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COMPARISON OF TREE CUTTINGS OF SIX BEAVER COLONIES IN  
ALLEGANY STATE PARK, NEW YORKBY ALBERT R. SHADLE, ALMA M. NAUTH, EDWARD C. GESE  
AND THOMAS S. AUSTIN

The lack of much definite information on food and tree cutting activities of the beavers led the senior author in 1937 to begin observations on a new colony. The first data taken involved only the one colony (Shadle and Austin, 1939), but to June 3, 1941, information on five more colonies has been obtained and a comparison of all these data is the basis for this paper.

The time involved in the data varies from 49 months each in colonies one, two, and three; 14 months in number four; 13 months in number five; 8 months in colony number six. The total time of all six colonies amounts to 182 months or fifteen years and two months of colony activity.

## CUTTINGS PER COLONY

The total recorded cuttings of the six colonies (Table 1) amount to 5,424 trees having a diameter of 1 to 17 inches across the cut stump. Nothing less than one inch in diameter was counted and, because of this limitation on the measurement of material recorded, the results given here represent a minimum rather than the maximum of the cutting done. While the bark and leaves form by far the greater portion of the beavers' food material, not all of the food value of the cuttings is utilized, as measured by Aldous (1938). This waste of food material may be due to several factors: (a) trees may fall in such a position that the beaver cannot use them; (b) trunks may be too large to handle and the bark so corky that younger, more desirable food is taken instead; (c) limbs and trunks may be used in lodge building and damming without removal of the food material; (d) so much material is cut at times that drying out spoils its food value before it is used.

It is impossible to determine the exact amount of cuttings used for food, the amount wasted, the amount used in lodge and dam construction and in repair work. Because (a) no satisfactory method is available for measuring the *bark-and-leaf* food value in relation to the diameter of the tree, (b) and because the volume of the tree is of little aid in estimating its food value and (c) because beyond a diameter of five inches, the greater the diameter of the tree, the greater will usually be the trunk waste, one is left mainly with the comparison of the different genera of trees cut, the numbers of trees per genus, and the diameters of the trees cut. The number and size of individual beavers per colony, the location of the colony, as in colony number two, the kinds and the sizes of the trees present, and the amount of wasted food material, all are important factors in determining the amount of cutting done by a colony.

## COLONY NUMBER ONE

This colony started in an area having plenty of *Populus* and *Salix* and 25 or more other genera of trees common to the region. During 49 months, 1,584 trees

TABLE 1.—Comparative Tree Cuttings in Allegany State Park, New York

COLONY.....	No. 1 Quaker Run	No. 2 Quaker Lake	No. 3 Upper Red House Creek	No. 4 Owasaka	No. 5 Lower France Brook	No. 6 Upper Quaker Run
DATES.....	April '37 to June 3, '41	April '37 to June 3, '41	April '37 to June 3, '41	March '40 to June 3, '41	April '40 to June 3, '41	Oct. 9, '40 to June 3, '41
TIME IN MONTHS.....	49	49	49	14	13	8
	<i>Populus</i> 593	<i>Carpinus</i> 240	<i>Carpinus</i> 643	<i>Populus</i> 302	<i>Populus</i> 392	<i>Populus</i> 115
	<i>Carpinus</i> 302	<i>Acer</i> 145	<i>Populus</i> 424	<i>Betula</i> 35	<i>Salix</i> 160	<i>Salix</i> 16
	<i>Amelanchier</i> 278	<i>Prunus</i> 85	<i>Acer</i> 215	<i>Salix</i> 34	<i>Carpinus</i> 40	<i>Carpinus</i> 8
	<i>Salix</i> 182	<i>Betula</i> 74	<i>Amelanchier</i> 170	<i>Acer</i> 28	<i>Prunus</i> 19	<i>Prunus</i> 4
	<i>Betula</i> 68	<i>Amelanchier</i> 43	<i>Betula</i> 106	<i>Carpinus</i> 24	<i>Amelanchier</i> 9	<i>Acer</i> 4
	<i>Prunus</i> 56	<i>Fagus</i> 43	<i>Tsuga</i> 103	<i>Amelanchier</i> 23	<i>Acer</i> 3	<i>Amelanchier</i> 1
	<i>Fagus</i> 53	<i>Hamamelis</i> 32	<i>Salix</i> 96	<i>Hamamelis</i> 15	<i>Pyrus</i> 3	<i>Betula</i> 1
	<i>Acer</i> 47	<i>Ostrya</i> 13	<i>Prunus</i> 66	<i>Prunus</i> 6	<i>Tsuga</i> 1	
	<i>Hamamelis</i> 3	<i>Tsuga</i> 12	<i>Fagus</i> 17	<i>Pinus</i> 2	<i>Hamamelis</i> 1	
	<i>Tsuga</i> 2	<i>Tilia</i> 9	<i>Hamamelis</i> 16	<i>Picea</i> 1		
		<i>Salix</i> 9	<i>Ostrya</i> 9	<i>Tsuga</i> 1		
		<i>Populus</i> 8	<i>Ulmus</i> 6	<i>Frazinus</i> 1		
		<i>Pinus</i> 1	<i>Tilia</i> 2			
		<i>Frazinus</i> 1	<i>Pyrus</i> 2			
			<i>Frazinus</i> 1			
Total.....	1584	715	1876	472	628	149
Waste cuts.....	19	13	38	2	0	4
Percent waste cuts...	1.2	1.8	2.0	0.4	0	2.5
Genera per colony....	10	14	15	12	9	7

of 10 genera have been cut. The first six genera are *Populus*, 593; *Carpinus*, 302; *Amelanchier*, 278; *Salix*, 182; *Betula*, 68; and *Prunus*, 56. As the first four have been practically exhausted, the beavers are turning more and more to *Betula*, *Fagus*, *Acer*, etc.

During this time eight young have been produced by the original pair.

#### COLONY NUMBER TWO

This colony is located on a small, deep, artificial lake, the high banks of which make an excellent site for a bank lodge, and bank burrows. Since deep water is always available for food storage, there is no need for dam construction. The *Populus* supply here consisted of only eight trees, and a very sparse supply of *Salix* grew at the east end of the lake. This lack of poplar and willow was caused by the preliminary destruction of trees and brush on the lake bed when it was prepared and the flooding of the area to a depth of over 20 feet.

This colony is unusual in several ways: (1) Lacking *Populus* and *Salix*, it used much greater numbers of twelve other genera for food; (2) no damming operations were ever undertaken and not more than 15 cubic feet of material were ever used on the single bank lodge, thus all the cuttings were probably used for food; (3) *Carpinus*, 240; *Acer*, 145; *Prunus*, 85; and *Betula*, 74, were the main food supply from the 14 genera of trees used; (4) the small number of cuttings (715) in 49 months is due to, (a) the presence of only two adult beavers and (b) no necessity for damming and building activities. The total, 715 cuttings, is much less than half the cuttings made by colonies one and three in the same length of time. (5) No young were ever seen at this colony although it was under continual observation each summer. Since no young were produced, and since the diet was quite lacking in the two important food plants, the point is suggested that an element essential for reproduction may be lacking in their food supply.

If these beavers are of the same sex, they are living within half a mile of another colony and there is ample opportunity for the selection of mates.

The general activities and reactions of the two were similar to those of other known pairs and it is believed that these two also are a pair.

#### COLONY NUMBER THREE

This colony had a plentiful supply of many kinds of trees, and of the 15 genera used there were 1,876 trees, the largest number cut by any colony. Since there were plenty of *Populus* and *Salix* present and many of the poplars were large ones (7"-15" diam.), the numerical order of the cuttings was rather unusual. It was *Carpinus*, 643; *Populus*, 424; *Acer*, 215; *Amelanchier*, 170; *Betula*, 106; and *Tsuga*, 103. The comparatively large number of hemlock cut, and the degree to which the bark had been stripped from the roots and as high as they could reach on the trunks, seemed ample evidence of the use of hemlock bark for food. Trees were often completely skinned at the base and killed, although they were not always cut down.

The large number of *Carpinus* cut by this colony is rather striking and was mentioned in an earlier paper (Shadle and Austin, *op. cit.*).

The number of beavers in this colony is not known.

## COLONY NUMBER FOUR

The small area in which this colony settled was well supplied with *Populus*, some *Salix* and the usual other genera were present. Of the 472 trees, *Populus*, 302, formed the main source of cuttings, but *Betula*, 35; *Salix*, 34; *Acer*, 28; *Carpinus*, 24; *Amelanchier*, 23; and six other genera have been used. A decided preference for *Populus* is shown and the first six genera on the general preference list are also the first six on this list. This colony probably has enough material to remain in this location only about two years, for the poplar is almost entirely depleted and they must soon turn to other less desirable food trees or seek a new location.

There were two adults and two young in this colony.

## COLONY NUMBER FIVE

The abundant supply of poplar and large willows is evident in the cutting-list of this colony. Of the 628 cuttings, *Populus*, 392; *Salix*, 160; and *Carpinus*, 40, make up 90 percent of the cuttings. Nine genera were used.

## COLONY NUMBER SIX

This colony settled in September and promptly built a long dam and a lodge and in eight months have cut 149 trees. Here *Populus*, 115; and *Salix*, 16, furnish 87 percent of the total cuttings.

## DISCUSSION

The importance of "availability" (Hamilton, 1939) in the determination of the food supply stands out prominently here (Table 2) and, while 17 genera and probably 25 species of trees were used, 7 genera furnished 93 percent of the cuttings. Two genera, *Populus* (33.8 percent) and *Carpinus* (23.1 percent) supplied 56.9 percent of the total of 5,424 cuttings. The large percentage of *Carpinus* compared with *Salix* (9 percent) was due to two factors: (a) most of the *Salix* used was less than one inch in diameter, and (b) small amounts of *Salix* were available in colonies nos. 2, 4, and 6.

In the numerical list of cuttings *Carpinus* was first in two colonies, second in one, third in two and fifth in one. In no other lists except Shadle and Austin (1939) has *Carpinus* or *Amelanchier* been cited as important items in beaver food, but the high percentages of these two genera and the great amounts of peeled branches found indicate that they are much used for food, as well as for construction at Allegany State Park, N. Y.

These findings substantiate Bradt's contention (1938) that, "It is seldom feasible to distinguish between various usages of material," such as food, construction, and repair of lodges and dams, because of the inability to determine the definite amounts used for each item. In these data the cuttings include a considerable range of trees, but again "their preferences are for a comparatively small number of trees" (Bradt, *op. cit.*). This numerical list as an order of preference, *Populus*, *Carpinus*, *Amelanchier*, *Salix*, *Acer*, *Betula*, and *Prunus*, differs slightly both from Bradt's (*op. cit.*) "aspen group, maples, and willows," and from Shadle and Austin's (*op. cit.*) "poplar, willow, shadbush, ironwood and

cherry." In the latter list, both large and small willows were included when placing *Salix* in second place. By the same calculations *Salix* would be in second or third place in the present list, instead of fourth place. Where plenty of *Populus* and large *Salix* are present, they occur in this order of preference, as in colonies five and six. Small size of much of the willow taken often modifies the preference list.

TABLE 2.—*Tree Cuttings of Six Beaver Colonies Compared By Genera*<sup>1</sup>

GENERA OF TREES CUT	COLONIES						TOTALS PER GENUS	PER CENT OF TOTAL
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6		
<i>Populus</i> .....	593	8	424	302	392	115	1834	33.8
<i>Carpinus</i> .....	302	240	643	24	40	8	1257	23.1
<i>Amelanchier</i> .....	278	43	170	23	9	1	524	9.6
<i>Salix</i> .....	182	9	96	34	160	16	497	9.0
<i>Acer</i> .....	47	145	215	28	3	4	442	8.0
<i>Betula</i> .....	68	74	106	35	—	1	284	5.2
<i>Prunus</i> .....	56	85	66	6	19	4	236	4.3
<i>Tsuga</i> .....	2	12	103	1	1	—	119	2.0
<i>Fagus</i> .....	53	43	17	—	—	—	113	2.0
<i>Hamamelis</i> .....	3	32	16	15	1	—	67	1.2
<i>Ostrya</i> .....	—	13	9	—	—	—	22	0.4
<i>Tilia</i> .....	—	9	2	—	—	—	11	0.2
<i>Ulmus</i> .....	—	—	6	—	—	—	6	—
<i>Pyrus</i> .....	—	—	2	—	3	—	5	—
<i>Pinus</i> .....	—	1	—	2	—	—	3	—
<i>Fraxinus</i> .....	—	1	1	1	—	—	3	—
<i>Picea</i> .....	—	—	—	1	—	—	1	—
Total cuts per colony.....	1584	715	1876	472	628	149	5424	100
Genera per colony.....	10	14	15	12	9	7		
Waste cuts.....	19	13	38	2	0	4	76	1.4
Approx. time in months.....	49	49	49	14	13	8		

Total number of genera cut by all six colonies: 17.

<sup>1</sup> Data to June 3, 1941.

In the Superior National Forest, Aldous (1938) found the order of preference aspen, white birch, alder and willow.

It is quite generally believed that only rarely, when other food is scarce, is coniferous material used as food and Seton (1909) says that the beaver "never is known to eat any part of a coniferous tree."

To the contrary, Warren (1927) states that he has found "numerous lodge pole pines from which the beaver have removed some of the bark, even when other food was close at hand." He concludes that "the beaver makes much more use of the conifer bark than it has been supposed to do." Our observations with regard to the use of the conifers is decidedly in agreement with Warren.

Numerous hemlocks were found, both cut and uncut, where the bark had been removed from the base of the tree and stripped as high as the strength of the bark strand would permit the beaver to tear it loose. The stripping of the bark was also carried along the roots even to a distance of two to four feet from the base. This method of stripping the bark off the trunk and roots is similar to that described by Warren and, since this is the way in which food material is usually handled and since none of the hemlock bark was seen about the lodges or dams, it was believed that it was probably used as food. Although this was observed in most of the colonies, colony number three showed more of this evidence than any of the others.

TABLE 3.—*Beaver cuttings as per genus and size distribution*

STUMP DIAM. IN INCHES	GENERA																TOTALS	PERCENTAGE	
	Populus	Carpinus	Amelanchier	Salix	Acer	Betula	Prunus	Tsuga	Fagus	Hamamelis	Ostrya	Tilia	Ulmus	Pyrus	Pinus	Fraxinus			Picea
1-1.9	476	810	282	478	330	110	136	49	65	60	16	7	4	2	1	3	1	2830	52.1
2-2.9	465	339	130	17	63	79	34	35	34	5	3	2	2	1	2	—	—	1211	22.3
3-3.9	281	77	51	2	29	40	16	11	8	2	2	1	—	—	—	—	—	520	9.6
4-4.9	175	22	42	—	11	24	11	8	3	—	1	—	—	—	—	—	—	297	5.4
5-5.9	116	5	11	—	6	9	8	7	2	—	—	—	—	—	—	—	—	164	3.0
6-6.9	103	4	1	—	2	12	9	4	1	—	—	—	—	—	—	—	—	136	2.5
7-7.9	58	—	3	—	1	3	5	3	—	—	—	—	—	—	—	—	—	73	1.3
8-8.9	39	—	3	—	—	4	14	2	—	—	—	—	—	—	—	—	—	62	1.1
9-9.9	34	—	1	—	—	1	—	—	—	—	—	1	—	1	—	—	—	38	—
10-10.9	35	—	—	—	—	1	1	—	—	—	—	—	—	1	—	—	—	38	—
11-11.9	10	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	12	—
12-12.9	21	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	22	—
13-13.9	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—
14-14.9	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—
15-15.9	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—
16-16.9	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Total	1834	1257	524	497	442	284	236	119	113	67	22	11	6	5	3	3	1	5424	

Under "Waste Cuts" is recorded the number of cut trees which fell in such a position that the beaver could not utilize them. The comparatively open growth in this area has resulted in a low percentage of waste. The percentages of waste per colony varied from 0.0 percent to 2.5 percent with an average of 1.4 percent for the total cuttings of all six colonies. The largest percentage noted in any colony, at any time, was 3.4. This represents a remarkably low waste when one considers that Aldous (*op. cit.*) gives aspen 29 percent and white birch 22 percent as "complete waste." Bradt (*op. cit.*) states that in heavy stands of aspen "sometimes nearly half of the trees cut in a given acre are lodged and wasted."

Aldous (*op. cit.*) formulated a method of determining the amount of food

available in the twigs and bark of *Populus* and *Alnus* trees in the winter condition. While trees are in leaf the amount of leaves taken with the bark and twigs would modify more or less the available food material, so that a correction should be made from Aldous' figures when the trees are cut and used during the leaf bearing period. This will be the subject of a later study.

A chart of the cuttings per genus arranged according to diameter of stump (Table 3) gave the following figures as to the size distribution of the cuttings.

SIZE	CUTTINGS	PERCENTAGE
1 in.	2830	52.1
2 in.	1211	22.3
3 in.	520	9.6
4 in.	297	5.4
5 in.	164	3.0
All larger diams.	402	7.6

Of the 5,424 trees, 4,041 or 74.4 percent were less than three inches in diameter; 4,561 or 84 percent were less than four inches in diameter. Only 7.6 percent had a diameter of six inches or more.

#### SUMMARY

1. The tree cuttings of six colonies of beavers in Allegany State Park, New York, involving a sum total of 15 years and 2 months of colony activity, are compared.

2. The total cuttings amounted to 5,424 trees, measuring from 1 to 17 inches in diameter.

3. A total of 17 genera of trees was cut for food, construction, and repair.

4. Two genera, *Populus* and *Carpinus*, furnished 56.9 percent of the total cuttings.

5. Seven genera in the following order of preference, *Populus*, *Carpinus*, *Amelanchier*, *Salix*, *Acer*, *Betula*, and *Prunus*, furnished 93 percent of the total cuttings.

6. As the depletion of the preferred genera progresses, the gradual shift to the less desirable genera is evident.

7. Two genera, *Carpinus* and *Amelanchier*, prominent on this list, are not mentioned on the other lists except that of Shadle and Austin (1939).

8. Contrary to a prevalent idea that conifers are not used as food, *Tsuga* bark appears to be a definite source of food in these colonies.

9. The total "waste cuts" of the 5,424 cuttings of all six colonies amount to 76 trees, 1.4 percent of all trees felled.

10. Of 5,424 trees, 4,041 or 74.4 percent were under three inches in diameter; 4,561 or 84 percent were less than four inches in diameter; 402 trees or 7.6 percent were six inches or more in diameter.

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## WEIGHT DATA ON FIVE WHALES

BY DANIEL P. QUIRING

During the summer of 1941, Dr. George Crile of the Cleveland Clinic Foundation organized an expedition to Fields Landing, California, for the purpose of making anatomical observations and securing weight data on whales. The party making up the expedition were Dr. and Mrs. Crile, James Barrett, and D. P. Quiring.

A whaling station is maintained at Fields Landing and with the cooperation of its staff it was possible to take five whales in 12 days. Three of these animals were humpback whales (*Megaptera nodosa* Bonn), one was a sperm whale (*Physeter catodon* Linne), and one was a finback (*Balaenoptera physalus* Linne).

### BODY WEIGHTS

Obviously it is difficult to determine accurately the body weight of a whale. Whalers generally follow the rule of assigning one ton of weight per lineal foot in estimating the body weight of adult whales. We used this rule for weight estimation of four specimens. This procedure appears to be fairly accurate for the humpback; the girth of the animal is relatively large in comparison to its length, and the body undergoes an abrupt tapering toward the tail. The sperm whale, on the other hand, shows a much greater degree of streamlining, giving the animal a relatively lesser girth for a given length. Our sperm and humpback whales ranged in length from 41 to 46 feet. The finback, on the other hand, measured 71 feet in length. It was decided to make an actual body weight determination of this animal. For this undertaking, we had the complete cooperation of the whaling station staff under direction of Mr. A. D. McBride, manager of the station. Without such aid the task would have been impossible.

Two Fairbanks-Morse platform scales of 1000 pounds capacity, and one Chatillon dynamometer of 600 pounds capacity were employed. Small glands were weighed on a Chatillon autopsy scale. The weights were carefully recorded by three of us, and the entire task was accomplished in two days. The whaling crew stripped blubber and muscle, disarticulated the animal in the usual manner, and sectioned the tissues into pieces convenient to handle. Body fluid and blood loss were considerable, and estimates were made for this loss. The weather