FOODS EATEN BY A BEAVER COLONY IN SOUTHEAST OHIO

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ABSTRACT

The food habits of stream-occupying beavers (*Castor canadensis*) were studied at two different sites, located approximately a mile part, in Athens and Vinton Counties in southeast Ohio from August, 1964, through June, 1965. The colony, consisting of five to six beavers, both adults and kits, cut or barked 352 stems at site 1 and 1,218 stems at site 2, and averaged between 245 and 295 stems per beaver for 10 months. At site 1, ironwood, buttonbush, Virginia pine and red elm were preferred foods, while common alder, red elm, ironwood, and soft maple were preferred at site 2. The distance traveled to feed on each species indicated that alder, soft maple, and red elm were most preferred. Utilization of preferred food species closely followed their availability at both sites, but it was stems less than 2.0 inches dbh that were usually cut. Less than one percent of the stems cut were wasted.

Food stocks are adequate for beaver along most streams in southeast Ohio, but conflicts with humans and with fluctuating water levels limit colony establishment. Until improved land-management practices or flood-control structures reduce present fluctuations in annual water levels, beaver colonies must remain transient on the major streams. Stream sites utilized for future transplants of beavers should be adjacent to stands of ironwood, red elm, common alder, maple (red and silver), buttonbush, and aspen, and be located where water levels are relatively stable.

INTRODUCTION

Beavers have been reintroduced into unglaciated eastern Ohio since 1936 (Belmont County), yet little is known of their ecology in this region (Bednarik, 1965; Bednarik and Henry, 1967). Occupation of a site by a beaver colony is often transient; introduced populations have fluctuated considerably in some counties, often to near extinction. Human activities frequently conflict with beaver occupancy at many sites so, because beavers have already occupied most of the best habitat, it is becoming more difficult each year to find suitable release sites for nuisance beaver.

Our purpose in investigating the food habits of a beaver colony was to provide more information for evaluating and managing new or existing colony sites on streams in unglaciated Ohio.

The topography of southeast Ohio is generally rugged, with steep, wooded hills and deep V-shaped valleys. Local relief ranges between 250 and 300 feet (Sturgeon *et al.*, 1958). The floodplain and stream-bank forests important to stream-occupying beavers have been extensively cut and cleared. Many stream banks were never entirely cleared, but the more desirable timber species have been removed, so that present floodplain and stream-bank forests in most places contain mixtures of elm (*Ulmus rubra, U. americana*), maple (*Acer rubrum, A. saccharinum*), sycamore (*Platanus accidentalis*), river birch (*Betula nigra*), box elder (*Acer negundo*), and ash (*Fraxinus americana, F. pennsylvanica*) (Hart, 1951).

The climate of southeast Ohio is of the mild continental type. The average growing season is 165 days; severe winter weather seldom limits beaver activity for an extended period. Annual precipitation is about 40 inches and is usually well distributed throughout the year. Of importance to beavers are the annual late-summer droughts of two-six weeks duration that often dry up water supplies, and the late winter and spring rains that often cause flooding.

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COLONY SITES

The colony studied consisted of four or five beavers: two adults and two or three kits. As many as four beavers, two adults and two kits, were observed at any one time, but, because no live trapping was attempted, the absolute population is not known (the definition of a colony used here is that proposed by Hay (1955) and reported by Rutherford (1964, p. 6) as ". . . a group of beavers occupying in common a pond, ponds or a stretch of stream utilizing the same food cache and maintaining communal dams").

During this study, the beaver colony was forced by both drought and flood to occupy two sites in the same watershed, in the adjacent counties of Athens and Vinton, located in southeast Ohio (Fig. 1). The straight-line distance between the two sites was 4,250 ft. If the beavers used Hewitt Fork to travel between the sites, the distance was 7000 ft. Site 1, occupying portions of sections 1 and 2, Brown Township, Vinton County, was formed by beavers damming a culvert under a railroad fill, thereby blocking the intermittent flow from the stream draining Bear Hollow (Fig. 1). A deep borrow pit immediately north of the railroad provided constant water for the colony. The surrounding swamp forest was subject to fluctuating water levels, dependent on watershed flow (Fig. 1). Site 2, in section 32, Athens County, approximately a mile away from site 1 was located at the junction of Hewitt Fork and the small intermittent stream draining Loper and King Hollows. The lodge, food cache, and dam were located in Hewitt Fork (Fig. 1). This stream has a variable water flow, ranging from 0.29 Ft^3/sec at very low flow to 73.8 Ft^3/sec during floods (Clifford and Snavely, 1954). In addition, Hewitt Fork is virtually devoid of aquatic life, because of pollutants emitted from coal mines and mine refuse; pH values of 2.9 and H_2SO_4 levels as high as 63 ppm have been recorded from this stream (Clifford and Snavely, 1954).

The sequence of movement of the beaver colony was as follows. In August, 1964, we found the colony at site 1 (Fig. 1). Based on the age of cuttings and the size of the beaver kits, the adult beavers are believed to have occupied the site during the previous winter. The source of the adults was probably Hewitt Fork or adjacent Raccoon Creek, which has supported a small population of beavers for several years.

Drought around 1 September 1964 reduced the available water at site 1 to such a low level that the colony was forced to move into Hewitt Fork and to site 2 (Fig. 1). The beavers remained at site 2 until the last week in January, 1965, when flooding in Hewitt Fork removed the food cache, inundated the lodge, and tore out the dam. The colony then returned to site 1, about 1 February 1965, presumbly by way of Hewitt Fork, and remained there for the duration of the study. A single beaver lived in a bank den adjacent to the main lodge at site 2 both before and after colony occupation.

Both sites had been occupied by one or more beavers in previous years. However, occupancy must have been only for short periods, because old cuttings were scarce and insufficient to effect food availability for our study colony.

METHODS

From August, 1964, to June, 1965, the active colony location was visited once each month and systematically searched for fresh beaver cuttings. All cut stumps were marked with paint to eliminate duplication on subsequent visits. The species, dbh, type of cutting (whether completely felled or only barked), and the distance to the nearest water were recorded for each cutting.

Circular plots (0.10 acre, 37.2′ radius) were located in each of the principle feeding areas to determine the availability of food species at each site. There were four such areas at each site, where beavers concentrated most of their cutting. One plot was located near the center of each cutting area for a total of four plots

at each site. Plot centers were determined by throwing a marking pin over the shoulder from a point near the center of each cutting area. All woody stems greater than 0.10 inch dbh were tallied in each plot.

The ultimate utilization of each cutting, whether eaten immediately, cached, or used in lodge or dam construction was not determined. Once stems were

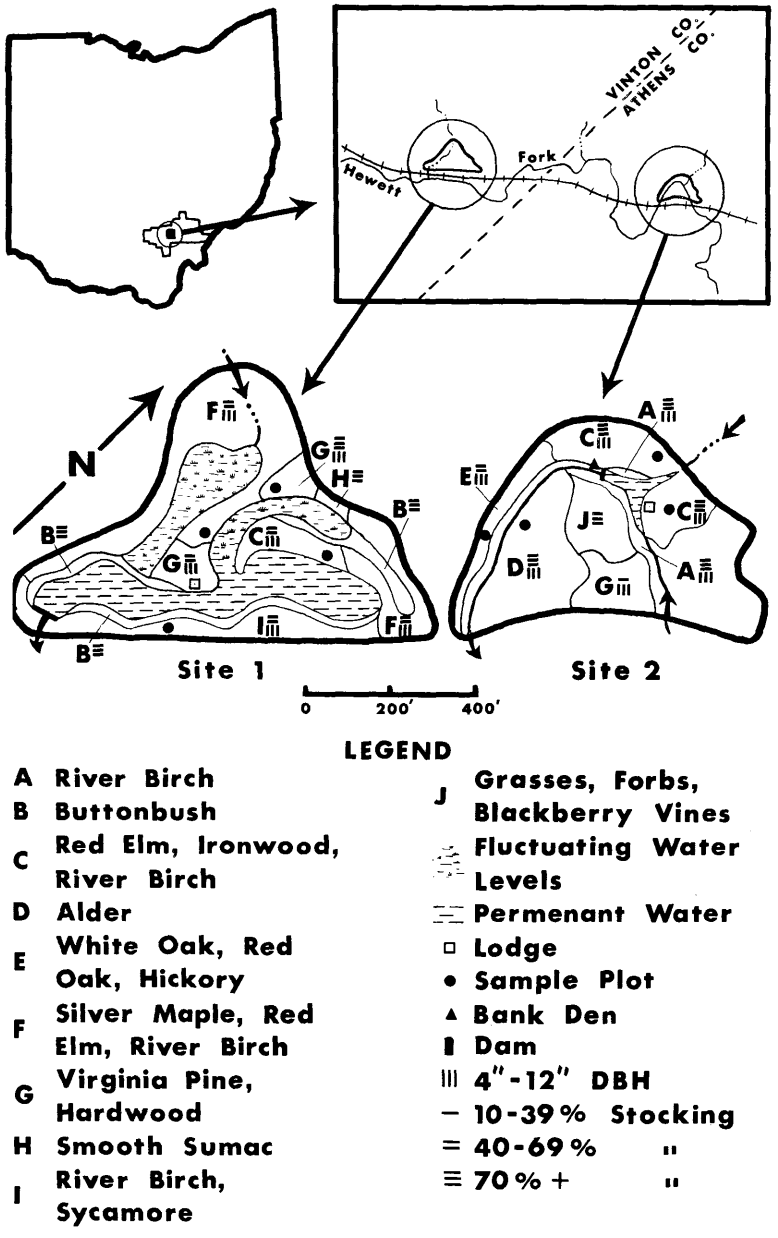

FIGURE 1. The location of two sites occupied by a beaver colony in Athens and Vinton Counties, Ohio from August, 1964 through June, 1965. The principle cover types surrounding each site are also shown.

debarked, species identification was quite difficult. A cutting was considered wasted if it was not removed from the vicinity of the stump or eaten after felling.

Plant nomenclature follows that of Braun (1961), *The Woody Plants of Ohio*, and of Fernald (1950), *Gray's Manual of Botany*.

TABLE 1

The number of woody stems cut or barked by beavers at two sites in southeast Ohio from August, 1964, through June, 1965, listed by species and size class

Species	Size at Cut (inches dbh)												Total	
	0.1–0.5		0.5–1.0		1.1–2.0		2.1–3.0		3.1+		Total			
	Cut	Bark	Cut	Bark	Cut	Bark	Cut	Bark	Cut	Bark	Cut	Bark	N	%
*Site 1**														
Ironwood *Carpinus caroliniana*	15	2	21	1	36	6	21	—	4	6	97	15	112	31.8
Buttonbush *Cephalanthus occidentalis*	93	—	—	—	—	1	—	—	—	—	93	1	94	26.7
Virginia pine *Pinus virginiana*	5	—	10	1	14	14	1	7	—	23	30	45	75	21.3
Red elm *Ulmus rubra*	7	—	7	—	4	—	2	—	1	—	21	—	21	5.9
Tuliptree *Liriodendron tulipifera*	1	—	—	—	—	—	—	—	2	9	3	9	12	3.4
Beech *Fagus grandifolia*	4	2	—	4	—	—	—	—	—	—	4	6	10	2.8
Shining sumac *Rhus copallina*	4	—	1	—	—	—	—	—	—	—	5	—	5	1.4
Oak *Quercus alba, Q. velutina*	2	—	—	—	3	—	—	—	—	—	5	—	5	1.4
Aspen *Populus grandidentata*	—	—	—	—	—	—	—	—	4	1	4	1	5	1.4
Ash *Fraxinus americana, F. pennsylvanica*	—	—	2	—	1	—	—	—	—	1	3	1	4	1.1
Black gum *Nyssa sylvatica*	1	—	—	—	2	—	—	—	—	1	3	1	4	1.1
River birch *Betula nigra*	—	1	—	—	—	—	—	—	—	—	—	1	1	Tr
Maple *Acer rubrum, A. saccharinum*	—	1	—	—	—	—	—	—	—	—	—	1	1	Tr
Flowering dogwood *Cornus florida*	1	—	—	—	—	—	—	—	—	—	1	—	1	Tr
Common apple *Pyrus malus*	—	—	1	—	—	—	—	—	—	—	1	—	1	Tr
Hawthorn *Crataegus* spp.	1	—	—	—	—	—	—	—	—	—	1	—	1	Tr
Total	134	6	42	6	60	21	24	7	11	41	271	81	352	
Percent of Total	39.8		13.6		23.0		8.8		14.8		100.0			
*Site 2***														
Com. alder *Alnus serrulata*	125	—	180	1	181	1	3	—	1	—	490	2	492	40.4
Red elm *Ulmus rubra*	174	—	91	—	45	—	6	—	1	—	317	—	317	26.0
Ironwood *Carpinus caroliniana*	49	—	46	—	35	—	21	—	23	5	174	5	179	14.7
Maple *Acer rubrum, A. saccharinum*	5	—	22	—	38	—	10	—	6	—	81	—	81	6.7
Ash *Fraxinus americana, F. pennsylvanica*	12	—	8	—	8	—	—	—	2	2	30	2	32	2.6
Tuliptree *Liriodendron tulipifera*	4	—	1	—	7	—	—	1	11	1	23	2	25	2.0
Black cherry *Prunus serotina*	9	—	4	—	4	—	3	—	—	—	20	—	20	1.6
Common apple *Pyrus malus*	—	—	2	—	4	—	3	—	4	—	13	—	13	1.1
Buttonbush *Cephalanthus occidentalis*	—	—	6	—	5	—	2	—	—	—	13	—	13	1.1
Box elder *Acer negundo*	4	—	2	—	2	—	3	—	—	—	11	—	11	Tr
Juneberry *Amelanchier arborea*	1	—	4	—	2	—	—	—	—	—	7	—	7	Tr
Oak *Quercus alba, Q. velutina*	—	—	—	—	1	—	2	—	3	1	6	1	7	Tr
Flowering dogwood *Cornus florida*	5	—	1	—	—	—	—	—	—	—	6	—	6	Tr
Shining sumac *Rhus copallina*	2	—	2	—	1	—	—	—	—	—	5	—	5	Tr
Black gum *Nyssa sylvatica*	—	—	1	—	3	—	—	—	—	4	4	4	8	Tr
Sassafras *Sassafras albidum*	1	—	1	—	—	—	—	—	—	—	2	—	2	Tr
Total	391	0	371	1	336	1	53	1	51	13	1202	16	1218	
Percent of Total	32.0		30.5		27.6		4.4		5.5		100.0			
Total wasted, both sites	—	—	1	—	1	—	1	—	5	—	8	—	8	Tr

*8–64; 2–1–65 to 6–15–65, 4–5 beavers.

**9–1–64 to 2–1–65, 5–6 beavers; 2–1–65 to 6–25–65, 1 beaver.

RESULTS

During this study, nearly twenty woody species were cut by beavers at both sites, but only a few species were extensively eaten. A total of 352 stems were cut or barked at site 1, and 1,218 were utilized at size 2 (Table 1). The colony was located at site 2 during the time of winter-food caching, when cutting is greatly accelerated. Food caching began at site 2 approximately 20 October 1964, and continued until mid-December, when cold weather and ice restricted beaver activity. Species most heavily utilized at site 1 were ironwood, buttonbush, Virginia pine, and red elm. Small Virginia pine was cut and removed, while larger (1.0 in.+ dbh) stems of this species were more often simply debarked. Removal of pine bark was particularly prevalent during early spring, when the beavers apparently fed extensively on the cambium of these pines. Buttonbush, which grew adjacent to or in the water surrounding the lodge and food cache (Fig. 1), was heavily utilized during the summer months. The remaining species seemed to have been eaten during all seasons.

TABLE 2

Size and composition of the woody plants found in the principle beaver feeding areas at two sites in southeast Ohio (Base on four .10-acre plots at each site)

	Size at Cutting Height (inches dbh)						
	0.1–0.5	0.5–1.0	1.1–2.0	2.1–3.0	3.1+	Total	Percent
				Site 1			
Ironwood *Carpinus caroliniana*	9	16	35	37	7	104	30.9
Red elm *Ulmus rubra*	14	10	22	4	5	55	16.3
River birch *Betula nigra*	—	1	8	3	31	43	12.8
Oak *Quercus alba, Q. velutina*	16	9	7	—	2	34	10.1
Virginia pine *Pinus virginiana*	5	6	10	3	9	33	9.8
Ash *Fraxinus americana, F. pennsylvanica*	3	1	5	1	4	14	4.2
Maple *Acer rubrum, A. saccharinum*	4	1	3	2	1	11	3.3
Beech *Fagus grandifolia*	2	4	1	—	—	7	2.1
Blueberry *Vaccinium* spp.	7	—	—	—	—	7	2.1
Other species*	8	7	3	3	8	29	8.6
Total	68	55	94	53	67	337	
Percent	20.2	16.3	27.9	15.7	19.9		
				Site 2			
Alder *Alnus serrulata*	213	218	169	23	1	624	36.5
Red elm *Ulmus rubra*	125	110	121	60	18	434	25.4
Ironwood *Carpinus caroliniana*	103	31	33	10	13	190	11.1
Hydrangea *Hydrangea arborescens*	103	—	—	—	—	103	6.0
Greenbrier *Smilax* spp.	61	—	—	—	—	61	3.6
Blackhaw *Viburnum prunifolium*	48	—	—	1	—	49	2.9
Maple *Acer rubrum, A. saccharinum*	12	10	9	9	3	43	2.5
Virginia creeper *Parthenocissus quinquefolia*	28	3	1	—	—	32	1.9
Blackberry *Rubus* spp.	31	—	—	—	—	31	1.6
Witherod *Viburnum cassinoides*	20	—	—	—	—	20	1.2
Flowering dogwood *Cornus florida*	15	1	1	—	—	17	1.0
Other species*	68	9	13	4	9	103	6.0
Total	827	382	347	107	44	1707	
Percent	48.4	22.4	20.3	6.3	2.6		

*Includes tuliptree, sassafras, black walnut *Juglans nigra*, elder *Sambucus candensis*, hickory *Carya* spp., oak, black gum, black cherry, Juneberry, grape *Vitis* spp., ash, hazelnut *Corylus americana*, witch-hazel *Hamamelis virginiana*, shining sumac, and common apple.

Common alder, red elm, ironwood, and soft maple (both red and silver) were the species most utilized at site 2. These were eaten throughout the period of study (Table 1). Differences in food selectivity at each colony site were in part based on availability; e.g. buttonbush was absent from site 2, alder from site 1.

The mean distance traveled to reach the important foods was calculated as a means of determining food preferences. Combining data from both sites, the mean distances for each species of tree were: Alder, 49 ft (Number = 494; range 5-150 ft), red elm, 29 ft (N = 321; range 0–100 ft), ironwood, 12.9 ft (N = 256; range 0–150 ft), soft maple, 48 ft (N = 89; range 0–150 ft), and ash, 24 ft (N = 50; range 0–100 ft). Significant differences were found ($p < .05$) between the mean distance travelled to several species (alder:elm; alder:ironwood; ironwood:elm; soft maple: elm). The greater distances travelled to reach alder, soft maple, and red elm probably indicate a preference for these species.

The species and diameters of the stems used by the beavers were compared with the availability of these stems found in the sample plots at each site (Tables 1 and 2). At site 1, beavers cut or barked the smaller stems significantly more often than the relative abundance of these smaller stems in the sample plots ($X^2(4) = 24.54$, $p < .01$), probably because of the ease of handling the felled stems. Most studies of beaver-feeding habits have noted their preference for small stems (Bradt, 1938; Henry, 1967). At site 2, this tendency was also noted, although utilization according to stem size more closely followed stem size frequency (Tables 1 and 2).

Utilization of preferred species closely followed availability at both sites. At site 1, Virginia pine was utilized in somewhat greater amounts than expected (see Tables 1 and 2), while the use of red elm and oak was somewhat less. At site 2, soft (red and silver) maple was utilized in greater amounts than its relative abundance in our stem tally, and river birch, present at both sites, was not eaten to any extent at all by the beavers.

Once cut, stems were seldom wasted. Less than one percent of the total stems cut were not utilized (Table 1). Stegeman (1954) found that waste was greatest in trees larger than 4 inches dbh. Most of the stems cut by the members of the colony were smaller than 4 inches and less prone to lodge in adjacent trees or on other obstacles.

Herbaceous species were utilized by beavers in the summer and fall months. The cut stems of queen-of-the-meadow (*Filipendula ulmaria*) and grasses (Gramineae) were frequently encountered during the summer and early fall. In addition, blackberry vines (*Rubus* spp.) were cut and utilized in the construction of the dam at site 2.

DISCUSSION

Bradt (1938) found an average of 216 woody stems cut by each beaver per year. Our data for four to five beavers (five-six beavers at site 2) indicated a somewhat greater utilization; combined averages for both sites for 10 months totaled between 245 and 295 stems cut per beaver. However, our colony lost their entire food cache at site 2 in the January, 1965, flood and, when relocated at site 1, had to continue to cut new trees for the remainder of the winter. Because aquatic vegetation was non-existent at site 2 and scarce at site 1, the beavers had to feed on woody plants during the summer months when they would normally consume large amounts of grasses, forbs, and aquatic plants (Bradt, 1938; Rutherford, 1964, Brenner, 1967).

The size of the feeding range of a beaver colony is a function of the interaction between the availability of food and water in relation to colony size (Brenner, 1967). Our colony did not remain at either site long enough to deplete the food supply immediately adjacent to the home lodge, and most of the cuttings were located within 100 yards of the home lodge.

Fluctuating water levels were a major problem for beavers at both sites.

Both floods and drought-induced low-water flows are problems commonly faced by stream-occupying beavers in southeast and south-central Ohio. Food supply is not usually a serious problem in these regions, although lake-dwelling beavers in southeast Ohio have occasionally depleted preferred food-plant species adjacent to the lake shore after several years. Preferred species, such as red elm, ash, alder, maple, and ironwood, of suitable diameters are common along most streams, and clones of aspen and willow are found in limited amounts throughout unglaciated Ohio.

Fortunately the mild winter weather of southeast Ohio permits beavers to cut food species throughout the year, and some cutting is done all through the winter. Thus the frequent loss of the food cache from floods does not jeopardize the colony to the extent that it might in regions where winter weather is more severe.

Southeast-Ohio streams with consistent all-season discharge necessary for permanent occupancy by beavers are usually located adjacent to croplands or to roads. Beaver-induced crop damage and flooding of roads, fields, and home sites from beaver dams are frequent complaints along these streams. Rapid runoff from rains causes floods in the larger watersheds in late winter and early spring and wreaks havoc with dams, food caches, and lodges, and undoubtedly drowns young kits. Henry (1967) has documented similar problems faced by beaver colonies in northeast Ohio.

At present, beaver colonies locating, either by natural establishment or by restocking, in streams in southeast Ohio rarely remain established long enough to deplete food stocks. Future transplants of beavers into streams in southeast Ohio should be made where numerous ironwood, red elm, alder, maple, and aspen of suitable diameters (<2.0 inch dbh) occur and where floods are not overly destructive. Unfortunately such sites not already occupied by beaver are rare in unglaciated Ohio. Transplants may succeed better in strip-mined lands or in new impoundments where water conditions are relatively stable. Based on the occupancy by beavers in the Hewitt's Fork and Raccoon Creek watersheds, highly acid waters such as often occur in old strip-mined areas are acceptable for beavers if suitable foods are present.

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