ATLANTIC BRANT MANAGEMENT PLAN

July 2002
Revised 2011
Hunt Plan Amended 2015

ATLANTIC BRANT MANAGEMENT PLAN

Prepared by the Snow Goose, Brant, and Swan Committee

July/2011

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PREFACE

The four Flyway Councils are administrative bodies established in 1952 to represent the state/provincial wildlife agencies and work cooperatively with the U.S. Fish and Wildlife Service, Canadian Wildlife Service, and Mexico for the purpose of protecting and conserving migratory game birds in North America. The Councils have prepared numerous management plans to date for most populations of swans, geese, doves, ducks, pigeons, and sandhill cranes in North America. These plans typically focus on populations, which are the primary unit of management, but may be specific to a species or subspecies. Management plans serve to:

- Identify common goals.
- Establish priority of management actions and responsibility for them.
- Coordinate collection and analysis of biological data.
- Emphasize research needed to improve management.

Flyway management plans are products of the Councils, developed and adopted to help state and federal agencies cooperatively manage migratory game birds under common goals. Management strategies are recommendations and do not commit agencies to specific actions or schedules. Fiscal, legislative, and priority constraints influence the level and timing of implementation.

The first Atlantic brant management plan was approved in 2002. The purpose of this updated Management Plan is to provide management goals, objectives, and strategies for Atlantic brant conservation. The Action Plan outlines steps necessary for appropriate brant management. The Hunt Plan (Appendix A) identifies the goal and objectives for brant harvest and contains strategies to attain them. The Research Plan identifies information needed to improve the approaches outlined in the Action and Hunt Plans. The Management Plan also includes the data sets used to manage the Atlantic brant population and descriptions of past and present surveys used to monitor the population and its habitats. This Plan is slated for review and, if deemed necessary, updating on a 5-year basis.

INTRODUCTION

Atlantic brant (*Branta bernicla hrota*) breed in the eastern, high Arctic and winter exclusively on the Atlantic Coast of the U.S. between Massachusetts and North Carolina (Figure 1). The breeding range of this stock is centered on the Foxe Basin in the eastern Arctic, with important colonies on Southampton, Baffin (Cape Dominion), Prince Charles, Air Force and North Spicer Islands. Smaller numbers of Atlantic brant have been previously observed on northern Baffin Island, in Committee Bay, and westward to Queen Maud Gulf. However, the bulk of the population is believed to nest in the Foxe Basin. A recently completed brant telemetry project confirmed key breeding colonies of Atlantic brant within the Foxe Basin, with smaller numbers on Coats and Mansel Islands in northern Hudson Bay. Telemetry work also identified 2 spring staging areas; one in western Long Island, NY used primarily during late April and early May and another in James Bay used during late May and early June. The core of the wintering range is from Cape May New Jersey to northwestern Long Island, New York in the U.S. where approximately 85% of the population winters.

The population size is monitored through the annual Midwinter Waterfowl Survey conducted in the Atlantic Flyway (AF). Historic midwinter surveys indicated a population fluctuating around a mean of about 150,000 brant over the period 1955-1968. A combination of poor breeding success and a large harvest brought the population to less than 50,000 in 1972, but it recovered to 125,000 in the fall of 1976. Severe cold on the wintering grounds in 1976-77 again caused a decline to less than 50,000 but the population has subsequently recovered to maintain an average population of greater than 149,000 over the period 1996 to 2010.

Historically, brant relied heavily on sub-tidal and intertidal marine plants and macroalgae, especially eelgrass (*Zostera marina*), sea lettuce (*Ulva sp.*), and alkali grasses (*Puccinellia sp.*) during staging and wintering. A wasting disease caused a severe reduction in eelgrass along the Atlantic coast and in the gulf and estuary of the St. Lawrence in the 1930's which continues to the present. The plant has never regained its former abundance there. Further losses in feeding habitat have occurred through shoreline development, dredging, and pollution. Although eelgrass is still heavily used by brant where it occurs, recent research indicates that in most areas, brant now rely primarily on sea lettuce, and increasingly, on upland grasses.

Important eelgrass beds still occur in James Bay, making this area a critical staging area for brant. Despite changes in the freshwater flow of several rivers feeding into James Bay due to hydroelectric development, these eelgrass beds remained abundant and productive through the mid-1990s. However, in 1999, a massive die-off of eelgrass occurred along much of the James Bay coast. 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 (*Chen caerulescens caerulescens*) populations could be having a detrimental impact on some marshes used by brant.

The purpose of this Management Plan is to provide a management goal, objectives, and strategies for Atlantic brant conservation. The Action Plan outlines steps necessary for appropriate brant management. The Research Plan identifies information needed to improve the approaches outlined in the Action and Hunt Plans. The Hunt Plan (Appendix A) identifies the management goal and objectives for brant harvest and contains strategies to attain them.

MANAGEMENT PLAN GOAL

The management goal is to maintain Atlantic brant at a population level that will provide optimum opportunity for people to use and enjoy brant on a sustainable basis that is consistent with habitat availability and international treaties.

SECTION 1
ATLANTIC BRANT ACTION PLAN

OBJECTIVES, STRATEGIES, AND TASKS

OBJECTIVE I: Maintain the long-term Atlantic brant Mid-Winter Waterfowl Survey index at or above 150,000 birds.

Rationale: The recreational, aesthetic, scientific, and ecological values associated with Atlantic brant are best realized from a healthy, sustainable population. Maintenance of populations of migratory birds is mandated by international treaties (U.S. Fish and Wildlife Service 1988).

Strategy I.A: Develop and implement hunting regulations that are consistent with maintaining a population objective of 150,000 brant in the Mid-winter Waterfowl Survey index.

Rationale: Hunting is a major source of mortality for Atlantic brant and the primary mortality source that is subject to control by managers. According to the Migratory Bird Treaty Act of 1918, hunting is a secondary consideration to maintaining populations of migratory birds (U.S. Fish and Wildlife Service 1988).

Responsibility: AF states, U.S. Fish and Wildlife Service (USFWS), Canadian Wildlife Service (CWS)

Strategy I.B: Maintain and improve population surveys and associated databases necessary to assess the population status of Atlantic brant.

Rationale: Annual assessment of the Atlantic brant population is needed to best inform management decisions. A number of factors can influence brant population dynamics. Atlantic brant occasionally experience production failures related to weather on their high Arctic breeding grounds. High winter mortality of Atlantic brant has been documented in years of unusually severe weather or scarce winter food. Aboriginal people as well as sport hunters in Canada and the U.S. harvest Atlantic brant.

Responsibility: USFWS, CWS

Task I.B.1: Continue to conduct an annual Mid-winter Waterfowl Survey for Atlantic brant, and explore means of improving the accuracy and precision of population estimates.

Rationale: The Mid-winter Waterfowl Survey (MWS) is the only assessment of population size for Atlantic brant. The MWS is believed to provide a reasonably good long-term index for the species (Kirby and Obrecht 1982). Atlantic brant occur in large flocks that readily take flight from approaching aircraft, making them difficult to estimate. Since 85% of wintering brant occur over a limited range within New Jersey and New York it is feasible for the same observers to annually conduct the MWS over the core brant wintering area. This minimizes observer bias and will result in more accurate counts. When observer changes are likely, a period of training and survey overlap should occur. Recent changes in the wintering distribution of brant have been noted through the MWS. There may be a need to develop a comparative alternative survey method (ground count) in sensitive, high-security areas such as western Long Island, New York.

Responsibility: AF states, USFWS

Task I.B.2: Improve and continue to conduct the Fall Productivity Survey during November within all states that contain concentrations of Atlantic

brant.

Rationale: This is the only on-the-ground assessment of brant production available and should be conducted annually by all states that winter Atlantic brant. Lingering concerns over the design of the fall productivity survey need to be addressed with the development of a new protocol that addresses survey design concerns (i.e. allows for calculation of variance estimates of production) but allows for use of the historic dataset.

Responsibility: AF states, USFWS, National Wildlife Refuges.

Task I.B.3: Continue to refine the Harvest Information Program (HIP) in a way that will ensure accurate and reliable estimates of U.S. brant harvest.

Rationale: In response to the poor precision and accuracy of brant harvest estimates derived from the historic U.S. federal harvest survey (Rogers 1979, Geissler 1990) changes to the HIP program were implemented in the late 1990's to specifically address brant hunting activity and harvest. These improvements have resulted in some gains in precision and accuracy. However, there are still some issues at the state level (e.g. extreme brant harvest estimates in southern states) to be resolved.

Responsibility: All AF states (especially those with significant brant harvest), USFWS

Task I. B.4: Obtain or improve estimates of sport and subsistence harvests of Atlantic brant in Canada.

Rationale: Harvest by sport hunters in Canada is currently estimated through the National Harvest Survey and since 1975 has averaged about 800 birds per year. Subsistence harvest by aboriginal hunters in Canada takes place mainly in James Bay at about 7,600 brant per year (A. Reed, CWS, see harvest management review) in Quebec and a few hundred in James Bay, Ontario. A few Atlantic brant are also harvested in the Baffin and Keewatin Regions of Nunavut. This constitutes about 30% of the average estimate of U.S. harvest from 1958 to 1999, excluding closed

seasons. Consequently, subsistence harvest may play an important role in brant population dynamics.

Responsibility: CWS

Task I.B.5: Improve and continue to conduct preseason banding

Rationale: Adequate levels of pre-season banding provide survival and recovery estimates that can be correlated with harvest and regulatory packages.

Responsibility: CWS, AF states, USFWS.

Task I.B.6: Develop models of brant production that provide useful estimates early enough to be used in the annual hunting regulations cycle.

Rationale: There is a continued need to develop an index to productivity that can be available to managers prior to the annual regulation setting process. Models predicting Atlantic Population Canada goose productivity have been developed (E. Reed, CWS, unpublished data) using weather station data and banding drive age ratios. Attempts to develop a similar relationship for brant have so far been elusive.

Responsibility: CWS, USFWS, Atlantic Flyway Council (AFC)

OBJECTIVE II: Protect and conserve existing Atlantic brant habitat on breeding, migration, and wintering grounds.

Rationale: The Atlantic brant population and resultant societal benefits cannot be maintained without adequate habitat. Breeding habitats are in remote areas, but could be threatened by resource extraction activities. Excessive grubbing by overabundant snow geese may damage brood-rearing areas. Climate change will likely impact breeding, staging, and wintering grounds. The implications of climate change, however, are poorly understood at this time. Migration and wintering habitats are likely to be affected by human development and disturbance. Several studies (Ebbinge et al. 1982, Ankney 1984, Vangilder et al. 1986, Ebbinge and Spaans 1995) provide evidence that energy acquired

on staging grounds is important for reproductive success in brant.

Strategy II.A: Identify, evaluate, monitor, and protect important habitat areas used by Atlantic brant.

Rationale: Maintenance of habitat integrity is critical to the management of Atlantic brant and the attainment of the population objectives in this plan. This entails identifying and protecting important natural habitats used by brant throughout their annual cycle.

Task II.A.1: Investigate factors affecting the quality of breeding habitats for production and use. Document and assess effects of overabundant snow geese on Atlantic brant breeding habitats.

Rationale: Arctic breeding habitats may be negatively affected by a number of biotic and abiotic factors including climate change, overabundant snow geese, and natural resource extraction activities.

Responsibility: CWS

Task II.A.2: Document the annual availability of winter foods and their effect on brant body condition, habitat use, and survival.

Rationale: Numerous studies suggest that food availability may be the primary factor limiting waterfowl populations during winter and migration (Haramis et al. 1986, Miller 1986, Conroy et al. 1989, Bergan and Smith 1993, Jeske et al. 1994, Ladin et al. 2011). Furthermore, some evidence suggests habitat condition and availability on the wintering grounds may influence reproductive success and survival (Heitmeyer and Fredrickson 1981, Kaminski and Gluesing 1987, Raveling and Heitmeyer 1989).

Responsibility: USFWS, U.S. Geological Survey, AFC, Atlantic Coast Joint Venture

Task II.A.3: Develop or improve remote sensing or other techniques necessary to evaluate the extent and quality of marine forage plants important to

Atlantic brant

Rationale: An annual or semi-annual assessment of submerged aquatic vegetation available to brant will better inform both short-term and long-term carrying capacity of important brant habitats. The ability to relate climate change and other factors to changes in these habitats will allow managers to more effectively plan conservation actions.

Responsibility: All cooperating agencies.

Task II.A.4: Conduct long-term monitoring of forage plants at staging areas.

Rationale: Monitoring of important brant staging habitats will provide critical insight to changes in these habitats in response to factors such as climate change and will allow managers to better plan conservation actions. In particular, the southwestern portion of Long Island (NY), and James Bay locations at Rupert Bay (QC) and the region between Attawapiskat (ON) and Akimiski Island (NU) have been identified as key spring staging areas. During fall, two areas in James Bay are particularly important, Cape Henrietta Maria (ON) and the area between Attawapiskat (ON) and Akimiski Island (NU). In both spring and fall, smaller numbers of brant stage at Lake Champlain (VT), the north shore of Lake Ontario near Port Hope, Brighton, and Belleville (all in ON), the lower Ottawa River near the confluence with the St. Lawrence River, the St. Lawrence River near Montreal (QC) and Trois-Rivieres (QC), and smaller lakes at the headwaters of the Harricana River near Val-d'Or (QC).

Responsibility: All cooperating agencies.

Task II.A.5: Educate wetland managers on continued need to manage over-abundant species.

Rationale: The United States National Park Service (NPS) and other wetland managers and landowners need guidance on waterfowl population management techniques to reduce over-abundant waterfowl populations

on key brant wintering grounds. Reduction of these species [e.g. resident Canada geese (*Branta canadensis*) and greater snow geese (*Chen caerulescens atlantica*)] will assist in maintaining the ecological balance between diversity of habitat and plant species for the benefit of all waterfowl species and consistency with the North American Waterfowl Management Plan.

Responsibility: U.S. Department of Agriculture (USDA) Wildlife Services, USFWS, AFC.

Task II.A.6: Measure marsh response to changes in abundance of resident Canada goose and snow goose populations on key brant wintering grounds.

Rationale: Grazing by resident Canada geese, wintering greater snow geese, and Atlantic brant is causing major damage to the vegetation in Jamaica Bay, New York (National Park Service, unpublished data). Further, year round grazing by resident Canada geese may be preventing recovery of marsh vegetation in Jamaica Bay resulting in brant being forced to forage in upland areas with more plentiful food resources. Recent work has indicated that upland grasses have a higher, albeit non-significant, nutritional density than eelgrass (Ladin et al. 2010). Brant feeding in upland areas also present a greater aviation hazard than when feeding in the marsh or roosting on the open waters of adjacent bays.

Responsibility: NPS, USFWS, AFC

OBJECTIVE III: Provide for human use consistent with the Management Plan goal.

Rationale: Atlantic brant are valued for viewing, photography, and hunting during migration and on the wintering areas. The continuation of these use opportunities is in the public interest and contingent upon ensuring that population objectives are achieved and maintained into the future.

Task III.A.1: Provide for viewing, photography, educational, cultural, and other

aesthetic uses of brant.

Rationale: Atlantic brant are valued by people living throughout the range for viewing and aesthetic values.

Responsibility: All cooperating agencies.

Task III.A.2: Provide for subsistence and sport harvest that is consistent with the Management Goal.

Rationale: The Hunt Plan (Appendix A) explicitly lays out regulatory packages for sport harvest in the U.S. under various indices of population abundance. In Canada, because the average annual sport harvest is a few hundred birds, only extreme changes in abundance will trigger regulatory changes. Should conditions be extreme enough to warrant changes in the Canadian sport harvest, aboriginal people in Canada will also be asked to reduce the subsistence harvest.

Responsibility: All cooperating agencies

OBJECTIVE IV: Minimize the risk of air-strikes and limit damage and depredation problems associated with Atlantic brant use of crops, golf courses, parks, and lawns.

Rationale: Considerable problems are caused by Atlantic brant mingling with Canada geese and feeding on terrestrial grasses throughout fall and spring staging, and in some areas, throughout the winter and spring. Concerns have been raised about increasing numbers of wintering and staging brant in close proximity to both LaGuardia and John F. Kennedy International airports on Long Island, NY and the potential risk that large flocks of brant may pose to air traffic safety.

Task IV.A.1: Develop strategies for minimizing the risk of Atlantic brant-aircraft strikes in close proximity to airports.

Rationale: Atlantic brant can pose a significant air-strike risk due to their large body size, propensity to be in large flocks, and the fact that they readily take flight when disturbed by aircraft. Since Atlantic brant are not

considered to be overabundant, significant lethal control measures are generally not the preferred alternative for abating this problem. Innovative integrated damage management programs need to be developed to resolve this important issue.

Responsibility: USDA Wildlife Services (WS), USFWS, AFC.

Task IV.A.2: Develop strategies for nuisance abatement that are consistent with overall population management objectives.

Rationale: Nuisance issues and public safety concerns with wintering and staging brant are increasing. It is also becoming increasing clear that population management (lethal control) at nuisance sites is not effective in abating problems.

Responsibility: WS, USFWS, AFC

OBJECTIVE V: Conduct research to improve our understanding of Atlantic brant biology, their population dynamics, and their relationships with habitat, the environment, and harvest.

Rationale: An improved understanding of brant biology will reduce the uncertainty currently associated with brant management and lead to a greater predictive ability, allowing managers to maximize recreational use while minimizing risks. Research that addresses the topics in the Research Plan (Section 2) will be useful for brant management.

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SECTION 2
ATLANTIC BRANT RESEARCH PLAN

OBJECTIVE: Conduct research to improve our understanding of Atlantic brant, their population dynamics, and their relationships with habitat, the environment, and harvest.

Purpose:

A good understanding of a species' biology and ecology is critical to the proper management of that species, especially for those that are hunted. Until recently, little was known about the population ecology, vital rates, habitat use and requirements, or current migratory pathways and timing of Atlantic brant. Since the implementation of the 2003 Plan, a number of the data gaps have been filled.

This updated research plan summarizes the recent work conducted on Atlantic brant and prioritizes the next steps in providing the necessary information needed by managers to achieve the Plan population goal and objectives.

Information Needs and Research Topics:

Since 2000, significant research has been conducted in the Atlantic Flyway (AF) on brant wintering ecology. A radio telemetry project completed in 2003 provided information on spring migration routes, key staging areas, and information on wintering ground habitat use. A study to determine food use and diurnal time and energy budgets of wintering brant was completed in 2009. An operational breeding ground banding program has been initiated and, dependent upon funding, will continue through at least 2013. Despite the informational gaps that have recently been filled, there remain a number of key voids that need to be elucidated.

1. *Annual assessment of production*

   Develop an accurate and reliable annual assessment of production that can be completed in time for hunting regulation decision making in July. This is especially important to avoid the over-harvest of mature birds during "bust" production years. During the early 1980s the USFWS developed a model to predict harvest age ratios based on variables derived

from high resolution, radiometer satellite data. The model appeared to perform well when initially developed, but during the late 1990s model performance suffered. For example, in 1999 the model predicted better than average production and a liberal hunting framework was subsequently selected (50-day season, 4-bird daily bag limit). However, banding crews on the breeding grounds observed few family groups or young. Based on this information the bag limit was decreased to 2 birds. The fall productivity survey found only 1.5% young in the fall flight (U.S. Fish and Wildlife Service 2000). Poor performance of this model stems from the fact that in the late 1990s input data were often outside of the range of the data used to develop the model. The model input data also did not capture severe weather events which could reduce production (G. Smith, USFWS, personal communication). Another potential problem with the model is that it used harvest age ratios as its index to production (P. Castelli, personal communication). Traditional harvest surveys do not assess brant harvest well (Geissler 1990) and corrections for potential differential vulnerability are not available. Finally, the satellite imagery was only available in large formats that covered much of western Baffin Island, but brant only breed along the thin strip of coastal habitat. Often conditions along the coastal strip were swamped by the large area of uplands. A production index is available from the fall production surveys conducted in November in the mid-Atlantic states. These data provide a more accurate index to production than do the harvest age ratios used in the previous model. Satellite imagery focused on the thin coastal habitats used by breeding brant would provide a more meaningful assessment of breeding habitat conditions than the broad brush approach used previously. Automated weather station data may be available to assess the effects of severe weather events. Attempts to develop a new model using the fall productivity data have proven elusive, primarily due to a lack of variance associated with the productivity estimates. A new approach to an old problem is likely warranted if this is to come to fruition.

a. *Breeding habitat quality*

Determine factors that affect the quality and use of breeding habitats. Any effects of snow goose overpopulation on brant breeding habitats should be assessed. Initiate

field studies at selected colonies to evaluate basic reproductive parameters and factors influencing annual productivity.

b. *Develop new remote sensing techniques to evaluate breeding and staging habitat conditions*

Atlantic brant nest and stage in remote areas that are not surveyed easily using conventional methods. To the extent that conditions in these areas affect production, reliable remote-sensed (satellite) methods should be developed to produce an accurate and reliable index to production on an appropriate scale. Past efforts have had to rely on information that only partially was applicable to brant breeding habitats (e.g. coastal areas). There is a chance that smaller scale photography now exists, which should allow refined estimates to be made from only brant breeding habitats.

2. *Annual survival*

Continue to use banding to determine annual survival of brant and document important sources of mortality. In 1998, funding was secured to establish an operational brant banding program on the Great Plain of the Koukdjuak on Baffin Island. This effort was extended in 2001 to Southampton Island, Nunavut and is currently slated to run through 2013. An assessment of the utility of post-season banding programs in the estimation of survival rates utilizing developing techniques for band recovery analysis is needed. Post-season banding as a supplement to breeding ground banding may reduce project costs for some cooperating agencies.

3. *Harvest rate and influence of hunting regulations*

Determine the harvest rates associated with various hunting regulation packages. Assess the influence of ancillary factors such as season timing, length and overlap of associated duck seasons, the number of brant hunters and hunting activity, winter weather, and population structure. Determining affect of various factors on harvest rates of brant will be a long-term project, as it will not be possible to manipulate natural factors and it is unlikely that harvest regulations will be manipulated solely to speed our learning.

4. *Eelgrass status in James Bay*

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. Important beds of eelgrass still occur in James Bay, making this area a critical staging area for these geese. Despite changes in the freshwater flow of several rivers feeding into James Bay due to hydroelectric development, these eelgrass beds remained abundant and productive through the mid-1990s. However, in 1999, a massive die-off of eelgrass occurred along much of the James Bay coast. No cause has yet been determined, and Hydro-Québec is continuing to monitor the situation. The potential for negative impact on the condition of brant before breeding appears considerable.

5. *Submerged Aquatic Vegetation (SAV) Survey*

   Based on current knowledge of wintering brant feeding ecology, determine whether an SAV survey is warranted and practical for determining wintering carrying capacity.

6. *Spring body condition index*

   Develop a body condition index of brant taken just prior to spring migration to serve as an indicator of reproductive potential. However, some work (Ebbinge 1982, Vangilder et al. 1986, Ebbinge 1989, Ebbinge and Spaans 1995) indicates that nutrient reserves acquired on staging areas may be more important for reproductive success than winter condition. For example, good body condition might allow brant to arrive in excellent physiological condition to breed, but bad weather could still limit breeding success. However, poor body condition might preclude good breeding success even if all other factors are positive. If this is the case, a condition index of this type could predict only the potential for breeding success, and other factors will need to be considered to predict actual success.

7. *Subsistence harvest in Canada*

   Develop a harvest survey to estimate aboriginal subsistence harvest in Canada. The Canadian sport harvest rarely exceeds a few hundred individuals because brant do not stop during the fall migration in southeastern Canada. However, subsistence harvest by aboriginal people, occurring in spring and fall, principally in eastern James Bay, can be substantial. The total native subsistence harvest was estimated at about 8,800 annually during the period 1974-1979. Alerted to the winter die-offs in 1976-1978 and of the closure of the sport hunting season, the Quebec Cree and Inuit reduced their harvests through the early 1980s and apparently have maintained a reduced harvest ever since.

Unfortunately, the native harvest survey in Quebec was not continued beyond 1979, so the magnitude of the current Canadian harvest cannot be determined. Accounting for this source of hunting mortality is important to improving our understanding of Atlantic brant population dynamics and the effects of hunting regulations and harvest on the population.

8. *Population model development*

   Develop a model or models to predict changes in the Atlantic brant population in response to harvest management, habitat, and other biotic and abiotic factors that influence population dynamics.

9. *Depredation of man-made wintering habitats*

   Develop non-lethal damage management methods that reduce risk to aviation from concentrations of wintering brant and alleviate property damage from flocks of feeding brant in late winter on upland grasses at airports, golf course, and other developed areas.

10. *Evaluate habitat quality and inter-species competition of winter habitat.*

    In Jamaica Bay, NY brant appear to be competing with resident Canada geese and greater snow geese for food resources. If numbers of Canada geese and snow geese were lowered would there be a resultant change in vegetative species composition in the marsh? Would a shift in abundance of natural food resources shift brant use of upland habitats to marsh habitats in Jamaica Bay as seen in the balance of brant wintering range? If habitat shifts in the western Long Island area were to occur then fewer brant would be killed to mitigate damage.

Immediate Projects and Tasks

Continue annual banding program

Continued annual preseason banding of brant will allow for estimates of survival rates and an assessment of the effects of hunting regulations on brant survival. An assessment should be made to evaluate the efficacy of winter banding to supplement preseason banding efforts on the breeding grounds.

Refine energetics models using nighttime time budget information

One of the products of the recently completed time and energy budget study was an

estimate of daily energetic needs of wintering brant. Those energetic models, however, relied upon the assumption that nighttime activity was similar to observed daytime activities. Nighttime observations will produce a much more realistic estimate of overall daily energetic costs of wintering brant.

Determine the cause and extent of eelgrass decline in James Bay and effect on staging brant.

Research has shown that nutrition and food supply on spring staging grounds is critical to brant breeding success. It appears that most if not all Atlantic brant stage on James Bay during the spring migration and failure of this preferred food source could severely limit breeding success.

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SECTION 3
SURVEYS AND DATABASES

Operational

Mid-Winter Waterfowl Survey. — The Mid-Winter Waterfowl Survey (MWS) provides the only assessment of Atlantic brant population size available at this time. The MWS is an annual survey conducted each January in geographical zones and segments in all Atlantic Flyway (AF) states (except Florida) that focus on the waterfowl wintering areas with the highest concentrations of birds. Therefore, the survey provides a relative index to the abundance of birds from year to year (Table 1). It is mostly conducted from aircraft with some ground and boat counts. Increasing security sensitivity around John F. Kennedy International and LaGuardia airports in western Long Island, New York may force the MWS in that area to be conducted solely from the ground in the future.

Fall Brant Productivity Survey. — Since 1972 fall productivity surveys have been conducted on the wintering grounds where age ratios and family sizes are recorded along the US Atlantic seaboard. Data for the period 1976-2010 are listed in Table 2. Since 1976, the fall population of Atlantic brant has contained an average of about 19% young with extremes of about 2% (1992) and 41% (1979). In 7 of those years (21% or about 1 in 5) recruitment was poor (<10% young) while 3 of the 7 years experienced a production "bust" (<5% young).

Annual Harvest Survey. — The annual U.S harvest of Atlantic brant is estimated through the Harvest Information Program (HIP). Established in 1992, HIP is a cooperative state-federal program that requires licensed migratory game bird hunters to register annually in each state in which they hunt. Each state is responsible for collecting the name, address, and date of birth from each migratory bird hunter, asking each of them a series of general screening questions about their his/her hunting success the previous year. The USFWS uses these data as the sample frame to develop annual estimates of migratory game bird hunter activity and harvest. Brant harvest estimates from the USFWS Waterfowl Parts Collection Survey and the HIP are presented in Table 3.

Inactive

Spring habitat conditions survey using satellite images. — This project used advanced high

resolution radiometer data to develop quantitative regression models to estimate immature-to-adult ratios of goose populations in the fall flight. The models developed were intended to augment qualitative production forecasts derived from communications with researchers and residents on the breeding grounds and from interpretation of weekly Northern Hemisphere Snow and Ice Boundary summaries prepared by the U.S. National Oceanic and Atmospheric Administration (Strong and Trost 1994). However, model performance was poor because predictions were often made from outside of the limits of the data used in developing the model and the project is no longer active (G. Smith, USFWS, personal communication).

Spring aerial high Arctic survey. — This was a low-altitude aerial survey of the principal known goose breeding areas in the Canadian Arctic conducted in the late 1980s and early 1990s. The surveys were conducted in mid- to late-June to assess the quality of breeding habitats and nest phenology of Arctic nesting geese. The survey also provided a quantitative database for monitoring conditions of nesting habitat and predicting fall age ratios of Arctic-nesting geese (Nieman et al. 1993). Specific objectives included: (1) an assessment of the extent of snow cover on goose nesting areas, (2) development of regression estimators to forecast age ratios in the fall flight, (3) monitoring of changes in breeding densities in key areas, and (4) detection and assessment of the effect of catastrophic events on breeding populations (Nieman et al. 1993:3-4).

Submerged Aquatic Vegetation (SAV) Survey. — Sea lettuce and eelgrass are the principal food sources for wintering brant along the Atlantic Coast. Eelgrass has experienced a near range-wide decline while sea lettuce experiences periodic production failures. A sea lettuce production failure during the winter of 1977-78 coupled with severe winter weather resulted in the starvation and death of approximately two-thirds of the Atlantic Coast wintering brant population. An aerial survey was established during the winter of 1980-81 to measure the relative abundance of sea lettuce and eelgrass in principal brant wintering grounds. The purpose of this survey was to provide an early warning of potential food supply problems, so that management agencies could be prepared for major mortality events.

The SAV survey was conducted in October from 1980 to 1988. Study areas were selected in New Jersey (2), Delaware (1), Maryland (1), and Virginia (2) in fall migration and wintering areas traditionally used by Atlantic brant. Aerial reconnaissance was made of these areas and sites with well-defined boundaries were selected to facilitate photography. The selected sites

were plotted on 1:24,000 scale, 7.5 minute quadrangle maps. Plot sizes varied from 162.4 ha to 417.9 ha and the total area was 1,942.8 ha. Vertical photographs were taken at 1,370m from a Cessna 182 using an Olympus OM2 with a 35-mm, f 2.8 lens and Kodak Kodachrome 64 ASA film. Ground surveys were conducted on each plot by state and federal cooperators to determine the vegetation type. Submerged aquatic vegetation beds appearing in the photographs were plotted on the quadrangle maps and the acreage determined by a planimeter. The USFWS Division of Migratory Bird Management maintains the historic files for this database, including study area locations and aerial photography.

The base year for this survey was 1980, which was considered to be an excellent year for SAV. This survey also identified 1984 and 1987 as above average years (above the long-term mean of 185.8 ha). No significant failures in submerged aquatic vegetation production were encountered during the 1980-88 period. This survey was discontinued by the USFWS in 1989 for budget reasons.

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Appendix A – Amended July, 2015

ATLANTIC BRANT HUNT PLAN

Harvest Management Review

From 1933 to 1952 the sport harvest of Atlantic brant was prohibited in the Atlantic Flyway (AF) (Rogers 1979). Seasons were closed in response to a population decline thought to have been triggered by the disappearance of eelgrass (*Zostera marina*), an important winter food of brant along the Atlantic Coast prior to 1933 (Cottam 1935, Cottam et al. 1944). The season was reopened during the fall of 1952.

Following the reopening of the season in 1952, the brant hunting seasons (1952-1953 to 1955-1956) ranged from 10 to 30 days in length with a daily bag of 3 to 6 birds. The seasons were then increased in 1958 to 60 or 70 days in length and bag limits were set at 6 birds per day. These regulations were maintained throughout the late 1950s and 1960s (Table 4). Under these conditions the Atlantic brant population fluctuated around an average of 180,000 birds and sustained a mean annual harvest of 21,000 (Penkala et al. 1978). During the early 1970s the population declined severely (Table 1) because of poor reproduction, winter mortality, and high harvest. As a result of this reduced population, hunting seasons were closed in the Atlantic Flyway from 1972-80 (except 1975 with a 30 day season and 2 bird bag) (Table 3).

In 1977, the Snow Goose Brant and Swan Subcommittee of the Atlantic Flyway Council (AFC) Technical Section developed the Minimum Population Level (MPL) system for brant harvest management. Under the original MPL system, the MWS (Table 1) estimate of brant from the previous January would have to be at least 80,000 birds for a hunting season to be held. This lower limit was later revised and increased to 100,000 birds. The subcommittee continued working with the MPL system which eventually became the Population Level (PL) system. Under the PL system the subcommittee proposed conservative hunting regulations (30 days/2 birds) when brant populations were <130,000 birds and liberal regulations (50 days/4 birds) when populations were at high population levels (Hindman and Ferrigno 1990). This system was used by the AFC to formulate their harvest recommendations until 1992. . However the system was never formally adopted by either the AFC or the U. S Fish and Wildlife Service (USFWS).

In 1992, an interim hunt plan for Atlantic brant was established and used for harvest

regulation-setting through the 2001-02 season. That hunt plan included: (1) a closed season when the MWS index was <100,000, (2) a 30-day, 2-bird season when the MWS index fluctuated between 100,000 and < 125,000, (3) a 50-day, 2-bird season when the MWS index was 125,000 but < 150,000, and (4) a 50-day, 4-bird season when the MWS index was > 150,000. These regulations were implemented as long as "productivity, food supply, age structure, or other factors do not preclude them."

Historically, the USFWS position on brant harvest had been that it was important to reduce or restrict hunting when the brant population was under 150,000 (Rogers 1979). The AF disagreed and ultimately the North American Waterfowl Management Plan population objective of 124,000 (U.S. Fish and Wildlife Service et al. 1998) was chosen for the first Brant Plan (2002). The 2011 Atlantic brant management plan has a population objective of 150,000 birds. There is precedent with many other Arctic goose populations for moderate harvest regulations when populations are below desired population objectives (e.g., AP Canada geese). There is also now a history of successfully implementing moderate regulations (50 days/2 bird bag) when brant populations are below 150,000 birds and still having population growth when breeding conditions were conducive.

Harvest rate indices for the U.S. are generally below 20% [harvest/ (harvest + MWS index), Table 4]. At that level sport hunting does not appear limiting. The exception is the hunting season of 1971-72, when harvest was estimated to have removed nearly 50% of the population. Based on previous experience, harvest rate indices <20% appear sustainable for Atlantic brant. Anecdotal information suggests that this large harvest occurred because a severe shortage of sea lettuce forced brant to seek food on the salt marshes rather than the bays, making them much more vulnerable to sport harvest.

Sport hunters in Canada take very few Atlantic brant. Since 1975, the average annual sport harvest of brant has been about 800 birds. Subsistence harvest is more important and has only been periodically measured. Hindman and Ferrigno (1990) reported "a small subsistence harvest of brant occurs on Hudson and James Bays, Quebec that rarely exceeds 1,000 birds." However, Reed (1991) estimated the mean annual aboriginal, subsistence harvest of brant in James Bay to be about 6,420 for the years 1972-73 through 1978-79. There was a voluntary reduction in aboriginal harvest following the severe winter die-offs of 1976-77 and 1977-78 and

a more realistic estimate of aboriginal harvest may be 7,600 brant per year, the mean estimated harvest of the remaining three years (A. Reed, CWS, unpublished data). An additional few hundred are taken annually by aboriginal hunters in western James Bay, and in the Baffin and Keewatin regions of Nunavut.

During the years when summer weather conditions in the Arctic are unfavorable for breeding, fall populations are composed primarily of adult and sub-adults. Few young are hatched during those poor breeding years; therefore, few new breeders enter the adult age class when that cohort matures three years later. When several years of poor reproduction occur consecutively, any bird harvested is a potential breeder. Under these conditions, restrictive regulations are needed to allow population recovery. During the first few years of recovery from a population low caused by sequential production failures, many of the birds in the population will be sub-adults, incapable of breeding that year. Overharvest at these times could hinder population recovery. Conversely, when the population is at a higher level and good production is forecast, opportunities for harvest should be expanded. The lack of a reliable production forecast in time for decision making in July is a major impediment to setting appropriate harvest regulations for Atlantic brant.

Atlantic Brant Harvest Management Goal

To provide for sport hunting opportunity and subsistence harvest for Atlantic brant that are consistent with maintenance of a viable population throughout its range.

Objectives

1. *Maintain the desired population*, i.e., ensure that hunting mortality in the AF does not limit the brant population from attaining the established population objective of 150,000 birds;
2. *Maximize hunting opportunity*, i.e., maximize the number of days when brant hunters can go afield with a minimum daily bag of two birds in U.S. regulations;
3. *Keep regulations simple*, i.e., minimize the complexity of restrictions within the regular total daily bag; and
4. *Learn from experience*, i.e., increase our understanding of how hunting regulations affect hunting activity, harvest rates, and brant population size.

Harvest Strategies

Harvest regulation packages were developed by factoring together long-term productivity rates with harvest information obtained from different regulation packages. The following harvest packages should be adhered to unless productivity is forecast to be poor (e.g., <10% of fall flight) or factors on the wintering grounds that could result in high non-hunting adult mortality (e.g., reduced biomass of SAV, oil spill) are known to be present at the time of regulation setting. Under these circumstances, the AFC and USFWS will determine what an appropriate harvest regulation should be for that year.

STRATEGY 1

A closed hunting season will be considered when the MWS index for Atlantic brant is < 100,000. Aboriginal and sport hunters in Canada will be advised of the situation and requested to consider reducing their harvests.

STRATEGY 2

A sport hunting season consisting of 30 days and a 1 bird bag will be considered when the MWS index is between 100,000 and 115,000.

STRATEGY 3

A sport hunting season consisting of 30 days and a 2 bird bag will be considered when the MWS index is between 115,000 and 130,000.

STRATEGY 4

A sport hunting season of 50 days and a 2 bird bag will be considered when the MWS index estimate is between 130,000 and 150,000.

STRATEGY 5

A sport hunting season of 60 days and a 2 bird bag will be considered when the MWS index is between 150,000 and 200,000.

STRATEGY 6

A sport hunting season of 60 days and a 3 bird bag will be considered when the MWS index is >200,000.

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Appendix B.

Figures and Tables

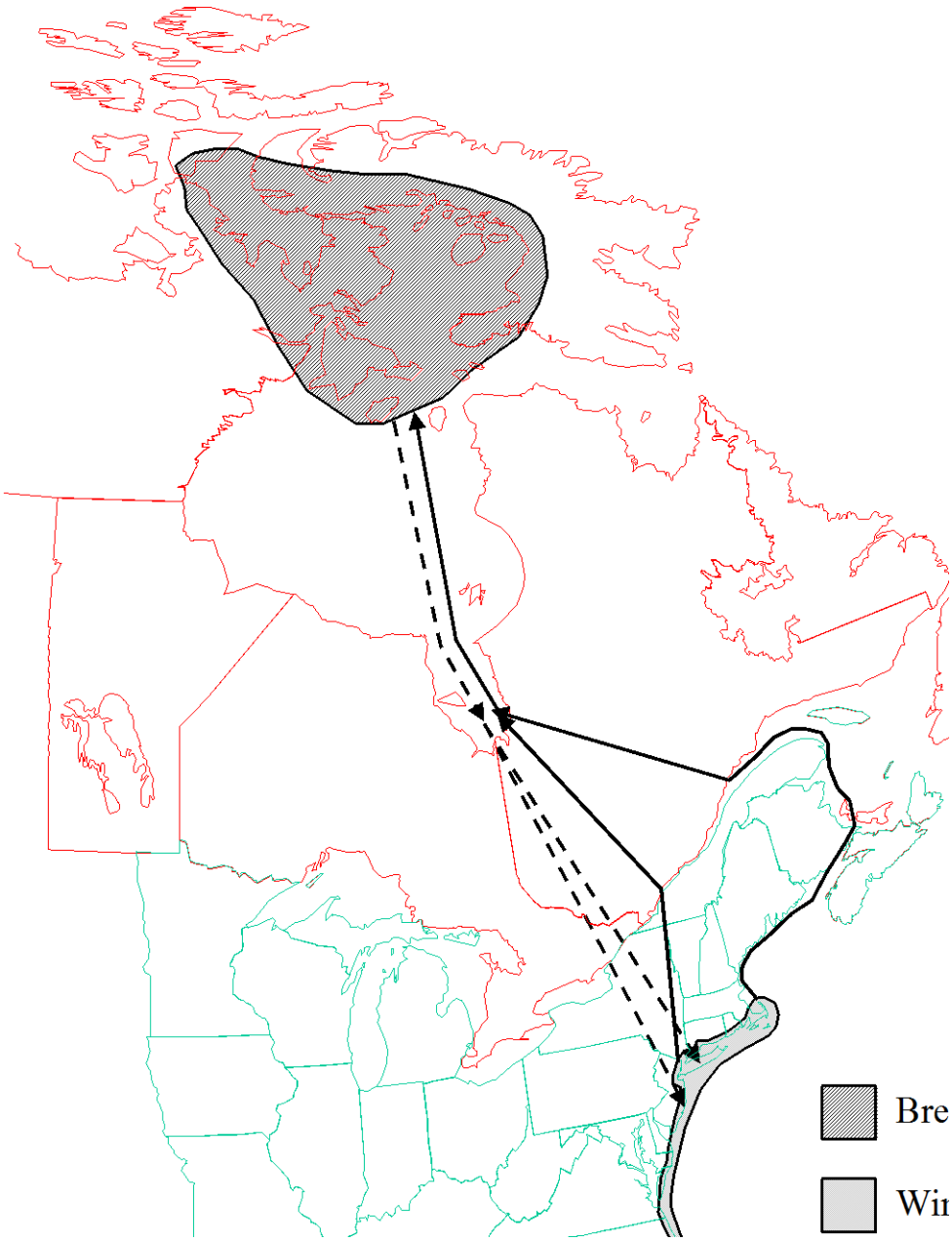

Figure 1. Breeding and wintering distribution of Atlantic brant.

Table 1. Atlantic brant Mid-winter Waterfowl Survey population estimates, 1948-2010.

Year	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1948	0	0	0	60	0	0	0	0	0	43,500	0	13,750	0	500	0	0	0	57,810
1949	0	0	0	0	35	0	0	0	0	57,300	0	9,200	7,400	1,500	0	0	0	75,435
1950	0	0	0	0	0	0	400	0	0	63,400	0	8,350	2,000	0	0	0	0	74,150
1951	4	0	0	0	0	4	0	0	0	82,700	310	3,050	24,100	2,400	0	0	0	112,568
1952	0	ND [b]	1	0	0	1	ND	0	0	90,000	0	4,850	8,500	154	0	0	0	103,506
1953	0	0	0	282	0	0	2,615	0	0	141,800	0	2,100	8,300	165	0	0	0	155,262
1954	0	0	0	735	0	0	17,198	0	0	162,600	1,600	32,170	3,000	850	0	0	0	218,153
1955	0	0	0	500	0	0	19,050	0	0	151,000	0	75	12,700	500	0	0	0	183,825
1956	0	0	0	0	0	0	25,350	0	0	108,100	450	11,300	18,750	435	0	0	0	164,385
1957	0	0	0	14	0	0	9,620	0	0	143,550	342	3,700	4,400	410	0	0	0	162,036
1958	0	0	0	50	0	0	14,550	0	0	184,500	946	7,350	3,486	175	0	0	0	211,057
1959	0	0	0	0	0	0	34,300	0	0	175,400	4,266	840	1,660	960	0	0	0	217,426
1960	0	0	0	75	0	0	33,400	1	0	183,200	3,840	972	16,350	500	0	0	0	238,338
1961	0	0	0	100	0	0	39,375	30	0	200,830	12,853	2,900	9,100	500	0	0	0	265,688
1962	0	0	0	505	0	0	28,680	51	0	88,750	804	800	4,700	200	0	0	0	124,490
1963	0	0	0	0	0	0	52,839	0	0	109,000	5,555	400	5,500	200	0	0	0	173,494
1964	0	0	0	960	0	0	23,840	0	0	143,550	9,200	1,900	2,900	350	0	0	0	182,700
1965	0	0	0	12	0	0	10,900	0	0	165,100	1,200	1,400	7,350	20	0	0	0	185,982
1966	0	0	0	300	0	0	17,500	0	0	151,600	1,100	0	1,350	0	0	0	0	171,850
1967	0	0	0	50	0	0	23,274	0	0	189,050	2,350	100	4,200	0	0	0	0	219,024
1968	0	0	0	75	0	0	15,375	0	0	182,000	1,500	600	13,500	300	100	0	0	213,450
1969	0	0	0	430	1	0	19,950	0	0	78,200	3,050	1,500	27,400	300	0	0	0	130,831
1970	0	0	0	6	0	0	6,705	0	0	96,100	800	300	1,900	700	0	0	0	106,511
1971	0	0	0	65	0	0	12,805	0	0	129,400	1,395	400	6,900	0	0	0	0	150,965
1972	0	0	0	2,925	0	0	14,852	0	0	48,600	665	3,200	2,800	200	0	0	0	73,242
1973	0	0	0	325	0	0	10,581	0	0	22,600	275	400	6,454	200	0	0	0	40,835
1974	0	0	0	332	0	0	21,436	0	0	46,350	1,435	1,200	16,700	200	0	0	0	87,653
1975	0	0	0	523	40	0	24,045	0	0	55,200	500	0	7,700	400	0	0	0	88,408
1976	0	0	0	1,128	0	0	17,040	0	0	99,000	1,135	1,600	6,900	200	0	25	0	127,028
1977	0	0	0	2,348	0	0	13,622	0	0	26,900	6,335	2,200	21,700	500	0	0	0	73,605
1978	0	0	0	3,845	135	136	8,936	0	0	14,600	2,278	1,600	10,810	400	25	0	0	42,765
1979	0	0	0	760	0	8	8,211	0	0	31,890	885	100	1,700	0	0	0	0	43,554
1980	0	0	0	3,282	3	0	18,912	0	0	31,570	3,269	2,300	8,406	1,500	0	1	0	69,243
1981	0	0	0	3,992	80	212	16,653	0	0	53,605	2,817	400	11,769	7,500	0	0	0	97,028
1982	0	0	0	1,707	300	0	14,925	0	0	63,000	2,600	1,000	17,500	3,400	0	0	100	104,532
1983	0	0	0	1,415	50	0	12,600	0	0	76,100	100	3,800	28,400	1,000	0	0	0	123,465
1984	0	0	0	2,407	200	310	2,500	0	0	89,800	1,400	1,400	29,000	300	0	0	0	127,317
1985	0	0	0	1,130	0	360	8,715	0	0	91,500	3,200	2,000	37,020	2,400	0	0	0	146,325
1986	0	0	0	935	720	100	4,503	0	0	69,400	400	0	33,810	500	0	0	0	110,368
1987	0	0	0	2,290	4	0	16,144	0	0	80,800	0	0	10,155	50	0	0	0	109,443
1988	0	0	0	935	2	227	15,710	0	0	89,400	1,000	100	23,330	479	0	0	0	131,183
1989	0	0	0	2,265	370	0	10,873	0	0	90,300	1,800	3,819	26,765	1,745	2	0	0	137,939
1990	0	0	0	985	175	500	18,950	0	0	89,000	1,965	2,853	18,511	2,420	85	0	0	135,444
1991	0	0	0	1,355	35	0	21,925	0	0	98,200	300	1,450	22,774	1,705	0	0	0	147,744
1992	0	0	0	920	160	100	22,321	0	0	144,315	357	581	12,988	3,038	0	0	0	184,780
1993	12	0	0	2,305	70	900	24,937	0	0	49,774	350	890	21,338	27	24	0	0	100,627
1994	10	0	0	1,715	0	0	12,919	0	0	122,260	1,300	1,460	16,357	1,138	0	0	0	157,159
1995	0	0	0	655	0	825	22,659	0	0	116,310	1,320	1,150	5,253	0	0	0	0	148,172
1996	13	0	0	1,035	185	1,500	13,941	0	0	75,065	4,050	1,272	8,036	806	0	0	0	105,903
1997 [c]	15	0	0	1,365	375	2,025	23,572	0	0	87,240	1,350	650	12,470	0	0	0	0	129,062
1998	0	0	0	1,856	6	2,740	37,782	0	0	67,285	0	1,980	26,325	0	0	0	0	137,974
1999	21	0	0	1,280	0	0	29,397	0	0	120,865	1,970	537	17,550	8	0	0	0	171,628
2000 [d]	0	0	0	2,365	132	1,010	17,874	0	0	120,225	0	400	15,150	0	0	0	0	157,156
2001 [d]	0	0	0	2,204	465	1,445	25,201	2	0	96,685	3,657	925	14,677	0	0	0	0	145,261
2002	0	0	0	3,025	500	940	37,675	0	0	124,590	0	535	14,355	0	0	0	11	181,631
2003	0	0	0	1,821	77	3,165	22,222	0	0	118,005	601	1,510	17,125	0	0	0	0	164,526
2004	4	0	0	1,989	1,548	401	20,748	0	0	83,850	2,271	1,295	17,480	0	0	0	4	129,590
2005	0	0	0	875	1,415	634	24,759	0	0	73,805	1,400	1,723	18,635	2	0	0		123,248
2006	0	0	0	1,760	1,002	1,750	60,324	0	0	63,815	2,145	2,353	13,122	368	0	0	0	146,639
2007	0	0	0	2,018	1,328	1,500	65,745	0	0	67,305	1,378	505	8,906	1,874	0	0	0	150,559
2008	6	0	0	2,916	1,214	1,257	56,115	0	0	88,190	1,300	1,400	7,760	1,460	0	0	0	161,618
2009	0	0	0	2,162	1,724	1,430	57,030	0	0	73,935	219	805	11,210	2,758	0	0	0	151,273
2010	0	0	0	1,572	935	3,509	65,580	0	0	55,485	504	1,035	9,040	1,690	0	0	0	139,350

Table 2. Atlantic brant productivity estimates, 1976-2009.

	Families				Other			Totals				Percent immatures	Average young per family	
Year	Number	Adults	Immature		Adults	Immature		Adults	Immatures		Total birds			
1976	104	208	246		6,312	393		6,520	639		7,159	8.9		2.4
1977	162	311	379		8,200	3,177		8,511	3,556		12,067	29.5		2.3
1978	144	284	308		10,362	361		10,646	669		11,315	5.9		2.1
1979	703	1,381	1,955		7,233	4,024		8,614	5,979		14,593	41		2.8
1980	622	1,232	1,637		15,247	6,733		16,479	8,370		24,849	33.7		2.6
1981	523	1,040	1,249		11,444	2,124		12,484	3,373		15,857	21.3		2.4
1982	429	1,002	1,009		14,863	3,853		15,865	4,862		20,727	23.5		2.4
1983	292	581	780		12,172	5,293		12,753	6,073		18,826	32.3		2.7
1984	335	655	789		11,310	2,456		11,965	3,245		15,210	21.3		2.4
1985	283	560	674		14,701	2,179		15,261	2,853		18,114	15.8		2.4
1986	105	210	263		19,690	506		19,900	769		20,669	3.7		2.5
1987	313	601	801		11,634	3,599		12,235	4,400		16,635	26.5		2.6
1988	274	542	667		12,068	3,856		12,610	4,523		17,133	26.4		2.4
1989	466	905	1,174		12,957	2,514		13,862	3,688		17,550	21		2.5
1990	387	732	838		15,777	1,176		16,509	2,014		18,523	10.9		2.2
1991	710	1,265	1,396		5,845	911		7,110	2,307		9,417	24.5		2
1992	124	242	212		19,510	230		19,752	442		20,194	2.2		1.7
1993	1,679	3,237	3,371		15,042	1,544		18,279	4,915		23,194	21.2		2
1994	619	1,203	1,210		18,029	968		19,232	2,178		21,410	10.2		2
1995	1,242	2,470	2,788		11,556	1,071		14,026	3,859		17,885	21.6		2.2
1996	830	1,637	1,826		19,523	2,011		21,160	3,837		24,997	15.3		2.2
1997	1,502	2,888	3,299		19,683	1,479		22,571	4,778		27,349	17.5		2.2
1998	1,006	1,990	2,621		15,545	2,942		17,535	5,563		23,098	24.1		2.6
1999	185	364	320		36,639	235		37,003	555		37,558	1.5		1.7
2000	1,305	2,542	2,769		15,098	3,155		17,640	5,924		23,564	25.1		2.1
2001	811	1,571	1,738		15,308	3,787		16,879	5,525		22,404	24.7		2.1
2002	637	1,214	1,157		55,047	3,045		56,261	4,202		60,463	6.9		1.8
2003	1,022	1,983	2,184		19,460	2,276		21,443	4,460		25,903	17.2		2.1
2004	848	1,672	1,663		22,337	1,950		24,009	3,613		27,622	13.1		2
2005											26699	15		2.1
2006											20659	24.2		2.8
2007											20818	31.1		2.2
2008											41.957	21.1		2.5
2009											40961	9.4		2.2

Table 3. Estimated Atlantic brant harvest in Atlantic Flyway states, 1952-2009.

Year	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1952	0	0	0	0	0	0	284	0	0	1,886	0	0	176	780	0	0	195	3,321
1953	0	0	0	99	120	0	2,125	0	0	1,621	0	0	0	0	0	0	0	3,965
1954	0	0	0	81	0	0	949	124	0	7,217	157	343	305	0	0	0	0	9,176
1955	55	0	0	289	43	0	1,491	0	0	4,486	494	135	336	53	0	0	0	7,382
1956	0	0	0	0	0	0	1,264	0	0	11,636	1,183	608	1,310	99	0	0	0	16,100
1957	51	0	0	196	0	27	3,673	90	0	14,941	0	323	1,201	2,967	0	0	0	23,469
1958	0	74	0	247	364	4	4,337	44	0	8,612	455	183	16	0	0	99	114	14,549
1959	18	0	32	120	42	153	9,428	1,020	0	20,918	1,516	1,294	148	657	37	0	0	35,383
1960	1,046	87	0	959	0	91	13,740	450	0	16,920	708	568	329	31	0	0	0	34,929
1961	46	46	15	273	17	0	4,899	333	0	12,741	111	131	320	197	0	0	0	19,129
1962	0	0	0	0	0	0	5,350	0	0	21,063	0	386	107	0	0	0	0	26,906
1963	0	0	0	226	0	0	6,568	0	0	24,910	375	0	1,970	0	0	0	0	34,049
1964	0	0	0	0	0	0	5,557	0	0	24,451	0	0	0	0	0	0	0	30,008
1965	0	79	0	0	0	0	3,026	0	0	10,530	0	101	45	0	0	0	0	13,781
1966	0	0	0	301	0	0	8,538	0	0	23,120	39	247	0	315	0	0	0	32,560
1967	0	41	0	36	286	0	3,120	0	0	18,755	130	201	87	87	0	0	0	22,743
1968	0	23	0	67	0	0	5,365	0	0	16,137	923	452	1,383	0	0	0	0	24,350
1969	0	255	81	93	116	0	2,948	0	0	13,671	0	448	775	0	0	0	0	18,387
1970	0	0	0	366	0	0	5,385	0	0	18,574	474	585	252	0	0	0	0	25,636
1971	0	0	0	74	46	0	20,007	305	0	42,350	396	494	3,081	0	0	0	0	66,753
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	195	0	0	0	0	195
1974	0	0	0	0	0	0	235	0	0	0	0	0	0	0	0	0	0	235
1975	0	0	0	1,425	0	0	6,397	178	0	18,688	1,035	623	2,050	0	0	0	0	30,396
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	443	129	0	0	0	572
1978	0	0	0	92	0	0	461	0	0	0	0	0	0	0	0	0	0	553
1979	0	0	0	0	0	0	230	0	0	0	0	224	0	0	0	0	0	454
1980	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	100
1981	0	0	0	2,146	0	29	19,624	0	0	8,227	564	1,043	2,086	0	0	0	0	33,719
1982	0	0	0	552	0	184	10,874	0	0	9,124	326	1,597	575	352	0	0	0	23,584
1983	0	83	0	1,771	440	0	21,515	0	0	7,358	164	0	1,205	1,868	0	0	0	34,404
1984	0	304	0	2,467	1,561	67	20,307	0	0	22,095	0	705	604	189	0	0	0	48,299
1985	0	57	0	2,271	344	0	11,115	0	0	14,331	715	1,979	306	316	0	0	0	31,434
1986	0	167	0	176	223	25	3,183	0	0	5,609	0	0	0	0	0	0	0	9,383
1987	0	0	0	980	0	0	2,213	0	0	3,059	0	1,745	245	0	0	0	0	8,242
1988	0	255	0	745	0	69	4,369	0	0	9,805	1,010	4,449	1,732	0	0	0	0	22,434
1989	0	258	0	708	0	42	6,655	0	0	7,476	1,057	2,224	4,501	3,022	0	205	0	26,148
1990	0	0	0	768	0	0	4,974	0	0	5,256	92	1,398	2,068	0	0	0	0	14,556
1991	0	0	0	717	0	0	3,983	0	0	7,185	0	0	524	0	0	0	0	12,409
1992	0	0	0	478	206	63	2,950	107	0	6,911	74	1,025	2,124	145	0	0	0	14,085
1993	0	303	0	528	145	125	2,420	115	0	5,252	0	0	1,602	0	0	0	0	10,491
1994	0	0	0	145	0	1,022	1,189	0	0	6,600	460	1,611	2,613	134	0	0	0	13,772
1995	0	0	0	327	177	0	4,397	0	0	8,171	154	0	1,800	375	0	0	0	15,346
1996	0	432	0	88	0	0	1,047	0	0	2,613	0	0	963	71	0	0	0	5,215
1997	0	0	0	450	0	48	3,981	0	0	7,301	741	0	4,109	1,234	0	0	0	17,865
1998	0	0	0	162	0	43	1,591	0	0	5,346	0	287	1,142	443	0	0	0	9,014
1999	0	0	0	171	0	131	1,751	0	0	6,087	372	752	222	182	0	0	0	9,669
2000	0	0	172	348	331	21	6,462	0	0	5,032	525	964	4,038	912	0	0	0	18,805
2001	0	200	0	900	300	600	6,600	100	0	6,800	300	800	3,500	4700	0	0	0	24,900
2002	0	0	0	700	800	600	7,200	100	0	9,800	1600	700	5,900	6000	0	0	0	33,400
2003	0	200	0	1600	2500	1200	10,400	100	0	9,900	1500	1700	9,200	6500	0	0	0	44,900
2004	0	0	100	300	1000	300	5,800	800	0	5,000	600	800	2,800	0	0	0	0	17,600
2005	0	0	0	500	700	700	4,700	0	0	8,300	1500	1700	6,100	6200	0	0	0	30,400
2006	0	0	0	400	0	400	3,400	0	0	5,200	800	2300	2,400	3600	0	0	0	18,500
2007	0	0	0	700	200	1200	4,800	0	0	7,600	900	1000	1,700	4200	0	0	0	22,300
2008	0	0	100	1100	300	1400	7,700	0	0	7,800	1500	1800	5,500	0	0	0	0	27,200
2009	0	0	0	400	500	600	7,100	300	0	8,300	900	2200	3,300	11400	0	0	0	35,100

Table 4. Historic Atlantic brant hunting season regulations and estimated harvests in the Atlantic Flyway.

Season length/bag limit	Hunting season	Previous midwinter	% young in fall flight	Harvest			
				Total	Age ratio (y:a)	Young	Adults
30/2	1981-82	97,028	17.90	33,719	0.26	6,958	26,761
	1982-83	104,532	23.50	23,584	0.53	8,170	15,414
	1986-87	110,368	3.70	9,383	0.07	614	8,769
	1987-88	109,443	26.50	8,242	0.56	2,959	5,283
	1993-94	100,627	21.20	10,489	0.73	4,426	6,063
	1996-97	105,903	15.40	5,282	0.14	649	4,633
	2005-06	123,248	15.00	30,400	0.15	3,917	26,424
	2006-07	146,639	24.20	18,500	0.27	3,920	14,420
	Mean	112,224	18.43	17,450	0.34	3,952	13,471
	SE	4,974	2.3	3,369	0.07	834	2,816
30/4	1975-76	88,408	44.2	30,396	1.05	15,569	14,827
50/2	1983-84	123,465	32.30	34,404	0.56	12,350	22,054
	1988-89	131,183	26.70	22,434	0.77	9,759	12,675
	1989-90	137,939	21.00	26,148	0.45	8,115	18,033
	1990-91	135,444	10.90	14,556	0.24	2,817	11,739
	1991-92	147,744	24.50	12,409	0.57	4,505	7,904
	1992-93	184,780	2.20	14,124	0.08	1,046	13,078
	1994-95	157,159	10.10	13,774	0.21	2,391	11,383
	1995-96	148,172	21.60	15,586	0.70	6,418	9,168
	1997-98	121,465	17.40	18,239	0.43	5,484	12,755
	1998-99	137,974	24.10	9,348	0.56	3,356	5,992
	1999-00	171,628	1.50	9,811	0.10	892	8,919
	2000-01	157,156	25.10	18,805	1.17	10,136	8,669
	2001-02	145,261	24.70	31,231	0.53	10,766	20,465
	2004-05	129,590	13.10	17,600	0.32	4,207	13,286
	2007-08	150,559	31.10	22,300	0.67	8,933	13,367
	2009-10	151,273	9.40	35,100	0.22	6,410	28,714
	Mean	145,675	18.48	19,742	0.47	6,099	13,638
	SE	4,235	2.40	2,059	0.07	899	1,491
60/3	2002-03	181,631	6.9	33,400	0.11	3,407	30,017
	2003-04	164,526	17.2	44,900	0.54	15,246	28,003
	2008-09	161,618	21.1	27,200	0.68	10,971	16,129
	Mean	169,258	15.07	35,167	0.45	9,875	24,716
	SE	5,407	3.67	4,491	0.15	2,998	3,753

Table 4 (Con't)

Season length/bag limit	Hunting season	Previous midwinter	% young in fall flight	Harvest			
				Total	Age ratio (y:a)	Young	Adults
50/4	1984-85	127,317	21.3	48,299	0.49	15,884	32,415
	1985-86	146,325	15.8	31,434	0.23	5,878	25,556
	Mean	136,821	18.55	39,867	0.36	10,881	28,986
	SE	9,504	2.75	8,433	0.13	5,003	3,430
60/6	1958-59	211,057	n.d.	14,549	n.d.	n.d.	n.d.
60/6	1959-60	217,426	n.d.	35,383	n.d.	n.d.	n.d.
60/6	1960-61	238,338	n.d.	34,929	n.d.	n.d.	n.d.
60/6	1961-62	265,688	0.03	19,129	n.d.	n.d.	n.d.
60/6	1962-63	124,490	22.5	26,906	n.d.	n.d.	n.d.
	Mean	211,400	11.3	26,179			
	SE	23,730	11.2	4,164			
70/6	1963-64	173,494	43.5	34,049	n.d.	n.d.	n.d.
70/6	1964-65	182,700	32.5	30,008	n.d.	n.d.	n.d.
70/6	1965-66	185,982	23.7	13,781	n.d.	n.d.	n.d.
70/6	1966-67	171,850	51.2	32,560	n.d.	n.d.	n.d.
70/6	1967-68	219,024	41.9	22,743	n.d.	n.d.	n.d.
70/6	1968-69	213,450	0.07	24,350	n.d.	n.d.	n.d.
70/6	1969-70	130,831	30.4	18,387	1.18	9,953	8,434
70/6	1970-71	106,511	39	25,636	1.02	12,945	12,691
70/6	1971-72	150,965	5.7	66,753	0.15	8,707	58,046
	Mean	170,534	29.8	29,807	0.78	10,535	26,390
	SE	12,161	5.8	5,103	0.32	1,258	15,875
Closed	1972-73	73,242	0.08	0	n.d.	0	0
Closed	1973-74	40,835	59.4	195	1	98	98
Closed	1974-75	87,653	12.1	235	0	0	235
Closed	1976-77	127,003	10.1	0	n.d.	0	0
Closed	1977-78	73,605	29.5	572	2.87	424	148
Closed	1978-79	42,740	5.3	553	0.38	152	401
Closed	1979-80	43,554	39.9	454	1.03	230	224
Closed	1980-81	69,242	33.7	100	0	0	100
	Mean	69,734	23.8	264	0.88	113	151
	SE	10,245	7.2	83	0.44	54	47