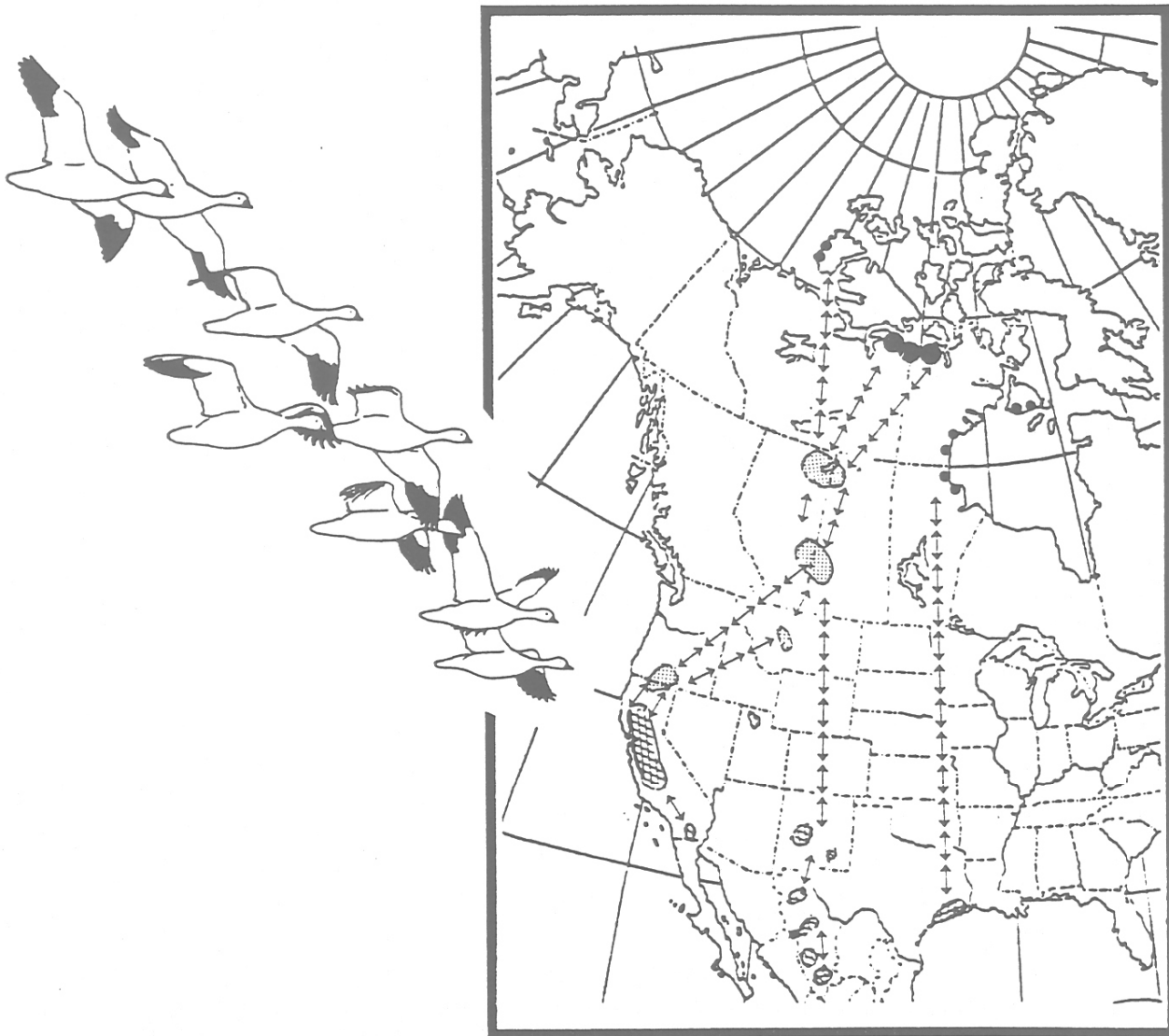


Ross' Geese



This management plan is one of a series of cooperatively developed plans for managing the various species of migratory birds of the Pacific Flyway. Inquiries about this plan may be directed to member states of the Pacific Flyway Council or to the Pacific Flyway Representative, U.S. Fish and Wildlife Service, 911 N.E. 11th Ave., Portland, OR 97232.

PACIFIC FLYWAY MANAGEMENT PLAN

FOR

ROSS' GEESE

Prepared for the:

Pacific Flyway Council
Dirección General de Conservación Ecológica de Recursos Naturales
U.S. Fish and Wildlife Service
Canadian Wildlife Service

Prepared by:

Subcommittee on White Geese
Pacific Flyway Study Committee

July 1992

Approved by:


Chairman, Pacific Flyway Council

7-31-92
Date

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I. INTRODUCTION

The purpose of this management plan is to provide guidelines for management of Ross' geese (*Chen rossii*) in the Pacific Flyway. The Ross' goose, one of the smallest of all North American geese, is endemic to North America, breeding in Arctic Canada and wintering in the Central and Pacific Flyways (Figure 1). Existence of the species was once considered precarious; however, within the past 40 years, there has been a great upsurge in numbers of Ross' geese. Hanson et al. (1956), in an incomplete survey, found only 1,951 Ross' geese in the region south of Queen Maud Gulf in July 1949. A visual aerial survey, also incomplete, of the same area in 1960 (Barry 1960) reported 9,000 Ross' geese. Visual surveys from 1965 to 1967 by Ryder (1969) tallied 32,086 Ross' geese nesting in the same area. In June 1976 Kerbes et al. (1983) estimated 77,300 Ross' geese nesting there, using aerial photography and ground truth surveys. Additional aerial photos and ground truth surveys showed the nesting population of Ross' geese had continued to expand to 90,700 in 1982, and to 137,700 - 177,400 in 1988 (Kerbes, unpublished).

Breeding colonies in the Queen Maud Gulf lowlands of the Central Canadian Arctic produce more than 95% of all Ross' geese, and an associated population of snow geese (*Chen caerulescens*). Some Ross' geese also are produced on Banks Island, along western and southern Hudson Bay, and Southampton Island. During winter, 95% of the population is in California and New Mexico, and most of the remainder is in Texas and northern Mexico. Major staging areas are in Alberta, Saskatchewan, Montana, Oregon and northeastern California (Figure 1, Appendix A). Surveys indicate Ross' geese may now number in excess of 200,000 birds.

II. GOALS AND OBJECTIVES

The Pacific Flyway goal of management described in this plan is to maintain or increase the numbers and influence distribution of this unique species for its intrinsic values, as well as for its direct benefits to society. It is recognized that the distribution of Ross' geese between the Pacific and Central Flyways is currently dynamic. Cooperative management planning between all jurisdictions needs to be integrated, as soon as possible, on the basis of best available information on breeding population units.

The objectives are:

1. Support a continental population of at least 100,000 breeding or 150,000 wintering Ross' geese, with a geographical and temporal distribution consistent with the welfare of the species and all uses.

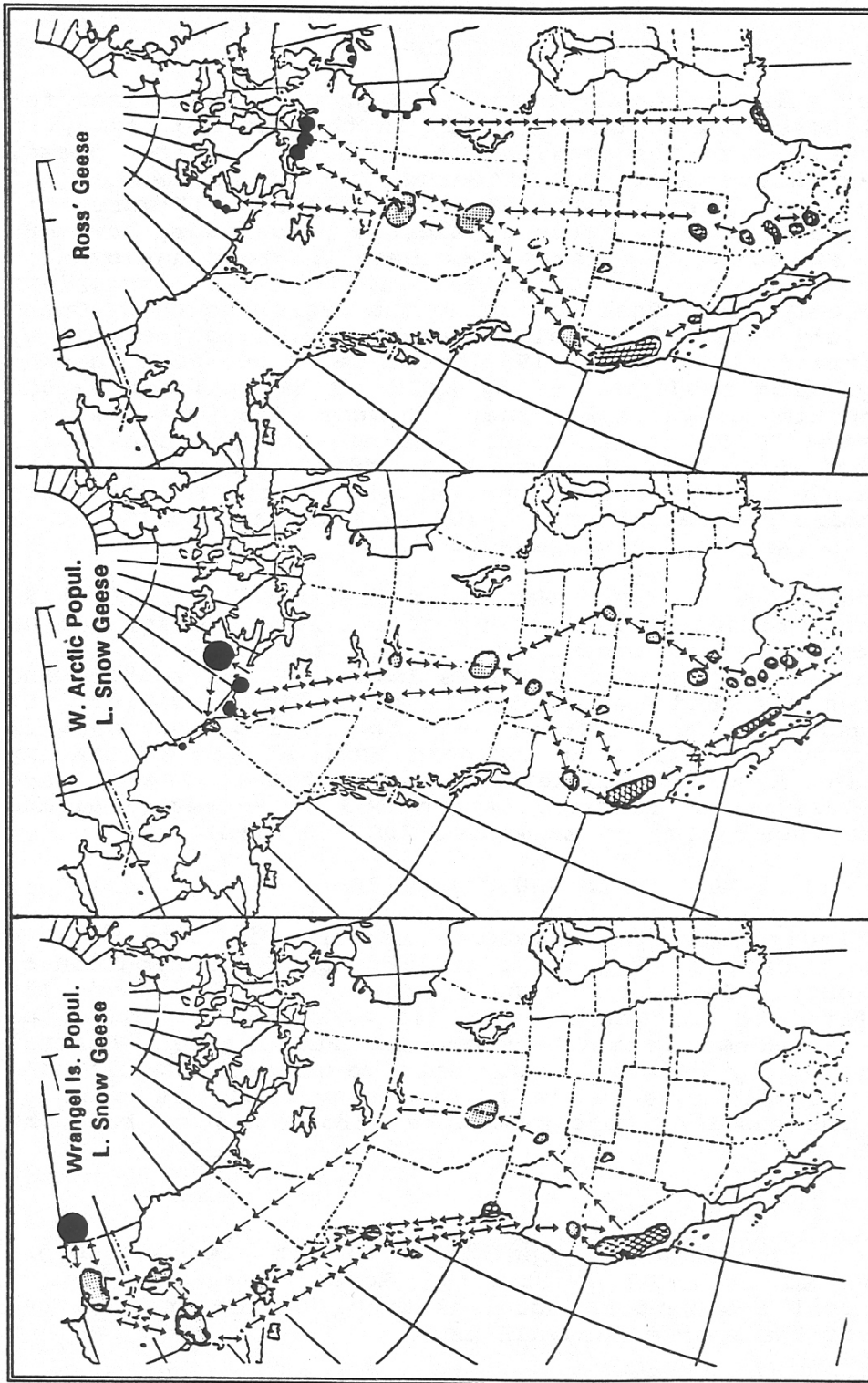


Figure 1. Distribution of lesser snow geese (Wrangel Island and Western Arctic populations) and Ross' geese as related to the Pacific Flyway.

2. Adopt a harvest strategy that would: (a) include Ross' geese without special restrictions in "white goose" regulations when the population is at or above 100,000 breeding birds, or 150,000 wintering birds; (b) reduce the harvest by progressively restrictive bag limits if the population indices fall below 100,000 breeders or 150,000 wintering birds; (c) close the season if the population indices fall below 50,000 breeding birds or 75,000 wintering birds; and (d) reinstitute restricted hunting when the indices reach 75,000 breeders or 110,000 wintering birds.
3. Maintain geographic and temporal distribution of Ross' geese through appropriate adjustments in regulations, if hunting causes shifts in such distribution.
4. Designate and preserve adequate habitat on all parts of the species' range to meet population objectives.
5. Manage Ross' geese to provide for aesthetic, educational, scientific and hunting uses.

III. STATUS

A. Breeding Ground Inventories

The lowlands adjacent to the Queen Maud Gulf in the central Canadian Arctic are where the vast majority of Ross' geese nest. Lesser snow geese also nest in the same area. Estimates of the breeding population of white geese in this area have been made since 1965 (Appendix B). Both species have increased dramatically since the first assessment in 1949 (Hanson et al. 1956), but snow geese are increasing more rapidly due to immigration from the east (R. Kerbes, pers. comm.). The latest inventory (1988) produced estimates from 137,800 to 177,400 Ross' geese nesting in the Queen Maud Gulf lowlands. No estimates are available of the breeding population at other arctic colonies, but a minimum of 3,500 Ross' geese were present on Banks Island in 1990 (R. Bromley, pers. comm.).

B. Winter Inventories

Annual winter surveys have indicated a slight increase in the Ross' goose population during the period from 1956 to 1978 (Appendix C). However, McLandress (1979) showed that a substantial portion of the Ross' goose population was outside the area covered on these surveys. He estimated that the 1977 postseason population in the Central Valley of California was 106,000 (Appendix C). That estimate was consistent with results of the 1983 nesting inventory in the Queen Maud Gulf lowlands (Kerbes et al. 1983), and more than double a 1964 estimate of the total population made during a survey of staging areas in Alberta and Saskatchewan (Dzubin 1965).

The largest segment of Ross' goose population winters in the Sacramento Valley rather than in the San Joaquin Valley as previously thought. McLandress (1979) suggested that the increase in the Ross' goose population in California has occurred primarily in this segment in the Sacramento Valley. Attempts were made in 1984-85 and 1985-86 by CFG and FWS personnel to update Ross' goose population data from the Central Valley of California using McLandress' method of censusing white geese, but without success. This method was successfully used in 1988-89 and 1989-90, resulting in estimates of over 200,000 Ross' geese wintering in California (Silveira 1989, pers. comm.).

In addition to those wintering in the Central Valley, an increasing number of Ross' geese winters in the southwest portion of the Central Flyway. Productivity surveys conducted in this area in 1985-86 estimated a white goose population of 150,000 to 180,000 geese, of which 10+% were Ross' geese (J. Voelzer, pers. comm.). Similar surveys in 1989-90 estimated 172,000 white geese, of which 12.6% were Ross'. Winter surveys on Bosque del Apache and Bitter Lake NWRs have also shown a constant upward trend in white goose numbers since 1960 (Appendix D). White goose species ratios at Bosque del Apache NWR (R. Drewien, pers. comm.) indicate an increase in the percentage of Ross' geese from 5.9% in 1978-80 to 15+% in 1989.

Accurate estimates of Ross' geese on the wintering grounds are difficult to make due to the mixing of Ross' and snow goose populations. It appears, however, that the Ross' goose wintering population is trending upward and is now well above 200,000 geese.

C. Migration Routes

The first stage in the migration of Ross' geese takes them from their breeding grounds adjacent to Queen Maud Gulf to the Peace-Athabasca Delta in northeastern Alberta. Until 1960, most of the geese migrated from the Delta to the area centering on Sullivan Lake, 110 miles southeast of Edmonton, Alberta (Dzubin 1965). However, during the early 1960's, an increasingly greater proportion of these geese stopped in the area between Macklin and Kindersley in southwestern Saskatchewan and the Provost area of southeastern Alberta. It appears that the P-A Delta may no longer be a major staging area.

From eastern Alberta and western Saskatchewan, Ross' geese migrate to the vicinity of Great Falls-Freezeout Lake, Montana. From there, most fly southwest to Summer Lake, Oregon and the Klamath Basin in northeastern California. After a short stay, they move on to the Sacramento Valley. Some will remain there for the winter, while others will eventually continue on to the east and west grasslands of Merced County in the San Joaquin Valley. Some Ross' geese are found as far south as Imperial Valley, California. These probably arrive via migration routes through Utah and Nevada.

Another segment of the Ross' goose population migrates down through the Central Flyway, with Bitter Lake NWR and Bosque del Apache NWR, New Mexico and the northern highlands of Mexico being the major fall and wintering areas. Voelzer (pers. comm.) believes that Ross' geese are changing their migration pattern and following snow geese down the eastern slope of the Rockies to New Mexico and Mexico. This could have an effect on the California wintering population.

Observations of neck-collared Ross' geese during the 1989-90 winter seemed to indicate no differences in sighting rates, either in California or New Mexico-Mexico, among birds banded from the West, Central or East subregions of the Central Canadian Arctic (Kerbes 1990). This suggests that no one segment of the Ross' goose breeding population is accounting for the increase in this species observed in the New Mexico-Mexico region. At the same time, 10 neck collars observed in California in 1989-90 were subsequently seen in New Mexico or Mexico the same year.

D. Chronology

Ross' geese appear in southeast Alberta and southwest Saskatchewan during the first week in September and the major influx takes place during the third week (Dzubin 1965). Departures from the Alberta-Saskatchewan staging area begin after the first week in October and have been largely completed by late October. By mid-October, Ross' geese have reached Freezeout Lake, Montana, with numbers increasing to late October or early November. They start arriving at Summer Lake, Oregon, in early October and in the Klamath Basin about mid- to late October, and remain about six weeks.

Early arrivals in the Klamath Basin precede early arriving Western Arctic snow geese, although the majority of Ross' geese arrive with the main flight of western Arctic snow geese. It was believed that Wrangel Island snow geese arrive in the Basin about two or four weeks before the main flight of Ross' and western Arctic snow geese (W. Rienecker, pers. comm.), but recent neck collar data suggests this is not the case (J. Silveira, pers. comm.). By early December the majority of Ross' geese have continued on to the Sacramento Valley. In mid-December, Ross' geese begin to arrive in the San Joaquin Valley grasslands, but the bulk of the birds which will winter here do not arrive until mid January (J. Silveira, pers. comm.).

Until recently, Central Flyway white geese were thought to migrate nonstop during the fall from southwestern Saskatchewan to New Mexico. However, around the winter of 1984-85, a significant number of birds have been not only stopping, but wintering in southeastern Colorado (J. Voelzer, pers. comm.). Those that move on to New Mexico peak during the last two weeks in November. As food becomes scarce in mid-December, they move on to the northern highlands of Mexico. In spring, the geese first swing northeast to southeast Colorado, north to Nebraska then northwest to Saskatchewan.

In late February or early March, California-wintering Ross' geese begin to move north to the Klamath Basin. They pause there two to four weeks before continuing their migration. They arrive in the Freezeout Lake, Montana, area by way of Summer Lake and Malheur NWR, Oregon, in late April and arrive in southeastern Alberta about the same time (Dzubin 1965). Current staging areas between the agricultural zone in Alberta and Saskatchewan and the Arctic breeding grounds are unclear. Ross' geese usually arrive on the breeding grounds in the Queen Maud Gulf area about the first week in June, and peak numbers are reached within three to four days (Ryder 1970).

E. Production and Mortality

Ross' geese arrive on their nesting grounds in family groups, and the yearlings remain with their parents until incubation starts. The yearlings then leave the nesting territories to congregate on communal areas (Ryder 1967). Nesting begins within a week of their arrival. In general, the proportion of young birds in the fall flight of Ross' geese will be average or higher, in nesting begins by late May. Production generally decreases if nesting is delayed much beyond June 15. The initiation of nesting and subsequent production of Arctic geese are strongly influenced by the extent and duration of snow cover.

Traditionally in the Queen Maud Gulf Lowlands both Ross' and snow geese nested in colonies on islands in shallow tundra lakes, where they were afforded some protection from predators, especially the Arctic fox (*Alopex lagopus*). During 1966-68, all nests at Karrak Lake averaged 3.7 eggs, but successful nests averaged 3.9 eggs per clutch. Ryder (1970) believed that older birds were the more successful nesters, thereby accounting for the larger clutch size in successful nests. Eggs hatch after being incubated an average of 22 days, and the young leave the nest a few hours after they are hatched.

Nest success is usually high, unless storms occur during the nesting period. During 1966-68, Ryder (1970) found that nest success at Karrak Lake ranged from 67% in 1968 to 88% in 1967. The principal cause of nest failure was predation. Family units leave the nesting grounds a few days after the hatch occurs and move to other island lakes and water courses, sometimes as far as 50 miles away. Families combine, so that three weeks after the hatch, aggregations may total 200 birds (Ryder 1967). A drop in brood size among the downy young was caused by abandonment and predation. Ryder (1967) observed glaucous gulls (*Larus hyperboreus*) snatching young Ross' geese off the water and devouring them.

In expanding in the Queen Maud Gulf since the 1960s, Ross' and snow geese have shown a major shift to nesting on suitable mainland areas of the main colonies. In 1976, 23% of the total nested on the

mainland (Kerbes et al. 1983). That proportion expanded to 55% in 1982 and to 84% in 1988 (Appendix B).

IV. HARVEST

Reported retrieved harvest of Ross' geese in the United States and Canada averaged 9,570 birds during the 1970s, with approximately 55% of this harvest occurring in the U. S. (Appendix E). Of the U. S. harvest, 92% was reported from the Pacific Flyway. Since then, total harvest averaged 13,630 Ross' geese, with 71% from the U. S. Within the U. S. harvest, the proportion from the Pacific Flyway has declined to an average of 54%, the rest occurring in the Central Flyway, with a few birds taken in the Mississippi Flyway. The harvest of Ross' geese in the Central Flyway apparently is increasing.

Indirect band recoveries from 1,044 Ross' geese banded at Tule Lake NWR and Gray Lodge Wildlife Area, 1952-1981, indicate that 42.4% of the harvest occurred in Canada, about equally divided between Alberta and Saskatchewan (37.2% combined). There is an indication that harvest within Canada shifted to the east during this time period (Appendix F). In the 1970s, 24% of the harvest was from Alberta, 64% was from Saskatchewan, and 12% was from Manitoba. During the 1980s, the percentages were 21%, 60%, and 19%, respectively. These numbers are not statistically significant, and the possibility exists that they are an artifact of misidentification of small snow geese as Ross' geese. Band recovery analysis of recent bandings in Canada may provide indications of any changes in this pattern.

The 1952-1981 banding estimated 52.9% of the harvest occurring in California, mainly in the Sacramento Valley (29.4%). Only a few Ross' geese have been taken at Summer Lake, Oregon, although it is a significant snow goose staging area (Appendix G). Data from state and federal areas in California, 1966-89, show a slightly decreasing trend in Ross' goose harvest, but an increase in percent of Ross' geese in the white goose harvest (Appendix H). This suggests that snow goose harvest is declining on these areas at a more rapid rate than is that of Ross' geese. The percentage of Ross' geese in the white goose harvest has fluctuated from 4 - 17% during the 1986-1989 seasons, with no clear trend. Apparent declines in white goose harvest on California public hunting areas is likely a result of declining hunter numbers.

The New Mexico-Mexico population of Ross' geese appears to be relatively untouched by hunter harvest and is believed to have a higher survival rate than Ross' geese wintering in California (J. Voelzer, pers. comm.). A measure of this factor is provided by goose harvest figures from Bosque Del Apache N.W.R. (Appendix I).

The impact of subsistence hunting on Ross' geese is unmeasured, but is believed to be negligible. Hunting presently does not appear to be limiting Ross' geese, considering that all indications show an increasing population.

The importance of this species to non-consumptive users is recognized but not quantified. Because of its limited winter range, it is often sought out by birders visiting California's Central Valley and New Mexico refuges.

V. CURRENT MANAGEMENT PRACTICES

1. Establishment and enforcement of hunting regulations.
2. Periodic (5-year interval) inventory of nesting Ross' and snow geese with aerial photography and ground truthing.
3. Annual fall white goose survey and mid-winter waterfowl inventory to determine population size. (Does not separate species.)
4. Federal and state harvest and hunter participation surveys, federal waterfowl parts collection survey, and bag checks on public hunting areas to monitor production and harvest.
5. Monitoring losses from disease.
6. Management of federal, state, territorial and provincial refuges, management areas and sanctuaries as protected areas for breeding and/or feeding and resting.
7. Providing the general public with the opportunity to view Ross' geese on federal, state and provincial lands.

VI. PROBLEMS

1. There is no accurate annual operational procedure for determining the numbers of Ross' geese, because they intermingle with lesser snow geese throughout their range, and because there is no estimate for breeding numbers outside the Queen Maud Gulf Migratory Bird Sanctuary.
2. Not all wintering and migration staging areas have been defined for Ross' geese (e.g. areas between agricultural areas of Saskatchewan and Alberta and the nesting grounds).
3. There is a threat of industrial and residential encroachment on wintering areas in California.
4. Nutritional requirements of wintering Ross' geese in the Pacific Flyway are unknown.
5. Disease losses, especially fowl cholera, of wintering Ross' geese have been serious, and fowl cholera has been confirmed on the breeding grounds.
6. Some Ross' geese are changing their migration pattern to coincide with that of snow geese migrating down the east slope of the Rocky Mountains to New Mexico and Mexico. There is evidence of direct movement between California and New Mexico, and Mexico as well. The extent and permanency of these shifts and effects on the California wintering population of Ross' geese are unknown, but the current neckband project will provide some information on this subject.
7. There is a possibility of interspecific competition on the breeding grounds between Ross' geese, snow geese, white-fronted geese, Canada geese, caribou and musk oxen, which may limit numbers and degrade habitat toward a lower carrying capacity.

VII. MANAGEMENT PROCEDURES

Habitat

1. Continue annual early spring habitat condition evaluation on major breeding colonies.

Lead Agencies: CWS, USFWS
Priority: 1

- Schedule: Ongoing
2. Proceed with management of Rio Grande Valley state and federal areas to improve local distribution of white geese.

Lead Agencies: New Mexico, USFWS
Priority: 2
Schedule: Ongoing
 3. Continue to promote agricultural practices and incentive programs in California's Central Valley that will maintain adequate acreage of rice stubble through the fall and winter for goose feeding areas.

Lead Agencies: USFWS, California
Priority: 2
Schedule: Ongoing

Surveys

1. Perform aerial photography census of white goose breeding colonies, with ground truthing to estimate Ross': snow goose ratios, every five years.

Lead Agencies: CWS
Priority: 1
Schedule: 1993
2. Continue the annual wintering population surveys in the Central and Pacific Flyways, including ground-truth surveys to determine Ross': snow ratios.

Lead Agencies: USFWS and states
Priority: 1
Schedule: Every 5 years, 1992, 1997, etc.; and photo surveys every 3 years, 1992, 1995; etc.
3. Continue to collect observations and complete comprehensive analyses of data on marked Ross' geese, banded for the international white goose neckbanding program.

Lead Agencies: CWS, USFWS, states, provinces, GNWT.
Priority: 1
Schedule: Ongoing
4. Continue annual determination of age ratios on fall migration staging areas, such as the western prairie provinces.

Lead Agencies: CWS, Saskatchewan, Alberta
Priority: 2
Schedule: Ongoing

5. Conduct annual aerial surveys supported by ground truthing in the prairie provinces to document distributional changes on spring and fall staging and migration areas.

Lead Agencies: CWS, Alberta and Saskatchewan

Priority: 2

Schedule: Ongoing

Public Use

1. Determine the effectiveness of regulations, continue to monitor the harvest of Ross' geese. Improve reliability of harvest surveys to accomplish this.

Lead Agencies: USFWS, CWS, provinces and states

Priority: 1

Schedule: Ongoing

VIII. RESEARCH NEEDS

1. Continue banding, marking, and analyses on Ross' geese to determine distribution shifts, effects of breeding ground habitat conditions on survival, and differential mortality rates among wintering flocks.

Lead Agencies: CWS, USFWS, states, provinces, GNWT, cooperators

Priority: 1

Schedule: Ongoing

2. Identify important spring and fall staging grounds of Ross' geese in Canada between the agricultural areas and the breeding grounds, and assess the security of these areas.

Lead Agencies: CWS, provinces, GNWT

Priority: 1

Schedule: Ongoing

3. Accelerate fowl cholera investigations and development of management procedures to minimize incidence of disease in Ross' geese throughout their range.

Lead Agencies: USFWS, CWS, states, provinces and GNWT

Priority: 1

Schedule: Ongoing

4. Determine the physiological and nutritional requirements of wintering Ross' geese.

Lead Agencies: USFWS and states
Priority: 2
Schedule: Undetermined

5. Evaluate present population surveys and investigate new methods for obtaining more accurate results.

Lead Agencies: USFWS, CWS, states, provinces, GNWT
Priority: 2
Schedule: Ongoing

6. Conduct ground research on the Queen Maud Gulf nesting grounds on breeding biology, nutrition, and food resources to determine if the burgeoning snow goose population is impacting Ross' geese. Relate this research to musk ox and caribou grazing in the area.

Lead Agencies: CWS, GNWT
Priority: 2
Schedule: Ongoing

IX. PLAN IMPLEMENTATION AND REVIEW

A Lesser Snow/Ross' Goose Subcommittee shall investigate both lesser snow and Ross' geese. The subcommittee shall meet twice annually or as needed to review progress toward achieving the goal and objectives of this plan and to recommend actions and revisions. The Subcommittee shall report, through the Pacific Flyway Study Committee, accomplishments and shortcomings of management efforts to the Pacific Flyway Council, Canadian Waterfowl Advisory Councils, state and federal agencies having relevant management responsibilities, and organizations interested in the management of geese.

The Subcommittee shall, through the Pacific Flyway Study Committee and Council, be responsible for integrating the provisions of this plan with plans and programs for management of Ross' geese in the Central Flyway and maintain an active, cooperative dialogue with the Central Flyway Technical Committee. In addition, the subcommittee will ensure that Ross' goose management and research guidelines are related to the Arctic Goose Joint Venture (North American Waterfowl Management Plan). It shall be the responsibility of the members to assure that the objectives and procedures of this plan are integrated and coordinated with those plans and activities of the various wildlife and land management agencies and local planning systems within their agency's venue.

The Subcommittee shall be comprised of a representative from each federal, provincial and state agency having management responsibility for this goose population. Chairmanship shall be appointed biannually and rotated among member agencies. The subcommittee will exercise its prerogative to invite participation (ex officio) at meetings by any individuals, group, agency or representative whose expertise, counsel or managerial capacity is required for the coordination and implementation of management programs.

Lead Agency/Group: Subcommittee

Priority: 1

Schedule: Twice annually at the March and July meetings of the Pacific Flyway Study Committee

Rotation of the chair, beginning October 1:

1991 - Alaska
1993 - CWS Western and Northern
1995 - Oregon
1997 - Montana
1999 - Washington
2001 - USFWS (Reg. 1)
2003 - Arizona
2005 - California

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Appendix A. Description of habitats used by Ross' geese of the Pacific Flyway

AREA	USE	NUMBER	SEASON	REMARKS	THREATS/SAFEGUARDS
<u>CANADA</u>					
Queen Maud Gulf Area	Breeding	138,000 to 177,000 nesting in 1988	Spring and Summer	From 1967 to 1988, Ross' geese have increased four- to five-fold, while snow geese have increased 27- to 31-fold	All nesting areas are in Migratory Bird Sanctuaries
Banks Island, Hudson Bay, and Southhampton Island	Breeding		Summer		All nesting areas are in Migratory Bird Sanctuaries
Eastern Alberta and Western Saskatchewan	Migration		Fall and Spring		Some staging lakes are in sanctuaries
<u>MONTANA</u>					
Freezeout Lake	Migration		Fall and Spring		
<u>OREGON</u>					
Klamath Wildlife Area (WA)	Migration		Fall and Spring		State refuge
Summer Lake (WA)	Migration		Fall and Spring		State refuge
Malheur National Wildlife Refuge	Migration		Fall and Spring		Federal refuge

APPENDIX A. (continued)

<u>AREA</u>	<u>USE</u>	<u>NUMBER</u>	<u>SEASON</u>	<u>REMARKS</u>	<u>THREATS/SAFEGUARDS</u>
<u>CALIFORNIA</u>					
Klamath Basin	Migration		Fall and Spring		Mostly on Federal refuges
Central Valley	Wintering	200,000+	Winter		Some State and Federal areas. Wetlands (e.g., duck clubs) remain relatively constant. Ricelands are stable, but world demand and price of rice can affect acreage. Disease (fowl cholera).
Imperial Valley	Wintering		Winter		One State wildlife area and one Federal refuge.
<u>NEW MEXICO</u>					
Bosque del Apache National Wildlife Refuge	Migration/ Wintering	57,000 white geese	Fall and Winter	Population increasing since the 1950s	Federal refuge.
Bitter Lake National Wildlife Refuge	Migration/ Wintering	75,000 white geese	Fall and Winter	Population increasing since the 1950s	Federal refuge.
<u>COLORADO</u>					
Southeast Colorado	Migration and some wintering (20,000 in 1984)	36,520 white geese	Fall and Winter	Population increasing since the 1950s	
<u>MEXICO</u>					
North Central	Wintering	90,000 white geese	Winter		

APPENDIX B. Inventories of Ross' and Snow Geese Nesting in the Queen Maud Gulf Lowlands of the Central Canadian Arctic - by visual survey 1965-67) and by aerial photography with ground-truth (1976, 1982, 1988).

	1965-67 ¹	1976 ²	1982 ³	1988 ³
No. of occupied colonies	37	30	41	57
Total nesting birds (Ross' plus Snows)	44,300	133,700	196,400	453,500
Total Ross' Geese (Percent of total geese)	34,000 (77%)	77,300 (58%)	90,700 (46%)	137,800 to 177,400 (30% to 39%)
Total Snow Geese	10,300	56,400	105,700	315,700
Percent blue phase of Snow Geese	5%	15%	8% ⁴	17% to 19%
Percent of total geese per colony:				
Colony 3	39%	41%	54%	47%
Colony 9	14%	11%	19%	18%
Colony 10	13%	20%	18%	21%
Colony 46	0%	0%	1%	5%
All other colonies	34%	28%	8%	9%
TOTAL	100%	100%	100%	100%
Percent of total geese nesting on islands ⁵	100%	77%	45%	16%

¹ From Ryder (1969) with extrapolation as in Kerbes et al. (1983).

² From Kerbes et al. (1983).

³ Kerbes, unpublished data, subject to revision.

⁴ Percent blue phase may have been underestimated, hence total number of Snow Geese may have been slightly higher than total here.

⁵ Mainland nesting occurred on colonies 3, 9m, 10, and 46 (Kerbes, pers. comm.).

APPENDIX C. Pacific Flyway winter population indices of Ross' and white geese.

Year	Ross' Goose Wintering Numbers (February Estimate)	"White Geese" Wintering Numbers January Estimate (Includes Ross')
1956-1960 Average	13,080 ¹	364,766 ²
1961-1965 Average	28,110 ¹	506,213 ²
1966-1970 Average	28,284 ¹	338,774
1971-1975 Average	25,223 ¹	436,612 ²
1976-1978 Average	31,151 ¹	410,368 ²
1977	106,410 ³	507,347 ²
1989	214,722 ⁴	560,650 ⁴
1990	168,427 ⁴	572,118 ²
1992	221,286 ⁵	598,100 ⁶

Note: Ross' figures do not include those birds wintering in the Mississippi and Central Flyways. "White geese" include birds from Wrangel Island, the Western Canadian Arctic, and the Central Canadian Arctic.

¹ Data from special February surveys in the San Joaquin Valley of California. These were discontinued after 1978.

² Data from Pacific Flyway midwinter waterfowl surveys.

³ Data from McLandress 1979

⁴ Data from Silveira 1989, 1990.

⁵ Data from Mensik and Silveria ([1993]).

⁶ December White Goose Survey.

APPENDIX D. Peak winter populations of white geese, species composition, and percentage young on Bosque del Apache NWR and State Management Areas, New Mexico.¹

Winter	Winter Popul. Snow & Ross' Combined	% Composition		% Young	
		Blue	Ross'	Snow	Ross'
1951	300	--	--	--	--
1952	250	--	--	--	--
1953	302	--	--	--	--
1954	351	--	--	--	--
1955	370	--	--	--	--
1956	391	--	--	--	--
1957	920	--	--	--	--
1958	327	--	--	--	--
1959	500	--	--	--	--
1960	757	2.6	--	--	--
1961	1,043	3.1	--	--	--
1962	1,228	2.4	--	17	--
1963	1,425	1.8	--	12	--
1964	1,800	0.0	--	--	--
1965	1,850	0.0	--	--	--
1966	2,600	1.3	--	50	--
1967	3,500	1.0	--	--	--
1968	3,800	0.9	--	--	--
1969	4,000	0.8	--	--	--
1970	7,900	1.3	--	47	--
1971	8,600	2.2	--	40	--
1972	8,020	1.2	--	13	--
1973	16,000	2.5	--	52	--
1974	13,000	1.1	--	9	--
1975	18,500	0.9	--	47	--
1976	21,250	2.5	--	42	--
1977	21,550	2.1	--	28	--
1978	26,875	1.3	--	7	--
1979	28,500	1.1	--	3	22
1980	30,040	2.0	--	28	31
1981	28,000	2.0	--	19	22
1982	28,650	2.2	--	11	--
1983	34,000	1.7	--	37	19
1984	39,300	4.7	7.4	29	22
1985	56,740	2.6	10.5	30	23
1986	36,900	1.9	12.8	6	12
1987	35,500	1.7	11.1	17	5
1988	41,610	1.9	9.7	26	12
1989	37,000	1.9	14.7	22	32
1990	36,700	1.3	17.2	19	13
1991	33,400	1.5	12.8	12	17
1992	29,000	1.1	16.2	12	12

¹Data for 1950-1959 from Bosque del Apache NWR files; for 1960-88 from Benning (1988); for 1989-91 Benning (1989-91); for 1992 from D.S. Benning (pers. comm.); for Ross' goose ratios and production from Drewein and Brown (1991).

APPENDIX E. Estimated lesser Ross' goose harvests in the Pacific Flyway, Alaska, the Central Flyway portions of four States, the Central, Mississippi, and Atlantic Flyways, and U.S.

Year	WA	OR	ID	MT(PF) ¹	WY(PF) ²	CA	NV	UT	CO(PF) ²	AZ	NM(PF) ²	PF Tot.	AK	MT(CF)	WY(CF) ²	CO(CF) ²	NM(CF) ²	CF Tot.	MF Tot.	AF Tot.	U.S. Tot.
1961																					
1962	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
1966	0	0	0	0	0	1,022	0	0	0	0	0	1,022	0	0	0	0	0	0	0	0	1,022
1967	0	0	0	0	0	533	0	0	0	0	0	533	0	0	0	0	0	0	0	0	533
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	26	2,514	0	0	0	0	0	2,540	0	0	0	0	0	0	0	0	2,540
1970	0	0	0	220	0	5,114	0	0	0	0	0	5,334	0	0	0	0	0	0	0	0	5,334
1971	0	0	0	0	0	3,646	0	0	0	0	0	3,646	0	0	0	0	0	0	0	0	3,646
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	4,398	0	126	0	0	0	4,524	0	0	0	0	0	0	0	0	4,524
1974	0	0	0	0	0	8,464	0	0	0	0	0	8,464	0	0	0	0	0	195	0	0	8,658
1975	0	176	0	0	0	6,968	0	0	0	0	24	7,168	0	0	0	0	0	146	0	0	7,313
1976	0	339	0	0	0	7,726	144	0	0	0	0	8,209	0	0	0	0	151	1,783	0	0	9,992
1977	0	273	0	522	0	3,395	0	0	0	0	0	4,190	0	0	0	0	70	299	0	0	4,489
1978	0	0	0	0	0	2,360	0	0	0	0	0	2,360	0	0	0	0	0	0	0	0	2,360
1979	296	0	78	73	0	4,419	0	0	0	170	0	5,036	0	0	0	0	352	1,598	0	0	6,633
1980	0	0	108	318	0	2,795	0	0	0	0	0	3,221	73	0	0	0	113	510	0	0	3,804
1981	177	161	0	188	0	6,316	0	0	0	126	0	6,968	0	0	0	0	401	2,705	0	0	9,673
1982	0	0	0	158	0	7,298	0	0	0	86	0	7,542	0	0	0	0	226	2,116	4,297	0	13,955
1983	0	133	0	78	0	6,789	367	0	0	0	0	7,367	0	0	0	0	411	1,674	276	0	9,317
1984	0	156	95	159	0	8,373	178	0	0	46	0	9,007	0	0	0	388	1,267	5,944	0	0	14,950
1985	0	182	0	830	0	8,913	0	0	0	464	0	10,389	0	0	61	161	639	3,832	108	0	14,329
1986	299	225	0	126	0	3,477	156	0	0	0	0	4,283	0	0	0	309	249	2,555	705	0	7,542
1987	0	0	0	99	0	2,375	84	0	0	0	0	2,558	0	0	0	0	404	404	155	0	3,116
1988	0	64	0	100	0	884	49	0	0	0	0	1,097	0	0	0	0	63	3,739	568	0	5,405
1989	0	94	0	257	0	5,105	27	38	0	0	0	5,521	0	0	0	0	1,614	8,415	0	0	13,936
1990	0	75	0	119	0	2,438	56	0	0	132	0	2,820	0	0	4	0	832	8,757	1,007	0	12,584
1992	0	0	0	0	0	3,253	0	0	0	240	0	3,493	0	0	0	41	1,843	7,179	329	0	11,002
1992 ³	0	73	0	39	0	3,007	0	0	0	0	0	3,118	0	0	0	136	100	4,595	237	0	7,950
Averages:																					
1962-70	0	0	0	24	3	1,020	0	0	0	0	0	1,048	0	0	0	0	0	0	0	0	1,048
1971-80	30	79	19	91	0	4,417	14	13	0	17	2	4,682	7	0	0	0	69	453	0	0	5,142
1981-90	48	109	10	211	0	5,197	92	4	0	85	0	5,755	0	0	7	86	611	4,014	712	0	10,481
1991-91	0	0	0	0	0	3,253	0	0	0	240	0	3,493	0	0	0	41	1,843	7,179	329	0	11,002
1962-date	25	63	9	106	1	3,599	34	5	0	41	1	3,884	3	0	2	33	282	1,821	248	0	5,955
% change from:																					
1962-70	-	-	-	-	-	195%	-	-	-	-	-	198%	-	-	-	-	-	-	-	-	659%
1971-80	-	-	-	-	-	-32%	-	-	-	-	-	-33%	-	-	-	-	-	914%	-	-	55%
1981-90	-	-	-	-	-	-42%	-	-	-	-	-	-46%	-	-	-	-	-	14%	-67%	-	-24%
1991-91	-	-	-	-	-	-8%	-	-	-	-	-	-11%	-	-	-	-	-	-36%	-28%	-	-28%
1991	-	-	-	-	-	-8%	-	-	-	-	-	-11%	-	-	-	-	-	-36%	-28%	-	-28%
% Composition of bag																					
1962-70	0.0%	0.0%	0.0%	0.6%	0.2%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	-	-	-	-	0.0%	0.0%	0.0%	0.1%
1971-80	0.1%	0.2%	0.1%	1.1%	0.0%	2.6%	0.2%	0.1%	0.0%	0.6%	6.5%	1.5%	0.1%	-	-	-	-	0.1%	0.0%	0.0%	0.3%
1981-90	0.1%	0.3%	0.0%	2.1%	0.0%	5.8%	1.3%	0.0%	0.0%	1.6%	0.0%	2.3%	0.0%	-	-	-	-	0.7%	0.1%	0.0%	0.6%
1991-91	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	0.0%	0.0%	0.0%	4.8%	0.0%	1.6%	0.0%	-	-	-	-	1.2%	0.0%	0.0%	0.6%
1992	0.0%	0.2%	0.0%	0.4%	0.0%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	-	-	-	-	1.1%	0.0%	0.0%	0.5%
% Flyway Hvst:												% U.S. Harvest									
1962-70	0%	0%	0%	2%	0%	97%	0%	0%	0%	0%	0%	100%	0%	-	-	-	-	0%	0%	0%	100%
1971-80	1%	2%	0%	2%	0%	94%	0%	0%	0%	0%	0%	91%	0%	-	-	-	-	9%	0%	0%	100%
1981-90	1%	2%	0%	4%	0%	90%	2%	0%	0%	1%	0%	55%	0%	-	-	-	-	38%	7%	0%	100%
1991-91	1%	2%	0%	3%	0%	93%	1%	0%	0%	1%	0%	32%	0%	-	-	-	-	65%	3%	0%	100%
1992	0%	2%	0%	1%	0%	96%	0%	0%	0%	0%	0%	39%	0%	-	-	-	-	58%	3%	0%	100%

¹In 1965, the Pacific Flyway portion of Montana was expanded

²In 1962, the state was divided into Pacific and Central Flyway portions.

³Preliminary data.

APPENDIX F. Index to Ross' goose harvest in Prairie Canada, 1968-1988, as measured by the National Species Composition Survey (A. Dzubin; R. Kerbes).

Year	ALBERTA Harvest (%)	SASKATCHEWAN Harvest (%)	MANITOBA Harvest (%)	Total
1970	179 (6)	1,726 (61)	939 (33)	2,844
1971	1,004 (27)	2,608 (71)	64 (2)	3,676
1972	567 (30)	975 (52)	343 (18)	1,885
1973	755 (13)	3,270 (59)	1,556 (28)	5,581
1974	954 (19)	3,534 (69)	617 (12)	5,105
1975	1,765 (27)	3,816 (58)	1,011 (15)	6,592
1976	1,541 (33)	3,128 (66)	100 (2)	4,769
1977	2,931 (72)	1,126 (28)	0 (0)	4,057
1978	478 (10)	3,668 (76)	663 (14)	4,809
1979	1,017 (12)	6,602 (80)	664 (8)	8,283
10-Year Mean 1970-1979	1,119 (24)	3,045 (64)	596 (12)	4,760
1980	906 (19)	2,985 (62)	925 (19)	4,816
1981	400 (13)	1,983 (64)	699 (23)	3,082
1982	363 (8)	3,451 (77)	690 (15)	4,504
1983	0 (0)	4,136 (93)	324 (7)	4,460
1984	1,078 (23)	3,452 (74)	150 (3)	4,680
1985	1,108 (15)	5,921 (78)	564 (7)	7,593
1986	2,249 (67)	511 (15)	610 (18)	3,370
1987	378 (7)	1,677 (31)	3,429 (62)	5,484
1988	1,797 (44)	1,286 (32)	972 (24)	4,055
1989	1,641 (33)	2,913 (60)	336 (7)	4,890
10-Year Mean 1980-1989	992 (21)	2,832 (60)	870 (19)	4,693

Source: Migratory birds killed in Canada - annual report. CWS Prog. Notes No. 19, 34, 71, 101, 137, 161, 179, and 194; and National Harvest Surveys, Ottawa.

APPENDIX G. Ross' goose harvest on Summer Lake Wildlife Area, Oregon, 1952-1991.

Year	Harvest	Year	Harvest
1952	1	1980	4
1953	0	1981	4
1954	1	1982	3
1955	3	1983	52
1956	4	1984	31
1957	5	1985	3
1958	1	1986	1
1959	0	1987	4
		1988	9
1960	6	1989	8
1961	0		
1962	0	1990	9
1963	8	1991	20
1964	20		
1965	9		
1966	8		
1967	12		
1968	16		
1969	5		
1970	27		
1971	7		
1972	0		
1973	109		
1974	23		
1975	56		
1976	39		
1977	28		
1978	1		
1979	15		

APPENDIX H. Ross' and snow goose harvest on California state and federal public hunting areas, 1980-91.

Year	Ross' Geese	Snow Geese
1980	332	3,144
1981	226	3,703
1982	626	3,210
1983	407	4,928
1984	533	6,882
1985	809	6,784
1986	380	2,640
1987	414	3,785
1988	197	3,832
1989	487	3,270
1990	324	4,594
1991	567	3,233
AVG	442	4,167

APPENDIX I. Goose harvest on Bosque del Apache NWR.