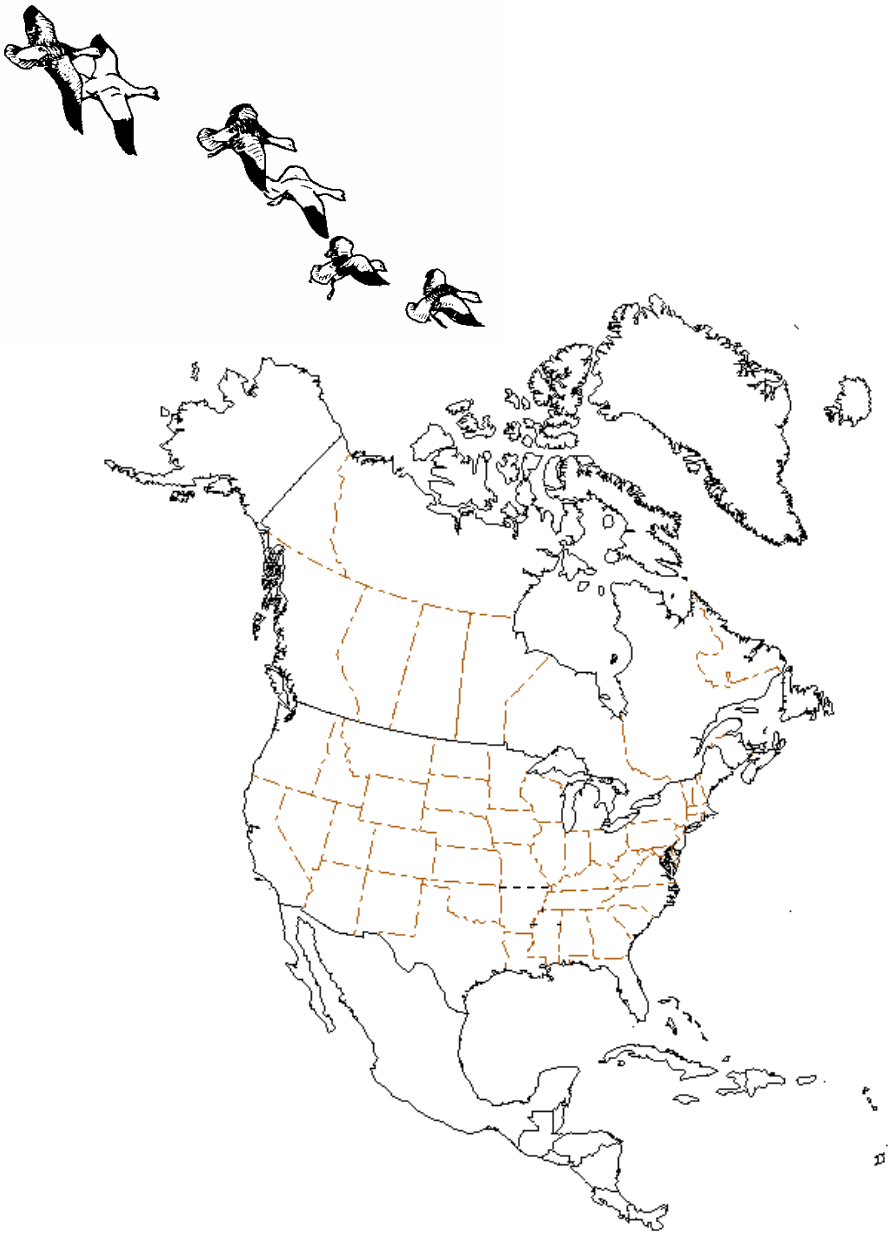
U.S. Fish and Wildlife Service

Final Environmental Impact Statement:

Light Goose Management



June 2007

FINAL ENVIRONMENTAL IMPACT STATEMENT:

Light Goose Management

RESPONSIBLE AGENCY:

Department of the Interior
U.S. Fish and Wildlife Service

RESPONSIBLE OFFICIAL:

Director
U.S. Fish and Wildlife Service
Main Interior Building
1849 C Street
Washington, DC 20240

FOR FURTHER
INFORMATION CONTACT:

James R. Kelley, Jr., EIS Project Manager
U.S. Fish and Wildlife Service
Division of Migratory Bird Management
BH Whipple Federal Building
1 Federal Dr.
Fort Snelling, Minnesota 55111-4056
(612) 713-5409
James_R_Kelley@fws.gov

Robert Blohm, Chief
Division of Migratory Bird Management
U.S. Fish and Wildlife Service
Mail Stop MBSP - 4107
4401 N. Fairfax Dr.
Arlington, Virginia 22203
(703) 358-1714

Executive Summary

The term “light geese” refers collectively to three taxa of geese that have light coloration: greater snow geese, Ross’s geese, and lesser snow geese. Various light goose populations in North America have experienced rapid population growth, and have reached levels such that they are damaging habitats on their arctic and subarctic breeding areas. Habitat degradation in arctic and subarctic areas may be irreversible, and has negatively impacted light goose populations and other bird populations dependent on such. Natural marsh habitats on some migration and wintering areas also have been impacted by light geese. In addition, goose damage to agricultural crops has become a problem. There is increasing evidence that lesser snow and Ross’s geese act as reservoirs for the bacterium that causes avian cholera. The threat of avian cholera to other bird species likely will increase as light goose populations expand. The management goal for light geese in the mid-continent region is to reduce the population by 50% from the level observed in the late 1990s. The management goal for greater snow geese is to reduce the population to 500,000 birds. We believe these population levels are more compatible with the ability of habitats to support them. This document describes various alternatives for the purpose of reducing and stabilizing specific populations of light geese in North America. We analyzed five management alternatives: A) no action; B) modify harvest regulation option and refuge management (PREFERRED); C) implement direct agency control of light goose populations on migration and wintering areas in the U.S.; D) seek direct light goose population control on breeding grounds in Canada; E) two-phased approach to light goose population control. Phase one of alternative E is identical to alternative B, whereas phase two includes elements of alternatives C and D. Under Alternative E, if implementation of phase one was not successful in reducing light goose populations we would assess the need to implement phase two. Alternatives were analyzed with regard to their potential impacts on light geese, other bird species, special status species, socioeconomics, historical resources, and cultural resources.

Table of Contents

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

PURPOSE OF AND NEED FOR ACTION

1.1 Introduction

This chapter discusses the purpose and need for action; background on the U.S. Fish and Wildlife Service (Service or "we") and Canadian Wildlife Service (CWS); the planning process, which includes scoping of issues and identification of alternatives; and the legal basis for the action.

This document has been developed to ensure that our proposed management action is in compliance with NEPA. Furthermore, this process will ensure that proposed actions do not adversely affect listed species and their critical habitats under the Endangered Species Act, as well as non-listed species covered under the Migratory Bird Treaty Act.

1.2 Purpose of Action

This document describes various alternatives for the purpose of reducing and stabilizing specific populations of light geese in North America. The term "light geese" refers collectively to three taxa of geese that have light coloration: greater snow geese, Ross's geese, and lesser snow geese. This document addresses concerns under the National Environmental Policy Act of 1969 (NEPA). The NEPA regulations direct Federal agencies to use the NEPA process, as a decision-making tool, as early as possible in any planning process (40 CFR 1501).

1.3 Need for Action

There is a need to reduce and stabilize the size of several populations of light geese that have become injurious, via their feeding actions, to habitats on their breeding, migration, and/or wintering grounds. In addition, there is a need to reduce certain light goose populations to alleviate damage to agricultural crops. Furthermore, there is a need to conduct population control that is cost-effective for wildlife agencies.

Lesser snow and Ross's geese are suspected carriers of the bacterium that causes the deadly disease avian cholera. Cholera outbreaks are often associated with high densities of birds and the disease affects nearly 100 species of birds, some of which are listed as threatened or endangered. There is a need to reduce certain light goose populations to reduce the likelihood of future cholera outbreaks.

The Stakeholder's Committee on Arctic Nesting Geese (1998) has stated that geese killed for management purposes should be killed as humanely as possible and utilized as food wherever feasible.

However, Johnson (1997) suggested that ethical use of birds may have to be set aside in favor of more rigorous efforts to control the population and save Arctic habitats. The Arctic Goose Habitat Working Group has stated that light geese are a valuable natural resource, as game animals and as food (Batt 1997). In developing their management recommendations, the Working Group did not consider any population reduction strategies that advocated slaughter and destruction of birds followed by their being wasted in landfills or some similar fate (Batt 1997). Therefore, there is a need to reduce light goose populations with alternatives that are as humane as possible and, where feasible, do not constitute a waste of the goose resource.

1.4 Background

1.4.1 Background Relevant to Need for Proposed Action

Various light goose populations in North America have experienced rapid population growth, and have reached levels such that they are damaging habitats on their Arctic and subarctic breeding areas (Abraham and Jefferies 1997, Alisauskas 1998, Jano et al. 1998, Didiuk et al. 2001). Habitat degradation in arctic and sub-arctic areas may be irreversible, and has negatively impacted light goose populations (Abraham and Jefferies 1997), and other bird populations dependent on such habitats (Gratto-Trevor 1994, Rockwell 1999, Rockwell et al. 1997). Natural marsh habitats on some migration and wintering areas have been impacted by light geese (Giroux and Bedard 1987, Giroux et al. 1998, Widjeskog 1977, Smith and Odum 1981, Young 1985). In addition, goose damage to agricultural crops has become a problem (Bedard and Lapointe 1991, Filion et al. 1998, Giroux et al. 1998, Delaware Div. of Fish and Wildlife 2000).

There is increasing evidence that lesser snow and Ross's geese act as prominent reservoirs for the bacterium that causes avian cholera (Friend 1999, Samuel et al. 1997, Samuel et al. 1999a). Over 100 species of waterbirds and raptors are susceptible to avian cholera (Botzler 1991). The threat of avian cholera to endangered and threatened bird species is continually increasing because of increasing numbers of outbreaks and the expanding geographic distribution of the disease (Friend 1999). This threat likely will increase as light goose populations expand (Samuel et al. 2001). The above issues are described in more detail in Chapter 3 Affected Environment.

The Arctic Goose Habitat Working Group recommended that light goose numbers in the mid-continent region should be reduced by 50% (Arctic Goose Habitat Working Group 1997). The Working Group outlined a strategy that advocated monitoring the number of mid-continent light geese to see that appropriate population reductions are achieved, and to simultaneously monitor habitats in the Arctic coastal ecosystem. They further recommended that when the population size reached a level that is causing no further habitat damage, the management program should be changed to stabilize light goose numbers at that threshold (Rockwell et al. 1997:96). In 1998, the Arctic Goose Habitat Working Group recommended a

short-term management goal of stabilizing the greater snow goose population at between 800,000 to 1 million birds (Giroux et al. 1998). However, a reduction of the population below that level was recommended if natural habitats continue to deteriorate, or if measures taken to reduce crop depredation do not achieve desired results (Giroux et al. 1998). More recently, the Canadian Stakeholders Committee in Quebec adopted a population goal of 500,000 birds to address continued habitat degradation and agricultural depredations in the St. Lawrence valley (Arctic Goose Joint Venture Technical Committee 2001). The population goal of 500,000 birds is in agreement with both the Atlantic Flyway Council goal and North American Waterfowl Management Plan goal for greater snow geese (U.S. Dept. of the Interior et al. 1998). Although the number of light geese breeding in the western Arctic is increasing, the Arctic Goose Habitat Working Group has not identified an immediate management concern for habitat in that region. The number of lesser snow geese in the western Arctic is expected to grow from the current level of approximately 579,000 birds to 1 million by the year 2010. Some researchers have suggested a proactive approach to management of western Arctic lesser snow geese by stabilizing the population at its current level before it escapes control via normal harvest (Hines et al. 1999).

1.4.2 U.S. Fish and Wildlife Service

We are the primary Federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife resources and their habitats. Our mission is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. Responsibilities are shared with other Federal, State, tribal, and local entities; however, we have specific responsibilities for endangered species, migratory birds, inter-jurisdictional fish, and certain marine mammals, as well as for lands and waters that we administer for the management and protection of these resources.

1.4.3 Canadian Wildlife Service

The mandate of Environment Canada, of which the CWS is part, is to preserve and enhance the quality of the natural environment, including water, air and soil quality; conserve Canada's renewable resources, including migratory birds and other non-domestic flora and fauna; conserve and protect Canada's water resources; carry out meteorology; enforce the rules made by the Canada - United States International Joint Commission relating to boundary waters; and coordinate environmental policies and programs for the federal government. The CWS handles wildlife matters that are the responsibility of the Federal government. These include protection and management of migratory birds, nationally significant habitat and endangered species, as well as work on other wildlife issues of national and international importance. In addition, CWS conducts research in many fields of wildlife biology.

1.4.4 Other Environmental Assessments and Rulemakings

In January 1999, we published a Final Environmental Assessment (EA) that examined several management alternatives for addressing problems associated with large populations of light geese. The

preferred management alternative identified in the EA was to authorize additional methods of take of light geese, and implement a conservation order for the reduction of overabundant light geese.

On February 16, 1999, we published 2 separate rules in the *Federal Register* (*FR*) that 1) authorized additional methods of take of light geese (lesser snow geese and Ross's geese) in the Central and Mississippi Flyways (64 *FR* 7507); and 2) created a conservation order for the reduction of the light goose population in the central portion of North America (64 *FR* 7517). At the same time, we announced our intent to initiate preparation of an Environmental Impact Statement (EIS) beginning in 2000 that would consider the effects on the human environment of a range of long-term resolutions for the light goose population problem.

On March 2, 1999, several private groups filed a motion for a preliminary injunction against the light goose regulations we published the previous month. Although the Federal judge refused to issue an injunction, he did indicate a likelihood the plaintiffs might succeed on their argument that we should have prepared an EIS prior to authorizing new light goose regulations. In order to avoid further litigation, and because we had earlier indicated we would initiate preparation of an EIS in 2000, we withdrew the regulations on June 17, 1999 (64 FR 32778), and began preparation of the EIS. Subsequently, the light goose regulations were re-instated when the Arctic Tundra Habitat Emergency Conservation Act (P.L. 106-108) was signed into law on November 29, 1999. On September 28, 2001 (66 FR 49668) we announced publication of the Draft EIS on light goose management.

1.5 Scoping and Public Involvement

1.5.1 Summary of Scoping Efforts

Scoping is the initial stage of the EIS process used to design the extent and influence of a management proposal. On May 13, 1999 (64 *FR* 26268), we published a Notice of Intent to prepare an EIS on light goose management (Appendix 1). The public notice opened a 60-day comment period and solicited public participation in the scoping process to identify issues, alternatives, and impacts that we should address in the EIS. On August 30, 1999 (64 FR 7332), we published a Notice of Meetings that identified the date and location of nine public scoping meetings throughout the U.S. (Appendix 2). The Notice of Meetings opened another comment period that lasted 84 days. Scoping meetings provided an additional opportunity for public comment on the issues, alternatives, and impacts to be addressed in the EIS.

The Notice of Intent was mailed to a standard mailing list that the Division of Migratory Bird Management uses for its *Federal Register* notices. In addition, we sent copies of the notice to all individuals, organizations, and agencies that submitted public comments during our 1998-1999 EA process. The Notice of Meetings was mailed to the same entities, as well as individuals, organizations, and agencies that submitted comments in response to the Notice of Intent published on May 13, 1999.

As part of our consultation with the Canadian government, CWS agreed to distribute French and English versions of our Notice of Intent to potentially affected groups in Canada. The CWS distribution list contained approximately 600 individuals, and national or provincial organizations that have indicated an interest in waterfowl management in Canada. The distribution list included wildlife management boards and councils that oversee wildlife programs affecting First Nations people in Canada.

On September 28, 2001 (66 FR 49668) and October 5, 2001 (66 FR 51274), notices were published in the *Federal Register* announcing the availability of a Draft EIS (DEIS) on light goose management for public review. On October 12, 2001 (66 FR 52147) we published a notice in the *Federal Register* to announce the schedule of public hearings to invite further public participation in the Draft EIS review process. Hard copies of the DEIS were sent out to our EIS mailing list. CWS sent notices of availability to entities that had responded to the notice of intent.

1.5.2 Issues and Concerns Identified During Scoping

Comments from the initial scoping process covered a range of issues and concerns, but were divided into 2 basic categories. A total of 332 comments were received, of which 278 (84%) agreed that light goose population levels present a problem and that active management should be pursued. The second group of comments (9% of respondents) questioned whether widespread habitat degradation has actually occurred and/or that light goose population levels are unprecedented. The second group of comments also indicated that no management actions should be taken against light geese, and that natural processes should be allowed to rectify any perceived habitat and/or population problems. A summary of issues and concerns identified during scoping is presented in Table 1.1.

Table 1.1. General categories of issues and concerns identified during the light goose EIS scoping process.

Issue or concern identified	Portion of draft EIS that addresses issue or concern
Documentation of light goose population growth	Chapter 3, Sections 3.1.4 – 3.1.8
Impacts on light geese	Chapter 3, Section 3.1.9; Chapter 4, Section 4.2
Documentation of habitat degradation	Chapter 3, Section 3.2
Impacts on habitat	Chapter 4, Section 4.3
Impacts on other species	Chapter 3, Section 3.3; Chapter 4, Section 4.4
Impacts on socio-economics	Chapter 3, Section 3.5; Chapter 4, Section 4.5

Management alternatives that were identified in public comments but not included for analysis in the EIS are reviewed in Chapter 2.

1.6 Policy, Authority, and Legal Compliance

The Secretary of the Interior is authorized and directed by the Migratory Bird Treaty Act to determine when it is compatible with the conventions to issue regulations to allow the take of these birds and their nests and eggs. Of the four migratory bird conventions, three are applicable to the adoption of these regulations: the *Convention Between the United States and the Union of Soviet Socialist Republics* (now Russia) *Concerning the Conservation of Migratory Birds and Their Environment* (1978), the *Convention for the Protection of Migratory Birds and Game Mammals* with Mexico (1937), and the *Convention for the Protection of Migratory Birds* with Canada (1916). With respect to the fourth, the *Convention Between the Government of the United States of America and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment* (1974), there is no positive evidence that the birds that are the subject of these regulations migrate between Japan and the United States (see Article I, Section 1.).

When two or more conventions are applicable to our adoption of regulations, we must ensure the action is compatible with each or, where conventions have provisions on the same specific issue, the more stringent of the provisions. Each of the conventions, negotiated at different times with four different countries, address particular issues important to each country and, because of differing perspectives and needs, contain agreements on similar actions that are presented in uniquely different ways.

The convention with Canada, in addition to including requirements regarding the authorization of the hunting of migratory game birds, the taking of migratory birds for scientific, educational, propagative and other purposes, and the harvesting of migratory birds and eggs by indigenous inhabitants of Alaska, allows for permitting the killing of migratory birds that are seriously injurious to agricultural or other interests in any particular community (see Article VII). It is our conclusion from all of the information available to us, and which is summarized and referenced in this Environmental Impact Statement, that several light goose populations have exhibited extraordinary growth. Due to their feeding actions, overabundant light geese have become seriously injurious to habitats on various breeding, migration and wintering areas and in some situations have also caused damage to agricultural crops. Consistent with the same article of the convention, the regulations also provide for the suspension of the permission granted by the regulations to take these birds when no longer needed to prevent the injuries to the habitat. In furtherance of the overall objectives of the convention, these regulations will help insure the preservation of these and other migratory birds covered by this convention.

The convention with Mexico provides that for migratory game birds the parties agree to establish "close seasons" (unspecified periods or lengths) during which migratory game birds may not be taken (see Article II). We read this to relate only to hunting because of the specific reference to "seasons". As such, the agreement to establish close seasons does not apply to the adoption of these regulations because this is not a

hunting program. It is a management action that is taken in order to reduce the severe habitat damage that light geese are causing on their nesting, migration or wintering grounds. There are no other applicable provisions in this convention except the overall purpose to protect these birds "(i)n order that they may not be exterminated." The specificity of the regulations with regard to implementation, monitoring, and reporting, coupled with the revocation and suspension provisions ensure that this will be met.

The convention with Russia, with a somewhat different approach, contains an agreement that the parties will prohibit the taking of migratory birds generally. It then provides for exceptions, one of which is "(f)or scientific, educational, propagative, or other special purposes not inconsistent with the principles of" the convention (see Article II). Another is for "the purpose of protecting against injury to persons or property" (see also Article II). These regulations fall within both of these exceptions. The action not only recognizes that birds of common interest to Russia and the United States "have common flyways, breeding, wintering, feeding, and moulting habitat which should be protected", the action is designed to protect that habitat. We are "implementing measures for the conservation of migratory birds and their environment and other birds of mutual interest" by taking actions available to us to prevent further destruction of breeding and feeding habitat by the unusually abundant light geese. (See provisions of the convention introductory to the Articles).

In addition to the specific provision regarding taking noted above, the 1916 treaty with Great Britain was amended in 1999 by the governments of Canada and the United States to provide broader principles regarding migratory bird management. These regulations and the efforts of the United States in this regard are compatible with those provisions. Article II of the amended U.S.-Canada migratory bird treaty (Treaty) states that, in order "to ensure the long-term conservation of migratory birds, migratory bird populations shall be managed in accord with… conservation principles" that include (among others): to manage migratory birds internationally; to sustain healthy migratory bird populations for harvesting needs; and to provide for and protect habitat necessary for the conservation of migratory birds.

Article III of the Treaty states that the governments should meet regularly to review progress in implementing the Treaty. The review shall address issues important to the conservation of migratory birds, including the status of migratory bird populations, the status of important migratory bird habitats, and the effectiveness of management and regulatory systems. The governments agree to work cooperatively to resolve identified problems in a manner consistent with the principles of the Treaty and, if the need arises, to conclude special arrangements to conserve and protect species of concern.

Article IV of the Treaty states that each government shall use its authority to take appropriate measures to preserve and enhance the environment of migratory birds. In particular, the governments shall,

within their constitutional authority, seek means to prevent damage to such birds and their environments and pursue cooperative arrangements to conserve habitats essential to migratory bird populations.

This EIS and planning process is in compliance with NEPA, which requires Federal agencies to consider all environmental factors related to their proposed actions. An EIS is an explanation/declaration of the consequences, both favorable and unfavorable, of a particular action that is contemplated by a Federal agency. In the DEIS published on September 28, 2001 we summarized then current information on light goose population levels, impacts of light geese on various habitats, and analyses of different alternatives for managing light goose populations. For the Final EIS we updated databases whenever possible and revised analyses to include such updates. The Environmental Protection Agency reviewed our DEIS and assigned a rating of Lack of Objection, stating that the DEIS provided adequate documentation of the potential environmental impacts (Appendix 3).

CHAPTER 2

ALTERNATIVES

2.1 Introduction

This chapter describes the process we employed to develop and analyze five alternatives for management of light goose populations. We also present a brief description of alternatives that were eliminated from detailed study and the reason for their elimination. The array of five alternatives that we analyzed in detail provides a means to compare different ways of meeting the purpose and need and for addressing issues outlined in Chapter 1.

2.2 Alternatives Considered But Eliminated From Detailed Study

During preparation of our EA, and during the scoping process of this EIS, we received recommendations to consider an array of options for managing light goose populations. The following recommendations were considered but rejected because they did not have the capacity to address our responsibilities, and did not possess the potential to alleviate problems associated with large light goose populations. Many of the recommendations involved minor modification of existing migratory bird hunting regulations that would not significantly increase harvest. We chose not to analyze such alternatives because they would create unnecessary confusion concerning regulations without significantly decreasing light goose abundance.

2.2.1 Establish a depredation order

We issue depredation orders to allow, without a permit, the killing of migratory birds that "…have accumulated in such numbers in a particular area as to cause or about to cause serious damage to agricultural, horticultural, and fish cultural interests…" (50 *CFR* Part 21.42). A depredation order would not be an efficient method of controlling light goose populations because much of the damage caused by light geese often is restricted to natural marsh and tundra habitats, which is not covered by depredation order regulations. However, light geese also cause damage to crops such as hay and cereal grains. In such cases, farmers would be eligible to apply for a depredation permit instead (50 *CFR* Part 21.41).

2.2.2 Egg removal

Removal or destruction of eggs on light goose breeding colonies has been suggested as a method to alleviate habitat damage. No field studies have been conducted in the Arctic that would provide information about the effectiveness of such a program. However, results from modeling the population dynamics of lesser snow geese in the mid-continent region indicate that egg removal would be an inefficient method of

reducing population growth, compared to methods that lower adult survival (Rockwell et al. 1997a). A 5.7% reduction in adult survival would induce a decline in the population, whereas a 36% decline in fertility (an end result of egg removal) would be needed to achieve the same effect (Rockwell et al. 1997a). To equal the effect of removing an adult bird from a population, all eggs produced by that goose during its entire lifetime must be removed (Smith et al. 1999). Furthermore, egg removal must be nearly complete in order to prevent recruitment from a small number of surviving nests offsetting the control efforts (Smith et al. 1999). Rockwell et al. (1997a) estimated that 2.7 million eggs would need to be removed annually from nests simply to reduce the population growth rate to just below 1.0. Costs for egg removal in the Arctic are not available; however Cooper and Keefe (1997) estimated that removal costs in Minnesota are $6.38 per egg. Using the Minnesota egg removal cost estimate for La Perouse Bay translates to $17 million per year to induce population decline at just one light goose colony site. Search time for egg removal in light goose colonies likely would be low due to high nest densities, but this savings would likely be offset by the high cost of conducting field work in the Arctic. Even if complete egg removal could be achieved at a colony site, the large number of adult birds remaining in the population would continue to degrade habitats. Due to high costs and the large number of surviving adults, we do not view egg removal as a viable alternative for consideration.

2.2.3 Permit the use of lead shot to take light geese

It was suggested that light goose harvest can be increased by allowing the use of lead shot, which is perceived as being ballistically superior to other shot types. Lead shot has been demonstrated to be poisonous to birds once ingested, and was responsible for annual mortality of 2-3% of the fall waterfowl population (Anderson et al. 2000). Consequently, we prepared an EIS in 1976, and a Supplemental EIS in 1986, to require the use of steel (nontoxic) shot for hunting waterfowl and coots in the U.S. In 1991, we implemented a nationwide ban on the use of lead shot for hunting waterfowl and coots (50 *CFR* Part 20.21[j]). Following the 1991 ban, several additional shot types have been approved for waterfowl hunting (e.g., bismuth-tin, tungsten-iron, tungsten-polymer, tungsten-matrix, tungsten-nickel-iron). Most waterfowl hunters now understand and support the need to use nontoxic shot and have adjusted well to the use of an alternative to lead. Legalization of lead shot to hunt light geese would result in massive deposition of lead in the environment that could be ingested by non-target species, which may include endangered or threatened species. Therefore, we consider the use of lead shot to increase the harvest of light geese to be unacceptable.

2.2.4 Permit the use of rifles and/or pistols

The use of rifles or pistols for migratory bird hunting was prohibited in 1935 (50 *CFR* Part 20.21[a]). Migratory bird hunters often hunt in close proximity to each other. Rifles and pistols have a significantly longer range than shotguns, and therefore present a human safety hazard for any persons inside or outside shotgun range. Additionally, there is no evidence to suggest that the use of rifles and pistols by hunters would increase harvest of light geese. Due to both the safety risks associated with the use of rifles or

pistols for migratory bird hunting, and the lack of evidence that their use would increase harvest of light geese, we will not consider them as options for reducing light goose populations.

2.2.5 Remove the Federal migratory bird hunting stamp requirement during normal season frameworks

All hunters 16 years of age and older must possess a valid Federal migratory bird hunting and conservation stamp (duck stamp) as prescribed in the Migratory Bird Hunting Stamp Act of 1934, as amended (16 U.S.C. 718 [a]) in order to hunt waterfowl during normal hunting seasons. Congressional action to amend the Migratory Bird Hunting Stamp Act of 1934 would be required to waive the Federal duck stamp requirement. Citizens that would hunt light geese during normal seasons likely would have already purchased a duck stamp to hunt other waterfowl species. Therefore, we do not believe that waiver of the duck stamp requirement would recruit additional hunters to harvest light geese during normal seasons.

2.2.6 Permit the use of reciprocal State hunting licenses

Federal regulations do not prohibit reciprocal licensing among States. Such agreements would expand opportunities to take light geese for non-resident hunters. Reciprocal licensing would permit an individual holding a valid hunting license in one State to hunt light geese within one or more other cooperating States. Whereas we have jurisdiction over the broader waterfowl hunting frameworks within which States operate, we must defer to State sovereignty where State hunting licenses are concerned (50 *CFR* Part 10.3). Therefore, we have no jurisdictional authority regarding State regulations or statute requirements for State migratory bird hunting licenses. Whereas we support the concept of reciprocal licensing, individual States must enter into a reciprocal licensing agreement on their own authority.

2.2.7 Permit the use of live decoys to take light geese

The use of live birds as decoys to attract and hunt waterfowl was prohibited in 1935 (50 *CFR* Part 20.21[f]). There is a risk of transmitting certain avian diseases to wild birds from captive-reared or domestic birds. We believe the use of live decoys to attract wild light geese would increase that risk; therefore this alternative was rejected.

2.2.8 Permit the use of baiting to take light geese

Baiting is the direct or indirect placing, exposing, depositing, distributing, or scattering of salt, grain, or other feed that could lure or attract migratory game birds to, on, or over any areas where hunters are attempting to take them. The use of baiting to hunt migratory birds was prohibited in 1935 (50 *CFR* Part 20.21[i]), and has continued to be a source of controversy. Therefore, authorization of baiting is not a viable alternative.

2.2.9 Apply dove baiting regulations to regulations for hunting light geese

Baiting regulations were modified in the early 1970s to distinguish those pertaining to dove hunting from those for hunting waterfowl (50 *CFR* Part 20.21[i]). Baiting regulations were modified again in 1999 to clarify which plant and soil management practices are legally compatible with dove and waterfowl hunting, respectively. One of the primary differences between dove and waterfowl baiting regulations is that doves may be hunted over areas where grain or feed has been distributed or scattered solely as the result of the manipulation of an agricultural crop or other feed on the land where grown (50 *CFR* 20.21[i][2]). Light geese and other waterfowl may not be hunted over such areas. Waterfowl may be hunted on or over the following lands or areas: where standing crops or flooded standing crops (including aquatics); standing, flooded, or manipulated natural vegetation; flooded harvested croplands; or lands or areas where seeds or grains have been scattered solely as the result of a normal agricultural planting, harvesting, post-harvest manipulation or normal soil stabilization practice (50 *CFR* 20.21[i][1][i]).

Some State waterfowl management plans include objectives to provide high-energy foods during winter and migration periods after normal hunting seasons have ended. Taking light geese over such areas during a conservation order would create a baited situation, and would be illegal. Therefore, States must choose between providing for the needs of many waterfowl species during critical periods, or allow increased harvest of light geese to control their population size. Baiting has been one of the most controversial issues throughout the history of waterfowl management. This is due primarily to the rapid response of waterfowl species to food availability, thus making them more susceptible to harvest. Manipulation of agricultural crops to make them available to wintering and migrating birds would attract not only light geese but also a variety of other waterfowl species. Allowing the taking of light geese on these manipulated sites may increase harvest of light geese for a short period, but it may also increase the likelihood of non-target species being taken. Furthermore, opening such sites to light goose hunting would create a disturbance to other species, thus making food resources unavailable to them for extended periods. We believe these potential negative impacts to other species outweighs the increase in light goose harvest that might be realized, and therefore will not include changes in baiting regulations as part of our management strategy.

2.2.10 Allow rallying or herding of light geese with the aid of a motorized vehicle or device

Migratory bird hunting regulations prohibit the take of migratory birds by means or aid of any motor-driven land, water, or air conveyance, or any sailboat used for the purpose of or resulting in the concentrating, driving, rallying, or stirring up of any migratory bird (50 CFR Part 20.21 [h]). Additionally, migratory birds may not be hunted by means, aid, or use of aircraft of any kind (50 CFR Part 20.21 [d]). Rallying with the aid of a powered device presents a potential safety hazard to hunters and any person within

range. Furthermore, rallying of birds may result in "flock-shooting" which may cause wounding of large numbers of birds that subsequently are not retrieved. Although the use of these techniques may cause a slight increase in harvest of light geese, we feel that the risk to human safety and the potential for wounding losses of birds are too great to allow their authorization.

2.2.11 Provide supplemental food to light geese on breeding areas

A recommendation was made to alleviate light goose damage to arctic and sub-arctic habitats by providing supplemental food to geese on their breeding grounds. There is no evidence to suggest that light geese would abandon the consumption of preferred natural foods during the breeding period in favor of food supplied artificially. Furthermore, if supplemental food sources are utilized by light geese, it is likely that high population levels will be maintained and recovery of natural vegetation in damaged habitats will be impossible. Maintenance of large, mobile goose populations will also increase the likelihood that intact habitats will be damaged in the future. Therefore, we did not analyze this alternative.

2.2.12 Alter U.S. farm policies to promote reduction of foods available to light geese on wintering and migration areas

The agricultural sector is a critical component of the U.S. economy. In 1999, approximately 143.8 million acres were planted to corn, rice, and wheat, producing a total crop value of over $25 billion (U.S. Dept. Agriculture 2000). In the Mississippi and Central Flyways, approximately 124 million acres were planted to corn, rice, and wheat, and produced $22 billion worth of crops. Reduction of the availability of post-harvest waste grain to light geese on private land would entail significant reductions in the total area planted to such crops. These reductions would seriously impact not only U.S. farmers, but also the U.S. economy in general. The Service has no regulatory control over U.S. farm policies and programs and therefore cannot manipulate the availability of agricultural foods to light geese. Furthermore, the potentially large negative impact of this alternative on the U.S. economy makes it impractical. Therefore, this alternative was not analyzed.

2.2.13 Control light goose populations through use of reproductive inhibitors

Conjugated linoleic acid has been demonstrated to reduce goose egg hatching rates in the laboratory when supplied consistently to birds during the egg formation period (Hill and Craven, unpublished data). However, no effective delivery mechanism has been developed for use in remote field situations on a broad scale. Therefore, researchers have suggested that reproductive inhibitors currently are not a practical method for controlling wild goose populations. Even if reproduction could be prevented, existing goose populations would remain high for many years due to the long life span of adult birds.

2.2.14 Allow commercial harvesting of light geese

The Migratory Bird Treaty prohibits the sale of migratory birds, their nests, and their eggs; except under certain conditions by Aboriginal peoples. Article II of the Treaty states that Aboriginal people in Canada may sell down and inedible by-products of their traditional harvest of migratory birds, but only within or among Aboriginal communities. Article II also provides for the limited sale of inedible by-products of migratory birds taken by indigenous inhabitants of Alaska, if such by-products are incorporated into authentic articles of handicraft. The harvest of such items must be consistent with the customary and traditional uses by indigenous inhabitants for their own nutritional and other essential needs. Such limitations on the commercial sale of light geese prevent this alternative from being an effective avenue for disposing of large numbers of light geese. Expansion of commercial sale of migratory birds by Aboriginal people, or authorization of commercial harvesting by non-Aboriginal people, would require a change in the Treaty. Such changes would entail time-consuming negotiations between the U.S. and Canadian Federal governments, with uncertain results. Many light goose populations would continue to increase during the negotiation period, thus making control more difficult if and when expanded commercial harvesting were eventually authorized. More importantly, the Canadian Wildlife Service has indicated that they do not support development of general commercial activities and take for the purpose of light goose control. They do not wish to establish a short-lived commercial opportunity that could have serious long-term effects on community support for and compliance with regulations. Therefore, we have chosen not to analyze this alternative.

2.2.15 Allow predators to control light goose populations

Major predators of light goose eggs and young include Arctic fox (*Alopex lagopus*), red fox (*Vulpes fulva*), herring gulls (*Larus argentatus*), glaucous gulls (*L. hyperboreus*), and parasitic jaegers (*Stercorarius parasiticus*; Mowbray et al. 2000, Sovada et al. 2001). Other predators include polar bear (*Ursus maritimus*), black bear (*U. americanus*), gray wolf (*Canis lupus*), coyote (*C. latrans*), common raven (*Corvus corax*), sandhill crane (*Grus canadensis*), long-tailed jaeger (*Stercorarius longicaudus*), snowy owls (*Nyctea scandiaca*), and caribou (*Rangifer tarandus*; Mowbray et al. 2000, Sovada et al. 2001). Adult geese do not commonly fall prey to predators (Sargeant and Raveling 1992). The nesting period in the Arctic typically is short and highly synchronized among individuals. The rapid increase in eggs and young available to predators during the nesting season likely overwhelms the ability of predator species to take full advantage of the new food supply (Sovada et al. 2001). Therefore, predation likely has little potential to limit growth of most light goose populations and we chose not to analyze this alternative.

2.3 Rationale for Design of Analyzed Alternatives

All alternatives considered were evaluated in relation to their ability to reduce and stabilize light goose populations, and prevent further degradation of habitats important to light geese and other migratory birds. NEPA regulations require analysis of a No Action alternative. Three additional alternatives were developed for the Draft EIS as a result of our previous EA on light goose management, as well as input received during the scoping phase of the EIS. One of the alternatives proposed to create additional regulatory tools and alter habitat management programs on some of our refuges for the purpose of reducing and stabilizing specific populations of light geese in North America. The remaining two alternatives in the Draft EIS proposed direct control of light goose populations either on the breeding grounds, or on migration and wintering areas.

We received substantial public comment on the Draft EIS concerning the original four alternatives. Several State wildlife agencies and Flyway Councils expressed concern that the alternatives were mutually exclusive and prevented a more integrated approach to management. Specifically, the States and Flyway Councils preferred a program that included the use of direct population control by wildlife agencies, if deemed necessary, to complement harvest of light geese resulting from regulatory tools such as a conservation order. In response to this input, we created and analyzed a fifth alternative that is essentially a combination of alternatives B, C, and D.

2.4 Description of Alternatives

2.4.1 Alternative A. No Action. Continue to manage light goose populations through existing wildlife management policies and practices.

Under the No Action alternative light goose populations would be allowed to increase in size. This alternative would continue to manage light geese through existing wildlife management policies and practices, with the exception of temporary light goose regulations implemented under the Arctic Tundra Habitat Emergency Conservation Act. Traditional harvest of light geese will continue during the regular season and will be managed using existing administrative procedures. Light goose hunting regulations adopted by States will be confined to Federal frameworks that provide for a maximum season length of 107 days, occurring during the period September 1 to March 10 as prescribed by the Treaty (U.S. Fish and Wildlife Service 1988). Existing hunt programs and existing administrative procedures for establishing new hunt programs, on national wildlife refuges administered by the Service will remain in place. Habitat management programs on refuges would continue as normal with regard to the purposes for which each refuge was established.

2.4.2 Alternative B (Preferred Alternative). Modify harvest regulation options and refuge management.

This alternative would modify Title 50 Code of Federal Regulations (*CFR*) Part 20 to allow the use of additional hunting methods to hunt light geese within current migratory bird hunting-season frameworks. We would authorize the use of electronic calls and unplugged shotguns to harvest light geese during normal light-goose hunting seasons when all other waterfowl and crane hunting seasons, excluding falconry, are closed.

This alternative would also create a new Subpart to 50 *CFR* Part 21 specifically for the management of overabundant light goose populations. Under this new Subpart, we would establish a conservation order under the authority of the Migratory Bird Treaty Act with the intent to reduce and stabilize light goose population levels. The conservation order would authorize each State/Tribe in eligible areas to initiate aggressive light goose harvest strategies, within the conditions that we provide, with the intent to reduce the populations. The order will enable States/Tribes to use hunters to harvest light geese, by way of shooting in a hunting manner, during a period when all waterfowl (including light geese) and crane hunting seasons, excluding falconry, are closed, inside or outside the migratory bird hunting season frameworks. The order would also authorize the use of electronic calls and unplugged shotguns, eliminate daily bag limits on light geese, and allow shooting hours to continue until one-half hour after sunset. Due to the dynamic nature of annual migration and wintering patterns of light geese it is not feasible to identify specific sites in the U.S. where harvest of light geese would occur in a given year. However, examination of recent patterns in snow and Ross's goose harvest by county provides a general overview of where goose concentrations and harvest would likely occur in the future (Appendix 4).

The Service will annually monitor and assess the overall impact and effectiveness of the conservation order to ensure compatibility with long-term conservation of this resource. Reduction of light goose populations to management goals will result in numeric levels that still provide abundant opportunities for non-consumptive uses of the resource (e.g. wildlife viewing). If at any time evidence is presented that clearly demonstrates that there no longer exists a serious threat of injury to the area or areas involved for a particular light goose population, we will initiate action to suspend the conservation order, and/or regular-season regulation changes, for that population. Suspension of regulations for a particular population would be made following a public review process. Specific details of light goose regulations under CFR Parts 20 and 21 are presented in Appendix 5. The conservation order will be conducted such that it does not adversely affect other migratory bird populations or any species designated under the Endangered Species Act as threatened or endangered.

Finally, this alternative would alter management practices on some Service national wildlife refuges to decrease the amount of sanctuary and food available to migrating and wintering light geese. The most likely action that a refuge would implement is creating new areas open to light goose hunting, or enlarging areas that currently are open. While some refuges may be opened for migratory bird hunting without area limitation, the National Wildlife Refuge System Administration Act of 1966 stipulates that only 40% of certain refuges may be opened to migratory bird hunting. The Fish and Wildlife Improvement Act of 1978 (Public Law 95-616) amended the 1966 Act to permit the opening of greater than 40% of certain refuges to hunting when it is determined to be beneficial to the species hunted. Following Executive Order 12996 issued on March 25, 1996, Congress enacted the National Wildlife Refuge System Improvement Act of 1997, amending the National Wildlife Refuge System Administration Act of 1966 to establish that compatible wildlife-dependent recreational uses involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation are the priority public uses of the Refuge System. In order to establish a refuge hunt program, a determination must be made that the program is compatible with the major purposes for which the refuge was established (U.S. Fish and Wildlife Service 1986). Establishment of a hunt program includes preparation of the plan itself, an Environmental Assessment, Section 7 consultation in accordance with the Endangered Species Act, and Proposed and Final Rules in the Federal Register (U.S. Fish and Wildlife Service 1986). Each year, we make new proposals for amendments to refuge-specific hunting regulations available for public review and comment in the Federal Register.

Due to the dynamic nature of annual migration and wintering patterns of light geese, as well as changing habitat conditions, we cannot provide a definitive listing of annual management actions that some refuges may implement. Changes to refuge management may also include alteration of habitat programs to reduce food availability for, and make habitats less attractive to, light geese. For example, many refuges have been undertaking reforestation programs. While such programs were not initiated in response to the light goose issue, they will have the added effect of reducing food available to light geese. Some refuges that harbor significant numbers of light geese may choose to alter impoundment water levels in order to create roosting areas and attract birds near hunted sites, or eliminate roosting areas to encourage birds to move to areas where hunting does occur. Reduction of areas planted to agricultural crops on some refuges will also decrease food available to light geese. Modification of prescribed burn programs may also be used to make certain areas on refuges more or less attractive to light geese depending on the size of the burn area. Any uses included with changes in management practices on a particular refuge will be permitted only after they have been determined to be compatible with the purposes for which the refuge was established, and due regard to potential impacts to special status (threatened or endangered) species has been made.

2.4.3 Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

We define direct control as the purposeful removal of large numbers of birds from a population using lethal means. This alternative would implement direct population control to achieve desired light goose population levels. Control efforts would be undertaken by wildlife agencies (Federal and/or State) on light goose migration and wintering areas in the U.S. Under this alternative we would create a special light goose permit within 50 *CFR* Part 21 specifically for the reduction of light goose populations. Regulations governing the issuance of permits to take, capture, kill, possess, and transport migratory birds are authorized by the Migratory Bird Treaty Act and are promulgated in 50 CFR parts 13 and 21. Federal courts have affirmed that all Federal agencies are subject to prohibitions in the Migratory Bird Treaty Act, including the restrictions on take of migratory birds. Executive Order 13186 state that *all* Federal agencies are subject to the provisions of the MBTA. Directors Order 131 clarifies Service policy regarding applicability of the MBTA to Federal agencies and the issuance of permits to agencies, including the Service. Any Federal personnel that undertake light goose management activities that will result in take of light geese must apply for and receive a permit from the appropriate Regional Office of the Service to do so. The permit would allow Federal and State agencies involved in migratory bird management, and/or their authorized designated agents, to initiate light goose population reduction actions within the conditions/restrictions of the program. Permits will be issued to the appropriate Regional Director of the Service that oversees the geographic area in question. The permit will delegate authority to Federal personnel and/or cooperating State wildlife agency personnel that will be involved in control activities.

Applications for the special light goose permit would require a statement from the agency that provides a general description of the action area, an estimate of the approximate number of light geese expected to be found in the action area and the approximate number of light geese that are to be taken. Permit holders would be required to properly dispose of or utilize light geese killed under the program. Light geese killed under this permit could be donated for scientific and educational purposes, or be donated to charities for human consumption. In the absence of such disposal options, geese may be buried or incinerated. Light geese, and their plumage, taken under these permits may not be sold, offered for sale, bartered, or shipped for purpose of sale or barter. Control activities would be undertaken such that they do not adversely affect other migratory bird populations or any species designated under the Endangered Species Act as threatened or endangered.

Agencies may use their own discretion for methods of take. Methods may include, but are not limited to, firearms, traps, chemicals or other control techniques that are consistent with accepted wildlife-damage management programs. The advantage of live-trapping is that non-target species would be released unharmed. Chemical control would be achieved by treating corn or other food with chemicals (e.g., DRC-

1339, Avitrol, or alpha chloralose) and broadcasting the treated bait in areas where light geese are feeding. Currently, these chemicals are not registered for use on light geese. Under this alternative, agencies would apply to the Environmental Protection Agency for use of these chemicals on light geese under a Section 18 Specific Exemption, or a Section 24C registration, under the Federal Insecticide and Rodenticide Act. All chemical control efforts would be used only in areas utilized by large flocks of light geese. This will increase efficiency of the control effort and minimize the take of non-target species, which tend to avoid sites used by large flocks of light geese (J. Cummings, U.S. Dept. Agriculture, personal communication).

Due to the dynamic nature of annual migration and wintering patterns of light geese, we cannot provide a definitive listing of sites where geese would be taken. However, examination of recent patterns in snow and Ross's goose harvest by county provides a general overview of where goose concentrations, and thus control efforts, would likely occur in the future (Appendix 4). By necessity, control efforts will have to be opportunistic with regard to daily and seasonal movements of geese. Sites likely would include agricultural fields and roosting areas near wetlands, preferably on Federal or State wildlife areas where access would not be an issue. Control activities would be undertaken such that they do not adversely affect other migratory bird populations or any species designated under the Endangered Species Act as threatened or endangered.

Permit holders will be required to keep records of all activities performed under the permit and submit annual reports to the Service office that granted the permit. We will annually review such reports and assess the overall impact of this program to ensure compatibility with the long-term conservation of this resource. If at any time evidence is presented that clearly demonstrates that there no longer exists a serious threat of injury to the area or areas involved for a particular light goose population, we will initiate action to suspend the special permits for that population. Specific conditions/restrictions of this permit are outlined in Appendix 6.

2.4.4 Alternative D. Seek direct light goose population control on breeding grounds in Canada.

This alternative would achieve light goose population reduction through direct control on the breeding grounds in Canada. We do not have the authority to unilaterally implement direct population control measures in Canada. However, we have discussed the issue of direct population control with the Canadian Wildlife Service during meetings of the Arctic Goose Joint Venture. The Joint Venture has formed a working group to outline potential methods of direct control if such measures are ever deemed necessary. The working group report by Alisauskas and Malecki (2003) outlined costs of conducting direct control on the breeding grounds. This alternative may or may not involve U.S. wildlife agency participation, depending on the availability of funding and manpower in Canada. Regardless, the Canadian government would be the lead authority under this alternative.

Methods of control would include shooting, trapping, or chemical control. Shooting of birds by sharpshooters would most likely be conducted during the nest incubation period when birds are attentive to nests, and their movements are limited. Personnel would be flown into nesting colonies and would conduct control efforts during the short nest incubation period. Sharpshooters would easily be able to identify bird species before shooting, and thus avoid take of non-target bird species. Capture methods would be employed during the brood-rearing period when young birds have not yet attained flight stage and adult birds are undergoing feather molt. In most instances, capturing of birds would be accomplished by driving birds into capture pens with the aid of helicopters. Birds would be euthanized after being captured. Any non-target bird species caught incidental to light goose trapping would be released. The agency costs of implementing this alternative depend on the distance of the specific breeding colony to the nearest human settlement, the timing of when direct control would occur (nest incubation period or post-hatch), and the fate of birds that are killed (un-retrieved or retrieved for processing).

Chemical control may also be employed during the flightless period when treated baits could be broadcast on sites utilized by large flocks of birds. Chemical types and methods of application would be similar to those outlined in Alternative C. The cost of conducting fieldwork in the Arctic under this alternative is much higher than control efforts in the U.S. To reduce costs, leaving goose carcasses in the field would be an option for consideration. Although we would consider this a waste of the goose resource, the nutrients contained in goose carcasses would be returned to the environment. Alternatively, carcasses could be collected and air-lifted to the nearest available facility for processing.

2.4.5 Alternative E . Two-phased Approach to Light Goose Population Control.

This alternative would achieve light goose population control using an integrated, two-phased approach involving increased harvest resulting from new regulatory tools (e.g. conservation order), changes in refuge management, and direct agency control. Phase one of this alternative is identical to Alternative B, whereas phase two includes elements of Alternatives C and D. In phase one, we would modify Title 50 Code of Federal Regulations (*CFR*) Part 20 to allow the use of additional hunting methods to hunt light geese within current migratory bird hunting-season frameworks. We would authorize the use of electronic calls and unplugged shotguns to harvest light geese during normal light-goose hunting seasons when all other waterfowl and crane hunting seasons, excluding falconry, are closed. In addition, we would create a new Subpart to 50 *CFR* Part 21 specifically for the management of overabundant light goose populations. Under this new Subpart, we would establish a conservation order under the authority of the Migratory Bird Treaty Act with the intent to reduce and stabilize light goose population levels. Specific details of the proposed light goose regulations under CFR Parts 20 and 21 are presented in Appendix 5.

During phase one, we would also alter management practices on some Service national wildlife refuges to decrease the amount of sanctuary and food available to migrating and wintering light geese. The most likely action that a refuge would implement is creating new areas open to light goose hunting, or enlarging areas that currently are open. Changes to refuge management may also include alteration of habitat programs to reduce food availability for, and make habitats less attractive to, light geese.

Although annual monitoring of our program will be conducted (see section 2.3.6), under this alternative we would evaluate the effectiveness of the light goose management program under phase one within 5 years of its initiation and assess the potential need for phase two. Phase two of this alternative incorporates direct agency control of light goose populations as described previously in Alternatives C and D. Direct population control would be implemented for a particular population after we determined that reduction of the population cannot be achieved solely through implementation of regulations, such as a conservation order, and changes in refuge management. Management actions initiated during phase one would be continued in order to compliment population reductions achieved in phase two.

Because we have no jurisdiction over management actions in Canada (Alternative D), this alternative provides that if phase two were needed it would begin with the actions outlined in Alternative C. If additional population control actions were found to be needed we would then approach the Canadian Wildlife Service and urge implementation of actions outlined in Alternative D. Initial direct control efforts would be undertaken by wildlife agencies (Federal and/or State) on light goose migration and wintering areas in the U.S. Under this alternative we would create a special light goose permit within 50 *CFR* Part 21 specifically for the reduction of light goose populations. Permits will be issued to the appropriate Regional Director of the Service that oversees the geographic area in question. The permit will delegate authority to personnel of the Service, other Federal personnel, and/or cooperating State wildlife agency personnel, to initiate light goose population reduction actions within the conditions/restrictions of the program. Control activities would be undertaken such that they do not adversely affect other migratory birds or any species designated under the Endangered Species Act as threatened or endangered. If at any time evidence is presented that clearly demonstrates that there no longer exists a serious threat of injury to the area or areas involved for a particular light goose population, we will initiate action to suspend the special permits for that population. Specific conditions/restrictions of this permit are outlined in Appendix 6.

Agencies may use their own discretion for methods of take. Methods may include, but are not limited to, firearms, traps, chemicals or other control techniques that are consistent with accepted wildlife-damage management programs. The advantage of live-trapping is that non-target species would be released unharmed. Chemical control would be achieved by treating corn or other food with chemicals (e.g., DRC-1339, Avitrol, or alpha chloralose) and broadcasting the treated bait in areas where light geese are feeding. Currently, these chemicals are not registered for use on light geese. Under this alternative, agencies would

apply to the Environmental Protection Agency for use of these chemicals on light geese under a Section 18 Specific Exemption, or a Section 24C registration, under the Federal Insecticide and Rodenticide Act. All chemical control efforts would be used only in areas utilized by large flocks of light geese. This will increase efficiency of the control effort and minimize the take of non-target species, which tend to avoid sites used by large flocks of light geese (J. Cummings, U.S. Dept. Agriculture, personal communication).

Due to the dynamic nature of annual migration and wintering patterns of light geese, we cannot provide a definitive listing of sites where geese would be taken in the U.S. However, examination of recent patterns in snow and Ross's goose harvest by county provides a general overview of where goose concentrations, and thus control efforts, would likely occur in the future (Appendix 4). By necessity, control efforts will have to be opportunistic with regard to daily movements of geese. Sites likely would include agricultural fields and roosting areas near wetlands, preferably on Federal or State wildlife areas where access would not be an issue. Prior to initiation of control efforts on any areas, the presence of threatened or endangered species would be determined in order to prevent potential impacts to such species.

If the combination of phases one and two of this alternative implemented in the U.S. is not successful in achieving desired population reduction goals, further management actions in Canada will be needed. These actions are identical to those outlined in Alternative D. Methods of control would include shooting, chemicals, or capturing. Shooting of birds by sharpshooters would most likely be conducted during the nest incubation period when birds are attentive to nests, and their movements are limited. Personnel would be flown into nesting colonies and would conduct control efforts during the short nest incubation period. Sharpshooters would easily be able to identify bird species before shooting, and thus avoid take of non-target bird species. Capture methods would be employed during the birds' flightless period in summer when they are undergoing feather molt. Capturing of birds would be accomplished by driving birds into capture pens with the aid of helicopters or float planes. Birds would be euthanized after being captured. Any non-target bird species caught incidental to light goose trapping would be released. The agency costs of implementing this alternative depend on the distance of the breeding colony to the nearest human settlement, the timing of when direct control would occur (nest incubation period or post-hatch), and the fate of birds that are killed. Chemical control may also be employed during the flightless period when treated baits could be broadcast on sites utilized by large flocks of molting birds. Chemical types and methods of application would be similar to those outlined in Alternative C.

Once the desired reduction of a particular light goose population is achieved, management actions can be curtailed. However, to prevent a rebound of the population certain maintenance level actions should remain in place. For example, retention of the use of additional hunting methods (electronic calls, unplugged shotguns) to hunt light geese within current migratory bird hunting-season frameworks would maintain

harvest pressure. Temporary reinstatement of a conservation order may be needed in some years to achieve the level of harvest necessary to maintain a population at the desired level.

2.3.6 Light Goose Population Monitoring

Common to all analyzed alternatives is the existence of a variety of light goose population monitoring programs in North America. These programs include annual winter surveys, periodic photo surveys of nesting colonies, and marking of birds with leg bands to estimate goose distribution, and survival and recovery rates. Monitoring of annual light goose harvest would continue through our normal waterfowl harvest surveys and those conducted by the Canadian Wildlife Service. More detailed descriptions of several of these programs are presented in Chapter 3. Information from monitoring programs will enable us to monitor the response of light goose populations to each of the alternatives. For Alternatives B-D, existing population monitoring programs will be used to determine when population reduction programs should be suspended.

Alternatives B, C, and E advocate light goose management on migration and wintering areas in the U.S. Under these alternatives, managers will minimize the risk of impacting lesser snow geese from Wrangel Island, Russia, which have experienced years of poor reproduction due to climatic conditions on their breeding areas. Monitoring of marked birds has indicated that birds from Wrangel Island that migrate to the Pacific Flyway through British Columbia and Washington are geographically separated from western arctic birds, which tend to migrate through Alberta and Saskatchewan (Armstrong et al. 1999). Harvest pressure on Wrangel Islands birds found in eastern Oregon can be reduced by delaying hunting seasons, or control efforts, in the fall. This is possible due to the tendency of Wrangel Island birds to arrive two weeks earlier than western arctic birds in such areas. Furthermore, potential light goose control efforts in the Imperial Valley of southern California will not impact Wrangel Island birds because the area is used primarily by birds from the western Arctic (Armstrong et al. 1999).

The Arctic Goose Joint Venture has prepared science needs documents for greater snow geese (Arctic Goose Joint Venture Technical Committee 2001) and lesser snow and Ross's geese (Arctic Goose Joint Venture Technical Committee 1998). These documents outline expenditures for existing population monitoring programs (described above) and those for programs to be developed in the next several years. New programs include expansion of population monitoring to other colony sites, vegetation mapping of previously un-mapped goose colony areas, vegetation monitoring, and monitoring biodiversity at colony sites. Information provided by such programs will be used in an adaptive management process, whereby managers will learn about the response of light goose populations and their habitats to whatever management alternative is implemented.

2.3.7 Current Light Goose Regulations

Under each alternative that is analyzed, traditional harvest of light geese will continue during the regular season and will be managed using existing administrative procedures. Light goose hunting regulations adopted by States will be confined to Federal frameworks that provide for a maximum season length of 107 days, occurring during the period September 1 to March 10 as prescribed by the Treaty with Canada (USDI 1988). Existing hunting programs, and administrative procedures for establishing new hunting programs, on national wildlife refuges administered by the Service will remain in place.

2.5 Comparison of Analyzed Alternatives

All of the alternatives we analyzed would allow harvest of light geese (Table 2.1). Alternative A (no action) would maintain normal light goose hunting seasons that are regulated through existing administrative procedures. Alternative B (Preferred Alternative) seeks to control light goose populations by increasing harvest within and outside normal hunting season frameworks, and by altering habitat management practices on Service-owned national wildlife refuges. Implementation of a conservation order would allow take of light geese outside of normal hunting season frameworks, while geese are still present on wintering and migration areas in the U.S. Authorization of new methods of take would increase the effectiveness of hunters during normal hunting seasons, as well as the effectiveness of participants in conservation order activities. Alteration of goose habitats and hunting programs on national wildlife refuges would slightly decrease the amount of food and sanctuary available to light geese on wintering and migration areas in the U.S. Alternatives C and D involve direct control of light geese by removing large numbers of birds from the population(s) in a short period of time. The primary difference between Alternatives C and D is whether control of birds occurs in the U.S. or Canada. Alternative E represents an integrated, two-phased approach to management that incorporates aspects of Alternatives B, C, and D. Phase one of Alternative E is identical to Alternative B. If sufficient population reduction is not achieved in phase one, phase two would be considered for implementation. Phase two of Alternative E would begin with implementation of management actions in the U.S. as described in Alternative C. If further population reduction was needed, we would consult with the Canadian Wildlife Service to urge implementation of Alternative D on the breeding grounds.

Table 2.1. Summary of light goose management alternatives to be analyzed.

Actions	Alternative A. No Action.	Alternative B. (Preferred). Modify harvest regulation options and refuge management.	Alternative C. Direct control of light goose populations on wintering and migration areas in U.S.	Alternative D. Direct control of light goose populations on breeding areas in Canada.	Alternative E. Two-phased approach to light goose population control.
Light goose populations	Allowed to increase.	Reduced through harvest.	Reduced by wildlife agencies in U.S.	Reduced by Canadian agencies on breeding grounds with possible U.S. assistance.	Reduced through harvest in phase one. Reduced through harvest and direct agency control in phase two.
Existing light goose harvest regulations	Remain in place.	Remain in place.	Remain in place.	Remain in place.	Remain in place.
New light goose regulations	No new regulations.	New methods of take and creation of a conservation order.	Creation of special light goose permit.	No new U.S. regulations.	New methods of take and creation of a conservation order. Creation of light goose permit for direct control.
Refuge hunt programs	Remain in place. Normal changes occur using existing administrative process.	Expanded.	Remain in place. Normal changes occur using existing administrative process.	Remain in place. Normal changes occur using existing administrative process.	Expanded.
Refuge habitat management	Proceeds as normal.	Modified .	Proceeds as normal.	Proceeds as normal.	Modified.

CHAPTER 3

AFFECTED ENVIRONMENT

3.0 Incorporation of new information received after publication of our Draft EIS on light goose management

Subsequent to our publication of the DEIS on light goose management on September 28, 2001 we continued to monitor the status of light goose populations through a variety of surveys. In addition, we have included newly-published information on the impacts of light geese on various habitats, estimates of the cost of direct population control in arctic and sub-arctic regions, as well as the socioeconomic impacts of non-consumptive use of light geese in Canada. We also have included this new information in our analysis of management alternatives outlined in the EIS (Chapter 4).

With regard to revised information on population status, we have included additional unpublished FWS and CWS survey information to provide the latest estimates of the spring population (Fig. 3.7) and winter index (Fig. 3.11) of greater snow geese. Current estimates of the winter index for MCP light geese (Fig. 3.12), WCFP light geese (Fig. 3.13), CMF light geese (Fig. 3.14), and light geese in the Pacific Flyway (3.15) are provided. As was discussed in our DEIS, these updated indices continue to show that light goose populations remain above desired NAWMP and Flyway Council goals.

Section 3.1.9 of the FEIS contains an expanded explanation of our concern about the impacts of habitat degradation on light goose populations. The need for this additional text arose from a public comment on the DEIS (see FEIS section 7.8, comment 141). The comment stated that the No Action alternative premise that light goose populations would be allowed to increase in size is untenable. In our response to the comment, we indicated that nowhere in the DEIS did we state that light goose populations would increase indefinitely. We stated the possibility that geese would seek out new habitats for food resources after they degraded other sites. The DEIS also raised the possibility that density-dependent regulation of the population would occur (see DEIS section 4.2.1). In the DEIS we cited Abraham and Jeffries' (1997) extensive review of light goose population increases, the effects of light geese on habitats, and the resulting impacts of habitat degradation on light geese themselves. In FEIS section 3.1.9 we have included citations of Cooch et al. (1989), Cooch et al. (1991a, b), Reed and Plante (1997), and Williams et al. (1993). Although we did not include these citations in the DEIS, the papers were discussed in the Abraham and Jeffries (1997) review paper upon which we based much of our concern. The cited papers merely reinforce our concern that light geese will damage breeding habitats to such an extent that food supplies may become depleted, body condition of adult birds and clutch sizes may decline, and goslings could experience slower growth rates or starvation.

Following publication of our DEIS, results of studies on greater snow geese by Feret et al. (2003) and Mainguy (2002) were published. We included results of these studies in the FEIS (section 3.1.10, page 46) because they provide new information on the impact of increased spring harvest of snow geese in Quebec. Years with spring harvest in Quebec may have caused reduced foraging time by geese on farmlands. Consequently, reduced intake of agricultural foods may in turn have caused reduced body condition and possibly reduced goose production later in spring (Ferer et al. 2002, Mainguy 2002). This new information was considered in our analysis of the impacts of management alternatives on light geese; however it did not change our conclusions. The information generated from the new studies reinforces our contention in the DEIS (section 3.1.10) that an agricultural food subsidy can improve body condition and survival of geese, and lead to enhanced productivity and population growth.

The FEIS contains updates from our annual waterfowl harvest surveys (section 3.1.11). Regular season harvest information for greater snow geese was updated (Fig. 3.17) and used to provide more recent estimates of harvest rates for the population (Fig. 3.18, Table 3.3). The additional years of harvest data following publication of the DEIS allowed us to refine our harvest rate estimates for greater snow geese (Table 3.3). At the time of publication of the DEIS there was sufficient information to estimate a harvest rate (16.7%) only for the 1999-2000 period (DEIS pg. 42). With finalized U.S. harvest data for the 1999-2000 regular season, the harvest rate estimate for greater snow geese was revised to 15% (FEIS Table 3.3). Harvest rates during 1999-2005 ranged from 13% to 25% (average 18.5%; FEIS Table 3.3). This new information allowed us to refine our estimates of harvest that would result if the U.S. implemented a conservation order for greater snow geese (Table 4.4). The information did not result in a change in our preferred alternative, and it merely allowed us to refine our prediction of how long a population reduction would take (Fig. 4.1).

We provide updates of regular season and conservation order harvest of CMF light geese in Table 3.4. In our DEIS we utilized preliminary data to estimate total CMF harvest for the 1998/99 and 1999/00 periods, which ranged from 1.0 to 1.3 million birds (DEIS Table 3.3). Our updated estimates for total annual harvest through spring 2005 ranged from 1.1 to 1.5 million birds (Table 3.4). This additional data was considered in our analysis of the impacts of modifying harvest regulations on CMF light geese (FEIS section 4.2.2). The additional data resulted in a slight lowering of the estimated percent increase in harvest resulting from new harvest regulations (Table 4.2); however the new information did not cause us to change our preferred alternative.

With regard to new information in the FEIS related to light goose impacts on habitat, we cite studies published by Jefferies and Rockwell (2002), Handa et al. (2002), and Handa and Jefferies (2000). Jefferies and Rockwell (2002) documented increases in the proportion of bare soil resulting from habitat degradation by light geese in 3 intertidal marshes at La Perouse Bay, Manitoba (Fig. 3.23). Handa et al. (2002)

commented on the short-lived nature of any plant communities that attempt to colonize exposed sediments. Handa and Jefferies (2000) pointed out the difficulties of trying to artificially re-establish marsh plant communities on a large scale. These studies reinforce our DEIS descriptions of habitat degradation and our contention of poor prospects of recovery of such habitats.

In FEIS section 3.3.2 we cited new information from Sherfy and Kirkpatrick (2003) that demonstrated potential light goose impacts on the availability of invertebrate food resources for shorebirds. This new study reinforces our concern expressed in the DEIS that habitat degradation caused by light geese has the potential to affect the ability of other bird species to utilize such habitats.

In our DEIS (section 3.5.2) we cited the lack of information on the economic impact of non-consumptive uses of the light goose resource. Recent information published by CWS (2005) provides insight to the potential economic impact of non-consumptive uses of waterfowl migration through Quebec. An economic impact of more than $19 million (Canadian $) can be attributed to birdwatching activities at four main waterfowl migration areas in Quebec. An additional $5 million was generated annually by 2 greater snow goose festivals, one Canada goose festival, and operation of associated educational centers (CWS 2005). We incorporated this information in our response to comment numbers 163 and 182 in FEIS Chapter 7. We incorporated these impacts in our analysis of each management alternative in section 4.6 of the FEIS; however the new information did not cause us to change our preferred alternative.

3.1 LIGHT GEESE

3.1.1 Definition

The term light geese refers collectively to three taxa in North America: lesser snow geese (*Chen caerulescens caerulescens*), greater snow geese *(C. c. atlantica*), and Ross's geese (*C. rossii*). These taxa are referred to as "light" geese due to their light coloration; as opposed to "dark" geese such as Canada geese (*Branta canadensis*) and white-fronted geese (*Anser albifrons*). Interestingly, there are two color phases of lesser snow geese: the dark phase, typically referred to as "blue" geese, and white phase, typically referred to as "snow" geese or "white" geese. Blue phase lesser snow geese are the same species as white phase lesser snow geese and the two color phases may interbreed. Regardless of the color phase, blue and snow geese are referred to as light geese.

3.1.2 Geographic Distribution of Species

Greater snow geese. — Greater snow geese breed in the eastern Arctic of Canada and migrate southward through Quebec, New York, and New England to their wintering grounds in the mid-Atlantic U.S. (Fig. 3.1).

Ross's geese. — Approximately 90-95% of Ross's geese breed in the Queen Maud Gulf region of the central Arctic (Kerbes 1994). Small numbers of Ross's geese also breed on Banks Island in the western Arctic, along western and southern Hudson Bay, and Southampton and Baffin Islands in the eastern Arctic. Prior to the 1960s, Ross's geese nested primarily in the central arctic region and most birds migrated to wintering areas in California. This species has dramatically expanded its range eastward in recent decades (Ryder and Alisauskas 1995; Fig. 3.1). Examination of the occurrence of Ross's geese in the harvest of the various Flyways (Fig. 3.2) illustrates the range expansion. Ross's geese did not occur in the Central Flyway

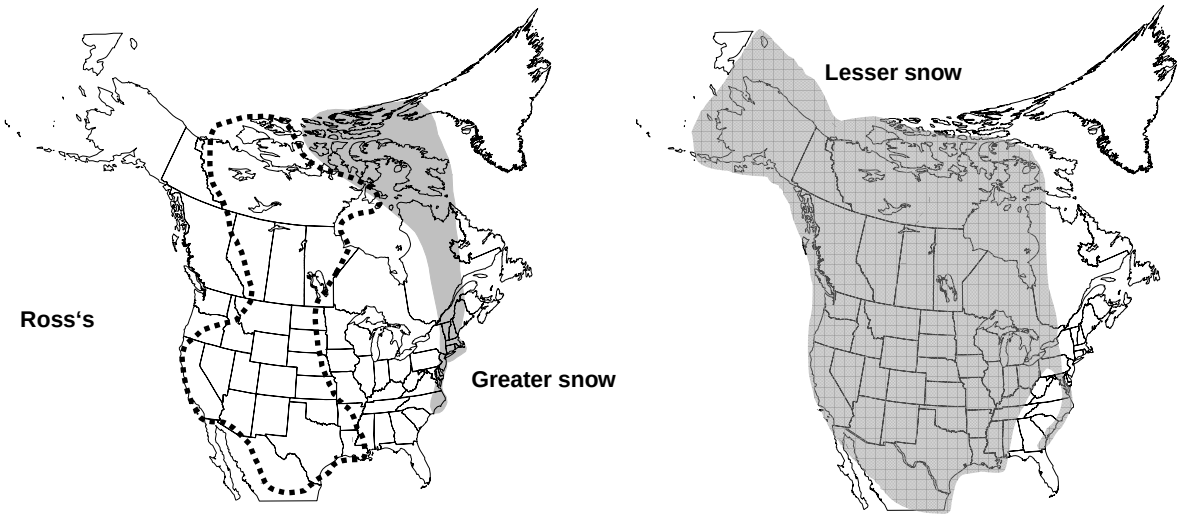


Fig. 3.1. Left. Primary geographic distribution of greater snow (shaded area) and Ross's (dotted line) geese. Right. Primary geographic distribution of lesser snow geese.

harvest survey until 1974, and did not occur in the Mississippi Flyway harvest survey until 1982. The first occurrence of Ross's geese in the Atlantic Flyway harvest was in 1996 (Sharp and Moser 1999). The largest proportion of Ross's geese winters in the Central Valley of California. Smaller numbers of Ross's geese winter in the southwest portion of the Central Flyway, and in Arkansas and Louisiana. Changes in the distribution of recoveries of banded birds further illustrate the range expansion from the 1950s to the 1990s (Table 3.1).

Lesser snow geese. — Lesser snow geese breed throughout much of the arctic region of North America. Additionally, a population that breeds on Wrangel Island, Russia, migrates through Alaska, western Canada, and several western States (Fig. 3.1). The wintering range of this species is broad, with birds nesting in the western Arctic tending to winter in the Pacific Flyway, and birds nesting in the central and eastern Arctic wintering in the Central and Mississippi Flyways (Table 3.1). Small numbers of lesser snow geese winter in the Atlantic Flyway.

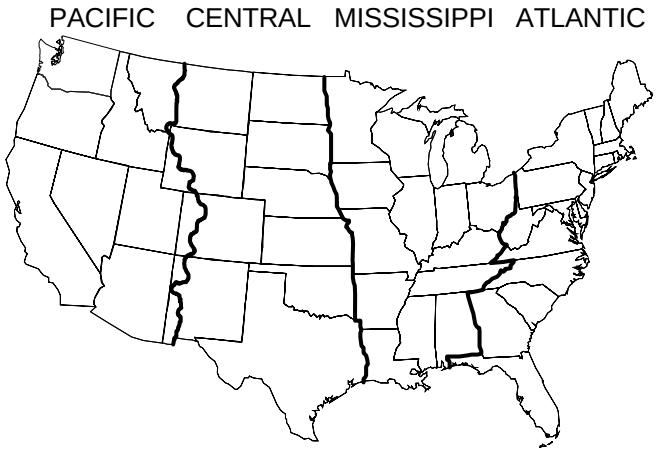


Fig. 3.2. Boundaries of administrative Flyways.

Table 3.1. Distribution of legband recoveries for lesser snow and Ross's geese banded in the western, central, and eastern Arctic by decade, 1950-98. Numbers in parentheses represent sample size for each species by decade. Recoveries are not weighted by population size, nor are they adjusted for differences in band-reporting rates among Flyways.

		Western Arctic[1]					Central Arctic[2]					Eastern Arctic and Subarctic[3]				
Species	Flyway	1950s (0)	1960s (0)	1970s (0)	1980s (0)	1990-98 (0)	1950s (2)	1960s (279)	1970s (274)	1980s (45)	1990-98 (479)	1950s (0)	1960s (7)	1970s (30)	1980s (9)	1990-98 (160)
Ross's	Pacific						100	96	94	87	60		29	3	0	8
	Central						0	3	5	13	32		43	90	100	63
	Mississippi						0	<1	<1	0	8		29	7	0	29
	Atlantic						0	0	0	0	0		0	0	0	0
		(41)	(648)	(448)	(190)	(334)	(0)	(25)	(42)	(34)	(409)	(3,293)	(8,685)	(16,328)	(9,810)	(3,603)
Lesser	Pacific	95	95	96	84	87		4	10	0	2	<1	<1	<1	<1	<1
	Central	5	5	4	15	11		88	80	82	61	78	70	70	74	63
	Mississippi	0	0	0	1	2		8	10	18	37	22	30	30	25	37
	Atlantic	0	0	0	0	0		0	0	0	0	0	0	0	<1	<1

[1] Area between 115° and 140° W longitude, above 65° latitude.

[2] Area between 95° and 115° W longitude, above 65° latitude.

[3] Area east of 95° W longitude.

3.1.3 Population Delineation

Waterfowl management activities frequently are based on delineation of populations that are the focus of management. In most instances, populations are delineated according to where they winter, whereas others are delineated based on location of their breeding grounds. For management purposes, populations can be comprised of one or more species of geese that generally breed and/or winter in similar areas. For example, lesser snow geese and Ross's geese in the central portion of North America are frequently found in the same breeding, migration, and wintering areas. Due to these similarities, the term "light goose population" is used to refer to various populations comprised of both lesser snow geese and Ross's geese, as described below. In descriptions of geographic areas, eastern Arctic refers to the area east of approximately longitude 95 ^{o} W; the central Arctic refers to the area between 95^{o} W and approximately 115^{o} W and the western Arctic refers to the area west of 115^{o} W (Fig. 3.3). Administrative Flyway boundaries also are used to describe population ranges (Fig. 3.2).

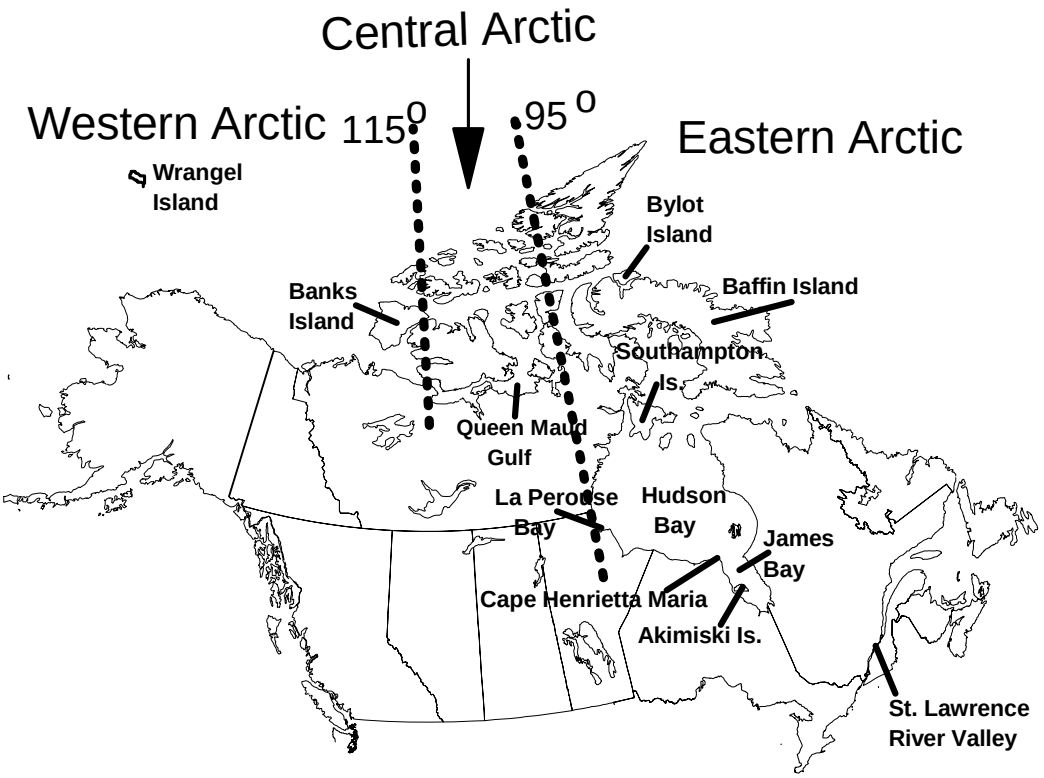


Fig. 3.3. Major arctic and subarctic geographic features referenced in text, with approximate 95 and 115 degrees longitude labeled to designate eastern, central and western arctic regions.

Greater snow geese. — A single population of greater snow geese is recognized in North America. The population is relatively isolated from other light goose populations, except for potential mixing with small groups of lesser snow geese in the central portion of the Atlantic Flyway (Fig. 3.1).

Mid-Continent Population (MCP) of light geese. — This term is used to describe light geese (lesser snow and Ross's geese) that migrate primarily through North Dakota, South Dakota, Nebraska, Kansas, Iowa, and Missouri, and winter in Arkansas, Louisiana, Mississippi, and eastern, central, and southern Texas (Fig. 3.4). MCP birds nest in colonies along the southern and western shores of Hudson Bay and on Southampton and Baffin Islands in the eastern Arctic, and in the Queen Maud Gulf region of the central Arctic (Fig. 3.3). Field studies conducted in Texas during winter indicate that MCP light geese are comprised of approximately 94.3% lesser snow geese and only 5.7% Ross's geese (Sullivan 1995).

Western Central Flyway Population (WCFP) of light geese. — WCFP light geese winter in southern Colorado, northwestern Texas, New Mexico, and the Northern Highlands of Mexico (Hines et al. 1999). WCFP light geese nest primarily in the central and western Canadian Arctic (Fig. 3.4), with nesting colonies on Banks Island (mostly lesser snow geese, with some Ross's geese) and Queen Maud Gulf (mostly Ross's geese, with some lesser snow geese). Observations of birds marked with neck collars indicate that 2.4 % of lesser snow geese from the central Arctic, and 24% of lesser snow geese from the western Arctic, migrate to WCFP wintering areas (Hines et al. 1999). Neck collar data are not available for Ross's geese. Overall, the WCFP is comprised of approximately 79% lesser snow geese and 21% Ross's geese (Thorpe 2000).

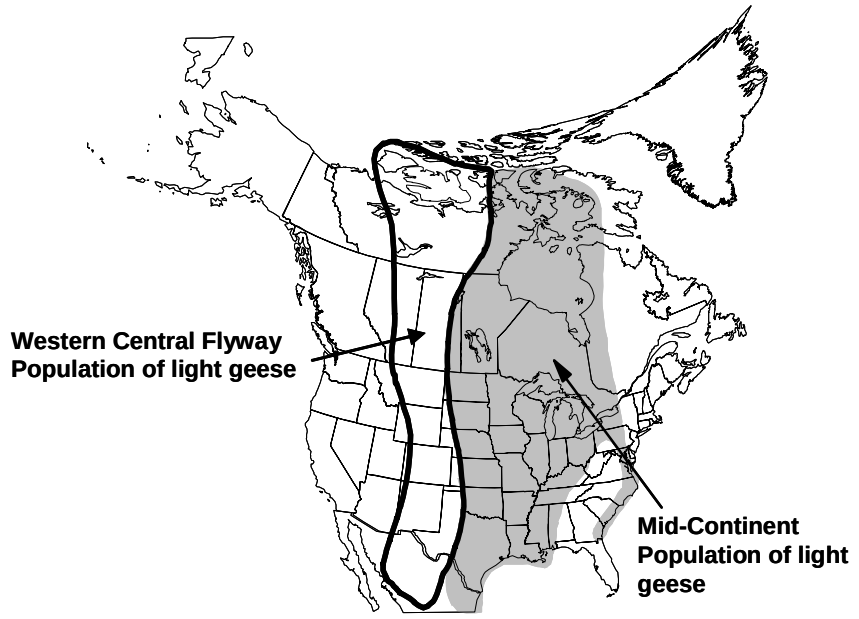


Fig. 3.4. Geographic distribution of the Mid-Continent Population and Western Central Flyway Population of light geese (Lesser snow and Ross's geese, combined).

MCP and WCFP light geese confine most of their migration and wintering activities to the Mississippi and Central Flyways. For this reason, these 2 populations were collectively referred to as Mid-Continent Light Geese (MCLG) in our previous Environmental Assessment (U.S. Fish and Wildlife Service 1999a). However, the term Mid-Continent Light Geese often was confused with the term Mid-Continent Population (MCP) of light geese. In order to eliminate such confusion, we have chosen to refer to the combination of MCP and WCFP birds as Central/ Mississippi Flyway (CMF) light geese.

Unlike the Central and Mississippi Flyways, there are no formal population designations of light geese in the Pacific Flyway; with the exception of the population of lesser snow geese that breed on Wrangell Island, Russia and migrate to the Pacific Flyway. In the absence of accepted population definitions, and for the purposes of this document, we have developed designations for lesser snow and Ross's geese that breed in the central or western Arctic and migrate to the Pacific Flyway.

Western Population of Ross's geese (WPRG). — We have chosen this designation for those Ross's geese that migrate to the Pacific Flyway; primarily to the Central Valley of California (Fig. 3.5). Birds of the WPRG nest mainly in the Queen Maud Gulf region of the central Arctic, with some birds nesting on Banks Island in the western Arctic. The WPRG comprises the largest percentage of wintering Ross's geese in the U.S. However, the percent of band recoveries of central Arctic Ross's geese that occur in the Pacific Flyway has declined from nearly 100% in the 1950s and 1960s, to 60% during 1990-98 (Table 3.1).

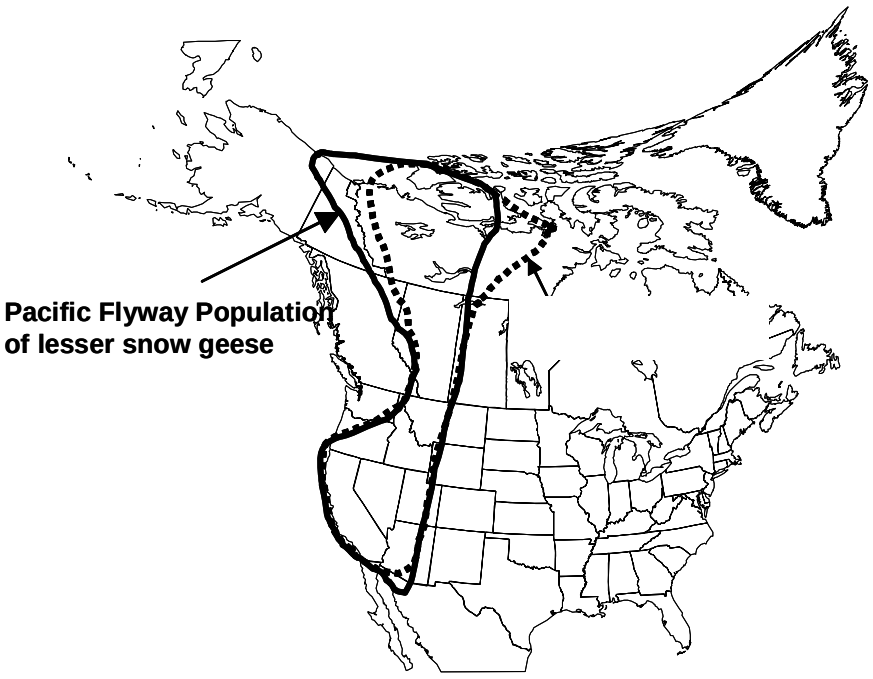


Fig. 3.5. Primary geographic distribution of the Western Population of Ross's geese (dashed line) and the Pacific Flyway Population of lesser snow geese (solid line).

Pacific Flyway Population of lesser snow geese (PFSG). — PFSG winter in the Pacific Flyway and nest primarily on Banks Island, and coastal river deltas on the mainland at Anderson River and Kendall Island in the western Arctic (Fig. 3.5). Neck collar observations indicate that approximately 76% of lesser snow geese that nest in the western Arctic migrate to PFSG wintering areas (Hines et al. 1999). Very few lesser snow geese banded in the central and eastern Arctic are recovered in the Pacific Flyway (Table 3.1).

Wrangel Island Population of lesser snow geese. — This population nests on Wrangel Island off the north coast of Russia, and winters in southern British Columbia, the Puget Sound area of Washington, and in northern California (Fig. 3.6).

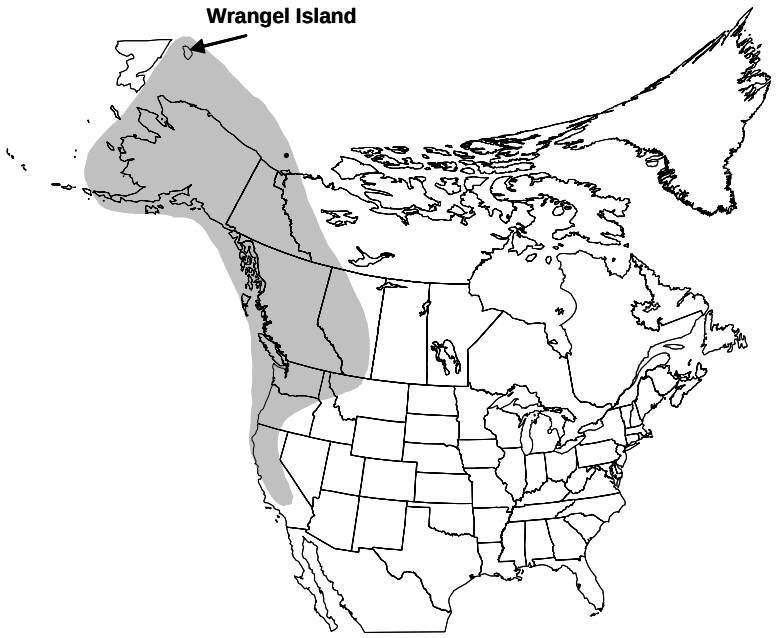


Fig. 3.6. Primary geographic distribution of the Wrangel Island Population of lesser snow geese.

3.1.4 Population Surveys

The status of light goose populations in North America is monitored using a combination of aerial and ground surveys conducted on breeding, migration, and wintering areas. Due to the difficulty of conducting surveys throughout the vast arctic region, light goose breeding colonies (primarily lesser snow geese and Ross's geese) are monitored on a 5-year rotating basis using low-level aerial photography (Kerbes 1994, Kerbes et al. 1999). Therefore, estimates of the number of breeding birds at each colony are not available every year. Surveys of breeding colonies provide estimates of the number of nesting birds, but not the number of non-breeding birds (primarily 1- and 2-year olds). Consequently, the total population size in spring is higher than breeding colony estimates. On the average, snow goose populations are considered to have 25-35% non-breeders in spring (Kerbes et al. 1999). Therefore, the total population size may be 1.3 to 1.5 times greater than breeding colony estimates indicate.

The size of the population of greater snow geese is estimated each spring (1965-present) when the entire population is staging in the St. Lawrence River Valley during northward migration (Reed et al. 1998). Recently, monitoring of radio-marked birds has been used to determine the percentage of birds that have dispersed outside the surveyed areas. The photo survey estimate is then corrected for the percentage of birds outside the survey coverage. By taking advantage of the concentration of the entire population at one point in time, this survey is a reliable method for monitoring population size of this species.

Mid-winter waterfowl surveys are conducted each year throughout the entire lower 48 States in the U.S. These surveys began in some areas as early as the 1930s; however, consistent survey coverage and data summarization began in 1955. Biologists did not begin separate inventories of MCP and WCFP light geese until the winter of 1969/70. Therefore, during 1955-1969, the CMF light goose count could not be separated into MCP and WCFP components.

Because not all areas in each State are surveyed, the mid-winter survey does not provide a complete population estimate for light geese. Instead, the survey provides an index to the winter population of geese, which should not be confused with the size of the breeding population. Past photographic inventories of eastern arctic nesting colonies suggested that winter indices averaged about half of the actual spring population estimate (Kerbes 1975). Boyd et al. (1982) used a correction factor of 1.6 to apply to winter indices to estimate the approximate size of the spring breeding population.

Surveys of light geese wintering in Mexico are conducted every 3 years. Therefore, a complete winter inventory of WCFP light geese is obtained every 3 years. However, WCFP light geese that occur in the U.S. are surveyed every winter in Central Flyway States. By maintaining similar survey methods from year to year, the winter index is utilized to monitor the relative size of the various populations each year. Because U.S. winter index data are available every year for most light goose populations (versus every 5 years for arctic breeding colony data), the winter index is utilized to annually monitor populations and aid in making many management decisions.

3.1.5 Population Status - Historical Accounts

Estimates of the size of light goose populations prior to the advent of modern aerial surveys (i.e. pre-1955) do not exist. There were no coordinated, simultaneous air or ground surveys conducted over the majority of light goose breeding or wintering ranges prior to 1955. Bent (1962:164-188; reprint of original 1925 publication) presents several accounts of observations of greater snow geese, Ross's geese, and lesser snow geese (distinguished as snow and blue geese) during winter, migration, and breeding periods. Some of these accounts allude to large numbers of birds concentrated over large areas; however, few report actual numbers of birds observed. Furthermore, observer variability cannot be adequately assessed from the accounts. The variability in observers' frames of reference to flock size is illustrated by comments of M.

Frazar and Harrison Lewis (Bent 1962:174). M. Frazar wrote a letter describing a "large flock" of greater snow geese he saw in 1908 that was comprised of "at least 75 birds." Lewis wrote of C. Dionne's reference to "considerable flocks" of snow geese comprised of "three or four thousand individuals." In this situation, 2 observers are referring to seemingly large flocks of birds, but the actual number of birds may be as low as 75, or as high as 3,000 to 4,000 birds. This variability in descriptions illustrates the difficulty in trying to compare historical, anecdotal accounts of light goose abundance with population estimates derived from standardized aerial surveys.

McIlhenny (1932) reported observing a flock of blue-phase snow geese in March 1914 that was estimated to contain 1.25-1.5 million birds. The methodology used to obtain the estimate was not specified. Prior to the 1960s, snow geese wintered almost exclusively in salt marsh habitats on the Gulf Coast (Lynch 1975, Bateman et al. 1988). In fact, McIlhenny (1932) felt that at least 70% of all wintering blue-phase lesser snow geese inhabited the marsh habitats near where his observations were made. By early March, the snow geese on the Gulf Coast seemed to gather into only 2 or 3 flocks (McIlhenny 1932). Therefore, it is not surprising that large flocks of birds were encountered in the first part of the 20th century. Lynch (1975) wrote that the number of geese wintering on the Gulf Coast prior to the advent of rice culture is unknown and is a matter of conjecture.

Johnsgard (1974) felt that early 20th century goose population estimates were either wildly optimistic, or the number of snow geese in the mid-continent region declined greatly in subsequent decades. If early anecdotal accounts of flock sizes were accurate, it is unclear why coordinated winter surveys several decades later accounted for far fewer birds. The 1954/55 winter count of light geese (primarily lesser snow geese) in the Mississippi Flyway was only 368,000 birds. There are no reports of large die-offs of geese between the early part of the 20th century and the advent of winter surveys in the mid-1950s. Furthermore, market hunting had been prohibited in 1918 with passage of the Migratory Bird Treaty Act. Therefore, evidence of large-scale declines in goose populations after the early 20th century does not exist. Evidence of arctic nesting colonies of sufficient size to corroborate early 20th century reports of large goose populations on wintering grounds also is lacking (Abraham and Jefferies 1997).

We do not question the observational abilities of the few naturalists that wrote about flocks of light geese in the mid-continent region near the turn of the 20th century. Nor do we doubt that they often encountered flocks of light geese that were of considerable size. However, it was impossible to obtain accurate range-wide estimates of light goose population size during the pre-survey period. Therefore, we have every reason to believe that current numbers of light geese in the mid-continent region are unprecedented.

In the early 20th century, Ross's geese were considered to be the rarest goose species that visited the U.S. (Bent 1962). Although locations of the species' breeding colonies were unknown, the principal wintering grounds were limited to the interior valleys of California. No population estimates were made in the early 20th century, although Bent (1962) cites a report of a flock of "several thousand individuals" on the Missouri River in Montana in April 1885.

Early explorers wrote of "many thousands of white and grey geese" near present-day Quebec City in 1535, and "many wild white geese" in the same region in 1663-64 (Abraham and Jefferies 1997). It is presumed that such birds were greater snow geese. Bent (1962) cites a 1906 report by C.E. Dionne of 5,000-6,000 geese on fall and spring migration areas in Quebec that represented "probably all the greater snow geese in a wild state." The limited information available suggests a gradual increase from about 2,000 birds in the early 1900s to approximately 20,000 birds by 1941 (Reed et al. 1998). Clearly, present-day population levels of greater snow geese are unprecedented in recorded history.

3.1.6 Population Status - Spring/Breeding Colony Survey Estimates

Estimation of the spring population of greater snow geese is straightforward, because most birds are encountered during the photo survey in the St. Lawrence Valley. However, determination of the number of breeding lesser snow and Ross's geese in various populations is problematic, because populations are named based on wintering ground affiliation. For example, MCP light geese are comprised of birds that breed in the eastern and central Arctic. WCFP light geese are comprised of birds that breed in the central and western Arctic. Because photo surveys of breeding colonies for a particular region are conducted every 5 years, simultaneous estimates from 2 different portions of a population's breeding range may be lacking. Therefore, we have chosen to present breeding population estimates for lesser snow and Ross's geese for the eastern, central, and western Arctic regions; rather than providing estimates for populations that are named based on wintering ground affiliation.

Greater snow geese. — The spring population estimate of greater snow geese increased from approximately 25,400 birds in 1965, to a preliminary estimate of 1,016,900 birds in 2006 (Reed et al. 1998, Reed et al. 2000; Canadian Wildlife Service, unpublished data; Fig. 3.7). The population growth rate during 1965-2006 was 8.0 % per year, which if sustained will result in a population over 2 million by 2015, and nearly 3 million by 2020. The Atlantic Flyway Council population objective, as well as the North American Waterfowl Management Plan (NAWMP) spring population goal for greater snow geese is 500,000 birds (U.S. Dept. of the Interior et al. 1998). Therefore, the preliminary population estimate for 2006 is 103 % higher than the Atlantic Flyway Council and NAWMP goals. The Arctic Goose Habitat Working Group

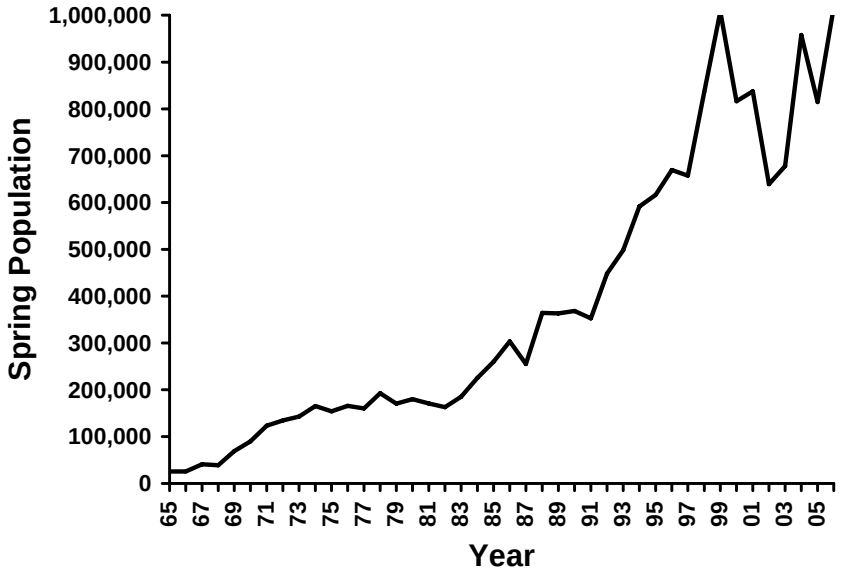


Fig. 3.7. Population growth of greater snow geese as measured by photo-inventories during spring migration in the St. Lawrence River valley, 1965-2006 (Canadian Wildlife Service, unpublished data). The 2006 estimate is considered preliminary as of July 2006.

recommended a short-term management goal of stabilizing the greater snow goose population at between 800,000 to 1 million birds (Giroux et al. 1998). However, a reduction of the population below this level was recommended if natural habitats continue to deteriorate, or if measures taken to reduce crop depredation do not achieve desired results (Giroux et al. 1998). The Canadian Stakeholders Committee in Quebec adopted a population goal of 500,000 birds to address continued habitat degradation and agricultural depredations in the St. Lawrence valley (Arctic Goose Joint Venture Technical Committee 2001).

Light geese in the eastern Arctic. — The number of breeding lesser snow geese on surveyed colonies in 1973 was approximately 1,057,400 birds (Kerbes 1975; Fig. 3.8). During 1973-97, the number of breeding lesser snow geese increased at an annual rate of 4.7%, to the most recent estimate of 3,010,200 birds (Table 3.2). Including additional non-breeding birds, the minimum total number of lesser snow geese in the eastern Arctic was nearly 4 million birds in 1997. The number of Ross's geese in the eastern Arctic has increased from 2,000 birds in 1990, to 52,000 birds in 1998 (Table 3.2). Population goals for light geese that breed in the eastern Arctic are developed based on their wintering ground affiliation; hence there is no general numeric goal for lesser snow or Ross's geese that breed in the eastern Arctic.

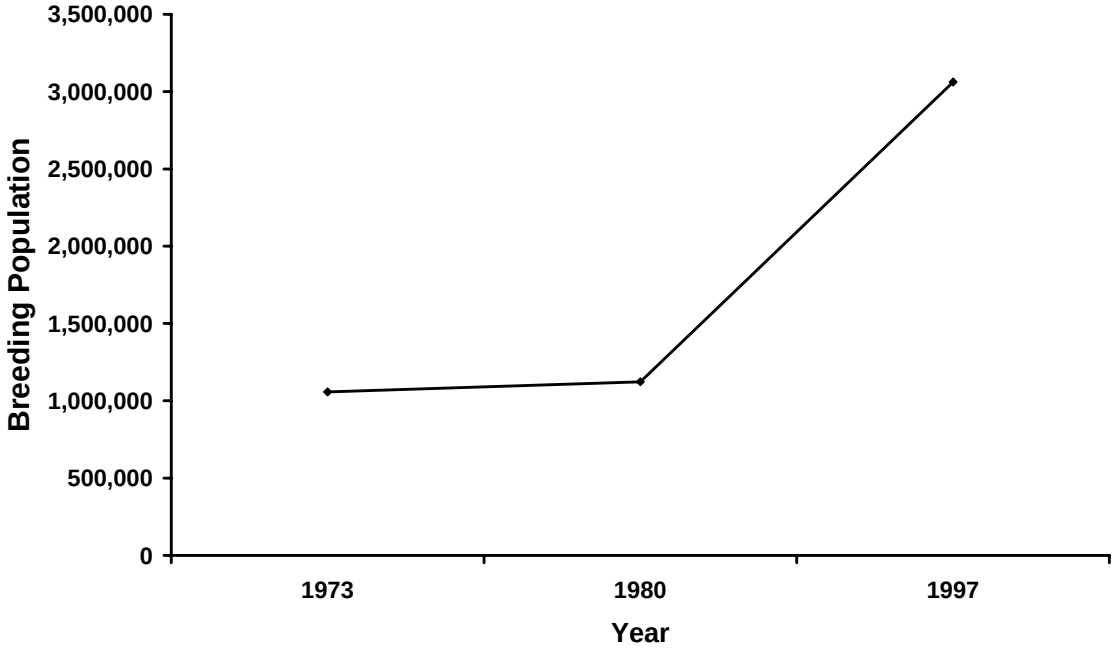


Fig. 3.8. Lesser snow goose population estimates from breeding colonies in the eastern Arctic, determined from photo inventories, 1973-97 (Kerbes 1975, Canadian Wildlife Service, unpublished data). Population estimates do not include Ross's geese or non-breeding birds.

Light geese in the central Arctic. — In 1966, the number of breeding light geese on surveyed colonies in the central Arctic was 44,300 birds (Kerbes 1994; Fig. 3.9). During the period 1966-98, the number of breeding light geese increased at an annual rate of 11.0%, to the current estimate of 1,383,200 birds (Table 3.1). Lesser snow and Ross's geese comprised 59% and 41%, respectively, of the total number of breeding geese in 1998 (Table 3.2). Including additional non-breeding birds, the minimum total number of light geese in the central Arctic was nearly 1.8 million birds in 1998. Population goals for light geese that breed in the central Arctic are developed based on their wintering ground affiliation; hence there is no general numeric goal for lesser snow or Ross's geese that breed in the central Arctic.

Light geese in the western Arctic. — The number of breeding lesser snow geese on surveyed colonies in 1976 was estimated to be 169,600 birds (Kerbes et al. 1999; Fig. 3.10). During the period 1976-2002, the number of breeding lesser snow geese increased at an annual rate of 5.2%, to the most recent estimate of 579,700 birds (Canadian Wildlife Service, unpublished data; Table 3.2). Including additional non-breeding birds, the minimum total number of lesser snow geese in the western Arctic was approximately 753,700 birds in 2002. Ross's geese are not commonly found on breeding colonies in the western Arctic; however, small numbers are found on Banks Island. Population goals for light geese that breed in the western Arctic are developed based on their wintering ground affiliation; hence there is no general numeric goal for lesser snow or Ross's geese that breed in the western Arctic.

Table 3.2. Breeding adult lesser snow and Ross's goose population estimates as determined from aerial photo inventories, 1966-99 (compiled by R. Kerbes, CWS, and CWS unpublished data). Inclusion of estimates of non-breeding adults would increase population estimates by 30%.

	Lesser snow geese									Ross's geese		
				Eastern Arctic								
Year	Wrangel Island[1]	Western Arctic	Central Arctic	Baffin Island	Southampton Island	West Hudson Bay	La Perouse Bay	Cape Henrietta Maria	Total	Central Arctic	Eastern Arctic	Total
1966			10.300							34.000		34.000
1973	86,000			446,600	155,800	390,200	5,600	59,200	1,057,400			
1976	58,000	169,900	56,400							77,300		77,300
1977	68,200					353,200						
1978	65,400					331,800						
1979	84,500			454,800	233,000			109,200				
1980	90,700					309,200	17,000		1,123,200			90,800
1981	89,000	207,500										
1982	100,00		105,700							90,800		
1985	85,000					436,400	28,100					
1987	100,00	205,100										
1988	80,000		279,000							188,000		
1990	60,000					201,900	46,400				2,000	190,000
1995	65,000	486,100										
1997				1,766,500	715,900	153,500	66,000	280,200	3,010,200			
1998			816,100							567,100	52,000	619,100
1999												
2000	95,000											
2002		579,700										

[1] Estimates for Wrangel Island represent total birds, including yearlings and non-breeding birds (Kerbes et al. 1999). Number of breeding birds varies widely depending on spring conditions.

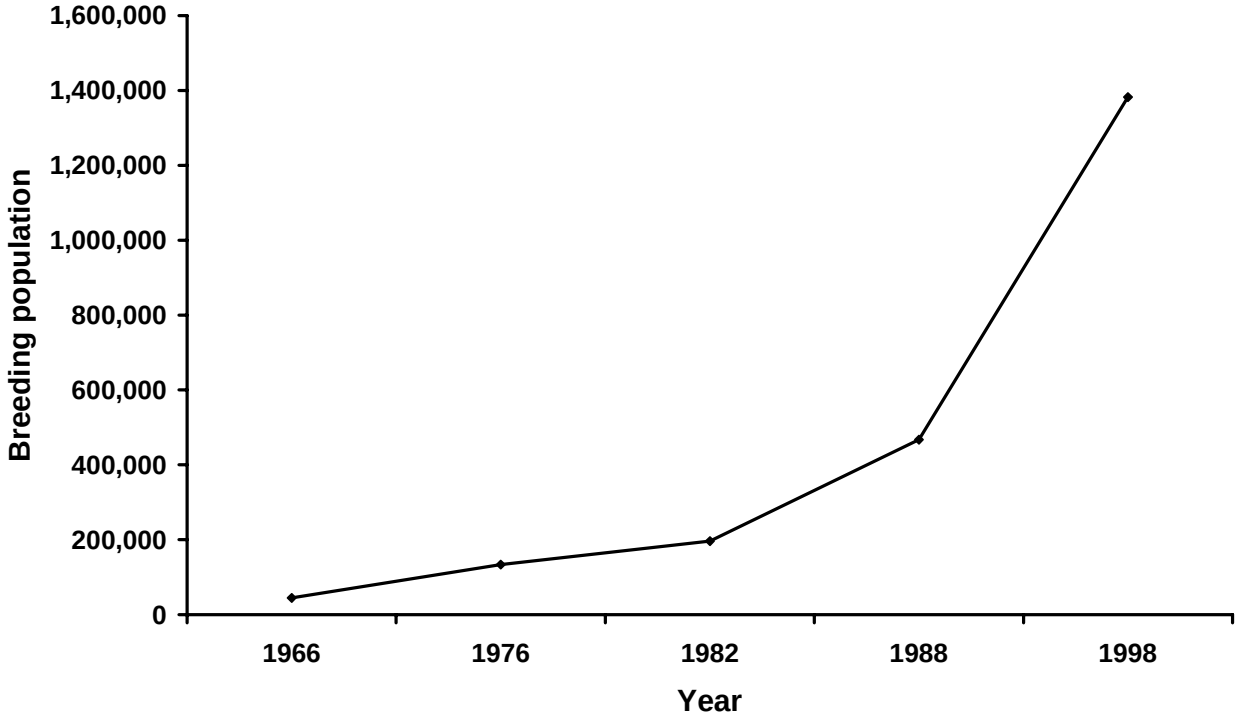


Fig. 3.9. Light (lesser snow and Ross's) goose population estimates from breeding colonies in the central Arctic as determined from photo inventories, 1966-98 (Kerbes 1994, Canadian Wildlife Service, unpublished data). Population estimates do not include non-breeding birds.

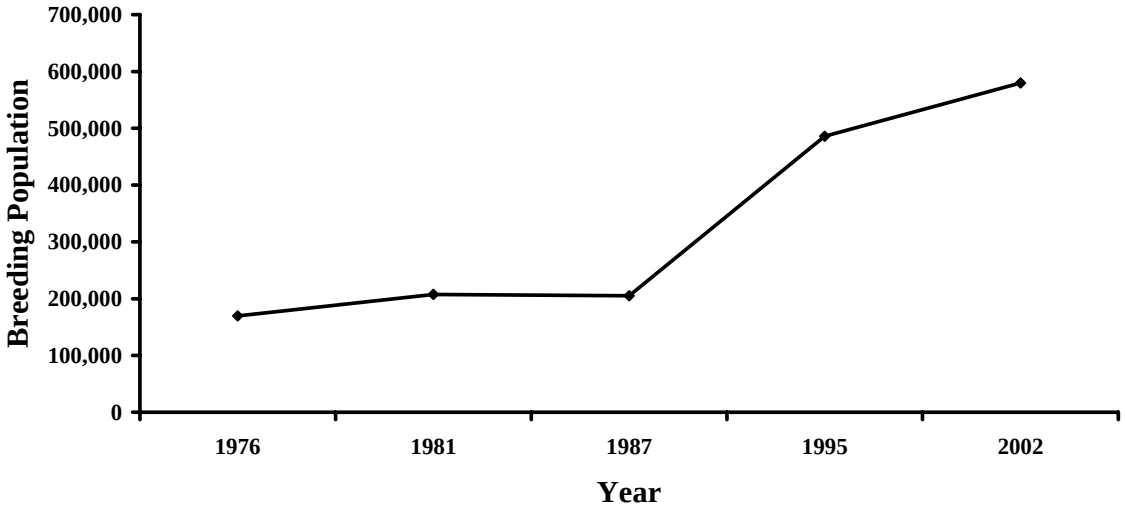


Fig. 3.10. Lesser snow goose population estimates from breeding colonies in the western Arctic as determined from photo inventories, 1976-2002 (Kerbes et al. 1999, Canadian Wildlife Service, unpublished data). Population estimates do not include non-breeding birds.

Wrangel Island Population of lesser snow geese. — The total population (breeders and non-breeders) of lesser snow geese on Wrangel Island declined from approximately 150,000 birds in 1970 to 56,000 birds in 1975, due to four consecutive years of poor reproductive success (Kerbes et al. 1999). The population increased during the 1980s to nearly 100,000 birds, but averaged only about 65,000 birds in the mid-1990s. In recent years the population size has increased, and was approximately 115,000 birds in 2005 (U.S. Fish and Wildlife Service 2005).

3.1.7 Population Status - Winter Survey Indices

Greater snow geese. — The winter index of greater snow geese has increased from approximately 46,000 birds in 1955, to approximately 385,000 birds in 2006 (U.S. Fish and Wildlife Service, unpublished data; Fig. 3.11). The index has been as high as 465,000 birds in recent years. The winter survey is a useful tool for providing information on the winter distribution of snow geese in the Atlantic Flyway. However, the winter survey counts a smaller proportion of the population than does the spring survey.

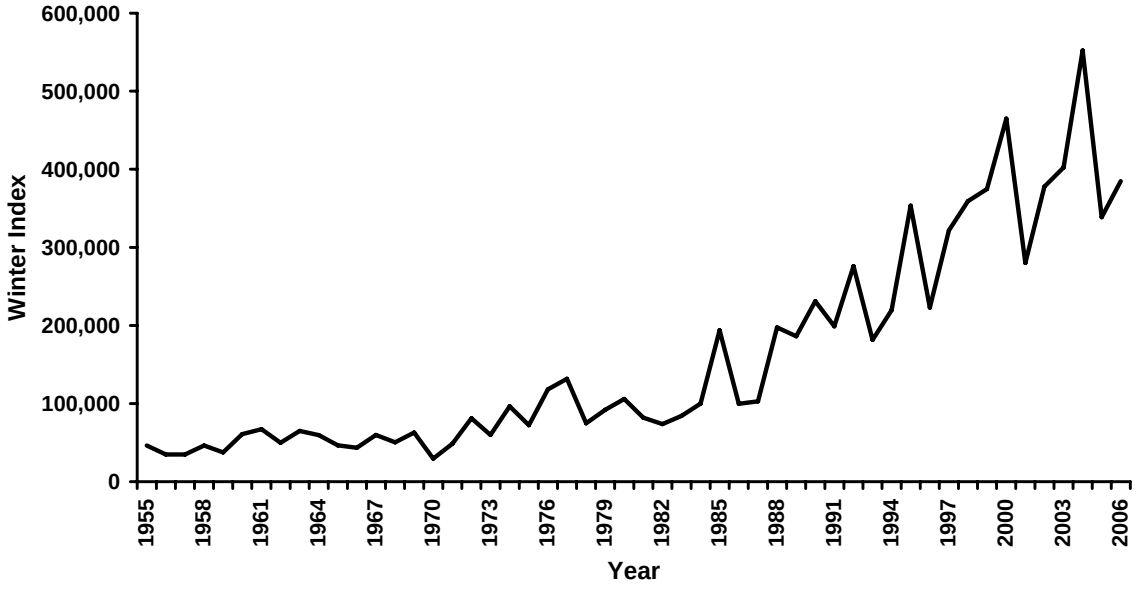


Fig. 3.11. Winter index of greater snow geese in the Atlantic Flyway, 1955-2006.

Mid-continent Population (MCP) of light geese. — The winter index of MCP light geese increased at a rate of 3.5% per year from approximately 777,000 birds in 1970, to a peak of nearly 3 million birds in 1998 (Fig. 3.12; U.S. Fish and Wildlife Service 2002). Following implementation of the conservation order in 1999, the winter index declined to 2.2 million in 2006. Field studies indicate that MCP light geese wintering in Texas are comprised of approximately 94% lesser snow geese and 6% Ross's geese (Sullivan 1995). Surveys conducted in Louisiana during 2001 and 2002 indicated that lesser snow geese comprised 90-98%, and Ross's geese 2-10% of light geese wintering in the state (Helm 2002). Using the average of

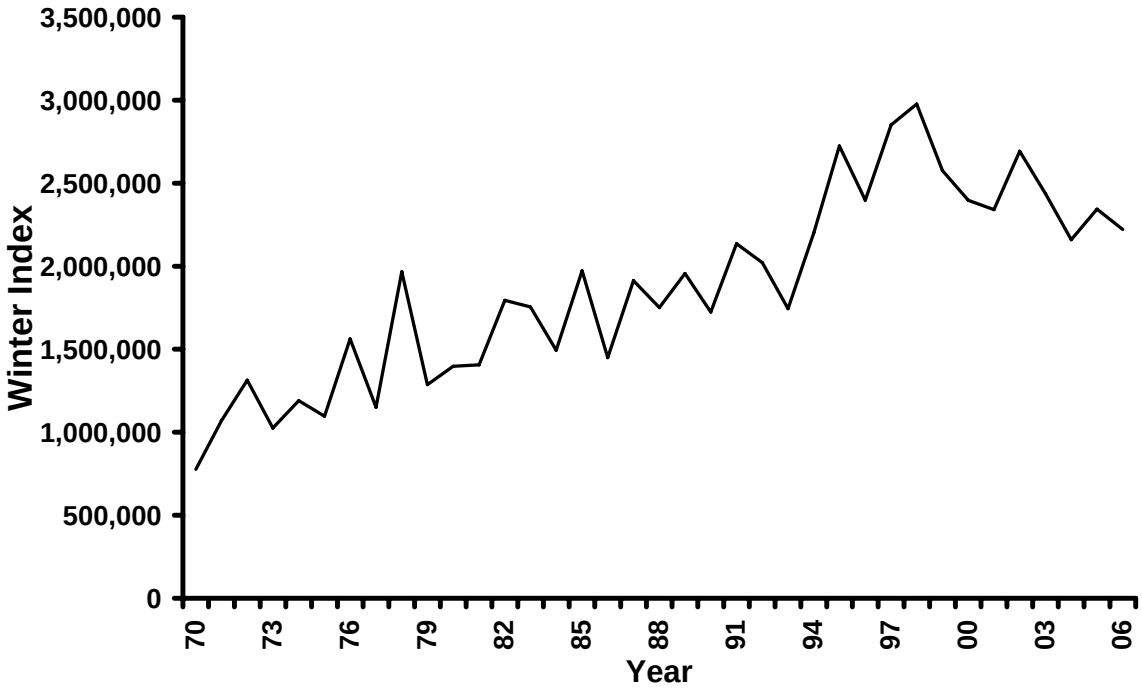


Fig. 3.12. Winter index of the Mid-Continent Population of light geese, 1970-2006.

species composition in Texas and Louisiana, the lesser snow and Ross's goose portions of MCP light geese in winter 1998 were approximately 2.8 million and 179,000 birds, respectively. The NAWMP winter index goal for MCP lesser snow geese is 1 million, and the Central and Mississippi Flyway Councils have set an upper management threshold (winter index) of 1.5 million for MCP lesser snow geese. The peak of the lesser snow goose winter index in 1998 was 198% higher than the NAWMP goal, and 98% higher than the management threshold adopted by the Flyway Councils. The 2006 winter index of lesser snow geese remained 109% higher than the Flyway Council management threshold and 39% higher than the NAWMP goal. There is no Flyway Council or NAWMP goal for Ross's geese in the MCP geographic range.

Western Central Flyway Population (WCFP) of light geese. — The winter index of WCFP light geese increased from 42,000 birds in 1970, to approximately 256,000 birds in 2000 (Fig. 3.13; Sharp and Moser 2000). During 1970-2000, the WCFP winter index increased 6.5% per year. Surveys were not flown in Mexico in 1998 or 1999 prior to implementation of the conservation order. Therefore, a complete WCFP winter index for the U.S. and Mexico was not available in 1998 to compare with the MCP peak that occurred in that year. As a result of increased harvest due to the light goose conservation order, the 2006 WCFP winter index has declined to approximately 228,000 birds.

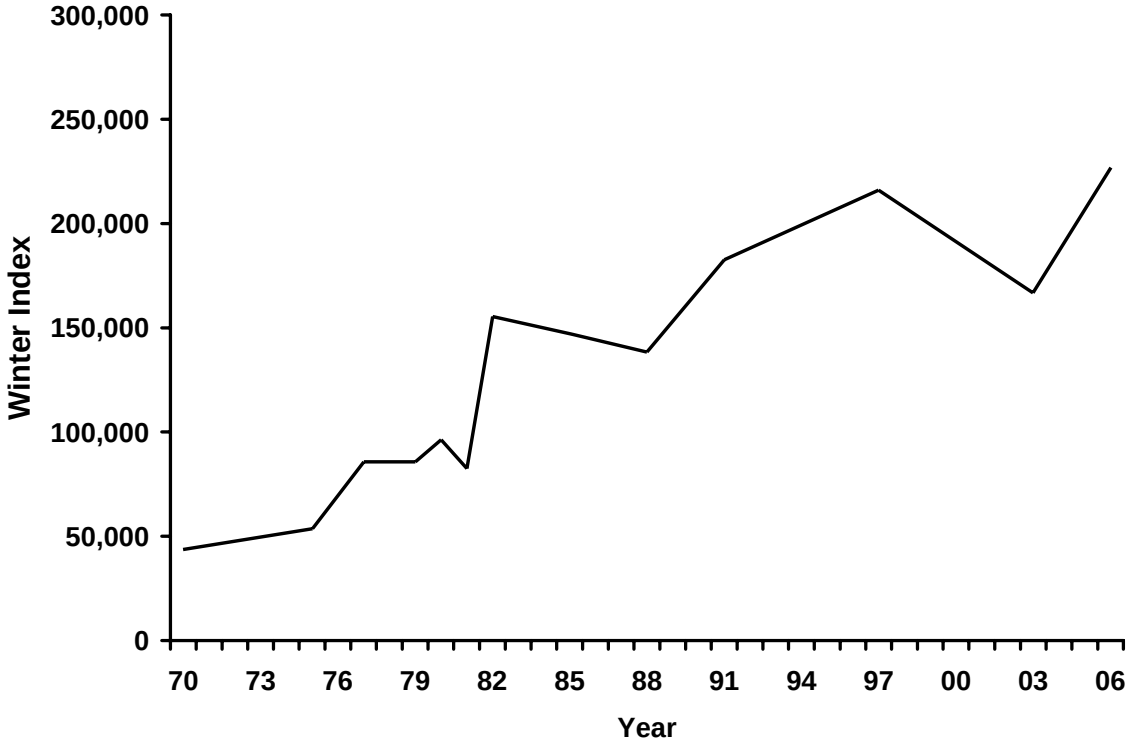


Fig. 3.13. Winter index of the Western Central Flyway Population of light geese, 1970-2006.

Lesser snow geese and Ross's geese comprise approximately 76% and 24%, respectively, of WCFP light geese (Thorpe 2000). Using these proportions when the population peaked in 2000, the Ross's goose component of WCFP light geese was approximately 61,700 birds. The lesser snow goose portion of WCFP light geese during the same year was approximately 194,300 birds; which was 77% higher than the NAWMP winter index goal of 110,000 for WCFP lesser snow geese. The 2006 winter index of 173,100 WCFP lesser snow geese (76% of the WCFP light goose index) was 57% higher than the NAWMP goal. Flyway Councils have not set management thresholds for WCFP lesser snow or Ross's geese. There is no NAWMP goal for Ross's geese in the WCFP geographic range.

MCP and WCFP components of CMF light geese were not tallied separately until 1970. However, winter indices for CMF light geese (MCP and WCFP combined) are available beginning in 1955. The U.S. portion of the winter index of CMF light geese increased from 693,421 birds in 1955 to 3.1 million birds in 1998 (Fig. 3.14). During 1955-1998, the CMF light goose winter index grew at an annual rate of 3.7%. However, the index declined at an annual rate of 2.7% after 1998 and was estimated to be approximately 2.4 million birds in 2006.

Fig. 3.14. Winter index of Central/Mississippi Flyway (CMF) light geese, 1955-2006. Only years in which surveys were flown in Mexico are plotted.

Western Population of Ross's geese (WPRG). — Annual winter indices are not available for the WPRG because it mixes with other light goose populations in the Pacific Flyway (Fig. 3.15). Special surveys conducted during the winters of 1988 and 1989 produced estimates of 214,700 and 168,400 Ross's geese in the Central Valley of California (Silveira 1989, 1990). A December, 2000, survey in California resulted in an estimate 256,000 Ross's geese (U.S. Fish and Wildlife Service, unpublished data).

The NAWMP does not contain winter index goals for Ross's geese. Instead, a continental breeding population goal of 100,000 Ross's geese is utilized. The Pacific Flyway Council (1992) has adopted a winter index goal of 150,000 Ross's geese. The combined 2000 winter index total of 408,750 MCP, WCFP, and WPRG Ross's geese is 172% higher than the Pacific Flyway Council winter index goal, and 308% higher than the NAWMP breeding population goal.

Pacific Flyway Population of lesser snow geese. — No winter indices are available for PFSG because they mix with other light goose populations in the Pacific Flyway (Fig. 3.15). The distribution of band recoveries indicates that 87% of lesser snow geese banded in the western Arctic are recovered in the

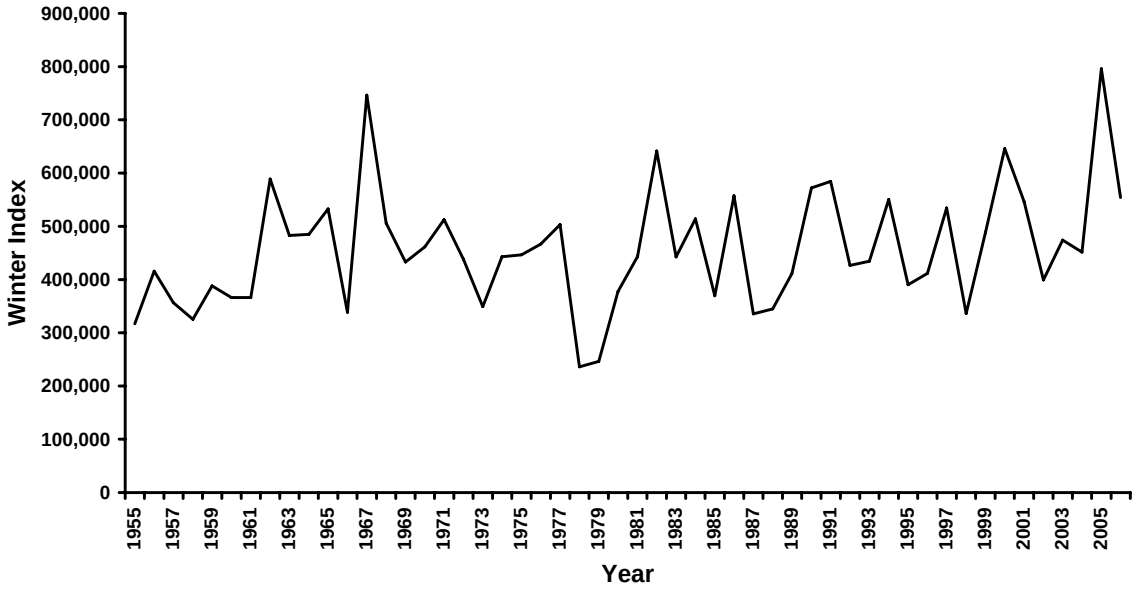


Fig. 3.15. Winter index of light geese in the Pacific Flyway, 1955-2006. Birds included in the index are derived from several breeding populations in the central and western Arctic, and Wrangel Island.

Pacific Flyway, whereas 2% or less of birds banded in the central and eastern Arctic are recovered in the Pacific Flyway (Table 3.1). Species composition surveys conducted in December, 2000, indicated a total of 409,000 lesser snow geese wintering in California (U.S. Fish and Wildlife Service, unpublished data).

Wrangel Island Population of lesser snow geese. — No winter indices are available for this population because it mixes with other light goose populations in the Pacific Flyway.

3.1.8 Population Status - Summary

The number of greater snow geese and CMF light geese increased dramatically during the past 30 years. Western arctic lesser snow geese have increased as well; however, their rate of increase has been slower than populations occurring to the east. The Wrangel Island lesser snow goose population has fluctuated widely, likely due to frequent failures in reproduction as a result of poor spring weather. Utilizing the most recent estimates for known colony sites, and accounting additional non-breeding birds, there currently are a minimum of approximately 5.8 million lesser snow and Ross's geese in the eastern and central Arctic, 0.7 million lesser snow geese in the western Arctic and Wrangel Island. The spring population of greater snow geese in the St. Lawrence River Valley is approximately 1 million birds.

North American Waterfowl Management Plan population goals for greater snow geese, MCP and WCFP lesser snow geese, and Ross's geese (MCP and WCFP combined) have all been exceeded. The joint

Central and Mississippi Flyway Council upper management threshold for MCP lesser snow geese was exceeded by 98% at the population peak. The Atlantic Flyway Council population objective for greater snow geese has been exceeded by 103%. These light goose population levels are the highest in recorded survey history, and likely are unprecedented (Abraham and Jeffries 1997; Reed et al. 1998).

3.1.9 Impacts of breeding habitat degradation on light geese

Habitat degradation on certain portions of the breeding grounds, and subsequent reduction in food resources, has led to several demographic changes in the goose populations using such areas. At the breeding colony at La Perouse Bay, lesser snow geese have experienced long-term declines in clutch size (Cooch et al. 1989), gosling body size (Cooch et al. 1991a,b) and gosling survival (Williams et al. 1993). These demographic parameters were negatively correlated with the size of the breeding colony, as well as the total flyway population, both of which increased significantly during the period of study (Cooch et al. 1989). Increasing numbers of breeding geese at La Perouse Bay caused a long-term degradation of habitat and reduction in available food resources (Williams et al. 1993). Reed and Plante (1997) documented a long-term decline in body mass, size, and condition of greater snow geese harvested on fall migration areas in Quebec. It was suggested that the declines in body size and condition of greater snow geese was due to a reduction in food availability on the breeding grounds (Reed and Plante 1997). However, the population had not yet shown any decline in productivity (Reed and Plante 1997).

Although the relative contribution of nutrients obtained on migration, staging area, or breeding colony sites in determining eventual clutch size of snow geese is not well understood, it is possible that decreased food availability on breeding areas has contributed to reduced clutch sizes (Cooch et al. 1989). Certainly, reduced food availability contributes directly to reduced gosling size at fledging and reduced gosling survival (Cooch et al. 1991a,b; Williams et al. 1993). Reed and Plante (1997) suggested that food availability on agricultural lands on migration and wintering areas may enable greater snow geese to attain adequate body condition for successful reproduction in spring. However, continued declines in body condition eventually will lead to reduced reproduction (Reed and Plante 1997).

The decline in body size of offspring of individual females in different nesting years suggests an environmental, rather than genetic (or selectional), basis for the change (Cooch et al. 1991a). Older female lesser snow geese tend to return to their natal colony areas, which have been degraded. However, younger females have recently tended to nest outside the traditional areas at La Perouse Bay and may be using more distant brood-rearing sites that have not been degraded (Rockwell et al. 1993, Cooch et al. 2001). Individuals that disperse to new areas experience higher reproductive success (Cooch et al. 2001), and thus "cheat" density-dependent regulation of the population (Abraham and Jefferies 1997). Correspondingly, the number of geese nesting at traditional colony sites at La Perouse Bay has declined, even though the number of geese

in the overall population nesting at La Perouse Bay and surrounding Cape Churchill area has increased (Cooch et al. 2001).

3.1.10 Migration and Wintering Ecology

Greater snow geese. — Upon leaving breeding colonies in late August, greater snow geese make an initial migration flight of over 1000 km to the central portion of the Ungava Peninsula. Geese stage on the Ungava for several days before they undertake a second long migration flight to the St. Lawrence River. Traditionally, birds staged during October almost exclusively on the St. Lawrence within a relatively small area of bulrush marshes before leaving on a non-stop flight to Delaware Bay (Reed et al. 1998). Beginning in the 1980s, some geese began dispersing from traditional staging areas early in October and moved southwesterly to Lake Saint-Pierre or northern Lake Champlain, where they feed in agricultural fields. Geese inhabit these new staging areas well into November and December. However, some birds are now over-flying the St. Lawrence altogether, and are flying directly to the U.S. in fall (Maisonneuve and Bedard 1992).

The winter range of greater snow geese extends along the Atlantic coast from New Jersey to South Carolina. Main concentration areas are in New Jersey, Delaware, Maryland, Virginia and North Carolina. As a result of population growth, there has been an increase in the number of birds wintering in Maryland and Delaware. Beginning in 1991, there also has been an increase in the number of birds wintering in New Jersey, Pennsylvania and New York. Concurrent decreases have occurred in the number of birds wintering in southern portions of the range (Reed et al. 1998).

Historically, greater snow geese flew non-stop in spring from Delaware Bay to traditional bulrush marshes on the St. Lawrence River. However, many birds now make intermediate stops on Lake Champlain, the Richelieu River, and Lac Saint-Pierre before moving to traditional marshes on the St. Lawrence. Many of these intermediate stopover areas have an agricultural base and are becoming important staging areas. In late May, some geese may stage for a short time in central and eastern portions of the Ungava Peninsula before migrating to breeding colonies (Reed et al. 1998).

Feret et al. (2003) documented apparent effects of the spring conservation harvest in Quebec on the ability of greater snow geese to store nutrient reserves on staging areas. Conservation harvest activity in Quebec is restricted to farmlands, and hunter activity on such lands during spring may have decreased the amount of time that geese could feed on agricultural foods such as corn (Feret et al. 2003). Reduction in time spent foraging on agricultural foods may have indirectly caused observed reductions in body condition of geese staging in Quebec during spring (Feret et al. 2003). Nesting studies indicated that reduced body condition in years with spring harvest likely caused a reduction in goose production as well (Mainguy 2002). The fact that body condition of birds is reduced when access to agricultural foods is restricted lends support

to our contention that an agricultural food subsidy has improved winter and spring condition of birds and has contributed to population growth.

Mid-continent Population (MCP) of light geese. — Prior to 1960, the lesser snow goose component of the MCP wintered exclusively on coastal marshes in Texas and Louisiana (Bateman et al. 1988). The migration from arctic breeding areas to the Gulf Coast often was completed nearly nonstop, with only occasional short stopovers (Lynch 1975). Therefore, light goose populations would not have been affected by wetland losses in interior portions of the continent in the first half of the 20th century. However, during the 1960s, noticeable changes in migration habits became evident. For example, Squaw Creek National Wildlife Refuge (NWR) in northwest Missouri rarely received any usage by snow geese during the 1940s. In the early 1970s, more than 200,000 snow geese regularly stopped at Squaw Creek NWR during fall migration (Bateman et al. 1988). Sand Lake NWR in South Dakota, and DeSoto Bend NWR in Iowa also held more than 200,000 snow geese during fall migration in the 1970s. Migration shifts continued, and MCP snow geese eventually began to stop in southern Canada and North Dakota during fall migration (Bateman et al. 1988). Currently, their wintering grounds extend across Texas, Louisiana, Arkansas, Oklahoma, Mississippi, and New Mexico and the central highlands of Mexico.

Prior to 1920, MCP lesser snow geese wintered primarily in a narrow band of brackish marsh along the Texas and Louisiana coasts (Bateman et al. 1988; Fig. 3.16). Birds seldom moved inland more than a few miles and did not consistently use bluestem prairies that lay directly north of marshes. Geese exhibited this distribution pattern until the 1920s in Texas, and the 1940s in Louisiana (Bateman et al. 1988). Due to the finite amount of suitable coastal marsh habitat available on the wintering grounds, winter food resources were presumed to be a limiting factor for winter survival (Lynch 1975).

As the extent of rice culture began to increase in Texas and Louisiana, rice fields became larger and were developed farther away from human activity centers. In addition, rice agriculture moved closer to the brackish marshes that geese inhabited. By the late 1940s, rice culture had expanded to and dominated the bluestem prairie areas of Texas and Louisiana, extending inland as far as 160 km at some points (Bateman et al. 1988). Geese began to utilize rice fields in Texas about 1920, but not until the 1940s in Louisiana. Texas rice fields were closer to natural marshes than those in Louisiana, which facilitated an earlier initiation date of use by geese. In the 1940s and 1950s, some landowners began pumping water into harvested rice fields and restricted hunting in and around water areas to hold birds for improved hunting. As a result, secure roosting areas were created (Bateman et al. 1988). Continued inland expansion of agricultural areas fostered a similar expansion of light goose wintering range. Furthermore, the addition of over 400,000 ha of rice culture significantly increased the amount of food resources available to geese.

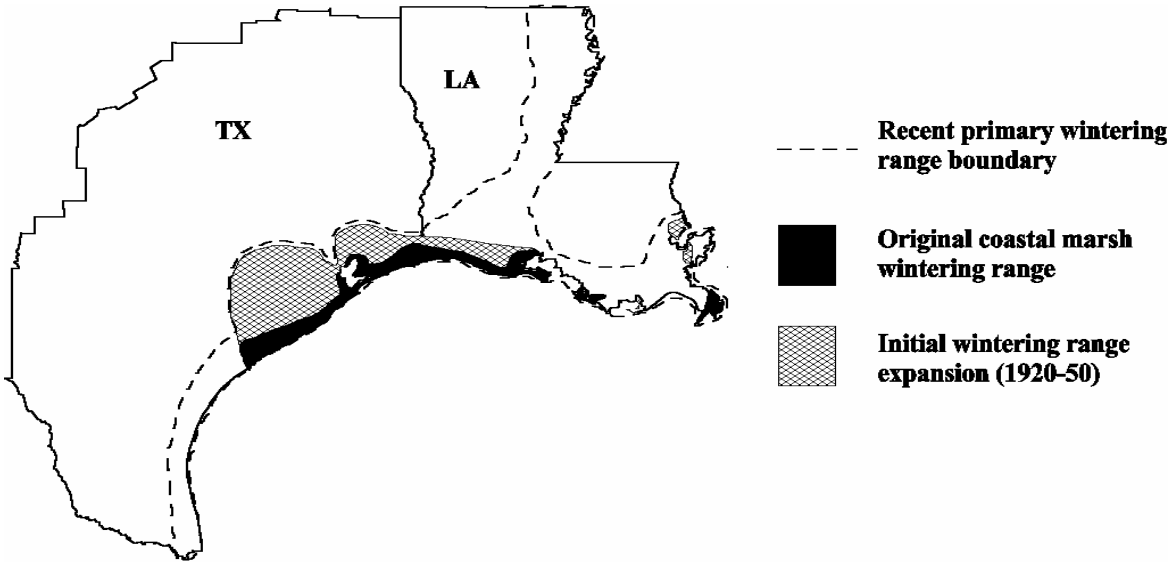


Fig. 3.16. Original coastal marsh wintering range (black shading), extent of initial range expansion (cross-hatch), and recent wintering range boundary (dashed line) of light geese in Texas and Louisiana (adapted from Bateman et al. 1988).

Historically, Ross's geese wintered in the interior valleys of California and eventually expanded into WCFP wintering range. In the early to mid-1980s, Ross's geese began to expand eastward and mix extensively with MCP lesser snow geese during winter. Evidence for this range expansion is illustrated by the increased occurrence of Ross's geese in harvests from eastern areas between 1974 and 1996. Inland range expansion of Ross's geese occurred in a fashion similar to that of lesser snow geese.

Western Central Flyway Population (WCFP) of light geese. — WCFP light geese typically migrate south along the western edge of the Central Flyway and winter primarily in northwestern Texas, Oklahoma, New Mexico, and the Central Highlands of Mexico. They have expanded their range and today overlap the MCP light goose range during spring migration. Their expansion inland, concurrent with agricultural expansion, was similar to that of MCP light geese.

Similar to the exploitation of agriculture in the wintering States, CMF light geese migrating through the mid- and northern-latitudes exploited cereal grain crops consisting of corn, wheat, barley, oats and rye and continue to do so today (Alisauskas et al. 1988). For example, an estimated 1 to 2 million light geese stage in the Rainwater Basin in Nebraska from mid-February to mid-March and primarily feed on post-harvest waste corn (USFWS 1998a). These waste crops provide light geese with additional nutrients during spring migration, thus enabling birds to arrive on the breeding grounds in prime condition to breed. Increased food resources afforded by agriculture during spring migration resulted in higher reproductive potential and breeding success (Ankney and McInnes 1978, Abraham and Jefferies 1997). Consequently,

more geese survived the winter and migration and were healthier as they returned to their breeding grounds in Canada.

Pacific Flyway Population of lesser snow geese (PFSG). — Lesser snow geese following westerly migration corridors interrupt their fall migration more frequently to rest and feed than do birds to the east (Bellrose 1980). The Mackenzie Delta is the major staging area for lesser snow geese in the western Arctic before birds move on to resting and feeding areas in southeastern Alberta and southwestern Saskatchewan (Bellrose 1980, Armstrong et al. 1999). In Montana, the migration corridors diverge into three components; one directed toward the southwest to the Klamath Basin of northern California, one south-southwest to Nevada, and a third directly south to the Bear River marshes in Utah. Eighty percent of western arctic lesser snow geese marked with neckbands migrated to the Klamath Basin and Central Valley, whereas smaller numbers winter in the Imperial Valley of California (Armstrong et al. 1999).

Lesser snow geese wintering in California shifted their feeding habits several decades ago from natural marsh plants to agricultural foods (Bellrose 1980). Geese consume grains of barley, wheat, and rice, and they also graze on shoots of pasture grasses and cereal grains. Natural marsh plants such as alkali bulrush are still important foods for lesser snow geese in the Bear River marshes of Utah and the Klamath Basin in California (Bellrose 1980).

Western Population of Ross's geese (WPRG). — Upon leaving breeding areas in the Queen Maud Gulf, many Ross's geese migrate to the Peace-Athabasca River Delta in northern Alberta (Bellrose 1980). Birds then move through eastern Alberta and western Saskatchewan, with some stopping near Freezeout Lake, Montana until mid-October (Bellrose 1980, Ryder and Alisauskas 1995). Most birds migrate through the Klamath Basin in California and winter either in the Sacramento Valley or in the grasslands of the San Joaquin Valley (Bellrose 1980, Ryder and Alisauskas 1995). During winter, Ross's geese utilize agricultural habitat much of the time for feeding (Ryder and Alisauskas 1995). Barley is an important food for birds in the Klamath Basin, whereas rice is commonly used in the Sacramento Valley (Bellrose 1980).

Wrangel Island Population of lesser snow geese. — Most lesser snow geese from Wrangel Island migrate along several corridors off or along the coast of southeast Alaska and British Columbia (Bellrose 1980). A small number of birds migrate to wintering areas through prairie areas in Alberta and Saskatchewan (Armstrong et al. 1999). Observations of birds marked with neckbands indicate that Wrangel Island birds winter either in British Columbia, Washington, or in the Central Valley of California (Armstrong et al. 1999). Food habits of Wrangel Island birds are assumed to be similar to other lesser snow geese in such wintering areas.

3.1.11 Harvest Estimates

Federal frameworks. — Light goose harvest is influenced by several variables that comprise frameworks for hunting seasons in the U.S. Federal frameworks are comprised of earliest opening and latest closing dates for hunting seasons and maximum season length and daily bag and possession limits (Appendix 7). State hunting regulations may be more restrictive than Federal frameworks, but cannot be more liberal. Waterfowl managers have attempted to increase the harvest of light geese by liberalizing all components of the Federal frameworks. Possession limits for light geese were increased in 1980 from 5 to 10 birds in the Mississippi Flyway and portions of the Central Flyway. Beginning in 1984, season closing dates were moved closer to the March 10 closing date allowed by the Migratory Bird Treaty. The season length for light geese was 60 days in 1961, but by 1991 had been increased to 107 days in western portions of the Central Flyway and all portions of the Mississippi and Central Flyways by 1994. In 1998 the daily bag limit for light geese was increased from 10 to 20 birds, and possession limits were eliminated.

Greater snow geese. — Regular season harvest estimates for greater snow geese in the U.S. and Canada are presented in Figure 3.17. The hunting season in the U.S. was re-opened in 1975. We calculated a regular season harvest rate index for greater snow geese by dividing the estimated regular season harvest in the U.S. and Canada by the population estimate of the previous spring (Fig. 3.18). To obtain a more accurate estimate of the harvest rate that includes harvest from the recent spring conservation order in Quebec, we determined the approximate fall population size using the method described by Reed et al. (1998). The size of the adult population in fall 1999 was determined by applying a spring-to-fall survival rate of 0.946 to the 1999 spring population estimate. The number of juveniles in the fall population was estimated by multiplying the adult population size in fall by the proportion of juveniles in the fall flight (0.028; Ferguson 1999), divided by the proportion of adults in the fall flight. We estimated a harvest rate of 15% by dividing the sum of the continental harvest during the 1999/00 regular season and the spring conservation harvest in Quebec during 2000, by the 1999 fall population estimate. Similar calculations produced harvest rate estimates ranging from 13% to 25% during 2000-2004 (Table 3.3)

Table 3.3. Parameters used to estimate harvest rates of greater snow geese, 1999-2004.

	Regular season harvest		Conservation order harvest			
Fall/Spring	U.S.	Canada	Quebec	Total harvest	Fall population	Harvest rate
1999/2000	54,115	43,000	54,600	151,715	981,037	0.15
2000/2001	70,495	108,500	49,800	228,795	1,181,054	0.19
2001/2002	77,354	97,116	71,800	246,270	998,966	0.25
2002/2003	38,734	48,259	22,650	109,643	622,199	0.18
2003/2004	35,067	89,738	32,900	157,705	761,743	0.21
2004/2005	31,548	66,326	34,594	132,468	1,030,591	0.13

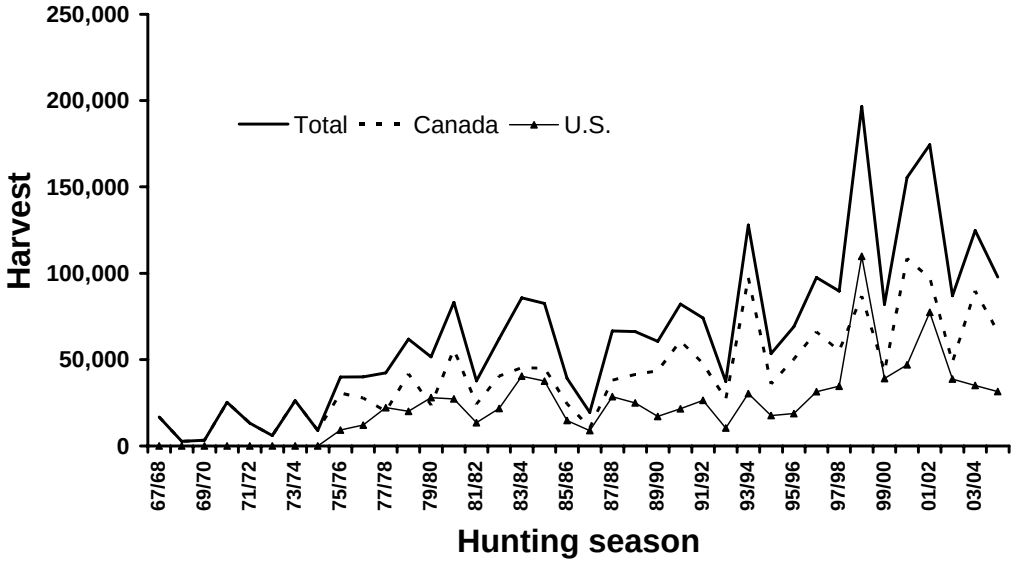


Fig. 3.17. Regular season harvest of greater snow geese in Canada and the U.S., 1967-04. U.S. estimates after 1998 are derived from the Harvest Information Program.

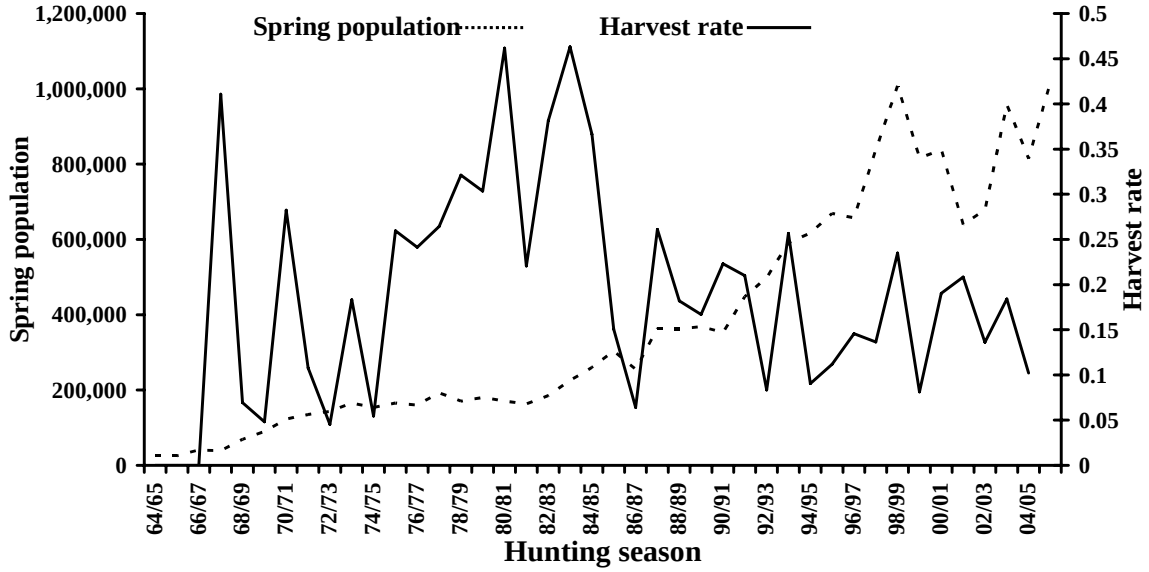


Fig. 3.18. Spring population estimates (1964-05) and regular season harvest rate indices (1967-05) of greater snow geese in the Atlantic Flyway. U.S. estimates after 1998 are derived from the Harvest Information Program.

CMF light geese. — Gradual liberalizations in regular-season frameworks prior to 1999 were ineffective at controlling the population growth of CMF light geese, as indicated by the harvest rate. Surveys to estimate light goose harvest were implemented in 1962. A crude index to the harvest rate was obtained by dividing the total estimated harvest in a given season by the population winter index for that season. This is not equal to the true harvest rate because the winter index represents only a certain portion of the total winter population. The harvest rate index for CMF light geese gradually declined after the 1960s, to a low in 1992/93 season (Fig. 3.19). This was partially due to a decrease in hunter numbers, but was primarily due to the high growth rate of the light goose population during this period (Fig. 3.20).

Concurrent with the advent of 107-day seasons in the early 1990s, total regular-season harvest of CMF light geese increased in a nearly linear fashion (Fig. 3.20). During 1992-1997, total regular-season CMF light goose harvest increased by approximately 79,800 birds each year. In spring 1999, alternative harvest strategies were implemented in the Central and Mississippi Flyways in an attempt to reduce the number of CMF light geese (February 16, 1999, *Federal Register*; 64 FR 7507-7529). Strategies included authorization of the use of electronic calls and unplugged shotguns to hunt light geese during the regular season when all other waterfowl and crane seasons (excluding falconry) were closed. In addition, States were authorized to implement a conservation order that allowed take of CMF light geese at any time of year, authorized use of electronic calls and unplugged shotguns, removed bag limits, and extended shooting hours, provided that all waterfowl and crane hunting seasons (excluding falconry) were closed.

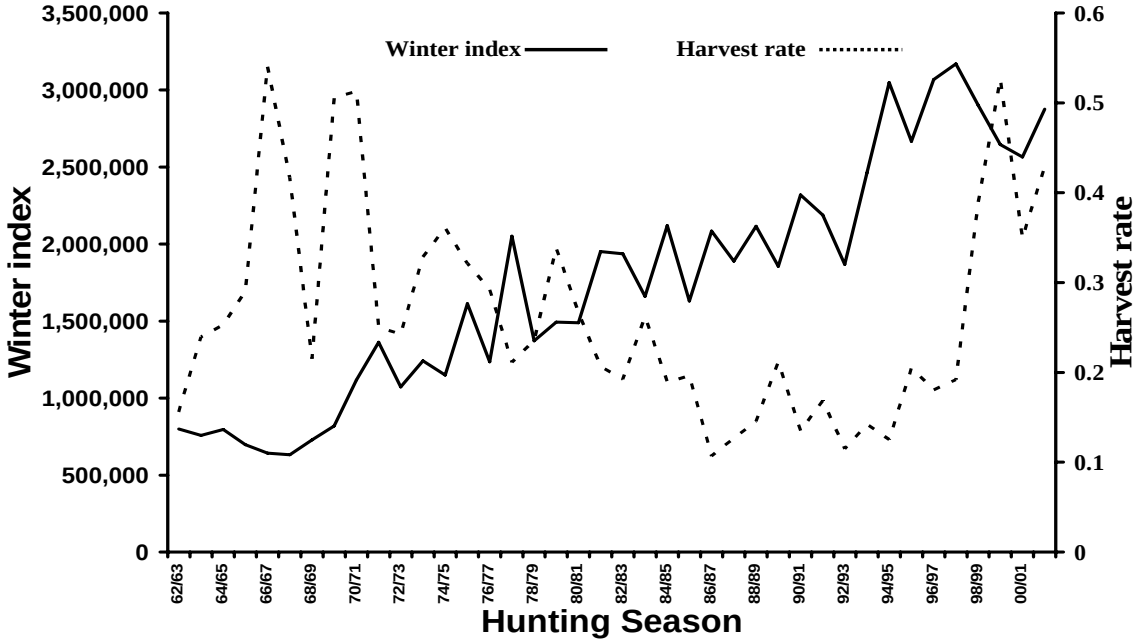


Fig. 3.19. Winter indices and harvest rates of Central/Mississippi Flyway light geese, 1962-2002.

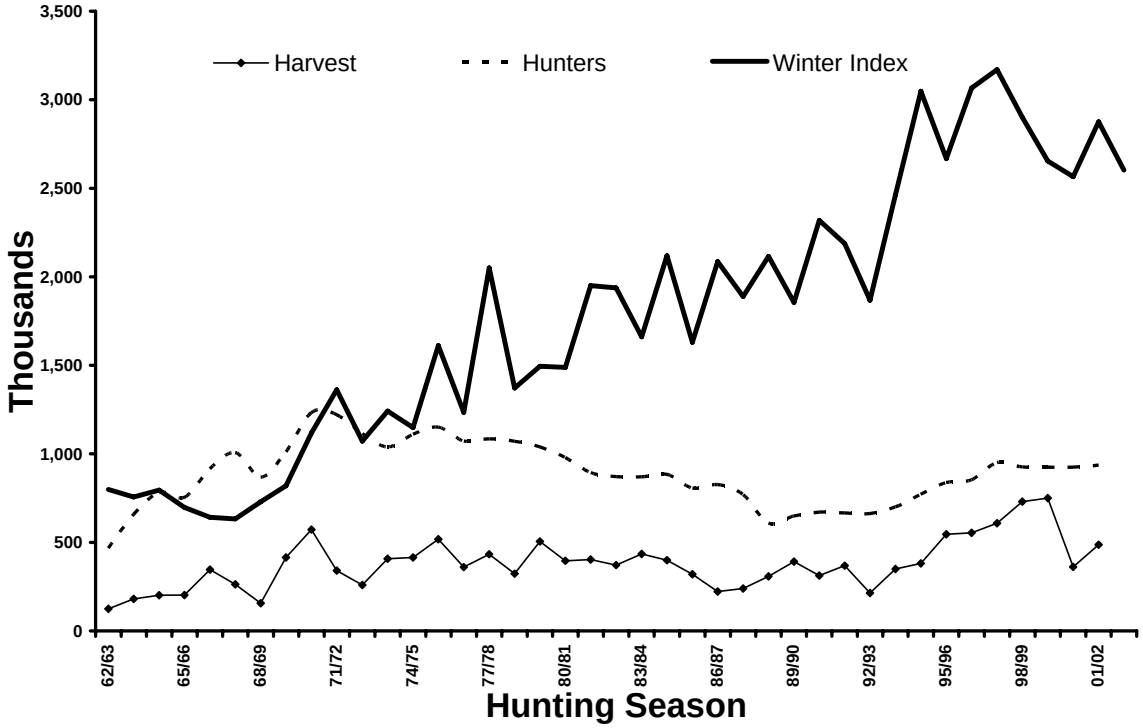


Fig. 3.20. Winter indices and harvests of Central/Mississippi Flyway light geese and active adult hunter numbers, 1962-2002.

To be eligible to implement a conservation order during the September 1-March 10 period in which hunting is allowed by the Treaty, States were required to close their regular seasons for waterfowl and cranes (excluding falconry). During winter and spring 1999, approximately 93,302 light geese were taken during the regular season in the time period when alternative methods of take were authorized in participating States (Table 3.3). In addition, approximately 398,455 light geese were taken during the conservation order.

The alternative light goose regulations were subsequently challenged in court in May 1999, and we eventually withdrew them in order to prevent further litigation. However, the regulations were later reinstated in November 1999, through enactment of the Arctic Tundra Habitat Emergency Conservation Act (P.L. 106-108). Following the 1998/99 season, there has been a decline in the number of light geese taken in the regular season during periods when special regulations were authorized in participating States (Table 3.4). This decline in special harvest during the regular season is due to the fact that more States have opted to close the regular season and implement a conservation order earlier in the year, which effectively reduced the length of the regular season.

Table 3.4. Estimated light goose (lesser snow and Ross's goose) harvests during regular season and conservation order periods in the Central and Mississippi Flyways (combined) during 1998-2004.

	Regular season harvest[1]					Conservation order harvest [2]		
	United States							
Season	Without special regulations	With special regulations[2]	U.S. sub-total	Canada sub-total	Total regular season	U.S.	Canada	Total harvest
1998/99	637,105	93,302	730,407	148,979	879,386	398,455	n/a	1,277,841
1999/00	630,662	35,000	665,662	151,203	816,865	643,470	1,267	1,461,602
2000/01	489,336	4,200	493,536	117,483	611,019	536,296	5,233	1,152,548
2001/02	580,379	4,000	584,379	142,080	726,459	749,349	7,718	1,483,526
2002/03	340,355	0	340,355	140,711	481,066	640,526	12,939	1,134,531
2003/04	418,549	0	418,549	165,457	584,006	805,583	16,881	1,406,470
2004/05	388,113	0	388,113	121,586	509,699	660,358	9,886	1,179,943

[1] U.S. estimates for 1998/99 season are from the U.S. Federal Harvest Survey, whereas estimates for 1999/00 and beyond are from the Harvest Information Program.
[2] State Harvest Survey estimates.

The total harvest of CMF light geese during 1999-2004 ranged from 1.2 to 1.5 million birds. This level of harvest approaches, and sometimes exceeds, the annual harvest of 1.4 million birds that is required to reduce the CMF light goose population by 50% (Rockwell and Ankney 2000). Any harvest in excess of 1.4 million birds in a given year reduces the amount of time required to reach population reduction goals (Rockwell and Ankney 2000).

Each year, thousands of light geese are captured on arctic breeding grounds and marked with uniquely numbered leg bands. Hunter reports of leg-banded birds harvested in subsequent months allow documentation of migratory patterns. Banding locations of CMF light geese harvested during conservation orders indicate that such geese originated from arctic breeding areas where habitat damage is occurring (Fig. 3.21). The majority of light geese harvested during conservation orders originated from the west coast of Hudson and James Bays and the Queen Maud Gulf region of the central Arctic.

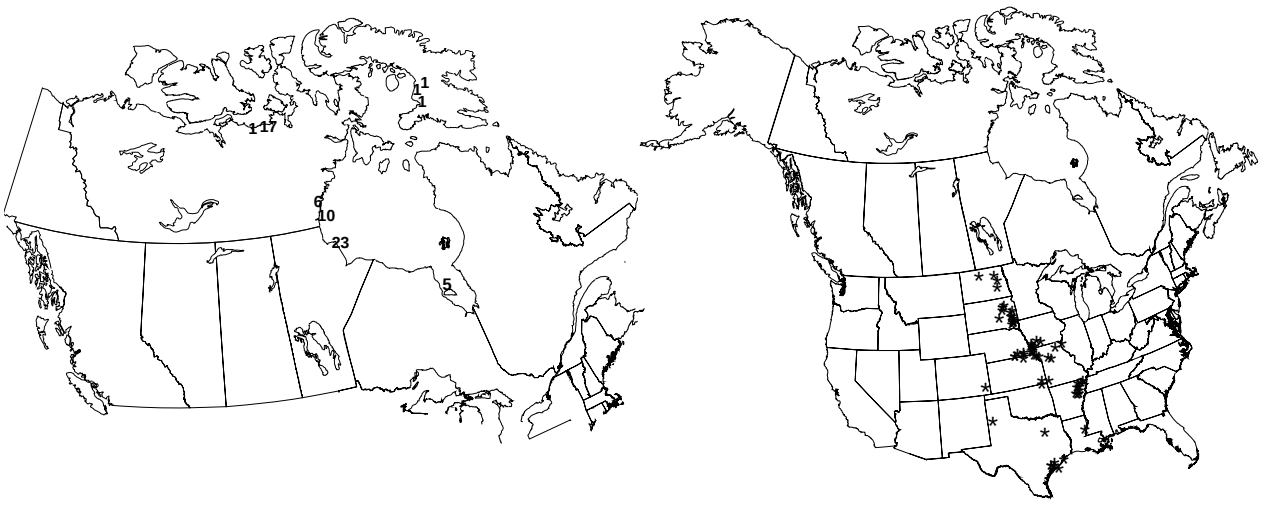


Fig. 3.21. Left: Banding locations of CMF light geese (summarized by degree blocks) harvested during conservation orders in the U.S. Right: Recovery locations of light geese harvested during conservation orders in the Central and Mississippi Flyways.

3.2 HABITAT

3.2.1 Breeding habitat conditions and degradation

Greater snow geese. — Greater snow geese nest in the high Arctic, where salt marsh habitat is rare. Instead, geese utilize inland freshwater habitats that include permanent water bodies (ponds/lakes) and wet sedge meadows (Giroux et al. 1998). Approximately 15% of the breeding population nests on the south plain of Bylot Island, and events occurring there are likely typical of those happening elsewhere in the breeding range (Reed et al. 1998). Although the south plain covers an area of approximately 1,600 km^2, only 11% of the land is covered by wetlands, the preferred feeding habitat of brood-rearing geese (Masse et al. 2001).

Although levels of grazing by geese can be very high on Bylot Island, there are presently no indications that grazing is preventing vegetative re-growth or denuding vegetated areas. However, monitoring of long-term goose exclosures has shown that composition of the plant community is modified by geese, and that annual plant productivity is reduced in heavily-grazed areas. Long-term, intense grazing by geese leads to a low-level production equilibrium between geese and plants. When grazing is experimentally stopped (via exclosures), plant biomass increases rapidly within a few years (Giroux et al. 1998). Unlike the situation where moderate grazing by lesser snow geese on salt-marsh plants can increase plant quality and quantity, grazing by greater snow geese has not shown such an "overcompensation" effect (Giroux et al. 1998). In addition, fecal matter deposited by greater snow geese in freshwater habitat does not appear to have the same fertilization effect that occurs with lesser snow geese in salt-marsh habitats (Giroux et al. 1998).

Short-term measurements of food availability on Bylot Island were used to estimate that greater snow geese consume 46% of total food available in wetland habitats (Masse et al. 2001). This suggests that the short-term ability of habitat to support geese has not been exceeded. However, if the high rate of increase of greater snow geese observed prior to 2002 resumes, it is highly probable that the intensity of grazing will increase and that the capacity of plants to recover will be exceeded (Masse et al. 2001).

Eastern and central Arctic light geese. — Light geese have a profound effect on habitat through their feeding actions, and have developed several modes of feeding on plant material for meeting their energy needs (Goodman and Fisher 1962, Bolen and Rylander 1978). Where spring thawing has occurred, and above-ground plant growth has not begun, lesser and greater snow geese dig into and break open the turf (grubbing), consuming the highly nutritious belowground portions (e.g., roots and rhizomes) of plants. Grubbing continues into late spring. Lesser and greater snow geese also engage in shoot-pulling where birds pull the shoots of large sedges, consume the highly nutritious basal portion, and discard the remainder of the plant. A third feeding strategy utilized by all light goose species is grazing of above-ground plant material by clipping action of the bill. The extent to which Ross's geese utilize grubbing and shoot-pulling is not known. However, Ross's geese are known to feed on below-ground roots of sedges and grasses in early spring (Ryder and Alisauskas 1995, Didiuk et al. 2001). Due to their smaller bill size, Ross's geese are able to graze shorter stands of vegetation than can lesser and greater snow geese. In addition, Ross's geese cause considerable damage to vegetation by pulling up plants during nest-building activities (Didiuk et al. 2001).

Under certain levels of grazing intensity, some salt marsh plants show enhanced growth following defoliation and are subject to multiple defoliations throughout the growing season (Abraham and Jefferies 1997, Bazely and Jefferies 1989, Hik and Jefferies 1990, Kotanen and Jefferies 1987). However, other plant species show only limited shoot growth or no growth following defoliation (Zellmer et al. 1993). At high levels of grazing intensity, plant communities are unable to rebound from constant feeding pressures (Srivastava and Jefferies 1996). Once snow geese graze an area to the point where they can no longer obtain sufficient food, they will leave to exploit other areas. Normally, this would allow plant communities to rebound from grazing. However, Ross's geese can further impact damaged areas after snow geese leave because they can graze on shorter stands of plants, which may delay or prevent recovery (Abraham and Jefferies 1997, Didiuk et al. 2001). The potential for plant recovery is further reduced by the short growing season in Arctic and sub-arctic habitats.

Accelerated habitat degradation results from a negative feedback loop between light geese and the plant communities they utilize (Abraham and Jefferies 1997; Fig. 3.22). Removal of above-ground plant cover reduces the thickness of the vegetative mat that insulates underlying sediments from the air. This causes an increase in the rate of evaporation from surface sediments and greater concentration of inorganic

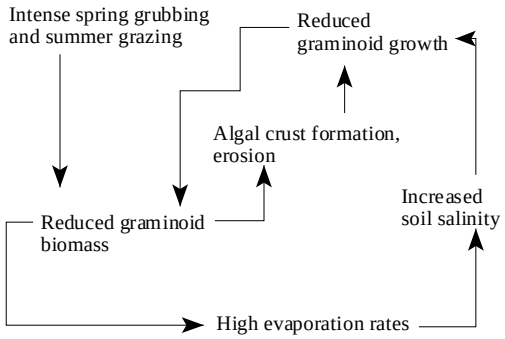


Fig. 3.22. Negative feedback loop between light geese and their habitat; which leads to habitat destruction (adapted from Abraham and Jefferies 1997).

salts from marine clays. Grubbing by geese further exposes the soil substrate (Iacobelli and Jefferies 1991, Srivastava and Jefferies 1996).

Srivastava and Jefferies (1996) documented seasonal changes in soil salinity due to changes in weather. However, their study also reported that soil water salinity increased with increased size of the bare mudflat. The larger a bare patch is, the more likely it will remain un-vegetated and the patch may even grow in area. There may therefore be a threshold in patch size beyond which bare areas do not re-vegetate (Srivastava and Jefferies 1996). Furthermore, soil salinity in the salt marsh was inversely related to aboveground plant biomass; bare sites are more saline than high biomass sites. Increases in the colony size of light geese at La Perouse Bay has resulted in a 50% reduction in aboveground biomass between 1979 and 1991, and it is likely that soil salinity has increased over the last decade in areas that are no longer vegetated or only partially vegetated (Srivastava and Jefferies 1996).

Increased soil salinity reduces and eventually eliminates growth of the salt marsh plant community. Foraging activity of light geese maintains an open marsh situation and continued salinization of soils. Eventually, salt marsh stands are destroyed and desertification results. Jefferies and Rockwell (2002) systematically monitored the increase in the proportion of bare soil in 3 different marsh areas at La Perouse Bay during 1986-97 (Fig. 3.23).

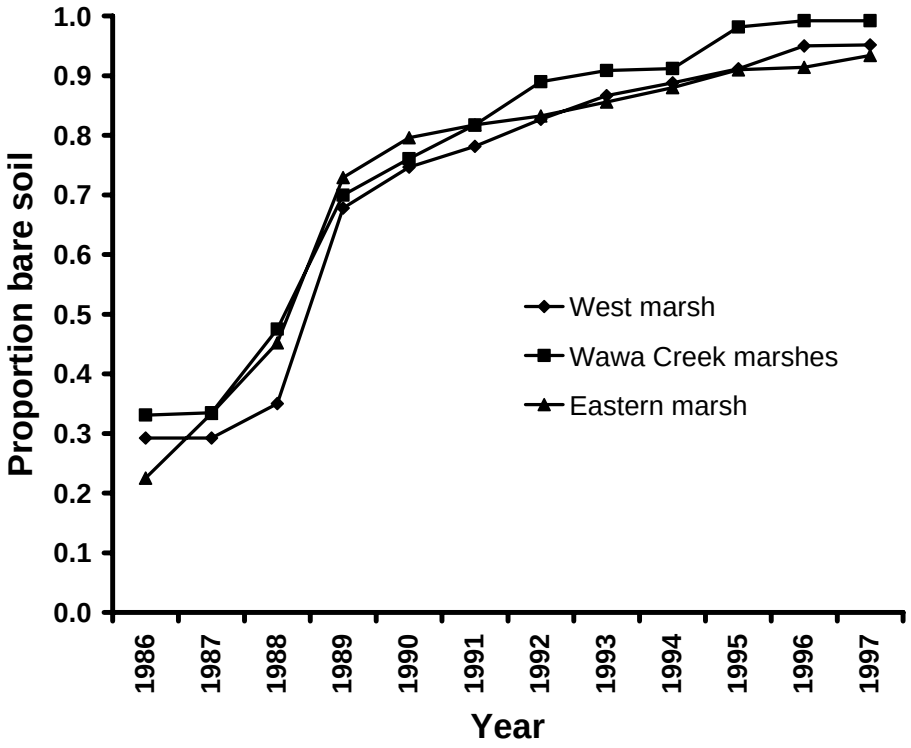


Figure 3.23. Increase in the proportion of bare soil resulting from degradation of habitat by light geese on each of 3 intertidal marshes at La Perouse Bay, Manitoba from 1986 to 1997 (adapted from Jefferies and Rockwell 2002).

Bare areas that contain remnant organic soil may become colonized by salt-tolerant plant species and algal mats, which are utilized as food by few, if any, wildlife species (Fig. 3.24). However, such plant cover is usually short-lived because it dries out, cracks, and is blown away (Handa et al. 2002). In other areas, mudflats become eroded and underlying glacial till and marine gravels are exposed (Fig. 3.25). Under such conditions there may be little or no chance of plant recovery within 25-50 years (Jano et al. 1998). Erosion of organic layers and sediments makes it unlikely that plant communities will re-establish within 50 years (Hik et al. 1992). These changes, coupled with those associated with the effects of isostatic uplift, indicate that when such areas are recolonized the species will be different from the former community. Hence, on a longer time scale (ca. 100-150 years) non-equilibrium conditions prevail.

Following habitat destruction, experimental sites where geese have been excluded by erection of fences have experienced little or no re-vegetation after 15 years of protection (Abraham and Jefferies 1997). Placement of exclosure fences in intact stands of vegetation at La Perouse Bay in 1986 was used to demonstrate removal of vegetation by geese from surrounding (un-protected) sites by 1996 (Kotanen and Jefferies 1997). The primary plant foods of light geese in salt marsh habitat reproduce mainly by vegetative propagation and often do not produce seeds (Jefferies and Gottlieb 1983, Chou et al. 1992). Therefore, once plants are removed by geese, there is little chance of re-establishment. Handa and Jefferies (2000) evaluated

Fig. 3.24. Example of light goose habitat destruction at La Perouse Bay, Manitoba. Empty pond basin at right was caused by goose grubbing activity. Red plants surrounding dead willow trees are salt-tolerant species. Photo by J. Kelley, USFWS.

Fig. 3.25. Goose exclosure plot at La Perouse Bay, Manitoba. Green vegetation is enclosed by fencing that prevents geese from feeding in plot. Areas devoid of vegetation outside of plot were exposed to goose feeding and are characterized by mudflats and exposed gravel. Photo by J. Kelley, USFWS.

the effectiveness of artificially transplanting marsh plants on bare sediments. Their study indicated that amending soil with peat and fertilizer could increase the survival rate of transplants. However, this technique has limited application because of the cost of large-scale re-vegetation and the need to exclude geese from such areas (Handa and Jefferies 2000).

Habitat degradation by light geese has been most extensively studied in specific areas where colonies have expanded exponentially and habitat degradation is severe. For example, comparison of satellite imagery for La Perouse Bay, Manitoba from 1973, 1984, and 1993 was used to document the decline in salt marsh vegetation as a result of the feeding activities of light geese (Jano et al. 1998; Fig. 3.26). Assuming a constant and linear rate of vegetation decline, the rate of decline at La Perouse Bay during 1984-93 was approximately 159 acres/year (Fig. 3.27; calculated from data in Jano et al. 1998).

Vegetation surveys conducted during 1993-95 indicate that destruction of vegetation and loss of habitat are widespread along the western and southern coasts of Hudson Bay and James Bay (Kerbes et al. 1990; Abraham and Jefferies 1997). The Hudson Bay Lowlands salt marsh ecosystem, for example, lies within a 1,200 mile strip of coastline along west Hudson and James Bays. This area contains approximately 135,000 acres of coastal salt marsh habitat; of which 35% is considered to be destroyed, 30% is damaged, and 35% is overgrazed (Abraham and Jefferies 1997). Habitats currently categorized as damaged or overgrazed are being further impacted and eventually will be destroyed if goose populations continue to expand.

The Hudson Bay Lowlands have undergone isostatic uplift following retreat of the last glacial episode. Upon being released from the weight of glaciers, the coastline has undergone a rate of uplift of between 0.5 to 1.2 meters per century (Hik et al. 1992). The gradual uplift causes modification to the soil environment and leads to a shift in communities of plants that tolerate drier conditions. In the absence of goose grazing this shift can occur within 5 years. However, the shift to a different plant community can be retarded by the grazing activity of geese, until the effects of isostatic uplift eventually predominate (Hik et al. 1992). Although isostatic uplift creates new salt marsh habitat as new land is exposed, the rate of increase of new habitat is too slow to keep up with the rate of habitat destruction caused by the increasing light goose population. As geese destroy salt marsh habitat and move inland they exploit other habitats that degrade much more quickly (R. Rockwell, personal communication).

Satellite imagery has been used to demonstrate habitat damage at other sites in the Arctic. For example, light goose population growth at Karrak Lake (approximately 750 miles northwest of La Perouse Bay) in the Queen Maud Gulf Migratory Bird Sanctuary has negatively affected habitat (Alisauskas 1998, Didiuk et al. 2001). Population growth rates of Ross's geese and lesser snow geese in Queen Maud Gulf during 1965-88 were 7.7% and 15.4%, respectively (Kerbes 1994). By 1989, 52% of plant communities within the areas occupied by nesting light geese at Karrak Lake were converted to exposed peat, and 7% had

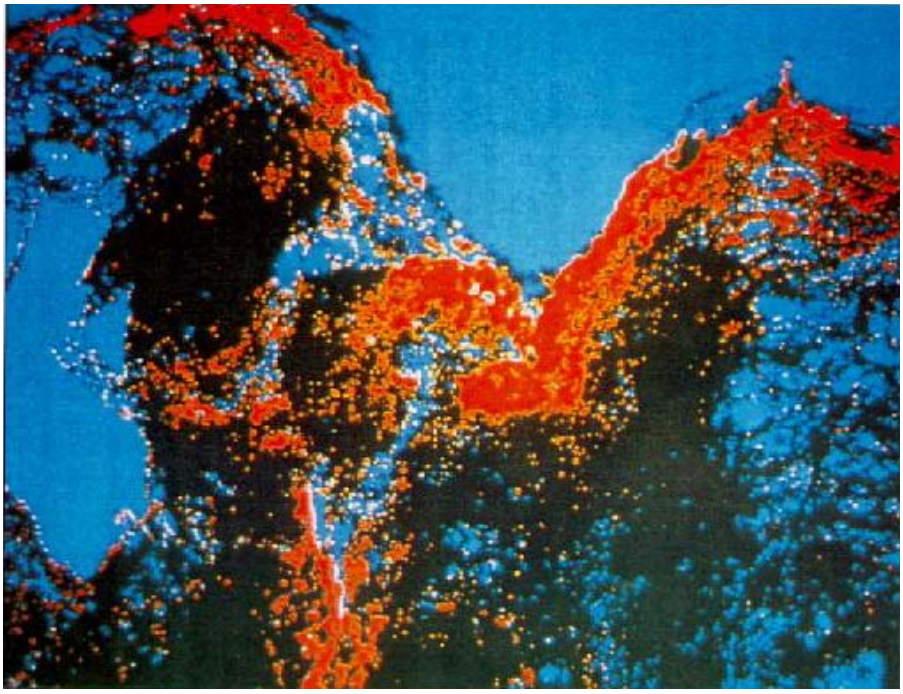


Fig. 3.26. Satellite imagery of the cumulative damage at La Perouse Bay caused by light geese during 1973-93. Water appears as blue, intact vegetation dark green, and damaged areas where there is bare soil or incomplete plant cover appears red. In 1973 these areas had complete vegetative cover (after Jano et. al. 1998). Width of photo covers approximately 16 kilometers.

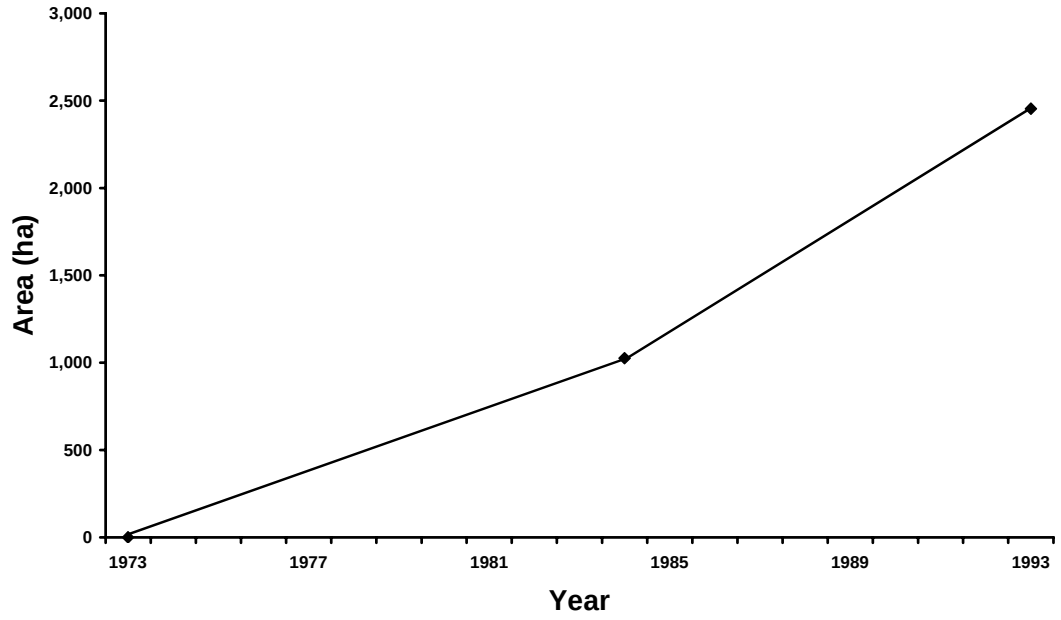


Fig. 3.27. Additional area (hectares) of salt marsh vegetation decline at La Perouse Bay after 1973 when monitoring began. Actual loss of vegetation was determined by comparison of satellite imagery from 1973, 1984, and 1993 (data from Jano et al. 1998).

further eroded to bare mineral soils (Alisauskas 1998). Loss of vegetation at colony sites may eventually lead to desertification (Alisauskas 1998). Furthermore, destruction of food plants caused by increasing numbers of Ross's and lesser snow geese could have negative effects on other species inhabiting the area (Kerbes 1994).

The breeding range of light geese is vast, and a comprehensive inventory of habitat status at all major colony sites is unavailable at this time. However, all colonies have been visited during the past 5-10 years, and many have a history of visits during the past 40 years. Field observations indicate that various levels of habitat degradation have been caused by light geese in areas beyond those discussed above. Due to the high cost of obtaining satellite imagery and conducting detailed vegetation surveys in the Arctic, information from many areas is qualitative. Nevertheless, such observations point to the wide geographic range in which vegetation damage has been observed. The following descriptions of conditions at several major breeding or staging areas for light geese were reported by Abraham and Jefferies (1997).

Akimiski Island, NWT. Vegetation damage to the intertidal region along much of the north shore of the island is extensive. Mudflats have replaced many stands of vegetation and only patches of vegetation remain. Vegetation in the upper intertidal zone also is being grazed and grubbed. Brackish and freshwater vegetation immediately inland from the upper limit of spring tides is grazed heavily in summer and shoot pulling is common in spring. Bare peaty areas occur as a result of goose foraging activities, and stands of dead willows occur locally in areas grubbed by geese.

West coast of James Bay, Ontario. Localized damage to vegetation as a result of grubbing is found in salt marshes. Grubbing is more evident north of the Attawapiskat River than south of it. Intensive spring foraging by staging snow and Canada geese has been documented for areas north of Ekwan Point up to the Lakitusaki River. The absence of large breeding colonies of snow geese has resulted in only localized damage to vegetation.

Cape Henrietta Maria, Ontario. This region contains an extensive area of intertidal salt marsh that has been severely grubbed and heavily grazed. Inland from the intertidal zone are extensive moss carpets that have developed as a result of goose feeding. These conditions exist on the James Bay coast as far south as Hook Point. Between Cape Henrietta Maria and the Sutton River to the west, large grubbed areas, degraded salt marsh stands, and moss carpets dominate the coastal zone. Salt marsh habitat immediately west of the Sutton River is in relatively good condition, although signs of increased grubbing of these marshes exist. Intensive habitat damage has been noted only near the core of the goose colony located in this area. However, moderate to heavy goose grazing of freshwater sedge meadows has been observed up to 8-10 km from the coast.

Hudson Bay coast of Ontario. The stretch of coastline from Sutton River to the Ontario-Manitoba border contains small fringe salt marshes that have been grubbed and heavily grazed by Canada geese and lesser snow geese. Small colonies with high snow goose nest densities occur in the vicinity of more extensive salt marshes east of the Winisk River, Shell Brook, and at the Pen Islands. The vegetation stand at the Pen Islands (20 km x 5 km) is in good condition. However, at the other locations some damage to vegetation is evident.

Hudson Bay coast of Manitoba. Although the coastline of Manitoba between the Black Duck River in the east and Rupert Creek at the southern end of the Cape Churchill Peninsula is a major spring staging area for geese; no large breeding colonies of snow geese are found there. Fringe salt marshes in the area between the border with Ontario and Cape Tatnum have been heavily grazed and grubbed by geese. Migrating birds pull plant shoots in sedge meadows inland from the coast. Some moss carpets have developed and many bare areas are present on the surface.

Knife and Seal Rivers, Manitoba. The estuaries of these rivers have staging, breeding, and post-hatching populations of lesser snow and Canada geese. There are a number of marshes that are badly grubbed and damaged. Moss carpets have developed where geese have removed sedge shoots.

Tha-Anne River to the Maguse River (west coast of Hudson Bay). The coastal intertidal salt marsh in this area has been replaced by mudflats throughout the entire coastal strip, except at Wolf Creek. Sedge plant communities have either been heavily grazed or replaced by peat barrens for distances up to 10 km inland from the coast. In some areas the peat has been eroded to expose gravel.

Southampton Island. Visits to breeding colonies indicate that there is widespread shoot-pulling of sedges, heavy goose grazing of shoots, and bare peat areas and moss carpets are present. At Boas River, formerly extensive salt marshes have been badly grubbed and reduced to remnant patches.

Southwestern Baffin Island. This region contains several large colonies of lesser snow geese that breed in coastal marsh areas and move inland along river valleys to feed on freshwater vegetation. Some riparian areas have developed moss carpets and the entire coastal area is heavily grazed.

Banks Island. Vegetation studies have not been conducted on the island; however, recent photographs of the area indicate vegetation changes as a result of goose grazing.

3.2.2 Migration and wintering habitat conditions and degradation

Greater snow geese. — The St. Lawrence River Valley is an important spring and fall staging area for greater snow geese. Traditionally, geese have utilized approximately 3,000 ha of bulrush marshes on the

river. However, increased goose populations in the 1970s fostered the spread of geese into cordgrass salt marshes during spring. Although no vegetation studies have been conducted in cordgrass salt marshes, it is believed that geese are not negatively impacting this habitat to a large extent (Giroux et al. 1998). Most vegetation studies have been conducted in bulrush marshes, where geese feed on both aboveground and belowground portions of plants.

Most vegetation studies in bulrush marshes were conducted in the mid-1980s, when the snow goose population was less than half of current levels. At that time, it was estimated that geese consumed 23-32% of below-ground plant biomass during fall and spring combined (Giroux and Bedard 1987, Reed 1989 cited in Giroux et al. 1998). Employment of goose exclosures was used to demonstrate a 62% difference in plant production between grazed and un-grazed study plots. Bulrush stem density in some marshes declined by 40% during 1971-96 (Giroux and Bedard 1987). Repeated measures of below-ground plant biomass suggested that geese had maintained the marsh system in a low-level steady state during the 1980s. However, decreased number of use-days by geese, declining productivity of bulrush habitats at some sites, changes in plant species composition, and erosion of marshes indicate that the carrying capacity of bulrush marshes may have been reached and that marshes can no longer accommodate the increasing number of snow geese (Giroux et al. 1998).

Until the 1960s, migrating greater snow geese staged in their traditional bulrush marshes of the upper St. Lawrence River estuary. However, birds gradually began field-feeding behavior during spring in the late 1960s and early 1970s, when the population level approached 100,000 (Filion et al. 1998). Geese showed a strong preference for new hayfields with young grass growth and waste grain from the previous year. Between 1980 and 1985, hay crop loss due to goose grazing increased from 0.47 to 0.78 metric tons/ha. Studies conducted in 1995 indicated an average hay yield loss of 24% for the first cut, and a 7-10 day delay in plant maturity as a result of goose grazing (Filion et al. 1998). Goose grazing also has been implicated for increasing the abundance of weeds and decreasing hay vigor, which increases production costs. This damage has prompted implementation of a compensation fund to cover 80% of farmers' losses (Table 3.5). More

Table 3.5. Compensation paid to farmers in Quebec as a result of crop damages due to grazing by greater snow geese (Filion et al. 1998).

Year	Number of farmers making claims	Total hectares affected	Estimated losses (Canadian dollars)	Total payments made (Canadian)
1992	251	8,176	$466,589	$373,271
1993	136	3,526	$211,514	$169,211
1994	309	10,348	$534,891	$399,970
1995	369	16,081	$904,043	$560,000
1996	293	11,940	$844,213	$560,000
1997	283	11,411	$485,312	$485,312

recent estimates of agricultural impacts during 1997-2003 indicate that $750,000 annually is paid to farmers for crop damage, and $100,000 is spent on scaring activities to move birds from fields (Canadian Wildlife Service 2005). Bedard and Lapointe (1991) predicted that rapid goose population growth would soon lead to unacceptable crop damage. In some areas, compensation has not been sufficient for farmers who experience losses and the Quebec Farmers Union has asked for control of the snow goose population (Filion et al. 1998). With recent shifts of geese toward the upper St. Lawrence estuary and their later departure from these regions, damage to forage production could increase and additional crops, such as winter cereals, could be affected (Filion et al. 1998).

Greater snow geese feed in bulrush marshes in the St. Lawrence River valley during their fall and spring migrations. In the early 1980s, it was estimated that geese spent approximately 90% of their spring feeding time in bulrush marshes and the remaining time in agricultural fields (Gauthier et al. 1988). More recent monitoring of radio-marked birds in spring indicated that the time feeding in bulrush marshes during spring has declined to less than 50% (Giroux et al. 1998). The use of bulrush marshes during fall varies depending on the amount of hunting activity in adjacent agricultural fields. During the mid-1980s, tidal marshes at Cap Tourmente National Wildlife Area accounted for only 30% of fall habitat use because large tracts of fields were available to geese. Along the south shore during the same time period, geese were totally dependent on marshes for feeding because of the presence of hunters in adjacent fields. More recently however, geese in such areas spend a greater percentage of their feeding time in agricultural fields, which reduces the use of marshes (Giroux et al. 1998).

Prior to the 1960s, the impact of greater snow geese on coastal marshes of the U.S. mid-Atlantic coast appeared to be relatively small. Goose impacts on marshes became more apparent as the population grew during the 1970s and 1980s. From New Jersey to North Carolina, areas of denuded marsh, or "eat-outs," were created by foraging geese (Giroux et al. 1998). Cordgrass (*Spartina* spp.) marshes that have been heavily grazed by snow geese have significantly less above-ground and below-ground plant biomass than undisturbed marshes (Widjeskog 1977, Smith and Odum 1981, Young 1985). Marshes that have experienced eat-outs may be able to recover relatively quickly if sufficient below-ground biomass remains to resume vegetative growth (Smith and Odum 1981). However, areas that are grazed by geese year after year may be maintained as mudflats (Young 1985). A coastal marsh eat-out at Forsythe NWR in New Jersey has been maintained by annual goose grazing. Wind and wave action in the resulting open water area is causing erosion and may be preventing plant re-establishment (Giroux et al. 1998).

Snow goose grazing has impacted natural marshes at several sites throughout the mid-Atlantic coast. For example, 500-600 acres of marsh at Bombay Hook NWR in Delaware have been lost or reduced to bare mud since the early 1980s (Young 1985). Approximately 1,700 acres of salt marsh in the vicinity of Forsythe NWR in New Jersey were severely impacted by snow geese during the 1970s, and the impacted

area appears to have increased gradually over time (Widjeskog 1978, Giroux et al. 1998). During the 1970s and 1980s, approximately 1,000-3,000 acres of cordgrass marsh along the Delaware Bay shore of New Jersey were impacted by snow geese (Giroux et al. 1998). Localized eat-outs have also been documented in Maryland and Virginia (Giroux et al. 1998). Goose impacts to coastal marshes appear to have been reduced in areas where birds have adapted to feeding in agricultural habitats. However, the nutritional subsidy that agricultural foods provides to birds likely has contributed to the increase in the goose population. Increased damage to coastal marshes during the last 5-10 years has occurred in areas where agricultural foods are less available or where large increases in goose numbers have rapidly occurred (Giroux et al. 1998).

The use of agricultural lands by greater snow geese in the mid-Atlantic region is a relatively recent development. During the 1960s, small groups of snow geese were first observed in agricultural fields in Virginia and North Carolina. Agricultural depredations by geese in the mid-Atlantic were first reported during the winter of 1971-72. Virginia and North Carolina experienced large numbers of crop damage complaints in the 1970s, but the number of reports has declined substantially. A 1998 poll of agency personnel in 6 mid-Atlantic states indicated that, on average, an annual total of less than 35 crop damage complaints (Giroux et al. 1998). However, goose damage was reported to be on the increase in Pennsylvania, Maryland, and Delaware, and stable in New Jersey, Virginia, North Carolina, and New York (Giroux et al. 1998). Crop damage assessment surveys were conducted in Delaware during 1998 and 1999 (Delaware Div. of Fish and Wildlife 2000). In 1998, a total of $500,000 in crop damage affecting 12,000 acres was documented; primarily in wheat, barley, and rye crops. In 1999, the number of acres affected had declined to 3,800, with damage amounts of $180,300. Although similar numbers of snow geese were present in both years, modification of hunting season opening dates for snow geese is believed to be responsible for the decline in crop damage.

With local exceptions, depredation problems resulting from feeding snow geese does not appear to be a serious widespread problem in the mid-Atlantic region. However, U.S. farmers are not traditionally compensated for wildlife damage and thus have little incentive to report damage to agencies. As snow goose populations continue to grow it is expected that agricultural depredations and complaints will increase.

CMF light geese. — As of yet, increasing light goose populations in the mid-continent region have not caused widespread crop depredation problems. A search of the crop damage reporting system of the U.S. Department of Agriculture indicated losses of $28,000 in Louisiana during January 1994 through November 2000 (U.S. Dept. Agriculture, unpublished data). Losses totaling $39,000 were reported in Texas from October 1993 to September 2000. Although many farmers may incur crop damage they often do not report such losses (M. Hoy, U.S. Dept. Agriculture., personal communication). Although light geese create eat-outs in natural marsh systems on the Gulf Coast, there are no indications that such occurrences are serious enough to warrant management action.

3.3 OTHER BIRD SPECIES

3.3.1 Waterfowl

There are 43 species of ducks and geese (*Anatidae*) that occur throughout the United States and Canada (Bellrose 1980). There are 36 species of ducks (consisting of dabblers, divers, sea ducks, and mergansers) and seven species of geese (Bellrose 1980). Waterfowl production is closely associated with habitat. During the 1960s, large portions of forested and other wetland waterfowl habitat were converted to agricultural production, which resulted in the loss of that habitat for many waterfowl species. Habitats in the Mississippi Alluvial Valley, Prairie Pothole Region of the Midwest, and important Gulf Coast wintering areas were converted to production of soybeans, rice, cereal grains, and other crops. However, Federal, State, and private conservation organizations established refuges, sanctuaries, and waterfowl production areas specifically to enhance production and protection of waterfowl and their habitats. Most North American goose populations remain numerically sound (USFWS 2006).

The Southern James Bay Population (SJBP) of Canada geese (*B. c. interior*) breeds on Akimiski Island and on the west coast of James Bay. Much of the population winters in the Mississippi Flyway, with a smaller portion also wintering in the Atlantic Flyway. The spring population of SJBP Canada geese on Akimiski Island declined 67% between 1985 and 1995 (Leafloor et al. 1996). The number of reports of goslings banded in early summer and subsequently retrieved in fall was low, even though gosling production and survival to the banding period had improved. Leafloor et al. (1996) suspected that non-hunting mortality had increased during brood-rearing and early fall migration, possibly due to the effects of chronic malnutrition caused by habitat degradation by feeding, nesting, molting, and staging geese. Large numbers of light geese utilize the north shore of Akimiski Island, and evidence suggests they result in negative impacts on Canada goose gosling survival by nesting light geese.

Numerous white-fronted geese and various other populations of Canada geese migrate, stage, and winter in the same areas as do CMF light geese. Large flocks of CMF light geese may be crowding other species during migration and wintering, forcing them to seek habitat elsewhere. The risk of transmitting avian cholera to these other goose species may also increase (see Section 3.4).

Migration and wintering ranges of most species of ducks overlap those of light goose populations. Aerial surveys of duck breeding populations across predominant nesting areas began in 1955. Today, the survey area encompasses over 2 million square miles of breeding habitat and spans across Alaska, Canada, north-central United States, and eastward to Labrador (U.S. Fish and Wildlife Service 2000). The status of waterfowl habitats and populations is reported annually by the U.S. Fish and Wildlife Service.

3.3.2 Other bird species

Habitat degradation caused by light geese has the potential to affect the ability of other bird species to utilize the same area. Desertification of salt marsh habitat will reduce or eliminate feeding grounds for birds migrating through impacted areas on their way northward. In addition, nesting habitat of bird species that normally breed in and near light goose colonies will be reduced or eliminated. Some local populations may not be high enough to withstand long-term setbacks resulting from habitat loss.

Local populations of more than 30 other avian species in the La Pérouse Bay area have declined, presumably due to habitat degradation from large numbers of foraging light geese (Table 3.6; Rockwell et al. 1997b). Declines in these populations represent an overall decline in use of the region by other wildlife species, resulting in a decrease in regional biological diversity. Significantly declining local populations of species listed by Rockwell et al. (1997b) include northern shoveler, American wigeon, red-breasted merganser, stilt sandpiper, parasitic jaeger, oldsquaw, Hudsonian godwit, short-billed dowitcher, and others.

Documentation of specific losses in bird nests have been determined by repeated visits to study plots. For example, local nesting populations of semi-palmated sandpipers and red-necked phalaropes at La Perouse Bay, Manitoba, were sampled on study areas during 1983-87, 1993, and 1998-99 (Gratto-Trevor 1994; Rockwell 1999; Fig. 3.28). In 1983, more than 120 semi-palmated sandpiper and 46 red-necked

Table 3.6. Locally declining populations of other avian species in the La Pérouse Bay area. **Bold** indicates a statistically significant decline (Rockwell et al. 1997b).

Tundra swan	Sandhill crane	Semipalmated sandpiper
Mallard	Ruddy turnstone	Red-necked phalarope
Black duck	Golden and black-bellied plover	**Parasitic jaeger**
American wigeon	Semipalmated plover	Bonaparte's gull
Northern Pintail	**Dowitcher**	Arctic tern
Northern shoveler	**Hudsonian godwit**	Short-eared owl
Green-winged teal	**Whimbrel**	Horned lark
Oldsquaw	**Stilt sandpiper**	Raven
Red-breasted merganser	Dunlin	Yellow warbler
Savannah sparrow	Tree sparrow	White-crowned sparrow
Lapland longspur	Snow bunting	Redpoll
Northern harrier	Least sandpiper	

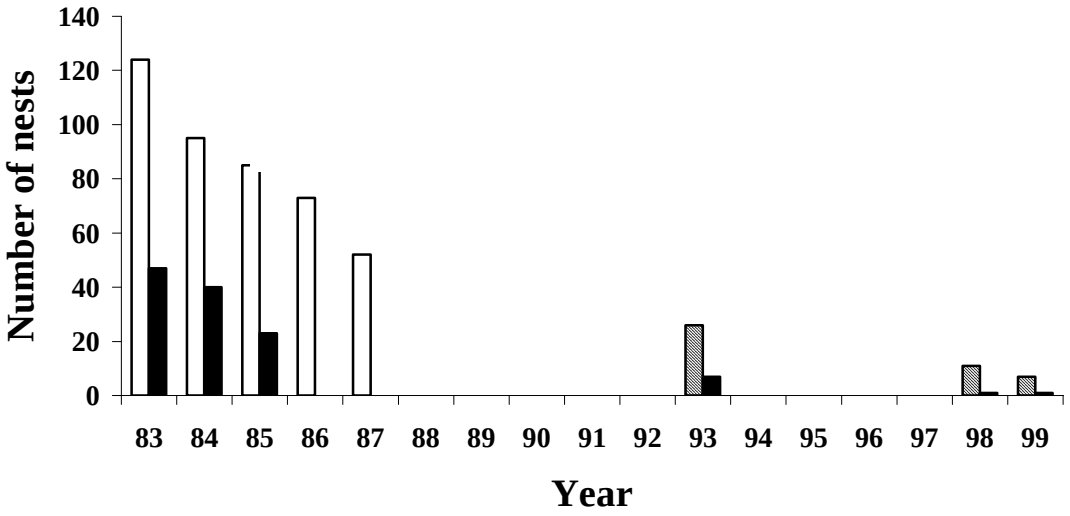


Fig. 3.28. Documented decline of semi-palmated sandpiper and red-necked phalarope nests on permanent study plots at La Perouse Bay, Manitoba, 1983-99 (Gratto-Trevor 1994; Rockwell 1999).

phalarope nests were documented (Gratto-Trevor 1994). When the study area was sampled in 1999, only 4 sandpiper and 1 phalarope nests were found (Rockwell 1999; Fig. 3.28). Results from these studies indicate declines in local populations of species in areas damaged by light geese. These results are not presented to suggest continental declines in populations of a particular species. However, if light goose populations continue to grow at current rates, and geese continue to exploit and destroy habitats in new breeding areas, it is possible that regional declines in populations of other bird species may occur.

Sherfy and Kirkpatrick (2003) utilized goose exclosures and invertebrate sampling in snow goose eat-outs and adjacent vegetation stands to examine potential impacts of geese on shorebird food resources in impoundments on Prime Hook NWR in Delaware. Although eat-out areas should have been more preferred by shorebirds for feeding due to the absence of vegetation, there was a significant reduction of invertebrates in such areas. The authors concluded that goose herbivory seemed to have a short-term, biologically significant effect on resource availability for other waterbirds.

3.3.3 Special Status Species

Due to the large geographical context of light goose management, a variety of special status species may occur in areas frequented by light geese. There are many endangered, threatened, proposed, and candidate species that occur in areas inhabited by light geese during migration and wintering periods. Although the geographic distribution of many of these species overlaps with those of light geese, the behavior, flight pattern, size, or other characteristics distinguish these species from any species of light geese.

A regional listing of endangered and threatened species occurring in various light goose areas is presented in Appendix 8.

Endangered whooping cranes (*Grus americana*) occur in light goose migration and wintering areas; primarily in the Central and Pacific Flyways. Spring migration pathways of whooping cranes overlap those of light geese in the Central Flyway (Fig. 3.29). However, peak of the spring migration of cranes through important stopover areas along the Platte River and other portions of Nebraska occurs during April (Fig. 3.30). Most cranes begin their spring migration in April and early May (Lewis et al. 1994), after most light geese have already left their wintering grounds. No whooping cranes have been recorded as being shot incidental to recent efforts intended to increase spring harvest of light geese in the Central Flyway.

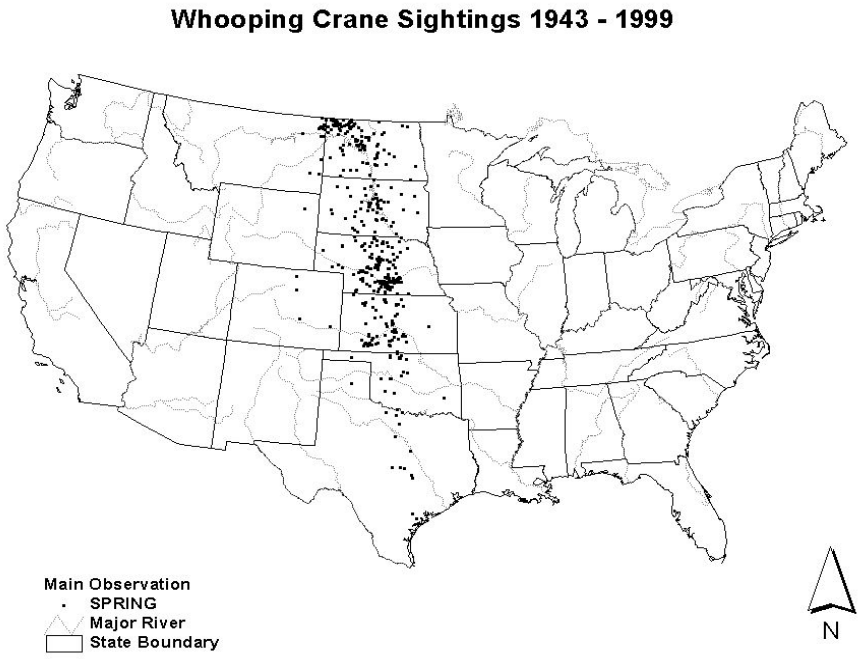


Fig. 3.29. Location of whooping crane sightings in the Central Flyway, 1943-99 (USFWS, unpublished data).

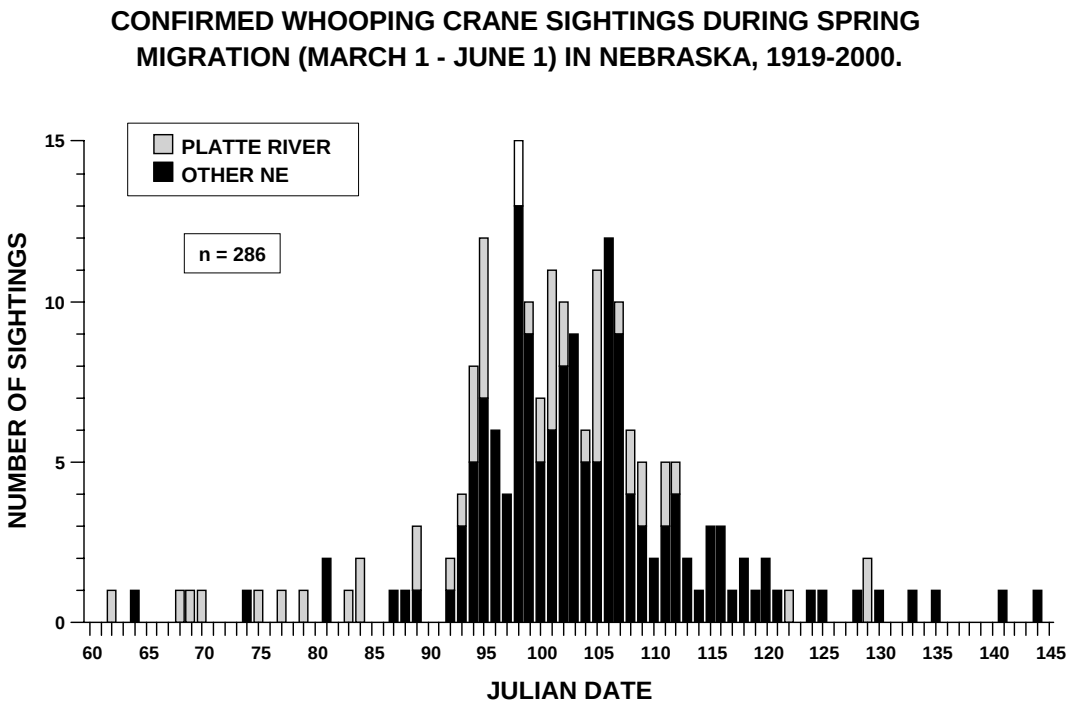


Fig. 3.30. Temporal distribution of whooping crane sightings in Nebraska, 1919-2000 (USFWS, unpublished data).

Protection of whooping cranes is ensured through implementation of the Aransas-Wood Buffalo Population Whooping Crane Contingency Plan (U.S. Fish and Wildlife Service and Central Flyway Council 2006). The contingency plan provides a mechanism for designating appropriate response options and reporting requirements whenever whooping cranes are confirmed as sick, injured, or dead, or when they are healthy but in a situation where they face hazards, such as shooting/hunting activities or contaminants and disease. Furthermore, plan objectives include reducing the likelihood of illegal shooting of whooping cranes by non-sportsmen or vandals, and increasing the opportunity to recover and rehabilitate wild whooping cranes found injured or sick.

3.4 AVIAN CHOLERA

Avian cholera is a highly contagious and deadly disease caused by the bacterium *Pasteurella multocida*, and is one of the most important diseases of North American waterfowl (Friend 1999). It is likely that most species of birds and mammals can become infected with P. multocida; however the multiple strains of the bacterium vary considerably in their ability to cause disease in different animals. The differences are most pronounced for cross infections between birds and mammals (Friend 1999). In wild birds, contamination from diseased birds is the primary source of infection (Friend 1999). Other means of transmission have been reported, each of which may occur for specific situations, but none of which are

primary means for disease transmission in wild birds (Friend 1999). There are multiple strains of the cholera bacterium and the strains vary considerably in their ability to cause disease in different animals. The differences are most pronounced for cross infections between birds and mammals (Friend 1999). Two reservoirs have been suggested as the source of avian cholera in waterfowl populations: carrier birds and sites of disease outbreaks (Samuel et al. 1997). However, most studies do not support the hypothesis that soil and water conditions on cholera outbreak sites act as a reservoir for the disease (Backstrand and Botzler 1986; Samuel et al. 1997).

Although much remains to be learned about the mechanism of transmission, there is increasing evidence that lesser snow and Ross's geese act as reservoirs for the bacterium that causes cholera (Friend 1999, Samuel et al. 1997, Samuel et al. 1999a). There are four major U.S. focal points for avian cholera in waterfowl: the Central Valley of California; the Tule Lake and Klamath Basins of northern California and southern Oregon; the Texas Panhandle; and Nebraska's Rainwater Basin (Friend 1999). The movement of cholera from these areas follows the well-defined pathways of waterfowl migration (Fig. 3.31), and is associated with movements of lesser snow and Ross's geese (Brand 1984; Samuel et al. 1999a).

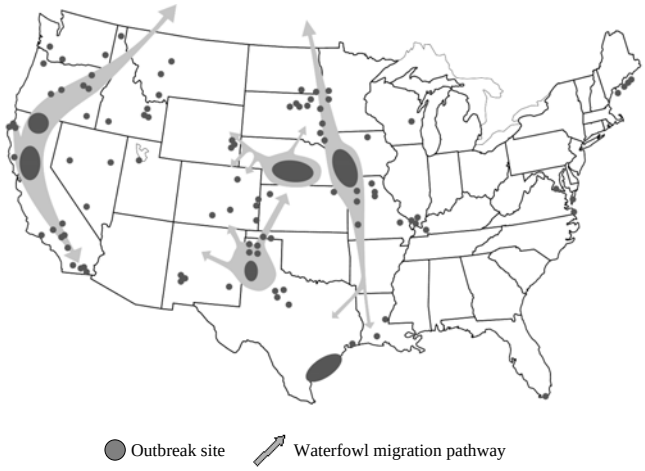


Fig. 3.31. Location of recurring avian cholera outbreaks and associated waterfowl migration pathways (Friend 1999).

Over 100 species of waterbirds and raptors are susceptible to avian cholera (Botzler 1991). Waterfowl species that are usually associated with cholera die-offs involving light geese include pintail, mallard, white-fronted geese, and Canada geese (Brand 1984, Samuel unpublished data). The threat of avian cholera to endangered and threatened bird species is continually increasing because of increasing numbers of cholera outbreaks and the expanding geographic distribution of the disease (Friend 1999). Potentially-affected species include whooping cranes and bald eagles (*Haliaeetus leucocephalus*). Various populations of sandhill cranes migrate, stage, and winter with CMF light geese and potentially could be affected by cholera outbreaks.

The potential for massive outbreaks of avian cholera in light geese and other waterfowl is illustrated by several documented die-offs. On Banks Island, avian cholera caused the death of at least 30,000 and 20,000 lesser snow geese in 1995 and 1996, respectively (Samuel et al. 1999a). Over 72,000 and 100,000 waterbirds died of cholera in the Rainwater Basin of Nebraska during 1980 and 1998, respectively (Brand 1984; Samuel, unpubl. report). Annual outbreaks of cholera involving the death of thousands of birds during individual events occur in Texas, Nebraska, and California (Fig. 3.32). Frequent outbreaks involving the death of small to moderate numbers of birds occur in Oregon, New Mexico, Colorado, South Dakota, Iowa, and Missouri; and occasional outbreaks occur in numerous other midwestern and western States (Friend 1999). Banding of vaccinated and control birds on breeding grounds indicate that survival of lesser snow geese that winter in the Central Valley of California is reduced 10-15% by avian cholera; and the disease accounts for about half of annual mortality (Samuel et al. 1999b). Evaluation of banding data from mid-continent white-fronted geese, and field observations of other waterfowl populations, suggest decreased survival rates due to avian cholera during some years (Friend 1999).

We believe that the increasing number and expanding geographic distribution of cholera outbreaks represent a serious threat to waterfowl and other bird populations that are susceptible to the disease. This threat is heightened due to the rapidly-increasing population of CMF light geese, which current scientific evidence suggests are carriers of the bacterium that causes the disease. Transmission of avian cholera is enhanced by the gregarious nature of most waterfowl species and by high densities of birds that result from habitat limitations, especially in winter and spring (Friend 1999). The likelihood of cholera outbreaks may be reduced when waterfowl occur in lower densities (Samuel et al. 1999b). Therefore, we believe that a reduction of light goose populations will reduce the risk of avian cholera outbreaks and associated impacts to other species in the future.

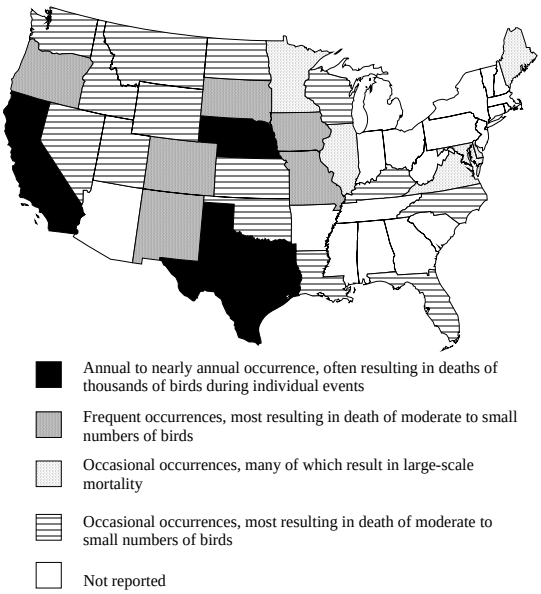


Fig. 3.32. Frequency of occurrence of avian cholera outbreaks in the U.S. (adapted from Friend 1999).

3.5 SOCIOECONOMIC CONSIDERATIONS

3.5.1 Economic impact of light goose hunting

Approximately 3.1 million people hunt migratory birds in the U.S. each year, and spend nearly $1.3 billion on trip- and equipment-related expenses (U.S. Department of the Interior 1997). Accounting for other indirect (influence of direct expenditures on secondary industries) and induced (wages and salaries for direct and indirect industries) impacts, migratory bird hunting results in a total economic impact of $3.6 billion each year in the U.S. (Teisl and Southwick 1995). Waterfowl (duck and goose) hunting represents 44% ($1.6 billion) of this total economic impact (Teisl and Southwick 1995). Estimates of the proportion of the total economic impact due to goose hunting are not available. However, goose hunting accounts for approximately 38% of the 22.2 million hunter days spent duck and goose hunting each year (U.S. Department of the Interior 1997:61). By assuming that days spent duck or goose hunting have equal cost, we estimate that the total annual economic impact of goose hunting in the U.S. is approximately $608 million.

Prior to implementation of special light goose regulations in the 1998/99 season, light geese represented approximately 24% of the total annual goose harvest in the U.S. (Martin and Padding 1999). Assuming that expenditures for goose hunting do not vary by species, light goose hunting creates an annual total economic impact of approximately $146 million. We used the percent distribution of harvest among Flyways to estimate the total economic impact of light goose hunting in each Flyway (Table 3.7).

Table 3.7. Light goose harvest in the U.S during 1997/98, and the proportion of the $146 million total economic impact generated by light goose hunting distributed among Flyways.

	Flyway				
	Atlantic	Mississippi	Central	Pacific	U.S.
Total light goose harvest	35,200	247,100	361,200	43,700	687,200
Percent of U.S. light goose harvest	5.1	35.9	52.6	6.4	100.0
Total economic impact resulting from light goose hunting ($ million)	$ 7.5	$52.5	$76.7	$9.3	$146.0

Hunting of greater snow geese and Canada geese in Quebec contributes more than $6 million (Canadian $$) annually to the economy (Canadian Wildlife Service 2005). Direct economic impacts of goose hunting accounts for nearly $3.5 million of this total. The amount of this total that could be attributed solely to greater snow geese was not determined during the study.

3.5.2 Economic impact of non-consumptive uses of light geese

Approximately 19.1 million people participate in non-consumptive uses (e.g. observe, photograph, etc.) of waterfowl in the U.S. each year, and spend $3.3 billion on trip- and equipment-related expenses (U.S. Department of the Interior 1997, Teisl and Southwick 1995). The total annual economic impact of non-consumptive uses of waterfowl in the U.S. is approximately $9.8 billion (Teisl and Southwick 1995). Information on the percentage of non-consumptive usage that can be attributed to duck or goose species is not available. Therefore, the economic impact solely of non-consumptive uses of light geese in the U.S. is not known.

A study of the economic impact of waterfowl migration through Quebec provided insight to the economic impact of non-consumptive uses, especially with regard to greater snow geese and Canada geese (Canadian Wildlife Service 2005). The total annual economic benefit of non-consumptive use of waterfowl migration through Quebec was estimated to be over $24 million (Canadian $$). Of this total, more than $19 million can be attributed to birdwatching activities at four main migration sites in Quebec. Additionally, $5 million annually was generated by 2 greater snow goose festivals, 1 Canada goose festival, and operation of associated educational centers (Canadian Wildlife Service 2005).

3.5.3 Subsistence uses of light geese

Greater snow geese are harvested by subsistence hunters in northern Quebec, the eastern Canadian Arctic, and Greenland. The bulk of the harvest of geese and eggs likely is by hunters from villages at Pond Inlet, Arctic Bay, Clyde River, Resolute Bay, Grise Fiord, and possibly Spence Bay (Reed et al. 1998). Geese likely are also harvested during migration through more southerly areas. The most recent estimate of annual subsistence harvest of greater snow geese from the above areas is approximately 1,185 birds and 1,414 eggs (Reed et al. 1998).

Although lesser snow geese are harvested over a broad area in the Arctic, most subsistence harvest occurs near Cree communities of the Hudson Bay Lowland in southern Hudson Bay (Abraham and Jefferies 1997). In the Ontario portion of that region, the human population is concentrated in Moosonee and the 8 native communities of Moose Factory, Mocreebec, New Post, Fort Albany, Kashechewan, Attawapiskat, Peawanuck, and Fort Severn. Whereas harvest of lesser snow geese dominates in fall, the spring harvest typically is comprised of Canada geese. In 1990, it was estimated that the spring waterfowl hunt consisted of 14,000 person-days of harvest effort and the fall hunt consisted of 10,000 person-days (Abraham and Jefferies 1997). The communities of Moose Factory and Kashechewan accounted for over half of the hunting effort. In 1994, estimated subsistence harvest of snow geese in the Hudson Bay Lowland area of Ontario was 56,536 birds (Abraham and Jefferies 1997). The total annual subsistence harvest of snow geese in 1994 was greater than in the 1950s (35,000-40,000), likely due to an increase in the aboriginal population

in the region. The mean annual harvest of snow geese per subsistence hunter on the Hudson Bay coast is approximately 37 birds (Abraham and Jefferies 1997). However, the annual harvest per hunter has remained similar during the past several decades, despite changes in goose population size (Abraham and Jefferies 1997). The fact that subsistence harvest has not risen proportionately with the increase in the size of the goose population (Johnson 1997) suggests that attempts to manage light goose populations by increasing subsistence harvest would be ineffective.

3.6 National Wildlife Refuge System

The Service's National Wildlife Refuge System (System) is comprised of 721 refuges and waterfowl production areas on more than 93 million acres in the U.S. (USFWS 1999a). As stated in the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57), which amended the National Wildlife Refuge System Administration Act of 1966, the mission of the System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans". While some refuges may be opened for migratory bird hunting without area limitation, the National Wildlife Refuge System Administration Act of 1966 stipulates that up to 40% of certain refuges may be acquired, reserved, or set apart as inviolate sanctuaries. The Fish and Wildlife Improvement Act of 1978 (Public Law 95-616) amended the 1966 Act to permit the opening of greater than 40% of these refuges to migratory gamebird hunting when it is determined to be beneficial to the species hunted. Following Executive Order 12996 issued on March 25, 1996, Congress enacted the National Wildlife Refuge System Improvement Act of 1997, amending the National Wildlife Refuge System Administration Act of 1966 to establish that compatible wildlife-dependent recreational uses involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation are the priority public uses of the Refuge System. In order to establish a refuge hunt program, a determination must be made that the program is compatible with the major purposes for which the refuge was established (USFWS 1986). Establishment of a hunt program includes preparation of the plan itself, an Environmental Assessment, a Finding of No Significant Impact, Section 7 consultation in accordance with the Endangered Species Act, and Proposed and Final Rules in the Federal Register (USFWS 1986). Each year, we make new proposals for amendments to refuge-specific hunting regulations available for public review and comment in the Federal Register.

Croplands (including cropland pasture) account for approximately 200,000 acres of land in the System; compared to approximately 495 million acres of non-Federal cropland in the U.S. in 1997 (U.S. Department of Agriculture 1999). Thus, refuge cropland comprises an insignificant amount (0.04%) of cropland when compared to the amount of croplands on private land. In any one year, only 40-60% of refuge cropland may actually be planted. Primary refuge crops include wheat, corn, soybeans and alfalfa. A certain

percentage of crops may be harvested and removed by cooperative farmers, but the remainder is left standing or manipulated to provide supplementary food for migrating and resident wildlife (USFWS 1993).

Greater snow geese

Certain refuges often host large concentrations of greater snow geese during migration and winter periods. Snow geese are routinely observed at 8 refuges in USFWS Region 5, with peak visitation ranging from 500 to 188,000 birds (Table 3.8). Peak populations occur on refuges during October through December, and in some months and years, more than 80% of snow geese in the Atlantic Flyway use Service refuges (USFWS, unpublished data).

Peak populations of greater snow geese on Bombay Hook NWR in Delaware have increased from 1,500 birds in 1968 to over 198,000 birds in 1997 (USFWS 1999c). Birds traditionally concentrate their feeding activity in a small portion of the refuge and create "eat-outs" of salt marsh habitat. A portion of the refuge was open to public hunting during the 1983-84 hunting season in an attempt to alleviate damage to the salt marsh. Hunter interest and participation in the hunt program was high in the first 2 weeks of the season, but quickly declined as fall progressed. Snow goose harvest has varied from 150 to 1,450 birds/year, with high harvest years being associated with a large percentage of young birds in the population (USFWS 1999c).

Table 3.8. Peak population estimates for greater snow geese on National Wildlife Refuges in Region 5, 1994-99.

Federal refuge and location	Peak population	Month/year of peak
Missisquoi NWR – VT	500	April 1999
Montezuma NWR – NY	15,000	April 1999
Forsythe NWR – NJ	22,000	November 1994
Bombay Hook NWR – DE	198,000	October 1997
Prime Hook NWR – DE	157,000	December 1997
Blackwater NWR – MD	6,500[1]	December 1998
Chincoteague NWR – VA	43,000	December 1996
Back Bay NWR - VA	8,700	January 1996

[1] Represents use by lesser snow geese

With the advent of the hunting program, geese changed their behavior patterns and began using adjacent Federal, State, and private lands. Even during periods of high hunter activity, snow geese continue to roost on Bombay Hook NWR in the evening. Thus, damage to salt marsh habitat has not declined. Despite high populations of snow geese on the refuge, implementation of a hunting program has had less than expected results in increasing harvest and reducing habitat damage. With the exception of Blackwater and Back Bay NWRs, Region 5 refuges that snow geese use have some portion of the refuge open to hunting (Table 3.9).

Table 3.9. Refuges in Region 5 that receive snow goose use, and the proportion of each refuge open to hunting (USFWS, unpublished data).

Refuge	Total refuge acres	Hunting allowed?	Acres hunted	% of refuge hunted
Missisquoi NWR - VT	6,517	Yes	1,626	25
Montezuma NWR - NY	7,730	Yes	1,100	14
Forsythe NWR – NJ	44,302	Yes	11,489	26
Bombay Hook NWR - DE	15,978	Yes	5,416	40
Prime Hook NWR – DE	8,839	Yes	1,100	12
Blackwater NWR – VA	24,053	No	0	0
Chincoteague NWR – VA	14,100	Yes	1,750	12
Back Bay NWR - VA	8,000	No	0	0

CMF light geese

Certain refuges in the southern portions of the Central and Mississippi Flyways are also important to light geese. The number of use/days by birds in a particular year often exceeds 1 million birds, but usage is dependent on seasonal weather conditions (Table 3.10).

Table 3.10. Average number of annual use/days by light geese on selected refuges in the southern portion of the Central and Mississippi Flyways (USFWS, unpublished data).

Refuge	State	Number of use/days
Lacassine NWR	LA	607,000
Cameron Prairie NWR	LA	715,000
Delta NWR	LA	3,000,000
Sabine NWR	LA	1,929,400
Upper Ouachita NWR	LA	1,200,000
Cache River NWR	AR	1,429,453
Bald Knob NWR	AR	2,250,000
Yazoo NWR	MS	1,175,400
Anahuac NWR	TX	3,500,000
McFaddin NWR	TX	4,000,000
Brazoria NWR	TX	1,500,000
San Bernard NWR	TX	1,600,000
Big Boggy NWR	TX	2,000,000
Aransas NWR	TX	2,500,000
Sequoyah NWR	OK	770,000

In the States of Arkansas, Louisiana, Mississippi, and Texas, goose usage of Federal refuges represents only 10-13% of the estimated number of wintering light geese in those States (USFWS, unpublished data). A similar situation likely exists for migration States farther north. Therefore, it appears that privately owned lands are much more important to wintering light geese than are Federal refuges.

High populations of light geese on refuges may result in depletion of food resources intended for other waterfowl and crane species. In addition, the incidence of cholera and avian tuberculosis may increase in association with high populations of light geese on refuges (Taylor and Kirby 1990). Experimental light

goose dispersal programs were attempted at Bosque del Apache NWR in New Mexico during 1986 (Taylor and Kirby 1990). A combination of crop manipulation, hazing, and to a lesser extent hunting, were able to move about 8,000 geese off the refuge in advance of normal dispersal movement. However, the program had the unintended effect of moving a large percentage of sandhill cranes and 2 whooping cranes off the refuge. Geese were unwilling to fly more than was necessary to escape disturbance, and often moved from one field to an adjacent field. Low hunter participation limited the effectiveness of the hunt program. Furthermore, hazing programs quickly reached a limit of effectiveness as geese became habituated to disturbance activities. Refuge staff concluded that making large-scale changes in goose distribution are impossible without dramatic and landscape-level changes in the environment (Taylor and Kirby 1990).

Several refuges recently have made changes to their waterfowl hunting programs and/or cropland management in an effort to increase the harvest of light geese and reduce food availability (Table 3.11). Hunt program changes usually involved increasing the number of days open to hunting during the regular season, participation in the conservation order, and/or opening waterfowl sanctuary areas. Changes to cropland management were not common on most refuges because most programs were geared to management of ducks and shorebirds rather than geese. Reduction of cropland was accomplished on some refuges by reforestation efforts unrelated to light goose management actions. Prior to implementation of changes in refuge management, there was a common perception that such changes would result in massive increases in light goose harvest. However, success of such changes was limited, and resulted in additional harvest of only 40 to 1,350 birds per refuge. Many refuges reported a lack of interest by local hunters, and that goose harvest was incidental to duck hunting. Hunters reported that geese quickly adjusted their daily movement patterns in response to hunter activity, thus decreasing success rates. Refuges often served only as roosting sites, and thus were not utilized for acquiring food. Several refuges indicated that changes to habitat management could not be made due to the likelihood of severe negative impacts to non-target waterfowl and shorebird species. Such impacts greatly outweighed any potential impacts on light goose food availability.

Table 3.11. Examples of changes in management on various National Wildlife Refuges (NWR) and impacts on light goose harvest (USFWS, unpublished data).

Refuge (State)	Management change	Impact on light geese
Yazoo NWR (MS)	Participated in conservation order	Additional harvest of 500 geese
Cache River NWR (AR)	Participated in conservation order Open waterfowl sanctuary to hunting Reforestation of agricultural land	Additional harvest of 100 geese by 5 hunters
Bald Knob NWR (AR)	Participated in conservation order Open waterfowl sanctuary to hunting Reforestation of agricultural land	Additional harvest of 250 geese

Lacassine NWR (LA)	No change due to negative impacts on non-target species	None
Cameron Prairie NWR (LA)	No cropland program (i.e., no change)	None
Brazoria NWR (TX)	Increase hunted acreage	Additional harvest of 1,350 geese
Anahuac NWR (TX)	Increase number of week days open to hunting	Additional harvest of 40 geese Additional 250 hunter-days
	No changes to farming program due to negative impacts on non-target species	
McFaddin NWR (TX)	Increase number of week days and acreage open to hunting	Additional harvest of 250 geese Additional 500 hunter-days
DeSoto NWR (IA)	Implemented controlled access hunt	For 1999 and 2000, 60-183 geese harvested by 83-122 hunters; movement of geese off refuge increased harvest on adjacent public hunting area by 500 geese

Beginning in 1997, we cooperated with State wildlife agencies to develop regional light goose action plans in the Central and Mississippi Flyways. Action plans identified important light goose wintering and migration areas, current habitat and hunting programs, and future potential for altering such programs to reduce food and sanctuary available to light geese. Prior to development of action plans, it was perceived that Federal refuges offered the potential for large-scale changes in total acreage open to light goose hunting. However, it became apparent that many Federal refuge areas had already been opened to hunting through normal administrative procedures for altering hunting programs. In some instances, hunting programs could not be expanded due to incompatibility with other refuge uses as outlined in the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57; October 9, 1997).

Light geese in the Pacific Flyway

Several refuges in the Pacific Flyway winter large concentrations of light geese (Table 3.12). Separate tallies for lesser snow and Ross's geese were not available.

3.7 Historical and Cultural Resources

The geographic extent of light goose breeding, migration and wintering areas is continental in scope and encompasses a variety of historical sites and cultural resources. The management alternatives analyzed in this document do not involve construction of new buildings, excavations, or other activities that normally disturb historical sites or cultural resources.

Table 3.12. Average number of annual use-days by light geese on selected refuges in the Pacific Flyway (USFWS, unpublished data).

Refuge	State	Number of use/days
Sonny Bono Salton Sea NWR	CA	1,800,000
Sacramento NWR	CA	5,646,850[1]
Delevan NWR	CA	4,649,265[1]
Colusa NWR	CA	2,895,735[1]
Sutter NWR	CA	2,083,980[1]
Butte Sink NWR	CA	283,760[1]

[1] Represents average for 1996-2000.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This section analyzes and describes potential environmental impacts and consequences that could result from the implementation of Alternatives A through E. This chapter is organized by impacts, with discussion of the consequences of each alternative relative to each impact. Generally, the impacts discussed are common to all alternatives, varying only in magnitude. Where appropriate, discussion of impacts will be separated by different populations of geese.

4.2 Impacts on Light Geese

4.2.1 Alternative A. No action.

Greater snow geese

Management of greater snow geese under the current harvest regime in the U.S. will likely result in a continued increase in population size. The population has been growing at an annual rate of 8%, which will lead to a population of 2 million birds by 2015. Under current hunting season frameworks, the annual regular-season harvest of greater snow geese in the U.S. during 2002-04 has ranged between 32,000 and 39,000 birds. This small annual harvest will likely not affect the population growth rate to a great extent. Harvest of greater snow geese in Canada is greater than that in the U.S. but does not appear to be sufficient to reduce the population to management objective levels. The population trajectory under this alternative will be dependent not only on harvest, but also on annual recruitment, which is influenced by spring weather. In years of favorable nesting conditions recruitment into the population will overwhelm harvest impacts to the population.

The breeding range of greater snow geese has expanded only slightly during the past 30 years. As a result, the density of birds at breeding colonies has increased. Without any management action to stabilize population size, we expect that bird densities on breeding colonies would continue to increase. Higher densities of birds on breeding colonies would eventually cause food supplies to become depleted and likely would result in poor body condition of adults and slower development and/or starvation of goslings. The geographical extent of the breeding range, and the likelihood of habitat degradation on new sites, would become greater as the population increases. However, this expansion likely would not occur until significant habitat damage has occurred on existing colony sites.

CMF Light Geese

Management of CMF light geese under the No Action alternative would result in an increase in goose numbers in the eastern and central Arctic, and expansion of the geographic range in which geese breed, migrate, and winter. Estimation of the impacts of the No Action alternative is complicated by the fact that population control efforts have been in place since 1999 by authorization of the Arctic Tundra Habitat Emergency Conservation Act. The No Action alternative would require that these control efforts be terminated. We assume that if control efforts are terminated, population growth of lesser snow and Ross's geese in the eastern and central Arctic would resume at the same rate observed during 1973-97 (see Chapter 3.1.6). Based on a growth rate of 4.7% per year, we expect the number of lesser snow geese in the eastern Arctic to approach 5.5 million in 2010. Similarly, we would expect the rapid increase in the number of Ross's geese in the eastern Arctic to resume. Removal of control efforts would also allow the number of lesser snow geese in the central Arctic to increase. Assuming a growth rate of 14.6%, the number of breeding birds would increase to over 4 million by 2010. The number of Ross's geese in the central Arctic likely would increase at a rate of 9.0% per year to approximately 1.6 million birds by 2010.

Based on linear regression of annual harvest in the U.S. during 1992-97, we expect that regular-season harvest of CMF light geese would increase by approximately 78,433 birds/year for at least several more years. However, this increase would be insufficient to cause a significant slowing of the population growth rate. Furthermore, we expect at some point that the magnitude of annual increase in regular season harvest would eventually subside and that total harvest would plateau, thus making control by hunting more difficult.

As the number of geese on eastern and central Arctic breeding areas increases, the amount of habitat degradation would increase as well. The geographic extent of breeding colonies would expand as geese seek out food resources in less disturbed areas. Impacts of decreased food supplies on light geese would likely occur over an extended period of time, and include an increase in mortality of goslings and adults from malnutrition, physiological stress, parasites, disease and predation due to insufficient breeding and brood-rearing habitat. Survivors likely would continue to decline in body size, possibly affecting breeding propensity and success over their lifetimes.

In the absence of population control, expansion of CMF light goose wintering and migration ranges within the conterminous U. S. would continue. Use of traditional migration routes and stopover areas likely would decline as the birds deplete local resources more quickly and earlier in each respective season, forcing light geese to occupy new areas where they would overlap with other species that heretofore were not directly affected. Mortality of light geese from avian cholera, and collateral mortality of bird species associating with light geese, likely would increase over time. Although uncertain, it is possible that density-

dependent regulation of the population would occur at some point. That is, it is possible that light geese would so deplete their food resources that a population decline would begin. The timing of a population decline of this nature currently is unpredictable, and the magnitude of such a decrease would depend on where the depletion of resources occurs (nesting areas, migration areas or wintering areas). The likelihood and time-scale of recovery of those resources is unknown. It is possible that light geese would learn to exploit new habitats in both the Arctic and elsewhere, thus spreading the damage and prolonging the habitat/population problem.

Western Population of Ross's Geese

Under the No Action alternative we expect the WPRG to continue to grow. In 1998, the estimated number of breeding Ross's geese in the central Arctic was a minimum of 567,100 birds, of which 60% likely migrated to the Pacific Flyway in winter. As mentioned previously, we expect the number of breeding Ross's geese in the central Arctic to be nearly 1.6 million by 2010. If Ross's geese continue to shift their wintering range eastward, the proportion of central Arctic Ross's geese that migrate to the Pacific Flyway likely would decrease. The consequences of increased population size and bird density on breeding colonies in the central Arctic was described under CMF light geese above.

Pacific Flyway Population of Lesser Snow Geese

At the current rate of population growth, the number of breeding lesser snow geese in the western Arctic will reach 1million by 2010. Approximately 76% of western Arctic lesser snow geese would migrate to the Pacific Flyway. As of yet, extensive damage to vegetation has not been reported on breeding areas in the western Arctic; however, field studies have not been in place to document whether or not any significant impacts have occurred. As population size and bird density increases on colony sites in the western Arctic, geese likely would begin to impact breeding habitats in a manner similar to birds in the eastern and central Arctic.

Wrangel Island Lesser Snow Geese

The population of Wrangel Island lesser snow geese averaged less than 100,000 birds since the 1980s. Spring weather on Wrangel Island directly influences goose productivity and may limit population growth. There are no indications that this population is impacting breeding habitats. Given the static nature of the trend of this population, it is unlikely that large-scale habitat damage by geese would occur in the near future.

4.2.2 Alternative B. (Preferred alternative). Modify harvest regulation options and refuge management.

Harvest Regulations

We estimated the potential impacts of this alternative using data resulting from regulatory liberalizations in the Central and Mississippi Flyways that started in 1999. Estimation of impacts was twofold: impacts associated with liberalization of regulations during the regular season; and secondly, the combined impact associated with regular season liberalizations and implementation of a conservation order.

The impact of authorizing new methods of take during the regular season was estimated by comparing mean light goose harvest in the 2 Flyways during 1996-98 to harvest in 1999 and 2000 for specific calendar dates in which states implemented regulation changes. Date-specific harvest estimates were not available for all participating States. Mean light goose harvest increased 244% on days for which special regulations were in effect during the regular season (Table 4.1). During liberalized time periods, mean lesser snow goose harvest increased 253%, whereas mean Ross's goose harvest increased 462%. The harvest of lesser snow geese far exceeded the harvest of Ross's geese. The change in lesser snow goose harvest among States ranged from a decrease of 1,787 birds to an increase of 29,039 birds. The change in Ross's goose harvest among States ranged from 0 to 2,873 birds. These estimates apply only to the time period in which methods of take were liberalized in various States (usually less than 30 days), and do not apply to the entire regular season. It should also be noted that after the 1999/2000 season, most states chose to simply begin a conservation order rather than implement liberalized regulations during the regular season. Therefore, we used data only from 1999 and 2000 to estimate the impacts resulting from regulation changes during the regular season.

We estimated the potential combined impact of new methods of take during the regular season and implementation of a conservation order by examining the harvest resulting from regulatory changes that occurred in the U.S. portion of the Central and Mississippi Flyways during 1999-2002. We incorporated two years of additional harvest data that was collected following publication of our Draft EIS. In this assessment, we assumed that regular season harvest of light geese would have continued to increase by 78,433 birds/year in the absence of new regulations. The rate of increase was determined from linear regression of harvest observed during 1992-97. By subtracting the expected regular season light goose harvest from the total observed harvest, we estimate that new regulations resulted in an increase in harvest ranging from 3 to 75% (average 41%, Table 4.2). This analysis did not examine years beyond 2002 because after that year the sampling framework used to estimate harvest was replaced by the Harvest Information Program. Harvest estimates derived after 2002 would not be comparable to those obtained during the 1992-97 baseline period.

Table 4.1. Impacts of liberalization in methods of take (electronic calls, unplugged shotguns), during portions of the regular season, on harvest of lesser snow geese (LSGO), Ross's geese (ROGO), and total light geese in 1999 and 2000, versus mean harvest for the same calendar periods in late winter/spring 1996-98.

		Light goose harvest								
	No. of	Mean 1996-98[2]			1999			2000		
State	days[1]	LSGO	ROGO	Light[3]	LSGO	ROGO	Light	LSGO	ROGO	Light
AR	16, 0	14,616	301	14,918	12,829	987	13,816	na	na	na
MO	23, 0	9,709	119	9,828	38,749	1,345	40,094	na	na	na
IL	22, 0	1,941	0	1,941	369	0	369	na	na	na
IA	29, 20	1,755	0	1,755	2,831	0	2,831			
		1,755	0	1,755				5,979	0	5979
CO	14, 6	335	167	502	3,517	703	4,220	0	0	0
KS	20, 32	2,209	364	2,573	5,029	718	5,747			
		4,007	471	4,478				1,519	676	2,195
NE	15, 36	3,144	131	3,275	11,035	811	11,846			
		6,035	289	6,324				17,859	3,162	21,021
SD	21, 0	601	0	601	7,623	173	7,796	na	na	na

[1] Number of days in 1999 and 2000 in which methods of take for light geese were liberalized during the regular season.
[2] If two estimates are provided for a state in a species column, the top number refers to mean harvest for dates chosen in 1999; bottom number refers to dates in 2000; "na" indicates that regulations were not changed.
[3] Lesser snow and Ross's geese combined.

Table 4.2. Estimated impacts resulting from implementation of new light goose (lesser snow and Ross's geese) harvest regulations in the U.S. portion of the Central and Mississippi Flyways.

Hunting season	Expected regular-season harvest with no new regulations[1]	Observed harvest in U.S. with new regulations[2]	Estimated additional U.S. harvest resulting from new regulations[3]	Estimated percent increase in harvest resulting from new regulations
1998/99	716,960	1,128,862	411,902	57.5
1999/00	795,394	1,393,118	597,724	75.1
2000/01	873,827	896,537	22,710	2.6
2001/02	952,261	1,232,497	280,236	29.4
			Average	41.2

[1] Estimated from linear regression of annual light goose harvest (Federal survey estimate) in the Central and Mississippi Flyways, 1992-97. Total harvest increased by 78,433 birds/year during 1992-97.
[2] Determined from Federal and State harvest surveys.
[3] Observed harvest (third column) minus expected harvest (second column).

Management on National Wildlife Refuges

Options for altering management practices on national wildlife refuges for the purpose of reducing food and sanctuary available to light geese are limited to changes in habitat management and hunting programs. Refuge croplands comprise less than 0.04% of total croplands in the U.S., and only 40-60% of such lands are actually planted each year. Furthermore, a certain percentage of crops are harvested and removed from refuges by cooperative farmers prior to arrival of geese. Therefore, we believe our ability to cause meaningful overall decreases in food availability is limited. This is especially true when geese utilize refuges as roosting areas and fly to adjacent croplands on private land to feed. Nevertheless, we have chosen to retain refuge crop reduction in this alternative as part of our overall effort to address the light goose problem. Acreage of crops that might be utilized by geese on refuges likely is variable from year to year depending on weather conditions, water level control, and reforestation efforts on some refuges. Therefore, we cannot determine the extent to which food availability can be altered. Given the above information, it is likely that the overall impact on food availability would be small.

Modification of refuge hunt programs has already occurred in concert with changes in overall light goose hunting frameworks (i.e., increased bag limits, season length). Furthermore, additional refuge areas in the mid-continent region have been opened to hunting in the past few years as a result of implementation of regional action plans (see Section 3.6). The impact of such changes has already been accounted for in recent light goose harvest estimates. Based on the small increase in harvest observed when refuges have expanded their hunt programs in recent years, we expect the impact of any additional openings in the mid-continent region to be minimal.

Greater snow geese

Adoption of this alternative is expected to result in a reduction of the population to 500,000 birds. Using the preliminary spring 2006 population estimate of 1,016,900 birds as a benchmark, achievement of the population goal would require harvest of 516,900 birds. The continental harvest of greater snow geese in 2004/05 was approximately 132,468 birds. This estimate includes 34,594 birds that were harvested in Quebec as a result of implementation of a conservation order harvest in spring (Table 4.3). Therefore, the impact of this alternative would be equal to the 384,482 additional birds that would need to be removed from the population to reach the goal of 500,000 birds (Table 4.3). Because Canada has already implemented harvest measures to reduce the number of greater snow geese, the extra harvest needed to reduce the population would need to occur in the U.S. The magnitude of this impact is subject to change, depending on the actual population size prior to implementation of any new regulations, size of the regular season harvest, and whether or not special spring harvest measures are continued in Quebec.

Table 4.3. Estimated impact of reducing the population of greater snow geese to 500,000 birds by authorizing new regulations in the U.S. to increase harvest.

	Annual harvest (2004/05)						
	Regular season	Conservation Order	Total	Spring 2006 population	Population goal	Population reduction required	Estimated impact of alternative
U.S.	31,548	na[1]	31,548				
Canada	66,326	34,594	100,920				
Total	97,874	34,594	132,468	1,016,900	500,000	516,900[2]	384,432[3]

[1] Conservation order not currently implemented in the U.S.
[2] Spring population (year 2006) minus population goal.
[3] Population reduction required minus total annual harvest observed in 2004/05.

We used results of population modeling (Gauthier and Brault 1998) to predict the size of the spring population following implementation of various levels of increased harvest rate (Fig. 4.1). At the time of the modeling exercise, the spring population level was 813,900 birds and the overall harvest rate was approximately 12% (Reed et al. 1998). Population trajectories in Fig. 4.1 correspond to impacts of harvest rates ranging from 21% to 35%. We did not examine harvest rates less than 21% because they did not cause decreases in population size (Gauthier and Brault 1998). We estimate that harvest rates between 30% and 35% are necessary to achieve a reduction of the population from 1,016,900 to 500,000 birds within 5 years, whereas a 27% harvest rate would achieve the reduction within 7 years. Extension of the population trajectories indicated that a 24% harvest rate would reduce the population within 12 years, and a rate of 21%

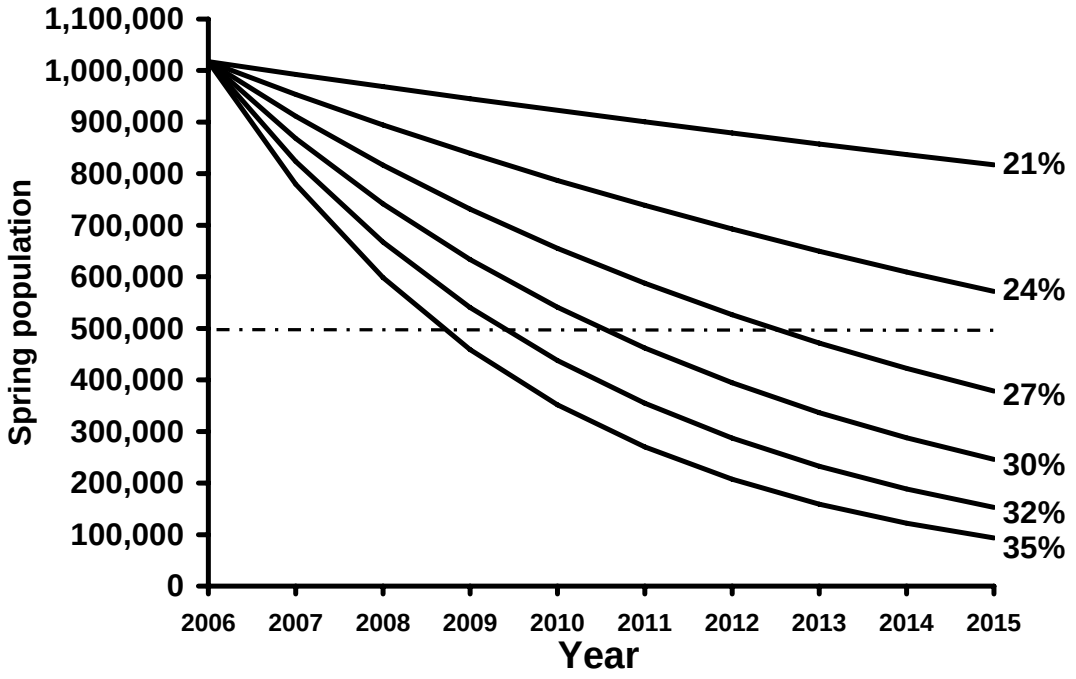


Fig. 4.1. Trajectories of the greater snow goose population resulting from implementation of various harvest rates (expressed as %), in relation to a population goal of 500,000 birds (dashed line). Trajectories begin with the preliminary spring 2006 population estimate of 1,016,900 birds.

would achieve reduction within 29 years. Previously, we estimated that harvest rates for greater snow geese in the Atlantic Flyway during 1999-2005 ranged from 13% to 25% (see Chapter 3.1.10). Based on information from the Central and Mississippi Flyways (Table 4.2), we estimate that authorization of new methods of take (regular season) and a conservation order in the U.S. portion of the Atlantic Flyway would result in a 41% increase in U.S. harvest of greater snow geese.

Using fall population estimates and projected harvest during 1999-2005 if special regulations were implemented in the U.S. (2005/06 harvest data not available at time of analysis), we estimate that an average projected harvest rate of 26% would result (Table 4.4). Using a harvest rate of 26%, and starting with the

Table 4.4. Projected continental harvest and harvest rate of greater snow geese if special regulations had been implemented in the U.S. portion of the Atlantic Flyway, 1999-2005

		Annual Harvest					
Season	Region	Regular season with no special regulations	Using special regulations	Total	Fall population[3]	Projected harvest rate[4]	Actual harvest rate[5]
1999/00	U.S.	54,115	76,302[1]	130,417			
	Canada	43,000	54,600[2]	97,600			
	Total	97,115	130,902	228,017	981,037	0.23	0.15
2000/01	U.S.	70,495	99,398[1]	169,893			
	Canada	108,500	49,800[2]	158,300			
	Total	178,995	149,198	328,193	1,181,054	0.28	0.19
2001/02	U.S.	77,354	109,069[1]	186,423			
	Canada	97,116	71,800[2]	168,916			
	Total	174,470	180,869	355,339	998,966	0.36	0.25
2002/03	U.S.	38,734	54,615[1]	93,349			
	Canada	48,259	22,650[2]	70,909			
	Total	86,993	77,265	164,258	622,199	0.26	0.18
2003/04	U.S.	35,067	49,444[1]	84,511			
	Canada	89,738	32,900[2]	122,638			
	Total	124,805	82,344	207,149	761,743	0.27	0.21
2004/05	U.S.	31,548	44,483[1]	76,031			
	Canada	66,326	34,594[2]	100,920			
	Total	97,874	79,077	176,951	1,030,591	0.17	0.13

[1]Represents additional 41% in U.S. harvest resulting from special regulations (column 3 multiplied by 0.41).
[2]Harvest from conservation order in Quebec.
[3] See Chapter 3.1.10 for calculations.
[4]Total projected harvest divided by fall population size.
[5] See Chapter 3.1.10 for calculations.

preliminary spring population of 1,016,900 birds in 2006, we estimate that the greater snow goose population would be reduced to the goal of 500,000 birds by approximately 2013 (Fig. 4.1). The magnitude of the impact of this alternative is subject to change, depending on the actual population size immediately prior to implementation of any new regulations in the U.S., size of regular season harvest, and whether or not special spring harvest measures are continued in Quebec. As discussed in Chapter 3.1.10, spring conservation harvest activity on agricultural lands in Quebec will continue to partially restrict snow goose access to agricultural foods and may assist in population reduction by causing a decrease in goose reproduction.

Peak populations of greater snow geese on national wildlife refuges occur during October through December (USFWS, unpublished data). Therefore, management actions to influence distribution of birds to make them more available to hunters should be implemented in fall. Previous experience with such efforts (see Chapter 3.6) has resulted in minimal success. The impacts associated with changes in refuge management in the mid-continent region were incorporated into the estimated increase in harvest following regulation changes in 1999. Because we utilized the same projection for the Atlantic Flyway, we do not anticipate additional impacts beyond the 41% increase in U.S. harvest if refuge actions are implemented there.

Once population reduction goals are achieved, steps would be taken to ensure that the number of greater snow geese remains stabilized and a resumption of population growth does not occur. Regular season harvest of geese in the U.S. portion of the Atlantic Flyway has not been increasing to the same extent as harvest in the mid-continent region. Future light goose hunting regulations would be adopted using existing administrative procedures, taking into account population surveys, harvest rates, and the outlook for production of young in a given year. Normal hunting regulations can be used during the regular season in years when population status appears to be stable. Additional methods of take and liberalization or removal of bag limits may need to be authorized during the regular season if additional harvest is required in a given year to achieve a stable population level. In years when a substantial increase in harvest is needed to reduce the population we may decide to temporarily re-instate a conservation order.

CMF Light Geese

Adoption of this alternative would result in a 50% reduction of the CMF light goose winter index from the peak 1997 estimate of 3.1 million, to our management goal of 1.55 million birds. Once attained, a winter index of 1.55 million would correspond to a minimum of 2.48 million breeding light geese on breeding colonies in the eastern and central Arctic. Accounting for an additional 30% for non-breeding birds, the total number of light geese following population reduction would be approximately 3.2 million in spring.

Because a large proportion of Ross's geese migrate to the Pacific Flyway, control activities implemented in the Central and Mississippi Flyways would impact Ross's geese to a much smaller degree than they would lesser snow geese. During 1997-99, the average composition of the Central Flyway light goose harvest was 92% lesser snow geese and 8% Ross's geese. During the same period, the average proportion of lesser snow and Ross's geese in the Mississippi Flyway was 97% and 3%, respectively. Upon implementation of this alternative, we assume that the proportions of lesser snow geese and Ross's geese in the Central and Mississippi Flyway harvests would be similar to those observed during 1997-99.

Population modeling indicated that an annual harvest of 1.4 million birds is required to reduce the number of CMF light geese by 50% (Rockwell and Ankney 2000). The total harvest of CMF light geese during 1999-2004 ranged from 1.2 to 1.5 million birds. This level of harvest approaches, and sometimes exceeds, the annual harvest of 1.4 million birds that is required to reduce the CMF light goose population by 50% (Rockwell and Ankney 2000). Any harvest in excess of 1.4 million birds in a given year reduces the amount of time required to reach population reduction goals (Rockwell and Ankney 2000). Assuming that the current rate of population decline continues, we believe that our management goal would be achieved by the year 2022.

We would closely monitor the status of CMF light geese using a combination of the annual winter population index, periodic photographic surveys of breeding colonies, Federal and State harvest surveys, and banding programs that provide estimates of survival and harvest rates. These monitoring capabilities ensure that our population control program can be curtailed when no longer needed, and that light geese will be in no danger of being over-harvested. We believe the target winter index is well above the level needed to sustain a healthy population and provide for consumptive and non-consumptive uses. Reduction of the number of light geese also would reduce the possibility of outbreaks of avian cholera within the population.

Once goals are achieved, steps would be taken to ensure that the number of light geese remains stable. Regular season harvest of CMF light geese, without special regulations, may be sufficient to maintain the goose population at desired levels if harvest continues to increase annually. However, we expect at some point that the magnitude of annual increase in regular season harvest will decrease and that total annual harvest will plateau. Future light goose hunting regulations would be determined using existing administrative procedures; taking into account population indices, harvest rates, and the outlook for production of young in a given year. Normal hunting regulations can be used during the regular season in years when population status appears stable. Additional methods of take (electronic calls and unplugged shotguns) and liberalization or removal of bag limits may need to be authorized during the regular season if additional harvest is required in a given year to achieve a stable population level. In years when a substantial increase in harvest is needed to reduce the population we may decide to temporarily re-instate a conservation order.

As mentioned previously, several federal refuges in the Central and Mississippi Flyways have expanded hunt programs during the past few years to increase harvest of light geese. The impacts we estimated for this alternative have already incorporated any harvest increases that occurred as a result of changes to refuge hunting programs. Furthermore, we believe we have limited potential to affect landscape-level changes in food availability. Therefore, we estimate that overall impacts associated with changes to refuge management would be minimal.

Western Population of Ross's Geese

Under this alternative we expect an increase in the number of Ross's geese that migrate from the central Arctic to the Pacific Flyway. This growth would continue as long as initial population control efforts are focused solely on birds that winter in the Central and Mississippi Flyways. However, growth of the WPRG will be offset somewhat by the continued eastward shift in the wintering range of Ross's geese. If habitat deterioration on breeding grounds in the central Arctic continues, despite efforts to reduce the number of light geese in the Central and Mississippi Flyways, it may become necessary to increase harvest of Ross's geese that migrate to the Pacific Flyway. However, such a strategy should consider the geographic distribution of wintering Wrangel Island lesser snow geese, which should not be subjected to increased harvest. Most Pacific Flyway Ross's geese follow a migration route through southwestern Saskatchewan, southeastern Alberta, and western Montana to wintering grounds in central California (Kerbes 1994). This geographic pattern should be considered when designing potential regulation changes to increase harvest of Ross's geese.

Pacific Flyway Population of lesser snow geese

Approximately 76% of lesser snow geese from the western Arctic migrate to Pacific Flyway Population wintering areas, and they comprise over 85% of snow geese found in California (Hines et al. 1999). At the current rate of population growth, the number of breeding lesser snow geese in the western Arctic will reach one million by 2010. Although studies have not been conducted, extensive damage to vegetation has not been reported on breeding areas in the western Arctic. However, as population size and bird density increases on colony sites, geese likely would begin to impact western breeding habitats in a manner similar to birds in the eastern and central Arctic. Hines et al. (1999) suggested a proactive approach to management of western Arctic lesser snow geese by stabilizing the population at its current level (i.e., approximately 0.5 million) before it escapes control via normal harvest. Alternative B would retain the option of implementing special light goose regulations in the Pacific Flyway if damage to western Arctic breeding habitats becomes evident. However, such a strategy should consider the geographic distribution of wintering Wrangel Island birds, which should not be subjected to increased harvest. Because 24% of western Arctic lesser snow geese migrate to the western Central Flyway, implementation of special regulations in the

Central Flyway would help slow the growth of western colonies.

Wrangel Island lesser snow geese

The population of Wrangel Island lesser snow geese has averaged less than 100,000 birds since the 1980s. Spring weather on Wrangel Island has a profound influence on productivity of geese and may limit population growth. There are no indications that this population is impacting breeding habitats. Given the static nature of the population of these geese, it is unlikely that they will cause large-scale habitat damage in the near future. Consequently, we do not anticipate that reduction measures will be necessary for this population.

Any future control measures for central and western arctic light geese that are implemented in the Pacific Flyway would be designed to avoid increased harvest of Wrangel Island birds. Wrangel Island birds that migrate through British Columbia and Washington are geographically separated from western Arctic birds, which tend to migrate through Alberta and Saskatchewan. Harvest pressure on Wrangel Islands birds in eastern Oregon can be reduced by delaying hunting seasons, or control efforts, in the fall. This is possible due to the tendency of Wrangel Island birds to arrive two weeks earlier than western Arctic birds in such areas. Furthermore, Wrangel Island birds do not winter in the Imperial Valley of southern California, which is frequented by birds from the western Arctic (Armstrong et al. 1999).

4.2.3 Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

Under this alternative, population reduction and/or stabilization would be achieved by direct removal of birds from the population using lethal means. Direct control efforts would be undertaken by wildlife agencies, and/or their designated agents, on light goose migration and wintering areas in the U.S. Methods of removal may include shooting, trapping, and/or chemical control. Traditional harvest of light geese would continue during the regular hunting season and would be authorized using existing administrative procedures. Light goose hunting regulations adopted by States would be confined to Federal frameworks that provide for a maximum season length of 107 days, occurring during the period September 1 through March 10 (U. S. Fish and Wildlife Service 1988). Existing hunt programs, and existing administrative procedures for establishing new hunt programs, on national wildlife refuges would remain in place.

The magnitude of direct removal of birds needed for a particular population of geese would be determined by the anticipated harvest resulting from normal hunting seasons. Direct removal would supplement normal harvest to achieve management goals. In most instances, impacts of this alternative on light geese are similar to impacts anticipated from alternative B. However, direct removal would be costly to

wildlife agencies, and could result in disposal and waste of potentially large numbers of geese if uses for carcasses could not be found. Failure to collect carcasses from wetlands could increase the likelihood of outbreaks of avian botulism, which are often associated with the presence of dead animal carcasses (Rocke and Friend 1999). The impacts of this alternative on individual light goose populations are discussed below.

Greater snow geese

Adoption of this alternative would result in a reduction of the population to 500,000 birds. If normal harvest of geese is insufficient to reduce the population, direct control would be implemented. The magnitude of direct removal required would depend on the extent to which the population goal has been exceeded, and the anticipated harvest of geese during the regular season. Furthermore, the magnitude of removal would determine if it is feasible to achieve the management goal in a single year, or if multiple years are required. Regardless of the time required to reach the population goal, direct control may result in disposal and waste of potentially large numbers of birds if appropriate uses for carcasses could not be found. Impacts associated with Alternative C are similar to those in Alternative B. Based on the preliminary spring 2006 population estimate of 1,016,900 birds, this alternative would require the removal of approximately 384,432 birds from the population (Table 4.3).

CMF Light Geese

Adoption of this alternative would result in a 50% reduction of the number of CMF light geese to the target level of 1.55 million birds, as measured by the winter index. Once achieved, a winter index of 1.55 million would correspond to a minimum of 2.48 million breeding light geese on breeding colonies in the eastern and central Arctic. Accounting for an additional 30% for non-breeding birds, the total number of light geese following population reduction would be approximately 3.2 million in spring. A 50% reduction of the CMF light goose population requires an annual removal of 1.41 million birds from the population (Rockwell and Ankney 2000). Control efforts implemented under this alternative would supplement regular season harvest to achieve a total annual removal of at least 1.41 million CMF light geese. Removal of additional birds in excess of 1.41 million will reduce the amount of time required to achieve the population goal.

We estimated the impact of this alternative by subtracting the regular season harvest observed during the 1997/98 regular season from the total annual removal of birds needed to achieve our management goal (Table 4.5). We chose the 1997/98 hunting season as a baseline, because it preceded the season in which special light goose regulations were authorized in the Central and Mississippi Flyways. Implementation of this alternative would require agency personnel to annually remove an additional 654,569

Table 4.5. Estimation of the number of Central/Mississippi Flyway light geese that would need to be removed on an annual basis by direct agency control in order to achieve a 50% reduction in number of geese.

	Regular season harvest (1997/98 season)			Number of birds that need to be removed to achieve goal[2]
	Lesser snow	Ross's	Light geese[1]	
Central Flyway	348,989	12,174	361,163	
Mississippi Flyway	238,993	8,125	247118	
Canada[3]	132,318	14,832	147,150	
Total	720,300	35,131	755,431	654,569

[1] Lesser snow and Ross's geese combined.
[2] Target harvest level (1.41 million birds) minus CMF light goose harvest observed during 1997/98.
[3] Manitoba and Saskatchewan, combined.

CMF light geese in order to achieve a total annual removal of 1.41 million birds. This represents a minimum number of birds that has been identified as being necessary to reduce the population. Removal of additional birds via direct control would reduce the time required to achieve the population goal. Direct control could result in disposal and waste of potentially large numbers of birds if uses for carcasses could not be found.

Because a large proportion of Ross's geese migrate to the Pacific Flyway, control activities implemented in the Central and Mississippi Flyways would impact Ross's geese to a much smaller degree than they would impact lesser snow geese. As discussed under Alternative B, the ratio of Ross's to lesser snow geese in the regular season harvest in the Central and Mississippi Flyways is 92:8 and 97:3, respectively. It is likely that personnel conducting control efforts would encounter Ross's and lesser snowgeese in the same proportion they are encountered by hunters. Therefore, we assume the ratio of Ross's:lesser snow geese in the segment of birds removed by agency personnel would be similar to the ratio observed in the regular season harvest.

Western Population of Ross's geese

Under this alternative we expect an increase in the number of Ross's geese that migrate from the central Arctic to the Pacific Flyway. This growth will continue as long as initial population control efforts for central arctic light geese are focused solely on birds wintering in the Central and Mississippi Flyways. However, growth of the WPRG would be offset somewhat by the continued eastward shift in the wintering range of Ross's geese that breed in the central Arctic. If light goose control efforts in the Central and Mississippi Flyways are not sufficient to halt habitat deterioration on breeding grounds in the central Arctic, it may become necessary to remove a certain number of Ross's geese that migrate to the Pacific Flyway. The actual number of Ross's geese to be removed in the Pacific Flyway cannot be determined at this time. The magnitude of removal would depend on the population size when control is deemed necessary. As discussed previously, strategies to reduce the number of Ross's geese should consider the geographic distribution of wintering Wrangel Island lesser snow geese, which should not be subjected to increased harvest.

Pacific Flyway Population of lesser snow geese

At the current rate of population growth, the number of breeding lesser snow geese in the western Arctic will reach one million by 2010. As mentioned previously, the majority of western Arctic birds migrate to the Pacific Flyway. Although studies have not been conducted, extensive goose damage to vegetation has not been reported on breeding areas in the western Arctic. However, as population size and bird density increases on colony sites, geese likely would begin to impact western breeding habitats in a manner similar to birds in the eastern and central Arctic.

This alternative would retain the option of implementing direct control of lesser snow geese in the Pacific Flyway if damage to western Arctic breeding habitats becomes evident and the number of western Arctic birds cannot be controlled through normal hunting seasons. The actual number of birds that may need to be removed cannot be determined at this time. Hines et al. (1999) recommended stabilization of the number of western Arctic birds at current levels (i.e., approximately 0.5 million). If we adopt Hines et al.'s recommendation, the number of birds removed would be the difference between 0.5 million birds and the size of the population when control is deemed necessary. The regular season harvest of lesser snow geese in the Pacific Flyway was approximately 40,600 birds in 2004/05. This level of annual harvest should be considered as part of the total number of birds targeted for removal from the population. Direct control measures should not be implemented in traditional wintering areas of Wrangel Island lesser snow geese.

Wrangel Island lesser snow geese

Given the current status of this population, we do not anticipate that control efforts would be needed in the foreseeable future. The population of Wrangel Island lesser snow geese averaged less than 100,000 birds since the 1980s. We expect the size of this population to remain within historical bounds under this alternative.

4.2.4 Alternative D. Seek direct light goose population control on breeding grounds in Canada.

This alternative would achieve light goose population reduction and stabilization through direct control in Canada. We do not have the authority to implement direct population control measures in Canada. Therefore, this alternative would require consultation with the Canadian government in order to urge implementation of such measures, which may or may not involve assistance from U.S. wildlife agency personnel. During the past several years we have held direct consultations with the Canadian Wildlife Service on the issue of light goose management. Participation of both agencies in the Arctic Goose Joint Venture has provided an additional avenue of discussion of light goose issues. The impacts of this alternative on individual light goose populations are discussed below.

Greater snow geese

Adoption of this alternative would result in a reduction of the population to 500,000 birds if Canada acts to implement direct control. Impacts of the alternative on geese are the same as those outlined in Alternatives B and C. The exact magnitude of direct removal would depend on the extent to which the population goal has been exceeded at the time of implementation, and the anticipated harvest of geese during the regular season. Furthermore, the magnitude of removal would determine if it is feasible to achieve the management goal in a single year, or if multiple years are required. Regardless of the time required to reach the population goal, direct control could result in disposal and waste of potentially large numbers of birds if appropriate uses for carcasses could not be found.

CMF Light Geese

Adoption of this alternative would result in a 50% reduction of the number of CMF light geese to the target level of 1.55 million birds, as measured by the winter index, if Canada acts to implement direct control. Once achieved, a winter index of 1.55 million would correspond to a minimum of 2.48 million breeding light geese on breeding colonies in the eastern and central Arctic. Accounting for an additional 30% for non-breeding birds, the total number of light geese following population reduction would be approximately 3.2 million in spring.

The impact of this alternative on CMF light geese is the same as that outlined under Alternative C (Table 4.5). To review, implementation of this alternative would require agency personnel to annually remove 654,569 light geese on eastern and central Arctic breeding areas. Such removal would supplement regular season harvest and result in a total annual removal of 1.41 million birds. This represents a minimum number of birds that has been identified as being necessary to reduce the population. Removal of additional birds via direct control would reduce the time required to achieve the population goal. Direct control could result in disposal and waste of potentially large numbers of birds if appropriate uses for carcasses cannot be found.

Western Population of Ross's Geese

The breeding range of the WPRG and CMF Ross's geese overlap with each other in the central Arctic. Under this alternative we expect that Ross's geese of both populations would be removed from breeding areas by agency personnel if Canada acts to implement direct control. Control efforts likely would focus on breeding areas where habitat damage is evident. Therefore, direct control of Ross's geese that

would have migrated to the Pacific Flyway would help achieve the management goal of protecting breeding habitat from goose destruction.

Pacific Flyway Population of lesser snow geese

At the current rate of population growth, the number of breeding lesser snow geese in the western Arctic will reach 0.8 million by 2005 and one million by 2010. As mentioned previously, the majority of western Arctic birds migrate to the Pacific Flyway. Although studies have not been conducted, extensive goose damage to vegetation has not been reported on breeding areas in the western Arctic. However, as population size and bird density increases on colony sites, geese likely would begin to impact western breeding habitats in a manner similar to birds in the eastern and central Arctic. At such time, direct control may become necessary.

This alternative would retain the option of implementing direct control of lesser snow geese in the western Arctic if it becomes evident they are damaging breeding habitats and that the number of western Arctic birds cannot be controlled through normal hunting seasons. The actual number of birds that may need to be removed cannot be determined at this time. Hines et al. (1999) suggested stabilization of the number of western Arctic birds at current levels (i.e., approximately 0.5 million). If we pursue their recommendation, and if Canada agrees to do so, the number of birds removed would be the difference between 0.5 million birds and the size of the population when control is deemed necessary. The regular season harvest of lesser snow geese in the Pacific Flyway was approximately 40,600 birds in 2004/05. This level of annual harvest should be considered as part of the total number of birds targeted for removal from the population.

Wrangel Island lesser snow geese

Given the current status of this population, we do not anticipate that control efforts would be needed in the foreseeable future. The population of Wrangel Island lesser snow geese has averaged less than 100,000 birds since the 1980s. We expect the size of this population to remain within historical bounds under this alternative.

4.2.5 Alternative E. Two-phased Approach to Light Goose Population Control.

Alternative E is a combination of Alternatives B, C, and D, implemented in a stepwise fashion. Therefore, the impacts of the preferred alternative on light goose populations are identical to those of the individual alternatives. Phase one of Alternative E, which is to modify harvest regulations and refuge management, would have impacts identical to Alternative B. Phase two, which would implement direct

population control, would have impacts identical to Alternatives C (wintering grounds) and D (breeding grounds). Management goals for each light goose population would remain unchanged. Consequently, the total number of birds removed from a particular light goose population under Alternative E would not differ from Alternatives B, C, or D. We envision that no more than 5 years would elapse in phase one before we evaluate the effectiveness of the light goose management program and assess the potential need for proceeding to phase two for a particular population.

Greater snow geese

Adoption of Alternative E is expected to result in a reduction of the population to 500,000 birds. Using the preliminary spring 2006 population estimate of 1,016,900 birds as an example, the impact of this alternative would be equal to an additional 384,482 birds beyond regular season harvest that would need to be removed from the population to reach the goal of 500,000 birds. We would attempt to achieve this reduction in phase one by implementing special harvest regulations in the U.S. to increase harvest of greater snow geese. We estimate that authorization of new methods of take (regular season) and a conservation order in the U.S. portion of the Atlantic Flyway would result in a 41% increase in U.S. harvest and raise the continental harvest rate to 26% (Table 4.4). Using a harvest rate of 26%, and starting with the preliminary spring population of 1,016,900 birds in 2006, we estimate that the greater snow goose population would be reduced to the goal of 500,000 birds by approximately 2013 (Fig. 4.2). The magnitude of the impact of this alternative is subject to change, depending on the actual population size immediately prior to implementation of any new regulations, size of regular season harvest, and whether or not special spring harvest measures are continued in Quebec.

If we determine within 5 years of implementing phase one that special harvest regulations by themselves are insufficient to reduce the population, direct control would be implemented in phase two. The magnitude of direct removal would depend on the extent to which the population goal has been exceeded and the anticipated harvest of geese during the regular season and during special conservation harvests. Implementation of phase two would not incur any removal of birds beyond that which is necessary to achieve the population goal of 500,000 birds. Direct control would initially be implemented in the U.S. after consultation with Canada. If further control is necessary, we would urge Canada to implement direct control in their country. Direct control may result in disposal and waste of potentially large numbers of birds if appropriate uses for carcasses could not be found.

CMF Light Geese

Adoption of Alternative E would result in a 50% reduction of the CMF light goose winter index from the peak estimate of 3.1 million, to our management goal of 1.55 million birds. Once achieved, a winter index of 1.55 million would correspond to a minimum of 2.48 million breeding light geese on

breeding colonies in the eastern and central Arctic. Accounting for an additional 30% for non-breeding birds, the total number of light geese following population reduction would be approximately 3.2 million in spring. Assuming that the current rate of population decline continues, we believe that our management goal would be achieved by the year 2022.

Under phase one of this alternative we would implement special regulations to increase light goose harvest in the Mississippi and Central Flyways. As outlined in Alternative B, we anticipate that U.S. harvest would range from 0.9 to 1.4 million birds using special regulations in combination with regular seasons. Combined with harvest in Canada, the total harvest of CMF light geese would range from 1.0 to 1.5 million birds. This level of harvest approaches, and sometimes exceeds, the annual harvest of 1.4 million birds that is required to reduce the population by 50%. Any harvest in excess of 1.4 million birds in a given year reduces the amount of time required to reach population reduction goals (Rockwell and Ankney 2000).

If we determine within 5 years of implementing phase one that special harvest regulations by themselves are insufficient to reduce the population, we would implement direct control. The magnitude of direct removal would depend on how much the population goal has been exceeded and the anticipated harvest of geese during the regular season and during special conservation harvests. Implementation of phase two would not incur any removal of birds beyond that which is necessary to achieve the winter index goal of 1.55 million birds. Direct control would initially be implemented in the U.S. after consultation with Canada. If further control is necessary, we would urge Canada to implement direct control in their country. Direct control may result in disposal and waste of potentially large numbers of birds if appropriate uses for carcasses could not be found.

Western Population of Ross's Geese

Under this alternative we expect an increase in the number of Ross's geese that migrate from the central Arctic to the Pacific Flyway. This growth would continue as long as initial population control efforts are focused solely on birds that winter in the Central and Mississippi Flyways. However, growth of the WPRG will be offset somewhat by the continued eastward shift in the wintering range of Ross's geese. If habitat deterioration on breeding grounds in the central Arctic continues, despite efforts to reduce the number of light geese in the Central and Mississippi Flyways, it may become necessary to increase harvest of Ross's geese that migrate to the Pacific Flyway. However, such a strategy should consider the geographic distribution of wintering Wrangel Island lesser snow geese, which should not be subjected to increased harvest. Most Pacific Flyway Ross's geese follow a migration route through southwestern Saskatchewan, southeastern Alberta, and western Montana to wintering grounds in central California (Kerbes 1994). This geographic pattern should be considered when designing potential regulation changes to increase harvest of Ross's geese.

Pacific Flyway Population of lesser snow geese

Approximately 76% of lesser snow geese from the western Arctic migrate to Pacific Flyway Population wintering areas, and they comprise over 85% of snow geese found in California (Hines et al. 1999). At the current rate of population growth, the number of breeding lesser snow geese in the western Arctic will reach one million by 2010. Although studies have not been conducted, extensive damage to vegetation has not been reported on breeding areas in the western Arctic. However, as population size and bird density increases on colony sites, geese likely would begin to impact western breeding habitats in a manner similar to birds in the eastern and central Arctic. Alternative E would retain the option of implementing special light goose regulations (phase one) or eventually direct control (phase two) in the Pacific Flyway if damage to western Arctic breeding habitats becomes evident. However, such a strategy should consider the geographic distribution of wintering Wrangel Island birds, which should not be subjected to increased harvest. Because 24% of western Arctic lesser snow geese migrate to the western Central Flyway, implementation of special regulations in the Central Flyway would help slow the growth of western colonies.

Wrangel Island lesser snow geese

The population of Wrangel Island lesser snow geese has averaged less than 100,000 birds since the 1980s. Spring weather on Wrangel Island has a profound influence on productivity of geese and may limit population growth. There are no indications that this population is impacting breeding habitats. Given the static nature of the population of these geese, it is unlikely that they will cause large-scale habitat damage in the near future. Consequently, we do not anticipate that reduction measures will be necessary for this population.

Under Alternative E, any future control measures for central and western arctic light geese that are implemented in the Pacific Flyway would be designed to avoid increased harvest of Wrangel Island birds. Wrangel Island birds that migrate through British Columbia and Washington are geographically separated from western Arctic birds, which tend to migrate through Alberta and Saskatchewan. Harvest pressure on Wrangel Islands birds in eastern Oregon can be reduced by delaying hunting seasons, or control efforts, in the fall. This is possible due to the tendency of Wrangel Island birds to arrive two weeks earlier than western Arctic birds in such areas. Furthermore, Wrangel Island birds do not winter in the Imperial Valley of southern California, which is frequented by birds from the western Arctic (Armstrong et al. 1999).

4.3 Impacts on Habitat

4.3.1 Alternative A. No action.

Greater snow geese

Management of greater snow geese under the No Action alternative would result in a continued increase in population size. The breeding range of greater snow geese has expanded only slightly during the past 30 years, resulting in increased density of birds on existing colonies. Without any management action to stabilize population size, we expect that bird densities on breeding colonies would continue to increase. The geographical extent of the breeding range, and the likelihood of habitat degradation on new sites, would become greater as the population increases. However, this expansion likely would not occur until significant habitat damage has occurred on existing colony sites.

The geographic extent of the main spring staging area for greater snow geese has expanded from a 40 km portion of the St. Lawrence valley to more than 400 km. We expect continued expansion of spring staging areas as the goose population increases. As mentioned in section 3.2.2, it appears that the capacity of some bulrush marshes in the St. Lawrence Valley to provide food resources for geese may have been reached and that they can no longer accommodate the increasing number of snow geese (Giroux et al. 1998). As the goose population continues to increase, the carrying capacity of natural marshes would be exceeded and further habitat degradation would occur. Increased use of cordgrass marshes likely would occur, as would the potential for habitat degradation in such habitat. Concurrently, we expect an increase in goose damage to agricultural crops in spring, especially in hayfields and winter cereal crops.

During the past 15 years, the length of the fall staging period in southern Quebec has become shorter, and more geese are flying directly to the U.S. without stopping in Quebec. As the goose population increases, we expect the length of the fall staging period in Quebec would continue to shorten, and the number of snow geese that fly directly to the U.S. in fall would increase. Earlier fall arrival of snow geese in the U.S. likely would increase goose impacts on agricultural crops and natural marshes. These impacts would be magnified if the total population increases as well.

CMF Light Geese

This alternative would result in a continued increase in CMF light geese and expansion of the geographic range in which they breed, migrate, and winter. As the number of geese found on arctic and subarctic breeding areas increases, the amount of habitat degradation on such areas would increase as well. The mechanism by which light geese cause habitat degradation and descriptions of the known extent of such

degradation were provided in Chapter 3.2.1.

Information from long-term studies conducted in the La Perouse Bay portion of Hudson Bay provide our best estimate of goose impacts on breeding habitats under the No Action alternative. Using data from Jano et al. (1998), we determined that the rate of salt marsh vegetation decline in La Perouse Bay during 1984-93 was approximately 159 hectares/year (393 acres/year; Fig. 4.3). Assuming this rate of vegetation decline has continued since 1993, we estimate that by 2010 an additional 5,150 hectares (12,720 acres) of salt marsh vegetation will have been destroyed by geese in La Perouse Bay.

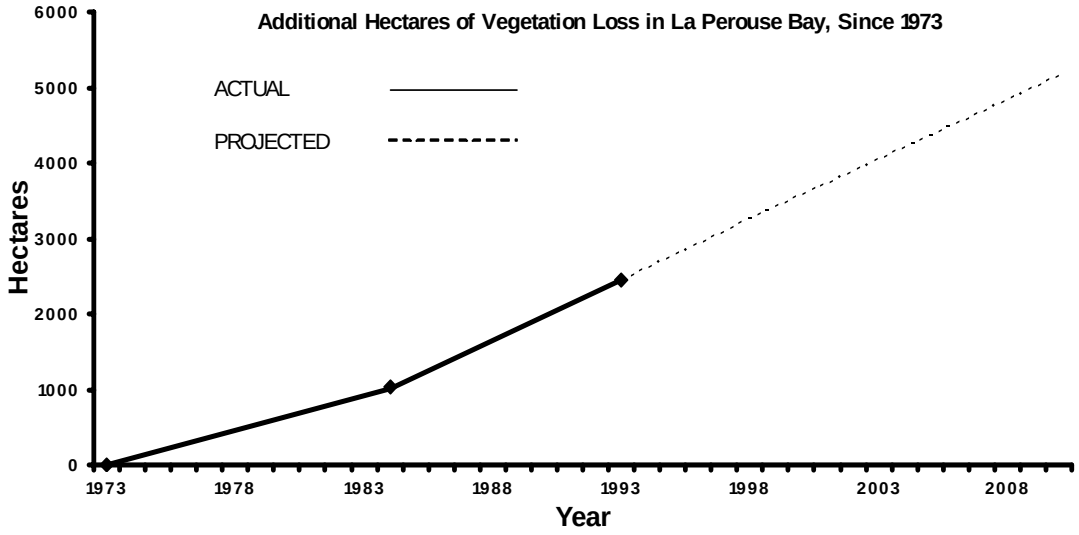


Fig. 4.2. Projection of additional hectares of salt marsh vegetation that would be lost at La Perouse Bay in the absence of light goose population control. Actual losses indicate additional habitat lost after monitoring began in 1973, and was determined by comparison of satellite imagery from 1973, 1984, and 1993. Projected losses assume the same rate of loss that occurred during 1984-93 (calculated from data in Jano et al. 1998).

Habitat losses due to impacts of light geese in the eastern and central Arctic are not restricted to La Perouse Bay. Vegetation surveys conducted during 1993-95 indicate that destruction of vegetation and loss of habitat are widespread along the western and southern coasts of Hudson Bay and James Bay (Kerbes et al. 1990; Abraham and Jefferies 1997). The Hudson Bay Lowlands salt marsh ecosystem, for example, lies within a 1,200 mile strip of coastline along west Hudson and James Bays. This area contains approximately 54,700 hectares (135,000 acres) of coastal salt marsh habitat; of which 35% is considered destroyed, 30% is damaged, and 35% is overgrazed (Abraham and Jefferies 1997). Under the No Action alternative, habitats currently categorized as damaged or overgrazed would be further impacted and eventually would be destroyed.

Many light geese that breed at higher latitudes of the eastern and central Arctic migrate through the Hudson and James Bay coastlines during spring migration. Therefore, even if the number of breeding birds at southern colonies were reduced, there would be heavy use of such habitats by geese migrating northward. The geographic extent of goose breeding colonies would expand as geese seek out food resources in less disturbed areas. As geese destroy salt marsh habitat they would move inland to exploit other habitats, which tend to degrade more quickly under the influence of geese (R. Rockwell, personal communication). The coastline has undergone a rate of isostatic uplift of between 0.5 to 1.2 meters per century (0.2 – 0.5 inches/year; Hik et al. 1992) upon being released from the weight of glaciers. Isostatic uplift will create new salt marsh habitat as new land is exposed. However, the rate of new habitat creation would be too slow to keep up with the rate of habitat degradation caused by light geese. Vegetation in newly-exposed areas would be consumed by geese, thus preventing establishment of vegetation communities.

Under the No Action alternative, we expect that increasing numbers of lesser snow and Ross's geese in the central Arctic (e.g. Queen Maude Gulf Migratory Bird Sanctuary) would magnify the extent of habitat damage that has already occurred (see section 3.2.1). Plant communities within light goose breeding colonies would continue to be converted to exposed peat, and eventually would erode to bare soil. Loss of vegetation at colony sites likely would lead to desertification, with little chance of recovery of plant communities. In the absence of population control, expansion of CMF light goose wintering and migration ranges within the conterminous United States would continue. Use of traditional migration routes and stopover areas likely would decline as the birds deplete local resources more quickly and earlier in each respective season. Goose damage to agricultural crops such as winter wheat likely would increase.

Western Population of Ross's geese

Under the No Action alternative, the size of the WPRG would continue to increase. The breeding range of the WPRG overlaps that of CMF light geese in the central Arctic. Therefore, the anticipated impacts of increased numbers of Ross's geese are identical to those outlined above for CMF light geese.

Pacific Flyway Population of lesser snow geese

Presently, extensive damage to vegetation has not been reported on light goose breeding areas in the western Arctic. However, field vegetation studies have not been in place to document whether or not any significant impacts have occurred. At the current rate of population growth, the number of breeding lesser snow geese in the western Arctic will reach one million by 2010. As population size and bird density increases on colony sites, we believe that geese may begin to impact breeding habitats in a manner similar to birds in the eastern and central Arctic.

Wrangel Island Lesser Snow Geese

The population of Wrangel Island lesser snow geese has averaged less than 100,000 birds since the 1980s. Spring weather on Wrangel Island has a profound influence on productivity of geese and may limit population growth. There are no indications that this population is impacting breeding habitats. Given the static nature of the trend of this population, it is unlikely that large-scale habitat damage by geese would occur in the near future under the No Action alternative.

4.3.2 Alternative B. (Preferred alternative). Modify harvest regulation options and refuge management.

Greater snow geese

Adoption of this alternative would result in a reduction of the population to 500,000 birds. Under current habitat conditions, achievement of this population level would prevent birds from exceeding the short-term ability of breeding habitats on Bylot Island to support them (Masse et al. 2001). Information on the long-term carrying capacity of habitats on Bylot Island is not available, though it is likely to be at a lower level than the short-term carrying capacity (Masse et al. 2001). We cannot fully assess the effects on other breeding areas due to the lack of information on their carrying capacity. However, we assume that geese would be less likely to exceed carrying capacities of such areas, or would be brought down closer to them, at lower population levels.

Reduction of the population would help prevent the carrying capacity of marshes on migration areas in the St. Lawrence Valley from being further exceeded. However, the influence of geese on natural marshes would not be eliminated. Instead, the low-level steady state described by Giroux and Bedard (1987) would be maintained. Similarly, goose damage to agricultural crops would be alleviated somewhat, but not eliminated.

CMF Light Geese

Adoption of this alternative would result in a 50% reduction of the number of CMF light geese. Such a reduction would likely decrease the rate of habitat destruction that is occurring on Arctic and subarctic habitats. Because habitats that are already destroyed may never recover, or will take decades to recover, remaining geese would still exploit remaining plant communities. However, due to a much smaller goose population, the pressure on such habitats would be alleviated somewhat. Because light geese migrate and winter in large flocks, localized damage to agricultural crops would likely continue even at lower population levels. However, the overall extent of damage should be reduced because fewer sites would be visited and/or fewer birds are present to consume crops.

Western Population of Ross's geese

The breeding range of the WPRG overlaps that of CMF light geese in the central Arctic. Therefore, the anticipated habitat impacts of this alternative with respect to the WPRG are identical to those outlined above for CMF light geese.

Pacific Flyway Population of lesser snow geese

Presently, extensive damage to vegetation has not been reported in western arctic breeding areas. However, field vegetation studies have not been in place to document whether or not any significant impacts have occurred. As population size and bird density increases on colony sites, we believe that geese may begin to impact breeding habitats in a manner similar to birds in the eastern and central Arctic. This alternative would allow implementation of population control measures if damage to western arctic habitat becomes evident.

Wrangel Island lesser snow geese

There are no indications that this population is impacting breeding habitats. Given the static nature of the trend of this population, it is unlikely that these geese would cause large-scale habitat damage in the near future. Therefore, we do not anticipate that reduction measures will be necessary for this population.

4.3.3 Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

Implementation of this alternative would result in the same level of population reductions discussed under Alternative B. Therefore, impacts to habitats for all light goose populations are the same as in Alternative B.

4.3.4 Alternative D. Seek direct light goose population control on breeding grounds in Canada.

Implementation of this alternative would result in the same level of population reduction discussed under Alternative B. Therefore, impacts to habitats for all light goose populations are the same as in Alternative B.

4.3.5 Alternative E. Two-phased approach to light goose population control.

Implementation of this alternative would result in the same level of population reductions discussed

under Alternative B. Therefore, impacts to habitats for all light goose populations are the same as in Alternative B.

4.4 Impacts on Other Species

4.4.1 Alternative A. No action.

Under this alternative, most light goose populations likely would increase in size and geographic range and would come into contact with other species more frequently. On the breeding grounds, light geese would seek out and exploit new areas and detrimentally alter habitats, thus adversely affecting other species that currently depend upon those habitats. We probably would continue to observe declines in local populations of other migratory birds in the Hudson Bay and James Bay salt marsh ecosystem as remaining habitats become so degraded that they are rendered unsuitable (see Chapter 3.3.4). Mammalian species, especially herbivores, that depend on those habitats would also be negatively affected. In addition, light geese would continue to compete with and displace individuals of other migratory bird species from favored habitats during winter and migration, thus creating the potential to negatively influencing their ability to survive and reproduce.

On the wintering grounds and in migration stopover areas, the incidence of avian cholera and mortality among other migratory bird species likely would increase due to transmission of the disease by growing light goose populations. The increasing number and expanding geographic distribution of avian cholera outbreaks represent a serious threat to waterfowl and other bird populations that are susceptible to the disease (Chapter 3.4). Transmission of avian cholera is enhanced by the gregarious nature of most waterfowl species and by high densities of birds that result from habitat limitations, especially in winter and spring (Friend 1999). As light goose populations grow, there would be increased likelihood of contraction of cholera by numerous waterbird and raptor species. Documented cases of cholera die-offs involving hundreds of thousands of birds in a single event point to the reasonable likelihood that larger die-offs would occur as light goose populations expand. Under the No Action alternative, we expect that waterfowl species such as pintail, mallard, white-fronted geese, and Canada geese would be affected by cholera outbreaks. Populations of sandhill cranes that migrate, stage, and winter with light geese would also be affected.

Under this alternative, regular light goose hunting seasons would remain in place. Hunting regulations allowed by the Migratory Bird Treaty Act permit the hunting of species that often use the same habitats as protected non-game bird species, and hunting activity may result in disturbance to protected birds (U.S. Fish and Wildlife Service 1975:203). However, we lack data on the magnitude and potential impact of such disturbance on non-game species. Madsen and Fox (1995) reviewed the impacts of hunting disturbance on waterbirds. Their review of case studies indicated that the presence of hunters in the vicinity of

waterbirds modifies the distribution and abundance of those birds in space and time. However, evidence for the ultimate impact of disturbance effects on individual birds is lacking (Madsen and Fox 1995). Finally, Madsen and Fox (1995) indicated that there is little understanding about the direct impact of hunting disturbance on birds at the population level.

Annual hunting regulations have an impact on all protected species by prohibiting the hunting of these birds. Protected species are sometimes killed as a result of hunter activity; however we do not believe this to be widespread. The loss of an individual or individuals of protected species results in a minor and temporary reduction in the population, but there are no known cases where regulations permitting migratory bird hunting have resulted in the long-term decrease in a protected species population level (U.S. Fish and Wildlife Service 1975:203, U.S. Fish and Wildlife Service 1988:98). Therefore, we believe that maintenance of regular light goose hunting seasons will have little impact on non-game species.

We point out that over 5 million acres of wetland habitat in the U.S. has been purchased through funds secured from the Service's Duck Stamp Program. This acreage is in addition to wetlands acquired through State programs. The Duck Stamp Program is a direct result of activities associated with waterfowl hunting because of the requirement for hunters to purchase a duck stamp. We believe the resulting preservation of wetland habitat likely outweighs any potential impacts on non-game species that might be caused by activities associated with hunting seasons.

4.4.2 Alternative B. (Preferred alternative). Modify harvest regulation options and refuge management.

Under this alternative, regular light goose hunting seasons would remain in place, or a conservation order would be implemented if a State chose to do so. Hunting regulations allowed by the Migratory Bird Treaty Act permit the hunting of species that often use the same habitats as protected non-game bird species, and hunting activity may result in disturbance to protected birds (U.S. Fish and Wildlife Service 1975). However, we lack data on the magnitude and potential impact of such disturbance on non-game species. Madsen and Fox (1995) reviewed the impacts of hunting disturbance on waterbirds. Their review of case studies indicated that the presence of hunters in the vicinity of waterbirds modifies the distribution and abundance of those birds in space and time. However, evidence for the ultimate impact of disturbance effects on individual birds is lacking (Madsen and Fox 1995). Finally, Madsen and Fox (1995) indicated that there is little understanding about the direct impact of hunting disturbance on birds at the population level.

Annual hunting regulations, as well as regulations pertaining to the conservation order, have an impact on all protected species by prohibiting the hunting of these birds. Protected species are sometimes killed as a result of hunter activity; however we do not believe this to be widespread. The loss of an

individual or individuals of protected species results in a minor and temporary reduction in the population, but there are no known cases where regulations permitting migratory bird hunting have resulted in the long-term decrease in a protected species population level (U.S. Fish and Wildlife Service 1975:203, U.S. Fish and Wildlife Service 1988:98). Other waterfowl and crane hunting seasons, excluding falconry, would be closed during periods of the regular season when new methods of take are authorized for light geese. Furthermore, all waterfowl and crane hunting seasons, excluding falconry, must be closed in order to implement a conservation order for light geese. Therefore, impacts of this alternative on non-target species would be minimized. Establishment or expansion of a hunt program for light geese on a particular refuge may increase disturbance levels within hunted impoundments. However, because light geese would be the only legal species for citizens to take, the impacts to non-target species would be minimized. Most activity associated with the light goose conservation order in southern and mid-latitude States would take place during late winter, prior to the onset of breeding activities of other wetland species, and therefore would have little if any impact. Depending on weather conditions, migration of light geese through northern latitude States in late winter and early spring is usually rapid (Bellrose 1980). Therefore, the time window during which any impacts to protected species from the conservation order may occur would be brief.

Implementation of this alternative would result in authorization of the use of electronic calls to take light geese. Field experiments indicate that use of electronic calls has little or no impact on non-target species (Olsen and Afton 2000, Caswell et al. 2003). Caswell et al. (2003) determined that Canada geese and white-fronted geese were less likely to fly within gun range of hunters using electronic snow goose calls and white goose decoys during fall in Canada, compared to traditional calls and dark decoy sets. Olsen and Afton (2000) determined that, of 463 geese shot using electronic calls under experimental conditions, only 4 were non-target species (Canada and white-fronted geese). The majority of non-target species taken were clearly the result of misidentification by hunters. Such take likely would have occurred under normal hunting conditions even if electronic calls were not being used (Olsen and Afton 2000). Therefore, we believe the impact of additional methods of take on non-target species would be minimal.

Under this alternative, some light goose populations would be reduced in size and would come into contact with other species less frequently. On the breeding grounds, light goose damage to habitats would be reduced, thus benefiting other species that depend upon those habitats. Observed declines in local populations of other migratory birds in the Hudson Bay and James Bay salt marsh ecosystem may be halted as a result of reduction in habitat damage by light geese. In addition, light geese would be less likely to compete with and displace individuals of other migratory bird species from favored habitats during winter and migration periods. Furthermore, we believe that reduction of overabundant light geese will decrease the likelihood of avian cholera outbreaks that would affect other species.

Alteration of refuge habitat programs to address light goose management will impact other species

as well. Removal of light goose roosting areas via water level drawdowns will displace some waterbird species to other impoundments that have sufficient water. However, drawdowns would benefit species that are attracted to mudflat habitat (e.g. shorebirds). Reduction of agricultural crops would remove a food supply utilized by species other than light geese. However, the overall benefits to other species of replacing monocultures of agricultural habitat with more natural habitats would likely far outweigh possible negative impacts of removing the agricultural food supply.

4.4.3. Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

The potential impacts of this alternative on non-target species are dependent on methods utilized to remove light geese from the population. If light geese are live-trapped, impacts to non-target species would be minimal because they can be released if they are caught incidental to trapping light geese. Lethal methods of capture, excluding removal by sharpshooters, are non-selective and may impact non-target species if they are found within target flocks of light geese. However, permits for light goose population reduction specifically prohibit agencies from taking any actions under the permit that would adversely affect non-target species. Light goose control efforts logically would focus on flocks where the prevalence of non-target species is low. The application of DRC-1339 and Avitrol for the control of birds involves pre-baiting sites to allow target species to become accustomed to feeding at a bait site. Application of treated bait is done under controlled conditions and is monitored for presence of non-target species. Baiting activities can be halted to protect non-target species if necessary. DRC-1339 and Avitrol do not persist in the environment and thus would not accumulate in the food chain.

Activities associated with light goose control in southern and mid-latitude States would take place during winter, prior to the onset of breeding activities of other wetland species, and therefore would have little if any impact on those species. Depending on weather conditions, migration of light geese through northern latitude States in late winter and early spring is usually rapid (Bellrose 1980). Therefore, the time window during which any impacts to protected species from direct control activities would be brief.

Under this alternative, some light goose populations would be reduced in size and would come into contact with other species less frequently. Light goose damage to breeding habitats would be reduced, thus benefiting other species that depend upon those habitats. Observed declines in local populations of other migratory birds in the Hudson Bay and James Bay salt marsh ecosystem may be halted as a result of reduction in habitat damage by light geese. In addition, light geese would be less likely to compete with and displace individuals of other migratory bird species from favored habitats during winter and migration periods. Furthermore, we believe that reduction of overabundant light geese will decrease the likelihood of avian cholera outbreaks that would affect other species.

4.4.4 Alternative D. Seek direct light goose population control on breeding grounds in Canada.

The potential impacts of this alternative on non-target species are dependent on methods utilized to remove light geese from the population. If light geese are live-trapped, impacts to non-target species would be minimal because they can be released if they are caught incidental to trapping light geese. Lethal methods of capture, excluding removal by sharpshooters, are non-selective and may impact non-target species if they are found within target flocks of light geese. Light goose control efforts logically would focus on flocks where the prevalence of non-target species is low. The application of DRC-1339 and Avitrol for the control of birds involves pre-baiting sites to allow target species to become accustomed to feeding at a bait site. Application of treated bait is done under controlled conditions and is monitored for presence of non-target species. Baiting activities can be halted to protect non-target species if necessary. DRC-1339 and Avitrol do not persist in the environment and thus would not accumulate in the food chain.

Under this alternative, some light goose populations would be reduced in size and would come into contact with other species less frequently. On the breeding grounds, light goose damage to habitats would be reduced, thus benefiting other species that depend upon those habitats. Observed declines in local populations of other migratory birds in the Hudson Bay and James Bay salt marsh ecosystem may be halted as a result of reduction in habitat damage by light geese. In addition, light geese would be less likely to compete with and displace individuals of other migratory bird species from favored habitats during winter and migration periods. Furthermore, we believe that reduction of overabundant light geese will decrease the likelihood of avian cholera outbreaks that would affect other species.

4.4.5 Alternative E. Two-phased approach to light goose population control.

Impacts to other species during phase one of Alternative E would be identical to those outlined in Alternative B. Impacts to other species during phase two of Alternative E would be identical to those of Alternative C if control was conducted on wintering grounds. Impacts would be identical to those of Alternative D if conducted on the breeding grounds.

4.5 Impacts on Special Status Species

4.5.1 Alternative A. No action.

Impacts of Alternative A on special status species would be similar to those outlined for other species in section 4.4.1. On the wintering and migration areas, incidences of avian cholera and mortality among other migratory bird species likely would increase due to transmission of the disease by light geese. Disease threat would also increase for threatened species such as bald eagles. Of concern is the possibility of

increasing exposure of avian cholera to the endangered whooping crane population, which also migrates through some of the same areas as mid-continent light geese. A major avian cholera outbreak could affect recovery efforts for whooping cranes if substantial numbers of individuals contract the disease.

Under this alternative, regular light goose hunting seasons would remain in place. Hunting regulations allowed by the Migratory Bird Treaty Act permit the hunting of species that often use the same habitats as protected non-game bird species, and hunting activity may result in disturbance to protected birds (U.S. Fish and Wildlife Service 1975). However, we lack data on the magnitude and potential impact of such disturbance on non-game species. Madsen and Fox (1995) reviewed the impacts of hunting disturbance on waterbirds. Their review of case studies indicated that the presence of hunters in the vicinity of waterbirds modifies the distribution and abundance of those birds in space and time. However, evidence for the ultimate impact of disturbance effects on individual birds is lacking (Madsen and Fox 1995). Finally, Madsen and Fox (1995) indicated that there is little understanding about the direct impact of hunting disturbance on birds at the population level.

Annual hunting regulations have an impact on all protected species, including endangered species, by prohibiting the hunting of these birds. Section 7, Endangered Species Act consultations are required of all migratory game bird hunting regulations, thus assuring that endangered species are not jeopardized by the regulations. Protected species are sometimes killed as a result of hunter activity; however take of special status species is rare. The loss of an individual or individuals of protected species results in a minor and temporary reduction in the population, but there are no known cases where regulations permitting migratory bird hunting have resulted in the long-term decrease in a protected species population level (U.S. Fish and Wildlife Service 1975:203, U.S. Fish and Wildlife Service 1988:98). Under this alternative, protection of endangered whooping cranes would be continued through implementation of the Aransas-Wood Buffalo Population Whooping Crane Contingency Plan (U.S. Fish and Wildlife Service and Central Flyway Council 2006).

4.5.2 Alternative B. (Preferred alternative). Modify harvest regulation options and refuge management.

Under this alternative, regular light goose hunting seasons would remain in place, or a conservation order would be implemented if a State chose to do so. Hunting regulations allowed by the Migratory Bird Treaty Act permit the hunting of species that often use the same habitats as protected non-game bird species, and hunting activity may result in disturbance to protected birds (U.S. Fish and Wildlife Service 1975). However, we lack data on the magnitude and potential impact of such disturbance on non-game species. Madsen and Fox (1995) reviewed the impacts of hunting disturbance on waterbirds. Their review of case studies indicated that the presence of hunters in the vicinity of waterbirds modifies the distribution and abundance of those birds in space and time. However, evidence for the ultimate impact of disturbance effects

on individual birds is lacking (Madsen and Fox 1995). Finally, Madsen and Fox (1995) indicated that there is little understanding about the direct impact of hunting disturbance on birds at the population level.

Annual hunting regulations, as well as regulations pertaining to the conservation order, have an impact on all protected species, including endangered species, by prohibiting the hunting of these birds. Section 7, Endangered Species Act consultations are required of all migratory game bird hunting regulations, and conservation order regulations, assuring that endangered species are not jeopardized by the regulations. Protected species are sometimes killed as a result of hunter activity; however take of special status species is rare. The loss of an individual or individuals of protected species results in a minor and temporary reduction in the population, but there are no known cases where regulations permitting migratory bird hunting have resulted in the long-term decrease in a protected species population level (U.S. Fish and Wildlife Service 1975:203, U.S. Fish and Wildlife Service 1988:98).

Under this alternative, protection of endangered whooping cranes would be continued through implementation of the Aransas-Wood Buffalo Population Whooping Crane Contingency Plan (U.S. Fish and Wildlife Service and Central Flyway Council 2006). The contingency plan provides a mechanism for designating appropriate response options and reporting requirements whenever whooping cranes are confirmed as sick, injured, or dead, or when they are healthy but in a situation where they face hazards, such as shooting/hunting activities or contaminants and disease. Spring migration pathways of whooping cranes overlap those of light geese in the Central Flyway (Fig. 3.24). Peak migration of cranes through important stopover areas along the Platte River and other portions of Nebraska occur during April (Fig. 3.25). Nebraska holds their light goose conservation order from mid-March to mid-April. Selection of such dates reduces potential impacts to whooping cranes. No whooping cranes have been shot incidental to efforts intended to increase harvest of light geese.

Other waterfowl and crane hunting seasons, excluding falconry, would be closed during periods of the regular season when new methods of take are authorized for light geese. As discussed in section 4.4.2, field experiments indicate that authorization of the use of electronic calls would have little or no impact on non-target species (Olsen and Afton 2000, Caswell et al. 2003). Furthermore, all waterfowl and crane hunting seasons, excluding falconry, must be closed in order to implement a conservation order for light geese. Light geese would be the only legal species that could be taken during special management actions. Therefore, impacts of this alternative on special status species would be minimized. In southern and mid-latitude States most activity associated with the light goose conservation order would take place in late winter prior to the onset of breeding activities of other wetland species, and therefore would have little if any impact on such species. Depending on weather conditions, migration of light geese through northern latitude States in later winter and early spring is usually rapid (Bellrose 1980). Therefore the time window in which any impacts would occur to other species would be brief.

Under this alternative, some light goose populations would be reduced in size and would come into contact with special status species less frequently. Light geese would be less likely to compete with and displace individuals of special status species from favored habitats during winter and migration periods. Furthermore, we believe that reduction of overabundant light geese will decrease the likelihood of avian cholera outbreaks that would affect special status species.

Impacts of altering refuge habitat programs on special status species would be similar to those outlined for other species in section 4.4.2. Considerations for the presence of special status species would be made prior to making changes to habitat programs on a particular refuge. Changes in habitat management would not be made on a particular refuge if special status species would be negatively impacted. As discussed in section 4.4.2, this alternative would reduce the risk of avian cholera outbreaks and subsequent impacts on special status species.

4.5.3. Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

The potential impacts of this alternative on special status species are similar to those outlined in section 4.4.3 for other species. Permits for light goose population reduction specifically prohibit agencies from taking any actions under the permit that would adversely affect non-target species. Control efforts would not be implemented at a particular location if special status species would be negatively impacted.

Under this alternative, some light goose populations would be reduced in size and would come into contact with special status species less frequently. Light goose damage to habitats would be reduced, thus benefiting any special status species that depend upon those habitats. In addition, light geese would be less likely to compete with and displace individuals of other migratory bird species from favored habitats during winter and migration periods. Furthermore, we believe that reduction of overabundant light geese will decrease the likelihood of avian cholera outbreaks that would affect special status species.

4.5.4. Alternative D. Seek direct light goose population control on breeding grounds in Canada.

The impacts of this alternative on special status species are similar to those outlined in section 4.4.4 for other species. The potential impacts of this alternative on special status species are dependent on methods utilized to remove light geese from the population. If light geese are live-trapped, impacts to non-target species would be minimal because they can be released if they are caught incidental to trapping light geese. Lethal methods of take that are non-selective would result in potential impacts to special status species if they are found among light geese on breeding colonies. Therefore, such methods would not be used on those colony sites. The use of sharpshooters to take light geese on colony sites would avoid any

impacts to special status species.

Under this alternative, some light goose populations would be reduced in size and would come into contact with special status species less frequently. Light goose damage to habitats would be reduced, thus benefiting any special status species that depend upon those habitats. In addition, light geese would be less likely to compete with and displace individuals of other migratory bird species from favored habitats during winter and migration periods. Furthermore, we believe that reduction of overabundant light geese will decrease the likelihood of avian cholera outbreaks that would affect special status species.

4.5.5 Alternative E. Two-phased approach to light goose population control.

Impacts to special status species during phase one of Alternative E would be identical to those outlined in Alternative B. Impacts to special status species during phase two of Alternative E would be identical to those of Alternative C if control was conducted on wintering grounds. Impacts would be identical to those of Alternative D if conducted on the breeding grounds.

4.6 Socioeconomic Impacts

The economic impact estimates associated with changes in both consumptive and non-consumptive expenditures identify the gross economic impacts associated with each of the alternatives. As such, they represent (for a given set of assumptions) a conservative, high-end estimate of the net economic effects of changes in light goose-related expenditures. From a multi-state or national perspective, changes in light goose expenditures simply result in a transfer or reallocation of resources from one type of expenditure pattern to another. For example, if one particular alternative results in a decrease of expenditures on light goose hunting, there would most likely be an increase in expenditures on other activities. A person who formerly hunted light geese may switch to duck hunting or some other type of hunting activity. Other people may devote more time and expenditures to other, non-hunting activities. Consequently, the project alternatives basically result in a change in expenditure patterns; overall spending at the national or multi-state level may remain about the same, but each particular pattern of expenditures results in different business or industrial sectors gaining or losing.

Perhaps the most noticeable effect of any change in the level of expenditures would be in sparsely populated rural areas where a business (or businesses) depends specifically on non-resident hunters spending money to hunt light geese in the area. Changes in hunting opportunities may noticeably decrease the number of hunters coming into a particular area with the resultant effect on hunting related expenditures. Consequently, for a particular town or county, there may be a decrease in hunting related expenditures that may not be offset by expenditures on other activities within the area. Since this project is national in scope, it

is not feasible to document the economic impact of the alternatives on all areas that may be potentially affected by the project. The economic impact estimates that follow identify the potential or gross impacts of changing expenditures associated with light goose hunting.

4.6.1 Alternative A. No action.

In the absence of population control measures we expect that light goose populations would continue to increase throughout Arctic and subarctic regions. As bird densities increase on breeding areas, additional habitats would be degraded and their ability to support geese would decrease. In addition, the incidence of avian cholera among light geese and other species is likely to increase throughout the Flyways, particularly at migration stopover sites. Losses to other species such as pintails, white-fronted geese, sandhill cranes, and whooping cranes, may be great. This may result in reduced hunting, bird-watching, and other opportunities. In addition, agencies would incur costs of salvaging carcasses following disease outbreaks. Salvage operations often cost $1/bird (M. Samuel, U.S. Geological Survey, personal communication); therefore, costs for collecting carcasses could amount to several hundred thousand dollars. Goose damage to winter wheat and other agricultural crops would continue and worsen. Habitat damage in the Artic would eventually trigger density-dependent regulation of the population, which likely would result in increased gosling mortality and may cause the population to decline precipitously. However, it is not clear when such population regulation would occur and what habitat, if any, would remain to support the survivors. Such a decline may result in a population too low to permit any hunting, effectively closing light goose hunting seasons. The length of the closures would largely depend on the recovery rate of the breeding habitat, which likely would take decades. Subsistence hunting of light geese may also be affected if a particular goose colony near a native community declined to very low levels. This scenario of overpopulation followed by population decline forms the basis for analysis of the economic impact of the No Action alternative.

Consumptive uses

Previously, we estimated that the total economic impact of light goose hunting in the U.S. was $146 million (Chapter 3.5.1). This impact was the result of expenditures on trip and equipment-related expenditures. Closure of light goose hunting in a particular Flyway likely would influence trip-related expenses to a greater degree because equipment purchased could be used to hunt other waterfowl species. We assume that hunters would take fewer trips per year if light goose hunting was closed. Trip-related expenditures represent approximately 44% of all annual expenditures of migratory bird hunters (U.S. Dept. Interior 1997). We assume that trip-related expenditures for light goose hunting are the same proportion of total expenditures as are those for all migratory bird hunting. Therefore, we estimate the total economic impact of trip-related expenditures for light goose hunting in the U.S. to be approximately $64.8 million. We used the geographic distribution of light goose harvest to estimate the economic impact of trip-related expenditures in each Flyway (Table 4.6). Such expenditures represent the economic losses in the U.S. that

Table 4.6. Potential economic impact of closure of light goose hunting in each Flyway, based on losses of trip-related expenditures by hunters in the U.S.

	Flyway				
	Atlantic	Mississippi	Central	Pacific	U.S.
Percent of U.S. light goose harvest	5.1	35.9	52.6	6.4	100.0
Total annual economic impact resulting from loss of trip-related expenditures ($ million)[1]	$ 3.3	$23.3	$34.1	$4.1	$64.8[2]

[1] Total economic impact of trip-related expenditures for light goose hunting in the U.S. ($64.8 million) multiplied by proportion of total U.S. harvest of light geese occurring in each Flyway.
[2] Total economic impact of light goose hunting in the U.S. ($146 million) multiplied by the proportion of total expenditures related to trip-related expenses (0.44).

would result from closure of light goose hunting in each Flyway.

Hunting of greater snow geese and Canada geese in Quebec contributes more than $6 million (Canadian $$) annually to the economy (Canadian Wildlife Service 2005). Of this total, approximately $2.7 million is tied to trip-related expenditures. The amount of this total that could be attributed solely to greater snow geese was not determined during the study. If Canada chose to close the hunting season on greater snow geese a large portion of the $2.7 million in expenditures likely would be lost.

The potential economic impacts for each Flyway under the No Action alternative assume that population levels would reach sufficient levels to cause severe habitat damage and decline of light goose populations. Clearly, all light goose populations are not at the same stage of development in relation to these potential events. The current situation with regard to CMF light geese is the most serious. Severe habitat damage has occurred on CMF breeding grounds and the effects of overpopulation are already being documented on certain portions of the breeding range. Therefore, the Central and Mississippi Flyway regions face the most immediate threat of closures to light goose hunting. However, we have no information to guide us in determining the timeframe in which such closures may occur.

A precipitous decline in a particular light goose population may negatively impact subsistence use of geese near native communities. As mentioned previously, the annual light goose harvest per subsistence hunter has remained fairly constant on the Hudson Bay coast during the past several decades, despite large increases in light goose abundance (see section 3.5.3). Therefore, subsistence harvest likely would not be affected until light goose population levels declined much below those observed during the same time period. There is no information available to guide us in determining the degree of population decline that would affect subsistence harvest. However, it is likely that severe habitat deterioration on a particular colony site would reduce the number of geese available to subsistence hunters near a neighboring community.

Subsistence hunting would then rely on birds migrating from other areas during fall migration. Native harvest of light geese on migration and wintering areas in the U.S. may also be affected by severe declines in light goose populations. Although light geese concentrate in larger flocks during migration and winter, there may be fewer total flocks available to subsistence hunters following a population crash.

Non-consumptive uses

Approximately 19.1 million people participate in non-consumptive uses (e.g., observe, photograph, etc.) of waterfowl in the U.S. each year, and spend $3.3 billion on trip- and equipment-related expenses (U.S. Department of the Interior 1997, Teisl and Southwick 1995). The total annual economic impact of non-consumptive uses of waterfowl in the U.S. is approximately $9.8 billion (Teisl and Southwick 1995). Information on the percentage of non-consumptive usage in the U.S. that can be attributed to light geese in each Flyway is not available. Therefore, the economic impact of non-consumptive uses of light geese in the U.S. is not known. In Quebec, it was estimated that the total annual economic benefit of non-consumptive use of waterfowl migration was estimated to be over $24 million (Canadian $$). Of this total, more than $19 million can be attributed to birdwatching activities at four main migration sites in Quebec. Additionally, $5 million annually was generated by 2 greater snow goose festivals, 1 Canada goose festival, and operation of associated educational centers (Canadian Wildlife Service 2005).

We do not expect the No Action alternative to affect non-consumptive users of light geese to the same extent as consumptive users. Although a population decline may force closure of light goose hunting seasons, remaining birds would still be available for non-consumptive uses. Birds would continue to utilize traditional migration routes and winter areas, although at reduced numbers.

Current estimates of crop damage in the U.S. due to light geese are incomplete because most farmers do not report damage. The incidence of crop damage likely would increase as light goose populations expand, and we would expect a concurrent increase in farmers' reporting of such damages. However, we have no information to guide us in determining the potential magnitude of financial losses. In Quebec, government payments to farmers that experience crop damage due to light geese have been as high as $560,000 in some years. Damages to farms in the U.S. may approach such levels as light goose numbers increase.

4.6.2 Alternative B. (Preferred alternative). Modify harvest regulation options and refuge management.

Under this alternative, States would be allowed to implement new regulations for light geese during the regular season of 107 days, as well as be able to implement a conservation order. In order to implement

new regulations during the regular season, all other waterfowl and crane hunting seasons, excluding falconry, must be closed. New regulations include new methods of take such as electronic calls and unplugged shotguns. Many hunters may choose to purchase electronic calls, and most would purchase additional shotgun shells; however, we believe the total economic impact due to these purchases would be minor.

A conservation order for light geese would allow States to authorize citizens to take light geese when all waterfowl and crane hunting seasons, excluding falconry, are closed. A conservation order would allow new methods of take, require no bag limits, and would provide liberal shooting hours to take light geese. States would be allowed to implement a conservation order during any time period. We assume that little or no additional economic impact would result from invoking a conservation order prior to and including the normal hunting season closing date of March 10. However, economic impacts would result from extending a conservation order beyond the normal March 10 closing date.

We estimated the potential economic impact of a conservation order in each Flyway by calculating the percent increase in days in which light geese could legally be taken beyond the normal 107-day season. We used light goose harvest in each State to weight the potential number of additional days citizens would take trips to take light geese in that State. We then calculated a weighted percent increase in total days for each Flyway. To estimate the economic impact of additional days, we multiplied the weighted percent increase in days to the economic impact of trip-related expenses for taking light geese in each Flyway (Table 4.7).

Information from conservation orders held in the Central and Mississippi Flyways during 2000 were used to determine the exact number of extra days in which take of light geese was allowed. For the Atlantic and Pacific Flyways, we assumed that southern States would authorize the take of light geese for an additional 21 days, and northern States would add 60 days. This assumption is reasonable given our experience in the Central and Mississippi Flyways, and the fact that light geese depart southern wintering areas fairly early in spring.

Implementation of this alternative would preserve the long-term health of light goose populations by slowing the rate of habitat degradation and avoiding a potential population crash, especially in the mid-continent region. Damage to agricultural crops would also be reduced. Non-consumptive users of light geese may be slightly affected by lower overall populations. Achievement of management goals in the mid-continent region would result in an estimated winter index of 1.6 million light geese that would continue to migrate to the U.S. Similarly, 500,000 greater snow geese would continue to migrate to the eastern U.S. after management goals were achieved. Light geese would continue to migrate in relatively large flocks and visit traditional migration and wintering areas. Therefore, we believe the short-term economic and aesthetic impact of this alternative on non-consumptive users would be minimal, and the long-term economic impact

Table 4.7. Potential economic impact of trip-related expenditures in the U.S. during an extended time in which to take light geese in each Flyway.

	Flyway				
	Atlantic	Mississippi	Central	Pacific	U.S.
Percent of U.S. light goose harvest	5.1	35.9	52.6	6.4	100.0
Total annual economic impact of trip-related expenditures (million)[1]	$ 3.3	$23.3	$34.1	$4.1	$64.8[2]
Weighted proportional increase in time frame in which light geese may be taken[3]	0.54	0.23	0.41	0.23	na[4]
Economic impact of additional days (million)[5]	$1.8	$5.4	$14.0	$0.9	$22.1

[1] Total economic impact of trip-related expenditures for light goose hunting in the U.S. ($64.8 million), multiplied by proportion of total U.S. harvest of light geese occurring in each Flyway.
[2] Total economic impact of light goose hunting in the U.S. ($146 million) multiplied by the proportion of total expenditures related to trip-related expenses (0.44).
[3] Additional days beyond March 10 in which take of light geese is authorized in each State, weighted by light goose harvest in each State. Proportion increase calculated by number of days beyond 107 days.
[4] Not estimated.
[5] Total economic impact of trip-related expenditures in Flyway, multiplied by proportional increase in time frame in which light geese can be taken in Flyway.

would be positively enhanced due to maintenance of healthy populations.

Avoidance of precipitous population declines would preserve subsistence uses of light geese. The annual light goose harvest per subsistence hunter has remained fairly constant on the Hudson Bay coast during the past several decades, despite large increases in light goose abundance. Therefore, we believe that reduction of a particular population to a level that has been observed in recent decades, and which habitats can better sustain, will have little short-term effect on subsistence hunting. Furthermore, we believe the long-term prospects for subsistence hunting will be preserved if light goose populations are maintained at levels that habitats can support.

4.6.3 Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

Under this alternative, population reduction would be achieved through direct action by agency personnel. Additional days in which to take light geese beyond traditional hunting seasons would not be made available to citizens. In the absence of additional days, there would be no additional economic impacts resulting from trip-related expenditures by people pursuing light geese. As with Alternative B,

implementation of this alternative would preserve the long-term health of light goose populations by slowing the rate of habitat degradation and avoiding a potential population crash, especially in the mid-continent region. Closure of normal light goose hunting seasons, and associated negative economic impacts, would be avoided. Damage to agricultural crops would also be reduced.

The impacts of Alternative C on subsistence use of light geese are similar to those outlined in Alternative B. We believe that reduction of a particular population to a level that habitats can better sustain will have little short-term effect on subsistence hunting. Furthermore, we believe the long-term prospects for subsistence hunting will be preserved if light goose populations are maintained at levels that habitats can support.

Non-consumptive users of light geese may be slightly affected by lower overall populations. Achievement of management goals in the mid-continent region would result in an estimated winter index of 1.6 million light geese that would continue to migrate to the U.S. Similarly, 500,000 greater snow geese would continue to migrate to the eastern U.S. after management goals were achieved. Light geese would continue to migrate in relatively large flocks and visit traditional migration and wintering areas. Therefore, we believe the short-term economic impact of this alternative on non-consumptive users would be minimal, and the long-term economic impact would be positively enhanced due to maintenance of healthy populations.

Direct population control operations have not previously been conducted for light geese; therefore, cost estimates are not available. Costs of capturing Canada geese for purposes of population reduction in Minnesota averaged $10/bird (Keefe 1996). Additional costs of processing captured birds for donation to food banks averaged another $6.80/bird, for a total of $16.80/bird (Keefe 1996). However, these costs represent capturing of birds during their flightless period after the nesting season. Capturing light geese with rocket nets on wintering sites likely would be inefficient (R. Cox, U.S. Geological Survey, personal communication), therefore we estimate the cost would increase to at least $20/bird. The total expense would be dependent on the magnitude of removal required at the time direct control was implemented. For example, a one-time agency removal of 384,432 greater snow geese from the population to achieve the management goal of 500,000 birds (see Table 4.3) would cost approximately $7.7 million. Agency removal of 655,000 CMF light geese from the population (see Table 4.5) would cost approximately $13.1 million/year until management goals were achieved.

The cost to agencies of using chemical agents to reduce light goose populations would be dependent on the specific chemical used. Currently, the most likely chemical control agents available for control of light geese are DRC-1339, Avitrol, and alpha chloralose. The average total cost per bird for using DRC-1339 or Avitrol to kill geese would be approximately $2.96 and $2.82, respectively (J. Cummings, U.S. Dept. of Agriculture, unpublished data). Birds killed using DR-1339 or Avitrol must be collected and destroyed or

buried due to chemical residues in carcasses. This would represent a waste of the goose resource and could potentially be met with negative public reaction. A one-time agency removal of 384,432 greater snow geese from the population using DRC-1339 or Avitrol would cost agencies over $1.1 million. Agency removal of 655,000 CMF light geese from the population would cost up to $1.9 million/year until management goals were achieved.

Birds captured through immobilization with alpha chloralose could be utilized for human consumption after a 30-day live holding period to allow chemical residues to be expelled from the bodies of geese. The added costs of holding live birds for a 30-day period prior to processing for human consumption would raise the agency cost of using alpha chloralose to approximately $15.26/bird (J. Cummings, U.S. Dept. of Agriculture, unpublished data). Processing of carcasses for consumption would add $6.80/bird (Keefe 1996), thus raising the total agency cost to $22.06/bird. The magnitude of negative public reaction would likely be reduced if birds were utilized for consumption after being captured with the aid of alpha chloralose. However, the total cost to agencies would be significantly higher than using other chemical agents. A one-time agency removal of 384,432 greater snow geese from the population using alpha chloralose would cost agencies approximately $8.5 million. Agency removal of 655,000 CMF light geese from the population would cost $14.5 million/year until management goals were achieved.

4.6.4 Alternative D. Seek direct light goose population control on breeding grounds in Canada.

As with Alternative C, this alternative would achieve population reduction through direct action by agency personnel. Additional days in which to take light geese beyond traditional hunting seasons would not be made available to citizens. In the absence of additional days, there would be no additional economic impacts resulting from trip-related expenditures by people pursuing light geese. Implementation of Alternative D would preserve the long-term health of light goose populations by slowing the rate of habitat degradation and avoiding a potential population crash, especially in the mid-continent region. Closure of normal light goose hunting seasons, and associated negative economic impacts, would be avoided. Damage to agricultural crops would also be reduced.

The impacts of Alternative D on subsistence use of light geese are similar to those outlined in Alternative B. We believe that reduction of a particular population to a level that has been observed in recent decades, and which habitats can better sustain, will have little short-term effect on subsistence hunting. Furthermore, we believe the long-term prospects for subsistence hunting will be preserved if light goose populations are maintained at levels that habitats can support.

Non-consumptive users of light geese may be slightly affected by lower overall populations under this alternative. Achievement of management goals in the mid-continent region would result in an estimated

winter index of 1.6 million light geese that would continue to migrate to the U.S. Similarly, 500,000 greater snow geese would continue to migrate to the eastern U.S. after management goals were achieved. Light geese would continue to migrate in relatively large flocks and visit traditional migration and wintering areas where non-consumptive uses take place. Therefore, we believe the short-term impact of this alternative on non-consumptive users would be minimal, and the long-term impact would be positively enhanced due to maintenance of healthy populations in the future.

The agency costs of implementing this alternative depend on the distance of the breeding colony to the nearest human settlement, the timing of when direct control would occur (nest incubation period or post-hatch), the magnitude of removal, and the fate of birds that are killed. Control utilizing sharpshooters during the nesting period would be constrained to a 20-day period during the later stage of incubation when geese confine their movements to the immediate vicinity of nest sites (Alisauskas and Malecki 2003). Cost estimates have been developed (Alisauskas and Malecki 2003) for scenarios of removing 50,000, 100,000, and 250,000 birds from a breeding colony at low and high efficiency rates (birds/minute). Different efficiency rates were examined because agencies have no previous experience with control efforts that could be used to develop cost estimates. Estimates were developed for instances when birds were either left un-retrieved or were retrieved for processing at the nearest human settlement.

The estimated cost of killing but not retrieving 50,000 birds on a colony site during the incubation period ranges from $2.48/bird to $3.17/bird (average $2.85) at a low efficiency rate, and $1.11/bird to $1.45/bird (average $1.29) at a high efficiency rate, depending on the distance to the nearest human settlement (Table 4.8). Retrieving and processing the same number of birds would raise the cost to an average of $11.52/bird (low efficiency) or $6.76/bird (high efficiency). The average cost of killing but not retrieving 250,000 birds on a colony site during the incubation period is $3.00/bird (low efficiency) or $1.15/bird (high efficiency). Retrieving and processing 250,000 birds would raise the costs to an average of $25.87/bird (low efficiency) or $8.93/bird (high efficiency). Therefore, killing and processing 655,000 CMF light geese from breeding colonies during incubation would cost agencies a minimum of $5.8million/year. If control was conducted during the brood-rearing period the average cost of killing but not retrieving 50,000 birds ranges from $2.00/bird (low efficiency) to $1.83/bird (high efficiency; Table 4.9). Retrieving and processing the same number of birds would raise the cost to an average of $8.60/bird (low efficiency) or $8.44 (high efficiency). The average cost of killing but not retrieving 250,000 birds on a colony site during the incubation period is $3.00/bird, whereas retrieving and processing the same number of birds would raise the costs to an average of $25.87/bird. Therefore, killing and processing 655,000 CMF light geese from breeding colonies during brood-rearing would cost agencies at least $6.7 million/year.

Table 4.8. Estimated costs (Canadian $$) of removal of light geese during the incubation period on specific colony sites in the eastern and central Arctic according to level of removal and disposition (un-retrieved or retrieved and processed) of carcasses. Estimates were calculated for low efficiency (1 bird shot/3 minutes) and high efficiency (1 bird shot/minute) harvest by sharpshooters (calculated from data in Alisauskas and Malecki 2003).

				Number of birds removed from population					
				Birds left un-retrieved			Birds retrieved and processed		
	Colony	Nearest community	Distance (km)	50,000	100,000	250,000	50,000	100,000	250,000
Low efficiency									
Number of 10-person crews				2	4	10	2	4	10
	La Perouse Bay	Churchill	20	$2.48	--[1]	--	$6.60	--	--
	McConnell River	Arviat	30	$2.50	$2.50	--	$6.85	$9.95	--
	East Bay	Coral Harbour	50	$2.54	$2.54	--	$7.34	$10.44	--
	Harry Gibbons	Coral Harbour	150	$2.73	$2.73	$2.72	$9.81	$12.90	$22.27
	Colony 68 QMG	Coral Harbour	160	$2.75	--	--	$10.06	--	--
	Henrietta Maria	Winisk	190	$2.81	$2.80	--	$10.80	$13.89	--
	Karrak Lake	Cambridge Bay	300	$3.02	$3.02	$3.01	$13.52	$16.59	$25.97
	Other QMG colonies	Cambridge Bay	300	$2.69	--	--	$11.56	--	--
	Colony 88 QMG	Cambridge Bay	310	$3.04	$3.03	--	$13.77	$16.84	--
	Colony 46 QMG	Cambridge Bay	325	$3.07	$3.06	--	$14.14	$17.21	--
	Colony 10 QMG	Cambridge Bay	354	$3.12	$3.12	$3.12	$14.86	$17.92	$27.30
	Colony 9 QMG	Cambridge Bay	360	$3.13	$3.13		$15.00	$18.07	--
	Great Plain	Iqaluit	380	$3.17	$3.17	$3.17	$15.50	$18.56	$27.94
			Average	$2.85	$2.91	$3.00	$11.52	$15.24	$25.87
One-time equipment investment				$80,200	$130,200	$280,200	$149,200	$199,200	$349,200
High efficiency									
Number of 10-person crews				1	2	3	1	2	3
	La Perouse Bay	Churchill	20	$1.11	--	--	$2.37	--	--
	McConnell River	Arviat	30	$1.12	$1.11	--	$2.58	$3.09	--
	East Bay	Coral Harbour	50	$1.14	$1.13	--	$3.02	$3.52	--
	Harry Gibbons	Coral Harbour	150	$1.23	$1.23	$1.07	$5.21	$5.69	$5.91
	Colony 68 QMG	Coral Harbour	160	$1.24	--	--	$5.42	--	--
	Henrietta Maria	Winisk	190	$1.27	$1.27	--	$6.08	$6.56	--
	Karrak Lake	Cambridge Bay	300	$1.38	$1.37	$1.15	$8.48	$8.95	$9.01
	Other QMG colonies	Cambridge Bay	300	$1.20	--	--	$7.30	--	--
	Colony 88 QMG	Cambridge Bay	310	$1.38	$1.38	--	$8.70	$9.17	--
	Colony 46 QMG	Cambridge Bay	325	$1.40	$1.40	--	$9.03	$9.50	--
	Colony 10 QMG	Cambridge Bay	354	$1.43	$1.42	$1.18	$9.66	$10.12	$10.12
	Colony 9 QMG	Cambridge Bay	360	$1.43	$1.43	--	$9.79	$10.26	--
	Great Plain	Iqaluit	380	$1.45	$1.45	$1.20	$10.22	$10.69	$10.66
			Average	$1.29	$1.32	$1.15	$6.76	$7.05	$8.93
One-time equipment investment				$55,200	$80,200	$105,200	$124,200	$149,200	$174,200

[1] Not calculated because level of harvest exceeds colony population estimate.

Table 4.9. Estimated costs (Canadian $$) of removal of light geese during the brood-rearing period on specific colony sites in the eastern and central Arctic according to level of removal and disposition (un-retrieved or retrieved and processed) of carcasses. Estimates were calculated for low efficiency (2,000 birds captured/crew/day) and high efficiency (5,000 birds captured/crew/day) harvest by sharpshooters (calculated from data in Alisauskas and Malecki 2003).

				Number of birds removed from population					
				Birds left un-retrieved			Birds retrieved and processed		
	Colony	Nearest community	Distance (km)	50,000	100,000	250,000	50,000	100,000	250,000
Low efficiency									
Number of 10-person crews				1	2	5	1	2	5
	La Perouse Bay	Churchill	20	$1.51	--[1]	--	$3.92	--	--
	McConnell River	Arviat	30	$1.54	$1.73	--	$4.15	$4.34	--
	East Bay	Coral Harbour	50	$1.59	$1.80	--	$4.62	$4.83	--
	Harry Gibbons	Coral Harbour	150	$1.83	$2.13	$3.14	$6.97	$7.26	$8.26
	Colony 68 QMG	Coral Harbour	160	$1.86	--	--	$7.20	--	--
	Henrietta Maria	Winisk	190	$1.93	$2.26	--	$7.91	$8.23	--
	Karrak Lake	Cambridge Bay	300	$2.20	$2.62	$4.07	$10.49	$10.90	$12.32
	Other QMG colonies	Cambridge Bay	300	$1.91	--	--	$8.76	--	--
	Colony 88 QMG	Cambridge Bay	310	$2.23	$2.65	--	$10.72	$11.15	--
	Colony 46 QMG	Cambridge Bay	325	$2.26	$2.70	--	$11.08	$11.51	--
	Colony 10 QMG	Cambridge Bay	354	$2.33	$2.80	$4.40	$11.76	$12.22	$13.78
	Colony 9 QMG	Cambridge Bay	360	$2.35	$2.82		$11.90	$12.36	--
	Great Plain	Iqaluit	380	$2.40	$2.89	$4.56	$12.37	$12.85	$14.48
			Average	$2.00	$2.44	$4.04	$8.60	$9.56	$12.21
One-time equipment investment				$20,000	$30,000	$60,000	$20,000	$30,000	$60,000
High efficiency									
Number of 10-person crews				1	1	2	1	1	2
	La Perouse Bay	Churchill	20	$1.34	--	--	$3.75	--	--
	McConnell River	Arviat	30	$1.36	$1.30	--	$3.98	$3.91	--
	East Bay	Coral Harbour	50	$1.41	$1.34	--	$4.45	$4.36	--
	Harry Gibbons	Coral Harbour	150	$1.66	$1.51	$1.81	$6.80	$6.62	$6.89
	Colony 68 QMG	Coral Harbour	160	$1.68	--	--	$7.03	--	--
	Henrietta Maria	Winisk	190	$1.76	$1.58	--	$7.73	$7.52	--
	Karrak Lake	Cambridge Bay	300	$2.03	$1.77	$2.18	$10.31	$9.99	$10.36
	Other QMG colonies	Cambridge Bay	300	$1.83	--	--	$8.68	--	--
	Colony 88 QMG	Cambridge Bay	310	$2.05	$1.78	--	$10.55	$10.22	--
	Colony 46 QMG	Cambridge Bay	325	$2.09	$1.81	--	$10.90	$10.56	--
	Colony 10 QMG	Cambridge Bay	354	$2.16	$1.86	$2.31	$11.58	$11.21	$11.-62
	Colony 9 QMG	Cambridge Bay	360	$2.18	$1.87	--	$11.72	$11.35	--
	Great Plain	Iqaluit	380	$2.22	$1.90	$2.37	$12.19	$11.80	$12.22
			Average	$1.83	$1.67	$2.17	$8.44	$7.96	$10.27
One-time equipment investment				$20,000	$20,000	$20,000	$20,000	$20,000	$20,000

[1] Not calculated because level of harvest exceeds colony population estimate.

Chemical control of light geese in the Arctic would be more costly than control in the U.S. Information is not available to guide us in projecting exact costs for chemical control in the Arctic. However, we assume that costs would be 40% higher than those on migration and wintering areas. A one-time agency removal of 384,432 greater snow geese from the population using DRC-1339 or Avitrol would cost agencies over $1.1 million, whereas use of alpha chloralose would cost approximately $8.5 million. Agency removal of 655,000 CMF light geese from the population using DRC-1339 or Avitrol would cost up to $2.7 million/year until management goals were achieved. Use of alpha chloralose for CMF light geese in the Arctic would cost $20.2 million/year until management goals were achieved.

4.6.5 Alternative E. Two-phased approach to light goose population control.

Socioeconomic impacts during phase one of Alternative E would be identical to those outlined in Alternative B above. Impacts during phase two of Alternative E would be identical to those of Alternative C if direct control was conducted on wintering grounds. Socioeconomic impacts would be identical to those of Alternative D if direct control was conducted on the breeding grounds during phase two.

4.7 Waste and Disposal of Geese

Previously we identified the need to prevent, where feasible, waste of the light goose resource under each management alternative. Although the concept of waste would appear to be more applicable to alternatives that call for reduction of light goose populations, some readers may consider the No Action alternative to be a waste of the goose resource if a population crash occurs. Problems associated with disposal of goose carcasses varies by alternative.

4.7.1 Alternative A. No action.

As mentioned above, some readers may consider this alternative to be a waste of the goose resource if a population crash occurs. The degree of waste depends on the time required for the potential crash to occur. A prolonged decline in a particular population may result in small numbers of birds dying over several years. Remaining carcasses likely would be consumed by scavengers as they became available. However, a rapid population crash would likely result in a large number of carcasses that would overwhelm the ability of scavengers to consume them. This represents a potential waste of the goose resource.

4.7.2 Alternative B. (Preferred alternative). Modify harvest regulation options and refuge management.

We believe this alternative has the best potential to prevent waste of the light goose resource. Light geese removed from the population by citizens participating in a conservation order would be taken to

individuals' homes and processed for consumption. Alternatively, individuals may also donate geese to food shelters. Agencies would not incur any costs for collection and disposal of carcasses.

4.7.3 Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

The potential for waste of the light goose resource under direct agency control is dependent on whether uses for goose carcasses can be found. Conditions of the permit for light goose control would require that agencies must utilize such birds by donation to public museums or public institutions for scientific or educational purposes, by processing them for human consumption and distributing them free of charge to charitable organizations, or by burying or incinerating them (Appendix 6). We believe that burying or incinerating carcasses would represent a waste of the goose resource and should only be used as a last resort.

Birds removed by killing with DR-1339 or Avitrol must be collected and destroyed or buried due to chemical residues in carcasses that make them unfit for human consumption. This would represent a waste of the goose resource and could potentially be met with negative public reaction. Furthermore, costs to agencies of collecting and burying or incinerating carcasses would be high. Waste of carcasses could be prevented if birds were captured with alpha chloralose and held for 30 days prior to processing for human consumption. However, agency costs would be substantially higher under this option (see section 4.6 for costs). The magnitude of light goose removal under Alternative C may make it difficult to prevent a portion of carcasses from being wasted. For example, agency removal of 655,000 CMF light geese could overwhelm facilities that are available to accept carcasses.

4.7.4. Alternative D. Seek direct light goose population control on breeding grounds in Canada.

The potential for waste of the light goose resource is higher if control is conducted in remote northern breeding areas. Agency costs for light goose control on northern breeding areas are much higher due to higher logistical costs of fieldwork in the Arctic. Therefore, the option of not collecting carcasses after population reduction occurs may have to be considered in order to reduce overall costs. We believe this would represent a waste of the resource that likely would be met with negative public reaction. As with Alternative C, the potential for waste of birds removed using the chemicals DR-1339 or Avitrol exists under Alternative D. Use of alpha chloralose would reduce waste, but would be much more expensive in northern breeding areas if birds had to be held in captivity for 30 days.

The magnitude of light goose removal under Alternative D may make it difficult to prevent a portion of carcasses from being wasted. For example, agency removal of 655,000 CMF light geese could

overwhelm facilities that are available to accept carcasses.

4.7.5 Alternative E. Two-phased approach to light goose population control.

Phase one of Alternative E would have the best potential to prevent waste of the light goose resource. Light geese removed from the population by citizens participating in a conservation order would be taken to individuals' homes and processed for consumption. Alternatively, individuals may also donate geese to food shelters. Agencies would not incur any costs for collection and disposal of carcasses during phase one.

Impacts during phase two of Alternative E would be identical to those of Alternative C if control was conducted on wintering grounds. Socioeconomic impacts would be identical to those of Alternative D if control was conducted on the breeding grounds during phase two.

4.8 Cumulative Impacts

4.8.1 Alternative A. No action.

Under the No Action alternative, we expect population increases to continue and damage to habitats to worsen and expand into new areas. Cumulative impacts to habitats, especially in sensitive tundra habitats, will be more persistent as the degree of damage increases with repeated exposure to goose feeding activities. Repeated incidences of light goose damage to agricultural crops may reach the point where farmers demand compensation for financial losses. Over time, we expect that cumulative impacts to other species that utilize the same habitats as light geese will become more evident. Higher light goose populations will increase the likelihood of disease outbreaks that would impact light geese as well as other susceptible species. Furthermore, it is possible that the No Action alternative would eventually lead to a decline in one or more light goose populations as a result of overpopulation. Such declines may force managers to restrict or close light goose hunting seasons, and subsistence hunting may be negatively impacted. Cumulative impacts to non-consumptive users would become evident if a population crash causes a reduction in the size and density of flocks, which may force citizens to travel longer distances to see remnant flocks.

Cumulative impacts also would occur if the No Action approach were adopted in situations where other wildlife species have became overabundant. For example, some local populations of resident Canada geese have become overabundant and are resulting in increasing numbers of conflicts with human activities. Continued use of the "no action" approach would likely increase the number of conflicts. Continued inaction for all situations where wildlife has become overabundant would likely cause significant cumulative impacts to habitats and conflicts with human activities would increase.

4.8.2 Alternative B. (Preferred alternative). Modify harvest regulation options and refuge management.

This alternative would return light goose populations to levels that we believe are more compatible with the ability of natural habitats to support them. The cumulative impacts to habitats would be that the rate of damage from light geese would be slowed. However, it is likely that habitats in Arctic and subarctic areas that are already damaged would take decades to recover, if recovery is even possible. Cumulative impacts under Alternative B may result in special regulations being alternately implemented and suspended for various light goose populations depending on the status of the population in relation to the management goal. With regard to habitat management on refuges, the cumulative impacts under Alternative B would be a reduction in the acreage of agricultural habitats in favor of more natural habitats. This impact should benefit a variety of species that tend to be absent from agricultural habitats.

Utilization of actions similar to Alternative B for other wildlife species that have become overabundant would have positive cumulative impacts. Populations would be maintained at levels more compatible with the ability of natural habitats to support them. Wildlife agencies would not incur additional costs associated with population control because they would not be directly involved in removal of animals from the population.

4.8.3 Alternative C. Implement direct light goose population control on wintering and migration areas in the U.S.

Cumulative impacts of direct population control under Alternative C differ from control under Alternative B. Due to high costs to agencies, direct population control likely would be implemented only when a particular population has greatly exceeded management goals. Therefore, control efforts may be less frequent under Alternative C in an effort to improve cost-efficiency. However, if approaches similar to Alternative C were used in by agencies in response to overabundance of other wildlife species, the cumulative financial costs would be prohibitively high. Costs for wildlife population control would consume greater proportions of agency budgets, and financial allocations to other management activities would have to be reduced.

4.8.4. Alternative D. Seek direct light goose population control on breeding grounds in Canada.

Cumulative impacts of direct population control under Alternative D are similar to those under Alternative C. However, the magnitude of financial cost would be much greater due to the high cost of conducting control efforts in remote breeding areas. Costs for wildlife population control on northern breeding areas would consume even higher proportions of agency budgets, thus resulting in more drastic

reductions in financial allocations to other management activities.

4.8.5 Alternative E. Two-phased approach to light goose population control.

Cumulative impacts during phase one of Alternative E would be identical to those outlined in Alternative B above. Impacts during phase two of Alternative E would be identical to those of Alternative C if control was conducted on wintering grounds. Cumulative impacts would be identical to those of Alternative D if control was conducted on the breeding grounds during phase two.

4.9 Impacts on Historical and Cultural Resources

The geographic extent of light goose breeding, migration and wintering areas is continental in scope and encompasses a variety of historical sites and cultural resources. The management alternatives analyzed in this document do not involve construction of new buildings, excavations, or other activities that normally disturb historical sites or cultural resources. Therefore, we expect no impacts to historical or cultural resources under any of the alternatives.

4.10 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* directs Federal agencies to incorporate environmental justice in their decision making process. Federal agencies are directed to identify and address as appropriate, any disproportionately high and adverse environmental effects of their programs, policies, and activities on minority or low-income populations. Impacts of the five management alternatives on subsistence users of light geese were discussed in section 4.6. To review, adoption of the No Action alternative would likely negatively affect native subsistence harvest of light geese if arctic habitat degradation severely reduced or eliminated availability of light geese near a native community. Native harvest of light geese on migration and wintering areas in the U.S. may also be affected by severe declines in light goose populations. Although light geese concentrate in larger flocks during migration and winter, there may be fewer total flocks available to subsistence hunters following a population crash. Subsistence harvest of light geese per hunter has remained fairly constant in recent decades, despite large increases in light goose abundance. Population control using Alternatives B, C, D, and E would return light goose population levels to those observed in recent decades. Therefore, we do not anticipate any negative impacts to subsistence harvest of light geese by natives under Alternatives B, C, D, or E. None of the alternatives would create any environmental pollution. No minority or low-income populations would be displaced by any of the alternatives.

Table 4.10. Summary of environmental consequences of light goose management alternatives.

Actions	Alternative A. No Action.	Alternative B. (Preferred) Modify harvest regulation options and refuge management.	Alternative C. Direct control of light goose populations on wintering and migration areas in U.S.	Alternative D. Direct control of light goose populations on breeding areas in Canada.	Alternative E. Two-phased approach to light goose population control.
Light goose populations	Allowed to increase, which may lead to population crash.	Reduced to management goal levels.	Reduced to management goal levels.	Reduced to management goal levels.	Reduced through harvest in phase one. Reduced through harvest and direct agency control in phase two.
Existing light goose harvest regulations	No change from current policies and procedures.	Remain in place; subject to modification if new regulations implemented.	No change from current policies.	No change from current policies.	Remain in place during phase one; subject to modification if new regulations implemented. No change from current policies during phase two.
New light goose regulations	No new regulations.	Implement new methods of take and a conservation order.	Creation of mew agency permit in U.S. for population control.	No new U.S. regulations.	New methods of take and creation of a conservation order. Creation of light goose permit for direct control.
Habitat	Continued degradation of breeding, migration, and wintering habitat.	Reduction or halting of habitat degradation	Reduction or halting of habitat degradation.	Reduction or halting of habitat degradation.	Reduction or halting of habitat degradation.

Table 4.10. Summary of environmental consequences of light goose management alternatives.

Actions	Alternative A. No Action.	Alternative B. (Preferred) Modify harvest regulation options and refuge management.	Alternative C. Direct control of light goose populations on wintering and migration areas in U.S.	Alternative D. Direct control of light goose populations on breeding areas in Canada.	Alternative E. Two-phased approach to light goose population control.
Refuge hunt programs	Remain in place. Normal changes occur using existing administrative process.	Expanded where compatible with refuge purposes.	Remain in place. Normal changes occur using existing administrative process.	Remain in place. Normal changes occur using existing administrative process.	Expanded where compatible with refuge purposes.
Refuge habitat management	Proceeds as normal.	Modified when compatible with refuge purposes.	Proceeds as normal.	Proceeds as normal.	Modified when compatible with refuge purposes.
Agricultural crop depredations	Increase	Reduced	Reduced	Reduced	Reduced
Waste and disposal of birds	Potential waste of goose resource if population crashes.	No waste of birds No disposal necessary.	Potentially large waste of goose resource if no uses can be found. Potentially high costs to agencies.	Potentially large waste of goose resource if no uses can be found. Potentially very high costs to agencies.	No waste of birds in phase 1. Potentially large waste of goose resource if no uses can be found in phase 2. Potentially very high costs to agencies.
Other species	Increased exposure to avian cholera outbreaks. Degradation of habitat near light goose nesting colonies.	Reduced likelihood of exposure to avian cholera outbreaks. Slowing of arctic habitat degradation.	Reduced likelihood of exposure to avian cholera outbreaks. Slowing of arctic habitat degradation.	Reduced likelihood of exposure to avian cholera outbreaks. Slowing of arctic habitat degradation.	Reduced likelihood of exposure to avian cholera outbreaks. Slowing of arctic habitat degradation.

Table 4.10. Summary of environmental consequences of light goose management alternatives.

Actions	Alternative A. No Action.	Alternative B. (Preferred) Modify harvest regulation options and refuge management.	Alternative C. Direct control of light goose populations on wintering and migration areas in U.S.	Alternative D. Direct control of light goose populations on breeding areas in Canada.	Alternative E. Two-phased approach to light goose population control.
Special status species	Potential increased exposure to avian cholera outbreaks.	Reduced likelihood of exposure to avian cholera outbreaks.	Reduced likelihood of exposure to avian cholera outbreaks.	Reduced likelihood of exposure to avian cholera.	Reduced likelihood of exposure to avian cholera outbreaks.
Socioeconomic	Increased potential for closure of light goose hunting season. Smaller impact on non-consumptive uses of light geese versus consumptive uses. Potential cost to agencies high if cholera outbreaks require clean-up operations. Negative impact on subsistence hunting if goose populations crash.	Maintenance of light goose hunting seasons. Increased economic impact associated with conservation order. Maintenance of quality of non-consumptive uses. Low cost to agencies. Little or no effect on subsistence harvest.	Maintenance of light goose hunting seasons. Maintenance of quality of non-consumptive uses. No increased economic impact. High agency costs. Little or no effect on subsistence harvest.	Maintenance of light goose hunting seasons. Maintenance of quality of non-consumptive uses. No increased economic impact. High agency costs. Little or no effect on subsistence harvest.	Phase 1: Same as B Phase 2: Same as C and D.
Cultural resources	No impact.	No impact.	No impact.	No impact.	No impact.
Cumulative impacts	Increases in other wildlife populations may cause damage to other habitats and increased conflicts with humans.	Other wildlife populations kept at levels at which habitats can support them. No increased agency costs.	Increased number of control programs for other species at potentially high cost to agencies.	Increased number of control programs for other species at potentially high cost to agencies.	Phase 1: Same as B Phase 2: Same as C and D

CHAPTER 5

List of Preparers

James R. Kelley, Jr., Wildlife Biologist, EIS Project Manager, Fort Snelling, MN

B.S. Wildlife Management, University of Maine
M.S. Fisheries and Wildlife, University of Missouri
Fifteen years of professional experience with the U.S. Fish and Wildlife Service in the Division of Migratory Bird Management.

Acknowledgements

Several Service employees provided helpful comments on previous drafts of this document. They include: T. Moser, J. Dubovsky, T. Chouinard, F. Bowers, J. Gosse, H. Hall, J. Caudill, J. Serie, D. Sharp, K. Gamble, G. Haas, J. Morton, T. Villanueva, R. Oates, A. Brackney, D. Peterson, D. Haukos, S. Kelly, J. Haskins, P. Schmidt, R. Blohm, and J. Andrew.

CHAPTER 6

List of Agencies, Organizations, and Individuals to Whom Copies of the DEIS or Notice of Availability were Sent

We assembled a mailing list of nearly 1,000 agencies, organization, and individuals for the Draft EIS. The list was constructed from the following: 1) the mailing list that the Division of Migratory Bird Management uses for its Federal Register notices; 2) individuals, organizations, and agencies that submitted public comments during our 1998-1999 Environmental Assessment process; 3) individuals, organizations, and agencies that submitted comments in response to our Notice of Intent published on May 13, 1999. A summary of agencies and organization on our mailing list is presented below; however, this list may not be all-inclusive.

As part of our consultation with the Canadian government, we asked the CWS to distribute French and English versions of our Notice of Intent to potentially affected groups in Canada. The CWS distribution list contains approximately 600 individuals, and national or provincial organizations that have indicated an interest in waterfowl management in Canada. The distribution list also includes wildlife co-management boards and councils that oversee wildlife programs affecting First Nations people in Canada. The Notice of Availability was mailed to those entities that submitted comments in response to the Notice of Intent, as well as provincial and territorial wildlife agencies and co-management boards.

Federal Agencies

U.S. Environmental Protection Agency
U.S. Department of Agriculture
Canadian Wildlife Service

State/Provincial Agencies

Texas Parks & Wildlife Department
Alabama Department of Cons. & Natural Resources
Alaska Department of Fish & Game
Arkansas Game & Fish Commission
Delaware Division of Fish & Wildlife
Georgia Department of Natural Resources
Hawaii Division of Forestry & Wildlife
Illinois Department of Natural Resources
Iowa Department of Natural Resources
Kentucky Department of Fish & Wildlife Resources
Maryland Department of Natural Resources

Massachusetts Division of Fisheries & Wildlife
Michigan Department of Natural Resources
Mississippi Dept. of Wildlife, Fisheries & Parks
Nebraska Game & Parks Commission
Nevada Division of Wildlife
New Jersey Division of Fish, Game & Wildlife
Tennessee Wildlife Resources Agency
West Virginia Division of Natural Resources
Wisconsin Department of Natural Resources
Connecticut Department of Environmental Protection
Florida Game & Fresh Water Fish Comm
Maine Deptartment of Inland Fisheries & Wildlife
New Hampshire Fish & Game Department
New York Department of Environmental Conservation
North Carolina Wildlife Resources Commission
Pennsylvania Game Commission
Rhode Island Division of Fish & Wildlife
South Carolina Department of Natural Resources
Virginia Department of Game & Inland Fisheries
Ohio Division of Natural Resources
Manitoba Dept. of Natural Resources & Energy
Ontario Ministry of Natural Resources
Nova Scotia Department of Natural Resources
Quebec Ministere de l'Environnement et de la faune
Indiana Department of Natural Resources
Louisiana Department of Wildlife & Fisheries
Minnesota Department of Natural Resources
Missouri Department of Conservation
Kansas Department of Wildlife & Parks
Montana Department of Fish, Wildlife & Parks
North Dakota Game & Fish Department
Oklahoma Department of Wildlife Conservation
South Dakota Game, Fish & Parks Department
Government of Northwest Territories Wildlife & Fisheries Division
Saskatchewan Environment & Resource Management
Arizona Game & Fish Department
California Department of Fish & Game
Colorado Division of Wildlife
Idaho Department of Fish & Game
New Mexico Department of Game & Fish
Oregon Department of Fish & Wildlife
Utah Division of Wildlife Resources
Washington Department of Fish & Wildlife
Wyoming Game & Fish Department
Alberta Natural Resource Services
British Columbia Ministry of Environment & Parks
Yukon Dept. of Renewable Resources

Organizations

National Audubon Society
International Association of Fish & Wildlife Agencies
Ducks Unlimited, Inc.
The Wildlife Legislative Fund of America
Humane Society of the U.S.
Wildlife Information Center Inc.
The Wildlife Society
Wildlife Management Institute
Fund for Animals, Inc.
Finger Lakes & Western New York Waterfowlers Association
National Audubon Society

Delta Waterfowl Foundation
Outdoor Writers Assoc. of America, Inc.
National Wildlife Federation
National Rifle Association
Defenders of Wildlife
World Society for the Protection of Animals
Fund for Animals, Inc.
National Fish & Wildlife Foundation
California Waterfowl Association
Waterfowl Improvement Assoc.
The Fund For Animals
Texas Falconry Advisory Board
Texas Waterfowl Outfitters
American Bird Conservancy
Wildlife Management Institute
New Jersey State Federation of Sportsmen's Clubs
Safaria Club International
Arlington Sportsman's Club
Animal Alliance of Canada
Voices for Animals
World Society for the Protection of Animals
The Fund for Animals Inc.
Oakville Humane Society
Etobicoke Humane Society
Marion County Humane Society
The Winnipeg Humane Society
Wildlife Watch and Affiliates, LC
Kenora & District Humane Society
Arnprior & District Humane Society
Alliston & District Humane Society
Ottawa-Carleton Wildlife Centre
Animal Protection Institute
Arnprior & District Humane Society
The Peoria Humane Society
People for the Ethical Treatment of Animals
Mississippi Valley Duck Hunters Assoc.
Illinois Waterfowlers Alliance, Inc.
Pennsylvania Farm Bureau
Conservation Federation of Missouri
KAW Valley Sportsmen's Association
Boulder County Audubon Society

Tribal

We mailed the DEIS to approximately 550 Tribal group contacts in North America. A list of contacts is available upon request.

Private individuals

Available upon request

CHAPTER 7
PUBLIC COMMENTS ON DEIS AND SERVICE RESPONSE

7.1 Introduction

Public comments were received from 414 private individuals, 24 Federal, State or Provincial agencies, 1 State Representative, 6 Tribal groups, 4 Flyway Councils, and 8 non-governmental organizations. Because the total number of comment pages is considerable, we have chosen not to reproduce the comments in this document. Copies of the public comments are available upon request from the U.S. Fish and Wildlife Service, Division of Migratory Bird Management. It was not practical to address each comment individually. Where appropriate, we summarized comments that revolved around a central theme and itemized them as single comments. Some comments were technically oriented and/or took several pages to make a particular point. In such instances, we have included direct quotes from the comment in order to avoid mis-characterization of the comment.

7.2 Comments from Federal Agencies

1) The Environmental Protection Agency (EPA) reviewed the DEIS and stated that they did not identify any environmental concerns with our preferred alternative (Alternative B), and that the document provides adequate documentation of the potential environmental impacts. The EPA recommended that, following selection of a management approach, the Service should carefully monitor its implementation and remain open to exploring other options as necessary and appropriate. The EPA assigned a rating of Lack of Objection to the DEIS (Appendix 3).

We will carefully monitor light goose populations and their habitats following implementation of new management approaches.

2) The Canadian Wildlife Service (CWS) commented that they, and a clear majority of scientists and managers who have provided information to them, feel that intervention is required to reduce overabundant populations of greater and lesser snow geese. CWS stated that non-intervention would not be a responsible choice. CWS acknowledges that Ross's geese are numerous in comparison to historical numbers and contribute proportionately to the habitat damage observed in conjunction with snow geese. CWS stated that although Canada has not included Ross's geese in special conservation measures at this time, they would consider regulations to include this species if further experience shows that it is necessary.

We agree that intervention is required and will consult with Canada upon implementation of our management actions. We also agree that Ross's geese are at record high levels and that they are contributing to habitat damage. Consequently, we have chosen to include Ross's geese in our current proposal for management action.

3) CWS stated that Alternative B is consistent with actions currently being taken in Canada and should be pursued first in order to increase harvest rates in the U.S. before looking at options involving direct population control. However, CWS indicated that, if Alternative B did not prove successful, direct control may be necessary at some time in the future. Furthermore, assuming success in our approach, the two Federal agencies need to jointly consider approaches for backing away from extraordinary special methods of control as soon as possible.

We have chosen Alternative B as our preferred alternative. If this alternative proves to be unsuccessful at reducing light goose populations we will consult with Canada to evaluate other management options. We agree that once population goals are achieved an exit strategy should be implemented. As we have indicated in Section 4.2.2, certain maintenance regulations may need to remain in place in order to prevent populations from rebounding after population goals are achieved. For example, the conservation order may be suspended once the goal for a particular population is reached. However, additional harvest beyond what would normally be expected with regular goose

Comments from Federal Agencies (continued)

seasons may be required to prevent the population from rebounding. In such a case, special regulations (e.g. use of unplugged shotguns, electronic calls) can be implemented during the regular season to increase harvest. However, use of such regulations would still require that other waterfowl and crane hunting seasons, excluding falconry, be closed.

4) CWS does not support development of general commercial activities and take for the purpose of light goose control. They do not wish to establish a short-lived commercial opportunity that could have serious long-term effects on community support for and compliance with regulations.

We agree that development of short-term commercial activities and take should not be promoted as a means of assisting with population control.

5) CWS agrees with current population goals for greater and lesser snow geese, but stresses that such goals are initial targets. Population goals should be re-examined as new information becomes available and progress towards the ultimate goal of reduced habitat damage and/or habitat recovery should be monitored.

We concur that the ultimate goal of management should be reduction of habitat damage and/or habitat recovery. Population goals should be periodically re-evaluated in the context of the status of habitats and their potential for recovery.

6) CWS clarified their role in the distribution of our Notice of Availability in Canada. The Notice of Intent to prepare the EIS was mailed to a list of approximately 600 individuals, and national and provincial organizations that have indicated an interest in waterfowl management in Canada. The list included wildlife co-management boards and councils that oversee wildlife programs affecting First Nations people in Canada. The Notice of Availability was mailed to those entities that submitted comments in response to the Notice of Intent, as well as provincial and territorial wildlife agencies and co-management boards.

Thank you. We have made changes in Chapter 7 that reflect this clarification.

7) The U.S. Geological Survey (USGS) commented that the weight of scientific evidence indicates that several populations of lesser snow geese have increased to such an extent that they present a threat to Arctic breeding habitats. In addition to lesser snow geese, other light goose species (greater snow and Ross's geese) have exhibited similar trends in exponential growth. Some of their populations may currently be contributing to the degradation of Arctic habitats. Scientific evidence indicates that several populations of light geese should be considered overabundant and management actions are required to reduce these populations. The USGS recommends adoption of Alternative B as the most appropriate for short-term management. The available scientific evidence indicates that Alternative A would be ineffective and the other alternatives would be extremely costly and logistically difficult.

Thank you for your comments.

8) The USGS commented that if 25-35% of the population in spring is comprised of non-breeding birds, and they are not counted in spring surveys, then the total population size would be 1.3 to 1.5 times greater than breeding colony estimates. The DEIS indicates the total population size would be only 1.25 to 1.35 times greater than the breeding colony estimate, which would under-estimate the total population size.

We have corrected this error in the Final EIS. The estimates for total population size we have given were derived by multiplying the breeding colony estimate by a factor of 1.3. Therefore, the estimates should be viewed as a minimum number of birds in the population.

9) The USGS commented that current science is insufficient to support the statement that lesser snow and Ross's geese are "known carriers" of the bacterium that causes avian cholera (DEIS page 64). Preliminary scientific evidence supports this conclusion, but further research is required.

Comments from Federal Agencies (continued)

We have modified our characterization of the status of lesser snow and Ross's geese from "known carriers" of the bacterium to suspected carriers. As the USGS states, preliminary scientific evidence supports the theory that these species are indeed carriers of the bacterium. We continue to believe that growing populations of light geese increases the likelihood of cholera outbreaks.

10) The USGS commented that additional scientific information is needed to determine the migration and wintering carrying capacity and habitat degradation impacts of greater snow geese on habitats described in section 3.2.2.

We agree that additional research will improve our knowledge of the carrying capacity of such habitats. The information provided by Giroux et al. (1998) suggests that the carrying capacity of such habitat (whatever it is) has been exceeded.

11) The USGS commented that further scientific information is needed to determine the impact of abundant light goose habitat use and/or food consumption on other waterfowl and bird species.

We agree that additional scientific information will help us better evaluate the impact of overabundant light geese on other species. Indeed, further scientific information is needed on a myriad of environmental issues. However, we believe the results from the studies that have been conducted indicate that overabundant light geese do impact other waterfowl and bird species.

12) The USGS commented that preliminary scientific evidence suggests that harvesting greater snow geese during spring in Quebec may negatively affect their body condition and thus reproduction. This raises the question of whether similar patterns may occur in non-target species that are subjected to this disturbance. Further research may be required to address this concern in all the alternatives.

Conducting further scientific research to obtain information not currently available is beyond the scope of this EIS process. In the Final EIS we have incorporated the findings of recent research on the effects of the spring conservation harvest on greater snow geese. We note that the observed decline in body reserves of greater snow geese on spring staging areas in Quebec was thought to be a result of increased disturbance and reduced access to agricultural foods due to the spring harvest. This supports our contention that light goose populations have increased due to an agricultural food subsidy, which has caused increases in winter/spring survival and reproductive success in light goose populations. We do not view reductions in spring body condition or reproduction of light geese as undesirable. If such factors can help to reduce the population they should be encouraged until population goals are achieved. Feret et al. (2003) indicated that greater snow geese *sometimes* form mixed feeding flocks (e.g. with Canada geese), and hypothesized that the negative impact of the spring harvest could also potentially affect other species. The number of breeding pairs in the Atlantic Population of Canada geese has increased 14% per year during 1997-2006 (U.S. Fish and Wildlife Service 2006), including years in which the spring harvest of greater snow geese has occurred. We note that Canada geese would be the species most likely to be affected by light goose hunting activities and there is no evidence that this non-target species has been affected by spring harvest of snow geese. Changes in habitat management and hunting programs on Service refuges take into account the potential effects on non-target species. Some refuges have chosen not to implement changes in light goose hunting because it was felt that disturbance to non-target species possibly would occur. Because hunting for light geese usually takes place in field situations, we believe that non-target waterbirds would be unaffected by such activities.

13) The USGS commented that neckband data indicate that most light geese in eastern Oregon originate from Wrangel Island. Delayed hunting or control efforts in the fall would not alleviate pressure on Wrangel Island geese. Control efforts in western Canada and U.S. should be designed to avoid harvesting Wrangel Island geese whenever possible. The EIS should also mention that one subpopulation of Wrangel Island geese winter in southern British Columbia and the Puget Sound area of Washington, whereas another subpopulation winters in the Central Valley of California.

Comments from Federal Agencies (continued)

We have clarified our wording in the description of how the distribution of Wrangel Island snow geese can be used in management decisions. Although there are 2 distinct areas where Wrangel Island snow geese winter, the Flyway Councils and the Service do not designate and manage separate segments of this population. Wrangel Island birds comprise the bulk of light geese that winter in eastern Oregon. However, some birds from the western Arctic arrive there up to 2 weeks later in the fall (Armstrong et al. 1999). Normal hunting seasons have been altered in the past by delaying the start of the season in Klamath County, Oregon to allow the influx of later-arriving birds from the western Arctic. By diluting the birds found in eastern Oregon with non-Wrangel Island birds the hunting pressure on Wrangel Island birds was thought to be alleviated (Armstrong et al. 1999). Similar considerations should be made on migration areas. We reiterate that we are not currently recommending any management actions in the Pacific Flyway.

7.3 Comments from Flyway Councils

Flyway Councils are comprised of the Directors of state wildlife agencies in each of the four flyways outlined in Figure 3.2 on page 26. Formal organization of the four Councils was completed by 1952, and the Service then assigned a flyway representative to each. Councils formed technical committees, typically composed of the principal waterfowl biologist for each state agency, to advise them on biological and other technical issues. Each year Councils make recommendations on migratory gamebird hunting regulations to the Service for review.

14) The Central Flyway Council (CFC) expressed opposition to the original four alternatives as written because they are mutually exclusive. The CFC supported Alternative B with modifications through 2005, but felt that Alternatives C and D should be implemented in an additive fashion if progress was not made towards habitat recovery and reducing Central/Mississippi Flyway light goose populations. The CFC stated that a new alternative should be developed if Alternative B cannot be modified to include additional control strategies. The Atlantic (AFC), Mississippi (MFC) and Pacific Flyway Councils (PFC) supported implementation of Alternative B. However, the AFC and MFC urged the Service to plan on implementing Alternatives C and D if management goals were not achieved.

We have retained Alternative B as our preferred alternative. However, we have developed and analyzed Alternative E, which is a new alternative that contains aspects of Alternatives B, C, and D, as suggested by the CFC. This two-phased approach would implement aspects of Alternative B first. Phase two of Alternative E contains aspects of Alternatives C and D and would be implemented if deemed necessary. Under this alternative, actions implemented during phase one would continue if phase two was implemented.

15) The CFC and several State agencies recommended that sandhill crane hunting be allowed to continue during the light goose conservation order. However, crane hunters should be prohibited from possessing electronic calls, unplugged shotguns, shooting after sunset and using any other means and methods that may become legal to promote additional light goose harvest. The CFC anticipates that this modification would be used only in Texas and would allow continuation of crane hunting opportunity while still meeting the obligation to reduce light goose populations.

Implementation of a conservation order for the reduction of light goose populations is unprecedented in the history of waterfowl management. The urgency of this management problem requires that extraordinary measures be implemented and that caution should be exercised to ensure that other migratory game bird populations are not impacted by such measures. Closure of crane and other waterfowl hunting seasons during a conservation order will eliminate or greatly reduce the possibility of increased harvest due to the use of new methods of take such as electronic calls, unplugged shotguns, and the allowance of shooting hours to one-half hour after sunset. Although some harvest opportunity on other species will be lost in some instances, we believe that the urgency to reduce the light goose population outweighs this loss.

Comments from Flyway Councils (continued)

16) The CFC and MFC expressed concern that the Service should not evade their responsibility to control light goose populations. The Service strategy appears to be simply to allow states to "apply" for permits if direct control is deemed necessary. The CFC expects that the planning and actual control activities, along with record-keeping and monitoring efforts, would be handled and coordinated by Service personnel with assistance from state personnel. The MFC also stated that the Service should be the lead agency in population control and that states may choose to assist in the effort.

As the agency given the authority to administer the MBTA in the U.S., the Service fully expects to be the lead agency in carrying out the light goose management program in the U.S. However, the Service's financial and personnel resources are not unlimited and we hope that our State partners will assist us in implementing many aspects of the light goose management program.

17) The CFC commented that the Service should begin steps to amend the MBTA to eliminate the obstacles that prevent timely implementation of management practices necessary to ensure the healthy future of not only light geese, but all waterfowl species.

We believe the MBTA provides for timely implementation of management actions. In 1996, the principal Treaty with regard to this effort was amended by the U.S. and Canada to provide for traditional subsistence hunting. Article III of the amended Treaty states that the governments should meet regularly to review progress in implementing the Treaty. The review shall address issues important to the conservation of migratory birds, including the status of migratory bird populations, the status of important migratory bird habitats, and the effectiveness of management and regulatory systems. The governments agree to work cooperatively to resolve identified problems in a manner consistent with the principles of the Treaty and, if the need arises, to conclude special arrangements to conserve and protect species of concern. Article IV of the Treaty states that each government shall use its authority to take appropriate measures to preserve and enhance the environment of migratory birds. In particular, the governments shall, within their constitutional authority, seek means to prevent damage to such birds and their environments and pursue cooperative arrangements to conserve habitats essential to migratory bird populations. Article VII of the Treaty authorizes permitting the take, kill, etc., of migratory birds that, under extraordinary conditions, become seriously injurious to agricultural or other interests. Simply amending the MBTA would not absolve the Service from its obligation to meet requirements imposed by NEPA, which require exhaustive public consultation periods prior to implementation of Federal actions.

18) The CFC recommended that decision criteria and a timetable for implementing Alternatives C and D should be developed in advance. These criteria should include habitat trends, light goose population trends, and the effects of overabundant light geese on other species of wildlife.

In developing each of the analyzed alternatives, we wrote them as if they would be implemented immediately upon completion of the EIS process, if they were chosen as the preferred alternative. Alternative E was written such that phase one would be in place for at least a 5 year period before an evaluation would be made about the necessity of implementing phase two. That evaluation would consider the trajectory of the light goose populations being targeted for reduction. Unfortunately, there are insufficient data available at this time to allow development of specific decision criteria with regard to habitat trends. Habitat studies specified in the Science Needs Documents of the Arctic Goose Joint Venture must be implemented in order to generate data that can be used in developing decision criteria.

19) The CFC recommended that language in the EIS should be clarified to provide implementation of actions to resolve geographic or site specific problems with light goose populations. Potentially, CMF light geese may be reduced to the overall goal, yet specific populations may remain above desired levels in certain areas of their range.

The Arctic Goose Habitat Working Group has not set numeric goals for light geese at specific breeding colonies. Rigorous habitat monitoring programs are not in place on many colony sites, thus precluding development of habitat criteria that would guide colony-specific management actions. Nothing contained in Alternatives D and E would

Comments from Flyway Councils (continued)

prevent managers from first implementing direct control on specific colonies where habitat damage is especially problematic. In section 4.6.4 we outlined colony-specific estimates of the cost of implementing various magnitudes of direct population control.

20) The CFC recommended that stipulations should be made in baiting regulations to allow for habitat manipulations similar to those currently allowed under dove hunting regulations for the taking of light geese when all other migratory bird seasons, excluding falconry, are closed. The CFC anticipates that this change would only be used in areas where crane hunting is closed. Unnecessary restrictions on habitat manipulation in order to avoid baiting situations during the conservation order not only would limit the take of light geese, but would have a significant detrimental impact on management of other migrating and wintering waterfowl in some States.

We discussed our consideration and rejection of this recommended alternative in section 2.2.9 of the Final EIS. One of the primary differences between dove and waterfowl baiting regulations is that doves may be hunted over areas where grain or feed has been distributed or scattered solely as the result of the manipulation of an agricultural crop or other feed on the land where grown (50 *CFR* 20.21[i][2]). Light geese and other waterfowl may not be hunted over such areas. The CFC states that changes to baiting regulations would only be used in areas where sandhill crane hunting is closed. However, in another comment the CFC requested that sandhill crane hunting be allowed to continue during a light goose conservation order. If baited areas are open to a conservation order it is likely that geese will be chased out of the area by hunting activity and any benefit of altering the baiting regulations would be short-lived. At the same time access to food by other species may be affected by such disturbance, which would defeat one of the purposes of the desire to change the baiting regulation for the conservation order. The issue of baiting has long been a controversial issue in waterfowl management due to the dramatic response of birds to the intentional placing of bait. We believe that if baiting regulations are liberalized for a light goose conservation order that uses of baiting outside the intended use may be encouraged. The Service recently spent considerable time revising baiting regulations and does not wish to re-open the issue.

21) The AFC, and several State agencies, commented that the stringent oversight and reporting requirements of the conservation order are an unnecessary burden on States choosing to participate. Harvest estimates should be derived from Harvest Information Program (HIP).

Information on hunter participation, methods used, and light goose harvest is critical for conducting a proper evaluation of the effectiveness of the conservation order. There are several reasons why HIP cannot be utilized to estimate these parameters. In order to utilize HIP to estimate light goose harvest beyond March 10, the duration of the HIP sampling period would need to be greatly expanded. By doing so, response rates from all migratory game bird hunters will decrease, and memory bias will increase. This will negatively impact the precision and accuracy of not only light goose estimates, but estimates for all migratory game bird species, including ducks and other goose species. We do not believe the substantial negative impact to HIP estimates of duck and other goose harvest can be justified for the sake of obtaining information on conservation order harvest. To avoid negative impacts to HIP estimates of other migratory game bird species, a separate light goose harvest survey could be conducted. However, the current HIP sampling frame is very large and a separate Federal survey would require large sample sizes to ensure that adequate numbers of conservation order participants were contacted; which is cost-prohibitive. A solution would be to implement a separate Federal light goose permit to create a sampling frame that would be used to generate harvest estimates. However, the permit would have to be enforced in order to ensure that the sample frame contained all participants. If the sample frame was incomplete, the conservation order estimates would be biased low. Enforcement and administration of a uniform Federal permit would be difficult. States that participate in the conservation order either have implemented their own permit, or they sample State duck stamp purchasers in order to obtain harvest estimates. We feel States are better equipped to develop harvest surveys tailored specifically to the conservation order in their State.

22) The AFC commented that the September 15 deadline for submission of State conservation order reports is reasonable. However, the Service does not mention when it will provide Flyways with a compiled report for use in consideration of regulations for upcoming seasons.

Comments from Flyway Councils (continued)

Each year we provide tables containing a compilation of State harvest estimates to Flyways that are eligible to participate in the conservation order. These reports are distributed well in advance of Flyway Technical Section meetings held in the winter. If a conservation order is implemented in the Atlantic Flyway we will prepare similar reports for the Flyway.

23) The AFC commented that they were disappointed that the Service did not take the opportunity in the EIS to address streamlining or simplifying the depredation permit system for farmers and other landowners affected by depredating snow geese.

We believe the system for issuing depredation permits is adequate in its current state. For example, farmers or landowners experiencing goose depredations in Region 3 can obtain a depredation permit the same day an application is made. Application forms are obtainable on our permits website (http://permits.fws.gov) for ease of access.

24) The MFC commented that they should be fully integrated in planning and coordination of this and other light goose management efforts.

The Service intends to continue consultation with all four Flyway Councils with regard to the light goose management program.

25) The CFC commented that the EIS should be clarified to provide for implementation of actions to resolve geographic or site-specific problems with light goose populations. Potentially, Central/Mississippi Flyway populations may be reduced to overall goals, yet specific populations may remain above desired levels in certain areas of their range.

Our preferred alternative advocates reduction of the number of Central/Mississippi Flyway light geese by 50%. It is clear that in some breeding areas such as La Perouse Bay the ability of the habitat to support geese has been exceeded. However, geese from northern breeding colonies utilize such sites on their northward migration and therefore add to habitat damage caused by geese that breed at the site. A general reduction of the number of Central/Mississippi Flyway light geese will help alleviate damage to sites being impacted most severely. The only method of further reducing the number of birds that use such sites is to implement direct control on the breeding grounds in Canada (Alternatives D or E). However, direct control in Canada would have to be implemented by the Canadian government.

7.4 Comments from State and Provincial Wildlife Agencies

26) The Ontario Ministry of Natural Resources commented that adoption of the no action alternative is not a responsible approach to the management of these species and habitats. The Ministry also stated that alternatives involving direct agency control are not viewed as the most effective approach at this juncture. With respect to Alternative D, there is significant concern regarding the capacity of the appropriate agencies to deliver a management program that is of sufficient scope and intensity to achieve the desired results.

We agree that the no action alternative is not a responsible approach to light goose management. Alternatives involving direct control will be costly and it is not likely that agencies can acquire sufficient resources to implement such programs in sufficient scope or intensity.

27) North Dakota Fish and Game (NDFG) inquired why a direct control strategy would not target the removal of more than 1.4 million CMF birds annually, especially in combination with harvest by regular hunting seasons and a conservation order? If direct control was ever necessary the population should be reduced as quickly as possible and not be constrained by some annual target level. If hunters are successful in removing 1.4 million light geese from the population and population growth is still not reversed, then

Comments from State and Provincial Wildlife Agencies (continued)

direct control efforts may be needed to remove an additional number of birds until habitat destruction is halted.

Rockwell and Ankney (2000) estimated that an annual harvest of 1.4 million birds would be required to reduce the number of snow geese in the mid-continent region by 50%. In the DEIS (page 81) we cited Rockwell and Ankney's comment that any harvest in excess of 1.4 million in a given year reduces the amount of time required to reach population reduction goals. The direct control alternatives were developed such that birds removed by direct control would supplement harvest resulting from normal hunting seasons. We chose to use the 1.4 million annual removal target so that the impacts of alternatives could be compared using a common objective. Although removal of more than 1.4 million birds obviously would reduce the population more quickly, it is uncertain whether or not the Service and its partners would have the financial resources to achieve such rapid removal. Therefore, we chose to use the annual target of 1.4 million as a baseline when we developed cost estimates for the direct control alternatives. If agency budgets allow, direct removal of additional birds could be accomplished more quickly. However, the overall impact of the alternative (i.e. 50% reduction) would remain unchanged.

28) NDFG commented that there is no guarantee that adoption of Alternative B would maintain an annual continental harvest of 1.4 million light geese. We believe that this is overly optimistic based on our experience with harvest, hunter behavior and light goose behavior.

A variety of factors such as weather, habitat conditions, and age composition of the fall population affect harvest of light geese. Therefore, it would be unreasonable to expect a guaranteed annual harvest of 1.4 million birds. However, our recent experience with implementation of a conservation order in the Central and Mississippi Flyways during 1999-2005 indicates that harvests ranging from 1.0 to 1.5 million birds can be realized in the U.S. Combined with harvest of light geese in Ontario, Manitoba and Saskatchewan the continental harvest of mid-continent light geese approaches and sometimes exceeds our target level of 1.4 million birds. We believe that additional experience with such regulations is needed before any determination can be made with regard to their long-term effectiveness.

29) NDFG commented that the document implies that if actions other than the current conservation order were to be used, it would be up to the States and other Federal agencies (we are at a loss to know which ones) to apply for some type of permit to meet all the stipulations, criteria and regulations of the Service. Is the Service suggesting that it will apply for its own permit from itself?

Federal courts have affirmed that all Federal agencies are subject to prohibitions in the Migratory Bird Treaty Act, including the restrictions on take of migratory birds. Executive Order 13186 state that all Federal agencies are subject to the provisions of the MBTA. Director's Order 131 clarifies Service policy regarding applicability of the MBTA to Federal agencies and the issuance of permits to agencies. Therefore, any Service personnel that undertake light goose management activities that will result in take of light geese must apply for a permit from the appropriate Regional Office of the Service to do so. Such permits may name State agency personnel as sub-permittees. Any State agency not named as a sub-permittee on an existing permit, that wishes to undertake direct control activities, must request to be a sub-permittee or apply for a separate permit from the appropriate Service Regional Office.

30) NDFG commented that they see nothing in the EIS that indicates how the Service would apply the resources of its entire agency, its field offices, its staff and its budgets to solving the light goose problem.

The Service's mission includes many trust responsibilities other than management of light geese. We believe it is unreasonable to expect our agency to devote its entire resources to solving the light goose problem. In our earlier response to a comment made by the Central and Mississippi Flyways we indicated that the Service intends to be the lead agency in carrying out the light goose management program in the U.S. However, the Service’s financial and personnel resources are not unlimited and we hope that our State partners will assist us in implementing many aspects of the light goose management program.

Comments from State and Provincial Wildlife Agencies (continued)

31) NDFG stated that, although the Service has no authority to address the issue of reciprocal State hunting licenses, the Service certainly has the primary responsibility for resolving the light goose overpopulation problem. If part of the solution can be derived from enhanced reciprocal licensing between States and between States and Provinces, then the Service can and should work toward achieving this.

We reiterate that, in accordance with 50 CFR 10.3, we have no jurisdictional authority regarding State regulations or statute requirements for State migratory bird hunting licenses. Federal regulations do not prohibit reciprocal licensing between States. We believe that Flyway Councils and State agencies are fully capable of recognizing the potential contribution that license reciprocity may have on light goose harvest and that they should act accordingly on their own authority if they so desire.

32) NDFG stated that the affected environment sections needs information on the general biology of light geese, such as breeding biology, general behavior, pairing, age of breeding, clutch size, nesting, productivity, migration, survival rates, and hunting and harvest.

Inclusion of a general discussion of the biology of light geese would unnecessarily add to the size of the document. We believe that we have provided sufficient accounts of the biology of the birds with respect to migration, habitat use, and harvest, etc., that allows the reader to understand the impacts of high goose populations on the environment.

33) The Louisiana Department of Wildlife and Fisheries (LDWF) recommended that management units on the following national wildlife refuges in Louisiana be opened to hunting during the conservation order: Delta, Lacassine, Cameron Prairie, Upper Ouachita, and Tensas River.

Changes in hunting programs on individual national wildlife refuges will be made with due regard to the expected light goose harvest that would result, potential impacts to special status species, and the intended purpose of the refuge. Delta NWR reported that, although the conservation order is in effect on the refuge on Wednesday, Thursday, Saturday and Sunday, there is little hunter participation. Cameron Prairie NWR reported that it does not currently participate in the light goose conservation order because over the past several years goose use of the refuge has declined and geese usually depart from the refuge by the time the conservation order is in effect. Cameron Prairie NWR reported that there is no reasonable opportunity to hunt light geese on the refuge because most geese have moved off the refuge as soon as the waterfowl season closes, with the exception of a grit site which is adjacent to a wildlife drive and photo blind. In addition, local hunters prefer to pursue white-fronted geese and are less interested in pursuing light geese. The Upper Ouachita NWR reports that access to the refuge is very poor during the time the conservation order is in effect due to road conditions. Furthermore, goose use of the refuge drops considerably after the duck season closes. Tensas River NWR reports that most of the large fields on the refuge have been reforested and provide virtually no goose habitat or harvest opportunity. Lacassine NWR reports that they have chosen not to open the area to the conservation order because most geese leave the refuge by the end of January and most local hunters would rather pursue white-fronted geese. Lacassine also indicated they would rather close the refuge after the regular waterfowl season to minimize disturbance for all waterfowl species prior to spring migration.

34) LDWF suggested that caution be used in modifying habitat programs on refuges for light goose management because such modifications may impact other wildlife species.

Our refuges will modify their habitat programs for light goose management with due regard to consideration of the impact of such programs on other wildlife species, especially those with special status.

35) Several State agencies recommended that the Service should begin immediate negotiations with Canada to allow a temporary variance in the Migratory Bird Treaty that would allow commercial use of light geese taken under direct control.

Comments from State and Provincial Wildlife Agencies (continued)

In their comments on the DEIS, the Canadian government indicated that they do not support the establishment of a short-lived commercial opportunity with light geese that could have serious long-term effects on community support for and compliance with regulations. We agree with the views of the Canadian government and therefore will not pursue an amendment to the Treaty.

36) Many State agencies suggested that methods of take for light geese should be expanded to include a variety of methods, such as use of live decoys, rallying, herding, hazing, model airplanes, rifles, and pistols.

Authorization of new methods of take for light geese in 1999 (i.e. electronic calls, unplugged shotguns, shooting hours one-half hour after sunset) represented a radical departure from decades of strict regulation of waterfowl harvest. Substantial support was expressed during our public scoping process for use of these methods to reduce light goose populations. However, such authorizations were also met with substantial negative public sentiment as well. Arguments for and against various methods often include one's personal view of ethical and non-ethical methods of take, which is not amenable to objective analysis. We believe that our proposed balance of authorizing new, and continued prohibition of other, methods of take is a reasonable compromise. Although authorization of additional methods of take may increase the harvest of light geese somewhat, we believe that such an expansion would be outweighed by erosion of public support for our light goose management program. Furthermore, temporary authorization of numerous methods of take will make it more difficult to enforce prohibition of such methods when they are no longer needed.

37) NDFG commented that the Arctic Goose Habitat Working Group did not specifically state that they did "not support any management alternatives that advocated slaughter and destruction of birds…." Rather the Working Group in their "Perils" report "did not consider any recommendations that advocated slaughter and destruction….." It is important to note that the Working Group did not address what might be acceptable to them if additional control strategies (beyond those recommended in their report) would need to be implemented.

We have corrected our quotation of the wording of the Working Group's philosophy towards management actions involving slaughter and destruction of birds. However, we note that one of the guiding principles of the Working Group was adopted as their process unfolded, and as they "reviewed possible management actions that might be taken to reduce the size of the mid-continent white goose populations." The Working Group decided that "any management action recommended by the Group would be based on the principle that the birds are valuable natural resources, as game animals and as food. Thus, we did not consider any recommendations that advocated slaughter and destruction of birds followed by their being wasted in land fills or some similar fate" (Batt 1997). The Working Group did not indicate that they were considering only interim management actions that might be taken before more drastic measures would be taken to reduce the population.

38) Several State agencies requested a clarification of the timetable of when certain management actions would occur. It was suggested that the Service adhere to the recommendation of the Arctic Goose Habitat Working Group that called for a 50% reduction in MCLG by the year 2005.

The goal of a 50% reduction in light goose numbers by 2005 was developed in 1997 by the Arctic Goose Habitat Working Group. We did not implement new regulations to increase the take of light geese until 1999. Given the lag time for implementation of regulations, it became improbable that a 50% reduction could be achieved within the original timetable. However, we note that light goose harvest has increased substantially as a result of new regulations and that the CMF light goose population in the mid-continent region is decreasing at a rate of 2.7% annually. At this rate of decline the management goal may be achieved by the year 2022.

Comments from State and Provincial Wildlife Agencies (continued)

39) NDFG stated that the Service should clarify their goal for this population management action. The outcome of implementation of a management alternative should be measured in terms of restored habitat, not snow goose populations or harvest. No one knows whether habitat goals can be achieved with a winter index of 1.5 million light geese or even 1.0 million light geese. We will know we have the proper number of geese only when habitat destruction has stopped and when habitat recovery is noted.

The ultimate goal of our light goose management program is alleviation of habitat destruction and also restoration, if possible, of habitats that have already been destroyed. However, as documented elsewhere in the EIS, habitat processes may require decades to monitor. Furthermore, it is unclear whether financial resources will be available to conduct intensive habitat monitoring programs in the Arctic (see below) that will allow frequent assessments of the rate of habitat destruction. We have followed recommendations from the Arctic Goose Joint Venture with regard to light goose population goals and results from published research indicating the level of harvest required to reach those goals.

40) The New York Division of Fish, Wildlife and Marine Resources commented that Service has not outlined a plan for long-term monitoring of habitat conditions.

The Science Needs Documents of the Arctic Goose Joint Venture (Arctic Goose Joint Venture Technical Committee 1998, Arctic Goose Joint Venture Technical Committee 2001) contains a description of projects and timetables aimed at monitoring long-term habitat conditions. We intend to use this document as we work with our State, Provincial, and Federal partners in managing light goose populations. Availability of funding will determine the extent to which identified projects are implemented.

41) Several States commented that depredation orders should not have been eliminated as an alternative to be studied in detail. The Service should consider changing rules and regulations on depredation orders so that they could be used for light goose control. Such regulations are self-imposed by the Service and thus could be changed by the Service. A depredation order would be an efficient means of allowing the public to help control goose numbers.

If a conservation order is created under our proposed alternative, creation of a separate depredation order for light geese would be un-necessary. The concept of a depredation order is to allow take of birds, *without permit*, to address damage to agricultural, horticultural, and fish interests. Without some type of permit system, creation of a light goose depredation order would not provide a mechanism to monitor harvest of geese. We believe it is important to monitor take of geese during control efforts in order to safeguard the status of light goose populations.

42) NDFG commented that egg removal should not have been eliminated from further study, and should be retained as a technique in addition to other management strategies. Using egg removal costs for territorial nesting Canada geese in Minnesota is not valid for estimating costs for colonial-nesting light geese. The estimated costs included in the DEIS are too high.

In our DEIS we acknowledged the fact that search time for eggs in a colonial-nesting situation would be short. However, we also stated that the high cost of fieldwork in the Arctic would likely offset this savings. In the absence of any other information we utilized cost estimates from the Minnesota study.

43) The Iowa Department of Natural Resources commented that the estimated costs for implementing Alternatives C and D are too conservative and would very likely be much larger because they do not adequately account for the lost economic value resulting from lost hunting opportunity or the true costs of killing and disposing of birds. Inadequate funding for current critical migratory bird conservation activities, much less new programs, also exacerbates the impracticality of implementing massive population control activities by state and federal agencies.

Comments from State and Provincial Wildlife Agencies (continued)

In our DEIS we used available information to develop our estimated costs of direct control. More recent information has become available on the estimated cost of direct control in the arctic and we have incorporated those estimates in the analysis of Alternative D. In our DEIS analysis of Alternatives C and D we stated that additional days in which to take light geese beyond traditional hunting seasons would not be made available to citizens. In the absence of additional days in which people could take light geese there would be no additional economic impacts resulting from trip-related expenditures. Therefore, we did include the absence of the economic impact as an indirect cost of Alternatives C and D.

44) NDFG agreed that hunters should be required to have a Federal migratory bird hunting stamp during normal hunting seasons. They also agreed with a Central Flyway Council recommendation submitted to the Service that the law should be changed so as not to require a duck stamp until a hunter is 18 years old. This has important implications for hunter retention and recruitment which could impact light goose harvest over the long term.

We do not believe that the 16 year age requirement for the duck stamp is a barrier to hunter recruitment or retention. Changing the age requirement to 18 years would require Congressional action, and we do not believe it would impact light goose harvest over the long term.

45) NDFG asked what are the years for the field studies in Texas that documented the percentage of Ross's geese in light goose wintering areas? Is there a significant trend of increasing Ross's geese in these data?

We cited the study by Sullivan (1995) that documented the percentage of light geese in Texas during the winter of 1994-95 that were comprised of Ross's geese. Follow-up studies have not been conducted that would allow a determination of whether there is a significant increasing trend in the Ross's goose component in Texas. We note that this study was initiated because of perceived increases in the number of Ross's geese wintering in Texas (Sullivan 1995). There are insufficient data to determine whether a trend exists.

46) NDFG commented that Johnson (1997) did not state that increasing subsistence harvest in the far north would be ineffective. Rather he points to the need to implement and increase this strategy along with other strategies.

We have modified the location of our citation of Johnson (1997) to reflect his view that subsistence harvest should be increased. We cited Abraham and Jefferies (1997) who stated that the annual harvest of snow geese per subsistence hunter has remained relatively unchanged during the past few decades. Our intent in this discussion was to point out that, because per capita snow goose harvest has remained unchanged for decades, calls for increased subsistence harvest (Johnson 1997) would likely be ineffective.

47) The Nebraska Game and Parks Commission (NGPC) supported the actions identified and proposed for special status species in Alternative B. Specifically, the Commission agreed with the Service that selection of the appropriate dates for implementation of a light goose conservation order minimizes risk associated with whooping cranes along the Platte River. The Commission believes that actions to protect whooping cranes already identified with the Whooping Crane Contingency Plan are sufficient.

We concur that setting of appropriate dates for a conservation order in Nebraska, along with action items identified in the Contingency Plan are sufficient to ensure that potential risks to whooping cranes are minimized.

48) The NGPC commented that the Service must be prepared to justify impacts on non-target species if/when direct control management actions are implemented. They supported the use of those direct control measures that minimize the impact to other species, but believe that collateral damage is unavoidable in actual operations. The NDFG also commented on this issue and stated that Service should be prepared to accept significant loss of other wildlife species during control operations in order to reduce light goose numbers. Where possible, attempts should be made to minimize impacts to other species.

Comments from State and Provincial Wildlife Agencies (continued)

In our description of alternatives we stated that direct control activities should be undertaken such that they do not adversely affect other migratory birds or any species designated under the Endangered Species Act as threatened or endangered. This will require inspection of control activity sites for the presence of non-target species to determine whether activities should proceed. If live-trapping is utilized in direct control activities, non-target species can be released unharmed. If sharpshooters are utilized we believe that impacts on non-target species will be avoided. At this time we do not believe it is acceptable to undertake control activities that would also result in significant loss of other wildlife species.

49) The New Jersey Division of Fish and Wildlife (NJDFW) commented that there are legitimate instances of damage to agricultural crops and losses by farmers. There is also significant damage to natural salt marsh habitats where the elevation has been lowered due to removal of belowground biomass.

Thank you for your comment.

50) The NJDFW commended Forsythe National Wildlife Refuge for making changes in their management programs to help reduce snow goose damage.

Thank you for your comment.

51) Several States commented that Alternative B in the DEIS refers to the possible need for additional methods of take but does not elaborate on what these methods might be or when they might be considered. These additional methods should be described in the FEIS so that they can be considered before any populations reaches critical levels.

At this time we have decided not to consider any methods of take beyond those currently described in Alternative B. Methods of take to be implemented specifically to increase harvest of light geese will be limited to unplugged shotguns and electronic calls. During the conservation order shooting hours will be allowed until one-half hour after sunset and daily bag limits will be removed. We believe that authorization of more drastic methods of take may erode public support for the light goose management program.

52) NDFG commented that the description of the hazing program on page 69 of the DEIS represents a serious inconsistency. If hazing programs were not effective in moving geese off of a refuge, such as described for Bosque del Apache NWR, then why wasn't more hunting allowed on the refuge?

We described Taylor and Kirby's (1990) results of efforts to use hazing, crop manipulation and hunting to alter goose movement patterns. Although approximately 8,000 geese were moved off of the refuge, the hazing program reached a limit of effectiveness as geese became habituated to disturbance. Low hunter participation limited the potential role that expansion of the hunt program could play in changing goose movement patterns (Taylor and Kirby 1990).

7.5 Comments from State Representatives

53) A State Representative from Delaware commented that snow geese have caused serious damage to crops on his farm and those in the surrounding area. The Representative also expressed concern for damage that snow geese are causing to local salt marshes, and the effects of overabundant geese on the well-being of many other plants, animals and fish. A concern was also expressed for the possibility of the spread of avian cholera from geese to the chicken industry. The Representative fully supports Alternative B and called on the Service to open more of Prime Hook NWR and Bombay Hook NWR to snow goose hunting.

We believe that implementation of Alternative B will reduce the greater snow goose population to desired levels and alleviate damage to agricultural crops and reduce the likelihood of a cholera outbreak. Prime Hook NWR allows ample opportunities to hunt snow geese in 26 marsh blinds during the waterfowl season. Also, field hunting is

allowed on 5 different zones on the refuge during the late goose season. The refuge feels they are providing hunting opportunity in areas where it is feasible to hunt snow geese, and in a fashion that is compatible with other hunting programs on the refuge. Bombay Hook NWR staff report that they have provided snow goose hunting opportunity that far exceeds demand at this time. The refuge is close to the maximum of acreage that can be opened to hunting while still providing for the needs of other migratory bird species.

7.6 Comments from Tribal Groups

We received comments from 5 Tribes in the U.S. and also the Assembly of First Nations from Canada. The Assembly of First Nations represents 633 First Nations across Canada. All comments were either in support of Alternative B, or indicated that Alternative B would not have an adverse impact on their Tribe. Specific comments are found below.

54) The Assembly of First Nations, representing 633 First Nations across Canada, supported Alternative B as the most humane and least wasteful option, and expressed their concern for light goose threats to other animals and plants, as well as light geese themselves, owing to the destruction of their habitat and food sources in the north. The AFN also commented that the options of allowing for a commercial hunt by Aboriginal people and altering U.S. farm practices (e.g. reducing waste grain) and policies should not be dismissed from consideration. The AFN believes that a commercial hunt by Aboriginal people would support economic development, encourage young people to stay on the land and would support their traditional lifestyle.

With regard to a commercial hunt by Aboriginal people, we point out that the Canadian Wildlife Service does not support development of general commercial activities and take for the purpose of light goose control. They do not wish to establish a short-lived commercial opportunity that could have serious long-term effects on community support for and compliance with regulations. We support the position of CWS and also do not support establishment of commercial activities for light goose control in the U.S. With regard to U.S. farm practices and policy, we reiterate that we have no control over U.S. farm policy and believe that attempts to consult with the Department of Agriculture to effect changes solely for the purpose of addressing the light goose issue would have such a minimal chance of success that it is precluded from being a viable management alternative.

55) The Wampanoag Tribe of Gayhead (WTG) in Massachusetts commented that Tribes should be listed as being eligible, along with State and Federal wildlife agencies, to apply for a light goose permit.

We have added Tribes as being eligible to apply for a light goose permit. In addition, Tribes can be named as sub-permittees on a State or Federal permit.

56) The WTG suggested that other indigenous nations of Canada should be contacted to enlist their assistance in the population control program.

We have no authority to enlist the help of indigenous nations of Canada in a light goose population control program. Only the Canadian Wildlife Service, or other Canadian government entity, can undertake such action. The CWS has encouraged native groups, such as the Arviat Hunters and Trappers Organization, to increase their harvest of light geese.

57) The WTG commented that the number of allowable days for hunting light geese should be expanded to the fullest extent allowed under the MBTA. Splits between other waterfowl hunting seasons should be utilized as light goose only seasons.

Current light goose hunting frameworks already provide the maximum number of days for light goose hunting allowed by the MBTA. Furthermore, light goose only seasons between other season splits are allowed, providing that all other waterfowl and crane hunting seasons, excluding falconry, are closed.

Comments from Tribal Groups (continued)

58) The WTG commented that the requirement to close all other waterfowl and crane hunting seasons when new methods of take are authorized for light geese is disruptive to sportsmen and subsistence users of waterfowl species.

We believe that a closure of all other waterfowl and crane hunting seasons, excluding falconry, is necessary to minimize the take of non-target species when light goose regulations are implemented.

59) The WTG commented that changes in refuge management practices to address the light goose problem would have undesirable impacts on other species.

Any changes in management practices on a particular refuge will be permitted only after they have been determined to be compatible with the purposes for which the refuge was established, and due regard to potential impacts to special status species has been made.

60) The WTG inquired where in the DEIS is the analysis of how the EIS would impact Tribes?

We present impacts of each alternative on Tribes in the Socioeconomic Impacts section of Chapter 4.

61) The WTG commented that, under the USFWS Native American Policy and Executive Orders of the President of the United States, the Service is compelled to consult with Tribal governments on a government-to-government basis. How has the Service complied with these directives in this process?

The Service has a long history of working with Native American governments in managing fish and wildlife resources (USFWS 1994). A list of Native American tribal governments was obtained through our Tribal liaison and was used to distribute the DEIS to tribal governments for formal review and comment.

62) The Sac and Fox Tribe of the Mississippi in Iowa commented that a conservation agreement, rather than a conservation order, should be developed between the Service and Indian Tribes. A conservation agreement would be more consistent with the unique government to government relationship with Tribes.

A separate conservation agreement is not needed in order for Tribes to participate in a light goose conservation order. Conservation order regulations clearly state the requirements for both State and Tribal governments to participate.

63) The Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians commented that, in the event that Alternative B is not implemented, the impacts of avian cholera should be mitigated so that the endangered and threatened species within the ancestral territories and homelands of the Coos, Lower Umpqua and Siuslaw people do not present a cumulative effect on these traditional and subsistence resources.

We believe that implementation of our preferred alternative will lower the risk of cholera outbreaks.

64) The Chukchansi Indian Tribe commented that the light goose population should be brought back to a stability point where it is in balance with the environment. One way to do this is to increase predator populations, however since humans have rid themselves of competitive predators, they themselves will have to play the predator role and increase harvest. More man-made nesting structures for gulls should be constructed so that gulls can feed on goose eggs.

There is no indication that light goose populations have increased due to a reduction in predator populations by humans. Although a variety of predators take light geese on the breeding grounds, the rate of removal by predators is far outweighed by growth of the light goose population. Construction of man-made nesting structures for gulls would be a highly inefficient means of attempting to increase gull populations and likely would be met with little success in reducing the number of geese.

7.7 Comments from Private Individuals

Public comments were received from 414 private individuals. Forty of the individuals made comments during public hearings. A majority (57%) of individuals supported some method of control of light goose populations. Of the 238 individuals that supported population reduction, very few advocated direct agency control. Approximately one-half of those individuals supporting population reduction submitted a form letter containing the following statements: they were concerned hunters and conservationists who care about the burgeoning population of snow geese, which are in need of help to save them from massive population decline; the population has exploded to alarmingly high levels due to changes in agricultural practices and the birds are now a menace to farmers; the population is destroying fragile arctic tundra habitat beyond repair; the management option of letting nature run its course is a no-win situation because the population will crash and millions of farming dollars will be lost and hundreds of thousands of acres of irreplaceable tundra will be destroyed; direct agency control would be costly and inefficient; and finally, that the conservation order approach (including legalization of electronic calls, unplugged shotguns, and extended shooting hours) should be used as a cost-effective way to reduce the population. Another 43 individuals submitted comments simply stating that they supported Alternative B for managing light geese. The remaining comments that indicated support for population reduction centered primarily on making recommendations for changes in methods of take allowed for harvesting light geese, liberalization of regulations during the regular goose season, and expansion of hunting opportunity on government lands.

Most individuals that advocated the No Action alternative opposed any liberalization in regulations that would result in increased harvest of light geese. Many of the comments from individuals opposing management action consisted of a form letter, or portion of the same form letter, containing the following statements: they were strongly opposed to liberalized regulations for snow geese and Ross' geese, which include extending the hunting season, opening wildlife refuges to increased hunting opportunities, and permitting normally illegal hunting methods such as electronic calls and unplugged shotguns; the geese are being blamed for "damaging" their "winter breeding grounds" (sic), when in reality the geese continue to play a normal role in their ecosystems, modifying vegetation as they normally would; goose reproduction in many areas of the Arctic has already declined in response to reduced food as part of natural population regulation; and finally, that only non-lethal methods of population control should be implemented.

65) The hunting season on light geese should not be extended.

The Service is not proposing to extend the light goose hunting season. We do not have the authority to extend the normal hunting season beyond the March 10 season ending date stipulated by the Migratory Bird Treaty Act. We are proposing implementation of a conservation order for the control of overabundant light geese in accordance with Article VII of the Migratory Bird Treaty.

66) Several individuals expressed opposition to new regulations that allow taking of light geese on wildlife refuges, which they feel should be a safe haven for all wildlife.

The proposed regulations do not open refuges or new areas on refuges to hunting. That type of action would be proposed on a specific refuge by refuge basis. The National Wildlife Refuge System Improvement Act of 1997 amended the National Wildlife Refuge System Administration Act of 1966 to establish that compatible wildlife-dependent recreational uses involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation are the priority public uses of the Refuge System. The National Wildlife Refuge System Administration Act of 1966 stipulates that up to 40% of the area of refuges acquired, reserved, or set apart as inviolate sanctuaries may be opened to migratory bird hunting. The Fish and Wildlife Improvement Act of 1978 amended the 1966 Act to permit the opening of greater than 40% of the area of these refuges to migratory gamebird hunting when it is determined to be beneficial to the species hunted. Therefore, the portion of our light goose management proposal that encourages, where appropriate, increased hunt programs on National Wildlife Refuges is consistent with the purposes of the refuge system.

67) One citizen commented that public hearings held during the EIS process were held only in rural areas, thus preventing any metropolitan, city or suburban dwellers from ever commenting on any plans. Therefore, the Service is engaging in biased hearings, soliciting comments only from hunters and farmers.

Comments from Private Individuals (continued)

We held a number of public scooping meetings throughout the U.S. prior to publication of the DEIS (see Federal Register Notice of Meetings in Appendix 2). In addition to Washington, DC, the majority of these meetings were held in large metropolitan areas and often were held in State capitals: Sacramento, CA, Bismarck, ND, Baton Rouge, LA, Dover, DE, Bloomington, MN (suburb of Minneapolis/St. Paul), and Kansas City, MO. Only 2 of the 9 meeting locations were held outside of large metropolitan areas (Pomona, NJ and Rosenberg, TX); however they were easily accessible to large population centers. Therefore, we do not believe that meeting locations produced any type of bias in comments submitted by citizens. Another series of public meetings on the DEIS were held in most of the same locations as the scoping meetings. We provided an extensive public comment period during the EIS process which provided all citizens a means to submit written comments on our proposals, either through the mail or electronically to our email address, regardless of the citizen's geographic location.

68) Several individuals commented that the Service proposal appears to be the result of lobbying by the gun, hunting, and guide/tourist industries.

No lobbyist from any gun, hunting, or guide/tourist industry contacted the Service to urge development of our proposal. Our management plan was based on results from work conducted by research scientists, population and habitat surveys, and on recommendations by scientists from the Arctic Goose Habitat Working Group of the Arctic Goose Joint Venture.

69) An individual commented that it was unfortunate that the Service is entirely dependent on revenues from the sale of hunting permits and paraphernalia. The resulting extreme bias of this agency is therefore obvious to anyone who cares to take a closer look.

There is no Federal hunting permit that is sold to generate revenues upon which the Service relies. Revenue from sales of State hunting permits goes to State fish and wildlife agencies and not the Service. Furthermore, the Service is not dependent on revenues of hunting paraphernalia. Federal excise taxes collected on the sale of hunting equipment under the Federal Aid in Wildlife Restoration Act is returned to State fish and wildlife agencies in the form of grants to undertake projects that benefit a variety of wildlife species. Therefore, the Service has not developed an extreme bias towards hunting interests due to a dependency on hunting permit revenues.

70) As with most proposals like this, there is money tied to the decision. Many times pursuit of wealth is the reason for the decision. In all cases the corporate link is not made public. Who stands to profit from this decision? The guess is that outfitters and sporting related business ventures.

Our management decision is based solely on a review of the available scientific data and our responsibility to conserve light goose populations and their habitat. Accusations of corporate profit being the foundation of our decision is totally without merit and no information has been presented to suggest otherwise. We analyzed the socio-economic impacts of the various management alternatives in section 4.6. Lack of data prevented us from estimating the impact of the alternatives on non-consumptive users of light geese. However, we believe that our preferred alternative will maintain the long-term health of light goose populations and thus benefit non-consumptive users. Furthermore, we believe the No Action alternative will negatively affect non-consumptive users due to potential population crashes.

71) Proposed light goose regulations are unethical and unsportsmanlike and will promote participation by the type of hunter that will not follow injured animals and put them out of their misery. Instead, new regulations that tighten control of hunting should be enacted to prevent "slob hunters" from being turned loose with guns.

The Service believes that the vast majority of people that would assist with the light goose management program are ethical and law-abiding citizens. Participants realize that these special measures are in response to an urgent wildlife management problem. We do not believe the proposed regulations create an unsafe situation, either for participants or non-participants, by users of guns.

Comments from Private Individuals (continued)

72) An individual expressed opposition to our proposal because when similar measures have been taken in the past, they are later regretted. The example of eradication of wolves, followed by their reintroduction was given. In order for an ecosystem to function all parts are important and the geese are one.

The Service is not proposing eradication of light geese. In fact, if a 50% reduction in the population is achieved the winter index of CMF light geese will still be 1.6 million birds. At the population goal level, light geese will remain a vital component of the Arctic ecosystem.

73) An individual commented that the Service has not demonstrated that they know where on the growth curve the light goose population currently exists. As the Service's graphs show, the populations are in a logarithmic growth phase, but no population can maintain this rate of growth due to density-dependent factors. Without knowledge about density-dependent effects on the population, other than reports of reduced gosling growth, the proposed hunting measures are not supported. If the population is not allowed to regulate itself the proposal is only a stop gap solution.

In section 3.1.9 we provide information on demographic responses of light geese at La Perouse Bay to high density of breeding birds. Increasing numbers of breeding geese at La Perouse Bay caused a long-term degradation of habitat and reduction in available food resources. In response, lesser snow geese have experienced long-term declines in clutch size, gosling body size, and gosling survival. However, geese have the ability to nest outside of traditional breeding colonies and use more distant brood-rearing sites. Individuals that disperse to new (less damaged) areas experience higher reproductive success, and thus "cheat" density-dependent regulation of the population. Therefore, it is impossible to know at what point the overall population will begin to decline in response to density-dependent factors. We believe it would be irresponsible to allow additional habitat degradation to continue, with long-term if not permanent consequences, simply for the sake of allowing the population to increase un-impeded for an unknown length of time and then eventually decline or crash.

74) The Service should not resort to lethal means to address the light goose issue. The natural ecological process of population regulation should not be upset.

There are no viable non-lethal methods for reducing light goose populations. The interaction of geese and their habitat has already been upset by an artificial infusion of an agricultural food subsidy. Because some goose populations have far exceeded the ability of habitats to support them, natural regulation of the population cannot occur without substantial additional habitat damage occurring.

75) The Service reports that six times as many people participate in non-hunting activities related to migratory birds as compared to hunting them. Times have changed and so must the Service and wildlife agencies.

We examined socioeconomic considerations in section 3.5 of the EIS and reported that more citizens participate in non-hunting than hunting activities related to migratory birds. However, the impacts of overabundant light goose populations will negatively affect a variety of bird species that non-hunters as well as hunters enjoy viewing. Furthermore, revenues generated by Duck Stamp sales go towards acquisition of habitats that support many non-game and game species. The fact that many citizens do not hunt does not negate the fact that increasing harvest is a legitimate wildlife management tool. Furthermore, this issue does not pertain to hunting seasons; the proposed program is designed to protect nesting, migration, and/or wintering areas.

76) Claims of habitat destruction are based on habitats where no systematic scientific data had been gathered. There were small fenced areas to document effects of heavy goose grazing on plants, but that is not representative of normal ecosystems.

In section 3.2.1 we cited the study by Jano et al. (1998) that systematically documented the loss of vegetation at La Perouse Bay using satellite imagery. We also cited the study conducted by Kotanen and Jefferies (1997), who

Comments from Private Individuals (continued)

utilized fenced vegetation sampling plots, as well as adjacent un-fenced plots, along a transect at La Perouse Bay to document habitat damage. Fenced and un-fenced plots were sampled during 1986, 1989, and 1995 to systematically document vegetation changes in response to goose grazing. The un-fenced plots were indeed representative of the "normal ecosystem", which in reality was being degraded by geese. We also cited the study conducted by Kerbes et al. (1990) that systematically sampled vegetation along the west coast of Hudson Bay during 1993-95 to demonstrate the impact of geese on plant communities. Intensive studies by Iacobelli and Jefferies (1991) and Srvivastava and Jefferies (1996) were cited as they described the effects of goose grubbing on soil salinity and degradation of vegetation stands. Therefore, the comment that claims of habitat destruction are not based on systematically-collected scientific data is un-warranted.

77) The use of a generalized management strategy for all snow geese ignores scientific distinctions and is contrary to historical tradition of managing snow geese.

We have developed population goals for several populations of light geese that incorporate geographic and biological characteristics of each population. Most of these goals have been developed independently through either interactions with Flyway Councils or through the North American Waterfowl Management Plan. Both of these avenues have continued to recognize historical designations of populations and taxa. Light goose regulations will be flyway-specific, and thus have the ability to manage light goose populations with due regard to their status.

78) The current population goal of 500,000 greater snow geese is much lower than the competing goal set by the Arctic Study Group of 800,000 to 1 million birds, and is based on incomplete information.

Our population goal of 500,000 birds is in agreement with the Atlantic Flyway Council and North American Waterfowl Management Plan population objectives. In 1997, the Arctic Goose Habitat Working Group recommended a short-term management goal of stabilizing the greater snow goose population at between 800,000 to 1 million birds. However, the Working Group recommended a reduction of the population below this level if natural habitats continue to deteriorate, or if measures taken to reduce crop depredation do not achieve desired results. Recently, the Canadian Stakeholders Committee in Quebec adopted a population goal of 500,000 birds to address continued habitat degradation and agricultural depredations in the St. Lawrence valley. The Arctic Goose Joint Venture Technical Committee has adopted the lower population goal. Managers believe the population must be reduced to reduce agricultural depredations, prevent further degradation of migration habitats, and prevent potential degradation of breeding habitats that could occur under high population levels.

79) If the habitat damage at Bombay Hook NWR has stabilized in the past two decades, then there is no need to further reduce the flock of greater snow geese.

Our management goal for greater snow geese is not predicated on the status of an individual marsh. The population of greater snow geese has been growing rapidly and has caused agricultural depredations and damage to natural marsh habitats on various migration and wintering areas.

80) The EIS disregards the psychological/physical effects of hunting stress on birds. The term "hunting pressure" is common in management literature. Because greater snow goose flock together, severe hunting pressure may also affect the flock as a whole, causing a loss of morale, and contribute to a population crash.

We are aware of no studies that have examined the psychological or physical effects of "hunting stress" or "morale" on birds at the population level. Furthermore, we disagree that use of the term "hunting pressure" is "common in management literature" with regard to migratory bird management in the context of psychology. When it is used, the term hunting pressure usually refers to the amount of hunting activity (e.g. hunter numbers, season length, bag limits, etc.) a population is exposed to. We are aware of no studies of bird populations that cite "morale" as a causative factor in a population crash of birds, if indeed the concept of morale can be applied to a species other than humans.

Comments from Private Individuals (continued)

81) Dispersing and fragmenting the flocks can result in a reduction of non-consumptive use and cause economic loss. Diminishing the flock may incite political action/complaints by millions of bird watchers who journey to see geese. Non-consumptive users may demand a revision of how the U.S. treats wildlife.

We examined the socioeconomic impacts of our preferred alternative in section 4.6.2. Implementation of this alternative would preserve the long-term health of light goose populations by slowing the rate of habitat degradation and avoiding a potential population crash, especially in the mid-continent region. Damage to agricultural crops would also be reduced. Non-consumptive users of light geese may be slightly affected by lower overall populations. However, light geese would continue to migrate in relatively large flocks and visit traditional migration and wintering areas. Therefore, we believe the short-term economic impact of this alternative on non-consumptive users would be minimal, and the long-term economic impact would be positively enhanced due to maintenance of healthy populations. By maintaining healthy populations we are fulfilling our trust responsibility to U.S. citizens, rather than allowing populations to further damage habitats, cause agricultural depredations, and potentially crash.

82) The concern about marsh eat-outs by greater snow geese is based on incomplete and incorrect information about historical processes. Kortright gave accounts of eat-outs during the 1930s and 1940s.

Although we stated that the impact of greater snow geese on coastal marshes of the U.S. mid-Atlantic coast appeared to be relatively small prior to the 1960s, we did not state that eat-outs were non-existent during that time. Clearly the occurrence and impacts of eat-outs have increased as the population has increased.

83) The issue is to provide sufficient marsh areas for natural cycles to operate and to support the flock of greater snow geese. Where marshes have been replaced by agricultural land the geese should be allowed to feed on agricultural crops with subsidies paid to farmers as is currently done in Canada.

By fostering the growth of the greater snow goose population through provision of agricultural crops and payments to farmers in the U.S., the population will continue rapid growth. In the absence of management actions to control the population, the carrying capacity of breeding habitats will be exceeded and, similar to events that have occurred in the mid-continent region, habitat degradation will ensue. We do not believe that is a responsible management alternative.

84) Dispersal of flocks by reducing impoundment areas may concentrate waterfowl and shorebirds on remaining ponds and may greatly increase the possibility of avian epidemic.

Management of water levels on our refuge impoundments will be made on a refuge-by refuge basis with due regard to the purposes for which each refuge was established. Management will also take into account available habitats that are adjacent to the refuge.

85) The Service is using scare tactics with regard to the issue of avian cholera, as if we are all going to die because of avian cholera. How many people have died of avian cholera?

Avian cholera is a disease that does not affect humans. Our concern with avian cholera is the potential for outbreak of the disease which could kill thousands of light geese as well as many individuals of other bird species.

86) One individual commented that the revised treaties relied upon in this EIS are in violation of the existing treaties in force with Mexico, Japan, and the Soviet Union and in violation of the 1918 treaty negotiated with Canada.

The comment is confusing and unclear, as revised treaties are the treaties in force. Regardless, this is a very important comment as it gives us a chance to explain in more detail why this action is in accordance with the authority provided to the Secretary by law. It raises the issue of compatibility with the migratory bird conventions applicable to the birds (light geese) that are the subject of this regulation. The Secretary of the Interior (having due regard for a number of factors that are addressed in this EIS) is authorized and directed by the Migratory Bird Treaty

Comments from Private Individuals (continued)

Act to determine when it is compatible with the conventions to issue regulations to allow the take of these birds and their nests and eggs. Of the four migratory bird conventions, three are applicable to the adoption of these regulations: the *Convention Between the United States and the Union of Soviet Socialist Republics* (now Russia) *Concerning the Conservation of Migratory Birds and Their Environment* (1978), the *Convention for the Protection of Migratory Birds and Game Mammals* with Mexico (1937), and the *Convention for the Protection of Migratory Birds* with Canada (1916). With respect to the fourth, the *Convention Between the Government of the United States of America and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment* (1974), there is no positive evidence that the birds that are the subject of these regulations migrate between Japan and the United States (see Article I, Section 1.).

When two or more conventions are applicable to our adoption of regulations, we must ensure the action is compatible with each or, where conventions have provisions on the same specific issue, the more stringent of the provisions. Each of the conventions, negotiated at different times with four different countries, address particular issues important to each country and, because of differing perspectives and needs, contain agreements on similar actions that are presented in uniquely different ways.

The convention with Canada, in addition to including requirements regarding the authorization of the hunting of migratory game birds, the taking of migratory birds for scientific, educational, propagative and other purposes, and the harvesting of migratory birds and eggs by indigenous inhabitants of Alaska, allows for permitting the killing of migratory birds that are seriously injurious to agricultural or other interests in any particular community (see Article VII). It is our conclusion from all of the information available to us, and which is summarized and referenced in this Environmental Impact Statement, that several light goose populations have exhibited extraordinary growth. Due to their feeding actions, overabundant light geese have become seriously injurious to habitats on various breeding, migration and wintering areas and in some situations have also caused damage to agricultural crops. Consistent with the same article of the convention, the regulations also provide for the suspension of the permission granted by the regulations to take these birds when no longer needed to prevent the injuries to the habitat. In furtherance of the overall objectives of the convention, these regulations will help insure the preservation of these and other migratory birds covered by this convention.

The convention with Mexico provides that for migratory game birds the parties agree to establish “close seasons” (unspecified periods or lengths) during which migratory game birds may not be taken (see Article II). We read this to relate only to hunting because of the specific reference to “seasons”. As such, the agreement to establish close seasons does not apply to the adoption of these regulations because this is not a hunting program. It is a management action that is taken in order to reduce the severe habitat damage that light geese are causing on their nesting, migration or wintering grounds. There are no other applicable provisions in this convention except the overall purpose to protect these birds “(i)n order that they may not be exterminated.” The specificity of the regulations with regard to implementation, monitoring, and reporting, coupled with the revocation and suspension provisions ensure that this will be met.

The convention with Russia, with a somewhat different approach, contains an agreement that the parties will prohibit the taking of migratory birds generally. It then provides for exceptions, one of which is “(f)or scientific, educational, propagative, or other special purposes not inconsistent with the principles of” the convention (see Article II). Another is for the purpose of protecting against injury to persons or property (see also Article II). These regulations fall within both of these exceptions. The action not only recognizes that birds of common interest to Russia and the United States “have common flyways, breeding, wintering, feeding, and moulting habitat which should be protected”, the action is designed to protect that habitat. We are “implementing measures for the conservation of migratory birds and their environment and other birds of mutual interest” by taking actions available to us to prevent further destruction of breeding and feeding habitat by the unusually abundant light geese. (See provisions of the convention introductory to the Articles).

Comments from Private Individuals (continued)

87) An individual stated that there are violations of the Ramsar Convention and other conventions to which Canada is a party and therefore no action should be taken for depredation of any of these geese, because it is an attempt to violate the hunting limitations of the Migratory Bird Treaty Act of 1918. It presents a major federal action to which Canada is in violation of her treaty obligations and deprives other countries of their food supplies and treaty protections.

Our proposed management action is compatible with the relevant conventions. As we described in Chapter 2, implementation of a conservation order is not in violation of any treaty. This is a management action taken under the authority of the MBTA and is compatible with the relevant conventions. Clearly, no country is being deprived of their food supplies or treaty protections.

88) An individual commented that habitat damage in the Arctic is caused by faulty mining practices - not closing drilling holes allows salinity to poison tundra vegetation.

There are no mining operations in the immediate vicinity of locations where habitat damage is occurring in the Arctic.

89) Chemical control of light goose populations is unacceptable. Non-target species (bird and mammal) may feed on bait treated with chemicals. Poison will remain in the environment and travel up the food chain.

The application of DRC-1339 and Avitrol for the control of birds involves pre-baiting sites to allow target species to become accustomed to feeding at a bait site. Application of treated bait is done under controlled conditions and is monitored for presence of non-target species. Baiting activities can be halted to protect non-target species if necessary. DRC-1339 and Avitrol do not persist in the environment and thus would not accumulate in the food chain.

90) Reduction of the population through hunting is an admission of failure in their management. It is the simple, unethical, fall-back solution.

We believe that the increase in some light goose populations is due to factors beyond our agency's control, and thus should not be construed as a case of mis-management. Provision of an agricultural food subsidy has occurred primarily on private lands, over which we have no control. In some flyways, we have liberalized regular hunting regulations to the maximum extent allowed under current law. These liberalizations have been insufficient to prevent further growth of the population. We believe that a conservation order is the most practical and cost-efficient approach to reducing light goose populations.

91) Calls for massive goose kills are based on the heretofore unchallenged opinion that just one vegetative community is correct for this ecosystem and that this successional stage should be maintained forever. This view is biologically naïve and ecologically narrow-minded.

We have not stated that a single successional stage should be maintained forever. In fact, in section 3.2.1 we document the succession of habitat change in response to isostatic uplift and goose grazing. However, goose damage has proceeded to such an extent in some areas that no vegetative community exist whatsoever. We do not believe that this can be characterized as a normal state of the ecosystem.

92) Many commentors submitted identical comments to the effect that, "light geese have been irrationally condemned for sabotaging their winter breeding habitat,……".

Such comments appear to be the result of copying a form letter that contains the phrase "winter breeding habitat". Use of such a phrase illustrates an apparent lack of understanding of the issues at hand, because there is no such thing as a "winter breeding habitat". We have documented habitat destruction for a variety of breeding, migration, and wintering habitats, depending on the light goose population being examined.

Comments from Private Individuals (continued)

93) The Service knows that fertilization of the soil on the breeding grounds is the solution to the problem but they will not apply it.

Handa and Jefferies (2000) demonstrated that amendments of peat and fertilizer to existing soil sediments assisted in establishment of transplants of existing plants in sediments of damaged habitats. However, the authors noted that removal and transplanting of soil plugs has limited application because of labor costs in large-scale re-vegetation projects, especially if the added constraint of excluding geese from transplant areas is considered. We also note that soil sediments have been completely eroded away in some portions of salt-marshes, thus decreasing the number of areas where re-establishment of plants can occur. Therefore, we do not believe that this approach is a feasible management alternative.

94) The USFWS continues to amaze us with their never-ending schemes to eliminate wildlife.

We believe that characterization of our light goose management plan as a "scheme to eliminate wildlife" is unfortunate and does not accurately reflect our population goals. We have not proposed to eliminate light geese. In fact, achievement of our population goal for mid-continent light geese will still leave approximately 3.2 million birds in the eastern and central Arctic region. The purpose of our management effort is to bring the light goose population into alignment with the carrying capacity of its breeding habitat to preclude further habitat damage and a potential population crash.

95) If hunters are allowed to go into new areas and be able to use new methods to hunt light geese they will shoot other birds and animals, including endangered species.

In sections 4.4 we examined the potential impacts of various management alternatives on non-target species. In section 4.5 we examined the potential impacts on special status species. In order to implement a conservation order and utilize new methods of take, all waterfowl and crane hunting seasons, excluding falconry, must be closed. Such closures will eliminate or minimize impacts to non-target species. We believe the Whooping Crane Contingency Plan will be more than sufficient to protect endangered whooping cranes.

96) The lack of a recommendation for any hunting restrictions on those waterfowl species supposedly negatively impacted by the light geese negates the validity of any claim that significant negative impacts on other species is occurring.

We have continually stressed that citation of studies that documented local impacts of goose habitat degradation on other bird species is not meant to indicate continent-wide declines in such species. Therefore, there is no need to propose hunting restrictions on those species. However, we note that harvest management of the Southern James Bay Population of Canada Geese has been conservative due to concerns about the status of the population and the potential effects of habitat degradation on the population (see page 62).

97) One individual commented that the absence of a consideration of arctic fox management is notable, especially considering the impact foxes had on the Aleutian goose.

The Aleutian Canada goose example is not applicable to the light goose issue because fox were introduced on Aleutian islands where they did not exist previously. Fox were able to decimate goose populations because the birds had no natural defenses against land predators on the previously mammal-free islands. Light geese in the eastern and central Arctic have been able to increase in the presence of pre-existing Arctic fox populations. However, the number of fox and other predators is insufficient to control the growth of goose populations.

98) One individual commented that wildlife agencies have eliminated predators for the sake of rabies management, however now there are no predators to control the goose population. A few years later the Service claims that there is goose population problem with the ulterior motive of supporting a minority of citizens that engage in blood sports.

Comments from Private Individuals (continued)

There is no information to support the argument that a predator reduction program aimed at rabies control is responsible for the growth of any light goose population. Our light goose management program is designed to prevent further damage to goose habitats and to alleviate crop damages caused by geese. The program is not designed to support the hunting community.

99) Clearly the best option is to have the sportsmen and women of this country and Canada harvest the surplus of snow geese. This method will come at no cost to the tax payers, is extremely effective, and will help lower the population of lesser snow geese to levels that are safe for both the birds and the environment.

Our preferred alternative advocates continuation of regulations that have allowed citizens to increase their harvest of light geese.

100) The option of letting nature run its course with regard to lesser snow geese is a no-win situation. The process would take several years to happen and in the meantime millions of farming dollars will be lost and large amounts of irreplaceable tundra will be destroyed. In the end, we will have almost no snow geese left on this continent, the farming industry will be crippled, and the tundra will be a wasteland for many generations.

We agree and do not believe that the No Action alternative is a responsible one, and have adopted a preferred alternative that advocates new regulations to increase the harvest of light geese.

101) Having the government roam the vast tundra in a "seek and destroy" mission would be an exercise in futility and would be extremely costly to taxpayers.

Direct control in Canada could not occur unless approved and implemented by the Canadian government. We analyzed 2 alternatives that entailed agency control and, due largely to their cost and potential for waste of the goose resource, we chose not to adopt them as our preferred alternative.

102) Once the snow goose population is controlled, a spring harvest should still be allowed but the number harvested should be limited.

Once our management goals are achieved it is possible that some form of maintenance regulations will need to remain in place to prevent goose population growth from rebounding. This can be done through continuation of special light goose regulations during the regular hunting season or periodic re-implementation of conservation orders if deemed necessary.

103) One individual commented that Nebraska should end their study on light geese which basically creates a snow goose refuge in the western half of the Rainwater Basin. Also, allowing only 4 days of hunting per week makes an extended stay by nonresidents impractical.

In 1999, Nebraska developed a management plan for the Rainwater Basin in cooperation with the Service to address potential impacts to non-target species as a result of efforts to increase light goose harvest. The western zone was closed to hunting in spring 2001 and 2003. In addition, hunting was limited to 4 days/week, and several basins were closed, in both the eastern and western zone when opened to hunting. Following completion of data collection and analysis in 2003, a final management plan will be developed for implementation in 2005.

104) One individual commented that it will be difficult to harvest more geese unless lands are open to hunting on Laguna Atascosa and Lower Rio Grande Valley NWRs in Cameron County, Texas. The refuges have acquired a lot of private land that at one time was open to waterfowl hunting.

In recent years, surveys indicate that national wildlife refuges in Cameron County, Texas have received relatively little use by light geese and few opportunities exist for harvesting geese. Therefore, harvest on such refuges would not represent a significant contribution to the regional harvest.

Comments from Private Individuals (continued)

105) There is no solution to the problem unless all private land is opened to hunting, which is not possible.

We have been able to increase the total harvest of light geese substantially without all private land being opened to hunting. We have attempted to educate the public about the light goose problem, which hopefully will encourage private landowners to open their land to hunting.

106) Prohibition of creeping contributed to the light goose population increase.

Federal regulations did not prohibit the act of creeping in the pursuit of light geese. Louisiana prohibited the act of creeping during goose hunting from the 1986/87 season to 1997/98. Light goose numbers in the mid-continent region began to increase many years prior to the initial State prohibition on creeping.

107) Goose roosting areas should not be opened to hunting, which will retain geese in the general area and make them available to hunters for a longer time period.

The composition of private and public lands throughout light goose migration and wintering areas will likely ensure that goose roosting areas not open to hunting will be available.

108) One individual commented that snow geese are destroying marshes on Prime Hook NWR (Delaware), however only 12 % of the refuge is open to hunting. The refuge fields that are open to hunting are worthless for snow goose hunting.

Most wetlands on Prime Hook NWR are freshwater marshes dominated by annual plants (H. Laskowski, FWS, personal communication). Plant communities dominated by annuals re-vegetate each year and are not as susceptible to goose damage as those communities dominated by perennials. Service biologists report that snow geese are not damaging marshes at Prime Hook NWR. The refuge allows ample opportunities to hunt snow geese in 26 marsh blinds during the waterfowl season. Also, field hunting is allowed on 5 different zones on the refuge during the late goose season. The refuge feels they are providing hunting opportunity in areas where it is feasible to hunt snow geese, and in a fashion that is compatible with other hunting programs on the refuge.

109) High license and stamp fees in Canada and the U.S. discourages hunters from pursuing light geese.

In the U.S. there is no Federal license or stamp requirement to participate in the conservation order. Individual States vary in their licensing and stamp requirements, over which we have no control. We would encourage States to maintain a minimum number of licensing and stamp requirements for individuals desiring to participate in the conservation order.

110) Consideration should be made to give hunters all tools necessary to increase light goose harvest during the entire regular season, even when other waterfowl seasons are open.

We believe that the potential impact to non-target species is too great to allow authorization of additional methods of take when other waterfowl and crane hunting seasons are open. Therefore, we propose to authorize new methods of take only when other waterfowl and crane hunting seasons, excluding falconry, are closed.

111) Continued monitoring of the success of various hunting methods is essential to evaluate control methods to achieve desired population reductions.

In order for States or Tribes to participate in the conservation order they are required to collect information on hunter numbers, harvest, and methods of take. This will allow us to evaluate the effectiveness of such methods for increasing light goose harvest.

112) Provide cheaper hunting opportunities for out of state hunters.

Comments from Private Individuals (continued)

There are no Federal licensing or stamp requirements for participating in the conservation order; however, States vary in their requirements for participants. During the regular hunting season, the only Federal requirements are to

be registered in the Harvest Information Program and possession of a Federal duck stamp. We cannot control the cost of State licenses for non-resident hunters. However, we would urge States to minimize financial obstacles associated with licenses or stamps for non-residents participating in the conservation order.

113) Allow light geese to be captured for breeders that raise migratory birds, and allow breeders to collect eggs or goslings from nesting areas.

The number of light geese that can be used by breeders is far less than the number of geese that need to be removed from the population. Therefore, this is not a viable alternative.

114) An individual suggested increasing the bag limit of light geese to 30-40 birds during the regular season whereas another individual recommended removing light goose bag limits altogether.

During the past decade we have gradually increased the daily bag limit on light geese to 20 birds and have removed the possession limit altogether. We believe that provision of additional days to take light geese via the conservation order will be more effective in increasing light goose harvest than changes in bag limit. The current system of regulation-setting would allow additional liberalization of bag limits if we deem it necessary.

115) How many birds need to be removed from the flock in order to have a healthy population and prevent destruction of sensitive areas, and how fast does the population need to be reduced?

In 1997, the Arctic Goose Habitat Working Group of the Arctic Goose Joint Venture adopted a management goal of reducing the light goose population in the mid-continent region by 50% by the year 2005. This suggests reducing the population from the 1998 winter index level of 3.2 million birds to 1.6 million birds. Because new harvest regulations were not implemented until 1999, it likely will be later than 2005 when this goal is reached. The winter index represents only a portion of the total population; therefore the number of light geese in the population after reduction will be greater than 1.6 million. The Working Group also suggested a stabilization of the greater snow goose population at 800,000 to one million birds by 2002. However, the Atlantic Flyway Council and the North American Waterfowl Management Plan goals for greater snow geese are 500,000 birds. We have adopted the management goal of 500,000 birds for greater snow geese, but have not specified a timeline for the goal.

116) A conservation order for greater snow geese should be allowed in the Atlantic Flyway between March 10 and April 30, not only to reduce the number of geese, but to help lessen the economic impact on our country's farmers.

Our preferred alternative would allow a conservation order to be implemented in the Atlantic Flyway to reduce the number of greater snow geese. The decision to implement a conservation order would require consideration of the population size in relation to the population goal. We have not stipulated any opening and closing dates in order to provide flexibility in implementing the management action.

117) Increase the number of hunters pursuing snow geese by banding a certain number of geese with leg bands with rewards of certain dollar values (up to $1 million) to those that turn them in.

In addition to the lack of funding to implement such a program, there is no information to suggest that hunter numbers would be increased to the extent that this would result in a cost-effective means to increase goose harvest. Additionally, a payment of $1 million to an individual retrieving the banded bird would be a disincentive for other hunters to harvest light geese because they would no longer have the opportunity to harvest the same bird. This would defeat the purpose of trying to increase overall harvest. Once population reduction is achieved, effective light goose population control will still require a certain maintenance level of harvest to prevent numbers from

Comments from Private Individuals (continued)

rebounding. Therefore, a program that relied on a $1 million band to maintain harvest would require the Service to budget $1 million every year for the foreseeable future.

118) Use sound, scientific reasoning in managing geese and do not allow emotional, illogical animal-rights activists to sway your decision-making.

We have based our light goose management program on available scientific information. We have solicited input from all interested parties and have considered and responded to all comments.

119) Letting geese and other animals starve to death until the population returns to normal is much crueler than increasing harvest.

We believe that taking no action would ultimately be a waste of the goose resource due to population decline and potential collapse, and would also allow much more habitat to be destroyed before the population is reduced.

120) Direct control options would incur expenses that would be paid out of tax dollars.

We have presented various expected costs to agencies for alternatives that involve direct control. Our preferred alternative will increase harvest through authorization of new methods of take and a conservation order. This management approach will present minimal costs to agencies versus direct control.

121) Enact a spring light goose stamp and use the money to restore and protect wetlands in the light goose flyway.

We believe that enactment of a light goose stamp would present a financial barrier to some citizens and may decrease the number of participants in a light goose conservation order.

122) Goose hunting on Forsythe NWR (New Jersey) should be closed because it decreases the success of hunters on surrounding private lands.

Harvest records from Forsythe NWR indicate that snow goose harvest has increased during the past few years. It is also believed that hunting activity on the refuge causes birds to move off of the refuge when large numbers of hunters are present. By moving off the refuge, such geese would become more available to hunters on private lands, thus increasing their success. Therefore, we believe that the hunt program on Forsythe NWR has played an important role in goose harvest management in New Jersey.

123) Goose hunting on Forsythe NWR should be expanded because geese have learned to use portions of the refuge that are closed to hunting.

As stated in the response to the previous comment, snow goose harvest on Forsythe NWR has increased in recent years. Refuge staff will manage the hunting program to allow snow goose harvest to continue, while still being compatible.

124) One reason the present program doesn't work is that geese are too tame and there is no sport in killing something that you can walk up to and shoot. Also, the need for a migratory bird stamp and the requirement for steel shot remain a deterrent. Therefore, deer and turkey hunters should be allowed to kill geese whenever they see them.

We are not aware of any situations where hunters have been able to walk up to light geese and shoot them because they usually are found in large flocks that are difficult to approach on foot without disturbing them. A migratory bird stamp is not required to participate in a conservation order. There are several other shot types, in addition to steel, that are legal for taking light geese. Deer and turkey hunters typically do not frequent the same habitat types that light geese utilize, and therefore they would not represent a source of people that would be able to significantly contribute to an increase in harvest.

Comments from Private Individuals (continued)

125) Wrangel Island geese migrate through the eastern portion of the Pacific Flyway (Montana, Utah, and Nevada) in spring, but very few individuals migrate through such areas in the fall. More liberal hunting regulations could be implemented in the eastern portion of the Pacific Flyway in the fall to manage the Western Arctic population of light geese.

At this time we are not proposing any increases in harvest of light geese in the Pacific Flyway. If new regulations are implemented in the Pacific Flyway in the future, due regard will be made to management of Wrangel Island birds.

126) More hunting areas should be allowed on J. Clark Salyer NWR (North Dakota) and shooting hours should be varied so that geese do not learn patterns of hunter activity.

Service refuges provide hunting areas in a proportion that is compatible with the intended purposes of the refuge. Varying shooting hours may pose an obstacle to some hunters that desire to hunt on refuge lands.

127) More areas in North Dakota should be closed to hunting to provide resting areas that will hold geese in the state for a longer time period and make them available to hunters.

The State of North Dakota has a network of waterfowl rest areas that may provide resting areas for light geese. In addition, resting areas can be found on portions of Federal wildlife refuges.

128) South Dakota is too restrictive in allowing non-resident hunters to pursue light geese and should offer a snow goose only non-resident fall hunting license.

We have no jurisdiction over restrictions that State wildlife agencies impose on hunters.

129) Goose hunting in the Rainwater Basin would be more successful if hunters were restricted to hunting over decoys and not allowed to jump shoot geese.

Not all hunters possess snow goose decoys and some have developed successful techniques for pursuing geese without the use of decoys.

130) The reason for the population growth is the prohibition of the use of lead shot. Restrictions on the use of lead shot should be removed.

There is no information to suggest that the prohibition of lead shot is responsible for light goose population growth. There are effective alternatives to lead shot available to hunters that have performance characteristics that approach that of lead shot. Removal of the prohibition of lead shot would have negative effects on a variety of wetland species due to the deposition of lead shot in or near wetlands.

131) Game wardens or other professionals should use .22 rifles to shoot geese.

At this time we do not believe that direct control by agency personnel is necessary. We have significantly increased harvest of light geese through authorization of new methods of take and a conservation order.

132) Change the Youth Waterfowl Hunt Days to allow harvest of geese.

Federal regulations with regard to Youth Waterfowl Hunt Days allow the harvest of ducks, geese, mergansers, coots, moorhens, and gallinules. Therefore, snow and Ross's geese may be taken during such days.

133) Direct agency control should be used to conduct the initial reduction of geese. The hunting community should be used to maintain control of the population.

Comments from Private Individuals (continued)

At this time we believe that our preferred alternative of authorizing new methods of take and a conservation order will be effective in reducing the population, and that costly direct control by agencies can be avoided.

134) Although population reduction is needed, the use of unplugged shotguns, removal of bag limits, and allowing shooting hours until one-half hour after sunset is not ethical because increases in crippling may occur.

Substantial support was expressed during our public scoping process for use of these methods to reduce light goose populations. However, such authorizations were also met with substantial negative public sentiment as well. Arguments for and against various methods often include one's personal view of ethical and non-ethical methods of take, which is not amenable to objective analysis. We believe that our proposed balance of authorizing new, and continued prohibition of other, methods of take is a reasonable compromise. We are aware of only one published study that examined the effect of new methods of take (electronic calls) on light goose harvest. Olsen and Afton (2000) found that electronic calls significantly increased success rates of hunters pursuing light geese. However, the study did not highlight any observed increase in crippling rate of geese.

135) Alternatives B and C should be implemented simultaneously to quickly reduce the light goose population because Alternative B alone may not be quick enough.

Based on recent experience with new methods of take and conservation orders, we believe that implementation of our preferred alternative will be effective in reducing light goose populations.

136) Alternative B should be combined with killing of goose embryos in eggs without destroying the egg, which will result in adult birds continuing to unsuccessfully incubate eggs and prevention of re-nesting efforts.

Conducting population control on Arctic breeding grounds is extremely expensive. We do not believe that killing goose embryos on Arctic areas would be a cost-effective method of light goose control.

137) Electronic calls should be allowed as a method of take during the regular light goose season.

Caswell et al. (2003) documented low response rate of non-target species to electronic snow goose calls used in Canada during the early fall. However, they cautioned that additional research should be conducted to determine the effects of electronic calls on non-target species during other portions of the hunting season in other regions. At this time we do not have sufficient information to ensure that non-target species would not be negatively impacted by the use of electronic calls during the regular season if seasons on non-target species are open. Caswell et al. (2003) stated that recordings used by hunters should be screened to ensure that calls of non-target species are not included on tapes or compact discs used for hunting snow geese. We believe that this would be difficult to enforce.

138) An individual asked if the reason the Service required that other waterfowl and crane hunting seasons to be closed is because the Service does not trust the average duck or goose hunter to know what they are shooting at.

Our decision to be cautious in the authorization of a conservation order and new methods of take is based on our desire to eliminate or minimize any potential impacts to non-target species. We believe that closure of other waterfowl and crane hunting seasons will heighten awareness of this concern and cause all hunters to be judicious in bird identification while pursuing light geese.

139) An individual inquired whether each State will have the power to set their own regulations with regard to light goose hunting.

Comments from Private Individuals (continued)

The Service will set the broad frameworks for light goose regulations that States must operate under. This applies to regular hunting season regulations as well as conservation order regulations. States are free to be more restrictive than Federal frameworks and thus may choose not to implement certain methods of take that are authorized by Federal regulations.

7.8 Comments from Private Organizations

140) Throughout much of its 50 page public comment, the Animal Protection Institute (API) contended that the Service has tried to "demonize" light geese. The API states that the species is now thought of as a "flying rat" or "tundra maggot".

The Service believes that characterization of our treatment of this issue as demonization of light geese is unfounded and unfortunate. We believe that we have objectively described light goose populations and their impact on the environment. Furthermore, we believe that accusations of demonization demonstrates a failure to recognize the Service's mandate to conserve migratory birds and that our proposed management action is in the best interest of the long-term health of light goose populations and their habitats. We trust that reference to derogatory names for light geese does not imply the Service has used such names to describe them. In no instance have we used such terms, nor do we condone their use.

141) The API commented that the premise that under no action light goose populations would be allowed to increase in size is ultimately untenable. No wildlife population has ever increased indefinitely in size, and there is much annual variation in recruitment rates.

Nowhere in the document do we state that light goose populations would increase in size indefinitely. In fact, in our discussion of impacts of the No Action alternative on light goose populations we state the possibility that density-dependent regulation of the population would occur. In section 3.1.9 we reviewed documented population responses to habitat degradation. Because light geese can cheat density-dependence by exploiting new habitats, it is not known how long it will take before a particular population will actually decline. The occurrence of annual variation in recruitment rates, which would affect growth of the overall population from year to year, is clearly indicated in the numerous graphs of population size (or indices) we present in sections 3.1.6 and 3.1.7.

142) The API commented that the Service rejects those historical data that indicate current light goose population sizes are not unprecedented. While the rejection is based on the fact that the early indicators are anecdotal, and thus cannot be compared to current statistics obtained from more objectively employed techniques, there is no logical reason to assume that early estimates must be hugely in error. While we can't know that light goose numbers were never as high as they currently are, we cannot know that they were not.

We contend that "historical data" (i.e. anecdotal accounts, often of only individual flocks of birds) or "early estimates" cited do not constitute estimates of the size of light goose populations prior to the implementation of systematic surveys. Accounts of individual flocks, or counts in a very limited geographic area, do not even remotely approach a population estimate. Therefore, a discussion of whether or not such supposed estimates are hugely in error is pointless. The comment that we can't know whether populations were never as high as they currently are, and we cannot know that they were not, does not help resolve the issue. In the absence of reliable data and population estimates from pre-survey periods, we must base our management program on information from our systematic surveys that indicate population levels are at historic highs.

143) The Humane Society of the U.S. and the Animal Protection Institute submitted lengthy comments that, in part, questioned whether light goose population levels documented in the DEIS are unprecedented. For example, they cited Lynch's (1975) account of approximately 185,000 geese in a single flock at Oyster Bayou (Louisiana) in the late 1930s, but that only 368,000 birds were counted in the entire winter survey of the Mississippi Flyway during 1954/55. They also cited Lynch's (1975) account of apparent declines in light geese using the Mississippi Delta as support for the hypothesis that the number of light geese in the mid-continent

Comments from Private Organizations (continued)

region had been at high levels prior to implementation of systematic surveys and that current high levels are not unprecedented.

Lynch's (1975) account of a single flock of 185,000 birds at Oyster Bayou in the late 1930s coupled with the entire flyway count of 368,000 in 1954/55 does not lend support to the hypothesis that goose populations existed at previously high numbers. Geese did not exhibit drastic changes from their tradition of utilizing a narrow band of saltmarsh habitat along the Louisiana coast until the 1940s (Bateman et al. 1988). Therefore, the count of 185,000 birds in a single flock during the late 1930s may have represented a large percentage of the entire wintering population. In the 1955 winter count of geese in the entire Mississippi Flyway, 98% of the 368,000 birds were counted in Louisiana (Fronczak 2003). As in 1955, we believe it is highly likely that Louisiana harbored the majority of light geese wintering in the Mississippi Flyway during the late 1930s when Lynch made his observations at Oyster Bayou. Therefore it is not surprising that he was able to count a large number of birds in a single flock. However, such observations do not support the hypothesis that numbers of light geese previously existed at levels comparable to today.

In his discussion of goose population declines, Lynch (1975) clearly was documenting a decline in the number of birds using the Mississippi Delta region of Louisiana. Lynch cited counts of "about 300,000" birds wintering on the Active Delta of the Mississippi during the late 1930s and early 1940s, but that aerial surveys of the same region in the 1970s produced estimates of only 50,000 birds. Lynch stated that, "Obviously the Snows and Blues formerly using this region have dropped greatly in numbers". We see no information in these accounts that support the hypothesis that the number of mid-continent light geese previously existed at levels that were as high as, or higher, than those that exist today. Lynch was simply stating that the number of birds using a *specific geographic area* had declined, and that "perhaps they moved westward to the Vermillion Bay marshes and other portions of southwest Louisiana" (Lynch 1975: 15). Furthermore, Lynch (1975:24) stated that some declines of geese at specific geographic areas "undoubtedly reflects geese that now were lingering in inland States for longer periods during fall migration, and making some attempts to overwinter at such places". Lynch also cited decreases in reproductive success in the arctic as a potential factor, or that some birds may have shifted their nesting grounds westward, which would cause them to migrate to wintering areas west of the Mississippi Delta (i.e. southwest Louisiana and east Texas). We conclude that any perceived declines in goose numbers in a particular region was primarily a redistribution of goose wintering grounds and not an actual decline in numbers. We reiterate that comparison of anecdotal accounts of light goose population size with data derived from systematic surveys cannot be used to prove one way or another whether populations previously existed at levels comparable to today. However, we must make our management decisions base on reliable survey data that indicate steady population growth.

144) The HSUS claims that some researchers, in particular R. Alison, have suggested that separating the Mid-Continent Population of light geese into Central Flyway and Mississippi Flyway components will show that, while light goose populations in the Central Flyway have increased, those in the Mississippi Flyway have declined in the past decade.

We are at a loss to understand how Dr. Alison, or anyone else that examines the data from the 2 Flyways, can come to the conclusion that the number of MCP light geese in the Mississippi Flyway has declined. Prior to the implementation of the conservation order in the 2 Flyways (1999), the number of MCP light geese in the Mississippi Flyway increased from 1.0 million in 1988 to over 1.9 million in 1998. During the same time period, the number of MCP light geese in the Central Flyway portion of the range increased from 736,000 birds in 1988 to over 1.0 million birds in 1998. Clearly, the number of MCP light geese in each Flyway has been increasing.

145) The API referred to work conducted by J.F. Scarry and C.M. Scarry that documented the occurrence of snow geese (presumably greater) in archaeological sites in North Carolina. From the frequency which these bones occur in some coastal regions, and given the lack of pump-action shotguns available to early native people, it seems prudent to at least acknowledge the likelihood that abundant populations of greater snow geese occurred before, leaving no lasting "damage".

Comments from Private Organizations (continued)

Presence of greater snow goose remains in archaeological sites merely points to the existence of the species prior to European settlement, something which we have never attempted to dispute. We do not believe the presence of such findings can be used to indicate a likelihood that the population once existed at a level as high as, or higher, than which exists today.

146) The API devoted 3 pages of their comments to questioning our use of information regarding changes in the winter distribution of light geese as it relates to habitat carrying capacity and population growth (DEIS Figure 3.13). They stated that it is contentious to assume that the carrying capacity of the "original coastal marsh wintering range" is somehow equal to what existed prior to the 20th century. A wintering range expansion does not equal an increase in bird numbers.

We fail to understand the concern that prompted the comment. In our review of migration and wintering ecology of CMF light geese we merely reviewed the available information concerning goose distribution and habitat use on the Gulf Coast. We did not state that range expansion equates to population growth. However, the available information suggests that geese formerly restricted their activity to a narrow band of brackish salt marsh. This pattern was exhibited until the 1920s in Texas, and the 1940s in Louisiana (Bateman et al. 1988). We have no way of documenting the carrying capacity of the coastal marshes prior to the 20th century, or even during the 1920s and 1940s. As the comment acknowledges, the original coastal marsh range has undergone enormous change in the last century. However, much of that change has undoubtedly occurred after the 1920s and 1940s. Therefore, it is not inconceivable that the carrying capacity of the marshes immediately prior to the 1920s was still fairly high. Our review focused on the increased use of agricultural land by geese once such land came into closer proximity to the wintering marshes. We believe that use of this new habitat allowed geese to increase the amount of food available to them, which likely led to increased survival rates and contributed to population growth.

147) The API commented that the Service has failed to adequately demonstrate a need to reduce light goose populations within the context of Article VII of the U.S.-Canada Migratory Bird Treaty. The "extraordinary conditions" mentioned in Article VII have not been identified. If alleged habitat damage is the result of extraordinary conditions then what are those conditions? Does extraordinary refer to phenomena such as global warming or grain subsidies?

We have not relied solely on Article VII of the Treaty to support our call for reduction of light goose populations. As we outlined in section 1.6 of the EIS, Article II of the amended Treaty states that migratory bird populations shall be managed in accord with conservation principles that include (among others) provision for and protection of habitat necessary for the conservation of migratory birds. We contend that reduction of light geese will result in a protection of habitat essential to light geese, as well as other migratory birds. Article IV of the Treaty states that each government shall use its authority to take appropriate measures to preserve and enhance the environment of migratory birds. We contend that our proposal will help preserve those portions of the arctic environment inhabited by light geese. Article VII authorizes take of migratory birds that, under extraordinary conditions, becomes seriously injurious to agricultural or other interests. We have already documented how light geese have become seriously injurious to arctic breeding habitats. Furthermore, we believe that high population levels documented through extensive survey methodology, combined with habitat damage, represents an extraordinary condition. Therefore, our proposal to increase take of light geese to alleviate this situation is warranted.

148) The API commented that, if the intentional planting of grains to feed migrant waterfowl is extraordinary, the solution lies in greater control over the practice. If extraordinary conditions are caused by the Service's own policy of providing grain subsidies, then the most effective solution is control of the subsidy. If the extraordinary conditions are grain subsidies created by agricultural practices then the impact of such subsidies on the environment's carrying capacity should be compared to primal conditions. The assumption that primal conditions were more hostile to light geese than current conditions is unsubstantiated. Also, the assumption that a change in the source of winter nutriment has enhanced the survival of migrant/wintering geese is not proven.

Comments from Private Organizations (continued)

There are no data available that would allow a valid comparison of the carrying capacity of primal and current conditions. In the description of our proposed alternative we address how our refuges should seek to reduce the availability of agricultural crops for light geese. Furthermore, our agency has no power to influence the nation's multi-billion dollar agricultural output merely to seek reduction of grain availability for light geese. We cite the availability of agricultural grains as a potential cause of increased survival in light geese because the changing pattern of habitat use to agriculture coincided with increases in light goose populations. Whether or not the theory can be proven with a degree of certainty does not diminish the fact that light goose populations have increased.

149) The HSUS cited Robertson and Slack's (1995) caution that recent and projected future declines in rice acreage, and increases in urbanization in Texas coastal areas, may result in sudden lesser snow goose declines. The HSUS urged the Service to consider trends in agricultural production and further wetland losses in the Final EIS.

We have reviewed the paper cited by the HSUS, which we were not aware of during preparation of the Draft EIS. We note that Robertson and Slack (1995) presented a variety of potential scenarios, or combination of scenarios, for future lesser snow goose populations wintering on the Texas coast in response to changes in agriculture and urbanization. One scenario involves snow geese simply expanding their winter range in search of suitable feeding habitat. Alternately, geese may continue to winter in the same region and use remaining agricultural and/or natural marsh habitats. If birds are unable to find suitable habitats, winter mortality may increase through starvation and disease. In addition, productivity may decline if birds begin spring migration in poor condition and they are unable to obtain nutrient reserves necessary for reproduction. Despite changes in Texas agriculture and urbanization cited by Robertson and Slack, the number of light geese in the mid-continent region has continued to increase. Given the ability of light geese to adapt to new food supplies on the wintering grounds, we believe it is more likely that geese will expand their wintering range in search of suitable feeding habitats, rather than experience a sudden decline. Finally, we note Robertson and Slack (1995) indicated that empirical data do not exist to allow predictive modeling of the snow goose population wintering on the upper Texas coast. Examination of trends in agricultural production and wetland losses is beyond the scope of this document. Considering all of the above, if light goose populations declined to levels consistent with our management goal we would take action to suspend a conservation order.

150) The HSUS commented that the DEIS considers all mid-continent light geese – and in some cases all North American light geese – as if they constituted a single population, regardless of the location of their Arctic breeding grounds.

In section 3.1.1 we clearly defined three different taxa of light geese in North America: greater snow geese, lesser snow geese and Ross's geese. Furthermore, in section 3.1.3 we clearly defined the various populations of light geese found in North America and described their breeding, migration and wintering ranges. We noted in the DEIS that the term mid-continent light geese is used simply to collectively refer to the Western Central Flyway Population (WCFP) and Mid-Continent Population (MCP) of light geese that migrate through and winter in the mid-continent region. Our analysis of Alternatives A-E clearly presented the anticipated impacts on several distinct populations of light geese.

151) The HSUS commented that some breeding colonies have experienced recent sharp declines even as others are increasing in size. Therefore, hunting pressure distributed widely throughout the U.S. (even if primarily concentrated within a particular flyway) will not necessarily result in targeted decreases of goose populations in those Arctic breeding areas that are being impacted most severely.

Breeding areas that are presently being impacted most severely by mid-continent light geese are located on the western Hudson Bay coastline. These sites are impacted the most because geese from a variety of breeding colonies migrate through and utilize the region on their way to more northern breeding sites. This feeding pressure is in addition to that resulting from birds that normally breed on such sites. Therefore, if population reduction is targeted only at sites where habitat degradation is most severe, it will necessitate removal of birds that would normally breed

Comments from Private Organizations (continued)

at a variety of colony sites; some of which are far removed from the site of habitat damage. Consequently, we believe that reduction of goose numbers in the U.S. will alleviate pressure on breeding habitats in a manner very similar to that which would occur if population reduction occurred only at damaged breeding sites. The HSUS did not specify which breeding colonies they believed to have experienced sharp declines. It is true that the number of geese nesting at *traditional* colony sites at La Perouse Bay has declined due to habitat degradation; however, the number of geese in the overall population nesting at La Perouse Bay and surrounding Cape Churchill area has increased (Cooch et al. 2001).

152) The HSUS commented that the proposed increase in hunter-induced mortality will most likely lead to compensatory population growth. Decreased local competition for food and increased reproductive output and survival will likely bring these populations quickly back up to levels perceived to be too high. Thus the plan may either result in no change in foraging pressure on breeding grounds or will allow only brief respites from high-intensity goose foraging. In contrast, allowing a natural crash in the goose population, or, in the short term, dispersal away from heavily grazed areas via the No Action Alternative may be more likely to allow for long term habitat recovery.

Our preferred alternative calls for retention of maintenance regulations that would ensure that harvest remains at a magnitude sufficient to prevent populations from rebounding once they were lowered to desired levels. We believe that allowing further habitat damage to occur while waiting for a population crash to occur at some time in the potentially distant future would be irresponsible. The benefit of immediately reducing the population to management goal levels, which still provide for the existence of numerous birds, would far outweigh the negative impacts associated with cumulative habitat destruction that would occur prior to any population crash that would occur in the distant future.

153) The HSUS commented that the Service implies that the plant community inside the fenced goose exclosure areas represents a natural plant community and therefore is a picture of what the breeding grounds should resemble. However, the exclosed area lacks a dominant herbivore and increased plant biomass within exclosures does not indicate the ecosystem contains a destructively high density of geese. Exclosure studies are generally useful in determining the relative effects of herbivore populations on the composition of the local plant community and should not lead one to believe that the exclosed area represents what is "normal".

We presented results of exclosure studies to illustrate two points. The first point being that sites which receive goose exclosures *after* being destroyed by the feeding action of geese do not experience re-vegetation even after 15 years. The second point is that experiments where goose exclosures are placed on intact stands of vegetation show that geese remove nearly all vegetation on sites where they can feed outside of the exclosure. Obviously, the purpose of such experiments is to remove (via exclusion) a dominant herbivore from a site; however, we did not state that vegetative stands within fenced areas represented a "normal" situation. We agree with the comment that exclosure studies are generally useful in determining the relative effects of herbivore populations on the composition of the local plant community. The results of the studies we cited show that geese can reduce the composition of the local plant community to zero or near-zero species.

154) The API commented that the Service states there may be little or no chance of plant recovery within 25-50 years after geese remove vegetation. However, due to isostatic uplift such areas will be much further inland after that amount of time. Newly emerging sea floor begins innocent of marsh vegetation, but the Service would have us believe that it will forever remain that way.

Studies indicate that once vegetation is removed by geese soil chemistry changes such that re-vegetation is affected. In some cases the soil on such areas is eroded away completely. Therefore, it does not matter where on the coastal marsh/upland habitat continuum the land resides in 50 years. Conditions likely will not be favorable for any type of plant establishment. Thus, if the land was further inland it would seem that upland species would be affected. We have never stated, or tried to have the reader believe, that newly exposed sediments would not be colonized by marsh plants. However, in the DEIS (page 52) we did state that, "although isostatic uplift creates new salt marsh

Comments from Private Organizations (continued)

habitat as new land is exposed, the rate of increase of new habitat is too slow to keep up with the rate of habitat destruction caused by the increasing light goose population."

155) The HSUS commented that a normal process of plant community succession in the salt-marsh habitats tends to produce a shift in plant types, from the preferred goose food plants, *Puccinellia* and *Carex* species, to *Calamagrostis* and *Festuca* species. Foraging activities of lesser snow geese and Ross's geese at low to moderate densities delay this succession but do not prevent it. Isostatic uplift and frost heave development both gradually reduce salinity over time, further favoring the switch to plants that are salt-intolerant and not preferred by geese. Tidal action also deposits dicotyledon seeds in goose foraging areas (Hik et al. 1992). According to Hik et al. (1992) this successional change has the result that "swards dominated by *Puccinellia*…are irreversibly lost from the system", however the authors define the length of this irreversible loss as 10-50 years. This is a long time from the perspective of a human but is not a considerable amount of time for an Arctic salt marsh ecosystem as a whole. Overgrazing of some types of preferred food plants due to a high goose population may actually speed up a shift in plant community composition. Regardless of the rate, this represents a normal ecological process that eventually results in a much more diverse secondary plant community. When grazing is accompanied by intensive grubbing, the grubbing and erosion may expose bare sediment and may require a longer period of time (probably on the order of 50-150 years) for the aforementioned assemblages of plants to reestablish (Hik et al. 1992, Srivastava and Jefferies 1996).

We note that Hik et al. (1992) utilize the term "destruction" when describing the impact of high numbers of geese on the vegetation communities they studied. With regard to the statement that isostatic uplift and frost heave development gradually reduces salinity over time (Hik et al. 1992), we note that this passage comes from Hik et al.'s paragraph describing plant community change *in the absence of goose grazing* (Hik et al. 1992:403). In our reading of Hik et al. (1992), nowhere do we see that they define the length of "irreversible loss" as 10-50 years. Instead, Hik et al. (1992:404) state that, "As time proceeds …, the swards dominated by *Puccinellia* (A) are irreversibly lost from the system (10-50 years), due to the effects of isostatic uplift." We interpret this statement to mean that as isostatic uplift acts on the system it will take 10-50 years for the *Puccinellia* swards to be converted to other plant communities. However, once the *Puccinellia* sward is lost it will not come back in 10-50 years (as suggested by the commentor) - it is "irreversibly lost from the system" (Hik et al. 1992). We sincerely doubt that Hik et al. would use the term "irreversible" if the *Puccinellia* sward could re-establish in as little as 10 years. Hik et al. (1992) further state that, "Where extensive grubbing and grazing have occurred in recent years on the La Perouse Bay salt-marsh, the plant assemblages characteristic of the states we have described become extinct…across the entire salt-marsh an estimated 50% of the vegetation has disappeared between 1985 and 1991 as a result of grubbing and subsequent erosion. Erosion of organic layers and sediments makes it unlikely that the assemblages of plants will re-establish within 50 years. These changes coupled with those associated with the progressive effects of isostatic uplift indicate that when such areas are recolonized the species will be different from the former assemblages. Hence on a longer time scale (c. 100-150 years) non-equilibrium conditions prevail." This statement does not mean that those plant assemblages necessarily *will* re-establish after 50 years. We acknowledge that some type of plant community may eventually (whether it be 50,100, or 150+ years) establish itself on sites formerly destroyed by geese. However, information available to us suggests that such communities will have diminished value to wildlife.

156) The API commented that, to the lay public, "desertification" conjures images of the Saharan sand dunes, or perhaps Catalina Island once the goats got through with it, but that is, emphatically, not what is happening even with regard the most extreme and extensive removal of vegetation by "light" geese anywhere on their breeding grounds.

The end point of a desert is not implied by the term desertification (Jefferies et al. 1995:204). The cause of the increased goose population and the loss of vegetation are strongly linked to human activities (such as use of agricultural crops, refuges, and lower harvest rates). Jefferies et al (1995) stated that the loss of vegetation on goose breeding areas can therefore be termed "desertification": the impoverishment of terrestrial ecosystems under the impact of humans.

Comments from Private Organizations (continued)

157) The HSUS commented that soil salinity in the salt marsh may vary spatially or temporally but the DEIS does not provide estimates of the proportion or area of bare mudflats thought to have very high versus more moderate salinity. This information would help the public determine which plants can recolonize mudflats and how soon.

The studies we cited that involve soil salinity did not contain any estimates of the proportion or area of mudflats that are comprised by different salinity classes. We are not aware of any other studies that would have such information.

158) The HSUS commented that the Draft EIS is not clear on the extent to which fresh water from snow melt, tides, etc., may help reduce soil salinity over the years and/or allow for vegetative reproduction of *P. phryganodes* and other graminoids.

We are not aware of any studies that have documented the extent to which soil salinity can be modified by fresh water inputs over the years. Srivastava and Jefferies (1996) documented seasonal changes in soil salinity due to changes in weather. However, their study also reported that soil water salinity increased with increased size of the bare mudflat. The larger a bare patch is, the more likely it will remain un-vegetated and the patch may even grow in area. There may therefore be a threshold in patch size beyond which bare areas do not revegetate (Srivastava and Jefferies 1996). Furthermore, soil salinity in the salt marsh was inversely related to aboveground plant biomass; bare sites are more saline than high biomass sites. Increases in the colony size of light geese at La Perouse Bay has resulted in a 50% reduction in aboveground biomass between 1979 and 1991, and it is likely that soil salinity has increased over the last decade in areas that are no longer vegetated or only partially vegetated (Srivastava and Jefferies 1996).

159) The HSUS commented that colonization by Arctic graminoids is slow, but these grasses do reproduce sexually. Puccinellia may be a sterile triploid and it has not been known to set seed. However, researchers studying genetic variations within and between populations of this ground found unexpectedly high genetic variability suggesting sexual reproduction may occur in this species.

Jefferies and Gottlieb (1983) examined genetic variability in *Puccinellia*. They hypothesized, a priori, that since the grass has never been observed to set seeds, genetic variability would be low due to the vegetative nature of reproduction by the species. However, their results indicated a high level of genetic variability, suggesting that it is possible that the species can reproduce by seed. They cautioned however that the actual cause of genetic variability remains to be determined. We do not dispute the findings of Jefferies and Gottlieb (1983). However, we do not believe that pointing to the mere existence of the possibility of the rare event of production of viable seeds is a sound argument that plants will recover from habitat destruction by geese. Furthermore, the soil conditions resulting from habitat degradation, not to mention outright loss of soil through erosion following loss of vegetative cover, will not be conducive to re-establishment of plants via seed.

160) The HSUS has produced video documentation during a fly over of the coastal regions from La Perouse Bay west and then north. The video shows vast areas of intact vegetational communities. On the ground still photos taken by the Animal Protection Institute show areas of mudflat interspersed with green vegetation taken within view of the fence of the research encampment. On the other hand, the Service document shows dramatic pictures of desert-like barrens and a satellite image of cumulative damage at La Perouse Bay "caused by light geese" over a ten-year period. The red areas in the satellite photo are not desert, they are areas either bare of above-ground vegetation or are incomplete vegetation where complete means vegetation not significantly acted upon by light geese and/or other herbivores.

We have viewed the HSUS video and believe that videos taken at the altitudes flown would not be able to demonstrate a difference between an "intact vegetational community" and a damaged or overgrazed area. It is believed that 65% of the 135,000 acres of coastal salt marsh habitat is damaged or overgrazed, however from the video this impact may not be detected. For example, an overgrazed area may have been converted to a moss carpet after removal of sedges by geese; however such an area would look green from the air. Only 35% of the marsh habitat is considered destroyed. Therefore, the video would potentially show a large amount of habitat mistakenly

Comments from Private Organizations (continued)

identified as an intact vegetation community. With regard to the satellite photo, the Animal Protection Institute failed to mention that the caption of this photo stated that in 1973 the areas in red had *complete* vegetation cover. In 1993 such areas where either bare soil or incomplete plant cover. Figure 3.20 of the DEIS also shows green vegetation interspersed in mudflats. These vegetation patches tend to be willow stands that eventually will die as soil salinity increases, as illustrated on page 35 of Abraham and Jefferies (1998). Furthermore, the satellite photo study documented a 20 year change in vegetation, not 10 years as the comment stated.

161) The HSSU commented that the reason for increased grubbing by resident and migrant geese at La Perouse Bay appears to be a combination of cooling trend in northern breeding habitats and increased temperatures at more southerly sites. If the increase in the size of the staging population in the southern areas is responsible for alleged habitat damage, then it would appear that increasingly late snowmelt in northern areas and global environment change is causally related to damage in at least some areas. The Service argument that agricultural subsidies are causally related to arctic damage by snow geese is therefore flawed.

We have stated that increased numbers of light geese, not climate change or agricultural subsidies, are responsible for habitat damage in arctic and sub-arctic nesting areas. We believe that agricultural subsidies and climate change are plausible causative factors in the growth of light goose populations. Abraham and Jefferies (1997) reviewed the occurrence of climate changes in northern and southern goose nesting areas, and we have incorporated this discussion in the Final EIS. Abraham and Jefferies (1997) reported that the center of the lesser snow goose breeding range has shifted south to areas with a less sever climate (i.e. rather than climate change *in situ*), which would allow for earlier nesting dates. With earlier nest initiation dates and longer growing seasons, higher average annual production would result in population growth of southern colonies such as Cape Henrietta Maria or La Perouse Bay. However, the slow growth of each of these colonies in the first two decades following their establishment argues against this phenomenon as being the sole mechanism to account for population growth. Jefferies et al. (1995) also reported on the occurrence of increased number of migrants staging at southern sites in some years due to colder temperature in more northern areas. Regardless of factors that impact the distribution of birds, it is the overall increase in the number of birds that has resulted in habitat damage. Not only has damage been documented on southern sites, but damage has also been documented in northern areas of the central Arctic. Abraham and Jefferies (1997) stated that agricultural subsidies have been the major influence enabling geese to increase in recent decades, whereas climate warming and expanded breeding range were cited as likely secondary causes.

162) The HSUS commented that, with regard to greater snow geese, damage to freshwater breeding habitats has not been documented and goose numbers appear to be below the estimated carrying capacity of the habitat. Also, greater snow goose colonies do not experience waves of migrant flocks traveling to more northerly colony sites, as happens with habitats in La Perouse Bay. The ecosystems used by greater snow geese may be quite different from saltwater habitats and birds may not be able to expand their breeding range. These differences suggest that greater snow geese may not be capable of creating a large impact on vegetation. There is no justification in terms of breeding habitat vegetation for reducing the greater snow goose population. Despite these differences, compared to the situation in the mid-continent region, the Service concludes that the greater snow goose population will increase as rapidly as birds in the mid-content region. Thus, liberalization of regulations in the Atlantic Flyway would constitute a large-scale preemptive strike that is unfounded.

In section 3.2.1 we described the interaction of greater snow geese and their breeding habitats. At the population levels observed during the mid-1990s, geese maintained the vegetation in a low-level steady state. Unlike the situation where moderate grazing by lesser snow geese on salt-marsh plants can increase plant quality and quantity, grazing by greater snow geese has not shown such an "overcompensation" effect. In addition, fecal matter deposited by greater snow geese in freshwater habitat does not appear to have the same fertilization effect that occurs with lesser snow geese in salt-marsh habitats. We do not view the differences in relationships with plants between the greater and lesser snow goose as a valid argument that greater snow geese are not capable of creating a large impact on vegetation. In fact, given the differences cited it is possible that greater snow geese may have an even greater potential to damage habitat. They simply have not reached the population size where such damage is likely. We

Comments from Private Organizations (continued)

forthrightly cited the study by Masse et al. (2001) that indicated greater snow geese were below the carrying capacity of habitat on Bylot Island. We note that Bylot Island hosts only about 15% of the total breeding population. In section 3.1.6 we documented that the greater snow goose population was indeed growing *faster* than light goose populations in the mid-continent region. Given the rapid growth rate in the absence of increased harvest it is clear that the carrying capacity will eventually be reached and likely exceeded if management actions are not implemented. Justification for population management does not need to be restricted to impacts on breeding habitats. We also believe the population needs to be reduced in order to prevent further damage to natural marsh habitats on migration and wintering areas and to reduce agricultural depredations by geese. Therefore, we do not believe the preemptive reduction and stabilization of the population is unfounded

163) The document does not represent a fair economic assessment with regard to greater snow geese because only data pertaining to agricultural crop depredations are included. Economic impacts from other activities, such as people viewing geese or hunting them, should be included. Omission of such information reflects an inherent bias of the document in favor of further demonizing light geese in support of the Alternative B.

In section 3.5.1 we clearly outline economic impacts associated with snow goose hunting in the U.S. portion of the Atlantic Flyway. Furthermore, in section 3.5.2 we addressed the reasons why it is not possible to determine the economic impacts associated strictly with non-consumptive uses of light geese in the U.S. In the FEIS we have included information from a recent CWS report that examined the economic impact of waterfowl migration through Quebec (Canadian Wildlife Service 2005). The report provided insight to the economic impact of non-consumptive uses, especially with regard to greater snow geese and Canada geese. The total annual economic benefit of non-consumptive use of waterfowl migration through Quebec was estimated to be over $24 million (Canadian $$). Of this total, more than $19 million can be attributed to birdwatching activities at four main migration sites in Quebec. Additionally, $5 million annually was generated by 2 greater snow goose festivals, 1 Canada goose festival, and operation of associated educational centers (Canadian Wildlife Service 2005). We also included data on compensation paid to farmers in Quebec merely to point out the increase in depredations that have occurred with increasing numbers of geese. A reduction in the goose population should alleviate such damage while still providing ample opportunity for non-consumptive users to enjoy views of staging geese.

164) The API commented that the document argues that farmers often do not report crop damage, however the document does not discuss how often crop-damage losses are over-estimated when compensation is paid to farmers. We do not know if it would compensate for the discrepancy between "estimated" losses and "total payments" shown with regard to Quebec farmers.

The Service has no way of knowing to what extent crop damage goes un-reported, thus making the requested analysis impossible. The losses reported for Quebec are from studies that utilize on-site vegetation plots to determine the extent to which hayfields are impacted by geese. This would eliminate the possibility that farmers are inflating reports of crop damage.

165) The API commented that the Service's view that animals should not alter the habitat in which they occur is a "politically-motivated whim".

Nowhere in the EIS do we express a view that animals should not alter the habitat in which they occur. In fact, in section 3.2.1 we review how, at lower population levels, geese alter vegetation through their feeding action and actually enhance shoot growth. However, at high population levels this relationship is disrupted and habitat damage occurs. To suggest that our concern over, and desire to prevent, this damage is a politically-motivated whim ignores numerous scientific studies that document the damage, and ignores the majority view of the Stakeholder's

Committee on Arctic Nesting Geese that calls for reduction of light goose populations to halt further habitat destruction.

166) The API commented that the Service's language with regard to the issue of avian cholera is disingenuous and is designed to mislead the reader into assuming that light geese are exceptionally a causative factor,

Comments from Private Organizations (continued)

perhaps "the" causative factor, in the occurrence of serious outbreaks of cholera. The Institute questioned why the Service is concerned that whooping cranes are a species "potentially affected" by cholera, but that the Service is not concerned about whooping cranes being a "potentially shot" species as a result of "encouraging kill-oriented hunters to shoot long-necked white waterbirds with black wing tips."

Our language with regard to the issue of avian cholera is the result of examining several scientific publications that point to lesser snow and Ross's geese as being reservoirs for the bacterium that causes the disease. Nowhere in our document do we state that light geese are the only reservoir for the bacterium. We focus on light geese as being a reservoir because 1) the EIS is a document dealing with light goose management and 2) the available scientific papers dealing with this disease continually cite light geese as being prominent carriers. We have included the discussion of whooping cranes as being potentially affected by cholera because we are required to address how special status species may be affected by light geese. Furthermore, the statement that we are not concerned that whooping cranes are a "potentially shot" species is unfounded because we specifically deal with that issue in sections 3.3.3 and 4.5.2 of the EIS, with regard to the Whooping Crane Contingency Plan.

167) The API commented that snow geese are not worthy of special concern with regard to spread of avian cholera. Cholera can strike anywhere there are collections of birds of any reasonably common species. For example, an outbreak of cholera in Chesapeake Bay in 1978 affected primarily scoters. However, no one is suggesting that there were too many scoters or that scoters should be subjected to aggressive lethal control measures.

We believe the analogy of cholera die-offs in scoters and snow geese is a poor one. In the EIS we mention that over 100 species of waterbirds and raptors are susceptible to avian cholera, yet we are not calling for the reduction of populations of those 100 species. The fact that scoters, or any other species, were involved in a cholera die-off is unrelated to our point that the literature repeatedly cites light geese as being potential carriers of the disease. This, combined with the high growth rates and dense flocking behavior of geese, is the foundation of our concern about the potential for high numbers of light geese to trigger a cholera outbreak.

168) The HSUS commented that the link between light geese and avian cholera outbreaks is "shaky at best". Samuel et al. (1999) cite previous unpublished work suggesting that 50% of adult snow geese infected with *Pasteurella multocida* may survive the infection "and thus a portion of these birds may be carriers of the bacteria." The HSUS stated that "it is a leap to then assume that the presence of antibodies after an infection necessarily means that an individual is capable of acting as a carrier." Even if 5% of the population were carriers of the disease it is highly unlikely that hunter-induced mortality would significantly reduce the number of carrier birds from the population.

The above comment refers to a statistic about the percentage of infected snow geese following cholera outbreaks on Banks Island in the western Arctic (Samuel et al. 1999). In the same paragraph in which the statistic was included, Samuel et al. (1999) stated that: 1) three major outbreaks of cholera occurred at Banks Island between 1991 and 1996; 2) 50% of the birds infected during cholera outbreak survived and thus a portion of these birds may be carriers of the bacteria; 3) there is evidence that cholera has become endemic in Banks Island snow geese; 4) the Banks Island population "may play an important role in transmitting this disease to other waterbirds, especially to wintering areas where many species are concentrated." Also in the same paragraph, Samuel et al. (1999) cite other studies indicating that "snow geese have been suspected of playing an important role in distributing avian cholera because mortality patterns have coincided with snow goose migration in the Central and Mississippi flyways (Brand 1984) and with the arrival of snow geese in California (J.G. Mensik, United States Fish and Wildlife Service, personal communication). In addition, regular mortality has been observed in northward migrating lesser snow and Ross's geese in Saskatchewan (Wobeser et al. 1979, 1983) and snow geese have frequently been involved in larger cholera outbreaks." In light of the above studies, the Service does not believe it is a "leap" to assume that light geese exposed to the disease can act as carriers. We do believe that reducing the number, and thus density, of light geese will reduce the likelihood of disease outbreaks.

Comments from Private Organizations (continued)

169) The HSUS commented that the Draft EIS glosses over the existence of other possible carriers or reservoirs for the bacteria that causes avian cholera. Many other birds and mammals contract *P. multocida*, often including strains that are virulent to waterfowl and other migratory birds. Avian scavengers may also move the bacteria to new sites.

We have added additional text in the Final EIS that refers to the existence of *P. multocida* in other species, which is a fact that we included in the Draft EIS when we cited that over 100 species of waterbirds and raptors are susceptible to cholera. However, Friend (1999) clearly states that contamination from diseased birds is the primary source of infection in wild birds. Other means of transmission have been reported, each of which may occur for specific situations, but none of which are primary means for disease transmission in wild birds (Friend 1999). There are multiple strains of the cholera bacterium and the strains vary considerably in their ability to cause disease in different animals. The differences are most pronounced for cross infections between birds and mammals (Friend 1999). Pointing to the existence of other possible reservoirs of *P. multocida* does not diminish the prominent role that light geese play as carriers of this disease in wild birds.

170) The HSUS commented that Service may argue that the main concern regarding cholera is with the density of snow geese and the fast rate of disease transmission that may result. Information provided in Friend (1999) states that attempts to reduce populations of migratory birds that may speed disease transmission can only be justified under special circumstances and conditions, including complete eradication and prevention of dispersal of potentially infected birds. Therefore, increased hunting pressure would not likely decrease cholera transmission among snow geese or other birds and may, in fact, speed up the spread of the disease to new sites.

The information cited in Friend (1999:88-91) deals specifically with *control* of avian cholera outbreaks once they have *already occurred*. In as much, we agree that the outbreak control methods recommended by Friend (1999) are valid once an outbreak has occurred. However, the point of discussion is that the reduction of light geese, beyond the immediate need to prevent further habitat destruction, may reduce the likelihood of cholera outbreaks occurring in the first place.

171) The API commented that the EIS states that transmission of cholera is enhanced by the gregarious nature of most waterfowl species and by high densities of birds that result from habitat limitations. However, the reader is led to believe that the breeding habitat of light geese is vast, and that the wintering and staging grounds are expanding as a result of agricultural subsidy. If these contentions are valid then there should be no concern about light geese suffering from habitat limitations that lead to avian cholera.

We cited Friend (1999) who stated that the spread of cholera is "…enhanced by the gregarious nature of most waterfowl species and by the dense concentrations of migratory waterbirds resulting from habitat limitations". Such concentrations are typical during winter and spring migration. As we stated on page 60 of the DEIS, the geographic extent of the breeding range of light geese is vast, insofar as the latitudinal and longitudinal extremes are concerned. However, the actual habitat types that light geese utilize comprises only a small fraction of the actual acreage found in the Arctic. Therefore, habitat is indeed limited. As for the wintering and migration grounds, agricultural lands did expand and provide geese with an agricultural subsidy. However, geese and many other waterfowl species still require and seek out wetland areas for roosting and other activities. There can be no dispute that the acreages of wetlands in the U.S. have seriously declined in the past 100 years, thus causing "habitat limitation". Higher goose populations on fewer wetland acres leads to higher bird concentrations, which enhances spread of cholera.

172) The API commented that the Service should have included a review of the role of the poultry industry in creating reservoirs from which avian cholera can enter the environment.

A review of the role of the poultry industry as it relates to avian cholera is beyond the scope of this document. As this is a document dealing with light goose management, we are specifically concerned with the prominent role that light geese appear to play in transmission of the disease.

Comments from Private Organizations (continued)

173) The API commented that it is curious that the Service does not address the other major cause of waterfowl die-offs, avian botulism. Botulism die-offs can involve thousands, even millions, of birds in a single episode. It could just as easily, although no more sincerely, be argued that botulism is "associated" with snow geese.

We see no reason to address the issue of avian botulism. Botulism is a disease caused by the ingestion of a toxin produced by the bacterium Pasteurella multocida (Friend 1999:75). The bacterium is prevalent in sediments of many wetland systems. Conditions that elevate wetland sediment temperatures and decrease dissolved oxygen,

including the presence of decaying organic matter and shallow water, may increase the risk of botulism outbreaks (Friend 1999). In contrast to avian cholera, the spread of botulism does not operate using a reservoir of carrier birds. Therefore, we have no concern that light geese serve as a reservoir for the botulism disease.

174) The API commented that the Service's assessment is extremely limited in trying to imply that light geese are the major cause of avian cholera, which first emerged when light geese numbers were, as the API suspects, declining (the 1940s; although it cannot be entirely ruled out that the disease has been present in North American wild bird populations since pre-Colonial times).

As we have addressed previously, there is no evidence to indicate that light goose populations once existed at levels as high as, or higher, than those observed today and then declined during the first part of the last century. Friend (1999) indicated that cholera is believed to have first occurred in the United States during the middle to late 1880s, but it was unreported as a disease of free-ranging migratory birds prior to the winter of 1943-44. Friend (1999) characterized cholera as an "emerging" disease of North American free-ranging migratory birds. We have never stated that light geese are the major cause of avian cholera; only that they have been cited in the scientific literature as being prominent reservoirs. Therefore, we do not believe statements that: 1) light goose populations were declining or were lower during the 1940s than they are today, and 2) the fact they are now cited as being prominent reservoirs for the bacterium, are mutually exclusive statements.

175) The API commented that the Service has created a National Wildlife Refuge system that forces light geese to concentrate on areas not open to hunting, which exacerbates the spread of disease. If the Service's concern about cholera were not merely another scare tactic designed to "demonize" light geese, but was genuine, at the very least the Service should review its own policies that lead to denser concentrations of light geese and other waterfowl.

The mission of the Service's 100-year old National Wildlife Refuge System goes far beyond management of light goose populations. Nevertheless, our proposed management alternative calls for some refuges to decrease the amount of sanctuary and food available to migrating and wintering light geese. Proposed management practices may also include altering or eliminating water areas that serve as roost sites. Therefore, we have reviewed our management policies that lead to denser concentrations of light geese.

176) The API commented that the document exhibits a double standard of conservation concern by discussing the loss of a few nests of semi-palmated sandpipers or red-necked phalaropes from a large population, but a greater concern is not expressed for the potential of whooping cranes, which actually is endangered, to be shot.

We do not believe we have utilized a double standard of conservation concern. Our discussion with regard to nest losses of sandpipers and phalaropes was used to illustrate the fact that light goose habitat destruction can affect other bird species utilizing the same area. With regard to whooping cranes, we addressed the potential impact of the light goose management program on cranes by describing how migration behavior of light geese and cranes differed in a way that would not favor illegal take. Furthermore, we described the Aransas-Wood Buffalo Population Whooping Crane Contingency Plan, which provides a specific mechanism for protecting cranes when they enter a situation where they face hazards such as hunting activities, contaminant, or disease situations. The discussion of protection of endangered cranes is totally un-related to our discussion of the impacts of habitat degradation on other species.

Comments from Private Organizations (continued)

We have not equated the status of sandpipers or phalaropes with that of whooping cranes, and therefore we do not believe that we have exhibited a double standard of conservation concern.

177) The HSUS commented that, considering the relative lack of interest on the part of sportsmen in hunting snow geese, they question the lumping together of all goose hunting expenditures rather than separately examining light goose hunting in the socioeconomic analysis.

We disagree that there is a lack of interest in hunting snow geese. Prior to implementation of special light goose regulations, light goose harvest represented approximately 24% of the total annual goose harvest in the U.S. Because light geese are generally considered more difficult to hunt due to their flocking behavior, we believe the fact they comprise nearly one quarter of the goose harvest indicates there is no lack of interest in pursuing them. Furthermore, we have not lumped together all goose hunting expenditures in our economic analysis. In section 3.5.1 we specifically addressed the economic impact of light goose hunting and estimated a total economic impact of approximately $146 million in the U.S. We further divided this economic impact of light goose hunting by flyway, based on the percent distribution of harvest among flyways (Table 3.6).

178) The HSUS commented that light geese are notoriously difficult to hunt, which calls into question the effectiveness of liberalized regulations in significantly reducing light goose populations.

Our experience with special light goose regulations during 1999-2006 indicates that such regulations have been very effective at increasing light goose harvest. In the five year period prior to implementation of special regulations (1993-1998), annual light goose harvest in the U.S. portion of the Central and Mississippi Flyways averaged only 488,000 birds. In the period when special regulations were implemented the average annual harvest was 1.1 to 1.5 million birds. During the same time period the winter index of CMF light geese has declined (Fig. 3.11). Therefore, given the short time frame in which special regulations have been in place, we believe they have been effective at reducing the size of the population.

179) The API commented that the Service proposal provides carte blanche ability to undermine decades of waterfowl management principles and procedures that were implemented in the first place in the interest of conserving waterfowl resources that had been depleted by market and sport hunting using precisely the strategies the Service now wants to make legal. This will promote a "cowboy" mentality and unprincipled "slob" hunting among hunters. This will cause illegal waste and wounding of birds.

The issue of overabundant light geese is one that waterfowl managers have not faced before. Therefore, extraordinary measures are needed to solve the problem. We have proposed to legalize only two methods of take, namely unplugged shotguns and electronic calls, out of the numerous methods of take that have been made illegal throughout the history of waterfowl management. We believe restricted legalization of a small number of methods of take will help increase harvest of light geese without promoting "unprincipled slob hunting" as alluded to. Regulations that prohibit wanton waste of waterfowl will remain in place.

180) The API expressed concern about the Service's ability to fine-tune and control harvest levels. A precipitous population decline may result if the Service is successful at reducing goose numbers through harvest at a time that coincides with a series of low recruitment years and high mortality from exceptional weather conditions on the wintering grounds.

We annually monitor light goose population levels through winter and spring surveys. In addition, we monitor climatic conditions and breeding success on the breeding grounds using satellite imagery, aerial surveys, and age ratios during banding operations. Therefore, it is highly unlikely that a series of years of catastrophic events that affect recruitment or winter mortality would go undetected. We also annually monitor light goose harvest through the Harvest Information Program and State surveys of harvest during their conservation orders. This system of annual monitoring will enable us to closely monitor the trajectory of light goose populations and to make changes in

Comments from Private Organizations (continued)

regulations and control efforts when appropriate. The monitoring system will remain in place, regardless of which alternative is implemented.

181) The API questioned why, other than for political reasons, light goose monitoring would not continue as an appropriate activity should the Service adopt the No Action alternative.

Nowhere in the EIS do we state that light goose monitoring would not continue as an appropriate activity if the No action alternative was implemented. In section 2.3.5 we clearly state that "common to all analyzed alternatives is the existence of a variety of light goose population monitoring programs in North America." In the Draft EIS, we further stated that these monitoring programs would be used to determine when population reduction programs advocated in Alternatives B-D should be suspended.

182) The API commented that, while the document acknowledges the far greater non-consumptive use and economic activity, versus consumptive use, of waterfowl, we disagree with the statement, "Information on the percentage usage that can be attributed to duck or goose species is not available." Such information could have been obtained by "monitoring birding email lists (such as BirdChat or OntBirds)" or by collecting information from snow goose festivals held in various locations in the U.S. and Canada.

Our statement regarding the lack of information on the percent non-consumptive usage of duck versus goose species relates directly to the National Survey of Fishing, Hunting and Wildlife-Associated Recreation conducted by the Service and the Bureau of Census, as well as the study conducted by Teisl and Southwick (1995). Neither source broke down economic activity into duck and goose components. These were, and still remain, the only available studies we are aware of that are conducted on a national scope that provide the socioeconomic data we needed to conduct our analysis for the U.S. We have included recent results of an economic impact study conducted in Quebec that gave estimates of the economic benefits of birdwatching and goose festivals (see section 3.5.2). Conducting a separate study of the economic impacts of snow goose festivals (if they exist) in the U.S. is beyond the scope and capability of the EIS, even if a comprehensive listing of such festivals was available.

183) The HSUS commented that in the Service's proposed rule (F.R. 66, pp. 52077-52090) there is a discussion of how habitat damage in the Arctic will eventually trigger a density-dependent regulation of the population and cause a decline in the population to a level that is too low to permit any hunting, thus closing light goose hunting seasons. This passage comes from the subsection "Environmental Consequences of Taking No Action" despite the fact that the statement regarding hunting seasons is clearly a socioeconomic impact and not an environmental one. The Service also points out that maintaining populations at usable levels will benefit hunters and birdwatchers and will ensure the future of a $146 million industry associated with light goose hunting in the U.S. This reveals something about the single-game-species management philosophy that the HSUS can only guess underlies the reasoning behind the management plan.

The EIS Chapter 3 dealing with the Affected Environment includes not only a discussion of light goose populations, other bird species, and habitat, but also the socioeconomic impacts of light goose hunting and non-consumptive use of light geese, and subsistence uses of light geese. Thus, the "affected environment" is not strictly related to birds or habitat. Consequently, it was appropriate to discuss the economic impacts of a population crash in the section of the proposed rule labeled, "Environmental Consequences of Taking No Action". This is analogous to the analysis of socioeconomic impacts of the No Action alternative (section 4.6.1) in Chapter 4 – Environmental Consequences. We clearly state that prevention of a population crash will benefit both hunters and birdwatchers. We cited the potential loss of $146 million associated with light goose hunting only because a similar cost estimate is not available for losses associated with non-consumptive uses in the U.S. However, in section 4.6.1 we point out that such losses will be lower than those associated with consumptive uses because birdwatching and related activities can continue at lower goose population levels, whereas goose hunting may be closed completely at the same low population level. Given the available data, we believe our analysis of impacts was balanced, and does not represent a single-game-species management philosophy.

Comments from Private Organizations (continued)

184) The HSUS commented that the Service admits that eventually density-dependent regulation of the population will occur and a population decline will result. Therefore, the Service agrees with critics of the plan, including Thomas and MacKay (1998), that density-dependent effects will reduce light goose populations. Nevertheless, the Service appears to be at least as concerned about producing a sustainable yield of light geese (and a steady revenue from hunters) as they are about "saving" Arctic breeding habitats. And, as we have argued previously, the plan is not likely to help the breeding grounds to any significant degree.

By agreeing with critics that density-dependent regulation of the population will occur at some time under the No Action alternative does not mean that we agree that the No Action alternative should be used to reduce the population. We have no information to guide us in determining how long it will take for population reduction, or population crash, to occur. Potentially, it could take several decades. We believe a tremendous amount of additional habitat destruction would occur during this time period. Therefore, it is our primary concern of preventing habitat destruction over a prolonged time period, and not prevention of hunting season closures, that has motivated development of our management plan for reducing light goose populations.

185) The HSUS commented that evidence cited by the Arctic Goose Habitat Working Group indicates that density-dependent processes are already affecting goose reproduction and survival and should eventually result in a population decline. For example, reduced food availability has been linked with decreases in clutch size, gosling size, and adult body mass in lesser snow geese. These proximate physiological effects on individuals are reflected in population decreases. Instead of allowing normal density-dependent processes to regulate goose populations, the Service proposes to increase hunting mortality which will likely only have a short-term effect on light goose populations.

We reviewed light goose responses to habitat degradation in section 3.1.9. The number of geese nesting at traditional colony sites at La Perouse Bay has declined; however, the number of geese in the overall population nesting at La Perouse Bay and surrounding Cape Churchill area has increased (Cooch et al. 2001). This is explained by the fact that older female snow geese tend to return to their natal colony areas, which have been degraded, and have lower reproductive output. Younger females have recently tended to nest outside the traditional areas at La Perouse Bay and may be using more distant brood-rearing sites (Rockwell et al. 1993, Cooch et al. 2001). Individuals that disperse to new areas experience higher reproductive success (Cooch et al. 2001), and thus "cheat" density-dependent regulation of the population (Abraham and Jefferies 1997). The ability of the light goose population to partially escape density-dependence means that habitat degradation will continue as the population increases. As stated in our previous response, we believe that population reduction may eventually occur. However, we believe that the amount of habitat destruction that will occur in the interim must be avoided.

186) The HSUS commented that density-dependent effects on greater snow geese appear to have begun via decreases in gosling mass, size and condition, apparently due to decreases in food availability during summer. It is clear that growth rates vary with annual variation in food availability, which may be affected in part by density-independent factors such as variation in the onset of spring.

We reviewed the studies by Reed and Plante (1997) and Giroux et al. (1998) as they relate to variation in gosling growth rates. The study conducted by Reed and Plante (1997) indicated long-term declines in gosling mass, size and condition. They attributed this decline to decreased food availability on the breeding grounds. However, declines in reproduction were not documented, likely due to agricultural subsidies on migration and wintering grounds, and the population continued to increase up until implementation of a conservation harvest in Quebec. Although the carrying capacity of breeding habitats such as Bylot Island has not been exceeded as of yet (Masse et al. 2001), the agricultural subsidy available to geese makes it possible that they will exceed the carrying capacity and cause habitat damage similar to that caused by lesser snow geese in the eastern and central Arctic. Density-independent effects on the population, such as timing of snowmelt in spring, will continue to impact goose populations, regardless of population size. Therefore, we fail to see how mention of these factors is germane to the overabundance issue.

Comments from Private Organizations (continued)

187) The HSUS commented that recently the Canadian Wildlife Service has documented reduced reproductive output and declines in local greater snow geese on staging areas. Declines are attributed to "very low reproductive output in 1999" in addition to increased mortality associated with conservation harvest. At Bylot Island, 2000 marked the second consecutive year in a row of late springs, resulting in later nest initiation and reduced nesting effort. Production of young was at a "record low" in 1999 and breeding conditions were still unfavorable in 2001.

It appears that the HSUS is citing information about reduced reproductive output by greater snow geese in recent years to bolster their argument that the population has begun to regulate itself and does not need to be reduced by management. The CWS report cited by the HSUS (Canadian Wildlife Service Waterfowl Committee 2000) clearly attributes reduced reproductive output by greater snow geese in 1999 and 2000 to late springs that result in unfavorable breeding conditions. We fail to see how population responses to climatic conditions can be used to argue that the greater snow goose population has begun to regulate itself. The observed reductions in reproductive output in 1999 and 2000 were not linked to density-dependent responses to reduced food availability on the breeding grounds. Production in 2001 and 2002 were still below average due to unfavorable weather, but an early spring and favorable weather resulted in above average production in 2003 (Canadian Wildlife Service Waterfowl Committee 2001, 2002, 2003). Late winters and harsh spring weather in the Arctic is often responsible for total or near-total failures in goose reproduction. Therefore, we do not view low reproduction years with late springs as a sign that the greater snow goose population is regulating itself. To the contrary, the preliminary spring 2006 population estimate increased to over 1 million birds.

188) Information contained in an HSUS Freedom of Information Act request included an internal FWS memo from a refuge staff employee in Texas. The memo stated that the refuge is blamed as the root of the light goose problem and is used to justify demands for more hunting opportunity. The memo further states that shifting geese to private lands will not mean more birds in the bag and that eliminating goose herbivory as a natural disturbance in the marshes would be undesirable. The commenter suggests 3 things to be taken from this memo: 1) it underscores the likely futility of liberalized goose regulations; 2) the Service should devote more time to the beneficial effects that light geese continue to have on at least some marsh areas in the U.S.; and 3) the suggestion by a Service employee that refuges are being pressured to open up more areas to hunting in order to pacify hunters, further illustrates the point that sport hunters are having a disproportionate influence on the decision process that should be grounded in science.

We addressed the success of liberalized goose regulations on increasing light goose harvest in our response to comment #28. We acknowledge that light geese play an integral role in the vegetation dynamics of some marshes in the U.S. However, we believe that, as in the arctic, the number of birds in some locations has risen to a point where the normal plant-herbivore interaction has been disrupted. With regard to sport hunters having a disproportionate influence on our decision process, we disagree. Numerous public comments from hunters indicate they wish to help solve the light goose problem, not that they only want additional hunting opportunity. Under our proposed alternative, individual refuges will still retain the power to manage their own hunting program if one exists. Establishment of any new hunting programs will be examined to determine if it is compatible with the purposes of the refuge. Therefore, sport hunters are not having a disproportionate influence on our decision process.

189) A concern was expressed that entreating hunters to spend more time and money hunting light geese for conservation purposes may make some hunters feel "it is their duty to attempt to shoot as many light geese as possible", which may increase the likelihood of hunters taking long shots and wounding birds. The commentor admits there is no direct support for this concern. However, if it does occur this would constitute waste, which the Arctic Goose Habitat Working Group and the Service have said should be avoided. Therefore the Service should develop a way to at least monitor waste.

As the commentor admits, there is no direct evidence to suggest that hunters are increasing wounding rates as a result of efforts to increase overall harvest. The increase in harvest has occurred largely as a result of additional days in which it is legal to harvest light geese, not because of hunters taking longer shots at birds. When polled, our Regional Law Enforcement offices did not report any instances of wanton waste associated with the conservation

Comments from Private Organizations (continued)

order. It would be extremely difficult to develop a new and separate monitoring system to attempt to monitor any waste that may occur during the conservation order. Furthermore, the lack of any evidence (in the form of citations) to suggest that such waste is occurring already makes the need for a new monitoring system a moot point.

190) Both the HSUS and API commented that the Service has misrepresented the conclusions of Thomas and MacKay (1998) when it attributes to these authors the suggestion that "isostatic uplift, not the feeding actions of geese, is responsible for habitat damage at breeding colony sites."

The reference to Thomas and MacKay (1998) with regard to isostatic uplift and vegetation damage has been removed.

191) The HSUS and API objected to our use of results from studies conducted by Gratto-Trevor (1994) and Rockwell et al. (1997b) to suggest that light geese are impacting other bird species. The validity of the methodology used by Rockwell et al. was questioned, and statements by Gratto-Trevor concerning the variety of factors that affect shorebird census, were used to argue against using such studies. Furthermore, it was argued that none of the species mentioned in these studies are threatened, endangered, or declining globally.

The fact that none of the species cited in the above studies are threatened, endangered, or declining locally is not germane to the issue of whether habitat degradation caused by light geese can impact other species. In our DEIS we specifically stated that results from these studies indicate local declines in areas damaged by light geese, and that the results were not presented to suggest continental declines of a particular species. Gratto-Trevor discussed several factors that affect shorebird censuses in the arctic, including breeding site fidelity. Buff-breasted sandpipers and Pectoral sandpipers were cited as species that do not exhibit site fidelity. However, Gratto-Trevor presented census results indicating declines in semi-palmated sandpipers and red-necked phalaropes, which were not included in her list of species that do not exhibit site fidelity. Therefore, we can only assume that these two species do indeed show site fidelity and that censuses repeated annually would be adequate to document declines. Gratto-Trevor stated that semi-palmated sandpipers and red-necked phalaropes in her study were individually recognizable (via unique color-band combinations) which, when combined with intensive nest searches, made it "possible to obtain an accurate estimate of the local breeding populations". Environmental factors such as weather and food availability were cited as factors that appeared to be related to the decrease in semi-palmated sandpipers, but foraging by snow geese "in the ever increasing local colony" was also cited as potentially having an impact on habitat quality for shorebirds. We believe that habitat destruction by the "ever increasing" goose colony in the 16 years between censuses conducted in 1983 and 1999 undoubtedly played a major role in the decline of these shorebird species in the area.

The study by Rockwell et al. (1997b) was criticized by the commentor as being conducted on only one site and therefore the results may not be applicable to birds in other regions. Furthermore, the data were criticized as apparently not being collected by way of a systematic census, but "almost as an after thought during the course of other research". In the description of study methods, Rockwell et al. (1997b:2-3) indicated that analyses were restricted to a time period when there was always a large number of individual observers in the field each day and that individuals were assigned specific, relatively small, study areas in which they spent the day collecting data on snow geese, vegetation in the marsh, and bird species encountered. Furthermore, Rockwell stated that in some years *systematic data* were also collected for semi-palmated sandpipers and red-necked phalaropes (among other species); which happen to be the 2 species for which we presented data for in section 3.3.2 of the EIS. Therefore, we believe Rockwell's study, as well as Gratto-Trevor's, are valid sources of information on the impacts of light geese on other species. In the Final EIS we have added results from the recent study by Sherfy and Kirkpatrick (2003) that indicated that snow geese may negatively influence the availability of invertebrates for other waterbirds in some managed wetland impoundments in the mid-Atlantic region.

192) The HSUS commented that in the Service's discussion of the *Branta canadensis interior* race of Canada geese, they implied that this race breeds only on Akimiski Island and on the west coast of James Bay. Citations are given that describe the range of *B.c. interior* to be much broader in geographic scope. There are no conservation concerns regarding either the species or subspecies of Canada goose identified in the document. Lesser snow geese are being made the villain in a highly volatile political situation in explaining a

Comments from Private Organizations (continued)

decline in a very small portion of the interior's range. This information does not justify an absurdly unfocused response to what may or may not be a localized concern as to encourage lethal culling in the southern U.S. in the assumption that it will relieve the situation with regard to a discreet and relatively tiny portion of an abundant species' overall range.

In our discussion of the Southern James Bay Population (SJBP) of Canada geese (page 57 of DEIS) we gave the scientific name of this population as *B.c. interior*. By identifying the specific population of geese within this subspecies, we were correct in describing the breeding range of SJBP as Akimiski Island and the west coast of James Bay. The fact that other populations of Canada geese within the B.c. interior subspecies breed elsewhere is inconsequential to our discussion specific to the SJBP situation. In no way did we state, or attempt to imply, that all B.c. interior geese breed only on Akimiski Island and the west coast of James Bay. We included the discussion of SJBP geese as the result of concerns expressed by Leafloor et al. (1996) which indicated that increasing populations of light geese may be negatively impacting SJBP birds. Our light goose management proposal is not solely in response to the SJBP issue, as the comment appears to suggest, but is a response to a variety of impacts that increasing population of light geese are causing.

193) The API commented that the proposed management action does not address the concern that anthropogenic mortality may usurp whatever, if any, natural selective processes of goose evolution that might occur. Lack of any reference to such concern is a serious flaw in the document. A recent study of translocated house finches in Montana and Alabama was cited as an example of how quickly reproductive strategies within a species can evolve so that they are more appropriate for their particular environment. Research papers indicating smaller clutch sizes, different maturation rates, smaller sizes, etc., in more populous light goose breeding areas tend to imply alarmist attitudes as if there is something fundamentally wrong to selection that does not favor what has been status quo. Light geese are evolving within the changing selective parameters of their environment, and is more likely in response to mostly anthropogenic-driven factors such as agricultural subsidies or global warming (versus being non-native as was the case with house finches).

We can only assume the reason to cite a concern that natural selection processes would be disrupted by increased human-induced mortality is the belief that, under the No Action alternative, light goose populations would rapidly evolve (through changes in clutch size, maturation rates, body size, etc.) to be more compatible with their changing breeding environment. Studies that have documented reductions in light goose clutch size, body mass, survival of goslings on nesting areas, etc., all cite the decrease in quantity and quality of food resources on breeding areas as the cause (see section 3.1.9). They further state that the decrease and degradation of food resources is due to the increased number of light geese on breeding areas that has overwhelmed the normal goose-plant interaction observed at lower goose densities. The decline in body size of offspring of individual females in different nesting years suggests an environmental, rather than genetic (or selectional), basis for the change (Cooch et al. 1991a). In other words, observed changes in the light goose population characteristics do not appear to be the result of evolution in reproductive strategies as suggested in the comment. Therefore, we do not believe that the population will regulate itself through changes in demographic factors such as clutch size rapidly enough to prevent further habitat damage. Our proposal to reduce the populations in a relatively short time period would not usurp natural processes of goose evolution and will help return bird densities to levels that the remaining plant communities can coexist with. We believe that reliance on density dependent mechanisms to reduce the goose populations have uncertain timetables and outcomes, and the amount of further habitat damage that will occur in the interim is unacceptable.

194) The API commented that there is no assessment given of the impact of activities associated with light-goose only hunting seasons on other wetland species. There is no assessment of the impact of numerous discharges of shotguns and amplified goose calls on the staging, mating, pair bonding or nesting activities of such species, and anecdotal evidence suggests that it is disruptive.

Comments from Private Organizations (continued)

We have incorporated information in the Environmental Consequences chapter of the Final EIS to address this comment. Numerous factors affect the staging, mating, pair bonding and nesting activities of wetland species. The Service lacks any comprehensive, quantitative information that would allow a broad evaluation of the impact of activities associated with either the light-goose only hunting seasons, or a conservation order. Hunting regulations allowed by the Migratory Bird Treaty Act permits the hunting of species that use the same habitats as other wetland species, and hunting activity may result in disturbance to protected birds (U.S. Fish and Wildlife Service 1975). Madsen and Fox (1995) reviewed the impacts of hunting disturbance on waterbirds. Their review of case studies indicated that the presence of hunters in the vicinity of waterbirds modifies the distribution and abundance of those birds in space and time. However, evidence for the ultimate impact of disturbance effects on individual birds is lacking (Madsen and Fox 1995). Madsen and Fox (1995) indicated that we have little understanding about the direct impact of hunting disturbance on birds at the population level. Most hunting activity associated with the light goose conservation order would take place in late winter in southern and mid-latitude States prior to the onset of breeding activities of other wetland species, and therefore would have little if any impact on such species. Depending on weather conditions, migration of light geese through northern latitude States in later winter and spring is usually rapid, and therefore the time window in which any impacts would occur to other species would be brief.

Annual regulations have an impact on all protected species, including endangered species, by prohibiting the hunting of these birds. Protected species are sometimes killed as a result of hunter activity; however we do not believe this is widespread. The loss of an individual or individuals of protected species results in the temporary reduction in the population, but there are no known cases where regulations permitting migratory bird hunting have resulted in the long-term decrease in a protected species population level (U.S. Fish and Wildlife Service 1975, U.S. Fish and Wildlife Service 1988). Section 7, Endangered Species Act consultations are required of all migratory game bird hunting regulations, as well as conservation order regulations, thus assuring that endangered species are not jeopardized by the regulations. Peak migration of whooping cranes through important stopover areas along the Platte River and other portions of Nebraska occur during April. Nebraska usually holds their light goose conservation order from mid-March to mid-April. Selection of such dates reduces potential impacts to whooping cranes. During the past five years, no whooping cranes have been shot incidental to efforts intended to increase harvest of light geese.

We point out that over 5 million acres of wetland habitat in the U.S. has been purchased through funds secured from the Service's Duck Stamp Program. This acreage is in addition to wetlands acquired through State programs. The Duck Stamp Program is a direct result of activities associated with waterfowl hunting because of the requirement for hunters to purchase a duck stamp. We believe the resulting preservation of wetland habitat likely outweighs any potential impacts that might be caused by activities associated with hunting seasons.

195) The API commented that Alternative B states that additional hunting pressure will be applied if desired population levels are not achieved within several years. What are the desired population levels and why are they desired? What does several years mean?

In sections 3.1.6 (greater snow geese) and section 3.1.7 (lesser snow and Ross's geese) we identified the NAWMP and Flyway Council population goals for each population. These goals were identified in the October 12, 2001 Federal Register notice (66 FR 52080). In the DEIS discussion of environmental consequences of our preferred alternative we described in detail the number of birds that would need to be removed from each population in order to reach these population goals. The goals are desired so that the number of geese is lowered to levels that are more compatible with their habitat. We have removed reference to the authorization of additional methods of take in the future.

196) The API questioned why the Service's intent is ambiguously stated as "reduce and/or stabilize" light goose population levels? There is no proof that reduction of the population would equal stabilization, or that stabilization is possible.

We utilized the phrase reduce and/or stabilize so that the special regulations could be used at different population levels. For instance, more aggressive regulations may be needed to reduce a population to the population goal.

Comments from Private Organizations (continued)

Stabilization of the population would be achieved by implementing less aggressive "maintenance regulations" to prevent the population from rebounding.

197) The API commented that the EIS discussion of greater snow geese traditionally staging during October almost exclusively on the St. Lawrence within a relatively small area of bulrush marshes before leaving appears to come only from anecdotal sources, which apparently are acceptable to the Service under certain circumstances. It is not clear from the text how a non-stop flight from Ungava in late August led to birds staging during October almost exclusively on the St. Lawrence. After four weeks of nonstop flying they made it to the St. Lawrence. How slowly did they fly?

We cited Reed et al. (1998) as the source of the discussion of greater snow goose use of bulrush marshes on the St. Lawrence. The observations of goose habitat use come from aerial surveys conducted on the staging areas since the mid-1950s (Reed et al. 1998). Reed et al. also cite the studies conducted by Heyland (1972), Bourget 1974, and Gauvin and Reed (1987) in this discussion. Therefore, we believe that use of such information is more reliable than relying on anecdotal information. The comment with regard to our description of the migration from Ungava to the St. Lawrence, apparently has been made as a result of misinterpretation of the document text. We did not state that the migration was completed by flying nonstop for four weeks, and to suggest otherwise is an unfortunate attempt to discredit our general description of migration chronology. We stated that birds leave breeding areas in mid-August and then make an initial flight to the Ungava Peninsula. Geese stage there for several days before they undertake another long migration to the St. Lawrence. We made no mention of the length of time required for this second leg of migration. Mention of the month of October was not connected with the description of migration, and was made only with regard to changes in habitat use by geese that use the St. Lawrence staging area.

198) It is unclear whether greater snow geese cause damage to marshes, which face increased risk from ice damage and high water levels (due to global warming) that are of much greater magnitude that could be achieved by grubbing geese.
Vegetation studies conducted in the 1980s concluded that geese and marshes were at equilibrium but at a low-level steady state. However, such studies were conducted when the goose population was less than half of current levels. Due to decreased use of marshes by geese, declining productivity of bulrush, and changes in plant species composition in the last decade suggest that the carrying capacity of the marshes has been reached and they could no longer accommodate the increased number of geese. These studies did not assess the potential role of higher water levels on marsh vegetation, therefore we cannot address that issue.

199) The API commented that the Document speculates (top of page 56) that, although marshes that have experienced 'eat outs', they may recover 'relatively quickly…areas that are grazed by geese year after year may be maintained as mudflats.' This is a non-sequitor, as a pure mudflat, devoid of plant biomass at or below ground level, obviously cannot be 'grazed by geese year after year' or for even one year. Geese don't graze on mud in the absence of vegetation, and such mud would not sustain geese. If the mudflat is not devoid of vegetation above, at, or below surface level then obviously there is reason to believe that it is a viable zone for feeding by mudflat-dependent species such as the Red Knot." As the Red Knot is in decline it would be helpful to know if it, or any of many other shorebird species, would benefit from maintenance of mudflats along the U.S. Atlantic coast. The API stated, "that is the kind of 'assessment' we were hoping for and believe the American people deserve.

We do not believe that reference to recovery of eat-outs and maintenance of mudflats on mid-Atlantic marshes was speculation on our part. In the DEIS discussion (page 56) we were citing results of studies by Giroux et al. (1998), Widjeskog (1977), Smith and Odum (1981), and Young (1985). The comment fails to mention our citation of these studies. Young (1985) used the term "graze" in describing all modes of feeding by snow geese. For example, Young stated that geese have been reported to "graze" to a soil depth of approximately 25 cm. Mudflat conditions appear after an eat-out, but that does not mean that all belowground plant biomass has been removed by geese. Therefore, a mudflat condition does not require, as the commentor states, complete removal of vegetation below surface level. Marsh vegetation can re-establish if belowground biomass is available (Smith and Odum 1981); and therefore geese can graze in a marsh year after year even if mudflat conditions appear during a portion of the year.

Comments from Private Organizations (continued)

However, if geese continue to remove belowground biomass year after year from a particular marsh there may be insufficient "reserve biomass" available to provide for re-growth (Smith and Odum 1981). A comprehensive review of the importance of mudflat maintenance to shorebirds along the U.S. Atlantic coast is beyond the scope of this document.

200) The API commented that the EIS does not assess the role of hunting as a contributing factor to alleged greater snow goose impacts on marshland vegetation.

In the Final EIS we have added a discussion of the role of hunting as it influences patterns of goose activity in marshes and adjacent fields in the St. Lawrence River valley. During the early 1960s geese spent the majority of their feeding time in natural bulrush marshes. There is no evidence to suggest that hunting pressure forced geese to use such habitat exclusively. Snow geese have evolved foraging strategies such as grubbing to take advantage of belowground food resources such as those found in natural bulrush marshes. Therefore, geese were using bulrush marshes because it was their preferred habitat, not because they were forced into such habitats by hunting pressure. Only when the population began to increase in size did geese begin to use other habitat to a greater degree. It is thought that geese had exceeded the carrying capacity of the bulrush marshes and were forced to seek food resources in other natural habitats (e.g. cordgrass marshes) and agricultural habitats.

201) The HSUS commented that populations of lesser snow geese and Ross' geese in the western Arctic are given short shrift in the DEIS, probably because of the lack of evidence of "damage" to vegetation on the breeding grounds in that region. In addition, the Service expresses concern over the dangerously low reproductive output and small population of Wrangel Island lesser snow geese. Wrangel Island birds migrate and winter in areas that overlap with those from birds of the western and central Arctic. However, the concern for Wrangel Island birds does not stop the Service from including the option of implementing special regulations in the Pacific Flyway if damage to western Arctic habitats becomes evident. If the known impacts of western Arctic light geese on breeding grounds is accurate, then there is no scientific basis for including the Pacific Flyway in the preferred alternative. A separate EIS for the Pacific Flyway should be conducted prior to any actions being taken there.

In response to this comment, we have included additional information on the status of western Arctic light geese in the Final EIS. Because this EIS is a comprehensive treatment of light goose management we do not believe it would be appropriate to omit the Pacific Flyway from our analysis. We clearly state in the preferred alternative that the Pacific Flyway will be eligible to implement special light goose regulations only if damage to breeding habitats in the western Arctic becomes evident. At this time, we are not recommending that the Pacific Flyway should implement such regulations. However, we point out that the number of light geese in the western Arctic is increasing and biologists have already broached the subject of the need to monitor the situation and possibly take actions to stabilize the number of birds in the western Arctic before they escape control via normal harvest and become overabundant (Hines et al. 1999, Canadian Wildlife Service Waterfowl Committee 2000). In the analysis of our preferred alternative in section 4.2.2 we clearly stipulate that any regulations implemented in the Pacific Flyway to reduce western Arctic birds should be designed to avoid increased harvest of Wrangel Islands birds. Inclusion of the Pacific Flyway in the current EIS does not preclude us from conducting additional NEPA analyses in the future, if we decide to implement regulations in the Pacific Flyway.

202) The HSUS commented that, according to the Canadian Wildlife Service (2000), western Arctic lesser snow geese at the Anderson River colony and Kendall Island were "well below historic levels" in 2000, apparently due to a combination of high egg predation and a late spring. Liberalized hunting regulations in the Pacific Flyway may reduce the size of the much larger western Arctic colonies on Banks Island, but it may be difficult to predict whether decreases at the already small and declining colonies would occur only in proportion to their current size.

We reiterate that we are not recommending implementation of special light goose regulations in the Pacific Flyway at this time. The Canadian Wildlife Service has not expressed any conservation concerns for the smaller colonies of lesser snow geese at Anderson River and Kendall Island in the western Arctic. In 2003, the number of birds at

Comments from Private Organizations (continued)

Kendall Island appeared to be stable, while numbers at the Anderson River colony seemed to be declining due to high levels of egg predation by grizzly bears (Canadian Wildlife Service Waterfowl Committee 2003). Ongoing habitat studies at the larger colony sites on Banks Island are being used by the Canadian Wildlife Service to determine whether it is necessary to stabilize growth of that population to prevent habitat problems associated with grubbing and grazing by geese (Canadian Wildlife Service Waterfowl Committee 2003). We are not aware of any banding or neck collar observation data that would indicate whether or not birds from Anderson River and Kendall Island have similar migration pathways to those from Banks Island. However, given the relatively close proximity of the sites it is likely that birds from these colonies have similar migration behavior. Therefore, any special regulations implemented in the Pacific Flyway would likely harvest birds in proportion to the size of the colony.

203) The API commented that there appears to be a self-perpetuating juggernaut driving a fear of "light" goose population size. API stated that they met a student who was working hard to prove how much "damage" was being done by Ross's geese, because that is what her professor wanted, and not simply allowing her research to lead her where it would, without a political goal in sight. API is concerned about "behind-the-back pressures taken against informed individuals who have dared to question the Service's position on 'light' geese". API gave an account of their discussion with an ornithologist who has spent many summers in the arctic and is convinced there is no light goose problem, but has asked not to be quoted by name because much of his funding comes from Ducks Unlimited. API reported that they have been told off the record by "some CWS biologists that essentially the need to lethally cull light geese is driven by DU's agenda", and that there is little to distinguish DU's need to encourage waterfowl hunting, its connections to hunting to support industry and its need to be seen as an active participant in "conservation" – from the supportive agenda of many waterfowl management staff of the Service.

We believe that mention of un-substantiated hearsay of real, imagined, or implied pressure to suppress views of scientists, biologists, ornithologists, or anyone else that does not support the Service's management philosophy is unfortunate. Our light goose management program is being driven by our responsibility to conserve light geese, light goose habitat, and habitats important to other wildlife species; not by an alleged agenda of Ducks Unlimited. Furthermore, we believe that claims that the agenda of the waterfowl management staff of the Service is merely to support DU's need to encourage waterfowl hunting and its connection to hunting to support industry are without foundation. Such comments are an unfortunate slight against a dedicated staff that is working in the public's trust to conserve a valuable wildlife resource.

204) The Friends of Animals suggested that proposals that advocate slaughter of animals tend to overlook more respectful and enlightened means toward stewardship. Instead, the Friends of Animals advocated "simply close-monitoring the breeding grounds would provide ample success and much more benefit to the management project".

Simply monitoring the breeding grounds will only document additional habitat damage that will undoubtedly occur as light geese continue to increase in number and cause additional damage to habitats before they move on to other areas to escape density dependence. We fail to see how simple monitoring can prevent such damage, and the Friends of Animals has provided no explanation how such an approach would prevent further damage.

205) The Policy Council of the American Bird Conservancy (ABC), which has 88 member organizations, concurred with the findings of the Arctic Goose Habitat Working Group and voted unanimously to support recommendations for a 50% reduction in the mid-continent light goose population. They urged close monitoring of the goose populations and habitat to determine when the threat to habitats has ended and control activities were no longer needed. The ABC does not support the No Action alternative, or alternatives that involve direct population control.

Thank you for your comment.

Comments from Private Organizations (continued)

206) The Wildlife Management Institute (WMI) supported Alternative B because it comes closest to meeting the recommendations of the Arctic Goose Stakeholder's Committee and the Arctic Goose Habitat Working Group. WMI expressed concern that the population goal chosen represents only a best guess as to what population level is appropriate, and urged the Service to be prepared to develop a new, even lower population target if habitat destruction is not halted and/or recovery is prevented. WMI urged monitoring of goose harvest and breeding populations to determine whether target reductions will be achieved, and supported research on a landscape level to determine if target population levels are sufficient to halt habitat degradation. WMI further urged the Service to be prepared to implement direct control on the wintering grounds if population reduction is not achieved.

Thank you for your comment.

207) The Pennsylvania Farm Bureau commented that increasing numbers of their membership are reporting damage to crops and property by snow geese. The Bureau supports proactive steps to reduce population levels of snow geese and associated agricultural damage. They further support a depredation program for snow geese on farms suffering damage from geese.

We believe that a reduction of the greater snow goose population will help to alleviate damage to agricultural crops in Pennsylvania and other Atlantic Flyway States. We issue depredation orders to permit the killing of migratory game birds that "…have accumulated in such numbers in a particular area as to cause or about to cause serious damage to agricultural, horticultural, and fish cultural interests…" (50 *CFR* Part 21.42). Light goose damage to natural marsh and tundra habitats is not covered by depredation order regulations. However, light geese also cause damage to crops such as hay and cereal grains. In such cases, farmers would be eligible to apply for a depredation permit (50 *CFR* Part 21.41).

208) The National Rifle Association (NRA) supported changes in regulations that would increase the harvest of light geese. With regard to changes in refuge habitat management, they suggested that natural food habitats may be severely impacted if agricultural crops are removed from refuges. They urged retention of some agricultural areas in certain situations to serve as buffers for natural habitats against light goose foraging.

Each refuge will make changes to their agricultural crop programs that are compatible with their biological program.

209) Ducks Unlimited, Inc. (DU) supports Alternative B for reducing light goose populations and believes the problem must be addressed since an enormous region of critical waterfowl and other water bird habitats will ultimately be destroyed if no action is taken. DU believes Alternative B is most appropriate because it will keep financial costs to the public very low.

Thank you for your comment.

210) The U.S. Sportsmen's Alliance agreed that light goose populations must be controlled and they supported Alternative B.

Thank you for your comment.

211) The New Jersey Waterfowl Association supported Alternative B and commented that the No action alternative, as well as alternatives that advocated direct control, would represent a waste of the goose resource.

Thank you for your comment.

Comments from Private Organizations (continued)

212) The United Kennel Club, Inc. (UKC) supported Alternative B to reduce light goose populations because it provides hunting opportunities and retains what is left of tundra habitat. The UKC commented that other alternatives either are not effective, or are not cost effective.

Thank you for your comment.

CHAPTER 8

LITERATURE CITED

Abraham, K. F., R. L. Jefferies, R. F. Rockwell, and C. D. MacInnes. 1996. Why are there so many white geese in North America? 7th International Waterfowl Symposium, Memphis, TN.

_____ and _____. 1997. High goose populations: causes, impacts and implications. Pages 7-72 *in* B. D. J. Batt, ed. Arctic Ecosystems in Peril: Report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 120 pp.

Alisauskas, R. 1998. Nutritional ecology and population biology of Ross' geese. Progress Report March 1998. Can. Wildl. Serv., Saskatoon, Saskatchewan. 27pp.

Alisauskas, R. 2000. Nutritional ecology and population biology of Ross' geese. Progress Report March 2000. Can. Wildl. Serv., Saskatoon, Saskatchewan. 18pp.

_____, and R. Malecki. 2003. Direct control methods for population reduction of light geese in the Arctic. Pages 43-86 in Johnson, M.A., C.D. Ankney, editors. 2003. Direct control and alternative harvest strategies for North American light geese: Report of the Direct Control and Alternative Harvest Measures Working Group. Arctic Goose Joint Venture Special Publication. U.S. Fish and Wildlife Service, Washington, DC and Canadian Wildlife Service, Ottawa, Ontario.

_____, S.M. Slattery, D.K. Kellett, D.S. Stern, and K.D. Warner. 1998. Spatial and temporal dynamics of Ross's and snow goose colonies in Queen Maud Gulf Bird Sanctuary, 1966-1998. Canadian Wildlife Service, Saskatoon, Saskatchewan. 21pp.

_____, C. D. Ankney, and E. E. Klaas. 1988. Winter diets and nutrition of mid-continental lesser snow geese. J. Wildl. Manage. 52:403-414.

Anderson, W.L., S.P. Havera, and B.W. Zercher. 2000. Ingestion of lead and nontoxic shotgun pellets by ducks in the Mississippi Flyway. J. Wildl. Manage. 64:848-857.

Ankney, C. D. and C. D. MacInnes. 1978. Nutrient reserves and reproductive performance of female lesser snow geese. Auk 95:459-471.

Arctic Goose Habitat Working Group. 1997. Conclusions and recommendations for future actions. Pages 117-120 *in* B. D. J. Batt, ed. Arctic Ecosystems in Peril: Report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 120 pp.

Arctic Goose Joint Venture Technical Committee. 1998. Science needs for the management of increasing snow goose populations. Arctic Goose Joint Venture Special Publication. Canadian Wildlife Service, Ottawa, Ontario and U.S. Fish and Wildlife Service, Washington, D.C. 61pp.

_____. 2001. Science needs for the adaptive management of the greater snow goose. Arctic Goose Joint Venture Special Publication. Canadian Wildlife Service, Ottawa, Ontario and U.S. Fish and Wildlife Service, Washington, D.C. 78pp.

Armstrong, W.T., K.M. Meeres, R.H. Kerbes, W.S. Boyd, J.G. Silveira, J.P. Taylor, and B. Turner. 1999. Routes and timing of migration of lesser snow geese from the western Canadian Arctic and Wrangel Island, Russia, 1987-92. Pages 75-88 *in* R.H. Kerbes, K.M. Meeres, and J.E. Hines (eds.),

Distribution, survival, and numbers of lesser snow geese of the Western Canadian Arctic and Wrangel Island, Russia. Can. Wildl. Serv. Occas. Pap. No. 98, Ottawa, Ontario.

Backstrand, J.M., and R.G. Botzler. 1986. Survival of *Pasteurella multocida* in soil and water in an area where avian cholera is enzootic. J. Wildl. Diseases 22:257-259.

Batt, B. D. J., editor. 1997. Arctic ecosystems in peril: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario.

Barry, T. W. 1960. Waterfowl reconnaissance in the western Arctic. Arct. Circ. 13:51-58.

Bateman, H.A., T. Joanen, and C.D. Stuzenbaker. 1988. History and status of mid-continent snow geese on their Gulf Coast winter range. Pages 495-515 In: M.W. Weller (ed), Waterfowl in Winter, University of Minnesota Press, Minneapolis. 624pp.

Bazely, D.R. and R.L. Jefferies. 1989. Leaf and shoot demography of an Arctic stoloniferous grass, Puccinellia phryganodes. J. Ecol. 77:811-822.

Bedard, J. and G. LaPointe. 1991. Responses of hayfields vegetation to spring grazing by greater snow geese Chen caerulescens atlantica. J. Appl. Ecol. 28:187-93.

Bellrose, F. C. 1980. Ducks, Geese, and Swans of North America. Stackpole Books, Harrisburg, PA.

Bent, A.C. 1962. Life histories of North American wild fowl. Part II. Dover Publications, Inc. New York. (Reprint of 1925 publication).

Bolen, E.G., and M.K. Rylander. 1978. Feeding adaptations in the lesser snow goose (Anser caerulescens). Southwest. Nat. 23:158-161.

Botzler, R.G. 1991. Epizootiology of avian cholera in wildfowl. J. Wildl. Dis. 27:367-395.

Bourget, A. 1974. Migrations de la sauvagine dans la region de Quebec. Pages 66-72 in H. Boyd (ed.) Waterfowl studies in eastern Canada, 1969-73. Canadian Wildlife Service, Report Series Number 29.

Boyd, H., G. E. J. Smith and F. G. Cooch. 1982. The lesser snow goose of the eastern Canadian Arctic: their status during 1964-1979 and their management from 1982-1990. Canadian Wildlife Service Occasional Paper No. 46. 21 pp.

Brand, C.J. 1984. Avian cholera in the Central and Mississippi Flyways during 1979-80. J. Wildl. Manage. 48:399-406.

Canadian Wildlife Service. 2005. The migration of waterfowl – The migration of greater snow goose and Canada goose: Economic benefits far outweigh costs. The Flight 2 (November 2005): 2 pp.

Canadian Wildlife Service Waterfowl Committee. 2000. Population status of migratory game birds in Canada: November 2000. CWS Migr. Birds Regul. Rep. No. 1.

Canadian Wildlife Service Waterfowl Committee. 2001. Population status of migratory game birds in Canada: November 2001. CWS Migr. Birds Regul. Rep. No. 4.

Canadian Wildlife Service Waterfowl Committee. 2002. Population status of migratory game birds in Canada: November 2002. CWS Migr. Birds Regul. Rep. No. 7.

Canadian Wildlife Service Waterfowl Committee. 2003. Population status of migratory game birds in Canada: November 2003. CWS Migr. Birds Regul. Rep. No. 10.

Caswell, J.H., A.D. Afton, and F.D. Caswell. 2003. Vulnerability of nontarget goose species to hunting with electronic snow goose calls. Wildl. Soc. Bull. 31:1117-1125.

Chou, R., C. Vardy and R.L. Jefferies. 1992. Establishment from leaves and other plant fragments produced by the foraging activities of geese. Functional Ecol. 6:297-301.

Cooch, E.G., D.B. Lank, R.F. Rockwell and F. Cooke. 1989. Long-term decline in fecundity in a snow goose population: evidence for density dependence? J. Animal Ecol. 58:711-726.

_____, _____, R.F. Rockwell and F. Cooke. 1991a. Long-term decline in body size in a snow goose population: evidence of environmental degradation? J. Animal Ecol. 60:483-496.

_____, _____, A. Dzubin, R.F. Rockwell and F. Cooke. 1991b. Body size variation in lesser snow geese: environmental plasticity in gosling growth rates. Ecology 72:503-512.

_____, R.F. Rockwell, and S. Brault. 2001. Retrospective analysis of demographic responses to environmental change: a lesser snow goose example. Ecol. Monogr. 71:377-400.

Cooper, J.A., and T. Keefe. 1997. Urban Canada goose management: Policies and procedures. Transactions of the North American Wildlife and Natural Resources Conference 62:412-430.

Delaware Division of Fish and Wildlife. 2000. Greater snow goose season and damage evaluation 1999-2000. 2pp.

Didiuk, A.B., R.T. Alisauskas, and R.F. Rockwell. 2001. Interaction with Arctic and subarctic habitats. Pages 17-26 in T.J. Moser, ed. The status of Ross's geese. Arctic Goose Joint Venture Ross's Goose Subcommittee. 65pp.

Duda, Mark, et al. 1995. Factors Related to Hunting and Fishing Participation in the United States: Phase IV: Quantitative Analysis. Harrisonburg, VA. Responsive Management.

Federal-State Contingency Plan Committee. 2000. 2000-2001 Contingency Plan: Federal-State Cooperative Protection of Whooping Cranes. 36pp.

Feret, M., G. Gauthier, A. Bechet, J-F. Giroux, and K.A. Hobson. 2003. Effect of a spring hunt on nutrient storage by greater snow geese in southern Quebec. J. Wildl. Manage. 67:796-807.

Ferguson, C. 1999. Waterfowl productivity surveys for the Atlantic Flyway – 1999. Pages 2-7 *in* J. Bidwell, ed. Productivity surveys of geese, swans, and brant wintering in North America 1999. U.S. Dept. Interior, Fish and Wildl. Serv., Arlington, VA. 79pp.

Filion, B., D. Luszcz, and G. Allard. 1998. Impact of geese on farmlands. Pages 58-64 *in* B. D. J. Batt, ed. The greater snow goose: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 88pp.

Friend, M. 1999. Avian cholera. Pages 75-98 *in* M. Friend and J.C. Franson, eds. Field manual of wildlife diseases. U.S. Dept. of Interior, Biological Resources Division, Information and Technology Report 1999-001.

Fronczak, D. 2003. Waterfowl harvest and population survey data. U.S. Fish and Wildlife Service, Columbia, Missouri. 92pp.

Gauthier, G., Y. Bedard, and J. Bedard. 1988. Habitat use and activity budgets of greater snow geese in spring. J. Wildl. Manage. 52:191-201.

_____, and S. Brault. 1998. Population model of the greater snow goose: projected impacts of reduction in survival on population growth rate. Pages 65-80 *in* B. D. J. Batt, ed. The greater snow goose: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 88pp.

Gauvin, J. and A. Reed. 1987. A simulation model for the greater snow goose population. Canadian Wildlife Service, Occasional Paper Number 64. 26pp.

Giroux, J-F., and J. Bedard. 1987. The effects of grazing by greater snow geese on the vegetation of tidal marshes in the St. Lawrence estuary. J. Appl. Ecol. 24:773-788.

_____, G. Gauthier, G. Costanzo, and A. Reed. 1998. Impact of geese on natural habitats. Pages 32-57 *in* B. D. J. Batt, ed. The greater snow goose: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 88pp.

_____, B. Batt, S. Brault, G. Costanzo, B. Filion, G. Gauthier, D. Luszcz, and A. Reed. 1998. Conclusions and management recommendations. Pages 81-88 *in* B. D. J. Batt, ed. The greater snow goose: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 88pp.

Goodman, D.C., and H.I. Fisher. 1962. Functional anatomy of the feeding apparatus in waterfowl. Southern Illinois University Press, Carbondale, Illinois. 193pp.

Gratto-Trevor, C. 1994. Monitoring shorebird populations in the Arctic. Bird Trends 3:10-12.

Handa, I.T., and R.L. Jefferies. 2000. Assisted revegetation trials in degraded salt-marshes. J. Appl. Ecol. 37:944-958.

_____, R. Harmsen, and R.L. Jefferies. 2002. Patterns of vegetation change and the recovery potential of degraded areas in a coastal marsh system of the Hudson Bay lowlands. J. Ecol. 90:86-99.

Hanson, H. C., P. Queneau, and P. Scott. 1956. The geography, birds, and mammals of the Perry River region. Arct. Inst. North Am. Spec. Publ. 3. 98 pp.

Helm, R. 2002. Results of the January 2002 Ross's goose survey. Louisiana Department of Wildlife and Fisheries, Baton Rouge, Louisiana. 3pp.

Heyland, J.D. 1972. Vertical aerial photography as an aid in wildlife population studies. Pages 121-136 in First Canadian Symposium on Remote Sensing.

Hik, D.S and R.L. Jefferies. 1990. Increases in the net above-ground primary production of a salt-marsh forage grass: a test of the predictions of the herbivore-optimization model. J. Ecology 78:180-195.

_____, R.L. Jefferies, and A.R.E. Sinclair. 1992. Foraging by geese, isostatic uplift and asymmetry in the development of salt-marsh plant communities. J. Ecology 80:395-406.

Hines, J.E., V.V. Baranyuk, B. Turner, W.S. Boyd, J.G. Silveira, J.P. Taylor, S.J. Barry, K.M. Meeres, R.H. Kerbes, and W.T. Armstrong. 1999. Autumn and winter distribution of lesser snow geese from the

Western Canadian Arctic and Wrangel Island, Russia, 1953-1992. Pages 39-73 *in* R.H. Kerbes, K.M. Meeres, and J.E. Hines (eds.), Distribution, survival, and numbers of lesser snow geese of the Western Canadian Arctic and Wrangel Island, Russia. Can. Wildl. Serv. Occas. Pap. No. 98, Ottawa, Ontario.

Iacobelli, A. and R.L. Jefferies. 1991. Inverse salinity gradients in coastal marshes and the death of stands of Salix: the effects of grubbing by geese. J. Ecol. 79:61-73.

Jano, A.P., R.L. Jefferies, and R.F. Rockwell. 1998. The detection of vegetational change by multitemporal analysis of LANDSAT data: the effects of goose foraging. J. Ecology 86:93-99.

Jefferies, R.L., and L.D. Gottlieb. 1983. Genetic variation with and between populations of the asexual plant Puccinellia x phryganodes. Can. J. Bot. 61:774-779.

_____, F.L. Gadallah, D.S. Srivastava, and D.J. Wilson. 1995. Desertification and trophic cascades in arctic coastal ecosystems: a potential climate change scenario? Pages 201-206 *in* T.V. Callaghan et al. (eds.) Ecosystems research report 10. Global change and Arctic terrestrial ecosystems. Proceedings of Papers Contributed to the International Conference, 21-26 August 1993, Oppdal, Norway. Environment Programme of Directorate-General XII – Science, Research, Development of the European Commission.

_____, and R.F. Rockwell. 2002. Foraging geese, vegetation loss and soil degradation in an Arctic salt marsh. Applied Veg. Sci. 5:7-16.

Johnsgard, P.A. 1974. Song of the north wind: a story of the snow goose. Anchor Press/Doubleday, Garden City, New York. 150pp.

Johnson, M.A. 1997. Management strategies to address the mid-continent lesser snow goose overpopulation problem. Pages 101-111 *in* B. D. J. Batt, ed. Arctic Ecosystems in Peril: Report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 120 pp.

Keefe, T. 1996. Feasibility study on processing nuisance Canada geese for human consumption. Minnesota Department of Natural Resources. 7 pp.

Kerbes, R.H. 1974. Colonies and numbers of Ross' geese and lesser snow geese in the Queen Maud Gulf Migratory Bird Sanctuary. Can. Wildl. Serv. Occas. Pap. No. 81, Ottawa, Ontario.

_____. 1975. The nesting population of lesser snow geese in the eastern Canadian arctic: a photographic inventory of June 1973. Can. Wildl. Serv. Rep. Ser. No. 35.

_____. 1994. Colonies and numbers of Ross' geese and lesser snow geese in the Queen Maud Gulf Migratory Bird Sanctuary. Can. Wildl. Serv. Occ. Pap. No. 81. 45pp.

_____, R.H., P.M. Kotanen, R.L. Jefferies. 1990. Destruction of wetland habitats by lesser snow geese: a keystone species on the west coast of Hudson Bay. J. Applied Ecology 27:242-258.

_____, R.H., V.V. Baranyuk, and J.E. Hines. 1999. Estimated size of the Western Canadian Arctic and Wrangel Island lesser snow goose populations on their breeding and wintering grounds. Pages 25-38 *in* R.H. Kerbes, K.M. Meeres, and J.E. Hines (eds.), Distribution, survival, and numbers of lesser snow geese of the Western Canadian Arctic and Wrangel Island, Russia. Can. Wildl. Serv. Occas. Pap. No. 98, Ottawa, Ontario.

Kotanen, P.M., and R.L. Jefferies. 1987. The leaf and shoot demography of grazed and ungrazed plants of Carex subspathacea. J. Ecol. 75:961-975.

Kotanen, P.M., and R.L. Jefferies. 1997. Long-term destruction of sub-arctic wetland vegetation by lesser snow geese. Ecoscience 4:179-182.

Leafloor, J. O., K. F. Abraham, D. H. Rusch, R. K. Ross, and M. R. J. Hill. 1996. Status of the Southern James Bay Population of Canada geese. 7th International Waterfowl Symposium, Memphis, TN.

Lewis, J.C., G. Archibald, R.C. Drewien, R. Edwards, G. Gee, B. Huey, L. A. Linam, R.A. Lock, S. Nesbitt, and T. Stehn. 1994. Whooping crane recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico, USA.

Lynch, J. J. 1975. Winter ecology of snow geese on the Gulf Coast, 1925-1975. 37th Midwest Fish and Wildlife Conference, Toronto. 45 pp.

Madsen, J., and A.D. Fox. 1995. Impacts of hunting disturbance on waterbirds – a review. Wildl. Biol. 1:193-207.

Mainguy, J., J. Bety, G. Gauthier, and J-F. Giroux. 2002. Are body condition and reproductive effort of laying greater snow geese affected by the spring hunt? Condor 104:156-161.

Maisonneuve, C. and J. Bedard. 1992. Chronology of autumn migration of greater snow geese. J. Wildl. Manage. 56:55-62.

Martin, Elwood M. and Paul I. Padding. 1997. Administrative Report - July 1997, Preliminary Estimates of Waterfowl Harvest and Hunter Activity in the United States during the 1996 Hunting Season. Laurel, Md.: U.S. Fish and Wildlife Service, Office of Migratory Bird Management.

Masse, H., L. Rochefort, and G. Gauthier. 2001. Carrying capacity of wetland habitats used by breeding greater snow geese. J. Wildl. Manage. 65:271-281.

McIlhenny, E.A. 1932. The blue goose in its winter home. Auk 49:279-306.

Mensik, G., and J. Silveira. 1993. Status of Ross' and lesser snow geese wintering in California, December 1992. USFWS unpublished report.

Mowbray, T.B., F. Cooke, and B. Ganter. 2000. Snow goose (Chen caerulescens). The birds of North America, No. 514 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Olsen, R.E., and A.D. Afton. 2000. Vulnerability of lesser snow geese to hunting with electronic calling devices. J. Wildl. Manage. 64:983-993.

Pacific Flyway Council. 1992. Pacific Flyway Management Plan for Ross' geese. Subcommittee on White Geese. Portland, OR. 24pp.

Reed, A. 1989. Use of a freshwater tidal marsh in the St. Lawrence estuary by greater snow geese. Pages 605-616 in R.R. Sharitz and J.W. Gibbons (eds.). Freshwater wetlands and wildlife. USDOE Office of Scientific and Technical Information. Tennessee.

Reed, A., and N. Plante. 1997. Decline in body mass, size, and condition of greater snow geese, 1975-94. J. Wildl. Manage. 61:413-419.

_____ , J-F Giroux, and G. Gauthier. 1998. Population size, productivity, harvest and distribution. Pages 5-31 *in* B. D. J. Batt, ed. The greater snow goose: report of the Arctic Goose Habitat Working Group.

Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 88pp.

_____, G. Gauthier, and J-F Giroux. 2000. Population and productivity surveys of greater snow geese in 2000. Report to the USFWS and the Atlantic Flyway Technical Section, February 2000. 6pp.

Robertson, D. G., and R. D. Slack. 1995. Landscape change and its effects on the wintering range of a lesser snow goose *Chen caerulescens caerulescens* population: a review. Biological Conservation 71:179-185.

Rocke, T.E., and M. Friend. 1999. Avian botulism. Pages 271-281 *in* M. Friend and J.C. Franson, eds. Field manual of wildlife diseases. U.S. Dept. of Interior, Biological Resources Division, Information and Technology Report 1999-001.

Rockwell, R.F. 1999. The impact of snow geese on nesting birds at La Perouse Bay. Interim report of the second year's activities – 10/15/99, Hudson Bay Project. 4pp.

_____, E.G. Cooch, C.B. Thompson, and F. Cooke. 1993. Age and reproductive success in female lesser snow geese: experience, senescence and the cost of philopatry. J. Animal Ecol. 62:323-333.

_____, and C.D. Ankney. 2000. Snow geese: can we pay down the mortgage? Pages 32-24 in: H. Boyd (ed.) Population modeling and management of snow geese. Can. Wildl. Serv., Occas. Pap. No. 102.

_____, E. Cooch, and S. Brault. 1997a. Dynamics of the Mid-continent population of lesser snow geese: projected impacts of reductions in survival and fertility on population growth rates. Pages 73-100 *in* B. D. J. Batt, ed. Arctic Ecosystems in Peril: Report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, D.C. and Canadian Wildlife Service, Ottawa, Ontario. 120 pp.

_____, D. Pollack, K. F. Abraham, P. M. Kotanen, and R. L. Jefferies. 1997b. Are there declines in bird species using La Pérouse Bay? The Hudson Bay Project status report for Ducks Unlimited, Inc.

Ryder, J. P. 1969. Nesting colonies of Ross' goose. Auk:86-282-292.

_____, and R.T. Alisauskas. 1995. Ross' goose (Chen rossii). *In:* The birds of North America, No. 162 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.

Samuel, M.D., D.R. Goldberg, D.J. Shadduck, J.I. Price, and E.G. Cooch. 1997. *Pasteurella multocida* serotype 1 isolated from a lesser snow goose: evidence of a carrier state. J. Wildl. Diseases 33:332-335.

_____ J.Y. Takekaws, G. Samelius, and D.R. Goldberg. 1999a. Avian cholera mortality in lesser snow geese nesting on Banks Island, Northwest Territories. Wildl. Soc. Bull. 27:780-787.

_____, J.Y. Takekawa, V.V. Baranyuk, and D.L. Orthmeyer. 1999b. Effects of avian cholera on survival of lesser snow geese *Anser caerulescens*: an experimental approach. Bird Study 46(Suppl.):S239-S247.

_____, K.A. Converse, and K.J. Miller. 2001. Diseases affecting Ross's geese. Pages 27-35 in T.J. Moser, ed. The status of Ross's geese. Arctic Goose Joint Venture Ross's Goose Subcommittee. 65pp.

Sargeant, A.B., and D.G. Raveling. 1992. Mortality during the breeding season. Pages 396-422 in B.D.J. Batt, A.D. Afton, M.G. Anderson, C.D. Ankney, D.H. Johnson, J.A. Kadlec, and G.L. Krapu,

editors. Ecology and management of breeding waterfowl. University of Minnesota, Minneapolis, USA.

Serie, J., and B. Raftovich. 2000. Atlantic Flyway waterfowl harvest and population survey data, July 2000. U.S. Dept. Interior, Fish and Wildlife Service. Laurel, MD. 90pp.

Sharp, D.E., and T.J. Moser. 1999. Light geese in the Central Flyway. U.S. Dept. Interior, Fish and Wildlife Service. Denver, CO. 34pp.

Sharp, D.E., and T.J. Moser. 2000. Light geese in the Central Flyway. U.S. Dept. Interior, Fish and Wildlife Service. Denver, CO.

Sherfy, M.H., and R.L. Kirkpatrick. 2003. Invertebrate response to snow goose herbivory on moist-soil vegetation. Wetlands 23:236-249.

Silveira, J.G. 1989. Distribution of lesser snow and Ross's geese in California, winter 1988-89. Unpublished report, California Department of Fish and Game, Sacramento, California.

_____. 1990. Distribution of lesser snow and Ross's geese in California, winter 1989-90. Unpublished report, California Department of Fish and Game, Sacramento, California.

Smith, T.J. III and W.D. Odum. 1981. The effects of grazing by snow geese on coastal salt marshes. Ecology 62:98-106.

Smith, A.E., S.R. Craven, and P.D. Curtis. 1999. Managing Canada geese in urban environments. Jack Berryman Institute Publication 16, and Cornell University Cooperative Extension, Ithaca, N.Y.

Sovada, M.A., R.M. Anthony, and B.D.J. Batt. 2001. Predation on waterfowl in arctic tundra and prairie breeding areas: a review. Wildl. Soc. Bull. 29:6-15.

Srivastava, D.S., and R.L. Jefferies. 1996. A positive feedback: herbivory, plant growth, salinity, and the desertification of an Arctic salt-marsh. J. Ecol. 84:31-42.

Stakeholders Committee on Arctic Nesting Geese. 1998. Report of the Stakeholders Committee on Arctic Nesting Geese. Unpublished report. 5pp.

Sullivan, B. D. 1995. Estimates of Ross' geese wintering in Texas during 1994-95. Texas Parks and Wildlife Department, Austin, TX. 3pp.

Taylor, J.P., and R.E. Kirby. 1990. Experimental dispersal of wintering snow and Ross' geese. Wildl. Soc. Bull. 18:312-319.

Teisl, M.F., and R. Southwick. 1995. The economic contributions of bird and waterfowl recreation in the United States during 1991. Southwick Associates, Arlington, VA. 11pp.

Thomas, V.G., and B.K. MacKay. 1998. A critical evaluation of the proposed reduction in the mid-continent lesser snow goose population to conserve sub-arctic salt marshes of Hudson Bay. Special Scientific Report. Animal Protection Institute and The Humane Society of the United States. Washington, D.C. 32pp.

Thorpe, P. 2000. Western Central Flyway Light Goose Productivity Report – 2000. Pages 19-27 in J. Bidwell, ed. Productivity surveys of geese, swans, and brant wintering in North America 2000. U.S. Dept. Interior, Fish and Wildl. Serv. Arlington, VA. 89pp.

U.S. Department of Agriculture. 1999. 1997 National Resources Inventory. Internet site: http://www.nhq.nrcs.usda.gov/land/publs/97highlights.html.

U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of the Census. 1997. 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation.

_____, Environment Canada, and Secretaria de Medio Ambiente, Recursos Naturales, y Pesca. 1998. 1998 Update to the North American Waterfowl Management Plan: expanding the vision. Washington, D.C.

U.S. Fish and Wildlife Service. 1975. Final Environmental Statement: Issuance of annual regulations permitting the sport hunting of migratory birds. U.S. Dept. Interior, Fish and Wildlife Service. Washington, D.C.

_____. 1986. Refuge Manual: Public Use Management Section 5: Hunting. National Wildlife Refuge System. U.S. Dept. Interior, Fish and Wildlife Service. Washington, D.C.

_____. 1988. Final Supplemental Environmental Impact Statement: Issuance of annual regulations permitting the sport hunting of migratory birds. U.S. Dept. of Interior, Fish and Wildlife Service. Washington, D.C.

_____. 1993. Draft Environmental Impact Statement: Refuges 2003 – A plan for the future of the National Wildlife Refuge System. U.S. Dept. of Interior, Fish and Wildlife Service. Washington, D.C.

_____. 1994. The Native American policy of the U.S. Fish and Wildlife Service. Washington, D.C. 9pp.

_____. 1997a. Harvest and population survey data book, Central Flyway, compiled by D.E. Sharp. Office of Migratory Bird Management, Denver, CO. 123 pp.

_____. 1997b. Productivity survey of geese, swans and brant wintering in North America. Office of Migratory Bird Management, Arlington, VA. 79 pp.

_____. 1997c. Waterfowl population status, 1997. U.S. Dept. Interior, Fish and Wildlife Service, Arlington, VA. 32pp.

_____. 1998a. Mid-continent Lesser Snow Goose Workshops: Central and Mississippi Flyways, Fall 1997. Office of Migratory Bird Management and Division of Refuges, Arlington, VA.

_____. 1998b. Administrative Report July 1998. Office of Migratory Bird Management, Laurel, MD.

_____. 1998c. Waterfowl Population Status, 1998. Department of Interior, U.S. Fish and Wildlife Service. Arlington, VA.

_____. 1999a. Final Environmental Assessment: Alternative regulatory strategies to reduce overabundant populations of mid-continent light geese. U.S. Dept. Interior, Fish and Wildl. Serv. Washington, D.C. 98pp.

_____. 1999b. Report of lands under control of the U.S. Fish and Wildlife Service as of September 30, 1999. U.S. Dept. Interior, Fish and Wildl. Serv. Washington, D.C. 45pp.

_____. 1999c. Response of greater snow geese (Chen caerulescens atlantica) to hunting at Bombay Hook NWR and related wetland changes. Progress Report 11. U.S. Dept. Interior, Fish and Wildl. Serv., Smyrna,DE 22pp.

_____. 2000. Waterfowl Population Status, 2000. U.S. Dept. Interior, Fish and Wildl. Serv., Arlington, VA.

_____. 2002. Waterfowl Population Status, 2002. U.S. Dept. Interior, Fish and Wildl. Serv., Arlington, VA.

_____. 2003. Waterfowl Population Status, 2003. U.S. Dept. Interior, Fish and Wildl. Serv., Arlington, VA.

_____. 2005. Waterfowl Population Status, 2005. U.S. Dept. Interior, Fish and Wildl. Serv., Arlington, VA.

_____. 2006. Waterfowl Population Status, 2006. U.S. Dept. Interior, Fish and Wildl. Serv., Arlington, VA.

_____ and Central Flyway Council. 2006. Aransas-Wood Buffalo Population Whooping Crane Contingency Plan, 2006. U.S. Dept. Interior, Fish and Wildl. Serv., Denver, CO. 42pp.

Widjeskog, L. 1977. Geese eat-outs. Final Report. New Jersey Division of Fish and Game. Project W-53-R-5. 6pp.

Widjeskog, L. 1978. Geese eat-outs. Performance Report. New Jersey Division of Fish and Game. Project W-58-R-1. 9pp.

Williams, T.D., E.G. Cooch, R.L. Jefferies, and F. Cooke. 1993. Environmental degradation, food limitation and reproductive output: juvenile survival in lesser snow geese. J. Animal Ecol. 62:766-777.

Wobeser, G., B. Hunter, B. Wright, D.J. Nieman, and R. Isbister. 1979. Avian cholera in Saskatchewan, spring 1977. J. Wildl. Diseases 15:19-24.

_____, R. Kerbes, and G.W. Beyersbergen. 1983. Avian cholera in Ross' and lesser snow geese in Canada. J. Wildl. Diseases 19:12.

Young, K.E. 1985. The effect of greater snow geese, Anser caerulescens atlantica, (Aves: Anatidae: Anserini) grazing on a Delaware tidal marsh. M.Sc. Thesis. University of Delaware. 63pp.

Zellmer, I.D., M.J. Clauss, D.S. Hik, and R.L. Jefferies. 1993. Growth responses of arctic graminoids following grazing by captive lesser snow geese. Oecologia 93:487-492.

Appendix 1

Federal Register

Thursday
May 13, 1999

Part XII

Department of the Interior

Fish and Wildlife Service

Migratory Bird Hunting; Intent To Prepare an Environmental Impact Statement on White Goose Management; Notice

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

Migratory Bird Hunting; Notice of Intent To Prepare an Environmental Impact Statement on White Goose Management

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of intent.

SUMMARY: The U.S. Fish and Wildlife Service (Service or ''we'') is issuing this notice to advise the public that we are initiating efforts to prepare an Environmental Impact Statement (EIS) that considers a range of management alternatives aimed at addressing population expansion of lesser snow geese, Ross' snow geese, and greater snow geese (white geese). This notice describes possible alternatives, invites public participation in the scoping process for preparing the EIS, and identifies the Service official to whom questions and comments may be directed. Potential sites of public scoping meetings in important white goose migration and wintering areas are yet to be determined. A notice of public meetings with the locations, dates, and times will be published in the **Federal Register**.

DATES: Written comments regarding EIS scoping should be submitted by July 12, 1999, to the address below.

ADDRESSES: Written comments should be sent to the Chief, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Department of the Interior, ms 634—ARLSQ, 1849 C Street NW., Washington, DC 20240. The public may inspect comments during normal business hours in room 634—Arlington Square Building, 4401 N. Fairfax Drive, Arlington, Virginia.

FOR FURTHER INFORMATION CONTACT: Mr. Jonathan Andrew, Chief, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Department of the Interior, (703) 358–1714.

SUPPLEMENTARY INFORMATION: With regard to Mid-continent light geese, because of the high population levels and habitat destruction described below, we believe that management action is necessary. In fact, we promulgated regulations on February 16, 1999, (64 FR 7507; 64 FR 7517) that authorized additional methods of take of light geese and established a conservation order for the reduction of the Mid-continent Light Goose Population. In issuing those regulations, we indicated that we would initiate preparation of an EIS beginning in 2000 to consider the effects on the human environment of a range of long-term resolutions for the MCLG population problem. Those regulations were subsequently challenged in Federal District Court by several animal rights groups. Though the judge refused to preliminarily enjoin the program, he did indicate a likelihood that the plaintiffs might prevail on the EIS issue when the lawsuit proceeded. In light of our earlier commitment to prepare an EIS on the larger, long-term program and to preclude further litigation on the issue, we decided to withdraw the regulations and to begin preparation of the EIS now.

Mid-Continent Light Geese

Lesser snow (*Anser c. caerulescens*) and Ross' (*Anser rossii*) geese, that primarily migrate through the Central and Mississippi Flyways, are collectively referred to as Mid-continent light geese (MCLG) because they breed, migrate, and winter in the ''Mid-continent'' or central portions of North America. They are referred to as ''light'' geese due to the light coloration of the white-phase plumage form, as opposed to ''dark'' geese such as white-fronted geese or Canada geese. We include both plumage forms of lesser snow geese (white, or ''snow'' and dark, or ''blue'') under the designation light geese.

The total MCLG population is experiencing a high population growth rate and has substantially increased in size within the last 30 years. Potential reasons for this high growth rate include decreased harvest rates, availability of waste grains in agricultural areas, establishment of refuges, and higher survival rates. The total MCLG population is comprised of two population segments; namely the Mid-continent Population (MCP) and the Western Central Flyway Population (WCFP). We use operational surveys conducted annually on wintering grounds to derive a winter index to light goose populations. The winter index of MCP light geese has more than tripled within 30 years from an estimated 800,000 birds in 1969 to approximately 2.6 million birds in 1999 and has increased an average of 5% per year for the last ten years (Abraham et al. 1996, USFWS 1998). The 1999 MCP winter index of 2.6 million geese is comprised of approximately 2.4 million lesser snow geese and 147,000 Ross' geese. The winter index of WCFP light geese has quadrupled in 23 years from 52,000 in 1974 to 216,000 in 1997 (USFWS 1997), and has increased an average of 9% per year for the last ten years (USFWS 1998). Counts of light geese wintering in Mexico are obtained every 3 years, therefore 1997 represents the last year that a total WCFP count was made. The 1997 WCFP winter index of 216,000 geese is comprised of approximately 151,000 lesser snow geese and 65,000 Ross' geese.

The total MCLG population (MCP and WCFP combined), based on the 1997 and 1999 winter indices, is approximately 2.8 million geese (Table 1). In 1991, the Central and Mississippi Flyway Councils jointly agreed to set lower and upper management thresholds for the MCP of snow geese at 1.0 million and 1.5 million, respectively, based on the winter index. Therefore, the current winter index of MCP lesser snow geese far exceeds the upper management threshold established by the Flyway Councils. Segments of the total MCLG population have also exceeded North American Waterfowl Management Plan (NAWMP) population objectives, which are also based on winter indices. The MCP lesser snow goose winter index of 2.4 million birds far exceeds the NAWMP population objective of 1 million birds (USDOI et al. 1998). The lesser snow goose portion of the WCFP light goose winter index is estimated to be 151,000 birds, which exceeds the NAWMP population objective of 110,000 birds (USDOI et al. 1998). The estimate of the Ross' goose component of the total MCLG population winter index (WCFP and MCP combined) is approximately 212,000 birds. This exceeds the NAWMP Ross' goose population objective of 100,000 birds (USDOI et al. 1998). We compare current population levels to NAWMP population objectives to demonstrate that the total MCLG population has increased substantially over what is considered to be healthy population level.

TABLE 1.—COMPONENTS OF THE MID-CONTINENT LIGHT GOOSE POPULATION (MCLG) WINTER INDEX

Species	MCP [a]	WCFP [b]	Total MCLG	Flyway council goal [c]	NAWMP goal [d]		
					MCP	WCFP	Total MCLG
Lesser snow goose	2,429,000	151,000	2,580,000	1.0–1.5 million	1,000,000	110,000	1,110,000

TABLE 1.—COMPONENTS OF THE MID-CONTINENT LIGHT GOOSE POPULATION (MCLG) WINTER INDEX—Continued

Species	MCP [a]	WCFP [b]	Total MCLG	Flyway council goal [c]	NAWMP goal [d]		
					MCP	WCFP	Total MCLG
Ross' goose	146,800	65,000	211,800	N/A [e]	N/A	N/A	100,000
Total	2,575,800	216,000	2,791,800	N/A	N/A	N/A	1,210,000

[a] Mid-Continent Population (1999 index).
[b] Western Central Flyway Population (1997 index).
[c] Represents lower and upper management thresholds.
[d] North American Waterfowl Management Plan goals.
[e] Not applicable; goal not developed.

By multiplying the current MCLG December index of 2.8 million birds by an adjustment factor of 1.6 (Boyd et al. 1982), we derive an estimate of 4.5 million breeding birds in spring. This is corroborated by population surveys conducted on light goose breeding colonies during spring and summer, which suggest that the breeding population size of MCLG is in excess of five million birds (D. Caswell pers. comm.). The estimate of 4.5 million birds does not include non-breeding geese or geese found in unsurveyed areas. Therefore, the total MCLG population currently far exceeds 4.5 million birds.

We believe that the MCLG population has exceeded the long-term carrying capacity of its breeding habitat and must be reduced. These geese have become seriously injurious to their arctic and subarctic habitat and habitat important to other migratory birds. We have described previously (February 16, 1999; 64 FR 7517) how light geese have impacted breeding habitats through their feeding actions, which triggers a series of events that leads to long-term habitat destruction. Batt (1997) summarized the results of numerous studies that have investigated the dynamics of the MCLG population and the impacts it is having on breeding habitats. We believe that MCLG population reduction measures are necessary to prevent further habitat destruction and to protect the remaining habitat upon which numerous wildlife species depend.

Batt (1997) estimated that the MCLG population should be reduced by 50% by 2005. That would suggest a reduction from the 1999 MCLG winter index of approximately 2.8 million birds to approximately 1.4 million birds. Central and Mississippi Flyway Council management thresholds for MCP lesser snow geese (not including WCFP lesser snow or Ross' geese) rests between 1.0 and 1.5 million birds, based on the winter index. Therefore, our goal to reduce the MCLG population to 1.4 million birds by 2005 closely parallels those established by Flyway Councils and the scientific community. Using previously mentioned conversion factors, a winter index of 1.4 million would translate to a minimum estimate of 2.24 million breeding MCLG in spring. The estimate of 2.24 million birds does not include non-breeding geese or geese found in unsurveyed areas. Therefore, the total MCLG spring population would be much higher. We plan to carefully analyze and assess the MCLG reduction on an annual basis, using the winter index and other surveys, to ensure that the populations are not over-harvested.

Greater Snow Geese

Greater snow geese (*Anser c. atlanticus*) breed in the eastern Arctic of Canada and Greenland and migrate southward through Quebec, New York, and New England to their wintering grounds in the mid-Atlantic U.S. The greater snow goose population has expanded from less than 50,000 birds in the late 1960s to approximately 700,000 today. These estimates are based on operational spring surveys conducted on staging areas in the St. Lawrence Valley. With a growth rate of about 9% per year, the population is expected to reach 1,000,000 by 2002 and 2,000,000 by 2010 (Batt 1998).

Although the greater snow goose population has experienced a high growth rate, studies in the Arctic have not documented extensive damage to breeding habitats as of yet. It is estimated that the population is only about one-half of the carrying capacity of the site of the largest breeding colony on Bylot Island. However, high populations of greater snow geese are negatively impacting natural marshes in the St. Lawrence estuary and some coastal marshes of the Mid-Atlantic U.S (Batt 1998). The Arctic Goose Habitat Working Group recommended that the population be stabilized by the year 2002 at between 800,000 to 1,000,000 birds (Batt 1998). This strategy is intended to prevent the destruction of arctic habitat that is likely to occur if the population exceeds the carrying-capacity of breeding areas.

Past Management Actions

We have attempted to curb the growth of white goose populations by increasing bag and possession limits and extending the open hunting season length for white geese to 107 days, the maximum allowed by the Migratory Bird Treaty between the U.S. and Canada. However, due to the rapid rise in white goose numbers and low hunter success rates, the harvest rate (the percentage of the population that is harvested) has declined. The decline in harvest rate indicates that current harvest regulations are not sufficient to stabilize or reduce population growth rates.

In cooperation with our State partners, we have developed several Regional Action Plans (Gulf Coast, Midwest, and Northern Prairie) in the central U.S. to implement land management activities that will assist in reduction of the MCLG population. Such activities include land management, water management, increasing accessibility of State and Federal lands to hunters, and development of public outreach programs. We do not believe that Regional Action Plans alone can achieve MCLG population reduction goals. However, the plans will compliment the management alternative chosen as a result of the EIS process.

On February 16, 1999, we published two rules that authorized new methods of take for white geese (electronic calls and unplugged shotguns; 64 FR 7507), and established a conservation order for the reduction of the MCLG population (64 FR 7517). The new regulations were made available only to States in the Mississippi and Central Flyways. Several animal rights groups subsequently filed a legal challenge to the Environmental Assessment and Finding of No Significant Impact upon which the implementation of the rules were based. Although the judge refused to issue an injunction, he did indicate

a likelihood that plaintiffs might succeed on their argument that an EIS should have been prepared. In order to avoid further litigation, we have decided to withdraw those regulations and initiate preparation of an EIS. The regulations will be withdrawn in a separate rulemaking notice in the **Federal Register**.

Alternatives

We are considering the following alternatives as a result of public comments received on the Environmental Assessment. After the scoping process, we will develop the alternatives to be included in the EIS and base them on the mission of the Service and comments received during scoping. We are soliciting your comments on issues, alternatives, and impacts to be addressed in the EIS.

A. No Action Alternative

Under the No Action Alternative, no additional regulatory methods or direct population control strategies would be authorized. Normal white goose hunting regulations that existed prior to February 16, 1999, would remain in place.

B. New Regulatory Alternatives (Proposed Action)

This alternative seeks to provide new regulatory options to wildlife management agencies that will increase the harvest of white geese above that which results from existing hunting frameworks. This approach may include legalization of additional hunting methods such as electronic calls, unplugged shotguns, expanded shooting hours, and baiting. This alternative also includes establishment of a conservation order in the U.S. to reduce and/or stabilize white goose populations. A conservation order would authorize taking of white geese after the normal framework closing date of March 10, through August 31.

The intent of this alternative is to significantly reduce or stabilize white goose populations without threatening their long-term health. We are confident that reduction or stabilization efforts will not result in populations falling below either the lower management thresholds established by Flyway Councils, or the NAWMP population objectives. Monitoring and evaluation programs are in place to estimate population sizes and will be used to prevent over-harvest of these populations.

C. Direct Population Control on Wintering and Migration Areas in the U.S.

This alternative would involve direct population control strategies such as trapping and culling programs, market hunting, or other general strategies that would result in the killing of white geese on migration and/or wintering areas in the U.S. Some of these types of control measures could involve disposal of large numbers of carcasses.

D. Seek Direct Population Control on Breeding Grounds by Canada

This alternative, if successful, would involve direct population control strategies, such as trapping and culling programs, market hunting, or other general strategies, that would result in killing of white geese on breeding colonies in Canada. Some of these types of control measures could involve disposal of large numbers of carcasses. We do not have the authority to implement direct population control measures on migration or breeding areas in Canada. Therefore, this alternative would require extensive consultation with Canada in order to urge implementation of control measures on breeding areas. Such measures may or may not involve active U.S. participation.

Issue Resolution and Environmental Review

The primary issue to be addressed during the scoping and planning process for the EIS is to determine which management alternatives for the control of white goose populations will be analyzed. We will prepare a discussion of the potential effect, by alternative, which will include the following areas:

(1) White goose populations and their habitats.

(2) Other bird populations and their habitats.

(3) Effects on other species of flora and fauna.

(4) Socioeconomic effects.

Environmental review of the management action will be conducted in accordance with the requirements of the National Environmental Policy Act (NEPA), as appropriate. This Notice is being furnished in accordance with 40 CFR 1501.7, to obtain suggestions and information from other agencies, tribes, and the public on the scope of issues to be addressed in the EIS. A draft EIS should be available to the public in the fall of 1999.

Public Scoping Meetings

A schedule of public scoping meeting dates, locations, and times is not available at this time. Notice of such meetings will be published in the **Federal Register**.

References Cited

Abraham, K.F., R.L. Jefferies, R.F. Rockwell, and C. D. MacInnes. 1996. Why are there so many white geese in North America? 7th International Waterfowl Symposium, Memphis, TN.

Batt, B.D.J., editor. 1997. Arctic ecosystems in peril: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U.S. Fish and Wildlife Service, Washington, DC and Canadian Wildlife Service, Ottawa, Ontario. 120 pp.

Batt, B.D.J., editor. 1998. The greater snow goose: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U.S. Fish and Wildlife Service, Washington, DC and Canadian Wildlife Service, Ottawa, Ontario. 88 pp.

Boyd, H., G.E.J. Smith and F.G. Cooch. 1982. The lesser snow goose of the eastern Canadian Arctic: their status during 1964–1979 and their management from 1982–1990. Canadian Wildlife Service Occasional Paper No. 46. 21 pp.

U.S. Department of the Interior, Environment Canada, and Secretaria De Desarrollo Social. 1998. 1998 update to the North American Waterfowl Management Plan—fulfilling the legacy: expanding the vision. U.S. Fish and Wildlife Service, Washington DC.

USFWS. 1997. Harvest and population survey data book, Central Flyway, compiled by D.E. Sharp. Office of Migratory Bird Management, Denver, CO. 123 pp.

USFWS. 1998. Waterfowl populations status, 1998. Department of Interior, U.S. Fish and Wildlife Service, Arlington, VA. 31 pp.

Authorship. The primary author of this Notice is James R. Kelley, Jr., Office of Migratory Bird Management.

Dated: May 7, 1999.

John G. Rogers,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 99–12141 Filed 5–12–99; 8:45 am]

BILLING CODE 4310–55–P

Appendix 2

Federal Register

Monday
August 30, 1999

Part V

Department of the Interior

Fish and Wildlife Service

Migratory Bird Hunting; Environmental Impact Statement on White Goose Management; Notice

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

Migratory Bird Hunting; Environmental Impact Statement on White Goose Management; Notice

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of meetings.

SUMMARY: The U.S. Fish and Wildlife Service (Service or ''we'') is issuing this notice to invite public participation in the scoping process for preparing an Environmental Impact Statement (EIS) that considers a range of management alternatives aimed at addressing population expansion of lesser snow geese, Ross' geese, and greater snow geese (white geese). This notice invites further public participation in the scoping process, identifies the location, date, and time of public scoping meetings, and identifies the Service official to whom questions and comments may be directed.

DATES: Written comments regarding EIS scoping should be submitted by November 22, 1999, to the address below. Dates for nine public scoping meetings are identified in the **SUPPLEMENTARY INFORMATION** section.

ADDRESSES: Written comments should be sent to the Chief, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Department of the Interior, 4401 N. Fairfax Dr., Suite 634—Arlington, VA 22203. Alternatively, comments may be submitted electronically to the following address: white—goose—eis@fws.gov. The public may inspect comments during normal business hours in Room 634 '' Arlington Square Building, 4401 N. Fairfax Drive, Arlington, Virginia. Locations for nine public scoping meetings are identified in the **SUPPLEMENTARY INFORMATION** section.

FOR FURTHER INFORMATION CONTACT: Mr. Jon Andrew, Chief, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Department of the Interior, (703) 358–1714, or James Kelley, Office of Migratory Bird Management (703) 358–1964.

SUPPLEMENTARY INFORMATION: On May 13, 1999, we published a Notice of Intent to prepare an EIS on white goose management (64 FR 26268). This action is in response to population expansion of white geese, which has resulted in habitat degradation in certain breeding, migration, and/or wintering areas of the three species of geese involved.

Lesser Snow Geese and Ross' Geese

We believe that the combined population of lesser snow geese and Ross' geese in the mid-continent region has exceeded the long-term carrying capacity of its breeding habitat and must be reduced. These geese have become seriously injurious to their arctic and subarctic habitat and habitat important to other migratory birds. We believe that population reduction measures are necessary to prevent further habitat destruction and to protect the remaining habitat upon which numerous wildlife species depend. The Arctic Goose Habitat Working Group estimated that the combined population of lesser snow geese and Ross' geese in the mid-continent region should be reduced by 50% by 2005 (Batt 1997). That would suggest a reduction from the 1999 winter index of approximately 2.8 million birds to approximately 1.4 million birds.

Greater Snow Geese

The greater snow goose population has expanded from less than 50,000 birds in the late 1960s to approximately 700,000 today. With a growth rate of about 9% per year, the population is expected to reach 1,000,000 by 2002 and 2,000,000 by 2010 (Batt 1998). While researchers have not documented the damage to the breeding habitat of greater snow geese to the same degree as the mid-continent white geese, high populations of greater snow geese are negatively impacting natural marshes in the St. Lawrence estuary and some coastal marshes of the Mid-Atlantic U.S (Batt 1998). The Arctic Goose Habitat Working Group recommended that the population be stabilized by the year 2002 at between 800,000 to 1,000,000 birds (Batt 1998). This strategy is intended to prevent the destruction of arctic habitat that is likely to occur if the population exceeds the carrying-capacity of breeding areas.

Alternatives

We are considering the following alternatives as a result of public comments we received previously. After the scoping process, we will develop the alternatives to be included in the EIS and base them on the mission of the Service and comments received during scoping. We are soliciting your comments on issues, alternatives, and impacts to be addressed in the EIS.

A. No Action Alternative

Under the No Action Alternative, no additional regulatory methods or direct population control strategies would be authorized. Existing white goose hunting regulations would remain in place.

B. New Regulatory Alternatives (Proposed Action)

This alternative seeks to provide new regulatory options to wildlife management agencies that will increase the harvest of white geese above that which results from existing hunting frameworks. This approach may include legalization of additional hunting methods such as electronic calls, unplugged shotguns, and expanded shooting hours. This alternative also includes establishment of a conservation order in the U.S. to reduce and/or stabilize white goose populations. A conservation order would authorize taking of white geese after the normal framework closing date of March 10, through August 31.

The intent of this alternative is to significantly reduce or stabilize white goose populations without threatening their long-term health. We are confident that reduction or stabilization efforts will not result in populations falling below either the lower management thresholds established by Flyway Councils, or the North American Waterfowl Management Plan population objectives. Monitoring and evaluation programs are in place to estimate population sizes and will be used to prevent over-harvest of these populations.

C. Direct Population Control on Wintering and Migration Areas in the U.S.

This alternative would involve direct population control strategies such as trapping and culling programs, market hunting, or other general strategies that would result in the killing of white geese on migration and/or wintering areas in the U.S. Some of these types of control measures could involve disposal of large numbers of carcasses.

D. Seek Direct Population Control on Breeding Grounds by Canada

This alternative, if successful, would involve direct population control strategies, such as trapping and culling programs, market hunting, or other general strategies, that would result in killing of white geese on breeding colonies in Canada. Some of these types of control measures could involve disposal of large numbers of carcasses. We do not have the authority to implement direct population control measures on migration or breeding areas in Canada. Therefore, this alternative would require extensive consultation with Canada in order to urge implementation of control measures on breeding areas. Such measures may or

may not involve active U.S. participation.

Issue Resolution and Environmental Review

The primary issue to be addressed during the scoping and planning process for the EIS is to determine which management alternatives for the control of white goose populations will be analyzed. We will prepare a discussion of the potential effect, by alternative, which will include the following areas:

(1) White goose populations and their habitats.

(2) Other bird populations and their habitats.

(3) Effects on other species of flora and fauna.

(4) Socioeconomic effects.

Environmental review of the management action will be conducted in accordance with the requirements of the National Environmental Policy Act (NEPA), as appropriate. This Notice is being furnished in accordance with 40 CFR 1501.7, to obtain suggestions and information from other agencies, tribes, and the public on the scope of issues to be addressed in the EIS. A draft EIS should be available to the public in the winter of 2000.

Public Scoping Meetings

Nine public scoping meetings will be held on the following dates at the indicated locations and times:

1. September 29, 1999; Pomona, NJ at the Richard Stockton College of New Jersey, A Wing Lecture Hall, Jimmie Leeds Road, 7 p.m. to 9:30 p.m.

2. September 30, 1999; Dover, DE at the Richardson and Robbins Auditorium, Delaware Department of Natural Resources and Environmental Control, 89 Kings Highway, 7 p.m. to 9:30 p.m.

3. October 3, 1999; Sacramento, CA at the Auditorium, Resource Building, 1416 Ninth St., 3 p.m. to 5:30 p.m.

4. October 5, 1999; Rosenberg, TX at the Texas Agricultural Extension Service Building, 1436 Band Road, 7 p.m. to 9:30 p.m.

5. October 6, 1999; Baton Rouge, LA at the Louisiana Room, First Floor, Louisiana Department of Wildlife and Fisheries Building, 2000 Quail Drive, 7 p.m. to 9:30 p.m.

6. October 12, 1999; Bismarck, ND at the North Dakota Game and Fish Department Auditorium, 100 N. Bismarck Expressway, 7 p.m. to 9:30 p.m.

7. October 13, 1999; Bloomington, MN at the Best Western Thunderbird Hotel and Convention Center, 2201 East 78th Street, 7 p.m. to 9:30 p.m.

8. October 14, 1999; Kansas City, MO at the Holiday Inn Sports Complex, 4011 Blue Ridge Cutoff, 7 p.m. to 9:30 p.m.

9. October 21, 1999; Washington, DC in the Auditorium of the Department of the Interior Building, 1849 C Street NW, 9 a.m. to 11:30 a.m.

Meeting participants may choose to submit oral and/or written comments on the EIS scoping process. To facilitate planning, we request that individuals or organizations that desire to submit oral comments at meetings to send us their name and the meeting location at which comments will be submitted. Name and meeting location information should be sent to the location indicated under the **ADDRESSES** caption. However, submission of names prior to a particular meeting is not required in order to present oral comments at any meeting.

Written comments may also be submitted by November 22, 1999, to the location indicated under the **ADDRESSES** caption. Alternatively, comments may be submitted electronically by November 22, 1999, to the following email address: white__goose__eis@fws.gov.

References Cited

Batt, B.D.J., editor. 1997. Arctic ecosystems in peril: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, DC and Canadian Wildlife Service, Ottawa, Ontario. 120pp.

Batt, B.D.J., editor. 1998. The greater snow goose: report of the Arctic Goose Habitat Working Group. Arctic Goose Joint Venture Special Publication. U. S. Fish and Wildlife Service, Washington, DC and Canadian Wildlife Service, Ottawa, Ontario. 88pp.

Authorship

The primary author of this Notice is James R. Kelley, Jr., Office of Migratory Bird Management.

Dated: August 24, 1999.

Paul R. Schmidt,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 99–22382 Filed 8–27–99; 8:45 am]

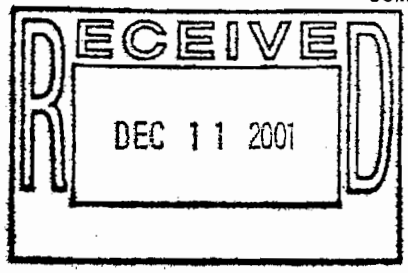
BILLING CODE 4310–55–P

Appendix 3

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 6 2001

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE



Jon Andrew
Chief
Division of Migratory Bird Management
U.S. Fish and Wildlife Service
4401 North Fairfax Drive
Suite 634
Arlington, Virginia 22203

Dear Mr. Andrew:

The Environmental Protection Agency (EPA) has reviewed the U.S. Fish and Wildlife Service's (Service) Draft Environmental Impact Statement (DEIS) for the **Light Goose Management Plan** (CEQ Document # 010357). Our review is pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

Based on our review, EPA has not identified any environmental concerns with the Service's preferred alternative of modifying harvest regulations and refuge management in order to reduce high population levels of light geese. We recognize that this effort is intended to reduce adverse impacts to arctic and sub-arctic habitats and light goose and other bird populations. However, we do recommend that following selection of a management approach, the Service should carefully monitor its implementation and remain open to exploring other options as necessary and appropriate. In our opinion, the DEIS provides adequate documentation of the potential environmental impacts. Accordingly, we have assigned a rating of **LO (Lack of Objections)** to the DEIS.

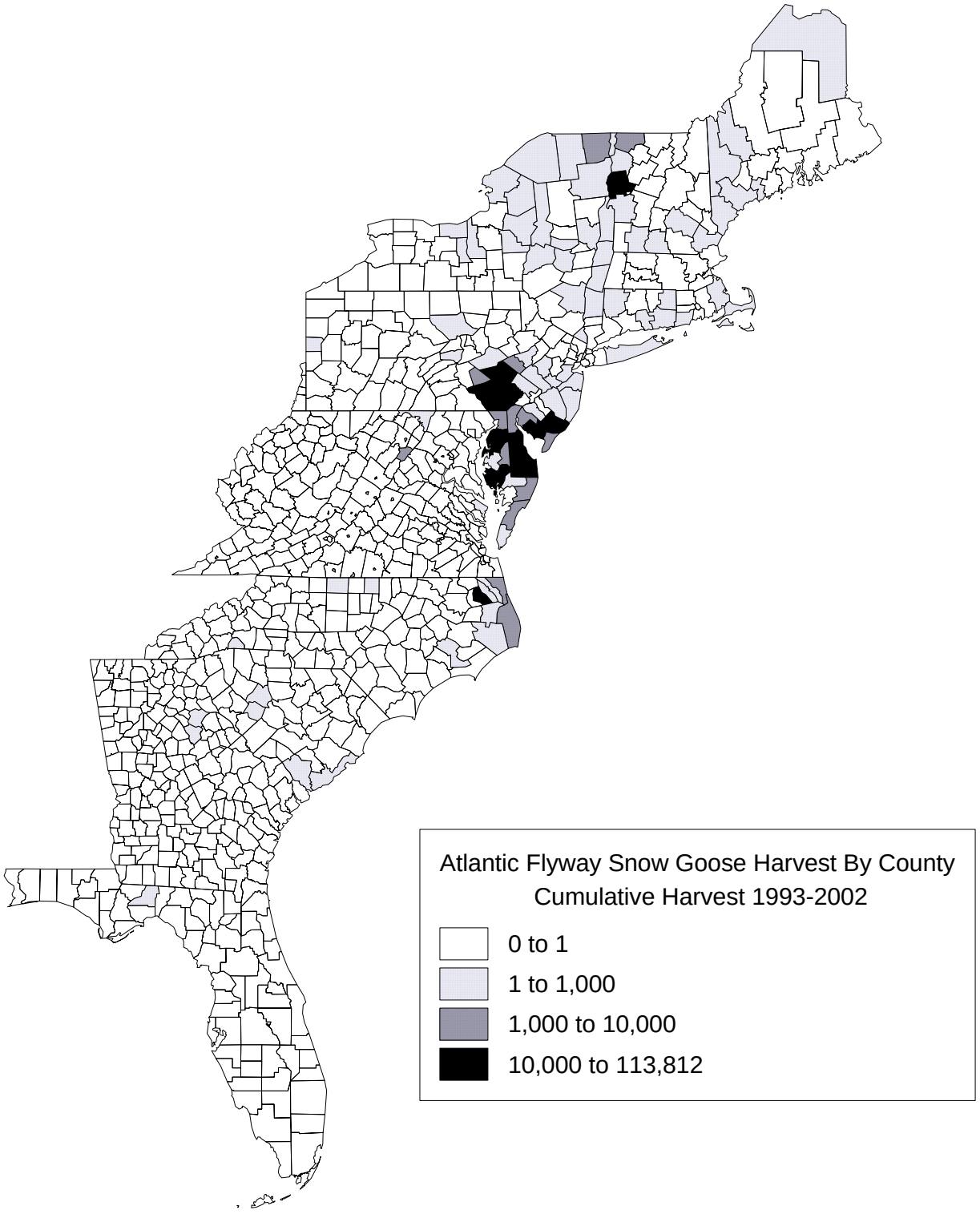
We appreciate the opportunity to review this DEIS. Should you have any additional questions please contact Cliff Rader of my staff at (202) 564-7159.

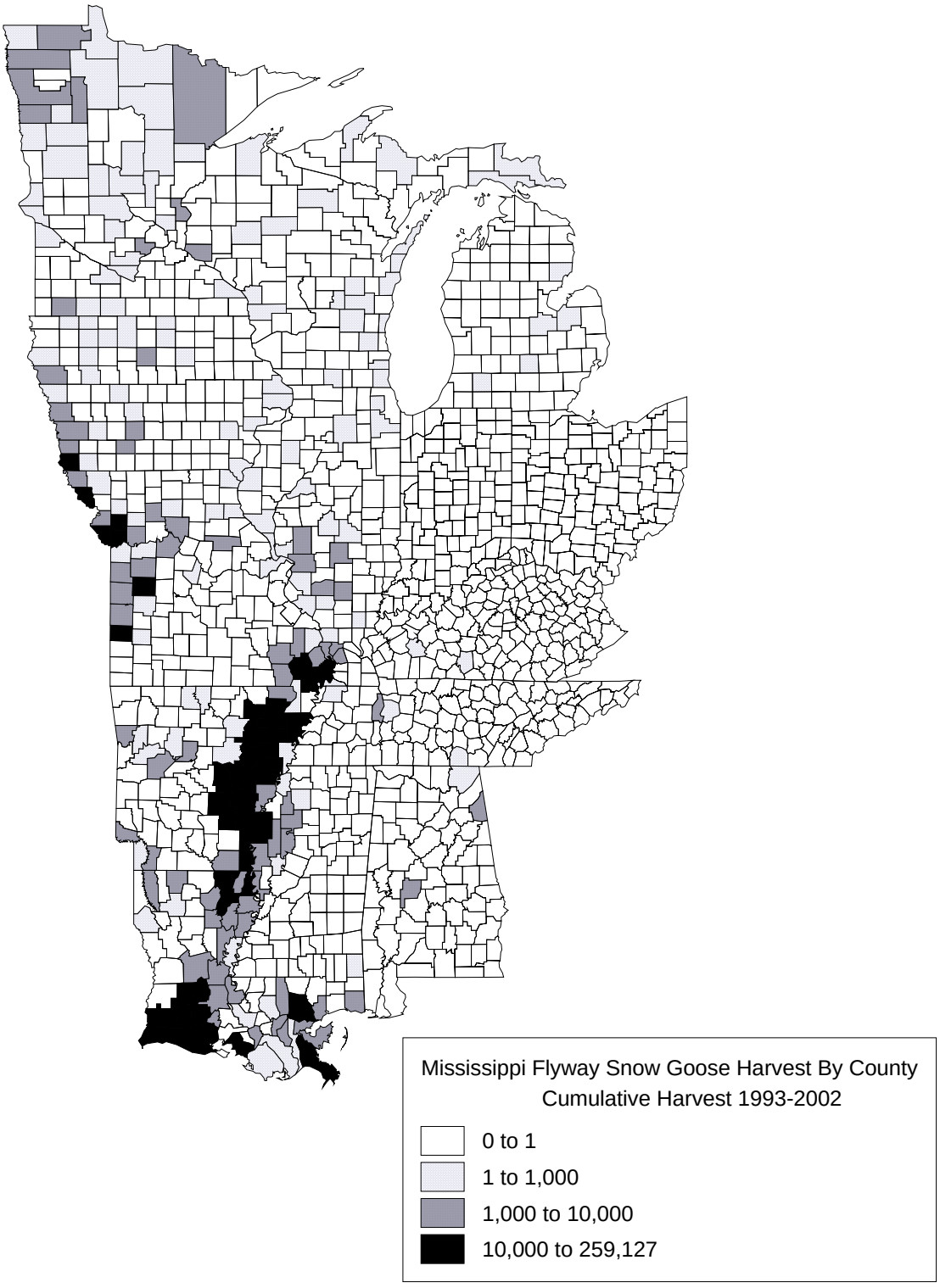
Sincerely,

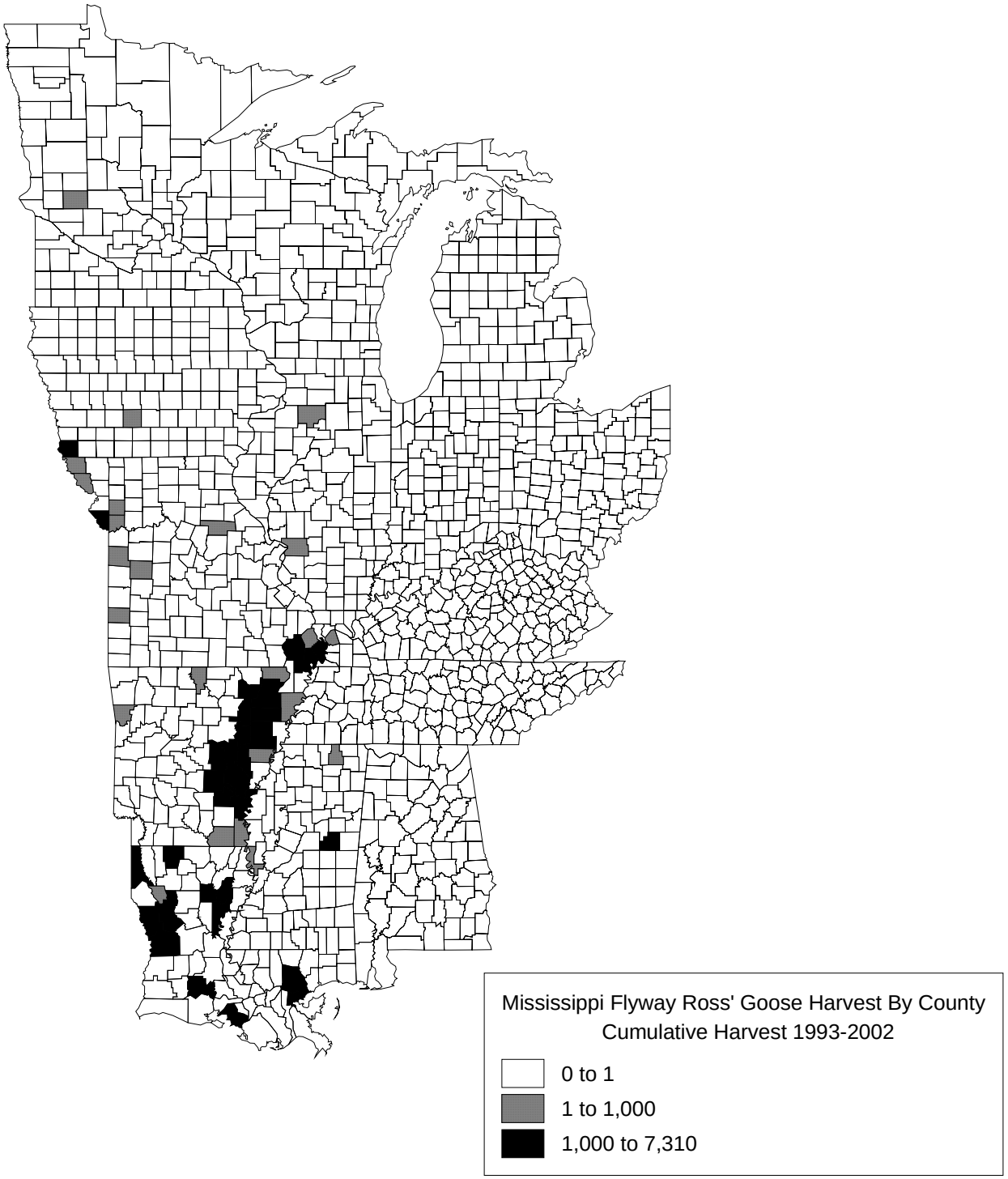
Anne N. Miller

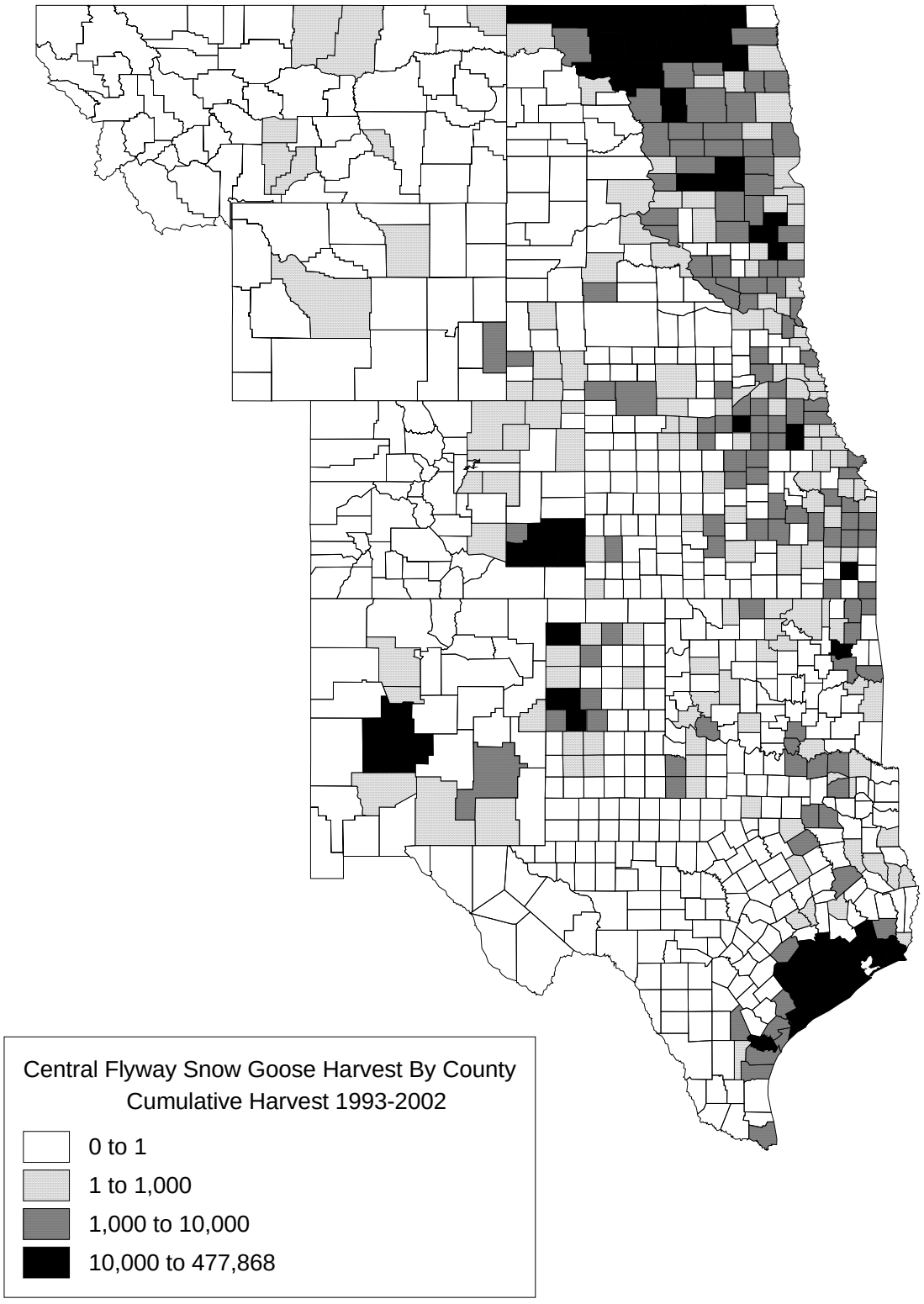
Anne Norton Miller
Director
Office of Federal Activities

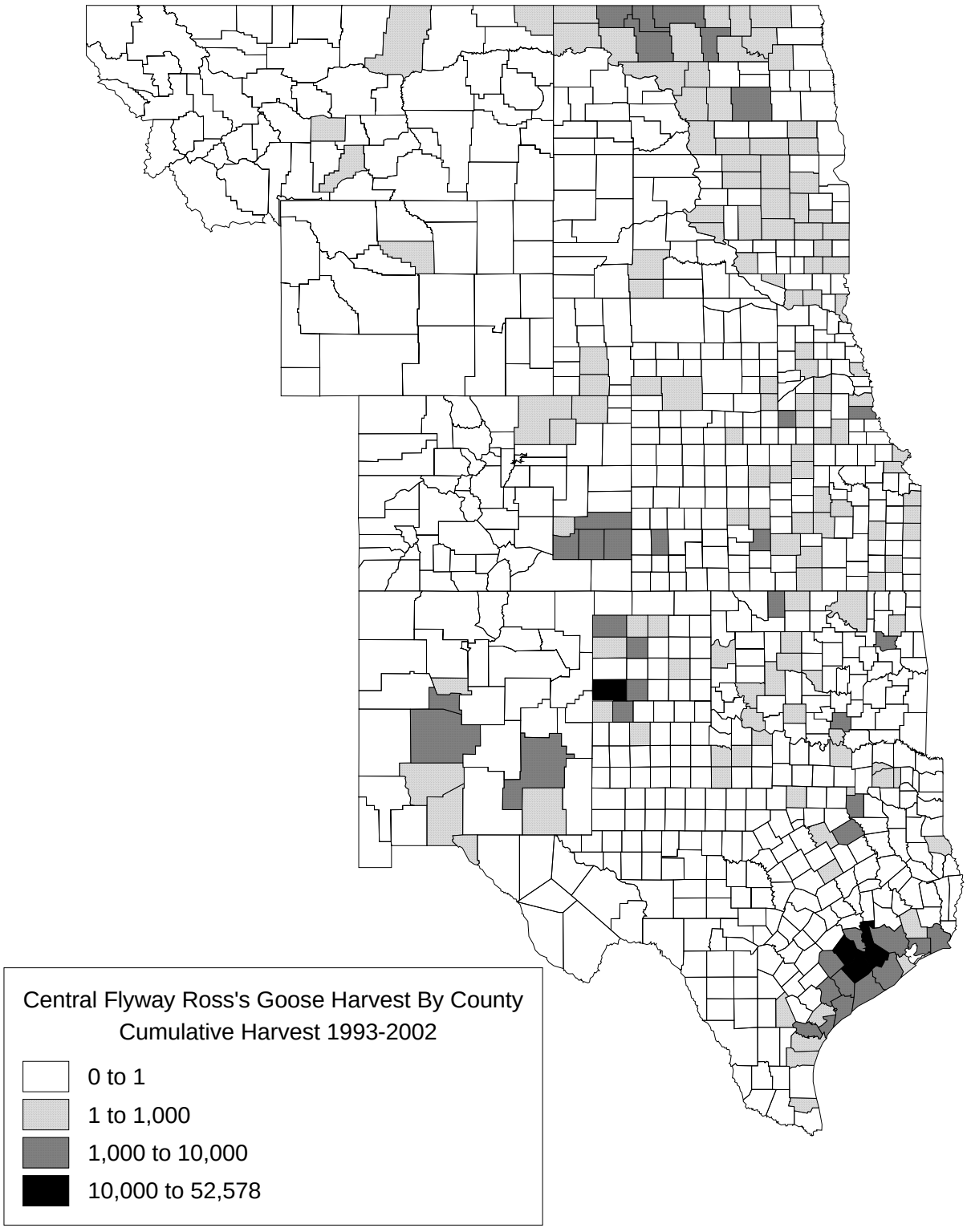
Appendix 4

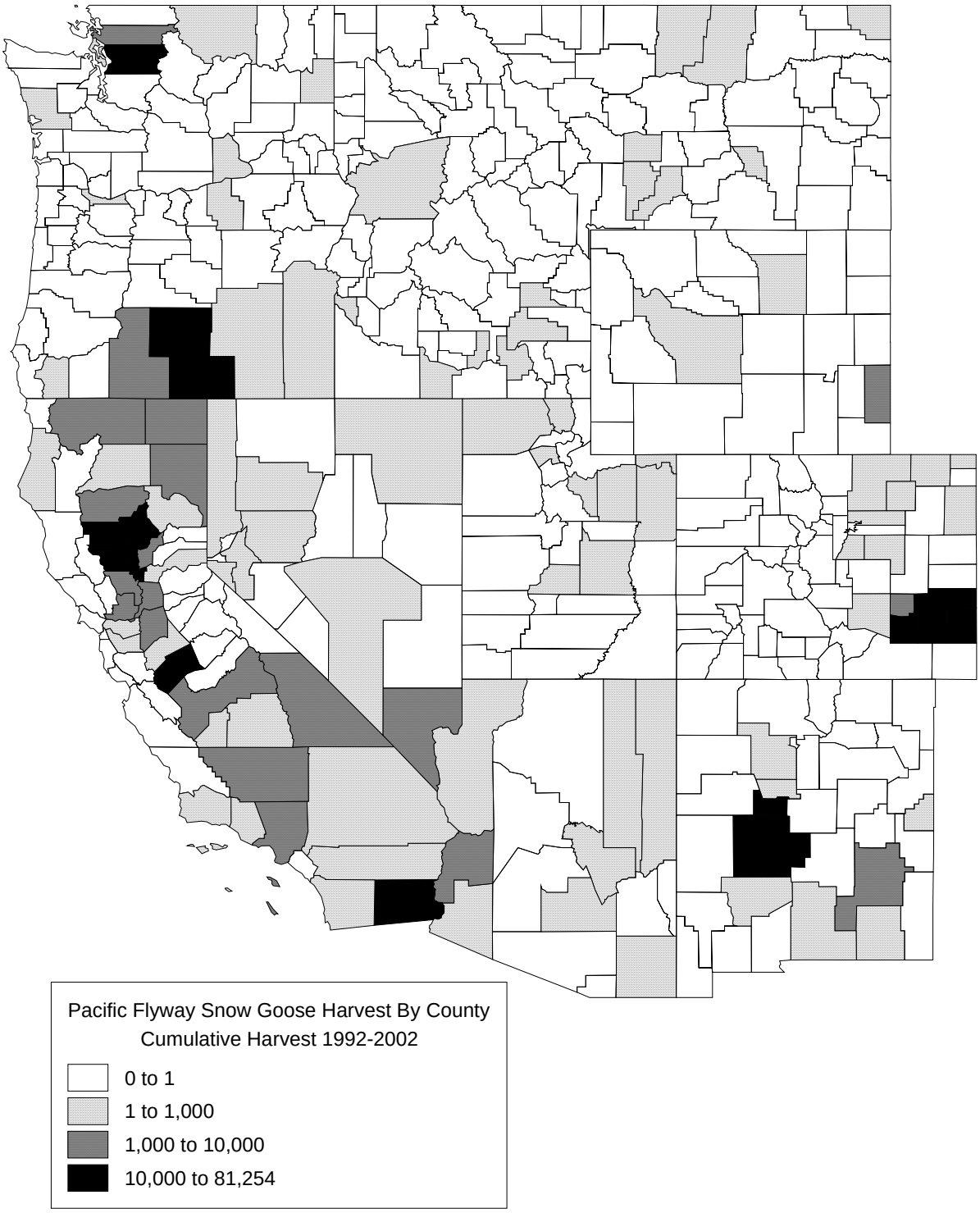

Atlantic Flyway Snow Goose Harvest By County
Cumulative Harvest 1993-2002
0 to 1
1 to 1,000
1,000 to 10,000
10,000 to 113,812

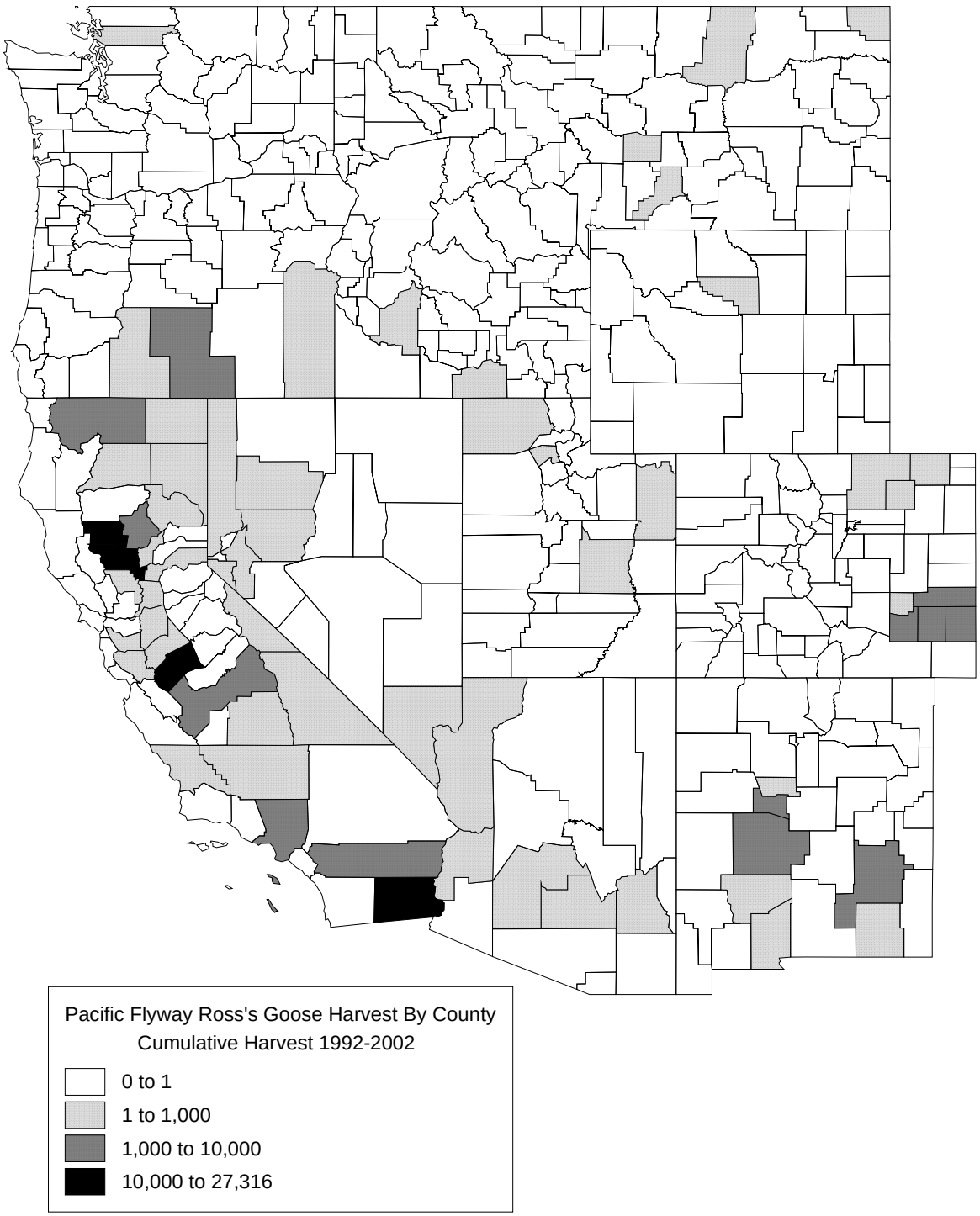

Mississippi Flyway Snow Goose Harvest By County
Cumulative Harvest 1993-2002
0 to 1
1 to 1,000
1,000 to 10,000
10,000 to 259,127


Mississippi Flyway Ross' Goose Harvest By County
Cumulative Harvest 1993-2002
0 to 1
1 to 1,000
1,000 to 7,310


Central Flyway Snow Goose Harvest By County
Cumulative Harvest 1993-2002
0 to 1
1 to 1,000
1,000 to 10,000
10,000 to 477,868


Central Flyway Ross's Goose Harvest By County
Cumulative Harvest 1993-2002
0 to 1
1 to 1,000
1,000 to 10,000
10,000 to 52,578


Pacific Flyway Snow Goose Harvest By County
Cumulative Harvest 1992-2002
0 to 1
1 to 1,000
1,000 to 10,000
10,000 to 81,254


Pacific Flyway Ross's Goose Harvest By County
Cumulative Harvest 1992-2002
0 to 1
1 to 1,000
1,000 to 10,000
10,000 to 27,316

Appendix 5

CFR Part 20

Revise paragraphs (b) and (g) of § 20.21 to read as follows:

§ 20.21 What hunting methods are illegal?

(b) With a shotgun of any description capable of holding more than three shells, unless it is plugged with a one-piece filler, incapable of removal without disassembling the gun, so its total capacity does not exceed three shells. This restriction does not apply during a light-goose-only season (greater and lesser snow geese and Ross's geese) when all other waterfowl and crane hunting seasons, excluding falconry, are closed.

(g) By the use or aid of recorded or electrically amplified bird calls or sounds, or recorded or electrically amplified imitations of bird calls or sounds. This restriction does not apply during a light-goose-only season (greater and lesser snow geese and Ross's geese) when all other waterfowl and crane hunting seasons, excluding falconry, are closed.

Revise § 20.22 to read as follows:

§ 20.22 Closed seasons.

No person shall take migratory game birds during the closed season except as provided in part 21.

Revise § 20.23 to read as follows:

§ 20.23 Shooting hours.

No person shall take migratory game birds except during the hours open to shooting as prescribed in subpart K of this part and subpart E of part 21.

CFR Part 21

Subpart E, consisting of §21.60, is revised to read as follows:

Subpart E - Control of Overabundant Migratory Bird Populations

§21.60 Conservation order for light geese

(a) What is a conservation order?

A conservation order is a special management action that is needed to control certain wildlife populations when traditional management programs are unsuccessful in preventing overabundance of the population. We are authorizing a conservation order under the authority of the Migratory Bird Treaty Act to reduce and stabilize various light goose populations. The conservation order allows new methods of taking light geese, allows shooting hours for light geese to end one-half hour after sunset, and imposes no daily bag limits for light geese inside or outside the migratory bird hunting season frameworks as described below.

(b) Which waterfowl species are covered by the order?

The conservation order addresses management of greater snow (*Chen caerulescens atlantica*), lesser snow (*C. c. caerulescens*) and Ross's (*C. rossii*) geese that breed, migrate, and winter in North America. The term light geese refers collectively to greater and lesser snow geese and Ross's geese.

(c) In what areas can the conservation order be authorized?

(1) The following States that are contained within the boundaries of the Atlantic Flyway: Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Vermont, Virginia, West Virginia.

(2) The following States, or portions of States, that are contained within the boundaries of the Mississippi and Central Flyways: Alabama, Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Texas, Wisconsin, and Wyoming.

(3) The following States, or portions of States, that are contained within the boundaries of the Pacific Flyway: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

(4) Tribal lands within the geographic boundaries in (1), (2), and (3) above.

(d) When will a conservation order be authorized in a particular Flyway?

(1) The Director may authorize a conservation order for the reduction of greater snow geese for any State or Tribe contained within the Atlantic Flyway by publishing a notice under subsection (e) when the May Waterfowl Population Status report indicates that the management goal of 500,000 birds has been exceeded and that special conservation actions conducted in Canada are insufficient to reduce the population. Authorization of the conservation order in the U.S. portion of the Atlantic Flyway will occur after the Director determines the degree to which the management goal has been exceeded, the trajectory of population growth, anticipated harvest that would result from implementation of the conservation order, and whether or not similar conservation actions will be conducted in Canada.

(2) The Director may authorize a conservation order for the reduction of mid-continent light geese (lesser snow and Ross's geese) for any State or Tribe contained within the Mississippi and Central Flyways by publishing a notice under subsection (e) when the May Waterfowl Population Status report indicates that the management goal of 1,600,000 birds (winter index for Mid-continent Population and Western Central Flyway Population, combined) has been exceeded. Authorization of the conservation order in the U.S. portion of the Mississippi and Central Flyways will occur after the Director determines the degree to which the management goal has been exceeded, the trajectory of population growth, anticipated harvest that would result from implementation of the conservation order, and whether or not similar conservation actions will be conducted in Canada.

(3) The Director may authorize a conservation order for the reduction of light geese (lesser snow and Ross's geese) for any State or Tribe contained within the Pacific Flyway by publishing a notice under subsection (e) when the Director determines that light goose numbers in the western Arctic have exceeded the ability of their breeding habitat to support them.

(e) How will the conservation order be authorized for a particular Flyway?

The Director will publish a notice in the Federal Register when a conservation order is authorized in a particular Flyway.

(f) What is required in order for State/Tribal governments to participate in the conservation order?

When authorized by the Director, any State or Tribal government responsible for the management of wildlife and migratory birds may, without permit, kill or cause to be killed under its general supervision, light geese under the following conditions:

(1) Activities conducted under the conservation order may not affect endangered or threatened species as designated under the Endangered Species Act.

(2) Control activities must be conducted clearly as such and are intended to relieve pressures on migratory birds and habitat essential to migratory bird populations only and are not to be construed as opening, re-opening, or extending any open hunting season contrary to any regulations promulgated under Section 3 of the Migratory Bird Treaty Act.

(3) Control activities may be conducted only when all waterfowl (including light goose) and crane hunting seasons, excluding falconry, are closed.

(4) Control measures employed through this section may be utilized only between the hours of one-half hour before sunrise to one-half hour after sunset.

(5) Nothing in the conservation order may limit or initiate management actions on Federal land without concurrence of the Federal Agency with jurisdiction.

(6) States and Tribes must designate participants who must operate under the conditions of the conservation order.

(7) States and Tribes must inform participants of the requirements/conditions of the conservation order that apply.

(8) States and Tribes must keep annual records of activities carried out under the authority of the conservation order. Specifically, information must be collected on:

(i) the number of individuals participating in the conservation order;

(ii) the number of days individuals participated in the conservation order;

(iii) the number of individuals that pursued light geese with the aid of a shotgun capable of holding more than three shells;

(iv) the number of individuals that pursued light geese with the aid of an electronic call;

(v) the number of individuals that pursued light geese during the period one-half hour after sunset;

(vi) the total number of light geese shot and retrieved during the conservation order;

(vii) the number of light geese taken with the aid of an electronic call;

(viii) the number of light geese taken with the fourth, fifth, or sixth shotgun shell;

(ix) the number of light geese taken during the period one-half hour after sunset; and

(x) the number of light geese shot but not retrieved.

(9) The States and Tribes must submit an annual report summarizing activities conducted under the conservation order on or before September 15 of each year, to the Chief, Division of Migratory Bird

Management, U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, Mail Stop MBSP-4107, Arlington, Virginia 22203. Information from Tribes may be incorporated in State reports.

(g) What is required in order for individuals to participate in the conservation order?

Individual participants in State or Tribal programs covered by the conservation order are required to comply with the following requirements:

(1) Nothing in the conservation order authorizes the take of light geese contrary to any State or Tribal laws or regulations; and none of the privileges granted under the conservation order may be exercised unless persons acting under the authority of the conservation order possesses whatever permit or other authorization(s) as may be required for such activities by the State or Tribal government concerned.

(2) Participants who take light geese under the conservation order may not sell or offer for sale those birds nor their plumage, but may possess, transport, and otherwise properly use them.

(3) Participants acting under the authority of the conservation order must permit at all reasonable times including during actual operations, any Federal or State game or deputy game agent, warden, protector, or other game law enforcement officer free and unrestricted access over the premises on which such operations have been or are being conducted; and must promptly furnish whatever information an officer requires concerning the operation.

(4) Participants acting under the authority of the conservation order may take light geese by any method except those prohibited as follows:

(i) With a trap, snare, net, rifle, pistol, swivel gun, shotgun larger than 10 gauge, punt gun, battery gun, machine gun, fish hook, poison, drug, explosive, or stupefying substance;

(ii) From or by means, aid, or use of a sinkbox or any other type of low floating device, having a depression affording the person a means of concealment beneath the surface of the water;

(iii) From or by means, aid, or use of any motor vehicle, motor-driven land conveyance, or aircraft of any kind, except that paraplegics and persons missing one or both legs may take from any stationary motor vehicle or stationary motor-driven land conveyance;

(iv) From or by means of any motorboat or other craft having a motor attached, or any sailboat, unless the motor has been completely shut off and the sails furled, and its progress therefrom has ceased. A craft under power may be used only to retrieve dead or crippled birds; however, the craft may not be used under power to shoot any crippled birds;

(v) By the use or aid of live birds as decoys; although not limited to, it shall be a violation of this paragraph for any person to take light geese on an area where tame or captive live geese are present unless such birds are and have been for a period of 10 consecutive days before the taking, confined within an enclosure that substantially reduces the audibility of their calls and totally conceals the birds from the sight of light geese;

(vi) By means or aid of any motor-driven land, water, or air conveyance, or any sailboat used for the purpose of or resulting in the concentrating, driving, rallying, or stirring up of light geese;

(vii) By the aid of baiting, or on or over any baited area, where a person knows or reasonably should know that the area is or has been baited as described in 50 CFR § 20.11(j-k). Light geese may not be taken on or over lands or areas that are baited areas, and where grain or other feed has been distributed or scattered solely as the result of manipulation of an agricultural crop or other feed on the land where grown, or solely as the result of a normal agricultural operation as described in § 20.11(h and l). However, nothing in this paragraph prohibits the taking of light geese on or over the following lands or areas that are not otherwise baited areas: (A) standing crops or flooded standing crops (including aquatics); standing, flooded, or manipulated natural vegetation; flooded harvested croplands; or lands or areas where seeds or grains have been scattered solely as the result of a normal agricultural planting, harvesting, post-harvest manipulation or normal soil stabilization practice as described in § 20.11(g, i, l, and m); (B) from a blind or other place of concealment camouflaged with natural vegetation; (C) from a blind or other place of concealment camouflaged with vegetation from agricultural crops, as long as such camouflaging does not result in the exposing, depositing, distributing or scattering of grain or other feed; or (D) standing or flooded standing agricultural crops where grain is inadvertently scattered solely as a result of a hunter entering or exiting a hunting area, placing decoys, or retrieving downed birds.

(viii) Participants may not possess shot (either in shotshells or as loose shot for muzzleloading) other than steel shot, bismuth-tin, tungsten-iron, tungsten-polymer, tungsten-matrix, tungsten-nickel-iron, tungsten-nickel-iron-tin, or other shots that are authorized in 50 CFR 20.21(j).

(h) Under what conditions would the conservation order be suspended?

The Director will annually assess the overall impact and effectiveness of the conservation order on each light goose population to ensure compatibility with long-term conservation of this resource. The Director will suspend the conservation order if at any time evidence is presented that clearly demonstrates that an individual light goose population no longer presents a serious threat of injury to the area or areas involved. Suspension by the Director will occur by publication of a notice in the Federal Register. However, resumption of growth by the light goose population in question may warrant reinstatement of the conservation order to control the population. The Director will publish a notice of such reinstatement in the Federal Register. Depending on the status of individual light goose populations, it is possible that a conservation order may be in effect for one or more light goose populations, but not others.

(i) Can the conservation order be suspended?

The Director reserves the right to suspend or revoke a State's or Tribe's authority under this program if we find that the terms and conditions specified in the program have not been adhered to by that

State or Tribe. The criteria for suspension and revocation are outlined in 50 CFR § 13.27 and § 13.28 of this subchapter. Upon appeal, final decisions to revoke authority will be made by the Director. Additionally, at such time that the Director determines that a specific population of light geese no longer poses a threat to habitats, agricultural crops, or other interests, or is within Flyway management objectives, the Director may choose to terminate part or all of the conservation order. In all cases, the Director will annually review the effectiveness of the program.

(j) Will information concerning the conservation order be collected?

The information collection requirements of the conservation order, as described in (f)(8) above, will be submitted for approval by OMB. Agencies may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The record-keeping and reporting requirements imposed under the conservation order will be utilized to administer this program, particularly in the assessment of impacts alternative regulatory strategies may have on light geese and other migratory bird populations. The information collected will be required to authorize State and Tribal governments responsible for migratory bird management to take light geese within the guidelines provided by the Service.

Appendix 6

Special light goose permit

(a) ***What is the special light goose permit and what is its purpose?***

The special light goose permit is a permit issued by our Regional Offices to Service personnel and State wildlife agencies authorizing certain light goose management and control activities. The term light geese refers collectively to three taxa in North America: lesser snow geese (*Chen caerulescens caerulescens*), greater snow geese *(C. c. atlantica*), and Ross's geese (*C. rossii*). These taxa are generally referred to as "light" geese due to their light coloration; as opposed to "dark" geese such as Canada geese (*Branta canadensis*) and white-fronted geese (*Anser albifrons*). However, there are two color phases of lesser snow geese: the dark phase, typically referred to as "blue" geese, and white phase, typically referred to as "snow" geese or "white" geese. Both color phases are considered light geese for management purposes.

Regional Offices will only issue such a permit when it will contribute to the reduction of a particular light goose population that the Director has determined to be injurious to habitats or other interests on breeding, migration, and/or wintering areas. The management and control activities conducted under the permit are intended to relieve or prevent injurious situations only. No person should construe the permit as opening, reopening, or extending any hunting season contrary to any regulations established under Section 3 of the Migratory Bird Treaty Act.

(b) ***Who may receive a light goose permit?***

Only Federal and State wildlife agencies (Agencies) are eligible to receive a permit to undertake light goose control activities. Additionally, only employees or designated agents of a permitted Agency may undertake activities for light geese in accordance with the conditions specified in the permit, conditions contained in 50 CFR part 13, and conditions specified in (d) of this section.

(c) ***How does an Agency apply for a permit?***

Any wildlife agency wishing to obtain a permit must submit an application to the appropriate Service Regional Office, specified in 50 CFR 2.2, containing the general information and certification required by 50 CFR 13.12(a) plus the following information:

(1) A statement showing that the light goose control activities will contribute to reduction of the light goose population(s) that the Director has determined to be injurious to habitats or other interests on breeding, migration, and/or wintering areas;

(2) The requested annual take of light geese;

(3) A statement indicating that the Agency will inform and brief all employees and designated agents of the requirements of these regulations and permit conditions.

(d) ***What are the conditions of the permit?***

The special light goose permit is subject to the general conditions in 50 CFR part 13, and, unless otherwise specifically authorized by the Regional Office in the permit, the conditions outlined below:

(1) *What are the limitations on management and control activities?*

(i) Take of light geese as a management tool under this section may not exceed the number authorized by the Regional Office and specified in the permit.

(ii) Methods of take for the control of light geese are at the Agency's discretion. Methods may include, but are not limited to, firearms, alpha-chloralose, traps, and other techniques consistent with accepted wildlife management programs.

(iii) Activities conducted under the permit may not affect endangered or threatened species as designated under the Endangered Species Act.

(2) *When may an Agency conduct management and control activities?*

Agencies and their employees and agents may conduct control activities whenever light geese are present in the geographic area for which they have jurisdiction. In the Pacific Flyway, control activities should incorporate

considerations for temporal and spatial aspects of migration of lesser snow geese from Wrangel Island, Russia, so as to avoid or minimize take of such birds.

(3) *How must the Agency dispose or utilize geese taken under this permit?*

Agencies and their employees and agents may possess, transport, and otherwise dispose of light geese taken under this section. Agencies must utilize such birds by donation to public museums or public institutions for scientific or educational purposes, by processing them for human consumption and distributing them free of charge to charitable organizations, or by burying or incinerating them. Agencies, their employees, and designated agents may not sell, offer for sale, barter, or ship for the purpose of sale or barter any light geese taken under this section, nor their plumage.

(4) *How does the permit relate to existing State law?*

No person conducting management and control activities under this section should construe the permit to authorize the killing of light geese contrary to any State law or regulation, nor on any Federal land without specific authorization by the responsible management agency. No person may exercise the privileges granted under this section unless they possess any permits required for such activities by any State or Federal land manager.

(5) *When conducting management and control activities, are there any special inspection requirements?*

Any Agency employee or designated agent authorized to carry out management and control activities must have a copy of the permit and designation in their possession when carrying out any activities. The Agency must also require the property owner or occupant on whose premises the Agency is conducting activities to allow, at all reasonable times, including during actual operations, free and unrestricted access to any Service special agent or refuge officer, State wildlife or deputy wildlife agent, warden, protector, or other wildlife law enforcement officer (wildlife officer) on the premises where they are, or were, conducting activities. Furthermore, any Agency employee or designated agent conducting such activities must promptly furnish whatever information is required concerning such activities to any such wildlife officer.

(6) *What are the reporting requirements of the permit?*

Any Agency employee or designated agent exercising the privileges granted by this section must keep records of all activities carried out under the authority of this permit, including the number of light geese killed and

their disposition. The Agency must submit to the issuing Regional Office an annual report detailing activities, including the dates, numbers and locations of birds taken and the techniques used, on or before September 15 of each year.

(7) *What are the limitations of the special permit?*

The following limitations apply:

(i) Nothing in this section applies to any Federal land within a State's boundaries without written permission of the Federal Agency with jurisdiction.

(ii) Agencies may not undertake any actions under any permit issued under this section if the activities adversely affect other migratory birds or species designated as endangered or threatened under the authority of the Endangered Species Act.

(iii) We will only issue permits to Federal and State wildlife agencies in the conterminous United States.

(iv) Agencies may designate agents who must operate under the conditions of the permit.

(v) *How long is the special permit valid?*

A special light goose permit issued or renewed under this section expires on the date designated on the face of the permit unless it is amended or revoked or such time that the Director determines that the light goose population in question no longer poses a threat to breeding, migration, and wintering habitats. In all cases, the term of the permit may not exceed five (5) years from the date of issuance or renewal.

(vi) *Can we revoke the special permit?*

We reserve the right to suspend or revoke any permit, as specified in 50 CFR 13.27 and 50 CFR 13.28.

(e) What are the OMB information collection requirements of the permit program?

Federal agencies may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. We will apply for an information collection permit and use the information to administer this program. We will require the information from Federal and State

wildlife agencies responsible for migratory bird management in order to obtain a special light goose permit, and to determine if the applicant meets all the permit issuance criteria, and to protect migratory birds. We estimate the public reporting burden for this collection of information to average 8 hours per response, including the time for reviewing instructions, gathering and maintaining data needed, and completing and reviewing the collection of information.

Appendix 7

Appendix 7. Federal frameworks for light goose hunting seasons in the U.S., 1961-2006.

	Atlantic Flyway					Mississippi Flyway				
				Limits					Limits	
	Season dates			Daily		Season dates			Daily	
Year	Opening	Closing	Days	Bag	Poss.[a]	Opening	Closing	Days	Bag	Poss.[a]
1961	Closed season					Oct. 1	Jan. 8	60	5	5
1962	Closed season					Oct. 1	Jan. 13	60	5	5
1963	Closed season					Oct. 1	Jan. 15	70	5	5
1964	Closed season					Oct. 1	Jan. 15	70	5	5
1965	Closed season					Oct. 1	Jan. 15	70	5	5
1966	Closed season					Oct. 1	Jan. 15	70	5	5
1967	Closed season					Sep. 30	Jan. 14	70	5	5
1968	Closed season					Sep. 28	Jan. 12	70	5	5
1969	Closed season					Sep. 27	Jan. 11	70	5	5
1970	Closed season					Oct. 1	Jan. 24	70	5	5
1971	Closed season					Oct. 1	Jan. 23	70	5	5
1972	Closed season					Oct. 1	Jan. 20	70	5	5
1973	Closed season					Oct. 1	Jan. 20	70	5	5
1974	Closed season					Oct. 1	Jan. 20	70	5	5
1975	Oct. 1	Jan. 31	30	2	4	Oct. 1	Jan. 20	70	5	5
1976	Oct. 1	Jan. 31	30	2	4	Oct. 1	Jan. 20	70	5	5
1977	Oct. 1	Jan. 31	60	2	4	Oct. 1	Jan. 20	70	5	5
1978	Oct. 1	Jan. 31	70	2	4	Oct. 1	Jan. 20	70	5	5
1979	Oct. 1	Jan. 31	70	4	8	Sep. 29	Jan. 20	70	5	5
1980	Oct. 1	Jan. 31	70	4	8	Oct. 4	Jan. 20	70	5	10
1981	Oct. 1	Jan. 31	90	4	8	Oct. 3	Jan. 20	70	5	10
1982	Oct. 1	Jan. 31	90	4	8	Oct. 2	Jan. 20	70	5	10
1983	Oct. 1	Jan. 31	90	4	8	Oct. 1	Jan. 20	70	5	10
1984	Oct. 1	Jan. 31	90	4	8	Sep. 29	Jan. 20	70	5	10
1985	Oct. 1	Jan. 31	90	4	8	Sep. 28	Jan. 20	70	5	10
1986	Oct. 1	Jan. 31	90	4	8	Oct. 4	Jan. 20	70	5	10
1987	Oct. 1	Jan. 31	90	4	8	Oct. 3	Jan. 17	70	5	10
1988	Oct. 1	Jan. 31	90	4	8	Oct. 1	Jan. 22	70	5	10
1989	Oct. 1	Jan. 31	90	5	10	Sep. 30	Jan. 21	80	7	14
1990	Oct. 1	Feb. 10	107	5	10	Sep. 29	Jan. 20	80	7	14
1991	Oct. 1	Jan. 10	107	5	10	Sep. 28	Jan. 31	80	7	14
1992	Oct. 1	Feb. 10	107	5	10	Oct. 3	Jan. 31	80	7	14
1993	Oct. 1	Feb. 10	107	5	10	Oct. 2	Feb. 14	80	7	14
1994	Oct. 1	Feb. 10	107	5	10	Oct. 1	Feb. 14	107	7	14
1995	Oct. 1	Feb. 10	107	5	10	Oct. 1	Feb. 14	107	10	20
1996	Oct. 1	Mar. 10	107	8	24	Sep. 28	Mar. 10	107	10	30
1997	Oct. 1	Mar. 10	107	10	30	Oct. 4	Mar. 10	107	10	30
1998	Oct. 1	Mar. 10	107	15	none	Oct. 3	Mar. 10	107	20	none
1999	Oct. 1	Mar. 10	107	15	none	Oct. 2	Mar. 10	107	20	none
2000-06	Oct. 1	Mar. 10	107	15	none	Sep. 30[b]	Mar. 10	107	20	none

[a] Possession limit (none means no limit)
[b] Saturday nearest September 24

	Central Flyway[b]					Pacific Flyway				
				Limits[c]					Limits[d]	
	Season dates			Daily		Season dates			Daily	
Year	Opening	Closing	Days	Bag	Poss.[a]	Opening	Closing	Days	Bag	Poss.[a]
1961	Oct. 1	Jan. 8	60	5	5	Oct. 7	Jan. 7	75	6,0	6,0
1962	Oct. 6	Jan. 6	75	5	5	Oct. 6	Jan. 6	75	6,0	6,0
1963	Oct. 5	Jan. 5	90,75	5	5	Oct. 5	Jan. 5	90	6,1	6,1
1964	Oct. 10	Jan. 10	90,75	5	5	Oct. 10	Jan. 10	90	6,1	6,1
1965	Oct. 1	Jan. 15	75	5	5	Oct. 9	Jan. 9	90	6,1	6,1
1966	Oct. 1	Jan. 15	75	5	5	Oct. 8	Jan. 8	90	6,1	6,1
1967	Sep. 30	Jan. 14	75	5	5	Oct. 7	Jan. 14	90	6,1	6,1
1968	Oct. 1	Jan. 15	75	2,5	2,5	Oct. 5	Jan. 12	93	6,1	6,1
1969	Oct. 1	Jan. 15	86	2,5	4,5	Oct. 4	Jan. 11	93	6,1	6,1
1970	Oct. 1	Jan. 17	90,75	2,5	4,5	Oct. 3	Jan. 17	93	6,1	6,1
1971	Oct. 1	Jan. 16	90,75	2,5	4,5	Oct. 2	Jan. 16	93	6,1	6,1
1972	Oct. 1	Jan. 24	93,72	2,4	4,4	Oct. 1	Jan. 20	93	6,1	6,1
1973	Sep. 29	Jan. 20	93,72	2,5	4,5	Set. 29	Jan. 20	93	6,1	6,1
1974	Sep. 28	Jan. 19	93,72	2,5	4,5	Sep. 28	Jan. 19	93	6,1	6,1
1975	Oct. 4	Jan. 18	93,72	2,5	4,5	Oct. 4	Jan. 18	93	3,1	6,1
1976	Oct. 2	Jan. 23	93,72	2,5	4,5	Oct. 2	Jan. 23	93	3,1	6,1
1977	Oct. 1	Jan. 22	93,86	2,5	4,5	Oct. 1	Jan. 22	93	3,1	6,1
1978	Sep. 30	Jan. 21	93,86	2,5	4,5	Sep. 30	Jan. 21	93	3,1	6,1
1979	Sep. 29	Jan. 20	93,86	2,5	4,5	Sep. 29	Jan. 20	93	3,1	6,1
1980	Oct. 4	Jan. 18	93,86	2,5	4,10	Oct. 4	Jan. 18	93	3,3	6,6
1981	Oct. 3	Jan. 17	93,86	2,5	4,10	Oct. 3	Jan. 17	93	3,3	6,6
1982	Oct. 2	Jan. 23	93,86	2,5	4,10	Oct. 2	Jan. 23	93	3,3	6,6
1983	Oct. 1	Jan. 22	93,86	2,5	4,10	Oct. 1	Jan. 22	93	3,3	6,6
1984	Sep. 29	Feb. 12	93,86	2,5	4,10	Sep. 29	Jan. 20	93	3,3	6,6
1985	Sep. 28	Feb. 16	93,86	5	10	Sep. 28	Jan. 19	93	3,3	6,6
1986	Oct. 4	Feb. 15	93,86	5	10	Oct. 4	Jan. 18	93	3,3	6,6
1987	Oct. 3	Feb. 14	93,86	5	10	Oct. 3	Jan. 17	93	3,3	6,6
1988	Oct. 1	Feb. 14	95,86	5	10	Oct. 1	Jan. 22	93	3,3	6,6
1989	Sep. 30	Feb. 18	95,100	5	10	Sep. 30	Jan. 21	93	3,3	6,6
1990	Sep. 29	Feb. 17	100,86[e]	5[e]	10[e]	Sep. 29	Jan. 20	93	3,3	6,6
1991	Sep. 28	Feb. 16	107,86[e]	5[e]	10[e]	Sep. 28	Jan. 19	93	3,3	6,6
1992	Oct. 3	Feb. 14	107	5,10	10,20	Oct. 3	Jan. 17	93	3,3	6,6
1993	Oct. 2	Feb. 13	107	5,10	10,20	Oct. 2	Jan. 23	100	3,3	6,6
1994	Oct. 1	Feb. 28	107	5,10	10,20	Oct. 1	Jan. 20	100	3,3	6,6
1995	Sep. 30	Mar. 10	107	5,10	10,20	Oct. 1	Jan. 21	100	3,3	6,6
1996	Sep. 28	Mar. 10	107	10	40	Sep. 29	Jan. 19	100	3,3	6,6
1997	Oct. 4	Mar. 10	107	10	40	Oct. 4	Jan. 18	100	3,3	6,6
1998	Oct. 3	Mar. 10	107	20	none	Oct. 3	Jan. 17	100	3,3	6,6
1999	Oct. 2	Mar. 10	107	20	none	Oct. 2	Jan. 23	100	3,3	6,6
2000	Sep. 30	Mar. 10	107	20	none	Sep. 30	Jan. 21	100	3,3	6,6
2001	Sep. 29	Mar. 10	107	20	none	Sep. 29	Jan. 20	100	3,3	6,6
2002	Sep. 21	Mar. 10	107	20	none	Sep. 21[f]	Jan. 26	107[f]	3,3	6,6
2003	Sep. 27	Mar. 10	107	20	none	Oct. 4	Jan. 25	100	3,3	6,6
2004	Sep. 25	Mar. 10	107	20	none	Oct. 2	Jan. 30	100	3,3	6,6
2005	Sep. 24	Mar. 10	107	20	none	Oct. 1	Jan. 29	100	4,4	8,8
2006	Sep. 23	Mar. 10	107	20	none	Sep. 30	Jan. 28	100	4,4	8,8

[a] Possession limit

[b] Central Flyway: If 2 numbers are given for days, bag and/or possession limits the first number is for the western tier states and the second number is for eastern tier states.

[c] Bag/possession limit for Ross's geese is 1/1 during 1963-1978. Season closed 1961-62.
[d] Pacific Flyway bag and possession limits are for lesser snow and Ross's geese, respectively.
[e] In 1990 and 1991, eastern tier states had the days/daily bag/possession limit option of either 86/5/7 or 100/10/14.
[f] In CA, OR, and WA season opening framework date was Sep. 28 and season length was 100 days.

Appendix 8

Regional listing of special status species that overlap in geographic range with various populations of light geese in Service Regions 1-7. Endangered (E), threatened (T), or experimental non-essential (XN) status of each species is indicated after scientific name.

Common name	Scientific name and status
Region 1 (Pacific)	
Hawaiian goose	(*Brant sandvicensis*) [E]
Light-footed clapper rail	(*Rallus longirostris levipes*) [E]
California clapper rail	(*Rallus longirostris obsoletus*) [E]
Yuma clapper rail	(*Rallus longirostris yumanensis*) [E]
California least tern	(*Sterna antillarum*) [E]
Brown pelican	(*Pelicanus occidentalis*) (Pacific coast pop.) [E]
Southwestern willow flycatcher	(*Empidonax trailii extimus*) [E]
California condor	(*Gymnogyps californianus*) [E]
Least Bell's vireo	(*Vireo belli pusillus*) [E]
Western snowy plover	(*Charadrius alexandrinus nivosus*) [T]
Bald eagle	(*Haliaeetus leucocephalus*) [T]
California gnatcatcher	(*Polioptila californica*) [T]
Inyo California towhee	(*Pipilo crissalis eremophilus*) [T]
Marbled murrelet	(*Brachyramphus marmoratus*) [T]
Northern spotted owl	(*Strix occidentalis caurina*) [T]
Giant Garter Snake	(*Thamnophis gigas*) [T]
Mountain plover	(*Charadruis montanus)* [P]
Western sage grouse	(*Centrocercus urophasianus phaios*) [C]
Region 2 (Southwest)	
Attwater's greater prairie-chicken	(*Tympanuchus cupido attwateri*) [E]
Masked bobwhite	(*Colinus virginianus ridgewayi*) [E]
Red-cockaded woodpecker	(*Picoides borealis*) [E]
Cactus ferruginous pygmy-owl	(*Glaucidiium brasilainum cactorum*) [E]
Yuma clapper rail	(*Rallus longirostris yumanensis*) [E]
Least tern	(*Sterna antillarum*) [E]
Northern aplomado falcon	(*Falco femoralis septentrionalis*) [E]
Brown pelican	(*Pelicanus occidentalis*) [E]
Southwestern willow flycatcher	(*Empidonax traillii extimus*) [E]
Black-capped vireo	(*Vireo atricapillus*) [E]
Golden-cheeked warbler	(*Dendroica chrysoparia*) [E]
California condor	(*Gymnogyps californianus*) [XN]
Mexican spotted owl	(*Strix occidentalis lucida*) [T]
Bald eagle	(*Haliaeetus leucocephalus*) [T]
Piping plover	(*Charadrius melodus*) [T]
Whooping crane	(*Grus americana*) [E]
Mountain plover	(*Charadruis montanus)* [P]
Lesser prairie-chicken	(*Tympanuchus pallidicinctus*) [C]

Region 3 (Great Lakes-Big Rivers)

Piping plover	(*Charadrius melodus*) [T]
Least tern	(*Sterna antillarum*) (Interior population) [E]
Bald eagle	(*Haliaeetus leucocephalus*) [T]
Copperbelly water snake	(*Nerodia erythrogaster neglecta*) [T]

Region 4 (Southeast)

Red-cockaded woodpecker	(*Picoides borealis*) [E]
Puerto Rican parrot	(*Amazona vittata*) [E]
Puerto Rican nightjar	(*Caprimulgus noctitherus*) [E]
Puerto Rican Plain pigeon	(*Columba inornata wetmorei*) [E]
Mississippi sandhill crane	(*Grus canadensis pulla*) [E]
Piping plover	(*Charadrius melodus*) [E]
Least tern	(*Sterna antillarum*) (Interior population) [E]
Everglade snail kite	(*Rostrhamus sociabilis plumbeus*) [E]
Puerto Rican broad-winged hawk	(*Buteo platypterus brunnescens*) [E]
Puerto Rican sharp-shinned hawk	(*Accipiter striatus venator*) [E]
Wood stork	(*Mycteria americana*) [E]
Brown pelican	(*Pelicanus occidentalis*) [E]
Cape Sable sparrow	(*Ammodramus maritimus mirabilis*) [E]
Florida grasshopper sparrow	(*Ammodramus savanarum floridanus*) [E]
Yellow-shouldered blackbird	(*Agelaius xanthomus*) [E]
Roseate tern	(*Sterna douglalli*) [T]
Bald eagle	(*Haliaeetus leucocephalus*) [T]
Audubon's crested caracara	(*Polyborus plancus audubonii*) [T]
Florida scrub jay	(*Aphelocoma coerulescens*) [T]
Bog turtle	(*Clemmys muhlenbergii*) [T]

Region 5 (Northeast)

Piping plover	(*Charadrius melodus*) [T]
Roseate tern	(*Sterna douglalli*) [E]
Bald eagle	(*Haliaeetus leucocephalus*) [T]
Plymouth redbelly turtle	(*Pseudemys rubriventris bangsi*) [E]
Bog turtle	(*Clemmys muhlenbergii*) [T]

Region 6 (Mountain-Prairie)

Least tern	(*Sterna antillarum*) (Interior population) [E]
Piping plover	(*Charadrius melodus*) [T]
Mexican spotted owl	(*Strix occidentalis lucida*) [T]
Bald eagle	(*Haliaeetus leucocephalus*) [T]
Whooping crane	(*Grus americana*) [E]

Region 7 (Alaska)

Eskimo curlew	(*Numenius borealis*) [E]
Spectacled eider	(*Somateria fischeri*) [T]
Steller's eider	(*Polysticta stelleri*) [T]