PRODUCTIVITY, MORTALITY, DISTRIBUTION AND POPULATION STATUS OF PACIFIC FLYWAY WHITE-FRONTED GEESE

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Abstract: In this report we have analyzed production, mortality, distribution and inventory data for the Pacific Flyway White-fronted Goose (*Anser albifrons*) to determine population status. Productivity information from breeding ground studies, field counts in California and age composition in the harvest were analyzed and compared to mortality estimates derived from band recoveries. The sport harvest of whitefronts, measured by Federal mail surveys, has declined significantly, contrary to the level of subsistence harvest in Alaska. The post-season population of whitefronts, measured by mid-winter inventories, has also declined significantly in recent years. We concluded that total harvest in recent years has exceeded the capabilities of the population to sustain itself. Management recommendations are made.

Prompted by an apparent reduction in numbers of white-fronted geese (*Anser albifrons*) migrating through the Great Plains, Miller et al. (1968) made intensive analyses of banding data from whitefronts banded in Saskatchewan. They concluded that there were two distinct populations of whitefronts in North America: the Mid-continent Population and the Pacific Flyway Population. Lensink (1969) analyzed band recoveries from whitefronts banded on the Yukon-Kuskowim (Y-K) Delta to determine their recovery distribution. King and Lensink (1971) subsequently postulated that this area produces the entire Pacific Flyway Whitefront Population. However, available data on this group of geese awaited complete analysis.

It is now recognized that low densities of breeding whitefronts occur in drainages of the Kvichak and Nushagak Rivers, on the base of the Alaska Peninsula southeast of the Y-K Delta (P. E. K. Shepherd, personal communications). In recent years up to 1,200 whitefronts have been observed molting in Redoubt Bay, Cook Inlet, some 600 km east of the Y-K Delta (D. E. Timm, unpublished data). E. J. Collins (personal communications) observed several whitefront broods in Redoubt Bay in 1974. Although as yet unconfirmed by banding, these geese likely are part of the Pacific Flyway Population. About 10 percent of the band recoveries from geese banded in the Innoko River Valley, about 250 km ENE of the Y-K Delta, occurred in the Pacific Flyway (Lensink 1969). He believed that this 10 percent represented molt migrants from the Delta. We believe that over 95 percent of the Pacific Flyway White-fronted Goose Population is inherent to the Y-K Delta.

The broad and flat Y-K Delta consists of wet tundra broken by numerous small ponds, shallow lakes, tidal sloughs and rivers. Geology of this area

was described by Coonrad (1957) and Hoare and Condon (1968) and its climate and habitat types as they relate to waterfowl were discussed by Dau and Mickelson (1979), Mickelson (1975) and Eisenhauer and Kirkpatrick (1977). About 17,750 Eskimos live on the Y-K Delta in 40 villages (Office of the Governor, State of Alaska, unpublished data) located primarily along rivers and the Bering Sea coast. Their economy, historically subsistence based (Klein 1966), has now changed to a mixed subsistence and cash economy.

Mid-winter inventories of the Pacific Flyway Whitefront Population indicate that these geese may be declining in numbers. The average number of birds observed during the past 8 years (1971-1978) was approximately 38 percent below that observed during the previous 8 year period (1963-1970). During some years the recorded sport hunting harvest in the Pacific Flyway plus the estimated spring and summer harvest on the Y-K Delta have exceeded the winter population determined by these inventories.

The questionable status of white-fronted geese in the Pacific Flyway and the changing management situation in Alaska necessitated a thorough analysis of information on tbis goose population. This report presents findings of this analysis and identifies management needs for this population of white-fronted geese.

METHODS

Estimates of Productivity

Production information for white-fronted geese has been collected since 1964 on the Y-K Delta by personnel of the U.S. Fish and Wildlife Service and several universities.

Field age ratio data were obtained primarily on Tule Lake National Wildlife Refuge, California by U.S. Fish and Wildlife Service personnel during late October (K. D. Norman, unpublished data) using methods described by Lynch and Singleton (1964). Dzubin and Miller (1966, unpublished report of the Central Flyway Waterfowl Technical Committee) and Lynch (1966, 1967, unpublished reports of U.S. Fish and Wildlife Service) discussed the inherent biases in these survey methods. The productivity counts at Tule Lake were taken after a light to moderate amount of hunting mortality had occurred.

Since 1962 the U.S. Fish and Wildlife Service has received goose tails from a stratified sample of waterfowl hunters throughout the United States. Tails from whitefronts taken in California (where about 93 percent of the sport harvest occurs) were analyzed to assess age ratios of harvested geese (Administrative Reports of the Office of Migratory Bird Management, U.S. Fish and Wildlife Service; permission to use these data received from Director, the agency). The number of white-fronted goose tails from California varied from 87 to 268 in a given year, but has averaged 168 since 1962.

Because few local and immature white-fronted geese had been banded on the Y-K Delta, differential vulnerability to hunting between young and adults could not be calculated using banding data alone. Miller et al. (1968) found that 2.3 immature whitefronts were taken for every adult in the Texas harvest which compared favorably to field age ratio counts in Saskatchewan.

We assumed that field age ratio counts at Tule Lake accurately represented annual production for the Pacific Flyway Population. Therefore, a vulnerability factor for young birds was calculated by dividing the ratio of young/

adult in the tail fan sample by the ratio of young/adult in the field counts.

Banding Area and Trapping Techniques

White-fronted geese were banded intermittently on the Y-K Delta since 1921 in eight degree blocks (60°-63° N, 160°-165° W). Prior to 1967 banding was done on a "birds available" basis. In 1967 a statewide white-fronted goose banding project was initiated to delineate Alaskan populations and to determine mortality rates and harvest areas (J. G. King, personal communications). During the 3 year portion of the study on the Y-K Delta, Federal game management agents used a light-weight net drive trap transported by float planes to whitefront molting areas (R. H. Tremblay, personal communications). All geese were sexed and classified as either locals (L), sub-adults (SY) or adults (ASY); plumage characteristics were used to separate SY from ASY geese (R. H. Tremblay, personal communications).

Harvest Estimates

Estimates of sport harvest in the United States portions of the Pacific Flyway were derived from U.S. Fish and Wildlife Service mail questionnaire surveys, the results of which are published in annual U.S. Fish and Wildlife Service Status Reports and Administrative Reports. Harvest estimates in British Columbia were obtained from Canadian Wildlife Service Progress Notes (February 1977, No. 71).

An estimate of waterfowl harvest during the spring and summer on the Y-K Delta was made by Klein (1966). Other indications of the magnitude of spring and summer harvest were obtained from the Calista Regional Native Corporation. The Calista Corporation circulated questionnaires to all villages on the Y-K Delta requesting individuals to record the number of birds, mammals and fish they harvested in 1976.

Population Size

The only long-term measure of population size has been mid-winter inventories conducted during January in the Pacific Flyway. However, the accuracy of these surveys is variable, due to factors such as bird visibility, local weather and water conditions (J. E. Chattin, personal communications). Some whitefronts winter in Mexico, but since mid-winter inventories are concentrated along the coast, an unknown number of geese in the interior are not counted.

Although results from individual mid-winter inventories cannot be regarded as accurate estimates of the population size for a given year, we relied on long-term averages as being indicative of population trends because the coverage in California has been relatively constant.

Analysis of Band Recoveries

Terminology used was most recently defined by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service (1976). All band recoveries reported to the Bird Banding Laboratory by August 1, 1978 were made available for this report. Those birds reported as shot or found dead during legal hunting seasons were utilized to estimate mortality rates and to determine distribution of the harvest.

We did not use recoveries from birds banded during the hunting season in California. Hickey (1951, 1952), Crissey (1955) and Gollop (1963) described the limitations and biases involved with banding during migration and during the season.

The stochastic model we used to analyze the recovery data was suggested by D. R. Anderson (personal communications) and described by Brownie et al. (1978). Models were tested that assumed all birds were banded as adults (Models 0,1,2) and also those where recoveries of adults and young were analyzed separately (Models H01, H02, H1, H2, H3). Because few locals were banded, we tested models that assumed adults were AHY and SY geese were "young." The H series models assume that age-specific differences exist in recovery and mortality rates, while Models 0, 1, and 2 assume that no such age-related differences occur.

Although we believe that recovery and mortality rates were slightly lower for AHY than SY banded geese, an inadequate sample of banded birds and recoveries--especially of females--precluded analysis by age class. Consequently, we used Model 1 for all data analyses because it demonstrated the best goodness of fit. Goodness of fit statistics were: all birds--X^2=13.2, df=16, P=0.66; males--X^2=10.0, df=15, P=0.82; females--X^2=16.7, df=11, P=0.12. Model 1 assumes that mortality and recovery rates are not constant from year to year.

RESULTS

Productivity

White-fronted geese arrive on the Y-K Delta in late April to early May (Figure 1) and prefer nest sites along tidal sloughs with slightly elevated banks located in heath tundra and in sedge-grass meadows. Although the geese nest over the entire Delta, spring breeding pair survey data (Figure 2) show that they prefer areas within 30 km of the coast (J. G. King, unpublished data).

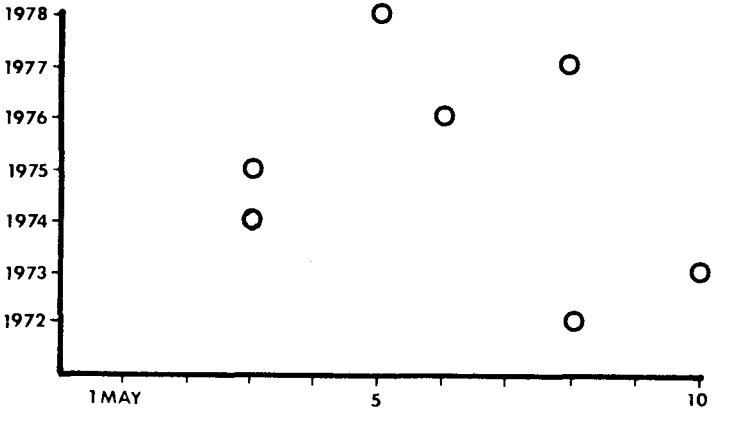

Figure 1. Dates of onset of peak arrivals of white-fronted geese on the outer Yukon-Kuskokwim Delta, Alaska.

Nesting density and production information were gathered at three study

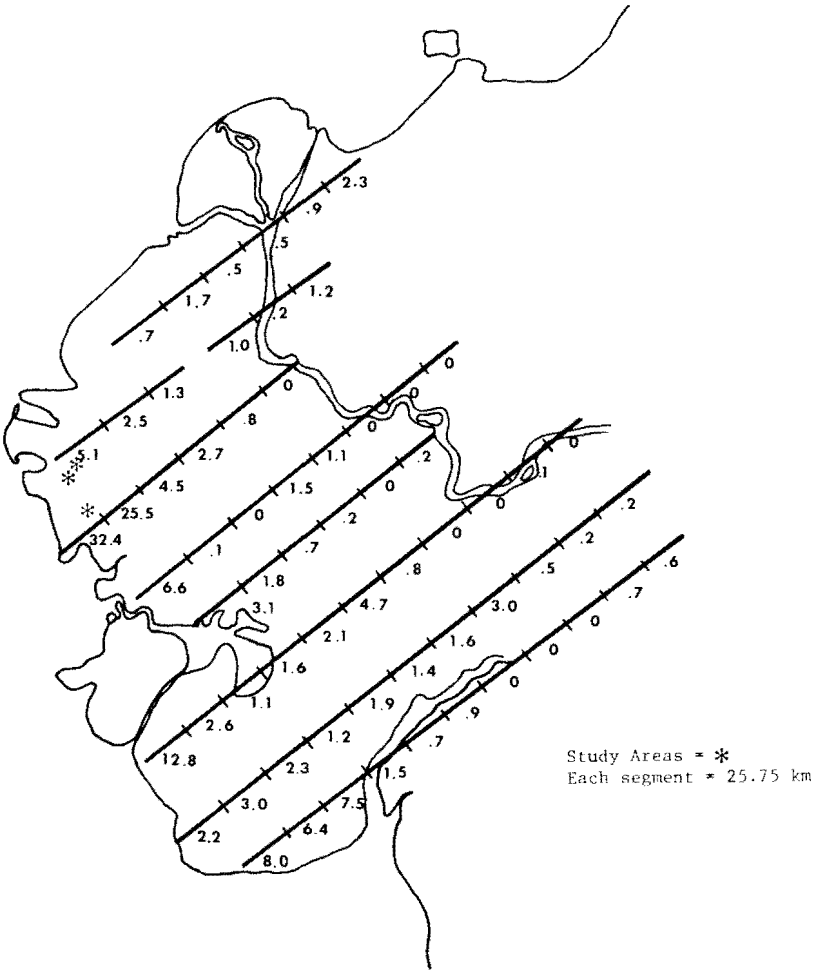

Figure 2. Average numbers of white-fronted geese seen during the spring breeding pair surveys, 1964-1973, on the Yukon-Kuskokwim Delta, Alaska.

sites (Figure 3). In a low meadow area (Onumtuk) with few sloughs, nest densities declined significantly from 1969 to 1978. Nest densities in another low sedge meadow area (Aphrewn) with many tidal sloughs increased about 70 percent from 1977 to 1978. On a mixed upland area, nest densities also increased significantly from 1977 to 1978 (C. Ely, personal communications).

Clutch and class 1 brood sizes for 1969-1978 averaged 4.3 $\pm$ 0.6 and 3.7 $\pm$ 1.2, respectively. Annual variations in these averages appeared to be unrelated to nesting density (Figure 4). The average annual sample of nests and class 1 broods for the 10 year period was 30 nests and 11 broods. During 5 years, however, only two or three broods were recorded each year. Comparable data for the Mid-continent Population have not been published, but T. W. Barry (personal communications) reported an average clutch size of 3.9 eggs (N = 12) on the Anderson River Delta, Canada.

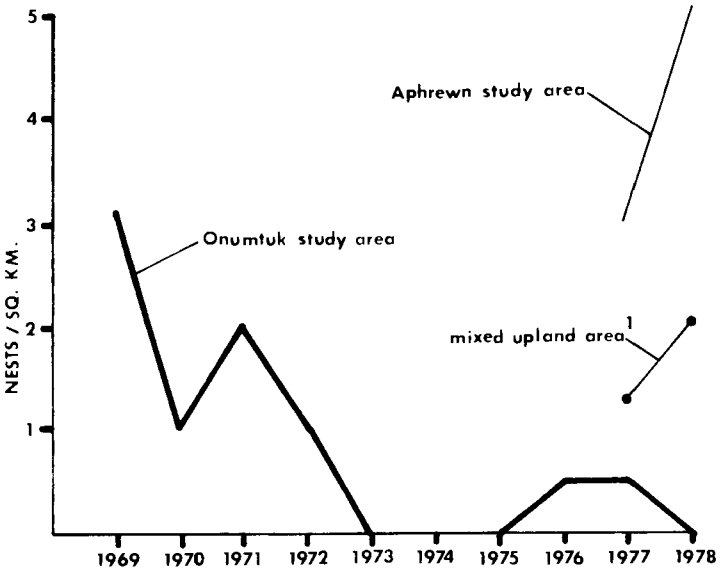

Figure 3. Nesting densities of white-fronted geese on study areas of the outer Yukon-Kuskokwim Delta, Alaska.

[1] C. Ely, unpublished data.

The average number of young per family at Tule Lake was 2.4 birds during 1962-1973 and 2.3 birds during 1962-1977. During the 1962-1973 period J. J. Lynch (1974, unpublished report, U.S. Fish and Wildlife Service) found an average of 2.6 young per family for the Mid-continent Whitefront Population on its wintering grounds.

The average differential vulnerability (d.v.) of 2.1 for young during 1962-1977 and 2.5 during 1962-1969 (Table 1) compares to a d.v. rate of 2.3

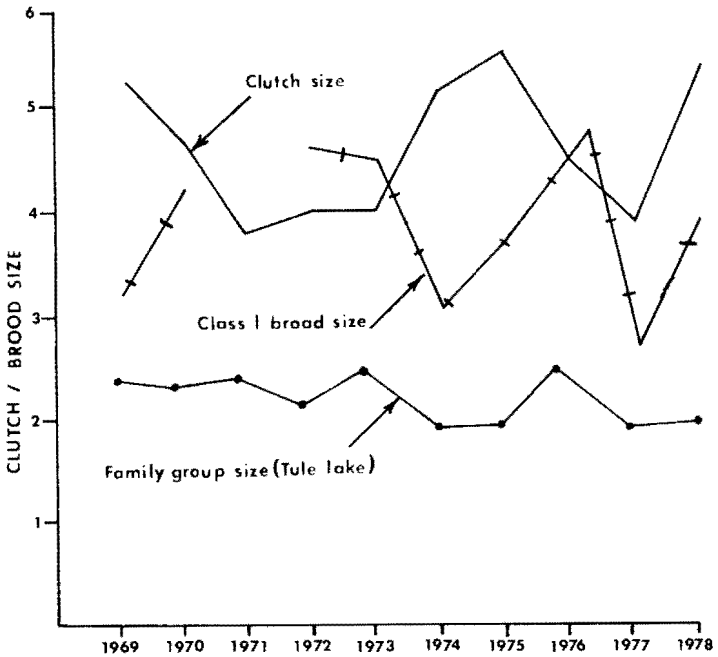

Figure 4. Average clutch and class I brood sizes of white-fronted geese on the Yukon-Kuskokwim Delta, Alaska and average young per family group at Tule Lake, California, 1969-1978.

for young of the Mid-continent Population during the 1961-1964 period (Miller et al. 1968), thus lending credibility to our method of calculating young/adult vulnerability. However, the average of 36.9 percent young in the Pacific Flyway Population for 1962-1977 (Table 1) is much greater than the average of 23.0 percent young in the western segment of the Mid-continent Population for the 1960-1966 period (Miller et al. 1968).

Sport Harvest

During the period 1962-1977, the average annual estimated retrieved harvest by sport hunters in the United States portion of the Pacific Flyway was 53,600 white-fronted geese (Table 2). For the 8 year periods 1962-1969 and 1970-1977, the harvests averaged 61,200 and 46,000 birds, respectively. A t-test was used to determine the significance of the 25 percent decline of harvest between the two 8 year periods 1962-1969 and 1970-1977. This test indicated a high probability of actual decline ($t=2.54$, $df=14$, $P<0.02$). In British Columbia during the 1972-1975 period, the average annual estimated

retrieved harvest was 350 white-fronted geese.

Table 1. Productivity and differential vulnerability of young in the Pacific Flyway White-fronted Goose Population, 1962-1977.

Year	Percent Young in California Harvest	Percent Young in California Field Age Counts	Differential Vulnerability
1962	66.0	38.9	3.1
1963	53.9	29.8	2.7
1964	58.3	31.7	3.0
1965	47.4	38.9	1.4
1966	61.5	41.8	2.2
1967	54.5	31.2	2.7
1968	60.0	40.7	2.2
1969	66.7	37.2	3.4
1970	52.4	28.2	3.1
1971	58.3	37.7	2.3
1972	61.5	42.2	2.2
1973	47.4	38.5	1.2
1974	37.5	28.6	1.5
1975	56.5	41.2	1.9
1976	65.5	49.9	1.9
1977	72.2	34.1	5.0
$\bar{x}$ 1962-69	58.5	36.3	2.5
$\bar{x}$ 1970-77	51.7	37.6	1.8
$\bar{x}$ 1962-77	55.1	36.9	2.1

Table 2. Retrieved harvest in the U.S. and mid-winter inventories throughout the Pacific Flyway, white-fronted geese, 1962-1977.[1/]

Year	Harvest	Mid-winter[2/] Inventory	Year	Harvest	Mid-winter[2/] Inventory
1962	52,400	128,600	1970	74,900	108,500
1963	69,100	171,800	1971	35,400	100,600
1964	57,500	137,400	1972	54,400	54,800
1965	48,100	69,200	1973	47,200	86,700
1966	71,600	185,600	1974	41,300	74,500
1967	67,500	71,900	1975	37,300	83,100
1968	51,700	117,900	1976	46,300	50,000
1969	72,000	208,400	1977	31,400	114,700
$\bar{x}$ 1962-69	61,200	136,400			
$\bar{x}$ 1970-77	46,000	84,100			
$\bar{x}$ 1962-77	53,600	110,200			

1/ Figures to nearest 100.
2/ Corresponds to year of harvest (i.e. 1973 survey was made January 1974).

L. D. Schroeder (personal communications) calculated the reliability of the whitefront harvest data from California to be within 15 percent; the estimates were more variable (± 69 percent to ± 191 percent) in other Pacific Flyway states which account for only 7 percent of the harvest. We assumed that the estimated retrieved harvest of whitefronts in the Pacific Flyway may vary by 20 percent annually.

Various rates of crippling loss have been reported for geese. Florschutz (1968) found crippling rates averaged about 22 percent for Canada geese (*Branta canadensis*) at Mattamuskeet, North Carolina, while Hunt (1968) reported a crippling loss of 21 percent for Canada geese at Horicon National Wildlife Refuge in 1962. Davenport et al. (1973) found this loss rate was 18 percent for ducks and geese at Sand Lake National Wildlife Refuge.

We assumed that the crippling loss of white-fronted geese in the Pacific Flyway was a minimum of 15 percent in excess of the retrieved harvest. Thus, the average sport harvest of white-fronted geese for the periods 1962-1969, 1970-1977 and 1962-1977, was 70,800, 53,300 and 62,100 geese, respectively, plus an unknown number in Mexico. If a ratio between band recoveries in Mexico (Table 4) and total harvest (Table 2) is assumed, about 6,500 whitefronts were taken there annually during 1967-1969.

Spring and Summer Harvest

Each spring and summer Eskimos on the Y-K Delta harvest waterfowl by shooting, picking eggs from nests and by the driving of molting birds. However, the latter method has declined in popularity. Because of their early arrival and wide distribution on the Delta, white-fronted and Canada geese receive more harvest pressure than other waterfowl species (Klein 1966).

Klein (1966) estimated that in 1964, 22,600 whitefronts were taken during the spring, summer and fall months. In addition, 40,000 eggs of all waterfowl were collected. Because most of the spring harvest occurs early (i.e. as soon as the birds arrive), a disproportionate amount of pressure is directed to mated pairs which are traditionally the first to arrive on the nesting grounds.

Since Klein's (1966) estimate of subsistence take in 1964, the human population on the Y-K Delta has increased 77 percent (Office of the Governor, State of Alaska, unpublished data). Assuming a proportionate relationship between human population and subsistence harvest determined by Klein (1966), J. G. King (unpublished data) calculated that the current harvest of white-fronted geese is 35,600 birds annually. With a comparable human population increase, the annual take would be 81,500 whitefronts in 2000.

Other indications of recent spring and summer take of waterfowl are available. We are aware of an 11 percent recovery rate on 213 banded black brant (*Branta bernicla*), which occurred within one month of banding during 1974. In 1972 about 2,000 boxes of shotgun shells were sold in the village of Hooper Bay, Alaska, which has a population of 550-600 people (D. I. Eisenhauer, personal communications). Approximately 10 villages comparable in size to Hooper Bay occur along the coastal fringe of the Delta.

The Calista Regional Native Corporation received questionnaires from 359 Natives on the Delta and the results indicated that 325,000 kg of birds were taken in 1976 (Calista Regional Corporation, unpublished data). Using this information and the following assumptions, we estimated the current white-fronted goose take in the spring: 1) 90 percent of the birds taken were waterfowl; 2) 60 percent were harvested in the spring; 3) 25 percent of the spring

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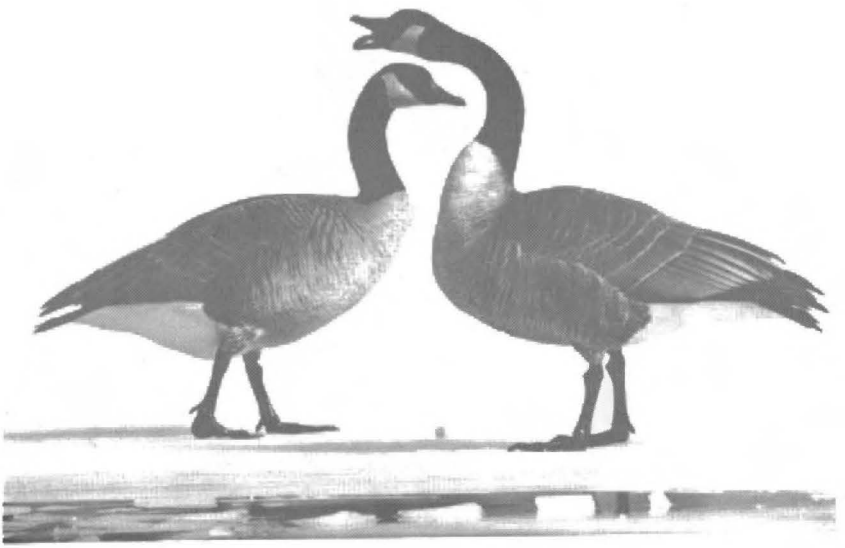

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