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AERIAL BEAVER SURVEY

NORTHERN MACKENZIE DISTRICT, SEPTEMBER 1957.

J. E. Bryant

AKLAVIK, N.W.T., October 1957

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PRELIMINARY DATA
NOT FOR PUBLICATION

ABSTRACT

The survey, mainly following watercourses, undertook to sample the beaver populations between Fort McPherson and Fort Franklin in order to determine population changes since the last surveys in 1952 and 1955. The accuracy of the survey method was checked by making repeat flights over four of the thirty nine transects.

A few areas in all districts except Fort Franklin showed population increases. There were, however, far more areas which showed decreases. The over-all decrease since the last surveys was near 60%. The least decrease was recorded in the Arctic Red River district (down 57% in 5 years), the greatest in the Fort Franklin district (down 78% in 2 years). Although it appeared that over-hunting and forest fires may have been responsible for some of the decreases, no explanation is presently known for most of them.

Where certain transects were flown twice, the results differed by as little as 10% to as much as 370%, averaging 77% and indicating that the survey method, as we used it, did not give the degree of accuracy which should be required. Presumably previous surveys have suffered the same inaccuracies, so that over-all comparisons of population densities should be more reasonably valid than the 80% difference would suggest.

Recommendations are made concerning further investigations, modifications of the survey methods and trapping in the Mackenzie Delta Beaver Sanctuary.

AERIAL BEAVER SURVEYS

NORTHERN MACKENZIE DISTRICT, SEPTEMBER, 1 9 5 7

J. E. Bryant

Introduction

The purpose of this report is to describe the results of an aerial beaver survey conducted from September 22 to 29, 1957, between Fort McPherson and Fort Franklin. The survey was one of a series being conducted by the Canadian Wildlife Service to determine relative beaver abundance in various parts of the Mackenzie District. Its objectives were to compare beaver populations in different areas, to determine if there had been any changes in those populations since the preceding surveys of 1952 and 1955, and to run a few checks on the accuracy of the survey method.

Fuller (1953) gave a full description of the method and later (1955) paraphrased it as follows: "The course is planned to follow rivers and creeks wherever possible so that the majority of the flight is over areas of potential beaver habitat. All beaver signs are recorded and a record is kept of the time of each observation. The time is also recorded each time a check point is passed on the course.

"In analysing the results, the number of colonies on each river, or in each area of similar habitat, is determined, and a density figure (colonies per minute) is derived by dividing the time spent in

surveying by the number of colonies seen." Dehaviland "Beaver" aircraft have been used in previous surveys, so that, among them, the colonies per minute figure can be used for comparison. In the present survey a Cessna 195 aircraft was used. (Cf. GSG, Aklavik Flying Service). Its cruising speed is 120 m.p.h. compared with the "Beaver"'s 110 m.p.h. Therefore, in order that the results of the present survey could be compared with those of previous surveys, a density figure of "miles per colony" was used. Distance was computed on the basis of average cruising speed X time, rather than taking the distance directly from the map. In analysing the results based on map-distance, it became obvious that there were many anomalies; map-distance/time was originally computed for the transects given in Table 3 and gave speed ratings for the 1955 figures from 47 to 320 m.p.h., and for the 1957 figures from 48 to 180 m.p.h. Obviously, more or less flying had been done along many transects than was indicated on the map. It was felt that, while still not accurate, determining mileage from Speed X Time would give a fairer comparison of results of the preceding surveys.

In previous surveys, the pilot was instructed to "fly along one side of the stream so that one observer devotes full attention to the stream while the other observer views some of the tributaries, and usually, a number of small lakes which lie along the course. Following

the main stream requires the intense concentration of the observer which produces fatigue. When this occurs, the pilot shifts the aircraft to the other side of the stream, which reverses the tasks of the observers." (Fuller, 1953). In the present survey, perhaps due to the different type of aircraft used, the pilot was unable to follow along the right-hand side of the stream and in consequence all stream observations had to be made by the left-hand observer.

Also in preceding surveys, long transects could be flown by carrying extra gasoline inside the aircraft. In the present survey we were limited to about three and one half hours' flying time, as the aircraft could not get off the water with full tanks let alone with extra fuel. It was therefore necessary to tailor the transects to the capabilities of the aircraft, which were much inferior to those of the "Beaver".

Two observers were used. Warden O. F. Eliason acted as second observer in the Norman and Franklin Districts and Warden A. Look in the other Districts. With a "Beaver" it would have been possible to carry both wardens on some of the transects and thus add to their experience and knowledge of the country.

The survey indicated that in almost all districts except the Ramparts River area, there has been a decrease in the beaver population of about 60% in the past two to five years. In most instances it has

not been possible to offer satisfactory explanations for the decreases. The survey method, as we carried it out, was found to be not very precise.

Results

The results of the survey are summarized in Tables 1 and 3. In Table 1 the actual time that each flight was made is listed instead of just the elapsed time, as has been done before. The innovation was made because it appeared that time of day may have a bearing on the accuracy of the results. Too few data are presently available to test that hypothesis, but if the data are accumulated for each survey, we should, in time, be able to determine if there is any particular time of day when observation accuracy is at a minimum. If that should happen to be the case, then future surveys could benefit by being restricted to the hours of maximum efficiency.

Because of their length, Tables 1 and 2 are placed at the back of this report.

The transect numbers in Table 1 agree with those on the accompanying map. Comparison of the 1955 and 1957 surveys is made in Tables 2, 4 and 5, and tests of the accuracy of the method in Table 6.

Discussion

(a) Fort McPherson District

Number of Transects		3
Distance, miles		124
Number of Colonies		18
Density, miles/colony,	average	6.9
	range	3.1 to 16.5

The greatest density was along the west side of the Mackenzie Delta, the least between McPherson and the Yukon boundary.

The only results which can be compared with previous surveys are those from transect #2, McPherson to Arctic Red River. Fuller (1952) found a density of 1.1 colonies per mile in 1952 or six times the density shown by the present survey. Fuller's figure is probably conservative whereas the 1957 figure, being the highest obtained on four flights, probably comes very close to the true population density. There thus appears to have been a great decrease in that area in the past five years.

McEwen (1953, a, b, 1954) conducted aerial and ground investigations of beaver in the area between McPherson and Arctic Red River in 1953 and 1954. He reported a density, from ground observations, of 0.5 colony per square mile and from aerial observation (of a greater area) of 0.3 colony per square mile. No evidence of disease was found, although reports of disease among the beaver had been brought in by

trappers in 1952. This area will be included in the discussion to follow on the Arctic Red River District, as both districts are included in the Mackenzie Delta Beaver Sanctuary.

The transect along the southwest edge of the delta was run to investigate reports by McPherson trappers that a fair beaver population existed in that area. The survey substantiated their claim.

All of the delta proper is divided into registered traplines which provide an excellent basis for small-area management. Although the delta has been protected as a beaver sanctuary for seventeen years, the beaver has not re-established itself to any appreciable degree except in the upper East Branch area and in the south-western portion. Elsewhere they do establish colonies from time to time but seem to have little chance of success, due partly to the esteem in which their flesh is held by the natives and partly to the scarcity of suitable habitat. Under the present sanctuary system, the natives can see little advantage to their leaving the beaver alone. If they could look forward to being able eventually to take a legal crop, it is the writer's opinion, as well as the opinion of other responsible persons in the area, that re-establishment of the species would stand a far better chance of success and that we would be practising far better conservation than under the present system. I think we may take it as proven that, under adequate control, beaver will increase rapidly

under a quota of one per lodge provided that adequate habitat is available. (See, for example, Conn, 1951; Nash, 1951). The present survey, while admittedly of a small fraction of the delta, indicates that there is a harvestable surplus of beaver in that area.

Transplanting beaver from "have" to "have not" areas has not met with success in the delta (McEwen, 1954). Seventeen years of total legal protection have not seen the delta repopulated. Can there be any harm in trying a third technique - managed cropping - to see if the species can be re-established by that means?

(b) Arctic Red River District

Number of Transects		13
Distance, miles		512
Number of Colonies		84
Density, miles/colony,	average	6.1
	range	1.3 to 22.0

The greatest density was on the Tree River, the least on a small tributary of the Arctic Red River (transect #11).

Transects 2, 3, 8, 9 and 14 lie within the upper Mackenzie Delta Beaver Sanctuary surveyed in 1952. The present survey showed an average density on those five transects of 11.9 miles per colony as against 2.3 miles per colony in 1952 (Fuller, 1952, transects A,

D, F, K).* The 1952 figure was thus five times greater than that

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* Table 1 of Fuller (1952) shows transects B and E, as well as the four above, in the Sanctuary. However, the copy on file at Aklavik has the notation on it that B and E were not in the Sanctuary. As the Aklavik copy is not accompanied by maps, I have assumed that the added notation is correct, since it was made by Mr. McEwen, who was quite familiar with the boundaries of the Sanctuary.

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obtained in 1957. Outside the Sanctuary, in the Arctic Red River District, the 1952 figure was only 1.8 times greater than that obtained in 1957. (2.8 vs 5.1 miles per colony in 1952 and 1957 respectively).

The upper portion of the Sanctuary was opened for beaver hunting in the Spring of 1954. Statistics available at the moment do not indicate what parts of the area were hunted in the succeeding two years, but by 1956 the Arctic Red River trappers requested that a closed season again be declared. Whatever the cause, the beaver population inside the Sanctuary has taken a mighty tumble. Outside the Sanctuary the indicated decrease is much smaller and is, in fact, within the known limits of accuracy of the survey method.

(c) Fort Good Hope District (exclusive of the Ramparts)

Number of Transects		6
Distance, miles		398
Number of Colonies		92
Density, miles/colony	average	4.3
	range	1.5 to 16.0

The greatest density was on a fork of the Ontaratue River, the least on the Tsintu River.

Four of the five transects east of the Mackenzie River can be compared directly with those flown in 1955 (see Table 2). The Tsintu River and Hanna River populations appear to have dropped by about 80% in the past two years, while those on the Donnelly River and the streams and lakes between Chick Lake and Lac a Jacques have shown a slight increase. No reasons can be put forth by the writer to explain the decreases on the Hanna and Tsintu Rivers. Possibly they were formerly over-populated and over-utilization of the feed is responsible. From the air, there did not appear to be sufficient favourable habitat on either of them to support the dense populations found in 1955.

(d) Ramparts River Area

The Ramparts River area was surveyed in the same manner as in 1952 and 1955, i.e. by flying along set transects and recording the number of lakes noted to be occupied or not occupied by beaver. A constant altitude of 1,500 feet (above ground) was maintained. Fuller (1952, 1955) has outlined some of the difficulties involved in such a survey: lack of time to determine multiple occupancy of a lake; the need to search shore-lines completely in order to

pronounce a lake unoccupied - a particularly difficult and in some cases impossible task on large lakes with irregular outlines; the variability among different observers' visual acuity; and the difficulty of navigation in flat, open, lake country. In 1955 Bryant's results (in Fuller, 1955) indicated that he was searching too wide a strip and apparently missing many colonies. Before starting the present survey, that error was discussed with Look and the decision was made to record only those lakes which could positively be stated to be occupied or unoccupied. We thus restricted our strip width to whatever could be positively covered and did not count any lakes, even if directly under the aircraft, if there was doubt as to their being occupied or not.

Table 3 indicates that the differences between individual's observations reported for the 1952 and 1955 surveys were not eliminated in the present one. Bryant's results closely parallel those of Fuller. Look's totals were lower but gave a percentage occupancy similar to those obtained by McEwen in 1952 and Bryant in 1955. (See Table 4).

TABLE 3

SUMMARY OF BEAVER OBSERVATIONS, RAMPARTS RIVER AREA, FORT GOOD HOPE DISTRICT, SEPTEMBER 24, 1967

TRANSECT NUMBER	OBSERVER	TIME IN MINUTES	LAKES OCCUPIED	LAKES UNOCCUPIED	TOTAL LAKES	PERCENTAGE OCCUPIED	COLONIES/ MINUTE	DISTANCE IN MILES¤	AREA IN SQUARE MILES♂	COLONIES/ SQUARE MILE♂
1	Bryant	11	15	29	42	31.0	1.1	22	21.4	0.61
	Look	11	2	4	6	33.3	0.2	22	10.4	0.19
2	Bryant	9	12	11	23	52.1	1.3	18	17.5	0.63
	Look	9	3	12	15	20.0	0.3	18	8.5	0.36
3	Bryant	6	5	9	14	35.7	0.8	12	11.7	0.43
	Look	5	1	7	8	12.5	0.2	10	4.7	0.21
4	Bryant	6	6	8	14	42.8	1.0	12	11.7	0.51
	Look	7	2	4	6	33.3	0.3	14	6.6	0.30
5	Bryant	7	7	11	18	38.9	1.1	14	13.6	0.51
	Look	7	0	8	8	0.0	0.0	14	6.6	0.00
SUB-TOTAL	Bryant	39	43	68	111	38.8	1.1	78	75.9	0.57
	Look	39	8	35	43	18.6	0.2	78	36.8	0.22
INTERVALS	Bryant	18	12	48	60	20.0	0.7	36	35.0	0.34
	Look	18	7	30	37	18.9	0.4	36	16.9	0.41
TOTALS	Bryant	57	55	116	171	32.2	1.0	114	110.9	0.50
	Look	57	15	65	80	18.8	0.3	114	53.7	0.28
GRAND TOTALS		57	70	181	251	27.9	1.2	114	164.6	0.43

¤ Distance computed from average speed of aircraft (120 m.p.h.) X time.
♂ Area computed as: Bryant, miles X 0.97; Look, miles X 0.47.

Table 4

COMPARISON OF RESULTS OBTAINED BY FOUR OBSERVERS IN THREE SURVEYS OF THE RAMPARTS RIVER AREA.

OBSERVER	YEAR	LAKES OCCUPIED	LAKES UNOCCUPIED	TOTAL	PERCENTAGE OCCUPIED
Fuller m	1952	59	136	196	30
	1955	66	131	197	34
McEwen m	1952	33	159	192	17
Bryant	1955	62	295	357	17
	1957	55	116	171	32
Look	1957	15	65	80	19
TOTALS	1952	92	295	387	24
	1955	128	426	554	23
	1957	70	181	251	28

m Figures given here are from Fuller, 1952, Table 2. They do not agree with Fuller, 1955, page 7.

I am at a loss to explain why there should be such a great individual variation among the various observers. The low counts (of occupied lakes) in 1955 and 1957 were made by the observer in the rear left position in the aircraft. There is no information to indicate which of the 1952 observers occupied that position. How

the observer's location in the aircraft could cause such a large discrepancy is difficult to explain, although a somewhat lesser difference, due to the same cause, was found in surveying moose (Flook and Bryant, 1957). Future surveys should aim to analyse further the effect of the observer's position so that, if it is a major consideration, due allowance can be made for it.

Table 5 compares the results of the 1952 and 1957 surveys (sufficient data were not available for the 1955 survey to include it). Fuller and McEwen (Fuller, 1952) had estimated their transects to be one mile on each side of the aircraft. Their transects and intervals totalled 119 miles (computed as time X average speed of the aircraft) and the total surveyed area was therefore 238 square miles. Since they observed 362 lakes, there were approximately 1.5 lakes per square mile. Using that figure as a basis for comparison, Bryant, in the present survey, utilised a strip width of 0.87 mile (176 lakes in 114 miles) and Look a width of 0.47 mile (80 lakes in 114 miles). The comparison in Table 5 indicates that there has been little change in the beaver population of the Ramparts area in the past five years. The trappers at Fort Good Hope, however, were of the opinion that there has been a marked reduction in beaver in that area in the past year. At the time of our survey the Indians had decided not to trap (or rather not to shoot, since

they trap very few) beaver in the Ramparts area in the spring of 1958.

The basic method of the survey seems to be a good one, but refinements are needed in order to make year-to-year results more readily comparable. Suggestions for such refinements are made in the "Recommendations" section of this report.

(e) Fort Norman District

Number of transects		11
Distance, miles		428
Number of colonies		16
Density, miles/colony,	average	6.2
	range	1.7 to 18.0

The greatest density was found between the Brackett River and St. Charles Mountain (Transect #32) and along the "St. Charles River" (Transect #33). One other transect (#35) along St. Charles Creek showed a density of 3.4 miles per colony but all the others were poor, from 7.7 to 18.0 miles per colony.

Eight of the eleven transects were the same as those flown in 1955 (Table 2). Of them, in five cases the population was down from 70% to 100% from the figures given in 1955. In two it was up 40% and in one no comparison could be made (#31). The average decrease on the eight transects was a little more than 60%. Mr. Timmins, the Game Warden formerly stationed at Fort Norman, was not

TABLE 5

OBSERVATIONS OF BEAVER ABUNDANCE IN THE RAMPARTS RIVER AREA

TRANSECT & YEAR	TIME IN MINUTES	LAKES OCCUPIED	LAKES UNOCCUPIED	TOTAL LAKES	PERCENTAGE OCCUPIED	COLONIES PER MINUTE	LENGTH IN MILES[m]	AREA IN SQUARE MILES[ø]	COLONIES PER SQUARE MILE
1 1952	13	17	52	69	24.6	1.3	24	48	0.35
1957	11	15	33	48	31.3	1.4	22	32	0.47
2 1952	9	21	24	45	46.7	2.3	17	34	0.62
1957	9	15	23	38	39.5	1.7	18	26	0.58
3 1952	9	15	30	45	33.3	1.7	17	34	0.44
1957	6	6	16	22	27.2	1.0	12	17	0.35
4 1952	7	13	23	36	36.1	2.1	12	24	0.54
1957	6	8	12	20	40.0	1.3	12	17	0.47
5 1952	7	10	26	35	28.6	1.4	12	24	0.42
1957	7	7	19	26	26.9	1.0	14	20	0.35
SUB-TOTALS									
1952	45	76	164	230	33.1	1.7	82	164	0.47
1957	39	51	103	154	33.1	1.3	78	112	0.46
INTERVALS									
1952	20	16	116	132	12.2	0.8	37	74	0.22
1957	18	19	78	97	19.6	1.1	36	52	0.37
TOTALS									
1952	65	92	270	362	25.4	1.4	119	238	0.39
1957	57	70	181	251	27.9	1.2	114	164	0.43

[m] Length computed as Speed X Time; 1952 - 110 m.p.h.; 1957 - 120 m.p.h.
[ø] Area computed as; 1952 - Length X 2; 1957 - (Length X 0.97) + (Length X 0.47). Explanation in text.

aware of any marked decrease in the Norman area. Nor could he suggest any reason for the decrease, except that on one transect (#26) he thought there was some possibility of over-trapping due to poaching by one trapper on another's line.

Even if the present survey was low by 100%, there would still be a decrease from 1955 on the order of 25%. With the decrease thus indicated, it is hoped that Warden Eliason now stationed at Fort Norman will, in time, be able to suggest possible causes.

(f) Fort Franklin District

Number of Transects		4
Distance, miles		228
Number of Colonies		13
Density, miles/colony,	average	17.5
	range	6.2 to 17.5 m

m On two transects no colonies were seen, so that while no ratio can be given for them individually, their effect on the total is real.

All four transects were previously flown in 1955 (Table 2). The population density then was 3.9 miles per colony or 35% higher than in 1957. One transect was flown also in 1952. The following

table compares the three surveys along this one transect:-

YEAR	TRANSECT NUMBER	TIME IN MINUTES	COMPUTED DISTANCE MILES	COLONIES		MILES/ COLONY
				ACTIVE	ABANDONED	
1952	H	41	75	30	3	2.6
1956	15	34	63	14	1	4.6
1957	37	35	70	0	0	...

There is thus seen to have been a rapid decrease in that area. Forest fires have destroyed some of the habitat but certainly some apparently good beaver areas remain.

Fur catch statistics are not at hand at the time of writing, but Mr. Timmins advises me that, in the spring of 1955, the Franklin beaver catch was about 300% higher than normal. Most of that year's catch was believed to have come from the area north of Fort Franklin sampled by transect #37.

It appears possible, then, that overhunting may be at least a contributing factor in the apparent decrease. Ground work in the area, interviews with reliable local trappers and extensive aerial coverage to determine the extent of forest fires seem indicated if the decrease is to be explained and corrective measures established.

It had been planned to survey the area to the south of McVicar

Arm (Great Bear Lake). However, the aircraft was unable to take off from Franklin with full tanks, and could not make the trip with less.

(g) Abandoned Colonies

Fuller (1955) mentioned a 1953 report by Flook in which it was suggested that abandoned colonies might give a clue to the past history of the beaver population in the areas surveyed. The following Table summarises all such data for the Northern District:-

RATIO, ACTIVE/ABANDONED COLONIES				
	YEAR			
DISTRICT	1952	1953	1956	1957
Fort McPherson	14.8	4.2		1.6
Arctic Red River				3.0
Fort Good Hope			3.0	2.1
Fort Norman			6.1	2.5
Fort Franklin	16.7		5.6	1.2
AVERAGES	15.2	4.2	4.4	2.3

The 1952 data was collected before the regular inclusion of an

"abandoned colonies" column in the work sheets and cannot, therefore, be compared directly with later surveys.

Without access to the yearly catch statistics of each district, proper appraisal of the significance of abandoned colonies cannot be made. However, it does appear that the ratio of active/abandoned colonies does not bear a simple relationship to the trend of the population as revealed by the censuses.

A rapid literature search has revealed only two papers which mention the proportion of active to abandoned colonies. Erickson (1939) reported an active/abandoned ratio of 2.5:1 in a presumably untrapped and nearly saturated population in Minnesota. That figure, under the given conditions, compares with Salvesen's claim that (in Norway) "beavers inhabit a lodge only two or three years". (Salvesen, 1928). May (1955), in the mountains of Colorado, found that counting all lodges resulted in a 54% over-estimation of the number of colonies in his study area, indicating that about one quarter of the lodges were abandoned. His active/abandoned ratio on our scale would be about 4:1 $\frac{(\ 100\ )}{54/154}$. None other of the two dozen or so papers examined appeared to contain information that had any bearing on the subject (omitting as erroneous the statement attributed by Seton (1953, Vol. IV:472) to Braithwaite that "they [beaver] will usually build a new house every year".).

In an expanding population one would expect a high ratio of active to abandoned colonies. In a decreasing population, a low ratio. However, it would seem that any interpretation of these ratios must be based on knowledge of the habitat; in a favourable location a colony might maintain itself for four or five years, yet be forced to move from another after one year if food there was unavailable. In the first situation one would have a "normal" active/abandoned ratio of 4:1 or 5:1, in the second an equally "normal" ratio of 1:1. If, however, in our surveys, the ratios are given by watercourses or by blocks of similar habitat, it is possible that year-to-year changes may be interpreted. As will be discussed in the following section, there is nevertheless room for considerable error in analysing the ratios transect by transect.

By accumulating and comparing the data from each survey, by making repeat aerial checks as well as ground checks, and by crudely inventorying the habitat on each transect, it is possible that the active/abandoned ratio may become a very useful tool in indicating population status. To date, the data available are insufficient to permit their being used with much confidence. About all that one can say is that the overall ratio of 1957, being much lower than that for 1955, tends to corroborate the overall population decrease in the past two years, the population change in the Franklin

District being of particular note.

(f) Accuracy of the Survey Method

Opportunity was taken of four instances when it was feasible to make more than one flight along a transect. Although the sample is too small to carry great significance, the following points are of interest (see Table 6):-

1. In all four instances, the second run produced a higher count than the first, irrespective of the order of the compass directions taken.

2. In all four cases the second run took longer to make and the "colonies/minute" figure therefore shows a lesser difference (probably a more accurate guide) than the actual difference in number of colonies seen.

3. The second run tended to bring to light more "parts" of each colony. Thus, while the number of lodges observed rose 240% and the number of feed beds 170%, the number of active colonies rose only 90%, indicating that the second runwas largely picking up more facets of each colony than had the first.

4. There was much more variation, on individual transects, in the number of abandoned colonies than in the number of active colonies. On the average, however, the variation was less for abandoned than for active colonies.

5. Because of the rather extreme variations in numbers of abandoned colonies, it would appear that we should not yet attach too much significance, except for over-all district averages, to this statistic.

6. Further testing in the northern as well as the southern districts should be made of the accuracy of the method so that interpretation of results may be more meaningful.

SUMMARY AND CONCLUSIONS

There appears to have been a 60% reduction in the beaver population of the northern Mackenzie District in the past two to five years.

In the McPherson-Arctic Red River area the reduction has been most notable in the upper portion of the Mackenzie Delta Beaver Sanctuary which was opened for beaver hunting in 1954 and 1955. The 1952 survey gave a population index within that part of the

TABLE 6

COMPARISON OF RESULTS ON TRANSECTS FLOWN MORE THAN ONCE DURING THE 1957 BEAVER SURVEY

TRANSECT & DATE	DIRECTION	TIME RUN	ELAPSED TIME IN MINUTES	FEED BEDS	LODGES	DAMS	ABANDONED COLONIES	TOTAL LIVE COLONIES	COLONIES/ MINUTE	CHANGE	ACTIVE/ ABANDONED
TRANSECT #2											
Sept. 22	W-E	1105-1119	14	1	0	0	6	1	0.07		0.2
Sept. 23	W-E	951-1006	15	5	5	0	6	5	0.33	X4.7	0.8
TRANSECT #5											
Sept. 22	W-E	1126-1200	32	4	4	1	4	6	0.16		1.5
Sept. 23	E-W	1152-1226	34	3	6	1	1	6	0.18	X1.1	6.0
TRANSECT #18											
Sept. 25	W-E	1704-1733	29	3	3	11	5	9	0.31		1.8
Sept. 29	E-W	1218-1249	31	15	14	6	9	18	0.48	X1.5	1.7
TRANSECT #32											
Sept. 25	E-W	1748-1800	12	7	5	1	1	8	0.67		8.0
Sept. 27	W-E	1010-1025	15	17	16	3	6	18	1.20	X1.8	3.0
TOTALS											
Minimum Run			87	15	12	13	16	23	0.26		1.4
Maximum Run			95	40	41	10	22	44	0.46	X1.8	2.0
CHANGE			X1.1	X2.7	X3.4	X0.8	X1.4	X1.9	X1.8		X1.4

Sanctuary five times greater than that obtained in 1957. Outside the Sanctuary the change was very much less.

In the Fort Good Hope district large decreases were found on two waterways but in the district as a whole there has been little evident change since 1955.

Variations between individual observer's results in the Ramparts River area continued in the present survey, indicating that refinements of the technique are necessary if year-to-year comparisons are to be valid.

In the Fort Norman district decreases up to 100% and averaging 60% were noted. In only one small area was the 1957 population greater than that recorded in 1955. No satisfactory explanations for such great and rapid decreases can be put forward at the present time.

In the Fort Franklin district the 1957 survey showed a population 80% lower than that found in 1955. All transects showed population reductions. Forest fires and heavy hunting pressure can be blamed for at least part of the decreases. The southeastern portion of the Franklin district could not be surveyed because of the poor condition of the aircraft used.

The significance of the proportion of active to abandoned colonies is not clear. There tended to be a general agreement between the population indices of the 1955 and 1957 surveys and

the active/abandoned ratio of the latter, but ground work, repeat aerial checks for accuracy, and habitat inventorying appear to be necessary before the full significance of the statistic can be appreciated.

The survey method was found to be not very accurate. Flying four transects twice showed differences ranging from 10% to 370% and averaging 77%. Since similar differences have probably occurred on previous surveys, comparisons of district averages should be reasonably valid, but little significance should normally be attached to population changes on individual transects.

RECOMMENDATIONS

1. The portion of the Mackenzie Delta Beaver Sanctuary opened for beaver hunting in 1954 and closed in 1956 should remain closed until future surveys indicate that its beaver population is again large enough to stand harvesting. If and when it is reopened, Fuller's 1952 recommendation should be heeded:-

> "If the Mackenzie Delta Beaver Sanctuary is abolished, it will be necessary to protect the area between the Peel and Arctic Red Rivers. Probably this could best be done by setting a quota and limiting the number of trappers allowed to harvest beaver in the area. In both the Sanctuary and the Ramparts areas this may be an inducement to the trappers to divide a registered area which is now unmanageable into two or more smaller and therefore more manageable units." (Fuller, 1952, p. 5).

2. For future reference, it would be well to determine, if now possible, the extent and methods of beaver hunting in 1954 and 1955 in the upper portion of the Mackenzie Delta Beaver Sanctuary. It seems at least possible that hunting may have been responsible for the marked decrease found in that area. If so, any information on hunting practices will be useful for reference when the time arrives to open it again. Both the McPherson warden and the Aklavik biologist should endeavour to obtain this information whenever and wherever opportunity permits. Possibly the R.C.M.P. will be willing to give some assistance as well.

3. It is recommended that, as an experiment, beaver trapping be legalised in that portion of the Mackenzie Delta Beaver Sanctuary lying within the confines of the alluvial portion of the delta; that a quota of one beaver per lodge be used as a start; that no quota be issued for any trapline containing fewer than three live beaver lodges; that no quota be issued for any trapline unless the registered holder can show on a map the exact location of each live lodge; that spot checks be made by either the Game Wardens or the resident biologist to ascertain the accuracy of at least a few of the trapper's censuses each year; that shooting beaver in the delta not be allowed; that a "trapper-extension" programme be initiated by the Wardens Service to teach

the trappers how to trap beaver and how to handle the pelts; and that suitable penalties be imposed on trappers found to have made false statements concerning the number of lodges on their traplines or found to have shot beaver.

4. If it is felt by Northern Administration that the information presently at hand concerning beaver density in the delta is insufficient to warrant the above recommendation, it is suggested that an intensive (50% coverage) aerial survey be conducted on the delta not later than the autumn of 1959 and preferably in 1958. Such a survey would cost about $500.00 to cover the area south of about 68°40'N. A more accurate picture of population density might be obtained by asking the trappers to conduct censuses of their traplines, but without being able to hold out any inducement for them to do so, it is unlikely that, under conditions now prevailing in the delta, we would get even the 40% return obtained in such a survey by McEwen in 1952-53. The aerial survey is therefore thought to be likely to give a more complete picture of beaver occupation of the delta.

5. Due to the high populations found on the Tree River (transect #12) and on the branch of the Ontaratue River sampled by transect #17, encouragement should be given to trappers from Arctic Red River and Fort Good Hope to trap those streams so that

over-population and subsequent harmful reduction of the feed does not occur. At the present time, the Tree River beaver are harvested only as they appear near the mouth of that stream in the Spring. Apparently little effort is made to crop them *in situ* at the sites of their upstream colonies.

6. A ground survey of the Tree River is also recommended to determine the present actual status of the population and habitat there. It could be undertaken jointly by the McPherson Warden and the Aklavik biologist. By flying in to its headwaters with a sectional canoe and paddling down to its mouth, a good appraisal of the situation could be made in very much less time than it would take to paddle both ways. The round trip from Aklavik to the headwaters via McPherson and back to Aklavik could be made with the Pacific Western Airlines "Beaver" stationed at Fort Smith for Northern Administration's use. The cost would be about $200.00 for flying and perhaps up to $50.00 for groceries and other incidentals for a one to two weeks' survey. The survey would provide:

(a) first-hand information on the potentialities of good beaver habitat north of the Arctic Circle;

(b) a useful reference point and basis for

comparison with other northern areas; and

(c) a very useful ground check on the accuracy of aerial surveys of stream habitat.

7. The basic method of surveying flat, lake country as in the Ramparts area appears to be good but refinements are needed in order to make year-to-year results more readily comparable. As a first step it is proposed that, in future surveys in the Ramparts area, angle markers be used to mark off the strip width. It would also be desirable to experiment with different transect widths. In order to eliminate personal bias it might be well to keep one's observations rigidly within the pre-marked strip and, where that strip bisects a lake, to ignore any portion of the lake beyond the strip; one would call unoccupied any lake in which there was no apparent colony within the pre-determined strip. It would appear to be good economics to spend a few hours to work out, in the field, means of reducing individual error. Four to five hours spent in two flying sessions close together might well do the trick. The cost would be about $700.00 (9 hours @ $75.00), including $500.00 for charter between Aklavik and Fort Good Hope. It is the writer's belief that aerial surveys of any species are not worth their expense unless there is some means of estimating their accuracy and therefore their worth from the standpoint of management. In the Ramparts surveys

there has been so much variation in the results obtained by the various surveyors that the added expense of refining and "controlling" the method seems warranted. Over the years, these surveys are going to have to be run by different observers, using different types of aircraft and with different pilots, and it is felt that a serious attempt should be made, now, to remove or at least to minimize as many other of the variables as possible.

8. In the Fort Norman and Fort Franklin areas ground work, interviews with reliable trappers and extensive aerial coverage to determine the extent of forest fires should be undertaken in order that a better understanding of the decreases in beaver recorded for those areas may be obtained and, if possible, corrective measures taken. Liaison between the Forest and Wildlife Section and the Canadian Wildlife Service should establish responsibility for any costs involved in such investigations over and above those occasioned in the routine work of the Wardens Service.

9. New transects should be laid out in the Fort Norman district particularly. Some of the old transects should be maintained for year-to-year comparisons but future surveys should undertake to sample the area east of the Mackenzie River at least as far south as Blackwater Lake, and on the west side of the Mackenzie south to the Keele River. Pre-arrangement with the Fort Norman Warden should be made to select the location of the new transects.

10. On future surveys, allotment of time should be made for checking the accuracy of the method. As a first approximation, it is suggested that a 10% recheck be made, i.e. an extra two hours on a twenty-hour survey.

11. In the discussion following Fuller's paper on the Mackenzie District beaver surveys (Fuller, 1953) the following question and answer appear (page 336, Trans. 18th N. Am. Wildl. Conf.):-

> Q. " ..... have you tried out any of these light-weight tape or wire recorders as an aid in getting your information down?"
>
> A. "We have used that quite extensively in waterfowl work, and we just have not gotten around to moving any of that equipment up into this area [Mackenzie District] yet. That, I think, will be one of the next developments. We are quite impressed with what you can do with that type of recording."

This seems a most excellent idea and it is a pity that advantage has not been taken of the availability within the Service of such recorders. Future surveys should utilize them. They would be particularly useful for taking down habitat descriptions, which are necessary for adequate appraisal of results, but very difficult to take down in long hand during the course of a survey.

12. The experience of making the present survey with a Cessna 195 from the Aklavik Flying Service prompts the recommendation that future surveys be made with a "Beaver" aircraft. The plane

we used was not suitable for the type of flying carried out, and in fact was not able to complete the survey southeast of Fort Franklin because of its poor performance. Its load capacity was extremely limited, being unable to take off with full tanks and two passengers even under favourable conditions. In some instances a number of hours were lost because of its poor take-off performance. If at all possible, it would be much preferable to use the Pacific Western Airlines "Beaver" from Fort Smith, or to hire one from Yellowknife for the work, even though such a move would make the survey slightly more expensive. If the southern and northern districts could be surveyed with one aircraft, as was done in 1952 and 1955, the extra cost would not be great, better coverage could be given and the results would therefore be more representative of the whole District.

ACKNOWLEDGMENTS

Acknowledgment is very gladly made of the able assistance of Mr. Lock and Mr. Eliason, game wardens at Fort McPherson and Fort Norman respectively, who acted as observers on the survey. Our pilot, Jack Wainwright, who made skillful use of a poor aircraft and did a good job of difficult navigation, added much to the success of the survey. And last, but certainly not least, acknowledgment is made of the generous hospitality tendered by: Mrs. Lock at McPherson; Mrs.

Chapman, Cpl. and Mrs. White, R.C.M.P. and Sgt. Douglas, R.C.C.S. at Fort Good Hope; Mrs. Eliason and Miss Finney, Dept. N. H. & W. at Fort Norman.

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Table 2

Comparison of Results of Beaver Surveys in 1955 and 1957 in the Good Hope, Norman, and Franklin Districts

Year	Transect Number	Time in Minutes	Colonies Active	Colonies Abandoned	Colonies/ Minute	Active/ Abandoned	Distance in Miles	Miles per Colony	Population Trend
Fort Good Hope District									
1955	24	30	18	8	0.60	2.3	55	3.1	
1957	24	32	5	3	0.16	1.7	64	12.8	X0.24
1955	25	14	9	4	0.64	2.3	26	2.9	
1957	23	14	6	2	0.43	3.0	28	4.7	X0.62
1955	27	7	1	2	0.14	0.5	13	13.0	
1957	22	14	5	2	0.36	2.5	28	5.6	X2.3
1955	28	26	20	5	0.72	4.0	48	2.4	
1957	21	24	3	0	0.13	...	48	16.0	X0.2
Totals									
1955		77	48	19	0.62	2.5	142	3.0	
1957		84	19	7	0.23	2.7	168	8.9	X0.3
Fort Norman District									
1955	16	9	7	0	0.78	...	17	2.4	
1957	33	5	6	0	1.20	...	10	1.7	X1.4
1955	17	14	11	2	0.79	5.5	26	2.4	
1957	32	15	18	6	1.20	3.0	30	1.7	X1.4
1955	18	20	15	4	0.75	3.8	37	2.5	
1957	27	29	4	1	0.14	4.0	58	14.5	X0.2

Table 2 (cont.)

Year	Transect Number	Time in Minutes	Colonies Active	Colonies Abandoned	Colonies/ Minute	Active/ Abandoned	Distance in Miles	Miles per Colony	Population Trend
Fort Norman District (cont.)									
1955	19	10	14	2	1.40	7.0	18	1.3	
1957	26	13	3	2	0.23	1.5	26	8.7	X0.1
1955	20	7	6	2	0.86	3.0	13	2.2	
1957	25	6	1	1	0.17	1.0	12	12.0	X0.2
1955	21	13	4	0	0.31	...	24	6.0	
1957	30	12	0	1	0.00	0.0	24	...	.....
1955	22	28	10	1	0.36	10.0	51	5.1	
1957	29	34	4	0	0.12	...	68	17.0	X0.3
1955	23	3	0	0	0.00	...	6	...	
1957	31	9	1	0	0.11	...	18	18.0	....
Totals									
1955		104	77	11	0.74	7.0	192	2.5	
1957		123	37	12	0.30	3.3	246	6.7	X0.4

Table 2 (cont.)

Year	Transect Number	Time in Minutes	Colonies Active	Colonies Abandoned	Colonies/ Minute	Active/ Abandoned	Distance in Miles	Miles per Colony	Population Trend
Fort Franklin District									
1955	12	15	1	1	0.07	1.0	28	28.0	
1957	36	16	0	0	0.00	...	32	....	.....
1955	13	31	18	2	0.58	9.0	57	3.2	
1957	39	28	9	5	0.32	1.8	56	6.2	X0.5
1955	14	36	22	4	0.61	5.5	66	3.0	
1957	38	35	4	6	0.11	0.7	70	17.5	X0.2
1955	15	34	14	1	0.41	14.0	63	4.5	
1957	37	35	0	0	0.00	....	70	....	....
Totals									
1955		116	55	8	0.47	6.9	214	3.9	
1957		114	13	11	0.11	1.2	228	17.5	X0.2
Grand Totals, Good Hope, Norman, and Franklin Districts									
1955		297	180	38	0.61	4.7	548	3.0	
1957		321	69	30	0.22	2.3	642	9.3	X0.3

TABLE 1

OBSERVATIONS OF BEAVER ABUNDANCE, NORTHERN MACKENZIE DISTRICT, SEPT. 22-29, 1957

No.	Description of Transect	Time Run	Elapsed Time in Minutes	Colonies Active	Colonies Abandoned	Colonies/ Minute	Active/ Abandoned	Distance in Miles	Miles/ Colony
	Fort McPherson District								
1	McPherson to Rat River	1250-1304	14	9	0	0.64	...	28	3.1
2	McPherson to Arctic Red R.	951-1006	15	5	6	0.33	0.8	30	6.0
3	McPherson to Yukon Boundary	1508-1541	33	4	5	0.12	0.8	66	16.5
	TOTALS, MCPHERSON DISTRICT		62	18	11	0.29	1.6	124	6.9
	Arctic Red River District								
4	Arctic Red River Settlement to Pierre Creek	1123-1128	5	5	3	1.0	1.7	10	2.0
5	Pierre Creek to Height of Land West of Travaillant Lake	1152-1226	34	6	2	0.18	3.0	68	11.3
6	Above Height of Land to Height of Land East of Travaillant L	1124-1152	28	13	3	0.47	4.3	56	4.1
7	Above Height of Land to Height of Land Northwest of Travaillant Lake	1055-1124	29	6	2	0.21	3.0	58	9.7
8	Above Height of Land to Height of Land, through "Observation Lake".	1040-1055	15	0	0	0.00	...	30	...

TABLE 1 (cont.)

No.	Description of Transect	Time Run	Elapsed Time in Minutes	Colonies Active	Colonies Abandoned	Colonies/ Minute	Ratio Active/ Abandoned	Distance in Miles	Miles/ Colony
9	Height of Land to Mackenzie River	1007-1030	23	4	2	0.17	2.0	46	11.5
10	Yukon Boundary to Arctic Red River	1541-1608	27	17	3	0.63	5.7	54	3.2
11	Arctic Red River to Tree River	1609-1620	11	1	2	0.09	0.5	22	22.0
12	Tree River	1620-1625 1336-1342	11	17	6	1.54	2.8	22	1.3
13	Tree River to Arctic Red River	1342-1400	18	3	0	0.17	...	36	12.0
14	Arctic Red River to 134°10'W, 67°25'N	1400-1433	33	7	3	0.21	2.3	66	9.4
15	Tree River to Headwaters of Ontaratue River	1625-1638	13	2	1	0.15	2.0	26	13.0
16	Ontaratue River to Tree River	1325-1334	9	3	1	0.33	3.0	18	6.0
	TOTALS, ARCTIC RED RIVER DISTRICT		256	84	28	0.33	3.0	512	6.1
	Fort Good Hope District (exclusive of the Ramparts)								
17	Headwaters to Main Stream of Ontaratue River	1638-1704	26	35	8	1.34	4.4	52	1.5

TABLE 1 (cont.)

No.	Description of Transect	Time Run	Elapsed Time in Minutes	Active	Abandoned	Colonies/ Minute	Active/ Abandoned	Distance in Miles	Miles/ Colony
18	Main Ontaratue River to Mackenzie River	1704-1733	29	15	9	0.48	1.7	58	3.9
19	Main Ontaratue to Headwaters of Ontaratue8	1249-1325	36	12	7	0.33	1.7	72	6.0
20	Mouth of Tsintu River to Mackenzie River opposite Beavertail Mountain	1640-1704	24	11	12	0.46	0.9	48	4.4
21	Mackenzie River to Chick Lake via Donnelly River	1628-1642	14	6	2	0.43	3.0	28	4.7
22	Chick Lake to Lac a Jacques	1643-1657	14	5	2	0.36	2.5	28	5.6
23	Lac a Jacques to Mouth of Tsintué River	1657-1721	24	3	0	0.13	...	48	16.0
24	Hanna River	1708-1740	32	5	3	0.16	1.7	64	10.4
	TOTALS FOR FORT GOOD HOPE DISTRICT		199	92	43	0.46	2.1	398	4.3
	Fort Norman District								
25	Oscar Creek	1740-1746	6	1	1	0.17	1.0	12	12.0
26	Oscar Creek to Norman Wells	1746-1759	13	3	2	0.23	1.5	26	8.7
27	Norman Wells to Fort Norman along right bank of Mackenzie River.	1801-1830	29	4	1	0.14	4.0	58	14.5

TABLE 1 (cont.)

No.	Description of Transect	Time Run	Elapsed Time in Minutes	Colonies Active	Colonies Abandoned	Colonies/ Minute	Active/ Abandoned	Distance in Miles	Miles/ Colony
28	Norman Wells to Fort Norman along Left Bank of Mackenzie River	1136-1209	33	8	2	0.24	4.0	66	8.3
29	Brackett Lake to Unnamed Lake at 126°10'W, 65°48'N	1032-1106	34	4	0	0.12	...	68	17.0
30	Unnamed Lake to Kelly Lake	1107-1119	12	0	1	0.00	0.0	24	....
31	Brackett Lake to Height of Land South of Mahony Lake	1416-1425	9	1	0	0.11	...	18	18.0
32	Brackett River to St. Charles Mountain	1010-1025	15	18	6	1.20	3.0	30	1.7
33	"St. Charles River"	1026-1031	5	6	0	1.20	...	10	1.7
34	Canol to Sans Sault Rapids	1555-1626	31	8	11	0.26	0.7	62	7.7
35	Fort Norman to small Lake on St. Charles Creek	1111-1138	27	16	4	0.59	4.0	54	3.4
	TOTALS FOR FORT NORMAN DISTRICT		214	69	28	0.32	2.5	428	6.2
	Fort Franklin District								
36	Fort Franklin to St. Charles River	1726-1742	16	0	0	0.00	...	32	...
37	Fort Franklin to two Large Lakes near Deerpass Bay, Great Bear Lake.	1539-1614	35	0	0	0.0	...	70	...

TABLE 1 (cont.)

No.	Description of Transect	Time Run	Elapsed Time in Minutes	Colonies Active	Colonies Abandoned	Colonies/ Minute	Active/ Abandoned	Distance in Miles	Miles/ Colony
38	Deerpass Bay to Bydand Bay	1454-1529	35	4	6	0.11	0.7	70	17.5
39	Bydand Bay to Height of Land South of Mahony Lake	1425-1453	28	9	5	0.32	1.8	56	6.2
	TOTALS FOR FORT FRANKLIN DISTRICT		114	13	11	0.11	1.2	228	17.5
	Summary								
	Fort McPherson District		62	18	11	0.29	1.6	124	6.9
	Arctic Red River District		256	84	28	0.33	3.0	512	6.1
	Fort Good Hope District		199	92	43	0.46	2.1	398	4.3
	Fort Norman District		214	69	28	0.32	2.5	428	6.2
	Fort Franklin District		114	13	11	0.11	1.2	228	17.5
	Totals for Northern Mackenzie District		845	276	121	0.33	2.3	1690	6.1

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(Ogilvie Range 106

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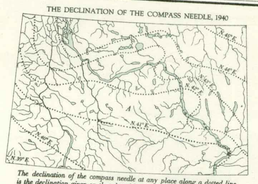
1957 BEAVER SURVEY FLIGHT LINES

Legend:

- Up to 2 miles per colony
- 2.1 to 4 miles per colony
- 4.1 to 8 miles per colony
- 8.1 to 12 miles per colony
- 12.1 to 18 miles per colony
- More than 18 miles per colony
- Route not included in survey

THE DECLINATION OF THE COMPASS NEEDLE, 1940



The declination of the compass needle at any place along a dotted line is the declination given on that dotted line. At other places the declination is between those given on the neighbouring dotted lines; thus at the place marked A, the declination is between N. 41° E. and N. 42° E. The declination of the compass needle is decreasing 5 minutes annually.

Aerial photography covers the entire sheet

REFERENCE

- Boundary; territorial (approximate)
- Town or village
- Settlement
- Trading post
- Cabin
- Royal Canadian Mounted Police
- Wireless station with call letters
- Sand bar or shoal
- Rapids and falls
- Esker
- Marsh or swamp
- Braided stream
- Height in feet (approximate) 400

ARCTIC R

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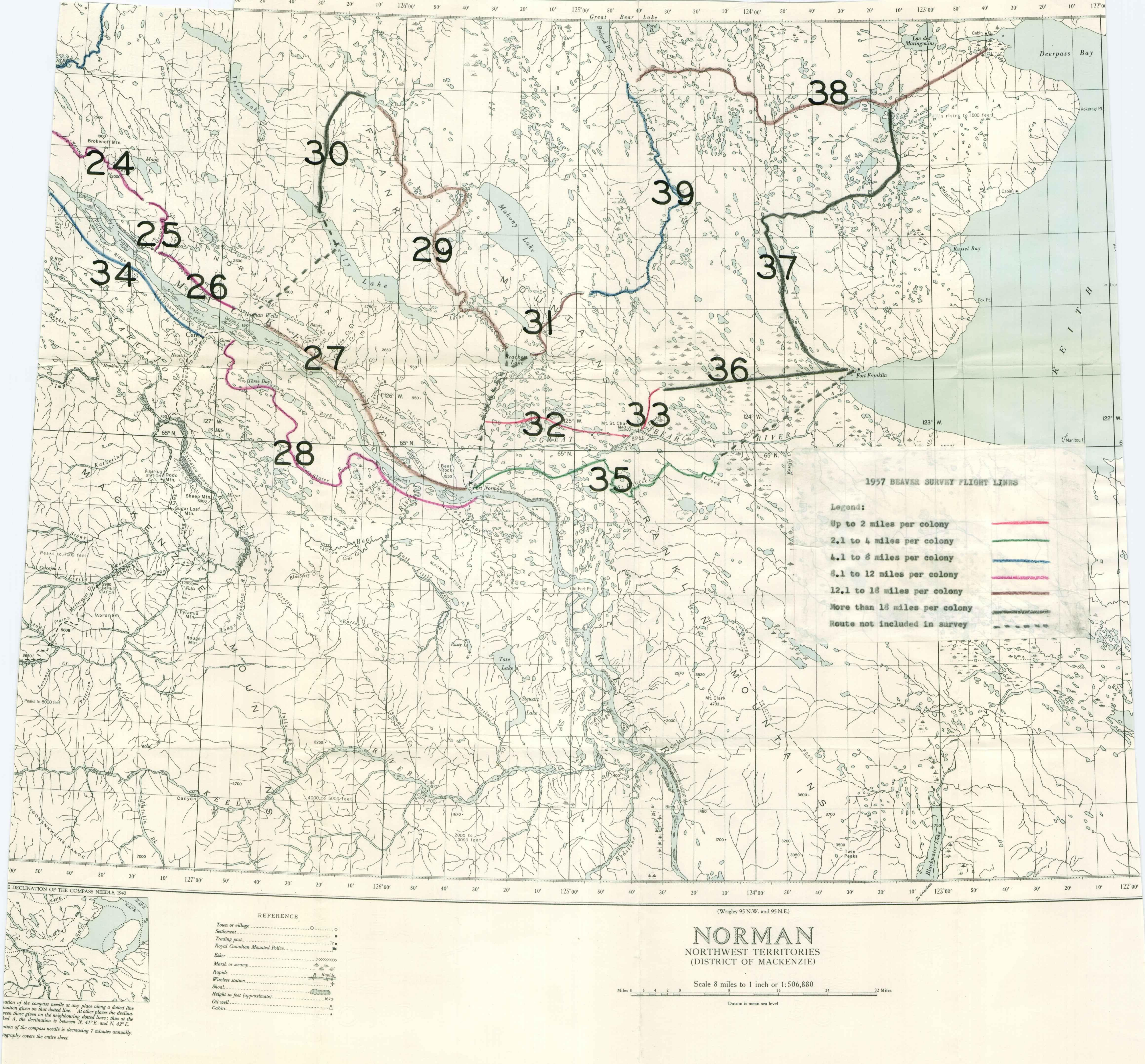
New Edition 1956

of the compass needle at any place along a broken line is the variation ng broken lines; thus at the place marked A, the variation is between 10°E. The variation of the compass needle is decreasing about 10 ears.


1957 BEAVER SURVEY FLIGHT LINES
Legend:
Up to 2 miles per colony
2.1 to 4 miles per colony
4.1 to 8 miles per colony
8.1 to 12 miles per colony
12.1 to 18 miles per colony
More than 18 miles per colony
Route not included in survey
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Great Bear Lake
Deerpass Bay
Fort Franklin
Fort Norman
Norman Wells
Mahony Lake
Kelly Lake
Great Bear River
Franklin Mountains
Mackenzie Mountains
Keele River
REFERENCE
(Wrigley 95 N.W. and 95 N.E.)
NORMAN
NORTHWEST TERRITORIES
(DISTRICT OF MACKENZIE)
Scale 8 miles to 1 inch or 1:506,880
Datum is mean sea level
Price 25 cents

TITLE

DATE LOANED	BORROWER'S NAME