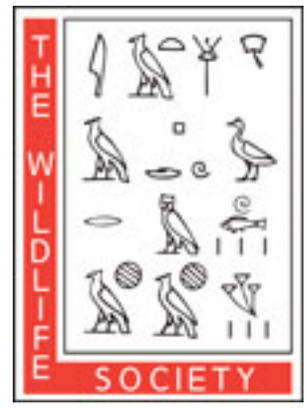

RESPONSE OF RED WILLOW TO BEAVER USE IN SOUTHEASTERN OREGON

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Red willow (*Salix lasiandra*) is a common willow species that assumes tree form in the riparian communities of western North America (Jepson 1957). Utilization by herbivores has reduced or entirely eliminated willow and other riparian tree species, such as alder (*Alnus tenuifolia*), aspen (*Populus tremuloides*), and cottonwood (*P. trichocarpa*), from many otherwise suitable habitats in the western United States (Munther 1981).

The purpose of this investigation was to document the effect of beaver (*Castor canadensis*) utilization on red willow within an area never used by domestic livestock. Thomas et al. (1979) recognized that a better understanding of the response of riparian shrubs and trees to utilization by herbivores is needed to refine future management.

STUDY AREA

The Jordan Crater Research Natural Area, approximately 12,703 ha in area, lies 40 km northwest of the community of Jordan Valley in southeastern Oregon. Annual precipitation averaged 28.1 cm. Temperature fluctuations were great with the possibility of frost occurring throughout the year at 1,311 m elevation.

Numerous perennial freshwater ponds and marshes were isolated from access by domestic livestock within recent lava flows (Kindschy and Maser 1978). Areas of rugged lava restricted beaver to certain ponds and marshes, whereas adjacent riparian communities had never experienced use by beaver. Red willow and coyote willow (*S. exigua*) were common within the riparian plant communities and afforded the only woody forage for wintering beaver.

Red willow provided the principal source of winter forage for four to six active beaver lodges. Beaver were known to have continuously inhabited the area for at least the past 47 years. Spring and summer beaver forage was largely herbaceous aquatic and riparian vegetation (Yeager and Rutherford 1957, Chabreck 1958).

METHODS

Red willows were divided into two populations: those exhibiting beaver use and those isolated from beavers. Tree height, crown width, basal diameter at ground level, annual basal diameter growth at a point 40 cm above ground level, and height of stumps following use were measured for 4 consecutive years (1979–82). The number of stems taken by beaver, expressed as a percentage of the total number of stems present, was estimated. In the course of the study 190 tree measurements were taken from 40 trees randomly selected within each willow population. Data from the two populations were compared and evaluated using standard statistical techniques (Tacha et al. 1982).

RESULTS

During each of the 4 years of observation, beaver made substantial use of accessible willow (Fig. 1). The extent of stem removal varied slightly (±15%) among years. An average of 82% of available stems was annually harvested. Mean height of cut stems was 61.3 cm (range 27.4–88.4). Cut stems had a mean length of 18.12 cm (SD 6.25), but often approximately 10% of the stems were left uncut. Stems of 0.3 cm or less in diameter were seldom taken; typical diameter ranged from 1.3 to 2.5 cm. Cut materials were normally removed from the site.

There was no correlation between basal diameter of stems harvested with those remaining

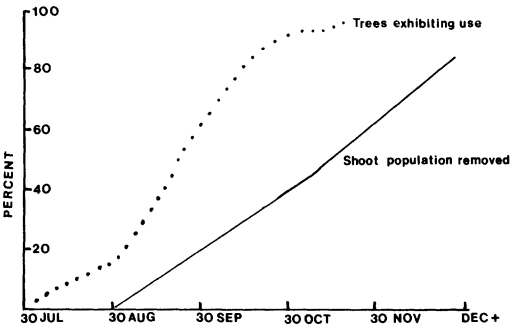

Fig. 1. Time of utilization of willow by beaver in the Jordan Crater Research Natural Area of southeastern Oregon. Means of data from 126 observations made during 1979–82. For example: 60% of the *trees* exhibited some extent of utilization by late September, although 60% of the *stems* present were not taken until late November.

Table 1. Comparison of characteristics of red willow used by beaver with those unused by beaver in southeastern Oregon, 1979–82.

	Unused ($N = 40$)	Used ($N = 40$)
Ht (m)	5.98 ± 1.1	2.36 ± 0.6
Canopy width (m)	5.20 ± 1.3	2.12 ± 0.6
Annual stem growth (cm)	33.20 ± 11.6	182.90 ± 37.8
Annual basal diam growth (cm)	0.87 ± 0.65	0.89 ± 0.02

uncut ($r = 0.31$, $P > 0.5$); nor was there a correlation between the number of stems removed and remaining stem length ($r = 0.26$, $P > 0.5$).

Comparison of willow used by beaver with those trees inaccessible to beaver revealed great difference in height, crown width, and stem growth. In contrast, no significant difference existed in the annual growth of basal diameters (Table 1). Growth was more variable for willow with a history of no utilization (CV = 34.9%) than for willow used by beaver (20.7%).

Multiple linear regression analysis demonstrated a correlation of stem elongation to prior beaver use ($R^2 = 0.53$, $P < 0.05$) but not to tree basal diameter ($R^2 = 0.34$, $P > 0.05$). Growth and past use fit a power curve well ($R^2 = 0.73$, $P < 0.01$) (Fig. 2).

During all years of sampling, willow with a history of beaver use started stem growth earlier in the spring than unused willow. Maximum growth rate occurred during August for both populations.

Crowns of unused willows occasionally exhibited dead or partially dead branches. Vigorous basal sprouting was observed on several of these trees with growths as great as that of willow used by beaver.

Red willow harvested by beaver typically had a primary trunk that averaged 24.3 cm (SD 13.6) basal diameter at ground level. Numerous secondary stems grew from the primary trunk, with 30 an approximate average. These secondary stems were favored by beaver for forage. An average of 18.12 cm of secondary stem remained following cutting by beaver. Each of these stems subsequently produced an average of 7.4 tertiary stems the following growing season.

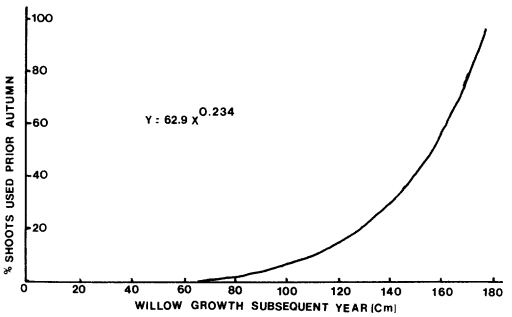

Fig. 2. Correlation of willow growth to prior utilization, southeastern Oregon, 1979–82. $R^2 = 0.73$, $N = 40$. The greater the percentage of stems cut per tree, the greater the subsequent growth the following growing season.

DISCUSSION

Red willows used by beaver were able to maintain high growth rates and increased in basal diameter similar to the rates of unused trees. Occasional basal sprouting on decadent, unused trees suggested natural renewal of crowns, an attribute making red willow well adapted to top removal by beaver. In California, Hall (1960) also noted a tolerance of willow to close harvest by beaver for at least one or two seasons. Periodic fluctuations of beaver populations likely allow recovery of vigor in willow and similar woody riparian species.

Beaver use normally occurred after the willow completed all growth and had translocated the majority of food reserves to the stumps and roots for winter (Hill et al. 1950). Subsequent growth the year following autumn harvest was closely correlated to the extent of top removal, apparently a result of the imbalance of the root/stem ratio.

Natural and prolonged heavy utilization of red willow by beaver did not appear to be responsible for the deterioration, reduction, and loss of this riparian species. Additional factors, including the continual cropping of willow regrowth by cattle during the growing season, were involved in limiting red willow stands in many of the riparian communities of southeastern Oregon.

LITERATURE CITED

CHABRECK, R. H. 1958. Beaver-forest relationships in St. Tammany Parish, Louisiana. J. Wildl. Manage. 22:179–183.

HALL, J. G. 1960. Willow and aspen in the ecology of beaver on Sagehen Creek, California. Ecology 41:484–494.

HILL, J. B., L. O. OVERHOLTS, AND H. W. POPP. 1950. Botany. McGraw-Hill Book Co., New York, N.Y. 710pp.

JEPSON, W. L. 1957. Flowering plants of California. Univ. California Press, Berkeley and Los Angeles. 1238pp.

KINDSCHY, R. R., AND C. MASER. 1978. Jordan Crater Research Natural Area. Supplement 7 *in* J. F. Franklin et al. 1972. Federal research areas in Oregon and Washington: a guidebook for scientists and educators. U.S. For. Serv., Washington, D.C. 498pp.

MUNTHER, G. L. 1981. Beaver management in grazed riparian ecosystems. Pages 234–241 *in* J. M. Peek and P. D. Dalke, eds. Wildlife-livestock relationships symposium: proc. 10. Coeur d'Alene, Idaho. For., Wildl. Range Exp. Stn., Univ. Idaho, Moscow.

TACHA, T. C., W. D. WARDE, AND K. P. BURNHAM. 1982. Use and interpretation of statistics in wildlife journals. Wildl. Soc. Bull. 10:355–362.

THOMAS, J. W., C. MASER, AND J. E. RODIEK. 1979. Riparian zones. Wildlife habitats in managed rangelands—the Great Basin of southeastern Oregon. U.S. For. Serv. Gen. Tech. Rep. PNW-80. Pac. Northwest For. Range Exp. Stn., Portland, Oreg. 18pp.

YEAGER, L. E., AND W. H. RUTHERFORD. 1957. An ecological basis for beaver management in the Rocky Mountain region. Trans. North Am. Wildl. Conf. 22:269–300.

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WINTER FOOD PREFERENCES OF PORCUPINES

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The porcupine (*Erethizon dorsatum*) occurs in much of North America in habitats ranging from desert-shrub (Reynolds 1957) to tundra (Murie 1926). Porcupine food preferences have received considerable attention (Gabrielson 1928, Rudolf 1949, Curtis and Wilson 1953, Ludeman 1954, Krefting et al. 1962, Marshall et al. 1962, Van Deusen and Myers 1962, Storm and Halvorson 1967, Brander 1973, Clarke and Brander 1973, Speer and Dilworth 1978) because their winter feeding may permanently damage or kill trees. Although these studies examined such factors as food availability, stand density, tree diameter, and insulation cover, none addressed the interaction of these factors. Seasonal movements and social behavior of porcupines have not been studied extensively. Faulkner and Dodge (1962) briefly discussed summer and winter home ranges. Smith (1979) radiotracked six porcupines from November through August in northeastern Oregon.

We studied the damage inflicted by porcupines and their habitat use from January to August 1982 at Itasca State Park in northwestern Minnesota. Objectives were to determine: (1) winter food and habitat preferences, (2) extent of bark damage inflicted by porcupines, and (3) their winter movements and home-range size.

METHODS

Observations on 17 porcupines were made from 19 January to 12 April 1982. Fourteen of them were captured and individually marked (five males, nine females). Eleven of the marked specimens occurred in two discrete groups, consisting of four females and one male near Green Lake, and four females and two males near French Creek. These areas are about 3 km apart and differ in the proportion of white pine (*Pinus strobus*) composing the forest overstory. Both areas are rather flat and dominated by unmanaged forests that have not been logged for at least 63 years. Dominant overstory species at French Creek include American linden (*Tilia americana*), balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), and American elm (*Ulmus americana*) (Tenneson 1983). Dominant species at Green Lake are paper birch, quaking aspen (*Populus tremuloides*), red maple (*Acer rubrum*), American linden, and northern red oak (*Quercus rubra*). Species composition and tree dbh distribution vary appre-