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SELECTION OF TREES FOR RUBS BY WHITE-TAILED DEER IN MAINE

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Considerable research has been conducted on scent-marking behaviors of ungulates (Bowyer and Kitchen, 1987; Eisenberg and Kleiman, 1972; Ewer, 1968; Graf, 1956; Leuthold, 1977; Peters, 1980; Ralls, 1971; Walther, 1984). Information on these behaviors has been especially well documented for *Odocoileus*. One type of scent mark, the "buck rub," is made by male deer debarking small trees and shrubs with their antlers then rubbing the frayed area with their glandular foreheads (Marchinton and Hirth, 1984).

Moore and Marchinton (1974) and Kile and Marchinton (1977) reported that deer did not rub trees primarily to remove antler velvet; rubbing behavior continued long after velvet shedding was completed. Rather, rubbing of trees by *Odocoileus* sp. often was associated with aggressive interactions between males (Bowyer, 1986; Geist, 1981; Hirth, 1977; Kile and Marchinton, 1977; Kucera, 1978; Moore and Marchinton, 1974), and most likely functioned to express dominance (Marchinton and Hirth, 1984; Peters, 1980). Some data on chemical composition of pheromones released and histology of glands used in scent marking are available (Atkeson and Marchinton, 1982; Muller-Schwarze, 1971, 1972; Muller-Schwarze et al., 1978; Quay, 1959; Quay and Muller-Schwarze, 1970; Volkman et al., 1978), as well as information on timing, location, and types of trees rubbed by deer (DeVos, 1967; Kile and Marchinton, 1977; Moore and Marchinton, 1974; Nielsen et al., 1982).

Rubs made by white-tailed deer (*O. virginianus*) typically were concentrated at trail junctions, along old roadbeds, and in woods adjacent to open areas (Moore and Marchinton, 1974). Kile and Marchinton (1977) reported that rubs were not distributed randomly, but were most frequent in areas with many small saplings. The physical characteristics of trees (Kile and Marchinton, 1977; Nielsen et al., 1982) and the aromatic qualities of some woody species (Kile and Marchinton, 1977) were important in determining trees that deer selected to rub.

We observed that deer rubs along forested edges of fields in central Maine did not correspond well with findings of Kile and Marchinton (1977) that aromatic trees were selected for scent marking. Thus, the purpose of this study was to test whether white-tailed deer in Maine used particular woody species for rubbing and to compare the physical characteristics of plants they rubbed with those available.

TABLE 1.—*Use of trees and shrubs for rubbing by white-tailed deer in central Maine, 1986. A significant positive Z value indicates selection, whereas a significant negative one shows avoidance.*

Plant species	Percent of rubbed trees (n = 103)	Percent of available trees (n = 96)	Z values
Populus tremuloides	33.0	15.6	2.85**
Rhus typhina	31.1	5.2	4.69***
Salix sp.	10.7	1.0	2.86**
Thuja occidentalis	7.7	10.4	−0.65
Prunus serotina	4.8	13.6	−2.14*
Fraxinus americana	3.9	4.2	−0.10
Acer rubrum	2.9	5.2	−0.82
Pyrus malus	1.9	4.2	−0.92
Prunus virginiana	1.0	16.7	−3.97***
Viburnum lentago	1.0	4.2	−1.44
Betula populifolia	1.0	2.1	−1.50
Ilex laevigata	1.0	0.0	1.00
Betula papyrifera	0.0	4.2	−2.06*
Acer saccharum	0.0	4.2	−2.06*
Ulmus americana	0.0	2.1	−1.50
Picea glauca	0.0	2.1	−1.50
Juniperus communis	0.0	1.0	−1.00
Larix laricina	0.0	1.0	−1.00
Cornus sp.	0.0	1.0	−1.00
Parthenocissus inserta	0.0	1.0	−1.00
Spiraea latifolia	0.0	1.0	−1.00

* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

Data were collected in March and April 1986, after all rutting behavior had ceased, at an elevation of 76 m along the edges of timothy hay (*Phleum pratense*) fields near Unity, Waldo Co., Maine (44°36'N, 69°23'W). Fields were adjacent to a deer wintering area dominated by conifers including *Abies balsamea, Picea glauca, Pinus strobus,* and *Thuja occidentalis,* and intermixed with northern hardwoods. The topography is rolling hills with swamps occurring in lowlands. A more complete description of this area was provided by Hodgman and Bowyer (1985).

Seventeen plots, each 30 by 125 m, were established randomly in forested areas along fields to locate trees with "buck rubs." An adequate number of plots was determined by examining reduction of variation in the frequency of occurrence of commonly rubbed species as sample size increased (Kershaw, 1964:29).

Data on tree species, height above the ground of the first branch along the trunk, tree diameter at midpoint of the rub, diameter at breast height, whether the trees possessed rough (rugose, scaly, or spiny) or smooth bark, whether the tree was alive, presence of aromatic substances obvious to us, and distance to the next nearest rub were recorded for each tree rubbed by deer. Only trees with rubs made immediately before, during, or immediately after rut were sampled. Availability of trees to scent mark was determined with 34 (5 by 5 m) random plots, two each nested within the 17 larger plots. Data similar to those collected for trees with rubs were recorded for all trees and shrubs within these quadrats. The Mann-Whitney U test, two sample Z test for proportions, and G test of independence (Zar, 1984) were used to test for differences between tree species rubbed by deer and those that were not. A test for spatial randomness of rubbed trees was calculated according to Clark and Evans (1954).

Twelve species of trees and shrubs were rubbed by deer; *Rhus typhina, Populus tremuloides,* and *Salix* sp. were selected, whereas *Prunus virginiana, P. serotina, Betula papyrifera,* and *Acer saccharum* were avoided (Table 1). No tree had more than one discrete rub. Of 103 trees and shrubs rubbed by deer, 90.3% possessed smooth bark, whereas only 61.5% of the random sample (n = 96) had smooth bark; the G test indicated these values differed significantly ($P < 0.001$).

Mean ($\pm SD$) diameter at breast height of trees with rubs was 1.7 ± 1.5 cm (range = <0.1–8.5 cm), whereas the mean of trees available to scent mark was 6.8 ± 8.2 cm (range = <0.1–40.7 cm); the Mann-Whitney U test showed these values differed significantly ($P < 0.001$). Mean ($\pm SD$) diameter of trees at the midpoint of rubs was 2.3 ± 1.6 (range = 0.6–9.5 cm). Mean ($\pm SD$) height of first branch above the ground on trees marked by deer was 94.2 ± 35.9 cm (range = 30.0–179.0 cm); the Mann-Whitney U test indicated this differed significantly ($P < 0.001$) from trees available to rub (78.6 ± 44.9 cm, range = 1.0–234.0 cm).

Because selection of tree species for rubbing by deer may have been a function of tree size, the analysis was repeated with the data set confined to trees with diameter at breast height and branch heights scent marked by deer; the same tree species were selected and avoided. Thus, aromatic properties of some species may have been a factor in determining whether they were rubbed by deer. The Z test showed that aromatic *Prunus* sp. was marked by deer significantly ($P < 0.001$) less often (5.8%) than these species were available (30.2%), even though most (82.8% of 29) *Prunus* sp. possessed smooth bark. Aromatic conifers, however, were not rubbed (7.8%) in a proportion significantly ($P > 0.20$) different from their availability (14.6%).

Roe deer (*Capreolus capreolus*) selected pines (*Pinus* sp.) to scent mark (Cumming, 1974), and Roosevelt elk (*Cervus elaphus roosevelti*) concentrated their marking behavior on red alders (*Alnus rubra*; Bowyer and Kitchen, 1987). White-tailed deer also selected particular species of trees; sumacs (*Rhus* sp.) were rubbed often by deer in Maine (Table 1) and Georgia (Kile and Marchinton, 1977). Kile and Marchinton (1977) reported that deer selected *Prunus*, but deer in our study avoided them (Table 1). Reasons for this difference may relate to the abundance of these aromatic species. Black cherry (*Prunus serotina*) and chokecherry (*P. virginiana*) were more common on our study area (30.2%) than black cherry (3.1%) in the Georgia study (Kile and Marchinton, 1977). Perhaps the aromatic properties of these species were more useful in drawing the attention of deer to rubs on the Georgia study area where occurrence of such trees was less frequent. Conifers also were abundant on our study site (14.6%) and were not used for rubs in a significantly different proportion than available.

Mean ($\pm SD$) distance from a tree rubbed by deer to its nearest neighbor (of any species) with a rub was 10.2 ± 22.9 m (range = <0.1–134.0 m). A test of spatial randomness indicated that these nearest-neighbor distances were significantly ($P < 0.001$) closer than expected (12.4 m). This test is biased toward a regular distribution (Sinclair, 1985), and indicates the strong degree to which rubs were clumped spatially.

White-tailed deer in Maine exhibited strong selectivity for trees they rubbed. Species with smooth bark, a relatively small diameter at breast height (≤8.5 cm), and high first branch (≥30 cm) were selected. The selection of smooth-barked trees with small trunks devoid of low branches also was reported for white-tailed deer rubs in Georgia (Kile and Marchinton, 1977) and Ohio (Nielsen et al., 1982). Others (Kile and Marchinton, 1977; Moore and Marchinton, 1974; Nielsen et al., 1982) also noted the clumped distribution of rubs reported in our study.

Rubs presumably serve as both visual and olfactory marks related to male dominance (Marchinton and Hirth, 1984). Placing these signs on trees located readily by conspecifics should be advantageous. Large conspicuous trees, however, may not have been rubbed because their thick bark was difficult for deer to remove. Some variation in selection by deer of tree species for scent marking on different areas may be explained by the relative abundance of these trees and how likely other deer are to locate scent marks on them.

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GROUP PREDATOR DEFENSE BY MULE DEER IN OREGON

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Deer (*Odocoileus*), when occupying open habitats, may acquire a degree of security from predators by forming groups. Safety for individuals in a group may accrue from the cover provided by conspecifics (Hamilton, 1971), the increased probability of detecting potential predators, or active group defense (Pulliam and Caraco, 1984). Rubenstein (1982) argued that such defense is best spent on related young because they can have greater reproductive value than older animals and share more genes than nonrelated individuals. Herein, I document an instance of four Rocky Mountain mule deer (*Odocoileus hemionus hemionus*) females defending a fawn under attack by three coyotes (*Canis latrans*). The most aggressive female was suspected not to be the dam of the defended fawn.

The incident occurred on John Day Fossil Beds National Monument, approximately 55 km W John Day, Oregon (44°32′N, 119°40′W). At approximately 0735 h Pacific Daylight Time on 18 August 1979 I observed a group of four female mule deer and two large, same-sized, nonspotted fawns in a meadow along the John Day River. The group included a large radio-collared female (no. 7) estimated to be older than 3 years and