ASPEN UTILIZATION BY BEAVER *(CASTOR CANADENSIS)* IN NORTHERN WISCONSIN

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Abstract

Johnson, Reed B. 1983. Aspen utilization by beaver *(Castor canadensis)* in northern Wisconsin. A quantitative survey of the feeding relationships of beaver at two ponds showed quaking aspen *(Populus tremuloides)* was the main food. Approximately 44 g/day (dry wt) of aspen inner bark were eaten by each adult beaver. Mixed coniferous-deciduous forest, with ample aspen, birch and willow, existed at both sites. The relationship between tree size cut and the amount of inner bark utilized was also examined. It was found that 1) proportionally more inner bark remained unutilized in larger trees which were cut, 2) generally, trees 3 to 5 in. in diameter were most likely to lodge in other trees when felled and thus remain unutilized, 3) approximately 9 to 12% of the available food from cut aspen was unutilized at each site.

Exploitation of beaver (*Castor canadensis*) was largely responsible for the early exploration of the northern United States and Canada by fur trappers. After near extirpation by overtrapping beaver have recovered well. Today populations have reached such levels that they are considered a nuisance in many areas.

The beaver has a great ecological impact upon the surrounding environment. Damming of streams floods valuable lowland forests, and occasionally, roads. Forest structure and composition near the ponds are altered by the cutting of large numbers of trees. Beaver meadows are formed when dams of abandoned ponds decay, lowering the water levels and allowing marsh vegetation to invade (Kendeigh 1974:84).

Whether one considers beaver a potentially valuable natural resource or a nuisance, it is important to have quantitative knowledge of the animals' food habits. A study was carried out from 14 May to 21 August, 1981, to observe feeding ecology of beaver in northern Wisconsin. Areas surrounding two beaver ponds were surveyed for forest composition, beaver food gathering strategies and food types. Various relationships between tree size and food utilization were examined in detail.

STUDY AREAS

The study was conducted on two active ponds in T39N, R4E, Sects 21 and 22, Oneida Co., Wisconsin. Pond 1 was located on a small stream about 1 mi SSE of Squaw Lake. The feeding area at this pond was roughly 300 yds W of the lodge. Pond 2 was located on Stone Creek about 1.5 mi N of Stone Lake. There were two feeding areas located on the west side of the pond about 100 yds S and 250 yds N of the beaver lodge.

METHODS

The quarter method (W.S. Brooks, pers. comm.) was used to determine the forest composition of feeding areas and surrounding forest at pond 1 and one feeding area at pond 2. The other feeding area at pond 2 was not surveyed for forest composition as it had recently been commercially harvested, so no mature trees existed in this area. Transect lines and sampling points along those lines were approximately 25 yds apart. Live trees and beaver cut stumps were counted only if

at least 3 in. dbh (diameter breast height) or at the height of the cut, respectively.

To determine the total annual quantity of inner bark eaten, height and diameter at cut were measured for all trees that had been cut by beaver within the last two years. Approximate age of the cut was determined by peeling bark from the stump and observing wood appearance. Those stumps more than two years old were not recorded.

Populations of two adult beaver and several young were observed at each pond. Calculations were based upon populations of three adult beaver per pond, the third "adult" allowing for the young which consume approximately the same amount of food annually as a single adult.

To determine the quantity of potential food per tree, a quaking aspen (*Populus tremuloides*) of the average size used by beaver was cut about 12 in. above the ground. From base to branches, 15 in. sections were cut and measured for diameter at both ends. The outer cork was shaved from these sections with a knife and the inner bark (cambium and phloem) was peeled off and stored in labeled plastic bags for later dry weight measurements. Approximately 10 to 15% of the branches were peeled and the inner bark similarly stored. Bark was dried for 48 h at 90°C and weighed immediately.

To determine the quantity of unutilized food per cut tree at each pond, measurements of the length, and diameter at the base and top of the untouched logs were recorded. At each feeding area the number of aspen trees lodging in other trees when cut were counted and their base diameters taken.

Results and Discussion

Rue (1964: 42) stated that every beaver pond has an occupation time limit regulated by food availability. Beaver prefer to feed near water both for safety from predators and for ease in food transport. At both ponds, feeding activity was always within 100 ft of the water. Several strategies have been developed by beaver to increase ease in procurement of food sources. The water level may be raised by increasing the size of the dam or building alternate dams, thus bringing more food within reach. This process is efficient, but limited by danger of flooding the lodge if the water levels are raised too much. An alternate strategy is the digging of canals to a food source. Both techniques were employed at one of the ponds. The canals measured were about 24 in. wide and 6 in. deep. Water levels were probably higher at the time they were in use, thus increasing their effective depth. At one site, a main canal along the forest edge was approximately 180 yds in length.

Feeding areas at both ponds were in mixed deciduous-coniferous forest, with different species dominating at each. The importance value (IV = sum of relative frequency, relative density and relative dominance), used in comparing the relative importance and influence of the different tree species, indicates that paper birch (*Betula papyrifera*), balsam (*Abies balsamea*) and quaking aspen in that order were the dominant species at pond 1 (Table 1). Spruce (*Picea* sp.), aspen and birch dominated at pond 2 with maple (*Acer* sp.), alder (*Alnus rugosa*), tamarack (*Larix laricina*), and white pine (*Pinus strobus*) present in lesser amounts (Table 1). The difference in species composition at the two ponds is probably due to different environmental conditions or different histories.

Aspens (*Populus* spp.) are the preferred food of beaver (Rue 1964). The proximity of water to the large population of aspen explains beaver presence in these areas. Other foods noted were willow (*Salix* spp.), alder, birch, various ferns, sedges, grasses and aquatic plants. The woody plants mentioned were important not only as food, but were extensively utilized by beaver as construction materials.

The feeding patterns of beaver change seasonally, with preference for woody vegetation in the fall, winter and early spring, and

TABLE 1. Forest Composition of Feeding Areas at Ponds 1 and 2.*

	N		*Frequency (%)*		*AVG. DBH (in)*		*Importance Value (IV)*	
	Pond 1	*Pond 2*	*1*	*2*	*1*	*2*	*1*	*2*
Alder *(Alnus rugosa)*	0	2	0	20	0	3.3	0	14
Aspen *(Populus tremuloides)*	4	9	33	50	7.3	3.5	28	48
Cut Aspen	9	2	31	20	4.2	3.3	38	13
Balsam *(Abies balsamea)*	13	1	54	10	9.2	3.1	96	6
Birch *(Betula papyrifera)*	24	9	92	70	6.0	6.8	127	67
Maple (*Acer* sp.)	0	4	0	30	0	3.2	0	23
Spruce (*Picea* sp.)	2	10	15	80	3.7	5.0	12	83
Tamarack *(Larix laricina)*	0	2	0	10	0	12.3	0	25
White Pine *(Pinus strobus)*	0	1	0	10	0	18.5	0	25
Total	52	40					300	300

	Pond 1	Pond 2
* Mean Distance (MD)	8.92 ft	11.83 ft
Mean Area (MA)	81 ft²	140 ft²
Total Density (TD)	538 trees/A	311 trees/A

for herbaceous foods during spring and summer. In Ohio, Svendsen (1980) estimated that non-woody vegetation accounted for 90% of the feeding time during the summer and 40 to 50% in early spring and fall. In Pennsylvania, however, Brenner (in Svendsen 1980) found that only 33% of the vegetation consumed per day in spring and summer months was herbaceous material. I found no information regarding herbaceous feeding by beaver in Wisconsin.

By correlating data on the amount of inner bark per tree (Fig. 1) with diameters and numbers of the cut stumps, I determined that, for both ponds, a single adult beaver ate an average of approximately 44 g (dry wt) of aspen inner bark per day. Aldous (1938) estimated that beaver eat 640-670 g wet wt per day, which is equivalent to 160-220 g dry wt of inner bark per day. My consumption estimates are probably the more accurate of the two because Aldous's estimates were based on aspen eaten by captive beaver that had no herbaceous vegetation to supplement their diet. Further, Aldous's weights included the cork layer and the wood in twigs and branches under 0.5 in. diameter. The present study excluded the cork layer and the wood of twigs which are of little nutritional value even if consumed.

At both ponds, cut trees were present on which the inner bark was partially or totally unutilized. By measuring the unused portions of cut trees, the weight of unutilized inner bark was estimated. A correlation of stump diameter to unused log length indicated that, as stump diameter increases, so does the length of unutilized log, and thus also the quantity of unutilized inner bark (Fig. 2).

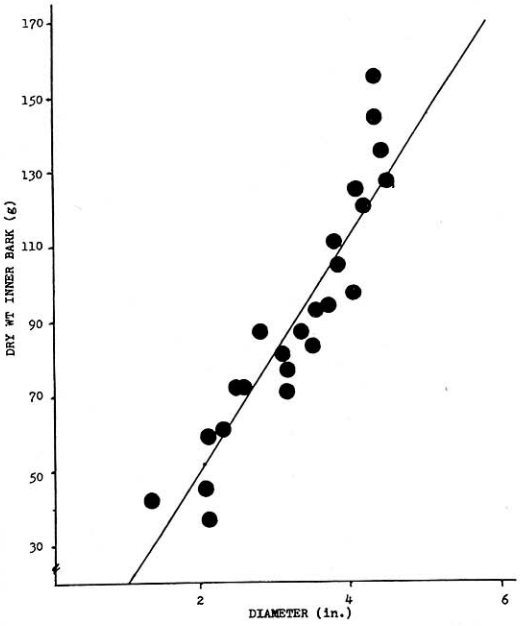

Fig. 1. The amount of phloem per 15 in. section versus the base diameter of the section.

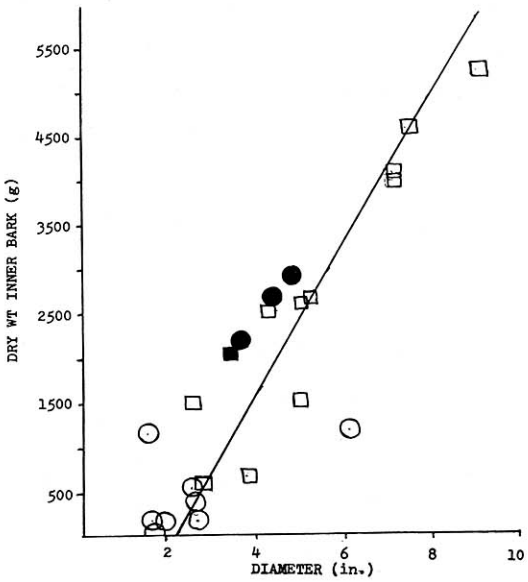

Fig. 2. The amount of unutilized inner bark of various sized log sections (open), and lodged trees (solid) at pond 1 (□) and pond 2 (○).

Nixon and Ely (1969) found that in trees under 2 in. dbh less than 1% was wasted. Aldous (1938) estimated that in aspen with a stump diameter (sd) of 1 in. there was 80% utilization and in trees of about 6 in. sd there was 35% utilization. Rue (1964: 109) estimated that the utilization of trees 4 to 6 in. in diameter was approximately 36%. There was a greater percentage of total utilization of the available food in the 1 to 3 in. sd trees, but the quantity of food per tree was small compared with that obtainable from larger trees. However, the latter were only partially utilized. Aldous (1938) found that a 7 in. tree, half utilized, would provide approximately the same amount of food as four 3 in. trees totally utilized. The present study confirms Aldous' estimate.

According to Aldous (1938), beaver prefer the relatively corkless bark of the small branches and limbs to that of the trunk. At both ponds the small branches of trees were generally totally utilized. Because the ratio of crown to trunk increases with trunk diameter, there is more preferred food available in larger trees even though there is more actual waste. However, larger trees are generally cut only after the small ones are used. Jenkins (1980) noted that beaver cut relatively more small trees as distance from water increased. That pattern was observed in the present study. Aldous (1938) observed that the degree of wastage in large trees is determined both by distance from water and by terrain. I also found relatively more trees were cut in the 1 to 3 in. sd class than in larger classes (Table 2).

Several reasons exist for the preference for, and more complete utilization of, smaller trees. Large trees take proportionately more time and energy to process, whereas small trees can be cut and carried to water after felling. Also, the large tree has a more extensive cork layer which is not utilized by the beaver for food. It would not be energy efficient to strip off the cork to get at the edible bark. Further, beaver prefer to feed in the water and a large tree, even if cut

TABLE 2. The Number and Diameter of Aspen Trees Cut at the Feeding Areas of Ponds 1 and 2 in the Last Two Years.

		Diameter Class (in)						
		0–1	*1–2*	*2–3*	*3–4*	*4–5*	*5–6*	*6–7*
Number of Trees	Pond 1	2	30	24	6	3	1	0
	Pond 2	1	23	26	5	3	1	2

* Mean diameter cut at Pond 1 = 2.4 in
Pond 2 = 2.5 in

into sections, is very cumbersome for a beaver to transport to the water.

Beaver do not plan the direction a tree falls when cut. Occasionally, a falling tree will become lodged in other trees and thus, suspended out of the beavers' reach, will remain unutilized. Compared to the number of trees cut, relatively few trees become permanently lodged. At both ponds, all lodged trees had a diameter of between 3 and 5 in. (Fig. 2). Apparently, trees under 3 in. sd were light enough in weight that the beaver could dislodge them, while trees over 5 in. sd were heavy enough to crash through most obstructions. Trees in the 3 to 5 in. class, however, became lodged and could not be pulled down. Generally the trees located near water lean toward the water or have more foliage in that direction because of reduced canopy and more sunlight so that when cut, the tree falls toward the water. This fact may influence the inverse relationship noted above of tree size to distance from water.

The total percentage of unutilized inner bark at both ponds, including lodged trees, was approximately 9-12% of the food available from cut aspen per year. This indicates that the beaver uses its food source efficiently. On the other hand, Aldous (1938) calculated that beaver waste 64% of the food available from cut aspen. It should be noted however, that his data involved a greater number of large trees than were found in the present study. Therefore, the relative efficiency of resource utilization probably varies from site to site, decreasing as forests mature and/or older trees become more prevalent.

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