McIlhenny, E. A. 1932. The blue goose in its winter home. Auk 49:279-306.
Prevett, J. P. 1969. McConnell River goose studies. 1969-1970: neckbanded snow, blue and small Canada geese. (Publisher unknown). 9 p. Mineogr.
Sherwood, G. A. 1967. Behavior of family groups of Canada geese. Tran. N. Amer. Wildl. Conf. 32:340-355.
Smithey, Douglas A. 1973. Social organization, behavior, and movement of Blue and Snow Geese wintering in Louisiana. Unpubl. Master's Thesis. La. State Univ., Baton Rouge. 135 p.

SUCCESS OF RESIDENT CANADA GEESE ON NATIONAL WILDLIFE REFUGES IN THE SOUTHEAST

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ABSTRACT

Resident flocks have become a hope for retaining wild Canada geese in the South. A history is presented of eight such flocks which were attempted on national wildlife refuges. Habitat requirements, management techniques, and significant problems are discussed. Successful flocks now established on five of the eight refuges are providing considerable public enjoyment.

The serious decline in numbers of Canada geese wintering in southern states has caused an increased interest in resident flocks. The notable success of some refuges in establishing flocks of giant Canada geese (*Branta canadensis maxima*) has made these geese very popular for breeding stock (Schoonover 1971). Eight national wildlife refuges in the Southeast have attempted to establish resident flocks of Canada geese with varying degrees of success.

Many southern refuges that winter Canada geese have had some type of goose pen for confining crippled birds or accommodating a decoy flock. Some refuges have had captive geese for years without making intentional efforts to establish a wild local flock. In the late 1950's and early 1960's, thousands of Canada geese were captured, transported south, rendered temporarily flightless, and released on southern refuges. Some of these birds were pinioned. It was hoped that these efforts would successfully establish new migration traditions to bring geese farther south, or to establish wintering flocks on new refuges. Again, the intent was not to establish resident flocks.

These mass transplants of geese all ended in almost total failure. By 1966, a new approach for keeping the Canada goose in the South was evolving. If migratory geese could not be induced to continue migrating south, perhaps it would be possible to establish resident flocks that would nest in the South and remain there year around. This is a history of eight efforts to establish such flocks on national wildlife refuges.

Cross Creeks National Wildlife Refuge is a 10,000-acre area on Barkley Reservoir near Dover, Tennessee. Most of the refuge is subject to temporary flooding by the flood control reservoir. Shallow impoundments on the refuge cover 1,800 acres, and 2,100 acres are forested. Cooperative farmers cultivate

approximately 4,200 acres, leaving the refuge share of corn, milo or millet as food for waterfowl.

The Cross Creeks goose flock was started in 1964, two years after the refuge was established. The original objective was a decoy flock which would help attract geese that were displaced from the Kentucky Woodlands Refuge where Barkley Reservoir had inundated goose habitat. The initial stock of 15 geese originated from Horseshoe Lake and Swan Lake. In 1967, 11 giant Canadas were received from Minnesota. In 1970, 6 giant Canadas were transferred from Wapanocca National Wildlife Refuge, Arkansas.

All of the geese placed in the pen were pinioned, but one or two escaped each year as high water levels in Barkley Reservoir permitted them to cross the fence. During the first few years, fluctuating water levels also destroyed all the attempted nests. It was not until 1969 that the first young reached flight stage. Nesting islands were provided to encourage nest construction at a high enough elevation to escape flooding. Since that time several broods have been raised each year.

Nesting success in the last two years has improved markedly. This, together with the fact that most of the geese are no longer confined to the pen, indicates that a resident flock is becoming established. At the close of the 1972 nesting season the flock totaled 73 birds. They are a delight to refuge visitors.

Eufaula National Wildlife Refuge was established on the Walter F. George Reservoir near Eufaula, Alabama, in 1964. It includes 6,000 acres of marsh and open water within the reservoir, 1,500 acres of forests, 2,000 acres of farmland, and over 1,500 acres of shallow impoundments which are managed for waterfowl food production. Agricultural lands are farmed by cooperative farmers who leave the refuge share of corn, millet and small grains in the fields.

The Eufaula captive goose flock was started in 1965 with 28 immature geese from Wheeler National Wildlife Refuge. In 1966, 78 immature geese from Wheeler and 78 goslings from Brigantine National Wildlife Refuge were released in the pen. Additional smaller stockings were made with *maxima* birds from Minnesota and with Brigantine stock from Harris Neck in 1967 and 1969.

As with the Cross Creeks flock, reproduction was hampered the first few years by fluctuating water levels in Walter F. George Reservoir. The Corps of Engineers, Mobile District, cooperated in the effort to establish this flock by stabilizing water levels as much as possible during the nesting season. Mammalian predators, primarily dogs and bobcats, gave the usual problems. The goslings transferred without parent birds were most susceptible. Human disturbance caused some nest abandonment.

After a slow start, the flock began a steady increase. By 1970, there were 19 breeding pairs that raised 28 young to flight stage. In 1972, there were 45 nest attempts and 60 young. The total population at the end of 1972 was approximately 231, none of which were still confined to the goose pen.

The birds nest on refuge impoundments, Walter F. George Reservoir, and farm ponds as far as 10 miles from the refuge. The birds appear to be self-sufficient and thriving. They are a continuing source of enjoyment to refuge visitors and reservoir fishermen.

St. Marks National Wildlife Refuge is on the Gulf Coast of Florida, south of Tallahassee. The uplands are mostly wooded with pine and scrub hardwoods, while only 600 acres are suited for cultivation. Almost 24,000 acres of salt marsh are included within the refuge boundaries, and there are 2,000 acres of shallow freshwater impoundments. Lakes and ponds total about 1,000 acres.

This flock was established in an effort to offset the steady decline in migratory Canada geese using the refuge. In 1967, seven pairs of pinioned adult *maxima* geese were received from Minnesota and South Dakota. In 1970 and 1972, a total of 55 additional geese of "Brigantine" stock (mostly immature) were stocked from Harris Neck National Wildlife Refuge. These geese were free fliers.

From 1967 to 1970, only two young survived to flight stage. It was suspected that the original geese were mostly unpaired birds. Predators caused a steady drain on the flock until 1970 when an improved electrical fence was installed. Since that time some mammal predation has continued outside of the pen. Red-tailed hawks apparently caught several downy young inside the pen. Survival of downy young stocked without their parents was generally poor. A total of 18 young were hatched and raised to flight stage during 1971 and 1972. The refuge flock totaled 39 at the end of 1972.

The flock has not as yet reached the point where annual production exceeds loss to predators. The stocked free-fliers do not seem as wary and self-sufficient as migrant birds. It was speculated that the small number of nesting attempts could be due to competition between pairs, but this does not seem likely in view of experience at other refuges. Some of the free-flying birds range quite far from the refuge. Two were killed by autos and another bird injured about 75 air miles west of the refuge.

Harris Neck National Wildlife Refuge is a small 2,700-acre area near Townsend, Georgia. Located on the coast, it includes an abandoned World War II airstrip. About half the 1,000 acres of open land are leased as pasture, while most of the remainder is used to grow small grain and green browse for the geese. One hundred acres of freshwater impoundments provide nesting and brood habitat for geese, while 1,000 acres of salt marsh and estuary provide additional feeding and loafing habitat.

This refuge flock was originally established as a decoy flock with the hope that a wintering flock would become established and migrate to Brigantine National Wildlife Refuge for nesting. The original breeding stocks is from two sources. Semi-domestic stock totaling 19 birds was purchased from an individual near Mattamuskeet in 1963. In 1963, 1964, and 1965 about 260 downy goslings were transplanted from Brigantine National Wildlife Refuge.

With this modest beginning 10 years ago, the Harris Neck flock has become the most successful of the resident flocks on Bureau refuges in the Southeast. On the Georgia coast, the birds make extensive use of the salt marshes. A 25-acre pen, 100 acres of green browse planting, and extensive acreage of pasture in the coastal estuary area have provided a habitat combination that is a huge success.

Predation by raccoon, bobcat, opossum, and crow has been a problem but not serious enough to prohibit growth of the flock. In the early summer of 1973, the season's production received a severe setback from bobcat predation. About 60 goslings were killed in a matter of days, making it necessary to cancel plans for transfer of geese to six other refuges.

Since the original stocking, all birds have been free fliers. Some still benefit from predator protection of the pen, but others are nesting successfully outside the pen. Since 1968, the geese have averaged raising well over 100 young to flight stage each year. The total flock numbered over 300 in 1972, and 98 offspring of these free-flying geese have been transplanted to five other refuges.

Though the number of migrant geese visiting Harris Neck has dwindled to 14 in 1972, the number of resident geese continues to rise. This flock is considered well established and appears to be the only hope for retaining wild Canada geese in the State. The birds range up and down the coast 30 or more miles from the refuge but have not established a migratory tradition to Brigantine.

Holla Bend National Wildlife Refuge is located near Russellville, Arkansas, in a former horseshoe bend of the Arkansas River that was separated from the river by a channel realignment. About 3,100 acres of agricultural land and 900 acres of woodland are surrounded on three sides by the abandoned river channel which serves as a lake of variable size. About 150 acres of fields can be flooded for waterfowl. Cooperative farmers raise corn, soybeans, and grain sorghum, leaving the refuge's share for waterfowl use.

The first geese for the Holla Bend flock were recieved from Swan Lake and Horseshoe Lake in 1957 soon after the refuge was established. Though some pinioned geese were kept in the 15-acre goose pen, most of the almost 8,000 geese brough to the refuge over the next eight years were merely transplanted with clipped or pulled wing feathers. The original objective was to establish a wintering tradition at Holla Bend. Most of these geese never returned to the refuge, though a small migrant flock of 1,000 - 2,000 geese still winter there.

The resident flock was down to 15 in 1970 when seven of them were transferred to Wapanocca. Eighteen *maxima* geese have since been added to the flock. Only one brood per year survived in 1971 and 1972, though the 21 residents attempted many more nests. The predator-proof fence excludes mammalian predators. Crows have been the primary cause of nest failures and constitute the most serious problem with flock success. Refuge personnel hope to reduce crow predation on nests by confining nesting pairs in protected enclosures. Young birds are permitted to leave the pen when they begin flying but have continued to return to the pen. The flock has not as yet shown favorable signs of becoming established but still could be successful. The total flock numbered 21 at the end of 1972.

Wapanocca National Wildlife Refuge, 12 miles from West Memphis, Arkansas, is named for the 1,300-acre lake that it surrounds. About 600 acres of the lake contain standing cypress timber, and about 2,050 acres of the upland are wooded. Cooperative farmers cultivate corn, soybeans, millet, and small grain on 1,900 acres, 265 of which can be flooded for waterfowl. Woody Pond and several green tree reservoirs provide nearly 500 acres of additional aquatic habitat.

As with Holla Bend, the Wapanocca flock was started with the mass transplants of geese in the early 1960's. A few of these birds were pinioned and kept in the 10-acre goose pen. A small flock of less than 500 migrant geese continues to winter at the refuge.

Mammalian predators have been the main problem with this flock. In January of 1973 a predator killed 12 pinioned geese, leaving only two others in the pen. Approximately 30 free-flying geese are now year-round residents of the refuge. This flock has yet to prove that it can become established.

Noxubee National Wildlife Refuge is located near Starkville, Mississippi. It includes gently rolling hills and level bottomlands. Most of the refuge is wooded, the uplands with pine and the bottomlands with hardwoods. Two large lakes (totaling 1,800 acres) and several green tree reservoirs (2,000 acres) provide considerable aquatic habitat. Agricultural land totals 2,500 acres, most of which is farmed for corn, soybeans, and small grain.

During the period of 1953 to 1961, over 1,000 Canada geese from Horseshoe Lake and Wheeler Refuge were transplanted to Noxubee. A 15-acre goose pen served to protect these geese, most of which had wing feathers pulled or clipped to make them temporarily flightless. A small number of pinioned geese were never successful in establishing a resident flock.

In 1966, 76 giant Canada geese were obtained from Sand Lake, South Dakota. Thirteen of these geese died due to improper pinioning and were replaced the following winter. This original flock of 76 birds became the nucleus for a very successful resident flock which has steadily increased ever since the first young successfully reached flight stage in 1969.

Young birds are left as free-fliers and some have successfully nested outside the pens. During the first two years of successful reproduction, about half the young migrated northward with the small migrant flock which winters on the refuge. Since the spring of 1971, most of the young have apparently chosen to remain with the resident flock. The entire flock now numbers 205 and must be considered established.

The usual problem with mammalian predators was not as serious as on other refuges. Some nests were lost due to flooding, and elevated nest platforms were constructed. It was noted that renesting does not occur if the first nest is destroyed. It is speculated that ambient temperatures might be too high for late nests.

Yazoo National Wildlife Refuge is located near Hollandale, in the heart of the Mississippi Delta. About half of the 12,000-acre refuge is wooded, and about half of this woodland is subject to shallow flooding during certain seasons. Approximately 1,000 acres are covered by lakes, bayous, or shallow impoundments. Cooperative farmers cultivate about 5,000 acres, leaving the refuge's share of the crops for waterfowl.

An unsuccessful transplant program to establish a wintering flock of geese was also conducted at Yazoo. In 1966, that approach was abandoned and a resident flock was started with 20 giant Canadas from Sand Lake, South Dakota. In 1968, 20 more breeders were acquired from Minnesota and 30 from Ohio. These were held in an 11-acre pen which was not predator-proof and did not contain adequate water. A few nesting attempts in 1968 ended in failure due to predation. In 1969 the first successful reproduction was realized.

A new 45-acre enclosure was completed in early 1970. With good predator protection and a larger pond, 32 young successfully reached flight stage. The following year there was also good reproduction but great horned owl predation on the downy young proved a severe problem.

Free-flying young leave the refuge during the summer but have returned in the fall. The free fliers totaled slightly over 200 in the spring of 1973. One goose raised and banded at Yazoo was recovered the following year at Horican Marsh, Wisconsin. Free flying geese have attempted nesting outside of the protection of the pen but so far are not known to have been successful. It appears, however, that this flock will soon reach the "established" status.

DISCUSSION

Each of these refuges relied on a permanent pen as a start in establishing a resident goose flock. The enclosures varied in size from three acres at Cross Creeks to 45 acres at Yazoo. Cost of constructing the pens ranged from $1,200 to $6,000.

Predation was a serious problem at every refuge. Mammalian predators were successfully controlled by electric fences, but great horned owls and hawks still preyed on downy young. Crows were serious egg predators at one refuge. Protection from predators is a must while a flock is becoming established. Several years are required for the free-flying young to sharpen self-preservation instincts for coping with predators. Major setbacks such as the one experienced at Harris Neck can be expected, especially with young geese.

Suitable habitat for geese is an important requirement for a successful flock. Adequate water is needed inside the pen. Fluctuating water levels will cause loss of nests by flooding, and this is one disadvantage of flood control reservoirs. Elevated nesting platforms have proved useful.

Commercial feeding is usually needed inside the pen. A special laying formula feed was found to increase clutch size and initial survival of young. Natural or planted foods or suitable agricultural crops outside the pen are needed for free-flying young. The natural sanctuary afforded by large reservoirs or nesting islands seems to provide a great advantage.

The giant Canada geese breeders appear to be quite successful. It may be that their size makes them most capable of dealing with predators, but they also seem to be very adaptable for resident flocks. Through generations of commercial breeding, it is possible that the migratory instinct has been lost or weakened.

Several refuges which maintained decoy flocks of other subspecies were unsuccessful in starting local flocks until they acquired *maxima* stock.

The geese acquired from Brigantine National Wildlife Refuge have also proved well adapted for resident flocks. The Brigantine flock itself tends to be nonmigratory, and hopes that the Harris Neck transplants would develop a migration habit to Brigantine have never materialized.

Other resident goose flocks have apparently been successful in the South. A well known flock is established on the Old Hickory Reservoir at Nashville. The Tennessee Valley Authority and Tennessee Game and Fish Commission are cooperating in an effort to establish a flock on Melton Hill Reservoir at Oak Ridge. The Louisiana Wild Life and Fisheries Commission has a successful flock at Rockefeller Refuge.

The Bureau's objective for the eight refuges discussed is to establish resident flocks that are not dependent on artificial feeding, special predator control, or artificial nest structures. Emphasis will not be placed on developing huntable populations but rather on maintaining flocks suitable for providing nonconsumptive public enjoyment.

CONCLUSIONS

1. Resident Canada goose flocks have become established on five out of eight refuges where they have been attempted.
2. A predator-proof enclosure with suitable surface water is a prerequisite for starting a flock.
3. Essential habitat includes natural aquatic feeding areas, planted foods or suitable agricultural crops. Large impoundments or estuarine waters are important for establishment of a wild flock.
4. The giant Canada geese and the "Brigantine stock" appear well suited for resident flocks.
5. Resident goose flocks could be the only hope for future generations to view wild Canada geese in some southern states.

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LITERATURE CITED

Schoonover, L. J. Return of the "Honker." U.S. Fish Wildl. Serv. 6pp. Mimeogr.