



Assessment of White-tailed Deer (*Odocoileus virginianus*) Impacts on the Woody Plant Community in the Vireo Ridge Restoration Area, 2003

Travis County Parks and Natural Resources

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INTRODUCTION

This report presents the results of a deer browse study conducted by Travis County Natural Resources field staff during October 2003 on the Vireo Ridge tract of the Jollyville Unit of the Balcones Canyonlands Preserve (BCP). The purpose of the study was: 1) to determine white-tailed deer (*Odocoileus virginianus*) herd size relative to the carrying capacity on this site, 2) to establish the need to maintain or reduce herd numbers, and 3) to monitor the regrowth of woody plants following habitat manipulation.

BACKGROUND

Central Texas currently has the highest population density of white-tailed deer in the United States (Richards 2000). Data collected by Texas Parks and Wildlife Department (Gore and Reagan 1984) indicate that, despite hunting pressure, this population continues to increase. Due to their increasing population, white-tailed deer have become a serious management concern for preserve managers and other land stewards in Travis County. With no significant limiting factor on herd numbers, deer can cause extensive damage to native plant communities, affecting long-term changes in the landscape. Deer foraging habits adversely affect native plant communities by eliminating some species, diminishing or enhancing the regeneration of others, and affecting changes in plant size and biomass production.

Deer overpopulation can be a critical problem on lands managed to protect endangered species. Over-browsing by white-tailed deer significantly reduces understory vegetation and thus available nesting cover for the black-capped vireo (*Vireo atricapilla*). Deer foraging habits also impact the golden-cheeked warbler (*Dendroica chrysoparia*) by inhibiting regeneration of hardwood species that are important components of their habitat.

White-tailed deer feed on forbs, mast, grasses, and browse. Browse is defined as the leaves and tender twigs of woody plants that are used as forage. Although deer prefer forbs, browse actually makes up the greatest part of their diet, constituting a dependable food source throughout the year (Armstrong 1991; Nelle 1994). Because browse is such an important part of the white-tailed deer diet, utilization of browse species can provide information on relative herd size and condition (Armstrong 1991; Nelle 1994). The presence or absence of certain browse species, the degree to which deer are utilizing these resources, and the extent of species regeneration can all indicate whether deer numbers are too high relative to the carrying capacity of the local habitat.

From 2001 to 2003, approximately 55 acres of Vireo Ridge were manipulated to create black-capped vireo habitat (Travis County Parks and Natural Resources 2003) – an early successional, deciduous shrubland with woody cover from ground-level to 2 m (Grzybowski 1995). In the restoration areas, large areas of woody plants were cut at ground-level, leaving islands of intact shrubs. Since a majority of the woody species which generate suitable vireo nesting habitat re-sprout once cut, while undesirable encroaching species such as Ashe juniper (*Juniperus ashei*) do not, this type of manipulation has been demonstrated to effectively restore black-capped vireo habitat. However, the size of the deer population is of special concern in this restoration area. First, this area, which was formerly very dense with woody plants - especially Ashe juniper - and practically impenetrable by deer, is now very open and easily accessible to deer for browsing. Second, if the deer population exceeds the carrying capacity of this site, deer browsing activity will likely inhibit regeneration of woody plants preferred as nesting habitat by black-capped vireos. However, a deer population management program was initiated on the Jollyville Unit in 2002 and could have a positive influence on the regeneration of woody plants in the restoration area.

In this study, our goal was to measure the impact of white-tailed deer on the vegetation in an area currently being restored to black-capped vireo habitat. Three plant community characteristics were of particular interest: 1) woody plant species composition, 2) the degree of woody plant use by deer, or degree of browsing, and 3) the size class distribution. We also collected data on the density and frequency of woody plant species.

METHODS

Circular plots were used to determine woody plant species composition, density, relative density and frequency. In 2002, seven plots with a radius of eight meters each, totaling 0.35 acres, were randomly established in the black-capped vireo habitat restoration area on Vireo Ridge (Travis County Parks and Natural Resources 2002). The center point of each plot was permanently marked with a t-post and all post locations were recorded with a Trimble GPS. In 2003, six of those plots were revisited, for a total of 0.30 acres. Each woody plant within a plot was recorded. Density was calculated as the total number of individuals of species *i* (including seedlings and saplings) divided by the total number of acres sampled. Relative density is the total number of individuals of species *i* divided by the total number of all species. Frequency is the number of plots in which a species occurred divided by the total number of plots sampled. Because an exact count of live oak seedlings and root sprouts was immeasurable, numbers for these were estimated.

Following TPWD (2001) guidelines for assessing browse intensity, each individual woody plant was classified as severely browsed, moderately browsed, or not browsed at all. To evaluate woody plant recruitment, the size class of each individual plant was also recorded. Because the study site has recently been disturbed, plant height is not necessarily a good indicator of age. However, since the study site is managed as black-capped vireo habitat, structure is more important than plant age. Shrubs were classified as seedlings (0 – 50 cm tall) or mature plants (≥ 51 cm tall), while trees were classified as seedlings, young trees, or mature trees. Tree size class was based on plant height and diameter at breast height (dbh), with three categories: 1) seedlings and suppressed seedling-sized saplings: 0 – 50 cm tall; 2) young trees (including saplings): ≥ 51 cm tall and <15 cm dbh; and 3) mature trees: ≥15 cm dbh. This was a modification of the 2002 method of age class determination, where a plant was classified as mature if it was re-sprouting from an adult that had been cut down, regardless of height (Travis County Parks and Natural Resources 2002). Additionally, the method for classifying twisted-leaf yucca (*Yucca rupicola*) was modified in 2003; if there were two leaves or fewer, it was classified as a seedling, otherwise it was classified as mature.

Woody plant species were then placed in four categories according to deer preference, based on research by Armstrong (1991) and Nelle (1994): preferred, good, low quality, and other. For our purposes, the designations "low quality browse" and "little utilized browse" used by Armstrong (1991) were combined into one category. Additional species listed by Nelle (1994) as "low quality browse" were included in this category as well. Browse species that were not listed by either researcher were designated as "other species."

RESULTS

Thirty-one woody species were found in the six plots at the Vireo Ridge study site (**Table 1**). Five species were preferred browse, 12 were good browse, 10 were low quality browse, and four were "other." Six species, four of which were categorized as low quality browse, were found in all plots – or had a frequency of 1.00 (**Table 1**): Ashe juniper, evergreen sumac (*Rhus virens*), flameleaf sumac (*R. lanceolata*), live oak (*Quercus fusiformis*), Mexican Persimmon (*Diospyros texana*), and poison ivy (*Toxicodendron radicans*). In contrast, eight species were present in only one plot, and thus had a frequency of 0.17. Most of these plants with a low frequency were either preferred or good browse.

Woody plants with the greatest density (**Table 1**) included poison ivy, shin oak (*Q. sinuata* var. *breviloba*), and live oak. Flameleaf sumac, Virginia creeper (*Parthenocissus*

quinquefolia), greenbriar (*Smilax Bona-nox*), redbud (*Cercis canadensis* var. *texensis*), twisted-leaf yucca, Texas ash (*Fraxinus texensis*), elbowbush (*Forestiera pubescens*), Ashe juniper, Texas oak (*Q. buckleyi*), and wild grape (*Vitis mustangensis*) were also dense at this site.

Most (77%; **Figure 1**) of the individual plants encountered were categorized as good browse. Additionally, 17% of the plants were low quality browse, 2% of the plants were preferred browse, and the remaining 4% were categorized as "other." For all plants combined, 71% (**Figure 2**) showed no signs of browse, 24% were moderately browsed, and 5% were severely browsed. This browsing pattern was similar to that observed in good and low quality browse (**Figure 3**), where most plants (greater than 50%) showed no signs of browse. In contrast, the majority of preferred browse plants were moderately browsed. Individual species ($n \geq 10$) that suffered the most browse pressure (greater than 50% moderately and/or severely browsed) were Texas oak, shin oak, elbowbush, and twisted-leaf yucca (**Table 2**). Except for twisted-leaf yucca, all species that suffered greatly from deer browse were either preferred or good quality deer browse.

An overwhelming majority of all trees sampled were seedlings, followed by saplings and mature plants (**Figure 4**). For preferred and low quality shrubs, there was a relatively equal amount of seedlings and mature plants. However, most shrubs in the good browse category were seedlings.

Overall, the results of the 2003 survey were very similar to the 2002 survey. Only one additional woody species was recorded in 2003 (Carolina snailseed (*Cocculus caroliniana*)), and the species composition remained relatively the same. Furthermore, trends were similar between years. That is, the proportion of plants in the different browse categories (**Figure 1**) and the extent of browse (**Figure 2**) were similar in 2002 and 2003. The main difference between years was that only 6% of preferred browse was severely browsed in 2003, a large reduction from the previous year (38%; **Figure 3**).

DISCUSSION

The composition of woody plant species at Vireo Ridge suggests that deer numbers are low to moderate relative to the carrying capacity of the habitat. Excluding species that were not categorized by Armstrong (1991) or Nelle (1994), 63% of all plant species and 83% all individual plants sampled were preferred or good quality deer browse species. However, it is

likely that the current woody plant composition of this site is related to the situation prior to habitat manipulation. Prior to manipulation, the close spacing of woody species such as Ashe juniper likely provided a physical barrier which protected highly palatable browse species. Now that the area has been opened up through clearing and deer have unlimited access to areas that have been manipulated, patterns of herbivory are likely to change. If the deer herd exceeds the carrying capacity of the habitat at Vireo Ridge, woody plant composition will likely change over time.

At present time, most of the woody plants sampled in this study were in the seedling size class. This is not surprising, given that the much of site was recently cleared. Of the plants experiencing browse pressure, either moderate or severe, most are important components of black-capped vireo habitat, either in the form of nest sites or cover. Species present on Vireo Ridge that frequently occur in black-capped vireo habitat include shin oak, Texas oak, live oak, sumac species, and redbud (Grzybowski 1995); all of these species showed varying extents of deer browse in 2003. Therefore, although the woody plant composition on Vireo Ridge indicates low to moderate deer numbers, the deer are browsing plant species that are a crucial component of black-capped vireo habitat. Ultimately, the foraging preference of deer on the preserve could have a negative impact on the recruitment of woody plants into the larger size classes, and thus the success of habitat restoration efforts.

RECOMMENDATIONS

- *Deer censusing*: TPWD recommends that a deer census be completed each year on lands where deer are harvested. An annual census will allow managers to evaluate the effectiveness of management strategies, determine whether desired deer densities have been attained, and calculate future harvest recommendations.

- *Culling*: As long as the deer herd exceeds the carrying capacity of the preserve, it is recommended that deer management continue on the Jollyville Unit. Experts recommend culling on preserve properties as the most effective management strategy. It allows a large number of deer to be harvested by expert hunters in one season.

- *Fencing*: Wildlife management professionals concur that white-tailed deer management is ineffective without deer-proof fencing of properties. This is due to the ingress and egress of deer between populations on adjacent properties. As long as deer from

surrounding properties can migrate into the preserve, no amount of culling will adequately reduce overpopulated herds.

- *Exclosure studies*: Further research of plant community characteristics at Vireo Ridge tract is necessary to better understand the impact of white-tailed deer on the native flora. Exclosures allow biologists to quantify plant community characteristics in the absence of herbivory by deer.

- *Plant monitoring*: Annual plant monitoring programs, such as the current browse study, will allow managers to assess the effectiveness of deer management strategies on a yearly basis. Additional studies quantifying woody plant cover in the restoration area would be a beneficial monitoring tool.

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Table 1. Species composition, density, relative density, and frequency of woody plants in study plots at Vireo Ridge, October 2003. Species arranged in order of browse preference by white-tailed deer, *Odocoileus virginianus* (Armstrong 1991; Nelle 1994).

		Density/acre[1]	Relative density[2]	Frequency[3]
Preferred Browse Species				
Carolina Buckthorn	*Rhamnus caroliniana*	43	0.005	0.50
Cedar Elm	*Ulmus crassifolia*	3	0.000	0.17
Texas Kidneywood	*Eysenhardtia texana*	10	0.001	0.17
Texas Oak	*Quercus buckleyi*	160	0.017	0.67
Texas Sophora	*Sophora affinis*	3	0.000	0.17
Good Browse Species				
Black Cherry	*Prunus serotina*	3	0.000	0.17
Carolina Snailseed	*Cocculus carolinus*	7	0.001	0.17
Elbowbush	*Forestiera pubescens*	197	0.021	0.67
Flameleaf Sumac	*Rhus lanceolata*	457	0.049	1.00
Greenbriar	*Smilax Bona-nox*	403	0.043	0.83
Hackberry	*Celtis sp.*	13	0.001	0.50
Poison Ivy	*Toxicodendron radicans*	3877	0.416	1.0
Possumhaw	*Ilex decidua*	40	0.004	0.50
Redbud	*Cercis canadensis* var. *texensis*	360	0.039	0.83
Shin Oak	*Quercus sinuata* var. *breviloba*	1220	0.131	0.83
Virginia Creeper	*Parthenocissus quinquefolia*	443	0.048	0.83
Wild Grape	*Vitis* sp.	147	0.016	0.83
Low Quality Browse Species				
Ashe Juniper	*Juniperus ashei*	190	0.020	1.00
Evergreen Sumac	*Rhus virens*	87	0.009	1.00
Fragrant Sumac	*R. aromatica*	23	0.003	0.33
Live Oak	*Quercus fusiformis*	770	0.083	1.00
Mexican Persimmon	*Diospyros texana*	120	0.013	1.00

		Density/acre	Relative density	Frequency
Low Quality Browse Species, cont'd.				
Mimosa	*Mimosa* sp.	7	0.001	0.17
Prickly Ash	*Zanthoxylum hirsutum*	17	0.002	0.50
Prickly Pear	*Opuntia lindheimeri*	3	0.000	0.17
Twisted-leaf Yucca	*Yucca rupicola*	253	0.027	0.67
Wafer Ash	*Ptelea trifoliata*	80	0.009	0.67
Other*				
American Beautyberry	*Callicarpa americana*	10	0.001	0.33
Southern Dewberry	*Rubus trivialis*	3	0.000	0.17
Texas Ash	*Fraxinus texensis*	247	0.026	0.50
Yaupon	*Ilex vomitoria*	127	0.014	0.83
Total		9327	1.000	

[1] density per acre = no. of individuals per acre
[2] relative density = no. individuals of species *i* / total individuals of all species
[3] frequency = no. of plots where species *i* occurs / total no. of plots
*refers to species not listed in Armstrong (1991) or Nelle (1994)

Table 2. Browse pressure by white-tailed deer (*Odocoileus virginianus*) on woody plants in study plots at Vireo Ridge, October 2003. Browse pressure was evaluated for each plant and classified as not evident, moderate, or severe (TPWD 2001). Percent in each class is given followed by number of individuals in each age class.

		Browse not evident				**Moderate browse**				**Severe browse**			
		% of total	Number of			% of total	Number of			% of total	Number of		
			seedling	young	mature		seedling	young	mature		seedling	young	mature
Preferred Browse Species													
Cedar Elm	*Ulmus crassifolia*	100	1	0	0	0	0	0	0	0	0	0	0
Texas Oak	*Quercus buckleyi*	25	11	1	0	67	31	1	0	8	4	0	0
Carolina Buckthorn	*Rhamnus caroliniana*	92	9		3	8	0		1	0	0		0
Texas Kidneywood	*Eysenhardtia texana*	33	1		0	67	1		1	0	0		0
Texas Sophora	*Sophora affinis*	100	1		0	0	0		0	0	0		0
Good Browse Species													
Black Cherry	*Prunus serotina*	100	1	0	0	0	0	0	0	0	0	0	0
Hackberry	*Celtis* sp.	50	1	1	0	25	1	0	0	25	1	0	0
Shin Oak	*Quercus sinuata* var. *breviloba*	11	32	7	7	72	251	9	4	17	63	0	0
Carolina Snailseed	*Cocculus carolina*	50	1		0	50	1		0	0	0		0
Elbowbush	*Forestiera pubescens*	34	13		7	58	34		0	8	5		0
Flameleaf Sumac	*Rhus lanceolata*	52	49		22	39	23		30	9	12		1

		Browse not evident				Moderate browse				Severe browse			
		% of total	Number of			% of total	Number of			% of total	Number of		
			seedling	young	mature		seedling	young	mature		seedling	young	mature
Good Browse Species, cont'd.													
Greenbriar	*Smilax Bona-nox*	36	30		13	50	57		3	15	16		2
Poison Ivy	*Toxicodendron radicans*	96	1116		1	4	40		2	0	4		0
Possumhaw	*Ilex decidua*	58	6		1	42	5		0	0	0		0
Redbud	*Cercis canadensis* var. *texensis*	83	73		17	17	16		2	0	0		0
Virginia Creeper	*Parthenocissus quinquefolia*	100	131		2	0	0		0	0	0		0
Wild Grape	*Vitis* sp.	89	29		10	9	4		0	2	1		0
Low Quality Browse Species													
Ashe Juniper	*Juniperus ashei*	100	37	19	1	0	0	0	0	0	0	0	0
Live Oak	*Quercus fusiformis*	66	145	0	8	27	57	5	0	7	15	1	0
Evergreen Sumac	*Rhus virens*	62	8		8	38	6		4	0	0		0
Fragrant Sumac	*R. aromatica*	29	2		0	71	4		1	0	0		0
Mexican Persimmon	*Diospyros texana*	78	14		14	19	7		0	3	1		0
Mimosa	*Mimosa* sp.	50	1		0	50	1		0	0	0		0
Prickly Ash	*Zanthoxylum hirsutum*	60	2		1	40	1		1	0	0		0

		Browse not evident				Moderate browse				Severe browse			
		% of total	Number of			% of total	Number of			% of total	Number of		
			seedling	young	mature		seedling	young	mature		seedling	young	mature
Low Quality Browse Species, cont'd.													
Prickly Pear	*Opuntia lindheimeri*	100	1		0	0	0		0	0	0		0
Twisted-leaf Yucca	*Yucca rupicola*	43	26		7	45	4		30	12	7		2
Wafer Ash	*Ptelea trifoliata*	79	12		7	21	1		4	0	0		0
Other*													
Texas Ash	*Fraxinus texensis*	61	45	0	0	39	29	0	0	0	0	0	0
American Beautyberry	*Callicarpa americana*	100	3		0	0	0		0	0	0		0
Southern Dewberry	*Rubus trivialis*	100	1		0	0	0		0	0	0		0
Yaupon	*Ilex vomitoria*	74	21		7	16	5		1	11	4		0

*refers to species not listed in Armstrong (1991) or Nelle (1994)

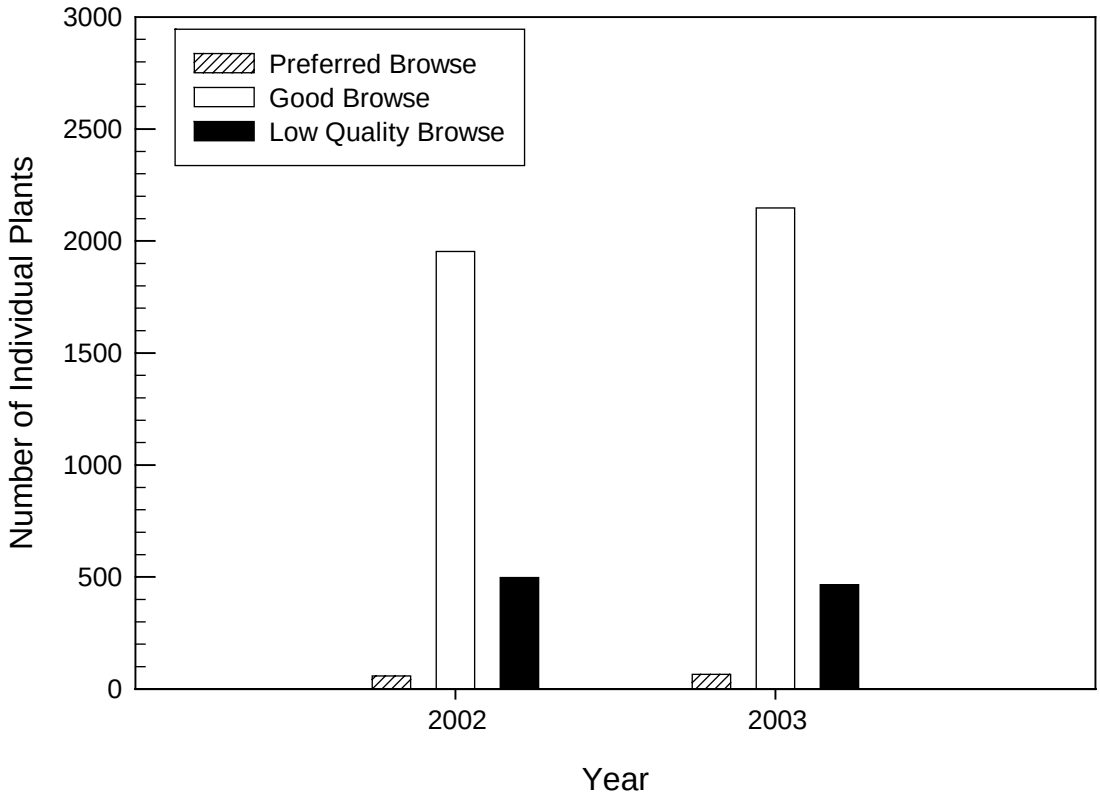

Figure 1. Distribution of woody plant browse quality in the Vireo Ridge restoration area of the Jollyville Unit, Travis County, Texas, during fall 2002 and 2003. Quality of browse is classified according to Armstrong (1991) and Nelle (1994).

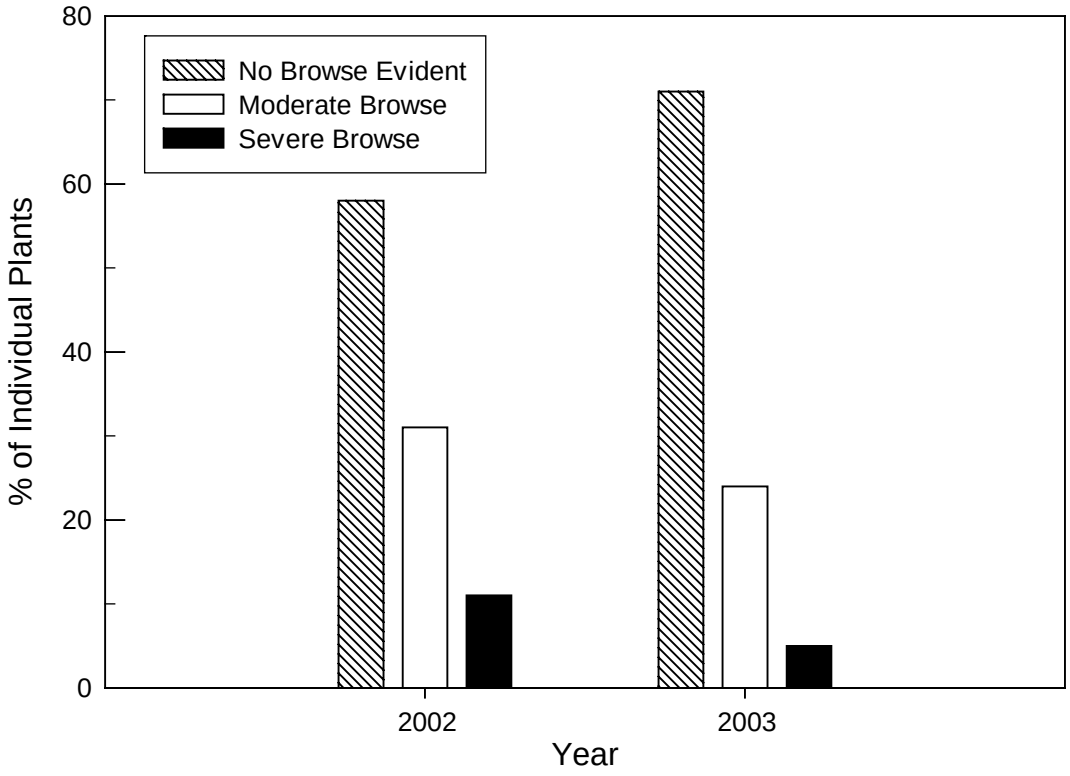

Figure 2. Severity of white-tailed deer (*Odocoileus virginianus*) browse pressure on woody plants in the Vireo Ridge restoration area of the Jollyville Unit, Travis County, Texas, during fall 2002 and 2003. Browse pressure is classified according to TPWD (2001) guidelines.

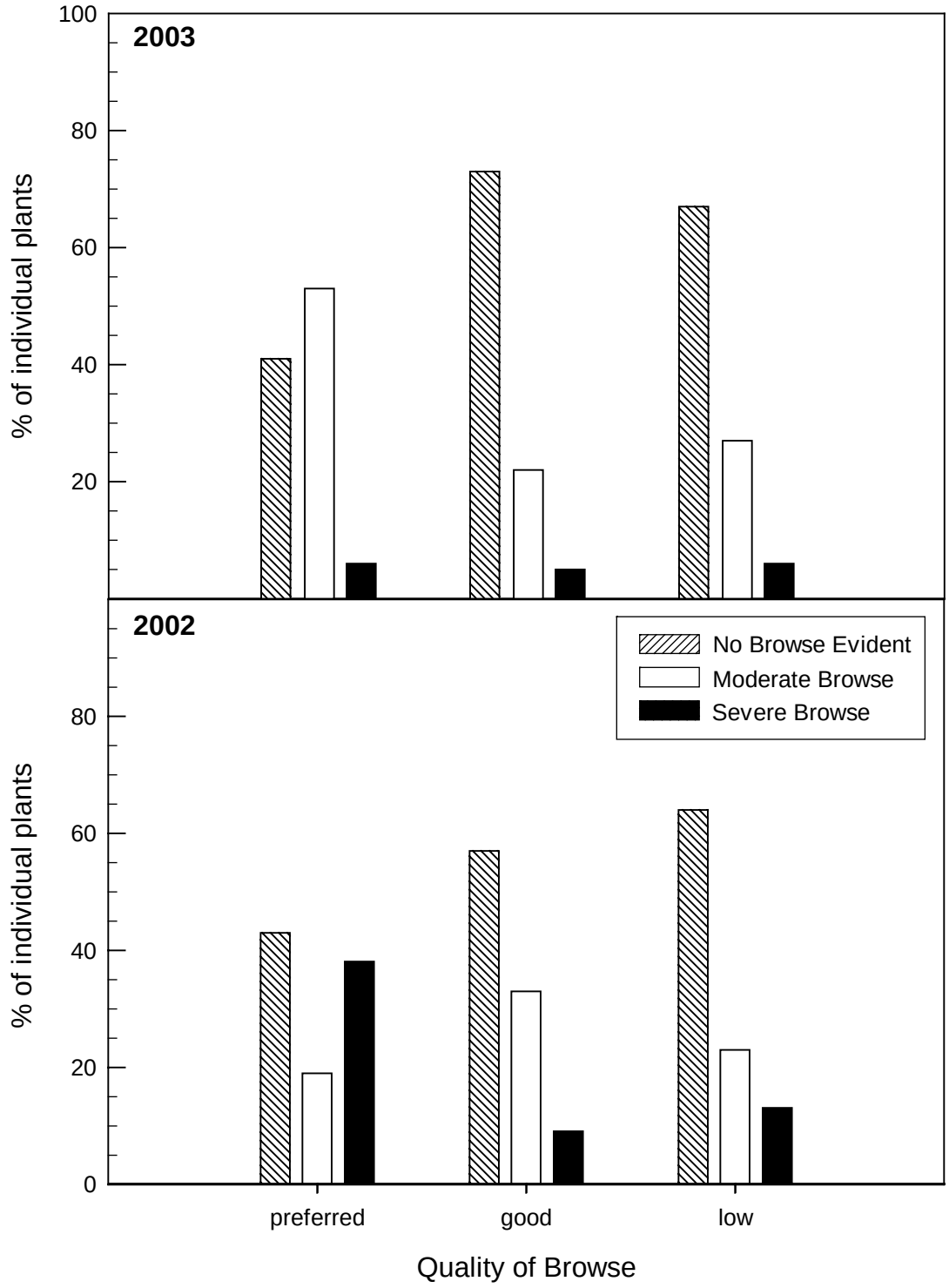

Figure 3. Extent of browse pressure on woody plants, sorted by browse preference, in the Vireo Ridge restoration area of the Jollyville Unit, Travis County, Texas. The top panel shows results from 2003, while the bottom panel shows 2002 data. Quality of browse is classified according to Armstrong (1991) and Nelle (1994), and browse pressure is classified according to TPWD (2001) guidelines.

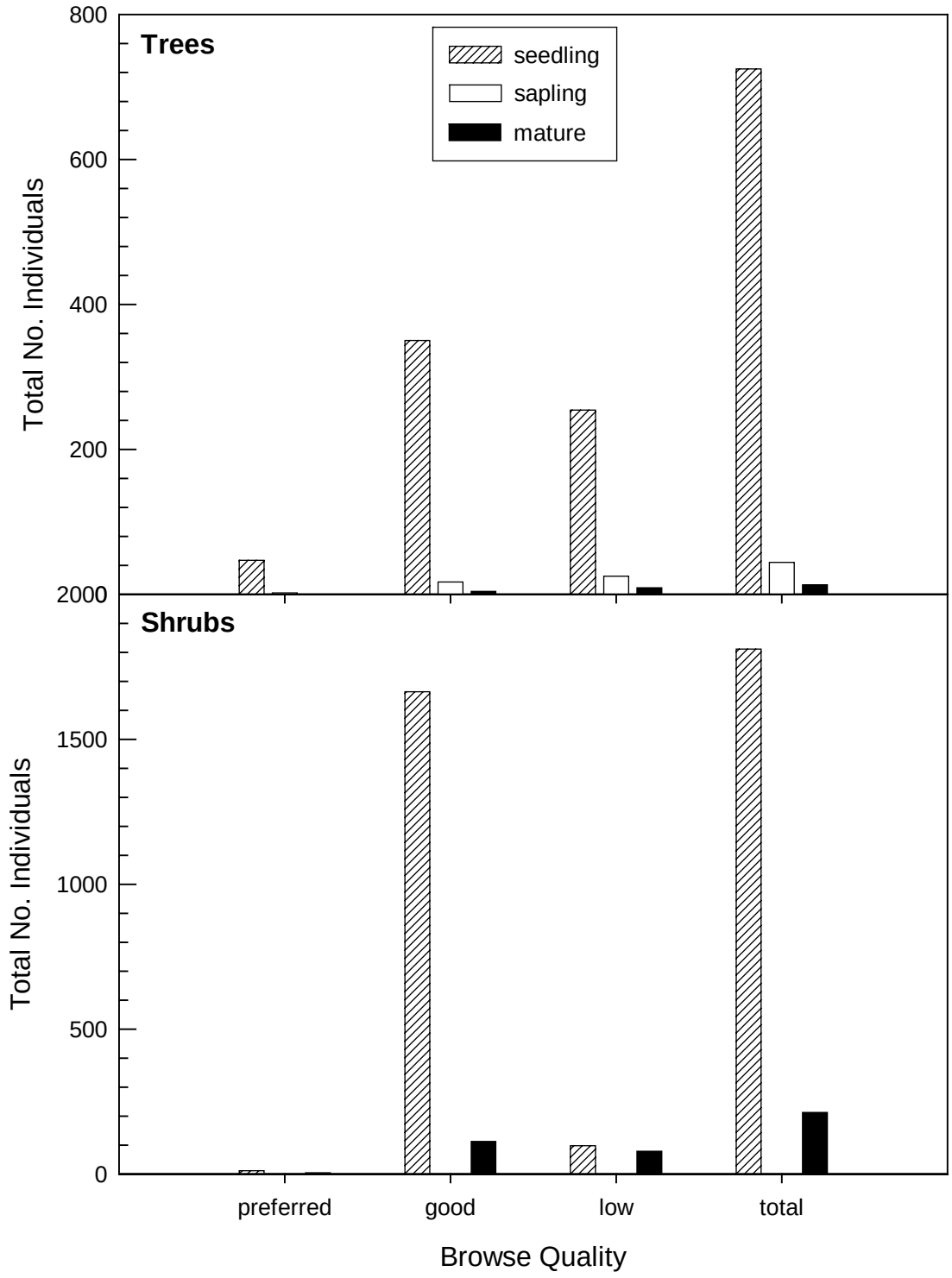

Figure 4. Distribution of woody plant size classes, sorted by browse preference, in the Vireo Ridge restoration area of the Jollyville Unit, Travis County, Texas. The top panel shows tree data, while the bottom panel shows shrub data. Quality of browse is classified according to Armstrong (1991) and Nelle (1994).