

CANADIAN WILDLIFE SERVICE
P. O. BOX 1590
SACKVILLE, N. B.
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REPORT
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1968

AN AERIAL SURVEY OF THE ISLAND OF NEWFOUNDLAND

APRIL 30 - MAY 14, 1968.

TO ASSESS THE RELATIVE ABUNDANCE AND DISTRIBUTION OF
WATERFOWL AND OTHER SPECIES.

D. I. GILLESPIE - DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT,
CANADIAN WILDLIFE SERVICE.

B. ROBERTS - DEPARTMENT OF MINES, AGRICULTURE AND RESOURCES,
PROVINCE OF NEWFOUNDLAND AND LABRADOR.

INTRODUCTION

A comprehensive aerial survey was flown across insular Newfoundland early in May 1968. Although the survey was designed to provide information on the distribution and relative abundance of the Canada goose Branta canadensis, it has also provided other descriptive material on a variety of species. These additional data are included in this report.

ACKNOWLEDGEMENTS

We would like to acknowledge the skills of the pilot of the aircraft, Mr. Alan McDonald, who succeeded in keeping us on course despite the caprices of Mother Nature. His ability to fly, navigate and spot geese made our work much easier than we imagined it would be.

Since this was a co-operative venture between the Canadian Wildlife Service and the Province of Newfoundland and Labrador ARDA ungulate study group, we would like to thank our supervisors who knowingly or unknowingly agreed to the participation.

METHODS USED

The survey was carried out in a Cessna 180 flown at an average air speed of 100 mph. The crew consisted of pilot-navigator and two observers. Survey lines, running east and west and spaced fifteen minutes of latitude apart, were drawn on Department of National Defence Series A501 topographical maps, scale 1:250,000. Observations were recorded, in flight, directly on the prepared maps. Between line observations were also recorded and the

flight paths charted, but because of the biases involved in this part of the survey this information is treated separately and is used only for descriptive purposes.

We surveyed intensively, along predetermined flight lines four special survey plots totalling approximately 1500 square miles. These plots were located in different cover types and were selected independently by the ARDA ungulate survey group of the Provincial Government.

The largest concentration of nesting Canada geese was located in the Swift Current area along the 48th parallel of N. latitude between the meridians of W. longitude 54°00' and 55°30'. To determine the extent of the area occupied by this large concentration and to assess the relative density of this group of birds, we mapped out an area between the parallels of N. latitude 47°45' and 48°15' and the meridians of W. longitude 54°00' and 55°30' and flew it on lines approximately four miles apart.

Map 1 shows the survey lines flown and the four special plots examined during the course of the survey which began on April 30, 1968 and ended May 14, 1968. The Swift Current area was flown on May 23, 1968.

SURVEY RESULTS

For the balance of this report the information will be grouped under three headings:

1. Established Survey Lines - The original survey that was flown along lines running east and west across the island, at intervals of fifteen minutes of latitude.

2. Special Survey Plots - Four plots made up of seven 1:50,000 Series A781 topographical sheets involving four different cover types and examined primarily for the purposes of the Provincial ARDA ungulate group.

3. The Swift Current Area - An area flown intensively, after all other flying had been completed, because this area supported the largest concentration of nesting geese observed.

1. Established Survey Lines

A total of 2400 linear miles or 600 square miles of survey lines were flown across the island. Along these lines 147 Canada geese were observed. The observations consisted of 20 individual birds, 33 pairs and 61 in groups of three or more. Map 2 shows the distribution of the breeding birds recorded along the survey lines while Map 3 shows the distribution of non-breeding birds. The heaviest concentration of nesting geese was recorded in the southeastern part of the island at approximately 48°00' N. latitude and 54°40' W. longitude. The largest group of non-breeding birds, 13, was recorded on the tidal flats of Hare Bay at 51°15' N. latitude and 56°00' W. longitude. Table 1 shows the flight line data of the established survey, grouped geographically into fifteen minute sections of longitude. It should be noted that this table outlines diagrammatically the portion of the island flown in this survey. In addition to the Canada geese, 610 ducks, 69 moose Alces americana and 178 caribou Rangifer caribou were recorded along the flight lines. These data appear in Table 2 with the data collected

on the flight lines charted between the original survey lines. Although the latter data have the bias of subjectivity we did collect considerable descriptive information from them. The most significant observations were the 200 Canada geese seen at Parson's Pond 50°00' N. latitude 57°35' W. longitude and the 22 Canada geese seen at the estuary of the Grand Codroy River 47°50' N. latitude and 59°20' W. longitude.

2. Special Survey Plots

A total of 26 Canada geese consisting of four individuals, seven pairs and eight in groups of three or more, were recorded on the lines flown over the four plots. The total surveyed area, along the flight lines, was 137.5 square miles. These data also appear in Table 2.

3. The Swift Current Area

The total area of the Swift Current plot was 2250 square miles. We sampled it at a rate of 7% or 157.5 square miles along the flight lines. Along the lines 25 individual Canada geese, 23 pairs and 41 in groups of three or more were recorded. The data collected on this plot are grouped according to fifteen minute intervals of longitude in Table 3. Map 4 shows the distribution of the observations.

Within an area centred at a monadnock, locally called the Tolt,

(48°01' N. lat., 54°40' W. long.), and with a radius of 12 miles we recorded 25 breeding pairs of geese along 25 square miles of survey lines. This area of major concentration also appears on Map 4.

We did not observe any broods of geese on any of our flights.

On May 23, when geese were disturbed on their nests, we were able to see eggs.

POPULATION DENSITIES

In our calculations we consider that the observations of an individual bird represents the presence of a pair and that birds in groups of three or more are non-breeding birds.

1. Established Survey Lines

The 2400 miles of survey lines across the 42,734 square miles of insular Newfoundland produced evidence of 53 pairs of breeding Canada geese (20+33) and a breeding bird density of 8.8 pairs per 100 square miles. Our observations, therefore, suggest a breeding population index of 3,761 pairs of geese for the island of Newfoundland.

The survey also produced observations on 61 non-breeding birds. This provides a spring density of 10.2 non-breeding Canada geese and a total population index of 4,359 non-breeding birds.

2. Special Survey Plots

There were eleven pairs of breeding Canada geese (4+7) observed along the 135.7 square miles of survey lines covered in the four plots. The breeding bird density from these data is 8.1 pairs per 100 square miles.

A non-breeding bird density of 5.9 birds per 100 square miles has been calculated from the observations of eight non-breeding birds.

Only two of the plots provided breeding geese and only three of the plots any geese at all. The White Bear plot (number 1 on Map 1) was the most southerly plot flown. It produced observations on seven pairs of geese and a density of 16.9 pairs per 100 square miles (41.3 square miles of flight lines were flown in this plot).

The Burnt Pond plot (number 2 on Map 1) was located immediately above White Bear and its northern portion provides a transition between the barrens and the forest region. On this plot we examined 35.4 square miles of flight lines and located four pairs of nesting geese and a density of 11.3 pairs per 100 square miles.

The Wiguels Lake plot (number 3 on Map 1) is largely a burnt over forest plot. No breeding geese were seen on this plot. There were three non-breeding birds located along 35.4 square miles of survey lines.

The Blue Mountain plot (number 4 on Map 1) is an alpine barrens situation. No geese were seen on this area that has an average altitude of 2000 feet. We flew 23.6 square miles of survey lines across this area.

3. The Swift Current Area

This area produced 48 pairs (23+25) of breeding Canada geese along

157.5 square miles of survey lines and a density of 30.5 pairs per 100 square miles.

The 41 birds seen in groups of three or more provided a non-breeding bird density of 26.0 birds per 100 square miles.

Map 4 indicates that the density of breeding birds is at its maximum in the vicinity of the Tolt. Within the circle we have described around this structure, an area of 375 square miles, we examined 25 square miles of survey lines and discovered 25 nesting pairs. The density of this area is 100 pairs of breeding birds per 100 square miles. No non-breeding birds occurred within the 375 square mile area, although 29 birds in five groups were located just outside its periphery.

DISCUSSION

The 1968 aerial survey of insular Newfoundland has provided us with new information and cause for much thought. A breeding population density, for Canada geese, considerably lower than that calculated previously was found; a local area of remarkably high density was encountered and outlined; the distribution of the Canada goose population on the island of Newfoundland has been sketched; an interesting relationship between the utilization of the barrens by geese and caribou has been noted; a new location with perhaps some potential for banding operations was examined; some problems of counting other species of waterfowl were encountered; the distribution of moose and caribou during early May 1968 was described; an early observation of caribou calving was noted; and generally the survey met most of the objectives we set out while planning the project.

There are no recent aerial surveys of Newfoundland's breeding waterfowl populations available for comparison with our work. The first aerial survey of any consequence, to be flown over the island, was made on May 14 and 15, 1954 by U.F. Crissey and F.A. Glover of the U.S. Fish and Wildlife Service. Their two flights, over and back, shown on Map 5 covered a distance of 612 linear miles. They saw 51 Canada geese on their transects and calculated a density of 33 breeding geese per hundred square miles. In correspondence accompanying the calculations Crissey remarked that, on the assumption the transects were representative of the island, the breeding population index (in 1954) was about 14,000 Canada geese.

The following year, 1955, the central portion of the island was flown by L.M. Tuck. Map 6 shows the area examined by this survey. From the data collected along the 805 miles of survey lines Tuck estimated that, at that time of the year, April 22 to 26, 1955, the population index of the interior of the island was 40,000 geese of which 30,000 were already paired.

The survey, carried out in 1968, was designed to provide data that would allow statistical inference. All the established flight lines were flown with the exception of about 100 miles, most of which fell across the Burin Peninsula. This portion of the survey was not flown because of inclement weather.

The ten mile to an inch (1:633,600) map of Newfoundland, used for the consolidation of our information provided a grid for analyzing the data. It is divided into 15 minute blocks outlining the limits of the Series A781 topographical sheets. The parallels of latitude, located at 15 minute intervals, describe our flight lines while the meridians of longitude, also

at 15 minute intervals, provide the boundaries of units used to analyze the data. The 2400 miles of flight lines are divided in this way, into 209 sections, each approximately 11.5 miles long. Tables 1 and 6 use this grid for describing the distribution of Canada goose and caribou-moose observations. Maps 7 and 8 also use this grid in describing goose and caribou distribution on the occurrence of occupied segments.

The 53 pairs of breeding Canada geese, observed in 209 sections of the flight lines provide a mean of .254 pairs. The low population density is reflected in the data which are asymmetrical and are skewed towards zero. The 95% confidence limits provide a range of .225 to .283 pairs per section and extrapolating from this, the population parameters fall between 3349 and 4213 pairs of breeding Canada geese.

The ratio of breeding birds to non-breeding birds was 1.74 to 1, according to the observations made along the established flight lines. If we apply this ratio to the statistics, the estimated population index of Canada geese for the island of Newfoundland in May 1968 falls somewhere between 10,547 and 13,269 birds.

The Swift Current area probably supports the heaviest density of breeding Canada geese on the island of Newfoundland. Using the same system of sampling, we recorded 48 pairs of breeding Canada geese on 53 sections of flight lines. These observations provide a mean of .91 pairs per section. The 95% confidence limits of this population are .56 to 1.26 pairs per section and the total number of pairs for the area falls between 424 and 954.

The obvious question is, why this high density of breeding birds? Dr. Tuck, in a discussion of our data, suggested that perhaps this flock is

the progeny of a group of birds his father maintained at Shoal Harbour (48°03' N. lat., 53°58' W. long.) and ultimately released to the wild. If this is so it should be relatively easy to prove as the geese return each spring and fall to Shoal Harbour. They are relatively tame and could be baited in, marked and released. With colour markers we should be able to locate them on the Swift Current area, if this is where they go to nest.

If Dr. Tuck's hypothesis is correct it would provide an interesting management experiment. There are extensive areas of barrens along the southern shore of the island, which, on our survey, looked similar to the Swift Current area yet supported, apparently, considerably lower numbers of geese. If the reasoning is correct we could establish a pinioned flock in one of these areas of low density to see if the population would respond in the manner suggested.

We noted, in our flights over the barrens, that in the area of maximum goose density the caribou density was not high and in the area of maximum caribou density the goose density was not high. The special survey plots 1 and 2 (the White Bear plot and the Burnt Pond plot) provided 14 pairs of Canada geese per hundred square miles and 200 caribou per hundred square miles. The Swift Current area, one hundred miles east and at the same latitude as the special sample plots showed 31 pairs of Canada geese and 17 caribou per hundred square miles.

When the distribution of the two species was mapped according to the occurrence of the species in the grid segments there was very little overlap in the observations. Breeding Canada geese were found in 37 of the 209 grid segments and caribou in 35. If May 7, showing the goose distribution, is

superimposed on Map 8, which shows the caribou distribution, it will be seen that there is overlap in only seven segments. The maps also indicate a more westerly distribution of caribou in comparison to the goose distribution. Perhaps there is a difference in the quality of the barrens that determines this apparent preference of the two species.

Two areas on the island have been exploited in the past for the banding of waterfowl - the Grand Godroy River at Upper Ferry (47°50' N. lat. and 59°15' W. long.) and Birchy Basin (49°30' N. lat and 57°05' W. long.). The former was quite productive but created some difficulty with local hunters, while the latter was not too productive. Neither was a source of geese.

Parson's Pond located on the west coast of the Northern Peninsula at 50°00' N. lat., 57°55' W. long. has been frequently mentioned as an interesting area for migrant birds. It lies in a band of post glacially uplifted marine sediments, covers an area of about 16 square miles and exhibits a tidal shoreline of about 25 miles. It is surrounded by a tremendous number of bogs.

Last winter between 200 and 300 Canada geese and perhaps 50 black ducks wintered there. We flew over portions of the pond twice during the course of our survey and recorded on one occasion 200 Canada geese in several small flocks and numerous small groups of black ducks. We made no attempt to cover the area intensively, but on the basis of our casual flights it was apparent that the area was fairly heavily utilized by waterfowl. The mud flats that surrounded the pond appeared to be suitable for the establishment of duck traps and for the use of cannon nets in capturing geese. It is well situated as a stopping place for migrant birds and its apparent productive capability suggests it could provide nesting birds. The 1967 hunter returns indicate

that it is a preferred hunting area but if the plans for the establishment of a new national park in the area are finalized, the problem of hunting in the area will be eliminated.

Besides Canada geese, we recorded observations on six other species of waterfowl. In total, there were 610 ducks seen. We were unable to identify 78 or about 13% of the ducks. Inexperience on the part of the crew and the roughness of the terrain over which we were flying probably accounts for this relatively high proportion of unknowns.

The common goldeneye, Glaucionetta clangula was the most commonly recorded species followed by two species of mergansers, the common merganser, Mergus merganser and the red-breasted merganser, Mergus serrator, the black duck, Anas rubripes, ring-necked duck, Aythya collaris and the green-winged teal, Anas carolinensis.

There were 72 black ducks seen consisting of 19 individual birds, 9 pairs and 35 in groups of three or more. We attempted to calculate confidence limits for the black ducks but our sample size is hardly adequate. The 95% confidence limits were .083 to .185 pairs of blacks per segment or for the island of Newfoundland the range is 1,235 to 2,754 pairs.

There are no comparable surveys of Newfoundland with which we might check our data, but L.M. Tuck, in 1950, flew 486 miles of survey lines over the Gander area and calculated a black duck density of one pair per 100 square miles and a total duck density of 56 pairs per hundred square miles. Crissey and Glover reported, in their correspondence, that they saw 186 ducks in their flights across the island, of which 21 or 11% were black ducks. Their ratio of black ducks to all ducks seen is reasonably close to our records, suggesting that at least as far as black ducks are concerned, we are not too inexperienced.

It will be noted in Table 2 that we recorded relatively fewer unidentified ducks on the "Coastal Lateral" and "Inland Lateral" flight lines. This can be explained by our method of flying. On these tangential lines we actually nursued the birds to determine species and to make accurate counts. On a limited survey, this type of flying would probably be efficient but on such an extensive survey where time and cost are also a consideration, the pursuit method had to be discarded.

We have already noted that this survey was a co-operative venture between the Canadian Wildlife Service and the Province of Newfoundland and Labrador APDA ungulate survey group. In our early planning we agreed to survey intensively four separate areas in the course of our flying in exchange for the services of Mr. Roberts as a second observer for the island wide survey. On a test run, made in late April, we decided that we could record without any loss of efficiency, all observations of waterfowl and ungulates on all lines flown. The information we recorded has provided us with a detailed description of the island's ungulate population, particularly that of the caribou herds.

Map 3, as indicated before, records the occurrence of caribou in the flight line segments. Map 9 shows a numerical distribution of the caribou seen.

On May 23, 1968 at 48°06' N. lat. and 54°45' W. long. we recorded two adult caribou with this year's calves. This is an early record for calving on the main body of the island.

When planning the survey we drew the flight lines on a map, recorded where gas caches were located and discussed flight plans with the pilot. Our original estimate of the time required to fly the survey was 35 hours at a total cost of \$2100. When it was decided to participate with the

provincial agency our estimated time had to be increased. We actually flew 51 hours and 40 minutes at a cost of \$3100. The Province of Newfoundland and Labrador ARDA ungulate study group assumed the cost for flying the special plots (12.5 hours for \$750) and brought our survey cost back within the predicted level (\$2350.). The Swift Current area was flown separately at a cost of \$365.

We recommend that the same survey should be repeated in 1969, and preferably with the same crew. Perhaps certain selected areas that the statisticians might suggest should also be flown in the hopes that they could prove to be indices of our waterfowl populations.

We also recommend, if the survey is repeated in 1969, that more detailed planning should be carried out in an effort to eliminate, as much as possible, uncharted flying. The tangential flights could possibly be predetermined with alternates to allow for weather.

REFERENCES:

- Crissey, M.F. and F. Glover, 1954. A summary of observations made in a flight across Newfoundland on May 14 and 15, 1954. Letter on file.
- Tuck, L.M., 1950. Waterfowl breeding ground survey in Newfoundland. Special Scientific Report, 8:85-86.
- 1952. Waterfowl breeding survey in Newfoundland. Special Scientific Report, 21:119-122.
- 1953. Waterfowl breeding ground studies in Newfoundland. Special Scientific Report, 25:133-135.
- 1954. Waterfowl breeding ground studies in Newfoundland. Special Scientific Report, 27:149-155.

----- 1956. Canada goose survey April - Newfoundland 5 pages 2 figures,
map. Report on file.

SUMMARY

1. An aerial survey of the island of Newfoundland was flown during the period April 30 to May 14, 1968.
2. The Swift Current area where we observed maximum goose density was flown again, on a more intensive scale, on May 23, 1968.
3. Along established flight lines totalling 2400 linear or 600 square miles, we recorded 147 Canada geese consisting of 20 individuals, 33 pairs and 61 birds in groups of three or more.
4. On four special survey plots 26 geese (four individuals, seven pairs and eight in groups of three or more) were recorded along survey lines totalling 137.5 square miles.
5. The area of maximum goose density, the Swift Current area, produced 112 Canada geese (25 individuals, 23 pairs, and 41 in groups of three or more). The area surveyed was 2250 square miles and the flight lines sampled 7% of it or 157.5 square miles.
6. No broods of Canada geese were seen on the survey.
7. The density of Canada geese on the island of Newfoundland, according to the observations made on the established flight lines, in May 1968, was 8.3 pairs per 100 square miles, while the non-breeding bird density was 10.2 per 100 square miles.
8. 95% confidence limits place the island's Canada goose population (breeding birds) between 3349 and 4213 pairs.

9. The density of the breeding Canada geese recorded on the special survey plots was 8.1 pairs per 100 square miles.
10. The Swift Current area had a breeding density of 30.5 pairs of Canada geese per 100 square miles and a non-breeding bird density of 26.0 per 100 square miles.
11. Within a limited area of the Swift Current area the density of breeding birds was 100 pairs per 100 square miles. This area covered 375 square miles.
12. There appears to be a difference in the relative utilization of the barrens by caribou and geese. In areas of high caribou density the goose density is low and vice versa.
13. Parson's Pond on the west coast of the Northern Peninsula may have some potential as an area for banding ducks and geese.
14. Six species of ducks were noted in our flight records and a total of 610.
15. Black ducks constituted 11.8% of the ducks seen but their sample size was too small to base confidence limits on.
16. Two caribou calves were noted on May 23, 1968, an early observation of calving in Newfoundland.
17. The survey cost the Canadian Wildlife Service \$2350.
18. We recommend that the survey should be flown again in 1969 with the same crew, if possible.

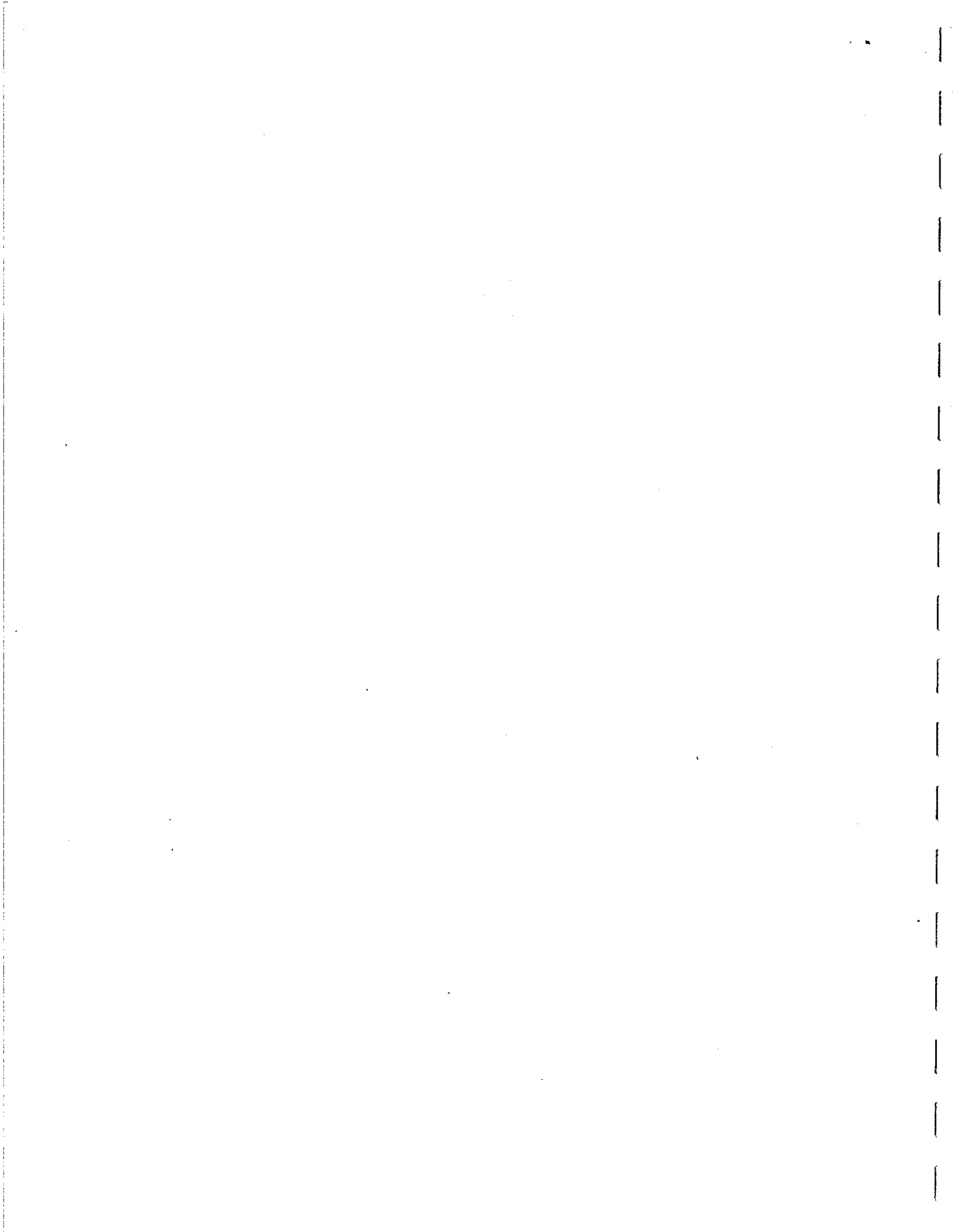


TABLE 1 (WEST HALF). FLIGHT LINE DATA GROUPED IN 15 MINUTE SECTIONS OF LONGITUDE -
 FLOWN APRIL 30 TO MAY 14, 1968.

TOTAL	-	-	-	-	1/2	0/1	$\frac{2/0}{5}$	$\frac{0/1}{3}$	$\frac{1/5}{3}$	$\frac{2/0}{6}$	0/2	$\frac{0/2}{6}$	$\frac{2/2}{25}$	TOTAL LGTH. OF LINES	N.LAT.
$\frac{0/0}{4}$													$\frac{0/0}{4}$	30	30'
$\frac{1/3}{21}$											0/1	$\frac{0/1}{3}$	$\frac{1/1}{18}$	33	15'
0/1											0/1	-	-	52	51°
-														50	45'
$\frac{0/0}{3}$													$\frac{0/0}{3}$	51	30'
-														48	15'
0/5									0/4				0/1	66	50°
-														78	45'
$\frac{1/0}{8}$							$\frac{0/0}{5}$			1/0			$\frac{0/0}{3}$	162	30'
$\frac{1/1}{6}$									$\frac{1/1}{3}$	$\frac{0/0}{3}$				212	15'
-														214	49°
0/1								0/1						222	45'
1/1							1/0						0/1	245	30'
$\frac{1/1}{3}$					1/1			$\frac{0/0}{3}$						216	15'
$\frac{2/1}{3}$					0/1					$\frac{1/0}{3}$			1/0	276	48°
1/1						0/1	1/0							255	45'
														52	30'
														56	15'
														52	47°
														30	46°45'
W.LONG. 15'		45'	30'	15'		45'	30'	15'		45'	30'	15'			
	59°				58°				57°				56°		

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TABLE 1 (EAST HALF). FLIGHT LINE DATA GROUPED IN 15 MINUTE SECTIONS OF LONGITUDE -
FLOWN APRIL 30 TO MAY 14, 1968.

TOTAL	$\frac{1}{0}$	1/2	2/1	0/1	3/5	3/3	1/1	0/3	-	-	-	$\frac{0}{0}$	-	-	TOTAL LGTH. OF LINES	N. LAT.
-	$\frac{4}{4}$	-	-	-	-	-	-	-	-	-	-	$\frac{13}{13}$	-	-	30	30'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	15'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	51°
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	45'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	30'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	15'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	50°
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78	45'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	30'
1/1	1/0	-	-	-	-	-	-	0/1	-	-	-	-	-	-	212	15'
0/1	-	-	-	-	-	0/1	-	-	-	-	-	-	-	-	214	49°
1/4	-	0/1	1/0	-	0/2	-	-	0/1	-	-	-	-	-	-	222	45'
1/3	-	0/1	1/0	-	-	-	0/1	0/1	-	-	-	-	-	-	245	30'
2/2	-	1/0	-	-	0/2	1/0	-	-	-	-	-	-	-	-	216	15'
7/6	-	-	0/1	0/1	3/1	3/2	1/1	-	-	-	-	-	-	-	276	48°
0/1	-	-	-	-	0/1	-	-	-	-	-	-	-	-	-	255	45'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	30'
$\frac{0}{0}$	$\frac{9}{9}$	-	-	-	-	-	-	-	-	-	-	$\frac{0}{0}$	-	-	56	15'
$\frac{0}{0}$	$\frac{4}{4}$	-	-	-	-	-	-	-	-	-	-	$\frac{0}{0}$	-	-	52	47°
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	46°45'
W. LONG.	45'	30'	15'		45'	30'	15'		45'	30'	15'		45'	30'		
				55°				54°				53°		52°		

$\frac{1}{1}$ = $\frac{\text{SINGLE/PAIR}}{\text{GROUP OF 3 OR MORE}}$

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TABLE 2. DATA COLLECTED DURING AERIAL SURVEY APRIL 30 to MAY 14, 1968.

Type of survey line	Total length miles	Area sq.miles	Geese	Black duck	Mergansers	Common Goldeneye	Unidentified ducks	Moose	Caribou
Established	2400	600	147	72	170	290	78*	69	178
Coastal lateral	340	85	6	27	13	37	13	-	-
Inland lateral	436	109	241	48	73	171	14**	10	31
Special ARDA plots	550	135.7	26	-	12	1	12	61	174
TOTAL	3732	929.7	420	147	268	499	117**	140	383

* 8 Identified Ring-necked ducks included

**4 Identified Green-winged teal included

TABLE 3. SWIFT CURRENT FLIGHT LINE DATA GROUPED IN 15 MINUTE SECTIONS OF LONGITUDE, FLOWN MAY 23, 1968.

TOTAL	$\frac{3/1}{8}$	$\frac{0/2}{4}$	$\frac{7/6}{4}$	$\frac{13/10}{16}$	$\frac{3/2}{9}$	$\frac{0/2}{0}$	N. LAT.
$\frac{1/2}{0}$	-	-	$\frac{0/2}{0}$	$\frac{1/0}{0}$	-	-	48°1500
$\frac{2/0}{12}$	$\frac{0/0}{8}$	$\frac{0/0}{4}$	-	$\frac{2/0}{0}$	-	-	1115
$\frac{3/1}{0}$	$\frac{1/0}{0}$	-	$\frac{0/1}{0}$	$\frac{2/0}{0}$	-	-	730
$\frac{4/4}{0}$	$\frac{2/0}{0}$	-	$\frac{2/0}{0}$	$\frac{0/2}{0}$	$\frac{0/1}{0}$	$\frac{0/1}{0}$	345
$\frac{7/6}{0}$	$\frac{0/1}{0}$	$\frac{0/1}{0}$	$\frac{2/1}{0}$	$\frac{4/2}{0}$	$\frac{1/1}{0}$	-	48°0000
$\frac{2/5}{5}$	-	-	-	$\frac{1/4}{0}$	$\frac{1/0}{5}$	$\frac{0/1}{0}$	5615
$\frac{4/1}{4}$	-	-	$\frac{1/1}{0}$	$\frac{3/0}{0}$	$\frac{0/0}{4}$	-	5230
$\frac{2/3}{20}$	-	-	$\frac{1/0}{4}$	$\frac{0/3}{16}$	$\frac{1/0}{0}$	-	4845
$\frac{0/1}{0}$	-	-	$\frac{0/1}{0}$	-	-	-	47°4500
W. LONG.	55°15	55°00	54°45	54°30	54°15	54°00	

TABLE 4. FLIGHT LINE DATA GROUPED IN 18 MILE STATISTICAL SEGMENTS.

Flight line	Parallel of lat.	0 Geese	1 Pair	2 Pairs	3 Pairs	4 Pairs	6 Pairs
A		2					
B	47°	3					
C		3					
D		3					
E		11	3				
F	48°	8	3		1	1	1
G		10	3		1		
H		9	4	1			
J		7	2	2			
K	49°	11	1				
L		9	2	1			
M		8	1				
N		4					
O	50°	1	1	2			
P		2					
Q		3					
R		2					
S	51°	2	1				
T			1		1		
U		1					
TOTALS		99	22	6	3	1	1

TABLE 5. FLIGHT LINE DATA (SWIFT CURRENT AREA) GROUPED IN 18 MILE STATISTICAL SEGMENTS.

Flight line	0 Geese	1 Pair	2 Pairs	3 Pairs	4 Pairs	5 Pairs
1	4			1		
2	3	2				
3	2	2	1			
4	1		4			
5	1	1	1			2
6	2		2	1		
7	2	1	2			
8	3	1			1	
9	4	1				
TOTALS	22	8	10	2	1	2

TABLE 6 (WEST HALF). FLIGHT LINE DATA GROUPED IN 15 MINUTE SECTIONS OF LONGITUDE.

TOTAL	-	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{0}{4}$	$\frac{0}{3}$	$\frac{15}{0}$	$\frac{4}{1}$	$\frac{4}{5}$	$\frac{15}{1}$	$\frac{7}{7}$	$\frac{49}{5}$	$\frac{24}{9}$	$\frac{18}{2}$	$\frac{7}{1}$	LENGTH OF LINE MILES	N. LAT
-															30	30'
-															33	15'
-															52	51°
$\frac{3}{0}$														$\frac{3}{0}$	50	45'
$\frac{3}{0}$											$\frac{3}{0}$				51	30'
$\frac{0}{2}$												$\frac{0}{2}$			48	15'
$\frac{1}{1}$									$\frac{1}{0}$		$\frac{0}{1}$				66	50°
$\frac{1}{2}$							$\frac{1}{0}$	$\frac{0}{2}$							78	45'
-															162	30'
$\frac{3}{1}$												$\frac{1}{0}$	$\frac{2}{0}$	$\frac{0}{1}$	212	15'
$\frac{0}{7}$										$\frac{0}{4}$	$\frac{0}{2}$	$\frac{0}{1}$			214	49°
$\frac{15}{7}$								$\frac{0}{1}$	$\frac{8}{0}$	$\frac{2}{1}$		$\frac{0}{4}$	$\frac{5}{1}$		222	45'
$\frac{10}{3}$							$\frac{2}{1}$	$\frac{3}{1}$	$\frac{0}{1}$		$\frac{1}{0}$			$\frac{4}{0}$	245	30'
$\frac{21}{2}$							$\frac{1}{0}$	$\frac{1}{0}$	$\frac{6}{0}$	$\frac{1}{1}$	$\frac{2}{0}$	$\frac{8}{0}$	$\frac{0}{1}$	$\frac{2}{0}$	216	15'
$\frac{77}{7}$		$\frac{0}{1}$	$\frac{0}{3}$	$\frac{0}{3}$		$\frac{15}{0}$					$\frac{43}{0}$	$\frac{15}{0}$	$\frac{3}{0}$	$\frac{1}{0}$	276	48°
$\frac{9}{8}$		$\frac{0}{1}$		$\frac{0}{1}$				$\frac{0}{1}$		$\frac{4}{1}$	$\frac{0}{2}$	$\frac{0}{2}$	$\frac{5}{0}$		255	45'
															52	30'
															56	15'
															52	47°
															30	46°45'
W. LONG. 15'		45'	30'	15'		45'	30'	15'		45'	30'	15'				
	59°					58°				57°					56°	

CARIBOU AND MOOSE

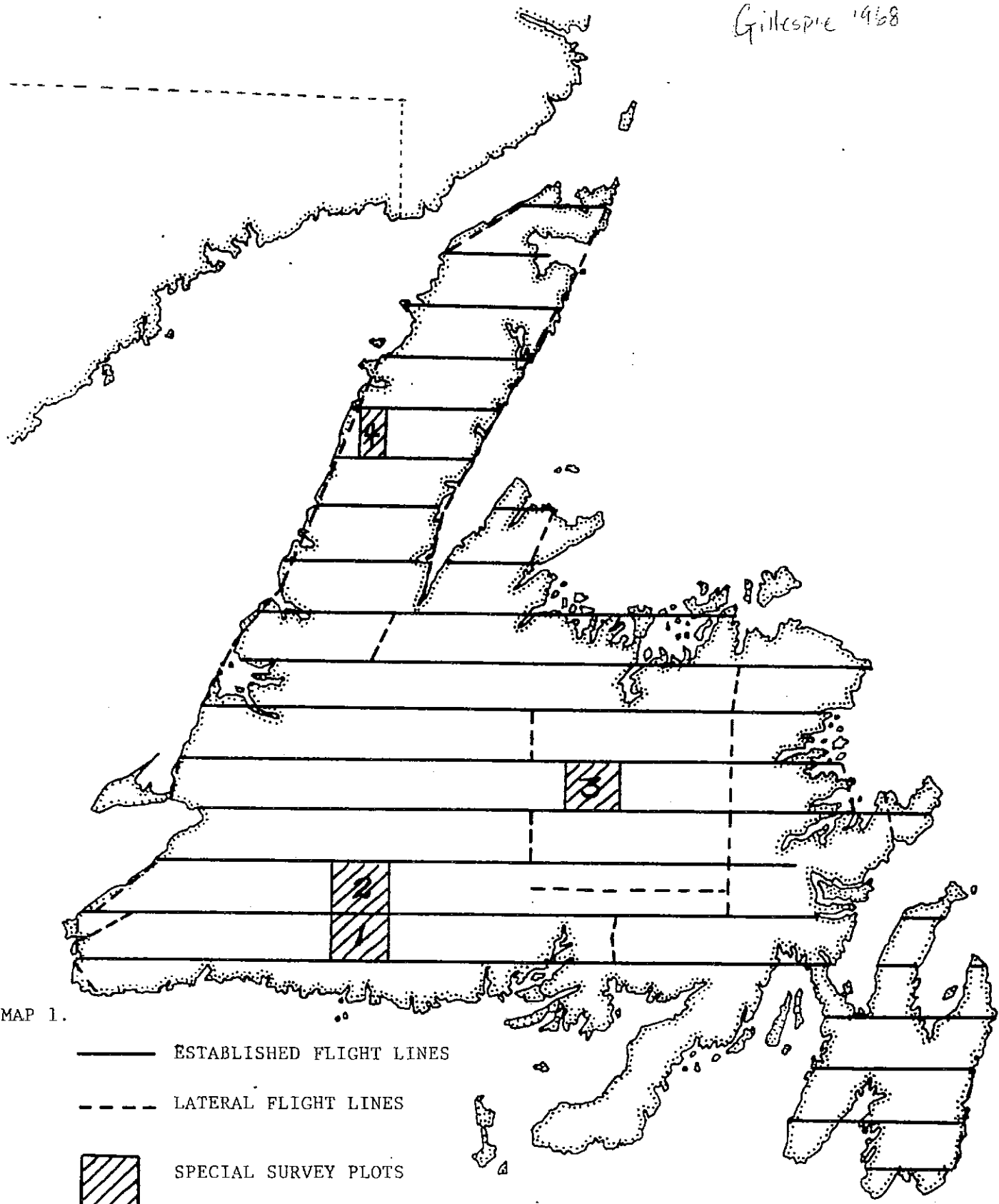
TABLE 6 (EAST HALF). FLIGHT LINE DATA GROUPED IN 15 MINUTE SECTIONS OF LONGITUDE.

TOTAL	$\frac{1}{1}$	$\frac{0}{11}$	$\frac{2}{4}$	$\frac{2}{7}$	$\frac{3}{8}$	$\frac{0}{2}$	$\frac{1}{2}$	$\frac{1}{0}$	-	$\frac{17}{2}$	$\frac{0}{1}$	-	-	-	LENGTH OF LINE MILES	N.
-	-	-													30	30
															33	15'
-	-														52	51°
															50	45'
															51	30'
															48	15'
															66	50°
															78	45'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	30'
$\frac{0}{1}$	-	-	-	-	$\frac{0}{1}$	-	-	-	-	-	-	-	-	-	212	15'
$\frac{0}{1}$	-	-	-	-	-	-	$\frac{0}{1}$	-	-	-	-	-	-	-	214	49°
$\frac{2}{5}$	$\frac{1}{0}$	$\frac{0}{2}$	$\frac{2}{1}$	$\frac{1}{2}$	-	-	-	-	-	-	-	-	-	-	222	
$\frac{9}{8}$	-	$\frac{9}{0}$	-	$\frac{0}{1}$	$\frac{0}{5}$	$\frac{0}{1}$	$\frac{0}{1}$	-	-	-	-	-	-	-	245	30'
$\frac{7}{9}$	$\frac{0}{1}$	-	$\frac{2}{2}$	$\frac{0}{3}$	$\frac{3}{2}$	$\frac{0}{1}$	$\frac{1}{0}$	$\frac{1}{0}$	-	-	-	-	-	-	216	15'
$\frac{0}{2}$	-	-	$\frac{0}{1}$	$\frac{0}{1}$	-	-	-	-	-	-	-	-	-	-	276	48°
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	255	45'
$\frac{0}{3}$	-	-	-	-	-	-	-	-	-	$\frac{0}{2}$	$\frac{0}{1}$	-	-	-	52	30'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	15'
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	47°
$\frac{17}{0}$										$\frac{17}{0}$	-	-	-	-	30	46°45'
W. LONG.	45'	30'	15'		45'	30'	15'			45'	30'	15'				
				55°				54°					53°		45'	30'
																52°

$\frac{1}{1}$ = $\frac{\text{CARIBOU}}{\text{MOOSE}}$

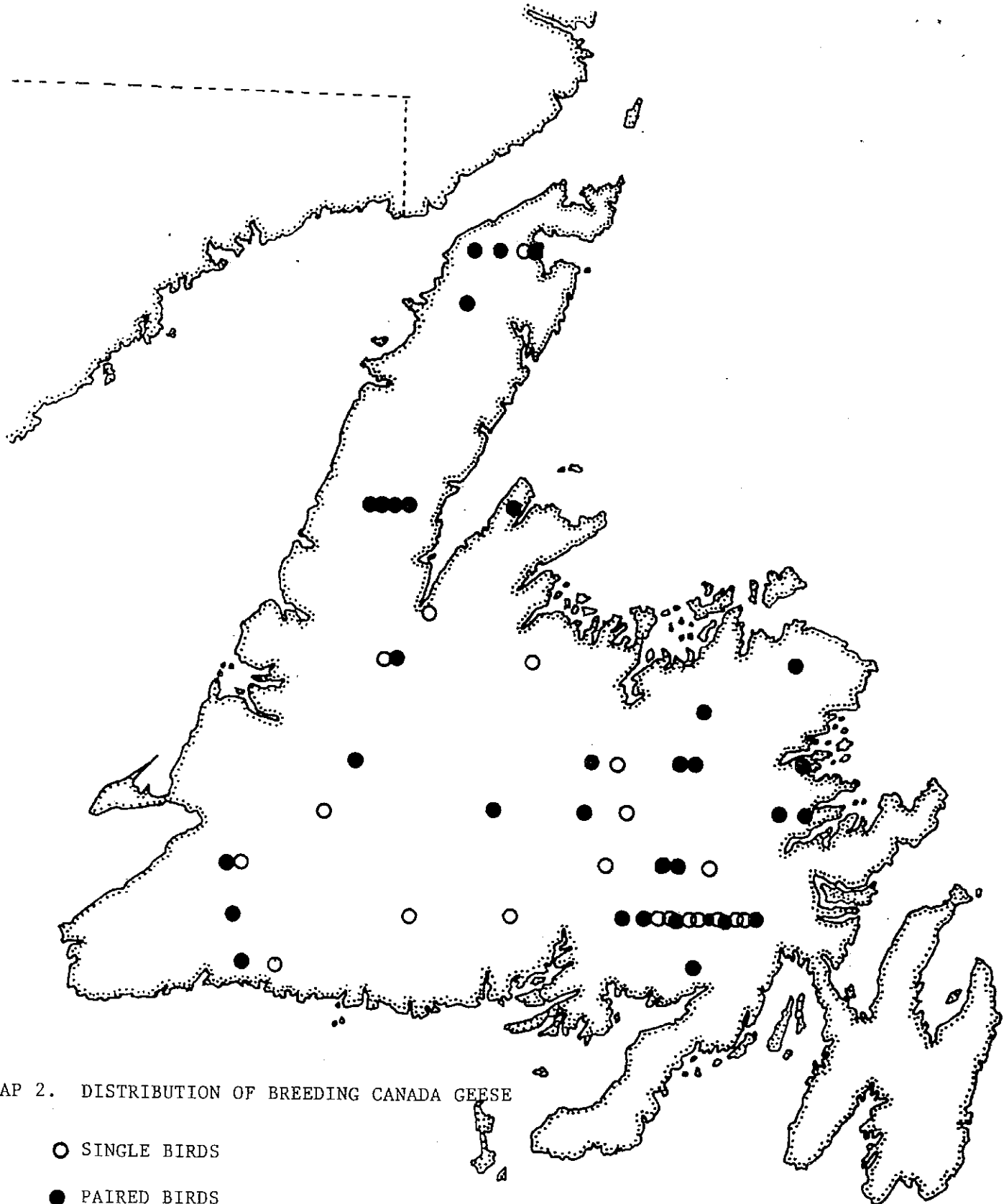
CARIBOU AND MOOSE

Gillespie 1968



MAP 1.

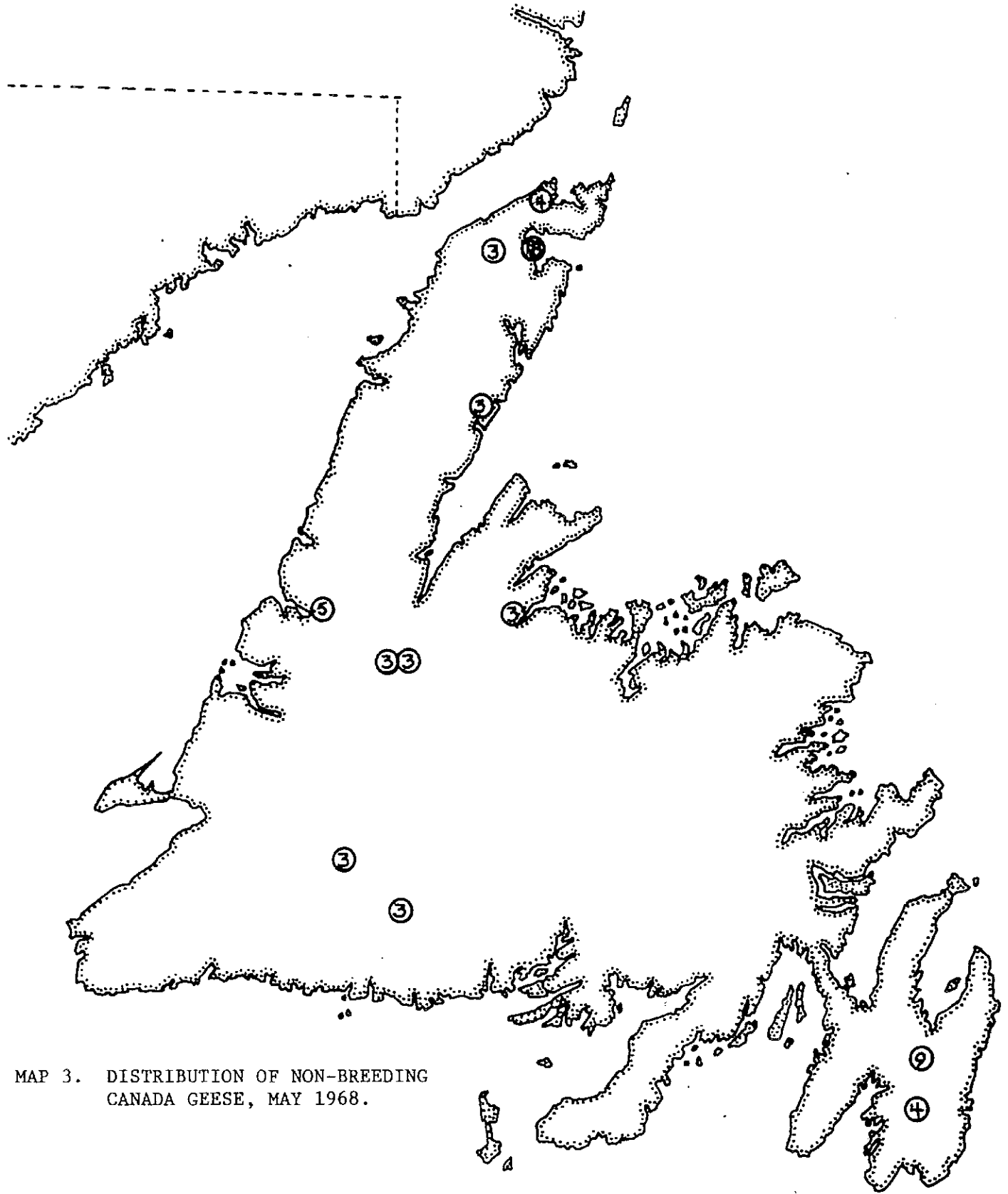
- ESTABLISHED FLIGHT LINES
- - - LATERAL FLIGHT LINES
- ▨ SPECIAL SURVEY PLOTS



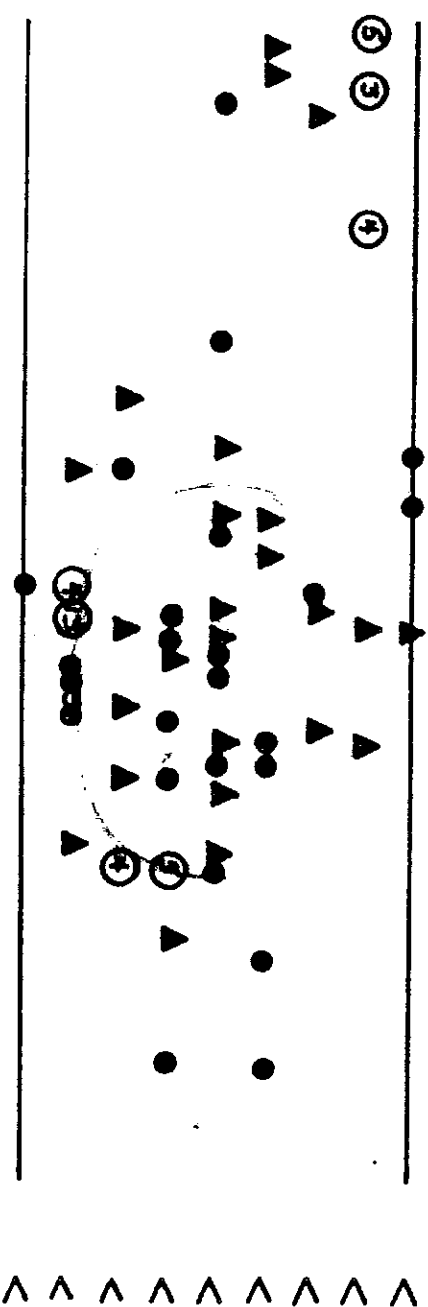
MAP 2. DISTRIBUTION OF BREEDING CANADA GEESE

○ SINGLE BIRDS

● PAIRED BIRDS

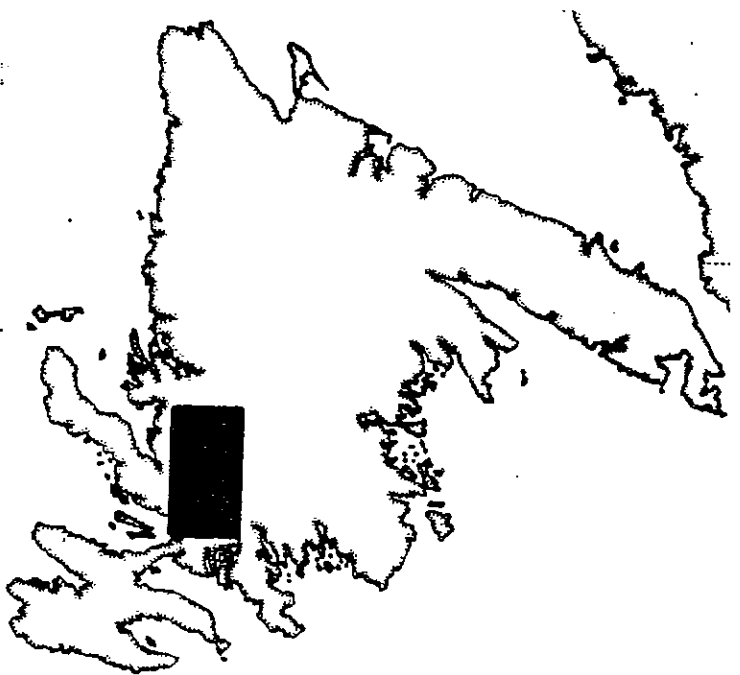


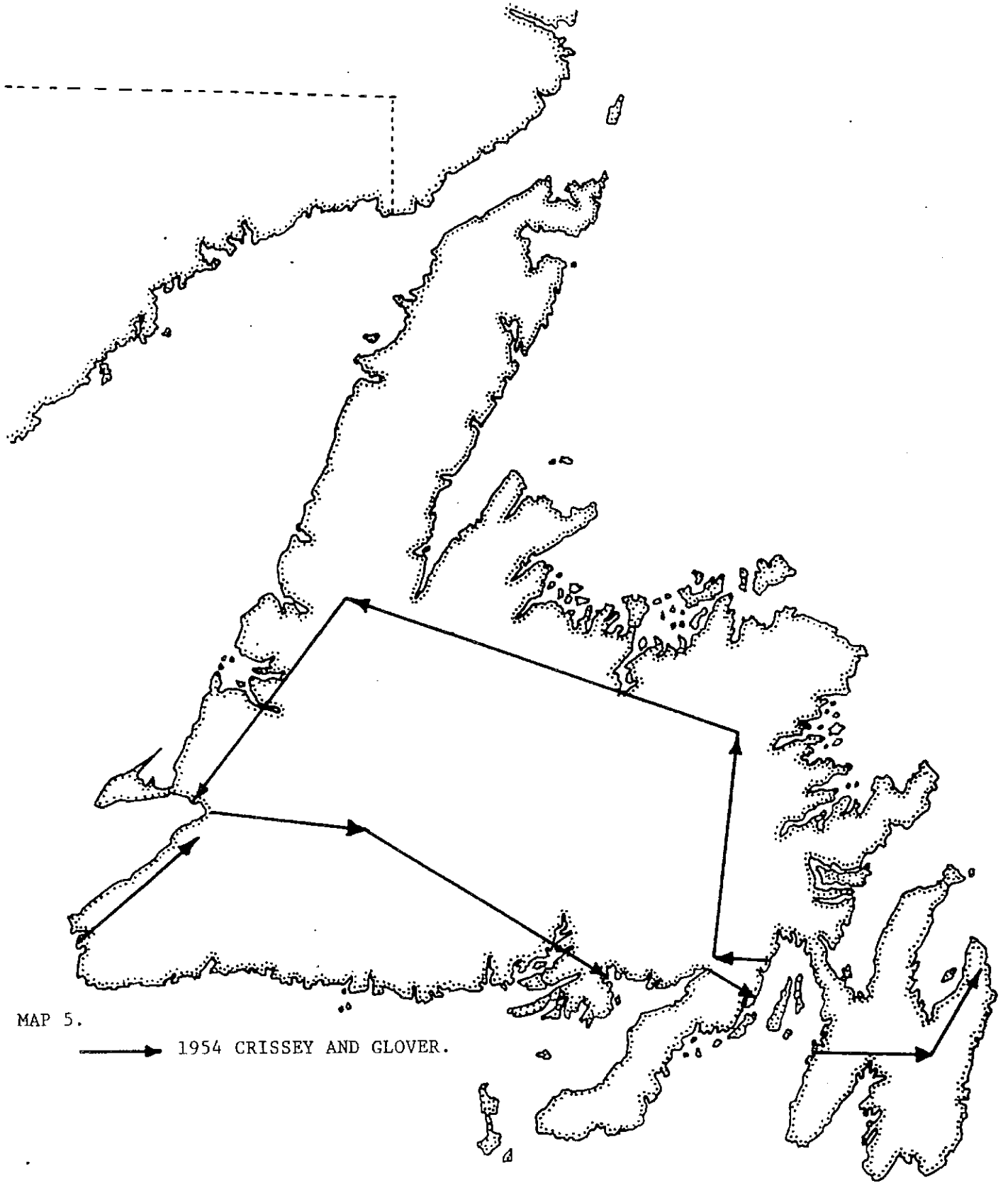
MAP 3. DISTRIBUTION OF NON-BREEDING CANADA GEESE, MAY 1968.



MAP 4. THE SWIFT CURRENT AREA FLOWN MAY 13, 1968.

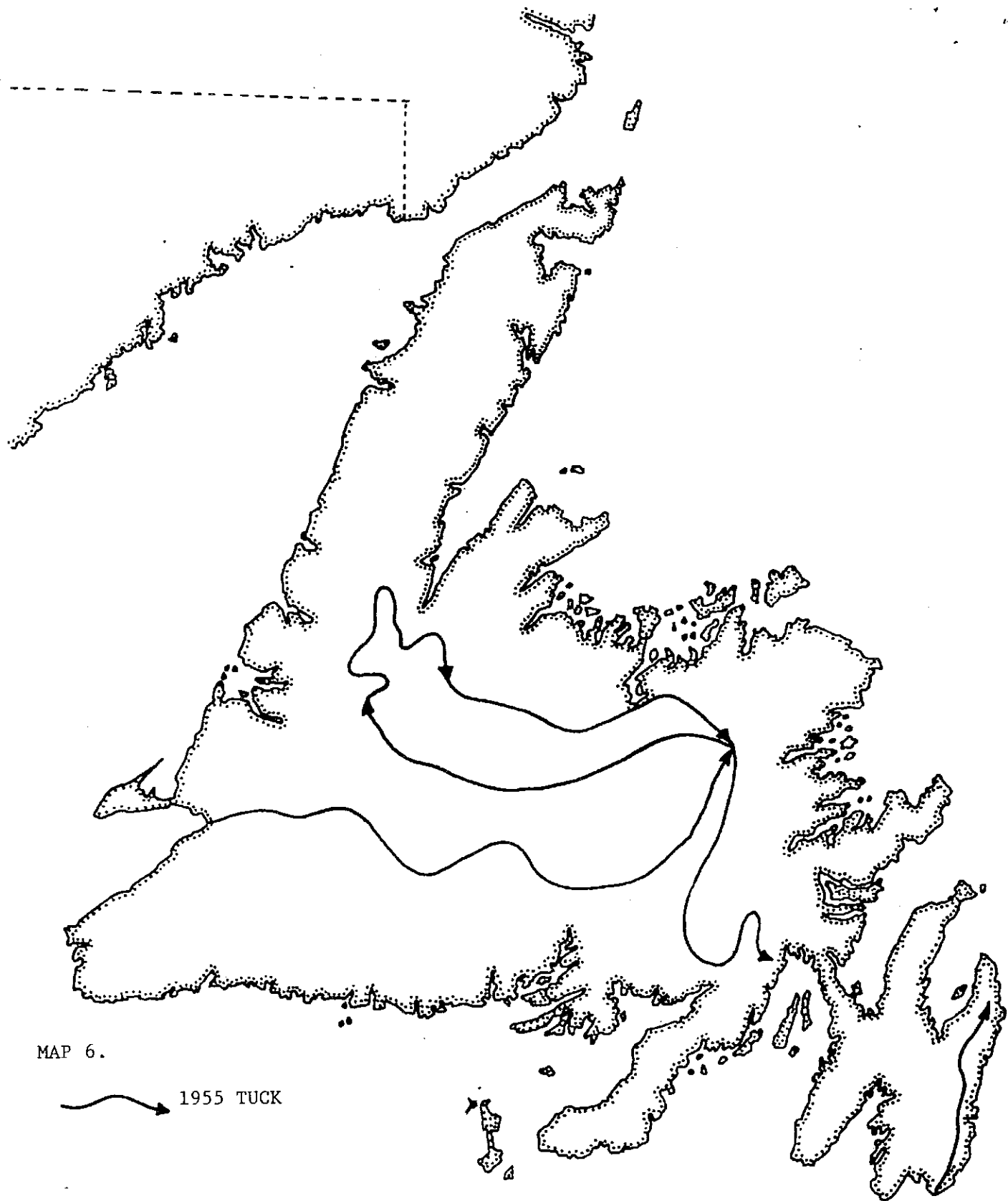
- ▲ SINGLE BIRDS
- PAIRED BIRDS
- GROUPS OF 3 OR MORE





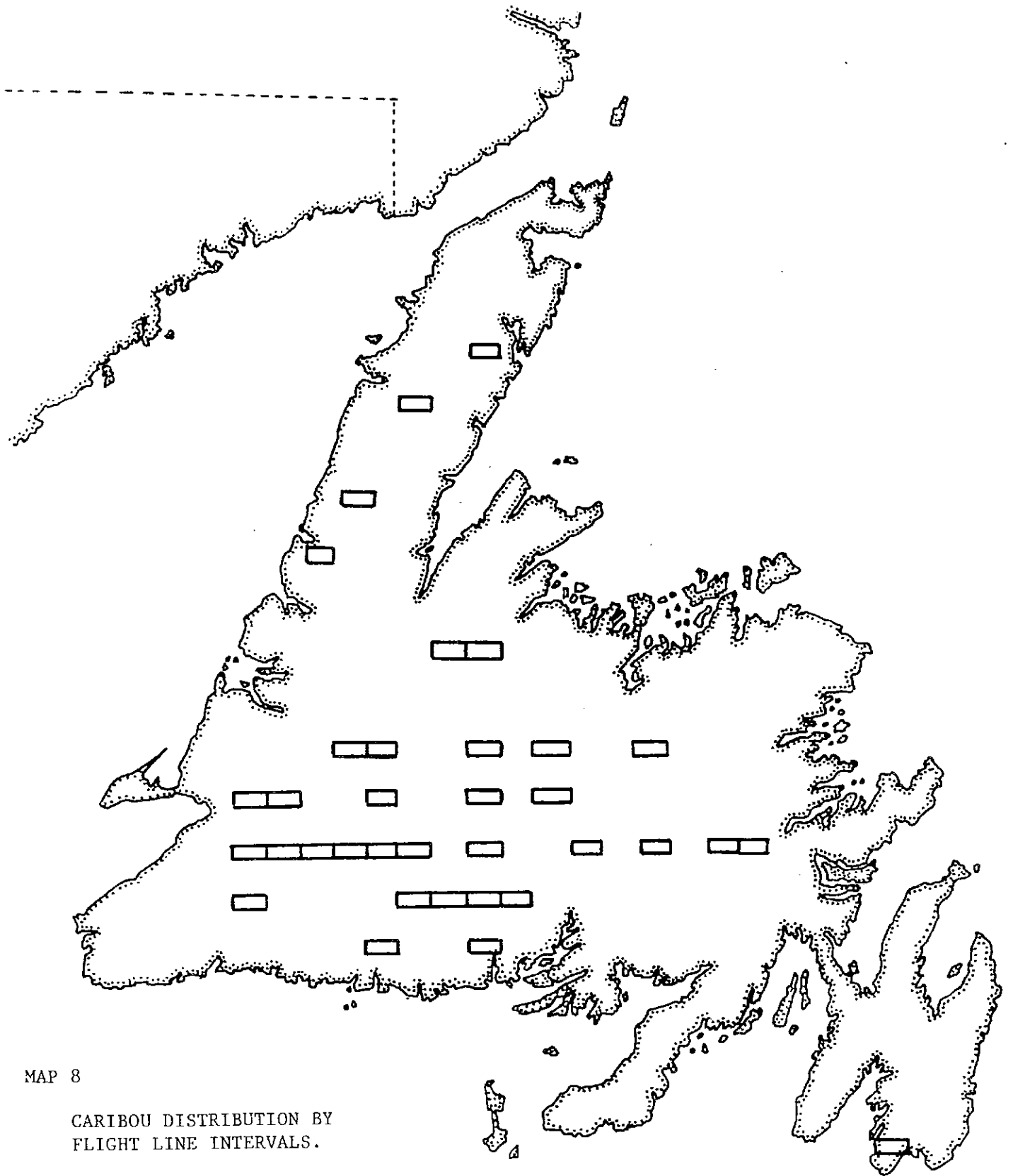
MAP 5.

→ 1954 CRISSEY AND GLOVER.



MAP 6.

→ 1955 TUCK



MAP 8

CARIBOU DISTRIBUTION BY
FLIGHT LINE INTERVALS.

