2000 ANNUAL REPORT
and 2001 MANAGEMENT PLAN

Anchorage Waterfowl Working Group

The first flocks of Canada geese returned to Anchorage on April 5, 2000. With one exception, Canada geese were last seen on October 22, having spent almost seven months in Anchorage. The exception was a small flock of 3-5 geese seen feeding and roosting on lawns of Alaska Pacific University and the Chester Creek ball fields at Lake Otis Boulevard through several light snowfalls until at least mid-November.

Goose Population Estimate and Trend

Crowley (1998) summarized the population status of Anchorage's Canada geese from 1996 to 1998 by compiling goose population counts and collar sightings in Anchorage, and goose leg band returns from hunters throughout the Pacific Flyway.

Surveys indicated that the goose population increased rapidly in the 1980s and early 1990s (12-15% annually). The growth rate was slowed in the late 1990s by a combination of lethal and nonlethal means. In Anchorage, increased shooting on airports, egg collecting, and gosling translocations contributed to the reduced rate of growth.

Mike Petrula estimated that 2,845 geese inhabited Anchorage this summer. The goose population appears to have declined 400-500 birds since July 1999 (Table 1). These numbers may change slightly after an analysis of collar loss is completed.

Table 1. Molt counts and population estimates of Canada geese in Anchorage, Alaska.

Year	Date	Total count	Average flock size	No. checked[1]	No. young	No. adults	No. collars	**Population estimate**
1996	July 9	2,682	72	2,682	635	2,047	37	**4,595 ± 642**
1997	July 7	3,030	57	2,971	793	2,237	155	**3,852 ± 641**
1998	July 7	2,604	50	2,403	559	2,045	543	**3,997 ± 243**
1999	July 14	2,317	57	2,317	479	1,838	419	**3,317 ± 160**
2000	July 12	2,082	39	2,082	443	1,639	284	**2,854 ± 184**

[1] Number of geese checked for collars.

To facilitate future population estimates, determine movements, and in conjunction with the U.S. Geological Survey's goose research project (see below), biologists banded 472 Canada geese in Anchorage. Sixty-eight geese were also collared, and 38 collared goslings were translocated to Seeley Lake in Susitna Flats State Game Refuge.

If the population continues to decline there may be an estimated 2,300-2,400 geese in Anchorage next July. Gosling transplants and the fall hunt will likely remove about 400 more birds. We anticipate that the population will be near the goal set for 2001 by the end of the year.

Airport Hazing and Goose Kills

USDA Wildlife Services dispersed 4,700 geese (including repeats) at Ted Stevens Anchorage International Airport, 1,090 at Merrill Field (Merrill Field staff hazed an additional 1,554 geese), and about 1,500 at Elmendorf AFB. Wildlife Services shot 59 geese at Anchorage International Airport and euthanized 24 more adult geese during the molt. They found 1 nest and collected all 5 eggs. About 50 geese were shot on Elmendorf AFB and about 40 adult geese were euthanized during the molt. No geese were shot at Merrill Field.

Goose/aircraft collisions appear to be declining. Air Force pilots are required to report bird strikes; civilian pilots are "encouraged" to report, but most do not. Pilots at Elmendorf reported 9 bird strikes in FY98 (October 1997 to September 1998), 7 in FY99, and 2 in FY00. There were 2 bird strikes reported at Merrill field in 2000. Wildlife Services personnel documented 15 wildlife strikes at Anchorage International Airport, but none involved Canada geese.

Research at Eielson AFB in Fairbanks indicates that grass over 12 inches in height deters goose use. Elmendorf AFB has allowed grass in large, open parade fields and lawns to grow the entire summer without mowing since 1998, except for eight-foot-wide swaths bordering streets and sidewalks. Over 500 acres of airfield clear zones will be replanted with tall native grasses over a 10-year period, if funding can be obtained.

USDA Wildlife Services was paid approximately $125,000 for hazing birds and mammals at Anchorage International Airport in 2000; about 35% of the effort was spent on geese (T. Smith, pers. commun.). USDA Wildlife Services was paid approximately $11,000 for hazing birds at Merrill Field; about 75% of the time was spent on geese (T. Smith, pers. commun.). The Elmendorf bird-dispersal program cost $200,000 in 2000. Neither Anchorage International nor Elmendorf AFB spent additional funds in 2000 for landscaping specifically to discourage goose feeding on grass near the runways.

Many geese are struck and killed by vehicles in Anchorage. Forty-three road-killed geese were counted by biologists in 2000. In addition, 29 injured adult geese and 22 goslings were brought to the Bird Treatment and Learning Center. Eighteen of the injured adults and 4 goslings subsequently died from their injuries or were euthanized. The remaining birds were treated and released. Nine of the 51 geese handled by the Bird Treatment and Learning Center were entangled in fishing line: 2 adults (euthanized), 6 adults and 1 gosling (untangled and released). Four of the 51 geese were killed by pets: 4 goslings by cats, and 1 adult by a dog. Undoubtedly vehicles, cats, dogs and others killed more geese that were not found.

Hunters are required to report the number of geese shot in the Anchorage Coastal Wildlife Refuge. Presumably, many of these are local geese. A few of Anchorage's Canada geese are also shot by Alaskan hunters outside of the Municipality. Numbers of Anchorage geese taken by hunters in other states and provinces, primarily in Oregon and Washington, have also increased, from about 100 in 1993 to about 250 in both 1996 and 1997. More recent harvest data from these states have not been analyzed.

Table 2. Canada goose hunting losses.

Year	Geese shot in Anchorage Coastal Wildlife Refuge[1]	Anchorage geese taken by falconers[2]	Recoveries of banded Anchorage geese shot by hunters in AK, OR, WA, BC[3]
1997	108	27	67
1998	118	20	125
1999	105	10	65
2000	72[4]	24	not available

[1] From annual registration hunt reports; unknown proportion of migrating geese.
[2] Estimates provided by 5 local falconers who hunt geese with gyrfalcons.
[3] National Bird Banding Laboratory records (number does not include unbanded geese shot).
[4] Preliminary.

Egg Collection

Other communities in the contiguous 48 states with overabundant Canada goose populations have tried several methods to reduce or stabilize growing goose populations by reducing hatching success. If all eggs in a nest are collected, the pair is likely to renest at least once. Some communities have addled eggs by shaking or killed embryos by coating eggs with an impermeable substance such as vegetable oil or paraffin. Female geese seldom renest as long as the eggs are left in the nest; however, they may continue to sit on the eggs for weeks after they would have hatched. Because female geese eat very little during incubation, this prolonged incubation period is stressful and may prove injurious.

Alaska is unique among the states in that some people have retained a strong tradition of collecting eggs from wild birds, including geese, for consumption. The Migratory Bird Treaty Act does not allow egg collecting; however, Canada goose eggs may be collected under special depredation permits. To avoid renesting, it may be important to leave one egg in each nest.

The U. S. Fish and Wildlife Service (USFWS) and Alaska Department of Fish and Game (ADFG) issued permits to landowners and managers, including the Municipality, who wanted to participate in reducing the goose population by allowing eggs to be collected for human consumption. Most of the marshes and bogs searched for nests were municipal and state property. Volunteer egg collectors, operating under the provisions of the permits, and biologists collected 487 eggs in early May.

Table 3. Canada goose eggs collected for human consumption in Anchorage, Alaska.

Year	No. eggs collected
1998	500
1999	399
2000	487

Eggs were donated to the Elders Programs of the Southcentral Foundation and the Cook Inlet Tribal Council. This program is popular with Alaskan Natives and the public in general. Illegal egg collecting (i.e., not under the provisions of a permit) continues to occur, especially in

midtown wetlands, such as Business Park. Illegal egg-collecting is problematic because it leads to trespassing, and the eggs of protected species, such as ducks and gulls, are collected. Illegal collectors take all eggs from each goose nest, which encourages the geese to renest. There is no easy way to determine the number of eggs collected illegally.

One egg was supposed to be left in each nest to discourage renesting attempts. AWWG members recommend that no eggs be left in nests during egg collecting next summer, and that a second collection be made in the same areas about a week later to foil renesting attempts. This recommendation is based on information collected by USGS biologists last summer (see below).

Gosling Translocation

Moving goslings to other suitable habitat in upper Cook Inlet is a nonlethal way to reduce the number of geese in Anchorage. Fish and Game and Fish and Wildlife Service biologists, USDA wildlife specialists, university students, professors, and other volunteers captured and moved 287 goslings from Anchorage to Seeley Lake, west of the Susitna River in 2000, including 56 goslings captured in June for the university feeding trials.

Table 4. Gosling Canada geese translocated from Anchorage, Alaska, to the Susitna Flats State Game Refuge.

Year	No. goslings translocated
1998	145
1999	184
2000	287

Most of the goslings were flown to Seeley Lake in a Cessna 185 on floats, piloted by Wally Saroka, a U.S. Fish and Wildlife Service enforcement officer, within a few hours of capture and released without adults. Some goslings were kept overnight in a small pen. The young geese soon joined local flocks.

Transplanted goslings tend to return to their release site, where they learned to fly, rather than their capture site. Collared goslings transplanted to Susitna Flats seldom return to Anchorage. Four transplanted goslings have been subsequently observed in Anchorage in July (presumably molting). Thus, an estimated 5% of the geese (4 of 88 collared geese) translocated in 1998 and 1999 have returned to the Anchorage Bowl.

Municipal Hazing, Goose Repellent, and Habitat Alteration

The city employs a contractor to spray athletic fields and some parks with methyl anthranilate. In summer 2000 the Municipality spent $18,000 on goose repellent, compared with about $16,000 the previous summer. After the geese returned, in early spring, the contractors sprayed de la Vega Park, the Park Strip downtown, Mulcahy fields, Westchester Lagoon park, South Anchorage Sports Field Complex (at O'Malley and C Street) and the Loussac Library lawn. Crews did not spray turf during the molt, except narrow strips along the grassy shores of Jewel and Cheney lakes and Westchester Lagoon. After the molt, in mid-summer, spraying

was continued at Westchester Lagoon, Spenard Lake park, Cheney Lake park, the Park Strip, South Anchorage Sports Field Complex and the softball fields on Northwood leased from Anchorage International Airport. In addition, the Alaska Native Medical Center and the Tudor Fund property owners' association (adjacent to the medical center) spent over $4,000 to spray lawns around the hospital and nearby lake, in cooperation with municipal parks.

Jerry Walton reported applications of methyl anthranilate on parks and other large municipal lawns was not very effective last summer. Migrant geese were less likely to avoid sprayed areas than local geese. Local geese seemed to avoid sprayed areas, except around molting lakes that were sprayed heavily several weeks before the molt period. This apparently did not deter the geese and spraying was curtailed during the molt. Athletic fields at some or all elementary schools were not mowed this summer to save money for school maintenance. This may have deterred some goose grazing.

The flock that habitually used the O'Malley golf course moved to a nearby airstrip on Cange Street after grass was seeded and fertilized.

The Municipality is in the process of updating its comprehensive plan. AWWG members participated in meetings throughout 2000 to ensure that the plan includes goose population control and habitat management. Only the Municipality can prohibit goose feeding throughout the metropolitan area; make parks and athletic fields less attractive to geese by altering habitat, using repellents, or hazing; and allow lethal goose control on city property. Municipal budget cuts may eliminate spraying next summer. Jerry is resurrecting the idea of using herding dogs with the new administration.

Alkali Grass (*Puccinellia*) Research Project

The AWWG supports research on alternative ground covers that do not attract geese. Arctic alkali grass (*Puccinellia arctica*[1]) is widespread on the North Slope, although its distribution appears to be patchy. It grows well in disturbed soil and is tolerant of salt and hydrocarbons. Pete Scorup, owner of Northern Native Seeds, never observed geese eating this species in 25 years of research on vegetation study plots on the North Slope. He planted several rows of the grass in the Palmer area in 1995 and has been monitoring growth and collecting seeds (5,000 seeds/gram). In 1998, Scorup recommended conducting experiments to assess the grass's palatability for urban Canada geese. Palatability can change when a species is translocated to different soils and when the plants are treated with fertilizer, lime, or other chemicals.

Major project findings:

Features of Puccinellia

- *Puccinellia* establishes relatively quickly over a wide range of soil conditions.
- The grass can be grown for seed production in the Palmer area.
- Seed production begins the second year after establishment.
- Some genotypes/phenotypes produce two seed crops a year (most do not).

[1] *Puccinellia arctica* has been changed back to an earlier name, *Puccinellia borealis*; however, taxonomists are still at work.

- Low-to-moderate fertilizer levels stimulate seed production of *Puccinellia*. High fertilizer rates stimulate vegetative growth and adversely affect seed production.
- *Puccinellia* from the North Slope is very susceptible to snowmold and other winter diseases when grown in southcentral Alaska.
- High rates of fertilizer tend to enhance snowmold development and result in reduced plant cover over time.
- *Puccinellia* has the ability to sustain repeated mowing.
- Close mowing enhances *Puccinellia* cover, probably by stimulating tiller production, and helps to reduce snowmold development.
- *Puccinellia* has outstanding wear characteristics when subjected to heavy trampling.
- *Puccinellia* is a poor competitor with other plants.

Palatability of Puccinellia plots in Anchorage

- *Puccinellia* received less goose grazing in the first year of establishment than in subsequent years. The older the grass, the more it was grazed.
- *Puccinellia* received significantly less grazing than plots planted to Nugget bluegrass, as well as the surrounding bluegrass lawns, every year and at every location in Anchorage.
- Different fertilizer rates and the addition of lime on *Puccinellia* plots had little effect on goose grazing activities in Anchorage.

Phytochemical comparisons

In a Master's thesis conducted through this project at University of Alaska Fairbanks, Trent Volz conducted phytochemical comparisons of *Puccinellia arctica* to palatable grasses *Poa pratensis*, *Puccinellia langeana*[2], and *Puccinellia phryganoides*. He found higher levels of ellagitannins in *Puccinellia arctica* may be sufficient for chemical defense against herbivory and responsible for its unpalatability to Canada geese.

Gosling grazing trials

In another Master's thesis conducted through this project at Alaska Pacific University, Christopher Rhea found that Canada goose goslings collected in Anchorage grew faster and larger on *Puccinellia* and preferred eating *Puccinellia* over Kentucky bluegrass. Those results were obtained at the Northern Native Seeds nursery at Palmer; there were inherent problems with this study because of the nursery layout.

Rebecca Parry, another Alaska Pacific University graduate student, repeated the gosling grazing trials on plots designed specifically for that purpose. Parry's work in 2000 confirmed Rhea's 1999 results. Parry also found a different variety of fungus associated with samples of *Puccinellia* from the North Slope (where *Puccinellia* does not appear to be eaten by geese) versus the same grass grown in southcentral Alaska. Dr. Carl Tobin plans to investigate these endophytes further. It is known that endophytes may affect grass palatability or digestibility.

[2] The revised name for this grass is *Puccinellia augustata*.

Nesting and Radio Transmitter Study

Biologists (Jerry Hupp, John Pearce, Gretchen Ruhl, and Martha Tomeo) and a veterinarian (Dan Mulcahy) with the U.S. Geological Survey, Biological Research Division, initiated a research project on survival, nesting success, productivity, and movements of urban Canada geese in Anchorage. Radio transmitters were surgically implanted in 100 geese and an additional 69 geese (control) were fitted with plastic leg bands. These birds were located and observed regularly throughout the summer. Researchers are attempting to determine the effect, if any, of the internal radio transmitters by comparing behavior, reproductive success, and survival of geese with and without the transmitters. Four of the geese are known mortalities: 1 by predation, 1 by vehicle collision, 1 shot at the airport, and 1 due to unknown causes.

The researchers found and monitored 185 goose nests. The first clutch was found on April 18, and the peak of nest initiation was on May 1. By May 5 most nesting geese had begun to lay (eggs were collected by volunteers on May 5 and May 8). They monitored the apparent success of 28 nests from which all but one egg had been collected. Twenty-two (79%) of these nests were abandoned within 1 week. Six (21%) of the nests were successful; of these, 1 more egg was laid in 4 of the nests, and in 2 nests the single remaining egg was incubated. The high rate of abandonment was unanticipated. It is possible that illegal egging or a nest predator attracted by the commotion removed the last egg from at least some these nests, causing the pair to abandon that attempt (and perhaps renest). It is also possible that the female chose to desert the nest or renest rather than incubate the remaining egg. The fate of these nests will be monitored more closely next summer, because the strategy of leaving 1 egg in the nest to minimize renesting attempts may not be as effective as we thought.

No-feeding Ordinance

People who feed geese create nuisance geese. Geese learn to congregate for handouts, often at inappropriate locations such as near roads or in parks. Geese from Anchorage's most popular feeding area, Westchester Lake, are frequent visitors at the city's three largest airfields. Geese that have learned to trust people who feed them are the most difficult to haze at airports; thus, they are more frequently shot as a last resort than their wild cousins. Feeding geese is not prohibited by law, except in specific locations. Existing federal laws prohibit feeding geese on Elmendorf Air Force Base. Existing state laws prohibit feeding geese at Anchorage International Airport and in Potter Marsh, part of the Anchorage Coastal Wildlife Refuge. Municipal law prohibits feeding geese at Merrill Field.

An Anchorage-wide no-feeding ordinance drafted by John Richard, the municipality's Chief Prosecutor, was forwarded to Assembly Member Bob Bell in 1998. It has not been introduced in the Assembly. The draft ordinance would amend Anchorage Municipal Code Title 8 by enacting a new section to read as follows:

> 8.75.170 Encouraging Waterfowl
>
> A. It is unlawful for any person to knowingly feed waterfowl on public or private property.

B. It is unlawful for any person to deposit or abandon food on public or private property under circumstances in which a reasonable person would know that the food was likely to be consumed by waterfowl.

C. It is unlawful for a private property owner or lessee to permit food to remain available under circumstances in which a reasonable person would know that the food is likely to be consumed by waterfowl.

D. Nothing in this section is intended to restrict the raising or keeping of domesticated waterfowl.

E. Violations of this section shall be punishable by a fine of not more than $300.00.

Assembly Members are encouraged to submit this ordinance for consideration.

Homeowner Assistance

In March 1998 the ADFG, USFWS, and USDA Wildlife Services published a brochure--*Homeowners' Guide to Goose Solutions*--which explained and illustrated techniques for minimizing goose problems on residential and commercial lawns. The guide was made available free-of-charge at local home-and-garden stores--including Eagle Hardware, Home Depot, Alaska Mill and Feed, Bells Nursery, and Alaska Greenhouse--and the main municipal parks office and the municipal greenhouse. In the last three summers AWWG agencies received few complaints about goose problems on residential lawns.

The brochure, Environmental Assessment, and other information is available on the USFWS website (www.r7.fws.gov/mbm/ancgeese/index.html) and the brochure is also on the ADFG website (www.adfg.state.ak.us).

Public Outreach and Education

Girl Scouts erected several kiosks to display Honk (the goose) posters, explaining why people should not feed waterfowl. Kiosks were built at Cheney Lake, Westchester Lake, and several sites around Lake Hood. DOTPF erected a no-feeding sign at the popular O'Malley/C Street goose feeding area. There is no clear indication that signs have deterred feeding, however. Footage for the video on the natural history of urban Canada geese was shot last summer, but the video is still in production. The 10 and 30-second public service announcements ("don't feed geese") produced last year by Tom Kempton at Loussac Library were aired on television last spring and are available again next spring. Captain Dave Garcia plans to show the two PSAs to all incoming Air Force personnel. Karen Laing updated the Fish and Wildlife Service website on urban goose management several times this year. Karen also passed out information promoting the use of native plants for landscaping to discourage urban goose feeding and loitering. ADFG and USFWS provided copies of the *Homeowner's Guide to Goose Solutions* at public information counters. Jerry Walton, Municipality of Anchorage, mailed copies of the *Homeowners' Guide to Goose Solutions* to city residents who lived adjacent to lakes used by geese.

2000 Research Projects

Public Education and No-feeding Signs – AWWG members will continue to talk to groups interested in urban goose management. USFWS will complete the video on urban goose ecology and behavior.

Goose Nesting Study – The USGS research project involving the use of radio transmitters will be continued.

***E. coli* Research** – Municipal Water Quality and ADFG staff will again try to collect fecal samples from a variety of waterbirds and mammals to determine their relative contributions to degraded water quality in Anchorage lakes and streams.

Ground Cover Research – Research on feasibility of *Puccinellia* will continue, as will Elmendorf AFB research on alternative native species.

Gosling Feeding Trials – Research on forage preference, nutrition, and digestibility of *Puccinellia* will continue.

Recent Literature on Canada Geese and Goose Control

Population biology and behavior

Immature Canada geese associated with family groups are more likely to survive to breeding age and are more successful in reproducing at age 2 than geese that were separated from family groups (Raveling et al. 2000). Geese normally mature sexually at 2 years of age, but frequently fail to breed successfully until 3 or 4 years old. Of 83 female geese, only those associated with other family members >75% of the time in their first or second years successfully produced young as 2-year-olds. Six of 43 females (14%) observed with families in their first year of life and 6 of 40 females (15%) observed with families in their second year of life had goslings as 2-year-olds. Individuals associated with ≥4 other family members in their first year were substantially more likely than other females to successfully breed as 2-year-olds. A successful reproductive effort can be multiplied in subsequent years. A 2- to 4-year-old Canada goose that is successful in rearing a brood is 3 times more likely to be successful the next year than is an unsuccessful bird of the same age. Social experience and protection by adults also affect survival. Single immature Canada geese, or those that were unidentified as to social status (i.e., probably singles), were 1.44 times more likely to die or disappear than immatures raised in a family. A major portion of this mortality in the first year of life is attributed to hunting rather than predation. The rate of loss between the first and fourth years of life was nearly identical for immatures raised with or without families.

Cooperative brood-rearing, like that found in urban Canada geese, is uncommon in birds. Gosser and Conover (2000) examined variation in cooperative brood frequencies among Canada geese nesting at 3 sites in Connecticut from 1982-1996. Four types of posthatch brood amalgamations are defined, based on how they are formed: (1) creching, (2) adoption, (3) kidnapping, and (4) gang brooding. Presumably the first 3 amalgamations involve young from more than 1 brood attended by a single adult or breeding pair. Gang brooding was

defined as “2 or more broods that have merged into a single functional unit that is attended by the parents of 2 or more of those broods.” Study sites were close to one another and had similar climates; thus gang broods were not likely a response to climatic conditions. Food was not limited or patchy in distribution; thus gang broods were not formed in response to food competition. Neither was predators found to be a cause. Results support the hypothesis that gang broods form from the inadvertent mixing of goslings before parents and young can individually recognize each other, when the goslings are about 3 weeks of age. Inadvertent mixing is correlated with (and probably facilitated by) high numbers of breeding geese, such as those found in urban areas. When family groups mix some parents remain, but some may abandon their young. It is not known whether gang broods increase gosling survival; however, not all of the observed variation in gang brooding frequencies was accounted for by inadvertent mixing.

Changing agricultural practices, wildlife refuges, and conservative management of all west coast Canada geese to protect a declining population of dusky Canada geese in Oregon have contributed substantially to the increasing numbers of Canada geese in Anchorage. Farmers in Oregon’s Willamette Valley plant numerous types of grass and clover (Henny and Naughton, no date). The area planted in grasses for seed increased from limited amounts in the 1950s to about 160,000 hectares (about 400,000 acres) in 1993. The cultivated grasses grow during the winter and provide fresh green vegetation, whereas most native plants are dormant in winter and do no provide forage for grazing geese. In the early 1950s most of the wintering geese in the Willamette Valley were dusky Canada geese, and the southern Willamette Valley was a major harvest area. In the mid-1960s, 3 national wildlife refuges were established in the valley to provide additional protection from hunting. The winter abundance of dusky Canada geese began to decline in the 1980s because of long-term ecological changes that occurred on the birds’ nesting grounds in Alaska, due to the 1964 Alaskan earthquake. Another subspecies, the cackling Canada goose, was also declining during this period, resulting in a flyway-wide hunting closure from 1984 to 1993. The Willamette Valley now supports about 10 times more geese in winter than it did 40 years ago (peak counts fewer than 10,000 in 1953 to about 90,000 in 1993). Overwintering lesser Canada geese from the Anchorage area received the benefits of the increased forage and protection.

Urban Canada goose movements were monitored in Anchorage to identify problem areas and evaluate effectiveness of hazing (York et al. 2000*b*). Fifty-nine percent of geese observed at Elmendorf Air Force Base were from molting sites $\leq$10 km from the airfield. However, 31 of 81 marked geese traveled $>$15 km from Campbell Lake to Elmendorf, by-passing available forage areas in between. Flocks of geese that molt $\leq$10 km from airfields could be targeted for translocation or removal during the flightless period, and geese hazed repeatedly from airports can be targeted for removal at dispersal sites by using collar codes. York et al. (2000*a*) also assessed the efficacy of hazing at airports in Anchorage. Monitoring movements of 1,236 collared geese, they found 208 used Elmendorf A.F.B. and 20% returned more than once after being hazed. Similar proportions of geese returned after hazing to other airfields in Anchorage: Anchorage International Airport (23% returned of 75 hazed collared geese) and Merrill Field (21% returned of 141 hazed collared geese). Hazed geese returning to airports multiple times are a special hazard to aircraft safety because they appear to have become habituated to non-lethal scare tactics.

States, provinces, and cities with urban Canada goose problems are shown on maps (Cooper 1997). They include 26 states, mostly northern tier, except Georgia, and 4 provinces.

Breeding Canada geese may affect use of lakes by red-throated and black-throated divers (Eriksson and Lindberg 2000), better known in North America as red-throated and arctic loons. Researchers in Sweden found no significant difference in loon reproductive success at lakes where introduced Canada geese have established a nesting population. They believe Canada geese do not threaten loon populations on a national or regional scale; however, red-throated loons have abandoned individual breeding tarns after geese moved in, and arctic loon nests close to goose nests were more likely to fail. Researchers thought the vigilance and aggressive behavior of geese might provide indirect protection to nesting loons towards potential nest predators as well as people visiting the site during incubation; however, this was not studied.

Management techniques

Stable isotope analysis can identify migratory and resident Canada geese (Caccamise et al. 2000). Researchers measured stable isotope ratios of carbon, nitrogen, and sulfur in the primary feathers. The stable isotope ratios of these elements depend on the type of food and habitat from which the food is taken and are unique to the area where the feathers were grown after the mid-summer molt. The technique has obvious value for managing populations of urban Canada geese in the contiguous United States. Although Anchorage's urban geese are not year-round residents, the technique may prove useful in differentiating between geese molting in the city vs. other parts of the state.

Not accounting for collar loss when using observations of collared geese to estimate survival can result in an underestimation of the survival rates and a loss of precision (Wiebe et al. 2000). Annual retention rates for 1.6 mm (1/16 inch) thick, single-wrapped collars (like those used on Anchorage geese) were 0.986 ± 0.004, with little difference between males and females during the 4-year study. Annual retention rates for Canada geese were much lower; however, their collars were 0.8 mm (1/32 inch) thick and double-wrapped. Differences may reflect variation in collar structure, plastic types (same in this study), attachment method, and manufacture method. Certain goose species or individuals may be more likely to engage in behaviors that increase collar loss. The different retention rates between white-fronted and Canada geese in this study may be due to collar construction (primarily thickness).

There was no significant annual difference in collar loss; however, retention beyond 4 years was not studied.

Bird strikes

Wildlife species were ranked according to their relative hazard to aircraft (Dolbeer et al. 2000). Researchers used the Federal Aviation Administration's Wildlife Strike Database for civil aircraft in the United States, 1991-1998. The hazard rankings were based on the percentage of strikes causing damage, major damage, and an effect on flight. Geese, primarily Canada geese, were the third most hazardous species group, after deer and vultures. The relative hazard score was strongly related to mean body mass, one reason why deer scored high relative to smaller mammals and birds. In a separate analysis, geese were the highest ranked species group for mean cost/strike. These findings should help airport operators prioritize management actions to reduce strike hazards.

A brief set of guidelines for controlling Canada geese on Canadian airports has some innovative recommendations for habitat modifications and scare techniques (MacKinnon 1999).

Control techniques

The Minnesota Department of Natural Resources determined the feasibility of processing urban Canada geese for human consumption (Keefe 1996). A communications plan identified specific audiences in need of information about the study, and there was virtually no public opposition. Geese were rounded up during the mid-summer molt. Some were held as long as 3 months and fed shelled corn and a commercial goose ration. Geese could also be held on suitable pasture to reduce costs. Initially, the food banks required processing at USDA-inspected facilities, which limited choices. Only a state-certification was required after the initial sample was processed, and the author believed USDA inspection may not be a requirement in the future. Geese processed in July weighed substantially less than those processed in fall and winter. Only the breast meat was salvaged in summer (yielding about 1.5 pounds/bird), but the breast and legs were processed in fall (yielding about 3.5 pounds/bird) and winter (yielding about 9 pounds/bird). These geese are larger than the lesser Canada geese in Anchorage. The cost of processing ($6-$8) and holding ($2-$7) geese added $8-$15 to the current capture and removal costs of $10, bringing the total cost to $18-$25 per goose. The author recommended that those receiving the benefits (e.g., municipalities and airports requesting goose removal) be charged for processing. A companion report by Dr. J. Cooper found potential health hazards of the birds' urban diet to be low, and the Minnesota Department of Health concurred.

Habitat modification is frequently proposed as a potentially effective, environmentally sound, and ultimately cost-effective method to reduce urban goose populations. Cooper (…) evaluated use of landscaping alteration and fencing in Minneapolis-St. Paul. Nesting habitat was not modified because draining or filling lakes and wetlands would be costly and have unacceptable impacts on other wildlife and humans. Like Anchorage, the bulk of goose complaints occurred during the brood-rearing period. At this time most of the geese are restricted to the vicinity of lakes and ponds, they have a high forage demand, and there is substantially higher human activity. It was assumed that broods grazed up to 100 meters from shorelines in suitable habitat. Cooper determined that a hectare (about 2.5 acres) of unfertilized and unmowed lawn could support 28 geese. Thus, 93% of the existing lawns and pastures within 100 meters of brood-rearing lakes would have to be altered to limit the population to 25,000 geese, i.e., the current population. Research on human landscape preference suggests that widespread replacement of mowed bluegrass lawns would be met with strong public opposition. Cost is also a problem. Cooper estimated the cost of replacing lawns with tall prairie grasses (comparable to Alaska's *Calamagrostis*), ground juniper, or low (2-foot-high) chain-link fence at $\$0.54/m^2$, $\$29/m^2$, and $9.84/m, respectively. Replacing 93% of the turf within 100 meters of brood-rearing lakes would cost the Twin Cities $33.9 million for prairie grass, $1.8 billion for ground juniper, and $12.3 million for fencing. The least expensive option, fencing, would require the city to spend $1/25^{th}$ of total cost annually to maintain or replace old fences. Conversely, removing 50% of the geese annually would maintain the population at the same level (25,000) and cost $10/bird to relocate and $25/bird to capture and process for human consumption ($125,000 to $312,000 annually). Thus, moving or killing geese can be considerably less expensive than landscape alteration, at least in the short-term.

An overhead wire grid was developed to discourage nonmigratory urban Canada geese from using water bodies (Lowney 1995). When access to water was denied, the local goose population abandoned the area, was substantially reduced, or shifted activities to nearby water bodies. Stainless steel wire was difficult to work with and required frequent maintenance. Polypropylene line (12 gauge) stretches, fatigues due to ultra-violet light, and has a life

expectance of 3-7 years. Kevlar line has virtually no stretch and a life expectancy of over 10 years. Kevlar's higher cost can be justified by its greater durability, little or no maintenance, and ease of handling. A two-strand perimeter fence was an integral part of the system. Overhead and perimeter wires limit recreational use. They are most applicable over small bodies of water at golf courses and corporation lands.

USDA biologists are sweeping a lake in Pennsylvania with laser beams to haze Canada geese (Associated Press 2001). This is the first time that lasers have been used to harass wild geese. The county's goose population has grown from 500 birds to more than 60,000 over the last 30 years. In the first trial virtually all of the 17,000 geese on the lake left, but they returned by the next afternoon. The "laser goose-dissuader" is essentially a $3,500 flashlight that projects a powerful beam of red light designed to terrify geese at a range of 400 yards (Blanchard 2001). Blanchard said the laser beam "shaved geese off the lake like a razor on black stubble." After 4 nights the number of geese that tried to land on the lake had dropped from 17,000 to 3,000.

Woodruff and Green (1995) report on use of herding dogs to haze Canada geese at several golf courses and agricultural fields. A professionally trained border collie typically costs $1,000 to $3,000. Combined teams of dogs and handlers are effective in limited areas. However, geese are simply moved from one location to another.

Herding dogs seem like a simple solution, but it isn't as easy as it appears. A seven-year pilot program used herding dogs to harass geese (Castelli and Sleggs 2000). Two border collies achieved almost 100% success at hazing geese from a large fenced compound (approximately 110 acres) with a small lake, probably because they were kept "on duty" year-round, 24 hours a day. (A single border collie and handler that visited a park an average of 4.7 times per day during fall reduced goose numbers by 68%. However, one week after the visits ended, the number of geese in the park was similar to the number prior to the harassment.) Hiring or contracting at least three dog handlers (because you can't expect someone to work 7 days a week, 24 hours a day all summer) would be expensive. Trained herding dogs cost over $1,000 each, and food and veterinary care was approximately $2,000 per year for two dogs. Other advice:

- Dogs should not be used during the nesting (May and June), molting and brood-rearing period (June, July, and early August) because dogs could easily catch and injure geese. During June and July flightless geese are almost completely restricted to grassy lawns adjacent to lakes and ponds for feeding. Successfully harassing flightless adults and goslings at swimming lakes would prevent the geese from feeding. These are the months that most people use local lakes for swimming in Anchorage.
- For properties that aren't fenced, use an electronic containment system to restrict dogs to the area of concern.
- In certain situations, such as residential areas, parks with continuous public use, areas bisected by roadways, and large water bodies, border collie use may not be appropriate.
- Contact with the public should be limited, because some people harass the dogs and some dogs harass people.
- Harassing urban geese shifts the problem somewhere else.

New repellents are expensive to develop, register, and commercialize. The only new avian primary repellent developed for use in the U. S. within the past decade is methyl anthranilate. A primary repellent is a compound that is congenitally avoided because it is perceived as noxious. Effective primary repellents depend on the stimulation of pain receptors. Bryant et al. (2000) cultured pain receptor cells from Canada geese to increase the speed and efficiency of

repellent screening while reducing costs and the number of animals necessary for research. Test results were encouraging for several mammal species and chickens; however, the goose tests were inconclusive. Further studies should correct problems in testing. Pain receptors of Norway rats responded identically to neurons cultured from deer and coyotes and may be useful surrogates for research. It is possible that pain receptors from chicken embryos will likewise prove useful surrogates for research into avian repellents, replacing the present need for behavior screening studies that require about 1 week per chemical and as many as 40 animals as test subjects.

Many techniques merely displace geese, rather than controlling population growth. Resident Canada geese in and near the Bronx Zoo were vasectomized for a more permanent solution (Hundgen et al. 2000). Researchers recommended conducting vasectomies on males caught during the breeding season because the vas deferens is enlarged (i.e., easier to find) and males captured defending a nest or goslings are known resident breeders. Of 340 eggs laid by females paired with vasectomized males, 12% were fertile. Of the 43 (12%) eggs that were fertile. 30 were laid by 5 females whose clutches were 100% fertile. Researchers believed the males paired with these females received incomplete vasectomies. The remaining 13 fertile eggs appeared randomly in clutches no larger than average, suggesting extra-pair copulation as opposed to egg-dumping by unrelated, nestless females. In comparison, of 526 eggs laid by females paired with non-vasectomized males, 90% were fertile. Where resident goose populations are small (<150 birds), nest territories are limited, and the necessary resources are available, vasectomies can effectively reduce the number of goslings produced.

If you can't control the geese, you can at least try to round up their feces. A cyclone vacuum system mounted on a trailer that was originally designed to sweep debris from parking lots has been modified to vacuum grassy areas on Long Island (Anonymous 2000). The machine can clean a 52-acre park in about 8 hours. Several companies are using the droppings for high-nitrogen compost.

Golfers and Canada geese are often incompatible. Baxter (1998) provides a set of guidelines enabling local authorities and private landowners to determine whether there are too many golfers in a location, non-lethal methods of controlling golfers, and methods of humanely dispatching golfers. It is important not to attribute human feelings to golfers. The author believes there may be surprisingly little public resistance to culling, if all other methods have failed.

Disease

Fecal samples were collected from resident Canada geese at 17 sites in and around Toledo, Ohio (Harrington et al. 2000). Feces from 13 sites were positive for *Cryptosporidium*, 3 sites were positive for *Giardia*, and 7 sites were positive from *Campylobacter*. Feces at 9 of the *Cryptosporidium*-positive sites were also positive for one of the other pathogens. The researchers concluded that Canada goose feces probably do represent a risk to health of park workers, the general public, and possibly to pets, especially dogs.

One hundred eighteen fecal droppings were collected from resident Canada geese at 2 sites in New York City (Rollender and Kostroff 2000). Fifty-two (44%) samples were positive according to the Premier *Cryptosporidium* Enzyme Immunoassay (EIA). Many of the negative EIA results were borderline. Seventeen of the EIA-positive samples were also positive according to the Direct Fluorescent Antibody (DFA) test. The nature of the droppings made DFA very difficult.

Resident Canada geese can act as carriers of infectious cysts of *Cryptosporidium* and can disseminate these oocysts in the environment, including drinking water supplies.

Goose feces were collected in a suburb of Chicago, Illinois (Tischler et al. 2000). The most numerous bacteria present in the feces were isolated and cultured. Approximately, 270 bacteria were isolated from adult geese and 20 bacteria from goslings. Gram positive isolates from adult geese showed a widespread resistance to ciprofloxacin, erythromycin, oxacillin, and streptomycin. Gram negative bacteria isolated from adult geese were predominantly resistant to tetracycline, erythromycin, penicillin, oxacillin, and vancomycin. It is unknown whether the antibiotic resistance in acquired with the mature microbial flora ore whether antibiotic resistance develops upon exposure to compounds in the environment.

Cryptosporidium is the most important biological water contaminant in the U.S. The most significant sources are wastewater treatment plants and animal farms, in particular cattle farms. *Cryptosporidium parvum* is highly prevalent in ruminants and is readily cross-transmissible to humans. Although no human cases of cryptosporidiosis have been linked to ingestion of raw shellfish, the potential for such transmission exists (Graczyk et al. 2000). Monitoring Chesapeake Bay oysters is expected to provide reliable information for the exposure assessment and risk characteristics of foodborne cryptosporidiosis due to consumption of raw oysters. [Note: There are no raw oysters in upper Cook Inlet, but high numbers of Canada geese and the locally abundant ruminant (moose) in Anchorage suggest a potential for cross-transmission to humans using local water bodies.]

Although influenza viruses can infect a wide variety of birds and mammals, the natural host of the virus is wild waterfowl, shorebirds, and gulls (Suarez 2000). When other species of animals, including chickens, turkeys, swine, horses and humans, are infected with influenza viruses, they are considered aberrant hosts. The evolutionary rate of influenza virus in the natural host reservoirs is believed to be slow, while in mammals the rate is much higher. However, research on three recent outbreaks provided strong evidence of adaptation of influenza to the new host species, chickens and turkeys.

Avian species, particularly waterfowl, are the natural hosts of influenza A viruses (Subbarao and Katz 2000). Avian influenza viruses were thought to be limited in their ability to directly infect humans until 1997. Two outbreaks in Hong Kong have established that avian viruses can infect humans without acquiring human influenza genes by reassortment in an intermediate host.

Influenza pandemics, defined as global outbreaks of the disease due to viruses with new antigenic subtypes, have exacted high death tolls from human populations. The last 2 pandemics were caused by hybrid viruses, or reassortants, that harbored a combination of avian and human viral genes (Horimoto and Kawaoka 2001). Avian influenza viruses are therefore key contributors to the emergence of human influenza pandemics. Since 1997, 2 influenza pandemics were directly transmitted from birds in live poultry markets in Hong Kong to humans. The identification of avian viruses in humans underscores the potential of these and other strains to produce devastating influenza outbreaks in major population centers.

2001 Management Plan

The population goal is to reduce the local goose population to 2,000 geese by the year 2001.

Our recommended management plan for 2001 is as follows.

Egg collecting and gosling translocations will continue. The Municipality and other interested landowners will apply for depredation permits. Agencies will try to collect 400-500 eggs by finding more nesting areas and using more volunteers, and will capture and move at least 150 goslings without adults. No eggs will be left in nests during egg collecting; however, a second collection will be made in the same areas about a week later to foil renesting attempts. AWWG will try to minimize illegal egging with press releases and media interviews.

The Municipality will continue to spray methyl anthranilate, budget permitting, and will consider experimenting with herding dogs at selected sites. Anchorage International Airport, Elmendorf AFB, and Merrill Field will continue to alter habitat on airport property that is attractive to geese, and will continue hazing, including lethal control, on airport property.

AWWG will continue to ask the municipality and Anchorage Assembly to adopt a no-feeding ordinance for waterfowl in the Municipality. We will continue to monitor goose population dynamics by counting them in spring, summer, and fall.

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