The mortality, behavior, and homing of transplanted juvenile Canada geese
by Dennis Charles Surrendi

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Fish and Wildlife Management
Montana State University

Abstract:
During the summers of 1967 and 1968, 273 flightless seven and eight week-old Canada geese (Branta canadensis maxima) were transplanted about 100 miles from their natal lakes near Brooks, to release sites northeast of Hanna, Alberta. All transplants received leg bands and colored neck collars for field identification. Observations of transplant behavior were calibrated to the nearest minute for quantitative analysis. Preflight mortality was determined from gosling counts made during the behavioral observations. Postflight locations, identity, and behavior of transplants were recorded. The mortality of goslings was negligible during the transplant operations. A preflight mortality of 4 percent was recorded. Feeding was the major daily preflight activity of transplants, and occurred most intensively at sunrise and sunset. Resident geese were dominant over transplants. Nonbreeding resident geese were more tolerant to transplants than were breeding pairs. The postflight movements of transplants from release sites occupied by residents were localized and as a unit under the leadership of the resident birds. Transplants on release sites unoccupied by resident geese dispersed from these lakes in small groups immediately after attaining flight. From 68 males and 68 females transplanted in 1967, 13 homing yearlings were recorded in the spring of 1968. All of the homing transplants were females. This represented a calculated 43 percent theoretical homing rate for yearling female Canada geese. Eighty-five percent of these females were initially sighted on or within one mile of their release sites. Eighty-five percent of the 13 homing females formed pair associations with unmarked ganders. The pair bonds involving some of the yearling females appeared to become unstable just prior to the summer molt migration. No yearling transplants were present on the study area after May 31. On August 23, 1968 one of the yearling females returned to its 1967 release site following a summer molt migration. Conclusions and management recommendations were presented.

129

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Approved:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

During the summers of 1967 and 1968, 273 flightless seven and eight week-old Canada geese (Branta canadensis maxima) were transplanted about 100 miles from their natal lakes near Brooks, to release sites northeast of Hanna, Alberta. All transplants received leg bands and colored neck collars for field identification. Observations of transplant behavior were calibrated to the nearest minute for quantitative analysis. Preflight mortality was determined from gosling counts made during the behavioral observations. Postflight locations, identity, and behavior of transplants were recorded. The mortality of goslings was negligible during the transplant operations. A preflight mortality of 4 percent was recorded. Feeding was the major daily preflight activity of transplants, and occurred most intensively at sunrise and sunset. Resident geese were dominant over transplants. Nonbreeding resident geese were more tolerant to transplants than were breeding pairs. The postflight movements of transplants from release sites occupied by residents were localized and as a unit under the leadership of the resident birds. Transplants on release sites unoccupied by resident geese dispersed from these lakes in small groups immediately after attaining flight. From 68 males and 68 females transplanted in 1967, 13 homing yearlings were recorded in the spring of 1968. All of the homing transplants were females. This represented a calculated 43 percent theoretical homing rate for yearling female Canada geese. Eighty-five percent of these females were initially sighted on or within one mile of their release sites. Eighty-five percent of the 13 homing females formed pair associations with unmarked ganders. The pair bonds involving some of the yearling females appeared to become unstable just prior to the summer molt migration. No yearling transplants were present on the study area after May 31. On August 23, 1968 one of the yearling females returned to its 1967 release site following a summer molt migration. Conclusions and management recommendations were presented.

INTRODUCTION

The natural dispersion of large Canada geese (Branta canadensis maxima) throughout their original breeding range, as indicated by Hanson (1965), can best be described as slow even under optimum habitat conditions. This lack of pioneering may be due to certain physiological and behavioral characteristics. Mayr (1942) stated that strong intrafamily bonds played an important role in the subspeciation of Canada geese over areas where geographic barriers were lacking. With reference to geese in general, Johnsgard (1965) attributed slow increase in numbers and lack of gene mixing to a delayed maturation and permanency of pair bonds respectively. Sherwood (1967) confirmed the formation of both pair and intrafamily bonds. He also found a lack of dispersion from the natal area particularly by females.

Due to the importance of Canada geese for their asthetic and sporting qualities, biologists have attempted to increase the productive efficiency of existing habitat within their breeding range. Workers of various wildlife agencies have attempted to artificially establish local breeding populations by using captive flocks or by transporting and releasing juveniles. These attempts have produced variable results. Phillips' (1928) summary of efforts to transplant wild birds in North America gave no mention of success with Canada geese. From sparse observations of leg banded birds and recoveries of leg bands, Pirnie (1938) concluded that the restocking of Canada geese by captive flocks was successful in southern Michigan. Williams and Kalmback (1943) studied leg band recoveries of both captive and transplanted juvenile Canada geese and

stated, "...they show no tendency to return to the area from which they came." A steady increase in the production of wild goslings at Seney Refuge from 1936 to 1945 was attributed by Johnson (1947) to the development of a local breeding population from a captive flock. In assessing the use of captive flocks for the restoration of Canada geese, Nelson (1963) suggested that quantitative evidence relating to the positive and negative results of such programs was lacking. He recommended that intensive research be conducted to assess future restoration projects.

The purpose of this study was to quantitatively assess the mortality, behavior, and homing of juveniles that had been transported by artificial means from their natal area to some distant point and released.

DESCRIPTION OF THE STUDY AREA

The study area was located in southeastern Alberta within 30 miles of the Town of Hanna (Figure 1). This region is of glacial origin (Wyatt et al., 1938-1943) and is characterized topographically by gentle undulations interspersed with hills and creek drainages. Local land use practices are primarily agricultural with the greatest emphasis on dryland grain farming and cattle ranching.

A complete and quantitative description of the vegetation found on the area is given by Coupland (1950). He described the vegetative cover as "mixed prairie" with the dominant grasses being Stipa comata, Stipa spartea var. curtiseta and Bouteloua gracilis. Artemisia frigida is the most abundant forb, while Symphoricarpos occidentalis and Rosa spp. are the most common shrubs.

The climate of the area represents that typically found in north temperate continental regions and is classed as a cool, semiarid type (Coupland, 1950). It is characterized by daily and seasonal extremes in temperature and a low annual precipitation. The mean average annual temperature is 36.4 degrees F. with monthly averages varying from 6.0 degrees F. in January to 64.3 degrees F. in July. The average annual precipitation is 14.54 inches. During June 1 to August 31 of 1967 and 1968, the precipitation totalled 3.24 inches and 7.54 inches respectively. Climatic information was obtained from the Canadian Department of Transport Weather Offices at Edmonton and Coronation.

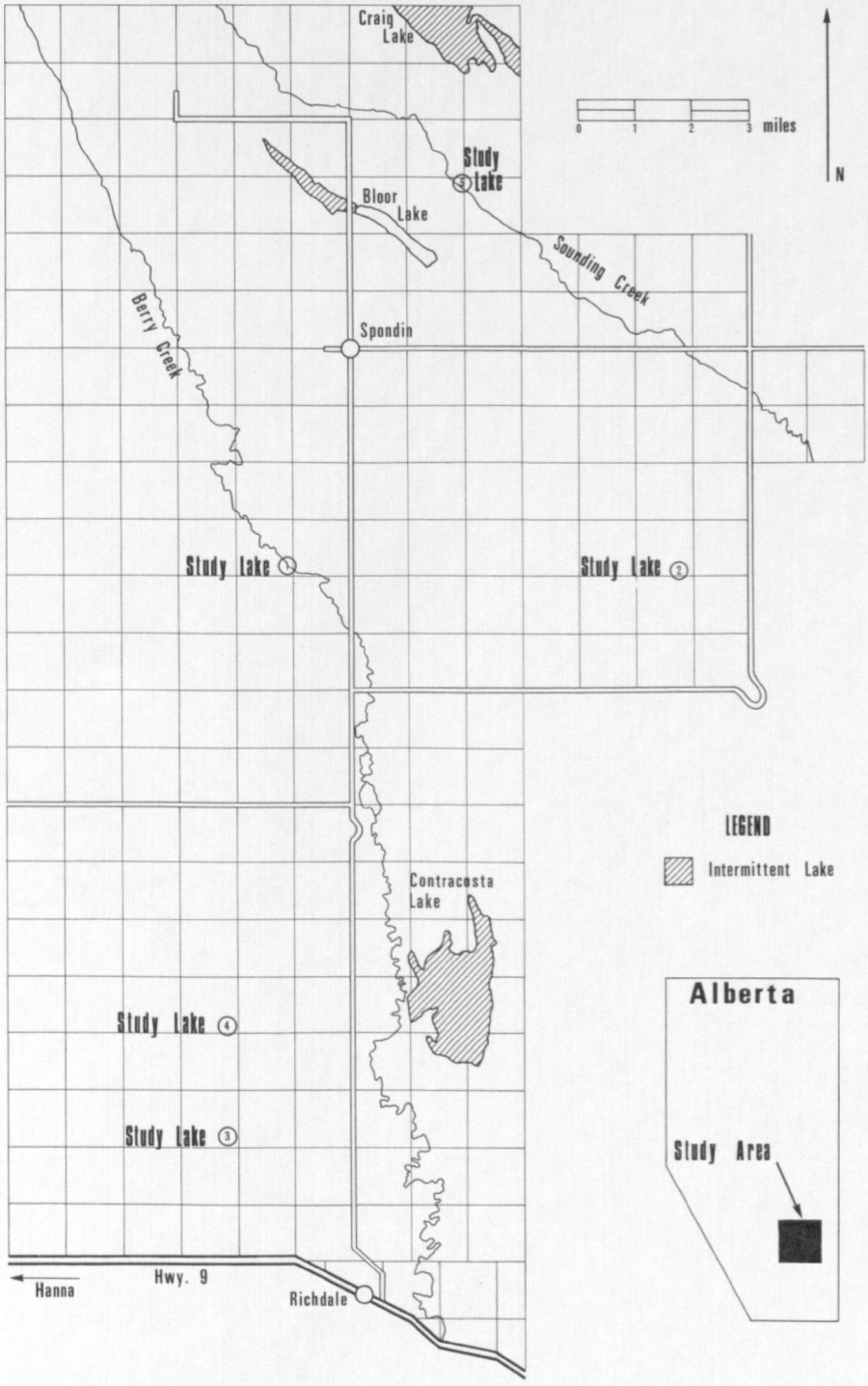

Figure 1. Map showing the study area and location of study lakes.

A lack of permanent natural water bodies throughout this region has prompted Ducks Unlimited (Canada) to construct over 175 dams in the area since 1940 to provide stable habitat for waterfowl production.

METHODS

Lakes with resident geese and those without were deliberately chosen. The lakes also satisfied these criteria: (1) a minimum flooded area of 50 acres, (2) the presence of potential goose nesting habitat, and (3) accessibility to the observer.

Geese used for transplanting were trapped on Ducks Unlimited impoundments about 100 miles south of the study area near Brooks, Alberta. The birds were aged and sexed using plumage and cloacal characteristics as summarized by Hanson (1962). Goslings were further aged to the nearest week from plumage descriptions presented by Yocum and Harris (1965). In addition to leg bands, all transplants received colored flexible plastic collars (Sherwood, 1966) bearing letter-numeral combinations to permit field identification of individual geese. Sherwood found that goslings older than seven weeks exhibited higher collar retention than goslings in younger age groups. Only flightless goslings between the ages of seven and eight weeks were used. The transplants were crated at the trapping sites, banded, and transported by motor vehicle to the study area where each cohort was released on a preassigned study lake in late afternoon or at night.

Throughout the study, all written accounts of transplant behavior were continuous and calibrated to the nearest minute for quantitative analysis. A 25 power spotting scope was used to aid observations.

Specific observational techniques were used during the preflight period. All cohorts were observed during each day from one hour before sunrise to one hour after sunset. Observational periods were of unequal

duration. They were rotated among the study lakes to obtain data on the daily behavior of each cohort. Variations in this procedure occurred due to inclement weather and equipment malfunctions. To avoid influencing the transplant behavior, I remained concealed during all preflight observations. Preflight mortality was determined from transplant counts during the behavioral observations.

Data concerning activities of transplants from sunrise until two hours after sunrise and from two hours before sunset to sunset were analyzed in half hour intervals. The analysis of activities prior to sunrise, throughout the midday (from two hours after sunrise until two hours before sunset), and after sunset was determined by grouping the data obtained for each respective time period (Appendix, Table III).

Transplant activities during the morning and evening were divided into three general categories: (1) Feeding, (2) Resting, and (3) Preening, Bathing, and/or Drinking. The activities in category three were assessed as one general activity because they all frequently occurred simultaneously within a group. Midday activities were separated into four categories: (1) Feeding, (2) Resting on Water, (3) Resting on Land, and (4) Preening, Bathing, and/or Drinking.

Greater mobility of the observer was required to obtain postflight data. All accessible water bodies and fields within the boundary of the study area were checked daily for geese (Figure 1). The location, identity, and behavior of all transplants were noted. Only during extended observations of postflight behavior did I attempt to remain concealed.

RESULTS AND DISCUSSION

Throughout the study, five Ducks Unlimited reservoirs were used as study lakes (Table I). In 1967, 136 goslings comprised of 68 males and 68 females were transplanted to Study Lakes 1, 2, and 3. The 1968 transplants were placed on Study Lakes 1, 3, 4, and 5. This latter group totalled 137 goslings, 64 of which were males. Because of insecure water levels resulting from a lack of spring runoff in the area of Study Lake 2, this lake was not used in the 1968 transplant program.

Preflight Period

Mortality

One gosling died during transplant operations. Of 273 released, 261 or 96 percent survived to flight (Table II). The preflight mortality varied on individual study lakes from a high of 13 percent (Study Lake 3 in 1967) to a low of 0 percent (Study Lake 1 in 1968). Gosling counts made three days after the time of their release on Study Lake 3 in 1967, and Study Lakes 3 and 5 in 1968, indicated that the major transplant losses occurred within two days following their release.

The formation of creches or gang broods (Brakhage, 1965) by wild and semidomestic juvenile Canada geese has made studies of gosling mortality difficult. By comparing the total number of goslings hatched with the total number attaining flight, Geis (1956) and MacInnes (1962) found the preflight mortality of two subspecies to be about 19 and 10 percent respectively. Other estimates have ranged from 3 percent (Williams and Marshall, 1938) to 83 percent (Kossack, 1950). The 4

TABLE I. STUDY LAKE SIZE, AND THE NUMBER AND SEX COMPOSITION OF GOSLINGS TRANSPLANTED TO THE STUDY LAKES DURING THE 1967 AND 1968 STUDY PERIODS.

Year	Study Lake	Lake Size (acres)1/	Shoreline Length (miles)1/	Number of Transplants	Sex of Transplants m	f
1967	*1	228.5	5.7	43**	19	24
	*2	216.7	4.1	46	24	22
	3	91.5	5.1	47	25	22
			Subtotals	136	68	68
1968	*1	above	above	41	21	20
	3	above	above	40	18	22
	4	52.0	3.9	33	11	22
	*5	178.5	5.1	23	14	9
			Subtotals	137	64	73
			Total	273	132	141

1/ Information obtained from the Hanna office of Ducks Unlimited (Canada).

* Resident geese present.

** Three transplants, hatched four miles from Study Lake 1, were included in this group.

TABLE II. THE 1967 AND 1968 TRANSPLANT PREFLIGHT MORTALITY

Year	Study Lake	Number of Goslings Released	Number of Transplants Present, 3 Days After Release	Number of Transplants Present 1 Wk. After Release	Number of Transplants Surviving To Flight	Number Lost	Per-Cent Lost
1967	*1	40	-- 1/	40 + 3 2/	42	1	2
	*2	46	--	46	45	1	2
	3	47	41	41	41	6	13
1968	*1	41	--	41	41	0	0
	3	40	38	38	38	2	5
	4	33	--	32	32	1	3
	*5	23	22	--	22	1	4
	Total =	270 + 3 2/ = 273			261	12	4

1/ Unable to make an accurate count of the transplants.

2/ Three transplants, hatched four miles from Study Lake 1, were released on Study Lake 1 18 days after the release of the original 40 transplants.

* Resident geese present.

percent loss of transplants in this study indicates a relatively low preflight mortality.

Though little data are available concerning differential mortality among age classes of Canada geese goslings, studies on ducks by Low (1945), Earl (1950), Miller and Collins (1954), Glover (1956), and Keith (1961) show the greatest loss of ducklings to occur within the first two weeks after hatching. Foley et al. (1961) recorded the survival to flight of transplanted mallard (Anas platyrhynchos) ducklings to be 39, 52, and 68 percent for three, five, and seven week-old ducklings respectively. Ryder (1967) also found a continuous drop in the brood size of Ross' geese (Chen rossii) to the age of three weeks, after which flock clumping made brood size counts invalid. With this information in mind, it appears likely that if goslings younger than seven weeks were used as transplants, a preflight mortality higher than 4 percent could be expected.

Coyotes (Canis latrans), long-tailed weasels (Mustela frenata), badgers (Taxidea taxus), striped skunks (Mephitis mephitis), marsh hawks (Circus cyaneus), and Swainson's hawks (Buteo swainsoni) were abundant on the study area. Eleven unsuccessful attempts by mammalian predators to capture transplants were observed. Goslings typically reacted to the presence of a predator by heeding alert warnings of other birds and moving off shore into secure water. Once on the water, the transplants became very curious of the intruder usually following it as it traversed the shoreline.

Daily Activities

A total of 9909 minutes (Approx. 165 hours) of observations on preflight activities was obtained (Appendix, Table III). These activities and their relative magnitude throughout the daylight hours are graphically presented in Figure 2.

Feeding was the major daily activity of transplants. A sharp increase occurred from dawn until sunrise when 100 percent of the observed goslings were feeding intensively. Intensive feeding was maintained until a half hour after sunrise. A steady decline in feeding followed. At two hours after sunrise 69 percent of the transplants were feeding. During the midday period, feeding comprised 58 percent of the gosling activity. Though feeding activity fluctuated throughout the midday period, at no time did its duration or intensity equal that observed in the morning or evening. Feeding activity increased steadily from 58 percent, two hours before sunset, to 100 percent at sunset. This was followed by a rapid decrease in feeding activity as darkness approached. The intensity and duration of feeding during the early morning suggested little or no feeding occurred at night.

The tremendous energy requirements for growth and feather development by Canada geese goslings (Williams, 1967; Hanson, 1965) is reflected in their daily activity. In my study, transplants from the age of seven weeks until flight spent over 58 percent of their daytime activity feeding. Similar feeding activities were reported by Low (1945) for redhead (Aythya americana) ducklings.

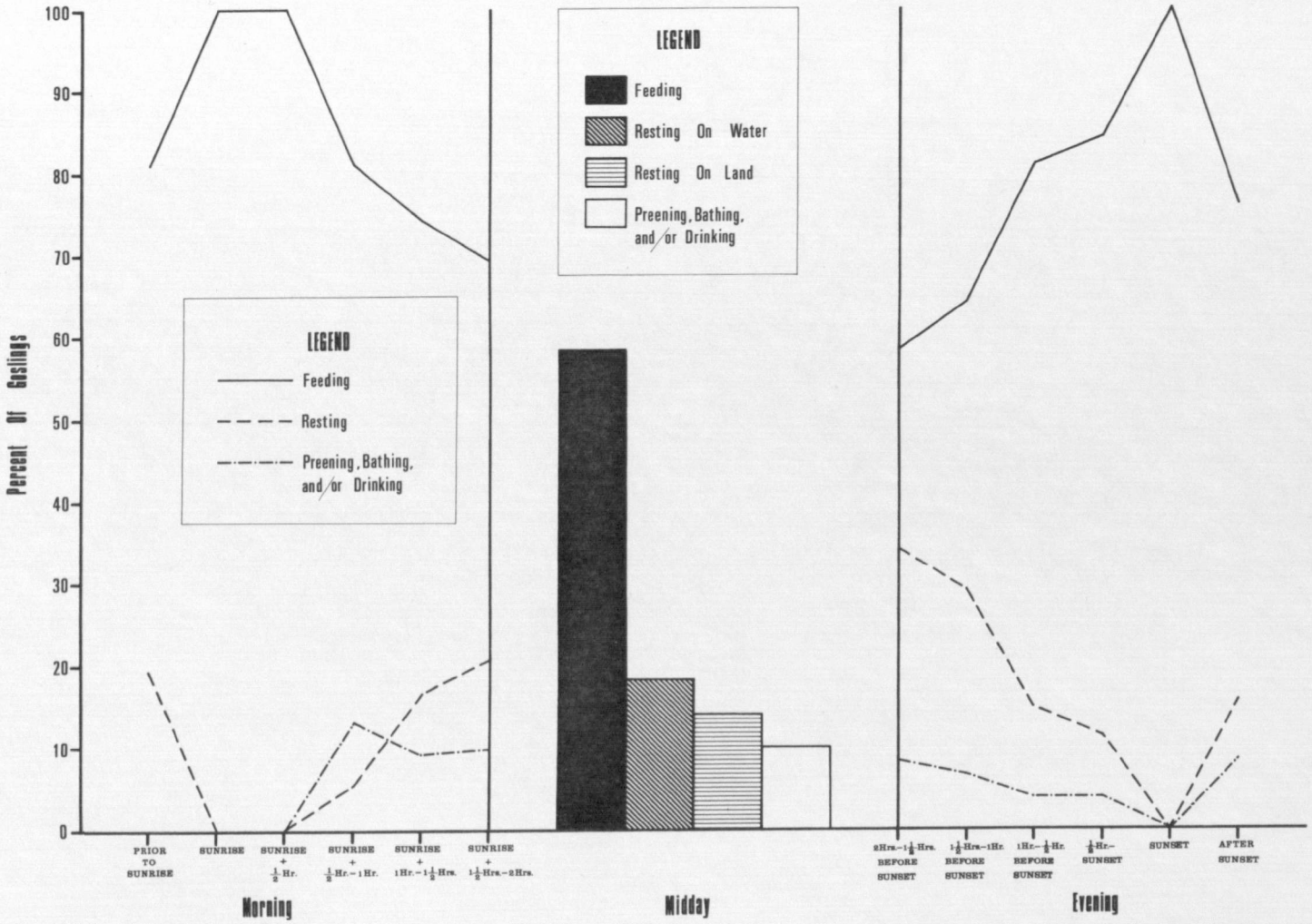

Figure 2. Daily preflight activity of transplanted goslings.

Throughout the daily observational periods, resting varied inversely with feeding activity (Figure 2). The lowest observed resting activity occurred during the intensive feeding periods of early morning and evening. Midday activity data show 56 percent of the resting occurs on water. All early morning and late evening resting sites were on islands or low, narrow peninsulas. Williams (1967) reported the use of similar areas by resting Canada geese.

The combined activity of preening, bathing, and drinking reached its highest peak (13 percent) a half hour after the period of intensive morning feeding. Throughout the rest of the morning and midday period, preening, bathing, and drinking made up about 10 percent of the transplant activity. Towards the late afternoon, preening, bathing, and drinking gradually declined until at sunset none of the transplants were observed in this combined activity. All intensive feeding periods were usually followed by drinking and preening activity. The duration of such activity varied directly with the duration and intensity of the feeding period preceding it. Bathing activity occurred more frequently during the midday period particularly when hot weather conditions prevailed. As darkness ensued and feeding activity declined, all transplants drank for a short time then preened extensively prior to their night rest period.

Social Behavior

Among the transplants, males displayed a slightly higher dominance than did females. Fifty-three percent of 103 observations of dominance displays were by males. Williams (1967) stated that, "Essentially the male controls the female...and older, bigger birds get the decisions over younger, smaller geese." Both Williams (1967) and Hanson (1965) confirmed that males are normally slightly larger than females of equal age. Transplants of either sex that were obviously younger or smaller than the others assumed a subordinate role in all activities.

Resident adults and goslings were dominant over the transplants at all times. On many occasions resident goslings, regardless of age, were observed to dominate transplants. This confirms Hanson's (1965) statement that, "...the...immature separated from its family was clearly at the bottom of the peck order...." Balham (1954) and Boyd (1953) also observed the above mentioned social relationships among geese.

Varying degrees of tolerance to transplants were exhibited by adult geese on some of the study lakes. The breeding status of resident adults was highly influencial in their behavior toward the transplants. A single, nonbreeding adult was observed to associate continuously with the transplants placed on Study Lake 5 in 1968. The nonbreeder joined the transplants immediately after they were placed on the lake. From this time on, it assumed the dominant role, showing leadership in all daily activities. The amount of tolerance exhibited by resident breeding pairs to the transplants appeared to be dependent on the age of the resident

goslings. In general, more tolerance was displayed by resident adults whose goslings approached the age of the transplants. In wild or semidomestic populations of Canada geese, brood grouping commonly occurs as the goslings increase in age (Brakhage, 1965). Adoption of these mixed broods is usually by the dominant pair in the brooding area (Sherwood, 1967).

Postflight Period

Mortality

Twenty-eight direct recoveries of transplants were reported during the two year study period. This includes 21 recoveries from the hunting season of 1967 and seven from the fall of 1968. No indirect recoveries have been reported to date.

Behavior and Activities

The presence of adults on study lakes had a noticeable effect on the movements and flock unity of transplants released on these lakes (Table IV). The postflight movements of transplants under the guidance of resident geese were more localized than those observed for transplants without adult leadership. Fifty-four (86 percent) of 63 fall postflight observations made during the two-year period were of transplants from study lakes where resident adults were present. Forty-three percent of these sightings were of transplants on or within one mile of their release sites (Table IV).

TABLE IV. 1967 AND 1968 FALL MOVEMENTS AND FLOCK UNITY.

Study Lake	Year	Number Surviving To Flight	No. Of Sightings On Or Within One Mile Of Home Lake After Flight	No. Of Sightings Over 1 Mile From Home Lake	Average Flock Size Of Transplants Sighted	
					No.	% Of Total No. Surviving To Flight
Lake 1	*1967	42	9	0	42	100
	*1968	41	4	20	41	100
Lake 2	*1967	45	4	0	45	100
Lake 3	1967	41	0	1	13	32
	1968	38	1	1	15	39
Lake 4	1968	32	0	6	12	38
Lake 5	*1968	22	6	11	22	100

* Resident adults present on the study lake.

Although many transplants attained flight less than one week after their release, an attraction to the resident birds appeared to inhibit their early departure from these lakes. Initial movements of transplants away from these sites did not occur until the residents attained flight. At this time, all surviving transplants left these lakes as a unit under the leadership of the resident birds. From subsequent post-flight sightings it is apparent that this relationship between residents and transplants remained intact from late July, when initial movements were observed, until early September when my final observations were made.

It appeared that when transplants were placed on lakes occupied by resident geese, the resident adults were adopted as foster parents by the transplanted goslings. It also appeared that the dominance of the transplants as a unit, relative to other geese encountered in the area during their fall movements, was dependent on the social status of the adopted resident birds. For example, on three occasions during the fall of 1968 I observed the transplants from Study Lake 1 and Study Lake 5 field feeding together, and on three other occasions I observed these same two groups feeding and loafing on Study Lake 5. Throughout all of these observations, the transplants from both lakes remained as distinctly separate units. The resident family leading the transplants from Study Lake 1 was comprised of a dominant pair with five goslings, whereas the transplants from Study Lake 5 were led by a single adult. This difference in social standing between the two flock leaders allowed the geese from Study Lake 1 to dominate those from Study Lake 5. This social order

designating an adult pair with a family dominant over a single adult follows that described by Hanson (1965) and Williams (1967).

Of nine fall postflight observations made of transplants from lakes without resident adults present, only one was recorded within one mile of their release site. These data indicate that transplanted goslings placed on lakes uninhabited by resident geese dispersed from their release sites immediately after attaining flight. Vaught (1964) reported similar behavior of transplanted flightless young blue-winged teal (Anas discors).

Goslings released on lakes without resident birds showed little flock coherence. When goslings on such lakes became adept at flight, they immediately departed from their release sites. This behavior was verified by postflight counts which showed the average flock size of transplants from study lakes without residents to be about one third of the original number surviving to flight on these areas (Table IV).

Yearling Activities

Homing

Two hundred and ten sightings of 13 homing transplants were made during the spring of 1968. All were females (Table V), and were from a potential of 136 (68 males and 68 females) goslings transplanted the previous summer. Calculations in Table VI indicate that theoretically, 43 percent of the surviving yearling females exhibited homing tendencies (95 percent confidence limits are $.25 < P_f - P_m < .61$). A single observation of one male transplant was recorded in the late spring as it passed

TABLE V. SEX, LOCATION OF INITIAL SIGHTING, AND MOVEMENTS OF HOMING YEARLING TRANSPLANTS DURING THE SPRING OF 1968.

Release Site	Identity Of Homing Transplant	Sex	Location Of Initial Sighting	Total No. Of Sightings On Study Area[1]	Sightings On Or Within 1 Mile Of Home Lake[1]		Sightings Over 1 Mile From Home Lake[1]	
					No.	% Of Total Sightings	No.	% Of Total Sightings
Lake 1	Yellow D3	F	Lake 1					
	Yellow B7	F	Lake 1	35	30	86	5	14
Lake 2	Blue B4	F	7 mi. W. of Lake 2					
	Blue C9	F	Lake 2					
	Blue B9	F	Lake 2					
	Blue D8	F	Lake 2					
	Blue D7	F	Lake 2					
	Blue C7	F	Lake 2	86	27	31	59	69
Lake 3	Blue H7	F	Lake 3					
	Blue H8	F	Lake 3					
	Blue I6	F	Lake 3					
	Blue H3	F	1 mi. N. of Lake 3					
	Blue F8	F	2 mi. N. of Lake 3	89	27	30	62	70
			Total Sightings - 210					

1/ Sightings of transplants from each release site were grouped for analysis.

TABLE VI. STATISTICAL ANALYSIS OF DIFFERENTIAL HOMING AMONG YEARLING CANADA GEESE.

	No. Of 1967 Trans-Plants	Theoretical Direct Recovery (%) 1/	% Neck Collar Loss 2/	Theoretical No. Of Goslings Surviving With Neck Collars	No. Of Birds Homing	Calc. % Of Collared Survivors Homing	Confidence Limits On P_f-P_m 3/
♂	68	49	15	30	0	0	0
♀	68	49	15	30	13	43	$*.25 < P_f-P_m < .61$

1/ Calculated average gosling kill in Brooks, Alberta area from Ducks Unlimited banding records of 1955 through 1963 inclusive (omitting 1957).

2/ Average neck collar loss reported by Sherwood (1966).

3/ P_f = the probability of female yearlings homing, P_m = the probability of male yearlings homing. In these calculations $P_m = 0$.

* 95 percent confidence limits calculated according to Steel and Torrie (1960).

through the study area with a group of unmarked geese apparently on a northward molt migration (Sterling and Dzubin, 1967). Because of its time of arrival and length of stay on the area, the presence of this bird appeared due to chance rather than a homing urge so I did not consider it in the following discussion.

Eleven (85 percent) of the initial sightings of homing transplants were on or within one mile of the lake where they were released the previous year (Table V). Transplants Blue B4 and Blue F8 were initially sighted seven and two miles from their respective release sites. Later observations confirmed the movement of these birds back to their home lakes. No marked transplants were sighted by Ducks Unlimited personnel at the trapping sites in the Brooks, Alberta area (Charles Lacy, personal communication).

The spring water conditions on the study lakes apparently influenced the movements of the homing transplants relative to their release sites. Throughout the spring observational period, Study Lakes 2 and 3 lacked secure water areas while Study Lake 1 possessed a relatively large, secure water body. Data presented in Table V show that 86 percent of the initial and subsequent sightings of homing transplants from Study Lake 1 were on or within one mile of this lake. Only about 30 percent of all initial and subsequent observations of transplants homing to Study Lakes 2 and 3 respectively were recorded on or within one mile of these lakes.

The homing transplants arrived on the study area over a 34 day period from March 23 to April 25 inclusive. When graphically illustrated in

Figure 3, these data show a greater number of initial sightings (69 percent) during the first half of this period indicating a more intensive yearling movement at this time.

Breeding Behavior

Eleven (85 percent) of the 13 homing yearling female transplants formed observable pair bonds with unmarked geese (Figure 3). Nine (82 percent) of these pair formations were made on the study area. These data indicate that most female Canada geese pair in the spring of their first year of life, and that this pairing activity is mainly confined to the breeding grounds. Naylor (1953), Balham (1954), and Hanson (1965) concluded that some pairing of yearling birds takes place on the breeding grounds. In addition to pair bond formations by yearlings, Sherwood (1967) found that the nesting ground was the location of all true pairing activity.

On May 17, two previously paired transplants (Blue I6 and Blue H3) were observed as single birds. Blue H3 appeared paired two days later but Blue I6 remained unpaired for the duration of its stay on the study area. Such pair behavior involving yearling geese has previously been reported. Balham (1954), with reference to pairing tendencies of yearling geese, recorded "short term associations between yearlings, or between yearlings and older geese." Similarly, Sherwood (1967) found that just prior to their summer molt, the loyalty between paired yearlings began to decline.

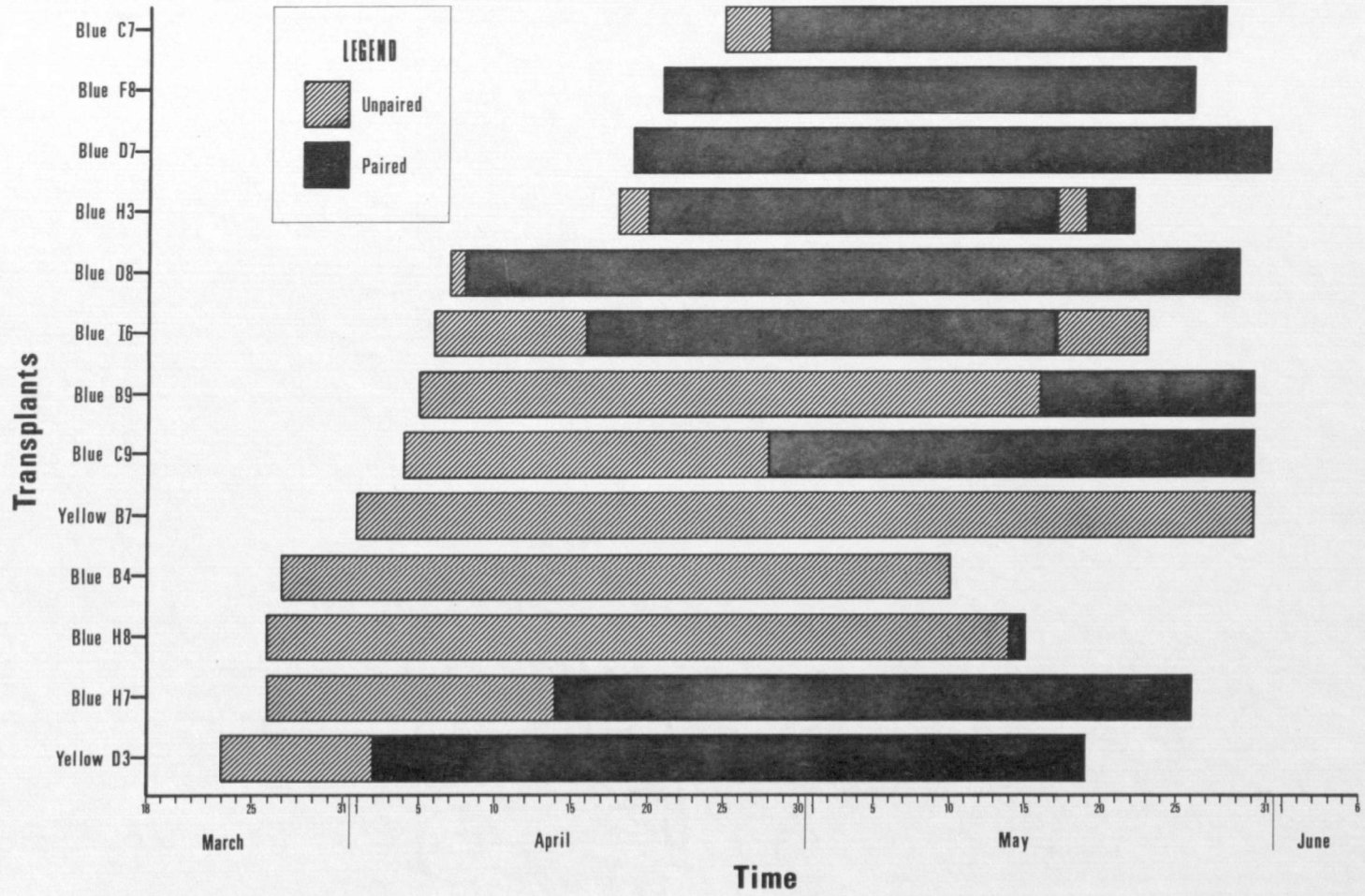

Figure 3. Spring arrival and departure dates, and pair status of homing yearling female geese on the study area.

Brakhage (1965) reported that nonbreeding females were tolerated by resident breeding pairs. In my study, 12 observations were recorded of yearling nonbreeders closely associating with incubating adult females or newly hatched resident goslings. Only one instance of intolerance toward a yearling female was observed. On this occasion a territorial gander evicted a yearling when it approached within five feet of an incubating goose.

Twenty dominance displays were made by pairs involving yearling female transplants. Seventeen (85 percent) of these were on the release sites of the females making up the pairs. Social relationships exhibited by pairs that included yearling females were similar to those described for all age classes by Williams (1967) and Hanson (1965). On all occasions, pairs that included yearling females were dominant over single birds but were subordinate to older breeding pairs. Dominance between pairs involving yearling females appeared to depend upon the size and aggressiveness of the respective ganders and also on the enthusiasm of the females involved.

During the spring observational period, a distinct relationship existed among: (1) the flock size in which a yearling was found, (2) the pair status of the yearling birds involved, and (3) the phenology of the breeding season. In late March and early April the yearlings arrived with large flocks of migrant birds. Following their arrival, they were observed associating with smaller groups of geese on or near their home lake. Once a pair bond was established, the two birds formed a separate unit, exhibiting

intolerance to other birds in the area. All of the unpaired yearlings usually associated in small groups. Brakhage (1965) and Sherwood (1967) observed similar associations of single nonbreeding geese. As late May approached, single and paired nonbreeding geese grouped into small flocks in preparation for their molt migration. Although increased tolerance was exhibited by paired nonbreeders at this time, all pairs remained as sub-units within the newly formed flocks. The exodus of nonbreeding geese from the study area was rapid. Ten (77 percent) of the 13 homing transplants left the study area between May 22 and May 31. Five of these ten left the area in the last three days of this period. No yearling transplants were present on the study area after May 31.

Late arriving yearlings either paired early or showed paired relationships when initially sighted (Figure 3). Although difficult to substantiate, the time of arrival and pairing behavior exhibited by this segment of the transplant population suggests that local differences in migrational patterns may exist.

Fall Activities

On August 23, 1968 Blue C7 was sighted on Study Lake 2, the lake where it was released in the summer of 1967. This bird had returned to its home lake apparently following a molt migration out of the study area. Two additional observations were made of Blue C7 in the same area. The return of yearlings to their natal lake following a summer molt was also recorded by Sherwood (1967).

Blue C7 left the study area for the molt migration on May 28, 1968. At this time it was a paired yearling. All observations of this bird in late August suggested that it was no longer paired. The pair bond formed during the spring of 1968 had apparently been broken on the molting grounds.

CONCLUSIONS

The primary objective of migratory waterfowl transplant programs is to introduce or reintroduce breeding populations of a desired species into a specific location. The success of such programs depends on the homing behavior of the species involved.

The transplant program attempted in this study verified the homing of yearling female Canada geese to the sites where they were released as goslings. These results indicate that the homing behavior of Canada geese is a learned response and not innate in its origin. If the latter were true, the geese would have homed to their true natal area. It appears that female Canada geese home to the specific site where they learn to fly as goslings. McCabe (1947) noted similar homing behavior among female wood ducks (Aix sponsa).

Although the mortality of transplants prior to flight appeared slightly lower on release sites occupied by resident geese, the localized postflight movements of these geese as a unit may have been detrimental to their survival. The heavy hunting pressure normally found on the area during the early fall coupled with the predictable behavior of these birds, probably resulted in a high local kill. This may account for the small number of homing geese observed on Study Lake 1. Conversely, the immediate dispersal from the study area by small groups of transplants from release sites not occupied by residents may have been of some survival value to these birds.

MANAGEMENT RECOMMENDATIONS

(1) Gosling transplant programs should lean heavily toward females.

(2) Seven and eight week-old goslings appear to be a desirable age group to use for transplant purposes.

(3) The transplant release sites should be characterized by a secure open water body and an abundance of available vegetation.

(4) Nesting habitat should be available at the release sites.

APPENDIX

TABLE III. DAILY PREFLIGHT ACTIVITY OF TRANSPLANTED GOSLINGS

Morning

Activity	Prior To Sunrise Min. Observed	% [1]	Sunrise %	Sunrise + 1/2hr. Min. Observed	%	Sunrise + 1/2hr.-1hr. Min. Observed	%	Sunrise + 1hr.-1 1/2hrs. Min. Observed	%	Sunrise + 1 1/2hrs.-2hrs. Min. Observed	%
Feeding	85	81	100	192	100	180	81	220	74	194	69
Resting	20	19	0	0	0	13	6	52	17	60	21
P.B.D. [2]	0	0	0	0	0	30	13	26	9	27	10
Subtotals	105			192		223		298		281	

Total = 1099 minutes of morning observations

Evening

Activity	2hrs.-1 1/2hrs. Before Sunset Min. Observed	%	1 1/2hrs.-1hr. Before Sunset Min. Observed	%	1hr.-1/2hr. Before Sunset Min. Observed	%	1/2hr.-Sunset Min. Observed	%	Sunset %	After Sunset Min. Observed	%
Feeding	230	58	278	64	334	81	501	84	100	273	76
Resting	135	34	126	29	64	15	71	12	0	59	16
P.B.D.	32	8	31	7	17	4	21	4	0	29	8
Subtotals	397		435		415		593			361	

Total = 2201 minutes of evening observations

Midday

	Feeding	Resting On Land	Resting On Water	Preening, Bathing, and/or Drinking
Minutes Observed	3857	913	1154	685
Percent Observed	58	14	18	10

Total = 6609 minutes of midday observations

Total Preflight Observations = 9909 minutes (approx. 165 hrs.)

1/ Indicates percent of transplants performing the activity.

2/ The combined activity of Preening, Bathing, and/or Drinking.

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