Canada goose breeding populations in Wisconsin. Number 38 1966

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by

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Particular credit is due Ralph C. Hopkins, Waterfowl Research Project Leader at Horicon from 1947 to 1951, who planned and participated in much of the early goose restoration work.

For direction along the way and for encouragement and assistance during the research study, we are indebted to Cyril Kabat, formerly Chief of Wildlife Research.

Our thanks are also due the many personnel employed at the Horicon Marsh Conservation Department station for the assistance they gave while a breeding flock was maintained there in the years 1946-57. Game manager James G. Bell provided equipment, materials and personnel whenever needed. George H. Amelong, Edward Lechner and Frank Burrow were particularly helpful in the year-round care of the geese. Miss Betty Sohre deserves credit for maintaining the banding data in a workable system throughout most of the study period.

Special mention must be made of the efforts of the following individuals: N. R. Stone under whose direction the Crex Meadows project has been functioning, Ben Hubbard for providing much of the information on geese in central Wisconsin and Harold Shine who contributed valuable records for the Green Bay area geese. The federal refuge offices at Necedah and Horicon readily supplied their data on wild geese and restoration attempts. Cover photo by R. W. Poulter.

In the preparation of this report, we have drawn freely on the advice and information provided by Harold C. Hanson concerning geese in Wisconsin, and particularly in relation to his work on the giant Canada goose *B. c. maxima.*

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Edited by Ruth L. Hine and James B. Hale

ABSTRACT

The Canada goose *(Branta canadensis)* was a common species in the original fauna of Wisconsin. It bred in considerable numbers and was an important migrant in spring and fall. Year-round hunting, stealing of eggs and young, and habitat destruction had largely eliminated the breeding population by about 1900. Re-establishment of local breeding flocks had occurred in the Green Bay area by the early 1930's from geese maintained by a private game breeder, and in central Wisconsin marshes in the early 1940's from geese in a restoration project on the Necedah National Wildlife Refuge and from birds escaping from a private game breeder.

The Wisconsin Conservation Department began Canada goose restoration attempts in 1946. Since that time, attempts to re-establish local breeding traditions have been tried on a number of areas through the use of penned flocks, release of semi-domestic family groups and immatures, release of wing-clipped wild geese and release of hunting season cripples. The only success has been in projects started with proven breeders confined in pens. Free-flying progeny from such projects have resulted in self-perpetuating migratory flocks at Horicon Marsh, Crex Meadows and to a limited extent at Powell Marsh. We now know that the principal breeding flocks in Wisconsin are the giant race *B. c. maxima.*

The establishment of a strong breeding tradition at Horicon Marsh has been retarded primarily by local hunting. From 466 goslings banded in the years 1950-57, 29 percent were recovered. Only 11 of 136 recoveries (8%) were in other states, and 120 of the recoveries were within 5 miles of the breeding pen. Local hunters shot more of the flock than band recoveries indicated. In 1957, only 6 of 17 banded geese known to have been killed on one farm adjoining the breeding area were reported. The effect of direct feeding to reduce local kill was demonstrated at Horicon. The pen-reared geese were migratory but despite the presence of large migrant goose populations at Horicon in both spring and fall, there was no evidence of significant movement to major winter refuges or north to the Canadian breeding range.

At Crex Meadows, local goose hunting has been prohibited for nine years and breeding geese appear well established. How well these birds will survive when hunting is permitted remains to be determined. A migratory pattern has been established, but a number of recoveries are occurring on the main winter range in southern Illinois where goose hunting is intensive. Banding of the annual production should be continued to evaluate mortality and distribution.

The free-flying flock at the Necedah National Wildlife Refuge may

be limited by predation during nesting. Local hunting is considered an important limiting factor for all the local flocks in central Wisconsin. Geese in the Green Bay area are increasing because the birds are protected and fed in refuge areas on a year-round basis.

Breeding and nonbreeding geese observed on statewide surveys show limited relationships to known breeding flocks and a variable pattern of annual frequency and distribution. Local hunting may be removing an important part of the pioneering geese each year before a good breeding tradition can be established.

Canada goose restoration projects appear incompatible with wetland projects aimed at attracting large fall migrant goose populations for hunting purposes. Availability of suitable nesting habitat suggests, however, that a significant expansion of local breeding flocks can be achieved, primarily by reducing hunting mortality and, where necessary, increasing nesting success. In the forested region of Wisconsin, lack of young succulent vegetation for broods will probably limit population size, unless such food is provided through management efforts. In the agricultural region of Wisconsin, crop depredations will probably serve as an economic ceiling limiting the size of local flocks. These limitations can be minimized through intensive management of habitat and hunting regulations.

CONTENTS

PERSPECTIVES

For almost 20 years, the Wisconsin Conservation Department has been involved in a number of projects aimed at re-establishing breeding populations of Canada geese *(Branta canadensis)* in the state. An evaluation of these projects is the main purpose of this report. We will also discuss other goose restocking projects, bring up to date our knowledge of the Canada goose as a local breeder, and set goose restoration into proper perspective in relation to Wisconsin's waterfowl management and research program.

History of Goose Restoration Projects

The use of captive flocks of Canada geese on waterfowl refuges and management areas is one of the oldest and most common management practices. As early as 1930, the Michigan Conservation Department had developed a breeding flock which produced goslings for small-scale releases in the wild (Pirnie, 1938). As the federal waterfowl refuge system developed, goose flocks were established at the Blackwater National Wildlife Refuge in Maryland in 1935 and at the Seney National Wildlife Refuge in upper Michigan in 1936. By 1940 over a dozen federal refuges had goose flocks and eventually 40 or more refuges tried the technique, including both the Horicon and Necedah National Refuges in Wisconsin (U.S. Department of the Interior, 1958). Objectives, in most cases, were to re-establish the Canada goose as a nesting species in its former range, or to establish it in new range, with the ultimate goal of contributing to local hunting opportunities. Some captive flocks were used in attempts to attract wild geese to new projects along migration routes and on the winter range.

Despite the early and extensive history of goose restoration projects, few evaluations have been described in the literature. The first review of a restocking project, which began in 1927 at the Kellogg Sanctuary in Michigan, was made by Pirnie (1938). Johnson (1947) summarized the first 10 years of the Seney Refuge project, which to date has been the most successful goose restoration attempt. Sherwood (1965) also published a detailed study on the Seney flock. In 1953, the U.S. Department of Interior's Branch of Wildlife Refuges prepared a report on the management of captive goose flocks (later revised, U.S. Department of the Interior, 1958) which discussed desirable techniques rather than scientific results.

Several state conservation department goose restocking projects have been reviewed. In New York, Benson and De Graff (1963) reported on the release of hand-reared goslings. Bednarik (1965a) and

Brakhage (1965) have had outstanding success with rearing geese in artificial nest structures.

What has been the role of restoration projects in Canada goose management? A reasonable answer is possible for the Mississippi Flyway. Nelson (1963a) summarized past and present accomplishments of both state and federal goose rearing activities. Federal refuges in this Flyway in the years 1936-62 produced 15,940 geese. Annual production in the period 1958-62 averaged 1,160 goslings. For state-owned projects, production in the years 1957-62 totaled 6,000, but averaged 2,600 in the last few years. Since 1962, the use of man-made nesting structures has contributed substantially to the success of local flocks.

Estimated production in the Flyway in 1965 probably totaled over 7,500 goslings. From a numerical standpoint, the annual production of a few thousand geese on state and federal projects is only a token contribution to Mississippi Flyway Canada goose populations, which now exceed 400,000 on the winter inventories and over 100,000 in annual harvest. Nevertheless, local breeding populations have provided challenging hunting in some areas, and perhaps more important, have restored a significant aesthetic heritage to many waterfowl marshes.

A recent study by Hanson (1965) re-established the existence of the giant Canada goose *B. c. maxima.* This important work contains a wealth of basic biological information on the large races of Canada geese, including data from most of the above-mentioned restoration projects and Wisconsin findings reported here. It also focused attention on subspecific aspects of geese in evaluating past stocking efforts and more important, the need to consider ecological relationships in future projects.

Historical Breeding Status in Wisconsin

Historical references to the status of Canada geese in Wisconsin are limited, but definitely establish the fact that breeding geese were widespread in the state. Kumlien and Hollister (1903:22) commented as follows: "Fifty years ago a common breeder in almost any swamp or large marsh or on the 'prairie sloughs' (now a feature of the past). At the present time only scattered pairs nest as far south as the southern third of the state. The last nesting record we have for southern Wisconsin was in Jefferson County from the years 1891-99 inclusive, when a goose deposited her eggs on the edge of a tamarack swamp, on the same mound of rubbish each year." One other early reference is that of Cory (1909:352) who stated: "The Canada goose is common during the migration in Illinois and Wisconsin and once bred in numbers along the upper Mississippi Valley, but at the present time a few pairs make their nest occasionally in Michigan and Wisconsin and possibly a very few in Illinois."

A glimpse of the historical abundance of nesting was provided by Dr. A. W. Schorger of the Department of Wildlife Management at the University of Wisconsin (pers. comm.) from the early notes of Dr. P. R. Hoy, noted ornithologist of early Wisconsin: "The Canada goose at that time nested abundantly. In 1850 their eggs were gathered by the bushel in a marsh north of Racine."

Evidence of local breeding on Horicon Marsh is cited by Scott (1942:8-9) who reprints an 1878 story of hunting on the area: "Here ducks of all kinds bred and hatched their young; wild geese also bred here and hatched here; this I know, as I had three of them as pets that were taken from the nest before they even reached the water." And later in this report there is an account of a chase and shooting in early August of "three, fine, fat, young geese on the marsh."

Other reports on Horicon Marsh indicate that after 1904, when the marsh was drained for unsuccessful agricultural ventures, waterfowl use was greatly reduced (Hubbell, 1913; Way, 1926; Freeman and Bussewitz, 1948). Goose nesting traditions also were apparently eliminated (Mitchell, 1943).

For most of the period 1904 through the early 1940's the area was semi-dry and relatively poor aquatic habitat. Permanent water levels were restored in 1943 as a result of public conservation interests which induced the state and federal governments to purchase the area for wildlife. Mitchell (1943) reported a reliable nesting record of a Canada goose that year. A suspected nesting attempt occurred in 1944 when a pair of geese were observed to prepare a nest site on a muskrat house and show territorial behavior; no eggs or young, were noted.

These few early reports show that the Canada goose was at one time a common breeder in Wisconsin. It is also clear that breeding geese had largely disappeared from the state by the turn of the century.

Wisconsin Restoration Projects

By 1940, privately owned goose flocks in Wisconsin were contributing free-flying geese. At Green Bay, the late Louis Barkhausen was reported to be rearing 100 or more free-flying goslings annually from a flock he established in 1932. Wallace Grange was rearing free-flying geese in 1939 at his game farm near Babcock just north of the Necedah National Wildlife Refuge. The Grange birds may have been involved in the small breeding flock established at the Necedah Refuge by 1942. In 1942, 34 of Grange's geese were purchased for the State Game Farm at Poynette, where they continued to produce young each year.

These successful projects encouraged the Wisconsin Conservation Department to attempt goose restoration on some of the large marsh-

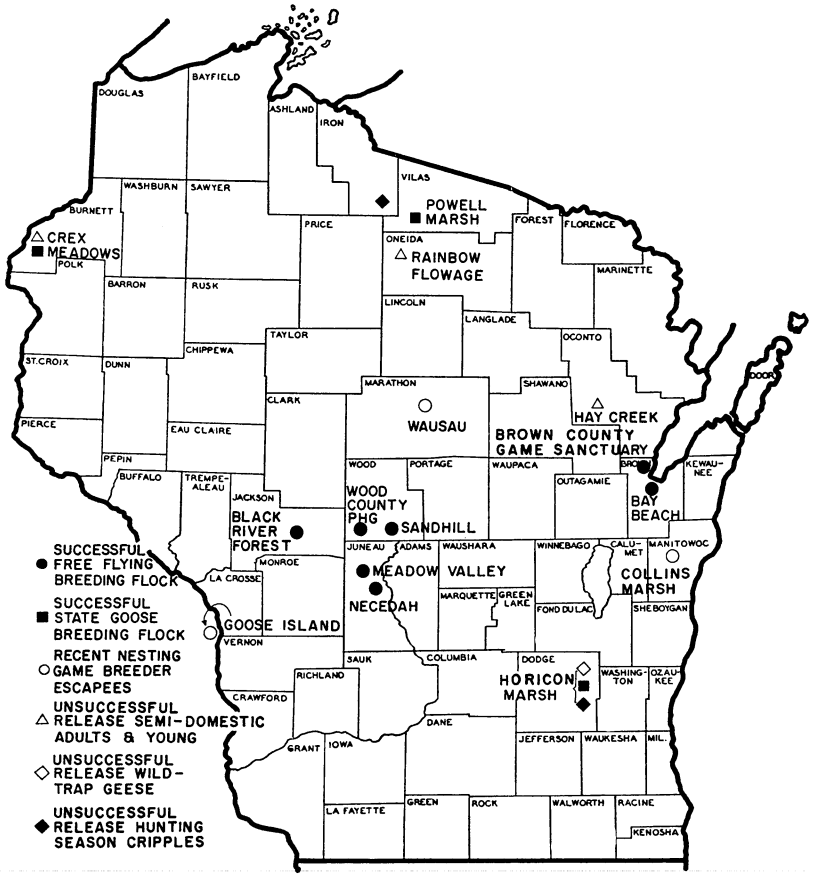


Figure 1. Location of goose restoration projects in Wisconsin. (Brown County Game Sanctuary was formerly known as the Barkhausen Refuge, and has been referred to by this name on subsequent maps.)

es being purchased for public ownership. In 1946 a captive goose flock was established on the state-owned Horicon Marsh Wildlife Area. A major part of this report is concerned with the productive aspects of the Horicon flock in the years 1950-57. Collias and Jahn (1959) reported on a goose breeding behavior study carried out on this flock in 1952. At the end of the 1957 breeding season, the adult breeders were split into two groups and were transferred to state waterfowl projects at Crex Meadows in Burnett County and Powell Marsh in Vilas County. The Crex Meadows flock is still active, but the Powell Marsh birds had such low reproductive success that breeding efforts in pens were terminated after the 1962 season.

Besides captive flocks, attempts were made to establish breeding traditions by releasing of semi-domestic geese and hunting season

Typical B.c. maxima used in Wisconsin goose-rearing projects. The male on the right has good physical characteristics of the race: eyebrow spot, large white cheek patch, massive bill, white breast, very large feet.

cripples (Fig. 1). These attempts were essentially unsuccessful but are briefly reviewed. In 1954, the staff at the Horicon National Wildlife Refuge released a group of wild, wing-clipped geese captured in net traps during spring migration. The results of this release are discussed.

As part of our interest in restoration activities, statewide surveys of breeding geese were started in 1949. Many cooperators, totaling about 125 annually, were used in the first few years. Attempts were made by these cooperators to trace all breeding records. By 1954, district game managers of the Wisconsin Conservation Department were the primary source of information. Reports included the production of all free-flying flocks as well as the number of nonbreeding birds present in the period from June 1 to July 31.

Subspecific Status of Breeding Flocks

A particularly important point brought out by Hanson (1965) is that most of the successful breeding flocks in the Midwest are *Branta canadensis maxima,* the giant Canada goose. Delacour (1951) had considered this goose already extinct when he originally described it

and defined the range. He considered the bird to be nonmigratory, well-known to market hunters in the late 1800's, and to have bred formerly from North Dakota and Minnesota south to Kansas, northern Arkansas, Tennessee and western Kentucky. However, Hanson rediscovered the giant Canada goose at Rochester, Minnesota in 1961, and later made extensive investigations of the race.

During the course of our study, no attempt was made to identify races of Canada geese. Some *B. c. interior* (the common migrant race in Wisconsin) were obtained by trapping in spring and fall. In general, however, our breeding stock was *B. c. maxima.* One large group of breeding geese came from Nebraska, where the original owner reported dressed weights of ganders at 14½ pounds (Wolfe, in litt., July 31, 1963), a size too large for anything but *maxima.* Several other groups of breeders were obtained at Bright Land Farms, Barrington, Illinois, from stock studied by Kossack (1950). According to Hanson, this flock was of the giant race and the original source of these birds was from a game breeder in Wisconsin. We purchased one small group of geese from a private game breeder in Rock County, Wisconsin. These geese were viewed by Hanson and confirmed as *B. c. maxima.*

HORICON MARSH PROJECT

The principal objective of rearing Canada geese at Horicon Marsh was to re-establish the species as a local breeder. The hope was that eventually local production would contribute to hunting opportunities in the area. The captive flock potentially had two other functions, to serve as a decoy flock in attracting migrants to the public hunting grounds on the Marsh and to serve as a public relations tool.

From 1946 through 1949 a breeding flock was built and suitable rearing facilities developed. Breeders were pinioned or wing-clipped. In later years some free-flying adults nested successfully in the pen, but we were never certain that they were inventoried each year. The breeding pen included 5 acres of water and 6 acres of cropland. A 2,000-acre waterfowl refuge was maintained around the breeding pen (Fig. 2). Breeding geese were fed a commercial "layer" pellet, the young geese a "grower" pellet. In fall and winter, oyster shell (for grit and mineral), mixed grain and alfalfa hay were fed in addition to the pellets. The cropland acres in the breeding pen were farmed to provide winter wheat and alfalfa hay browse. In winter, breeders were held in the open pen and any free-flying geese could stay if they desired. The geese themselves generally maintained open water on the pond except in subzero weather when it was necessary to saw holes in the ice.

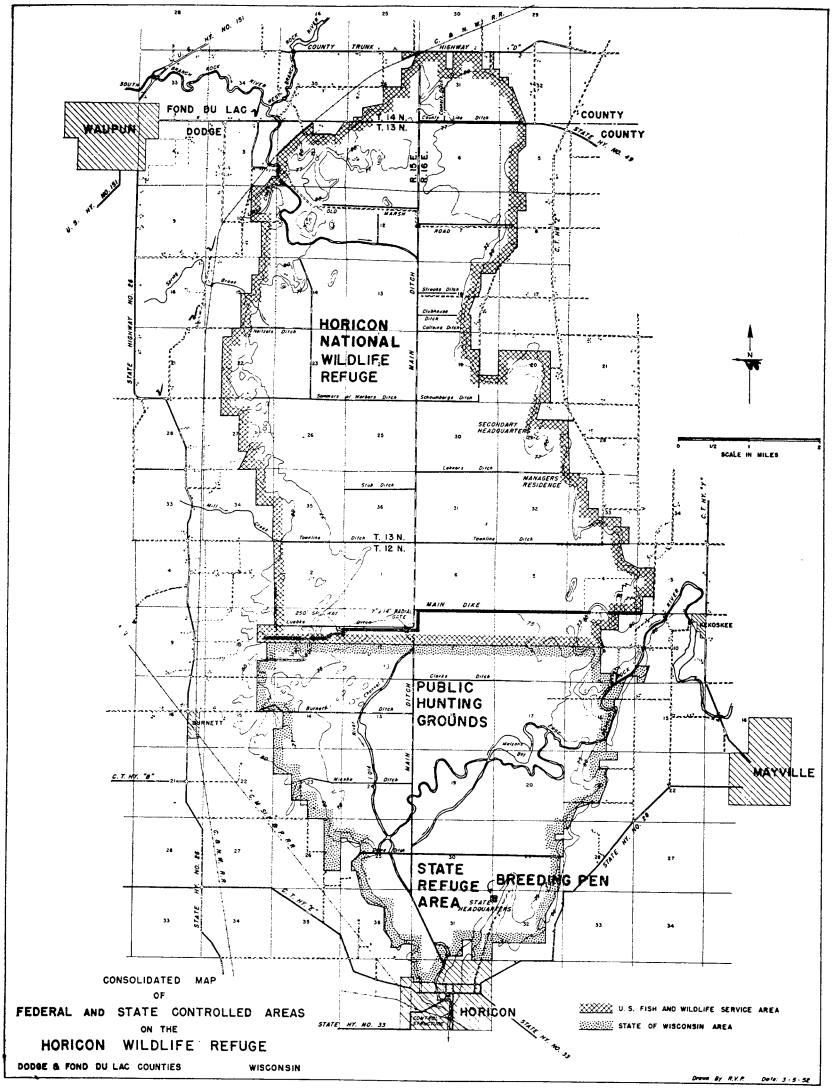


Figure 2. Map of Horicon Marsh showing location of breeding pen and refuge areas.

Nesting generally occurred along the shoreline, but some females nested up to 100 yards from water. Natural nesting material was generally used, but bales of straw placed at approximately 100-foot intervals along the shore were frequently used as nest sites. In 1952, 38 brush piles were placed in the enclosure, 18 of which were in the water. Straw was placed on the brush piles. These structures, which averaged 15 feet in diameter and 4 feet in height, were readily accepted as nest sites.

Beginning in 1950 and continuing through 1957, all young geese were banded and released as free-flyers. Annual inventories of breeders and other geese associating with the flock were carried out in early June when the young geese were banded.

Breeding and Production

Breeding and production data from the Horicon captive flock during the years 1950-57 are shown in Table 1. None of the geese were individually color-marked, except during the behavioral study in 1952. In other years, only general data were recorded. Detailed information on breeding aspects of other flocks were reported by Brakhage (1965), Bednarik (1965a), Hanson (1965) and Sherwood (1965). Our data compare favorably with these studies. There are also a few points in our study that may be of interest or have bearing on future projects.

The number of successful breeding pairs in the 11-acre enclosure ranged from 22 to 25 each year. Stabilization of numbers of breeders was related to the available space for nest sites and territories (Collias and Jahn, 1959).

Horicon Marsh Canada goose rearing project. Captive breeders were maintained in the pond area on a year round basis. Free-flying progeny gradually spread over a few square miles of the surrounding marsh, nesting on muskrat houses and old ditchbanks. Pairs nesting on the marsh often returned with their broods to the immediate vicinity of the pen.

Pairs in the pen readily utilized brush islands as nest sites. The island provided a defendable site for one pair. In all but one year, flooding was no problem. However, the island nests were not secure from raccoons.

Predator losses also influenced the number of pairs. Mammals were unimportant, although routine control of raccoons was carried out as a precautionary measure. Mink or red fox were observed inside and outside the pen but no evidence was found that they disturbed the geese. The larger birds of prey, however, caused some mortality. In the winter of 1955-56, a golden eagle killed 17 flightless adults, and the following winter 7 more adult breeders were lost to a golden eagle (possibly the same bird). Great-horned owls and occasionally snowy owls were observed in the pen area during the winter months. These predators were responsible for an occasional kill in that season. Females were killed more often by avian predators. On two occasions, the breeding flock was raided and several geese killed and taken by poachers. These losses to avian predators and man broke up some pairs and removed other pairs completely thereby accounting for some of the sexual imbalance in the breeding flock.

Under pen conditions, the breeding flock at Horicon generally started nesting in late March. Migrant geese were just returning from the winter range at this time. In some years, incubation had started before the pond was completely ice-free. Occasionally migrant geese, which normally reach peak levels about mid-April, were still present when the first brood appeared.

In 1950 and 1951, nest sites were generally limited to the shoreline

of the 5-acre pond, with most pairs attempting to establish territories on the shore adjacent to the upland rather than on the dike encompassing the pond. When brush islands were established in 1952, 19 of 32 nests were on these structures. Ten of 18 brush piles in the water and 9 of 20 on the shoreline were used. In succeeding years there was a gradual shift to the use of the brush islands in the water. Of 22 nests in 1956, 18 were on islands over water, two were on brush piles on the shore and two nests were on the upland. In 1957, brush islands were available only in the water and all were used. One other nest was on a shoreline pile and 7 were of natural material on the upland. The use of brush piles in this project increased the nesting potential and the nesting success, by reducing territorial strife. We made no attempts to use other types of nesting sites although a variety of structures have been tried in other projects.

The location of nests with respect to the distance from water ranged from 3 feet to 280 feet. Upland nest sites were often used year after year. In 1956 and 1957, the same pairs built nests 250 and 280 feet from the water. Three other nests located on the upland were 125, 140 and 150 from water. All three of these sites were used successfully for three consecutive seasons, presumably by the same pairs.

Nests averaged about 2 per acre for the entire penned area. When considering the tendency of pairs to select brush islands on the pond, nest densities for the 5 acres of water were greatest in 1956 when there were 3.6 nests per acre of water.

Spring flooding was an infrequent source of nest loss, but in 1956, five nests were destroyed by high water levels. Low temperatures in the early stages of nesting were an annual threat, but one which we did not adequately investigate. Its effect was detected in one year, 1957, when temperatures dropped to 15° F. on April 11. The two eggs in each of two late nests were frozen solid and cracked open. Neither of these nests were being incubated as the clutches apparently were not complete. Frozen eggs probably occurred in other years, too, as temperatures of 15-20° F. occurred almost every year during the early part of the nesting period. The effect would depend upon how many of the nests were in laying stages and not being incubated. During the entire course of our study, there were no instances observed of renesting attempts by geese, regardless of the cause of nest loss.

Clutch size in six years of data averaged 5.1 for 111 nests, with the range 2-8 eggs. Of the 111 nests, 72 percent produced one or more goslings. An examination of the clutch size in relation to the number of eggs hatching for 81 nests with individual egg histories shows that 16 nests (20%) did not hatch any eggs, and 17 nests (21%) hatched all the eggs. In total, 57 percent of the eggs hatched (Table 1).

Several cases of exceptionally long incubation were noted. In 1956, incubation of a nest with two eggs was started on April 4. The male remained on territory in defense of the nest until June 18. The female continued to incubate this nest until July 3, a total of 91 days. Both eggs proved to be infertile. In 1957, complete clutches of infertile eggs in two nests were incubated 59 and 61 days.

The number of goslings reared to flying age totaled 80 percent of the 311 eggs hatched. Although but a small fraction of the goslings lost to various causes were found dead in the pen, we considered that the largest portion of the losses were occurring during the first three weeks of life. One of the major causes of these losses appeared to be the tendency of more dominant pairs to acquire "gang broods." Brakhage (1965) referred to these as creches and reported that several pairs accompanied the goslings. We had no evidence that more than one pair possessed gang broods at Horicon Marsh. Normal movements of 20 or more pairs in the 11-acre enclosure eventually led to conflicts of pairs with broods. Conflicts occurred most frequently at the feeding hoppers, along the trails from shoreline to upland grazing sites and at favored shoreline loafing sites. When fighting occurred among

TABLE 1

Breeding and Production Data for the Horicon Marsh Project, 1950-57

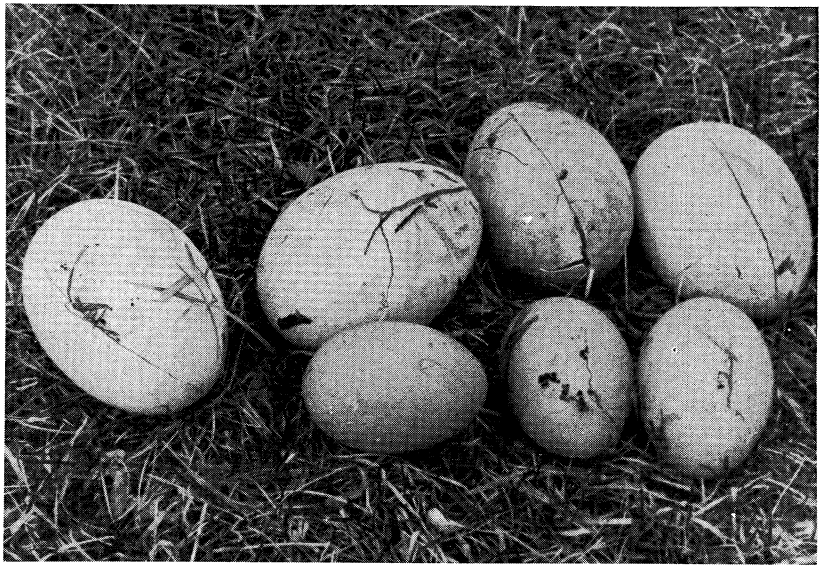
	Years								
	1950	1951	1952	1953	1954	1955	1956	1957	Totals
Breeders*									
Male	17	22	38	34	33	26	33	33	169
Female	10	15	34	26	22	25	22	31	137
Nests									
Number	6	13	23	—	—	25	22	22	111
Average clutch	4.7	4.6	5.8	—	—	4.8	5.2	5.2	5.1
Percent successful**	83	54	70	—	—	80	64	82	72
Eggs									
Number	28	60	132	—	—	114	81	130	545
Percent hatched	78	43	54	—	—	66	61	54	57
Percent infertile[1]	11	52	7	—	—	25	17	28	22
Percent dead at hatch	0	0	8	—	—	0	11	14	9
Percent destroyed	11	5	31	—	—	9	11	4	11
Goslings banded[2]	17	24	68	74	78	88(20)	52(34)	65(10)	466(64)

*Includes only those birds 3 years of age or older. Total does not include the adults for 1953 and 1954.

**Percent successful refers to the hatching of one or more eggs in each nest.

[1]Includes all losses due to infertility and early embryonic death.

[2]Figures in parentheses are number of goslings of free-flying geese which were chased into propagation pen. Not all these goslings were hatched outside of the pen and not all survived to be banded. However, there was no way to separate them from goslings produced by the flightless breeders.



Eggs from two Canada goose nests (2 eggs each) and one mallard nest were frozen solid on April 11, 1957 at Horicon Marsh when the temperature dropped to 15° F. Early nesting habits and temperatures in the 10-20° F. range during laying suggest that freezing could influence hatchability to a greater degree than detected in our studies.

the adults, the broods often joined together and the more dominant pair moved off with its own brood and some or all of the other broods. In some conflicts, aggressive ganders would occasionally strike and kill a small gosling. In one case, an entire brood of four goslings was killed by a gander with its own brood. It was when aggregate broods were formed by goslings in the younger age classes that we considered mortality to be high. Brood care, especially during cold and wet weather in spring, appeared poor in the large broods. The largest gang brood noted was one of 38 goslings being cared for by one pair of adults. Pairs with 10-12 young were fairly common each year.

Distribution and Mortality

The banding of Canada geese in restoration projects apparently has been a routine, though seldom evaluated, activity. Very low recovery rates may be the reason. Pirnie (1938) reported no recoveries beyond a few miles for 95 geese reared and banded at Kellogg Sanctuary, Michigan. Banding of 482 geese at Seney Refuge showed a 10 percent total recovery including records from nine states and Ontario, Canada (Johnson, 1947). Seney geese definitely established a migratory habit and homed back to the area for breeding. Brakhage (1962) reported that the Missouri population at Trimble did not fluctuate seasonally and that banding indicated hunting mortality was not a factor. In 12

years of banding there were only 3 distant recoveries (Brakhage, 1965). Migratory behavior and homing were indicated by the recovery of 13.9 percent of 443 adult and 9.2 percent of 143 immature game farm geese that established nesting colonies in New York (Benson and De Graff, 1963). Bednarik (pers. comm.) reported a very low band recovery rate for three goose rearing projects in Ohio; however, he suspected banded geese were being harvested locally in considerable numbers that were not reported. The Ohio goose flocks, which totaled about 8,000 birds in 1965, are essentially nonmigratory.

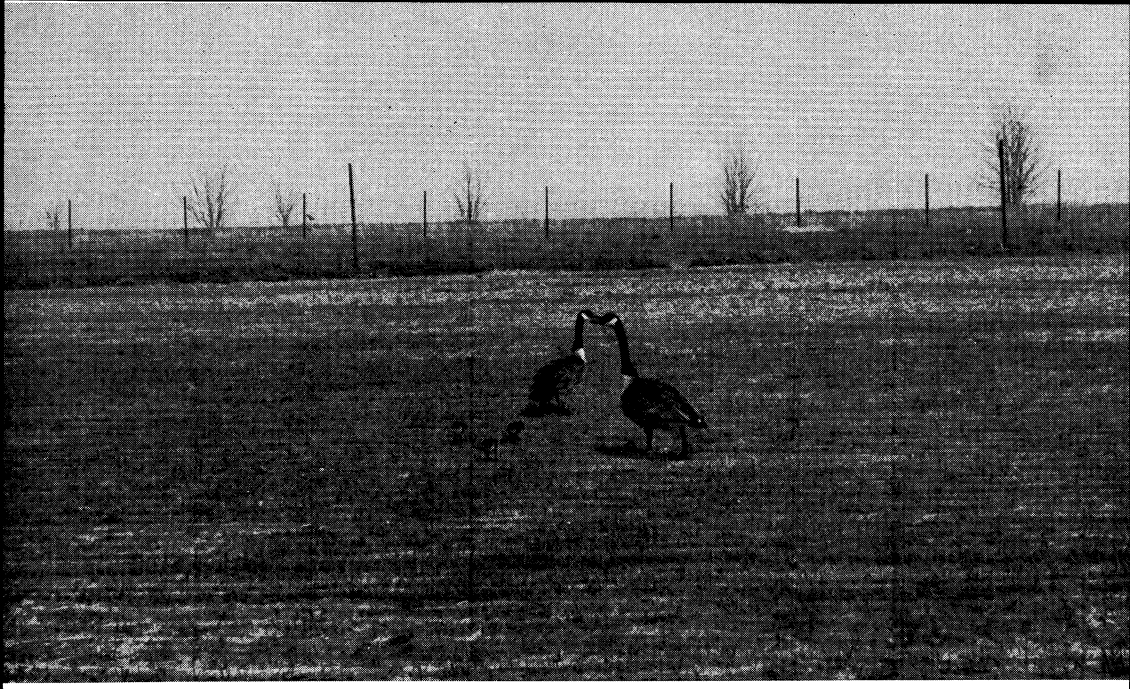
The most significant analysis of banding data for home-grown goose flocks is by Sherwood (1965) at Seney Refuge in the years 1962-65. Through the use of color-marked geese the mortality rate, migration routes and winter range of the local flock were established separately from information for northern migrants and nonbreeding geese from southern Michigan that molted at Seney.

At Horicon, a total of 466 Canada goose goslings were banded and released in the period 1950-57. Males comprised 52 percent of the birds. Band recoveries in the years 1950-65 totaled 136 (29%). Included were 113 shot by hunters, 19 found dead from various causes, and 4 trap-and-release records. No differences in total recovery occurred in males as compared to females. In males, however, the first-year recovery rate was 39 percent compared to only 14 percent for females.

Annual distribution of the 113 hunting season recoveries is shown in Table 2. Hunters reported taking 24 percent of the 466 geese reared at Horicon. Some of the 19 birds "found dead" were picked up in the breeding pen. Several of these were known to have been wounded by hunters before returning to the pen to die.

First-year recoveries totaled 30 percent, but varied widely from year to year. The low percentage (7%) for 1956 is a direct result of an intensive hand-feeding program in the pen that year. In both 1954 and 1955 one private holding of about 9 acres adjoining the breeding area refuge was used extensively as a fall feeding site by the local flocks. The kill appeared greater than desirable. In 1956, the hand-feeding of corn and small grain successfully reduced the flights to surrounding areas. This practice was not permitted in 1957 and the local kill again increased considerably.

Of interest are the 1957 kill records from the 9-acre site mentioned above. In that year the owner recorded 57 geese killed, of which 17 were banded birds from the restoration project. A check of the band recovery data showed that only 6 (35%) of these bands were reported. In 1957, a number of broods were being produced on the marsh area adjoining this shooting site. These birds, in our opinion, were a significant part of the 57 geese shot that year. In many cases, the hunters



An abundance of browse seems essential for goslings. At Horicon Marsh and Crex Meadows, a few acres of spring planted winter wheat provided this requirement. Other management techniques such as mowing and burning also proved successful in providing the green growth attractive to broods.

knew they were shooting birds of local origin, but it did not deter their hunting efforts. The study by Sherwood (1965) also points to a low reporting rate, in the 20-25 percent range. This is considerably lower than the estimated 50 percent rate generally considered to apply to Canada geese.

One other point related to band recoveries is the absence of reports for the years 1960-62 and 1964-65. In those years, there were still a few banded geese using the breeding pen for at least part of the year. Lack of recoveries probably reflects the short 8- to 11-day goose hunting seasons around Horicon Marsh. These short seasons resulted from rapid harvest of kill quotas assigned to the area as management of the *B. c. interior* geese in the Mississippi Valley population. In 1963, there were 3 recoveries in a goose hunting season that lasted 36 days.

The distribution of band reports for the Horicon project are shown in Figure 3. Of the 136 reports, only 11 (8%) have been in other states. Seven of these non-Wisconsin reports were first-year birds. Four were in later years. No out-of-state reports occurred before 1954 and only one after 1956. All of the southward reports occurred in December and January, after the Wisconsin waterfowl season closed and after final freeze-up forced migrant geese to leave the Horicon area. In 1954, 2 first-year recoveries occurred in northeastern Illinois only 30 miles apart, and 1 yearling bird was found dead of lead poisoning

TABLE 2

Recoveries of Canada Geese Banded as Goslings at the Horicon Marsh Project, 1950-65

Year Banded	Number Banded	Year and Number of Recoveries*												Totals	
		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960-1962	1963	No.	Percent
1950	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	24	0	0	1	0	1	0	0	0	0	0	0	0	2	8
1952	68			0	4	9	1	0	1	0	0	0	0	15	22
1953	74				0	12	1	1	1	0	0	0	1	16	22
1954	78					11	13	1	3	1	0	0	0	29	37
1955	88						8	4	5	0	1	0	0	18	21
1956	52							1	11	1	1	0	1	15	29
1957	65								14	3	0	0	1	18	28
Totals	466	0	0	1	4	33	23	7	35	5	2	0	3	113	24
First year recovery															
Number		0	0	0	0	11	8	1	14					34	
Percent		0	0	0	0	38	44	7	78					30	

*Includes only hunting season recoveries. No recoveries were reported in 1964-1965 although banded geese were annually present at Horicon.

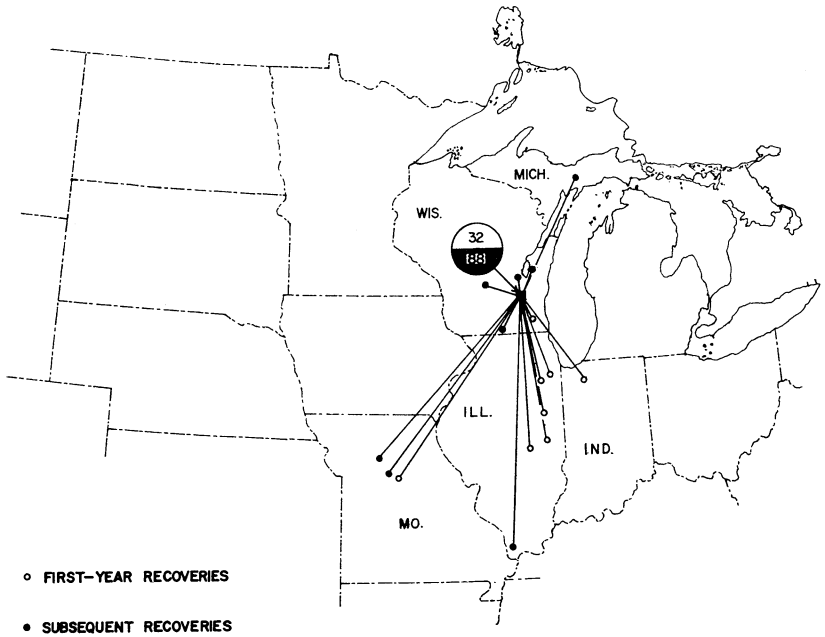


Figure 3. Band recoveries from the Horicon Marsh Project based on 466 geese banded from 1950-57 and 136 recovered in years 1950-64. (The 32 first-year and 88 subsequent recoveries in the large circle were within 10 miles of the banding site.)

near the Swan Lake National Refuge in Missouri. In 1955, 6 Horicon geese were shot: a Missouri hunter killed 2 birds on the same day, one a first-year bird and the other a yearling; an Illinois hunter killed 2 first-year birds on the same day; 1 first-year bird was taken at the Kankakee State Game Area in Indiana and 1 first-year bird was shot along the Illinois River in central Illinois. In 1956, one 2-year-old bird was shot at the Seney Refuge in Michigan. The only other report in another state was a bird trapped and released at Horseshoe Lake, Illinois in 1963.

For the 125 recoveries in Wisconsin, only 5 reports (4%) have been received of geese taken more than 10 miles from the banding site. These five include the following: 1954 — 1 yearling bird found dead at the Rock Prairie Goose Refuge (in February), the site of a wintering flock of *B. c. maxima;* 1955 — one 2-year-old bird trapped and released at the Fond du Lac City Park, and an immature bird trapped and released in Waukesha County in winter at a private game farm with captive Canadas; 1957 — one 2-year-old bird shot along Lake Winnebago about 40 miles northeast of Horicon; 1961 — one 6-year-old bird trapped and released in fall at the Necedah National Wildlife Refuge.

Local vulnerability of the pen-reared geese is further shown by the concentration of band recoveries on the 8,000-acre public shooting grounds near which the Horicon breeding project was located. The 120 recoveries listed for the Horicon area are presented as percentages occurring at various distances from the banding site in Figure 4. Hunters along the periphery of the 2,000-acre refuge around the breeding pen took 84 percent of the geese. Few of the free-flying geese were flying out more than 5 miles and if any feeding flights extended over 10 miles, band recoveries do not indicate their occurrence. Of the 19 recoveries occurring on the uplands away from the Marsh, only 2 were of first-year birds. This suggests that the young produced by the flightless adults were staying in the immediate area around the pen.

From a behavior standpoint, the geese banded in our study lacked some of the wariness of wild geese. Association with man in the breeding season and to a lesser extent during the other seasons suggested that the local band recoveries might be occurring during the very

Figure 4. Distribution of 120 band recoveries in the vicinity of the Horicon Marsh Project.

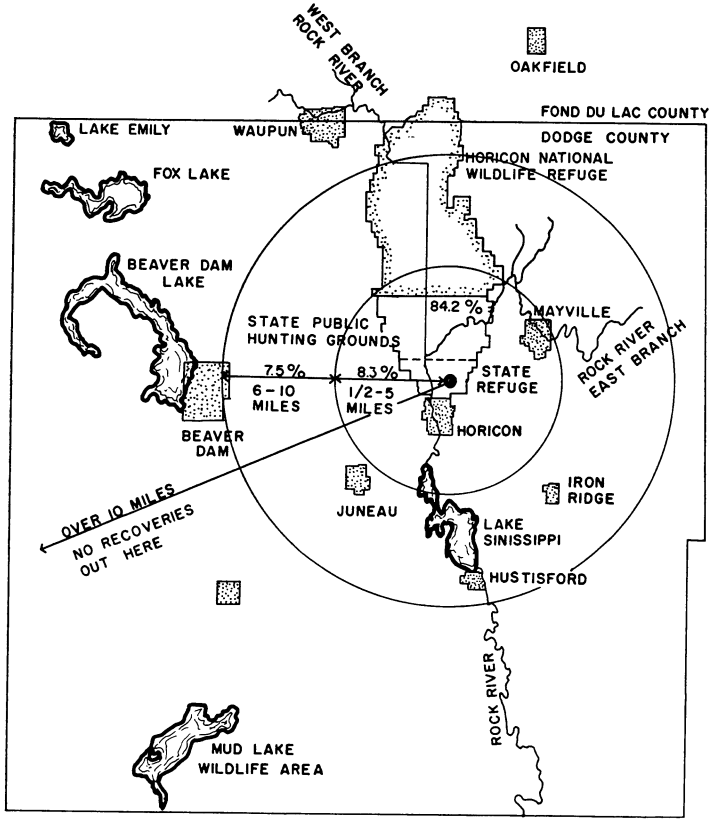


TABLE 3

Hunting Season Distribution of Band Recoveries by Weekly Intervals for Canada Geese from the Horicon Marsh Project, 1950-64

	Number Recovered	Percent of Recoveries by Weekly Intervals							
		1st*	2nd	3rd	4th	5th	6th	7th	8th
First year recoveries	23	39(13)	13	9	13	4	4	9	9
Subsequent recoveries	64	33(22)	14	19	11	6	4	11	2
Total recoveries	87	35(20)	14	16	12	6	4	10	3

*Figures in parentheses are the percentage of recoveries occurring on the first two days of the hunting seasons.

early part of the hunting season. Early season vulnerability of hand-reared mallards was clearly demonstrated at Horicon, with almost one-half of all recoveries occurring in the first two days of hunting (Hunt et al., 1958). Distribution of Canada goose recoveries was summarized for the first two days of hunting and then by 7-day intervals (Table 3). During the years when most recoveries occurred, the hunting season lasted 55 to 70 days. The data show about one-fifth of the kill occurring in the first two days and increasing to over one-third by the end of the first week of hunting. After that, some kill occurred throughout the season.

When banding goslings each year, a considerable number of free-flying geese banded in previous years were captured (Table 4). We cannot consider this homing, due to the fact that some geese stayed on the area all year, along with the flightless breeders. Yearlings were checked in significant numbers each year. Sherwood (1965) found that yearling Canada geese from southern Michigan migrated north to Seney Refuge to molt. He also found that yearling geese at Seney, which returned north with their parents, were driven off during nesting and rejoined their parents' new family after the molt. We have

TABLE 4

Canada Geese Recaptured During Annual Summer Inventories at Horicon Marsh Project, 1950-57*

Year Banded	Number Banded	Year of Inventory and Percent Recaptured						
		1951	1952	1953	1954	1955	1956	1957
1950	17	71	47	24	24	18	18	0
1951	24		33	4	4	0	0	0
1952	68			66	38	9	6	4
1953	74				55	12	10	4
1954	78					56	14	9
1955	88						35	18
1956	52							40

*Recaptures occurred in July when geese were flightless due to molt. Band numbers were read and birds released.

no evidence that yearling geese from Horicon migrated to other areas during the summer. Other older geese inventoried in the pen bred there, returned to molt, or had been driven into the pens with their broods which had been reared in surrounding areas. Although a considerable number of banded birds were handled it was not possible to assess total annual mortality because of the many free-flying geese that were not captured. In any event, there is a strong attachment to the place of origin.

Annual winter inventory figures also show trends in survival (Table 5). The small number of out-of-state band recoveries suggests the lack of significant migration in the period of years when wintering conditions were maintained for the breeders. A few wild geese probably were staying too, but we considered their number insignificant. After 1957, open water was not maintained deliberately because the breeding flock had been removed. Numbers of geese present in the area after 1957 fluctuated to some extent with the severity of the weather, but they have gradually disappeared from the breeding area. In several years, a few thousand migrant geese *B. c. interior* have wintered on the Horicon Refuge and at Fox Lake. Some of the local geese could have been with these concentrations.

TABLE 5

Winter Inventory of Free-Flying Canada Geese at the Horicon Marsh Project*

	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
No. Geese	120	157	120	250	75	11	31	74	0	26	0	0

*Excludes known flightless adult breeders. Open water was not maintained after 1957.

Relation to Wild Canada Geese at Horicon Marsh

The wild Canada goose population (primarily *B. c. interior)* on Horicon Marsh in fall rose from about 12,000 in 1949 to 100,000 by 1961 (Hunt et al., 1962). Most of these birds use the 20,796-acre federal refuge portion of the Marsh. In the years 1950-52, we banded a total of 1,147 Canada geese on the federal refuge. All of the banding occurred during the hunting season period of October-December. A summary of the recovery data is shown in Table 6, and locations of recovery are shown in Figures 5 and 6.

In comparison to the pen-reared birds, wild geese had a higher first year recovery rate and a higher total recovery rate. Other points to note in wild geese are (1) the wide distribution of recoveries, (2) the large portion recovered in Ontario, and (3) the important segments recovered in Illinois and Missouri. The Ontario recoveries are largely from the breeding range and the Illinois recoveries from the

TABLE 6

Distribution of Band Recoveries of Wild Canada Geese Banded at Horicon Marsh 1950-52 and Recovered in the Years 1950-64

Location of Recovery	Recoveries					
	First Year		Subsequent Years		Totals*	
	No.	Percent	No.	Percent	No.	Percent
Manitoba	1	1	0	0	1	T
Ontario	16	10	37	14	53	13
Quebec	0	0	1	T	1	T
South Dakota	0	0	2	1	2	T
Wisconsin	86	57	103	38	189	45
Michigan	0	0	16	6	16	4
Illinois	27	18	70	26	97	23
Indiana	4	3	4	2	8	2
Ohio	0	0	2	1	2	T
Missouri	9	5	18	7	27	6
Kentucky	4	3	5	2	9	2
Arkansas	1	1	2	1	3	T
Tennessee	2	1	2	1	4	1
Mississippi	0	0	3	1	3	T
Louisiana	0	0	1	T	1	T
Alabama	1	1	0	0	1	T
Texas	0	0	1	1	1	T
Virginia	0	0	1	T	1	T
New York	0	0	1	T	1	T
Totals	151	36	271	64	422	36**

*T = Trace.
**Based on banding of 1,147 geese, presumably *B.c. interior.*

heart of the winter range of the Mississippi Valley Canada goose population.

Despite the presence of large concentrations of wild Canada geese at Horicon Marsh, the pen-reared birds did not develop similar migration and distribution patterns. Only one of the goslings reared at Horicon was reported from the main winter range in Illinois. There is no indication of migration to the breeding range in Ontario. In none of the years of the project was there a band recovery from the heavily hunted periphery of the federal refuge at Horicon or any observations of flight patterns to the area. The fact that the pen-reared geese were primarily *B. c. maxima* indicates they do not normally mix with other races. Migrant Canadas leaving Horicon Marsh in fall follow the Rock River drainage into Illinois (Fig. 6). The few first-year recoveries from the pen-reared geese suggest a southeastward orientation down the Fox River draining through the lake regions of northeast Illinois.

Local Breeding at Horicon Marsh

The major objective of the Horicon project was to establish free-flying local breeders on the Marsh. To this end, limited success was achieved. The first brood in the wild from free-flying geese was located on a muskrat house in 1952. Annual censuses showed production of

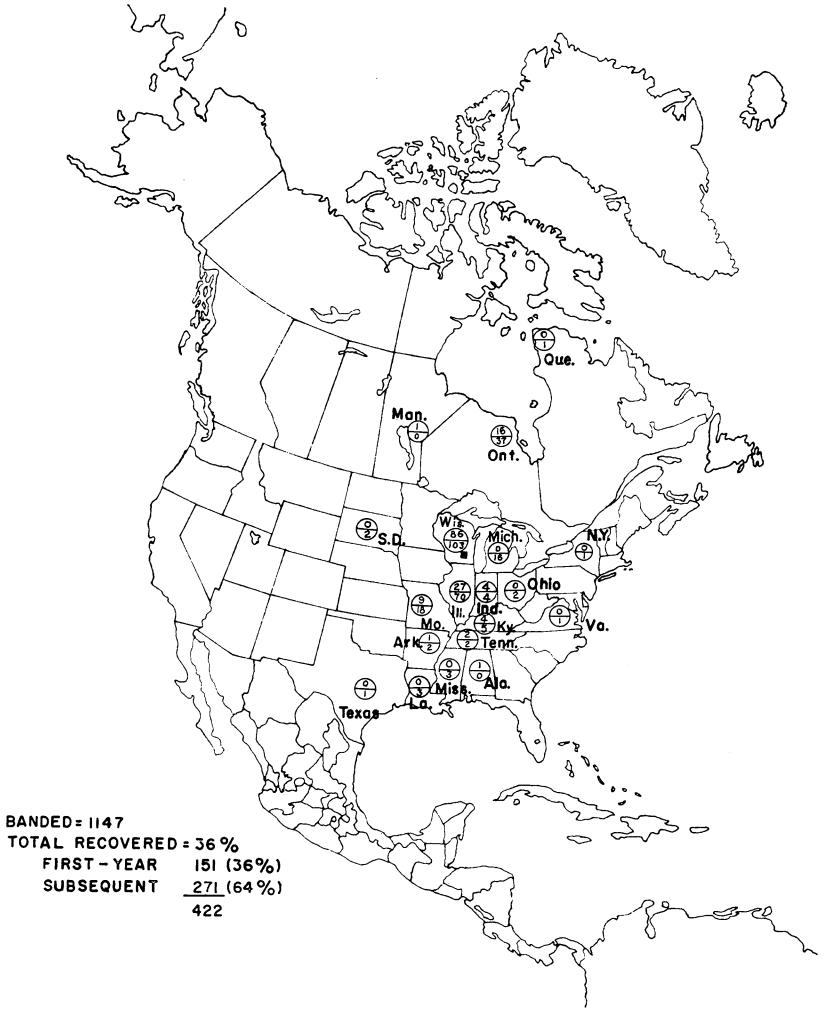


Figure 5. Distribution of band recoveries from wild Canada geese banded at Horicon National Wildlife Refuge during 1950-52 and recovered during 1950-64. (Upper figure in circle shows first year recoveries; lower figure, subsequent recoveries.)

30 to 45 goslings in the area during most years when the breeding flock was maintained. After removal of the breeding flock in 1957, local production gradually decreased (Table 7).

No banding of free-flying geese that bred or remained in the area was attempted. Some of the nonbreeders and a few pairs that raise young on the Marsh generally return to the breeding pen each summer. Local hunting mortality still appears to be the main factor limiting the number of breeding pairs. However, there appears to be enough production to maintain a small population. In the spring of

1965, there were at least 4 nesting pairs and 17 nonbreeding adults in the vicinity of the old propagation pen. In early August 1965 a crop damage complaint near Horicon involved about 60 geese. These birds were undoubtedly the bulk of the local flock.

Other Aspects of the Breeding Flock

In the years when the breeding flock was maintained at Horicon, it decoyed a few hundred migrant geese into the 2,000-acre refuge each fall. In 1956, a peak of 6,000 geese used the area for a week. Since the transfer of the breeders in 1957, few migrants were present in the hunting season. Some of the early fall migrants stopped each year before they became oriented to the federal refuge area. Several hundred geese also were present each spring, apparently attracted to the area by the local breeders.

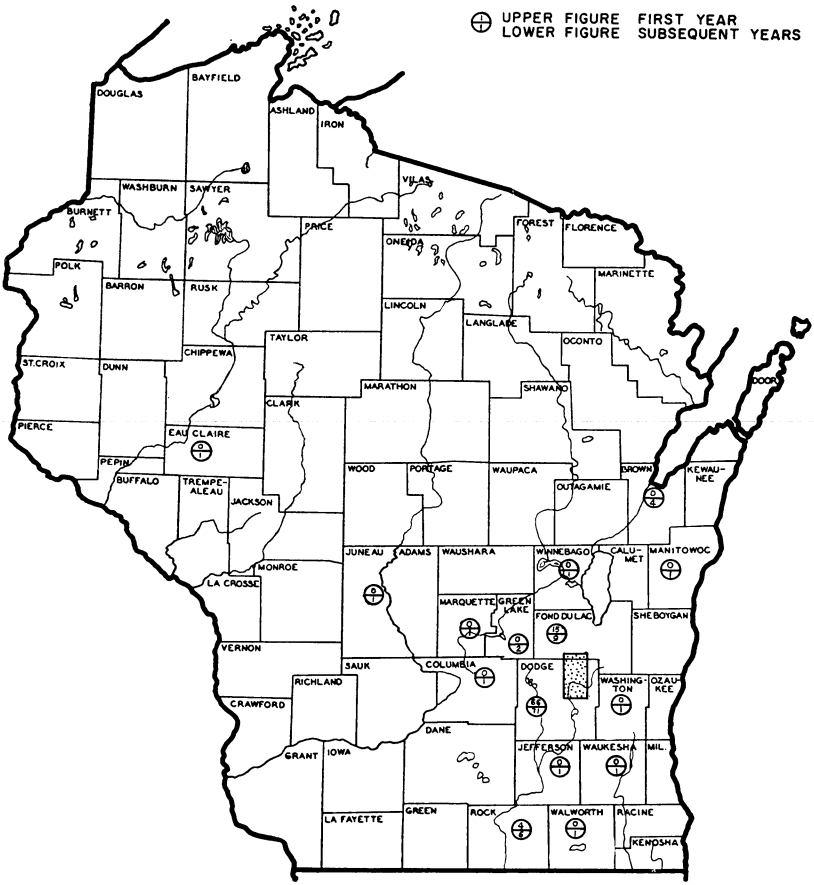


Figure 6. Distribution of 189 band recoveries in Wisconsin from 1,147 wild Canada geese banded at Horicon National Wildlife Refuge during 1950-52 and recovered 1950-64.

TABLE 7

Local Production from Free-Flying Canada Geese in the Vicinity of Horicon Marsh Project, 1952-65*

Year	Nonbreeders	Breeding Pairs	Total Broods**	Brood Sizes[1]								Total Young[1]
				1	2	3	4	5	6	7	8	
1952	?	1	1						1			6
1953	32	11	11		1	2	3	3				35+
1954	24	15	11			3	6	1		1		45
1955	22	8	8(4)		3	1	1	1	2			30(20)
1956	36	11	11(8)	1	1	1	2	4	2			46(34)
1957	18	6	6(2)				1	3	1		1	33(10)
1958[2]	40	12	12	2	1	2	2	4	1			44
1959	14	8	8			1	1	2	4			41
1960	29	6	6				2	1	2	1		32
1961	16	4	4				2		1	1		21
1962	20	5	5			1		2	1	1		25
1963	32	4	4				3		1			18
1964	32	3	2	1		1						4

*Local area is limited to Dodge County.

**Figures in parentheses are the number of broods and young that were brought to the propagation pen by free-flying adults.

[1]Only complete brood counts of 6-7 week old goslings.

[2]In July 1957, the breeding flock was transferred to other projects. A total of 138 free-flying geese reared in the project were inventoried and released at that time.

As a public relations tool, the goose restoration project attracted only minor attention. Local hunters, of course, followed late-summer feeding flights with considerable diligence. Primary interest of local people centered on the expanding migrant goose populations at the Horicon National Wildlife Refuge. Hunting interests that developed around the federal refuge carried over to increased hunting pressure on the local flock. By the late 1950's, the relative ease with which geese could be harvested in the Horicon area removed the Canada goose from the trophy class of game. The magnitude of public interest in hunting and viewing the fall goose concentrations at Horicon have been described by Keith (1964). Aesthetic values of a few locally reared birds cannot match the public interest in 100,000 migrant Canada geese parading within a stone's throw of thousands of viewers along the roads in the federal refuge.

CREX MEADOWS PROJECT

The success in rearing Canada geese at Horicon Marsh and the spread of free-flying nesting pairs to the surrounding marshes after the first few years suggested that similar projects on other state-owned areas were desirable. The Crex Meadows Wildlife Area (Fig. 7) in northwestern Wisconsin (Burnett County) was considered the best

site for further restoration attempts. The early history of the Crex Meadows revealed that Canada geese nested there at the time of settlement in the late 1800's (Wis. Conservation Dept., 1959) and that nesting continued some time after 1900. Early waterfowl records compiled by N. R. Stone (pers. comm.) reveal that 20-25 pairs nested on Munson Lake in the period 1905-11. He also had note of a brood on Forman Lake in about 1938.

Crex Meadows history is typical of other large marshes acquired by state and federal agencies for waterfowl management areas — early but unsuccessful drainage atempts, farming and other agricultural failures, uncontrolled fires and eventual reversion back to the

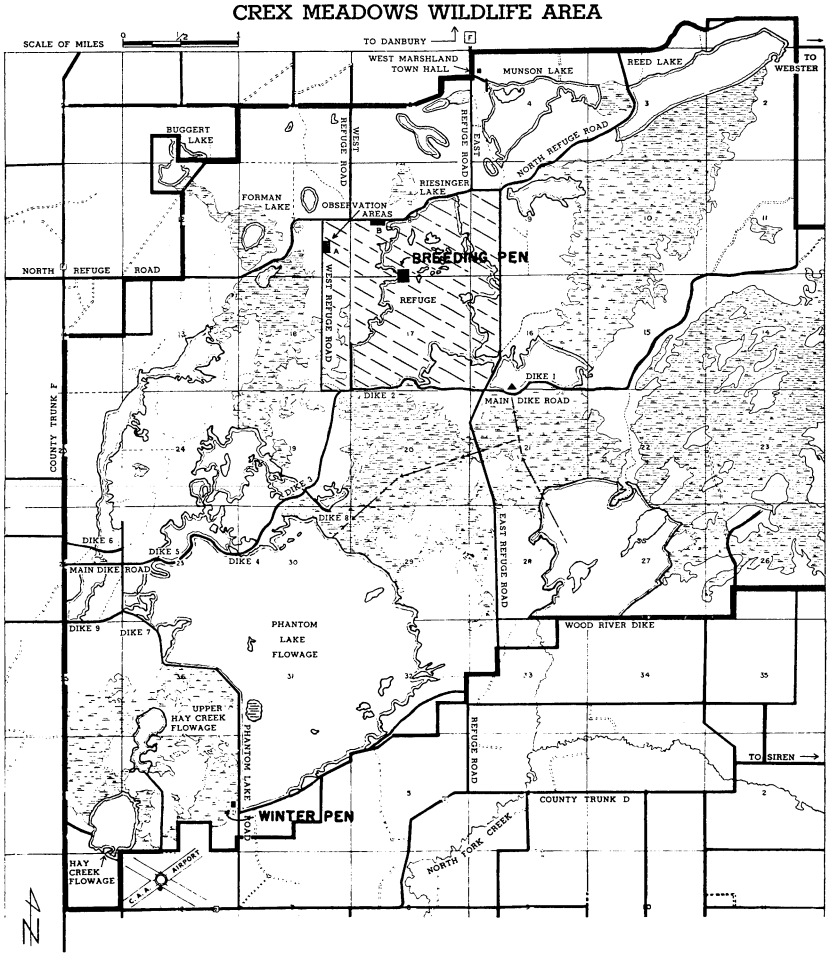


Figure 7. Map of Crex Meadows Wildlife Area showing location of breeding pen and winter pen.

wild state. From about 1912 to the early 1930's, the Crex Carpet Company successfully harvested wire grass for carpets. Due to changing markets and plant succession, this activity also failed. In 1940 most of the marshlands were tax delinquent. State acquisition and restoration were started in 1945. By 1957 over 20,000 of the 25,000-acre goal had been restored to productive wetland and wildlife habitat.

The two objectives in establishing a captive Canada goose flock were (1) to re-establish a local breeding tradition, and (2) to have a decoy flock on the ground to attract migrant geese. Some hunting opportunities were visualized, but the remoteness of the area suggested gradual development of hunting and other recreational activities.

In June, 1952, four pairs of adults and their 21 young were purchased from a private game breeder and released on Phantom Lake Flowage. Observations indicated good survival throughout the summer. No refuge area was available at that time in the release area. Six of the young were shot the first two days of hunting in 1952 and one other immature later in the season. In subsequent years only one bird was captured (in 1957) with its brood near the Crex goose breeding pen. This bird was killed a year later by a great-horned owl in the Crex pen. A brood produced on Crex in 1956 probably was also from geese stocked in 1952. No other band recoveries from this release were reported. The whereabouts of the released geese between 1952 and 1956 is unknown. They apparently were not on Crex, as Conservation Department personnel would have noted them in those years. The brood captured in 1957 was banded and these birds were recovered in inventories in later years. They apparently nested on the area in later years.

A breeding flock of 28 adult males and 24 females from the Horicon project was placed in a 6-acre pen in the late summer of 1957. Two acres of natural water were increased by ditching to create nesting islands in the pen. The severe winter weather conditions prohibited keeping the birds in the breeding pen, so a 2-acre sheltered winter pen was constructed on a seepage drain from the Phantom Lake pool. Additions to the breeding flock included 13 adults from a private game breeder in 1958, and 26 hunting season cripples from Horicon in 1961. Feeding and routine care were similar to Horicon techniques. Birds occupied the breeding pen from April 1 to freeze-up in November, when they were transferred to the winter pen (Fig. 7). Goslings were banded in July and released as free-flyers. While none of the young geese produced annually were deliberately held overwinter, a few remained with the breeders in the winter pen in 1958. Young of the year

Crex Meadows winter pen where flightless breeders were maintained. Note the geese sitting on top of the wire. These are probably young geese which are attempting to remain with their parents. Final freeze-up and severe winter weather eventually forced the free-flying geese to leave the area. (Photo courtesy N. R. Stone)

were forced to migrate by freeze-up and removal of breeders to winter quarters.

In the general area of the breeding pen, row crops of corn, buckwheat and fall-sown grain were grown on 300 acres to attract fall migrant waterfowl. A 1,600-acre refuge was maintained around the breeding pen. In addition, hunting of all species of geese was prohibited in the entire western half of Burnett County since 1957 to protect and encourage the spread of the local breeding flock.

Breeding and Production

Results of seven years of nesting activity from the captive flock at Crex Meadows are summarized in Table 8. Nesting densities were from 2 to 3 nests per acre in the pen. The average clutch size of 4.5 was somewhat lower than the 5.1 for the flock when it was at Horicon

Every year at Crex Meadows, several days of low temperatures, in the 10-20° F. range, occurred during the first half of April, the period when nesting started. Despite these low temperatures, hatching success was 68 percent. Records for 1961 show a definite influence of cold and snow in causing abandonment in 6 nests, but in other years no effects were noted. The remoteness of the breeding pen prevented detailed observations.

TABLE 8

Breeding and Production Data for the Crex Meadows Project, 1958-64*

Years	Number Nests	Average Clutch	Percent Successful	Number Eggs	Percent Hatched	Average Brood Size**	Number Goslings Banded[1]
1958	12	5.3	67	64	61	4.8	27
1959	12	4.6	75	55	82	5.0	31
1960	13	4.5	77	59	63	3.7	34
1961	19	3.8	53	72	53	3.8	19
1962[2]	—	—	—	—	—	—	46
1963	18	4.3	89	78	87	4.3	43
1964	13	4.8	69	62	63	4.3	20
Totals	87	4.5	71	390	68	4.3	220

*Data from flightless adults held in 6-acre pen.
**Based on complete brood counts.
[1]Goslings were banded and released as free-flyers.
[2]Breeding records not available.

One other significant factor concerning production was the frequent loss of goslings to great-horned owls. This predator was very common in the extensive wild habitat around the breeding pen. During the fall months, golden eagles passing through the area were responsible for an occasional kill of both first-year birds and flightless breeders.

Distribution and Mortality

The absence of goose hunting at Crex Meadows was evident in examining band recoveries from the 117 males and 103 females banded in the period 1958-64. A total of only 36 band reports (16%) were received (Fig. 8). Only 21 recoveries were from birds shot by hunters (Table 9). Of the 21, 4 were in the first year — 1 in southeastern Ontario, 1 in Maryland, and 2 in northeastern Illinois. Of the 17 recoveries in later years, 10 have been in Illinois, 2 in Wisconsin, 2 in Minnesota, and 1 each in Kentucky, Iowa and Tennessee. Two of the

TABLE 9

Band Recoveries from Canada Geese Banded as Goslings at the Crex Meadows Project, 1958-64

Year	Number Banded	Year and Number Recovered*							Total	
		1958	1959	1960	1961	1962	1963	1964	No.	Percent
1958	27	0	1	0	2[1]	1	0	1	5	18
1959	31		1	0**	1(2)	0(1)	0	0	2	6
1960	34			0	3(2)	1	1(1)	1	6	18
1961	19				0(3)	0	0[2]	2	2	11
1962	46					1	2(1)	1	4	9
1963	43						1(2)	1	2	5
1964	20							0	0	
Totals	220	0	2	0	6	3	4	6	21	10

*Figures in parentheses are additional birds found dead at Crex Meadows where no goose hunting is permitted.
**One bird found dead of unknown cause at Dryden, Ontario, Canada on June 12, 1960.
[1]One additional bird found dead at Barrington, Illinois area, December 9, 1960.
[2]One bird was trapped and released at Horseshoe Lake, Illinois, January 30, 1963.

Nesting islands were constructed at Crex Meadows. Two logs laid in a V-shape with an opened bale of hay in-between served as a nest site. Only one pair occupied each island. Flooding was a problem in one year. An electric fence kept ground predators from entering the pen but horned owls were a constant threat.

Illinois recoveries and the Kentucky recovery were from the main winter range of the Mississippi Valley population of *B. c. interior* at Horseshoe Lake, Illinois (Hanson and Smith, 1950). The cluster of 4 subsequent recoveries in mid-Illinois were on the same date and at the same site in 1961. In the group of hunting season recoveries, 15 were females and 6 were males. For the 15 band reports from sources other than hunters, 14 have been found dead (12 were at Crex) and 1 bird was trapped and released at Horseshoe Lake, Illinois. Twelve of the nonhunting reports were of males.

When fall migrant geese are observed passing through the Crex Meadows area or depart from there, they appear headed in a south-southwest direction toward the Swan Lake Refuge in Missouri where the Eastern Prairie Population concentrates (Hanson and Smith, 1950). Limited band recovery information from migrant Canadas at Crex Meadows also support use of the area by the Swan Lake flock. However, band recoveries from geese reared at Crex suggest a migration down the St. Croix and Mississippi River valleys. First-year recoveries in southeastern Ontario and Maryland suggest wide wanderings for young Canada geese.

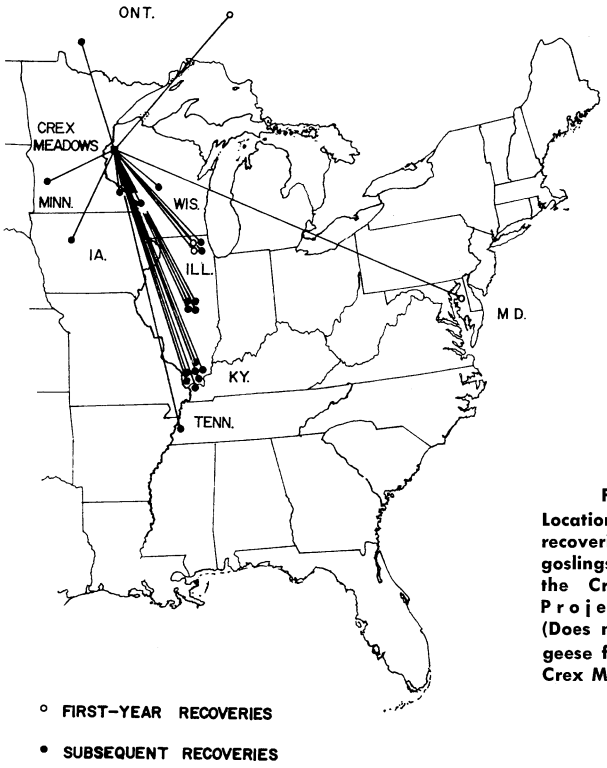


Figure 8.
Location of 24 band recoveries from 220 goslings banded at the Crex Meadows Project, 1950-64. (Does not include 12 geese found dead at Crex Meadows.)

A point of some interest is that 4 birds reared and banded in the Crex pen were shot in the vicinity of the Bright Land Farms at Barrington, Illinois. Many of the original breeders used at Horicon and later transferred to Crex were obtained there. Apparently some of the breeders escaped and migrated with their young or other Crex geese to their original home.

During the banding of goslings, some of the birds reared in previous years are usually captured in the breeding pen (Table 10). The proportion of such recaptures was lower at Crex than at Horicon. The pen, however, is only 6 acres in size and more territorial strife and aggressive behavior occur. Other banded birds are present in summer but they remain outside the pen. Some banded pairs return to the pen area with their broods as at Horicon, but they retreat to the marsh when disturbed and hence cannot be chased into the pen.

Establishing a Local Breeding Tradition

A summary of observations of free-flying Canada geese on the entire Crex Meadows project is presented in Table 11. The number of nonbreeding adults has shown a slow rise but indicates good survival.

TABLE 10

Canada Geese Recaptured in Annual July Inventories at Crex Meadows Project, 1958-63*

Year Banded	Number Banded	Year of Inventory and Percent Recaptured					
		1959	1960	1961	1962	1963	1964
1958	27	44	4	8	4	4	4**
1959	31		19	16	3	6	6**
1960	34			18	0	18	6
1961	19				21	10	0
1962	46					11	0
1963	43						2

*These geese were reared in a 6-acre pen, banded and released as free-flying immatures. They were forced to migrate at freeze-up time when the adult breeders were transferred to a winter pen about 7 miles away. Recapture occurred inside the breeding pen which was surrounded by an 8-foot high woven-wire fence.

**One individual from 1958 and 1959 was inventoried each year.

Brood records show breeding success in both 1956 and 1957, before the captive flock was established. The broods in each of those years probably were produced by some of the semi-domestic geese released there in 1952. In view of the fact that 6 broods were observed in 1960 and that 1958 was the first year of production, some of the 1958 stock must have nested at 2 years of age. Since then there has been a gradual increase in production and broods are now a common sight in summer. Indications of a spreading out of pairs is shown by the sighting in 1962 of 2 broods on Fish Lake which lies about 5 miles south of Crex Meadows.

An objective for the captive flock at Crex Meadows was to decoy migrant waterfowl to the area. This aspect has met with good success

TABLE 11

Local Production from Free-Flying Canada Geese at Crex Meadows Project, 1956-64*

Year	Number of Nonbreeders	Breeding Pairs	Total Broods	Brood Size**							Total Young
				1	2	3	4	5	6	7	
1956[1]	?	1	1				1				4
1957[1]	?	1	1						1		6
1958[2]	8	0	0								0
1959	45	0	0								0
1960	35	6	6		1	2	1	2			22
1961	40	9	9			1	1	3	2	2	48
1962	45	11	11			1	3	4	1	2	55
1963	54	17	17		2	3	4	4	3	1	74
1964	50	25	10[3]			3		2	3	2	51

*Local production limited to records in Burnett County.

**Only complete brood counts are included. Average of 4.6 goslings per brood in years 1960-64.

[1]Broods in 1956 and 1957 apparently were produced from survivors of a release of 29 geese on the area in 1952.

[2]First year of breeding by captive flock transferred from Horicon Marsh project.

[3]Brood counts limited to Crex Project in 1964 although nesting pairs were present on nearby marshes.

although it is impossible to separate attraction effect of the refuge from the food program for waterfowl. Several thousand ducks and geese use the refuge each fall. The ducks are largely mallards and the geese include blues and snows as well as Canadas.

A pleasing surprise has been the increasing public interest in the Crex Meadows goose flock in both summer and fall. The fact that local sportsmen have been willing to forego goose hunting for 9 years to permit the breeding flock to become established speaks for itself.

POWELL MARSH PROJECT

Powel Marsh lies in northern Wisconsin on the western edge of Vilas County (Fig. 9). An extensive marshy area of about 12,800 acres, it contains Little Trout Lake (991 acres) and several other small lakes (Vogl, 1964). Part of the area on the south is in the Lac du Flambeau Indian Reservation. Almost entirely wild land except for recent cranberry development along the north edge, the area was subject to repeated, uncontrolled fires and served no particular interests or purposes. Following some of the early fall fires, thousands of geese, largely blues and snows, stopped in migration to feed on the resprouting sedges and other marshy plants. The spectacular but accidental concentrations of geese prompted game managers to consider deliberate manipulation of the habitat to attract birds every year. In developing a program for the area in 1957, plans were made to establish a captive Canada goose flock.

The success of the Seney Refuge breeding flock in nearby upper Michigan suggested that breeding efforts be given important consideration at Powell Marsh, even though no evidence indicated nesting by geese in earlier years. A second objective was to have live geese on the Marsh to decoy migrant geese to the area. Local hunters were expected to benefit primarily from the attraction of migrants.

A 7-acre breeding pen, about one-third of which was water, was completed in the summer of 1957. In July of that year 27 adult Canada geese (11 males and 16 females) from the Horicon flock were transferred to Powell. All of the breeders *(B. c. maxima)* were stock originating at Bright Land Farms in Illinois. In late September, 16 more adults were received from the Illinois source and in November 6 adults from a private breeder at La Crosse, Wisconsin were added. Severe winter weather conditions and a lack of suitable facilities forced the transfer of the geese to the Poynette State Game Farm (Columbia County) in the southern part of the state. They were transferred back to Powell in early March. An additional 100 geese were added to the flock, bringing the total to 151. Most of these additional

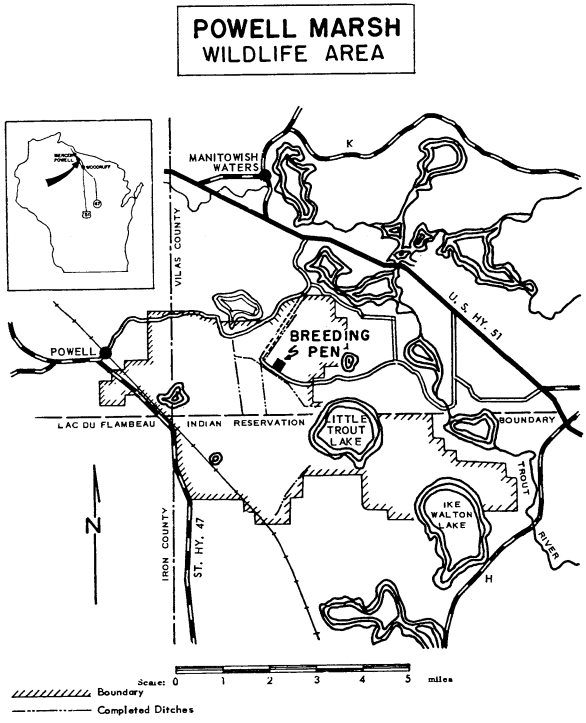


Figure 9. Map of Powell Marsh Wildlife Area showing location of goose breeding pens.

geese were hunting season cripples, probably *B. c. interior*, from Horicon. In mid-July of 1958, 26 geese escaped from the breeding pen. These birds were not recaptured, but many completed the molt and became free-flyers. Annual transfers of the breeders to Poynette in winter occurred through 1962. From 100 to 150 birds have been in the flock each year. The breeding flock was maintained in a 14,000-acre refuge from 1957-60. Gradual reductions in refuge area occurred through 1962 until about 7,000 acres remained. About 300 acres in the refuge were planted with buckwheat and rye, and 1,000 acres were burned each fall for green browse for geese. The captive flock was removed after the 1963 season. Other techniques were similar to those used at Crex Meadows.

For all practical purposes breeding and production were a complete failure under penned conditions at Powell Marsh. Each year, two or three nests were built and goslings hatched, but none ever survived to banding age. An occasional nest of infertile eggs also was found. Conditions apparently were too crowded for successful ground nesting. We are not sure whether the transfer in spring upset nesting; in most years the birds were moved in early March before breeding behavior developed at Poynette.

Powell Marsh Canada goose rearing pen. Space for successful nesting and brood rearing was too limited for the number of geese (150) maintained in the pen. (Photo courtesy D. K. Tyler)

Some local production, however, was established on Powell Marsh. Apparently the broods produced were from the adults that escaped in the summer of 1958. Two to three broods totaling 10-12 young were seen anually. In 1963, 3 broods (of 4, 3, and 1 young) were reared by free-flying adults and a brood of 4 was observed in 1964.

The success of the captive flock in decoying migrants has been difficult to establish. Some success was evident in attracting the first few hundred geese to the area. After that, the wild geese on the ground served as effectively in decoying other geese. The use of an electric record player to emit goose calls was also used at Powell. Observations suggest that this device was helpful on some occasions when the captive flock was inactive. In most years peak numbers of Canada geese were at the 1,500-2,000 level, but in some years reached 5,000. Several thousand blue and snow geese were present each year, and in 1958 they peaked at 20,000. Here again it is difficult to separate the effect of protection of the refuge from the influence of the food program on the geese.

OTHER RESTORATION ATTEMPTS BY THE WISCONSIN CONSERVATION DEPARTMENT

Vilas County Project

In the fall of 1950, a sportsmen's group in Vilas County received assistance from the Conservation Department in setting up a small breeding flock of Canada geese at Boulder Junction. A breeding pen (60 x 150 yards) was constructed around a former fish rearing pond and adjacent marshy area. An adult breeding flock of 10 pairs, probably *B. c. maxima,* from a private game farm and the Poynette Game Farm was held overwinter on the area. In the spring of 1951, 8 nests were found containing 46 eggs. Only 12 eggs were hatched from 3 nests, and 5 goslings were successfully reared. Nest failures were blamed on 3 days of constant harassment of nesting pairs by bald eagles which nest in the area. Great-horned owls were reported to have taken some of the goslings. All the young geese were banded and released as free-flyers. They remained overwinter with the adults.

During the fall of 1951, migrant Canada geese were attracted to the pen area. Flocks seldom stayed longer than a few days, and at most 100 wild birds were present.

In the winter of 1951-52, 2 adult birds were found dead in the pen. Autopsy showed 1 bird to have avian tuberculosis and the other a fowl paratyphoid of the *Salmonella* bacteria group. Later in the spring, another bird died of a *Salmonella* infection. Tuberculin tests in the summer were positive on 3 other adults. Breeding success in the 1952 season was again very poor; only 2 nests hatched. These 2 broods, of 5 and 6 goslings, were reared, banded and released as free-flyers.

The finding of tuberculosis in the breeding flock was considered to be too great a risk to continue the flock at the pen site. Spread of the disease to other birds in the flock and the possibility of contaminating the wild geese that used the area resulted in termination of breeding efforts in the fall of 1952. There were 16 geese remaining on the area at that time and these were donated to a private game breeder in the area. Confinement in new quarters and subsequent testing failed to turn up additional sick geese. These geese formed the nucleus of a small local breeding flock maintained under federal permit. No band recoveries occurred from the 16 goslings reared in 1951 and 1952.

Rainbow Flowage Release

Another attempt to establish breeding geese in northern Wisconsin was made with the release of 51 young geese on the Rainbow Flow-

age (Oneida County) in June, 1952. These birds, probably *B. c. maxima*, were purchased from a private game breeder in Rock County. Rainbow Flowage is a 2,099-acre water reservoir subject to periodic draw-down for electrical power purposes. Game managers considered the area suitable for nesting and as a refuge for attracting fall migrant geese.

In the first two months after release, the geese remained on Rainbow Flowage in the general area of release. About mid-August, when the flock was flying, it moved about 8 miles to another lake and caused some unfavorable public reaction by grazing on cottage lawns. Attempts were made to scare the geese (by shooting) but this failed. Recapture of the flock was attempted and 19 birds were recovered. These were donated to the private permittee who received the breeding flock from Vilas County.

A number of band recoveries were obtained from the Rainbow Flowage release. In September 1952, 6 of the geese were found dead on the flowage. An autopsy revealed the cause to be goose influenza. One bird was found dead on the flowage in the winter following release, and 2 birds were trapped and released in farmyards the same winter, one at Clinton, Iowa, and one just south of Horicon Marsh. Some birds apparently survived and returned to the release area for 6 geese were observed on the flowage in the summer of 1953. No broods were produced and no other band records have been received in later years.

Oconto and Iron County Releases

A release of a semi-domestic pair of geese and their brood of 6, probably *B. c. maxima*, was made on Hay Creek Marsh in Oconto County in June 1952. The birds were observed regularly during the summer and 2 were recovered during the early part of the hunting season in the general area of release. No subsequent information has been received nor were geese observed in the release area in other years.

A release of hunting season cripples (6 adults and 8 immatures) from the 1952 season at Horicon was made in April 1953 on a marsh in Iron County. No band recoveries were received, although these geese were noted as in good condition and flying about in the late summer of 1953.

RESTORATION ATTEMPTS AT HORICON NATIONAL WILDLIFE REFUGE

Limited Canada goose restoration attempts have been made on the 20,796-acre Horicon National Wildlife Refuge which occupies the northern two-thirds of the Horicon Marsh. In the spring of 1950, 39 crippled geese (of unknown sex and age) from the 1949 hunting season at Horicon were pinioned, because of serious injuries, or wing-clipped and released on the marsh. No nesting was indicated as these geese remained in one large group. One bird was shot in the 1950 hunting season at Horicon and one at Horseshoe Lake, Illinois. An additional 6 geese were recaptured after final freeze-up on Horicon. None of the other geese have been reported as recovered.

In the period 1950 through 1952, a captive flock of hunting season cripples and birds trapped in spring, presumably *B. c. interior*, was maintained at the federal refuge headquarters on the east side of the marsh approximately six miles north of the state-operated project. No production was known to occur under penned conditions.

Several Canada goose broods have been observed on the federal refuge. In 1953, two pairs with broods of 3 and 5 goslings were noted along the east side north of the refuge headquarters. Both of these broods were considered as produced by pinioned geese from the federal captive flock that had been released on the marsh in the spring of 1953. Also in 1953, a pair with a brood of 3 goslings was observed on the main ditch near the dike. This brood was produced by a pair of free-flying geese from the state rearing project (the adults still retained plastic neck bands from experiments carried out in 1952). Only one other brood was observed on the federal area. This occurred in 1961, when a pair and 5 goslings were noted on the dike in July. This brood was also considered to be from free-flying geese from the state project. The lack of breeding geese on the refuge is perplexing in view of the available acreage, limited disturbance, apparently suitable nesting habitat, and source of geese from the free-flying flock on the state end of the marsh. There is little likelihood that additional nesting records have occurred since the refuge is inventoried on a weekly basis during the waterfowl production period.

In 1954 the refuge staff attempted to induce local breeding by the release of wild geese trapped during the spring migration. In early April, 139 geese, presumably *B. c. interior*, were banded, wing-clipped and released. The group consisted of 72 males and 66 females, plus one of unknown sex and age. At least 63 males and 31 females were considered in the adult or sub-adult age classes. None of these geese were known to exhibit breeding behavior. In general, they remained

in one group and were observed at several locations in the refuge throughout the summer. Most of these geese successfully completed the molt and regular feeding flights to upland areas occurred by early August.

Band recovery data suggest that survival of these geese was good. At least 29 percent of the birds released were subsequently recovered (Table 12). Of the 41 recoveries, 12 (29%) occurred in the first year (fall and spring migration following release). Seven of the first-year recoveries were from Horicon Marsh, 1 was at the Willow Slough Game Area in Indiana, 1 on the winter range in southern Illinois, and 3 were from the Canadian breeding range the following spring. Locations of subsequent recoveries (Fig. 10) are well within the limits of *B. c. interior* set by Hanson and Smith (1950). Few recoveries of the spring-banded geese occurred in southern Illinois and more in the southwestern part of James Bay in Ontario and in Michigan. Recoveries from geese banded at Horicon in fall occur predominantly in Illinois and Ontario. The apparent shift in recovery locations to a more easterly distribution suggests that Canada geese from other breeding and winter ranges were banded in spring.

TABLE 12

Locations of Band Recoveries of Wild Canada Geese Wing-Clipped and Released at the Horicon National Wildlife Refuge in April, 1954*

	Adult		Immature		Unknown	Total**
	Male	Female	Male	Female	Sex & Age	
Number banded	63	31	9	31	5	139
Number recovered	22	5	2	11	1	41
Percent recovered	35	16	22	36	20	29
First year recoveries						
Horicon Marsh	3	1	1	2		7(58)
Illinois	1					1(8)
Indiana				1		1(8)
Ontario	1			1	1	3(25)
Total no.	5	1	1	4	1	12
Percent						29
Subsequent recoveries						
Horicon Marsh	7	1		1		9(31)
Other Wisconsin	1		1	2		4(14)
Ontario		1		2		3(10)
Michigan	4	1		1		6(21)
Illinois	3	1		1		5(17)
Kentucky	1					1(3)
Tennessee	1					1(3)
Total no.	17	4	1	7		29
Percent						71

*Recovered through 1964-65 hunting season.

**Figures in parentheses are percentages recovered within the first year and subsequent years respectively.

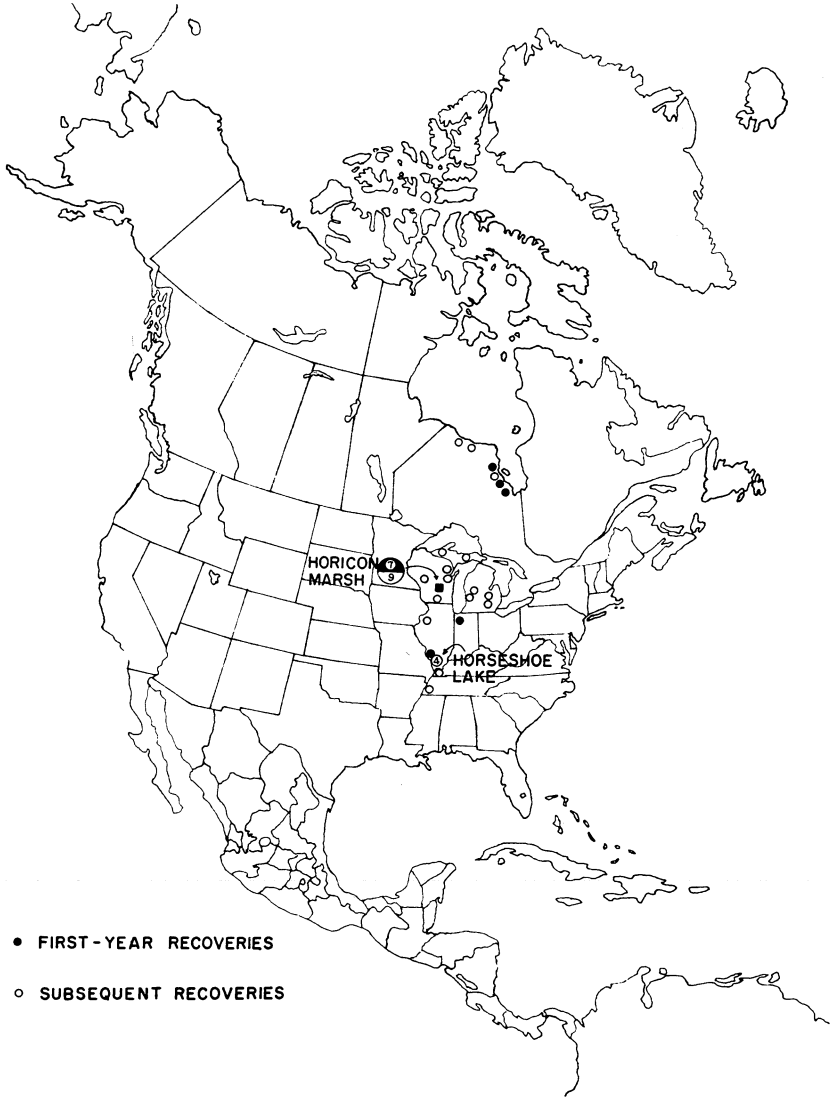


Figure 10. Location of band recoveries from 139 wild Canada geese trapped in spring, wing-clipped and released at the Horicon National Wildlife Refuge in 1954.

The recovery of 28 percent of the subsequent recoveries at Horicon Marsh is not an indication that the original group of wing-clipped geese spent subsequent summers on the area. No adult Canada geese were observed in the breeding season on the refuge in the years 1955-60. That the geese resumed their normal behavior can be seen from the location of recoveries (Table 12) and the annual distribution of recoveries by hunters (Table 13).

TABLE 13

Annual Distribution of Band Recoveries for Wild Canada Geese Wing-Clipped and Released at Horicon National Wildlife Refuge in April, 1954

Sex & Age*	Number		Percent Recovered Each Year**							
	Banded	Recovered	1954	1955	1956	1957	1958	1959	1960	1964
Adult Male	63	22	19	38	9	9	9	9	5	1
Adult Female	31	5	20	0	0	20	20	20	20	0
Immature Male	9	2	50	0	50	0	0	0	0	0
Immature Female	31	11	27	27	18	0	18	10	0	0
Unknown Age & Sex	5	1	0	100	0	0	0	0	0	0
Totals	139	41	22	30	13	7	13	10	5	1

*Age based on tail feather characters.
**No recoveries were reported for the years 1961-63.

OTHER WISCONSIN GOOSE FLOCKS

Central Area Breeding Geese

According to Nelson (1963a) breeding stock used to re-establish Canada goose nesting at the Necedah National Wildlife Refuge in Juneau County came from a breeding flock on the Bear National Wildlife Refuge in Utah (these may have been the race *B. c. moffitti).* These birds were pinioned (or wing-clipped) and apparently held under penned conditions. Records from Frank Martin (in litt., Aug. 14, 1952) revealed the first Canada goose nest (5 eggs) on the refuge was found in 1942, but it was not clear if it was in the wild or in a pen. In 1942, 22 birds escaped during the summer and 14 were recaptured in fall. The 18 remaining captive birds were pinioned in 1942. How long the captive flock was held is unknown. Two of the original breeders were reported shot near the refuge in 1951. Breeding records showed production of 14 goslings in 1943 and 26 in 1944. In 1958 an estimated 83 goslings were reared. In recent years, however, production has averaged about 50 goslings per year. While some breeders and nests may be destroyed by coyotes, raccoon predation is considered the key limitation to nesting success on the refuge.

It was also pointed out earlier that free-flying geese were being reared at the Sandhill Game Farm near Babcock by Wallace Grange. Grange (in litt., July 3, 1963) reported releasing 40-50 pinioned and wing-clipped geese on his area on March 21, 1938. Concerning breeding, he wrote: "They nested and had a considerable number of successful broods, which were often seen. In the early years, the geese were unusually successful, and later they (nests) seemed more subject to predation, especially by raccoon. In fall, we caught up as many we

could, but this was only partially successful and we are happy that some went wild." By the fall of 1940, 100 free-flying geese were in the area. When local hunting encroached along the edges of the Sandhill Game Farm and resulted in the killing of a number of geese each year, the breeding flock was sold by Mr. Grange in 1942. Several years later a few pairs of breeders were purchased by Mr. Grange from a game breeder who had obtained some of the original Sandhill flock. These birds were released on the area and slowly increased in number. Some of the adults refused to migrate, forcing provision of winter quarters. In 1952, 23 young were produced. Unfortunately, a fire in the winter quarters in 1953 destroyed the breeding adults. No further attempts with captive geese were tried. Several pairs of free-flying geese have reared broods there each year since 1953.

Breeding Canada geese have spread to several other large state-owned waterfowl management areas and to several cranberry marshes in the central area. The Wood County Public Hunting Grounds, which lies immediately west of Sandhill, the Meadow Valley Wildlife Area, lying adjacent to the Necedah Refuge, and the several flowages in the Black River Forest Unit of the Central Wisconsin Conservation Area have had breeding geese since the early 1950's. These birds undoubtedly came from the breeding flocks at either Necedah or Sandhill. Brood production and nonbreeding adults present in this general region of the state are presented in Table 14.

This island on the Rynearson Pool at the Necedah National Wildlife Refuge has been used for 13 consecutive years as a nest site by Canada geese. Located about 100 yards from shore, the island apparently is too far from shore to be searched by raccoon and coyote which are common on the refuge. (Photo courtesy Edward Collins)

TABLE 14

Canada Goose Production and Nonbreeding Geese at Necedah National Wildlife Refuge and Adjoining State-Owned Projects in Central Wisconsin, 1942-64*

Year	Breeding Pairs	Total Broods	Total Young	Brood Size**									Nonbreeding Adults
				1	2	3	4	5	6	7	8	9	
1942	1	1	5					1					37
1943	3	3	14				2		1				32
1944	—	—	26										—
1945	.....			no data									.....
1946	1	1	6						1				—
1947	2	2	12					1		1			20
1948	7	7	39			1	1	3			1	1	—
1949	7+	7+	32	1				1					14
1950	13	11	46	1		2	3	3	2				49
1951	6	6	32			1	1		3	1			11
1952	10	10	44		1	2	2	4			1		32
1953	19	11	50			1	4	5	1				40
1954	16	7	46			1	4	1					31
1955	6	6	28		1		1	2	2				14
1956	13	8	44				2	3		3			35
1957	15	15	79				4	5	4	2			52
1958	24	24	122		1	2	6	7	2	5	1		76
1959	26	26	127			3	1	6	2				31
1960	17	17	77		1	2	5	6	2	1			87
1961	29	29	141		2	1	3	3	2	1	1		84
1962	36	36	166		1	5	6	3	1				23
1963	59	37	184			4	4	3	2				172
1964[1]	24	24	76			4	4	4	2				210

*State-owned projects include Meadow Valley, Wood County Public Hunting Grounds, Sandhill Game Farm, and Central Wisconsin Conservation Department lands.

**Only complete brood counts included.

[1]Pair and brood counts were based on a sampling of areas covered in previous years.

The value of these local breeders in attracting fall migrants was noted at all the areas mentioned. Refuge units are present, and include 39,607 acres in Necedah, 4,500 acres at Sandhill Game Farm, about 2,000 acres each for Meadow Valley and Wood County Public Hunting Grounds. Migrant geese are also provided with agricultural crops and aquatic foods as a direct effort of management. The breeding flocks, however, do attract the migrants initially. From banding programs at Necedah, we know that most of the migrant Canada geese are a part of the Mississippi Valley population using the Illinois winter range. Reports of some neck-banded geese from Necedah have also been received from Tennessee around Reelfoot Lake. One band recovery occurred in Iowa from a gosling banded at Necedah in the summer of 1951. Otherwise we know nothing about where the local nesting populations spend the winter. The limiting factor currently appears to be local hunting. However, since the birds are forced to migrate, hunting farther down the Flyway may also be important.

Typical shoreline nest cover used by Canada geese in Central Wisconsin. Muskrat houses are seldom available for nesting in this part of the state due to a lack of suitable marsh vegetation for house construction and deep freezing of shallow marshes in many winters. (Photo courtesy Edward Collins)

Green Bay Area Breeding Geese

A captive Canada goose flock was started by Louis Barkhausen near Green Bay in 1932 with 3 pairs of geese obtained from the Jack Miner Sanctuary at Kingsville, Ontario. The first broods were produced in 1934. Breeding increased annually to a production of over 100 goslings per year in the late 1930's. Although a number of the adults were kept flightless, most of the flock consisted of free-flying geese. Protection for the flock was provided by making the 400-acre property a refuge. Early banding work on this flock (late 1930's) showed them to be essentially a resident population. Local hunters accounted for the few band recoveries. Perhaps influencing the lack of migration was the availability of feed and water provided for the flightless breeders.

In 1948, part of the Barkhausen breeding flock was given to the Bay Beach Sanctuary in the city of Green Bay. Located only 7 miles from the Barkhausen Estate, an interchange occurred between the flock established at Bay Beach and the original flock. We considered these geese as a unit. Trends in numbers of nonbreeders and brood production for these geese are shown in Table 15.

TABLE 15

Canada Goose Production and Nonbreeding Geese at the Barkhausen Game Sanctuary and Bay Beach Wildlife Area in Brown County, Wisconsin, 1950-64*

Year	Breeding Pairs	Total Broods	Total Young	Brood Size**								Nonbreeding Adults
				1	2	3	4	5	6	7	8	
1950	13	3+	28		1					1	1	—
1951	11	—	41	1			1	1		1		11+
1952	14	—	52			2	1	2		1		—
1953	22	—	54	.....			no	data				—
1954	9	9	27		3	3	3					52
1955	9	8	48			1		1	3	2	1	31
1956	21	21	72	2	4	3	7	5				21
1957	32	24	97		1	7	10	2	4			14
1958	39	35	133	2	1	2	3	2	2	1		86
1959	27	27	103	.....			no	data				48
1960	13	13	50+	.....			no	data				95
1961	53	53	190	.....			no	data				32
1962	—	—	140	.....			no	data				—
1963	—	—	115	.....			no	data				—
1964[1]	—	—	163	.....			no	data				—

*An interchange of geese occurs between these two projects, which are about 7 miles apart. Local production from free-flying geese began at Barkhausen in 1932. Bay Beach received a breeding flock from Barkhausen in 1948.

**Only complete brood counts are included.

[1]The resident breeding flock totaled about 90 geese at Bay Beach and 60 at Barkhausen.

In 1951, we banded 37 of the free-flying geese in the Barkhausen flock. Only one recovery was obtained and that was by a local hunter. Some of the other geese probably are still surviving as an occasional banded bird is noted in the pairs with broods seen on the area. In July 1965, a major part of the flock at Bay Beach was captured during the molt. Of 167 birds banded, 53 were goslings. During the hunting season of 1965, 3 young of the year were shot in the Green Bay area.

Annual mid-winter inventory figures recorded at Green Bay since 1951 show an occasional decline but in general the trend has been increasing. About 100 geese wintered there in 1951, 200 by 1953 and a peak of 450 occurred in 1959. Since 1960, the number has fluctuated between 250 and 436, counted in 1964. There may be a few geese of other races *(B. c. interior)* counted each year but we consider the bulk of the birds inventoried to be from the immediate Green Bay area.

The subspecific status of the geese at Barkhausen and Bay Beach is definitely *B. c. maxima.* Harold C. Hanson considers them to be excellent examples of the race as far as plumage and body form are concerned. The flock, however, does not contain any noticeable specimens in the 20-pound range as occurs occasionally in the adult male class.

Private Flocks under Federal Permit

A summary of Canada geese in the possession of private game breeders in Wisconsin reveals that 170 individuals have 1,909 geese (Nelson, 1963b). The number of geese held by various permittees shows: 126 have up to 10 geese, 20 have 11-20 geese, 16 have 21-50 geese, 7 have 51-100 geese and one party has over 100 geese. Many of these birds are undoubtedly *B. c. maxima* since the flocks have been in family ownerships dating back to the days of live decoys. Many of these private flocks are also producing goslings each year. The number of young reared increased from 253 in 1962 to 599 in 1965 (Reeves and Seaton, 1966). It is probable that some of the adult geese observed in the state during the summer months are birds escaping from the private flocks.

Currently, three private flocks in Wisconsin are known to be producing young that have spread to the wild or are being released in the wild. At La Crosse on the Mississippi River, the Badger State Sportsmen's Club is rearing Canada geese under penned conditions. This project has been active for several years and young geese have been permitted free flight. In 1963, 6 broods were reported within a radius of 15 miles of the project, and 74 goslings were reared and released by the project as free-flyers. An additional 15 adult geese from the breeding flock were released in 1963 down river to reduce competition in the pen. In 1964, 5 broods were reared in the area. An estimated 150 wild Canada geese stopped in the breeding area during fall migration.

At Wausau, Wisconsin, 9 adult Canada geese were established in the city park. In 1963, 3 nests were established. Only 4 goslings were reared as free-flyers. In 1964, 3 pairs again nested but only one brood of 2 goslings was reared.

Occasional broods are reported near the site of a privately owned nesting flock in Manitowoc County. Four broods of free-flying geese were observed there in 1964, and 2 broods on Collins Marsh in 1965 were thought to be from the same source.

It seems likely that private goose flocks will continue to contribute a few breeding pairs to the Wisconsin waterfowl scene. Local hunters probably will be the limiting factor in preventing an increase of free-flying geese in such flocks. In one instance, a private breeder recently eliminated a sizeable flock of breeders (over 50) because of hunting along his property boundary. Local hunters were killing his geese and a problem arose over prohibiting hunting on surrounding lands due to feeding practices being interpreted as baiting.

TRENDS IN STATEWIDE BREEDING EXCLUSIVE OF LOCAL FLOCKS

Annual breeding surveys of Canada geese were made in Wisconsin in the period 1949-64. Adult geese and brood observations were traced back to 1946 by cooperators in our surveys. The records of nonbreeding adult geese are shown in Table 16, and are separated into paired and unpaired groups. Confirmed brood records from reliable observers are listed in Table 17. These data exclude the general area around breeding sites of established flocks. It is our thinking that very few other breeding records of geese have occurred than those listed, for only in rare instances are reports obtained referring to observations in previous years.

In considering the distribution of broods and nonbreeding geese reported in the statewide surveys, the observations are not tightly clustered around the major restoration projects previously discussed. Plotting the confirmed brood observations (Fig. 11) revealed that only 5 of 30 records were within 25 miles of established breeding flocks. These brood records also show that only in rare instances have more than one pair nested successfully in the same year in the same county and that very rarely were there broods produced in consecutive years on the same sites. The trend in brood observations has been far from encouraging.

Adult geese have been observed as pairs, suggesting breeding but with no broods observed (Fig. 12), and as singles or flocks larger than pairs on many sites (Fig. 13). The most significant fact in these records is the decreasing trend occurring since 1954: in that year 61 nonbreeding geese were noted on 6 sites, while in 1964 only one pair of nonbreeding geese was reported for the entire state.

During the period of years concerned in surveys of breeding and nonbreeding geese we have observed a number of the adults and broods. All of these birds were, in our opinion, *B. c. maxima.* Their origin probably is from the established free-flying flocks or from private flocks under federal permit. The sporadic pattern and current status of breeding records suggest that habitat for breeding Canada geese may be suitable over much of the state but that other factors are limiting the spread and increase in nesting geese. Available evidence shows that excessive hunting mortality is the major factor limiting numbers of local breeding geese in Wisconsin.

EVALUATION OF GOOSE RESTORATION PROJECTS

Studies of Canada goose breeding populations in Wisconsin have shown that there are self-sustaining flocks at Crex Meadows, Green Bay, and in the central counties on and in the vicinity of the Necedah

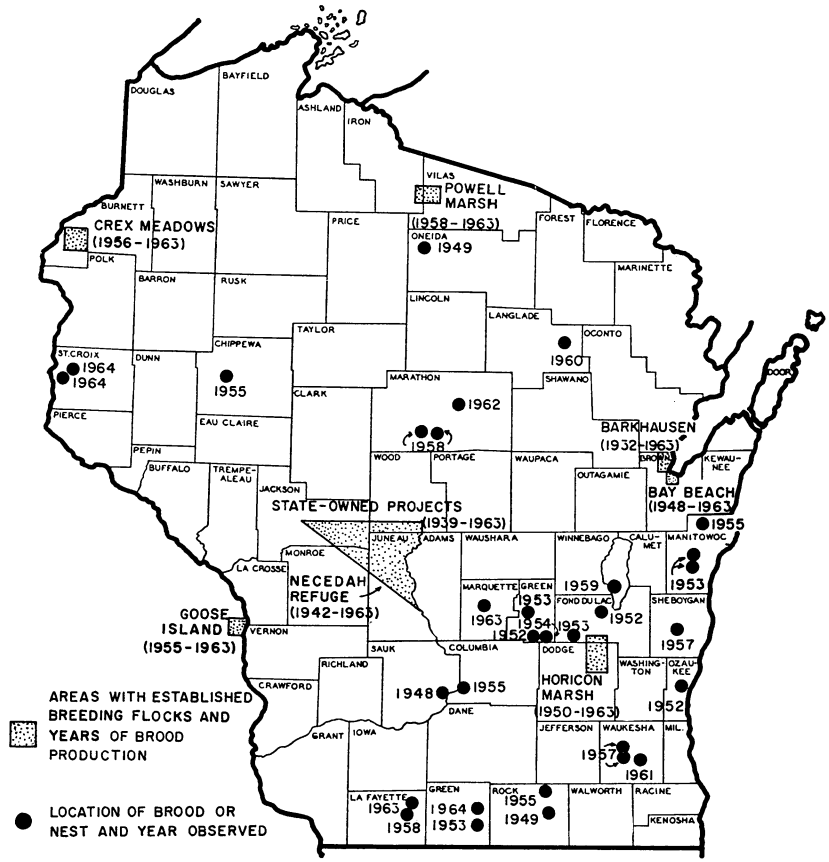


Figure 11. Confirmed breeding records of Canada geese in Wisconsin, 1946-64. (All areas with established breeding flocks also had breeding records of Canada geese in 1964.)

National Wildlife Refuge. Breeding geese are barely maintaining themselves at Horicon Marsh and Powell Marsh. Annual production on a statewide basis may total about 400 goslings. It has been clearly established that these nesting flocks are the giant Canada goose *(B. c. maxima)*.

Conservation Department efforts have involved a variety of repopulation attempts, but success has been achieved only at Crex Meadows. However, most efforts were of a limited nature, essentially "trial and error" endeavors, for evaluation purposes. Primary sources of free-flying flocks, other than at Crex and the small number of birds at Powell and Horicon, have been traced to early goose-rearing projects of private game breeders.

Several points are evident from Wisconsin studies.

1. Attempts to establish a self-sustaining breeding flock at Horicon Marsh were incompatible with refuge management programs designed

TABLE 16

Records of Nonbreeding Adult Canada Geese Observed in Wisconsin From June 1 to September 1, 1947-64*

	Paired Canada Geese			Unpaired Canada Geese			Annual Total
Year	County	Site	Number of Pairs	County	Site	Number of Geese	of Geese Observed
1947	Sauk	Lake Wisconsin	1				2
1948	Sauk	Lake Wisconsin	1				2
1949				Winnebago	Lake Poygan	5	
1949				Columbia	Lake Wisconsin	5	10
1950	Columbia	Lake Wisconsin	1	Columbia	Lake Wisconsin	1	
1950	Oconto	Unknown	1	Chippewa	Stanley	3	
1950	Price	Unknown	1	Dunn	Elk Lake	9	
1950	Waushara	Fish Lake	1	Jefferson	Princess Point	6	
1950				Oconto	Niles Flowage	14	
1950				Vilas	Trout Lake	6	47
1951	Jefferson	Princess Point	1	Jefferson	Cold Spring	19	
1951				Jefferson	Princess Point	15	
1951				Walworth	Turtle Creek	1	
1951				Winnebago	Oshkosh	1	38
1952	Jefferson	Ft. Atkinson	1	Jefferson	Princess Point	30	
1952				Jefferson	Rock Lake	5	
1952	Fond du Lac	Eldorado Marsh	1				
1952	La Crosse	Spring Slough	1				
1952	Marinette	Unknown	1				
1952	Oconto	Evergreen River	1				
1952	Ozaukee	Belgium	1				
1952	Walworth	Turtle Creek					49
1953	Lincoln	Merrill	1	Dane	Deansville Marsh	1	
1953	Marquette	Comstock Lake	1	Green Lake	Ripon	1	
1953	Walworth	Turtle Lake	1	Sauk	Fairfield Twp. (Sec. 3)	3	
				Winnebago	Fox River	29	40

TABLE 16 (Cont.)

Year	Paired Canada Geese			Unpaired Canada Geese			Annual Total of Geese Observed
	County	Site	Number of Pairs	County	Site	Number of Geese	
1954				Dane	Mazomanie	30	
1954				Jefferson	Red Cedar Lake	6	
1954				Green Lake	Lake Maria	6	
1954				Rock	Lake Koshkonong	5	
1954				Sauk	Fairfield	3	
1954				Waushara	Fish Lake	11	61
1955	Chippewa	Ruby Twp. (Sec. 2)	1	Columbia	Mud Lake	4	
1955	Door	Gardner Twp. (Sec. 21)	1	Winnebago	Rush Lake	15	23
1956	Fond du Lac	Van Dyne	1				
1956	Lincoln	Prairie River	1				4
1957	Rock	Johnstown Twp. (Sec. 3)	1	Chippewa	Tilden	1	
1957				Iowa	Wis. River at Tower Hill	1	
1957				Jefferson	Red Cedar Lake	4	
1957				Rock	McCombs Pond	3	11
1958				Jefferson	Mud Lake	3	3
1959	Clark	Sherwood Lake	1		Lake Koshkonong	4	
1959	Fond du Lac	Thornton Refuge	3				
1959	Outagamie	Wolf River-Shiocton	1				14
1960				Lafayette	Yellowstone Lake	1	1
1962	Manitowoc	Collins Marsh	3	Marathon	Wausau	6	12
1963				Fond du Lac	Eldorado Marsh	7	
1963				Shawano	Navarino Marsh	1	8
1964	Columbia	Caledonia Twp. (Sec. 15)	1				2

*Excluded are records from the immediate areas of breeding flocks at Horicon, Necedah, Crex Meadows, Goose Island, Powell Marsh, and Green Bay.

TABLE 17

Confirmed Canada Goose Brood Records in Wisconsin, 1948-64*

Year	County	Site	Brood Size
1948	Sauk	Lake Wisconsin	5
1949	Oneida	Bellmore Lake	4
1949	Rock	Johnstown Township	5
1952	Fond du Lac	Eldorado Marsh	5
1952	Green Lake	Lake Maria	7
1952**	Ozaukee	Belgium	6
1953	Fond du Lac	Waupun	10
1953	Green	Brodhead	5
1953	Green Lake	Markesan	7
1953	Manitowoc	Valders	6
1953	Manitowoc	Valders	7
1954	Green Lake	Lake Maria	7
1955	Chippewa	Delmar Township	5
1955	Columbia	Lake Wisconsin	3
1955	Manitowoc	Mott Lake	5
1955	Rock	McCombs Pond	8
1957	Sheboygan	Cedar Grove	4
1957	Waukesha	Summit Township	4
1957	Waukesha	Genesee Township	1
1958	Lafayette	Woodford	2
1958	Marathon	Big Eau Pleine Flowage	8
1958	Marathon	Big Eau Pleine Flowage	7
1959	Winnebago	Lake Winnebago	5
1960	Langlade	Mary Lake	5
1961	Waukesha	Waterville	4
1962	Marathon	Wausau	4
1963	Marquette	Germania Marsh	9
1963	Lafayette	Yellowstone Lake	9
1964	Green	Brodhead	4
1964	St. Croix	Burkhardt Mill Pond	7
1964	St. Croix	Lake Mallalieu	6

*Excluded are records from the immediate areas of breeding flocks at Horicon, Necedah, Crex Meadows, Goose Island, Powell Marsh, and Green Bay.

**Pair and nest found. Success of nest not determined. May have been birds escaping from private game farm.

to attract and harvest large numbers of migrant Canada geese. During several years in the mid-1950's, annual production totaled over 100 goslings from the captive and free-flying breeders. Migrant goose numbers were also increasing rapidly, from 12,000 in the fall of 1949 to over 60,000 in 1956. The large numbers of geese also attracted large numbers of hunters. Duck hunting was also at a peak in the mid-1950's. Hunter densities on the state-owned portion of Horicon Marsh often averaged one hunter per acre on 5,000-6,000 acres of aquatic habitat. Few if any goose populations face such heavy hunter concentrations. Any goose was fair game even though some local hunters knew they were shooting geese from the breeding flock. While duck hunting has declined, fall goose concentrations have continued to build, peaking at over 100,000 by 1961. Goose hunting pressure has remained high and seems directly responsible for the decline in the local breeding flock.

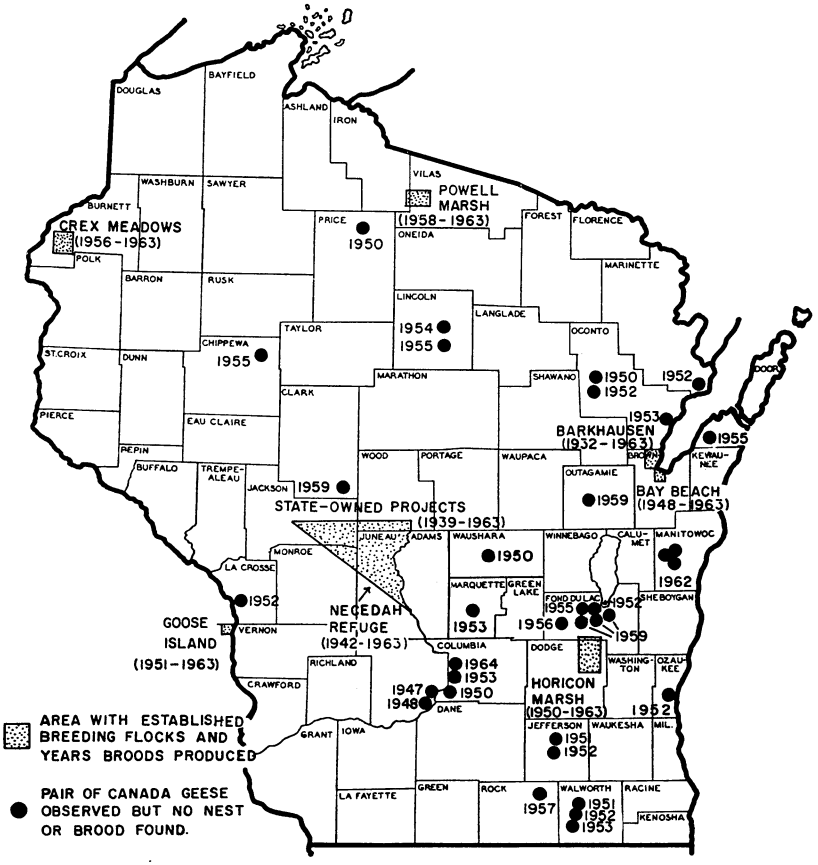


Figure 12. Location of Canada goose pairs with no nests or broods noted, from June 1 to September 1, 1946-64. (All areas with established breeding flocks also had Canada goose pairs without nests or broods in 1964.)

2. Current breeding flocks in Wisconsin exist only where captive flocks of *B. c. maxima* were maintained for a period of years. Releases of flightless giant Canada geese, as adults alone, immatures alone, or a combination of both, did not prove successful in areas of intensive goose hunting and severe winter weather, which forces migration of most waterfowl. A few scattered nesting records of pioneering pairs occur annually in areas 25 or more miles from current breeding flocks. Only rarely have such nestings occurred at one location for several years. Protection of these pairs and their young from local hunting could probably result in establishing some permanent breeding traditions. This would require increased public interest in the birds and appropriate action to enhance their survival.

3. Sanctuaries to protect breeding geese from local hunting have

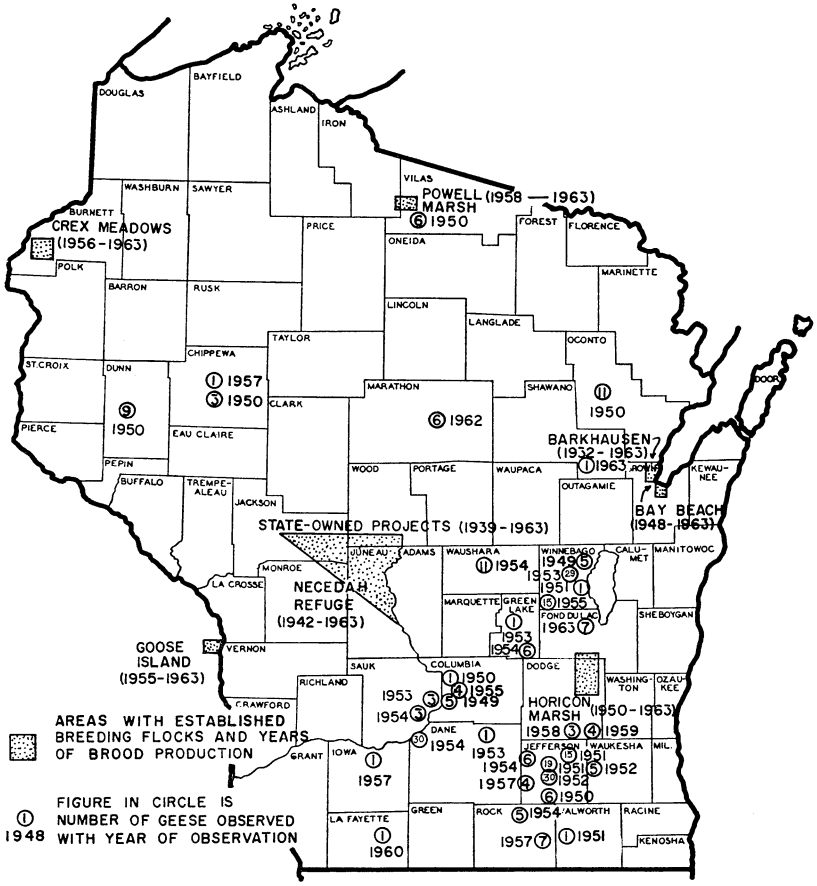


Figure 13. Locations where nonbreeding Canada geese have been observed in Wisconsin, from June 1 to September 1, 1947-64. (All areas with established breeding flocks also had nonbreeding Canada geese in 1964.)

shown varying degrees of success. Closing half of Burnett County to goose hunting has undoubtedly helped establish the Crex Meadows flock. On the other hand, a 2,000-acre breeding refuge and the nearby 20,000-acre federal refuge did not adequately protect the Horicon flock. We also consider gunning pressure on central area breeding geese to be excessive, despite the 40,000-acre Necedah Refuge and smaller refuges on four state projects in that area. Acreage alone is inadequate to judge the effectiveness of a sanctuary. The protected area should include the normal daily cruising radius of the breeding flock during the hunting season, until such time as local harvest is considered desirable.

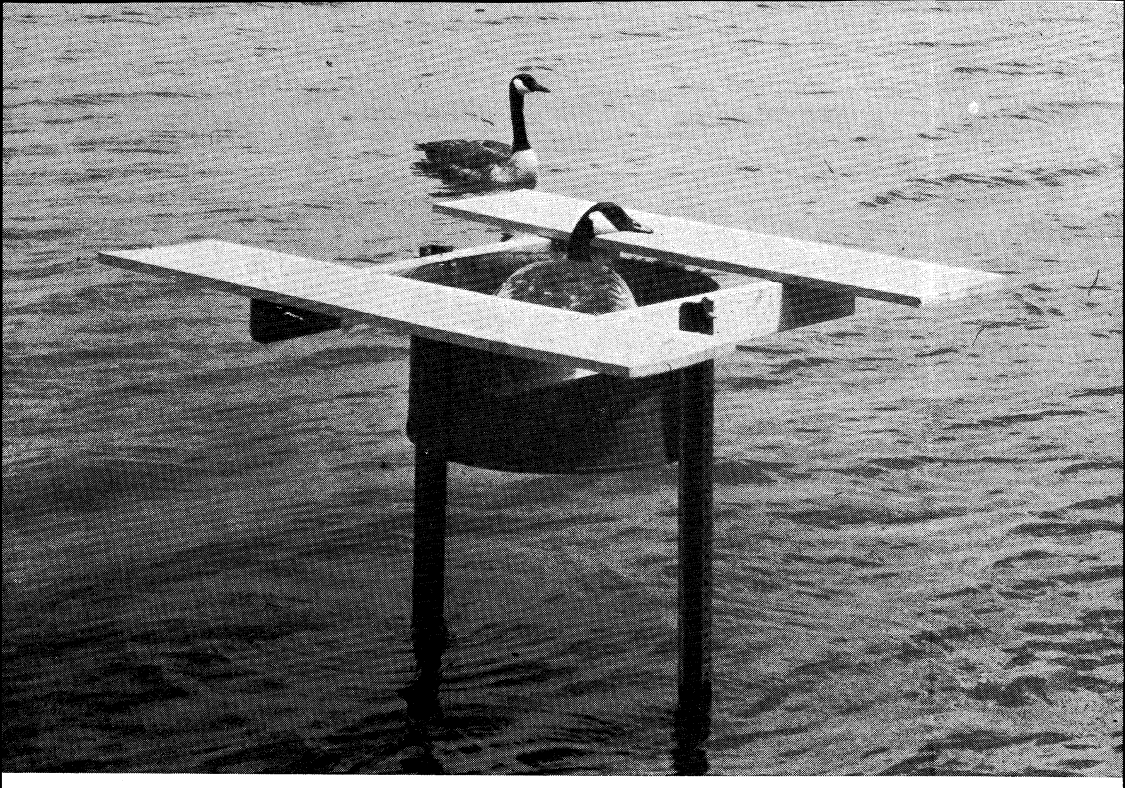
4. Local hunting mortality on breeding goose flocks can be con-

trolled, at least on some areas, by intensive hand-feeding programs. Direct feeding can reduce the daily radius of feeding flights and, consequently, the exposure to hunting. This was clearly demonstrated at Horicon where first-year band recovery rates declined from over 40 percent without feeding to only 7 percent with intensive feeding. Geese at Green Bay also are induced to remain within the city park in fall and winter by hand feeding. This flock has limited local hunting mortality and is now non-migratory as a result of the feeding program.

5. A basic problem in Wisconsin involves wintering characteristics of breeding goose populations. The flock at Crex Meadows was eventually forced to migrate by severe winter weather conditions. Open water and food were generally unavailable by late November and the geese moved out. Some band recoveries suggest a termination of southward migration at Horseshoe Lake, Illinois. The value of establishing local breeding flocks that end up being harvested at such heavily hunted sites can be questioned. We also question expenditure of state funds for rearing projects when Wisconsin's local geese are harvested primarily in other states, as now occurs with the Crex Meadows flock due to restrictions on local hunting. Protection must be afforded the geese at their wintering ground through inter-state cooperative agreements. Where hunting mortality is the major factor limiting size of breeding populations, there is no other alternative to encourage the population to expand and utilize existing breeding habitat. In our opinion, there are a few sites where geese could winter in Wisconsin if food supplies were developed. But we consider it most desirable to establish a migratory-homing pattern if the geese can avoid undue mortality enroute to and at their eventual wintering sites.

6. Perhaps one of the most ignored aspects in Canada goose restoration projects is the cost-benefit relationship. State and federal agencies have been rearing geese for years, yet we know of no complete cost accounting reports. No estimates are available on costs of Wisconsin's projects either. Maintaining the goose flock at Bay Beach Sanctuary in Green Bay is estimated by park officials to cost about $4,000 annually for feed (corn and small grains). They also have a considerable investment in ponds, pumps, and aerators. Private game breeders provide some indication of the value of breeding flocks. Adults are selling for about $40 per mated pair and young of the year from *B. c. maxima* stock at about $15 per bird. Thus, local breeding flocks represent a considerable investment and are a valuable resource above and beyond their ornithological and aesthetic values.

Recent investigations of Canada goose breeding populations in other states and countries reveal several factors regarding goose rear-



Canada goose nesting structure used in Ohio. Elevated nest sites essentially eliminate flooding and predator losses. Three such structures can be made from one 55-gallon barrel at an estimated cost of $6.00 each (Karl Bednarik, pers. comm.). The wooden platforms serve as a loafing site and defendable area for the male, thus permitting closer spacing of nest structures. (Photo courtesy Karl Bednarik)

ing projects. One of the most significant breakthroughs in accelerating the rate of increase in local breeding flocks has been the work of Brakhage (1965) in Missouri and Bednarik (1965b) in Ohio with elevated nesting structures. Over a period of years, their breeding flocks have developed a tradition of nesting in tubs, barrels, and on platforms erected several feet or more above the ground or water. Predation by animals and flooding losses of nests have been essentially eliminated, and nest success has been 100 percent in some years. High nest densities are possible, censusing is easy, and new breeding flocks have been established by placing nest structures in desired habitat. But nesting structures are not always used immediately. Sherwood (1965) experienced no use of nest structures at Seney Refuge in Michigan. Very likely the Seney geese had not learned to use the structures.

Diseases can be an important mortality factor in breeding flocks in some types of habitat. Sherwood (1965) encountered a loss of 500 goslings, or 80 percent of the 1964 production, at Seney from the blood parasite, *Leucocytozoon*. A similar large loss occurred there in 1960.

We have no indication of the importance of diseases in limiting Wisconsin breeding flocks. But *Leucocytozoon* is common in ducks at Crex Meadows and in the Necedah area (Anderson, et al., 1962; Trainer et al., 1962). Powell Marsh is somewhat similar in habitat to the Seney Refuge. Thus, the potential for serious disease losses is present.

Predation can be a significant factor inhibiting goose nesting success. Sherwood (1965) found that coyotes and raccoons were major predators on nests, goslings, and adult breeders at Seney Refuge. Brakhage (1965) listed the raccoon as the most important predator on ground nests in Missouri. High nest losses indicate insecure nesting habitat. This is a factor which can be modified in local situations. At Seney, some animal control and more nesting islands located over 200 feet or more from shore were recommended. Brakhage reduced raccoon losses through greater use of nesting tubs. These findings at Seney and in Missouri could apply equally to all of Wisconsin's breeding flocks.

In addition to factors influencing breeding success, goose depredations on private lands can limit overall population size of local breeding flocks. When the breeding area is of large size (thousands of acres) and has a variety of attractive food and water to serve the birds during the breeding season, post-breeding season, and in fall, crop depredations will, of course, be no major problem locally. This is often the situation on large wildlife refuges or management areas. But in areas where adult breeders and their progeny are attracted to private cropland for feeding during the post-breeding season and in early fall, crop depredations become an economic ceiling on population size. The total number of geese in areas where this situation prevails depends on the degree of tolerance individual landowners have for the birds. Experiences with Canada geese after their successful introduction into England (Boyd, 1963) and New Zealand (Riggert, 1963; Miers, 1964) show the realistic nature of the economic ceiling that governs goose population size where lands have been intensively developed for grazing and cropping. Farmers considered the birds detrimental because they fed on livestock forage, vegetables, and grains. Strong pressures from agricultural interests subsequently encouraged reduction of most of the largest flocks.

Though these relationships between Canada goose populations and man's activities have occurred in foreign lands, the principles involved can, we believe, be expected to operate where aquatic goose breeding sites are interspersed in areas intensively developed for agriculture in the United States. We hope that these cases do not discourage people from initiating projects to restore breeding Canada geese, but rather aid people in visualizing realistically the potential for such projects.

MANAGEMENT AND RESEARCH IMPLICATIONS

Wisconsin's Game Management Division has listed as one of its long range objectives the rearing of 10,000 Canada geese on an annual basis (Wis. Conserv. Dept., 1965). This goal probably can be achieved. An aggressive wetland acquisition program, aided materially by a 50 million dollar statewide program, financed by a 1 cent cigarette tax (Wis. Dept. Resource Development, 1961), has accumulated almost one-quarter of a million acres of prime wetlands. There are several dozen large wetland projects with potential nesting habitat for geese, in addition to many lesser marshes and some of the 8,000 or so lakes in the state.

Whether or not significant attempts are made to establish breeding flocks of geese will depend on an aroused public interest, the desire of game managers to establish such projects, the decision of Game Administration to support and budget for such a program, and the success in negotiating inter-state cooperative agreements to protect the birds at wintering sites. A basic conflict may arise in respect to anticipated development of 10 to 15 waterfowl management projects aimed at attracting 10,000 or so migrant Canada geese for hunting purposes. Nevertheless, establishment of new breeding goose flocks appears possible on several areas and existing flocks could be increased considerably through more intensive management. This largely involves increasing nesting success and minimizing mortality, mainly due to shooting, of the birds having established traditions to use each of the management areas.

In the event that further interest develops in establishing local flocks, information is available to guide management. An excellent discussion of factors involved in starting new flocks is presented by Hanson (1965). The Minnesota Department of Conservation has also published a fine set of guidelines on rearing and releasing Canada geese, as part of their program to promote goose restoration projects (Ledin, et al., 1965).

Encouragement of nesting goose flocks in Wisconsin should involve the following considerations:

1. A program to establish nesting geese in elevated tubs, in barrels, or on platforms, should be tried with established breeding populations. Predation and flooding are the most serious causes of nest failure. Though muskrat houses provide preferred sites for giant Canadas (Hanson, 1965), the number available in spring at the time of nest site selection can vary widely between years in Wisconsin. Spring flooding at Horicon Marsh has made most muskrat houses unavailable to breeding geese in some years. At some other marshes, where geese

were known to have nested previously, muskrats were absent or at such low levels that their houses were absent for several years. This occurs following drought years when water levels are low and ice forms to the bottom of shallow marshes. Provision of elevated nesting structures would insure availability of nest sites annually and enhance nesting success. While nesting in tubs may detract from aesthetic values associated with this majestic bird, one cannot argue with the success obtained in Ohio and Missouri in rapidly building local breeding flocks. Costs of elevated goose nesting structures seem reasonable. They appear to be on a par with wood duck nest boxes.

2. At least one free-flying breeding flock should be managed by the state to serve as a source for restocking purposes. The Green Bay flocks offer an excellent opportunity for expansion. These birds are fine physical specimens of the giant Canada goose. At Bay Beach Sanctuary, present numbers of free-flying breeders appear to occupy all suitable upland habitat on the area. Addition of nesting structures on the ponds offers a great potential for increasing production. At the Brown County Game Sanctuary (formerly the Barkhausen Estate), land clearing and improved feeding areas for broods and wintering geese, combined with the addition of elevated nest structures, could make this 400-acre area a real goose factory. Financial assistance for this project might be provided by the state. Another possibility is a cooperative program with county officials, utilizing the cost-sharing feaures of the County Conservation Fund. Small refuges now exist around both of these breeding sites. Very likely the need would develop to increase the size of the refuge at the Brown County Game Sanctuary if the goose flock enlarged. A potential advantage of using geese from the Green Bay flocks is that birds transferred to other projects may return there for the winter period. This would be a desirable feature, since other states would not be involved in protecting the birds from hunters.

3. Potential sites for additional captive breeding flocks should be selected. Careful consideration of the related aspects of sanctuary, hunting restrictions, etc., will be needed. Public support to prevent excessive local goose hunting may pose a problem at some sites, if migrant geese are present. Improvements of other flocks appear possible by releasing geese of breeding age on such areas as the Sandhill Wildlife Area and Powell Marsh. Habitat improvements for both nesting and feeding should also be anticipated in areas where geese now breed, if these flocks are to increase.

4. Suggest that some of the many private game breeders possessing good stock of giant Canada geese encourage their breeders to nest in tubs or elevated structures. These game breeders are often the source

for birds used for restocking purposes. Starting new projects with geese already "imprinted" to safe nesting structures would provide a decided advantage.

5. Consider developing a cooperative program to exchange or purchase Canada geese from Bright Land Farms at Barrington, Illinois. As pointed out previously, many of the geese used in Wisconsin projects were from the Bright Land Farms flock. Some of the band recoveries from both Horicon Marsh and Crex Meadows geese also occurred in that vicinity. An effort is now underway in Illinois to promote goose rearing projects (Waddell, 1966). Izaak Walton League officials are promoting the idea with the aid of Harold Hanson and other interested officials. One of the major areas of activity will be at the Bright Land Farms. If both Illinois and Wisconsin develop significant goose-rearing programs, consideration should be given to the possibilities of encouraging geese to breed in Wisconsin and winter near Bright Land Farms.

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The role of research in relation to Canada goose restoration will be determined by the problems encountered in expanding, establishing and managing the breeding flocks. Most basic biology, ecology, and management principles have been determined. Effect of diseases and predators on some flocks needs further study. General research interest is necessary to assess productivity, migration patterns, and annual mortality of each flock. Continuous banding is required to assess these factors.

We wish to emphasize that the know-how to establish goose breeding flocks in Wisconsin is at hand. Management has stated an objective of producing 10,000 home-grown geese annually. Implementing such a program will require the concerted interest and assistance of many individuals and private groups, as well as state and federal agencies. Accomplishing this program will be a challenge to everyone concerned.

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APPENDIX A

Scientific Names of Plants and Animals Used In The Text

BIRDS	
Canada goose	*Branta canadensis*
Blue & snow geese	*Chen caerulescens*
Golden eagle	*Aquila chrysaetos*
Snowy owl	*Nyctea scandiaca*
Great horned owl	*Bubo virginianus*
Mallard	*Anas platyrhynchos*
Bald eagle	*Haliacetus leucocephalus*
MAMMALS	
Mink	*Mustela vison*
Red fox	*Vulpes fulva*
Raccoon	*Procyon lotor*
Muskrat	*Ondatra zibethica*
PLANTS	
Alfalfa	*Medicago sativa*
Buckwheat	*Fagopyrum esculentum*
Rye-grass	*Lolium temulentum*
Winter wheat	*Triticum aestivum*
Sedge	*Carex* spp.
Wiregrass	*C. stricta*
FISH	
Muskellunge	*Esox masquinongy*

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