AN INVESTIGATION OF SOME PROBLEMS OF ECOLOGY OF THE BEAVER *Castor canadensis canadensis* Kuhl, IN NORTHERN MANITOBA

A THESIS

PRESENTED TO

THE FACULTY OF GRADUATE STUDIES

THE UNIVERSITY OF MANITOBA

IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF SCIENCE

---

by

John Blake Nash

April 1951

Much of the work reported in this thesis was done while the writer was in the employ of the Game and Fisheries Branch, the Department of Mines and Natural Resources of the Province of Manitoba and grateful acknowledgement is made of permission to use the material and data obtained during that employment.

To Dr. A. Savage, Faculty of Agriculture, the University of Manitoba, for assistance and advice in problems of pathology and to Mr. Fred Zeiler, Department of Mathematics, University of Manitoba for aid in the mathematical problems of population studies, the writer offers his sincere thanks.

TABLE OF CONTENTS

INTRODUCTION

During the last decade there has been a five fold increase in the numbers of beaver in the province of Manitoba. The ecological status of the beaver, the factors which brought about this population increase and the attendant game management problems form the subjects of the investigations reported in this thesis.

Ecologically the beaver is a native of the aspen park and mixed wood areas of the province. Driven from this natural habitat by unregulated trapping and by the habitat reduction attendant upon the advances of agriculture, the species now exists, except for a few scattered colonies, in the northern coniferous forest which occupies most of the territory between the 54th and 57th parallels of latitude and which also extends southward on the east side of Lake Winnipeg to the Lake of the Woods.

In this unfavorable district the beaver existed in small numbers until 1942 when, under the combined effects of habitat modification and a particularly well chosen plan of controlled trapping, the population began to increase sharply and within seven years rose to a number more than five times that shown by the 1942 census. The population now appears to be relatively stable under the influence of systematic trapping and it is the hope of the authorities concerned to maintain this level in the areas now in production and to increase the total by introducing the beaver to areas not presently occupied. The subsequent pages deal with the problems involved in achieving this aim.

Systematic position of the beaver.

The beaver is a rodent belonging to the family Castoridae. Miller (1923) lists three species of beaver in North America, *Castor canadensis* Kuhl, *C. caecator* Bangs, and *C. subauratus* Taylor. These species

are recognized by Anthony (1928) but Pratt (1929) reduces subauratus to subspecies rank and this classification is now commonly recognized. Twelve subspecies of C. canadensis are now recognized, Castor canadensis canadensis Kuhl, being the only one found in Manitoba.

Review of the literature.

Most of the available literature is contained in the published papers of American ecologists in the employ of various state and federal agencies. Each author appears to have concentrated on some specific phase of the problem so these only will be reviewed.

Bailey (1922) surveys the general habits of beaver and concentrates on the problems of damage by beaver and on the possibilities of farming the animal. He describes the live trap which he designed and which has been of great value in the majority of subsequent work.

Rasmussen (1940) states the effect upon trout of beaver activities in trout waters.

Tappe (1942) describes the current status of beaver in California and gives detailed accounts of the histories of individual colonies introduced in recent years.

Couch (1942) reviews briefly the damage and benefit activities of beaver in the United States and gives detailed instructions in the techniques and skills of live trapping and transplanting beaver.

Rasmussen and West (1943) describe transplanting operations in Utah with special reference to the identification tagging of beaver.

Erickson (1944) lists the parasites of beaver.

Grasse and Putnam (1950) discuss the food preferences and requirements of beaver and give much valuable information regarding the relationship

of beaver to other wild life.

Deficiencies in the Literature.

Very little information was found regarding the effect of food supply upon distribution and abundance of the beaver. No information upon the growth of population or upon population coaction was found.

The Ecological Factors Involved.

For any species, ecology is reduced to a question of the ability of Biotic Potential of the species to oppose the forces of the Environmental Resistance encountered in the specific habitat.

The Manitoba beaver appear to be exposed to the following factors of environmental resistance:

Climate
Coverage
Water Supply
Food Supply
Predators
Parasites
Disease
Population Coaction.

These factors will be discussed separately and with each will be included the factors of Biotic Potential by which the beaver resists them.

The most important factors appear to be those of food supply and population coaction and it is upon these that this investigation has been concentrated.

Beaver Morphology.

Certain morphological characteristics of the beaver though not readily assignable to any particular phase of the investigation are of general importance to a n understanding of the ecology and are therefore presented.

The Game Management Problem.

The task of a game manager is to discover the ecological factors of the species involved and by exploiting these to obtain the maximum desired effect. This effect varies with species and depends upon their relative position in regard to the other species of the area. For instance, wolves are in general detrimental to the rest of the game population and minimum wolf populations are therefore desirable. On the other hand beaver produce desirable fur and the problem becomes one of so manipulating the controllable elements of the ecological equation as to produce the maximum sustained yield of pelts.

The common pitfall of game management has been an unwillingness to reduce populations when necessary. This is an understandable result of the struggle on the part of the authorities to prevent the extinction of some badly maltreated species but has been shown in several instances to be quite as disastrous as overcropping. It will be shown that this may constitute a real threat to the beaver population of Manitoba.

The general problem of trapping comes under the heading of predation and is dealt with in that section.

CHAPTER I

MORPHOLOGY

Morphological adaptations and data.

Certain morphological adaptations of the beaver to an aquatic existence are of ecological importance. The animal possesses nostril and ear valves which close upon submersion. The lips may be closed behind the incisors, allowing the use of these teeth for underwater cutting. The fore limbs are reduced in size and increased in dexterity and are used as hands in many building operations. The hind feet are elongated and webbed and the shape and musculature of the hind legs are modified for powerful swimming. The tail is broadened by dorso-ventral flattening and serves as a most efficient rudder particularly during the many towing tasks which the beaver undertakes. The adaptations of the limbs, while of undoubted value in the water, render the beaver slow and awkward when on land.

Attempts have been made to determine the age of beaver from morphological measurements, particularly of weight. The works of various authors are shown in Table I. The general findings are that average weights may be attributed to each age group but that the inter-group gradient is so gradual as to prevent definite classification of many individuals.

TABLE I.

SUMMARY OF THE FINDINGS OF VARIOUS AUTHORS

ON AGE - WEIGHT RELATIONS OF BEAVER.

AUTHOR	AVERAGE WEIGHT IN POUNDS OF BEAVER OF KNOWN AGES.					
	Kit	1 year	2 year	3 year	adult (mature)	max.
BAILEY (1922)	2	25--30	40--45	50	60--70	100--110
SHAW (1948)	---	17	33	---	40	---
MOORE (1949)	---	--	--	---	40	65
Swank (1949)	1--12	18--25	--	---	--	56
GRASSE (1950)	9	24	29	---	41	---
COOK (1948	---	20	25-33	---	35	

Table II lists morphological measurements made by the writer from a sample of beaver livetrapped along the right of way of the Hudson Bay Railway in the vicinity of Thicket Portage Manitoba. These data were obtained during the months of July and August. Also included are the data on two captive beaver held at the University of Manitoba and measured in December, ages of which are known to be ten years.

It will be noted that there is a division into five fairly definite groups about the 8, 18, 26, 33 and 45 pound levels which probably represent the mean weights of kit, 1 year, two year, mature and old beaver respectively.

The tail breadth measurements fall into five groups of the following means: 3, 3½, 4½, 5 and 6 inches and appear to be related to the last four of the weight groups.

Neither the tail length nor the ratio of the tail proportions appear to show any orderly arrangement in groups nor any correlation with the other measurements.

There is no apparent sexual dimorphism shown.

From the foregoing the writer concludes that the mean weights and tail breadths for age groups of beaver are as shown in Table III. It is also concluded that, due to the lack of any clear cut divisions between the groups, the larger specimens of one group may easily be confused with the smaller specimens of the next larger group and that hence many individuals could not accurately be classified. However, since the bulk of the members of each group appear to be close to the group mean it appears that sufficiently accurate information as to the age composition of a population could be obtained to be of ecological significance.

TABLE II

MORPHOLOGICAL DATA OF A SAMPLE OF MANITOBA BEAVER
TAKEN AT THICKET PORTAGE, MANITOBA. 1950.

Tag No.	Sex	Weight (lb.)	Tail Size (in.)	Tail Ratio Length/Breadth	Body Length	Body Girth
----	?	7¼	---	----	---	---
---	?	8¼	6⅛	----	16½	---
1611	F	12½	8 x 3	2.65	19	21½
1624	M	15	10 x 3¼	3.08	22	23
1625	F	18	9½ x 3¼	2.92	23½	22½
1626	?	18½	9 x 3½	2.57	25	22
1615	M	21	10 x 3-3/4	2.65	24	23
1604	F	21½	9¼ x 3½	2.64	23	23
1612	M	24	10½ x 4	2.66	24	27½
1620	M	25	10 x 4-3/4	2.10	25½	26½
1627	?	25	10½ x 4	2.57	28	25
1704	F	25	10 x 4¼	2.35	27¼	25
1616	M	26	10 x 4	2.50	24	23
1701	F	26	11 x 3-3/4	2.92	25½	23½
1602	M	26	9½ x 3½	2.76	26	24
1703	F	26	9½ x 4½	2.23	24	27
1628	?	26½	11 x 4¼	2.58	24	23
1622	M	27½	11 x 4½	2.44	24	27
1607	M	28	11½ x 4	2.90	26½	23
1633	M	29	11 x 5	2.20	30	26½
1702	M	30½	12½ x 4-3/4	2.63	24	24
1606	F	30¼	12¼ x 5½	2.23	23½	26
1614	F	32	12 x 4-3/4	2.53	25	28
1617	M	32	10½ x 4½	2.44	23½	30
1629	M	32	11 x 5	2.20	30	27½
1636	F	32	11 x 5	2.20	31	26
1623	F	32½	12 x 5	2.40	29	30
1634	?	32½	12 x 4½	2.65	31½	27
1637	F	33	11¼ x 5¼	2.65	32	27
1610	M	34½	12 x 4½	2.66	26	29½
1619	M	34½	11 x 5	2.20	27½	30
1618	M	36	11 x 5	2.20	27½	30
1621	F	46¼	12½ x 5-3/4	2.18	32	30
Lab.1	M	44	11 x 6	1.81	32	28
Lab. 2	F	46½	9 x 6	1.50	30	29

TABLE III

MEAN WEIGHTS AND TAIL BREADTHS OF MANITOBA BEAVER

	PROBABLE AGE GROUP				
	Kit	1 yr.	2 yr.	Adult	Old
Weight (lb.)	8	18	26	33	45
Tail Breadth (in.)	--	3	3½	4½ - 5	6.

CHAPTER II

CLIMATE

This factor operates chiefly through its effect upon the food supply of the beaver which is considered separately.

The only sub-factor of climate which operates directly is temperature which is effectively countered by the protective instincts detailed hereafter.

Bailey (1922) gives the range of the beaver as "most of the continent of North America from the mouths of the Rio Grande and Colorado Rivers and Northern Florida north to Labrador, Alaska and the mouth of the MacKenzie River, well within the Arctic Circle." This indicates survival of the species through a temperature range from -60 degrees F. to 100 degrees F. or occasionally even more.

This temperature forces the beaver to construct shelters and further deprives him of access to much of his food supply by effectively sealing over the waters in which the animal has taken refuge.

The beaver's protective instinct leads him to build "houses" or "lodges" having underwater entrances. These shelters are built in the water or upon the bank and are solidly constructed of poles and branches set firmly in the ground and solidly plastered with mud to form a thickwalled structure which when frozen is windproof and will retain the body heat of the occupants. Ventilation is afforded by an unplastered area at the top and entrance is effected by one or more "plunge holes" or tunnels the entrance of which is under water. Channels are dug to ensure sufficient water depths at the tunnel entrances and the mud so obtained is used in construction of the house.

The Manitoba beaver almost uniformly build houses although each

colony has associated with it a number of extensive bank burrows, also with underwater entrances, which provide alternative shelters and may be used as rest and breathing places during the beaver's water travel under the ice. Young beaver are reported often to use bank burrows during their first winter away from the parental house but it has been the writer's experience that this is more the exception than the rule.

Beaver colonies along the Hudson Bay Railway grade are systematically live trapped to extinction each summer to prevent damage to the grade and are quite as systematically re-colonized the following spring, presumably by young beaver leaving the parental colony. No signs of bank colonies were observed and in many instances the immigrants ignored the existing house and built a new one.

The beaver of the Deer River (Mile 442, The Hudson Bay Railway) live in bank burrows during the summer months but retire to houses in the surrounding muskeg creeks for the winter. This practise is due to the regular flooding and ice action experienced on this River each spring.

The size and shape of beaver houses varies considerably from tall hemispherical structures well offshore to low, long, roundtopped structures often set well up on the bank. All are characterized by wall from 18 inches to 2 feet thick.

The building material varies with the habitat. Willow and alder with peeled poplar is most common but birch, tamarack, spruce and any shrubs will be used if available. In marshland, large quantities of reeds are utilized. Figures 1. and 2. show houses typical of the habitat. The house in Fig. 1. is located in the marshes of the Saskatchewan delta and considerable quantities of marsh vegetation were utilized in its construction. This house was 22 feet in diameter and 7 feet high. The house in figure 2. is

representative of the bank type of house, and measured 30 feet long, 12 feet broad and 3½ feet high. Located in the forested district north of Flin Flon, Manitoba, it was constructed of willow, alder, balsam poplar and aspen poplar.

When the water is frozen over the beaver is unable to forage ashore for his usual food. He meets this effect of low temperature by storing food under water where it is accessible throughout the winter. In the foreground of Fig. 2. may be seen a typical feed pile which extends from the top to the bottom.

By way of contrast, it is reported from California (Tappe, 1942) that the three local subspecies (shastensis, subauratus and repentinus) normally prefer to live in bank burrows, building houses only when the rocky banks preclude successful burrowing.