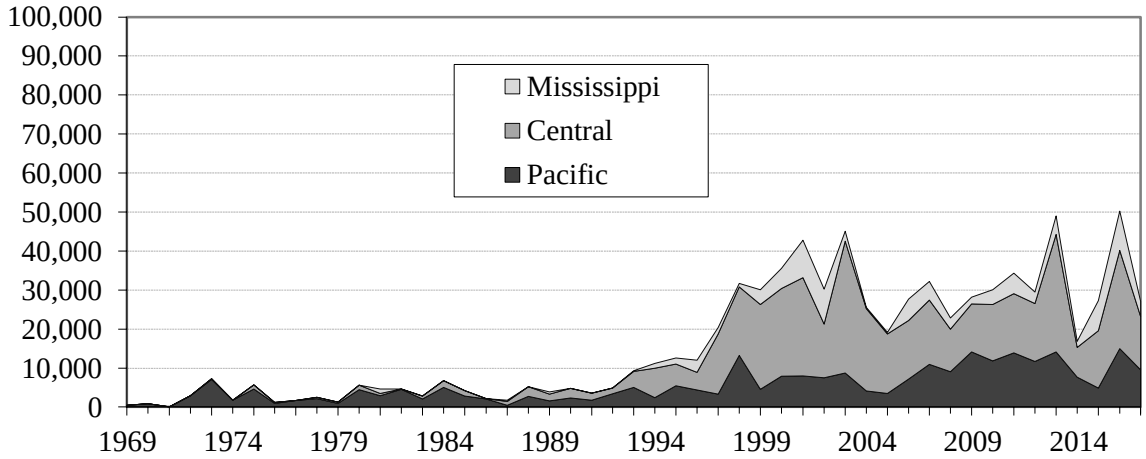

Figure 6. Annual harvest of Ross's geese during regular season in the U.S. states of the three western flyways, 1969-2018 (USFWS and CWS, unpublished data).

In Canada, nearly all of the harvest occurs in Saskatchewan. In recent years, harvest during the Conservation Order (US) or special measure regulations (Canada) has accounted for an increasing proportion of the total harvest of juveniles and adults (Figure 8). In 2015 and 2018, production was particularly poor, with essentially no juveniles harvested in the spring during those years.

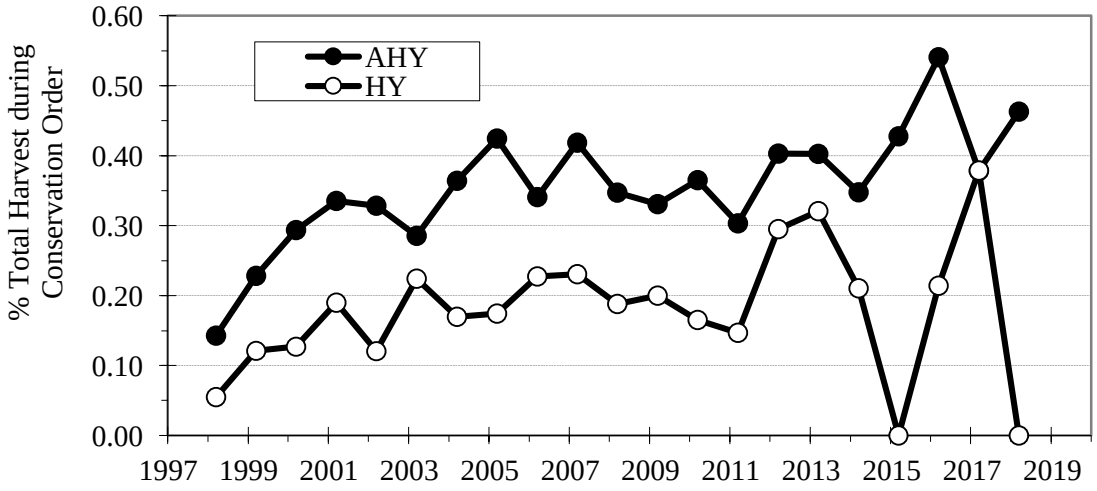

Figure 8. Proportion of Ross's goose harvest occurring in the Conservation Order (US) or Conservation Season (Canada). Proportion of adult harvest (black dots) and juvenile (open dots) harvest 1998-2018 (R. T. Alisauskas, Environment and Climate Change Canada).

During the same period that overall harvest increased, the harvest rate (i.e., the proportion of the population that is harvested annually) was stable or declining (Figure 9),

indicating that increased harvest did not keep pace with the increase in population size. Harvest rates of adults have been fairly stable since the implementation of special measures, and averaged only 2.6% during 2010–2018. Harvest rates of juvenile Ross's geese are positively related to juvenile survival, suggesting that more juveniles are harvested in years when more juveniles are available in the fall flight (Alisauskas et al. 2006).

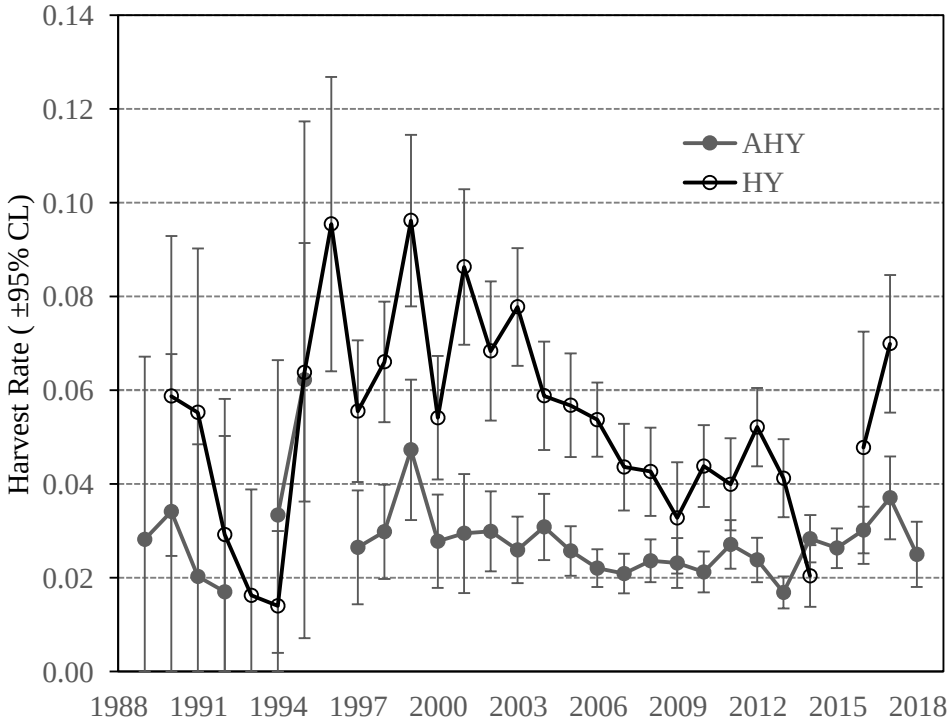

Figure 9. Harvest rates of adult (black dots) and juvenile (open dots) Ross's geese, 1989-2018. Years without estimates were due to zero or few bandings.

Population size of Ross's geese, as indexed by Lincoln estimates, increased rapidly from the mid-1990s until the mid-2000s, but has been stable to declining thereafter (Figure 10). Adult population size peaked near about 2.8 million birds in 2013, but has averaged 1.6 million adults more recently (2014-2018).

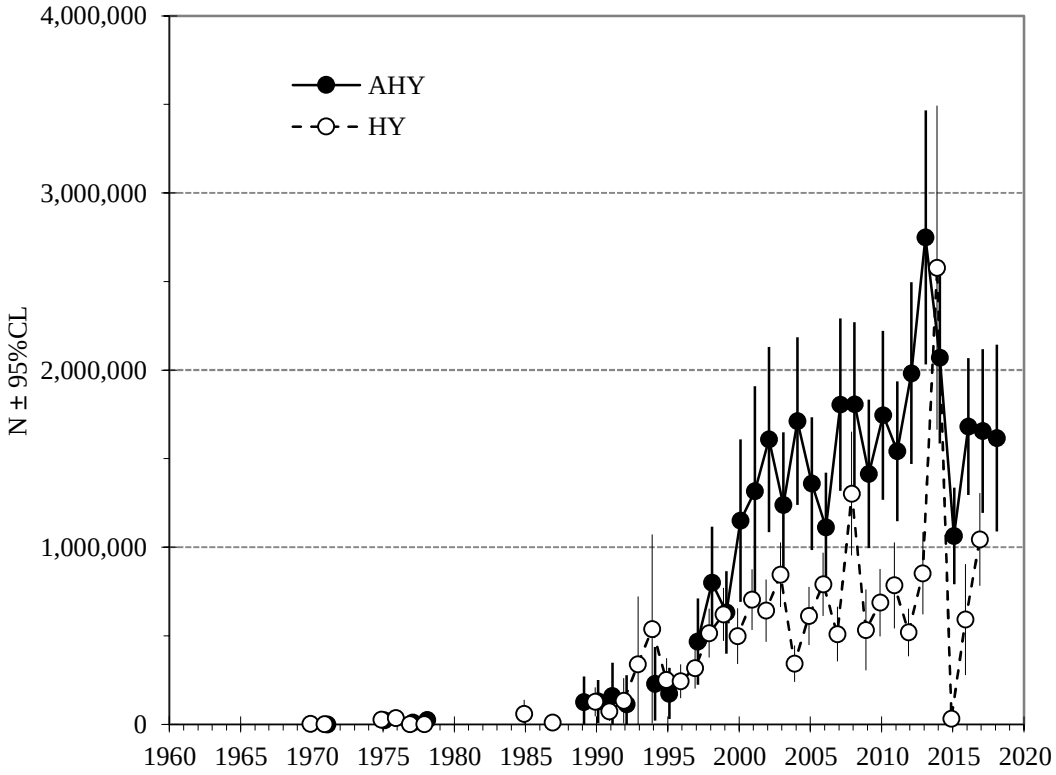

Figure 10. Lincoln estimates of population size (+/-95% CI) in August for adult (black dots) and juvenile (open dots) Ross's geese, 1970-2018. Years without estimates were due to no or limited bandings (R. T. Alisauskas, Environment and Climate Change Canada).

Gosling:adult age ratios in August have declined during the past decades, with very low or no production observed in several recent years (e.g. 2015, 2018; Figure 11). Immature:adult age ratios of Ross's geese harvested in the Central and Mississippi Flyways have also shown a similar long-term decline (Figure 12). Ross et al. (2017) found that proportion of juveniles at banding was influenced by both the size of female pre-breeding nutrient reserves, and mismatches between peak gosling hatch and peak forage quality. Importantly, the degree of mismatch is worsening, as goose nesting phenology appears unable to keep pace with advancing vegetation phenology (Ross et al. 2017).

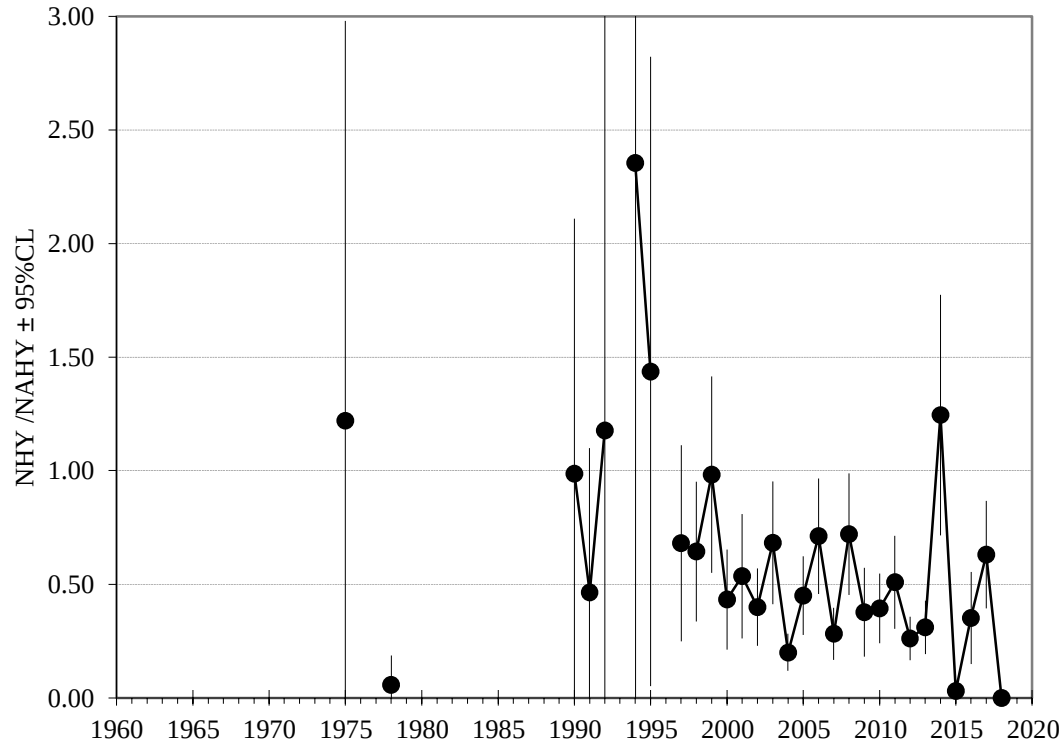

Figure 11. August age ratio of Ross's geese shown as the ratio of the number of goslings, $N_{HY,}$ to number of adults, N_{AHY} ,each estimated annually using Lincoln's method from 1975-2018 (R. T. Alisauskas, Environment and Climate Change Canada).

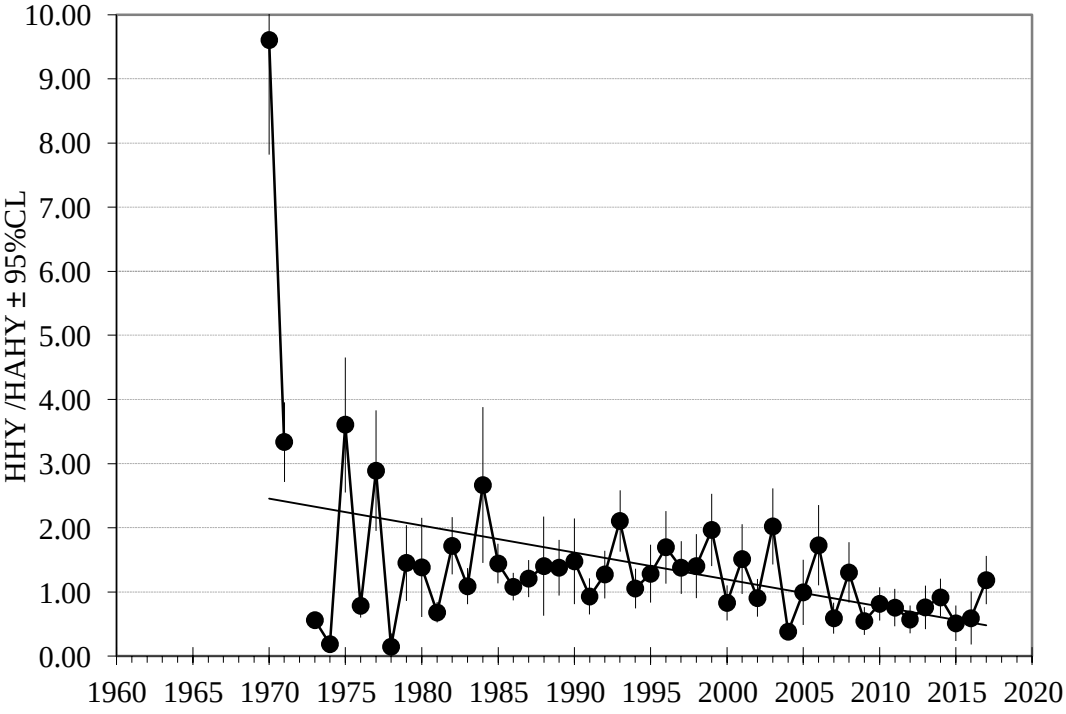

Figure 12. Age ratios (juvenile:adult) of Ross's geese harvested in the Central and Mississippi Flyway, 1970-2018 (R. T. Alisauskas, Environment and Climate Change Canada).

Analyses of band recovery data from 1989 to 2013 demonstrate that adult and juvenile survival has increased, with adult survival rates exceeding 90% in recent years (Figure 13; Alisauskas et al. 2018). Reduced population growth and declining age ratios, at the same time as adult survival rates have increased (Alisauskas et al. 2018), suggest that density-dependent population regulation may be occurring through a reduction in the recruitment rate (Ross et al. 2017).

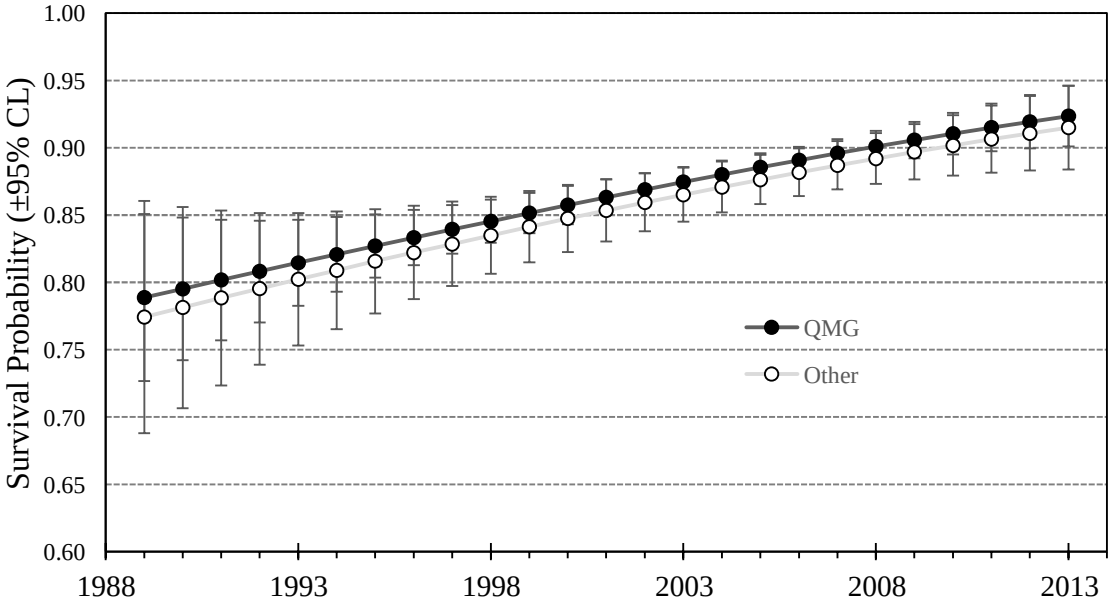

Figure 13. Model-averaged survival rate estimates for adult Ross's geese captured and marked at Queen Maud Gulf and six other breeding areas in Canada's Arctic, 1989-2013. Figure J1.7 in Alisauskas et al. 2018, used with permission.

Management Objective

Although additional harvest opportunities have not had the desired effect on this population (Leafloor et al. 2012), the large-scale ecological consequences of continued population growth are incompletely understood, and the management community has recommended that managers continue to explore options to maximize harvest by hunters,

and the use of lesser snow and Ross's geese by hunters (AGJV 2015). Given incomplete knowledge regarding the proportion of available habitat negatively impacted and the carrying capacity of Arctic habitats, we are unable to prescribe a more biologically meaningful population objective than the initial management target which was to reduce the population by 50% from the level observed in the late 1990s (USFWS 2007). The 1997-1999 adult population size based on Lincoln estimates was 710,000 adults; 50%=355,000. Therefore, the management objective of this plan is simply to reduce the size of the populations of Ross's geese by maximizing harvest during regular seasons and through continued use or expansion of special harvest measures. The intent is to increase adult harvest rates, which is considered the most accepted means of slowing or reducing the population growth rate. To achieve population reductions, it will be necessary to increase adult harvest rates to about 10-12%, assuming that all harvest is additive to natural mortality (Dufour et al. 2012), and that recruitment levels do not change drastically. Harvest levels in this range would be necessary to reduce adult survival below 80%, the level predicted to result in negative population growth (Rockwell et al. 1997).

Harvest Management Strategy

Similar to midcontinent lesser snow geese, uncertainty surrounding Arctic carrying capacity and potential nesting distribution prevents us from prescribing a biologically derived population objective, and we instead prefer to describe a minimum population threshold and maximum harvest rate threshold wherein regulatory restrictions would be considered. When populations of light geese were declared overabundant in 1997, the management goal was to reduce the overall population of light geese (lesser snow and Ross's geese) to 50% of the annual wintering ground estimates at the time (USFWS 2007). In recent years, Lincoln estimates have become widely used for monitoring abundance of other Arctic goose populations, and are considered more useful indices than wintering ground estimates, which suffer from a number of problems including unknown sources of bias, unknown variance around estimates, lack of standardization and replication, and unknown species and age composition.

The minimum population threshold of Ross's geese for management purposes is 355,000 adults, which corresponds to 50% of the average Lincoln population estimates between 1997-1999 (710,000 adults).

When the 3-year running average of adult harvest rate remains below 11%, and the three year running average Lincoln estimate of adult population size remains above 355,000 adults, maximum harvest opportunity should be offered during regular hunting seasons, and through continued use of special harvest measures like the Conservation Order in the US, and Special Conservation Measures for Over-abundant Species in Canada. It is recognized that constraints on maximizing harvest opportunity exist in some jurisdictions, due to management objectives for other waterfowl species, as well as other considerations.

If adult harvest rates reach or exceed 11%, and the population declines to a 3-year average of less than 355,000 adults, consideration will be given to enacting hunting regulation restrictions required to achieve harvest and survival rates consistent with the long-term population objective. The current 3-year average of Lincoln population size is 1.65 million adult Ross's geese (2016-2018).

The most recent data available will be used to calculate the 3-year running average of adult population size, and adult recovery rates. To adjust recovery rates to harvest rates, we will use the most recent available estimates of band reporting rates for geese. Since there is reportedly little variation in reporting rates by species in the same geographic area (Nichols et al. 1995; Zimmerman et al. 2009), we suggest continued use of reporting rate estimates of midcontinent mallards (Arnold et al. 2019, and S. Boomer, unpubl. data).

Population Monitoring

Ross's geese will be monitored using harvest rates and Lincoln estimates of population size, which will require banding a representative sample of these geese on their breeding grounds in northern Canada each year, and deriving age-specific harvest estimates from federal hunter surveys. Long-term banding programs provide not only information about survival and harvest rates, but also indices of annual production, harvest distribution, migration chronology, and population size. Banding data are the primary tools used for

evaluating the effect of regulatory changes in several Mississippi Flyway Management Plans (e.g., Canada Goose, White-fronted Goose, Cackling Goose, Lesser Snow Goose).

Alisauskas et al. (2012a) found recovery distributions of Ross's geese differed by banding area (Queen Maud Gulf vs Eastern Arctic), mostly due to a higher proportion of QMG recoveries being in the Pacific Flyway, and a lower proportion occurring in northern Canada (Figure 14). Some geographic variation in survival and harvest rates has been found among colonies of lesser snow geese, and it is therefore important to continue banding at representative sites across the breeding range (Alisauskas et al. 2011, Dufour et al. 2012).

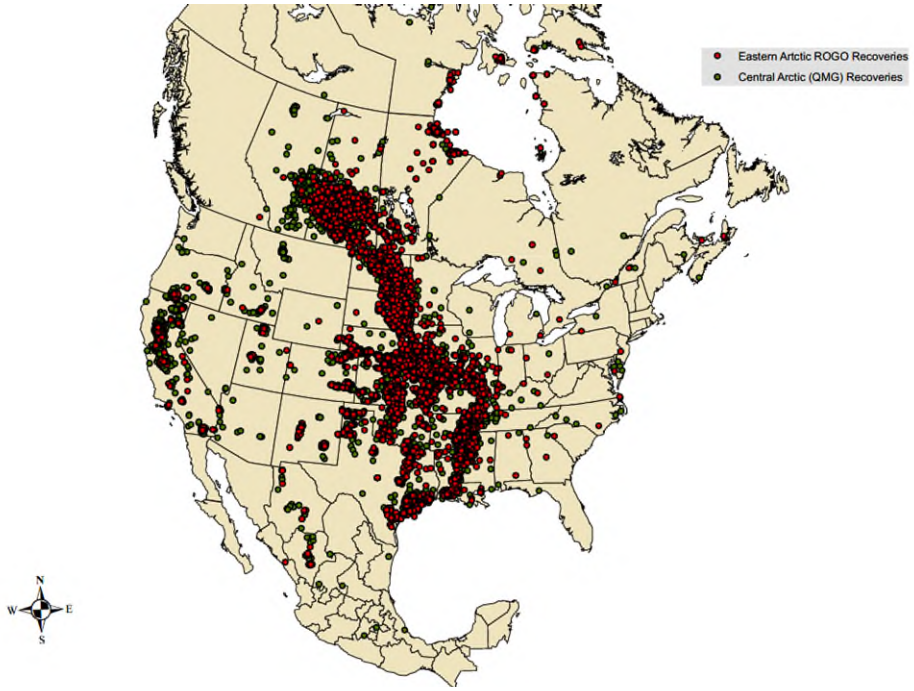

Figure 14. Distribution of shot recoveries (direct and indirect) of adult and juvenile Ross's geese banded 2000-2019 in the central Arctic (Queen Maud Gulf) and eastern Arctic (Southampton and Baffin Island).

Annual pre-season banding of Ross's geese (Table 1) predominantly occurs at 3 sites in the Canadian Arctic. Banding will be maintained at the current (2014-2018) effort, and will be carried out by the Canadian Wildlife Service through the Arctic Goose Banding Program (AGBP; Leafloor 2012), which also bands other species of Arctic nesting geese in these areas (e.g., White-fronted geese, Cackling geese, Atlantic Brant, Ross's geese). The

AGBP is administered and delivered by the Canadian Wildlife Service, but is cooperatively funded by all flyways and both federal governments. Ross's geese are also banded incidentally as part of banding efforts targeting lesser snow geese in northern Manitoba. This work is led by the Hudson Bay Project, and is partially funded by the Central and Mississippi Flyway Councils.

Adults remain the most important cohort for harvest management purposes, but juvenile bandings are important for age-specific abundance and survival estimates, and juveniles will continue to be banded in accordance with their availability in the central Arctic and on Baffin Island.

Table 1. Ross's goose pre-season banding (normal, wild) sample sizes, and spatial distribution across northern Canada, 2014-2018 (see Figure 2 for locations).

Banding Location	**Mean HY banded per year**	**Mean AHY banded per year**	**Mean ROGO banded per year**	**Spatial Distribution of AHY bandings**
Baffin Island	270	690	960	15%
Queen Maud Gulf	582	4663	5245	80%
Northern Manitoba	55	79	134	2%
Southampton Island	0	224	224	3%
TOTAL	**907**	**5656**	**6563**	

Estimation of age-specific harvest will occur annually using tail feathers collected via the annual waterfowl Parts Collection Survey in the U.S. and the Species Composition Survey in Canada. Age-specific harvest estimates, when combined with band recovery data, allow estimation of the number of adult birds in the population (Alisauskas et al. 2012a), and the trend information provided by these estimates will allow evaluation of progress towards achieving the management objective. Finally, Padding and Royle (2012) suggested that goose harvest estimates in the United States were biased high, and recommended using a

adjustment factor of 0.67 to correct estimates based on the harvest questionnaire survey for years prior to 1999, and to use an adjustment of 0.61 for HIP-based estimates of harvest from 1999 onward. We recommended that harvest estimates from both the United States and Canada continue to be adjusted by these correction factors.

Information Needs

The growth and expansion of Ross's geese and mid-continent lesser snow geese continues to cause concern because of potential adverse impacts on habitat and on sympatric species, especially in Arctic and sub-arctic habitats. Ross's geese contribute to habitat alternation on sub-arctic staging areas along western Hudson Bay, where they grub below-ground biomass, shoot pull, and crop vegetation close to the ground (Didiuk at al. 2001) as part of nutrient acquisition in preparation for nesting. Ross's geese also contribute to habitat alteration on their breeding grounds; Alisauskas et al. (2006) documented changes in plant communities and declines in species diversity and richness in freshwater habitat in the central Arctic, which resulted from nest building and foraging by breeding Ross's and snow geese. They predicted continued habitat alteration as rapid expansion of colonies continued in the central Arctic. Uncertainty remains about habitat capacity in staging and nesting areas, and impacts on other species, especially as populations of light geese appear to have declined in recent years. In addition to efforts to evaluate carrying capacity and impacts of overabundant light geese on other species, which began as a targeted endeavor though the Arctic Goose Joint Venture in 2017, Ross's goose management would benefit from the following research efforts, some of which are already underway:

- addressing uncertainty in data used to calculate Lincoln estimates of abundance (e.g., updated band reporting estimates given recent changes in band inscriptions [web address only]);
- improving knowledge of habitat use in subarctic and Arctic staging areas;
- improving knowledge of habitat quality and availability at Arctic staging areas and breeding colonies;

- improving knowledge of recovery of freshwater habitats altered by geese in Arctic and subarctic staging and nesting areas, especially as some colonies have declined;
- impact of habitat changes caused by light geese on other populations of geese, other migratory birds, and a variety of other species, including plants;
- evaluation of tail fan criteria used to separate Ross's geese and lesser snow geese in the Parts Collection Survey (PCS) in the United States and the Species Composition Survey (SCS) in Canada;
- evaluation of regular-season harvest estimates through the Harvest Information Program in the U.S.;
- coordinated harvest surveys (consistent methodology) to better estimate spring harvest in the US;
- assessment of breeding colony dynamics and the role of emigration vs *in situ* recruitment;
- implementation of fall productivity surveys in Prairie Canada, such that long-term trends in age-ratios can continue to be monitored, in addition to estimates obtained at banding, or in the event of low sample sizes at banding, or missed-years of banding;
- monitoring of pre-breeding nutrient reserves of Ross's geese, given the influence of spring reserves on annual productivity, and apparent long-term declines in reserves.
- updated, comprehensive survival analyses of adult and juvenile Ross's geese
- update assessment of threshold adult harvest rates, given changes in productivity since the previous analyses were conducted by Dufour et al. 2012

Long-term research programs at Karrak Lake led by Science and Technology Branch, Environment and Climate Change Canada, continue to contribute information about changes in recruitment, abundance, and distribution of Ross's geese, and are already addressing, or positioned to address, many of the above priority research needs. In addition, research programs in northern Manitoba (The Hudson Bay Project) contribute ancillary

information about expansion of Ross's geese at the extreme southern part of their range. The continued support of the Mississippi, Central, and Pacific Flyways, and other funding entities will be important in retaining and furthering these efforts.

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