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Forage Selection of Native and Nonnative Woody Plants by Beaver in a Rare-Shrub Community in the Appalachian Mountains of North Carolina

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Abstract – *Castor canadensis* (Beaver) is a selective forager that can modify the species composition and structure of plant communities. However, no studies have examined the use of woody plants by Beaver in temperate forests that contain a dominant nonnative plant. We investigated foraging of woody plants by Beaver in a riparian shrub community that is dominated by both native and nonnative species, including the federally threatened shrub *Spiraea virginiana* (Virginia Spiraea). We established 48 random, 25-m transects along a 12-km reach of the Cheoah River in the Appalachian Mountains of North Carolina. We sampled woody plants every 5 m using a modified point-centered quarter method to estimate relative abundance and to quantify browsing by Beaver. We used a mixed linear model to determine Beaver forage selection on the 9 most abundant plant species and Virginia Spiraea. We recorded 984 plants of 58 woody species (55 native, 3 nonnative). Beaver browsed 24% of the woody species sampled and 8% of all stems. This finding suggests that the overall effects of browsing in this community were relatively low, likely because of the high gradient and turbulent nature of the Cheoah River. Relative stem abundance and location along the river did not differentially affect local levels of browsing. However, Beaver were selective foragers at both the species and individual-plant level. Of the 9 most abundant species, *Carpinus carolinana* (Musclewood), *Liquidambar styraciflua* (Sweetgum), and *Alnus serrulata* (Tag Alder) were selected most often; *Lindera benzoin* (Spicebush), Virginia Spiraea, *Cornus amomum* (Silky Dogwood), and *Ligustrum sinense* (Chinese Privet) were moderately selected. Least frequently selected species were *Rhododendron maximum* (Rosebay Rhododendron), *Leucothoe fontanesiana* (Doghobble), and *Xanthorhiza simplicissima* (Yellowroot). Browsing appeared to have a positive effect on both the invasive nonnative shrub, Chinese Privet, and the rare Virginia Spiraea by stimulating asexual reproduction and inducing plants to spread through suckering. This study demonstrates the importance of understanding the reproductive strategies of woody plants when gauging the community-wide effects of foraging by Beaver, particularly when an invasive plant species is present.

Introduction

Castor canadensis Kuhl (Beaver) is a generalist herbivore that feeds on most species of woody plants and numerous herbaceous and aquatic plants (Jenkins and Busher 1979, Rosell et al. 2005). They are selective foragers on woody plants (e.g.,

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Belovsky 1984, Busher 1996, Jenkins 1975, Svendsen 1980) and can modify the species composition and structure of plant communities (Raffel et al. 2009, Rosell et al. 2005). However, forage use by Beaver can vary widely depending on a variety of factors that affect plants, including geographic location, topography, and associated hydrology (Rosell et al. 2005).

The effects of Beaver on plant communities are related to the assemblage of plant species that are present (Jones et al. 1997). Because they forage selectively, Beaver can alter habitats to favor certain types of plants (Raffel et al. 2009, Rosell et al. 2005). For example, in forested systems, browsing by Beaver may cause a shift in composition of woody plant communities towards early-successional species (Fryxell 2001, Pastor and Naiman 1992, Rosell et al. 2005). In addition, long-term foraging by Beaver can decrease the diversity of woody plants and alter the composition to less palatable species (Fryxell 2001, Raffel et al. 2009, Rosell et al. 2005). Disturbances related to Beaver may also increase the potential for invasion of exotic plant species (Anderson et al. 2005, Bandano et al. 2007), and thereby threaten rare species in a community (Lake and Leishman 2004). However, to our knowledge no studies have examined forage selection by Beaver in a temperate forest that contains a dominant, nonnative woody plant, and only one study has examined the impacts of Beaver on a rare woody plant (Rossell et al. 2013).

To understand the impacts of Beaver on plant communities, it is important to determine which plants they select as browse (Rosell et al. 2005). Understanding the foraging patterns of Beaver in shrub dominated-communities presents unique challenges because each plant may have multiple stems at heights that are accessible to Beaver. The most common method for determining Beaver-forage selection of woody plants is by counting only browsed and unbrowsed basal stems (e.g., Belovosky 1984, Brzyski and Schulte 2009, Fryxell 2001, Jenkins 1975, Raffel et al. 2009, Rossell et al. 2013). However, this approach may be problematic when focusing on a shrub community because different plant growth forms (i.e., shrubs, trees) vary in the number of stems available as forage. Thus, considering only basal stems may underestimate the extent of foraging on shrubs and bias forage selectivity towards trees. Therefore, a method that counts both basal and lateral stems as available forage may more accurately reflect the forage selection of Beaver in a shrub community.

Spiraea virginiana (Virginia Spiraea) is a rare shrub of the southern Blue Ridge and Appalachian Plateau physiographic provinces (Ogle 1991a). It has a limited range and occurs in only 7 states: Georgia, Kentucky, North Carolina, Ohio, Tennessee, Virginia, and West Virginia (USFWS 1992). Virginia Spiraea is currently listed as federally threatened and has a global ranking of G2, or globally imperiled (Buchanan and Finnegan 2010). The species is considered endangered in North Carolina (Buchanan and Finnegan 2010), with only 9 known populations (C. Wells, USFWS, Asheville, NC, pers. comm.). Virginia Spiraea is a disturbance-dependent species, occurring along high-gradient sections of second- and third-order streams and rivers (Anders and Murrell 2001, Ogle 1991b, USFWS 1992). This species

is threatened for a variety of reasons including habitat loss and competition from exotic woody plants (Ogle 1991b, USFWS 1992).

Rossell et al. (2013) reported that Virginia Spiraea is a preferred forage species of Beaver along the Cheoah River in North Carolina. However, that study was limited to a stretch of river where nonnative woody species were a minor component of the shrub community—a situation atypical of many alluvial forests of the southern Appalachian Mountains where nonnative woody species are often abundant (Drake et al. 2003, Merriam 2003). The purpose of our study was to use both basal and lateral stem counts to determine forage selection by Beaver of the most abundant woody species in a riparian shrub community that included Virginia Spiraea and other native and nonnative woody species as potential forage.

Methods

Study area

We conducted our study along a 12-km reach of the Cheoah River in Graham County, NC (elevation range = 386–524 m; N 35°24', W 83°53'). This section of river is part of the Cheoah River Floodplain Significant Natural Heritage Area, designated nationally significant because it contains numerous rare plant and animal species (Schwartzman 2012). Virginia Spiraea was first documented along the Cheoah River in 1940 (North Carolina Natural Heritage Program [NCNHP], Raleigh, NC, unpubl. data). However, in that same year, the population was considered extirpated because of road building (USFWS 1992). Surveys in 1986 indicated that this population was still extirpated (Ogle 1991a), but Virginia Spiraea was rediscovered in 2000 along the river (NCNHP, unpubl. data). Currently, 23 subpopulations (defined as a grouping of plants, regardless of the number of genets; Brzyski and Culley 2011), which vary in size from 1 small plant to plants covering more than 20 m^2, occur along the riparian zone of the river.

The Cheoah River is a dam-controlled, high-gradient system, with large-boulder and pool habitats interspersed with Class III and Class IV rapids (NCDOC 2007). From 1928 to 2005, only minimal flows were maintained in the Cheoah River to maximize production of hydroelectric power (Dilts et al. 2005). In 2005, a more natural flow regime was established to restore the river's ecological communities (Dilts et al. 2005). Current flow rates include monthly base flows of 1.1–2.8 m^3s^{-1} (40–100 cfs) and approximately 20 annual high-flow events that peak around 28 m^3s^{-1} (1000 cfs; FERC 2005). The study area's average annual precipitation is 167.7 cm, average annual high temperature is 20.3 °C, and average annual low temperature is 6 °C (National Climatic Data Center 2011).

The riparian corridor we studied consisted of 2 habitats. The downstream section (9.2 km) is narrow and adjacent to US Highway 129. It provided habitat for 19 subpopulations of Virginia Spiraea and consisted of a small alluvial floodplain, with a scour zone extending several meters up steep banks characterized by large boulders and rip-rap. The plant community was second-growth, Montane Alluvial Forest (Schafale and Weakley 1990), with a partially open canopy dominated by *Liriodendron tulipifera* (Tulip Poplar), *Acer rubrum* (Red Maple),

and *Platanus occidentalis* (American Sycamore). The shrub layer was sparse to moderately dense and dominated by species including *Cornus amomum* (Silky Dogwood), *Alnus serrulata* (Tag Alder), *Carpinus caroliniana* (Musclewood), and *Xanthorhiza simplicissima* (Yellowroot). The herb layer was sparse and included *Osmunda regalis* L. (Royal Fern), *Polystichum acrostichoides* (Michx.) Schott (Christmas Fern), and *Lespedeza cuneata* (Dum. Cours.) G. Don (Sericea Lespedeza). Vines were prevalent and included *Toxicodendron radicans* (L.) Kuntze (Poison Ivy), *Pueraria lobata* Willd. (Kudzu), and *Celastrus orbiculatus* Thunb. (Oriental Bittersweet).

The upstream section (2.8 km), where 4 subpopulations of Virginia Spiraea occurred, generally had a wider floodplain, with a substrate comprised mostly of sand and gravel. It was adjacent to Joyce Kilmer Road and a US Forest Service road. The vegetation was similar to the downstream section, but had a higher abundance of species typical of Acidic Cove Forests (Schafale and Weakley 1990), including *Betula lenta* L. (Sweet Birch), *Tsuga canadensis* (Eastern Hemlock), *Rhododendron maximum* (Rosebay Rhododendron), and *Leucothoe fontanesiana* (Doghobble). The shrub layer was moderately dense, and *Ligustrum sinense* (Chinese Privet) and *Arundinaria gigantea* (Walt.) Muhl. (River Cane) dominated some areas. The herb layer was sparse to moderately dense and consisted of grasses and forbs.

Little is known about the Beaver population along the Cheoah River. Beaver were thought to be extirpated in North Carolina by 1897 and were reintroduced to the western portion of the state in 1956 (NCWRC 2011). Beaver are currently considered common, inhabiting most watersheds in North Carolina (NCWRC 2011). At the time of our study, 1 lodge and 1 bank den occurred in our study area.

Data collection

During the summer of 2011, we used a modified point-centered quarter method (Cottam and Curtis 1956) to estimate the relative abundance of woody plants in the shrub layer and quantify the extent of browsing by Beaver. We divided the study area into seventy-two 167-m-long segments. Within each segment, we randomly established two 25-m transects along the center of the scour zone using a random numbers table to generate a downstream starting location. Because Beaver do not typically forage on the steep, rocky banks of the Cheoah River (Rossell et al. 2013), we located transects in areas where the slope <15%. Also, because plant composition compared to surrounding areas was different where the US Forest Service had conducted exotic pest control, we chose untreated locations for our transects. Using these criteria, we were able to establish 48 transects, covering approximately 9% of the study area.

We used a 25-m tape to set up transects parallel to the river and sampled 6 points at 5-m intervals along each transect. At each sampling point, we established 4 quarters by centering a 5-m PVC pipe perpendicular to the measuring tape. Within each quarter, we located the nearest woody plant (<2.5 cm basal diameter) up to 2.5 m from the center point, identified it to species, and counted the number of browsed and unbrowsed stems ≤10 cm above the substrate (the approximate height

that Beaver cut stems at the study site). This height limit allowed an estimate of the number of available stems (i.e., both basal and lateral stems) Beaver would typically consider as forage. If an individual plant occupied more than one quarter, we counted the number of stems (browsed and unbrowsed) in all quarters where it occurred, and recorded the totals in the quarter where the stems were closest to the center point. In the remaining quarters, we sampled the next closest individual plant. We recorded only 6 Virginia Spiraea plants using this method and subsequently decided to augment the data by sampling all plants of this species that occurred within 2.5 m of the transects, which added 4 plants to the sample size. Because plants that propagate via underground structures are difficult to delineate, we defined an individual plant as all basal stems that occurred within 50 cm of each other. We identified stems browsed by Beaver by sharp, angled cuts that usually included incisor marks (Lesica and Miles 2004).

Data analysis

Initially, we fit 2 generalized linear mixed models to the data. The response variable for each model was the proportion of stems browsed for each plant of the 9 most abundant species and Virginia Spiraea. We included only the 9 most abundant species in the analysis because each one had a sample size >30, and together represented the majority of the total stems available as forage. The models incorporated a binomial distribution for number of stems browsed with a logit-link function. To avoid pseudo-replication, each model included transect and plant as random effects to account for potential autocorrelation of browsing patterns within transects and stems within plants. One model had stem abundance and species as fixed effects, whereas the other model had only species as a fixed effect.

The equation for the models was of the form: log (p / [1 - p]) = intercept + random effects + fixed effects + random error, where p represents the probability that an individual stem was browsed. Because the model with two fixed effects indicated stem abundance was not significantly related to browsing ($P = 0.64$), we used the model with species as the fixed effect for all subsequent analyses. For each species, we estimated the proportion of stems browsed by reverse-transforming the species-effect estimate using the equation: estimated proportion browsed = exp (species-effect estimate) / (1 + exp [species-effect estimate]). We then used the estimated proportions browsed to determine the forage-selection rank of each species. We used SAS version 9.2 (SAS Institute, Cary, NC) for all statistical analyses and considered results significant at alpha = 0.05.

Results

We recorded a total of 984 plants of 58 species (55 native, 3 nonnative; Appendix 1); 24% of the plants were browsed by Beaver. We assessed 7433 stems, of which 8% were browsed by Beaver. The 9 most abundant species represented 81% of the total stems and included 8 native and 1 nonnative species (Table 1). Virginia Spiraea ($n = 6$) ranked 30th in relative abundance and accounted for <1% of the total plants. Nonnative plants accounted for 19% of the stems. The nonnative species Chinese Privet was 3rd in relative abundance, equal in abundance to the native

species Musclewood (Table 1). Chinese privet represented 6% of the total plants and 16% (n = 1190) of the total stems. We also documented the non-native shrubs *Rosa multiflora* (Multiflora Rose), which accounted for 2.5% (n = 24) of the total plants, and *Albizia julibrissin* Durazz., which accounted for 0.001% (n = 1) of the total plants (Appendix 1).

Relative amounts of foraging on stems differed among the 9 most abundant species and Virginia Spiraea ($P < 0.0001$), and varied among individual plants within species (estimated variance due to plant effect = 1.45, standard error of estimated variance = 0.21). Amounts of foraging were not affected by location of transect (estimated variance due to transect effect = 0.12, standard error of estimated variance = 0.12). After adjusting for plant and transect effects using the linear model, Musclewood, Sweetgum, and Tag Alder were the forage species Beaver selected most often; Spicebush, Virginia Spiraea, Silky Dogwood, and Chinese Privet were moderately selected. Least-often selected were Rosebay Rhododendron, Doghobble, and Yellowroot (Table 1).

Discussion

With the exception of Virginia Spiraea, the study area's native woody plant species assemblage is typical of Montane Alluvial Forests in North Carolina (Schafale and Weakley 1990). Virginia Spiraea's rarity is reflected in the finding that this species occurred only 6 times in our sampling and accounted for <1% of the total plants. The nonnative component of the community consisted of 3 species, which comprised 8% of the total woody plants. Chinese Privet tied for third in the list of the most abundant species in our samples. Nonnative species, particularly Chinese Privet and Multiflora Rose, have become increasingly common in riparian communities of the southern Appalachian Mountains because of their prolific reproductive abilities (Drake et al. 2003, Merriam 2003).

Table 1. Estimated proportion of stems browsed by Beaver for the 9 most abundant woody species and Virginia Spiraea along the Cheoah River, Graham County, NC, summer 2011. Plants = number of plants recorded at 5-m intervals along forty-eight 25-m transects, PB = proportion browsed (total stems browsed of a species / total stems of a species x 100), APB = adjusted proportion browsed (calculated by reverse transforming the fixed effect [species] of the mixed logistic regression model), LCL = 95% lower confidence limit of APB x 100, UCL = 95% upper confidence limit of APB x 100.

Species	Plants	Mean # stems	PB	APB	LCL	UCL	Selection rank
Carpinus caroliniana	58	2.3	24.8	17.4	10.2	28.0	1
Liquidambar styraciflua	36	2.2	19.2	17.0	8.5	31.2	2
Alnus serrulata	71	3.3	17.9	16.7	10.7	25.2	3
Lindera benzoin	31	3.9	20.7	14.4	7.0	27.3	4
Spiraea virginiana	10	17.2	23.3	11.5	3.9	29.3	5
Cornus amomum	258	4.2	10.1	8.3	6.2	11.1	6
Ligustrum sinense	58	20.3	9.4	6.4	3.6	11.0	7
Rhododendron maximum	32	7.8	9.2	5.7	2.6	11.9	8
Leucothoe fontanesiana	32	12.8	4.7	3.3	1.5	7.1	9
Xanthorhiza simplicissima	46	55.4	1.8	1.2	0.6	2.3	10

The high species richness (58 species) at the study site is similar to the richness (59 species) reported in Rossell et al. (2013); both results reflect the high diversity of woody plants in the southern Appalachian Mountains (Whitaker 1956). This high species richness is particularly evident compared to other communities inhabited by Beaver. For example, reported values of woody plant species richness include 38 in Louisiana bayous (Chabreck 1958), 35 in North Carolina wetland communities (Bartel et al. 2010), 15 in hardwood forests around southeastern Ohio impoundments (Voelker and Dooley 2008), and 14 in riparian forests around ponds at Isle Royale National Park in Michigan (Belovsky 1984).

The impacts of Beaver along the Cheoah River were relatively low during our study. Twenty-four percent of all woody plants and 8% of all stems were browsed by Beaver, which is substantially less than levels reported in other studies. Northcott (1971) reported 73–76% of woody plants were browsed around Beaver colonies in Newfoundland, and Voelker and Dooley (2008) reported 55% and 36% of woody plants were browsed around active and abandoned Beaver impoundments in Ohio, respectively. Howard and Larson (1985) and Slough and Sadlier (1977) reported that high-gradient streams support fewer Beaver than low-gradient streams. Therefore, because of the high gradient and turbulent nature of the Cheoah River, it was not surprising that the extent of Beaver browsing at our study site was less than in communities adjacent to low-gradient streams and impoundments.

Beaver are known to be selective foragers (e.g., Chabreck 1958, Jenkins 1975, Raffel et al. 2009, Shadle et al. 1943, Svendson 1980) and the significant species effect in our study confirmed this finding. That our estimated variance of the plant effect was almost 7 times the standard error also indicated that Beaver are selective at the individual-plant level. This selectivity may be related to various factors. For example, Beaver may prefer plants with larger stem diameters over plants with small stem diameters. This suggestion is supported by McGinley and Whitman (1985), who found that the mean diameter of *Populus fremontii* Watson (Fremont Cottonwood) stems cut by Beaver was 98% greater than uncut stems. Age and browsing history of plants also may affect Beavers' forage preferences (Basey et al. 1988, 1990). In certain plants, browsing by Beaver is known to stimulate production of root suckers that contain higher levels of secondary compounds that deter Beaver foraging (Basey et. al. 1988, 1990; Bryant and Kuropat 1980).

Studies have reported that variables such as proximity to a den (Fryxell and Doucet 1993, Jenkins 1980, McGinley and Whitham 1985), density of woody plants (Brzyski and Schulte 2009, Fryxell and Doucet 1993), stream width and gradient (Beier and Barrett 1987, Curtis and Jensen 2004, Howard and Larson 1985), and bank steepness and floodplain width (MacCracken and Lebovitz 2005) can affect local Beaver foraging activities. In contrast, our findings that Beaver browsing was not affected by transect location (estimated variance of transect effect was equal to the standard error) or relative stem abundance indicate that these attributes did not differentially affect local levels of browsing at our study site. However, Rossell et al. (2013) did report a transect effect. We are uncertain of the reason for this difference between the results of our studies because the design of both was similar; the

disparity may be related to the different methods used to quantify Beaver foraging (i.e., plant level versus stem level).

The finding that the 9 most abundant species accounted for 81% of the total stems supports our use of the most abundant plants as an index to evaluate the effects of Beaver in this community. The selection ranks in our study are in general agreement with other studies representing the same species (Brenner 1962, Brzyski and Schulte 2009, Chabreck 1958, Northcott 1971, Jenkins 1979, Raffel et al. 2009, Rossell et al. 2013, Shadle et al. 1943, Svendson 1980, Voelker and Dooley 2008). The two species selected most often in our study, Musclewood and Sweetgum, are consistently reported among Beavers' preferred forage species throughout the eastern US, including Louisiana (Chabreck 1958), Georgia (Bryzyski and Schulte 2009), Massachusetts (Jenkins 1979), New York (Shadle et al. 1943), and Pennsylvania (Brenner 1962). High concentrations of secondary chemicals in plants also can negatively affect forage selection by Beaver (Bryant and Kuropat 1980, Bryant et al. 1991). The low use of Yellowroot, Doghobble, and Rosebay Rhododendron support this suggestion because all 3 of these species can contain high levels of secondary metabolites that inhibit herbivory (Hughes 2011, Nielson 1980, Schmeller et al. 1997).

It has been reported that browsing by Beaver can stimulate clonal growth in certain plants (Baker et al. 2005, McGinley and Whitman 1985). In our study, this effect is apparent in Chinese Privet and Virginia Spiraea, both of which had a relatively large number of stems per plant and were moderately browsed by Beaver (Table 1). Chinese Privet is highly invasive and known to vigorously respond to cutting through root sprouting (Drake et al. 2003). This species often forms dense stands (Drake et al. 2003, Miller 2003) and can reduce the richness and abundance of native woody plants when it is prevalent in an area (Wilcox and Beck 2007). Virginia Spiraea reproduces almost exclusively by asexual reproduction through rhizomatous growth (Anders and Murrell 2001, Ogle 1991b). Chinese Privet has been recognized as a threat to Virginia Spiraea (USFSW 1992) and other native flora (Wilcox and Beck 2007). Because browsing may exacerbate the threat of Chinese Privet by causing it to spread through increased root sprouting, we recommend that control measures be implemented to reduce the abundance of Chinese Privet, particularly in areas where this species co-occurs with rare plants such as Virginia Spiraea.

Conclusions

This study is the first to examine the use of woody plants for foraging by Beaver in a riparian shrub community dominated by both native and nonnative species and containing a rare woody species. The overall levels of browsing in this community were low compared to other communities inhabited by Beaver, likely because of the high gradient and turbulent nature of the Cheoah River. Our findings indicate that relative stem abundance and location along the river did not differentially affect local levels of browsing. Beaver were selective foragers at both the species and the individual-plant level. Of the 9 most abundant species, Musclewood and

Sweetgum were the most utilized forage species, whereas Yellowroot, Doghobble, and Rosebay Rhododendron were the least utilized. Chinese Privet, a highly invasive nonnative shrub, and Virginia Spiraea, a federally threatened shrub, were both moderately utilized by Beaver. Browsing by Beaver appeared to have a positive effect on both Chinese Privet and Virginia Spiraea by stimulating asexual reproduction and inducing plants to spread through underground propagation. Our study demonstrates the importance of understanding the reproductive strategies of woody plants when gauging the effects of foraging by Beaver on a community, particularly when an invasive species is present.

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Appendix 1. List of woody plant species sampled for Beaver browsing in forty-eight 25-m transects along the Cheoah River, Graham County, NC, summer 2011.

Species	Common Name	Number of plants	Browsed by Beaver
Acer rubrum L.	Red Maple	15	Yes
Acer saccharum L.	Sugar Maple	1	No
Albizzia julibrissin Durazz.	Mimosa	1	Yes
Alnus serrulata (Ait.) Willd.	Tag Alder	71	Yes
Aralia spinosa L.	Hercules' Club	7	No
Asimina triloba (L.) Dunal	Pawpaw	10	Yes
Betula nigra L.	River Birch	1	No
Calycanthus floridus L.	Hairy Allspice	15	Yes
Carpinus caroliniana Walt.	Musclewood	58	Yes
Carya cordiformis (Wang.) Koch	Bitternut Hickory	1	No
Carya glabra (Mill.) Sweet	Pignut Hickory	12	Yes
Carya tomentosa Nutt.	Mockernut Hickory	1	No
Carya sp.	Hickory	1	No
Cornus amomum Mill.	Silky Dogwood	258	Yes
Cornus florida L.	Flowering Dogwood	2	No
Corylus americana Walt.	American Hazelnut	2	No
Diospyros virginiana L.	Persimmon	5	No
Fraxinus americana L.	White Ash	8	Yes
Fraxinus pennsylvanica (Vahl) Fern	Green Ash	5	Yes
Halesia carolina L.	Silverbell	25	Yes
Hamamelis virginiana L.	Witch-hazel	3	No
Hydrangea arborescens L.	Wild Hydrangea	12	Yes
Ilex Montana T. & G.	Mountain Holly	9	Yes
Ilex opaca Ait.	American Holly	7	Yes
Itea virginica L.	Sweet Spires	14	Yes
Juglans nigra L.	Black Walnut	1	No
Kalmia latifolia L.	Mountain Laurel	24	Yes
Leucothoe fontanesiana Steud.	Doghobble	32	Yes
Ligustrum sinense Lour.	Chinese Privet	58	Yes
Lindera benzoin (L.) Blume	Spicebush	31	Yes
Liquidambar styraciflua L.	Sweetgum	36	Yes
Lirodendron tulipifera L.	Tulip Poplar	8	Yes
Magnolia fraseri Walt.	Frazier Magnolia	1	No
Magnolia tripetala L.	Umbrella Magnolia	8	Yes
Morus rubra L.	Red Mulberry	1	No
Nyssa sylvatica Marsh.	Black Gum	25	Yes
Pinus strobus L.	White Pine	6	No
Platanus occidentalis L.	Sycamore	2	Yes
Prunus serotina Ehrh.	Black Cherry	1	No
Pyrularia pubera Michx.	Buffalo Nut	1	No
Quercus alba L.	White Oak	11	No
Quercus coccinea Muenchh.	Scarlet Oak	4	No
Quercus rubra L.	Red Oak	3	No

Species	Common Name	Number of plants	Browsed by Beaver?
Rhododendron maximum L.	Rhododendron	32	Yes
Rhus copallina L.	Winged Sumac	3	Yes
Rhus glabra L.	Smooth Sumac	7	Yes
Robinia pseudoacacia L.	Black Locust	3	No
Rosa multiflora Thunb.	Multiflora Rose	24	Yes
Salix sp.	Willow	2	Yes
Sambucus canadensis L.	Elderberry	2	No
Sassafras albidum (Nutt.) Nees	Sassafras	4	No
Spiraea virginiana Britton	Virginia Spiraea	6	Yes
Tilia americana L.	Basswood	1	Yes
Tsuga canadensis (L.) Carr.	Eastern Hemlock	1	No
Vaccinium sp.	Blueberry	2	Yes
Viburnum dentatum L.	Arrowwood	28	Yes
Viburnum prunifolium L.	Blackhaw	7	Yes
Xanthorhiza simplicissima Marsh.	Yellowroot	46	Yes