



A study in beaver ecology in western Montana with special reference to movements
by Joseph E Townsend

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree
of Master of Science in Fish and Wildlife Management

Montana State University

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Abstract:

A study in beaver ecology with emphasis on movements was conducted on a 160 acre area in Missoula County, Montana during the summers of 1949 1950 1951 and the commercial trapping season of 1952. Data were obtained by live-trapping and recapturing marked beavers, and by recording signs of beaver activity. Methods of trapping, marking, sexing, and ageing are explained and evaluated. Beaver activities as manifested by structures, plant cuttings and scats, are used with trapping data to evaluate population changes of "colony sites" as influenced chiefly by movements. Movements of various age classes are discussed. Territorial behavior and population pressure as delimiting factors of colonies are discussed.

A STUDY IN BEAVER ECOLOGY IN WESTERN MONTANA WITH SPECIAL REFERENCE
TO MOVEMENTS

by

JOSEPH E. TOWNSEND

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Submitted to the Graduate Faculty

in

partial fulfillment of the requirements

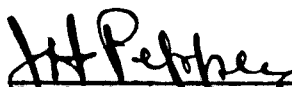
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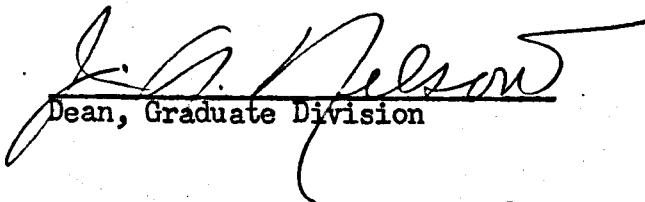
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ABSTRACT

A study in beaver ecology with emphasis on movements was conducted on a 160 acre area in Missoula County, Montana during the summers of 1949, 1950, 1951 and the commercial trapping season of 1952. Data were obtained by live-trapping and recapturing marked beavers, and by recording signs of beaver activity. Methods of trapping, marking, sexing, and ageing are explained and evaluated. Beaver activities as manifested by structures, plant cuttings and scats, are used with trapping data to evaluate population changes of "colony sites" as influenced chiefly by movements. Movements of various age classes are discussed. Territorial behavior and population pressure as delimiting factors of colonies are discussed.

INTRODUCTION

A study in beaver ecology with special reference to movements was conducted in the Seeley Lake area of Missoula County, Montana. Data were obtained by live-trapping, individually marking, and recapturing beavers in the summers of 1949, 1950 and 1951 on a 160 acre area and from 15 trapped (14 pelted, 1 released) in this area during the 1952 commercial trapping period. Thirty-six beavers were caught 62 times. Supplementary information was obtained by studying and recording beaver sign throughout the study area.

The writer wishes to thank the following for aid in the study: Dr. Don C. Quimby, who directed the study, for advice in the field and in the manuscript preparation; Mr. Adrian Hess for help in statistical analysis; Dr. W. E. Booth for assistance in plant identification; my father and mother, Mr. and Mrs. George B. Townsend, for permission to conduct the study on their property; Mr. Robert Christianson and especially my brother, George, for aid in collecting material and data from winter trapping; the Montana State Fish and Game Department for permission to conduct the study and for the use of live-traps; my wife, Marjorie, for aid in typing and in preparation of figures and tables.

DESCRIPTION OF AREA

The study area (fig. 1) is located within the river meander plain of the Clearwater River valley, $3\frac{1}{2}$ miles upstream from Seeley Lake. The valley is bounded to the west by the Mission mountain range and to the east by the Swan range. Its width at the study area is about 2 miles. The meander plain of the river, 20 to 30 feet below the valley floor, is

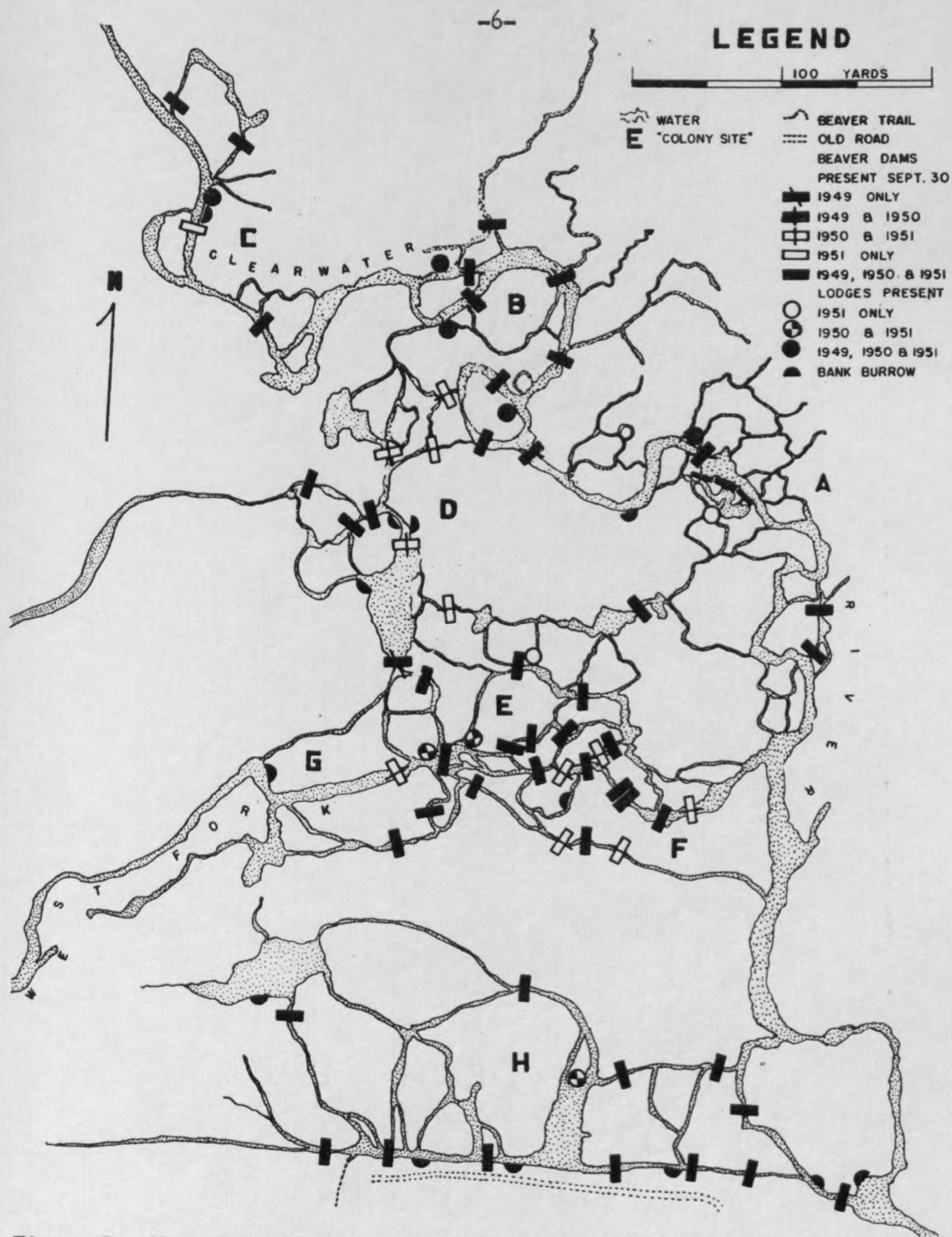


Figure 1. Map of study area, showing water, beaver structures and "colony sites" (site I, on upper West Fork, is excluded).

one-half to 1 mile wide.

Excluding the meander plain, the valley is heavily timbered with western larch (Larix occidentalis), on the lower slopes, and ponderosa pine (Pinus ponderosa), douglas fir (Pseudotsuga taxifolia) and Engelmann spruce (Picea engelmanni) on the upper slopes. Stands of lodgepole pine (Pinus contorta), are found at various elevations. The meander plain is characterized by willow (Salix spp.) and redosier dogwood (Cornus stolini-fera), with Engelmann spruce along the higher stream banks and lodgepole pine on extensions of dry land.

The Study Area

The study area includes a 1 mile segment of the Clearwater River, a spring creek tributary and the lower parts of two other tributaries. The river (fig. 1) enters the area from the northwest and cuts diagonally across to the southeast corner. It is characterized by low banks (6-12 inches in height is common), a gravel bottom and low turbidity. Width varies from 10 to 50 feet, depth from a few inches to about 4 feet. Volume flow in July and August (floating chip and watch method) was from 15 to 20 cubic feet per second; high spring water considerably increases this flow and a reduction is apparent in late summer.

Findell Creek, a shallow stream, 2 to 6 feet wide, enters the river from the northeast.

The West Fork of the Clearwater River, a larger stream, enters from the west. Its channel has been much influenced by beaver activity. Consequently, it joins the river through a network of channels and beaver runs.

A small stream originating from a spring in the southern end of the area enters the river at its point of exit from the study area.

Principal vegetative types are: coniferous forest, woody shrub, emergent aquatics, and submerged and floating aquatics. A grove of quaking aspen (Populus tremuloides) is present just south of the area.

The coniferous forest consists of Engelmann spruce, a few scattered western larch, and 3 stands of lodgepole pine. The spruce is restricted to the higher stream banks of 2 areas: (1) A stand of old mature trees along the lower section of the river with an extension up the main channel of the West Fork, and (2) a scattered stand of young trees, 6 to 8 feet in height, occurring as a low canopy under the lodgepole extension from the west into the middle of the area (fig. 1). The western larch occurs as a very scattered stand of old, single trees. Many are dead. No larch reproduction is evident. The lodgepole pine occurs: (1) on an extension of dry land (previously mentioned) from the west into the middle of the study area, (2) in a heavy growth between the West Fork and the southern boundary and (3) a small stand near the entry of Findell Creek.

Representative plants under the mature spruce were common juniper (Juniperus communis), bearberry honeysuckle (Lonicera involucrata), mountain snowberry (Symphoricarpos albus), saskatoon serviceberry (Amelanchier alnifolia), hudson bay currant (Ribes hudsonianum), alder buckthorn (Rhamnus alnifolia), ^American strawberry (Fragaria vesca) field mint (Mentha arvensis), bunchberry dogwood (Cornus canadensis), and starry solomonplume (Smilacina stellata). Those under the pine include bearberry honeysuckle, mountain snowberry, common juniper, american strawberry and common beargrass (Xerophyllum tenax).

The woody shrubs, in order of abundance, were willow, redosier dogwood, and thinleaf alder (Alnus tenuifolia). This type covered the non-wooded land area with the exception of extremely wet or inundated parts. In the drier localities various plants were found with the woody shrubs. Representative are: alder buckthorn, field mint, common cow parsnip (Hera-
cleum maximum), bluejoint reedgrass (Calamagrostis canadensis), bearded wheatgrass (Agropyron subsecundum) and sheep sorrel (Rumex acetosella).

The most extensive areas of emergent aquatics were in the region of the West Fork, with its network of canals and beaver runs. Beaked sedge (Carex rostrata) and green bulrush (Scirpus atrovirens) were dominant. Emergent plants found in the river were slender burreed (Sparganium multi-
pedunculatum), spikesedge (Eleocharis macrostachya), ovalhead sedge (Carex festivella), beaked sedge, and shortawn foxtail (Alopecurus ae-
qualis). In the spring creek along the south border of the study area, rocky mountain rush (Juncus saximontanus) and ovalhead sedge were found bordering areas of beaked sedge and green bulrush.

Submerged and floating aquatics collected were: river- american brook-
lime (Veronica americana), maretail (Hippuris vulgaris), common water-
starwort (Callitriche palustris), stiff watercrowfoot (Ranunculus longi-
rostris) and watercrowfoot (Ranunculus trichophyllus); West Fork - Illi-
nois pondweed (Potamogeton illinoensis) and common waterstarwort. Green
algae (Mougeotia sp.) was very common in the river, and blue-green algae
(Cylindrospermum sp.) was found scattered throughout the area. Plant
nomenclature for monocotyledons follow W. E. Booth's Flora of Montana
Part I and for dicotyledons Gray's Manual of Botany (8th Edition).

The area has not been extensively farmed; the last agricultural usage was in 1940, when a few head of stock were pastured. With the exception of commercial trapping in the years 1942, 1944 and 1947, and trapping during the study, neither the beaver nor their activities have been legally subjected to human interference for at least 30 years.

METHODS

Mapping

A United States Forest Service aerial photograph and a ground survey of the waterways were used to map the area. All beaver structures were designated on the map and subsequent changes during the study were recorded (fig. 1). The structures were generally concentrated in 9 areas or "Colony sites" assigned letters A - I.

Trapping

Live-trapping was accomplished with both Bailey and Hancock beaver live-traps. Traps were set in localities of apparent beaver activity, and their locations usually changed if a beaver was not caught within 3 nights.

Three different type trap sets were used: bait, runway and dam. The bait set consisted of scent (beaver castoreum) and/or food (fresh aspen or willow) with the trap set to catch an investigating beaver. The runway set was in a waterway, such as a canal, with sticks often placed in a "V" to guide the animal directly over the trap. A dam set was made by breaking a hole in a dam and placing a trap in its upstream opening.

Thirty-one beavers were live-trapped 47 times in 590 trap-nights (1 trap set 1 night), an average of 12.6 per beaver (Table I).

Table I - Analysis of Various Types of Live-trap Sets; 1949-'50-'51

Month	Bait			Runway			Dam			All Sets		
	TN	C	TN/C	TN	C	TN/C	TN	C	TN/C	TN	C	TN/C
June*	42	1	42.0	14	0	-	9	0	-	65	1	65.0
July	86	6	14.3	21	2	10.5	33	3	11.0	140	11	12.7
August	100	6	16.7	23	3	7.7	65	8	8.1	188	17	11.1
September	118	7	16.9	29	3	9.7	50	8	6.3	197	18	10.9
Total trapping periods	346	20	17.3	87	8	10.9	157	19	8.3	590	47	12.6

Symbols - * No trapping until after June 15 in any year

TN Trap-nights

C Beaver catches

TN/C Trap-nights per beaver catch

The data for the entire trapping period show: (1) beavers were captured more efficiently in dam sets, requiring 8.3 trap-nights per animal, in comparison to 10.9 and 17.3 for runway and bait sets respectively and (2) trapping efficiency generally increased as the season progressed. Analysis, by month, reveals that runway sets were the most efficient trapping method in July and August, and dam sets in September. A bait set accounted for the only beaver caught in June; this method reached its highest efficiency in July. The relationship of trapping efficiency to beaver activity will be discussed later.

In March and April of 1952, 15 beavers were commercially trapped (14 pelted, 1 released) from the study area. Ten had been previously live-trapped.

Marking

Six beavers were marked in 1949 by punching holes in the webs of the hind feet with a 3/16 inch leather punch (method and code system described by Aldous, 1940). An additional beaver, accidentally released be-

fore examination, was identified by a large distinctive notch in the tail. In 1950, nine were web-punched. Three others, when caught, bore marks of unknown origin sufficient for identification without additional marking; each beaver had at least 3 identifiable marks, such as a notched tail, notched ear, split web(s), missing toe(s) or feet, etc. In 1951, eight were web-punched. Seven of these were also marked by punching a hole in the tail. Three others bore marks of unknown origin as described above; 2 of these were further marked by tail-punching. In the 3 years, the identity of 30 beavers was thus established in the area.

No recaptures were made in 1949, but the notched-tail beaver (caught in August) was found dead in October. In 1950, one animal marked September 10, 1950 was recaptured September 17. In 1951, two beavers marked in 1949 were recaptured; one of them 3 times, the other once. Seven, originally caught in 1950 (4 web-punched and 3 bearing marks of unknown origin) were recaptured in 1951; 3 twice, the others once. One, web- and tail-punched in July 1951 was recaptured a month later. At the time of recapture in 1951 all web-punched beavers, with one exception, were tail-punched. The 10 marked animals caught in the 1952 pelting operation included 5 of the 1951 recaptures (originally trapped: 1 - 1949; 3 - 1950; 1 - 1951). Recaptured for the first time in 1952 were: one web-punched in 1950, one web-punched in 1951 and two web- and tail-punched in 1951. Another, whose hind feet were torn by the trap, could not be identified with certainty. It had at least one punch mark. Another could possibly have been obliterated.

These recaptures supply a basis for evaluating web-punching as a means of marking. The beaver examined 7 days after web-punching ap-

parently suffered no ill effects; the holes in the webs were distinct. After 11 months the web-punches of this animal had healed into light colored, linear scars, $1/8$ inch in length, from which fine lines radiated into the surrounding web. A lump could be felt in the intercutaneous fascia. Eight months later, the only change noticeable in these same marks was a darkening in color. The web-punches of another beaver, 1 month after punching, were partially filled with tissue, and 6 months later were completely filled. This pattern of web-punches filling in and eventually healing into faint scars is evident in the histories of 11 of 12 beavers for which recapture data are available. Twenty-one recaptures, representing periods of from one week to $33\frac{1}{2}$ months, were analyzed. The exception to this healing pattern was a beaver whose web-punch had been enlarged with a scissors; examination, 11, 13, and 20 months after marking, revealed a distinct hole, $\frac{1}{4}$ inch in diameter, through the web.

Aldous lists two disadvantages to web-punching: (1) unless the holes in the upper and lower surfaces of the web coincide, only a faint scar remains after healing and (2) identification by inexperienced personnel is unreliable. Great care was taken to inflict the holes so that they would normally coincide. This was verified by examination of pelted beavers in 1952, eleven of 13 punched webs had the upper scar directly over the lower. It would appear that regardless of care taken in punching, web-punches made with a $3/16$ inch leather punch will eventually heal into a faint scar.

The technique, although serving the purposes of this study, was not entirely satisfactory. Identification of individuals often required very

careful and deliberate examination, but it is felt that all beavers were properly identified, excluding one, mutilated in the 1952 pelting operation. This belief is strengthened by data obtained on supplementary marked animals. In all instances the web marks of this group were similar to those identified in beavers that were web-punched only. Furthermore, weights and body measurements of beavers identified by web marks were in every instance in agreement with the original records within the limits of normal change.

In view of these shortcomings, the writer would not recommend this method of marking for a large scale study.

Tail-punching was found to be satisfactory up to 10 months, but no data are available for longer periods. The holes did not fill in completely although they did decrease in size.

Sexing

Presence of a baculum, determined by inserting a finger in the urogenital opening (Bradt, 1938), was considered positive evidence of a male (Bradt was thus able to sex all beavers except kits). Ten males were sexed by this method. No accurate method of sexing live kits was known to the writer, but of the 4 live-trapped, 1 (male) was later examined as a 2-year-old, 2 (male and female) were commercially trapped and examined, and 1 (male) was found dead in a trap. Four adult females, when first captured, were sexed on the basis of conspicuous mammary glands. Of 13 sexed as females by the absence of a baculum, 2 had conspicuous mammae when recaptured, 2 were verified by examination during the 1952 pelting operation, 2 were recaptured and again no baculum felt,

5 were not recaptured, and 2 were found to be erroneously sexed. A 31 pound animal sexed in 1949 as a female proved to be a male when recaptured in 1951. An adult male pelted in 1952 was incorrectly sexed in 1951. In both cases a male was involved. Evidently considerable experience is necessary to reach the high degree of efficiency in establishing the presence of a baculum indicated by Bradt.

The sex of 26 of 31 was established within reasonable doubt. Five, sexed as females by the absence of a baculum, were not verified by recapture. The possibility of one or more of these being erroneously sexed is recognized.

Ageing

Beavers were weighed and measured (total length, length and width of scaly part of tail, and hind foot) to determine whether the measurements fell into distinct and separate categories. Frequency distributions suggested that these measurements were not taken from a single group. Inspection of the frequency distributions and field experience indicated that weight was the best criterion for establishing separate categories. To substantiate the hypothesis that weight frequency (fig. 2) represented more than one group, Chi-square for testing "goodness of fit" of the normal frequency curve was computed. The large value of Chi-square (13.47 with $df=2$) would occur as the result of chance alone in less than 1 time in 100, strongly suggesting that more than one group had been weighed.

Further examination of the weight frequency distribution shows an apparent grouping of weights into three categories: (1) 8-12 pounds, (2) 20-26 pounds, and (3) 30 pounds and over. These apparent groups were

Frequency

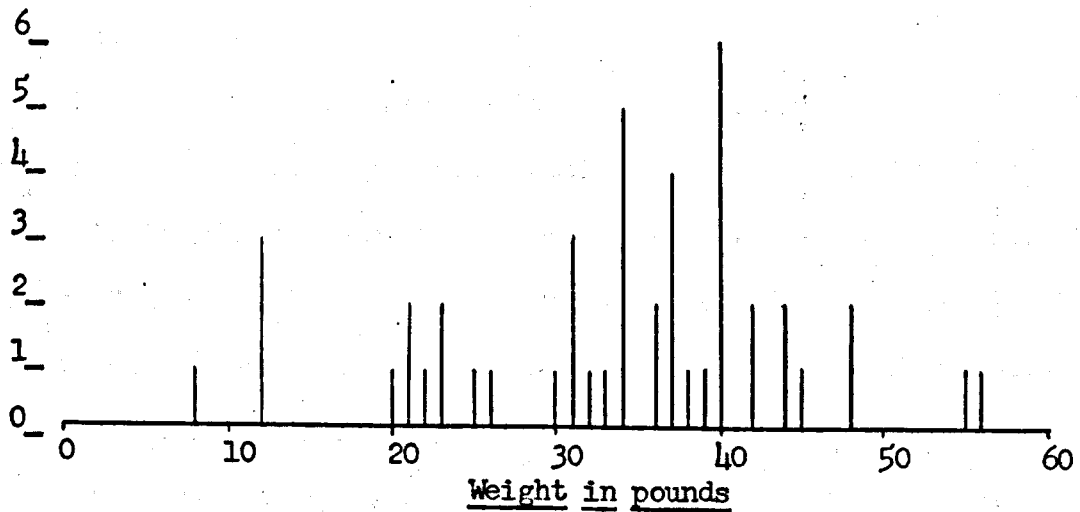


Figure 2. Frequency distribution of beaver weights.

Frequency

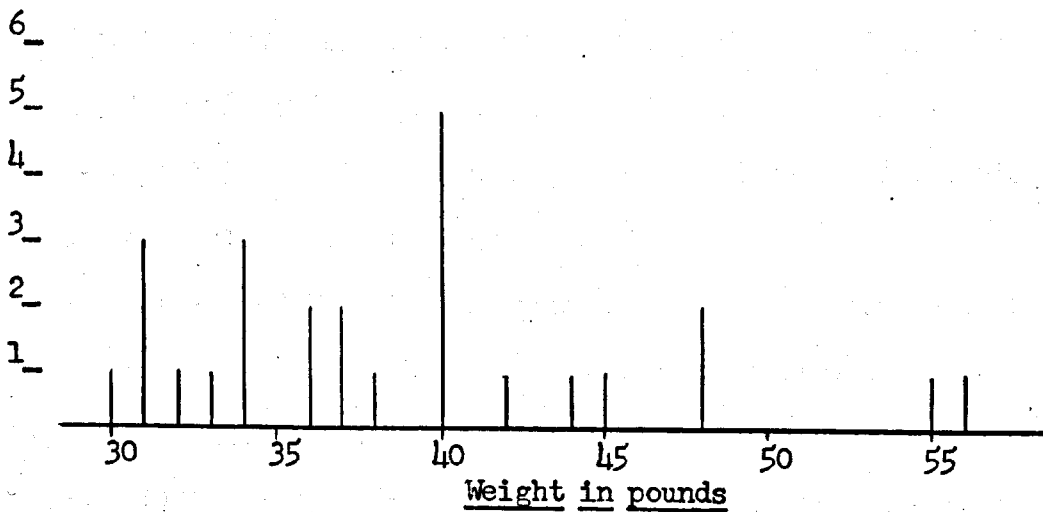


Figure 3. Frequency distribution of beaver weights exclusive of kits, yearlings, and suckled females.

tested for equal variances ("F" test, Dixon and Massey, 1951) and the hypothesis rejected. The three were then tested for equal means (variances not equal, "t" test, Dixon and Massey, 1951). The hypothesis of equal means was rejected at the 1% level. The means were from different populations.

The beavers, whose weights fell into group 1, were classified in the field as kits on the basis of their small size and immaturity. The work of Bradt (1939) substantiates this classification. He gives the weights by months of 4 beaver kits for the first year of life. The lowest weight in August was 6.8 pounds and the highest in September was 13 pounds.

At the end of their first year, Bradt's kits weighed 20.5-26.3 pounds. These weights agree with those of the second group. Further evidence that the second group of weights was obtained from year-old beavers is presented by the trapping records. Beaver No. 4 was caught as a kit on August 25, 1949 - weight 12 pounds; on September 11, 1951 - 34 pounds. No. 9 was caught July 24, 1950 - weight 21 pounds; August 12, 1951 - 33 pounds. No. 11 weighed 21 pounds on August 11, 1950 and 30 pounds one year later, July 26, 1951. The latter animal was weighed again September 22, 1951 - weight 36 pounds. Evidently the second group of weights represented a yearling class.

By elimination of the kits and yearlings and by reference to beavers 4, 9 and 11 (above), the weights of the third group were thought to represent 2-year-olds and older.

Hammond (1943) gives weights of 118 beaver caught in the Lower Souris National Wildlife Refuge during February, March and April 1942. The

weights of his suggested age groups (first year, second year and adult beaver), generally agree with those above if allowance is made for seasonal differences.

Since 2-year-old beavers are of particular significance in beaver emigration (Bradt, 1938), it was desirable to separate this group from the adult population. On the basis that beavers first breed at $2\frac{1}{2}$ years (Bradt, 1938), all females showing evidence of suckling young (conspicuous mammae) were judged to be 3 years old or older, thus eliminating them from the 2-year-old group.

A frequency distribution of the third group of weights, exclusive of suckled females (fig. 3), suggested two groups: 30-36 pounds and 37 pounds and over. The two groups were tested for equal variances ("F" test), and this hypothesis rejected. The two were then tested for equal means (variances not equal, "t" test). The rejection of the latter hypothesis at the 5% level suggested that these two groups of weights were obtained from different populations. The records of beavers 4, 9 and 11 (previously discussed) suggest that the lower weight group represented 2-year-old beavers. The upper weight group obviously represents an adult class. The record of beaver No. 1 supports this conclusion (June 26, 1949 - 31 pounds, 2-year-old; August and September 1951 - 44-48 pounds, 4-year-old).

Confidence limits, at the 99% level, established for the means of the weights for kits, yearlings, 2-year-olds and adults (females with kits excluded) were 5.16 - 16.84, 20.40 - 25.02, 30.73 - 34.87, and 38.98 - 48.62 respectively. Classification of a few animals whose weights were near the border-line between 2-year-olds and adults was verified by

reference to body measurements. Only one exception to weight classification was noted. Both the 1950 and 1951 weights of beaver No. 12 fell well within the range of the 2-year class (31 and 34 pounds respectively) but 1950 body measurements indicated a 2-year-old and 1951 measurements an adult. Ulcerous sores on the body of this animal were noted in 1950.

Body measurements of kits, yearlings, 2-year-olds and adults, as determined by weight, sexual activity and established-age animals, are given for the summer months in Table II.

BEAVER ACTIVITIES

From the middle of June to the end of September, 1950 and 1951, the area was covered at least twice a week and notes on beaver structures, food cuttings and scats were recorded. In 1949 fewer data were taken.

Structures

Beaver structures were typically dams, lodges, stockpiles, canals, burrows and scent mounds. Dams varied in size from small canal dams, 2 feet long and a few inches high (height measured from top of dam to stream bed) to larger stream dams up to 42 feet long and 5 feet high.

Lodges were similar in size, shape and construction; about 3 to 4 feet high, 10 feet wide, and 18 feet long. All were on dry land within 10 feet of water. Eight of 10 were concealed by vegetation.

Stockpiles, usually willow, were found near lodges in water 3 to 5 feet deep. Canals ranged in size from 2 to 10 feet wide and a few yards to 120 yards long. No bank burrows were excavated, but a number were found. Scent mounds were typically a pat of mud. Three over 2 feet high

TABLE II

Summer Weights and Measurements of Various Age Classes of Beavers

	No. Kits	No. Yearlings	No. Two-years	No. Females with kits	No. Adults without kits
JULY					
Weight*	0	2 21.5(21-22)	2 30.5(30-31)	3 38.7(37-40)	5 42.6(37-56)
Hind foot**	0	2 5.75(5.5-6.0)	1 6.25	3 6.75(6.5-7.0)	5 6.7(6.3-7.0)
Total length	0	2 31.5(30-33)	1 36.0	3 38.0(37-40)	5 39.8(38-43)
Tail width	0	2 3.4(3.25-3.5)	1 4.0	3 4.9(4.5-5.1)	5 5.0(4.5-5.5)
Tail length	0	1 9.0	1 8.5	3 10.3(10-11)	4 10.5(9.5-11.0)
AUGUST					
Weight	2 10(8-12)	3 21.3(20-23)	3 34.3(33-36)	4 36.8(34-42)	4 40.5(34-48)***
Hind foot	2 4.6(4.5-4.9)	3 6.0(6.0)	3 6.6(6.5-6.75)	4 6.7(6.5-6.75)	4 7.0(6.75-7.5)
Total length	2 24.7(24.5-25)	3 33.0(31-35)	2 37.5(37-38)	4 38.5(37-41)	4 40.7(37-45)
Tail width	2 2.4(2.3-2.5)	3 4.4(4.0-4.75)	3 4.4(4.0-4.75)	4 4.8(4.5-5.75)	4 4.7(4.25-5.25)
Tail length	1 6.0	1 8.0	3 10.1(10-10.3)	4 10.6(10-10.75)	3 10.5(10-11)
SEPTEMBER					
Weight	2 12.0(12)	3 24.7(23-26)	5 32.8(31-36)	1 44.0	7 44.1(37-55)
Hind foot	2 4.8(4.5-5.0)	3 6.1(6.0-6.25)	5 6.45(6.25-6.5)	1 6.5	7 6.9(6.75-7.0)
Total length	2 29.5(25-34)	3 32(31-33)	5 37.0(36-38)	1 40.0	7 40.7(39-43)
Tail width	2 2.5(2.5)	3 4.0(3.75-4.3)	5 4.65(4.0-4.75)	1 4.75	7 5.2(5.0-5.5)
Tail length	2 7.3(7.0-7.5)	3 9.1(8.75-9.5)	5 9.8(9.5-10.5)	1 11.0	7 10.6(10.0-11.3)
SUMMER					
Weight	4 11.0(8-12)	8 22.6(20-26)	10 32.8(30-36)	8 38.4(34-44)	16 42.8(34-56)***
Hind foot	4 4.7(4.5-5.0)	8 5.9(5.5-6.25)	9 6.5(6.25-6.8)	8 6.7(6.5-7.0)	16 6.8(6.3-7.5)
Total length	4 27.0(24.5-34)	8 32.3(30-35)	8 37.0(36-38)	8 38.5(37-41)	16 40.4(37-45)
Tail width	4 2.4(2.3-2.5)	8 3.7(3.0-4.25)	9 4.5(4.0-5.0)	8 4.8(4.5-5.75)	16 5.0(4.25-5.5)
Tail length	3 6.8(6.0-7.5)	6 8.9(8.0-9.5)	8 9.7(8.5-10.5)	8 10.5(10-11)	14 10.6(9.5-11.25)

*Weight in pounds.

**All body measurements in inches.

***Includes Beaver 12 (see text).

were found (result of over 2 years activity).

Table III - Time of Dam Building Activity in 1949, 1950 and 1951.

	1949		1950		1951		Total	
	DS	DF	DS	DF	DS	DF	DS	DF
JULY								
1st half	0	0	0	0	0	0	0	0
2nd half	1	0	0	0	2	0	3	0
AUGUST								
1st half	3	4	4	3	2	2	9	9
2nd half	4	3	14	4	6	3	24	10
SEPTEMBER								
1st half	3	4	2	13	3	5	8	22
2nd half	1	1	0	0	2	5	3	6

Symbols - DS, dams started; DF, dams finished.

Seasonal dam building activity is summarized in Table III. Maintenance on dams not damaged by spring high water was noted throughout the summer, but new construction and major repair were concentrated in late August and early September. Few dams were started in September, but maintenance and improvement, as suggested by the high efficiency of dam trap-sets at this time (Table I), was an important activity.

Table IV - Time of Scent Mound Activity in 1949, 1950 and 1951, as Indicated by Number of Scent Mounds Constructed.

	June		July		August		September	
	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half
1949	0	3	5	1				
1950	2	6	5	1	1			
1951	2	11	10	4	3	2		
Total	4	20	20	6	4	2		

Table IV shows seasonal scent mound activity. Here, as above, a correlation is found between trapping efficiency and activity. The peak period for scent mound construction, July, agrees with the most efficient

time for bait sets (Table I).

Five lodges were built during the study; all late in the season (found the following summer). No stockpiles were known to have been accumulated before the last week of September. Two canals were constructed, both in the first half of August.

Food Cuttings

Food cuttings of willow, dogwood, alder and aspen (aspen in "colony site" H only) were found throughout the summer. Rhizomes of beaked sedge were utilized during June, July and August. Pondweed and waterstarwort were heavily utilized in "colony sites" D and E during August (based on observations of feeding beaver and plant cuttings). Mint and cow parsnip were eaten to a minor extent. One instance of young lodgepole utilization in September (bark completely eaten off) and two of young Engelmann spruce in July were noted. Cuttings were occasionally taken from the few common juniper in "colony site" F.

Willow and redosier dogwood were the most heavily utilized food plants, possibly due to availability. Preference for aspen (Bradt - 1938, Aldous - 1938, Soper - 1937 and many others) was demonstrated in "colony site" H, where it was used almost exclusively despite the presence of willow and dogwood. Aquatics, where available, were important during August. Bradt (1938) has suggested the importance of aquatic vegetation in the summer months, and Tevis (1950) recorded heavy utilization.

Scats

Scats were of considerable importance in determining beaver presence. Color was a bright, greenish-brown. Three different sizes

were recognized, small - one-half to three-fourths inch, medium - 1 to 2 inches and large - over 2 inches in diameter, and were thought to be generally associated with different age classes. The possibility of an adult dropping a small scat was recognized, but field observations and the trapping record show that kits were active in areas where small scats were found (Tables V, VI and VII). Observations of droppings in quiet water in 6 localities indicated that the bright greenish color was lost within 2 to 3 days, deterioration of form started in 4 to 7 days, and complete deterioration occurred between 10 and 14 days. Droppings were always found in the water.

POPULATION DYNAMICS

Beaver populations and movement during the term of the study will be presented by "colony site" on the basis of trapping data and activities as summarized in Tables V, VI, and VII. The reader is referred to figure .1 for location and structures of the "colony sites".

"Colony Site" A

No. 5, adult male (only capture), was caught 8/27/49. Activity data suggest no more than one adult until September when abandonment evidently took place. A stockpile of the previous winter suggested the site was inhabited at that time, possibly by No. 5.

In 1950, the lack of a previous winter's stockpile suggested the desertion noted in 1949 continued throughout the winter. Cuttings were present in June and September in the southern part, and in the western part in September only. Large scats were observed in the western part in August and September. No. 15, non-breeding adult female, was caught in

Table V - Population Dynamics Data, Summer 1949.

COLONY SITES	- A	- B	- C	- D	- E	- F	- G	- H	- I	-
CATCHES			none	none			none	none	none	
Adults	8/27-5M*	8/20-6aS*								
		10/?-6aS								
2 yrs.	none	none			8/14-2M	6/26-1M				
1 yr.	none	8/23-3F								
		8/27-6M								
Kits	none	8/25-4M								
STRUCTURES										
Dams**	6	8	3	3	7	6	6	12	?	
Dams built	1	4	1	none	none	6	none	none	?	
Lodges	1	3	1	none	none	none	none	none	none	
Lodges in use	1	2	1							
Stockpiles										
previous year	1	1	?	none	1	none	none	none	?	
FOOD CUTTING***										
June	?	?	none	?	L	L	L	H	?	
July	L	L	none	?	L	L	L	L	none	
August	L	M	L	none	L	H	M	L	none	
September	none	H	L	?	M	M	L	M	?	
SCATS****										
June	?	?	?	?	M	none	?	LM	?	
July	L	LM	none	?	M	M	M	M	none	
August	L	LMS	none	none	MS	M	none	M	none	
September	none	LMS	M	?	MS	M	none	LM	?	

*8/27/5M(Caught Aug. 27 - Beaver No. 5 Male); 8/20 6aS(Aug. 20 - No. 6a - a suckling female).

**Dams present Sept. 30.

***L - Light; M - Medium; H - Heavy.

****LMS - Large, Medium and Small (see text).

Table VI - Population Dynamics Data, Summer 1950

COLONY SITES	-	A	-	B	-	C	-	D	-	E	-	F	-	G	-	H	-	I	-
CATCHES						none		none										none	
Adults		9/17-15F		none						none		7/20-8S		none		7/19-7F 9/13-14F			
2 yrs.		none		9/23-17F						none		none		9/10-12F 9/17-12F					
1 yr.		none		9/22-16F 9/25-18M						7/24-9F 7/26-10F		none		8/11-11M					
Kits		none		none						none		none		9/10-13M					
STRUCTURES																			
Dams		5		6		3		8		8		10		6		12		1	
Dams built		none		2		1		5		1		9		1		none		1	
Lodges		1		3		1		none		none		none		2		1		none	
Lodges in use		none		1		1				none				1		1			
Stockpiles previous yr.		none		1		1		none		1		none		1		none		?	
FOOD CUTTING																			
June		L		L		none		?		L		L		none		H		?	
July		none		none		none		M		L		M		L		L		none	
August		none		L		L		M		M		L		M		L		none	
September		M		M		M		H		H		L		M		H		M	
SCATS																			
June		none		none		L		none		M		M		none		M		?	
July		none		none		none		M		M		M		none		M		none	
August		L		M		L		LM		M		MS		MS		none		none	
September		L		M		L		LM		M		MS		MS		L		?	

Table VII - Population Dynamics Data, Summer 1951

COLONY SITES	- A	- B	- C	- D	- E	- F	- G	- H	- I
CATCHES									
Adults	8/27-25S	7/17-19M 7/21-20F 9/10-1M 9/16-1M	8/25-20F	8/9-1M 8/16-7S 9/13-27M	7/17-8S 8/12-12F 8/29-8S	7/11-15S 7/25-14F 9/25-31M	7/24-21M	8/17-7S	9/21-29S
2 yrs.	8/9-23M	none	9/22-30F	8/12-9F 9/11-4M	9/22-11M	none	7/26-11M	none	none
1 yr.	none	none	none	none	none	none	9/16-28M	none	none
Kits	none	none	none	none	none	8/19-24M	none	9/8-26F	none
STRUCTURES									
Dams	5	4	4	8	8	10	6	12	1
Dams built	none	none	2	3	none	8	1	none	1
Lodges	2	3	1	none	1	none	2	1	none
Lodges in use	1	none	1	none	1	none	1 ?	1	none
Stockpiles previous yr.	1	1	1	1	1	none	1	none	?
FOOD CUTTING									
June	none	L	none	L	M	none	none	H	L
July	M	M	none	M	M	L	M	L	L
August	M	L	M	H	L	M	L	L	M
September	L	L	M	M	M	M	M	L	M
SCATS									
June	none	L	none	LM	LM	M	none	LM	L
July	L	L	none	LM	LM	LM	M	M	L
August	LS	L	L	LMS	LMS	MS	M	MS	LMS
September	L	L	LM	LMS	LMS	LM	M	MS	LMS

the southern part 9/17/50 (caught in "colony site F, 7/11/51", suckled - pelted lower H, 4/8/52, pregnant). Neither reconstruction of the river dam destroyed by high spring water, nor use of the lodge was noted. This and her subsequent record (see above) suggests No. 15 was a "transient". The 1951 records suggest that the activity in the western part was not associated with beaver No. 15.

In 1951 No. 25, suckled female, was caught 8/27/51, in the western part of the area (pelted lower A, 4/8/52, pregnant), and No. 23, two-year-old male (only capture), in the southern end, 8/9/51. The western part contained a new lodge and a stockpile; both probably originated in the fall of 1950. The lodge was occupied and both large and small scats (indicating kits) were found nearby. The evidence suggests that No. 25 moved in, in late summer 1950, and was possibly responsible for the activity in the western part noted at that time. The age of No. 23, 2-year-old, probably precludes it being the mate of No. 25 (Bradt 1938). Its status was probably that of a "transient". The 1952 record suggests No. 19 as the mate of No. 25 at that time.

In the 1952 commercial trapping season (February 16 to April 19), the only activity in the study area during March was noted in sites A, C and H. A and C are on the river which remained relatively open during March, and H on the spring fed tributary (fig. 1). The West Fork areas were frozen in and covered with snow. These areas started to break up during the first week in April. Open water appeared April 10 and trapping efficiency on the river increased rapidly from this date. Before April 10, traps set in the river near the western part of site A caught No. 19, adult male (B, 7/17/51), and a pregnant female No. 25

(A, 8/27/51, suckled). After April 10, beavers No. 12, adult non-pregnant female (G, 9/10/50 and 9/17/50, 2-year-old - E, 8/12/51, non-breeding), No. 11, 2½-year-old male (G, 8/11/50 and 7/26/51 - E, 9/22/51), No. 13, 1½-year-old male (G, 9/10/50), and No. 34, 1½-year-old male (only capture), were caught in the southern part of the area. The evidence suggests No. 19 and 25 were a resident pair, the others "transients".

"Colony Site" B

In 1949 a typical colony (according to Bradt, 1938, and Cook, 1943) was present. In addition to No. 6a, suckled female (found dead B, 10/29/49, suckled), 2 yearlings, Nos. 3 and 6 (only captures), and a male kit, No. 4 (lower D, 9/11/51), caught in the area, evening observations in late August and September showed a colony composition of 2 adults, 3 yearlings and 3 or 4 kits. The start of a stockpile among the remnants of the previous winter's storage was noted. Two lodges were occupied and 4 river dams were built and maintained. The presence of yearlings suggested this colony had been active since late summer 1947 or longer.

In 1950 a 2-year-old female, No. 17 (only capture), and 2 yearlings, No. 16, female, and No. 18, male (only captures), were caught in September. Neither kits nor adults were recognized during evening observations. No scat evidence of kits or large beavers was found. One lodge was inhabited and only 2 of the river dams destroyed by spring high water were reconstructed. Possibly the death of the adult female in October 1949 caused a break up in colony structure. Evidence suggests that the 1950 yearlings were 1949 kits of this area. E was apparently the only other site in 1949 with kits (Table V, scats) and yearlings

trapped in that site in 1950 suggested no yearling movement from that site (possibility of kit survival without the maternal parent is shown by the trapping record of No. 4). No. 17 was possibly a yearling member of the 1949 colony. Indications of stockpile accumulation in late September confirmed by the presence of a previous winter's storage in 1951 suggest these 3 remained during the winter. They were not recaptured in the study area.

No dams were reconstructed or lodges occupied during the summer of 1951. The area remained unchanged in April 1952. Evidently no resident beavers were present. Two adults were trapped in July 1951, No. 19, adult male (pelted A, 3/13/52), and No. 20, adult non-breeding female (C, 8/25/51 and 4/8/52, pregnant) in the lower end (fig. 1). No. 19 moved from lower B to the western part of A, a distance of approximately 0.1 river-mile, between July 1951 and April 1952. As previously mentioned he was probably the mate of No. 25. No. 20 moved upstream to site C (a move of 0.2 river-miles), between July 21 and August 25. She was commercially trapped at the latter site April 8, 1952. An adult male, No. 1 (F, 6/26/49, 2-yr-old - Lower D, 8/9/51 - Pelted C, 3/9/52), was caught in Lower B 9/10/51 and in Upper B 9/16/51. The 1951 record shows an upstream movement toward C, where he was commercially trapped March 1952. Nos. 1 and 20 were apparently at that time a resident pair of C (further evidence later).

In the 1952 commercial trapping operation two $2\frac{1}{2}$ -year-olds were caught in the second week of April (No. 33, only capture, and an unidentifiable marked beaver). Lack of resident evidence (previously discussed), and time of capture suggest that these two were "transients".

"Colony Site" C

In 1949 a river dam was built. The lodge and burrow showed signs of use in August and September. Medium scats and light food cutting were noted in late summer. Remains of previous winter's storage in 1950 suggested the 1949 population remained through the winter. It is doubtful if this population included a resident, breeding pair, because no small scats were found in 1950.

In 1950 the river dam (destroyed by high spring water) was reconstructed and the lodge and burrow were used. Large scats suggested the presence of an adult(s). Food cuttings were present in August and September. Stock-pile evidence of 1951 indicated 1950-'51 winter resident(s), but scat data suggested no breeding pair.

In 1951 two river dams were constructed. The lodge and burrow were used. Food cuttings and large scats were recorded in August and September. Medium scats were found in September only. An adult female, No. 20 (B, 7/21/51, non-breeding - Pelted C, 4/8/52, pregnant), was captured 8/25/51. A 2-year-old female, No. 30 (only capture), was live-trapped 9/22/51. Scat data, direct observation (entered lodge when released from trap), and successful trap-set (dam set) suggested it was at that time sharing the site and possibly the dam work with No. 20.

No. 20, pregnant female (record above), was commercially trapped 4/8/52, and No. 1, adult male (F, 6/26/49, 2-yr-old - Lower D, 8/9/51 - Lower B, 9/10/51 - Upper B, 9/16/51), on 3/9/52. Winter residents were present at this time (March - April 1952) as evidenced by scats and a partially used stockpile near the lodge. When No. 1 was trapped the river was still partly covered with ice and beaver activity as evidenced

by cuttings and tracks in snow were found only in C, A and H. The evidence suggested Nos. 1 and 20 as a resident, breeding pair. No. 32, adult male (only capture), was commercially trapped $\frac{1}{4}$ mile upstream from C in April 1952. Date and place of capture suggested he was "unattached" at that time.

"Colony Site" D

In 1949 no residents were apparent. The large pond (fig. 1) was nearly dry and its retaining dam not repaired.

Considerable activity was noted in 1950. The pond-retaining dam was reconstructed, resulting in the filling of the pond. Four smaller dams were built. Scats and cuttings were noted in July, August and September. No small scats were seen. A large beaver and a smaller one were often observed in the pond during August and September. A 1951 stockpile suggested there were 1950-'51 winter residents.

In 1951, the pond-retaining dam and 2 others (all damaged by spring high water) were reconstructed. Three were trapped below the pond-retaining dam (north or lower D): No. 1, adult male, on 8/9/51 (F, 6/26/49, 2-year-old - Lower B, 9/10/51 - Upper B, 9/16/51 - Pelted C, 3/9/52); and two 2-year-olds, No. 9, female, 8/12/51 (E, 7/24/50) and No. 4, male, 9/11/51 (B, 8/25/49). Despite heavy trapping in September the 2-year-olds were not recaptured; they had probably moved. A large beaver was often observed in lower D during August, and was once identified as No. 1 by observation of tail punches. He appeared to be using a bank burrow.

Two were trapped in upper D (above or south of the pond-retaining dam). No. 7, suckled female, was caught in a dam set 8/16/51 (H, 7/19/50, non-breeding). The next day she was trapped in a short run.

leading to the aspen grove in "colony site" H. The distance was 0.23 airline miles or 0.29 water miles by the shortest route (including 25 feet overland and passage through G). No. 27, adult male, was trapped in a short run 9/13/51 (only capture). Many fresh scars on the head and tail suggested recent battles. Scat evidence indicated a kit(s) south of the pond-retaining dam, none below it. Medium scats only, were present below the dam in September. Both large and medium were seen above the dam throughout the summer.

The data suggested No. 7 (apparently maintaining a dam in D and feeding in H) was using both sites D and H. She was with kit(s) (suckled mammae). Small scats were in D and a kit was caught in H. She was trapped in H in 1950. No plausible explanation is available for this "unusual behavior". The male, No. 27, trapped above the dam was using a blind run. He may have been a resident. The beavers captured below the dam, Nos. 1, 9 and 4, were judged to be "wandering" or "transient" animals. The evidence for No. 1 is obvious. The age (2-yr-old), and negative recapture record in September is suggestive for the other two.

"Colony Sites" E and F

Sites E and F were so closely associated that they are discussed together. Site F includes a group of structures along the main channel and a southern diversion of the West Fork. E includes a group of adjacent structures on West Fork diversions north of the main channel (fig. 1). High spring waters follow the main channel and have relatively little effect on E.

In 1949 two 2-year-old males were caught: No. 2 in E, 8/14/49 (only

capture) and No. 1 in F, 6/26/49 (Lower D, 8/9/51 - Lower B, 9/10/51 - Upper B, 9/16/51 - Pelted C, 3/9/52). Presence of a kit(s) in E was suggested by scats and by the presence of yearlings in 1950. Six dams were built in F and none in E. Age and time of capture suggested No. 1 was a "transient". Time of capture and successful trap set (dam) possibly suggested No. 2 was maintaining a dam(s) in E at this time.

In 1950 a dam was constructed in E. Nine, damaged by high spring water, were reconstructed in F. Small scats were noted near the burrow in F (fig. 1) in August and September. Two yearling females, No. 9 (D, 8/12/51) and No. 10 (only capture), were trapped in E, 7/24/50 and 7/26/50 respectively. A suckled female, No. 8, was caught in F, 7/20/50 (E, 7/17/51 and 8/29/51, suckled). At least one yearling was observed in F. The data suggested No. 8 may have been the maternal parent of kit(s) in F and the yearlings in E, and possibly a resident of both sites.

In E in 1951, a new lodge and a previous winter's stockpile were noted. Three beavers were trapped in dam sets: No. 8, suckled female, 7/17 and 8/29 (record above); No. 12, non-breeding adult female, 8/12 (G, 9/10/50 and 9/17/50, 2-yr-old - Pelted Lower A, 4/18/52, non-breeding); and No. 11, 2-year-old male, 9/22 (G, 8/11/50 and 7/26/51 - Pelted Lower A, 4/15/52). Small scats indicated a kit(s) present.

In F in 1951, eight washed out dams were reconstructed. Scent mound activity was relatively heavy. Four beavers were trapped: No. 15, suckled female, 7/11 (Lower A, 9/17/50 - Pelted lower H, 4/8/52, pregnant), No. 14 adult non-breeding female, 7/25 (H, 9/13/50), No. 24, kit, 8/19 (only capture - dead), and No. 31, adult male, 9/25 (only capture). Small scats were not found after the kit died.

Beaver No. 15 moved from lower A (1950) to F, where she was with a kit in 1951. She was evidently inhabiting at least part of the area used by No. 8 in 1950. No. 8 was now found as a breeding, resident female in E. Beavers No. 12, adult non-breeding female, and 11, 2-year-old male, had moved from residency in G, 1950 (also early 1951 for No. 11), to E, where they were trapped apparently assisting in dam maintenance, 1951. The status of No. 14, a very fat, crippled female (non-breeding), was possibly that of a "wandering" adult. No. 31 could have been a "wanderer" or he may have been the mate of either No. 15 or 8 (or both?).

"Colony Site" G

In 1949 few data were taken. Cuttings were noted throughout the summer; medium scats in July.

In 1950 two new lodges were noted in the lower end (eastern); one apparently abandoned before completion. Remnants of a previous winter's stockpile were found nearby. A new dam was constructed in the West Fork above the lodges. Medium and small scats were found above the dam and near the burrow in August and September only. Three beavers were caught: No. 12, 2-year-old female, near the burrow in the western part, 9/10, and at the new dam, 9/17 (E, 8/12/51, non-breeding - Pelted Lower A, 4/18/52, non-breeding); No. 13, male kit (Pelted Lower A, 4/17/52), in the same trap with No. 12 Sept. 10; and No. 11, yearling male, in the eastern part, 8/11/50 (G, 7/26/51 - E, 9/22/51 - Pelted Lower A., 4/15/52). The relationship of these beavers is not clear, but their subsequent records suggest they remained together. All were commercially trapped within 3 days in April 1952 in Lower A. Although the evidence (Bradt, 1938) would

indicate the improbability of a 2-year-old with kits the fact that Nos. 12 and 13 were caught in the same trap is suggestive. Grasse and Putnam (1950) report a 23 pound female with a kit. They concluded she "...mated as a year old instead of waiting until the conventional age of two".

In 1951 a previous winter's stockpile suggested winter occupancy. The dam was very poorly reconstructed. A section washed out by spring water was replaced, but little subsequent maintenance was noted. Water level was little affected. No small scats were found. Three beavers were caught: No. 21, adult male (only capture), and No. 11, 2-year-old male (G, 8/11/50 - E, 9/22/51 - Pelted lower A, 4/15/52) near the burrow in the western part, 7/24 and 7/26 respectively; and No. 28, yearling male (only capture), in a dam set, below the east lodge, 9/16. No. 11 was evidently still a resident at that time, but he soon moved (see record). No. 21 was possibly a wanderer, but he may have been a resident since 1950 (although not trapped then). No. 28 was possibly one of the 1950 kits.

"Colony Site" H

This group of structures is located along an abandoned country road on the south border of the study area (fig. 1). The water table rises perceptibly in the spring, but no damage is sustained by beaver structures. A beaver trail leads across the old road into an aspen grove.

In 1949 two burrows were used, one in the western part and one in the river pool (fig. 1). Heavy cutting was noted in June followed by light feeding in July and August. No small scats were recorded.

In 1950 a new lodge was noted. It appeared to be used by a beaver(s) in June and early July, but was occupied by a family of musk-

rats during August. In September no muskrats were observed and peeled aspen cuttings near the entrance suggested beaver occupancy. Beaver feeding was heavy in June and September, light and sporadic during July and August. No small scats were found. Two adult, non-breeding females were trapped: No. 7, 7/19 (Upper D, 8/16/51, suckled - H, 8/17/51, suckled) and No. 14, 9/13 (F, 7/25/51, non-breeding). No previous winter's storage was found. The status of Nos. 7 and 14 at that time is obscure. They were possibly "unattached" or "wandering".

In 1951, No. 7, suckled female (record above), was trapped 8/17 (one day after capture in D). No. 26, female kit (Pelted H, 3/27/52), was caught 9/8. Small scats were found in August and September. No previous winter's storage was noted.

During the 1952 pelting operation No. 26 (above) was taken, and another kit (only capture) was released. Tracks in the snow indicated an adult in the site. Most of the water was free from ice cover. In the eastern part (Lower H or river pool), Nos. 35, 1½-year-old male (only capture), and 15, pregnant female (Lower A, 9/17/50, non-breeding - F, 7/11/51, suckled), were pelted 4/14 and 4/8 respectively. Age and time of catch would suggest that No. 35 was a "transient". The status of No. 15 at this time is obscure. She may have been wandering or she may have moved her place of residence since July 1951 and was now a resident of lower H.

"Colony Site" I

No data are available for 1949. In September 1950, a dam was built and a burrow used.

In 1951 the washed out dam was reconstructed. Light cutting in June and July and medium in August and September was recorded. A suckled female, No. 29 was trapped 9/21 (only capture). Small, medium and large scats were present in August and September. Possibly No. 29 was² member of a 1950-'51 winter resident pair.

DISCUSSION AND CONCLUSIONS

Bradt (1938) concluded from a study of 42 colonies that "The 'typical' beaver colony consists of an individual family, including the two parents, the yearlings born the previous year, and the kits of the current year.". His tabular data show 8 of 42 with such a composition, 9 contained a pair and kits, 2 a pair and yearlings, 11 (1 a single female, the others with female(s) and kits or yearlings) had no male of breeding age, 6 a single male, and 6 a male and female. Evidently 34 of 42 were not "typical". Johnson (1927) based his census work on this "typical" colony, but recognized variations. Warren's (1926) observations seem to suggest many variations from this "typical" family group. If Bradts definition of a colony - "...a group of beavers occupying a pond or stretch of stream in common, utilizing a common food supply, and maintaining a common dam or dams. They may or may not be living in the same lodge or burrows." - is applied to the writer's data, colonies ranging from single animals to a "typical" family group (B) are found; very similar to Bradt's tabular data.

Bradt indicated "coming" 2-year-olds leave or are driven out of the family in the spring before the birth of a new litter. The present data seem to corroborate this. Of 8 live-trapped as yearlings, 6 were not re-

captured, strongly suggesting movement(s) away from the study area. One was recaptured twice as a 2-year-old, once in the original area (but no breeding female present) and later in a nearby area. The other was caught as a 2-year-old after moving. In the 1952 commercial trapping season 2 unmarked coming 2-year-olds were caught away from active colonies. Three marked as kits supply some circumstantial evidence as to age when movement occurs. One was commercially trapped at the original site as a coming yearling. The other two were not caught as yearlings, but both were trapped away from their original sites; one as a two, the other as a coming two.

The apparent activities of 2-year-olds handled during the summer supply some evidence as to their time of "settling". Two handled in June and July (F and G) showed no signs of residency. Only one of 3 in August showed signs of settling (A, D, and E). In September only 1 of 5 was judged to be unsettled (B, C, D, E, and G).

Johnson (1927) stated - "...males are frequently found living by themselves at some distance from the lodge...". Bradt suggested the male is driven from the lodge before the birth of the young, and lives separately until late summer. The present data would suggest adult male movement in my study area was much more extensive than that suggested by either Bradt or Johnson for their areas. Of the 6 mature males (3-year-olds included) trapped during the 1952 commercial season, 2 caught in active colonies early in March were judged residents (A and C), 4 caught in April away from active colonies were judged "transients" (A, B, C). No further data are available until July when Nos. 19 (B) and 21 (G)

were captured in areas evidently without resident breeding females. In August Nos. 5 (A) and 1 (D) were found "unattached". In September No. 1 (B) was found moving upstream toward C where it is believed he found a mate (C). September was the first summer month in which male adults were caught in areas known to contain breeding females (D and F). This pattern of adult behavior possibly explains Bradt's 10 colonies of females with kits or yearlings but no adult males, and 6 with single males. The fact that 19 of his colonies contained a breeding pair with kits and/or yearlings is not necessarily in disagreement with the behavior of males indicated in this study. His data were collected from April into November (Bradt, 1933). Males were found with females in September in this study.

Non-breeding adult females possibly showed a pattern of movement similar in some respects to that of the adult males. This was demonstrated by No. 20, "unattached" in July (B) and residing in a different area in August (C). Four others were judged "wandering" or "unattached" at various times (A, F and H).

Movement of 2 breeding females was noted. No. 7 (D and H) moved from D to H in 1 day. No. 15 moved from F to lower H between 1951 and 1952.

Abandonment of various localities has been recorded on the basis of year to year observations of beaver structures by Warren (1927). Bradt recorded the movement of an entire colony for reasons of food supply. The present data show movement of a group of beavers from site G (1950) to E (1951) and from the latter to lower A (1952). No reason is apparent for the first move. The population pressure evident in E in 1951 could

have possibly been a factor in the second.

Gradual break up of a colony and abandonment of a site following the death of the breeding female is apparent in site B.

Territorial behavior was apparently exhibited by the inhabitants of D (1951) and A (1950 and 1951). Each site had "fringe areas" in outlying structures where beavers judged to be "wandering" or "unattached" were evidently restricted. They apparently did not use the area utilized by breeding residents. An adult male appeared to be defending the "resident area" of D in September. The fact that non-residents were not restricted by the physical make-up of the group of beaver structures constituting the so-called site appeared to be obvious. Further evidence that residents may be a restricting factor is afforded by the history of site B. The "typical" colony of 1949 began to disintegrate in 1950 and by 1951 the site was freely used by "wandering" beavers.

The fact that home range and territory in mammals are not synonymous has been pointed out by Burt (1943). The same author also stated, "Population density ... may influence the size of the home range and cause it to coincide more closely with the size of the territory.". This statement is apparently borne out by the history of sites E and F. Actually on the basis of continuity of physical structures of these sites they appeared to be one unit, which was evidently the case in 1950. No. 8, breeding female, used both at that time, but in 1951 No. 8 was apparently restricted to E and No. 15, breeding female, was found using F.

These data lead to the conclusion that colonies can not be limited arbitrarily by the grouping of beaver structures in this study area, where they are often continuous over wide areas.

The fact that the beaver colonies in this study area were not static seems obvious. The numerical population and sex and age composition of colonies changed seasonally and yearly. The status of an area or site was liable to change from year to year. Undoubtedly much of this was due to disturbing factors such as high spring water. Colonies were present which appeared to resemble the "typical" colony. These same colonies would not conform at other times. It appeared that a breeding female, if successful, would eventually become the maternal member of a family group consisting of kits, yearlings, and possibly during late summer, fall, and winter an adult male, providing there were no disrupting factors. This would constitute not the "typical", but the potentially ultimate or maximum beaver colony.

SUMMARY

1. A study in beaver ecology with emphasis on movement was conducted on a 160 acre area in Missoula county, Montana, during the summers of 1949, 1950 and 1951 and the winter commercial trapping season of 1952.

2. The area contained a 1 mile segment of the Clearwater River, a spring creek tributary, and the lower parts of 2 other tributaries.

3. The principal vegetative types on the area were coniferous forest, woody shrub, emergent aquatics, and submerged and floating aquatics. Woody shrub, mostly willow, was predominate.

4. Data were obtained from live-trapping and recapturing 31 beavers and from commercially trapping 15, ten of which were previously live-trapped. Sixty-one catches were made. Of the 3 types of trap sets used, bait, runway and dam, dam sets were generally the most efficient, but

were surpassed by runway sets in July and August.

5. Beavers were marked by the Aldous web-punch method, which was found to be adequate for the purposes of this study, but the results would not justify its use for large scale studies.

6. Sexing of all age classes but kits was accomplished by establishing the presence of a baculum for males and conspicuous mammae or absence of a baculum for females. No method of sexing kits was established.

7. All beavers trapped were classified as either kits, yearlings, 2-year-olds, or adults by weight, sexual activity and established-age animals.

8. Beaver activities as manifested by structures, plant cuttings and scats were recorded to aid in the interpretation of usage of "colony sites". (a) Dam building activity peaked near the first of September. (b) Scent mound activity was greatest in July. (c) Food cuttings were principally willow. Aquatic plants were heavily utilized in August. (d) Three sizes of scats, large, medium and small were recognized and were believed to be associated with age classes.

9. Nine "colony sites" were arbitrarily chosen on the basis of groups of structures. Populations and movements based on trapping and activities were presented by these sites.

10. Movement from the study area was suggested by 6 live-trapped yearlings which were not recaptured. Two, caught when yearlings and recaptured when 2-year-olds, indicated movement from their original sites. Three live-trapped as kits, and later recaptured, supplied evidence

suggesting movement occurred during the second year of life. Activities of 2-year-olds handled during the summer suggested their time of "settling" was late summer.

11. Adult males were found to undergo considerable summer movements. None was found with breeding females in April, July or August. Four were found in areas with breeding females in September and March. Data were not available for the other months.

12. Non-breeding females possibly showed a movement similar to adult males. Breeding females showed relatively little movement.

13. Instances of group movement were limited to 2 successive yearly moves by a group of possibly three beavers.

14. Territorial behavior of residents rather than grouping of beaver structures appeared to delimit colony boundaries in at least 2 instances.

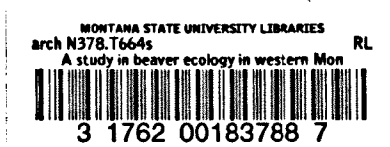
15. The home range of a breeding female was reduced following the "settling" of another breeding female in the same group of structures; indicating population pressure may determine colony limits.

16. The numerical population, and sex and age composition of colonies were subject to both seasonal and yearly changes.

17. A successful female may become the maternal member of a family group consisting of kits, yearlings, and, in late summer, fall, and winter, possibly an adult male. This would not necessarily be a "typical" colony, but the potentially ultimate or maximum colony.

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