DEPARTMENT OF NATURAL RESOURCES

# RESEARCH

# REPORT 127

April 1984

# SURVEY OF RADIO-MARKED CANADA GEESE IN THE HUDSON BAY LOWLANDS OF NORTHERN ONTARIO

By:
Gerald Bartelt
William Wheeler
Daniel Doberstein

Bureau of Research, Horicon

Dept. of Natural Resources
Technical Library
3911 Fish Hatchery Road
Fitchburg, WI 53711-5397

CONTENTS

ABSTRACT . . . . . 2

INTRODUCTION . . . . . 3

METHODS . . . . . 4

RADIO TRACKING EQUIPMENT . . . . . 4
Solar-powered Radio Transmitters. . . . . 4
Battery-powered Radio Transmitters . . . . . 4
Receiving System . . . . . 4
SEARCH PROCEDURE. . . . . 6
Navigation . . . . . 6
Aircraft Altitude and Speed, Transect Width . . . . . 6
Density Transects. . . . . 8
AREA SEARCHED. . . . . 9

RESULTS AND DISCUSSION . . . . . 11

EQUIPMENT PERFORMANCE . . . . . 11
Receiving Equipment . . . . . 11
Solar- and Battery-powered Transmitters . . . . . 11
LOCATION OF GEESE . . . . . 12
BREEDING STATUS OF GEESE . . . . . 16
DENSITY OF GEESE. . . . . 18

SUMMARY . . . . . 18

MANAGEMENT CONSIDERATIONS . . . . . 19

APPENDIX: Spurious Signals . . . . . 22

LITERATURE CITED . . . . . 23

Department of Natural Resources • Madison, Wisconsin

## ABSTRACT

Because the breeding success of Canada geese (Branta canadensis) is important to management of the Mississippi Valley goose population, especially in setting harvest quotas, this study evaluated the use of radio telemetry to determine: 1) breeding range and density of the population on the Hudson Bay Lowlands of northern Ontario; 2) possible separation of the Wisconsin and Illinois segments on the breeding grounds; and 3) proportion of 2-year-old geese that nest.

Radio telemetry techniques and aerial surveys were found to be effective, but solar-powered transmitters should not be used without further testing.

Approximately 95% (90,800 mile$^2$) of the breeding range of the Mississippi Valley population of Canada geese (Branta canadensis) was surveyed by aircraft for 156 radio-marked geese. Eight radio-marked geese were located (31% of 15 geese with battery-powered transmitters and 2% of 141 geese marked with solar-powered transmitters). The poor performance of the solar-powered transmitters was probably due to the lack of sunny weather and transmitter malfunction.

Radio-marked geese were found from 30 miles south of the Attawapiskat River, north to Hudson Bay and 100 miles west of the Severn River. Locations of radio-marked geese on the breeding range do not indicate a separation of the Illinois and Wisconsin population segments on the Hudson Bay Lowlands.

Transects to estimate goose density indicate that the coastal areas were more heavily used by pairs and groups of geese than were interior areas. Pairs were widely scattered in the interior of the Hudson Bay Lowlands.

Too few 2-year old geese were located to adequately define their role in breeding. With the use of battery-powered transmitters, future surveys could further indicate the distribution and density of the Mississippi Valley goose population on the breeding grounds, test the separation of the Illinois and Wisconsin segments on the breeding range, and possibly measure the proportion of 2-year-old geese that nest.

# INTRODUCTION

Management of the Mississippi Valley Canada goose population (Branta canadensis) is directed at increasing the number of geese and altering their fall and winter distributions (U.S. Fish and Wildlife Service 1979). To reach these goals, accurate information is required on the distribution, density, and annual productivity of these geese on the breeding grounds. This information is especially needed for establishing annual harvest quotas.

The objective this study was to evaluate radio telemetry techniques for use as Canada geese on the Hudson Bay Lowlands in order to: (1) delineate the current breeding range and density of the Mississippi Valley goose population on the Hudson Bay Lowlands in northern Ontario; (2) determine if the Illinois and Wisconsin segments are separate entities on the breeding grounds; and (3) reveal the proportion of 2-year-old geese that nest. Because the performance of the radio telemetry techniques used to gather the data was essential to the overall success of the study, evaluation of these techniques became an important part of this paper.

The vastness of the breeding range, the low density of breeding pairs, and the high cost of research in this area have discouraged research on the breeding grounds. However, recent advancements in radio telemetry equipment offer new possibilities for research in this area. Because the Hudson Bay Lowlands are both remote and vast, it was necessary to design an appropriate survey procedure, which combined with new telemetry techniques, could provide more accurate data.

Knowledge of the breeding range of the Mississippi Valley population is based primarily on band recoveries. Hanson and Smith (1950) outlined the breeding range of the Mississippi Valley population as it existed in the 1940's. Vaught and Arthur (1965) described the breeding range from band recoveries in 1955-56 and 1960-61. Reeves et al. (1968) further described the breeding range from band recoveries in 1960-64. Since recoveries are only received from areas inhabited by people, an incomplete picture of the breeding range of the Mississippi Valley population of geese still remains. Aerial surveys were conducted in northern Ontario by Kaczynski (1966), but the geese were so widely scattered and secretive that transects were unreliable for population and range definition.

Crissey (1968) first proposed that segments (groups of geese) within major populations might be managed separately. Raveling (1969) suggested that segments observed on migration and wintering areas might also be separated into the same segments on the breeding grounds. Kennedy and Arthur (1974), using aerial counts and harvest data, hypothesized that there were two segments in the Mississippi Valley population which might be managed separately. Craven (1978) supported the conclusions of Kennedy and Arthur. But Craven and Rusch (1983) reported that breeding ground aggregations were not maintained through the fall and winter. Additionally, Trost et al. (1982) concluded that the wintering aggregation of geese at Ballard County, Kentucky could not be identified as a specific segment nesting in only one region of the breeding range. Thus, the theory of separate manageable segments of geese within the Mississippi Valley population is unclear and needs additional testing.

A large part of managing the Mississippi Valley population of Canada geese is setting annual harvest quotas. To adequately set these quotas, the productivity of the population should be known. The proportion of 2-year-old geese that nest can have a large effect on the total productivity of geese because it alters the size of the breeding population. Hanson and Smith (1950) reported that practically all females are productive at 2 years of age, but they considered these results tentative and suggested that further information be collected. This aspect of goose biology is not well understood.

## METHODS

### RADIO TRACKING EQUIPMENT

#### Solar-powered Radio Transmitters

Solar-powered radio transmitters mounted on plastic neck-collars (Fig. 1) were placed on 179 Canada geese during 1979-81. Two solar panels recharged a nickel-cadmium battery which powered each radio transmitter. Each radio collar was color-coded for identification, and the ends of the radio collar were riveted to help keep the collar in place. A tag with a return address and a $20 reward offer for the return of the collar was attached. The life expectancy of these solar transmitters was three years.

In the spring of 1982, 141 of the 179 geese radio marked with solar-powered transmitters were assumed alive. (All but 29 of these 141 geese were located in the fall of 1981; however, these 29 were not considered failed transmitters because some areas on the winter range were not checked in 1981.) Of the 141 geese assumed alive, 133 geese had been radio marked in east central Wisconsin and 8 had been radio marked in southern Illinois and Kentucky.

Twenty-five were collared in 1979, 65 were radio marked in 1980, and 51 were radio marked in 1981. In the spring of 1982, the age and sex of these 141 geese were as follows: 7 females and 3 males were 1 year old; 7 females and 9 males were 2 years old; 32 females and 27 males were 3 years old; and 29 females and 27 males were 4 years or older. Of the 141 radio-marked geese, 75 were female and 66 were male.

#### Battery-powered Radio Transmitters

Radio transmitters powered by lithium batteries were attached to 15 geese using a backpack harness. Personnel from Southern Illinois University at Carbondale radio marked these geese at Crab Orchard National Wildlife Refuge, Illinois in October 1981 (11 geese) and January 1982 (4 geese). In the spring of 1982, 2 of these geese were 2-year-old females and 13 were females 3 years or older.

#### Receiving System

A State of Wisconsin Cessna 337 aircraft (Fig. 2) was equipped with a 2-element "H" antenna attached to each wing tip by a mounting system designed by the New Mexico Fish and Game Department (Dave Beaty, Telonics, Inc., pers.

FIGURE 1. Canada goose with solar-powered radio transmitter mounted on plastic neck collar.

FIGURE 2. Cessna 337 aircraft equipped to survey for radio-marked geese.

comm. 1982). The antennas were "side looking" and pointed down at a 30-degree angle (Fig. 3). Coaxial cable from each antenna was run through the wings and into the cockpit. There, the cables from both antennas were joined with a 2-port combiner (Fig. 4). A signal received from either antenna could be heard at the output of the combiner. The signal was then split by a 2-port splitter and a cable went to each scanning receiver. This arrangement allowed each receiver to scan different frequencies simultaneously using both antennas. When a signal was received, the combiner-splitter equipment was removed and replaced with a "right-left" switch. This switch helped locate the exact position of a transmitter by switching signal reception from the right to the left antenna and vice versa. The antenna receiving the strongest signal indicated the direction of the transmitter.

Two programmable scanning receivers were used to search for the frequencies of radio-marked geese. One-half of the 156 frequencies of both solar-powered and battery-powered transmitters were programmed into the memory of each receiver. To accommodate any frequency drift of the transmitters, a frequency 2 kHz above and below each transmitter frequency was also programmed into the receivers' memories. Both receivers scanned a frequency for 1.2 seconds before advancing to the next frequency. At this rate, each receiver took 4 minutes 45 seconds to search for all possible frequencies.

Receiving equipment was tested before every flight to ensure all equipment was operating properly. Headphones were used to eliminate outside noise and aid in hearing radio signals.

## SEARCH PROCEDURE

### Navigation

Navigation was accomplished by Loran-C navigation system, compass, and landmarks. The Loran-C navigation system is a triangulation system of radio signals emitted from Loran-C stations in the United States. The latitude-longitude of the transect to be flown was programmed into the Loran-C unit. The unit then determined the compass direction to reach and maintain the transect course and calculated the exact location of the aircraft at any moment. It was an exceptional navigational aid in this featureless terrain.

At the latitude of Winisk (Fig. 5) the Loran-C radio coverage diminished. Compass bearings were then used for navigation, with verification by known landmarks on a map. Compass bearings were also used to check the accuracy of the Loran-C system. At an altitude of 5,000 ft, large lakes were usually visible as landmarks to check the aircraft's course.

### Aircraft Altitude and Speed, Transect Width

Tests with transmitters in a known location indicated that at an altitude of 5,000 ft, a signal could be detected from 12 miles. Allowing coverage of 10 miles from either side of the aircraft, transects were therefore spaced 20 miles apart on the breeding range (Fig. 5). The aircraft covered the 10 miles

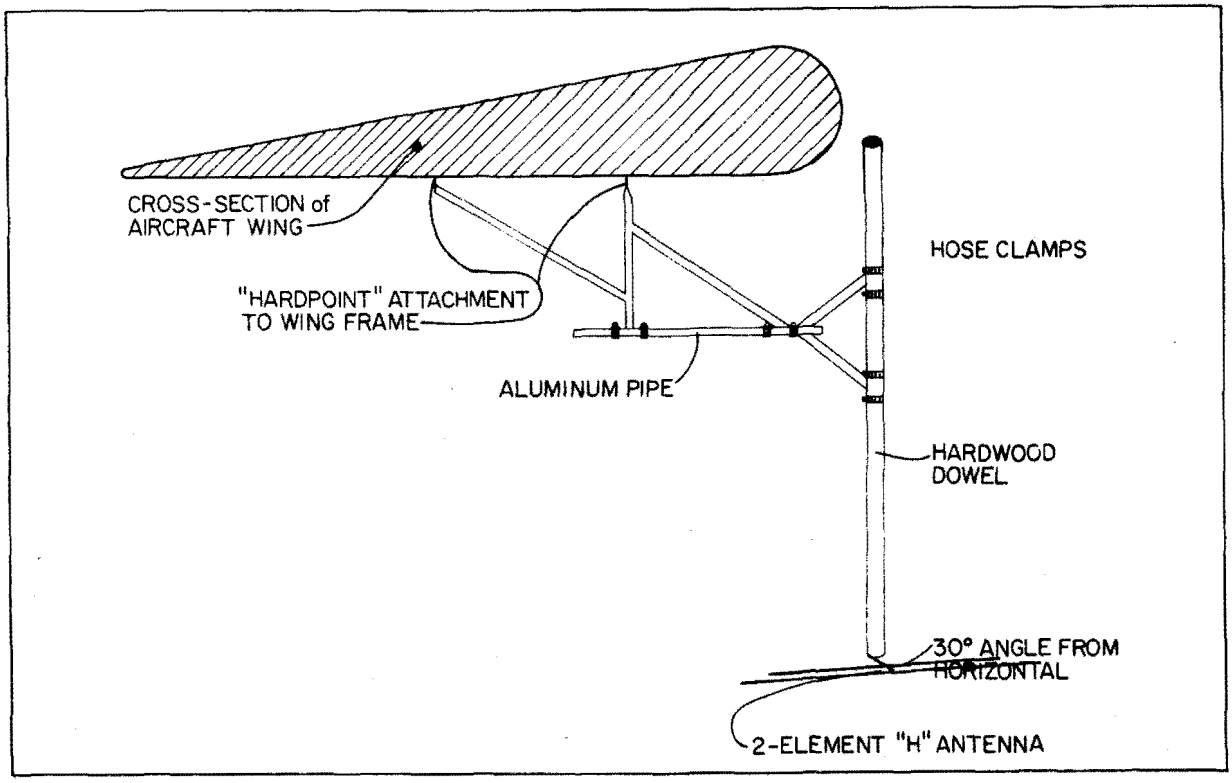


FIGURE 3. Side view of antenna attachment to the wing of the Cessna 337.

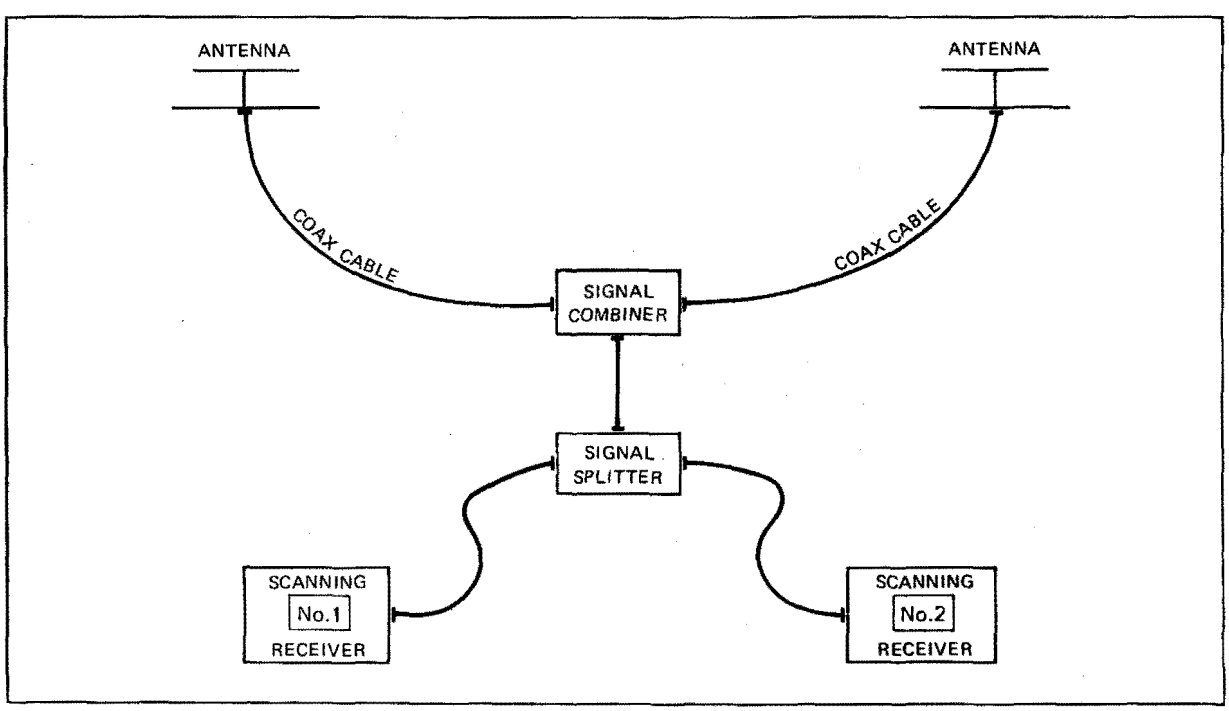


FIGURE 4. Receiving equipment used to survey the Hudson Bay Lowlands for radio-marked geese.

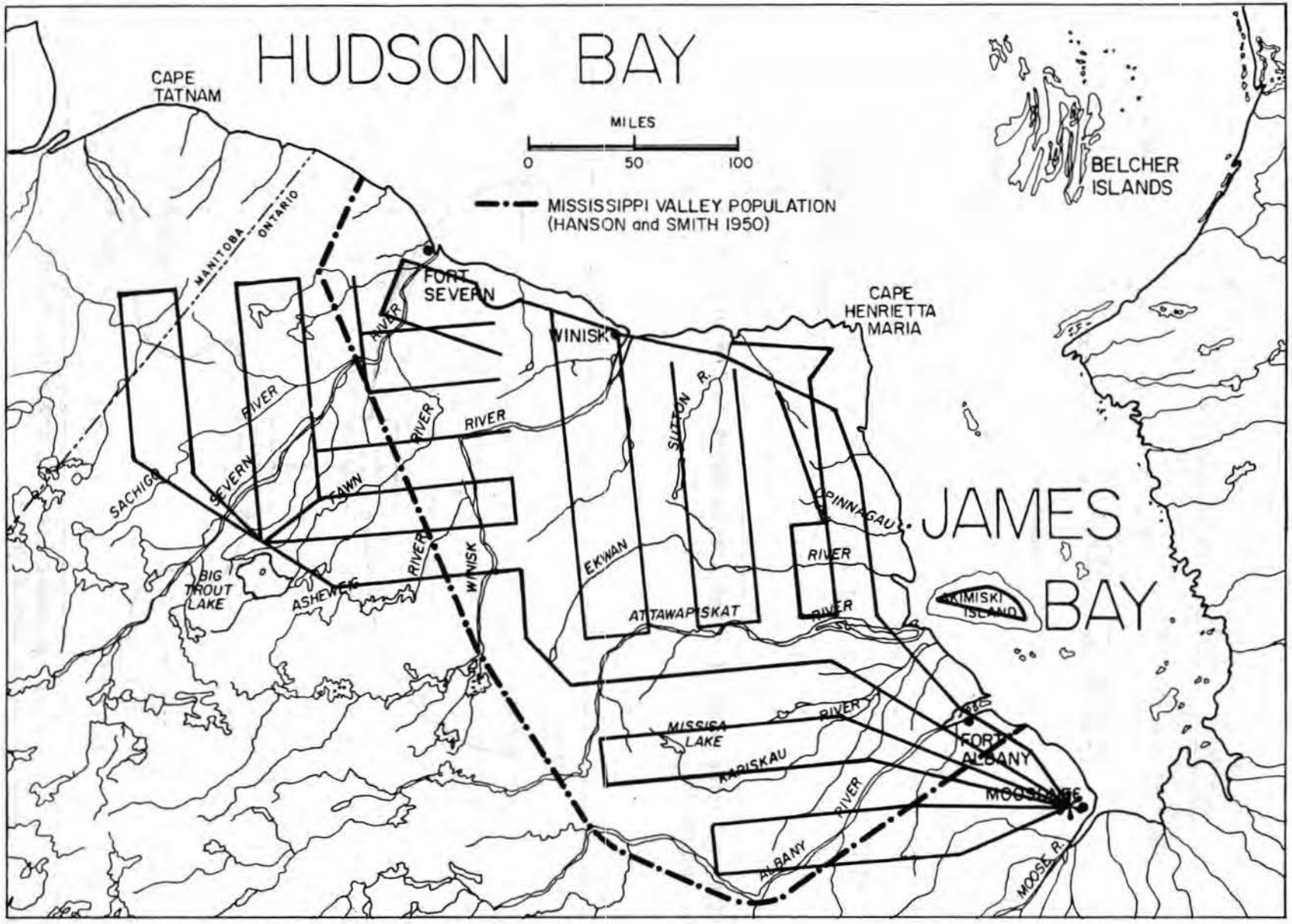


FIGURE 5. Location of aerial transects used to survey for radio-marked geese in the Hudson Bay Lowlands.

in 5 minutes--at a ground speed of 120 mph. In less than 5 minutes each receiver searched for every programmed frequency. Thus, the aircraft did not move beyond the transmitting range of any transmitter before the receiver checked for its frequency at least once.

Tests conducted at Madison, Wisconsin and Moosonee and Winisk, Ontario, with transmitters in a known location, verified that this method--flying at an altitude of 5,000 ft, speed of 120 mph, transects spaced 20 miles apart, and scanning frequencies at 1.2 sec/frequency--was the best procedure to survey an area and detect radio transmitters.

Once a signal was detected, the aircraft was flown in the direction of the signal after noting the point at which the plane left the transect. As signal strength increased, the aircraft's altitude was decreased. The aircraft path was continually corrected to the direction of the transmitter until the radio-marked goose was located. Once a signal was detected, it took an average of 15 minutes to locate the transmitter. Every effort was made to see the radio-marked goose.

The exact location and breeding status of the goose (whether or not it was in a breeding pair) and the habitat type in the area were noted. The aircraft then climbed back to an altitude of 5,000 ft, returned to the point where it left the transect, and resumed the search procedure.

### Density Transects

Fourteen transects of varying lengths (14-67 miles) were flown to estimate the density of geese on the breeding range (Fig. 6). Each transect was flown at an altitude of 200 ft and all geese in singles, pairs, and groups were counted within 0.25 miles of either side of the aircraft. Single geese were assumed to be paired. An effort was made to sample areas along the coasts (within 50 miles) of James Bay and Hudson Bay (7 transects) and in the interior of the Hudson Bay Lowlands (7 transects). These transects were not sufficient to provide absolute densities, but they do provide an index to Canada goose distribution on the Hudson Bay Lowlands. Additional density transects could not be conducted because of high fuel consumption in reducing the aircraft's altitude to 200 ft to count geese and returning to 5,000 ft to survey for radio-marked geese.

## AREA SEARCHED

The aircraft was flown from Wisconsin to Moosonee, Ontario on 26 May 1982. Eight days between 27 May and 9 June were spent flying the surveys. The weather was unsuitable for flying on the other days.

During late May and early June most geese were still territorial and remained near the nest site (Harry Lumdson, Ontario Ministry of Natural Resources, pers. comm). Thus, most geese should still have been on the breeding range at the time of the survey. Approximately 95% of the reported breeding range of the Mississippi Valley goose population was searched for radio-marked geese

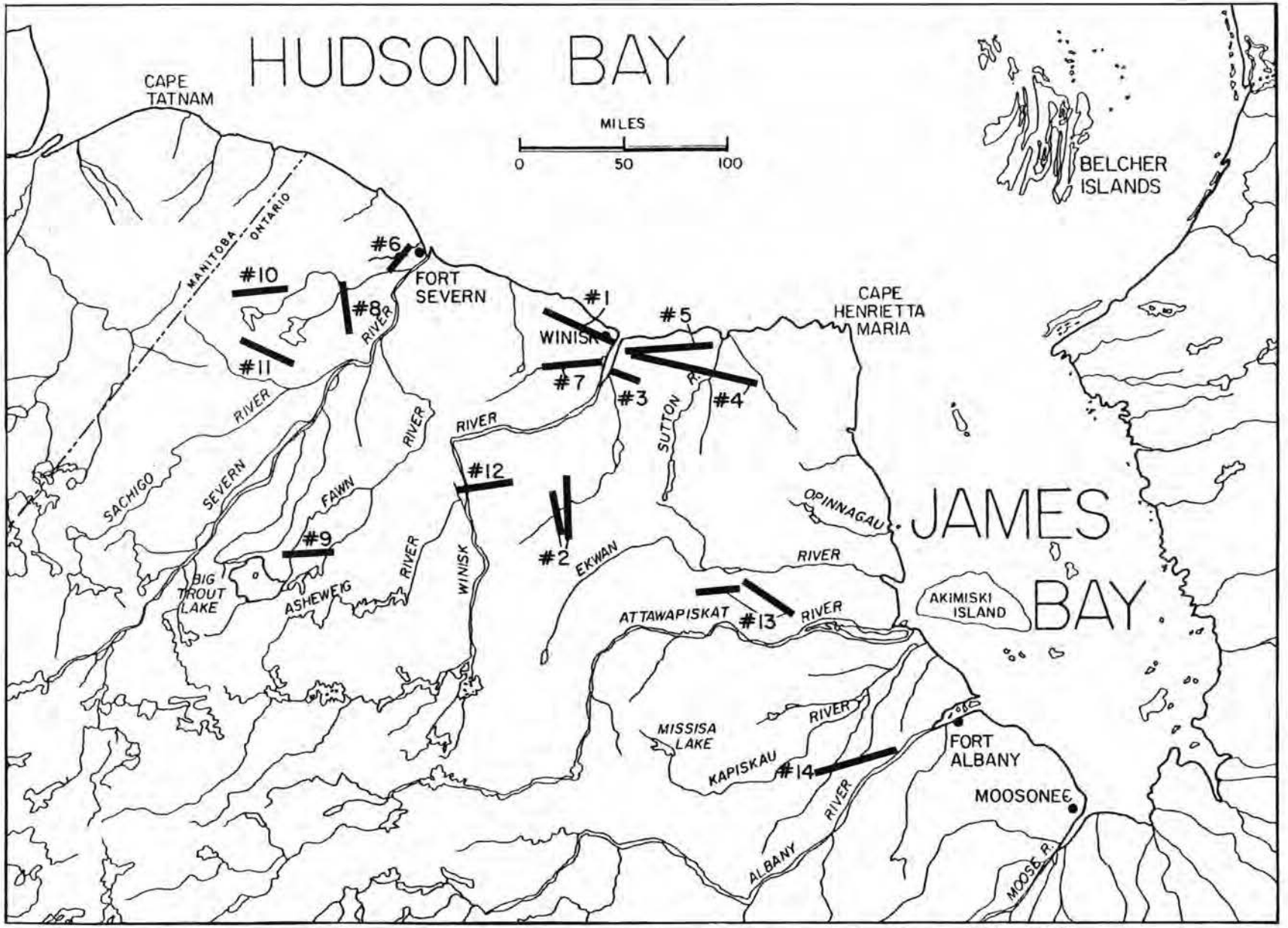


FIGURE 6. Location of aerial transects used to estimate Canada goose density on the Hudson Bay Lowlands.

(Fig. 5). The area stretched from Moosonee north to Cape Henrietta Maria (including Akimiski Island), west to Fort Severn and the Manitoba border, southeast to Big Trout Lake, and then southeast to the Albany River. About 90,800 miles$^2$ were searched during 53 hours of flight time. The total cost of the project was $7,500 excluding wages and cost of telemetry equipment.

Fuel, food, and lodging were available at Moosonee, Winisk, and Big Trout Lake. From these three sites it was possible to cover the entire range of the Mississippi Valley population with the exception of the area north of the Severn River. If fuel had been flown into Fort Severn prior to the survey, this area could also have been surveyed.

## RESULTS AND DISCUSSION

### EQUIPMENT PERFORMANCE

#### Receiving Equipment

The receiving equipment was tested at both Moosonee and Winisk, Ontario, with transmitters in known locations. Both tests indicated that the survey procedure should provide complete coverage of the area searched. In three cases, signals from a radio-marked goose found on one transect were detected again on an adjacent transect, suggesting some overlap of radio coverage. In another instance, a radio-marked goose was detected 14 miles away. Again, this suggested that the survey area was adequately covered.

#### Solar- and Battery-powered Transmitters

Of the 8 radio-marked geese located on the breeding grounds, 5 geese carried battery-powered transmitters (33% of geese originally marked with battery transmitters) and 3 had solar-powered transmitters (2% of geese marked with solar transmitters). It appears solar-powered transmitters performed poorly.

One reason for the poor performance of the solar-powered transmitters could be that incubating geese might spend much of the day with their heads on their backs shading the solar panels. However, this was eliminated as a possible cause of poor performance because 42% of the radio-marked geese were males which do not incubate. Thus, these geese should have been active and exposed the solar panels to the light. Another possibility is that the solar panels became coated with mud or some other substance that limited their effectiveness. One radio-marked goose was observed in the winter of 1982-83 in Illinois with mud-covered solar panels, and the transmitter was not emitting a signal.

Another probable cause for failure of the solar-powered transmitters is lack of sunshine in this area. According to the manufacturer of the solar-powered transmitters, the transmitter could lose power and have a reduced range of signal transmission after 4-5 days of low, over-cast skies or foggy weather. However, after a sunny day the transmitter should be back to full power.

To test this, we shaded a solar-powered transmitter for 10 days. Even after it was placed in the sun for 4 hours, it still showed a greatly reduced range (0.5 mile). Apparently it takes more than 4 hours of sunlight to completely recharge the transmitter once it has been discharged.

Data and weather conditions obtained from Canadian Atmospheric Environment Service weather stations at Churchill, Manitoba (northern end of the breeding range), and at Moosonee, Ontario, (southern end of the breeding range) during the survey period indicated an average of 4.2 hours of sunlight/day. The lack of sunny weather in the study area probably limited the effectiveness of the solar-powered transmitters.

The obvious explanation for the low number of radio-marked geese found might be that they were not in the area searched. Nonbreeding geese often leave the breeding range on a molt migration. However, 82% of the radio-marked geese were 3 years old or older and should have been nesting in the area searched.

During the fall and winter of 1982-83, 60 of the 141 (43%) radio-marked geese with solar-powered transmitters were located in Wisconsin and Illinois. Of the 60 transmitters located, 37 (62%) were transmitting a signal and 12 (20%) were not functioning. These were checked for a signal while under observation. Eleven (18%) other geese with solar-powered transmitters were observed in Wisconsin and Illinois (not checked for a signal while under observation), but did not have a signal recorded for them despite repeated searches throughout the fall and winter. These 11 transmitters probably were not functioning. Of the 37 transmitters that did emit a signal, 17 (46%) were observed with the transmitter not functioning or functioning improperly (highly intermittent signals) on 1 or more occasions during the fall and winter.

Signal loss and transmitter malfunction were usually associated with long periods of cloudy weather. Poor sunlight conditions, which reduced the range of transmitters, and/or transmitter malfunction are the most probable causes for the small number of solar-powered transmitters located on the breeding grounds.

On the other hand, the battery-powered transmitters seemed to work fairly well. The battery-powered transmitters had a life expectancy of 6 months. Eleven of these transmitters were activated in October 1981 and some had been transmitting for 7 months at the time of this study. However, it is not known how many of these transmitters ceased working by the time we conducted this survey.

## LOCATION OF GEESE

Radio-marked geese were located from 30 miles south of the Attawapiskat River, north to the Hudson Bay coast to 100 miles west of the Severn River, (Table 1, Fig. 7). Additional work is needed to verify this range, especially in the area north and west of the Severn River.

TABLE 1. Locations of radio-marked geese on the Hudson Bay Lowlands.

| Radio Frequency | Age | Sex | Marking Location | Marking Date | Date(s) Located | Lat.-Long. Coordinates | Comments |
|---|---|---|---|---|---|---|---|
| 149.670 | Adult | Male | Grand River Wis. | 2 Oct 1981 | 27 May 1982 | N55°11.6' W84°20.0' | Saw goose; definite pair; did not leave area; on 2-acre pond in muskeg and bog area. |
| | | | | | 28 May 1982 | * | Signal from same area as 27 May 1982. |
| | | | | | 29 May 1982 | * | Signal from same area as 27 May 1982 and 28 May 1982. |
| 151.392 | Adult | Female | Crab Orchard NWR, Ill | 15 Oct 1981 | 28 May 1982 | N54°04.6' W86°09.1'; 5.8 miles west of transect. | Saw goose; definite pair; in area of spruce-ringed potholes, some muskeg. |
| 151.113 | Adult | Female | Crab Orchard NWR, Ill | 15 Oct 1981 | 29 May 1982 | N52°58.9' W83°03.0 | Saw goose; definite pair; stayed in area; area comprised of braided muskeg with many potholes, little spruce. |
| 151.289 | Adult | Female | Crab Orchard NWR, Ill | 15 Oct 1981 | 29 May 1982 | N54°54.7' W83°26.4' | Saw goose; definite pair; did not flush; area of coastal muskeg, no spruce, flat and marshy; other geese in area. |
| | | | | | 7 Jun 1982 | N53°06.3' W82°53.6' | Strong signal.* |

TABLE 1. (Continued)

| Radio Frequency | Age | Sex | Marking Location | Marking Date | Date(s) Located | Lat.-Long. Coordinates | Comments |
|---|---|---|---|---|---|---|---|
| 150.960 | Adult | Female | Crab Orchard NWR, Ill | 20 Oct 1981 | 3 Jun 1982 | N55°20' W87°00' | Goose would not flush, although flew low several times; might be on nest at edge of large lake; small potholes and spruce surround lake. |
| | | | | | 4 Jun 1982 | N55°00.9' W87°11.3' | Good signal; about 14 miles from original location.* |
| | | | | | 4 Jun 1982 | N55°18.7' W87°11.3' | Good signal.* |
| 149.025 | 3 years | Male | Horicon NWR, | 7 Oct 1980 | 4 Jun 1982 | N55°18.7' W87°11.3' | Strong signal; saw goose; definite breeding pair; on edge of spruce encircled lake. |
| 151.012 | 2 years | Female | Crab Orchard NWR, Ill | 28 Oct 1981 | 5 Jun 1982 | N55°25.0' W89°44.6' | Saw goose; definite pair; dry area, little water; group of 3 geese running on ground; also group of 9 geese. |
| 148.788 | Adult | Female | Grand River Wis. | 10 Oct 1981 | 6 Jun 1982 | N52°42.5' W85°18.2' | Goose would not flush; in area of spruce, some potholes, little muskeg. |

* Did not try to locate goose accurately.

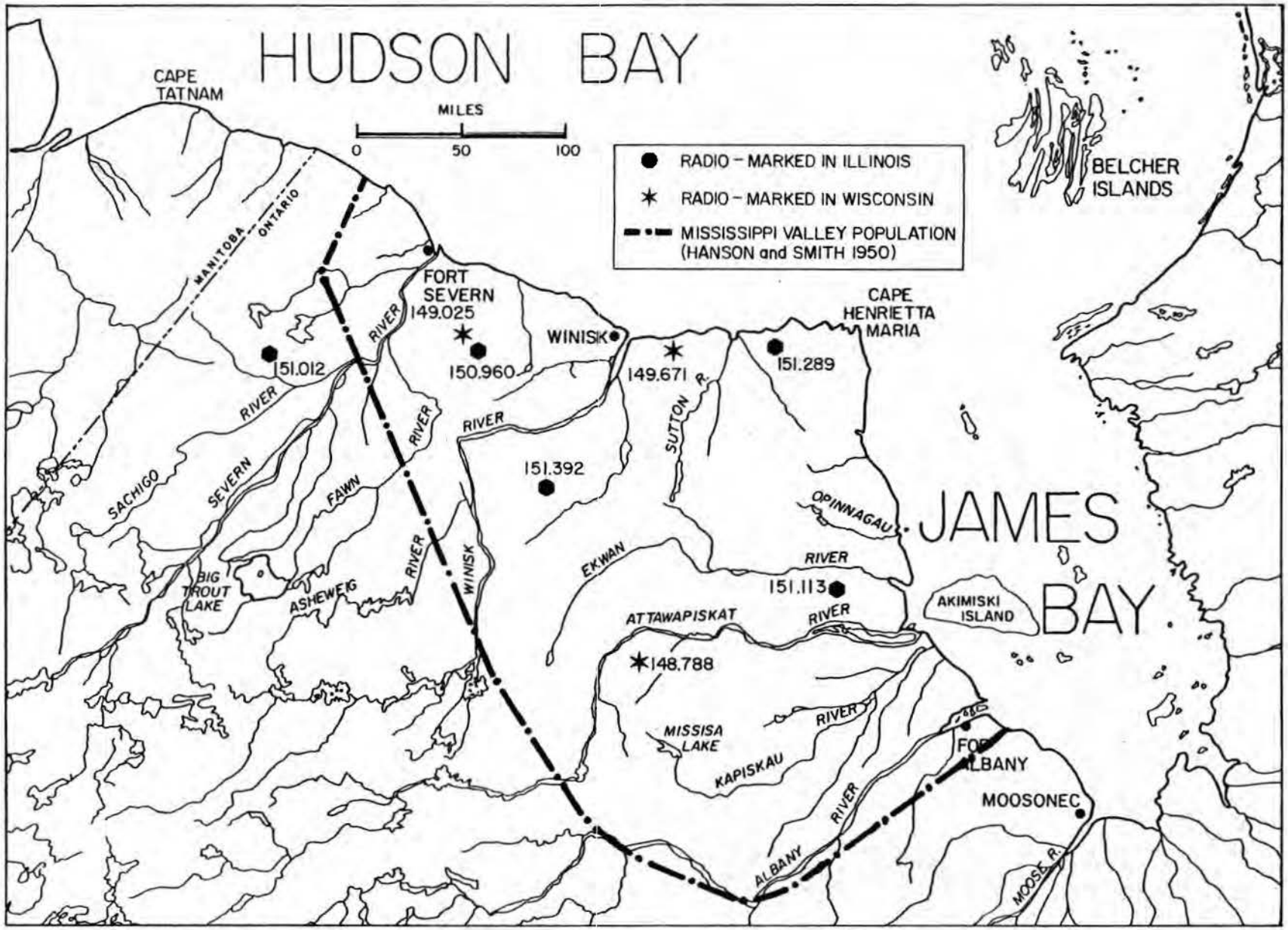


FIGURE 7. Location of radio-marked geese found on the Hudson Bay Lowlands.

Of the 8 radio-marked geese located, 5 were found within 50 miles of the coasts of James Bay and Hudson Bay. The habitat of this area is characterized by numerous potholes and abundant surface water (Fig. 8). Only 3 radio-marked geese were located within the interior of the Hudson Bay Lowlands. This region generally consisted of muskeg and spruce with large lakes and potholes (Fig. 9). All radio-marked geese were found in areas of numerous lakes and potholes, except for 1 goose which was located west of the Severn River in a rather dry area with just a few small potholes.

Although the sample was small, geese that were radio marked in either Illinois or Wisconsin in October and November were found together on the breeding grounds. According to this sample there does not appear to be any separation of the Illinois and Wisconsin segments on the breeding range. However, additional information is needed to further test this premise.

## BREEDING STATUS OF GEESE

Of the 8 radio-marked geese found, 5 were females of breeding age (3 or more years old), and all but 2 of these geese were seen in pairs. The 3 pairs that were seen appeared to be territorial and were assumed to be breeding pairs. The 2 geese that were not seen would not flush despite repeated low passes of the aircraft over the source of the radio signal. These geese were assumed to be incubating and reluctant to leave their nests.

A 2-year-old radio-marked female goose was also located and observed. It was paired with another goose but no nest was seen. Two of the radio-marked geese found were adult males (3 or more years old). Both of these geese were seen in pairs and appeared territorial. They were assumed to be breeding pairs.

All radio-marked geese seen appeared territorial and were reluctant to leave the area where they were found. Usually they would fly only a short distance before landing. One radio-marked goose was located on 3 consecutive days in the same area. Another was located on 2 consecutive days in the same area. A third radio-marked goose was relocated in the same area 9 days after it was first found. Because of these observations we assumed all located geese were nesting geese although none of the radio-marked geese were seen on nests.

No nests were located while searching for radio-marked geese in Ontario. However, some goose nests were found by personnel of the Wisconsin Cooperative Wildlife Research Unit by using a fixed-wing aircraft at low altitudes (less than 100 ft) on a study area near Cape Churchill, Manitoba (Rusch pers. comm. 1982). With additional searching at low altitudes, it may be possible to locate the nests of radio-marked geese in northern Ontario. This would be extremely important to determine the proportion of 2-year-old radio-marked geese that are both paired and nesting. However, this technique is untested with fixed-wing aircraft in the spruce and muskeg habitat in northern Ontario. Use of fixed-wing aircraft with floats or a helicopter to search for the nest in the area around a radio-marked goose may be more feasible and safer.

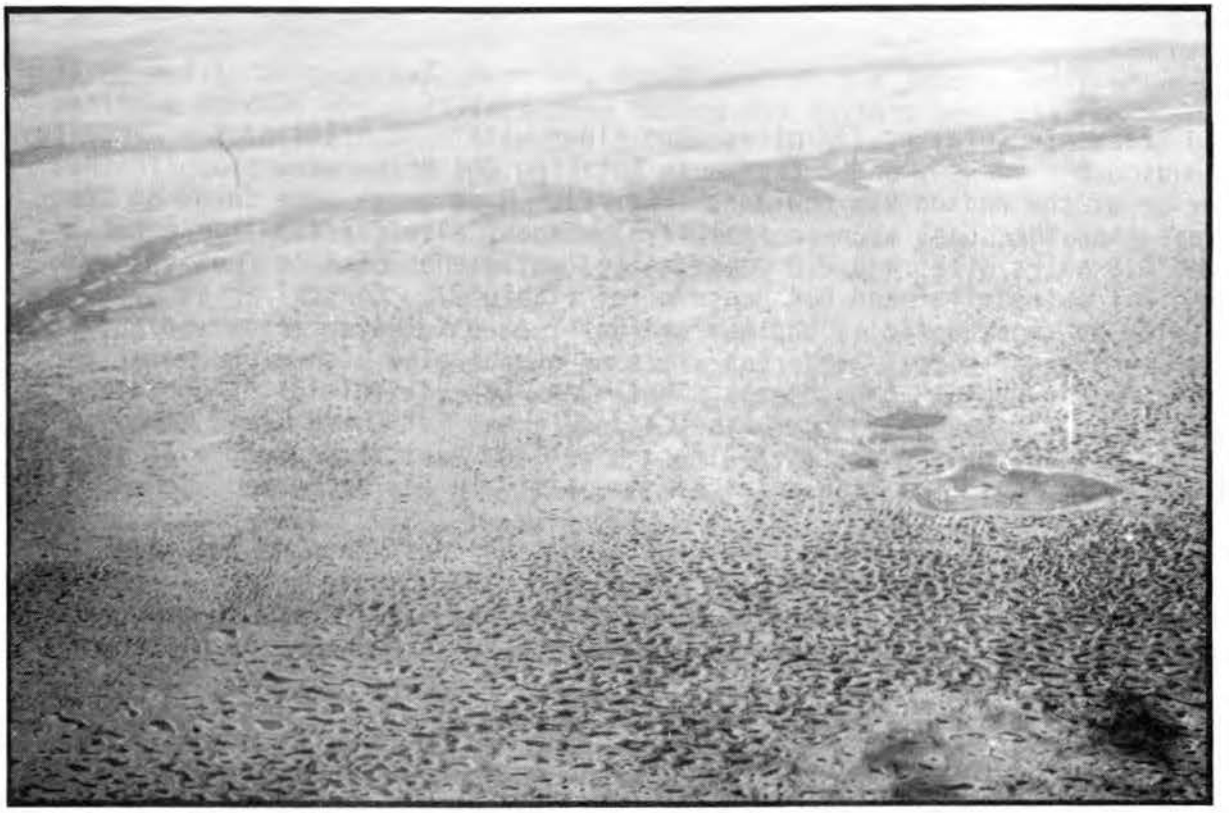

FIGURE 8. Most radio-marked geese were located in the coastal areas which are characterized by numerous potholes such as these near the James Bay coast.

FIGURE 9. The few radio-marked geese located in the interior of the Hudson Bay Lowlands were usually found in areas of lakes or potholes like these.

## DENSITY OF GEESE

Seven transects totaling 233 miles were flown within 50 miles of the James Bay and Hudson Bay coasts, and 7 transects totaling 204 miles were flown in the interior of the Hudson Bay Lowlands (Fig. 6). More geese were found on the surveys near the coast than on interior lowlands. The coastal transects showed 0.8 pairs/mile$^2$ and 2.8 geese/mile$^2$, while the interior routes showed 0.1 pairs/mile$^2$ and 0.4 geese/mile$^2$ (Table 2). Coastal areas typically had more potholes and surface water than interior areas and had a higher density of geese. Interior areas were generally higher and drier muskeg and spruce with less dense potholes and lakes (Table 3). Some areas in the interior did have numerous potholes and lakes, but these areas were not as continuous as along the coasts. Although wetland habitat seemed to be in ample supply, these interior areas had a relatively low density of geese.

More groups of geese were also observed along the coast than in the interior. Approximately 39% of the geese seen along the coast were in groups. While in the interior areas, 25% of the geese were in groups (Table 2). These groups of geese may have been nonbreeders and unsuccessful breeders that concentrated in the coastal areas.

TABLE 2. Canada goose densities on the Hudson Bay Lowlands in northern Ontario.

| Area Surveyed | Transect Length (miles) | No. Geese Seen | Percent in Pairs | Percent in Groups | Pairs/ mile$^2$ | Geese/ mile$^2$ |
|---|---|---|---|---|---|---|
| Coastal** | 233 | 290 | 61 | 39 | 0.8 | 2.8 |
| Interior | 204 | 40 | 75 | 25 | 0.1 | 0.4 |

*7 transects were flown in coastal areas and 7 in the interior of the Hudson Bay Lowlands (Fig. 4).
**Transects within 50 miles of the James and Hudson Bay coasts were considered coastal transects.

## SUMMARY

1. This study developed a survey procedure to locate radio-marked geese on the breeding grounds. Even though few radio-marked geese were found (due to poor sunlight conditions and poor performance of the solar-powered transmitters), the information gained encourages the continued use of battery-powered transmitters for studying Canada geese on the breeding grounds of northern Ontario.

2. Our findings indicate little change from the previously described breeding range of the Mississippi Valley goose population. However, no radio-marked geese were found more than 30 miles south of the Attawapiskat

River and 1 radio-marked goose was found west of the Severn River near the Manitoba border, which differs from Hanson and Smith's observations (1950). Additional work is needed to verify this range, especially north and west of the Severn River.

3. Separation of the Illinois and Wisconsin segments was not observed on the breeding range. Further testing is required.

4. Pair status of radio-marked geese was determined by aircraft. All radio-marked geese were assumed to be nesting geese although none were seen on nests. To positively determine nesting status of geese, nests should be located. These nests might be found with aircraft searches at lower altitudes (less than 100 ft) or use of a helicopter or fixed-wing aircraft with floats (once radio-marked geese are located). However, this technique of nest finding is untested in northern Ontario.

5. Too few 2-year old geese were located to adequately define their role in breeding; however, with the use of battery-powered transmitters and the procedures described in this paper, more could be learned about their role.

6. More pairs of geese, as well as groups of geese, were located in the coastal areas than in the interior Hudson Bay Lowlands. Pairs were widely scattered in the interior areas.

## MANAGEMENT CONSIDERATIONS

Use of telemetry techniques in conjunction with aerial surveys is feasible on the Hudson Bay Lowlands in northern Ontario. Using battery-powered transmitters (some lasting up to 2 years) and the procedure outlined in this report, the current range of the Mississippi Valley population could be delineated more accurately. Additional areas (north and west of the Severn River) could be included to further describe the breeding range. Battery-powered transmitters could be placed on geese in Wisconsin and Illinois in October to further test the separation of these segments on the breeding range the next spring, and pair status of 2-year-old radio-marked geese might be determined.

All of this information is important to the future management of the Mississippi Valley goose population. As the population of geese has greatly increased, substantial changes in the distribution of geese could also have taken place. If separation of the Wisconsin-Illinois segments could be further documented, the segments might be managed separately. To adequately set harvest quotas, the productivity of the population should be known and the proportion of 2-year-old geese that nest can have a large effect on the size of the breeding population.

TABLE 3. Results of density transects on the Hudson Bay Lowlands in northern Ontario in 1982.*

| Transect No. | Date | Transect Length (miles) | No. of Pairs | No. of Groups** | Total Geese | Pairs/ mile | Pairs/ $mile^2$ | Geese/ $mile^2$ | Habitat Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 28 May | 37 | 22 | 5 | 63 | 0.6 | 1.2 | 3.4 | Muskeg with scattered potholes. |
| 2 | 28 May | 44 | 10 | 0 | 16 | 0.2 | 0.5 | 0.7 | Muskeg mixed with spruce; some lakes, but mainly high, dry land. |
| 3 | 28 May | 14 | 5 | 5 | 35 | 0.4 | 0.7 | 5.0 | Spruce and muskeg with streams running through; few potholes. |
| 4 | 29 May | 67 | 29 | 6 | 79 | 0.4 | 0.9 | 2.4 | Much muskeg and many potholes in places; spruce decreases as go away from Winisk River. |
| 5 | 29 May | 47 | 14 | 4 | 41 | 0.3 | 0.6 | 1.7 | Muskeg and potholes with little spruce. |
| 6 | 3 Jun | 16 | 11 | 3 | 37 | 0.7 | 1.4 | 4.6 | Spruce-covered beach ridges with muskeg between ridges; more potholes and muskeg, and less spruce as go inland. |
| 7 | 4 Jun | 29 | 2 | 3 | 25 | 0.1 | 0.1 | 1.7 | Much spruce interspersed with potholes and some muskeg. |
| 8 | 4 Jun | 23 | 5 | 0 | 10 | 0.2 | 0.4 | 0.9 | Dry muskeg and spruce with few potholes; last quarter of transect has more potholes. |
| 9 | 5 Jun | 23 | 0 | 0 | 0 | | | | Dry muskeg and spruce with widely scattered, deep lakes (Canadian shield country). |

TABLE 3. (Continued)

| Transect No. | Date | Transect Length (miles) | No. of Pairs | No. of Groups** | Total Geese | Pairs/ mile | Pairs/ $mile^2$ | Geese/ $mile^2$ | Habitat Description |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 5 Jun | 29 | 0 | 0 | 0 | | | | High, dry muskeg and spruce with large potholes and streams connecting them. |
| 11 | 5 Jun | 29 | 0 | 0 | 0 | | | | High, dry muskeg and spruce, no large potholes, only small shallow ponds. |
| 12 | 6 Jun | 23 | 3 | 2 | 20 | 0.1 | 0.3 | 1.7 | Muskeg and spruce; many potholes. |
| 13 | 7 Jun | 16 | 0 | 0 | 0 | | | | Muskeg and string bogs; few spruce; many small potholes, but few large lakes. |
| 14 | 9 Jun | 40 | 2 | 0 | 4 | 0.1 | 0.1 | 0.3 | High, dry muskeg and spruce; many string bogs. |

*All density transects were flown at an altitude of 200 ft and a speed of 140 mph. All geese 1/4 mile on either side of the aircraft were counted.

**Group size ranged from 3-10 geese/group.

## APPENDIX A. Spurious Signals

Several spurious signals resembling radio transmitter signals were picked up by the receiving equipment. Pulsing signals like that of a goose transmitter were received from 149.900 to 150.050 kHz. However, with fine tuning the signals became an intermittent or even an constant tone. Another set of signals received from 149.925-149.975 kHz pulsed once every 10 seconds and kept changing pitch. These signals may have been transmitted from a signal buoy, since the signals were coming from Hudson Bay. These spurious signals were received many times from all parts of the breeding range. Therefore, future telemetry work in this region should avoid this range of frequencies to prevent confusion with transmitters.

## LITERATURE CITED


Craven, S. R.
1978. Distribution, migration, and survival of MVP Canada geese associated with east-central Wisconsin. Univ. Wis.-Madison, PhD Thesis. 135 pp.

Craven, S. R. and D. H. Rusch
1983. Winter distribution and affinities of Canada geese marked on Hudson and James Bays. J. Wildl. Manage. 47(2):307-19.

Crissey, W. F.
1968. Informational needs for Canada goose management programs. Pp. 141-47 in Canada Goose Management. R. L. Hine and C. Schoenfeldt, eds. Dembar Educ. Res. Serv., Madison, Wis.

Hanson, H. C and R. H. Smith
1950. Canada geese of the Mississippi Flyway with special reference to an Illinois flock. Ill. Nat. Hist. Surv. Bull. 27:67-210.

Kaczynski, C. F.
1966. Canada goose surveys in eastern Canada--Progress Report, 1956, 1962-65. U.S. Fish and Wildl. Serv. Admin. Dep. 105. 16 pp.

Kennedy, D. D. and G. C. Arthur
1974. Subflocks in Canada geese of the Mississippi Valley population. Wildl. Soc. Bull. 2:8-12.

Raveling, D. G.
1969. Roost sites and flight patterns of Canada geese in winter. J. Wildl. Manage. 32(2):319-30.

Reeves, H. M., H. H. Dill, and A. S. Hawkins.
1968. A case study in Canada goose management: the Mississippi Valley population. Pp. 150-65 in R. L. Hine and C. Schoenfeldt, eds. Canada Goose Management. Dembar Educ. Res. Serv., Madison, Wis.

Trost, R. E., D. H. Rusch, and V. R. Anderson
1982. Population affiliation of Canada geese associated with Ballard County, Kentucky. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 35:49-58.

U.S. Fish and Wildlife Service
1979. Management plan for the Mississippi Valley population of Canada geese 1979-83. U.S. Fish and Wildl. Serv. Off. Migr. Bird Manage. 51 pp.

Vaught, R. W. and G. C. Arthur
1965. Migration routes and mortality rates of Canada geese banded in the Hudson Bay Lowlands. J. Wildl. Manage. 29:244-52.

ACKNOWLEDGEMENTS

We wish to thank W. Anderson, D. Thornburg, and T. Miller of the Illinois Department of Conservation who provided helpful suggestions for the project and were responsible for obtaining funding. W. Anderson also reviewed the manuscript. P. Previtt and F. Johnson, Ontario Ministry of Natural Resources, provided logistic arrangements and shared their knowledge of the Hudson Bay Lowlands. H. Lumdson, Ontario Ministry of Natural Resources, provided many helpful suggestions in planning the project. H. Hanson, Illinois Natural History Survey, shared his experience on the Hudson Bay Lowlands and aided in planning the search. G. Montgomery, Ontario Ministry of Transportation and Communications, was a most gracious host and provided logistic support at Winisk, Ontario.

S. Tonkewitz, Telonics, Inc., helped design the receiving system and loaned a programmable receiver to the project. O. Rongstad, University of Wisconsin-Madison, and R. Andersen, University of Wisconsin-Stevens Point, graciously loaned their programmable receivers as back-up equipment. D. Joyner and his graduate students at Southern Illinois University captured and radio marked the geese banded in 1981 and 1982 in Illinois and provided us with the frequencies of these geese. D. Rusch, Wisconsin Cooperative Wildlife Research Unit (WCWRU), provided many helpful suggestions for the project. R. Trost, WCWRU, helped design the project, provided statistical advice, reviewed the manuscript, and captured and radio marked the geese in Illinois and Kentucky in 1980. R. Kahl, W. Vander Zouwen, and L. Vine provided valuable observations of radio-marked geese and the performance of solar-power transmitters.

We especially want to thank R. Hunt for his many helpful suggestions in the planning and execution of this project, his review of the manuscript, and his support throughout the study.

This research was funded by the Illinois Department of Conservation.

Editors: Charmaine Daniels
Lori Goodspeed
Copy Editor: Gloria Wienke
Word Processor: Sue Holloway
Graphic Artist: Richard Burton