ECOLOGICAL RESTORATION OF FIRE-MAINTAINED OAK WOODLANDS IN MASSACHUSETTS

A Thesis Presented

by

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DEDICATION

To my friend and partner—my loving wife—and my sons, Lyle and Clayton. Without the support, encouragement, and patience of my family, I never would have made it into the Forest and into a new life.

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ABSTRACT

ECOLOGICAL RESTORATION OF FIRE-MAINTAINED OAK WOODLANDS IN MASSACHUSETTS

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This study describes the results of a factorial experiment involving three levels of overstory thinning (none, moderate, heavy) and two levels of prescribed burning (no burn, burn) in three replicated blocks of upland oak forest in Pelham, Massachusetts to reproduce qualities of the fire-maintained oak woodlands that are thought to have existed in southern New England prior to European settlement. The primary aspects studied were overstory structure, soft mast (berry) production, and understory openness. A reference site in Worcester, MA exhibits an open understory maintained by frequent burning and supports a unique natural community of flora and fauna. Overstory thinning was completed in January 2001, and understory burning in June 2001. Two growing seasons after treatments, burning reduced the cover of understory shrubs ($p=0.0002$). There was a significant interaction ($p=0.011$) between the treatments with regards to tree species in the understory. Overall, thinning increased the cover of tree species in the understory ($p=0.002$), and burning decreased the cover of tree species for all but the moderate thinning treatment ($p=0.04$). The number of understory species browsed by wildlife was increased by both the thinning ($p<0.0001$) and burning ($p=0.026$) treatments. Neither treatment significantly affected overall species diversity of vegetation. Thinning increased production of soft mast ($p=0.001$) and increased available light to the shrub-level understory ($p<0.0001$). Stem density, flower production, and berry production of *Vaccinium angustifolium* were highly correlated with available light ($p<0.0001$). Prescribed burning increased understory visibility in the year following application ($p=0.008$). Horizontal foliar density (HFD) increased linearly with distance ($p<0.001$) and decreased with height above ground ($p<0.001$). The combined results suggest that the combination of overstory thinning and understory burning is a promising method to create woodland openings that meet wildlife, aesthetic, and recreation goals for public and private landowners, while restoring a rare natural community to the Massachusetts landscape.

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CHAPTER 1

INTRODUCTION

Historical Changes in Massachusetts Forests

Changes in land-use and cultural practices since European settlement have substantially altered the vegetation of southern New England (Foster 1992, Motzkin et al. 1999). By 1909, more than half of the region's forest of more than 8 million acres (3.2 million hectares) had been cleared for agriculture (Irland 1999). Despite the reforestation of much of Massachusetts in the latter part of the 20th century, the structure and composition of the resulting forests differ from inferred conditions before the arrival of European settlers (Fuller et al. 1998).

Bromley (1935) speculates that the predominant vegetation of pre-colonial southern New England was not a closed canopy forest, but rather "a woodland greatly modified by fire and anthropeic factors." While there is little agreement on the exact amount of tree cover which constitutes a woodland, the term is generally understood to represent a community intermediate to open, grass-dominated savannas and closed-canopy forests (Anonymous 2002). Foresters define a woodland as "a plant community in which, in contrast to a typical forest, the trees are often small, characteristically short-boled relative to their crown depth, and forming only an open canopy with the intervening area being occupied by lower vegetation, commonly grass," whereas forests are described as having "more or less dense and extensive tree cover" (Helms 1998). Early land surveys showed the predominance of oak, hickory, and chestnut in central and western Massachusetts (Whitney 1994), and the long-term dominance of oak species appears to be closely related to the occurrence of wildland fire (Abrams 1992). Bromley used descriptions of early settlers such as Morton (1632) to characterize the original woodlands as partially closed canopies of large oak, chestnut, and hickory trees with open, park-like understories of low shrubs and herbaceous vegetation, maintained by aboriginal American inhabitants using frequent, low-intensity surface fires. While there remains controversy surrounding the extent of these fire-maintained woodlands (Forman and Russell 1983, Meyers and Peroni 1983, Russell 1983), historical and palynological evidence is consistent with such areas having at least occurred near Indian habitation along the coast and rivers (Patterson and Sassaman 1988) and in the uplands near major river drainages (Byers 1946). Research in northern hardwood forests of Ontario, Canada show that this use of fire can dramatically change the species composition of forests (Clark and Royall 1995). A recent study of frequently burned upland sites in Worcester, MA found an overstory structure and composition similar to the fire-maintained oak woodlands described above, and a unique community of understory flora and fauna (Rawinski 2000).

One of the few palynological studies of a basin adjacent to modern upland oak forests noted not only a significant decrease in local fires subsequent to European settlement, but also a paradoxical increase in charcoal levels at a time when climate was cooler and moister (Foster et al. 2002a). The authors offer as one alternative that "Indian-set fires…were purposefully set to manipulate the woodland environment." They assert that their results support the conclusions that fire is important in New England oak forests and that this "landscape must be considered controlled, at least in part, by cultural, as well as natural and environmental factors over past millennia" (Foster et al. 2002a). The fact that these local results from one upland basin are not supported by a broader regional study (Parshall and Foster 2002), suggests that, in Parshall and Foster's words, "we do not yet have the appropriate palaeoecological records…to answer this question fully." Of the 18 sites in Parshall and Foster's regional analysis, five (Bates, Harlock, Lily-New Salem, Walden, and Sandy Hill Ponds) appear to be located in upland oak forests, and only the first three of these are inland sites. From the 18 sites, the authors identify two response patterns to European settlement: a tendency towards white pine in northern hardwood forests, and trend away from oak and hickory and towards pitch pine in pine-oak forests. In contrast, the authors do not identify the third pattern that is clear in their detrended correspondence analysis for the five upland oak forest sites: subsequent to European settlement, upland oak forests moved away from oak and hickory and towards white pine. This pattern is consistent with a reduction in understory burning in this forest type. A study of coastal ecosystems concluded that historical evidence points towards Indian use of fire to maintain open oak woodlands, although the palynological evidence is unable to distinguish between oak shrublands, woodlands, and closed oak forests (Motzkin and Foster 2002).

Since the cessation of Indian burning, the present-day structure of the forests of Massachusetts has become largely a result of landform, elevation, and the history of land-use since European settlement (Foster 1992, Gerhardt and Foster 2002). This history includes the logging and burning of most of the landscape to clear it for pasture and tillage, cultivation, pasturing, and cordwood cutting for a century or more, followed by abandonment (Raup 1966, Cronon 1983, Irland 1999, Foster and O'Keefe 2000, Hall et al. 2002). The wave of reforestation following farm abandonment in the late 19th century and extensive harvesting in the early 20th century created forests of uniform ages. As these forests have matured, the structural diversity of stands across the landscape has decreased. For example, USDA Forest Service Forest Inventory and Analysis (Dickson and McAfee 1988, Alerich 2000) surveys suggest that the proportion of seedling/sapling stands to total forested area decreased from over 20% in 1972 to 7% in 1985 and to approximately 5% in 1998. This represents the culmination of a nearly century-long trend. Among other factors, fire suppression in the 20th century allowed grasslands and shrublands (including sapling stands) to become forested (Mitchell 2000). A lack of burning has left few patches of open woodland amongst the sea of closed-canopy forest.

In contrast, the present-day distribution of tree species in southern New England is a function not only of human influences (Fuller et al. 1998), but also of long-term post-glacial climate changes and the migration patterns of individual species following the last glacial maximum approximately 18,000 years ago (Davis 1976). A review of palynological studies in the Northeast (Russell et al. 1993) shows significant interaction between changes in climate and changes in land-use, although anthropogenic deforestation and subsequent reforestation dominated the climate effects over the past few centuries. Fuller et al. (1998) conclude that even with regional reforestation “there has been no return to pre-European regional patterns of forest composition and dynamics.” Davis (1976) observed that entire interglacial periods of 10,000 to 20,000 years are “too short for attainment of an ecosystem equilibrium.” Fuller et al. (1998) suggest that modern “low levels of disturbance and perhaps insufficient time” prevent even a trend towards pre-historic patterns. Those prehistoric forests may have had characteristics of value to public and private forest owners today. While we cannot accelerate the passage of time, appropriate management activities may be able to emulate a disturbance regime capable of providing that trend.

Native American, pre-Columbian inhabitants of southern New England not only cleared forests for agriculture (Byers 1946), but also created open woodlands that allowed passage for hunting while providing food sources for game species (Day 1953). American Indians used frequent low-intensity surface fires in the spring and fall to maintain areas of open forests for easier hunting and to stimulate the production of both hard and soft mast (nuts/acorns and berries/fruits, respectively) in the chestnut/oak (*Castanea dentata/Quercus* spp.) forests of the Northeast (Bromley 1935, Day 1953, Magee and Ahles 1999, Wade et al. 2000). At a landscape level, these frequently burned open areas probably occurred within a mosaic of less frequently burned mature forests (Patterson and Sassaman 1988).

Rawinski’s (2000) study of extant oak woodlands in Worcester, MA describes an ecosystem maintained by frequent anthropogenic fires that burn individual sites at least every 5 to 10 years. These upland sites support a highly diverse flora and fauna, including several mammal species and many bird, butterfly, and unusual moth species, all within the limits of Worcester, the second largest city in the state. Although described as early successional, the woodlands remain visually open and easily traversed, supporting remarkable aesthetic and recreational features. Urban birdwatchers, berry-pickers and hikers share the woods with wild turkeys (*Meleagris gallopavo)*, cottontail rabbits (*Sylvilagus floridanus)* and the Harris' checkerspot butterfly (*Chlosyne harrisii*). One of the primary requirements of forests managed for recreation and aesthetics is a relatively open understory and low shrub layer, allowing easy passage for hikers, skiers, and natural history observers. Many people consider the open, park-like atmosphere of woodlands and savannas to be aesthetically pleasing (Brush 1979). A study of recreational campers found that they preferred camp-sites that were only about 60% shaded (James and Cordell 1970).

Studies on the effects of fire on forest composition (Lorimer 1985, Abrams 1992) found that periodic burning favors oak species and could be crucial to maintaining oak dominance in upland forests of the eastern United States. Attempts to use prescribed fire for the restoration of oak forests have, however, shown mixed results. In one study in North Carolina, a single prescribed burn along a hillslope gradient showed that one year after the burn, there were significantly different effects based on slope position and initial overstory composition (Elliott et al. 1999). These ranged from overstory mortality of 31% along the pine-hardwood ridgetop, to 3% mortality on the oak-dominated mid-slope, to no mortality on the mesic lower slope. In the understory, burning resulted in decreased basal area of shrubs, but post-burn sprouting increased the density of ericaceous shrubs. Burning increased understory species diversity on the ridges, but decreased it on the mid-slopes. In contrast to the immediate overstory changes seen by Elliott et al. (1999), Blake and Schuette (2000) report that even four understory burns over a period of seven years had no significant effect on overstory composition or structure in a Missouri hardwood forest. Patterson (personal communication) found that repeated prescribed burns over a period of 18 years in the understory of a Cape Cod oak-pine forest resulted in up to 20-30% mortality of overstory trees, with mortality strongly dependent on season and interval between burns and on history of gypsy moth defoliation. The oak woodlands in Worcester described by Rawinski (2000) show that it is possible for fire and other natural disturbances (perhaps gypsy moth mortality) to create an oak woodland canopy without mechanical harvesting of trees, but that many burns over a period of decades would be necessary to do this.

Current Management Techniques

Modern Massachusetts oak forests managed for wood products lack many of the important characteristics of fire-maintained oak woodlands, including both understory species composition and overstory structure. Although the principal determinants of understory flora in New England forests are site characteristics such as soil moisture and soil fertility (Dawson 1847, Whitney 1991), these interact with the age and species composition of the overstory (Whitney and Foster 1988). In a posthumously-published work, Thoreau described old (presumably primary) oak forests in Massachusetts in the mid-19th century as having “little or no underwood,” as compared with young oak forests of the time, and noted that “you walk freely in every direction” in the older forests (Thoreau 1993). Reconstructions of stand growth histories of modern oak forests in southern New England showed that an initial canopy of species such as maples and birches was overtaken by oaks about 30 years after stand initiation, resulting in a closed canopy of oak trees (Oliver 1978). Silvicultural management of these stands is often aimed at maximizing the growth of high-value oak trees in mixed stands of hardwoods and conifers (Kelty 1996). Stand improvement treatments, such as thinning, favor large oaks similar to those in oak woodlands, however such treatments open the canopy for only short periods of time. This results in a sparse understory with little soft mast production, possibly due to low light availability (Hall 1955). Although stand replacement techniques such as shelterwood cutting produce a canopy structure similar to fire-maintained oak woodlands, the effect is short-lived as a dense new stand initiates and the remaining canopy is subsequently removed (Hibbs and Bentley 1983, 1984). Timber extraction without concern for silvicultural principles is also widely practiced in oak forests of the region (Abrams and Nowacki 1992, Whitney 1994). This "high-grading" of the forest (Mauri 1998) removes mature oaks and releases the sub-canopy of maples and birches, creating either a rapidly-closing canopy or a dense thicket of shrubs and saplings, depending on the degree of logging (Oliver 1978).

Programs such as the Coverts Project (Kittredge 1999) attempt to educate landowners on the improvement of habitat for selected species through sound forest management practices, including the creation of forest openings containing young stands of early seral vegetation. Although these openings create brushy habitat for wildlife species such as ruffed grouse (*Bonasa umbellus*) and wild turkey and increase the structural diversity of the forests within which they are created, they differ in both structure and composition from oak woodlands.

Combining Wildlife and Recreational Goals

Characteristics of fire-maintained oak woodlands meet two goals of many private and public forest landowners that are often considered to be in conflict: the creation of habitat for selected wildlife species and the use of forest stands for passive recreation (Beattie et al. 1993). Forests managed for passive recreation may favor some wildlife species, but the resulting open understories often lack the forage, browse, mast and cover for species associated with early seral stages. Conversely, openings that create early successional habitat become impassable tangles of briars and brush making most recreational uses impossible.

The evaluation of techniques to restore vegetative communities and to support multiple management objectives, such as wildlife and recreation, requires knowledge of the specific effects of those techniques on key attributes of the forest. Unfortunately, there is little existing knowledge regarding appropriate practices for combining habitat improvement with recreational and aesthetic goals through the restoration of fire-maintained woodlands.

Whether pre-historic, fire-maintained woodlands were created by extensive Indian burning and dominated the landscape, represented only small patches near aboriginal villages and surrounding uplands, or were restricted to lightning-caused fires on dry ridgetops (Ruffner and Abrams 1998), such woodlands are rare today. My primary goal in this project was to explore methods of restoring the woodland habitat that existed as at least patches in upland closed forests prior to European agricultural clearing, subsequent reforestation, and 20th century fire suppression. Recreating such patches could provide a habitat that can support the flora and fauna that thrive in that community, while also maintaining the open understory favored for recreation. By combining partial overstory removal with understory burning, I hypothesized that it would be possible to recreate, on a small scale, the woodland forest structure and community composition that would otherwise require multiple low-intensity fires repeated over a period of decades. Although repeated burning might be necessary to maintain these woodlands, many of the structural, aesthetic, and compositional benefits would be available far sooner with combined thinning and burn treatments. The woodland openings thus created would not replace the openings currently used to provide early seral vegetation, but rather complement them.

Aspects of Woodland Restoration

The principal question underlying my thesis research is "Can we rapidly and efficiently restore characteristics of fire-maintained oak woodlands using a combination of overstory thinning and understory prescribed burning?" I focused on the effects and interactions of these treatments on the vegetative community, including vegetation composition and structure, soft mast production, horizontal foliar density, and fire and fuels management implications. Several of these parameters were compared to a reference oak woodland maintained by frequent anthropogenic fire (Rawinski 2000). A related study (Fownes and Hawthorne *in preparation*) explores how these treatments affected soil parameters such as nutrients, pH, nitrification, and nitrogen mineralization in post-treatment research unit soils, in an attempt to identify aspects of the ecophysiological responses of the vegetative community.

CHAPTER 2

STUDY OVERVIEW

Site Description

The study sites are in the Cadwell Memorial Forest, Pelham, Massachusetts (Figure 1 and Figure 2), on the slopes of Mt. Lincoln and an adjacent hill. These summits in the Pelham Hills lie between the Connecticut Valley to the west and the Quabbin Reservoir to the east, in the Worcester Plateau Ecoregion (Griffith et al. 1994). The Forest is owned by the University of Massachusetts. Cellar holes, wells, and a cemetery indicate 19th century agricultural activities by settlers of European descent, with subsequent abandonment, as is typical of many forests in the state. Since acquiring the land in 1953, the University has managed portions of the forest for timber and firewood. Timber improvement and harvesting operations are also conducted on private in-holdings. With the exception of a few plantations and experimental plots, the forest is predominantly mixed oak—hardwoods, white pine—hardwoods, and red maple (*Acer rubrum)* swamp. Understory vegetation varies among sites, with dense mountain-laurel (*Kalmia latifolia)* and other ericaceous shrubs common. The communities of the upper slopes of Mt. Lincoln include a diverse mixture of species less common in the forests of the region. A dense, often impenetrable high shrub layer includes abundant huckleberry (*Gaylussacia baccata),* sassafras (*Sassafras albidum)*, mountain holly (*Nemopanthus mucronatus),* and shadbush (*Amelanchier* spp.). The low shrub layer is dominated by blueberry (*Vaccinium angustifolium* and *V. pallidum*) with common ground layer species including wintergreen (*Gaultheria procumbens*) and club mosses (*Lycopodium* spp.) Scattered black gum (*Nyssa sylvatica)* and a few pitch pine (*Pinus rigida)* trees punctuate the mixed oak overstory. Several species of Lepidoptera, including spicebush swallowtail (*Papilio troilus)* and spicebush silkmoth (*Callosamia promethea*), feed on the sassafras (Wagner et al. 1997, Boettner et al. 2000). A state-listed species of special concern, the imperial moth (*Eacles imperialis*), also feeds on sassafras, but has not been observed at Cadwell.

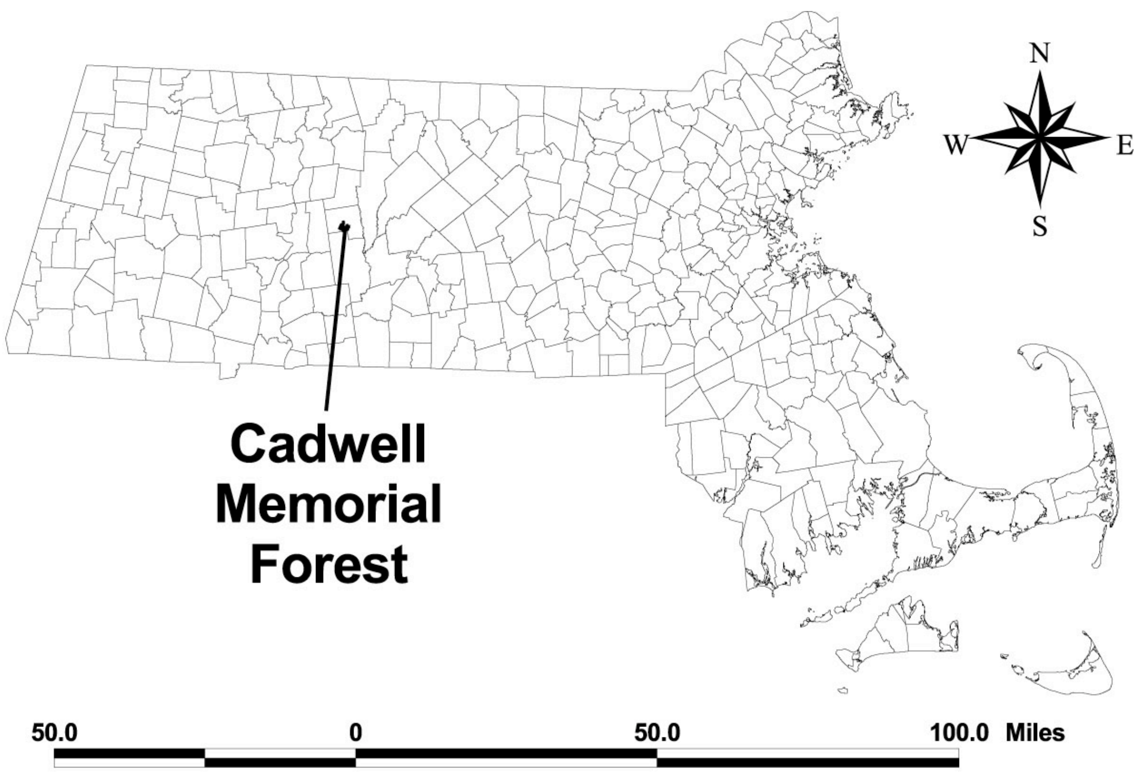


Figure 1. Location of Cadwell Memorial Forest, Pelham, MA.

Site Selection

Initial candidate sites were selected in the summer of 2000 based on data collected by a study of understory and overstory vegetation on the Forest (O'Keefe 1987). Ongoing projects (Kelty unpublished, Wilson unpublished) provided data on geology, soils, landform, shrub distribution and other parameters. These data were combined using ArcView Geographic Information System software (ESRI 1999) to produce maps of the forest indicating key attributes. I visited all areas of the forest for which the Wilson data show more than 30% ground cover by one or more berry-producing species (chiefly *Vaccinium* spp. and *Gaylussacia baccata)*. Each research block was chosen to ensure an area of at least 2 ha with homogeneous vegetation, to avoid interference with pre-existing research projects, and to minimize variations in slope, aspect, and soil. To enable final block selection, sample size determination and preparation of cutting plans, I measured basal area by overstory tree species and percent cover by understory shrub species in the candidate areas. The resulting three research blocks were assigned the letters A, B, and C (Figure 2). The two blocks (A and B) near the summit of Mt. Lincoln were very similar to one another, whereas the third block (C) adjacent to a power line right-of-way on the eastern side of the Forest had overstory trees larger in both height and diameter, and a more diverse understory. Historical photographs from the 19th Century show the summit of Mt. Lincoln, including the area of blocks A and B, as cleared pastures. Although additional blocks, especially those with a wider range of site characteristics, would have allowed me to make broader statistical inferences, I was limited to three blocks by time, funding, and availability of sites.

At each block, six 0.25-ha (50 m x 50 m) research units surrounded by 10 m wide buffer strips were initially marked with flagging. Corners were subsequently marked with 3/4” (1.8 cm) steel rebar topped with a yellow plastic cap. Units were oriented approximately to the cardinal directions. Due to a peculiarity of the original survey of the town of Pelham, many property lot boundaries, including those in Cadwell Memorial Forest, run approximately 350° T, instead of due north. This convention was

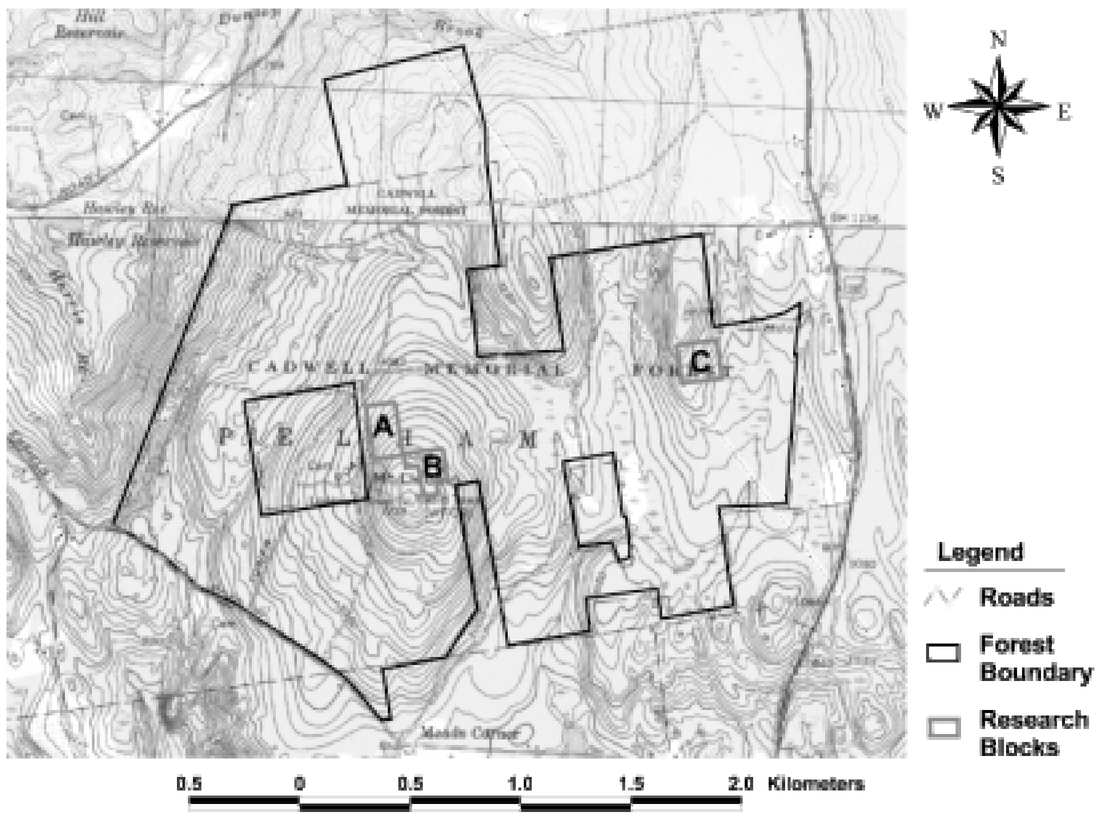


Figure 2. Locations of three research blocks (A, B, and C) in Cadwell Memorial Forest, Pelham, MA. Topographic detail is from USGS 7.5 minute series topographic quadrangles, as scanned and projected by MassGIS (1995).

followed when the Forest was surveyed for permanent forest inventory plots, and I chose to continue the tradition to avoid having research units traversed by the sampling transects that connect O'Keefe's forest inventory plots. In the remainder of this thesis, when I refer to a cardinal direction, it should be understood as being relative to the Cadwell grid system. Thus, Cadwell "north" is 350° T. The research units were assigned in a randomized complete block design to one of six groups. The groups represented a factorial design of the two independent treatment variables: burn or no-burn, and three levels of overstory removal: none, moderate (residual basal area 50 ft^2/acre = approximately 12m^2/ha), and heavy (residual basal area 25 ft^2/acre = approximately 6 m^2/ha). Thus, the six treatment groups included control, understory burning in existing vegetation, and the four combinations of overstory removal followed by understory burning.

I selected a reference fire-maintained oak woodland in Worcester, MA from those studied by Rawinski (2000)—the Perkins Farm Conservation Area—based on its overstory species and topography, which were similar to those of the Cadwell Memorial Forest sites.

Treatments

Brush and saplings were removed in 3- to 5-meter-wide fire-breaks around each burn unit in November 2000 by a crew using mechanical brush saws. Overstory cutting was completed in January 2001 using a conventional logging system (manual felling with chainsaws and bole removal with a rubber-tired skidder). All stems between 1" and 5" (2.5 to 12.7 cm) DBH were felled and left in place, with the exception of the first units cut in block A. In these units, especially the moderate cut–no burn unit, small stems were left standing, due to operator oversight. All cut stands were marked to leave the largest oaks, as these would have been the most likely individuals to survive the repeated surface fires that I was trying to simulate. Slash was lopped and scattered to reduce ladder fuels and to improve drying.

Although I had originally planned to conduct dormant-season burns in April 2001, a late snow-melt followed immediately by a drought lasting until late-May forced the postponement of burning until June 2001. My goals were to top-kill shrubs and saplings, and to remove as much slash as possible. High fire intensity resulted in more mortality of the overstory in some units than expected. This decrease in basal area may have exaggerated the effects of the burning in the affected units (chiefly the heavy cut burn unit in block A, and the heavy and moderate cut burn units in block B).

CHAPTER 3

STAND COMPOSITION AND STRUCTURE

Introduction

The first attributes studied were the composition and structure of overstory and understory vegetation. Pre-treatment measurements were used to characterize the overstory vegetation of the study site. Post-treatment measurements were analyzed to validate that thinning treatments were applied as prescribed. To analyze treatment effects, I tested the null hypotheses that there would be no change in the basal area and density of overstory trees due to burning, that there would be no change in the cover of understory vegetation due to treatments, and that overstory basal area and density would not differ between reference fire-maintained oak woodlands and units with combined thinning and burning treatments. My alternative hypotheses were that overstory thinning would increase the cover of understory vegetation, while burning would decrease understory cover.

Methods

Photographic documentation

I documented the effects of the treatments photographically, beginning just before the burn treatments. Although pre-thinning conditions were not photographed, the control plots provide untreated areas which can be compared with treated areas for any sampling period. Photographs were taken with a Canon AE-1, 35 mm camera and a Canon FD 1:1.8, 50 mm lens, using Fujichrome Sensia 400 ASA E-6 color slide film. Photographs were taken from the southwest and southeast corner markers of each unit using a tripod centered over the corner post to hold the lens at breast height (1.5 m). The camera was pointed towards the center of the unit, and angled so that roughly an equal amount of ground and sky were visible in the frame. Shutter speed was selected to allow a lens aperture of at least f/11, to ensure a depth of field adequate to focus both on nearby shrubs and on trees at the opposite corner of the research unit. Mid morning light with partly sunny or clearer skies produced the best results. The complete photo series consisted of five sets of pictures for each unit, with a sixth set for those units that were burned. The sets were taken in June 2001 (both before and after burning), late July 2001, February 2002, June 2002, and September 2002. All photos taken from the southwest corner were archived with Dr. William A. Patterson III at the Department of Natural Resources Conservation, University of Massachusetts, Amherst. If future photos are taken only once each year, they should be taken in early to mid-June, to provide the best year-to-year comparison.

Overstory inventory

In order to quantify the variability of overstory species among and within blocks, I conducted an intensive survey of woody species in the three experimental blocks of the study area in Fall 2000. I estimated frequency, density, and dominance of high shrub and overstory species for each of the three blocks using circular plots (Mueller-Dombois and Ellenberg 1974). I sampled approximately 20% of the total study area by measuring two, 0.025-ha plots in each of the six, 50-m x 50-m units in each block. I randomly selected two of the four quadrants of each unit, and located, with the random toss of a small object, the center of an 8.9 m radius plot near the center of each quadrant. In each plot, I recorded the species, status (live/dead), diameter at breast height, and crown class (dominant, co-dominant, intermediate, or overtopped) of all woody plants greater than 3 cm in diameter at breast height (1.4 m). These stems included individual plants occupying both the overstory canopy and a high shrub layer.

To document the mortality and removal caused by the thinning and burning treatments, I repeated the overstory woody stem measurements described above in June 2002. With only two samples per unit, frequency measurements were not meaningful at the unit level. Overstory vegetation was also measured using the above methods at two representative points along a permanent transect originally laid out by Rawinski (2000) at Perkins Farm in Worcester, to supplement Rawinski's measurements.

Species diversity

I compiled species lists in July 2001 and June 2002. Relevé samples (Mueller-Dombois and Ellenberg 1974, Elzinga et al. 1998) were based on 10 m x 10 m plots located near the center of each unit. Plot centers were located by the random toss of a small object, avoiding the trampled area that developed near the center of each unit. For each species, I recorded the presence or absence of any browsed individuals of that species. More complete species lists were compiled in September/October 2002 (Barron 2002).

Understory cover

From late July to early August 2002, I measured shrub and herb cover using the point intercept technique (Mueller-Dombois and Ellenberg 1974, Elzinga et al. 1998). Points were spaced every 50 cm along three, 40 m long transects in each unit. Transects were oriented N-S, 12 m apart, beginning 12 m east and 5 m north of the southwest corner. At each sample point, a 0.125” diameter steel rod was lowered vertically. Intercepts were recorded by species for 0 to 50 cm and 50 cm to 3 m at each point.

Results

Pre-treatment results

To analyze the three study blocks for any pre-treatment differences, I calculated pre-treatment density and dominance measures for each of the species that occurred in all three blocks. I used the quadrat data to estimate population means and confidence intervals for each block These means showed significant differences in only two cases (Table 1). The larger oaks in block C were reflected in a significantly higher basal area ($p=0.0018$), compared to both blocks A and B, despite similar densities. The prevalence of understory red maples in blocks A and B resulted in a higher density ($p=0.0005$) compared to block C, despite similar basal areas.

Plant community ecologists often use chi-squared analysis to test for species homogeneity among different sites (Mueller-Dombois and Ellenberg 1974). Chi-squared analysis of the measurements of overstory woody species by unit showed that the overall pre-treatment dominance (as measured by basal area) by species was independent of block effects ($\chi^2 = 6.725$, $p > 0.9999$). Overall pre-treatment density, however, differed significantly by block ($\chi^2 = 1084.286$, $p < 0.0001$). Similarly, pre-treatment dominance within each of the three blocks showed no significant differences, whereas pre-treatment density by species varied significantly across the 12 plots sampled within each block (Table 2).

Table 1. Pre-treatment absolute frequency, density, and dominance, and pre-treatment importance value for woody species with individuals > 3 cm DBH in three blocks at Cadwell Memorial Forest, Pelham, MA, sorted by importance value. Means (±95% confidence interval for density and dominace) are based on 12 samples from each block.

Species	Block	*Frequency (quadrats w/sp present)*			*Density (stems ha^{-1})*			*Dominance (BA m^2 ha^{-1})*			*Importance value (Rel. freq. + rel. density + rel. dom.)*		
		A	B	C	A	B	C	A	B	C	A	B	C
Quercus rubra/ Q. coccinea/ Q. velutina		100%	100%	100%	287±68	370±98	327±56	10.6±2.0	9.7±2.5	17.6±1.9	100	107	124
Acer rubrum		100%	100%	100%	940±117	967±159	461±124	3.0±0.6	3.3±0.8	2.6±1.3	91	98	69
Castanea dentata		67%	75%	67%	70±44	97±50	43±28	0.1±0.1	0.1±0.1	0.1±0.0	16	21	15
Amelanchier spp.		75%	75%	0%	133±78	103±48	0±0	0.5±0.4	0.2±0.1	0.0±0.0	24	22	0
Pinus strobus		75%	17%	83%	57±33	10±14	51±24	0.6±0.4	0.2±0.3	0.4±0.3	20	5	20
Hamamelis virginiana		25%	0%	92%	43±46	0±0	146±86	0.0±0.0	0.0±0.0	0.1±0.1	7	0	29
Betula lenta		0%	0%	92%	0±0	0±0	101±50	0.0±0.0	0.0±0.0	0.8±0.4	0	0	28
B. papyrifera		33%	33%	0%	47±46	63±59	0±0	0.8±0.7	0.6±0.6	0.0±0.0	13	14	0
B. populifolia		50%	33%	0%	93±100	40±52	0±0	0.4±0.3	0.1±0.1	0.0±0.0	16	9	0
Q. alba		8%	8%	42%	3±7	3±7	21±17	0.1±0.2	0.1±0.1	0.9±0.8	2	2	13
Sassafras albidum		8%	25%	0%	3±7	17±18	0±0	0.0±0.0	0.0±0.0	0.0±0.0	2	6	0
Nyssa sylvatica		0%	17%	0%	0±0	27±40	0±0	0.0±0.0	0.3±0.4	0.0±0.0	0	7	0
Nemopanthus mucronatus		17%	8%	0%	27±37	3±7	0±0	0.0±0.0	0.0±0.0	0.0±0.0	5	2	0
Q. ilicifolia		8%	17%	0%	3±7	13±20	0±0	0.0±0.0	0.0±0.1	0.0±0.0	2	4	0
Vaccinium corymbosum		8%	8%	0%	3±0	10±20	0±0	0.0±0.0	0.0±0.0	0.0±0.0	2	2	0
B. alleghaniensis		0%	0%	8%	0±0	0±0	2±4	0.0±0.0	0.0±0.0	0.0±0.0	0	0	2
Total					1710±206	1723±201	1153±114	16.0±2.3	14.6±1.5	22.5±1.7			

Table 2. Chi-squared analysis of within-block, pre-treatment variability of dominance (basal area) and density (stems/ha) for woody species with individuals > 3 cm DBH in three blocks at Cadwell Memorial Forest, Pelham, MA,

	A	B	C
Within block χ^2 for basal area	0.809	1.652	0.767
p	1.000	0.973	0.876
Within block χ^2 for density	146.7	168.4	67.1
p	< 0.00001	< 0.00001	< 0.00001

In these analyses, the overstory oaks in the red/black oak group were combined, due to the difficulties in clearly identifying some individuals and initial investigator inexperience. This does mask a key difference: tree oaks in block C were predominantly *Quercus rubra*, while those in blocks A and B were predominantly *Q. coccinea* and *Q. velutina*. Additionally, several species were entirely absent from one or more blocks. *Amelanchier* spp., *Sassafras albidum, Nemopanthus mucronatus,* and *Quercus ilicifolia* did not occur in block C. *Hamamelis virginiana* was absent from block B, and *Nyssa sylvatica* was found only in block B. *Betula* species were similarly split between blocks, with *B. lenta* and *B. alleghaniensis* occurring only in block C, and *B. papyrifera* and *B. populifolia* occurring only in blocks A and B.

Validation of thinning treatments

Because the woody species data included stems as small as 3 cm, they included both tall shrubs and overstory trees. The resulting density data exhibited a strong bi-modal distribution. Additionally, overstory data collected for the reference woodlands by Rawinski (2000) were only for stems 10 cm or larger. For these reasons, I used only live stems larger than or equal to 10 cm DBH in the following analyses.

To validate that overstory thinning treatments were applied as intended, post-treatment density and basal area of live stems were summed across all species within each quadrat, and the two quadrats were averaged for each unit (Table 3). Data were normally distributed (Shapiro and Wilk 1965) and variances were homogeneous (Bartlett 1937).

The treatment unit means were used in an analysis of variance (Table 4) to test the hypothesis that overstory dominance and density would not differ among treatments. The expectation was that the overstory would be reduced only by the thinning treatment and not by the burning. The resulting total density and basal area (Figure 3) show the desired trends, and the ANOVAs found highly significant effects of thinning and significant differences among blocks. Several discrepancies in individual units were expected, based on observed differences in the actual treatment activities within those units. For example, the prescribed burn in the heavy cut unit of Block B scorched the canopy, resulting in mortality of several of the overstory trees, and the unburned moderate cut unit of Block C had fewer, larger overstory trees than other units, even before treatments. Despite these variations, the overall means came very close to the intended residual basal area of 50 ft^2/acre (approximately 11.5 m^2/ha) for the moderate thinning and 25 ft^2/acre (5.7 m^2/ha) for the heavy thinning treatments (Figure 3a).

Table 3. Total basal area (a) and density (b) of live woody stems ≥ 10 cm DBH in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments (B=burn, NB=no burn, H=heavy thinning, M=moderate thinning, N=no thinning).

a. Basal area (m^2/ha)

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	9.2	8.6	14.3	5.2	8.9	13.2
B	1.4	9.2	7.9	6.0	10.6	16.6
C	8.4	16.4	16.6	5.6	13.2	19.3
Mean	6.4	11.4	13.0	5.6	10.9	16.4

b. Density (stems/ha)

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	240	220	500	100	260	500
B	80	300	360	140	360	620
C	140	280	440	120	100	420
Mean	153	267	433	120	240	513

Table 4. Analysis of variance of post-treatment basal area (a) and density (b) of live woody stems ≥ 10 cm DBH in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments.

a. Basal area (m^2/ha)

Number of obs = 18   R-squared = 0.8098
Root MSE = 2.7284   Adj R-squared = 0.6766

Source	Partial SS	df	MS	F	Prob > F
Model	316.860469	7	45.2657813	6.08	0.0057
thin	229.788912	2	114.894456	15.43	0.0009**
burn	2.25390203	1	2.25390203	0.30	0.5942
block	68.1814647	2	34.0907324	4.58	0.0387*
thin*burn	16.6361907	2	8.31809537	1.12	0.3648
Residual	74.4417706	10	7.44417706		
Total	391.30224	17	23.0177788		

b. Density (stems/ha)

Number of obs = 18   R-squared = 0.8452
Root MSE = 82.9993   Adj R-squared = 0.7368

Source	Partial SS	df	MS	F	Prob > F
Model	376022.222	7	53717.4603	7.80	0.0022
thin	350711.111	2	175355.556	25.45	0.0001**
burn	200	1	200	0.03	0.8681
block	12977.7778	2	6488.88889	0.94	0.4219
thin*burn	12133.3333	2	6066.66667	0.88	0.4443
Residual	68888.8889	10	6888.88889		
Total	444911.111	17	26171.2418		

a. Basal area b. Density

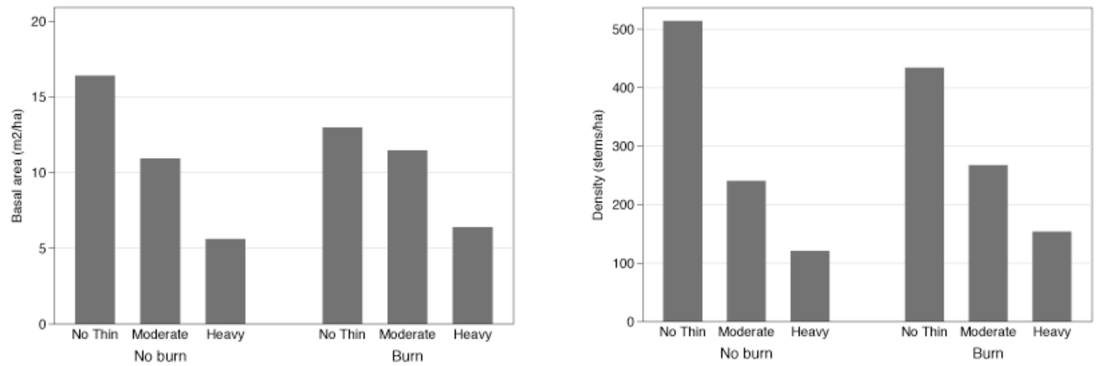


Figure 3. Mean overstory basal arean (m^2/ha) (a) and density (stems/ha) (b) of live woody stems ≥ 10 cm DBH in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments.

To validate that thinning treatments also removed the smaller stems as intended, I calculated post-treatment density and basal area of live stems ≥ 3 cm and < 10 cm, by summing across all species within each quadrat, and averaging the two quadrats for each unit (Table 5). Variances were non-normal (Shapiro and Wilk 1965) and heterogeneous (Bartlett 1937). As variance did not increase with increasing means, log transformation did not improve normality, and a visual inspection of the data suggested that analyses of variance were not appropriate. Nonetheless, the treatment means exhibit the desired trends (Figure 4), and the means for each unit (Table 5) show that for blocks B and C the cutting treatments were successful at removing most of the smaller diameter stems. These data also support my subjective observations after treatments that the thinning operation in block A unintentionally left many of the small diameter (1” to 5” DBH) woody stems standing, especially in the moderate cut units (Table 5).

a. Basal area b. Density

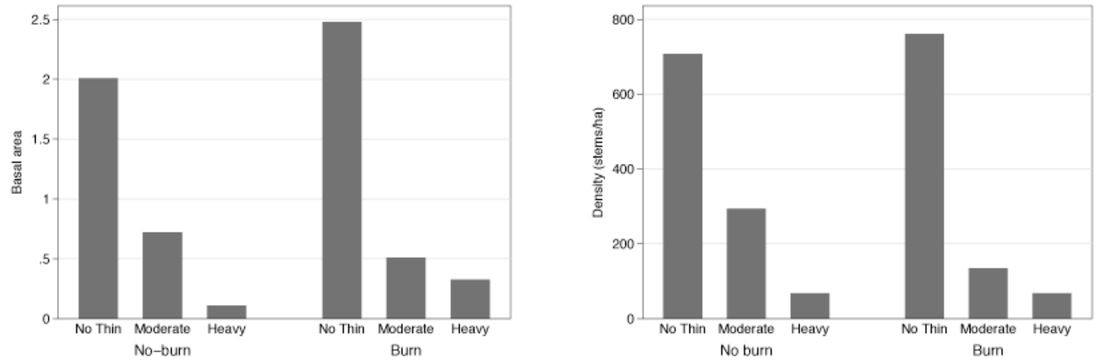


Figure 4. Mean basal area (m^2/ha) (a) and density (stems/ha) (b) of live woody stems ≥ 3 cm and < 10 cm DBH in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments.

Table 5. Total basal area (a) and density (b) of live woody stems ≥ 3 cm and < 10 cm DBH in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments (B=burn, NB=no burn, H=heavy thinning, M=moderate thinning, N=no thinning).

a. Basal area (m^2/ha)

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	0.97	1.2	3.2	0.25	2.2	2.2
B	0	0	2.8	0	0	1.9
C	0	0.29	1.4	0.07	0	1.9
Mean	0.32	0.51	2.5	0.11	0.72	2.0

b. Density (stems/ha)

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	200	340	820	120	880	780
B	0	0	980	0	0	640
C	0	60	480	80	0	700
Mean	67	133	760	67	293	707

Mortality caused by burning treatments

The goal of the prescribed burns was to top-kill shrubs, without damaging the overstory. Several of the prescribed burns exhibited greater than anticipated intensity. Although I had not collected data on woody vegetation between the thinning and burning treatments, the sampling included measurement of standing dead stems. This allowed me to further investigate mortality caused by burning. To explore the mortality in both larger shrubs and overstory trees, I calculated post-treatment density and basal area by summing dead stems across all species by size class within each quadrat, and averaging the two quadrats for each unit (Table 6). The same two size classes as above were examined: 3 cm to 10 cm DBH, and ≥10 cm DBH. Variances were homogeneous (Bartlett 1937) but non-normal (Shapiro and Wilk 1965). As variances increased with increasing means, all analyses were performed on log-transformed data (where transformed=ln(data+1)).

Analyses of variance (Table 7) were used to test the hypothesis that basal area and density of dead stems would not differ among treatments. The expectation was that burning would result in greater mortality than unburned treatments, especially among the smaller stems. Thinning was expected to reduce the number of all stems, including dead stems. The resulting density and basal area (Figure 5) show the desired trends. ANOVAs showed significant increases in both basal area and density of dead stems $>$ 10 cm due to burning (Table 7a and b), as well as significant differences among blocks. Total basal area of dead stems $<$ 10 cm also showed a significant increase with burning. Although there was a trend towards a higher density of dead stems $<$ 10 cm with burning, this effect was not significant ($p=0.1457$). In contrast, thinning did significantly reduce the number of small, dead stems in both burned and unburned treatments.

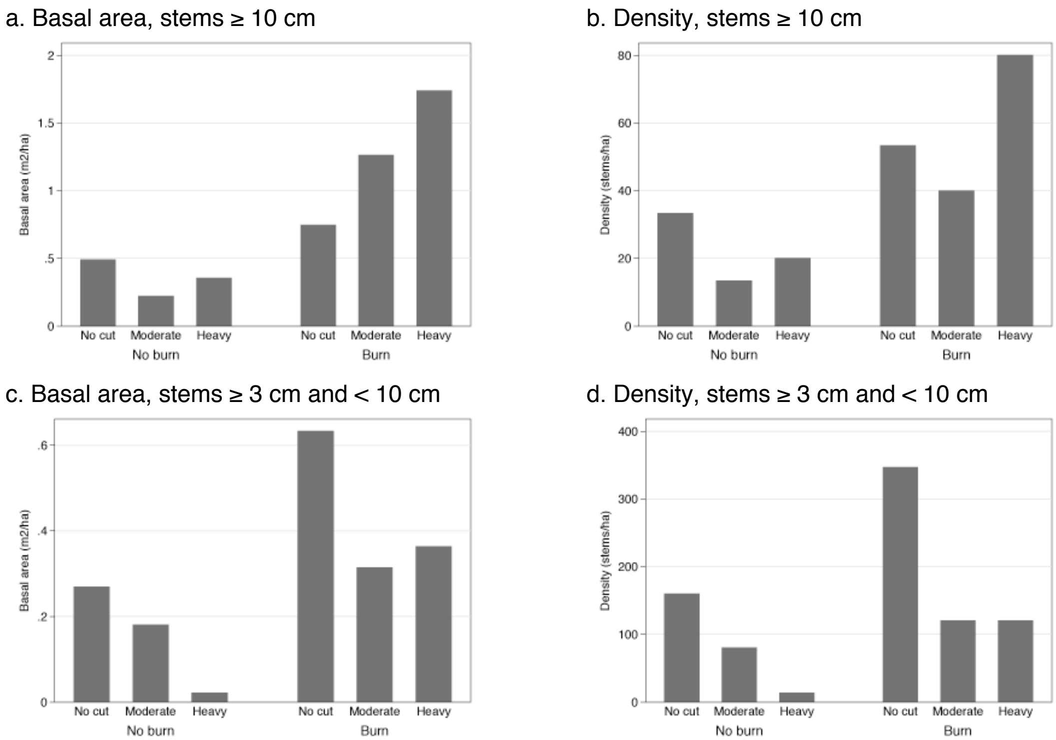


Figure 5. Mean basal area (m^2/ha) and density (stems/ha) of dead standing woody stems in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments.

Table 6. Basal area and density of dead standing woody stems in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments (B=burn, NB=no burn, H=heavy thinning, M=moderate thinning, N=no thinning).

a. Basal area (m^2/ha), stems ≥ 10 cm

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	0	0.57	0	0	0	0
B	3.5	2.2	1.5	1.1	0.67	0.62
C	1.8	0.97	0.7	0	0	0.85
Mean	1.7	1.3	0.75	0.35	0.22	0.49

b. Density (stems/ha), stems ≥ 10 cm

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	0	40	0	0	0	0
B	160	40	120	60	40	60
C	80	40	40	0	0	40
Mean	80	40	53	20	13	33

c. Basal area (m^2/ha), stems ≥ 3 cm and < 10 cm

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	0.43	0.75	1.2	0.06	0.54	0.21
B	0.69	0	0.41	0	0	0.34
C	0	0.19	0.28	0	0	0.26
Mean	0.36	0.31	0.63	0.02	0.18	0.27

d. Density (stems/ha), stems ≥ 3 cm and < 10 cm

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	160	300	620	40	240	100
B	200	0	220	0	0	220
C	0	60	200	0	0	160
Mean	120	120	347	13	80	160

Table 7. Analyses of variance of post-treatment basal area and density of dead standing woody stems in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Analyses are on log-transformed data, ln(ba+1) and ln(density+1).

a. Basal area (m^2/ha), stems ≥ 10 cm

Number of obs = 18; R-squared = 0.8304
Root MSE = .251723; Adj R-squared = 0.7118

Source	Partial SS	df	MS	F	Prob > F
Model	3.10346373	7	.443351962	7.00	0.0034
thin	.038317366	2	.019158683	0.30	0.7456
burn	.865530637	1	.865530637	13.66	0.0041**
block	1.9744564	2	.987228202	15.58	0.0008**
thin*burn	.225159326	2	.112579663	1.78	0.2187
Residual	.633643579	10	.063364358		
Total	3.73710731	17	.219829842		

b. Density (stems/ha), stems ≥ 10 cm

Number of obs = 18; R-squared = 0.7427
Root MSE = 1.37316; Adj R-squared = 0.5627

Source	Partial SS	df	MS	F	Prob > F
Model	54.4411256	7	7.77730366	4.12	0.0218
thin	.630119262	2	.315059631	0.17	0.8484
burn	10.0905904	1	10.0905904	5.35	0.0433*
block	39.7419084	2	19.8709542	10.54	0.0034**
thin*burn	3.97850751	2	1.98925375	1.05	0.3840
Residual	18.8556684	10	1.88556684		
Total	73.296794	17	4.31157612		

c. Basal area (m^2/ha), stems ≥ 3 cm and < 10 cm

Number of obs = 18; R-squared = 0.6297
Root MSE = .18535; Adj R-squared = 0.3705

Source	Partial SS	df	MS	F	Prob > F
Model	.584194369	7	.083456338	2.43	0.0985
thin	.127557438	2	.063778719	1.86	0.2062
burn	.174933729	1	.174933729	5.09	0.0476*
block	.259647531	2	.129823766	3.78	0.0599
thin*burn	.02205567	2	.011027835	0.32	0.7326
Residual	.343546489	10	.034354649		
Total	.927740859	17	.054572992		

d. Density (stems/ha), stems ≥ 3 cm and < 10 cm

Number of obs = 18; R-squared = 0.6586
Root MSE = 1.94816; Adj R-squared = 0.4196

Source	Partial SS	df	MS	F	Prob > F
Model	73.2196522	7	10.4599503	2.76	0.0713
thin	34.2535857	2	17.1267929	4.51	0.0401*
burn	9.45028417	1	9.45028417	2.49	0.1457
block	27.7269873	2	13.8634937	3.65	0.0644
thin*burn	1.78879495	2	.894397473	0.24	0.7943
Residual	37.9531239	10	3.79531239		
Total	111.172776	17	6.53957506		

Understory vegetation

Intercept data for understory vegetation were summed by species across all three transects in each unit, combining the high and low shrub strata. This produced 240 binomial sampling points in each unit. Means and confidence intervals were calculated from these binomial proportions (Clopper and Pearson 1934) by unit, thinning treatment, and burning treatment. For treatment means, units were grouped together as if they belonged to a single population (Figures 7, 8, 10, and 11). The narrower confidence intervals produced are not statistically defensible, since this artificial grouping represents pseudo-replication (Hurlbert 1984, van Mantgem et al. 2001). However, these confidence intervals were used for purposes of exploring the results to identify potential differences only, and not to draw any statistical inferences. I visually inspected plots of the results for cases where the confidence intervals did not overlap, and found this to occur with four species: *Acer rubrum, Gaylussacia baccata*, *Vaccinium angustifolium*, and *Vaccinium pallidum* (Figures 6, 7, and 8). I also classified each species as tree, shrub, or herb, and calculated overall and group means and confidence intervals by unit and treatment (Figures 9, 10, and 11).

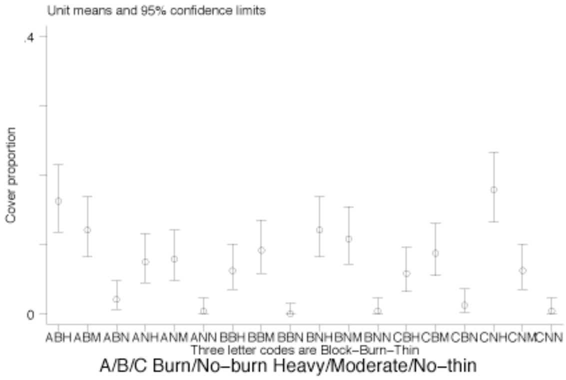
The confidence intervals for unit means in Figure 6 show several distinct patterns. Cover of *Acer rubrum* is significantly lower in all of the un-thinned units than in the thinned treatments (Figure 6a). Cover of *Gaylussacia baccata* is significantly lower in block C than blocks A and B, but the only significant treatment effects are reductions in some of the burn treatments (Figure 6b). Although some individual units do differ significantly, *Vaccinium angustifolium* and *V. pallidum* show no clear patterns of significant differences (Figure 6c and d).

Figure 7 combines data from both burn treatments to show means by thinning treatment. Despite the pseudo-replication this introduces (Hurlbert 1984, van Mantgem et al. 2001), the only differences indicated by confidence intervals not overlapping are that both thinning treatments have higher cover of *Acer rubrum* than the un-thinned treatment, and the heavy-thinned treatment has higher cover of *Vaccinium angustifolium* than the un-thinned treatment. Similarly, Figure 8 combines data across thinning treatments to show means by burn treatment. The only potential differences were decreased cover of both *Gaylussacia baccata* and *Vaccinium angustifolium* due to burning.

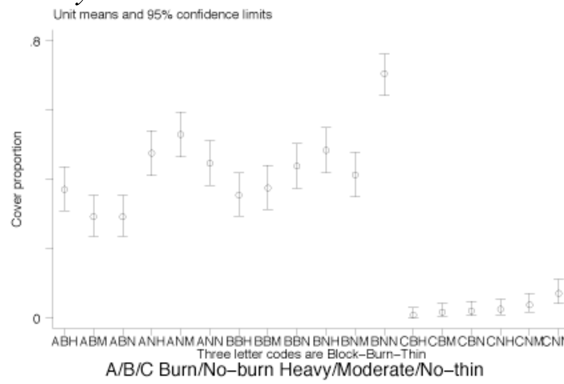
The overall unit means in Figure 9a appeared to show that in general burning treatments reduced understory cover, while thinning treatments increased cover. Both of these effects were much less pronounced on shrub species (Figure 9b), whereas only the increase with thinning was obvious for tree species (Figure 9c). No consistent patterns emerge for treatment effects on herb species cover (Figure 9d).

The increase in cover due to thinning appears more pronounced in the graph that combines data from both burned and unburned treatments (Figure 10). Although the caveats about pseudo-replication mentioned above apply here as well, cover was greater with greater intensity of thinning for all species overall and for each subgroup (shrub, tree, and herb species). Likewise, Figure 11 shows that burned treatments had less cover for all understory groups than unburned treatments.

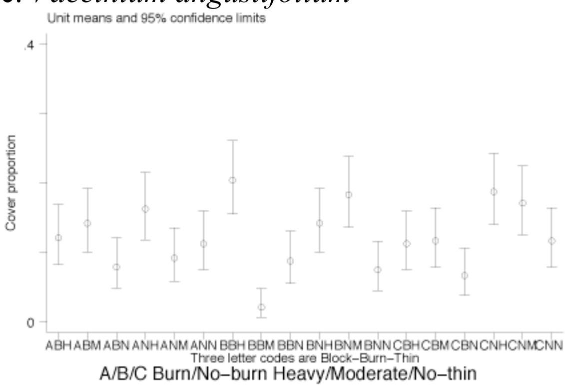
a. *Acer rubrum*



b. *Gaylussacia baccata*



c. *Vaccinium angustifolium*



d. *Vaccinium pallidum*

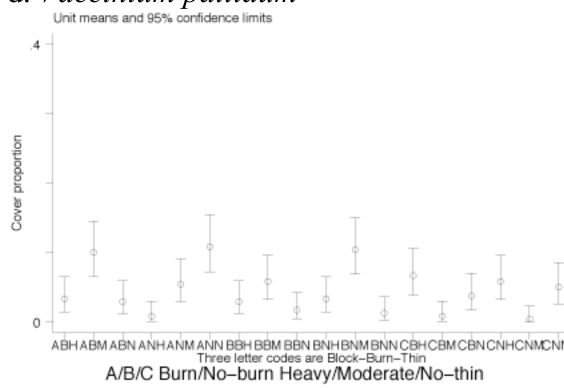


Figure 6. Unit means and 95% confidence intervals for cover proportions of four species in the shrub layer (0 to 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Estimates are from binomial data (Clopper and Pearson 1934), N=240.

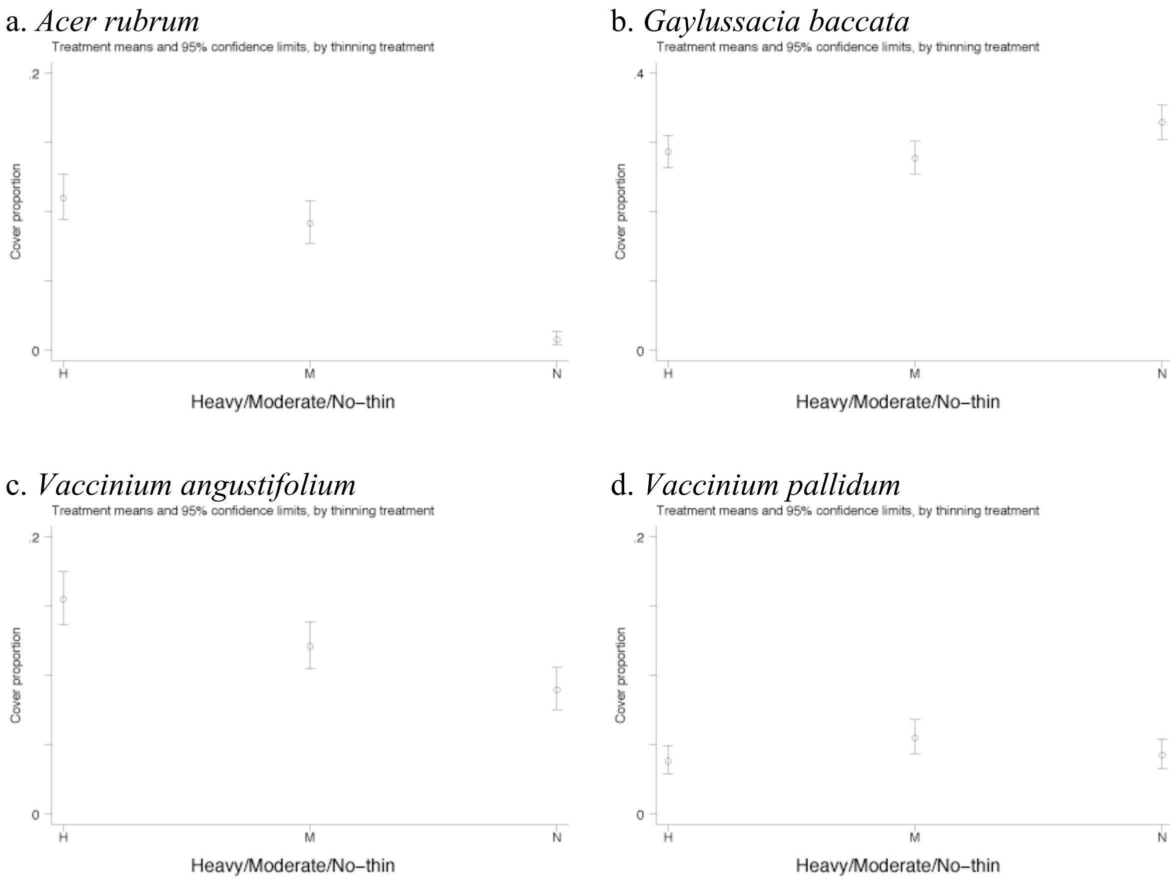


Figure 7. Thinning treatment means and 95% confidence intervals for cover proportions of four species in the shrub layer (0 to 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning. Estimates are from binomial data (Clopper and Pearson 1934), N=1440.

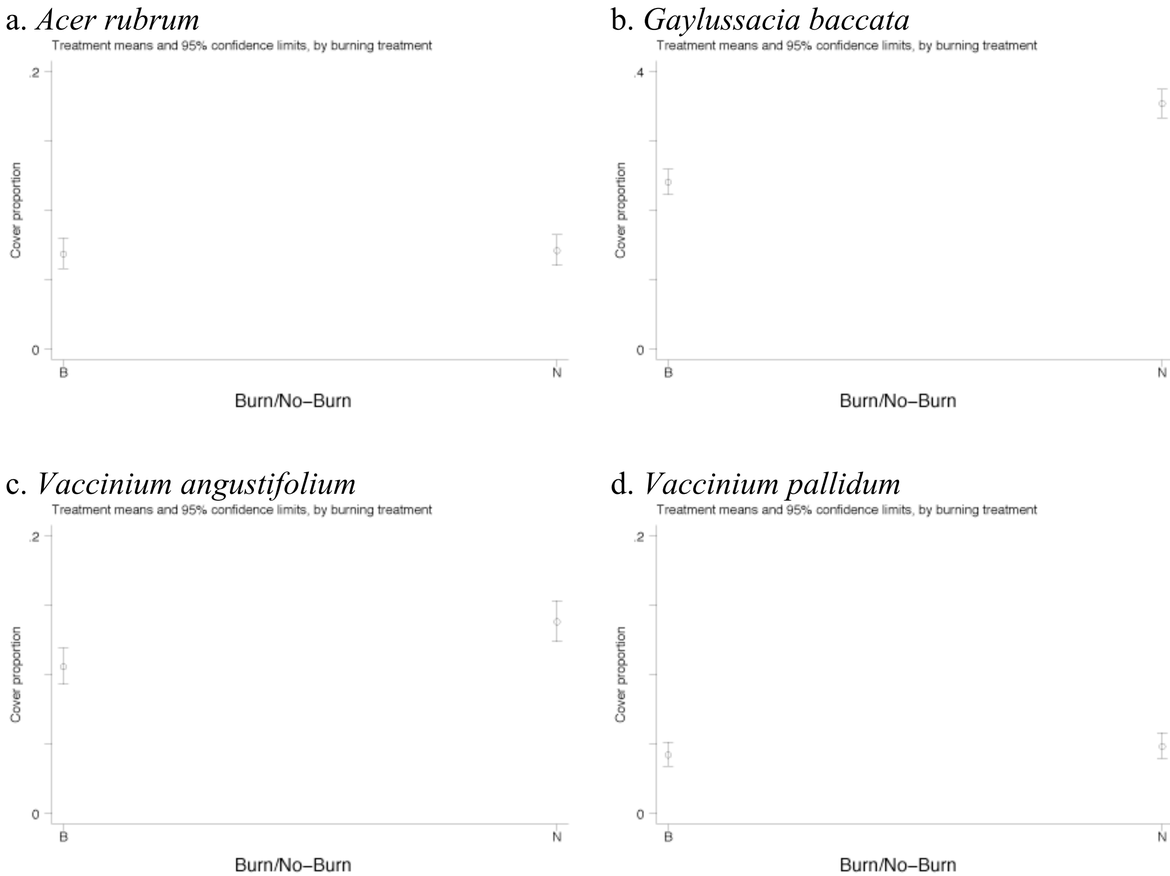


Figure 8. Burning treatment means and 95% confidence intervals for cover proportions of four species in the shrub layer (0 to 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Estimates are from binomial data (Clopper and Pearson 1934), N=2160.

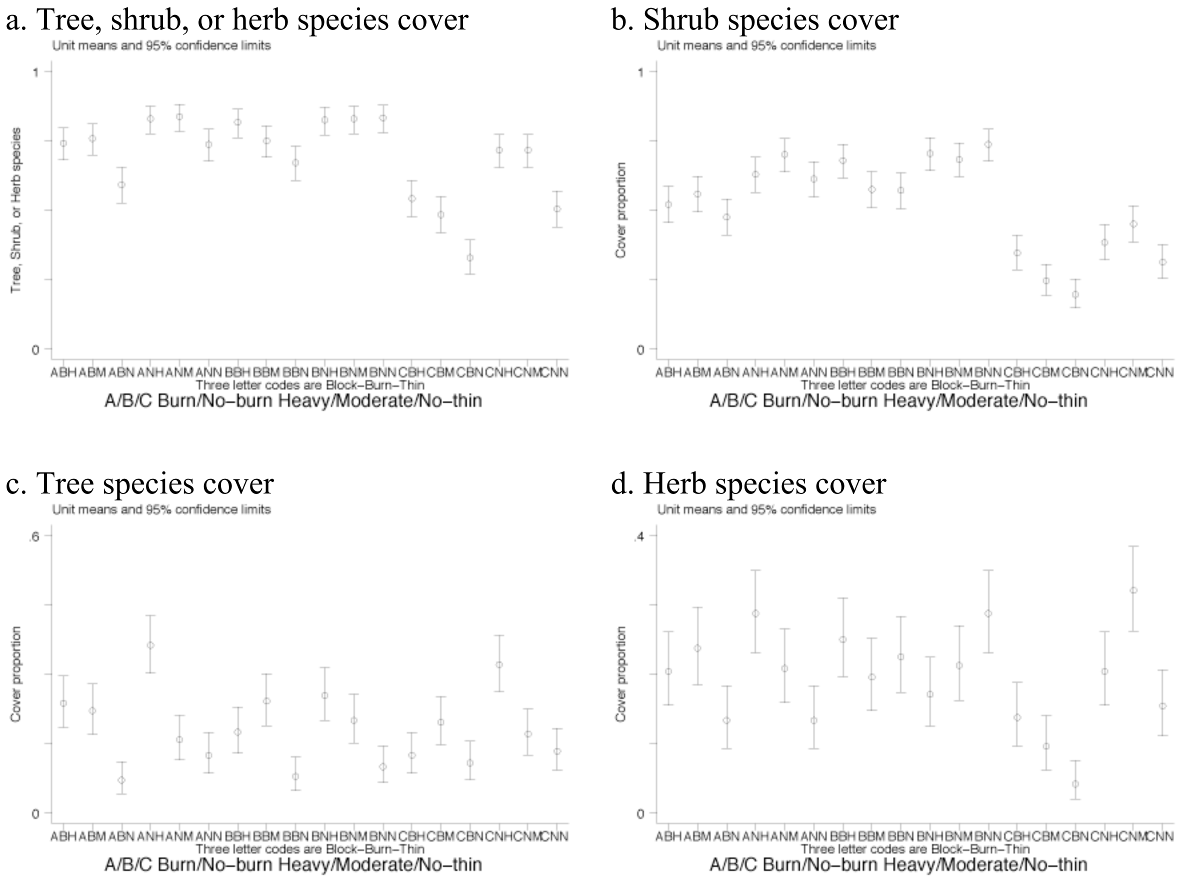
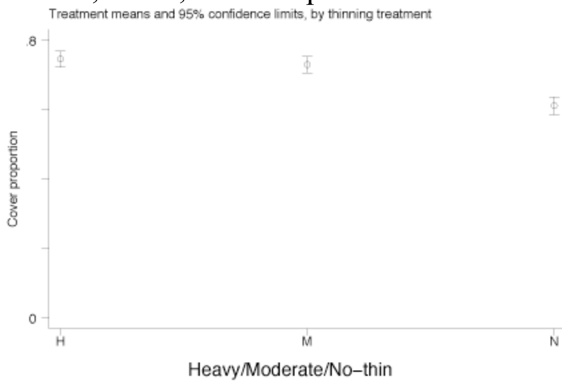


Figure 9. Unit means and 95% confidence intervals for cover proportions of four groups in the shrub layer (0 to 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning. Estimates are from binomial data (Clopper and Pearson 1934), N=240.

a. Tree, shrub, or herb species cover



b. Shrub species cover

c. Tree species cover

d. Herb species cover

Figure 10. Thinning treatment means and 95% confidence intervals for cover proportions of four groups in the shrub layer (0 to 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Estimates are from binomial data (Clopper and Pearson 1934), N=1440.

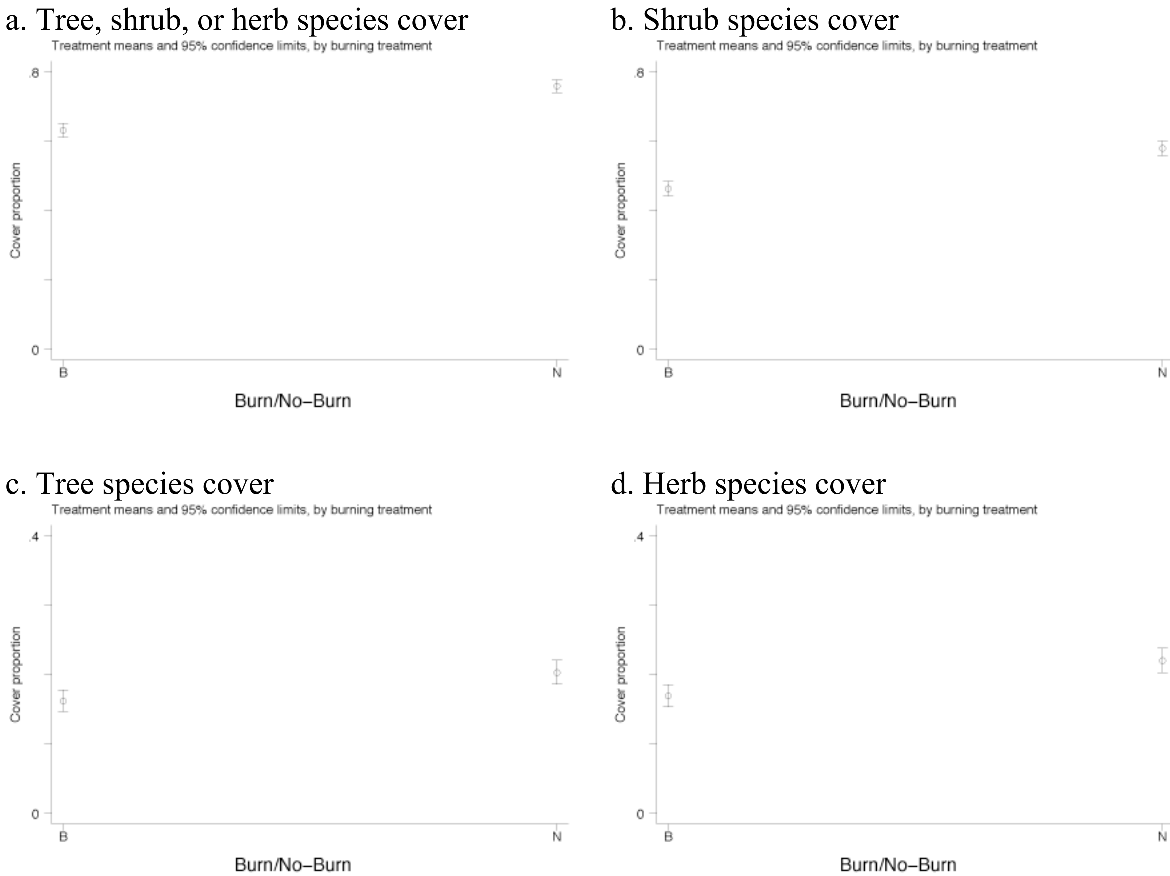


Figure 11. Burning treatment means and 95% confidence intervals for cover proportions of four groups in the shrub layer (0 to 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Estimates are from binomial data (Clopper and Pearson 1934), N=2160.

Unit cover proportions for each of the above groups and species were transformed with the arcsin-sqrt transformation (Zar 1996), and the results were normally distributed (Shapiro and Wilk 1965) with homogeneous variance (Bartlett 1937) in all cases except overall cover by tree, shrub, and herb species combined. The distribution of the overall cover group was negatively skewed, but the variances of the transformed data were constant (p=0.82 by Bartlett’s test). Moreover, the distribution of the residuals after accounting for treatment and block effects was normal, suggesting that the use of analysis of variance is appropriate even in this case.

I used an analysis of variance to test the hypothesis that cover of understory vegetation would not vary by treatment. I expected that thinning would increase the cover of understory vegetation, and that burning would decrease this cover in the year following the burn treatment. I tested this hypothesis on groups of species and on individual species.

Table 8 and Figure 12 summarize the treatment effects on four species groups: all species combined, tree species, shrub species, and herb species. All species combined showed a significant increase in percent cover due to thinning treatments, a significant decrease due to burning, and a significant block effect. Tree species in the understory also showed a significant increase in cover due to thinning, however this was complicated by a significant interaction with the burning treatment: the moderate cut–burn treatment had higher cover by tree species than the moderate cut–no burn treatment. Shrub species cover was significantly reduced by burning treatments, and showed a trend towards higher cover with higher levels of thinning. Shrub cover also varied significantly by block, with block C having less cover than blocks A and B. Combined cover of herb species showed no significant treatment effects, but did show a trend in the burn units towards higher cover with higher levels of cutting.

Table 8. Analyses of variance of post-treatment cover of vegetation groups in the shrub layer (between 0 and 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Analyses were made on arcsin, square-root-transformed data.

a. Cover of all species combined

```
                       Number of obs =      18     R-squared     =  0.9299
                       Root MSE      = .054739     Adj R-squared =  0.8809

      Source |  Partial SS    df       MS           F     Prob > F
  -----------+----------------------------------------------------
       Model |  .397647181     7   .05680674      18.96     0.0001
             |
        thin |  .074438065     2  .037219032      12.42     0.0019**
        burn |  .088467998     1  .088467998      29.52     0.0003**
       block |  .230490327     2  .115245163      38.46     0.0000**
   thin*burn |   .00425079     2  .002125395       0.71     0.5151
             |
    Residual |  .029964082    10  .002996408
  -----------+----------------------------------------------------
       Total |  .427611262    17  .025153604
```

b. Cover of tree species combined

```
                       Number of obs =      18     R-squared     =  0.8760
                       Root MSE      = .047901     Adj R-squared =  0.7893

      Source |  Partial SS    df       MS           F     Prob > F
  -----------+----------------------------------------------------
       Model |  .162147753     7  .023163965      10.10     0.0008
             |
        thin |  .113559504     2  .056779752      24.75     0.0001**
        burn |  .012745885     1  .012745885       5.55     0.0402*
       block |  .001992771     2  .000996386       0.43     0.6594
   thin*burn |  .033849594     2  .016924797       7.38     0.0108*
             |
    Residual |  .022945245    10  .002294524
  -----------+----------------------------------------------------
       Total |  .185092998    17  .010887823
```

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Table 8. Cont.

c. Cover of shrub species combined

	Number of obs =	18	R-squared =	0.9597	
	Root MSE =	.045331	Adj R-squared =	0.9315	

Source	Partial SS	df	MS	F	Prob > F
Model	.489539633	7	.069934233	34.03	0.0000
thin	.014122793	2	.007061397	3.44	0.0731
burn	.06744026	1	.06744026	32.82	0.0002**
block	.398758126	2	.199379063	97.03	0.0000**
thin*burn	.009218453	2	.004609227	2.24	0.1568
Residual	.020549161	10	.002054916		
Total	.510088794	17	.030005223		

d. Cover of herb species combined

	Number of obs =	18	R-squared =	0.4605	
	Root MSE =	.093024	Adj R-squared =	0.0828	

Source	Partial SS	df	MS	F	Prob > F
Model	.073849576	7	.010549939	1.22	0.3749
thin	.01946308	2	.00973154	1.12	0.3626
burn	.022134509	1	.022134509	2.56	0.1408
block	.02853809	2	.014269045	1.65	0.2405
thin*burn	.003713897	2	.001856949	0.21	0.8105
Residual	.086534087	10	.008653409		
Total	.160383663	17	.009434333		

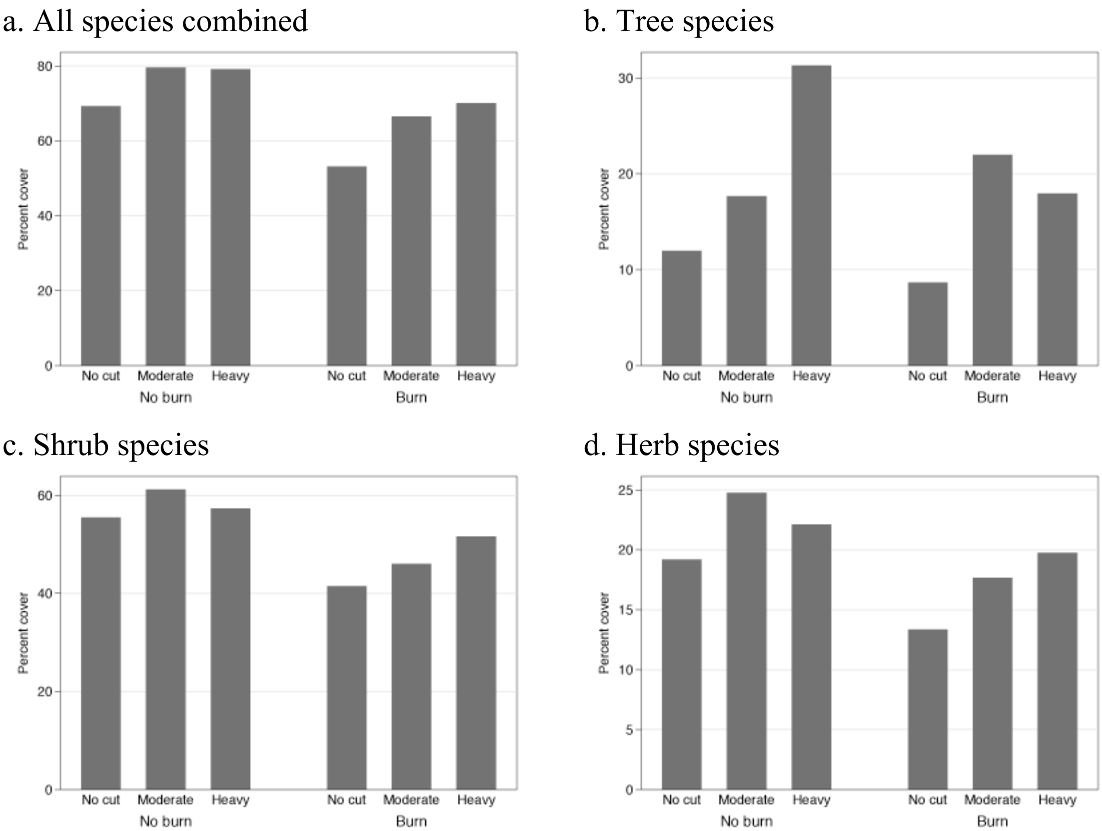

Figure 12. Effects of thinning and burning on post-treatment cover of vegetation in the shrub layer between 0 and 3 m in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments.

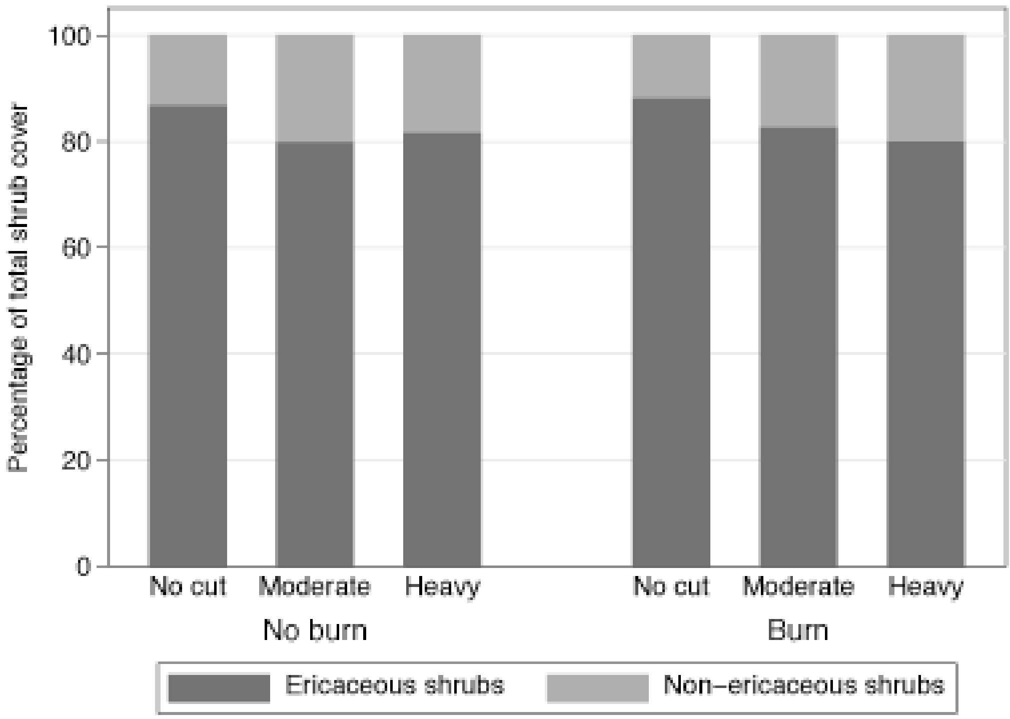

Figure 13. Proportions of total post-treatment shrub cover by ericaceous and non-ericaceous shrubs between 0 and 3 m in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments.

Although an analysis of variance (not-shown) found no significant treatment effects on the proportion of total shrub cover by ericaceous and non-ericaceous shrubs, there was a trend towards increased non-ericaceous shrubs with overstory thinning (Figure 13). One year after burning, there was not even a trend in relative proportions do to the burning treatment.

Treatment effects on individual species were meaningful only for those species that occurred in most or all research units and that had more than just a few individuals sampled (Table 9). Analyses of variance to test the same hypotheses as above found significant treatment effects for five species: *Gaylussacia baccata*, *Acer rubrum*, *Hamamelis virginiana, Carex spp.,* and *Trientalis borealis (*Table 10 and Figure 14). Of these, only the first two occurred in all units. Two additional species. *Aronia arbutifolia* and *Quercus velutina,* showed significant effects, but these were discarded, as they were based on only a few intercepts in fewer than half of the research units. Thinning significantly increased cover of *Acer rubrum* in the shrub layer, while burning significantly decreased the cover of *Gaylussacia baccata* (see Table 10 for all p values). Burning significantly decreased the cover of *Hamamelis virginiana*, and thinning tended to increase its cover. Thinning also increased the cover of *Carex* spp., while burning decreased the cover of *Trientalis borealis.* Although there were trends towards higher cover of *Vaccinium angustifolium* with increased thinning and towards lower cover with burning (Figure 14d), these trends were not significant. Likewise, the decrease in cover of *Vaccinium pallidum* with increased thinning, visible in the graph of treatment means (Figure 14e), was not significant.

Table 9. Numbers of intercepts and numbers of research units on which significant treatment effects on vegetation cover were based for seven species in the shrub layer (between 0 and 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments.

Species	Total intercepts	Total research units
Gaylussacia baccata	1360	18
Acer rubrum	382	18
Hamamelis virginiana	197	11
Carex spp.	53	12
Trientalis borealis	35	13
Aronia arbutifolia	16	9
Quercus velutina	6	4

Table 10. Analyses of variance in post-treatment cover of individual species in the shrub layer (between 0 and 3 m tall) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Analyses were made on arcsin, square-root-transformed data.

a. *Gaylussacia baccata*

Number of obs = 18; R-squared = 0.9613
Root MSE = .073056; Adj R-squared = 0.9342

Source	Partial SS	df	MS	F	Prob > F
Model	1.32635042	7	.189478632	35.50	0.0000
thin	.014854992	2	.007427496	1.39	0.2929
burn	.081384176	1	.081384176	15.25	0.0029**
block	1.2239705	2	.61198525	114.66	0.0000**
thin*burn	.006140755	2	.003070377	0.58	0.5801
Residual	.053372144	10	.005337214		
Total	1.37972257	17	.081160151		

b. *Acer rubrum*

Number of obs = 18; R-squared = 0.8503
Root MSE = .066142; Adj R-squared = 0.7454

Source	Partial SS	df	MS	F	Prob > F
Model	.248406742	7	.035486677	8.11	0.0019
thin	.237926505	2	.118963252	27.19	0.0001**
burn	1.5263e-06	1	1.5263e-06	0.00	0.9855
block	.004319477	2	.002159739	0.49	0.6245
thin*burn	.006159234	2	.003079617	0.70	0.5176
Residual	.043747406	10	.004374741		
Total	.292154148	17	.017185538		

c. *Hamamelis virginiana*

Number of obs = 18; R-squared = 0.9277
Root MSE = .054289; Adj R-squared = 0.8771

Source	Partial SS	df	MS	F	Prob > F
Model	.378320118	7	.054045731	18.34	0.0001
thin	.024035227	2	.012017613	4.08	0.0507
burn	.015836693	1	.015836693	5.37	0.0429*
block	.327229697	2	.163614848	55.51	0.0000**
thin*burn	.011218502	2	.005609251	1.90	0.1993
Residual	.029473437	10	.002947344		
Total	.407793555	17	.023987856		

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Table 10. Cont.

d. *Carex* spp.

Number of obs = 18			R-squared = 0.7703		
Root MSE = .049338			Adj R-squared = 0.6096		

Source	Partial SS	df	MS	F	Prob > F
Model	.081648577	7	.011664082	4.79	0.0133
thin	.021119958	2	.010559979	4.34	0.0440*
burn	.000797482	1	.000797482	0.33	0.5797
block	.059439861	2	.02971993	12.21	0.0021**
thin*burn	.000291277	2	.000145638	0.06	0.9423
Residual	.024341962	10	.002434196		
Total	.105990539	17	.006234738		

e. *Trientalis borealis*

Number of obs = 18			R-squared = 0.5275		
Root MSE = .050323			Adj R-squared = 0.1968		

Source	Partial SS	df	MS	F	Prob > F
Model	.028274704	7	.004039243	1.60	0.2426
thin	.003584396	2	.001792198	0.71	0.5159
burn	.016281539	1	.016281539	6.43	0.0296*
block	.008346345	2	.004173172	1.65	0.2407
thin*burn	.000062425	2	.000031212	0.01	0.9878
Residual	.02532396	10	.002532396		
Total	.053598664	17	.003152863		

f. *Vaccinium angustifolium*

Number of obs = 18			R-squared = 0.4660		
Root MSE = .076182			Adj R-squared = 0.0922		

Source	Partial SS	df	MS	F	Prob > F
Model	.05064903	7	.007235576	1.25	0.3630
thin	.03037263	2	.015186315	2.62	0.1219
burn	.013941281	1	.013941281	2.40	0.1522
block	.00199479	2	.000997395	0.17	0.8445
thin*burn	.004340329	2	.002170165	0.37	0.6973
Residual	.058037244	10	.005803724		
Total	.108686274	17	.00639331		

Continued, next page

Table 10. Cont.

g. *Vaccinium pallidum*

Number of obs = 18 R-squared = 0.1268
Root MSE = .100631 Adj R-squared = -0.4845

Source	Partial SS	df	MS	F	Prob > F
Model	.014701341	7	.002100192	0.21	0.9758
thin	.002062145	2	.001031072	0.10	0.9041
burn	.000142048	1	.000142048	0.01	0.9081
block	.005696776	2	.002848388	0.28	0.7606
thin*burn	.006800373	2	.003400186	0.34	0.7225
Residual	.101266044	10	.010126604		
Total	.115967385	17	.006821611		

a. *Acer rubrum*

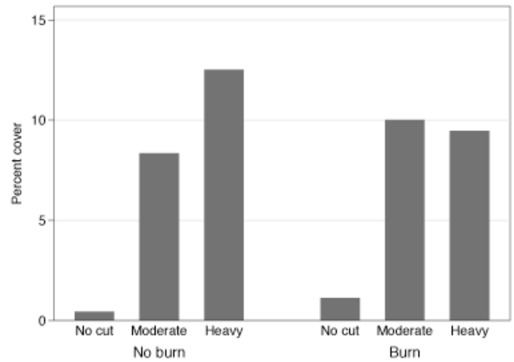
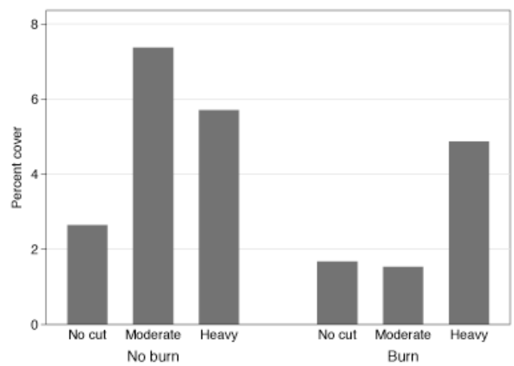
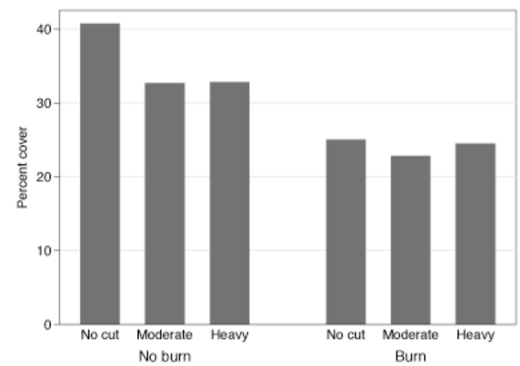


Figure 14. Effects of thinning and burning on post-treatment cover of seven species (one tree, four shrubs, two herbs) in the shrub layer between 0 and 3 m approximately one year after burning and 1.5 years after thinning in three blocks at Cadwell Memorial Forest, Pelham, MA.

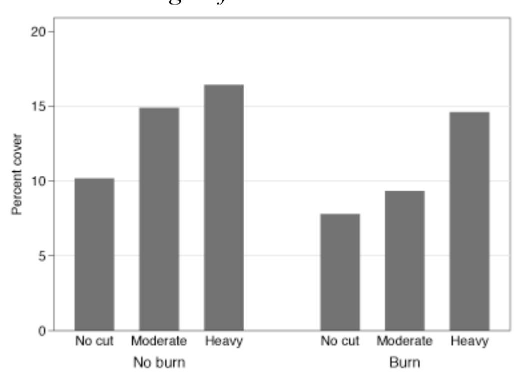
b. *Hamamelis virginiana*



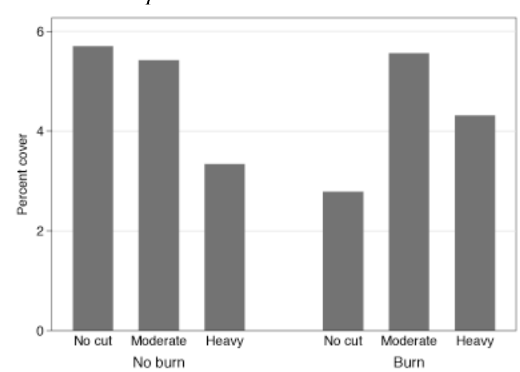
c. *Gaylussacia baccata*



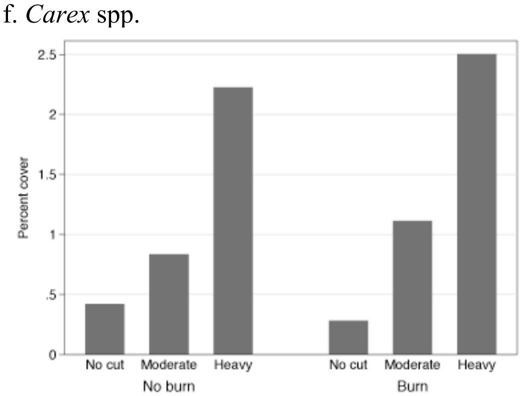
d. *Vaccinium angustifolium*



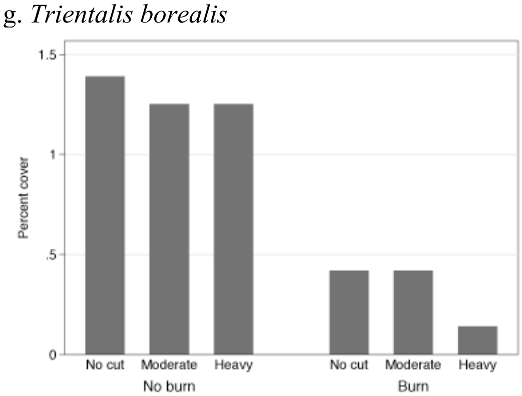
e. *Vaccinium pallidum*



f. *Carex* spp.



g. *Trientalis borealis*



Plant communities

An analysis of species composition in two of the study blocks (A and B) by Barron (2002) found few convincing treatment effects on community composition. She conducted tabular comparisons (Mueller-Dombois and Ellenberg 1974) on presence/absence data for species in the full research units and on relevé data from a sub-plot in each unit. She also used cluster analysis with two difference measures: absolute and standard chord (Orlóci 1967). The four analyses resulted in four groupings of research units, with no apparent pattern due to treatments. Barron concludes that this implies there are no meaningful differences in species composition among the treatments. A further analysis using both Jacquard and Sorensen similarity indices (Mueller-Dombois and Ellenberg 1974) found only small differences among the research units measured. These analyses should be repeated on the complete data set from all 18 research units after future burn treatments are completed in 2004.

I calculated the percentage of species for which browsing had been observed in July 2001 (Figure 15). The browse proportions were transformed with the arcsin-sqrt transformation (Zar 1996), and the results were normally distributed (Shapiro and Wilk 1965) with homogeneous variance (Bartlett 1937). I used an analysis of variance to test the hypothesis that browsing of understory vegetation would not vary by treatment. I expected that both thinning and burning would independently increase the percentage of species browsed, as treatments resulted in young, tender sprouts.

The analysis showed that both the thinning and burning treatments significantly increased the percentage of species that were browsed in the understory (Table 11).

These results corresponded well to informal observations of wildlife in the research units; deer, moose, and their scat were more frequently observed in the thinned and burned units than in the untreated controls. A later study on vegetative reproduction in a subset of the research units (Barron et al. 2002) confirmed that browsing occurrence was higher in the units with higher levels of “disturbance” (thinning and burning).

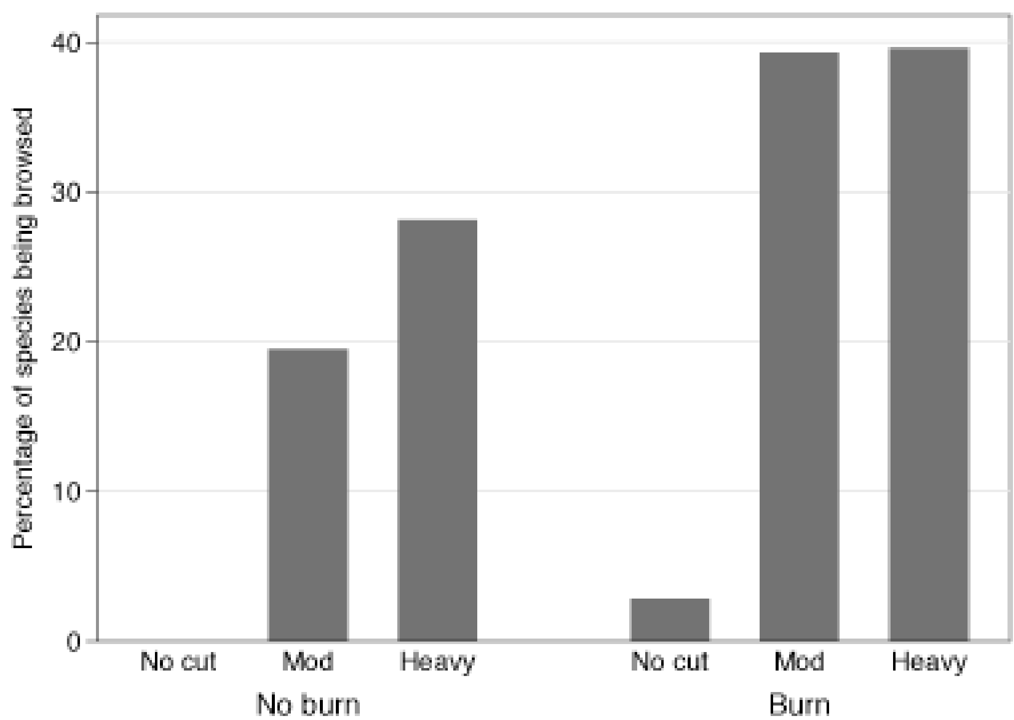


Figure 15. Effects of thinning and burning on percentage of species browsed in the understory (July 2001) approximately one year after burning and 1.5 years after thinning in three blocks at Cadwell Memorial Forest, Pelham, MA.

Table 11. Analyses of variance in percentage of species browsed in the understory (July 2001) in three blocks at Cadwell Memorial Forest, Pelham, MA, approximately one year after burning and 1.5 years after thinning treatments. Analyses were made on arcsin, square-root-transformed data.

Number of obs = 18 R-squared = 0.9014
Root MSE = .11901 Adj R-squared = 0.8324

Source	Partial SS	df	MS	F	Prob > F
Model	1.29506552	7	.185009361	13.06	0.0003
thin	1.18400341	2	.592001704	41.80	0.0000**
burn	.096290383	1	.096290383	6.80	0.0262*
block	.001914006	2	.000957003	0.07	0.9351
thin*burn	.012857727	2	.006428863	0.45	0.6476
Residual	.141634382	10	.014163438		
Total	1.43669991	17	.084511759		

Comparison with reference woodlands

Rawinski (2000) measured overstory vegetation ≥ 10 cm DBH for several fire-maintained oak woodlands in Worcester, MA. To compare these with my study sites at Cadwell, I calculated both pre- and post-treatment means and confidence intervals for stems ≥ 10 cm (Figure 16). Because of the significant pre-treatment differences described above between block C and blocks A and B at Cadwell, I calculated means and confidence intervals separately for block C. I calculated post-treatment means and confidence intervals for three groups of treatments: un-thinned, moderately thinned, and heavily thinned. All three blocks were grouped together, since the thinning treatments had removed any significant differences in overstory density and basal area among the blocks. Burned and unburned units were also grouped, as the above analysis found no significant effect of burning on overstory density and basal area.

All sites at Cadwell had significantly higher pre-treatment densities of overstory trees than the reference woodland. Block C also had a significantly higher pretreatment basal area than the Perkins Farm site. Un-thinned controls maintained their significantly higher density and similar basal area to the reference woodland. Moderately thinned units had significantly lower basal area than the un-thinned controls, and similar density and basal area to the reference woodlands. Heavily thinned units had significantly lower basal area than both the un-thinned controls and the reference woodland, and density that was significantly lower than the controls, but similar to the reference woodland.

a. Basal area (m^2/ha) b. Density (m^2/ha)

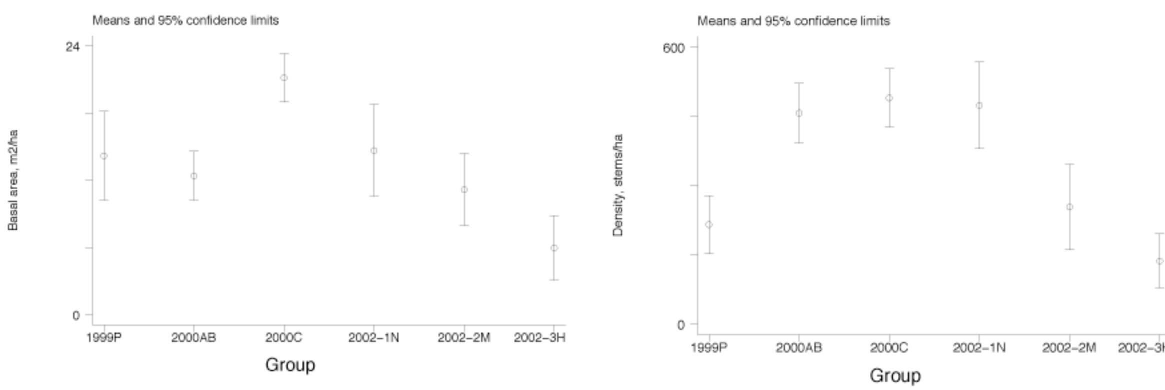


Figure 16. Means and 95% confidence intervals for basal area (a) and density (b) of live woody stems ≥ 10 cm DBH for six groups of plots at Perkins Farm, Worcester, MA and Cadwell Forest, Pelham, MA. Perkins Farm group is 1999P (n=18). Cadwell groups are 2000AB – Pre-treatment study blocks A and B (n=12); 2000C – Pre-treatment study block C (n=6); 2002-1N – No cut treatment units (n=6); 2002-2M – Moderate cut treatment units (n=6); and 2002-3H – Heavy cut treatment units (n=6). Thinning treatments were completed in January 2001 and burning in June-July 2001.

Discussion

Effects on overstory

The overstory species structure and composition of the study sites at Cadwell Forest (Pelham) appear to be similar to that of many mixed oak forests in Massachusetts. The sites are dominated by tree oak species, but have many smaller red maple and other trees in the lower canopy and understory. Although each tree species is distributed homogeneously by basal area, the density of those stems is not. Areas of more numerous, smaller stems are scattered among areas of fewer, larger trees. This pattern has most likely emerged from the history of gypsy moth defoliation in these forest stands. The consistent overall basal area within each block is a function both of the age of the stand and of the site conditions. Differences in density appear to stem from gap dynamics: when individual canopy trees or small groups die, primarily from insect damage, large numbers of tall shrubs and saplings quickly fill in the gap. Fallen, rotting trees are common in Cadwell Forest, apparently dating from the 1979-1982 gypsy moth defoliations, and are frequently surrounded by such growth.

The original study design assumed that only the thinning treatments would change the composition of the canopy. Burning was scheduled in the early spring, and was expected to affect the understory only. Although the change to growing season burns resulted in the mortality of some canopy trees, too few were affected to cause an overall effect of burning on the canopy. Despite significant differences in species composition and structure among blocks, the resulting research units exhibited the desired, experimentally produced gradient in both basal area and density of canopy trees (Figure 3), and of tall shrubs and smaller trees (Figure 4).

Although the effect of burning was too small to be seen as a decrease in the overall size and number of live canopy trees, the analysis of standing dead stems showed that even a single prescribed burn in units with slash produced by the thinning treatments significantly increased the basal area of standing dead stems in both the large (>10 cm DBH) and small (3 cm to 10 cm) size classes, and increased the number of those stems in the large size class (Figure 5). A more detailed study of mortality on a subset of these study plots found significantly higher levels of mortality among small size classes than larger size classes for both *Acer rubrum* and *Quercus* spp., but no significant mortality differences due to species (Barron et al. 2002). After many repeated burns, this effect should be detectable as decreases in the number of remaining living canopy trees. This would be responsible for the eventual creation of a woodland structure. In the short-term, the results suggest that cutting followed by a single burn could be effective alternative to girdling trees to create snags and coarse woody debris for wildlife purposes. While girdling trees with a chainsaw can be a more efficient method, insufficiently deep cuts may fail to kill the tree, while overly deep cuts can cause the tree to fall within a single year (Dan Pepin, personal communication).

Effects on understory

Overall, the effects the thinning and burning treatments on the vegetation in the shrub layer one year after treatments were as expected: cover increased with increasing levels of thinning, and decreased due to burning treatments (Figure 12). The cover of only one tree species, *Acer rubrum*, and three shrub species, *Gaylussacia baccata, Vaccinium angustifolium,* and *V. pallidum*, showed apparent differences in their confidence intervals (Figures 6, 7, and 8). Although neither of the *Vaccinium* species was significantly affected, the trends for *V. angustifolium* were consistent with the overall shrub layer results, i.e., cover increased with thinning, and decreased due to burning. In addition, analyses of variance uncovered several more species that showed significant effects not identified by confidence interval comparisons (Table 10). The effects on individual species suggest clear differences in the response of these species to the treatments. Two—*Gaylussacia baccata* and *Trientalis borealis*—were unaffected by thinning, but showed decreases in cover due to burning. This decrease was greatest for *T. borealis*. Others responded almost entirely to the changes brought about by thinning: especially *Acer rubrum* and *Carex* spp. Only one, *Hamamelis virginiana*, showed significant effects that matched the direction of overall effects for both thinning and burning.

The range of individual species responses to these treatments illustrates how disturbances could change the species composition of the vegetation community. The lack of any detectable change in species diversity or composition due to the thinning and burning treatments may indicate either that changes from any given event are very small, or that the methods used to measure the change are insufficient. A study of vegetation composition on some of these sites concluded that over half of each research unit would need to be sampled in order to be confident of identifying 90% of the species present (Barron 2002), especially those less common herbaceous species that occurred as just one or a few individuals. These less-widely distributed species are often the most important to the survival of fauna such as Lepidoptera (Rawinski 2000).

Thinning and burning treatments effectively created browse for wildlife species, attracting deer and moose. In addition to the quantified results on the proportion of species browsed, I personally observed moose, deer, grouse, wild turkey, and many small mammal species, always on thinned and burned units, rather than on untreated ones.

Comparison with reference site

The Cadwell sites share similar site conditions—dry, acidic, glacial till soils with small inclusions of moister microsites—and similar land-use histories—clearing for pasture followed by agricultural abandonment—with fire-maintained oak woodlands in Worcester. They also share similar overstory species with the Worcester woodlands. The overstory structure of the Pelham forest, however, differs from that of the Worcester woodland. Although the total basal area of trees in the two areas was similar, the density of stems ≥ 10 cm DBH was nearly twice as high in the Pelham stands; the reference fire-maintained oak woodland had fewer, larger overstory trees.

Not surprisingly, removing overstory trees was a straightforward way to reduce Cadwell densities to woodland levels. Heavy thinning also reduced basal area to below that of the reference woodland, but basal areas in the moderately thinned units were not significantly different from the woodland in Worcester. As the heavy thinning regime is quite similar to that recommended for maximizing diameter growth of oaks for timber production (Hibbs and Bentley 1983), it is reasonable to expect rapid future increases in overstory basal area in the treatment units.

One of the key characteristics of oak woodlands not shared by the Pelham stands was an almost complete lack of a high shrub layer at Worcester. By contrast, the Cadwell oak forest presented a nearly impenetrable thicket of tall shrubs, from 1 m tall *Gaylussacia baccata* to 5 m tall *Nemopanthus mucronatus, Kalmia latifolia,* and *Hamamelis virginiana.* Prescribed fire successfully top killed much of this shrub layer, although preliminary analysis of vegetative reproduction on these sites found extensive sprouting (Barron et al. 2002). This suggests that additional burning will be necessary to prevent regrowth of tree and shrub species, especially in the combined treatments.

Conclusion

The goal of this portion of the study was to identify whether thinning and/or burning treatments could change stand structure and composition from a closed-canopy oak forest to an open, oak woodland. After validating pre-treatment conditions and that treatments were applied as intended, I found that the combination of moderate overstory thinning with understory burning moved both the forest overstory and the shrub layer in the direction of a fire-maintained oak woodland. While heavy overstory thinning combined with burning resulted in even greater changes, the risk of mortality to residual overstory trees as occurred in block B suggests that the added slash from heavy thinning may limit the usefulness of prescribed fire unless greater attention is paid to clearing downed wood from around the base of reserve trees. Moderate thinning treatments were successful at reducing overstory density to woodland levels, and the overstory basal area should recover to woodland levels as the remaining trees increase their diameter growth. Prescribed burning successfully reduced shrub cover initially. The lack of any detectable change in species diversity and the absence of invasive exotic species provide reassurance that even heavy thinning and intense understory burning do not produce these undesirable outcomes.

Although a single set of treatments did not significantly change the understory species composition, short-term differential responses to burning by individual species, such as the decreases in *Gaylussacia baccata* and *Trientalis borealis* and the increases or lack of detectable change in *Vaccinium* spp. and *Carex* spp., suggest that future applications of prescribed fire may gradually change the managed stands to more closely match the reference woodlands. While some of this difference may be due to the ages and sizes of the understory species in question, the differential responses between the similarly sized perennial herbs and between the ericaceous shrub species provides evidence of differences in species responses to fire. Additional research is needed to determine the season and frequency of maintenance burns to keep shrub cover low, and long-term studies should focus on the effects on individual species and on overall species composition. In particular, future studies should address whether multiple understory burns increase the cover of ericaceous shrub species relative to other shrub species, and should focus on the competition from resprouting tree and tall shrub species.

CHAPTER 4

SOFT MAST PRODUCTION

Introduction

This chapter addresses treatment effects on *Vaccinium angustifolium* growth and fruit production, and explores the role of available light in these effects. Fire improves vegetative growth of certain soft mast (berry-producing) shrubs relative to other shrubs in forest understories (Swan 1970, Patterson personal communication). This increase in soft mast provides important wildlife and recreation benefits and is typical of oak woodlands in the years following understory fires. Fire-responsive understory shrubs in Massachusetts oak forests include species such as blueberry *(Vaccinium angustifolium, V. pallidum*, and their hybrids*)*, huckleberry *(Gaylussacia baccata)*, species in the genera *Viburnum* and *Amelanchier*, and the half-shrub *Gaultheria procumbens* (Anonymous 2001).

The effects of light availability on the production of soft mast in *Vaccinium angustifolium* have long been known (Hall 1955, 1958, Hall and Ludwig 1961). An early experiment with shade screens and blueberry flower bud production (Hall 1958), found that even at 66% available light, flower bud production in the first year following burning was one half the production of plants in the open. Linear regression analysis of Hall's data showed highly significant effects of light on both above-ground biomass and flower bud production ($p=0.0001$, $R^2=0.98$). Hall and Ludwig's 1961 study growing blueberry plants under layers of cheesecloth found that significantly fewer flower buds were produced under approximately 50% of full sunlight.

Burning fully open blueberry barrens has also been shown to significantly increase berry production, but only after one growing season. Jordan and Eaton (1995) found that yields were very low in the growing season immediately following dormant season burns, followed by peak berry production the next year, followed by yields in the third year of only 70% of the peak year's production. They concluded that while the initial reduction was due to the destruction of above-ground stems, the subsequent increase and decline were due to the release of organically bound nutrients into the soil, followed by a gradual reduction in nutrient availability, as they were again tied up in standing biomass. Nitrogen fertilization experiments (Eaton and Patriquin 1988, Eaton 1988, Eaton and Patriquin 1989, 1990) found that while uptake of fertilizer nitrogen by lowbush blueberry stems and leaves was rapid following burn-pruning and increased vegetative growth, berry production did not consistently show a significant increase due to fertilization. I do not further discuss nutrient effects in this thesis, although a related project addresses issues related to treatment effects on soil nutrient levels and nitrogen cycling (Fownes and Hawthorne *in preparation*).

Wildlife species present in Massachusetts that feed on blueberries include upland game birds such as ruffed grouse (*Bonasa umbellus*) and wild turkey (*Meleagris gallopavo)*, song-birds including the eastern bluebird (*Sialia sialis),* larger mammals such as white-tailed deer (*Odocoileus virginianus*), black bear (*Ursus americanus)*, and red fox (*Vulpes vulpes)*, and small mammals, including mice, shrews and voles (Martin et al. 1951, Anonymous 2001, DeGraaf and Yamasaki 2001, Foster et al. 2002b).

Although researchers in Maine, Michigan and Canada have studied extensively the growth and propagation of low-bush blueberry in heathlands and the effects of burning on soil nutrients (as they affect berry production) (Sanderson et al. 1996, Eaton et al. 1997, Hanson and Mandujano 1997), less information is available for blueberry response to management activities in oak woodlands. Subjective observations of repeated burning in oak woodlands on Cape Cod suggest that both fire and adequate light through thinning or mortality of canopy trees are required to stimulate berry production (Patterson, personal observation). This observation is consistent with an earlier study that suggested that flowering and fruiting occurs only in canopy openings with 50% or more of full sun (Hall 1955), and with ongoing research that suggests plants flower but fruiting is reduced under partial shade (Patterson personal communication).

Although I focused on lowbush blueberry species in this study, both as an indicator of the desired community type and as one of the desired species for wildlife and recreation, I also quantified the treatment effects on the growth (but not mast production) of other understory herbs and shrubs. Effects on cover of non-blueberry species were described in Chapter 3. The null hypothesis tested in this portion of the study was that the production of blueberry flowers and fruits would not differ among treatments. The alternative hypothesis was that combined thinning and burning would increase the production of blueberry flowers and fruits.

The decreases in shrub cover and in horizontal foliar density, described in Chapters 3 and 5, respectively, suggest that one effect of burning in forest understories may be an increase in blueberry production due to an increase in available light to the low shrub layer. I addressed two null hypotheses related to light availability. The first was that the amount of light available to the low shrub layer would not differ among treatments. I predicted an increase with degree of thinning and with burning. The second was that production of *Vaccinium* spp. flowers and berries would not differ among treatments. I expected an increase with increasing shrub-level available light.

Methods

A study of methods to estimate cover of *Vaccinium* in cultivated heathlands found that the most efficient method was pacing transects: simply walking across the heathlands at an even pace and counting the total number of steps and the number of steps that landed on a blueberry plant (Nams 1994). That study also found that very small sample plots were the most efficient way to estimate stem densities. My initial attempts at using these methods and others such as the point-center quarter method (Mueller-Dombois and Ellenberg 1974, Elzinga et al. 1998) failed due to the over-dispersed distribution of the shrubs in the forest setting.

Vaccinium production

To address the shortcomings of the methods described above, I used rectangular quadrats to minimize sample-to-sample variability (Elzinga et al. 1998). After blueberry flower buds had opened in May 2002, I measured the density of stems and flowers of *Vaccinium angustifolium* and *Vaccinium pallidum.* I systematically located five east-west transects 10 m apart, beginning 5 m north of the south edge of each unit. Along each transect, I sampled nine, 1 m x 0.25 m quadrats 5 m apart, resulting in a total of 45 quadrats for each of the 18 research units. In each quadrat, I counted the total number of stems, the number of flowering stems, and the number of flowers on each flowering stem.

In early July 2002, I measured the production of *V. angustifolium* berries. The sampling harvest was timed to occur after approximately 25% of the berries had ripened. This minimized the number of berries lost to predation, while ensuring that an adequate number of ripe berries were present for estimating total production. Berries did not ripen simultaneously in all units. I prioritized plot sampling to correspond with observed berry ripening (Table 12).

Table 12. Dates of berry sampling to ensure approximately 25% ripe berries in each unit.

Date	Units sampled
1-2 July	C6 (Heavy cut–no burn)
2 July	C5 (Heavy cut–burn), C4 (No cut–burn), C1 (Control)
3 July	C3 (Moderate cut–burn), C2 (Moderate cut–no burn)
8 July	A6 (Heavy cut–burn), A5 (Moderate cut–no burn), A1 (Control), A2 (No cut–burn)
9 July	A3 (Moderate cut–burn), A4 (Heavy cut–no burn)
10 July	B2 (Moderate cut–burn), B3 (Moderate cut–no burn), B6 (Heavy cut–burn), B1 (Heavy cut–no burn), B5 (No cut–burn), B4 (Control)

To estimate total berry production, I established four, 1 m wide by 40 m long quadrats in each research unit. Quadrats were oriented N-S to minimize inter-sample variation by capturing variability due to light within each quadrat, and were spaced every 10 m. Within the quadrats, every *V. angustifolium* berry that was within the quadrat was harvested, regardless of where the stem on which it grew was rooted. Berries were separated into green and ripe categories, and weighed in the field by quadrat. Berries were then aggregated for each unit, keeping ripe and green berries separate. Approximately 50-g sub-samples were made of the aggregated ripe and green berries, the remaining green berries were discarded, and the remaining ripe berries were reserved for non-research uses. The sub-samples were weighed in the field to the nearest 0.1 gram, and the berries in each sub-sample were subsequently counted and dried by freeze-drying followed by oven drying at 70° C for 48 hours. The dried sub-samples were weighed to the nearest 0.01 gram, and mean per-berry dry and fresh weights were calculated for both green and ripe berries by unit.

Light availability

Light available to the shrub understory was measured in two ways. In July 2001, June 2002, and late August 2002, canopy foliage density or leaf area index (LAI), mean tilt angle (MTA), and diffuse non-interceptance (DIFN) were measured using a LAI-2000 Plant Canopy Analyzer (LI-COR 1992). Light measurements were made with two analyzers simultaneously: one was placed in a nearby clearing with an unobstructed view of the sky, and the second was located immediately above the stratum of berry-producing shrubs (approximately 0.5 m above the ground). The first analyzer recorded light measurements from the open sky every 30 seconds. The second was used to record 21 observations at 2 m intervals along a 40 m east-west transect centered 10 m north of the south edge of each research unit. Both analyzers were oriented identically to 350° T and leveled with an attached bubble level. To ensure that only the canopy immediately above the research units was measured, the units were fitted with 45° view restrictors and the band of data closest to the horizon was discarded. The number of sample points in each unit was determined using a two-stage sampling method (LI-COR 1992). Data were downloaded to a desktop computer, and processed with the LI-COR C2000 software to combine readings from the two analyzers and calculate LAI, MTA, and DIFN.

In late August to early September 2002, canopy cover was estimated using a spherical densiometer (USDI National Park Service 2001). Estimates were made from five points within each research unit: the center of the unit and the approximate centers of the four quadrants—NE, SE, SW, and NW. At each of these points, readings were made at breast height (approximately 1.5 m) facing in each of the four cardinal directions, resulting in 20 samples for each unit. All measurements in a unit were averaged to provide a single estimate of canopy cover by unit.

Results

Calculating total berry yields

I used linear regression analysis to estimate fresh-to-dry and green-to-ripe regression equations from the mean berry weights calculated from sub-sample data. Since measuring the green berries required them to be harvested, it was not possible to allow those berries to ripen in order to calculate a regression equation. Instead, measurements from simultaneously harvested green and ripe berries harvested from the same units were used to calculate this relationship. While I had no direct evidence that all green berries would ripen to the size and weight of the sampled ripe berries, subsequent informal observations over the remainder of the growing season and the pattern of gradual ripening of lowbush blueberries (Trevett 1962) provided some assurance that, absent adverse weather conditions, most green berries would ripen similarly to the ripe berries I sampled. Initial results from the following growing season suggest that this was not the case in 2003 (Patterson, personal communication).

Several units had either no or just a few berries. Regression equations were calculated from data for only the 12 units with more than two berries collected. Visual analysis of residual variances showed them to be normally distributed in both cases. The linear relationship between green and ripe berries (Equation **1**) was significant (p=0.04) and the relationship between dry and fresh weight of ripe berries (Equation **2**) was highly significant (p=0.0067). Attempts to use logarithmic or quadratic regression improved neither the statistical significance of the analysis, nor the amount of variance (R^2) accounted for. The linear regression with intercept appeared to best fit the data for the range of berry weights observed.

a. Fresh weight of ripe berries as a function of fresh weight of green berries.

b. Dry weight of ripe berries as a function of fresh weight of ripe berries.

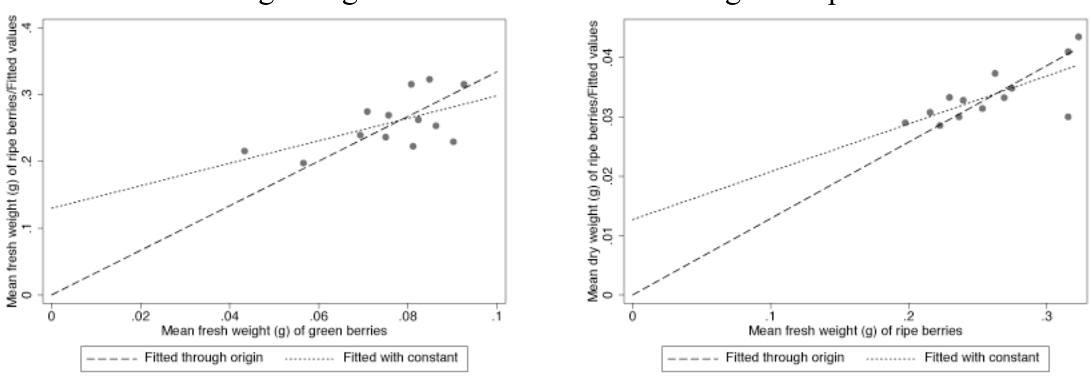


Figure 17. Relationships between fresh weight of ripe berries and green berries (a), and dry and fresh weights of ripe berries (b) of *Vaccinium angustifolium* approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham. Analysis is on mean weights averaged from sub-sample data from the 13 units with berries present in July 2002.

Equation 1. Ripe fresh weight = 0.130+ 1.684 × Green fresh weight (R^2= 0.3281)

Equation 2. Ripe dry weight = 0.013 + 0.0807 × Ripe fresh weight (R^2= 0.5027)

Table 13. Unit means for density of *Vaccinium angustifolium* and *V. pallidum* stems (a), flower production of *V. angustifolium* and *V. pallidum* (b), and four measures of berry production of *V. angustifolium* (c-f), approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham. (B=burn, NB=no burn, H=heavy thinning, M=moderate thinning, N=no thinning).

a. Density (stems/m^2) of *Vaccinium* spp.

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	36.6	47.0	30.7	28.1	17.0	32.3
B	45.4	19.8	28.4	31.1	26.9	22.8
C	35.8	39.0	25.2	36.4	33.8	20.1
Mean	39.3	35.3	28.1	31.9	25.9	25.1

b. Flower production (#/m^2) of *Vaccinium* spp.

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	157.4	215.5	6.25	113.6	8.9	0.4
B	180.4	7.5	0.0	37.4	121.5	0.0
C	124.6	84.9	0.0	358.4	65.9	0.0
Mean	154.1	102.7	2.1	169.8	65.4	0.1

c. Berry production (#/m^2) of *V. angustifolium*

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	29	28	0	48	0	0
B	42	0	0	4	1	0
C	21	20	0	46	19	0
Mean	31	24	0	33	7	0

d. Fresh weight berry production (kg/ha) of *V. angustifolium*

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	73.3	70.1	0.0	124.8	0.6	0.0
B	111.0	0.7	0.0	10.9	1.8	0.6
C	60.0	48.1	0.7	124.0	55.5	0.3
Mean	81.4	39.7	0.7	86.6	19.3	0.4

e. Dry weight berry production (kg/ha) of *V. angustifolium*

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	9.5	9.2	0.0	16.1	0.1	0.0
B	14.2	0.0	0.0	1.4	0.2	0.1
C	7.5	6.4	0.0	15.9	6.9	0.0
Mean	10.1	5.2	0.0	11.1	2.4	0.0

f. Dry weight berry production (kg/ha) divided by proportional cover (ha/ha) of *V. angustifolium*

	Burn and Thin					
	B			NB		
Block	H	M	N	H	M	N
A	158	130	0	199	1.8	0
B	139	0	0	19.8	2.7	2.1
C	133	109	2.6	169	80	0.7
Mean	144	80	0.9	129	28	0.9

I predicted the mean weight of a ripened green berry for each unit using Equation **1**, and the mean weight of a dried ripe berry for each unit using Equation **2**. I predicted the mean weight of a dried ripened green berry for each unit using both equations, sequentially.

I estimated ripe and green berry production in g/m^2 by averaging the quadrat data by unit, and the number of green and ripe berries produced per m^2 by dividing the mean weight of berries produced in each unit (in g/m^2) by the mean per-berry weights (g) from the sub-sample data for each unit. The projected ripened weight of green berries was calculated by multiplying the predicted per-berry ripened weight by the number of green berries. I then estimated total fresh weight production of berries as the sum of ripe berry production and projected ripened green berry production, and similarly for total dry weight production (Table 13). Production per unit cover was calculated by dividing total dry weight berry production by the proportional cover of *Vaccinium angustifolium* from the point intercept data presented in Chapter 3.

Treatment effects on *Vaccinium angustifolium* production

I used analyses of variance (Table 14) to test the hypotheses that density of stems, flower production, and berry production would not vary among treatments. I expected a significant interaction between thinning and burning treatments: that thinning treatments alone would increase flower and berry production, that burning treatments alone would increase stem density, flower production, and berry production, and that combined treatments would show larger effects than either treatment alone.

Variances for stem density were homogeneous (Bartlett 1937), and were distributed normally (Shapiro and Wilk 1965). Variances for flower and berry production were not homogenous, and were positively skewed. Since variances increased with increasing means, analyses of these measures were conducted on log-transformed data (where transformed=ln(data+1)). Visual inspection of the resulting residuals showed them to be normally distributed.

Stem density showed no statistically significant treatment effects, although there was a clear trend towards increasing density with increasing levels of thinning (Figure 18a). In contrast, all of the measures of flower and berry production showed highly significant treatment effects, with values increasing with the level of overstory thinning (Figure 18b-f). A trend towards increased berry production on a dry weight per cover basis due to burning ($p = 0.12$) was overshadowed by the effect of thinning.

Table 14. Effects of thinning and burning treatments on density of *Vaccinium* spp. stems (a) and flowers (b), and on number (c) and ripe-equivalent dry weight (d) of *Vaccinium angustifolium* berries, approximately one year after burning and 1.5 years after thinning in three blocks at Cadwell Memorial Forest, Pelham.

a. *Vaccinium angustifolium* and *V. pallidum* (stems/m^2)

Number of obs = 18 R-squared = 0.4191
Root MSE = 8.33105 Adj R-squared = 0.0124

Source	Partial SS	df	MS	F	Prob > F
Model	500.665312	7	71.5236159	1.03	0.4667
thin	243.03841	2	121.519205	1.75	0.2229
burn	195.580264	1	195.580264	2.82	0.1241
block	30.6021906	2	15.3010953	0.22	0.8059
thin*burn	31.4444474	2	15.7222237	0.23	0.8013
Residual	694.0644	10	69.40644		
Total	1194.72971	17	70.2782183		

b. *V. angustifolium* and *V. pallidum* (flowers/m^2), log-transformed data

Number of obs = 18 R-squared = 0.8457
Root MSE = 1.12578 Adj R-squared = 0.7377

Source	Partial SS	df	MS	F	Prob > F
Model	69.4690017	7	9.9241431	7.83	0.0022
thin	67.2212922	2	33.6106461	26.52	0.0001**
burn	.553895596	1	.553895596	0.44	0.5235
block	1.59875692	2	.799378458	0.63	0.5521
thin*burn	.095057003	2	.047528501	0.04	0.9633
Residual	12.6737621	10	1.26737621		
Total	82.1427639	17	4.83192729		

c. *V. angustifolium* berries (berries/m^2), log-transformed data

Number of obs = 18 R-squared = 0.7693
Root MSE = 1.03488 Adj R-squared = 0.6078

Source	Partial SS	df	MS	F	Prob > F
Model	35.714048	7	5.10200686	4.76	0.0135
thin	30.1646984	2	15.0823492	14.08	0.0012**
burn	.605421487	1	.605421487	0.57	0.4695
block	4.30456758	2	2.15228379	2.01	0.1847
thin*burn	.639360481	2	.319680241	0.30	0.7483
Residual	10.7098096	10	1.07098096		
Total	46.4238576	17	2.73081515		

Continued, next page

Table 14. Cont.

d. Dry weight of *V. angustifolium* berries (kg/ha), log-transformed data

Number of obs =	18	R-squared =	0.7572
Root MSE =	.769888	Adj R-squared =	0.5872

Source	Partial SS	df	MS	F	Prob > F
Model	18.4844996	7	2.64064281	4.46	0.0169
thin	15.3414033	2	7.67070167	12.94	0.0017**
burn	.37600722	1	.37600722	0.63	0.4443
block	2.42603183	2	1.21301591	2.05	0.1799
thin*burn	.341057259	2	.17052863	0.29	0.7560
Residual	5.9272775	10	.59272775		
Total	24.4117771	17	1.43598689		

e. Dry weight of V. angustifolium berries per unit cover (kg/ha), log-transformed data

Number of obs =	18	R-squared =	0.7829
Root MSE =	1.34224	Adj R-squared =	0.6310

Source	Partial SS	df	MS	F	Prob > F
Model	64.9778414	7	9.28254877	5.15	0.0103
thin	53.9820729	2	26.9910365	14.98	0.0010**
burn	.851182711	1	.851182711	0.47	0.5075
block	9.26440934	2	4.63220467	2.57	0.1256
thin*burn	.880176372	2	.440088186	0.24	0.7878
Residual	18.0161573	10	1.80161573		
Total	82.9939986	17	4.88199992		

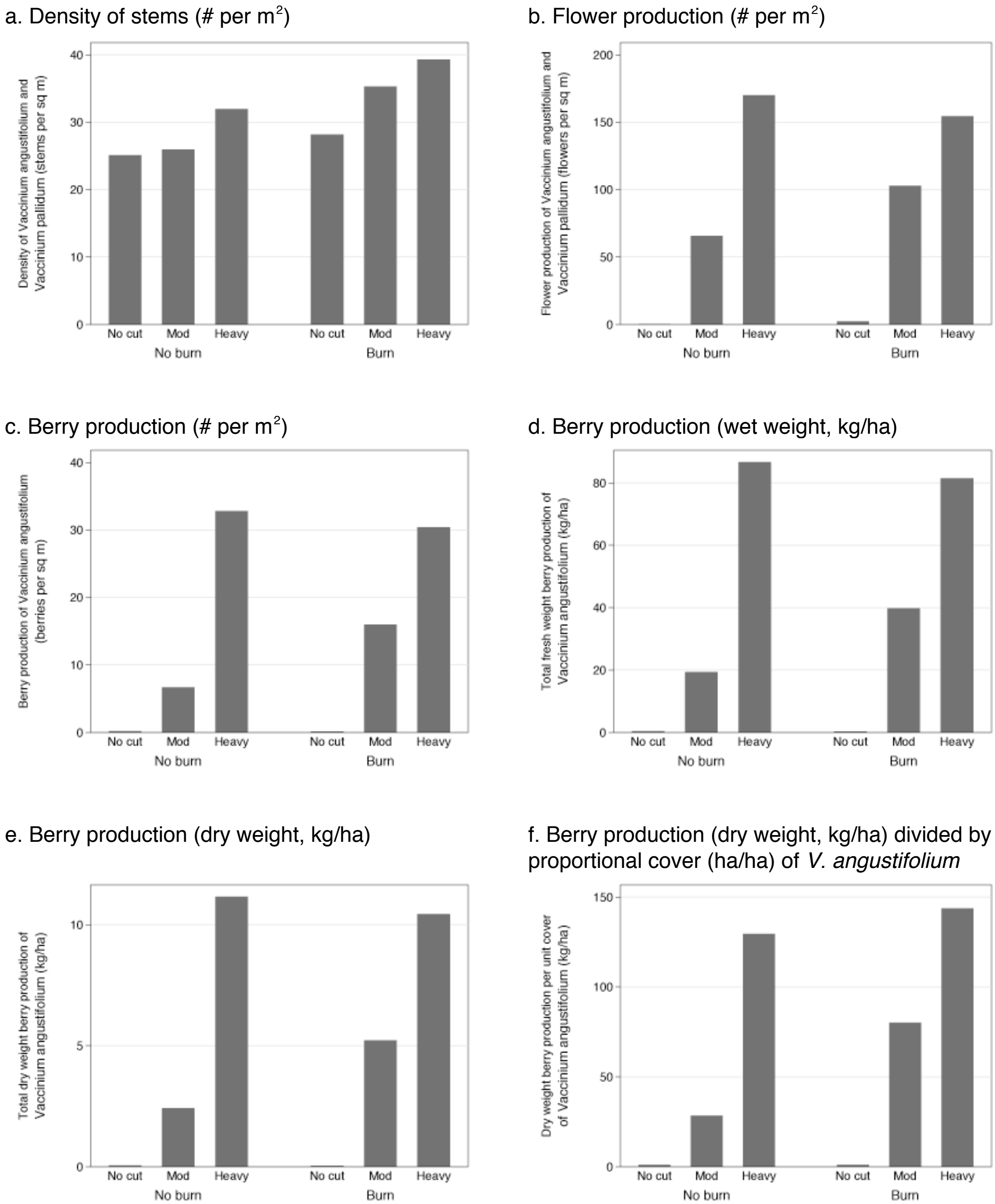


Figure 18. Effects of thinning and burning treatments on density of *Vaccinium angustifolium* and *V. pallidum* stems (a), flower production of *V. angustifolium* and *V. pallidum* (b), and four measures of berry production of *V. angustifolium* (c-f), approximately one year after burning and 1.5 years after thinning in three blocks at Cadwell Memorial Forest, Pelham.

Effects of thinning on available light in the understory

I used analyses of variance to test the hypotheses that available light would not vary among thinning and burning treatments (Table 15). I expected that both thinning and burning would increase available light. Available light was measured in June 2002 as diffuse non-interceptance (DIFN) at the low shrub layer using the LAI-2000, and in August 2002 percent canopy cover was measured at breast height using a spherical densiometer. To transform percent canopy cover into a measure of light rather than of shade, the canopy gap fraction was calculated as 1 – canopy cover (expressed as a fraction between 0 and 1). As variances increased with increasing means, the analyses were performed on log-transformed data. Transformed data and residuals were distributed normally (Shapiro and Wilk 1965), and variances were homogeneous (Bartlett 1937). The results showed that thinning significantly increased both shrub-level and breast-height light measures ($p<0.0001$), but burning had no effect. Results for DIFN measurements taken in July 2001 and August 2002 also showed significant differences among the three blocks in the study.

I conducted regression analyses on the relationships between residual basal area and the log-transformed measures of available light (Table 16). Figure 19 illustrates these relationships, which were highly significant in all cases. I estimated canopy gap fraction as a function of DIFN measured in August 2002, using log-transformed data. The resulting linear regression equation (Equation **3**) showed a close relationship ($R^2=0.85$, $p<0.0001$) between the two methods (Figure 20).

Equation 3. $\mathbf{lngaps = 0.375 \times lndifn + 0.201}$

Table 15. Analysis of variance of diffuse non-interceptance (DIFN) measured at the top of the low-shrub stratum (a) and canopy gaps measured with a spherical densiometer at breast height (b) approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA. Analyses are performed on log-transformed data, where transformed = ln(data).

a. DIFN (Jul 2001)

Number of obs = 18; R-squared = 0.9589
Root MSE = .242626; Adj R-squared = 0.9301

Source	Partial SS	df	MS	F	Prob > F
Model	13.7314783	7	1.96163975	33.32	0.0000
thin	12.2121359	2	6.10606793	103.73	0.0000**
burn	.152158737	1	.152158737	2.58	0.1390
block	1.17444347	2	.587221734	9.98	0.0041**
thin*burn	.1927402	2	.0963701	1.64	0.2426
Residual	.588675448	10	.058867545		
Total	14.3201537	17	.842361983		

b. DIFN (Jun 2002)

Number of obs = 18; R-squared = 0.9242
Root MSE = .288306; Adj R-squared = 0.8712

Source	Partial SS	df	MS	F	Prob > F
Model	10.1374184	7	1.44820262	17.42	0.0001
thin	9.2936099	2	4.64680495	55.90	0.0000**
burn	.07717213	1	.07717213	0.93	0.3580
block	.456854525	2	.228427263	2.75	0.1119
thin*burn	.309781818	2	.154890909	1.86	0.2052
Residual	.831200908	10	.083120091		
Total	10.9686193	17	.645212899		

c. DIFN (Aug 2002)

Number of obs = 18; R-squared = 0.9389
Root MSE = .24505; Adj R-squared = 0.8962

Source	Partial SS	df	MS	F	Prob > F
Model	9.23550815	7	1.31935831	21.97	0.0000
thin	7.44119572	2	3.72059786	61.96	0.0000**
burn	.221433083	1	.221433083	3.69	0.0838
block	1.46178475	2	.730892377	12.17	0.0021**
thin*burn	.111094596	2	.055547298	0.93	0.4280
Residual	.600494977	10	.060049498		
Total	9.83600313	17	.578588419		

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Table 15. Cont.

```
d. Canopy gap fraction (Aug 2002)
                           Number of obs =      18     R-squared     =  0.9035
                           Root MSE      = .124934     Adj R-squared =  0.8359

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  1.46118197     7  .208740281      13.37     0.0002
                         |
                    thin |  1.32432643     2  .662163217      42.42     0.0000**
                    burn |  .007735878     1  .007735878       0.50     0.4975
                   block |   .12649313     2  .063246565       4.05     0.0514
               thin*burn |  .002626527     2  .001313263       0.08     0.9199
                         |
                Residual |  .156085132    10  .015608513
              -----------+----------------------------------------------------
                   Total |   1.6172671    17  .095133359
```

Table 16. Results of regression analysis of several measures of available light as functions of residual basal area (June 2002) approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA. All analyses performed on log-transformed data, where transformed = ln(data).

Variable	Constant	Linear coefficient	R-squared	Prob > F
lnDIFN (Jul 2001)	0.3746078	-0.1527149	0.8028	0.0000**
lnDIFN (Jun 2002)	-0.0947978	-0.1305224	0.7656	0.0000**
lnDIFN (Aug 2002)	0.0172205	-0.1282485	0.8243	0.0000**
lnCanopyGap (Aug 2002)	-0.2059079	-0.0471116	0.6765	0.0000**

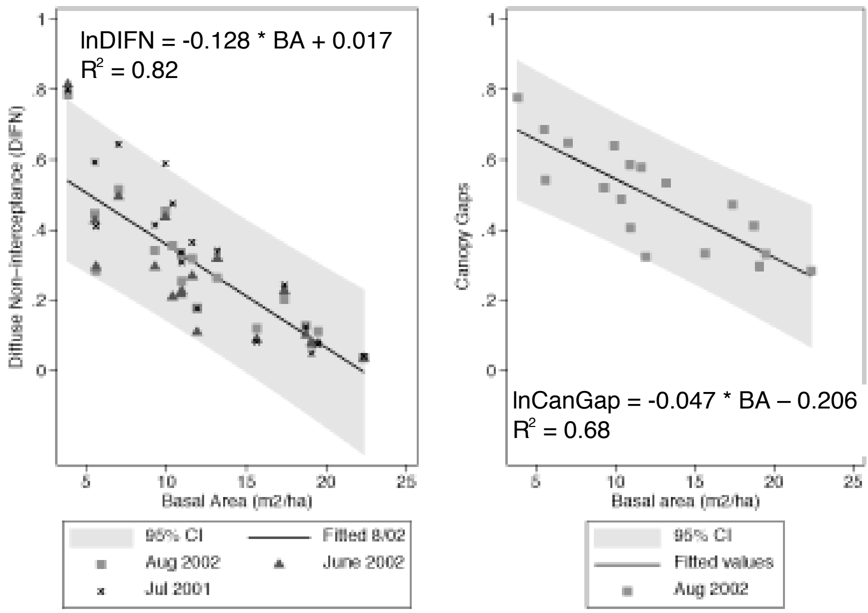

Figure 19. Available light estimated by diffuse non-interceptance (DIFN) measured at the top of the low-shrub stratum (a) and canopy gaps measured with a spherical densiometer at breast height (b), as functions of basal area (m^2/ha) of woody vegetation greater than 3 cm DBH. Trend lines are fitted to the August 2002 data.

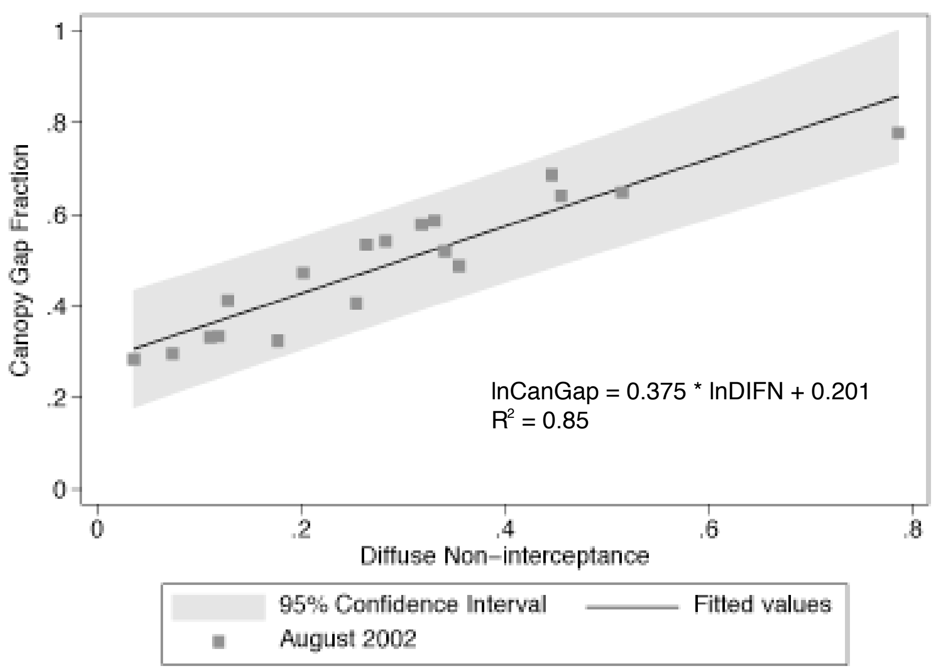

Figure 20. Relationship in August 2002 between diffuse non-interceptance (DIFN) measured at the top of the low-shrub stratum and canopy gap fraction measured at breast height, approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA.

Effects of light availability on *Vaccinium* density and cover

I used linear regression analysis to test the hypotheses that stem density and cover of *Vaccinium* species would not vary with increasing light availability (Table 18). I expected that both would increase with available shrub-level light. Variances for stem data were homogeneous (Bartlett 1937) and were distributed normally (Shapiro and Wilk 1965); analysis was conducted on untransformed data. Cover proportions were transformed using arcsin-square root, as discussed in Chapter 3. DIFN was log-transformed as above.

Stem density of *Vaccinium angustifolium* and *V. pallidum* combined increased linearly with available light. Cover of *V. angustifolium* also increased with light, however, there was no relationship between available light and cover of *V. pallidum.*

Table 17. Results of regression analysis of *Vaccinium* spp. density and cover as functions of available light measured by diffuse non-interceptance (DIFN, June 2002) approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA. Cover data were arcsin, square-root-transformed. DIFN was transformed as ln(DIFN).

Variable	Constant	Linear coefficient	R-squared	Prob > F
Stems/m^2 (untransformed)	39.4177	5.285823	0.2565	0.0320*
Cover of *V. angustifolium* (arcsin-square root)	.2991232	.0342961	0.2516	0.0339*
Cover of *V. pallidum* (arcsin-square root)	0.1247457	-0.009986	0.0187	0.5881

Effects of light availability on *Vaccinium* flower production

I used regression analysis to test the hypothesis that the production of *Vaccinium* flowers would not vary with increasing light availability (Table 18). I expected that flower production would increase with available shrub-level light. As the flowers sampled in June, 2002 had grown from flower bud primordia that been produced in 2001, I used DIFN measurements from July 2001 as the independent variable. Since variances increased with increasing means, the analysis was conducted on log-transformed data, where transformed=ln(data+1). DIFN was log-transformed as above. The results were highly significant, as illustrated in Figure 21.

Table 18. Results of regression analysis of *Vaccinium* spp. flower production in June 2002 as a function of available light measured by diffuse non-interceptance (DIFN, July 2001) approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA. Flowers/m^2 were transformed as ln(flowers+1), DIFN was transformed as ln(DIFN).

Variable	Constant	Linear coefficient	R-squared	Prob > F
Flowers/m^2	5.797791	1.965371	0.6734	0.0000**

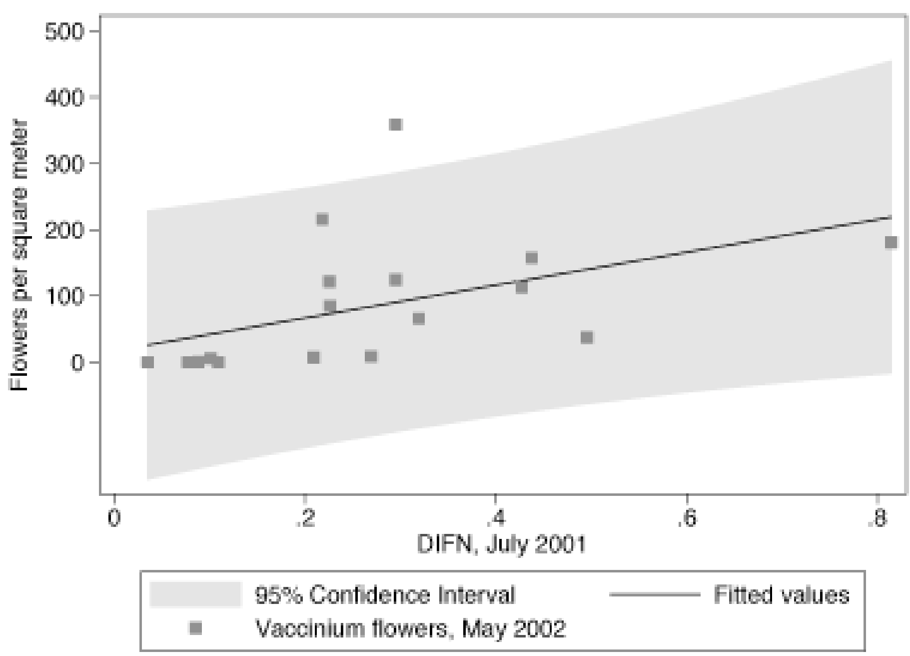

Figure 21. Relationship between *Vaccinium* spp. production (flowers/m^2) measured in June 2002 and diffuse non-interceptance (DIFN) measured at the top of the low-shrub stratum in July 2001 approximately one year after burning and 1.5 years after thinning in three blocks at Cadwell Memorial Forest, Pelham, MA.

Effects of light availability on *Vaccinium* berry production

I hypothesized that the production of berries in 2002 would not vary with available light during the 2002 growing season. I expected that berry production would increase with the amount of light. Since variances increased with increasing means, the analyses were conducted on log-transformed data, where transformed=ln(data). DIFN was log-transformed as above. Linear regression analysis showed highly significant relationships between available light in June 2002 and several measures of *Vaccinium angustifolium* berry production sampled in July 2002 (Table 19, Figure 22).

An analysis of covariance was used to test the hypothesis that log-transformed dry weight berry production per unit cover would not vary with thinning and burning treatments or available light (Table 20). I expected that production would be increased only by available light, and not by other effects of the thinning treatment. The analysis showed significant differences only among the three blocks of the study, and a trend towards increased production with increasing DIFN (available light), indicating that there were no significant thinning effects once the effects of light availability were separated out.

Table 19. Results of regression analysis of several measures of *Vaccinium* spp. abundance as functions of available light measured by diffuse non-interceptance (June 2002) approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA. All analyses performed on log-transformed data (transformed = ln(data+1)). DIFN transformed as ln(DIFN).

Variable	Constant	Linear coefficient	R-squared	Prob > F
Berries/m^2	4.12	1.51	0.54	0.0005**
Berry fresh weight (kg/ha)	5.34	1.94	0.57	0.0003**
Berry dry weight (kg/ha)	2.87	1.07	0.52	0.0008**
Berry dry weight per unit cover (kg/ha)	5.85	1.99	0.52	0.0007**

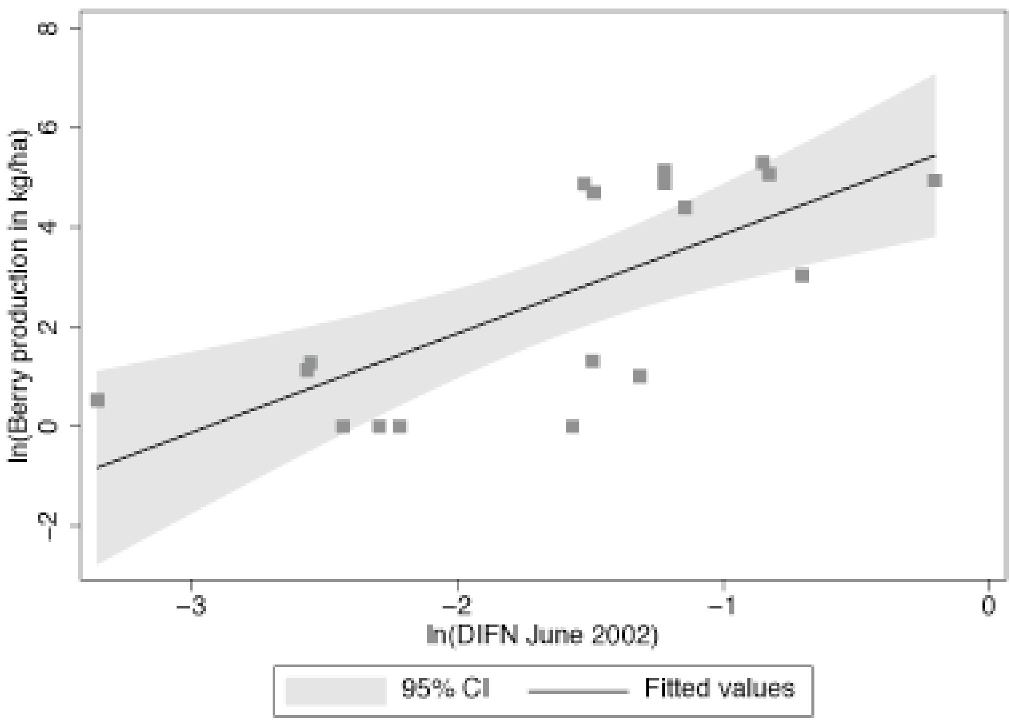

Figure 22. Relationship between dry weight ripe-equivalent *Vaccinium angustifolium* berry production on a per-cover basis and diffuse non-interceptance (DIFN) measured at the top of the low-shrub stratum in June 2002 after thinning and burning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA.

Table 20. Analysis of co-variance of dry weight blueberry production as a function of diffuse non-interceptance (DIFN) in June 2002 and treatments approximately one year after burning and 1.5 years after thinning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA. All data are log-transformed.

```
                     Number of obs =      18     R-squared     =  0.8346
                     Root MSE      = 1.23518     Adj R-squared =  0.6875

            Source |  Partial SS    df       MS           F     Prob > F
        -----------+----------------------------------------------------
             Model |    69.26293     8  8.65786625       5.67     0.0088
                   |
              thin |  1.33277561     2  .666387807       0.44     0.6591
              burn |  .077937897     1  .077937897       0.05     0.8262
             block |  13.5489003     2  6.77445017       4.44     0.0455*
         thin*burn |   3.5100384     2   1.7550192       1.15     0.3590
          lndifn_6 |  4.28508865     1  4.28508865       2.81     0.1281
                   |
          Residual |  13.7310686     9  1.52567429
        -----------+----------------------------------------------------
             Total |  82.9939986    17  4.88199992
```

Discussion

Although I did not prove that all green berries would ripen similarly, the significant relationship between concurrently harvested green and ripe berry weights validated my use of regression equations to estimate what the total weight of berries would have been, had green ones been allowed to ripen. This supported my method of avoiding most of the effects of predation by sampling berries while most are still green, and provided an accurate method of calculating total ripe-equivalent berry production. The highly significant linear relationship between fresh and dry weights of *Vaccinium* berries provides confidence that the moisture content of fresh berries did not vary appreciably among the berries sampled. Future research should examine patterns of berry ripening, and explore whether late-ripening berries have weights and moisture contents similar to early-ripening berries.

The original east-west orientation of the stem and flower sampling transects was chosen arbitrarily. After completion of this sampling, I realized that it was likely that there was a north-south gradient in daily available light, due to the shading by trees adjacent to the thinned units. The most shade would occur at the southern end of the unit and the most light at the northern end. To capture as much of this variability as possible, and thereby minimize sample-to-sample variation, subsequent transects and quadrats for berry sampling were oriented north-south. The oversight on the initial sampling method may have contributed to the lack of significance of treatment effects on stem density. The trend was towards increasing density with increasing levels of overstory thinning. This relationship was significant in the regression analysis between available light and stems/m^2.

Flower and stem sampling did not distinguish between *Vaccinium angustifolium* and *V. pallidum* plants, even though these were visually quite distinct. During berry sampling, none of the *V. pallidum* berries were ripe, and the decision was made to harvest only *V. angustifolium* berries. Future sampling should be sure to distinguish between the flowers of the two species, in order to separate the effects on each species and to allow the analysis of relationships between flowering and fruiting.

Commercial lowbush blueberry growers burn their fields once every two years, often in the fall, or very early spring. The first growing season after burning is referred to as the "growing year," and produces either no crop or only a modest crop, while the second year (or "first crop year") produces the highest yields (Jordan and Eaton 1995). This is due in part to the fact that *Vaccinium angustifolium* flower bud primordia form in the late summer and early fall, before burning. In this study, burning occurred during the growing season of 2001. This destroyed all above ground blueberry biomass, at a time when carbohydrate reserves had already been depleted by spring growth and flowering. It also shortened the growing season by nearly one-half. Not only did this eliminate fruit production for the year 2001, but the allocation of carbohydrates to vegetative growth of new aboveground leaf and stem biomass is likely to have reduced development of flower primordia in Fall 2001 (Kozlowski and Pallardy 1997).

Despite the timing of the prescribed burning, flower and berry production in 2002 were not reduced by the burn treatments. In fact, although not significant, there was a small but clear trend towards increased production due to the burning treatment when adjusted for percent cover (Table 13f, Figure 18f). Production was also significantly increased by thinning treatments. This held true for number of berries, total fresh and dry weight per hectare, and dry weight per unit cover of *Vaccinium angustifolium*. Given the fact that plants in the burn units were much younger and smaller than plants in the unburned units, the similar values for flower and berry production are highly important, and suggest that a significant burning effect may have been masked by the reduction in size and growing season length caused by burning after flowering and leaf-out.

Even when adjusted for the proportional cover of *Vaccinium angustifolium,* dry weight yields in 2002 were only a fraction of yields from commercial blueberry fields. Commercial yields in unfertilized fields are typically just over 3 metric tons on a fresh weight basis per hectare in the first crop year (second growing season) after burn-pruning (Jordan and Eaton 1995, Eaton et al. 1997). Using my equations for fresh to dry weight, this is the equivalent of about 400 kg/ha dry weight for unshaded fields with nearly complete *Vaccinium* cover. The cover-adjusted mean of 144 kg/ha for the heavy-cut/burn treatments in my study is about one-third of commercial production. Mean available light is just over 50% in these heavy-cut/burn treatments. Regression analysis found a highly significant linear effect of available light on all measures of berry production. If this linear relationship holds true for higher light levels, I would expect a doubling of light to result in a doubling of production. This would imply that production in my heavily thinned stands should be around 50% of that in open barrens with 100% available light.

What factors account for the remaining difference between production in my study and commercial production? Since most commercial fields are composed of wild (not artificially selected) varieties of blueberry, it is unlikely that genetic differences are responsible. Regression analysis (not shown) of berry production as a function of overall shrub cover or of overstory basal area found no significant relationships, suggesting that competition for resources other than light was not a determining factor. One likely remaining factor is the detrimental effect of the growing season burn, as described above.

As described in Chapter 3, degree of thinning resulted directly in changes to residual basal area of live woody stems. Available light in the understory, in turn, was closely related to residual basal area. This relationship held whether available light was calculated with the LAI-2000 as DIFN at the level of the low shrub stratum or using a spherical densiometer at breast height to estimate the canopy gap fraction. The close relationship between DIFN and canopy gap fraction suggests that either method could be used in future research. Alternatively, photosynthetically active radiation (PAR) could be measured with a quantum sensor such as the Li-Cor LI-190.

Increases in available light were clearly shown to be strongly correlated to increased production of both *Vaccinium* spp. flowers and *Vaccinium angustifolium* berries. Of the factors measured, this effect accounted for much of the increases in production, although burning in the thinned areas also provided modest, though not statistically significant, increases. As the burning treatments were conducted in June 2001, after full leaf-out of the *Vaccinium* spp., it is somewhat surprising that the plants were capable of setting enough flower buds in fall 2001 to produce the flowers and berries that were measured in 2002. It will be valuable to observe the 2003 blueberry production, and repeat the above analysis.

In the year following treatments, the effects of thinning on available light were dramatically greater than the effects of burning on available light. As the canopy and high shrub layer regrow, and as additional burn treatments are conducted, this analysis should be repeated to determine if burning effects increase in importance.

Conclusion

Although overstory thinning and the concomitant increase in available light directly increase flower and berry production, the case for effects of burning was not clearly established by this study. One way of approaching this remaining question is by comparison with the effects seen by burn-pruning commercial blueberry heathlands.

Commercial blueberry yields in the second crop year are often only 70% of the first crop year after dormant season burns (Jordan and Eaton 1995). However, it is unclear how yields will change in the second crop year (2003) after a growing season burn in a woodland setting. The physiological effects on flower bud production described above and the drastically shortened growing season following the burns in 2001 are likely to have depressed the level of production in burned units in 2002 below what it would otherwise have been. This implies that there may be a larger, possibly significant, effect of burning in conjunction with thinning on flower and berry production in 2003.

This study raises several questions for future research. How close can production in a woodland setting come to commercial open-field production? Clearly, berry production will always be strongly affected by both available light and the proportional cover of *Vaccinium* species. Although commercial fields often approach 100% cover, differences both in actual cover and in sampling methods result in highly variable estimates of blueberry yields (Nams 1994). It remains to be seen whether there are factors other than light and cover that will keep woodland berry production below that of commercial fields. Does burning affect *Vaccinium* species indirectly by suppressing other species? What will be the long-term trend in cover of *Vaccinium* species and in available light at the shrub layer? Previous subjective observations (Patterson pers. comm.) suggested that frequent burning in closed oak forests increased the cover of *Vaccinium*, but did not increase fruit production over 19 years. This implies that burning alone will require many decades to achieve woodland light levels. An earlier study found that clear-cutting of a forest followed by burning did not increase the cover of blueberry plants (Hall 1955). Hall suggests that opening forests gradually will "allow invasion by vigorous blueberry rhizomes." If this is the case, future floristic measurements from the current study area should also show increases in cover of blueberry shrubs. Taken together, these results suggest that overstory thinning can create favorable woodland light levels that are transient, while regular burning is necessary to maintain and increase the cover and production of *Vaccinium* species.

Additional observations in 2003 and after future burning treatments will be needed to validate this.

CHAPTER 5

HORIZONTAL FOLIAR DENSITY

Introduction

People seem drawn to “park-like” woodlands, where low understories allow them to see a great distance and easily walk where they will. Early settlers described New England woodlands where “the trees growe here and there as in our parks and makes the Country very beautifull and commodious” (Morton 1632), late 20th Century forest landowners expressed a preference for open understories (Brush 1979), and a modern ecologist portrayed the positive attitudes of urban visitors to existing oak woodlands (Rawinski 2000). In this study, I tested the null hypothesis that eye-level perception of openness would not differ among treatments. My expectation was that this openness would increase with burning treatments.

Methods

Horizontal foliar density (HFD) is measured as the percentage of a fixed-size target that is obscured by vegetation when viewed from a given distance (Hays et al. 1981). Although usually used as a measure of wildlife habitat quality, HFD is used here to quantify the openness of forest stands for aesthetic and recreational purposes. After full leaf-out in June 2002, I measured 35 m and 15 m horizontal foliar density at heights of 50 cm, 100 cm, 150 cm and 200 cm above the ground. Observations were made looking toward the center of each research unit from points along the four diagonals of the unit, resulting in 16 observations at each distance per study unit.

Early post-treatment measurements had been taken by a team of undergraduate students before leaf-fall in September 2001, however inexperience on the part of observers led to spurious results. Measurements in 2002 were completed by a single observer. The target was viewed through binoculars held next to a vertical sighting pole marked at the same heights as the target centers. I recorded the percentage of the target obscured by comparing it to a template containing random patterns corresponding to 20%, 40%, 60% and 80% obscured, and estimating to the nearest 10%.

Results

Unit means were calculated by averaging the four diagonal measurements for each combination of distance from target and height above ground (summarized in Figure 23). I used stepwise multiple regression analysis to construct a model relating HFD to height, distance, treatments, overstory stem density, overstory basal area, and browsing percentage (from Chapter 3). Since fire behavior data were not collected during the prescribed burns, there were no independent continuous variables available to quantify the burn treatments. I arbitrarily encoded burning with the value '1' for burned, and '2' for unburned. Thinning treatments and blocks were similarly encoded. Terms were added to the model by forward selection if their significance level was $\leq$0.10. Variances were homogeneous (Bartlett 1937), and visual inspection of the residual variances, showed that they were normally distributed. Since data within each unit were not independent, I used the Huber/White robust variance estimate to adjust for within-cluster correlation (Rogers 1993, Williams 2000).

The resulting regression equation (Table 21a) was highly significant and accounted for nearly 70% of the variability in HFD ($p<0.0001$, $R^2=0.684$). Only height, distance, and burning met the significance level to be added to the model. Height accounted for 57% of the variance, distance accounted for 6% of the variance, and burning accounted for 7% of the variance (Table 21b). Despite these highly significant results, confidence intervals were large. With 95% confidence, the overall effect of burning was to decrease the HFD by between 5.6 and 32.7 percentage points. Burning decreased HFD, while HFD decreased with height above ground and increased with distance to the target. In contrast to the significant increases in shrub cover due to thinning found in Chapter 3, thinning had no significant effect on HFD.

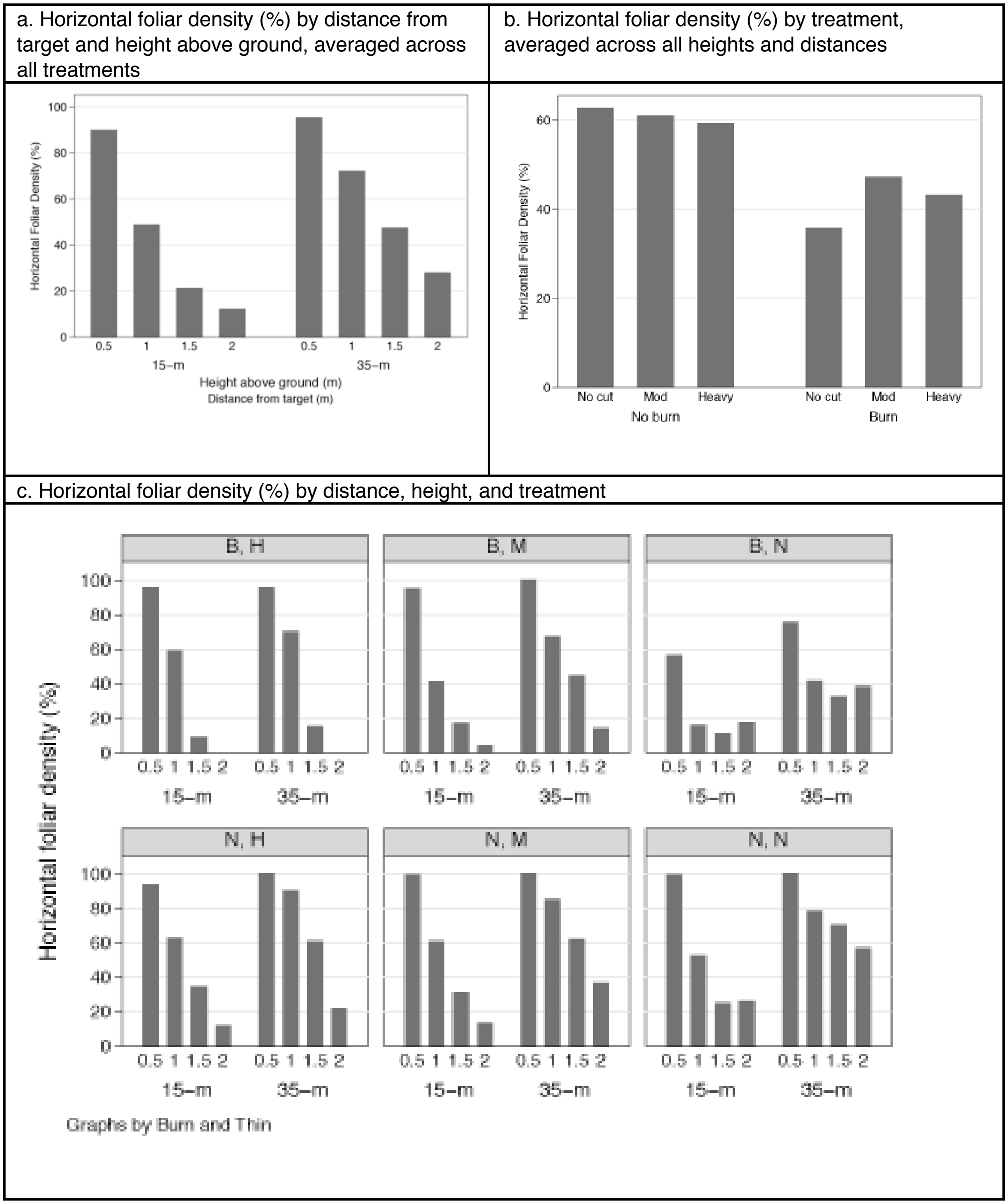

Figure 23. Mean horizontal foliar density (percentage of target obscured) by height above ground and distance from target (a), by treatment (b), and by height, distance, and treatment (c) in three blocks at Cadwell Memorial Forest, Pelham, one year (June 2002) approximately one year after burning and 1.5 years after thinning treatments, B=burn, NB=no burn, H=heavy thinning, M=moderate thinning, N=no thinning.

Table 21. Effects of treatments, block, height above ground, and distance from target on horizontal foliar density in three blocks at Cadwell Memorial Forest, Pelham, approximately one year after burning and 1.5 years after thinning treatments.

a. Multiple linear regression analysis of significant effects (the categorical variable burn was encoded as 1 for burned, and 2 for unburned; height in cm above ground, distance in m from target) on horizontal foliar density (percent of target obscured).

```
Regression with robust standard errors                 Number of obs =     144
                                                        F(  3,    17) =  186.20
                                                        Prob > F      =  0.0000
                                                        R-squared     =  0.6841
Number of clusters (unit) = 18                          Root MSE      =  20.674

------------------------------------------------------------------------------
             |               Robust
     hfd_pct |      Coef.   Std. Err.      t    P>|t|      95% Conf. Interval
-------------+----------------------------------------------------------------
      height |  -.4842222   .0427178   -11.34   0.000**  -.5743489   -.3940955
    distance |     .86875   .1382373     6.28   0.000**   .5770949    1.160405
        burn |   19.14583   6.407481     2.99   0.008**    5.62723    32.66444
       _cons |   61.73264   14.94368     4.13   0.001**   30.20422    93.26106
------------------------------------------------------------------------------
```

b. Sources of variance

Source	Partial SS	R^2
Model	129576.35	0.684
burn	13196.2656	0.070
height	105512.022	0.557
distance	10868.0625	0.057
Residual	59838.1062	0.316
Total	189414.457	

Discussion

Mean HFD at 15 m decreased from 50.7% to 35.2%, and mean HFD at 35 m decreased from 71.7% to 48.9% with burning (Figure 23). How does this change appear to someone walking in the woods? Before burning, one could see 15 m into the woods before half of one's view was obscured. After a single burning treatment, this distance had more than doubled to 35 m.

While the results show significant decreases in HFD with prescribed burning, it is unclear how long this effect will last. Like the measurements of decreased cover of shrubs described in Chapter 3, regrowth is likely to be rapid. The most dramatic decreases in HFD due to burning were visible in the un-thinned units, suggesting an interaction with thinning which was not revealed by statistical analysis. This trend suggests that high HFD in the thinned stands may be due to rapid regrowth—growth which was suppressed in unthinned units by canopy shading. Visually inspecting the graphs in Figure 23c shows that most of the reductions in HFD due to burning in thinned units occurs at 1.5 m and above. Since burning had originally removed nearly all of the foliage shorter than 2 m by top-killing or consuming the shrub layer, the vegetation must have grown fast enough in the one year following burning treatments to replace the 1.0 m and lower foliage by the time HFD was measured.

HFD measurements should be repeated annually to determine the rate of vegetation regrowth, and to estimate the fire return interval needed to maintain or further improve stand openness. HFD sampling should also be repeated after future burn treatments. Although there was no significant relationship shown between the proportion of species browsed and HFD, these data were collected over one year apart. Measurements of occurrence and severity of browsing should be made at the same time as HFD measurements, to establish whether browsing helps to keep HFD low. No measurements of horizontal foliar density were made for the reference oak woodland, making it impossible to quantify whether a single burn treatment was sufficient to reduce HFD to woodland levels. Future studies should include measurements of HFD on reference woodlands.

The success of understory burning alone at increasing horizontal visibility suggests an alternate set of treatments that deserves further study. If an understory burn was conducted in advance of thinning, the resulting top-killed shrubs and small trees should sprout less in the closed canopy stand than in a thinned stand. The thinning would then be carried out after litter fuel accumulation had begun approaching a level sufficient to conduct a second burn, perhaps one to two years later (see Chapter 6). After the thinning, the slash would be allowed to dry, and a second understory burn applied.

Conclusion

Although the methods presented in Chapter 3 were sufficient for measuring changes in the cover of shrub vegetation, the horizontal foliar density techniques described in this chapter provided vertical stratification of visual density with less effort than the point intercept method with multiple strata. Two researchers were able to complete HFD measurements on all 18 units in approximately 12 hours, including travel time. The same researchers required nearly 80 hours to complete point intercept sampling. Although the point intercept sampling included additional data (species intercepted), it was for only two strata. Because of the setup time, using the point intercept method to sample only foliar density would not be appreciably faster than using it to record cover by individual species. HFD also provided a better measure of the subjective experience of understory openness, as it is based on looking horizontally through the vegetation, as opposed to looking vertically down on the vegetation. Although HFD has primarily been used as a tool for quantifying wildlife habitat, it also provides a low-cost method of objectively measuring one aspect of aesthetic and recreational values. Unfortunately, subsequent experience has shown that without adequate training and calibration, the method produces inconsistent results among observers.

Prescribed burning was an effective treatment for increasing understory visibility in the year following application. I expect that this effect will diminish over time as shrub and tree species resprout. It is likely to diminish less rapidly in the unthinned, burn units, due to lower light availability, a result that is counter to the other goal of this study—the increase in soft mast production. Additional research is necessary to determine how often maintenance burning is necessary, and to better compare this treatment with reference fire-maintained oak woodlands.

CHAPTER 6

FUELS AVAILABILITY

Introduction

One of the principal factors controlling fire return interval is the rate at which fuel accumulates after consumption by fire (Pyne et al. 1996). In oak forests and woodlands, this fuel is predominantly litter in the form of leaves and small branches from oak and other deciduous trees and shrubs. To better understand the effects of thinning treatments on fuel loads, I tested the hypothesis that fuel loads would not differ among thinning treatments. I expected that thinning would increase the amount of fuel.

Methods

Between April and June of 2001, I sampled pre-burn fuels on the six thin-burn units, after thinning treatments had been completed, and on the three burn-only units (i.e., those without cutting). Downed wood and leaves, standing live stems, and standing dead stems were destructively harvested from five, 40x40 cm plots in each of the units assigned to a burn treatment. Sample plots were located by the random toss of a small object in each of the four quadrants and near the plot center. This material was dried at 70° C for 72-hours and weighed to estimate mass of live and dead fuels. Downed fuels were separated into leaves, needles, and wood in three size (time-lag) classes: 0"– 1/4" (1-hr), 1/4"–1" (10-hr), and 1"-3" (100-hr). Live fuels were categorized by size class and species (*Vaccinium* spp., *Gaylussacia baccata,* herbaceous, and other). Standing dead fuels were sorted by size class. Non-woody fuels were considered to be in the 1-hr time lag class. I measured downed woody fuels in each unit with four 30 m planar intercepts (Brown 1971, 1974). Additional litter fuels data were collected in November 2002 from 12, 40x40 cm plots using the same methods for a related study (Ohman et al. 2003) on litter accumulation, decomposition, and fuel continuity in a subset of the research units.

Results

Data from the five 40 x 40 cm sample plots were averaged for each research unit (Table 22), and analyses of variance conducted to test the hypotheses that fuel loads by time-lag class would not vary with level of thinning. Variances were homogeneous (Bartlett 1937) and were distributed normally (Shapiro and Wilk 1965). While these analyses showed only trends towards increased loads with increased intensity of thinning for individual time-lag classes of downed, dead fuel, thinning did significantly increase the overall total of downed, dead fuel (Table 23). Although fuels appeared to increase with level of thinning (Figure 24), a difference of means test on combined downed dead fuels found no significant difference between heavy and moderate cut treatments ($t=0.1755$, $p= 0.8692$). Overall, thinned units had approximately twice the fuel load of downed, dead fuel as un-thinned units. This comprises approximately the same amount of litter and, for wood, twice as much 1-hr, three times as much 10-hr, and nearly 19 times as much 100-hr fuel (Table 22).

Table 22. Fuel loading of downed woody fuels and litter in metric tonnes/ha for a. unthinned, b. moderately thinned, and c. thinned units in three blocks at Cadwell Memorial Forest, Pelham, in spring 2001, approximately three months after thinning treatments and prior to prescribed burning.

a. Unthinned

Variable	Obs	Mean	Std. Err.	95% Conf.	Interval
litter	3	5.30	0.44	3.42	7.19
dd1hr	3	1.67	0.50	-0.46	3.80
dd10hr	3	1.95	0.43	0.12	3.78
dd100hr	3	0.12	0.12	-0.39	0.62
total	3	9.04	1.33	3.34	14.74

b. Moderately thinned

Variable	Obs	Mean	Std. Err.	95% Conf.	Interval
litter	3	5.74	0.60	3.17	8.31
dd1hr	3	3.37	0.61	0.74	5.99
dd10hr	3	6.48	2.12	-2.65	15.60
dd100hr	3	1.85	1.20	-3.32	7.01
total	3	17.43	2.04	8.64	26.23

c. Heavily thinned

Variable	Obs	Mean	Std. Err.	95% Conf.	Interval
litter	3	5.70	0.39	4.02	7.38
dd1hr	3	3.48	0.19	2.64	4.32
dd10hr	3	6.14	0.34	4.67	7.60
dd100hr	3	2.56	1.10	-2.17	7.30
total	3	17.89	1.58	11.08	24.69

Table 23. Effects of thinning on dead, downed fuels in three blocks at Cadwell Memorial Forest, Pelham, approximately three months after thinning treatments and prior to prescribed burning.

a. Litter

Number of obs = 9 R-squared = 0.9385
Root MSE = 264.68 Adj R-squared = 0.8770

Source	Partial SS	df	MS	F	Prob > F
Model	4275171.5	4	1068792.88	15.26	0.0109
thin	351311.625	2	175655.812	2.51	0.1969
block	3923859.88	2	1961929.94	28.01	0.0044**
Residual	280222.656	4	70055.6641		
Total	4555394.16	8	569424.27		

b. Downed, woody, 1-hr fuels

Number of obs = 9 R-squared = 0.8199
Root MSE = 674.344 Adj R-squared = 0.6399

Source	Partial SS	df	MS	F	Prob > F
Model	8282645.86	4	2070661.47	4.55	0.0856
thin	6171420.21	2	3085710.11	6.79	0.0518*
block	2111225.65	2	1055612.82	2.32	0.2142
Residual	1818960.32	4	454740.08		
Total	10101606.2	8	1262700.77		

c. Downed, woody, 10-hr fuels

Number of obs = 9 R-squared = 0.7675
Root MSE = 1972.64 Adj R-squared = 0.5351

Source	Partial SS	df	MS	F	Prob > F
Model	51396551.5	4	12849137.9	3.30	0.1370
thin	38182191.6	2	19091095.8	4.91	0.0839
block	13214359.9	2	6607179.97	1.70	0.2925
Residual	15565292.8	4	3891323.2		
Total	66961844.3	8	8370230.54		

d. Downed, woody, 100-hr fuels

Number of obs = 9 R-squared = 0.3795
Root MSE = 1988.64 Adj R-squared = -0.2410

Source	Partial SS	df	MS	F	Prob > F
Model	9675385.76	4	2418846.44	0.61	0.6772
thin	9497424.47	2	4748712.23	1.20	0.3904
block	177961.292	2	88980.6458	0.02	0.9779
Residual	15818740.6	4	3954685.16		
Total	25494126.4	8	3186765.8		

e. Total downed, dead fuels (litter + 1-hr + 10-hr + 100-hr)

Number of obs = 9 R-squared = 0.9371
Root MSE = 1771.17 Adj R-squared = 0.8742

Source	Partial SS	df	MS	F	Prob > F
Model	186955329	4	46738832.3	14.90	0.0114
thin	148905914	2	74452956.8	23.73	0.0060**
block	38049415.6	2	19024707.8	6.06	0.0615
Residual	12548208	4	3137052		
Total	199503537	8	24937942.2		

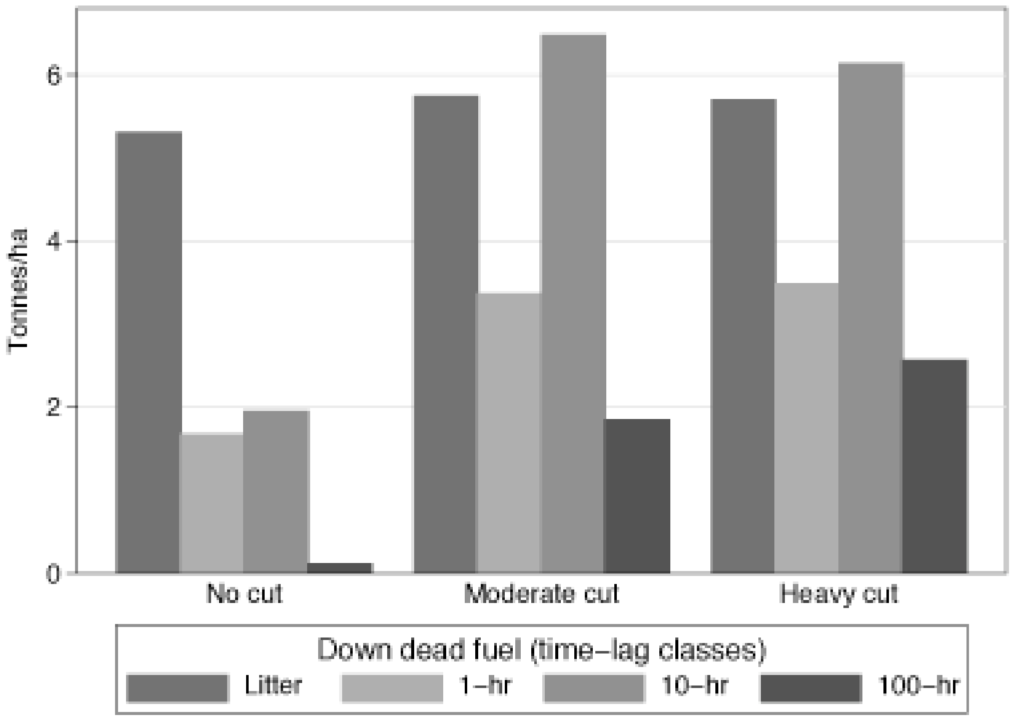

Figure 24. Downed woody fuel by time-lag class and litter for thinned and unthinned treatments in three blocks at Cadwell Memorial Forest, Pelham, approximately three months after thinning treatments and prior to prescribed burning.

The post-burn (November 2002) data from Ohman et al.'s (2003) twelve, 40x40 cm sub-plots were averaged to provide unit means for litter fuels on the burn units in blocks A and B, and these unit means were used to calculate confidence intervals by thinning treatment (Table 24). I conducted an analysis of variance to test the hypothesis that litter fuel loads would not vary with level of thinning. Since litter accumulation is strongly affected by the density of trees present, I expected that thinning would decrease the amount of litter present. Variances were homogeneous (Bartlett 1937) and were distributed normally (Shapiro and Wilk 1965). The results showed a highly significant reduction in the post-burn accumulation of litter as a result of thinning treatments (Table 25). To further quantify the relationship between degree of thinning and litter accumulation, I used linear regression analysis to predict leaf litter in November 2002 from residual overstory density in June 2002 (see Chapter 3). The results were highly significant, and accounted for nearly all of the variation in litter fuel loads (Table 26, Figure 25).

Table 24. Fuel loading of litter in metric tonnes/ha thinned and un-thinned units in two blocks (A and B) at Cadwell Memorial Forest, Pelham, in November 2002, 22 months after thinning and 16 months after prescribed burning. Data are from Ohman et al. (2003).

Variable	Obs	Mean	Std. Err.	95% Conf. Interval	
Unthinned	2	6.33	0.07	5.43	7.22
Moderate thin	2	4.45	0.19	1.98	6.92
Heavy thin	2	4.12	0.28	0.58	7.66

Table 25. Effects of thinning on dead, downed fuels in three blocks at Cadwell Memorial Forest, Pelham, 22 months after thinning and 16 months after prescribed burning.

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	5.67259217	2	2.83629608	35.32	0.0082**
Within groups	.24089244	3	.08029748		
Total	5.91348461	5	1.18269692		

Table 26. Linear regression analysis of litter fuel loads (metric tonnes/ha) as a function of residual density overstory trees >3 cm (stems/ha) and in two blocks (A and B) at Cadwell Memorial Forest, Pelham, 22 months after thinning and 16 months after burning treatments. Data are from Ohman et al. (2003).

Source	SS	df	MS
Model	5.88712842	1	5.88712842
Residual	.026356187	4	.006589047
Total	5.91348461	5	1.18269692

Number of obs	= 6
F(1, 4)	= 893.47
Prob > F	= 0.0000
R-squared	= 0.9955
Adj R-squared	= 0.9944
Root MSE	= .08117

ltha	Coef.	Std. Err.	t	P>|t|	95% Conf. Interval	
stemsha	.0019969	.0000668	29.89	0.000**	.0018114	.0021824
_cons	3.653988	.0549793	66.46	0.000**	3.501341	3.806635

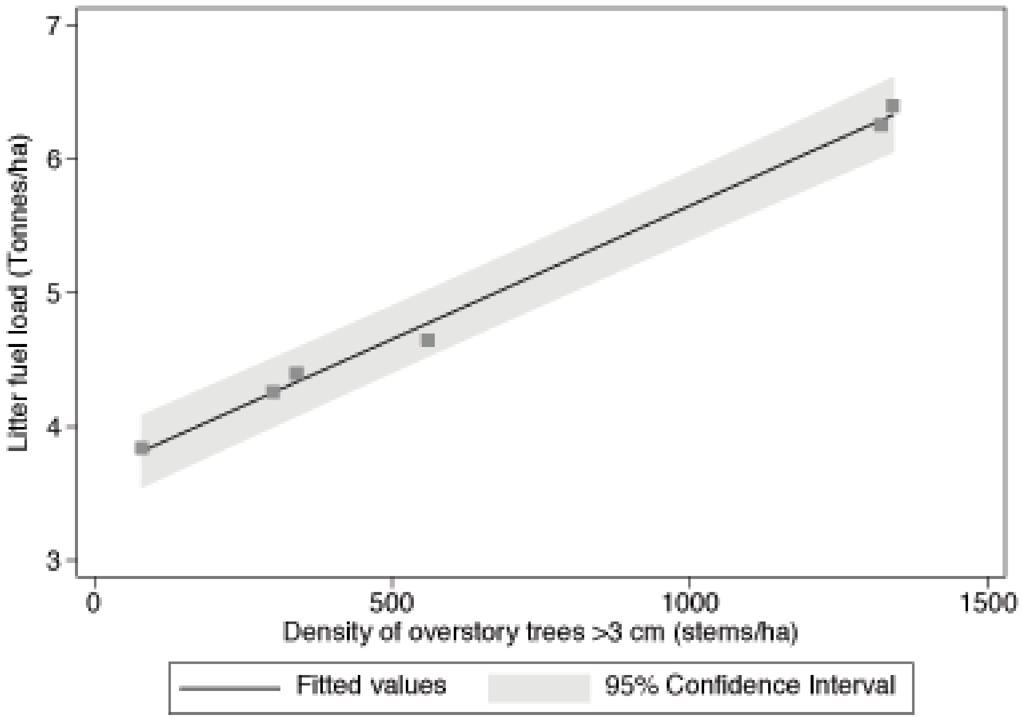

Figure 25. Relationship between residual density of overstory trees >3 cm (stems/ha) and litter fuel loads (metric tonnes/ha) in two blocks (A and B) at Cadwell Memorial Forest, Pelham, 22 months after thinning and 16 months after burning treatments. Litter fuels data are from Ohman et al. (2003).

Discussion

Overstory thinning operations can potentially change fuels in several ways. The lopped and scattered tops of harvested trees and taller shrubs immediately add fuel to the fuel bed. Smaller standing dead shrubs may be broken off by logging equipment. Live shrubs may be damaged, resulting in an increase in standing dead fuel.

The doubling of total downed dead fuels may overestimate the impact of thinning on subsequent fire behavior. Most of the 100-hr fuels and perhaps half of the 10-hr fuels are unavailable, except under very dry conditions, when burning may be perceived to be too dangerous (Patterson, personal communication). A more useful comparison considers only litter, 1–hr fuels, and a percentage of 10-hr fuels. Assuming 20% of the 10-hr fuels are available to burn, thinned stands would have had approximately 10.4 metric tons per hectare, compared to about 7.4 metric tons for un-thinned stands—an increase of 40%, which almost certainly increased fire intensity. The decreases in wind reduction factor and dead fuel moisture in the thinned units also appeared to increase fire intensity relative to the un-thinned units.

The close relationship between residual overstory density and post-burn litter fuels (as measured by Ohman et al. 2003) not only suggests an important role for canopy litter production in restoring adequate fuel loads to support additional burning, but also provides a method of estimating appropriate target levels of thinning for a desired level of fuel accumulation. Results from their study of post-burn litter accumulation on the burn units in blocks A and B suggest that post-fire net litter accumulation on the thinned burn plots was insufficient to support prescribed burning in spring 2003, two years after the initial burns, but could reach sufficient levels by spring 2004. That study also found that the units with heavily thinned canopies showed reduced fuel bed continuity, further reducing their ability to carry a prescribed fire in the years following a burn. This underscores the role of canopy litter production in restoring fuel loads, and suggests that moderate thinning regimes may be more appropriate than heavy thinning where burning is required on a three-year or shorter interval, such as to support berry production. Although Ohman et al. collected woody fuels, they had not yet processed these samples or provided data for woody fuels, preventing conclusions regarding effects on 1-hr, 10-hr, and 100-hr woody fuels.

Overstory thinning reduced the future accumulation of litter, in two ways. In addition to decreased litter fall, early results from a related study suggest a highly significant inverse relationship between residual overstory basal area and soil temperature (Fownes and Hawthorne *in preparation*). Since rates of litter decomposition are strongly influenced by soil temperature (Paul 2001), if burning were not conducted in the same year as the thinning treatment, litter loading would decrease substantially compared to un-thinned areas, due to the combined effects of decreased litter fall and increased decomposition rates in the more open stands.

Conclusion

Although canopy thinning had no immediate effect on litter fuels, it did directly increase woody fuel loads. Nearly two years after prescribed burning, litter fuel loads had fully recovered in the un-thinned units, but were approximately 70% of their pre-burn levels in the thinned plots. Litter recovery may take three years or more in the thinned units.

These observations suggest that initial restoration fires after thinning for oak woodlands will exhibit more intense fire behavior than fires in un-thinned stands. Such behavior was observed in the current study, especially in the heavily cut plots. Also, with thinning, the prescribed fire return interval for maintenance of oak woodlands will need to be three years or greater, to allow for adequate recovery of litter loads.

The observed rapid growth of shrub and tree sprouts (see Chapter 3) and the concomitant rise in horizontal foliar density (see Chapter 5), argues for a return interval of no more than three years, at least during the initial restoration phase, in order to maintain an open woodland understory. Additional research will be necessary to determine whether this interval can be increased for maintenance purposes after some number of restoration burns.

CHAPTER 7

CONCLUSIONS

I set out on this study to explore methods for combining overstory thinning with understory burning to restore some of the unique qualities of the oak woodlands that are reported to have been created and maintained by native Americans in southern New England prior to the arrival of European settlers. Given the short time-frame (three years) of the study, it was not possible to study longer-term effects, such as changes in the composition of vegetative communities. Instead, I focused on several aspects of woodlands of importance to wildlife, aesthetics, and recreation: overstory structure, soft mast production, and understory openness.

My intention has been to gather enough knowledge on the effects of these treatments to provide a method for land managers to create woodland openings in forests owned by individuals, public agencies, and non-profit organizations. These woodland openings not only provide important wildlife and recreational benefits, but also can increase the diversity of forest structure in a homogeneous forest landscape of similarly aged stands.

By undertaking a replicated and controlled experiment, I have been able to clearly identify and separate the effects of thinning and burning on the attributes being studied. Although limiting site selection to three locations at Cadwell Memorial Forest restricts our ability to draw statistical inferences, the similarity of the study sites to many other upland oak forests in southern New England provides some assurance that the treatments used will produce similar effects elsewhere.

Overview of Effects Observed

Neither thinning nor burning alone was sufficient to produce the desired combination of woodland attributes. Both moderate and heavy overstory thinning were successful at reducing the number of trees to match woodland levels. To reach these levels, however, I also reduced the basal area to below woodland levels. Basal area will recover to woodland levels as stand growth is concentrated in the remaining overstory trees. Using standard growth tables, this recovery should take between five and fifteen years (Anonymous 1975). Burning in addition to thinning was necessary to reduce shrub cover, although repeated burns will be necessary to maintain this level of cover. Despite the mortality of some overstory trees in the burning treatments, this mortality was limited to heavily thinned stands, and there was no significant effect of burning on density of live woody stems larger than 10-cm DBH.

Burning affected individual understory species differently, with most shrub species decreasing in percent cover, tree species in the understory showing no effect of burning, and herbaceous species ranging from no effect (*Carex* spp.) to a dramatic reduction (*Trientalis borealis*). While these effects were not enough to significantly change plant associations after a single burn, the accumulation of these differential effects after repeated fires may eventually result in changes to the community type.

Thinning had significant effects on the cover of only two species, *Acer rubrum* and *Carex* spp., both of which were increased by thinning. Thinning also tended to increase the percent cover of some shrubs (*Hamamelis virginiana* and *Vaccinium angustifolium*), while its effects on other species was less clear.

Thinning also increased available light to the understory, and this increase in light favored lowbush blueberry plants, resulting in higher cover, more flowers, and an increase in berry production. Despite my apprehension that a growing season burn in 2001 would dramatically decrease berry production in 2002, there were no significant effects of burning on berry production. Data from 2003 will be needed to identify whether understory burning results in the increases in yields observed with burning in open blueberry barrens. It appears that while overstory thinning increases light to woodland levels in the year after treatments, periodic burning is necessary to maintain these levels at shrub height, and to favor *Vaccinium* species over the longer term.

Prescribed burning increased understory visibility in the year following application, as reflected in the measurements of horizontal foliar density. In fact, burning alone duplicated the reported horizontal structure of pre-European woodlands with a single treatment. This is significant, given that Indians did not mechanically thin stands. The fire history of the reference woodlands in Worcester suggests that burning (and probable mortality from gypsy moth defoliation) can eventually produce the desired overstory structure as well. The thinning treatment accelerated the process of opening the canopy, but had the adverse impact of stimulating sprouting and lengthening fire return intervals. The vertical stratification of the changes in understory visibility indicates that the effect may be short-lived in the thinned stands, with resprouting and regrowth rapidly restoring density to pre-treatment levels. In the thinned stands, more frequent periodic burning is necessary to maintain the open understory than in the unthinned stands. While vegetation response shows that burning should be frequent to maintain understory vegetation attributes in combined thin-burn stands, fuels data suggest that the interval will need to be at least three years between burns.

Management Summary

Based on the results of this research, it is now possible to describe a method for creating and maintaining a woodland opening that meets combined wildlife, aesthetic, and recreational goals. While this method does not directly address timber production, in some cases the income from the sale of wood products resulting from the initial thinning operations may offset or exceed the cost of the treatments. Unfortunately, in many southern New England oak forests, repeated high-grading has left little commercial value in the standing trees (Mauri 1998). In stands lacking sufficient timber value to cover the cost of thinning and prescribed burning, cost-sharing funds for wildlife habitat improvement may be available from state or federal agencies. I would like to stress that while the research for this management option was not aimed directly at meeting timber management goals or improving the quality and quantity of wood products, the combination of moderate thinning with understory burning is compatible with such forest uses. By leaving the largest and healthiest oaks, woodland openings should improve not only wildlife, aesthetic, and recreational values, but also timber values. Although widely used elsewhere in the United States (Barnes et al. 1998, Lanham et al. 2002), the effects of understory prescribed burning on the actual or perceived economic value of oak stands in southern New England remain open for future study.

A management guide for woodland openings will be produced with more details, including cost estimates, as part of a project funded by the USDA through the Massachusetts Agricultural Experiment Station. The following provides a basic overview of the method.

Select a hardwood forest site with at least 25 square feet/acre basal area of overstory oak trees, and an understory containing at least scattered blueberry shrubs (the study sites had 5-10% cover of *Vaccinium angustifolium*). Although the study was limited to approximately 1/2-acre openings, the techniques should be practical on a scale of multiple acres.

Table 27. Sample schedule of management tasks for creation and maintenance of an oak woodland opening.

	Timing	**Tasks**	**Browse**	**Soft mast**
1	Winter, Year 1	Thin overstory		
2	Summer, Year 1		Increased growth	
3	Summer, Year 2		Similar to year 1	Increased mast
4	Autumn, Year 2	Clear firebreaks around unit one		
5	Autumn, Year 2 or Spring, Year 3	Burn unit one		
6	Summer, Year 3		Increased in unit 1	Some mast in both units
7	Summer, Year 4		Similar to year 3	Peak mast production in unit 1
8	Autumn, Year 4	Clear firebreaks around unit two		
9	Autumn, Year 4 or Spring Year 5	Burn unit two		
10	Summer, Year 5		Increased in unit 2	Some mast in both units
11	Summer, Year 6		Similar to year 5	Peak mast production in unit 2
		Repeat steps 4-11		

Thin the overstory to between 25 and 50 sq. ft./acre residual basal area, leaving the largest oaks. Logging should ideally be completed during the dormant season with sufficient snow cover to reduce compaction of the existing blueberry stand and the easily compressed duff layer. Remove the boles of felled trees for firewood or timber. Fell all 1” to 5” DBH trees and shrubs. Although trees 1” to 2” DBH can be killed by the prescribed fire, it may be desirable to fell these smaller saplings for aesthetic reasons. Lop and scatter both the tops of the larger felled trees and the smaller trees and shrubs. This treatment provides an increase in growth of browse from stump sprouts and an increase in soft mast production in the growing season immediately following the thinning.

If a large enough area is being treated (e.g., three to five acres), divide the area into two or more burn units. Clear shrubs from firebreaks around the first burn unit, using a gasoline-powered brush saw or other equipment. Conduct an understory during the dormant season, either in the autumn following thinning, or the next spring before bud break. This schedule (Table 27) allows sufficient time for 10-hr and 100-hr fuels to dry (18 to 29 months, depending on the timing of the thinning and burning treatments). Burn the other unit two years later, and repeat so that each unit is alternately burned every three to five years. This approach provides a high production of browse for wildlife following the understory burns, but recreational and aesthetic values diminish quickly in the years following the burn. Production of soft mast should peak in the second growing season after each burn.

Alternatively, an initial understory burn can be conducted one to two years before the overstory thinning and understory burning. This combination of treatments should provide higher visibility for recreation than the treatments described above, however production of browse for wildlife will be much lower. Production of soft mast will not be stimulated until the second growing season after the overstory thinning and understory burn.

Future Research

This research raised many questions deserving additional study. Measurements of woody vegetation density and dominance, shrub cover, soft mast production, horizontal foliar density, and fuel loading should be repeated. Long-term studies should be made of the effects of repeated burning on individual species and on overall species composition. In particular, future studies should address whether multiple understory burns increase the cover of ericaceous shrubs relative to other species. Research is needed to determine the optimal season and frequency of maintenance burns to keep shrub cover low, maintain low HFD, and maximize berry production, while ensuring adequate fuels for a complete burn. Additional research is also necessary to better compare this treatment with reference fire-maintained oak woodlands, including repeating many of the measures of HFD and *Vaccinium* production at reference woodlands.

All of these results suggest a resilient plant community taking advantage of every change provided by disturbance: forest vegetation responding to increased light with rapid growth and increased seed (fruit) production on the part of soft mast species. Although a single set of treatments significantly changes the overstory and understory structure of the forest, without a long-term change in the disturbance regime, the forest understory will rapidly return to its former state. While there is disagreement as to whether communities maintained by human disturbance are "natural," even after millennia of disturbance (Hunter 1996), the oak woodland community maintained by anthropogenic fire supports not only rare species absent from most “natural” communities (Rawinski 2000), but also a range of other wildlife species and human uses. These woodland openings provide a new technique for meeting combined wildlife, aesthetic and recreational goals, and help to further increase the diversity of vegetation types and forest stand structures in southern New England forests.

APPENDIX A

Study Data

APPENDIX B

Horizontal Foliar Density Comparison Sheet

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APPENDICES

APPENDIX A

STUDY DATA

This appendix contains the raw data referred to in this study.

<u>Treatments by Unit</u>

		Treatments	
		N=No burn, B=Burn	N=No thin, M=Moderate, H=Heavy
Unit	Block	Burn	Thin
A1	A	N	N
A2	A	B	N
A3	A	B	M
A4	A	N	H
A5	A	N	M
A6	A	B	H
B1	B	N	H
B2	B	B	M
B3	B	N	M
B4	B	N	N
B5	B	B	N
B6	B	B	H
C1	C	N	N
C2	C	N	M
C3	C	B	M
C4	C	B	N
C5	C	B	H
C6	C	N	H

Canopy Heights

Unit	Canopy ht (m)	Slope (degrees) along 350° T	Plot aspect	Angle from vertical to top of trees on plot edge
A1	11.2	5	N	81
A2	12.6	5	N	79
A3	14	8	N	80
A4	12.8	6	N	79
A5	11.6	6	N	81
A6	12.6	5	N	79
B1	11	3	NE	79
B2	13	4	NE	77
B3	11	4	NE	80
B4	10	3	NE	80
B5	9.6	4	NE	82
B6	11.8	3	NE	78
C1	16	-3	SE	66
C2	18	-3	ESE	63
C3	18	-8	SE	58
C4	17	-5	ESE	63
C5	22.4	-5	SE	55
C6	18	-5	SE	61

<u>Species Codes</u>

Species codes used in overstory and understory data sets

Species	2000 Overstory	2002 Overstory	2002 Understory	Classification for understory analysis
Acer pennsylvanicum	ACEPEN		ap	tree
Acer rubrum	ACERUB	ARUB	ar	tree
Amelanchier spp.	AMESPP	AMESPP	amel	tree
Aralia nudicalis			an	herb
Aronia arbutifolia			aa	shrub
Betula alleghaniensis	BETALL			
Betula lenta	BETLEN	BLEN	bl	tree
Betula papyrifera	BETPAP	BPAP	bpap	tree
Betula populifolia	BETPOP	BPOP		
Carex spp			cs	herb
Castanea dentata	CASDEN	CDEN	cd	tree
Dennstaedtia punctilobula			dp	herb
Diphasiastrum digitatum			dd	herb
Epigea repens			er	herb
Gaultheria procumbens			gp	herb
Gaylussacia baccata			gb	shrub
Hamamelis virginiana	HAMVIR	HVIR	hv	shrub
Kalmia angustifolia			ka	shrub
Kalmia latifolia	KALLAT	KLAT	kl	shrub
Lycopodium hickeyi			lh	herb
Lycopodium obscurum			lo	herb
Maienthemum canadense			mc	herb
Nemopanthus mucronatus	NEMMUC	NMUC	nm	shrub
Nyssa sylvatica	NYSSYL	NSYL	ns	tree
Osmunda claytoniana			if	herb
Pinus strobus	PINSTR	PSTR	ps	tree
Populus tremuloides	POPTRE			
Prunus spp			ps	shrub
Pteridium aquilinum			pa	herb
Quercus alba	QUEALB	QALB	qa	tree
Quercus coccinea	QUECOC	QCOC	qc	tree
Quercus ilicifolia	QUEILI		qi	tree
Quercus rubra	QUERUB	QRUB		
Quercus spp	QUESPP	Q Sp		
Quercus velutina	QUEVEL	QVEL	qv	tree
Rhododendron roseum			rr	shrub
Rubus hispidus			rh	shrub
Rubus setosus			rs	shrub
Sassafras albidum	SASALB	SALB	sa	shrub

Trientalis borealis			tb	herb
Unknown fern			fern	herb
Uvularia sessilifolia			us	herb
Vaccinium angustifolium			va	shrub
Vaccinium corymbosum	VACCOR	VCOR	vc	shrub
Vaccinium pallidum			vp	shrub
Viburnum acerifolium			vace	shrub
Viburnum cassinoides			vcas	shrub
Moss spp			moss	
? (A4-1)			rd	
rock			rock	

Overstory Data, Pelham, 2000

Standing woody stems ≥ 3-cm DBH. Data sorted by unit, quadrat (q), species, and dbh. Quadrat size for blocks A and B was 0.025 ha, for Block C 0.04 ha. L=Live, D=Dead. CC: D=Dominant, C=Co-dominant, I=Intermediate, S=suppressed/overtopped/dead.

Unit	Q	Spp	L/D	CC	DBH
A1	1	ACERUB	L	I	10.8
A1	1	ACERUB	L	S	10.0
A1	1	ACERUB	L	S	8.0
A1	1	ACERUB	L	S	7.6
A1	1	ACERUB	L	S	7.5
A1	1	ACERUB	L	S	7.5
A1	1	ACERUB	L	S	7.3
A1	1	ACERUB	L	S	6.0
A1	1	ACERUB	L	S	5.2
A1	1	ACERUB	L	S	5.2
A1	1	ACERUB	L	S	5.1
A1	1	ACERUB	L	S	4.9
A1	1	ACERUB	L	S	4.8
A1	1	ACERUB	L	S	4.2
A1	1	ACERUB	L	S	3.9
A1	1	ACERUB	L	S	3.8
A1	1	ACERUB	L	S	3.8
A1	1	ACERUB	L	S	3.8
A1	1	ACERUB	L	S	3.7
A1	1	ACERUB	L	S	3.6
A1	1	ACERUB	L	S	3.5
A1	1	ACERUB	L	S	3.2
A1	1	ACERUB	L	S	3.0
A1	1	ACERUB	L	S	3.0
A1	1	AMESPP	L	S	5.5
A1	1	AMESPP	D	S	4.7
A1	1	BETPAP	L	C	17.3
A1	1	BETPAP	L	C	16.2
A1	1	BETPAP	L	C	13.8
A1	1	CASDEN	D	S	6.1
A1	1	CASDEN	L	S	3.6
A1	1	QUECOC	L	C	25.5
A1	1	QUECOC	L	C	25.1
A1	1	QUECOC	L	C	22.4
A1	1	QUERUB	L	C	18.6
A1	1	QUERUB	L	S	13.4
A1	1	QUERUB	L	S	3.5
A1	1	QUEVEL	L	C	18.5
A1	1	QUEVEL	L	I	14.0
A1	1	QUEVEL	L	I	13.5
A1	1	QUEVEL	L	I	11.6
A1	2	ACERUB	L	I	10.2
A1	2	ACERUB	L	S	8.0
A1	2	ACERUB	L	S	7.2
A1	2	ACERUB	L	I	7.2
A1	2	ACERUB	L	I	7.0
A1	2	ACERUB	L	I	6.5
A1	2	ACERUB	L	S	6.4
A1	2	ACERUB	L	S	6.4
A1	2	ACERUB	L	I	6.2
A1	2	ACERUB	L	S	5.5
A1	2	ACERUB	L	S	4.8
A1	2	ACERUB	L	S	4.5
A1	2	ACERUB	L	S	4.3
A1	2	ACERUB	L	S	3.5
A1	2	ACERUB	L	S	3.5
A1	2	ACERUB	D	S	3.5
A1	2	ACERUB	L	S	3.4
A1	2	ACERUB	L	S	3.2
A1	2	ACERUB	L	S	3.1
A1	2	ACERUB	L	S	3.0
A1	2	AMESPP	L	I	8.1
A1	2	AMESPP	L	S	7.8
A1	2	AMESPP	L	S	7.6
A1	2	AMESPP	L	S	6.8
A1	2	AMESPP	L	S	6.5
A1	2	CASDEN	D	S	7.5
A1	2	CASDEN	D	S	6.5
A1	2	PINSTR	L	I	15.7
A1	2	PINSTR	L	S	6.2
A1	2	QUECOC	L	D	32.8
A1	2	QUECOC	L	C	23.2
A1	2	QUECOC	L	C	22.9
A1	2	QUECOC	L	C	15.5
A1	2	QUECOC	L	I	12.8
A1	2	QUEVEL	L	C	20.2
A1	2	QUEVEL	L	I	14.2
A2	1	ACERUB	L	I	12.9
A2	1	ACERUB	L	I	12.7
A2	1	ACERUB	L	I	10.9
A2	1	ACERUB	L	I	10.7
A2	1	ACERUB	L	S	10.7
A2	1	ACERUB	L	S	9.9
A2	1	ACERUB	L	I	9.1
A2	1	ACERUB	L	I	7.9
A2	1	ACERUB	D	S	7.1
A2	1	ACERUB	L	I	7.1
A2	1	ACERUB	L	S	7.1
A2	1	ACERUB	L	I	7.0
A2	1	ACERUB	L	S	5.6
A2	1	ACERUB	L	S	5.4
A2	1	ACERUB	L	S	5.1
A2	1	ACERUB	L	S	5.1
A2	1	ACERUB	L	S	5.1
A2	1	ACERUB	D	S	4.9
A2	1	ACERUB	L	S	4.7
A2	1	ACERUB	D	S	4.4
A2	1	ACERUB	L	S	4.3
A2	1	ACERUB	L	S	3.8
A2	1	ACERUB	L	S	3.8
A2	1	ACERUB	L	S	3.7
A2	1	ACERUB	L	S	3.6
A2	1	ACERUB	L	S	3.6
A2	1	ACERUB	L	S	3.5
A2	1	ACERUB	L	S	3.3
A2	1	ACERUB	D	S	3.3
A2	1	ACERUB	L	S	3.0
A2	1	ACERUB	L	S	2.8
A2	1	ACERUB	L	S	2.6
A2	1	ACERUB	L	S	2.6
A2	1	ACERUB	L	S	2.5
A2	1	ACERUB	L	S	2.5
A2	1	ACERUB	L	S	2.5
A2	1	BETPOP	L	I	13.2
A2	1	CASDEN	D	S	4.6
A2	1	CASDEN	D	S	4.4
A2	1	CASDEN	D	S	3.4
A2	1	CASDEN	D	S	2.9
A2	1	PINSTR	L	S	9.6
A2	1	PINSTR	L	S	4.6
A2	1	QUECOC	L	D	30.7
A2	1	QUERUB	L	D	29.7
A2	1	QUERUB	L	D	22.1
A2	1	QUERUB	L	S	10.4
A2	2	ACERUB	L	C	15.6
A2	2	ACERUB	L	C	15.2
A2	2	ACERUB	L	C	13.2
A2	2	ACERUB	L	C	10.2
A2	2	ACERUB	L	C	8.5
A2	2	ACERUB	L	I	7.5
A2	2	ACERUB	L	I	7.4
A2	2	ACERUB	L	I	6.8
A2	2	ACERUB	L	I	6.5
A2	2	ACERUB	D	S	5.8
A2	2	ACERUB	L	S	5.7
A2	2	ACERUB	D	S	5.3
A2	2	ACERUB	D	S	4.9
A2	2	ACERUB	L	I	4.8
A2	2	ACERUB	D	S	4.7
A2	2	ACERUB	L	S	4.6
A2	2	ACERUB	L	S	4.5
A2	2	ACERUB	L	S	4.4
A2	2	ACERUB	D	S	4.3
A2	2	ACERUB	L	S	4.2
A2	2	ACERUB	L	S	3.6
A2	2	ACERUB	L	S	3.2
A2	2	ACERUB	L	S	3.2
A2	2	ACERUB	D	S	3.2
A2	2	ACERUB	L	S	3.0
A2	2	ACERUB	L	S	2.8
A2	2	ACERUB	L	S	2.5
A2	2	ACERUB	L	S	2.5
A2	2	AMESPP	L	S	12.6
A2	2	AMESPP	L	I	10.3
A2	2	AMESPP	L	I	10.2
A2	2	AMESPP	L	I	9.6

Unit	Q	Spp	L/D	CC	DBH
A2	2	AMESPP	L	I	9.0
A2	2	AMESPP	L	I	7.6
A2	2	AMESPP	D	S	6.7
A2	2	AMESPP	D	S	6.6
A2	2	AMESPP	L	S	5.6
A2	2	AMESPP	L	S	5.5
A2	2	AMESPP	D	S	5.1
A2	2	AMESPP	D	S	5.0
A2	2	AMESPP	D	S	5.0
A2	2	AMESPP	L	S	4.2
A2	2	BETPOP	L	C	15.9
A2	2	BETPOP	L	D	15.5
A2	2	BETPOP	D	S	10.5
A2	2	BETPOP	L	I	7.0
A2	2	CASDEN	L	S	4.0
A2	2	CASDEN	L	S	3.2
A2	2	CASDEN	L	S	2.8
A2	2	PINSTR	L	S	4.2
A2	2	QUECOC	L	C	18.2
A2	2	QUERUB	L	D	31.2
A2	2	QUERUB	L	D	26.2
A2	2	QUERUB	L	D	20.2
A2	2	SASALB	L	S	4.4
A3	1	ACERUB	L	C	14.0
A3	1	ACERUB	L	I	10.2
A3	1	ACERUB	L	C	9.9
A3	1	ACERUB	L	C	9.4
A3	1	ACERUB	L	C	8.4
A3	1	ACERUB	L	I	7.6
A3	1	ACERUB	L	S	7.1
A3	1	ACERUB	L	I	6.4
A3	1	ACERUB	L	I	6.4
A3	1	ACERUB	L	I	6.4
A3	1	ACERUB	L	I	6.1
A3	1	ACERUB	L	S	5.6
A3	1	ACERUB	L	I	5.6
A3	1	ACERUB	L	S	5.6
A3	1	ACERUB	L	S	5.6
A3	1	ACERUB	L	I	5.6
A3	1	ACERUB	L	S	5.3
A3	1	ACERUB	L	I	5.3
A3	1	ACERUB	L	I	5.3
A3	1	ACERUB	L	S	5.1
A3	1	ACERUB	L	S	4.8
A3	1	ACERUB	L	I	4.8
A3	1	ACERUB	L	S	4.8
A3	1	ACERUB	L	S	4.6
A3	1	ACERUB	L	S	4.3
A3	1	ACERUB	L	S	4.1
A3	1	ACERUB	L	S	3.8
A3	1	ACERUB	L	S	3.6
A3	1	ACERUB	L	S	3.6
A3	1	ACERUB	L	S	3.3
A3	1	ACERUB	L	S	3.0
A3	1	ACERUB	L	S	3.0
A3	1	ACERUB	L	S	2.8
A3	1	ACERUB	L	S	2.8
A3	1	ACERUB	L	S	2.8
A3	1	AMESPP	L	I	7.9
A3	1	AMESPP	L	S	6.1
A3	1	AMESPP	L	S	4.1
A3	1	AMESPP	L	S	2.8
A3	1	BETPAP	L	D	21.8
A3	1	BETPAP	L	D	20.3
A3	1	BETPAP	D	S	16.3
A3	1	BETPAP	L	I	6.1
A3	1	BETPAP	L	S	5.1
A3	1	BETPAP	L	S	4.8
A3	1	BETPAP	L	S	3.0
A3	1	CASDEN	L	I	4.8
A3	1	PINSTR	L	C	16.5
A3	1	QUERUB	L	D	24.4
A3	1	QUERUB	L	D	22.4
A3	1	QUERUB	L	D	19.8
A3	1	QUERUB	L	D	17.3
A3	1	QUERUB	L	C	16.8
A3	1	QUERUB	D	S	14.0
A3	1	QUERUB	D	S	13.5
A3	1	QUESPP	D	S	16.3
A3	1	QUEVEL	L	D	32.8
A3	1	QUEVEL	L	D	29.0
A3	1	QUEVEL	L	C	21.6
A3	1	QUEVEL	L	D	18.8
A3	1	QUEVEL	L	C	12.4
A3	1	SPP1	L	S	4.6
A3	1	SPP1	L	S	2.8
A3	1	SPP1	L	S	2.8
A3	2	ACERUB	L	I	11.2
A3	2	ACERUB	L	C	10.2
A3	2	ACERUB	L	C	9.7
A3	2	ACERUB	L	C	9.4
A3	2	ACERUB	L	I	8.4
A3	2	ACERUB	L	I	7.1
A3	2	ACERUB	L	I	6.4
A3	2	ACERUB	L	S	6.1
A3	2	ACERUB	L	I	6.1
A3	2	ACERUB	L	I	5.8
A3	2	ACERUB	L	I	5.8
A3	2	ACERUB	D	S	5.1
A3	2	ACERUB	L	S	4.8
A3	2	ACERUB	L	S	4.8
A3	2	ACERUB	L	I	4.6
A3	2	ACERUB	L	I	4.6
A3	2	ACERUB	L	S	4.6
A3	2	ACERUB	L	S	4.1
A3	2	ACERUB	L	S	4.1
A3	2	ACERUB	L	S	4.1
A3	2	ACERUB	L	I	3.8
A3	2	ACERUB	L	S	3.0
A3	2	ACERUB	L	S	2.8
A3	2	ACERUB	L	S	2.5
A3	2	ACERUB	D	S	2.5
A3	2	AMESPP	L	S	6.1
A3	2	CASDEN	D	S	3.8
A3	2	CASDEN	L	S	3.0
A3	2	HAMVIR	L	S	4.1
A3	2	HAMVIR	L	S	4.1
A3	2	HAMVIR	L	S	3.6
A3	2	HAMVIR	L	S	3.6
A3	2	HAMVIR	L	S	3.3
A3	2	HAMVIR	L	S	2.8
A3	2	HAMVIR	L	S	2.8
A3	2	HAMVIR	L	S	2.5
A3	2	QUERUB	L	D	23.1
A3	2	QUERUB	L	D	23.1
A3	2	QUERUB	D	S	12.7
A3	2	QUERUB	D	S	11.2
A3	2	QUESPP	D	S	4.1
A3	2	QUEVEL	L	D	26.7
A3	2	QUEVEL	L	D	25.4
A3	2	QUEVEL	L	D	24.4
A3	2	QUEVEL	L	D	22.9
A3	2	QUEVEL	L	D	21.6
A3	2	QUEVEL	L	D	20.1
A3	2	QUEVEL	L	D	19.1
A3	2	QUEVEL	L	C	14.2
A4	1	ACERUB	L	I	11.5
A4	1	ACERUB	L	S	8.2
A4	1	ACERUB	L	S	7.9
A4	1	ACERUB	L	S	7.0
A4	1	ACERUB	L	I	7.0
A4	1	ACERUB	L	S	6.7
A4	1	ACERUB	L	I	6.6
A4	1	ACERUB	L	S	5.4
A4	1	ACERUB	L	S	5.3
A4	1	ACERUB	L	I	5.2
A4	1	ACERUB	L	S	5.0
A4	1	ACERUB	L	S	4.6
A4	1	ACERUB	L	S	4.5
A4	1	ACERUB	L	S	4.2
A4	1	ACERUB	L	S	4.2
A4	1	ACERUB	L	S	4.2
A4	1	ACERUB	L	S	4.1
A4	1	ACERUB	L	S	4.1
A4	1	ACERUB	L	S	3.8
A4	1	ACERUB	L	S	3.5
A4	1	ACERUB	L	S	3.3
A4	1	ACERUB	L	S	3.0
A4	1	AMESPP	L	I	8.3
A4	1	AMESPP	L	S	8.1
A4	1	AMESPP	L	I	7.8
A4	1	AMESPP	L	I	6.7
A4	1	AMESPP	L	S	5.9
A4	1	AMESPP	L	I	5.0
A4	1	AMESPP	L	S	4.8
A4	1	AMESPP	L	S	4.0
A4	1	AMESPP	L	S	3.4
A4	1	BETPOP	L	I	8.0
A4	1	BETPOP	L	S	5.0
A4	1	CASDEN	D		6.8
A4	1	CASDEN	D	S	6.1
A4	1	CASDEN	D		5.5
A4	1	CASDEN	D		5.3
A4	1	CASDEN	D		4.4
A4	1	CASDEN	L	S	4.4
A4	1	CASDEN	D	S	4.2
A4	1	CASDEN	D		4.0
A4	1	CASDEN	D		3.5
A4	1	CASDEN	D		3.3
A4	1	CASDEN	L	S	3.2
A4	1	CASDEN	L	S	3.2
A4	1	CASDEN	D	S	3.1
A4	1	CASDEN	D	S	3.0
A4	1	CASDEN	L	S	3.0
A4	1	NEMMUC	L	S	4.0
A4	1	NEMMUC	L	S	3.3
A4	1	NEMMUC	L	S	3.0
A4	1	PINSTR	L	S	7.4
A4	1	QUEVEL	L	D	32.3

Unit	Q	Spp	L/D	CC	DBH
A4	1	QUEVEL	L	C	28.2
A4	1	QUEVEL	D	S	8.8
A4	1	QUEVEL	L	D	4.4
A4	2	ACERUB	L	I	8.2
A4	2	ACERUB	L	S	7.8
A4	2	ACERUB	L	I	6.8
A4	2	ACERUB	L	I	6.6
A4	2	ACERUB	L	S	6.6
A4	2	ACERUB	L	I	6.4
A4	2	ACERUB	L	S	5.8
A4	2	ACERUB	L	S	5.3
A4	2	ACERUB	L	S	5.0
A4	2	ACERUB	L	S	4.6
A4	2	ACERUB	L	S	4.4
A4	2	ACERUB	L	S	4.3
A4	2	ACERUB	L	S	4.3
A4	2	ACERUB	L	S	4.0
A4	2	ACERUB	L	S	3.9
A4	2	ACERUB	L	S	3.8
A4	2	ACERUB	L	S	3.5
A4	2	ACERUB	L	S	3.5
A4	2	AMESPP	L	S	7.2
A4	2	AMESPP	L	S	6.2
A4	2	AMESPP	L	S	5.5
A4	2	AMESPP	D		5.2
A4	2	AMESPP	L	S	5.0
A4	2	AMESPP	L	S	4.5
A4	2	AMESPP	L	S	4.2
A4	2	AMESPP	L	I	3.3
A4	2	BETPOP	L	I	7.1
A4	2	BETPOP	L	I	6.4
A4	2	BETPOP	L	I	6.3
A4	2	BETPOP	L	S	6.0
A4	2	BETPOP	L	I	5.8
A4	2	BETPOP	L	S	4.8
A4	2	BETPOP	L	S	4.7
A4	2	BETPOP	L	S	4.2
A4	2	BETPOP	L	S	4.2
A4	2	BETPOP	L	S	4.1
A4	2	BETPOP	L	S	4.0
A4	2	BETPOP	L	S	3.5
A4	2	BETPOP	L	S	3.5
A4	2	BETPOP	L	S	3.3
A4	2	BETPOP	L	S	3.2
A4	2	CASDEN	L	S	5.8
A4	2	CASDEN	L	I	5.3
A4	2	CASDEN	D		4.9
A4	2	CASDEN	D		4.5
A4	2	CASDEN	D		4.5
A4	2	CASDEN	L	I	4.3
A4	2	CASDEN	L	S	4.2
A4	2	CASDEN	D		4.2
A4	2	CASDEN	D		3.6
A4	2	CASDEN	D		3.5
A4	2	CASDEN	L	S	3.0
A4	2	CASDEN	L	S	3.0
A4	2	CASDEN	D		3.0
A4	2	PINSTR	L	I	12.9
A4	2	POPTRE	D		13.4
A4	2	QUECOC	L	D	21.3
A4	2	QUECOC	L	C	16.0
A4	2	QUEILI	L	S	3.0
A4	2	QUEVEL	L	D	24.2

Unit	Q	Spp	L/D	CC	DBH
A4	2	QUEVEL	L	C	20.0
A4	2	QUEVEL	L	C	16.5
A4	2	QUEVEL	L	C	13.6
A5	1	ACERUB	L	S	9.5
A5	1	ACERUB	L	S	8.6
A5	1	ACERUB	D	S	8.4
A5	1	ACERUB	L	I	8.4
A5	1	ACERUB	L	S	7.0
A5	1	ACERUB	L	I	6.8
A5	1	ACERUB	L	I	6.8
A5	1	ACERUB	L	S	6.7
A5	1	ACERUB	L	S	6.7
A5	1	ACERUB	L	S	6.6
A5	1	ACERUB	D	S	6.4
A5	1	ACERUB	D	S	6.4
A5	1	ACERUB	L	S	5.7
A5	1	ACERUB	L	S	5.6
A5	1	ACERUB	L	S	5.5
A5	1	ACERUB	L	S	5.5
A5	1	ACERUB	L	S	5.4
A5	1	ACERUB	L	S	5.4
A5	1	ACERUB	L	S	5.4
A5	1	ACERUB	L	S	5.0
A5	1	ACERUB	D	S	5.0
A5	1	ACERUB	D	S	4.7
A5	1	ACERUB	L	S	4.7
A5	1	ACERUB	L	S	4.5
A5	1	ACERUB	L	S	4.5
A5	1	ACERUB	D	S	4.3
A5	1	ACERUB	L	S	4.3
A5	1	ACERUB	D	S	4.3
A5	1	ACERUB	L	S	4.1
A5	1	ACERUB	D	S	4.0
A5	1	ACERUB	L	S	4.0
A5	1	ACERUB	L	S	3.9
A5	1	ACERUB	D	S	3.2
A5	1	ACERUB	D	S	2.9
A5	1	ACERUB	L	S	2.5
A5	1	ACERUB	L	S	2.5
A5	1	ACERUB	L	S	2.5
A5	1	ACERUB	L	S	2.5
A5	1	AMESPP	L	S	6.4
A5	1	BETPAP	L	C	27.1
A5	1	BETPAP	L	S	7.5
A5	1	BETPAP	L	S	7.1
A5	1	BETPAP	L	S	3.1
A5	1	BETPAP	L	S	2.6
A5	1	CASDEN	D	S	3.6
A5	1	CASDEN	D	S	3.3
A5	1	CASDEN	D	S	2.5
A5	1	HAMVIR	L	S	3.7
A5	1	HAMVIR	L	S	3.2
A5	1	HAMVIR	L	S	3.2
A5	1	HAMVIR	L	S	3.1
A5	1	HAMVIR	L	S	3.0
A5	1	HAMVIR	L	S	2.8
A5	1	HAMVIR	L	S	2.8
A5	1	HAMVIR	L	S	2.6
A5	1	HAMVIR	L	S	2.6
A5	1	NEMMUC	L	S	3.8
A5	1	NEMMUC	D	S	3.6
A5	1	NEMMUC	L	S	3.3
A5	1	NEMMUC	L	S	3.1

Unit	Q	Spp	L/D	CC	DBH
A5	1	NEMMUC	L	S	3.1
A5	1	NEMMUC	L	S	3.0
A5	1	NEMMUC	L	S	2.6
A5	1	NEMMUC	D	S	2.5
A5	1	PINSTR	L	I	15.4
A5	1	QUECOC	L	C	23.8
A5	1	QUECOC	L	C	18.9
A5	1	QUERUB	L	S	28.0
A5	1	QUERUB	L	C	25.6
A5	1	QUERUB	L	C	21.5
A5	1	QUERUB	L	C	18.6
A5	1	QUERUB	D	S	18.4
A5	1	QUERUB	L	C	17.8
A5	1	QUERUB	D	S	8.8
A5	1	QUERUB	D	S	6.2
A5	1	QUEVEL	L	C	25.0
A5	1	QUEVEL	L	C	22.5
A5	2	ACERUB	D	S	16.0
A5	2	ACERUB	L	C	15.1
A5	2	ACERUB	L	I	11.4
A5	2	ACERUB	L	S	11.3
A5	2	ACERUB	L	S	9.7
A5	2	ACERUB	L	S	9.3
A5	2	ACERUB	L	S	9.3
A5	2	ACERUB	L	I	9.1
A5	2	ACERUB	D	S	7.9
A5	2	ACERUB	L	S	7.9
A5	2	ACERUB	L	S	7.8
A5	2	ACERUB	L	S	7.5
A5	2	ACERUB	L	S	7.3
A5	2	ACERUB	L	S	7.3
A5	2	ACERUB	L	S	7.0
A5	2	ACERUB	D	S	6.9
A5	2	ACERUB	L	S	6.9
A5	2	ACERUB	L	S	6.7
A5	2	ACERUB	L	S	6.5
A5	2	ACERUB	L	S	6.5
A5	2	ACERUB	L	S	6.4
A5	2	ACERUB	L	S	5.9
A5	2	ACERUB	L	S	5.8
A5	2	ACERUB	L	S	5.7
A5	2	ACERUB	L	S	5.3
A5	2	ACERUB	D	S	5.1
A5	2	ACERUB	L	S	5.0
A5	2	ACERUB	L	S	4.9
A5	2	ACERUB	L	S	4.7
A5	2	ACERUB	L	S	4.7
A5	2	ACERUB	L	S	4.4
A5	2	ACERUB	L	S	4.3
A5	2	ACERUB	L	S	4.3
A5	2	ACERUB	L	S	4.2
A5	2	ACERUB	L	S	3.9
A5	2	ACERUB	L	S	3.6
A5	2	ACERUB	D	S	3.5
A5	2	ACERUB	D	S	3.0
A5	2	ACERUB	D	S	3.0
A5	2	AMESPP	L	S	9.5
A5	2	AMESPP	L	S	6.8
A5	2	AMESPP	L	S	6.1
A5	2	AMESPP	L	S	5.2
A5	2	AMESPP	D	S	4.9
A5	2	BETPOP	L	S	7.9
A5	2	BETPOP	L	S	7.0

Unit	Q	Spp	L/D	CC	DBH
A5	2	BETPOP	L	S	6.4
A5	2	BETPOP	L	S	5.6
A5	2	BETPOP	L	S	3.2
A5	2	BETPOP	L	S	3.0
A5	2	BETPOP	L	S	2.8
A5	2	BETPOP	L	S	2.7
A5	2	CASDEN	D	S	5.0
A5	2	CASDEN	L	S	4.5
A5	2	CASDEN	L	S	4.4
A5	2	CASDEN	D	S	4.4
A5	2	CASDEN	D	S	4.3
A5	2	CASDEN	D	S	4.1
A5	2	CASDEN	D	S	4.1
A5	2	CASDEN	L	S	3.3
A5	2	CASDEN	D	S	3.0
A5	2	CASDEN	D	S	3.0
A5	2	CASDEN	D	S	2.5
A5	2	PINSTR	L	S	18.5
A5	2	PINSTR	L	S	9.9
A5	2	PINSTR	L	S	9.0
A5	2	PINSTR	L	S	6.1
A5	2	PINSTR	L	S	4.0
A5	2	QUECOC	L	C	27.6
A5	2	QUEVEL	L	C	28.1
A5	2	QUEVEL	L	C	25.6
A5	2	QUEVEL	L	C	21.9
A6	1	ACERUB	L	I	9.0
A6	1	ACERUB	L	I	8.9
A6	1	ACERUB	L	S	8.0
A6	1	ACERUB	D	S	7.7
A6	1	ACERUB	L	S	6.9
A6	1	ACERUB	L	S	6.5
A6	1	ACERUB	L	S	6.4
A6	1	ACERUB	D	S	6.2
A6	1	ACERUB	L	S	5.7
A6	1	ACERUB	L	S	4.8
A6	1	ACERUB	L	S	4.4
A6	1	ACERUB	L	S	4.3
A6	1	ACERUB	L	S	4.2
A6	1	ACERUB	L	S	4.2
A6	1	ACERUB	D	S	4.1
A6	1	ACERUB	D	S	4.0
A6	1	ACERUB	L	S	4.0
A6	1	ACERUB	L	S	4.0
A6	1	ACERUB	D	S	3.7
A6	1	ACERUB	L	S	3.5
A6	1	ACERUB	L	S	3.5
A6	1	ACERUB	L	S	3.1
A6	1	BETPOP	L	S	5.1
A6	1	CASDEN	D	S	8.4
A6	1	CASDEN	D	S	3.2
A6	1	CASDEN	D	S	2.7
A6	1	CASDEN	L	S	2.7
A6	1	PINSTR	L	I	17.0
A6	1	PINSTR	L	I	14.4
A6	1	PINSTR	L	S	10.1
A6	1	QUECOC	L	C	28.0
A6	1	QUECOC	L	C	24.5
A6	1	QUERUB	L	C	19.6
A6	1	QUERUB	L	C	19.5
A6	1	QUERUB	L	I	10.4
A6	1	QUERUB	D	S	8.4
A6	1	QUEVEL	L	C	29.4

Unit	Q	Spp	L/D	CC	DBH
A6	1	QUEVEL	L	C	23.7
A6	2	ACERUB	L	I	9.1
A6	2	ACERUB	L	I	7.8
A6	2	ACERUB	L	S	7.0
A6	2	ACERUB	L	S	6.8
A6	2	ACERUB	L	S	6.4
A6	2	ACERUB	L	S	6.4
A6	2	ACERUB	L	S	6.3
A6	2	ACERUB	L	S	6.2
A6	2	ACERUB	L	S	6.1
A6	2	ACERUB	L	S	6.0
A6	2	ACERUB	L	S	6.0
A6	2	ACERUB	L	S	6.0
A6	2	ACERUB	L	S	5.9
A6	2	ACERUB	L	S	5.6
A6	2	ACERUB	L	S	5.5
A6	2	ACERUB	L	S	5.1
A6	2	ACERUB	L	S	5.1
A6	2	ACERUB	L	S	5.0
A6	2	ACERUB	L	S	4.5
A6	2	ACERUB	L	S	4.4
A6	2	ACERUB	L	S	4.1
A6	2	ACERUB	L	S	4.1
A6	2	ACERUB	L	S	4.0
A6	2	ACERUB	L	S	3.8
A6	2	ACERUB	L	S	3.4
A6	2	ACERUB	L	S	3.1
A6	2	ACERUB	L	S	3.0
A6	2	ACERUB	L	S	3.0
A6	2	ACERUB	L	S	2.6
A6	2	ACERUB	L	S	2.6
A6	2	BETPAP	L	I	17.4
A6	2	BETPAP	D	S	15.4
A6	2	CASDEN	D	S	4.5
A6	2	CASDEN	D	S	3.8
A6	2	CASDEN	L	S	3.6
A6	2	CASDEN	L	S	3.1
A6	2	CASDEN	L	S	3.0
A6	2	HAMVIR	L	S	3.0
A6	2	HAMVIR	L	S	3.0
A6	2	HAMVIR	L	S	3.0
A6	2	QUEALB	L	I	17.2
A6	2	QUECOC	L	C	23.8
A6	2	QUECOC	L	C	18.4
A6	2	QUERUB	L	C	23.3
A6	2	QUERUB	L	C	21.8
A6	2	QUERUB	L	C	21.6
A6	2	QUERUB	L	C	18.8
A6	2	QUERUB	L	C	18.8
A6	2	QUERUB	L	I	16.8
A6	2	QUERUB	L	C	16.7
A6	2	QUERUB	L	I	16.7
A6	2	QUERUB	L	C	15.0
A6	2	QUERUB	D	S	13.4
A6	2	QUERUB	L	S	10.6
A6	2	QUERUB	D	S	9.6
A6	2	QUERUB	L	S	2.7
B1	1	ACERUB	L	C	13.5
B1	1	ACERUB	L	C	13.0
B1	1	ACERUB	L	C	12.2
B1	1	ACERUB	L	I	12.0
B1	1	ACERUB	L	I	11.5
B1	1	ACERUB	L	I	10.5

Unit	Q	Spp	L/D	CC	DBH
B1	1	ACERUB	L	I	9.2
B1	1	ACERUB	L	I	8.8
B1	1	ACERUB	L	I	8.5
B1	1	ACERUB	L	I	7.9
B1	1	ACERUB	D	S	7.4
B1	1	ACERUB	L	S	7.3
B1	1	ACERUB	L	S	6.8
B1	1	ACERUB	L	S	6.7
B1	1	ACERUB	L	S	6.6
B1	1	ACERUB	L	S	6.2
B1	1	ACERUB	L	I	6.2
B1	1	ACERUB	L	S	6.1
B1	1	ACERUB	L	S	6.0
B1	1	ACERUB	L	I	5.8
B1	1	ACERUB	L	S	5.6
B1	1	ACERUB	L	I	5.6
B1	1	ACERUB	L	I	5.5
B1	1	ACERUB	L	S	5.4
B1	1	ACERUB	L	S	5.0
B1	1	ACERUB	L	S	5.0
B1	1	ACERUB	L	S	4.9
B1	1	ACERUB	L	S	4.6
B1	1	ACERUB	L	S	4.6
B1	1	ACERUB	L	S	4.2
B1	1	ACERUB	L	S	4.0
B1	1	ACERUB	L	S	3.8
B1	1	ACERUB	L	S	3.8
B1	1	ACERUB	L	S	3.8
B1	1	ACERUB	D	S	3.5
B1	1	ACERUB	L	S	3.3
B1	1	ACERUB	L	S	3.2
B1	1	AMESPP	L	S	6.5
B1	1	AMESPP	L	S	5.9
B1	1	AMESPP	L	S	5.2
B1	1	AMESPP	L	S	4.1
B1	1	AMESPP	L	S	3.8
B1	1	AMESPP	L	S	3.5
B1	1	BETPAP	L	C	14.1
B1	1	BETPAP	L	C	13.9
B1	1	BETPAP	L	C	12.5
B1	1	BETPAP	L	C	11.8
B1	1	BETPAP	L	S	6.0
B1	1	BETPAP	L	S	5.9
B1	1	BETPAP	L	S	4.1
B1	1	BETPAP	L	S	3.3
B1	1	CASDEN	D	S	4.8
B1	1	CASDEN	L	S	4.2
B1	1	CASDEN	L	S	3.6
B1	1	QUECOC	L	D	24.4
B1	1	QUECOC	L	C	17.1
B1	1	QUECOC	L	I	16.8
B1	1	QUECOC	L	I	16.6
B1	1	QUECOC	L	C	14.5
B1	1	QUECOC	L	S	4.4
B1	1	QUEVEL	L	D	18.8
B1	1	QUEVEL	D	S	16.3
B1	1	SASALB	L	S	7.8
B1	1	SASALB	L	S	3.0
B1	1	VACCOR	L	S	3.8
B1	1	VACCOR	L	S	3.6
B1	1	VACCOR	L	S	3.0
B1	2	ACERUB	L	S	12.3
B1	2	ACERUB	D	S	11.5

Unit	Q	Spp	L/D	CC	DBH
B1	2	ACERUB	L	I	9.8
B1	2	ACERUB	D	S	9.5
B1	2	ACERUB	L	I	8.5
B1	2	ACERUB	L	S	7.6
B1	2	ACERUB	L	S	7.5
B1	2	ACERUB	L	S	6.4
B1	2	ACERUB	L	S	6.0
B1	2	ACERUB	L	S	5.7
B1	2	ACERUB	L	S	5.2
B1	2	ACERUB	L	S	5.0
B1	2	ACERUB	L	S	4.9
B1	2	ACERUB	L	S	4.8
B1	2	ACERUB	L	S	4.7
B1	2	ACERUB	L	S	4.5
B1	2	ACERUB	L	S	4.3
B1	2	ACERUB	L	S	4.2
B1	2	ACERUB	L	S	4.1
B1	2	ACERUB	L	S	4.0
B1	2	ACERUB	L	S	4.0
B1	2	ACERUB	L	S	3.7
B1	2	ACERUB	L	S	3.5
B1	2	ACERUB	L	S	3.2
B1	2	ACERUB	D	S	3.0
B1	2	AMESPP	L	S	7.2
B1	2	AMESPP	L	S	5.0
B1	2	AMESPP	L	S	3.8
B1	2	AMESPP	L	S	3.5
B1	2	AMESPP	L	S	3.0
B1	2	AMESPP	L	S	3.0
B1	2	BETPAP	L	I	16.8
B1	2	BETPAP	L	S	10.6
B1	2	BETPAP	L	S	5.0
B1	2	BETPAP	L	S	4.0
B1	2	BETPAP	D	S	3.0
B1	2	PINSTR	L	S	5.1
B1	2	QUECOC	L	D	31.5
B1	2	QUECOC	L	D	21.3
B1	2	QUECOC	D	I	16.0
B1	2	QUEILI	L	S	10.2
B1	2	QUEILI	D	S	5.2
B1	2	QUEVEL	L	C	22.6
B1	2	QUEVEL	L	D	22.5
B1	2	QUEVEL	L	C	19.7
B1	2	QUEVEL	L	D	18.0
B1	2	QUEVEL	D	S	10.2
B1	2	SASALB	D	S	7.0
B1	2	SASALB	L	S	5.0
B1	2	SASALB	L	S	4.9
B2	1	ACERUB	L	C	17.7
B2	1	ACERUB	L	C	13.5
B2	1	ACERUB	L	I	9.6
B2	1	ACERUB	L	S	6.5
B2	1	ACERUB	L	S	6.5
B2	1	ACERUB	L	S	5.5
B2	1	ACERUB	L	S	5.5
B2	1	ACERUB	L	S	5.3
B2	1	ACERUB	L	S	5.1
B2	1	ACERUB	L	S	4.8
B2	1	ACERUB	L	S	4.5
B2	1	ACERUB	L	S	4.2
B2	1	ACERUB	L	S	4.1
B2	1	ACERUB	L	S	4.0
B2	1	ACERUB	L	S	3.7

Unit	Q	Spp	L/D	CC	DBH
B2	1	ACERUB	L	S	3.7
B2	1	ACERUB	L	S	3.6
B2	1	ACERUB	L	S	3.5
B2	1	ACERUB	L	S	3.5
B2	1	ACERUB	L	S	3.5
B2	1	ACERUB	L	S	3.5
B2	1	ACERUB	L	S	3.4
B2	1	ACERUB	L	S	3.3
B2	1	ACERUB	L	S	3.2
B2	1	ACERUB	L	S	3.2
B2	1	ACERUB	L	S	3.1
B2	1	ACERUB	L	S	3.1
B2	1	ACERUB	L	S	3.0
B2	1	ACERUB	L	S	2.9
B2	1	ACERUB	L	S	2.8
B2	1	ACERUB	L	S	2.8
B2	1	ACERUB	L	S	2.7
B2	1	ACERUB	L	S	2.6
B2	1	BETPOP	L	S	3.6
B2	1	CASDEN	L	S	5.2
B2	1	CASDEN	D	S	4.8
B2	1	CASDEN	D	S	3.9
B2	1	CASDEN	D	S	3.9
B2	1	CASDEN	D	S	3.6
B2	1	CASDEN	L	S	3.4
B2	1	CASDEN	L	S	3.3
B2	1	CASDEN	L	S	3.3
B2	1	CASDEN	D	S	3.0
B2	1	CASDEN	D	S	2.9
B2	1	CASDEN	D	S	2.9
B2	1	QUECOC	L	C	26.5
B2	1	QUECOC	L	C	25.2
B2	1	QUECOC	L	C	21.8
B2	1	QUECOC	L	C	19.8
B2	1	QUECOC	L	C	18.5
B2	1	QUECOC	L	C	18.0
B2	1	QUECOC	L	I	16.0
B2	1	QUECOC	D	S	6.8
B2	1	QUEVEL	L	C	22.3
B2	1	QUEVEL	L	C	20.1
B2	1	QUEVEL	L	C	18.7
B2	1	QUEVEL	L	C	17.9
B2	1	QUEVEL	L	S	4.2
B2	1	QUEVEL	L	S	2.5
B2	2	ACERUB	L	I	6.7
B2	2	ACERUB	L	I	6.5
B2	2	ACERUB	L	S	5.8
B2	2	ACERUB	L	I	5.7
B2	2	ACERUB	L	I	5.4
B2	2	ACERUB	L	I	5.0
B2	2	ACERUB	L	S	4.6
B2	2	ACERUB	L	S	4.4
B2	2	ACERUB	L	S	4.2
B2	2	ACERUB	L	S	4.2
B2	2	ACERUB	L	S	4.1
B2	2	ACERUB	L	S	4.0
B2	2	ACERUB	L	S	3.7
B2	2	ACERUB	L	S	3.5
B2	2	ACERUB	L	S	3.5
B2	2	ACERUB	L	S	3.5
B2	2	ACERUB	L	S	3.5
B2	2	ACERUB	L	S	3.4
B2	2	ACERUB	L	I	3.4

Unit	Q	Spp	L/D	CC	DBH
B2	2	ACERUB	L	S	3.2
B2	2	ACERUB	L	S	3.0
B2	2	ACERUB	L	S	2.9
B2	2	ACERUB	L	S	2.8
B2	2	ACERUB	L	S	2.6
B2	2	ACERUB	L	S	2.6
B2	2	ACERUB	L	S	2.6
B2	2	ACERUB	L	S	2.5
B2	2	ACERUB	L	S	2.5
B2	2	ACERUB	L	S	2.0
B2	2	CASDEN	D	S	5.6
B2	2	CASDEN	D	S	5.1
B2	2	CASDEN	L	S	5.1
B2	2	CASDEN	D	S	5.1
B2	2	CASDEN	D	S	5.0
B2	2	CASDEN	D	S	4.8
B2	2	CASDEN	D	S	4.0
B2	2	CASDEN	L	S	3.1
B2	2	CASDEN	D	S	3.0
B2	2	CASDEN	D	S	2.9
B2	2	QUECOC	L	C	27.2
B2	2	QUECOC	L	C	24.9
B2	2	QUECOC	L	C	23.8
B2	2	QUECOC	L	S	21.5
B2	2	QUECOC	L	C	21.2
B2	2	QUECOC	L	C	19.3
B2	2	QUECOC	L	C	18.5
B2	2	QUECOC	L	C	15.6
B2	2	QUECOC	L	S	4.8
B2	2	QUECOC	L	S	4.2
B2	2	QUECOC	L	S	4.1
B2	2	QUECOC	L	S	3.0
B2	2	QUEVEL	L	C	16.6
B2	2	QUEVEL	L	I	16.0
B2	2	QUEVEL	L	C	15.0
B2	2	QUEVEL	L	S	13.1
B2	2	QUEVEL	D	S	9.6
B2	2	QUEVEL	L	S	2.6
B3	1	ACERUB	L	I	10.8
B3	1	ACERUB	L	S	9.4
B3	1	ACERUB	L	S	9.3
B3	1	ACERUB	L	S	7.5
B3	1	ACERUB	L	S	7.3
B3	1	ACERUB	L	S	6.7
B3	1	ACERUB	L	S	6.5
B3	1	ACERUB	L	S	6.5
B3	1	ACERUB	L	I	6.0
B3	1	ACERUB	L	S	6.0
B3	1	ACERUB	L	S	5.9
B3	1	ACERUB	L	S	5.5
B3	1	ACERUB	L	S	5.4
B3	1	ACERUB	L	S	5.3
B3	1	ACERUB	L	S	4.9
B3	1	ACERUB	L	S	4.9
B3	1	ACERUB	L	S	4.8
B3	1	ACERUB	L	S	4.4
B3	1	ACERUB	L	S	4.3
B3	1	ACERUB	L	S	4.2
B3	1	ACERUB	L	S	4.0
B3	1	ACERUB	L	S	4.0
B3	1	ACERUB	L	S	3.9
B3	1	ACERUB	L	S	3.7
B3	1	ACERUB	D	S	3.7

Unit	Q	Spp	L/D	CC	DBH
B3	1	ACERUB	L	S	3.4
B3	1	ACERUB	L	S	3.1
B3	1	ACERUB	L	S	3.1
B3	1	ACERUB	L	S	3.0
B3	1	ACERUB	L	S	2.9
B3	1	ACERUB	L	S	2.9
B3	1	ACERUB	L	S	2.9
B3	1	ACERUB	L	S	2.8
B3	1	ACERUB	L	S	2.6
B3	1	AMESPP	L	I	10.6
B3	1	BETPOP	D	S	8.9
B3	1	BETPOP	L	I	5.2
B3	1	BETPOP	L	S	3.0
B3	1	CASDEN	L	S	7.0
B3	1	CASDEN	L	S	6.2
B3	1	CASDEN	D	S	4.9
B3	1	CASDEN	L	S	4.4
B3	1	CASDEN	D	S	4.1
B3	1	CASDEN	D	S	4.0
B3	1	CASDEN	L	S	3.7
B3	1	CASDEN	L	S	3.3
B3	1	CASDEN	L	S	3.3
B3	1	CASDEN	L	S	3.2
B3	1	CASDEN	L	S	3.0
B3	1	CASDEN	D	S	3.0
B3	1	CASDEN	L	S	2.7
B3	1	CASDEN	L	S	2.6
B3	1	CASDEN	L	S	2.5
B3	1	PINSTR	L	I	23.0
B3	1	PINSTR	L	S	4.3
B3	1	QUECOC	L	C	27.4
B3	1	QUECOC	L	C	20.8
B3	1	QUECOC	L	C	17.6
B3	1	QUECOC	L	C	16.9
B3	1	QUECOC	L	C	16.8
B3	1	QUECOC	L	C	16.5
B3	1	QUECOC	L	C	15.2
B3	1	QUECOC	L	C	13.6
B3	1	QUESPP	D	S	15.0
B3	1	QUEVEL	L	C	22.4
B3	1	QUEVEL	L	C	20.2
B3	1	QUEVEL	L	I	16.3
B3	1	QUEVEL	D	S	16.2
B3	1	QUEVEL	D	S	14.3
B3	1	QUEVEL	L	I	12.2
B3	1	QUEVEL	D	S	8.5
B3	2	ACERUB	L	I	19.0
B3	2	ACERUB	L	I	11.5
B3	2	ACERUB	L	I	9.2
B3	2	ACERUB	D	S	8.8
B3	2	ACERUB	L	S	8.2
B3	2	ACERUB	L	S	8.2
B3	2	ACERUB	L	S	8.0
B3	2	ACERUB	L	S	6.5
B3	2	ACERUB	L	S	6.5
B3	2	ACERUB	L	S	6.4
B3	2	ACERUB	L	S	6.2
B3	2	ACERUB	L	I	5.7
B3	2	ACERUB	L	S	5.6
B3	2	ACERUB	L	S	5.5
B3	2	ACERUB	L	S	4.1
B3	2	ACERUB	L	S	3.9
B3	2	ACERUB	L	S	3.3

Unit	Q	Spp	L/D	CC	DBH
B3	2	ACERUB	L	S	3.2
B3	2	ACERUB	L	S	3.0
B3	2	ACERUB	L	S	2.7
B3	2	AMESPP	L	S	6.7
B3	2	AMESPP	L	S	4.9
B3	2	AMESPP	L	S	4.1
B3	2	AMESPP	L	S	2.9
B3	2	CASDEN	D	S	6.7
B3	2	CASDEN	D	S	4.1
B3	2	CASDEN	D	S	4.0
B3	2	CASDEN	L	S	2.7
B3	2	QUEALB	D	S	13.5
B3	2	QUEALB	D	S	8.6
B3	2	QUECOC	L	C	23.5
B3	2	QUECOC	L	C	21.9
B3	2	QUECOC	L	C	21.1
B3	2	QUECOC	L	C	20.2
B3	2	QUECOC	L	C	19.0
B3	2	QUECOC	L	C	14.3
B3	2	QUECOC	L	S	12.9
B3	2	QUECOC	L	S	4.6
B3	2	QUERUB	L	C	17.2
B3	2	QUERUB	L	C	14.5
B3	2	QUESPP	D	S	5.2
B3	2	QUEVEL	L	C	21.5
B3	2	QUEVEL	L	C	17.3
B3	2	QUEVEL	D	S	4.8
B3	2	QUEVEL	L	S	4.0
B3	2	QUEVEL	L	S	3.5
B4	1	ACERUB	L	C	17.9
B4	1	ACERUB	L	C	15.1
B4	1	ACERUB	L	I	11.8
B4	1	ACERUB	L	I	11.4
B4	1	ACERUB	L	S	10.5
B4	1	ACERUB	L	S	10.2
B4	1	ACERUB	L	I	8.2
B4	1	ACERUB	D	S	6.5
B4	1	ACERUB	L	S	6.2
B4	1	ACERUB	L	S	6.2
B4	1	ACERUB	L	S	5.6
B4	1	ACERUB	L	S	5.3
B4	1	ACERUB	L	I	5.0
B4	1	ACERUB	L	I	4.8
B4	1	ACERUB	L	S	4.2
B4	1	ACERUB	L	S	3.9
B4	1	ACERUB	L	S	3.7
B4	1	ACERUB	L	S	3.6
B4	1	ACERUB	D	S	3.5
B4	1	ACERUB	D	S	3.3
B4	1	ACERUB	L	S	3.2
B4	1	AMESPP	L	S	7.5
B4	1	AMESPP	D	S	6.0
B4	1	AMESPP	L	S	5.8
B4	1	AMESPP	L	S	3.1
B4	1	BETPAP	L	S	11.0
B4	1	BETPAP	L	S	9.9
B4	1	BETPAP	D	S	6.2
B4	1	BETPAP	L	S	4.0
B4	1	CASDEN	L	S	4.0
B4	1	CASDEN	D	S	3.5
B4	1	CASDEN	L	S	3.0
B4	1	QUEVEL	L	C	22.5
B4	1	QUEVEL	L	D	22.4

Unit	Q	Spp	L/D	CC	DBH
B4	1	QUEVEL	L	D	21.0
B4	1	QUEVEL	L	C	19.9
B4	1	QUEVEL	L	C	19.2
B4	1	QUEVEL	L	C	17.4
B4	1	QUEVEL	L	C	14.8
B4	1	QUEVEL	L	I	14.8
B4	1	QUEVEL	L	S	3.2
B4	2	ACERUB	L	I	14.2
B4	2	ACERUB	L	I	10.5
B4	2	ACERUB	L	I	9.0
B4	2	ACERUB	L	S	8.9
B4	2	ACERUB	L	I	7.8
B4	2	ACERUB	L	S	7.0
B4	2	ACERUB	L	S	6.7
B4	2	ACERUB	L	I	6.1
B4	2	ACERUB	L	S	5.5
B4	2	ACERUB	L	S	4.8
B4	2	ACERUB	L	S	4.6
B4	2	ACERUB	L	S	4.5
B4	2	ACERUB	L	S	4.0
B4	2	ACERUB	D	S	4.0
B4	2	ACERUB	L	S	3.7
B4	2	ACERUB	L	S	3.5
B4	2	ACERUB	L	S	3.3
B4	2	ACERUB	L	S	3.2
B4	2	ACERUB	L	S	3.2
B4	2	ACERUB	L	S	3.0
B4	2	CASDEN	D	S	7.2
B4	2	CASDEN	D	S	6.8
B4	2	CASDEN	D	S	5.5
B4	2	CASDEN	D	S	3.7
B4	2	QUECOC	L	C	23.6
B4	2	QUECOC	L	C	14.1
B4	2	QUEVEL	L	D	24.3
B4	2	QUEVEL	L	D	23.2
B4	2	QUEVEL	L	D	21.8
B4	2	QUEVEL	L	D	20.5
B4	2	QUEVEL	L	C	18.0
B4	2	QUEVEL	L	C	17.9
B4	2	QUEVEL	D	S	17.0
B4	2	QUEVEL	L	I	16.8
B4	2	QUEVEL	L	C	15.5
B4	2	QUEVEL	D	S	12.8
B4	2	QUEVEL	L	S	10.5
B4	2	QUEVEL	L	S	3.6
B5	1	ACERUB	L	I	11.2
B5	1	ACERUB	L	S	10.5
B5	1	ACERUB	L	S	7.0
B5	1	ACERUB	L	I	6.8
B5	1	ACERUB	L	S	5.2
B5	1	ACERUB	L	S	5.0
B5	1	ACERUB	L	S	4.2
B5	1	ACERUB	L	I	4.2
B5	1	ACERUB	L	S	4.0
B5	1	ACERUB	L	I	3.1
B5	1	ACERUB	L	S	3.0
B5	1	ACERUB	L	I	3.0
B5	1	ACERUB	L	I	3.0
B5	1	ACERUB	L	S	3.0
B5	1	AMESPP	L	S	3.3
B5	1	AMESPP	L	S	3.2
B5	1	AMESPP	L	S	3.0
B5	1	BETPOP	L	S	7.8

Unit	Q	Spp	L/D	CC	DBH
B5	1	BETPOP	L	S	5.1
B5	1	BETPOP	L	S	5.0
B5	1	BETPOP	L	S	4.9
B5	1	BETPOP	L	S	4.2
B5	1	BETPOP	L	S	4.0
B5	1	BETPOP	L	S	3.5
B5	1	BETPOP	L	S	3.2
B5	1	CASDEN	D	S	5.2
B5	1	CASDEN	D	S	4.5
B5	1	CASDEN	D	S	4.4
B5	1	CASDEN	L	S	3.8
B5	1	CASDEN	L	S	3.6
B5	1	CASDEN	D	S	3.3
B5	1	CASDEN	D	S	3.2
B5	1	CASDEN	L	S	3.0
B5	1	QUECOC	L	D	20.5
B5	1	QUECOC	L	C	17.2
B5	1	QUECOC	L	D	16.0
B5	1	QUECOC	L	I	15.7
B5	1	QUECOC	L	C	15.0
B5	1	QUECOC	D	S	10.6
B5	1	QUEILI	L	S	5.5
B5	1	QUEILI	L	S	3.8
B5	1	QUEILI	L	S	3.4
B5	1	QUEVEL	L	D	20.3
B5	1	QUEVEL	L	C	20.2
B5	1	QUEVEL	L	C	16.4
B5	1	QUEVEL	L	I	13.0
B5	1	QUEVEL	L	I	13.0
B5	1	QUEVEL	D	S	11.8
B5	1	QUEVEL	D	S	7.8
B5	2	ACERUB	L	I	12.7
B5	2	ACERUB	L	I	10.7
B5	2	ACERUB	L	I	10.1
B5	2	ACERUB	L	I	6.6
B5	2	ACERUB	L	S	5.4
B5	2	ACERUB	L	S	5.2
B5	2	ACERUB	L	S	4.9
B5	2	ACERUB	L	S	4.8
B5	2	ACERUB	L	S	4.6
B5	2	ACERUB	L	S	4.5
B5	2	ACERUB	L	S	4.4
B5	2	ACERUB	L	S	4.4
B5	2	ACERUB	L	S	4.3
B5	2	ACERUB	L	S	4.2
B5	2	ACERUB	L	S	4.0
B5	2	ACERUB	L	S	4.0
B5	2	ACERUB	L	S	4.0
B5	2	ACERUB	L	S	4.0
B5	2	ACERUB	L	S	3.9
B5	2	ACERUB	L	S	3.7
B5	2	ACERUB	L	S	3.1
B5	2	ACERUB	L	S	3.0
B5	2	AMESPP	L	S	5.0
B5	2	AMESPP	L	I	4.9
B5	2	AMESPP	L	S	4.2
B5	2	AMESPP	L	S	3.8
B5	2	BETPOP	L	S	6.5
B5	2	CASDEN	D	S	7.0
B5	2	CASDEN	L	I	4.5
B5	2	CASDEN	D	S	4.4
B5	2	CASDEN	L	I	4.1
B5	2	CASDEN	D	S	4.0

Unit	Q	Spp	L/D	CC	DBH
B5	2	CASDEN	D	S	4.0
B5	2	CASDEN	L	S	3.9
B5	2	CASDEN	D	S	3.9
B5	2	CASDEN	D	S	3.9
B5	2	QUEILI	D	S	5.0
B5	2	QUERUB	L	D	26.1
B5	2	QUERUB	L	C	22.2
B5	2	QUEVEL	L	D	21.3
B5	2	QUEVEL	L	C	20.5
B5	2	QUEVEL	L	C	18.0
B5	2	QUEVEL	L	C	16.9
B5	2	QUEVEL	L	C	16.5
B5	2	QUEVEL	D	S	12.7
B5	2	QUEVEL	L	I	4.9
B6	1	ACERUB	L	C	14.7
B6	1	ACERUB	L	I	10.8
B6	1	ACERUB	L	I	9.6
B6	1	ACERUB	L	I	9.3
B6	1	ACERUB	L	I	9.1
B6	1	ACERUB	L	I	9.0
B6	1	ACERUB	L	S	8.5
B6	1	ACERUB	L	I	8.1
B6	1	ACERUB	L	S	8.1
B6	1	ACERUB	L	S	8.0
B6	1	ACERUB	L	S	7.7
B6	1	ACERUB	L	I	7.2
B6	1	ACERUB	L	I	6.8
B6	1	ACERUB	L	I	6.8
B6	1	ACERUB	L	S	6.7
B6	1	ACERUB	L	S	6.7
B6	1	ACERUB	L	S	6.0
B6	1	ACERUB	D	S	6.0
B6	1	ACERUB	L	S	5.5
B6	1	ACERUB	L	S	5.4
B6	1	ACERUB	L	I	5.3
B6	1	ACERUB	L	I	5.2
B6	1	ACERUB	L	S	5.0
B6	1	ACERUB	L	I	5.0
B6	1	ACERUB	L	S	5.0
B6	1	ACERUB	L	S	4.8
B6	1	ACERUB	L	S	4.7
B6	1	ACERUB	L	S	4.6
B6	1	ACERUB	L	S	4.5
B6	1	ACERUB	L	S	4.2
B6	1	ACERUB	L	S	4.2
B6	1	ACERUB	L	S	4.1
B6	1	ACERUB	L	S	4.0
B6	1	ACERUB	L	I	4.0
B6	1	ACERUB	D	S	3.8
B6	1	ACERUB	L	S	3.5
B6	1	ACERUB	L	S	3.1
B6	1	ACERUB	D	S	3.1
B6	1	ACERUB	L	S	3.0
B6	1	ACERUB	L	S	2.7
B6	1	ACERUB	L	S	2.6
B6	1	AMESPP	L	S	7.1
B6	1	AMESPP	L	S	5.5
B6	1	BETALL	L	S	2.8
B6	1	CASDEN	D	S	5.3
B6	1	CASDEN	D	S	4.8
B6	1	CASDEN	D	S	4.6
B6	1	CASDEN	L	I	4.2
B6	1	CASDEN	D	S	4.0

Unit	Q	Spp	L/D	CC	DBH
B6	1	CASDEN	D	S	3.3
B6	1	CASDEN	L	S	3.2
B6	1	CASDEN	L	I	2.7
B6	1	CASDEN	L	S	2.6
B6	1	NEMMUC	L	S	3.1
B6	1	NYSSYL	L	I	18.0
B6	1	NYSSYL	L	I	13.1
B6	1	NYSSYL	L	S	12.2
B6	1	NYSSYL	L	S	8.4
B6	1	NYSSYL	L	S	6.4
B6	1	NYSSYL	L	S	6.3
B6	1	NYSSYL	D	S	5.3
B6	1	QUESPP	D	S	14.7
B6	1	QUEVEL	L	C	25.6
B6	1	QUEVEL	L	S	2.7
B6	2	ACERUB	L	I	11.0
B6	2	ACERUB	L	I	10.6
B6	2	ACERUB	L	I	10.3
B6	2	ACERUB	L	C	10.3
B6	2	ACERUB	L	S	9.2
B6	2	ACERUB	L	I	8.5
B6	2	ACERUB	L	I	8.1
B6	2	ACERUB	L	I	8.1
B6	2	ACERUB	L	I	8.0
B6	2	ACERUB	L	I	7.3
B6	2	ACERUB	L	I	6.5
B6	2	ACERUB	L	S	6.4
B6	2	ACERUB	L	S	6.4
B6	2	ACERUB	L	I	5.9
B6	2	ACERUB	L	S	5.8
B6	2	ACERUB	L	S	5.8
B6	2	ACERUB	L	I	5.8
B6	2	ACERUB	L	S	5.6
B6	2	ACERUB	L	I	5.6
B6	2	ACERUB	L	I	5.4
B6	2	ACERUB	D	S	5.2
B6	2	ACERUB	L	S	5.1
B6	2	ACERUB	D	S	5.0
B6	2	ACERUB	L	S	4.9
B6	2	ACERUB	L	S	4.5
B6	2	ACERUB	L	S	4.5
B6	2	ACERUB	L	S	4.1
B6	2	ACERUB	L	S	3.5
B6	2	ACERUB	L	S	3.5
B6	2	ACERUB	L	S	3.3
B6	2	ACERUB	L	S	3.1
B6	2	AMESPP	L	I	9.8
B6	2	AMESPP	L	S	6.2
B6	2	AMESPP	L	S	3.1
B6	2	BETPAP	L	D	17.0
B6	2	BETPAP	L	C	16.7
B6	2	BETPAP	L	C	15.7
B6	2	BETPAP	L	C	12.7
B6	2	CASDEN	D	S	11.0
B6	2	CASDEN	D	S	7.8
B6	2	CASDEN	D	S	4.6
B6	2	CASDEN	L	S	4.3
B6	2	CASDEN	D	S	4.1
B6	2	CASDEN	D	S	3.6
B6	2	CASDEN	D	S	3.5
B6	2	CASDEN	D	S	3.5
B6	2	CASDEN	L	S	3.3
B6	2	CASDEN	D	S	3.2

Unit	Q	Spp	L/D	CC	DBH
B6	2	CASDEN	D	S	3.2
B6	2	CASDEN	L	S	3.1
B6	2	NYSSYL	L	I	12.2
B6	2	NYSSYL	L	I	11.6
B6	2	QUEALB	L	C	14.8
B6	2	QUECOC	L	C	20.7
B6	2	QUEVEL	D	S	16.0
B6	2	QUEVEL	L	I	15.3
B6	2	QUEVEL	D	S	13.2
B6	2	QUEVEL	D	S	11.1
B6	2	QUEVEL	L	S	7.8
B6	2	QUEVEL	L	S	4.8
B6	2	QUEVEL	D	S	4.7
B6	2	SASALB	L	S	3.0
C1	1	ACEPEN	L	S	2.5
C1	1	ACERUB	L	S	10.2
C1	1	ACERUB	L	S	8.6
C1	1	ACERUB	L	S	7.9
C1	1	ACERUB	L	S	7.9
C1	1	ACERUB	L	S	7.6
C1	1	ACERUB	L	S	7.6
C1	1	ACERUB	L	S	7.2
C1	1	ACERUB	L	S	6.4
C1	1	ACERUB	L	S	6.4
C1	1	ACERUB	L	S	5.1
C1	1	ACERUB	L	S	4.6
C1	1	ACERUB	L	S	3.8
C1	1	ACERUB	L	S	3.8
C1	1	ACERUB	L	S	3.8
C1	1	ACERUB	L	S	3.2
C1	1	BETLEN	L	I	18.7
C1	1	BETLEN	L	I	11.7
C1	1	BETLEN	L	S	10.8
C1	1	BETLEN	L	S	10.5
C1	1	BETLEN	L	S	10.5
C1	1	BETLEN	L	S	9.9
C1	1	BETLEN	L	S	7.2
C1	1	BETLEN	L	S	7.2
C1	1	BETLEN	L	S	6.7
C1	1	BETLEN	L	S	6.7
C1	1	BETLEN	L	S	5.5
C1	1	BETLEN	L	S	5.5
C1	1	BETLEN	L	S	4.2
C1	1	BETLEN	L	S	2.5
C1	1	CASDEN	L	S	7.0
C1	1	CASDEN	L	S	5.7
C1	1	CASDEN	D	S	5.1
C1	1	CASDEN	D	S	5.1
C1	1	CASDEN	L	S	3.2
C1	1	CASDEN	L	S	3.2
C1	1	CASDEN	L	S	3.2
C1	1	CASDEN	L	S	2.9
C1	1	CASDEN	L	S	2.5
C1	1	HAMVIR	L	S	4.4
C1	1	HAMVIR	L	S	2.5
C1	1	HAMVIR	L	S	2.5
C1	1	HAMVIR	L	S	2.5
C1	1	PINSTR	L	S	3.2
C1	1	PINSTR	L	S	3.0
C1	1	QUEALB	L	I	20.0
C1	1	QUERUB	L	D	47.6
C1	1	QUERUB	L	D	47.6
C1	1	QUERUB	L	D	38.5

Unit	Q	Spp	L/D	CC	DBH
C1	1	QUERUB	L	C	31.1
C1	1	QUERUB	L	C	28.6
C1	1	QUERUB	L	D	27.6
C1	1	QUERUB	L	D	27.3
C1	1	QUERUB	L	C	25.7
C1	1	QUERUB	L	C	24.8
C1	1	QUERUB	L	I	23.2
C1	1	QUERUB	D	S	11.9
C1	2	ACERUB	L	C	20.3
C1	2	ACERUB	L	I	19.1
C1	2	ACERUB	L	I	18.0
C1	2	ACERUB	L	I	16.3
C1	2	ACERUB	L	I	16.3
C1	2	ACERUB	D	S	16.0
C1	2	ACERUB	D	S	13.5
C1	2	ACERUB	L	I	13.0
C1	2	ACERUB	L	I	12.7
C1	2	ACERUB	L	I	12.4
C1	2	ACERUB	L	I	12.4
C1	2	ACERUB	D	S	10.7
C1	2	ACERUB	D	S	10.7
C1	2	ACERUB	L	S	10.4
C1	2	ACERUB	L	S	10.4
C1	2	ACERUB	L	S	9.1
C1	2	ACERUB	D	S	8.9
C1	2	ACERUB	L	S	6.9
C1	2	ACERUB	D	S	6.4
C1	2	ACERUB	L	S	6.1
C1	2	ACERUB	L	S	5.1
C1	2	ACERUB	D	S	5.1
C1	2	ACERUB	D	S	4.1
C1	2	ACERUB	L	S	3.6
C1	2	ACERUB	D	S	2.8
C1	2	ACERUB	L	S	2.5
C1	2	BETLEN	L	S	8.6
C1	2	BETLEN	L	S	6.4
C1	2	BETLEN	L	S	5.3
C1	2	BETLEN	L	S	2.8
C1	2	BETLEN	L	S	2.5
C1	2	BETLEN	L	S	2.5
C1	2	BETLEN	L	S	2.5
C1	2	CASDEN	D	S	7.1
C1	2	CASDEN	D	S	6.4
C1	2	CASDEN	L	S	4.1
C1	2	CASDEN	L	S	4.1
C1	2	CASDEN	L	S	4.1
C1	2	CASDEN	D	S	3.8
C1	2	CASDEN	L	S	3.6
C1	2	CASDEN	D	S	3.3
C1	2	CASDEN	L	S	3.3
C1	2	CASDEN	L	S	3.0
C1	2	CASDEN	D	S	3.0
C1	2	CASDEN	L	S	2.5
C1	2	CASDEN	L	S	2.5
C1	2	CASDEN	L	S	2.5
C1	2	CASDEN	L	S	2.5
C1	2	CASDEN	D	S	2.5
C1	2	HAMVIR	L	S	3.8
C1	2	HAMVIR	L	S	3.6
C1	2	HAMVIR	L	S	2.8
C1	2	PINSTR	L	S	13.0
C1	2	QUEALB	L	C	30.5
C1	2	QUEALB	L	C	26.7

Unit	Q	Spp	L/D	CC	DBH
C1	2	QUEALB	L	C	20.3
C1	2	QUERUB	L	D	45.7
C1	2	QUERUB	L	C	31.2
C1	2	QUERUB	L	C	25.9
C1	2	QUERUB	L	C	24.9
C1	2	QUERUB	L	C	24.1
C1	2	QUERUB	L	C	20.6
C1	2	QUERUB	L	C	20.3
C1	2	QUERUB	L	I	17.8
C1	2	QUERUB	D	S	15.5
C1	2	QUERUB	D	S	13.3
C1	2	QUERUB	L	I	13.0
C1	2	QUERUB	L	I	13.0
C1	2	QUERUB	L	I	12.7
C2	1	ACERUB	L	I	22.5
C2	1	ACERUB	L	I	21.0
C2	1	ACERUB	L	C	20.0
C2	1	ACERUB	L	I	19.1
C2	1	ACERUB	L	I	17.5
C2	1	ACERUB	L	I	17.1
C2	1	ACERUB	L	S	16.5
C2	1	ACERUB	D	S	15.9
C2	1	ACERUB	L	S	14.6
C2	1	ACERUB	L	S	14.6
C2	1	ACERUB	L	S	14.3
C2	1	ACERUB	L	S	14.0
C2	1	ACERUB	L	S	13.7
C2	1	ACERUB	L	S	12.1
C2	1	ACERUB	L	S	11.4
C2	1	ACERUB	L	S	10.8
C2	1	ACERUB	L	S	10.2
C2	1	ACERUB	L	S	8.3
C2	1	ACERUB	L	S	6.7
C2	1	BETALL	L	S	5.7
C2	1	BETLEN	L	S	9.5
C2	1	BETLEN	L	S	3.2
C2	1	BETLEN	L	S	2.5
C2	1	CASDEN	D	S	7.0
C2	1	CASDEN	D	S	5.7
C2	1	CASDEN	D	S	5.7
C2	1	CASDEN	D	S	5.1
C2	1	CASDEN	L	S	5.1
C2	1	CASDEN	D	S	3.2
C2	1	CASDEN	L	S	2.5
C2	1	CASDEN	L	S	2.5
C2	1	CASDEN	D	S	2.5
C2	1	CASDEN	D	S	2.5
C2	1	HAMVIR	L	S	5.1
C2	1	HAMVIR	L	S	4.4
C2	1	HAMVIR	L	S	4.4
C2	1	HAMVIR	L	S	4.1
C2	1	HAMVIR	L	S	3.8
C2	1	HAMVIR	L	S	3.8
C2	1	HAMVIR	L	S	3.8
C2	1	HAMVIR	L	S	3.8
C2	1	HAMVIR	L	S	3.8
C2	1	HAMVIR	L	S	3.8
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	3.2

Unit	Q	Spp	L/D	CC	DBH
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	3.2
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	HAMVIR	L	S	2.5
C2	1	KALLAT	L	S	2.9
C2	1	KALLAT	L	S	2.5
C2	1	PINSTR	L	I	24.4
C2	1	PINSTR	L	S	8.9
C2	1	PINSTR	L	S	7.6
C2	1	QUEALB	L	C	25.7
C2	1	QUEALB	L	C	24.4
C2	1	QUEALB	L	I	18.4
C2	1	QUERUB	L	D	48.6
C2	1	QUERUB	L	D	47.0
C2	1	QUERUB	L	C	30.5
C2	1	QUERUB	L	C	25.1
C2	1	QUERUB	L	I	23.8
C2	1	QUERUB	D	S	16.2
C2	1	QUERUB	L	S	12.4
C2	1	VACCOR	L	S	2.5
C2	2	ACEPEN	L	S	2.5
C2	2	ACERUB	L	S	16.5
C2	2	ACERUB	L	S	16.2
C2	2	ACERUB	D	S	15.9
C2	2	ACERUB	L	S	13.0
C2	2	ACERUB	D	S	11.1
C2	2	ACERUB	L	S	9.2
C2	2	ACERUB	D	S	8.9
C2	2	ACERUB	L	S	8.3
C2	2	ACERUB	L	S	7.9
C2	2	ACERUB	L	S	6.0
C2	2	ACERUB	L	S	2.5
C2	2	BETLEN	L	S	19.7
C2	2	BETLEN	L	I	16.8
C2	2	BETLEN	L	S	5.7
C2	2	BETLEN	L	S	3.8
C2	2	CASDEN	L	S	3.8
C2	2	CASDEN	D	S	3.8
C2	2	CASDEN	D	S	3.2
C2	2	CASDEN	L	S	2.5
C2	2	CASDEN	D	S	2.5
C2	2	CASDEN	L	S	2.5
C2	2	HAMVIR	L	S	3.8
C2	2	HAMVIR	L	S	3.8
C2	2	HAMVIR	L	S	3.8
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2

Unit	Q	Spp	L/D	CC	DBH
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	3.2
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	HAMVIR	L	S	2.5
C2	2	PINSTR	L	S	14.9
C2	2	PINSTR	L	S	11.1
C2	2	PINSTR	L	S	10.2
C2	2	PINSTR	L	S	8.3
C2	2	PINSTR	L	S	8.3
C2	2	QUEALB	L	C	29.5
C2	2	QUERUB	L	D	42.5
C2	2	QUERUB	L	D	38.7
C2	2	QUERUB	L	C	37.1
C2	2	QUERUB	L	C	35.6
C2	2	QUERUB	L	I	26.7
C2	2	QUERUB	L	I	26.0
C2	2	QUERUB	L	I	23.5
C3	1	ACERUB	D	I	18.5
C3	1	ACERUB	D	S	17.8
C3	1	ACERUB	D	I	17.8
C3	1	ACERUB	L	I	11.4
C3	1	ACERUB	D	S	10.2
C3	1	ACERUB	L	I	10.2
C3	1	ACERUB	L	I	10.2
C3	1	ACERUB	L	S	9.9
C3	1	ACERUB	L	I	9.7
C3	1	ACERUB	L	S	9.4
C3	1	ACERUB	L	S	8.1

Unit	Q	Spp	L/D	CC	DBH
C3	1	ACERUB	L	I	8.1
C3	1	ACERUB	L	I	7.9
C3	1	ACERUB	L	I	6.9
C3	1	ACERUB	L	S	6.4
C3	1	ACERUB	L	S	6.1
C3	1	ACERUB	L	S	6.1
C3	1	ACERUB	D	S	5.3
C3	1	ACERUB	L	I	4.6
C3	1	ACERUB	L	S	4.3
C3	1	ACERUB	D	S	4.1
C3	1	ACERUB	L	I	4.1
C3	1	ACERUB	L	S	3.0
C3	1	BETLEN	L	I	16.5
C3	1	BETLEN	L	I	5.1
C3	1	CASDEN	D	I	5.8
C3	1	CASDEN	D	S	4.3
C3	1	HAMVIR	L	S	4.6
C3	1	HAMVIR	L	S	4.1
C3	1	HAMVIR	L	S	3.8
C3	1	HAMVIR	L	S	3.8
C3	1	HAMVIR	L	S	3.6
C3	1	HAMVIR	L	S	3.6
C3	1	HAMVIR	L	S	3.3
C3	1	HAMVIR	L	S	3.3
C3	1	HAMVIR	L	S	2.8
C3	1	HAMVIR	L	S	2.8
C3	1	HAMVIR	L	S	2.5
C3	1	PINSTR	L	I	15.2
C3	1	PINSTR	L	S	6.4
C3	1	PINSTR	L	S	5.1
C3	1	PINSTR	L	S	4.6
C3	1	PINSTR	L	S	3.3
C3	1	QUERUB	L	C	43.2
C3	1	QUERUB	L	C	40.6
C3	1	QUERUB	L	I	35.6
C3	1	QUERUB	L	C	35.6
C3	1	QUERUB	L	C	33.0
C3	1	QUERUB	L	C	29.5
C3	1	QUERUB	L	C	26.7
C3	1	QUERUB	L	C	25.4
C3	1	QUERUB	L	C	23.6
C3	1	QUERUB	L	C	23.6
C3	1	QUERUB	L	C	22.9
C3	1	QUERUB	L	C	21.8
C3	1	QUERUB	L	I	17.8
C3	1	QUERUB	D	S	17.8
C3	1	QUERUB	L	S	13.5
C3	1	QUERUB	D	S	11.9
C3	2	ACERUB	L	S	8.6
C3	2	ACERUB	D	S	8.1
C3	2	ACERUB	L	S	6.0
C3	2	ACERUB	L	S	4.1
C3	2	ACERUB	L	S	4.1
C3	2	ACERUB	L	S	3.8
C3	2	ACERUB	L	S	3.3
C3	2	BETLEN	L	S	8.3
C3	2	BETLEN	L	I	8.3
C3	2	BETLEN	L	S	6.4
C3	2	CASDEN	D	S	5.0
C3	2	CASDEN	D	S	3.6
C3	2	HAMVIR	L	S	5.5
C3	2	PINSTR	L	S	9.4
C3	2	PINSTR	L	S	6.0

Unit	Q	Spp	L/D	CC	DBH
C3	2	PINSTR	L	S	5.2
C3	2	QUERUB	L	D	35.6
C3	2	QUERUB	L	D	32.9
C3	2	QUERUB	L	D	28.4
C3	2	QUERUB	L	C	27.4
C3	2	QUERUB	L	C	27.1
C3	2	QUERUB	L	C	26.7
C3	2	QUERUB	L	C	25.8
C3	2	QUERUB	L	C	25.7
C3	2	QUERUB	L	C	23.2
C3	2	QUERUB	L	C	22.9
C3	2	QUERUB	L	C	22.5
C3	2	QUERUB	L	C	20.7
C3	2	QUERUB	L	I	20.2
C3	2	QUERUB	D	S	19.6
C3	2	QUERUB	D	S	17.5
C3	2	QUERUB	L	I	17.4
C3	2	QUERUB	D	I	14.6
C3	2	QUERUB	D	I	11.3
C3	2	QUERUB	L	S	10.4
C3	2	QUERUB	D	S	6.2
C3	2	QUERUB	L	S	5.8
C3	2	QUERUB	L	S	5.1
C3	3	ACERUB	L	I	17.1
C3	3	ACERUB	L	I	16.8
C3	3	ACERUB	L	S	13.3
C3	3	ACERUB	L	I	12.7
C3	3	ACERUB	L	S	10.4
C3	3	ACERUB	L	S	8.4
C3	3	ACERUB	L	S	7.5
C3	3	ACERUB	L	S	6.4
C3	3	ACERUB	D	S	6.1
C3	3	ACERUB	L	S	5.7
C3	3	ACERUB	L	S	5.3
C3	3	ACERUB	L	S	5.2
C3	3	ACERUB	L	S	5.2
C3	3	ACERUB	D	S	4.8
C3	3	ACERUB	L	S	4.1
C3	3	ACERUB	L	S	3.8
C3	3	ACERUB	L	S	3.7
C3	3	ACERUB	D	S	3.2
C3	3	ACERUB	L	S	3.0
C3	3	ACERUB	L	S	3.0
C3	3	ACERUB	L	S	3.0
C3	3	ACERUB	L	S	2.9
C3	3	BETLEN	L	I	13.6
C3	3	BETLEN	L	S	7.6
C3	3	BETLEN	L	S	6.7
C3	3	BETLEN	L	S	6.1
C3	3	BETLEN	L	S	5.6
C3	3	BETLEN	L	S	3.9
C3	3	BETLEN	L	S	3.9
C3	3	BETLEN	L	S	3.2
C3	3	BETLEN	L	S	3.0
C3	3	BETLEN	L	S	2.8
C3	3	HAMVIR	L	S	2.9
C3	3	HAMVIR	L	S	2.8
C3	3	QUEALB	D	I	23.2
C3	3	QUEALB	L	I	21.6
C3	3	QUEALB	L	I	20.3
C3	3	QUEALB	D	S	15.1
C3	3	QUEALB	L	S	11.3
C3	3	QUERUB	L	D	35.9
C3	3	QUERUB	L	D	34.3
C3	3	QUERUB	L	C	26.5
C3	3	QUERUB	L	D	26.2
C3	3	QUERUB	L	D	24.6
C3	3	QUERUB	L	D	23.4
C3	3	QUERUB	L	D	22.9
C3	3	QUERUB	L	D	20.8
C3	3	QUERUB	L	D	20.8
C3	3	QUERUB	L	I	17.0
C3	3	QUERUB	D	S	6.1
C4	1	ACERUB	L	I	14.0
C4	1	ACERUB	L	I	11.4
C4	1	ACERUB	L	S	11.4
C4	1	ACERUB	L	S	7.6
C4	1	ACERUB	L	S	7.6
C4	1	ACERUB	L	S	6.9
C4	1	ACERUB	L	S	6.4
C4	1	ACERUB	L	S	6.4
C4	1	ACERUB	L	S	5.8
C4	1	ACERUB	L	S	5.8
C4	1	ACERUB	L	S	5.1
C4	1	ACERUB	L	S	5.1
C4	1	ACERUB	L	S	5.1
C4	1	ACERUB	L	S	5.1
C4	1	ACERUB	L	S	5.1
C4	1	ACERUB	L	S	4.3
C4	1	ACERUB	L	S	4.3
C4	1	ACERUB	L	S	3.8
C4	1	ACERUB	L	S	3.8
C4	1	ACERUB	L	S	3.3
C4	1	ACERUB	L	S	3.3
C4	1	BETLEN	L	I	15.2
C4	1	BETLEN	L	I	8.9
C4	1	BETLEN	L	I	8.1
C4	1	BETLEN	L	S	6.9
C4	1	BETLEN	L	S	5.1
C4	1	BETLEN	L	S	5.1
C4	1	CASDEN	D	S	5.3
C4	1	CASDEN	D	S	4.1
C4	1	CASDEN	D	S	3.8
C4	1	HAMVIR	L	S	3.3
C4	1	HAMVIR	L	S	3.3
C4	1	HAMVIR	L	S	3.0
C4	1	HAMVIR	L	S	3.0
C4	1	HAMVIR	L	S	2.8
C4	1	HAMVIR	L	S	2.8
C4	1	PINSTR	L	S	9.1
C4	1	PINSTR	L	S	8.9
C4	1	PINSTR	L	S	5.3
C4	1	QUERUB	L	C	31.8
C4	1	QUERUB	L	C	31.8
C4	1	QUERUB	L	C	30.5
C4	1	QUERUB	L	C	28.7
C4	1	QUERUB	L	C	26.7
C4	1	QUERUB	L	C	26.7
C4	1	QUERUB	L	C	25.4
C4	1	QUERUB	L	C	24.1
C4	1	QUERUB	L	C	24.1
C4	1	QUERUB	L	C	23.4
C4	1	QUERUB	L	C	22.9
C4	1	QUERUB	L	C	22.1
C4	1	QUERUB	L	C	21.6
C4	1	QUERUB	L	C	21.6
C4	1	QUERUB	L	C	21.6
C4	1	QUERUB	L	C	20.3
C4	1	QUERUB	D	I	15.2
C4	1	QUERUB	D	S	10.2
C4	2	ACERUB	L	I	9.9
C4	2	ACERUB	L	I	8.9
C4	2	ACERUB	L	I	8.6
C4	2	ACERUB	L	I	7.4
C4	2	ACERUB	L	I	7.1
C4	2	ACERUB	L	I	7.1
C4	2	ACERUB	L	I	6.6
C4	2	ACERUB	L	I	6.6
C4	2	ACERUB	L	S	6.6
C4	2	ACERUB	L	I	6.1
C4	2	ACERUB	L	S	5.6
C4	2	ACERUB	L	S	5.3
C4	2	ACERUB	L	S	5.1
C4	2	ACERUB	L	I	4.8
C4	2	ACERUB	L	S	4.6
C4	2	ACERUB	L	S	4.3
C4	2	ACERUB	L	I	4.3
C4	2	ACERUB	L	S	4.3
C4	2	ACERUB	L	S	4.3
C4	2	ACERUB	L	S	4.3
C4	2	ACERUB	L	S	4.3
C4	2	ACERUB	L	S	4.1
C4	2	ACERUB	L	S	4.1
C4	2	ACERUB	L	S	3.8
C4	2	ACERUB	L	S	3.6
C4	2	ACERUB	L	S	3.3
C4	2	ACERUB	L	S	3.3
C4	2	ACERUB	L	S	3.0
C4	2	ACERUB	L	S	2.8
C4	2	ACERUB	L	S	2.5
C4	2	ACERUB	L	S	2.5
C4	2	ACERUB	D	S	2.5
C4	2	BETLEN	L	I	21.3
C4	2	BETLEN	L	I	15.5
C4	2	BETLEN	L	I	11.2
C4	2	BETLEN	L	I	7.4
C4	2	BETLEN	L	I	7.1
C4	2	BETLEN	L	S	6.9
C4	2	BETLEN	L	I	6.6
C4	2	BETLEN	L	I	4.3
C4	2	BETLEN	L	I	2.5
C4	2	CASDEN	L	I	3.6
C4	2	CASDEN	L	S	3.0
C4	2	CASDEN	L	S	2.8
C4	2	HAMVIR	L	S	2.5
C4	2	PINSTR	L	S	3.3
C4	2	QUERUB	L	C	32.0
C4	2	QUERUB	L	C	31.8
C4	2	QUERUB	L	C	31.8
C4	2	QUERUB	L	C	31.5
C4	2	QUERUB	L	C	29.2
C4	2	QUERUB	L	C	26.9
C4	2	QUERUB	L	C	24.1
C4	2	QUERUB	L	C	23.9
C4	2	QUERUB	L	C	22.9
C4	2	QUERUB	L	C	22.6
C4	2	QUERUB	L	C	22.4
C4	2	QUERUB	L	I	18.0
C4	2	QUERUB	L	I	16.8

Unit	Q	Spp	L/D	CC	DBH
C4	2	QUERUB	L	I	16.8
C4	2	QUERUB	D	I	13.2
C5	1	?	D	S	21.5
C5	1	?	D	S	15.7
C5	1	?	D	S	14.0
C5	1	?	D	S	5.0
C5	1	?	D	S	3.2
C5	1	?	D	S	2.5
C5	1	ACERUB	D	S	13.3
C5	1	ACERUB	L	S	10.4
C5	1	ACERUB	L	S	8.3
C5	1	ACERUB	L	S	6.2
C5	1	ACERUB	L	S	5.6
C5	1	ACERUB	L	S	5.2
C5	1	ACERUB	L	S	5.0
C5	1	ACERUB	L	S	5.0
C5	1	ACERUB	L	S	4.4
C5	1	ACERUB	L	S	4.4
C5	1	ACERUB	L	S	4.3
C5	1	ACERUB	D	S	4.2
C5	1	ACERUB	L	S	3.9
C5	1	ACERUB	L	S	3.8
C5	1	ACERUB	L	S	3.6
C5	1	ACERUB	L	S	3.0
C5	1	ACERUB	L	S	3.0
C5	1	ACERUB	L	S	2.9
C5	1	BETLEN	L	I	19.1
C5	1	BETLEN	L	S	8.6
C5	1	BETLEN	L	S	6.7
C5	1	BETLEN	D	S	5.2
C5	1	BETLEN	L	S	4.7
C5	1	BETLEN	L	S	3.2
C5	1	BETLEN	L	S	2.7
C5	1	CASDEN	D	S	6.0
C5	1	CASDEN	D	S	4.4
C5	1	CASDEN	D	S	4.4
C5	1	CASDEN	D	S	4.2
C5	1	CASDEN	L	S	3.9
C5	1	CASDEN	D	S	3.3
C5	1	CASDEN	L	S	3.2
C5	1	CASDEN	L	S	3.0
C5	1	CASDEN	L	S	2.8
C5	1	CASDEN	L	S	2.5
C5	1	HAMVIR	L	S	3.7
C5	1	HAMVIR	L	S	3.4
C5	1	HAMVIR	L	S	3.2
C5	1	HAMVIR	L	S	3.2
C5	1	HAMVIR	L	S	2.9
C5	1	HAMVIR	L	S	2.8
C5	1	HAMVIR	L	S	2.8
C5	1	HAMVIR	L	S	2.7
C5	1	HAMVIR	L	S	2.7
C5	1	HAMVIR	L	S	2.7
C5	1	HAMVIR	L	S	2.5
C5	1	PINSTR	L	S	4.4
C5	1	QUERUB	L	C	38.2
C5	1	QUERUB	L	C	35.1
C5	1	QUERUB	L	C	30.2
C5	1	QUERUB	L	C	28.6
C5	1	QUERUB	L	C	26.0
C5	1	QUERUB	L	C	25.1
C5	1	QUERUB	L	C	24.9
C5	1	QUERUB	L	C	22.0

Unit	Q	Spp	L/D	CC	DBH
C5	1	QUERUB	L	C	22.0
C5	1	QUERUB	L	I	21.8
C5	1	QUERUB	L	I	21.5
C5	1	QUERUB	L	I	21.3
C5	1	QUERUB	L	C	20.4
C5	1	QUERUB	L	I	18.7
C5	1	QUERUB	D	S	18.4
C5	1	QUERUB	L	I	16.8
C5	1	QUERUB	D	S	15.4
C5	1	QUEVEL	L	C	20.7
C5	1	QUEVEL	L	I	15.5
C5	2	?	D	S	9.7
C5	2	?	D	S	5.0
C5	2	?	D	S	5.0
C5	2	?	D	S	4.4
C5	2	ACERUB	L	S	10.9
C5	2	ACERUB	L	S	8.4
C5	2	ACERUB	L	S	6.0
C5	2	ACERUB	L	S	5.6
C5	2	ACERUB	L	S	5.5
C5	2	ACERUB	L	S	5.3
C5	2	ACERUB	L	S	5.1
C5	2	ACERUB	L	S	4.7
C5	2	ACERUB	L	S	4.7
C5	2	ACERUB	L	S	4.6
C5	2	ACERUB	L	S	4.3
C5	2	ACERUB	L	S	4.3
C5	2	ACERUB	L	S	4.1
C5	2	ACERUB	L	S	4.1
C5	2	ACERUB	L	S	3.8
C5	2	ACERUB	L	S	3.7
C5	2	ACERUB	L	S	3.0
C5	2	ACERUB	L	S	2.9
C5	2	ACERUB	L	S	2.5
C5	2	BETLEN	L	I	19.1
C5	2	BETLEN	L	S	8.5
C5	2	BETLEN	L	S	2.9
C5	2	CASDEN	D	S	4.3
C5	2	CASDEN	D	S	4.1
C5	2	CASDEN	D	S	3.6
C5	2	CASDEN	L	S	2.7
C5	2	HAMVIR	L	S	4.1
C5	2	HAMVIR	L	S	3.3
C5	2	HAMVIR	L	S	3.3
C5	2	HAMVIR	L	S	3.0
C5	2	HAMVIR	L	S	3.0
C5	2	HAMVIR	L	S	3.0
C5	2	HAMVIR	L	S	3.0
C5	2	HAMVIR	L	S	2.9
C5	2	HAMVIR	L	S	2.8
C5	2	HAMVIR	L	S	2.8
C5	2	HAMVIR	L	S	2.8
C5	2	HAMVIR	L	S	2.8
C5	2	HAMVIR	L	S	2.8
C5	2	HAMVIR	L	S	2.7
C5	2	HAMVIR	L	S	2.7
C5	2	HAMVIR	L	S	2.7
C5	2	HAMVIR	L	S	2.5
C5	2	HAMVIR	L	S	2.5
C5	2	HAMVIR	L	S	2.5
C5	2	QUERUB	L	C	38.4
C5	2	QUERUB	L	C	30.4
C5	2	QUERUB	L	C	24.6

Unit	Q	Spp	L/D	CC	DBH
C5	2	QUERUB	L	C	22.9
C5	2	QUERUB	L	C	21.8
C5	2	QUERUB	L	I	21.2
C5	2	QUERUB	L	C	21.1
C5	2	QUERUB	L	C	21.1
C5	2	QUERUB	L	C	20.7
C5	2	QUERUB	D	S	20.6
C5	2	QUERUB	L	C	18.4
C5	2	QUERUB	L	I	15.5
C5	2	QUERUB	D	S	14.9
C5	2	QUEVEL	L	C	37.6
C5	2	QUEVEL	L	C	19.8
C6	1	ACERUB	L	C	17.8
C6	1	ACERUB	L	I	12.7
C6	1	ACERUB	D	S	12.7
C6	1	ACERUB	D	S	11.4
C6	1	ACERUB	L	I	11.4
C6	1	ACERUB	D	S	10.8
C6	1	ACERUB	L	S	8.9
C6	1	ACERUB	L	S	8.9
C6	1	ACERUB	L	S	8.9
C6	1	ACERUB	L	S	7.6
C6	1	ACERUB	L	S	7.6
C6	1	ACERUB	L	S	7.6
C6	1	ACERUB	L	S	6.4
C6	1	ACERUB	L	S	6.4
C6	1	ACERUB	L	S	6.4
C6	1	ACERUB	L	S	6.4
C6	1	ACERUB	L	S	6.4
C6	1	ACERUB	D	S	5.7
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	D	S	5.1
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	L	S	5.1
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.8
C6	1	ACERUB	L	S	3.2
C6	1	ACERUB	L	S	2.5
C6	1	ACERUB	L	S	2.5
C6	1	ACERUB	L	S	2.5
C6	1	ACERUB	L	S	2.5
C6	1	ACERUB	L	S	2.5
C6	1	ACERUB	L	S	2.5
C6	1	ACERUB	L	S	2.5
C6	1	ACERUB	L	S	2.5

Unit	Q	Spp	L/D	CC	DBH
C6	1	ACERUB	L	S	2.5
C6	1	CASDEN	L	S	5.7
C6	1	HAMVIR	L	S	3.8
C6	1	HAMVIR	L	S	3.8
C6	1	HAMVIR	L	S	3.8
C6	1	HAMVIR	L	S	3.8
C6	1	HAMVIR	L	S	3.8
C6	1	HAMVIR	D	S	3.8
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	HAMVIR	L	S	2.5
C6	1	QUERUB	L	C	34.3
C6	1	QUERUB	L	D	30.5
C6	1	QUERUB	L	D	28.6
C6	1	QUERUB	L	I	25.4
C6	1	QUERUB	L	D	25.4
C6	1	QUERUB	L	C	24.1
C6	1	QUERUB	L	C	24.1
C6	1	QUERUB	L	C	21.6
C6	1	QUERUB	L	D	21.6
C6	1	QUERUB	L	I	20.3
C6	1	QUERUB	L	C	20.3
C6	1	QUERUB	L	C	19.1
C6	1	QUERUB	L	C	19.1
C6	1	QUERUB	L	D	18.4
C6	1	QUERUB	D	S	17.8
C6	1	QUERUB	L	I	17.8
C6	1	QUERUB	L	I	16.5
C6	1	QUERUB	L	C	15.2
C6	1	QUERUB	L	I	15.2
C6	1	QUERUB	D	S	15.2
C6	1	QUERUB	D	S	11.4
C6	1	QUERUB	D	S	7.6
C6	1	QUERUB	L	S	2.5
C6	2	ACERUB	L	I	15.2
C6	2	ACERUB	L	S	12.7
C6	2	ACERUB	L	S	11.4
C6	2	ACERUB	L	S	10.2
C6	2	ACERUB	L	S	10.2
C6	2	ACERUB	L	I	10.2
C6	2	ACERUB	L	I	10.2
C6	2	ACERUB	L	S	8.9
C6	2	ACERUB	L	S	8.9
C6	2	ACERUB	L	S	8.9
C6	2	ACERUB	D	S	8.9
C6	2	ACERUB	L	S	7.6
C6	2	ACERUB	L	S	7.6
C6	2	ACERUB	L	S	7.6
C6	2	ACERUB	L	S	7.6
C6	2	ACERUB	L	S	7.6
C6	2	ACERUB	L	S	7.6
C6	2	ACERUB	L	S	6.4
C6	2	ACERUB	L	S	6.4
C6	2	ACERUB	L	S	6.4
C6	2	ACERUB	L	S	6.4
C6	2	ACERUB	L	S	3.8
C6	2	ACERUB	L	S	3.8
C6	2	ACERUB	D	S	3.8
C6	2	ACERUB	L	S	3.8
C6	2	ACERUB	L	S	3.8
C6	2	ACERUB	L	S	3.2
C6	2	ACERUB	L	S	3.2
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	ACERUB	L	S	2.5
C6	2	BETLEN	L	S	7.6
C6	2	CASDEN	L	S	5.1
C6	2	CASDEN	L	S	3.8
C6	2	CASDEN	L	S	2.5
C6	2	CASDEN	L	S	2.5
C6	2	CASDEN	L	S	2.5
C6	2	HAMVIR	L	S	5.1
C6	2	HAMVIR	L	S	3.8
C6	2	HAMVIR	L	S	3.8
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	HAMVIR	D	S	2.5
C6	2	HAMVIR	L	S	2.5
C6	2	PINSTR	L	S	5.1
C6	2	PINSTR	L	S	2.5
C6	2	QUEALB	L	C	21.6
C6	2	QUEALB	L	S	5.1
C6	2	QUEALB	L	S	2.5
C6	2	QUEALB	L	S	2.5
C6	2	QUERUB	L	D	30.5
C6	2	QUERUB	L	D	27.9
C6	2	QUERUB	L	D	27.9
C6	2	QUERUB	L	C	24.1
C6	2	QUERUB	L	C	24.1
C6	2	QUERUB	L	D	22.9
C6	2	QUERUB	L	C	21.6
C6	2	QUERUB	L	C	21.6
C6	2	QUERUB	L	D	19.1
C6	2	QUERUB	D	I	19.1
C6	2	QUERUB	L	I	19.1
C6	2	QUERUB	D	I	19.1
C6	2	QUERUB	L	C	17.8
C6	2	QUERUB	L	C	17.8
C6	2	QUERUB	L	C	17.8
C6	2	QUERUB	D	S	17.8
C6	2	QUERUB	L	C	16.5
C6	2	QUERUB	L	C	16.5
C6	2	QUERUB	L	C	15.2
C6	2	QUERUB	D	S	15.2
C6	2	QUERUB	D	S	15.2
C6	2	QUERUB	D	S	14.0

Overstory Data, Pelham, 2002

Standing woody stems ≥ 3-cm DBH. Data sorted by unit, quadrat (q), species, and dbh. Quadrat size was 0.025 ha. L=Live, D=Dead. CC: D=Dominant, C=Co-dominant, I=Intermediate, S=suppressed/overtopped/dead. DBH in cm.

Unit	Q	Spp	L/D	CC	DBH
A1	1	ARUB	L	I	10.6
A1	1	ARUB	L	I	10.1
A1	1	ARUB	L	S	8.4
A1	1	ARUB	L	S	7.5
A1	1	ARUB	L	S	7.5
A1	1	ARUB	L	S	7.3
A1	1	ARUB	L	S	7.2
A1	1	ARUB	L	S	5.3
A1	1	ARUB	L	S	4.9
A1	1	ARUB	L	S	4.9
A1	1	ARUB	D	S	4.2
A1	1	ARUB	L	S	4.1
A1	1	ARUB	L	S	4
A1	1	ARUB	L	S	3.9
A1	1	ARUB	L	S	3.8
A1	1	ARUB	L	S	3.8
A1	1	ARUB	L	S	3.8
A1	1	ARUB	L	S	3.8
A1	1	ARUB	L	S	3.7
A1	1	ARUB	L	S	3.4
A1	1	ARUB	L	S	3
A1	1	ARUB	L	S	3
A1	1	BPAP	L	C	17.2
A1	1	BPAP	L	C	16.1
A1	1	BPAP	L	I	13.8
A1	1	CDEN	D	S	6
A1	1	CDEN	D	S	3.7
A1	1	QCOC	L	C	26.4
A1	1	QCOC	L	C	25
A1	1	QCOC	L	C	22.6
A1	1	QCOC	L	C	18.9
A1	1	QVEL	L	C	18.7
A1	1	QVEL	L	I	14.2
A1	1	QVEL	L	I	13.1
A1	1	QVEL	L	I	11.3
A1	2	AMESPP	L	S	8
A1	2	AMESPP	L	S	7.7
A1	2	AMESPP	L	S	7.2
A1	2	AMESPP	L	S	6.8
A1	2	AMESPP	L	S	6.7
A1	2	ARUB	L	I	14.1
A1	2	ARUB	L	I	10.9
A1	2	ARUB	L	S	7.8
A1	2	ARUB	L	S	7.7
A1	2	ARUB	L	S	7.5
A1	2	ARUB	L	S	7.3
A1	2	ARUB	L	S	7.2
A1	2	ARUB	L	S	7
A1	2	ARUB	L	S	7
A1	2	ARUB	L	S	6.9
A1	2	ARUB	L	S	6.7
A1	2	ARUB	L	S	5.5
A1	2	ARUB	L	S	5.1
A1	2	ARUB	L	S	4.2
A1	2	ARUB	L	S	3.3

Unit	Q	Spp	L/D	CC	DBH
A1	2	ARUB	L	S	3.2
A1	2	CDEN	D	S	6.5
A1	2	CDEN	D	S	4.8
A1	2	PSTR	L	I	16
A1	2	PSTR	L	S	6.2
A1	2	QCOC	L	C	27.8
A1	2	QCOC	L	C	25
A1	2	QCOC	L	C	23
A1	2	QCOC	L	C	22.9
A1	2	QCOC	L	C	22.9
A1	2	QCOC	L	C	16
A1	2	QCOC	L	I	14.6
A1	2	QCOC	L	C	14.2
A1	2	QCOC	L	C	13.2
A2	1	AMESPP	L	S	9.5
A2	1	AMESPP	L	S	9
A2	1	AMESPP	L	S	9
A2	1	AMESPP	L	S	8.7
A2	1	AMESPP	L	S	7.7
A2	1	AMESPP	L	S	7.1
A2	1	AMESPP	L	S	6.9
A2	1	AMESPP	L	S	6.6
A2	1	AMESPP	L	S	6.5
A2	1	AMESPP	L	S	5.8
A2	1	AMESPP	D	S	5.4
A2	1	AMESPP	D	S	4.9
A2	1	AMESPP	D	S	4.7
A2	1	AMESPP	L	S	4.6
A2	1	ARUB	L	I	14
A2	1	ARUB	L	I	11.5
A2	1	ARUB	L	S	11.3
A2	1	ARUB	L	I	10.8
A2	1	ARUB	L	S	9.3
A2	1	ARUB	D	S	9.1
A2	1	ARUB	L	S	9
A2	1	ARUB	L	S	8.5
A2	1	ARUB	L	S	7.8
A2	1	ARUB	L	S	7.4
A2	1	ARUB	D	S	7.3
A2	1	ARUB	L	S	7.1
A2	1	ARUB	L	S	7
A2	1	ARUB	L	S	6.5
A2	1	ARUB	D	S	5.9
A2	1	ARUB	L	S	4.8
A2	1	ARUB	D	S	4.5
A2	1	BPAP	L	C	22.7
A2	1	BPAP	L	C	22.2
A2	1	BPAP	L	I	17.5
A2	1	BPAP	L	I	13
A2	1	BPAP	L	I	11.4
A2	1	BPAP	L	I	10
A2	1	BPAP	L	S	6.3
A2	1	BPAP	L	S	5.5
A2	1	CDEN	D	S	3.7
A2	1	CDEN	L	S	3.2

Unit	Q	Spp	L/D	CC	DBH
A2	1	CDEN	D	S	3
A2	1	QCOC	L	C	32.2
A2	1	QVEL	L	C	26.7
A2	1	QVEL	L	C	22.4
A2	2	ARUB	L	I	15.5
A2	2	ARUB	L	I	12.5
A2	2	ARUB	L	S	11.3
A2	2	ARUB	L	S	10.7
A2	2	ARUB	L	I	10.6
A2	2	ARUB	L	S	10.5
A2	2	ARUB	L	I	9.9
A2	2	ARUB	L	S	9.3
A2	2	ARUB	L	S	9
A2	2	ARUB	L	S	8.4
A2	2	ARUB	L	S	8.3
A2	2	ARUB	L	S	8
A2	2	ARUB	L	S	7.5
A2	2	ARUB	L	S	7.3
A2	2	ARUB	D	S	6.8
A2	2	ARUB	D	S	6.6
A2	2	ARUB	D	S	6
A2	2	ARUB	L	S	6
A2	2	ARUB	L	S	5.9
A2	2	ARUB	D	S	5.8
A2	2	ARUB	D	S	5.6
A2	2	ARUB	D	S	5.5
A2	2	ARUB	D	S	5.2
A2	2	ARUB	L	S	5
A2	2	ARUB	D	S	5
A2	2	ARUB	L	S	5
A2	2	ARUB	D	S	5
A2	2	ARUB	L	S	4.5
A2	2	ARUB	L	S	4.5
A2	2	ARUB	L	S	4.3
A2	2	ARUB	D	S	4.3
A2	2	ARUB	D	S	4.1
A2	2	ARUB	D	S	3.6
A2	2	ARUB	D	S	3.5
A2	2	ARUB	D	S	3.4
A2	2	ARUB	D	S	3.3
A2	2	ARUB	D	S	3.2
A2	2	ARUB	D	S	3.2
A2	2	ARUB	D	S	3.2
A2	2	ARUB	D	S	3.1
A2	2	CDEN	D	S	5.7
A2	2	CDEN	D	S	3.3
A2	2	HVIR	L	S	4.2
A2	2	HVIR	L	S	3.3
A2	2	HVIR	D	S	3
A2	2	HVIR	L	S	3
A2	2	QCOC	L	C	28.3
A2	2	QCOC	L	C	24.1
A2	2	QVEL	L	C	29.2
A2	2	QVEL	L	C	28.6
A2	2	QVEL	L	C	20.8

Unit	Q	Spp	L/D	CC	DBH
A2	2	QVEL	L	I	13.9
A3	1	ARUB	L	I	11.2
A3	1	ARUB	L	I	10.4
A3	1	ARUB	D	S	9.4
A3	1	ARUB	L	S	6.1
A3	1	ARUB	L	I	5.8
A3	1	ARUB	D	S	5.4
A3	1	ARUB	L	S	4.4
A3	1	ARUB	L	S	3.9
A3	1	ARUB	L	S	3.9
A3	1	CDEN	D	S	4.2
A3	1	CDEN	D	S	3.5
A3	1	HVIR	D	S	4.1
A3	1	HVIR	D	S	3.8
A3	1	HVIR	D	S	3.2
A3	1	QCOC	L	C	24.1
A3	1	QCOC	L	C	22.5
A3	1	QVEL	L	C	26
A3	1	QVEL	L	C	21
A3	2	AMESPP	D	S	7.3
A3	2	AMESPP	D	S	7
A3	2	AMESPP	D	S	6
A3	2	ARUB	L	I	9.6
A3	2	ARUB	L	I	9.6
A3	2	ARUB	L	I	9.3
A3	2	ARUB	L	I	9.1
A3	2	ARUB	L	I	9.1
A3	2	ARUB	D	S	8.6
A3	2	ARUB	L	S	7.4
A3	2	ARUB	L	S	7.3
A3	2	ARUB	L	S	6.2
A3	2	ARUB	L	S	3.9
A3	2	ARUB	L	S	3.7
A3	2	BPOP	L	S	4.8
A3	2	CDEN	L	S	5
A3	2	CDEN	D	S	4.9
A3	2	CDEN	D	S	4.2
A3	2	CDEN	D	S	4.1
A3	2	CDEN	D	S	3.8
A3	2	QCOC	L	C	27.6
A3	2	QCOC	L	C	22.7
A3	2	QCOC	L	C	22.6
A3	2	QCOC	D	S	13.4
A3	2	QVEL	L	C	27.2
A3	2	QVEL	L	C	22.7
A4	1	ARUB	L	I	3.1
A4	1	QCOC	L	C	28.8
A4	1	QCOC	L	C	26.1
A4	2	AMESPP	L	S	7.2
A4	2	AMESPP	L	S	4.7
A4	2	AMESPP	L	S	3.5
A4	2	ARUB	L	I	6
A4	2	CDEN	L	S	5.4
A4	2	CDEN	D	S	4.5
A4	2	QCOC	L	C	27.9
A4	2	QCOC	L	C	24.5
A4	2	QCOC	L	C	20.9
A5	1	ARUB	L	I	21.5
A5	1	ARUB	L	I	10
A5	1	ARUB	L	S	9.6
A5	1	ARUB	L	S	9.2
A5	1	ARUB	L	S	8.1
A5	1	ARUB	L	I	7.7

Unit	Q	Spp	L/D	CC	DBH
A5	1	ARUB	L	S	6.8
A5	1	ARUB	L	S	5
A5	1	ARUB	L	S	5
A5	1	ARUB	L	S	5
A5	1	ARUB	L	S	4.9
A5	1	ARUB	D	S	4.4
A5	1	ARUB	L	S	4.2
A5	1	ARUB	L	S	4
A5	1	ARUB	L	S	4
A5	1	ARUB	L	S	3.9
A5	1	ARUB	L	S	3.7
A5	1	BPOP	L	S	5.8
A5	1	CDEN	D	S	6.6
A5	1	CDEN	D	S	6.4
A5	1	CDEN	D	S	4.9
A5	1	CDEN	L	I	4.9
A5	1	CDEN	D	S	3.9
A5	1	CDEN	D	S	3.5
A5	1	CDEN	D	S	3.3
A5	1	PSTR	L	S	10
A5	1	PSTR	L	S	9.4
A5	1	QCOC	L	C	31.3
A5	1	QCOC	L	C	26.6
A5	1	QCOC	L	C	26.1
A5	1	QVEL	L	C	22.6
A5	1	QVEL	L	C	21.4
A5	2	AMESPP	L	S	6.8
A5	2	AMESPP	L	S	5.2
A5	2	AMESPP	L	S	3.8
A5	2	ARUB	L	I	11.8
A5	2	ARUB	L	I	10.7
A5	2	ARUB	L	I	10
A5	2	ARUB	L	S	9.3
A5	2	ARUB	L	I	8
A5	2	ARUB	L	S	7.2
A5	2	ARUB	L	S	6.7
A5	2	ARUB	L	I	5.6
A5	2	ARUB	D	S	5.2
A5	2	ARUB	L	S	4.6
A5	2	ARUB	L	S	3.8
A5	2	ARUB	L	S	3.6
A5	2	ARUB	L	S	3.2
A5	2	BPOP	D	S	7.7
A5	2	BPOP	L	I	7
A5	2	BPOP	L	S	5.9
A5	2	BPOP	L	S	4.1
A5	2	BPOP	L	S	3.2
A5	2	BPOP	L	S	3.2
A5	2	BPOP	L	S	3
A5	2	CDEN	D	S	8.1
A5	2	CDEN	L	S	5.2
A5	2	CDEN	L	S	4.1
A5	2	NMUC	L	S	4.4
A5	2	NMUC	L	S	4
A5	2	NMUC	D	S	3.8
A5	2	NMUC	L	S	3.7
A5	2	NMUC	L	S	3.5
A5	2	NMUC	L	S	3.5
A5	2	NMUC	D	S	3.2
A5	2	NMUC	L	S	3.2
A5	2	NMUC	L	S	3.1
A5	2	QCOC	L	C	26.5
A5	2	QCOC	L	C	24

Unit	Q	Spp	L/D	CC	DBH
A6	1	ARUB	L	I	12.2
A6	1	QVEL	L	C	24.8
A6	1	QVEL	L	C	23.7
A6	1	QVEL	L	C	21.8
A6	1	QVEL	L	C	19.7
A6	1	QVEL	L	C	19.5
A6	1	QVEL	L	C	18.3
A6	2	ARUB	L	I	9.8
A6	2	ARUB	D	S	9.1
A6	2	ARUB	L	S	8.2
A6	2	ARUB	L	S	7.8
A6	2	ARUB	L	S	7.3
A6	2	ARUB	L	S	5.5
A6	2	ARUB	D	S	4.2
A6	2	ARUB	D	S	3.8
A6	2	PSTR	D	S	3.6
A6	2	QCOC	L	C	25
A6	2	QVEL	L	C	27.8
A6	2	QVEL	L	C	23.3
A6	2	QVEL	L	C	22.5
A6	2	QVEL	L	C	22.4
B1	1	QCOC	L	C	31.1
B1	1	QCOC	L	C	23.9
B1	1	QCOC	L	C	23.8
B1	1	QCOC	L	C	18.8
B1	1	QCOC	L	C	18.1
B1	1	QSPP	D	S	14.8
B1	1	QSPP	D	S	13.8
B1	2	QCOC	L	C	21.5
B1	2	QRUB	L	C	22.9
B1	2	QSPP	D	S	16.2
B2	1	QCOC	L	C	26.5
B2	1	QCOC	L	C	22.3
B2	1	QCOC	L	C	20.2
B2	1	QCOC	L	C	19.8
B2	1	QCOC	L	C	19.2
B2	1	QCOC	L	C	17.1
B2	1	QVEL	L	C	23
B2	1	QVEL	L	C	21.1
B2	1	QVEL	L	C	19
B2	1	QVEL	L	C	17.5
B2	1	QVEL	L	I	15.3
B2	2	ARUB	L	I	11.1
B2	2	QCOC	L	C	22.6
B2	2	QCOC	L	C	22.5
B2	2	QVEL	D	S	26.7
B2	2	QVEL	L	I	13.6
B3	1	QCOC	L	C	28.6
B3	1	QCOC	L	C	21
B3	1	QCOC	L	C	20.6
B3	1	QCOC	L	C	17.6
B3	1	QCOC	L	C	17.1
B3	1	QCOC	L	C	15.4
B3	1	QCOC	L	C	14.7
B3	1	QCOC	D	S	14.5
B3	1	QRUB	L	C	23.8
B3	1	QRUB	L	C	21.3
B3	2	QCOC	L	C	20
B3	2	QCOC	L	C	20
B3	2	QCOC	L	I	18
B3	2	QCOC	L	I	15.3
B3	2	QCOC	L	I	14.5
B3	2	QVEL	L	C	23.1

Unit	Q	Spp	L/D	CC	DBH
B3	2	QVEL	L	C	18.8
B3	2	QVEL	L	S	17.7
B3	2	QVEL	L	I	14.5
B4	1	ARUB	L	I	10.2
B4	1	ARUB	L	S	9.3
B4	1	ARUB	L	I	9
B4	1	ARUB	L	S	8
B4	1	ARUB	L	S	7.4
B4	1	ARUB	L	I	7.2
B4	1	ARUB	L	S	6.3
B4	1	ARUB	D	S	6
B4	1	ARUB	L	S	5.8
B4	1	ARUB	L	S	5.5
B4	1	ARUB	L	S	5.3
B4	1	ARUB	L	S	5.1
B4	1	ARUB	L	S	5.1
B4	1	ARUB	L	S	4.4
B4	1	ARUB	L	S	4.3
B4	1	ARUB	L	S	4.3
B4	1	ARUB	D	S	3.9
B4	1	ARUB	L	S	3.8
B4	1	ARUB	L	S	3.3
B4	1	ARUB	L	S	3.2
B4	1	ARUB	L	S	3.2
B4	1	BPOP	D	S	12.2
B4	1	BPOP	L	S	5.2
B4	1	CDEN	D	S	3.9
B4	1	CDEN	D	S	3.5
B4	1	CDEN	D	S	3.1
B4	1	PSTR	L	C	20.2
B4	1	PSTR	L	S	7.4
B4	1	QCOC	L	C	22.6
B4	1	QCOC	L	C	22
B4	1	QCOC	L	C	20.3
B4	1	QCOC	L	C	20.2
B4	1	QCOC	L	C	19.3
B4	1	QCOC	L	C	19
B4	1	QCOC	L	C	18.8
B4	1	QCOC	L	I	17.7
B4	1	QCOC	L	C	17.5
B4	1	QCOC	L	I	16.7
B4	1	QCOC	L	C	14.8
B4	1	QCOC	L	C	13.7
B4	1	QSPP	D	S	10.1
B4	1	QVEL	L	C	16.3
B4	1	QVEL	L	C	13.4
B4	1	SALB	D	S	4.1
B4	2	AMESPP	L	S	8
B4	2	AMESPP	D	S	6.3
B4	2	AMESPP	L	S	3.3
B4	2	ARUB	L	S	17.8
B4	2	ARUB	L	C	17.1
B4	2	ARUB	L	I	15.7
B4	2	ARUB	L	S	12
B4	2	ARUB	L	I	11.8
B4	2	ARUB	L	I	9.3
B4	2	ARUB	L	S	9.1
B4	2	ARUB	L	I	8.3
B4	2	ARUB	L	S	7.4
B4	2	ARUB	L	I	6.8
B4	2	ARUB	D	S	6.3
B4	2	ARUB	L	S	5.5
B4	2	ARUB	D	S	3.4

Unit	Q	Spp	L/D	CC	DBH
B4	2	ARUB	L	S	3.4
B4	2	ARUB	L	S	3.3
B4	2	ARUB	D	S	3.2
B4	2	ARUB	D	S	3.2
B4	2	BPOP	L	S	6.2
B4	2	QCOC	L	C	23.8
B4	2	QCOC	L	C	23.8
B4	2	QCOC	L	C	23.3
B4	2	QCOC	L	C	22.8
B4	2	QSPP	D	S	11.9
B4	2	QVEL	L	C	23.2
B4	2	QVEL	L	C	23.1
B4	2	QVEL	L	C	17.7
B4	2	QVEL	L	C	17.5
B4	2	QVEL	L	I	14.3
B4	2	QVEL	L	I	10.7
B4	2	VCAS	L	S	3
B5	1	AMESPP	L	S	6.6
B5	1	ARUB	L	S	8.8
B5	1	ARUB	L	S	8.4
B5	1	ARUB	L	S	6.5
B5	1	ARUB	L	S	6.3
B5	1	ARUB	L	S	5.5
B5	1	ARUB	L	S	5.5
B5	1	ARUB	L	S	5.1
B5	1	ARUB	L	S	5
B5	1	ARUB	L	S	4.5
B5	1	ARUB	L	S	4
B5	1	ARUB	L	S	4
B5	1	ARUB	L	S	3.3
B5	1	ARUB	L	S	3.2
B5	1	BPAP	L	I	9.2
B5	1	CDEN	D	S	6
B5	1	CDEN	L	S	5.8
B5	1	CDEN	L	S	4
B5	1	CDEN	D	S	4
B5	1	CDEN	D	S	3.8
B5	1	KLAT	L	S	5.4
B5	1	KLAT	L	S	5.3
B5	1	KLAT	L	S	4.2
B5	1	KLAT	L	S	3.2
B5	1	QALB	L	S	11.1
B5	1	QALB	L	S	8
B5	1	QCOC	L	C	19.1
B5	1	QCOC	L	C	18.9
B5	1	QCOC	L	C	18.4
B5	1	QCOC	L	C	18.3
B5	1	QCOC	L	C	17.6
B5	1	QCOC	L	I	16.1
B5	1	QCOC	D	S	16.1
B5	1	QCOC	L	C	15.3
B5	1	QCOC	L	S	13.9
B5	1	QCOC	D	S	10.4
B5	1	QCOC	L	S	5.8
B5	1	QSPP	D	S	10.9
B5	1	QSPP	D	S	8
B5	1	QVEL	L	I	18.8
B5	1	QVEL	L	I	9.1
B5	1	QVEL	L	S	3.1
B5	2	AMESPP	D	S	5.7
B5	2	AMESPP	L	S	3.8
B5	2	ARUB	L	I	12.1
B5	2	ARUB	L	I	9.4

Unit	Q	Spp	L/D	CC	DBH
B5	2	ARUB	L	S	9.2
B5	2	ARUB	L	I	8.4
B5	2	ARUB	L	I	8.3
B5	2	ARUB	L	S	8
B5	2	ARUB	L	I	7.4
B5	2	ARUB	L	S	6.6
B5	2	ARUB	L	S	6.5
B5	2	ARUB	L	I	5.7
B5	2	ARUB	L	S	5.5
B5	2	ARUB	L	S	5
B5	2	ARUB	L	S	4.7
B5	2	ARUB	D	S	4.3
B5	2	ARUB	L	S	4
B5	2	ARUB	D	S	3.8
B5	2	ARUB	L	S	3.7
B5	2	BPOP	L	S	6.3
B5	2	BPOP	L	S	5.8
B5	2	BPOP	L	S	4.8
B5	2	BPOP	L	S	3.2
B5	2	BPOP	L	S	3
B5	2	CDEN	D	S	5
B5	2	CDEN	D	S	4.5
B5	2	CDEN	L	S	4
B5	2	CDEN	L	S	4
B5	2	CDEN	L	S	3.6
B5	2	CDEN	D	S	3.2
B5	2	QALB	L	S	8.3
B5	2	QCOC	L	C	21.5
B5	2	QCOC	L	C	20.7
B5	2	QVEL	L	C	20.5
B5	2	QVEL	L	C	14.3
B5	2	QVEL	L	C	14.1
B5	2	QVEL	L	I	12.4
B5	2	QVEL	L	C	12
B5	2	QVEL	D	S	3.2
B6	1	AMESPP	D	S	7.2
B6	1	AMESPP	D	S	4.8
B6	1	ARUB	D	S	7.7
B6	1	ARUB	D	S	7.6
B6	1	QVEL	L	C	22.3
B6	2	AMESPP	D	S	5.8
B6	2	ARUB	D	S	15.8
B6	2	ARUB	D	S	8.2
B6	2	ARUB	D	S	7.8
B6	2	ARUB	D	S	6.3
B6	2	ARUB	D	S	4.5
B6	2	NSYL	L	C	13.7
B6	2	NSYL	L	C	11
B6	2	NSYL	L	I	10.3
B6	2	QALB	D	S	14.3
B6	2	QVEL	D	S	20
B6	2	QVEL	D	S	15.5
B6	2	SALB	D	S	4.6
C1	1	ARUB	L	I	11.8
C1	1	ARUB	L	S	8.1
C1	1	ARUB	L	S	7.5
C1	1	ARUB	L	S	7.3
C1	1	ARUB	L	S	7.1
C1	1	ARUB	L	S	7
C1	1	ARUB	L	S	6.3
C1	1	BLEN	L	I	17.6
C1	1	BLEN	L	S	11.5
C1	1	BLEN	L	I	8.4

Unit	Q	Spp	L/D	CC	DBH
C1	1	BLEN	L	S	7
C1	1	BLEN	L	S	5.6
C1	1	BLEN	L	S	4.3
C1	1	BLEN	L	S	4.1
C1	1	BLEN	L	S	3.4
C1	1	CDEN	L	S	5.5
C1	1	CDEN	L	S	4.5
C1	1	CDEN	D	S	4
C1	1	CDEN	L	S	3.3
C1	1	CDEN	D	S	3.2
C1	1	HVIR	L	S	3.1
C1	1	PSTR	L	S	3
C1	1	QRUB	L	C	34.1
C1	1	QRUB	L	C	31.7
C1	1	QRUB	L	C	31
C1	1	QRUB	L	C	28.6
C1	1	QRUB	L	C	27.5
C1	1	QRUB	L	C	26.7
C1	1	QRUB	L	I	25.1
C1	1	QRUB	L	I	22.3
C1	1	QRUB	D	S	13.3
C1	2	ARUB	D	S	19
C1	2	ARUB	L	S	18.6
C1	2	ARUB	L	I	13.6
C1	2	ARUB	L	S	13.4
C1	2	ARUB	L	S	11
C1	2	ARUB	L	S	10.8
C1	2	ARUB	L	S	10.5
C1	2	ARUB	L	S	9.4
C1	2	ARUB	L	S	8.8
C1	2	ARUB	L	S	8
C1	2	ARUB	L	S	8
C1	2	ARUB	L	S	7.7
C1	2	ARUB	L	S	6.6
C1	2	ARUB	L	S	6
C1	2	ARUB	L	S	5.9
C1	2	ARUB	L	S	5.7
C1	2	ARUB	D	S	5.5
C1	2	CDEN	D	S	6.1
C1	2	CDEN	D	S	5.1
C1	2	CDEN	D	S	4.3
C1	2	CDEN	L	S	4
C1	2	CDEN	D	S	3.6
C1	2	CDEN	D	S	3.4
C1	2	HVIR	L	S	4
C1	2	HVIR	L	S	4
C1	2	HVIR	L	S	3.7
C1	2	HVIR	L	S	3.4
C1	2	HVIR	L	S	3.4
C1	2	HVIR	L	S	3.1
C1	2	HVIR	L	S	3.1
C1	2	HVIR	L	S	3
C1	2	QRUB	L	C	39.8
C1	2	QRUB	L	C	36.1
C1	2	QRUB	L	C	29.9
C1	2	QRUB	L	I	16.8
C2	1	QALB	L	C	26.3
C2	1	QRUB	L	C	49.1
C2	1	QRUB	L	C	47.5
C2	2	QRUB	L	C	42.9
C2	2	QRUB	L	C	34
C3	1	ARUB	D	S	9.1
C3	1	ARUB	L	S	8

Unit	Q	Spp	L/D	CC	DBH
C3	1	ARUB	D	S	3.2
C3	1	QALB	L	C	28.4
C3	1	QRUB	L	C	33.3
C3	1	QRUB	L	C	32.3
C3	1	QRUB	L	C	29.9
C3	1	QRUB	L	I	23.7
C3	1	QRUB	L	I	20.9
C3	1	QRUB	L	I	15.6
C3	2	ARUB	L	S	14.1
C3	2	ARUB	L	S	8
C3	2	ARUB	L	S	7.5
C3	2	CDEN	D	S	5.5
C3	2	Q Sp	D	S	17.5
C3	2	QCOC	L	C	36.7
C3	2	QCOC	L	I	20
C3	2	QRUB	L	C	33
C3	2	QRUB	L	C	28.6
C3	2	QRUB	L	C	27
C3	2	QRUB	L	C	26.8
C4	1	ARUB	L	I	11.4
C4	1	ARUB	L	S	7.5
C4	1	ARUB	L	S	7.3
C4	1	ARUB	L	S	7.2
C4	1	ARUB	L	S	7.1
C4	1	ARUB	L	S	6.8
C4	1	ARUB	L	S	6
C4	1	ARUB	D	S	6
C4	1	ARUB	L	S	6
C4	1	ARUB	L	S	5.5
C4	1	ARUB	L	S	4.7
C4	1	ARUB	D	S	4.6
C4	1	ARUB	L	S	4.4
C4	1	ARUB	L	S	4.2
C4	1	ARUB	L	S	4.1
C4	1	ARUB	D	S	3.4
C4	1	ARUB	D	S	3.1
C4	1	BLEN	L	I	21.9
C4	1	BLEN	L	I	16
C4	1	BLEN	L	S	7.5
C4	1	PSTR	L	S	3.2
C4	1	QRUB	L	C	32
C4	1	QRUB	L	C	29.6
C4	1	QRUB	L	C	24.5
C4	1	QRUB	L	C	23
C4	1	QRUB	L	C	22.3
C4	1	QRUB	L	I	18
C4	1	QRUB	L	I	16.5
C4	1	QRUB	D	S	13.8
C4	2	ARUB	L	S	16.1
C4	2	ARUB	L	I	14
C4	2	ARUB	L	S	12.5
C4	2	ARUB	L	I	12
C4	2	ARUB	L	S	7.2
C4	2	ARUB	D	S	4.3
C4	2	ARUB	L	S	3.2
C4	2	ARUB	L	S	3.1
C4	2	BLEN	L	I	9.7
C4	2	BLEN	L	S	8.7
C4	2	BLEN	L	S	8.5
C4	2	BLEN	L	S	7
C4	2	BLEN	D	S	3.3
C4	2	BLEN	L	S	3.2
C4	2	BLEN	D	S	3

Unit	Q	Spp	L/D	CC	DBH
C4	2	CDEN	D	S	5.5
C4	2	CDEN	D	S	4.2
C4	2	CDEN	D	S	3.7
C4	2	HVIR	L	S	3.2
C4	2	PSTR	L	S	5.6
C4	2	QRUB	L	C	29.3
C4	2	QRUB	L	C	27.5
C4	2	QRUB	L	C	26.5
C4	2	QRUB	L	C	24.8
C4	2	QRUB	L	C	23.5
C4	2	QRUB	L	C	22.8
C4	2	QRUB	L	C	20.9
C4	2	QRUB	L	I	18.8
C4	2	QRUB	D	S	16
C5	1	BLEN	L	I	21.4
C5	1	QRUB	L	C	30
C5	1	QRUB	L	C	23.5
C5	2	ARUB	L	S	10.8
C5	2	QALB	D	S	19
C5	2	QRUB	L	C	39.8
C5	2	QRUB	L	C	33.9
C5	2	QRUB	L	I	23.8
C5	2	QRUB	D	S	14
C6	1	ARUB	L	S	3.5
C6	1	ARUB	L	S	3
C6	1	QCOC	L	I	16
C6	1	QRUB	L	C	27.3
C6	1	QRUB	L	C	25.9
C6	1	QRUB	L	C	24.6
C6	1	QRUB	L	C	24.5
C6	2	QRUB	L	C	25.6

Understory Data, Pelham, 2002

Point intercept data for Cadwell Forest, Pelham, MA, Summer 2002.
All vegetation 0-m to 0.5-m (below) and 0.5-m to 3.0-m (above)
Data are sorted by unit, transect (t), and point.
Transect was 40-m long, yielding 80 points from 5-m to 44.5-m.

Unit	T	Point	Above	Below
A1	1	5		
A1	1	5.5		
A1	1	6		
A1	1	6.5		vp
A1	1	7		gb,pa
A1	1	7.5	gb	
A1	1	8		va
A1	1	8.5		ka
A1	1	9		
A1	1	9.5		
A1	1	10		
A1	1	10.5		gp,lo
A1	1	11		ka
A1	1	11.5		
A1	1	12	pa	gb
A1	1	12.5		
A1	1	13	gb	gb
A1	1	13.5		
A1	1	14		
A1	1	14.5		vp
A1	1	15		va
A1	1	15.5		gb
A1	1	16	gb	ka
A1	1	16.5		gb
A1	1	17		pa,va
A1	1	17.5	gb	va
A1	1	18		gb
A1	1	18.5		vp
A1	1	19		
A1	1	19.5	cd	pa
A1	1	20	cd	
A1	1	20.5	cd	pa,gp
A1	1	21		
A1	1	21.5	gb	vp
A1	1	22		gb
A1	1	22.5	vcas	vp
A1	1	23		gb
A1	1	23.5		
A1	1	24	gb	
A1	1	24.5	gb	
A1	1	25	gb	gb
A1	1	25.5		gb
A1	1	26	gb	
A1	1	26.5		gb
A1	1	27	cd	vp
A1	1	27.5	pa	vp
A1	1	28		gb
A1	1	28.5		gb
A1	1	29		gb,va
A1	1	29.5		gb
A1	1	30		ka,gb
A1	1	30.5		gb
A1	1	31		
A1	1	31.5		gb
A1	1	32		gb,ka
A1	1	32.5		gp
A1	1	33		
A1	1	33.5	pa	
A1	1	34		gp
A1	1	34.5		va
A1	1	35		gb
A1	1	35.5		gb,va
A1	1	36		
A1	1	36.5		va,pa,gb
A1	1	37	gb	
A1	1	37.5		tb
A1	1	38	gb	gb
A1	1	38.5		gb,vp
A1	1	39		gb
A1	1	39.5		vp
A1	1	40		
A1	1	40.5	ps	va
A1	1	41	ps	ps,gb
A1	1	41.5	ps	
A1	1	42	ps	
A1	1	42.5	ps	gp
A1	1	43	ps	vp
A1	1	43.5	ps	er
A1	1	44	pa	
A1	1	44.5		tb
A1	2	5		
A1	2	5.5		
A1	2	6	gb	vp
A1	2	6.5		va
A1	2	7		gb
A1	2	7.5	gb,pa	gb
A1	2	8		ka
A1	2	8.5		qc
A1	2	9		gb
A1	2	9.5	pa	gb,va
A1	2	10		
A1	2	10.5		gb,gp
A1	2	11		
A1	2	11.5		gb
A1	2	12	gb	
A1	2	12.5		gb
A1	2	13		gb
A1	2	13.5		
A1	2	14		
A1	2	14.5	qc	vp
A1	2	15	gb	gb
A1	2	15.5	amel	
A1	2	16		gb
A1	2	16.5	pa	gb,gp
A1	2	17	gb,cd	gb
A1	2	17.5		gb
A1	2	18		gb
A1	2	18.5		
A1	2	19		
A1	2	19.5		pa,gb
A1	2	20		
A1	2	20.5		

Unit	T	Point	Above	Below
A1	2	21		gb
A1	2	21.5		
A1	2	22	gb	pa
A1	2	22.5		gb
A1	2	23		va
A1	2	23.5		va
A1	2	24		amel
A1	2	24.5		
A1	2	25		gb
A1	2	25.5	gb	va
A1	2	26		va
A1	2	26.5		
A1	2	27		gb
A1	2	27.5	cd	
A1	2	28	cd	
A1	2	28.5	gb	ka
A1	2	29	qc	
A1	2	29.5		
A1	2	30		gb
A1	2	30.5		gb
A1	2	31	cd	gb
A1	2	31.5	cd	ka
A1	2	32		gb
A1	2	32.5		
A1	2	33		gb
A1	2	33.5	gb	va
A1	2	34	gb	va
A1	2	34.5		gb
A1	2	35		va
A1	2	35.5	nm	gb
A1	2	36	nm	gb
A1	2	36.5	nm	gb
A1	2	37		moss
A1	2	37.5		va
A1	2	38		
A1	2	38.5		
A1	2	39		
A1	2	39.5		
A1	2	40		
A1	2	40.5	cd	gb
A1	2	41		
A1	2	41.5	gb	
A1	2	42		gb
A1	2	42.5		gb
A1	2	43		
A1	2	43.5		va
A1	2	44		gb,gp
A1	2	44.5		
A1	3	5	gb	
A1	3	5.5	cd	
A1	3	6		gb,mc
A1	3	6.5		
A1	3	7		gb
A1	3	7.5		va
A1	3	8		gb
A1	3	8.5		
A1	3	9	vcas	
A1	3	9.5		va
A1	3	10		gb,gp
A1	3	10.5		gb,va
A1	3	11	gb	gb
A1	3	11.5		
A1	3	12		gb
A1	3	12.5		
A1	3	13		
A1	3	13.5		gb
A1	3	14		va
A1	3	14.5		
A1	3	15		
A1	3	15.5		

Unit	T	Point	Above	Below
A1	3	16		
A1	3	16.5		vp
A1	3	17		gp
A1	3	17.5		
A1	3	18		gb
A1	3	18.5		
A1	3	19		
A1	3	19.5		ar
A1	3	20		vp
A1	3	20.5		
A1	3	21		gb
A1	3	21.5		gb,vp
A1	3	22		
A1	3	22.5		
A1	3	23	cd	gb
A1	3	23.5	cd	gb
A1	3	24	gb	vp
A1	3	24.5		vp
A1	3	25		gb
A1	3	25.5	pa	gb,vp
A1	3	26		vp,gb
A1	3	26.5		gb
A1	3	27		vp
A1	3	27.5		vp
A1	3	28		gb
A1	3	28.5		vp
A1	3	29		gb,vp
A1	3	29.5		vp
A1	3	30		va
A1	3	30.5		
A1	3	31	cd	
A1	3	31.5	cd	
A1	3	32	cd	
A1	3	32.5		gb
A1	3	33		
A1	3	33.5		va
A1	3	34		pa
A1	3	34.5	pa	va
A1	3	35		
A1	3	35.5		
A1	3	36		
A1	3	36.5	gb	vp
A1	3	37		pa
A1	3	37.5	vp	vp
A1	3	38		
A1	3	38.5	gb	gb
A1	3	39	gb	
A1	3	39.5		amel
A1	3	40		gp
A1	3	40.5		gb,gp
A1	3	41		gb
A1	3	41.5		gb
A1	3	42		gb
A1	3	42.5		gb
A1	3	43		
A1	3	43.5		gb
A1	3	44		gb
A1	3	44.5		gb
A2	1	5		
A2	1	5.5		vp,ka
A2	1	6		
A2	1	6.5	ps	
A2	1	7		gb
A2	1	7.5		
A2	1	8		gp
A2	1	8.5		gb
A2	1	9		pa,gp
A2	1	9.5		ka
A2	1	10		ka
A2	1	10.5		

Unit	T	Point	Above	Below
A2	1	11		gb
A2	1	11.5		
A2	1	12		gb
A2	1	12.5	cd	
A2	1	13		gb
A2	1	13.5		
A2	1	14		
A2	1	14.5		
A2	1	15		
A2	1	15.5		gb
A2	1	16		hv
A2	1	16.5		gb
A2	1	17		
A2	1	17.5		
A2	1	18		gp
A2	1	18.5		vcas
A2	1	19		vcas
A2	1	19.5		va
A2	1	20		gb
A2	1	20.5		
A2	1	21		pa
A2	1	21.5		gb
A2	1	22		vcas
A2	1	22.5		
A2	1	23		gp
A2	1	23.5		pa,gb
A2	1	24		
A2	1	24.5		vcas
A2	1	25		
A2	1	25.5		gb,vp
A2	1	26		ka
A2	1	26.5		
A2	1	27		
A2	1	27.5		
A2	1	28		
A2	1	28.5		gb
A2	1	29		ar
A2	1	29.5		va
A2	1	30		gb
A2	1	30.5		
A2	1	31		va
A2	1	31.5		gb
A2	1	32		gb
A2	1	32.5		gb
A2	1	33		cd
A2	1	33.5		va
A2	1	34		
A2	1	34.5		va
A2	1	35		va
A2	1	35.5		
A2	1	36		
A2	1	36.5		va
A2	1	37		gb
A2	1	37.5		va
A2	1	38		va
A2	1	38.5		[a
A2	1	39		
A2	1	39.5	cd	ar
A2	1	40	cd	cd
A2	1	40.5	cd	g[
A2	1	41	cd	va
A2	1	41.5		
A2	1	42		[a.va
A2	1	42.5		[a
A2	1	43		va
A2	1	43.5		cs
A2	1	44		vp
A2	1	44.5		pa,gb
A2	2	5		amel
A2	2	5.5		

Unit	T	Point	Above	Below
A2	2	6		ka
A2	2	6.5		vp
A2	2	7		
A2	2	7.5		
A2	2	8		
A2	2	8.5		pa,gb
A2	2	9		gb
A2	2	9.5		gb
A2	2	10		vcas
A2	2	10.5	cd	
A2	2	11		gb
A2	2	11.5		
A2	2	12		
A2	2	12.5		gb
A2	2	13		gb
A2	2	13.5		gb
A2	2	14		gb
A2	2	14.5		
A2	2	15		
A2	2	15.5		ar
A2	2	16		pa
A2	2	16.5		
A2	2	17	pa	
A2	2	17.5		
A2	2	18		
A2	2	18.5		pa,gb
A2	2	19		gb
A2	2	19.5		ka
A2	2	20	pa	gb
A2	2	20.5		gb
A2	2	21		gb
A2	2	21.5		gb
A2	2	22		gb
A2	2	22.5		gb
A2	2	23	pa	gp
A2	2	23.5		pa,gb
A2	2	24		
A2	2	24.5		
A2	2	25		gb
A2	2	25.5		gb
A2	2	26		
A2	2	26.5		
A2	2	27	pa	
A2	2	27.5		gb
A2	2	28		pa,gb
A2	2	28.5		
A2	2	29		gp,vcas
A2	2	29.5		qv
A2	2	30		
A2	2	30.5		gb
A2	2	31		
A2	2	31.5		gb
A2	2	32		
A2	2	32.5		moss
A2	2	33		
A2	2	33.5		gb
A2	2	34		ka
A2	2	34.5		
A2	2	35		
A2	2	35.5	pa	gb
A2	2	36		gb
A2	2	36.5		
A2	2	37		
A2	2	37.5		
A2	2	38		gb
A2	2	38.5		gb
A2	2	39		pa,ka
A2	2	39.5		va
A2	2	40		ka
A2	2	40.5		

Unit	T	Point	Above	Below
A2	2	41		aa,pa,gb
A2	2	41.5		
A2	2	42		
A2	2	42.5		
A2	2	43		vcas,ar,gp
A2	2	43.5		
A2	2	44		
A2	2	44.5		
A2	3	5		
A2	3	5.5		va
A2	3	6		
A2	3	6.5		
A2	3	7		gb
A2	3	7.5		gb
A2	3	8		gp
A2	3	8.5		
A2	3	9		gb
A2	3	9.5		
A2	3	10		gb
A2	3	10.5		
A2	3	11		
A2	3	11.5		
A2	3	12		
A2	3	12.5		
A2	3	13		ka,va
A2	3	13.5		va,gb
A2	3	14		
A2	3	14.5		
A2	3	15		vcas,aa
A2	3	15.5		
A2	3	16		gb
A2	3	16.5		va
A2	3	17		gb
A2	3	17.5		
A2	3	18		gb
A2	3	18.5		
A2	3	19		
A2	3	19.5		
A2	3	20		va
A2	3	20.5		pa,gb
A2	3	21		
A2	3	21.5		gb
A2	3	22		gb
A2	3	22.5		vp,gp
A2	3	23		vcas
A2	3	23.5		va
A2	3	24		vp
A2	3	24.5	cd	
A2	3	25		pa,ka
A2	3	25.5		gb
A2	3	26		
A2	3	26.5		vp
A2	3	27		gb
A2	3	27.5		
A2	3	28		
A2	3	28.5		pa,gb
A2	3	29		
A2	3	29.5		
A2	3	30		
A2	3	30.5		
A2	3	31	amel	
A2	3	31.5		
A2	3	32		gp
A2	3	32.5		gb
A2	3	33	ar	
A2	3	33.5		
A2	3	34		
A2	3	34.5		
A2	3	35		gb
A2	3	35.5		gb

Unit	T	Point	Above	Below
A2	3	36		
A2	3	36.5		vcas
A2	3	37		
A2	3	37.5		
A2	3	38		
A2	3	38.5		gb
A2	3	39		amel
A2	3	39.5		gb,ka
A2	3	40		gb
A2	3	40.5		
A2	3	41		gb,lo
A2	3	41.5		pa,gb
A2	3	42		pa,moss
A2	3	42.5		
A2	3	43		
A2	3	43.5		
A2	3	44		pa,gb
A2	3	44.5		
A3	1	5	amel	amel,vp
A3	1	5.5	amel	amel
A3	1	6		gb
A3	1	6.5		vp
A3	1	7	pa	qb,gp
A3	1	7.5		vp
A3	1	8		
A3	1	8.5		qi
A3	1	9		gb
A3	1	9.5	ar	vp
A3	1	10		
A3	1	10.5		gb
A3	1	11		gb
A3	1	11.5		pa
A3	1	12	ar	pa
A3	1	12.5	pa,ar	gb
A3	1	13	ar	
A3	1	13.5		gb
A3	1	14		gb
A3	1	14.5		gb,va
A3	1	15		gb
A3	1	15.5		
A3	1	16		gb,cs
A3	1	16.5		vp
A3	1	17		gb
A3	1	17.5		gb
A3	1	18		
A3	1	18.5		
A3	1	19		
A3	1	19.5		
A3	1	20		va
A3	1	20.5		pa,vp
A3	1	21		gb,ka
A3	1	21.5		vp,va
A3	1	22		
A3	1	22.5		gb,gp,va
A3	1	23		gb
A3	1	23.5		va
A3	1	24	ar	
A3	1	24.5	ar	ar
A3	1	25		ka
A3	1	25.5		gb,gp
A3	1	26		
A3	1	26.5		gb,gp
A3	1	27	ar	gp
A3	1	27.5		
A3	1	28		cs
A3	1	28.5	cd	cd,gb
A3	1	29	cd	
A3	1	29.5	cd	ka
A3	1	30	cd	
A3	1	30.5	cd	

Unit	T	Point	Above	Below
A3	1	31		vp
A3	1	31.5		
A3	1	32		gb
A3	1	32.5		vp
A3	1	33	pa	
A3	1	33.5	ar	va
A3	1	34	ar	ar
A3	1	34.5		
A3	1	35	ar	ka
A3	1	35.5		
A3	1	36		
A3	1	36.5		
A3	1	37		pa,va,vp
A3	1	37.5		
A3	1	38		moss
A3	1	38.5	ar	aa
A3	1	39		
A3	1	39.5		
A3	1	40		gb,gp
A3	1	40.5		gb
A3	1	41		
A3	1	41.5		pa,gb
A3	1	42		gb
A3	1	42.5		
A3	1	43		gb,ka
A3	1	43.5		
A3	1	44		gb
A3	1	44.5		gb
A3	2	5		
A3	2	5.5		
A3	2	6		nm
A3	2	6.5	ar	ar,nm
A3	2	7	ar	ar,gb,va
A3	2	7.5		pa
A3	2	8		ka
A3	2	8.5		pa,gb
A3	2	9		gb,pa
A3	2	9.5	ar	pa,va
A3	2	10	ar	va
A3	2	10.5	ar	
A3	2	11		tb
A3	2	11.5		va
A3	2	12		
A3	2	12.5		gb,gp
A3	2	13		va
A3	2	13.5		gb
A3	2	14		amel,ka
A3	2	14.5	pa	pa,vp
A3	2	15		gb
A3	2	15.5		pa,gb
A3	2	16		pa
A3	2	16.5		pa,va
A3	2	17		gp
A3	2	17.5		gb,va
A3	2	18		pa,gb,va,gp
A3	2	18.5		
A3	2	19		gb,pa,vcas
A3	2	19.5		vp
A3	2	20		pa,gb
A3	2	20.5		vp
A3	2	21		
A3	2	21.5		pa
A3	2	22		vo
A3	2	22.5		
A3	2	23		vp
A3	2	23.5		
A3	2	24		gb,va
A3	2	24.5		gb
A3	2	25		
A3	2	25.5		vp

Unit	T	Point	Above	Below
A3	2	26		
A3	2	26.5		gb
A3	2	27		
A3	2	27.5		
A3	2	28	pa	gb
A3	2	28.5		gb,pa,vcas
A3	2	29		
A3	2	29.5		amel
A3	2	30		amel
A3	2	30.5		gb
A3	2	31		pa,gb
A3	2	31.5		pa,va
A3	2	32		vp
A3	2	32.5		pa,va
A3	2	33		
A3	2	33.5		gb
A3	2	34		
A3	2	34.5		ka
A3	2	35		
A3	2	35.5		
A3	2	36		
A3	2	36.5		
A3	2	37		vp
A3	2	37.5		gb
A3	2	38	cd	pa,ar,vp
A3	2	38.5	cd	cd,gb
A3	2	39		vp
A3	2	39.5		gb
A3	2	40		gb,va
A3	2	40.5		qv
A3	2	41	cd	va
A3	2	41.5		gb
A3	2	42		gp
A3	2	42.5	ar	
A3	2	43	ar	ar
A3	2	43.5	ar	ar,pa
A3	2	44	ar	
A3	2	44.5	ar	ar
A3	3	5		gp,pa,gb
A3	3	5.5		gb
A3	3	6		
A3	3	6.5		gp,gb
A3	3	7		pa
A3	3	7.5		
A3	3	8		pa
A3	3	8.5		
A3	3	9		pa
A3	3	9.5		ar
A3	3	10		gp
A3	3	10.5		vp
A3	3	11		gp
A3	3	11.5		cd
A3	3	12		va
A3	3	12.5	cd	va
A3	3	13	cd	va,gb
A3	3	13.5		gb
A3	3	14		
A3	3	14.5		
A3	3	15		
A3	3	15.5		gb
A3	3	16	cd	tb
A3	3	16.5	cd	gb
A3	3	17	cd	
A3	3	17.5		
A3	3	18		gp
A3	3	18.5		vp,ka
A3	3	19		vp,ka
A3	3	19.5		vp
A3	3	20		
A3	3	20.5		gb

Unit	T	Point	Above	Below
A3	3	21		gb
A3	3	21.5		gb
A3	3	22	qc	qc
A3	3	22.5	qc,ar	ar,gb
A3	3	23		gb
A3	3	23.5		
A3	3	24		ka
A3	3	24.5		
A3	3	25		gb,ka
A3	3	25.5		pa,gb
A3	3	26		gb
A3	3	26.5		vcas,gb,ka
A3	3	27		gb
A3	3	27.5		gb,va
A3	3	28		gb,gp
A3	3	28.5	cd	pa,gb
A3	3	29	cd	ka
A3	3	29.5		ka,vcas
A3	3	30		pa
A3	3	30.5		vp
A3	3	31		pa,va
A3	3	31.5		pa
A3	3	32	ar	ar
A3	3	32.5		pa
A3	3	33		va
A3	3	33.5		va,nm,gp
A3	3	34		nm
A3	3	34.5		nm
A3	3	35	cd	
A3	3	35.5		
A3	3	36		
A3	3	36.5		
A3	3	37		va
A3	3	37.5		va
A3	3	38		va
A3	3	38.5		
A3	3	39		pa,ka
A3	3	39.5		ka
A3	3	40		va
A3	3	40.5		
A3	3	41	ar	ar,pa
A3	3	41.5	ar	va
A3	3	42		ka
A3	3	42.5		va
A3	3	43		ar
A3	3	43.5		ar,va
A3	3	44		
A3	3	44.5		
A4	1	5	cd,qi	gb
A4	1	5.5	cd	gb
A4	1	6		pa,amel
A4	1	6.5		
A4	1	7		
A4	1	7.5		gb
A4	1	8		gb
A4	1	8.5	gb	pa,gb,gp
A4	1	9	pa	
A4	1	9.5		gb
A4	1	10	cd	gb,ka
A4	1	10.5	cd,pa	pa,va
A4	1	11	cd	ka
A4	1	11.5	pa	
A4	1	12	qc	
A4	1	12.5		va
A4	1	13	ar,gb	ka
A4	1	13.5	ar	gb,va
A4	1	14	ar	
A4	1	14.5	hv,qc	gb,gp
A4	1	15	hv	gb
A4	1	15.5	hv	

Unit	T	Point	Above	Below
A4	1	16		gb,ka
A4	1	16.5		pa,va
A4	1	17		
A4	1	17.5		
A4	1	18	qc	va
A4	1	18.5	qc	qc,va
A4	1	19		
A4	1	19.5		gb
A4	1	20	gb	
A4	1	20.5		us
A4	1	21		gb
A4	1	21.5		
A4	1	22		pa,amel
A4	1	22.5	pa	gb,amel
A4	1	23	gb	pa
A4	1	23.5		ka
A4	1	24		gb,vp
A4	1	24.5		gb
A4	1	25		gb
A4	1	25.5	gb	gb,va
A4	1	26	gb	gb
A4	1	26.5		gb
A4	1	27	cd	gb
A4	1	27.5	cd	gp
A4	1	28	cd	gb
A4	1	28.5	cd,gb	
A4	1	29	cd	
A4	1	29.5		gp
A4	1	30		
A4	1	30.5	amel	ka
A4	1	31	qi	qi
A4	1	31.5	gb,qi,vcas	gp
A4	1	32	aa	
A4	1	32.5		gb,va
A4	1	33		gb,an
A4	1	33.5	pa	gb
A4	1	34		
A4	1	34.5	pa	gb
A4	1	35	gb	va
A4	1	35.5		
A4	1	36		
A4	1	36.5		gb
A4	1	37		gb
A4	1	37.5	ar	gb
A4	1	38	gb,rd,cd	
A4	1	38.5	cd,gb	gp
A4	1	39		
A4	1	39.5	cd	gb
A4	1	40	cd	gb
A4	1	40.5	cd	va
A4	1	41	cd	va
A4	1	41.5	gb	gb
A4	1	42		ka
A4	1	42.5		gb
A4	1	43		vp
A4	1	43.5		gb
A4	1	44		
A4	1	44.5		
A4	2	5		gp
A4	2	5.5	qc,pa	gb
A4	2	6	qc	gb
A4	2	6.5		gb
A4	2	7		pa
A4	2	7.5		vcas,gb
A4	2	8		pa,gb
A4	2	8.5	pa	
A4	2	9	pa	va
A4	2	9.5	pa	gb
A4	2	10		qi
A4	2	10.5	qi	a,gp

Unit	T	Point	Above	Below
A4	2	11		ka
A4	2	11.5	gb,ar	
A4	2	12	ar	ar
A4	2	12.5	ar,pa,gb	gb
A4	2	13	ar	va
A4	2	13.5	gb	
A4	2	14		
A4	2	14.5		gb
A4	2	15		gb
A4	2	15.5		gb
A4	2	16		
A4	2	16.5	cd,gb	gb,va
A4	2	17	cd,hv	gb
A4	2	17.5	hv	pa,gb,va
A4	2	18		hb,gb
A4	2	18.5		va
A4	2	19		va
A4	2	19.5		v
A4	2	20		gb,qc
A4	2	20.5		
A4	2	21		va
A4	2	21.5		pa
A4	2	22		gb
A4	2	22.5		
A4	2	23		
A4	2	23.5	pa	gb
A4	2	24		gb
A4	2	24.5		pa
A4	2	25		pa
A4	2	25.5	qc	
A4	2	26	qc	qc,gb
A4	2	26.5		gb
A4	2	27		
A4	2	27.5		
A4	2	28		
A4	2	28.5		pa
A4	2	29	pa	va
A4	2	29.5	ar	gb
A4	2	30	ar	gb
A4	2	30.5	ar	gb
A4	2	31	cd	gp
A4	2	31.5		va
A4	2	32	cd,pa	va
A4	2	32.5		gb,va
A4	2	33	qc	gb
A4	2	33.5		
A4	2	34	cd	gb,ka
A4	2	34.5		
A4	2	35		gb
A4	2	35.5	ar	gp
A4	2	36	ar	
A4	2	36.5		gb
A4	2	37	cd,qi	
A4	2	37.5	cd	gb
A4	2	38		pa,va
A4	2	38.5		gb,va
A4	2	39	gb	gb,va
A4	2	39.5		gb,va,vcas
A4	2	40		
A4	2	40.5		pa,va
A4	2	41		va
A4	2	41.5	gb	
A4	2	42		
A4	2	42.5		gp
A4	2	43		amel,va
A4	2	43.5		pa,va
A4	2	44		va,pa
A4	2	44.5		gp
A4	3	5	cd	pa
A4	3	5.5	cd	

Unit	T	Point	Above	Below
A4	3	6		
A4	3	6.5		gp
A4	3	7	qc	
A4	3	7.5	qc	gb,va
A4	3	8	gb	gb
A4	3	8.5		
A4	3	9		gb
A4	3	9.5	cd	
A4	3	10	cd,gb	
A4	3	10.5		pa
A4	3	11		gb
A4	3	11.5	pa	va
A4	3	12		ka
A4	3	12.5	ar	ka
A4	3	13		pa
A4	3	13.5	cd	pa
A4	3	14	cd	pa,gp
A4	3	14.5	cd	gb
A4	3	15	pa,qi	
A4	3	15.5	gb	ka,cd
A4	3	16	cd	
A4	3	16.5	cd	
A4	3	17		va
A4	3	17.5	pa	va
A4	3	18		gb
A4	3	18.5		cs
A4	3	19	qi	
A4	3	19.5	cd	gb
A4	3	20	cd,pa	
A4	3	20.5	cd	pa,gb
A4	3	21	pa	gb,qc
A4	3	21.5		gb,pa,amel
A4	3	22	pa	gb,va
A4	3	22.5		pa,va
A4	3	23		gp
A4	3	23.5		
A4	3	24		gb,gp
A4	3	24.5	ar,cd	va
A4	3	25	cd,ar	ar
A4	3	25.5	ar	ar,gb
A4	3	26		gb
A4	3	26.5	pa	pa,gb
A4	3	27		
A4	3	27.5		pa,cs
A4	3	28		
A4	3	28.5	qo	gp
A4	3	29		gb
A4	3	29.5	cd	pa
A4	3	30	cd,gb	gb,cd,gp
A4	3	30.5	cd	gb
A4	3	31		
A4	3	31.5	cd	gb
A4	3	32		
A4	3	32.5		qo
A4	3	33		gb
A4	3	33.5		
A4	3	34		gb
A4	3	34.5	amel	pa,hv
A4	3	35	amel,gb	pa,amel
A4	3	35.5		gb
A4	3	36		gb
A4	3	36.5		
A4	3	37	qi	gb
A4	3	37.5		gb
A4	3	38		gb
A4	3	38.5		
A4	3	39		va,gb,pa,amel
A4	3	39.5		
A4	3	40		
A4	3	40.5	gb	gb

Unit	T	Point	Above	Below
A4	3	41		gb
A4	3	41.5		gb
A4	3	42		gb
A4	3	42.5	ar	gb
A4	3	43		gb
A4	3	43.5	gb	gb
A4	3	44		
A4	3	44.5		
A5	1	5	pa	gb,va
A5	1	5.5	amel,gb	
A5	1	6	pa	ka,gb
A5	1	6.5		va
A5	1	7		ka
A5	1	7.5		gb,va
A5	1	8	gb	gb
A5	1	8.5		gb
A5	1	9		gb
A5	1	9.5		gb,ka
A5	1	10		gb
A5	1	10.5		
A5	1	11	amel	gb,vp
A5	1	11.5		
A5	1	12		gb
A5	1	12.5		gb
A5	1	13		ar
A5	1	13.5	ar,nm	nm
A5	1	14		ka,tb
A5	1	14.5		gb,moss
A5	1	15		
A5	1	15.5	nnm	gb
A5	1	16		nm
A5	1	16.5		gb
A5	1	17	cd	gb
A5	1	17.5		
A5	1	18		va
A5	1	18.5		
A5	1	19		gb
A5	1	19.5		
A5	1	20		ka
A5	1	20.5	gb	vcas
A5	1	21		
A5	1	21.5		gb
A5	1	22		
A5	1	22.5		
A5	1	23		nm,gb
A5	1	23.5	gb	gb,nm
A5	1	24		ka
A5	1	24.5		gb
A5	1	25		gb
A5	1	25.5		gb
A5	1	26	cd	gb
A5	1	26.5		gb
A5	1	27	gb	gb
A5	1	27.5		gb,ka
A5	1	28	pa	gb
A5	1	28.5		
A5	1	29	qi	gb
A5	1	29.5	pa	ka
A5	1	30		gb
A5	1	30.5		gb
A5	1	31		gb
A5	1	31.5		qi,gb
A5	1	32		gb
A5	1	32.5		gb
A5	1	33		
A5	1	33.5		gb
A5	1	34		gb
A5	1	34.5	qc	pa
A5	1	35	amel	
A5	1	35.5		gb

Unit	T	Point	Above	Below
A5	1	36		gb
A5	1	36.5		gb
A5	1	37	pa	pa
A5	1	37.5		gb
A5	1	38		gb,gp
A5	1	38.5	gb	
A5	1	39	vcas,gb	gb
A5	1	39.5		gb,gp
A5	1	40		gb
A5	1	40.5		gb
A5	1	41		gb
A5	1	41.5	nm,gb	gb
A5	1	42	pa	gb
A5	1	42.5		gb
A5	1	43	pa	gb
A5	1	43.5	pa	gb
A5	1	44	cd	nm
A5	1	44.5		vp
A5	2	5		
A5	2	5.5	pa	gb
A5	2	6	ar	
A5	2	6.5	gb	gp
A5	2	7		gb
A5	2	7.5		pa
A5	2	8	gb	vp
A5	2	8.5		gb,tb
A5	2	9		gb,va
A5	2	9.5		gb,ka
A5	2	10		gb
A5	2	10.5		
A5	2	11		gb
A5	2	11.5	qi	gb
A5	2	12	cd	gb
A5	2	12.5	cd	gp
A5	2	13		ka,aa
A5	2	13.5		pa,ka
A5	2	14		aa
A5	2	14.5		pa
A5	2	15		
A5	2	15.5	ar	ar
A5	2	16	ar	
A5	2	16.5		gb,va
A5	2	17		gb
A5	2	17.5		
A5	2	18		gb,ka
A5	2	18.5	pa	gb
A5	2	19	vp	pa,gb
A5	2	19.5	vp	pa
A5	2	20	gb	gb
A5	2	20.5	pa	ka
A5	2	21		
A5	2	21.5	pa	
A5	2	22		vcas
A5	2	22.5		
A5	2	23		gb,va
A5	2	23.5		gb,va
A5	2	24		
A5	2	24.5		pa
A5	2	25	ar	
A5	2	25.5		ka
A5	2	26	gb	gp
A5	2	26.5		gb
A5	2	27	gb	gb
A5	2	27.5		
A5	2	28		gb
A5	2	28.5		gp
A5	2	29		gb
A5	2	29.5		va
A5	2	30		gb
A5	2	30.5		tb

Unit	T	Point	Above	Below
A5	2	31		gb
A5	2	31.5		cd,ka
A5	2	32	ar	
A5	2	32.5	ar	
A5	2	33		
A5	2	33.5		gb,vp
A5	2	34		
A5	2	34.5		hv,gb
A5	2	35	hv	gb
A5	2	35.5		gb,vp
A5	2	36		gb,vp
A5	2	36.5	gb	
A5	2	37	hv,gb	gb
A5	2	37.5		gb
A5	2	38		gb,va
A5	2	38.5		
A5	2	39		gp
A5	2	39.5		
A5	2	40		pa,gb,ka
A5	2	40.5		ka,gb
A5	2	41	pa	
A5	2	41.5		
A5	2	42		
A5	2	42.5	gb	
A5	2	43		gb
A5	2	43.5		va
A5	2	44		vp
A5	2	44.5	gb	vp
A5	3	5	gb	va
A5	3	5.5		gb
A5	3	6		an
A5	3	6.5		gb
A5	3	7		gp
A5	3	7.5		
A5	3	8	m,	
A5	3	8.5	m,	nm
A5	3	9	gb	ka
A5	3	9.5	gb	tb
A5	3	10	aa.gb	gb
A5	3	10.5	gb	ka,gp
A5	3	11		
A5	3	11.5		gb
A5	3	12		
A5	3	12.5		ka
A5	3	13	gb	ka
A5	3	13.5	nm	va
A5	3	14	pa	ka
A5	3	14.5		amel,tb
A5	3	15		ka
A5	3	15.5		ka
A5	3	16		gb
A5	3	16.5		vp,gp
A5	3	17	ar	gb,va
A5	3	17.5		gb,ka
A5	3	18		pa,va
A5	3	18.5	ar	gb
A5	3	19	gb,cd,ar	
A5	3	19.5	cd	va
A5	3	20	cd	va
A5	3	20.5	cd,gb	gb
A5	3	21		va
A5	3	21.5		ka,va
A5	3	22		gb,va
A5	3	22.5		
A5	3	23		gb
A5	3	23.5		ka
A5	3	24		gb
A5	3	24.5		gb
A5	3	25		
A5	3	25.5		gb

Unit	T	Point	Above	Below
A5	3	26		pa
A5	3	26.5		gb
A5	3	27		ka
A5	3	27.5		ar
A5	3	28		gb
A5	3	28.5	ar	gp,ar,gb
A5	3	29	ar	ar
A5	3	29.5		gb
A5	3	30		
A5	3	30.5	ar	gb
A5	3	31		ka,gp
A5	3	31.5	ar	
A5	3	32	ar	pa,gb
A5	3	32.5	pa.ar	vp
A5	3	33		
A5	3	33.5		gb
A5	3	34		gb
A5	3	34.5		va
A5	3	35		
A5	3	35.5		gb
A5	3	36	cd	gb
A5	3	36.5	cd	cd
A5	3	37		pa
A5	3	37.5		
A5	3	38		ar
A5	3	38.5		pa
A5	3	39		pa
A5	3	39.5		
A5	3	40		
A5	3	40.5		gb
A5	3	41		pa
A5	3	41.5		gb
A5	3	42		
A5	3	42.5	gb	vp
A5	3	43		
A5	3	43.5		ka,gp
A5	3	44		va
A5	3	44.5		gp
A6	1	5		vp
A6	1	5.5	pa	pa,gb,ka
A6	1	6		va
A6	1	6.5		pa,gb
A6	1	7		gb
A6	1	7.5		gb
A6	1	8		va
A6	1	8.5		
A6	1	9		pa
A6	1	9.5		va
A6	1	10		va
A6	1	10.5		gb
A6	1	11		vp
A6	1	11.5		
A6	1	12		va
A6	1	12.5		
A6	1	13		pa,ka,va
A6	1	13.5		va
A6	1	14		ar,gb,pa
A6	1	14.5	ar	ar
A6	1	15		gb,va
A6	1	15.5		ka
A6	1	16	ar	ar
A6	1	16.5	ar	ar,gb
A6	1	17		ar,gp
A6	1	17.5		pa,gp
A6	1	18		gb
A6	1	18.5		
A6	1	19		gb
A6	1	19.5		
A6	1	20		gb,gp
A6	1	20.5		

Unit	T	Point	Above	Below
A6	1	21		gb,gp
A6	1	21.5		gb
A6	1	22		
A6	1	22.5		
A6	1	23		
A6	1	23.5		vp,gb
A6	1	24		ar
A6	1	24.5		
A6	1	25	cd	gb
A6	1	25.5	cd	cd
A6	1	26		
A6	1	26.5		pa
A6	1	27		ar,va
A6	1	27.5	pa	gb
A6	1	28	ar	pa,ar
A6	1	28.5	cd	
A6	1	29	qv	gb,ka
A6	1	29.5	qv	vp
A6	1	30		
A6	1	30.5		
A6	1	31		
A6	1	31.5		gb
A6	1	32		gp,ka
A6	1	32.5		gb
A6	1	33		pa,gp
A6	1	33.5		
A6	1	34		gb
A6	1	34.5		gb
A6	1	35		
A6	1	35.5		
A6	1	36		gb
A6	1	36.5		gp
A6	1	37		
A6	1	37.5		gb,va
A6	1	38		gp
A6	1	38.5		gp
A6	1	39	pa	pa
A6	1	39.5		
A6	1	40		
A6	1	40.5		pa
A6	1	41		
A6	1	41.5	ar	gp
A6	1	42	ar	amel
A6	1	42.5	ar	gb
A6	1	43		ar
A6	1	43.5		gp
A6	1	44		
A6	1	44.5		gb
A6	2	5		gb
A6	2	5.5		gb
A6	2	6		ka
A6	2	6.5		b
A6	2	7	ar	
A6	2	7.5	ar	ka
A6	2	8	ar	ar
A6	2	8.5	cd	
A6	2	9		cd
A6	2	9.5		
A6	2	10	ar	pa
A6	2	10.5	ar	pa,vp
A6	2	11	ar	pa
A6	2	11.5		pa,va
A6	2	12		gb
A6	2	12.5		pa,gb
A6	2	13		
A6	2	13.5	ar	ar,gb
A6	2	14		gp
A6	2	14.5		pa,va
A6	2	15		gb
A6	2	15.5		

Unit	T	Point	Above	Below
A6	2	16		gb
A6	2	16.5		ka,gb
A6	2	17		
A6	2	17.5		
A6	2	18	hv	vp
A6	2	18.5	qv	
A6	2	19		ka
A6	2	19.5		pa,ka
A6	2	20		
A6	2	20.5		va
A6	2	21		va
A6	2	21.5		ka,gp
A6	2	22		
A6	2	22.5		
A6	2	23	ar	ar
A6	2	23.5		va
A6	2	24		pa
A6	2	24.5		gb
A6	2	25		
A6	2	25.5		pa
A6	2	26		pa
A6	2	26.5		
A6	2	27		pa,gb
A6	2	27.5	cd	cd,ka
A6	2	28	ar	gb
A6	2	28.5	ar	ar
A6	2	29		pa
A6	2	29.5		gb
A6	2	30		gb
A6	2	30.5		
A6	2	31	cd	
A6	2	31.5		pa,va
A6	2	32		pa
A6	2	32.5	ar	ar
A6	2	33	ar	ar
A6	2	33.5	ar	ar
A6	2	34	ar	ar
A6	2	34.5		gb,va
A6	2	35		
A6	2	35.5		
A6	2	36		vcas
A6	2	36.5		
A6	2	37		
A6	2	37.5		
A6	2	38		gb,va
A6	2	38.5		
A6	2	39		gb
A6	2	39.5		gb
A6	2	40		gb
A6	2	40.5		
A6	2	41		
A6	2	41.5		hv
A6	2	42		
A6	2	42.5		gb
A6	2	43		gb,va
A6	2	43.5		
A6	2	44		
A6	2	44.5		
A6	3	5	ar	ar,gb
A6	3	5.5		gb
A6	3	6		gb
A6	3	6.5		gb
A6	3	7		
A6	3	7.5		gb
A6	3	8	ar	gb
A6	3	8.5		
A6	3	9		
A6	3	9.5		gb
A6	3	10		
A6	3	10.5		gb

Unit	T	Point	Above	Below
A6	3	11	cd	cd,gb
A6	3	11.5		gb,gp
A6	3	12		gb
A6	3	12.5		gb
A6	3	13	ar	ar,va
A6	3	13.5		gb
A6	3	14		gb
A6	3	14.5		gb,ka
A6	3	15		
A6	3	15.5		amel,gb,va
A6	3	16		gb
A6	3	16.5		
A6	3	17		gb,va
A6	3	17.5		
A6	3	18		gb
A6	3	18.5		gb
A6	3	19	cd	cd,gb
A6	3	19.5		gb
A6	3	20		
A6	3	20.5	pa	gb
A6	3	21		pa,gb,va
A6	3	21.5		pa,gb
A6	3	22		
A6	3	22.5		ar
A6	3	23		gb
A6	3	23.5		va,gb
A6	3	24		vp
A6	3	24.5		gb
A6	3	25		gb,va
A6	3	25.5		
A6	3	26		gb
A6	3	26.5		ka,va
A6	3	27		
A6	3	27.5		gp
A6	3	28		gb
A6	3	28.5		gp
A6	3	29		gb
A6	3	29.5		
A6	3	30		gb
A6	3	30.5		gb
A6	3	31		gb
A6	3	31.5		ar,gb
A6	3	32		gb
A6	3	32.5		gb
A6	3	33	cd	cd,gb,ka
A6	3	33.5	cd	
A6	3	34	cd	cd,gb
A6	3	34.5		gb,cs
A6	3	35		cs
A6	3	35.5		pa,ka,vp
A6	3	36	ar	ka,va
A6	3	36.5	ar	ar
A6	3	37	ar	gb
A6	3	37.5		pa,us
A6	3	38		gb,gp
A6	3	38.5		
A6	3	39	ar	ar
A6	3	39.5	ar	ar
A6	3	40		
A6	3	40.5		
A6	3	41	cd	cd
A6	3	41.5	cd	
A6	3	42	ar	
A6	3	42.5	ar	va
A6	3	43		ar
A6	3	43.5		pa,va
A6	3	44		gb
A6	3	44.5		vo
B1	1	5	qi	qi
B1	1	5.5	pa	

Unit	T	Point	Above	Below
B1	1	6		gb
B1	1	6.5		ap
B1	1	7	ap	ap,gb
B1	1	7.5		
B1	1	8	ar	ap
B1	1	8.5	ar	
B1	1	9	ar	
B1	1	9.5		va,tb
B1	1	10	amel	ap
B1	1	10.5		gb
B1	1	11		vcas
B1	1	11.5		
B1	1	12		pa,gb,va
B1	1	12.5	gb	gb
B1	1	13		
B1	1	13.5	ar	gb
B1	1	14		gb,pa
B1	1	14.5		
B1	1	15		gb,gp
B1	1	15.5		
B1	1	16		gb
B1	1	16.5		sa,gb,va
B1	1	17		gb
B1	1	17.5		
B1	1	18		va
B1	1	18.5		gb
B1	1	19		tb
B1	1	19.5		tb,vcas,gb,gp
B1	1	20		gb
B1	1	20.5		pa,tb
B1	1	21		pa,vcas
B1	1	21.5		gb
B1	1	22		gb,va
B1	1	22.5	gb	gb
B1	1	23		gb
B1	1	23.5		pa,va,gb
B1	1	24		pa,gb
B1	1	24.5		
B1	1	25		
B1	1	25.5		gb
B1	1	26	ar	gb
B1	1	26.5	kl	kl,tb
B1	1	27	gb	
B1	1	27.5		
B1	1	28		
B1	1	28.5	vcas	kl
B1	1	29		ka,gb,vp
B1	1	29.5		ka,vp,vcas
B1	1	30		vp,gb,ka
B1	1	30.5		gb
B1	1	31		sa,gb
B1	1	31.5	sa	gb
B1	1	32		gb,va
B1	1	32.5		gb
B1	1	33		
B1	1	33.5		gb
B1	1	34		gb
B1	1	34.5		gb
B1	1	35	gb	gb,ka
B1	1	35.5	ar	ar,gb
B1	1	36	ar	gb
B1	1	36.5		gb
B1	1	37		gb
B1	1	37.5		gb,va,gp
B1	1	38	pa	hv,gb,pa
B1	1	38.5	pa	pa,gb
B1	1	39		nm
B1	1	39.5		nm
B1	1	40		nm,gb
B1	1	40.5		gb,nm

Unit	T	Point	Above	Below
B1	1	41		
B1	1	41.5		gb
B1	1	42		pa,gb
B1	1	42.5		
B1	1	43		gb
B1	1	43.5		
B1	1	44		
B1	1	44.5		
B1	2	5		
B1	2	5.5		sa,va
B1	2	6		va
B1	2	6.5		va,vp
B1	2	7		va
B1	2	7.5		aa
B1	2	8		gb
B1	2	8.5	qc	
B1	2	9		qc,gb
B1	2	9.5		
B1	2	10		gb
B1	2	10.5		gb,qa
B1	2	11	amel	vc
B1	2	11.5		
B1	2	12		gb
B1	2	12.5		gb
B1	2	13	ar	
B1	2	13.5		gb,amel
B1	2	14		ka
B1	2	14.5		gb,ka
B1	2	15		
B1	2	15.5		
B1	2	16		gb,rr
B1	2	16.5		sa
B1	2	17		va
B1	2	17.5		
B1	2	18	gb	gb
B1	2	18.5	ar	ar
B1	2	19	ar	ar
B1	2	19.5	ar	
B1	2	20	ar	gb
B1	2	20.5	ar	gb,ar
B1	2	21	ar	gb,gp
B1	2	21.5	ar	gp,va
B1	2	22		tb,gb
B1	2	22.5		va
B1	2	23		
B1	2	23.5		
B1	2	24	ar	ar
B1	2	24.5		
B1	2	25		
B1	2	25.5		gb,qc
B1	2	26	gb	gb
B1	2	26.5	bp	gb,bp
B1	2	27	ar	ar
B1	2	27.5		gb
B1	2	28		gb
B1	2	28.5	ar	ar,gb
B1	2	29		va
B1	2	29.5	amel	amel
B1	2	30		
B1	2	30.5		va
B1	2	31		va
B1	2	31.5		va,aa
B1	2	32		pa,gp
B1	2	32.5	hv	hv
B1	2	33		
B1	2	33.5		
B1	2	34		va
B1	2	34.5		gb
B1	2	35		
B1	2	35.5		

Unit	T	Point	Above	Below
B1	2	36		gb
B1	2	36.5		vp
B1	2	37		ka,qi
B1	2	37.5		va
B1	2	38		amel,gb
B1	2	38.5		ka
B1	2	39	vcas	pa,vcas
B1	2	39.5	vcas	
B1	2	40	amel	amel,gb
B1	2	40.5		gb
B1	2	41		gp
B1	2	41.5		gb,vp
B1	2	42		gb,vp
B1	2	42.5	cd	gb
B1	2	43		pa,gp
B1	2	43.5		
B1	2	44	pa	gp
B1	2	44.5		tb,va,gb
B1	3	5		sa
B1	3	5.5		gb
B1	3	6		gb
B1	3	6.5		va,gb
B1	3	7		
B1	3	7.5		va
B1	3	8		gb
B1	3	8.5		gb,amel
B1	3	9		gb
B1	3	9.5		nm,gb
B1	3	10		
B1	3	10.5		gb
B1	3	11		gb
B1	3	11.5		gp
B1	3	12		sa,va
B1	3	12.5		
B1	3	13		
B1	3	13.5	bp	sa,bp
B1	3	14		sa,ka
B1	3	14.5		ka
B1	3	15	ar	gb,va
B1	3	15.5		ka,gp
B1	3	16	cd	gb,gp
B1	3	16.5	cd	gb
B1	3	17		gb
B1	3	17.5		
B1	3	18		gb
B1	3	18.5	ar	gb,gp
B1	3	19	ar	ar,gb
B1	3	19.5	ar	gb,vcas
B1	3	20		gb
B1	3	20.5	pa	gb
B1	3	21	gb	gb
B1	3	21.5	qi	gb
B1	3	22	ar	ar
B1	3	22.5	ar	gb,ar
B1	3	23		gb
B1	3	23.5		
B1	3	24		
B1	3	24.5		gb
B1	3	25		gb,aa
B1	3	25.5	qi	gb,ka
B1	3	26		gb
B1	3	26.5		
B1	3	27		
B1	3	27.5		ka
B1	3	28		gb
B1	3	28.5	cd	pa
B1	3	29	cd	nm
B1	3	29.5	cd	cd,va
B1	3	30	cd	amel
B1	3	30.5	cd	va

Unit	T	Point	Above	Below
B1	3	31	cd	cd,gb
B1	3	31.5	cd	gb,ka
B1	3	32	pa	pa
B1	3	32.5	pa	tb
B1	3	33		
B1	3	33.5		gb
B1	3	34	amel	amel,gp
B1	3	34.5		amel,ka
B1	3	35		ka
B1	3	35.5	ar	qi,va
B1	3	36	cd,ar	
B1	3	36.5	cd	va
B1	3	37		gb
B1	3	37.5		gb
B1	3	38	pa	gb,va
B1	3	38.5		gb
B1	3	39		gb
B1	3	39.5		va
B1	3	40		gp,gb
B1	3	40.5		ka,gb
B1	3	41		sa,pa,gb
B1	3	41.5	ar,pa	ka
B1	3	42	ar	gb
B1	3	42.5		sa,va
B1	3	43		pa,ka
B1	3	43.5		va,ka
B1	3	44		pa,gb
B1	3	44.5	ar	kvp,pa
B2	1	5	qc	va
B2	1	5.5		
B2	1	6	cd	pa,ka
B2	1	6.5	cd	cd,nm
B2	1	7	cd	cd,vp
B2	1	7.5	cd	pa,vp
B2	1	8		
B2	1	8.5		cd,ka,gb
B2	1	9	cd	gb
B2	1	9.5	cd	cd
B2	1	10		pa,gp
B2	1	10.5		
B2	1	11		
B2	1	11.5	ar	ar
B2	1	12	ar	nm
B2	1	12.5	pa	nm
B2	1	13		nm
B2	1	13.5		nm
B2	1	14		nm
B2	1	14.5		ar,nm,ka
B2	1	15		
B2	1	15.5		
B2	1	16		
B2	1	16.5		nm
B2	1	17		nm
B2	1	17.5		nm
B2	1	18	ar	nm
B2	1	18.5	ar	
B2	1	19	ar	nm
B2	1	19.5		nm
B2	1	20		nm,gb
B2	1	20.5	pa	cd,va
B2	1	21	cd	cd
B2	1	21.5	cd	cd,gb
B2	1	22	cd	vp,gb,cd
B2	1	22.5	cd	vp
B2	1	23		ka
B2	1	23.5		gb
B2	1	24		gb
B2	1	24.5		
B2	1	25	cd	gb
B2	1	25.5	cd	

Unit	T	Point	Above	Below
B2	1	26	cd	ar,gb
B2	1	26.5	ar	ar
B2	1	27		nm
B2	1	27.5		
B2	1	28		gp
B2	1	28.5		gb,nm,va
B2	1	29		nm,gp
B2	1	29.5		nm
B2	1	30		nm
B2	1	30.5		gp
B2	1	31		gp
B2	1	31.5		
B2	1	32	qc	nm
B2	1	32.5		nm,gb
B2	1	33		
B2	1	33.5		
B2	1	34		ka,gb
B2	1	34.5		pa,vp,gp
B2	1	35		
B2	1	35.5		
B2	1	36		pa,gb
B2	1	36.5		
B2	1	37		
B2	1	37.5		
B2	1	38		
B2	1	38.5		vp
B2	1	39		va
B2	1	39.5		gb
B2	1	40		gb
B2	1	40.5		gb
B2	1	41	cd	nm
B2	1	41.5		nm
B2	1	42	cd	cd
B2	1	42.5	cd	cd
B2	1	43	cd	amel
B2	1	43.5		amel
B2	1	44	amel	nm
B2	1	44.5		amel,nm
B2	2	5		vp, gb
B2	2	5.5		vp
B2	2	6		pa,gb
B2	2	6.5		
B2	2	7	nm	nm,pa
B2	2	7.5	pa	pa,vp,gp
B2	2	8		nm
B2	2	8.5		nm
B2	2	9		pa
B2	2	9.5		
B2	2	10		ar,gb
B2	2	10.5	ar	ar,pa
B2	2	11		
B2	2	11.5		pa
B2	2	12		pa,gb
B2	2	12.5		pa
B2	2	13		gb
B2	2	13.5		
B2	2	14		gb,gp
B2	2	14.5	ar	ar
B2	2	15	ar	
B2	2	15.5	ar	
B2	2	16		nm,gb
B2	2	16.5		
B2	2	17		qi
B2	2	17.5		
B2	2	18		gb
B2	2	18.5		an
B2	2	19		
B2	2	19.5		gb
B2	2	20		gb
B2	2	20.5		

Unit	T	Point	Above	Below
B2	2	21		
B2	2	21.5		gb
B2	2	22		gb
B2	2	22.5		gb
B2	2	23		
B2	2	23.5		pa,gb
B2	2	24		
B2	2	24.5		gb
B2	2	25		
B2	2	25.5		
B2	2	26		
B2	2	26.5		
B2	2	27	cd	gb
B2	2	27.5	cd	
B2	2	28		
B2	2	28.5		
B2	2	29	cd	pa
B2	2	29.5	cd	vcas
B2	2	30		cd,vcas,gb
B2	2	30.5		gb
B2	2	31		
B2	2	31.5		gb
B2	2	32		gb
B2	2	32.5		
B2	2	33		gb
B2	2	33.5	pa	pa
B2	2	34		gb,pa
B2	2	34.5		gb
B2	2	35		pa
B2	2	35.5		
B2	2	36	cd	gb
B2	2	36.5	cd	cd,gb,ka
B2	2	37		gb
B2	2	37.5		gb
B2	2	38		
B2	2	38.5		gb
B2	2	39		
B2	2	39.5		gb
B2	2	40		gb
B2	2	40.5	pa	gb
B2	2	41		vcas
B2	2	41.5		gb
B2	2	42		gb
B2	2	42.5	pa	
B2	2	43	ar,pa	
B2	2	43.5	ar	ar
B2	2	44	ar	ar,gb
B2	2	44.5		gb
B2	3	5		gp
B2	3	5.5		gb,gp
B2	3	6	gb	
B2	3	6.5	ar	gb
B2	3	7		pa,gb
B2	3	7.5		gb
B2	3	8		
B2	3	8.5		
B2	3	9		vp,gb
B2	3	9.5		gb
B2	3	10		
B2	3	10.5		
B2	3	11		
B2	3	11.5		
B2	3	12		gb
B2	3	12.5		gb,gp
B2	3	13		
B2	3	13.5		gb
B2	3	14		aa
B2	3	14.5		gb
B2	3	15		pa,gb
B2	3	15.5		gb

Unit	T	Point	Above	Below
B2	3	16		pa,gb
B2	3	16.5	ar	
B2	3	17	pa	gb
B2	3	17.5		
B2	3	18		gb
B2	3	18.5	pa	pa
B2	3	19		pa
B2	3	19.5		nm
B2	3	20		
B2	3	20.5		
B2	3	21		
B2	3	21.5		nm
B2	3	22		nm
B2	3	22.5		nm
B2	3	23		
B2	3	23.5		pa,gb
B2	3	24		
B2	3	24.5		gb,nm,gp
B2	3	25		va
B2	3	25.5		
B2	3	26		gb
B2	3	26.5		gb
B2	3	27	gb	gb
B2	3	27.5		gb
B2	3	28		gb
B2	3	28.5		gb
B2	3	29		gb
B2	3	29.5		gb
B2	3	30	ar	gb
B2	3	30.5	ar	
B2	3	31		
B2	3	31.5		
B2	3	32		
B2	3	32.5		vp
B2	3	33	pa	pa,gb
B2	3	33.5	pa	pa,gb
B2	3	34		ar,gb
B2	3	34.5	ar	gp
B2	3	35		gb
B2	3	35.5		
B2	3	36		gb,vp,gp
B2	3	36.5		pa
B2	3	37	cd	
B2	3	37.5	cd	tb
B2	3	38	cd	
B2	3	38.5	cd	cd
B2	3	39	cd	
B2	3	39.5		gb
B2	3	40		gb
B2	3	40.5		gb
B2	3	41		gb,vp
B2	3	41.5		vp
B2	3	42		
B2	3	42.5		gb
B2	3	43		
B2	3	43.5		gb
B2	3	44		gp,gb
B2	3	44.5		vcas
B3	1	5		
B3	1	5.5		
B3	1	6		
B3	1	6.5		
B3	1	7		pa,gb
B3	1	7.5	gb	gb,va
B3	1	8	gb	gb
B3	1	8.5		pa
B3	1	9		gb
B3	1	9.5		va
B3	1	10		va
B3	1	10.5		ar

Unit	T	Point	Above	Below
B3	1	11		va
B3	1	11.5		gb,va
B3	1	12	cd	va
B3	1	12.5	cd	gb
B3	1	13	pa	pa,gb
B3	1	13.5	pa	pa,gb
B3	1	14		pa,gb
B3	1	14.5		gb
B3	1	15		pa,va
B3	1	15.5		gb
B3	1	16		
B3	1	16.5		gp
B3	1	17		
B3	1	17.5		gb,va
B3	1	18	ar	gb
B3	1	18.5		ar,va
B3	1	19		gb,va
B3	1	19.5		gb
B3	1	20		
B3	1	20.5		
B3	1	21		ar,va
B3	1	21.5	pa	gb
B3	1	22		pa,gp
B3	1	22.5		va
B3	1	23		va
B3	1	23.5	ar	va
B3	1	24	ar	vp
B3	1	24.5	ar	
B3	1	25	pa	gb,va
B3	1	25.5		gp
B3	1	26	ar	cd
B3	1	26.5		ar,gb,vp
B3	1	27		gb
B3	1	27.5		pa
B3	1	28		
B3	1	28.5	cd	
B3	1	29	cd	gb
B3	1	29.5	cd	
B3	1	30	cd	gb
B3	1	30.5		gp,an
B3	1	31	amel	
B3	1	31.5		
B3	1	32		ka
B3	1	32.5		
B3	1	33		vp
B3	1	33.5		gb
B3	1	34		gb
B3	1	34.5		va
B3	1	35		pa,amel
B3	1	35.5		gb
B3	1	36		
B3	1	36.5		gb,vp
B3	1	37		pa,gb
B3	1	37.5		vp
B3	1	38		gb
B3	1	38.5		vp,va
B3	1	39		ka
B3	1	39.5		
B3	1	40		gb
B3	1	40.5		gb
B3	1	41		gb
B3	1	41.5		vp
B3	1	42		gb
B3	1	42.5	ar	ka
B3	1	43		
B3	1	43.5		vp
B3	1	44		gb
B3	1	44.5	pa	vp
B3	2	5		moss
B3	2	5.5		gp

Unit	T	Point	Above	Below
B3	2	6		
B3	2	6.5		
B3	2	7		
B3	2	7.5		gp
B3	2	8		gb
B3	2	8.5		nm
B3	2	9		
B3	2	9.5	ar	moss
B3	2	10		
B3	2	10.5	ar	va
B3	2	11	ar	ar,aenl
B3	2	11.5		ka
B3	2	12		gb,vp
B3	2	12.5		pa,gb
B3	2	13		va,gp
B3	2	13.5		gb
B3	2	14		gb,va
B3	2	14.5		
B3	2	15		pa,vp
B3	2	15.5	vp	vp
B3	2	16	amel	vp,gb
B3	2	16.5		vp
B3	2	17		vp
B3	2	17.5		vp
B3	2	18		pa,vp
B3	2	18.5		vp
B3	2	19		vp
B3	2	19.5		vp
B3	2	20		ar,gb
B3	2	20.5		vp
B3	2	21		gp
B3	2	21.5		gb,cs
B3	2	22		va,cs
B3	2	22.5		gb,va
B3	2	23		va
B3	2	23.5		
B3	2	24		gp
B3	2	24.5		va
B3	2	25		gb
B3	2	25.5		pa
B3	2	26		gb,va
B3	2	26.5		
B3	2	27		ka,gb
B3	2	27.5	ka	ka,gb
B3	2	28		
B3	2	28.5		gb
B3	2	29		gb,pa
B3	2	29.5		va
B3	2	30		gb
B3	2	30.5		gb
B3	2	31		gb
B3	2	31.5	gb	gb,gp
B3	2	32		gb,gp
B3	2	32.5	gb	gb
B3	2	33		
B3	2	33.5		gb
B3	2	34		gp
B3	2	34.5		
B3	2	35		
B3	2	35.5		gb
B3	2	36		va
B3	2	36.5	ar	va
B3	2	37		ar,gb
B3	2	37.5		va
B3	2	38		gb
B3	2	38.5		
B3	2	39		vp
B3	2	39.5	cd	
B3	2	40	cd	
B3	2	40.5	cd	vp

Unit	T	Point	Above	Below
B3	2	41		gb
B3	2	41.5		gb,gp
B3	2	42		
B3	2	42.5	ar	gb,va
B3	2	43	ar	ar,gb
B3	2	43.5		vp
B3	2	44		gb,va
B3	2	44.5		gb
B3	3	5		nm
B3	3	5.5		nm
B3	3	6		nm
B3	3	6.5		amel,va
B3	3	7	cd	ka,gb,va
B3	3	7.5	cd	gb
B3	3	8	ar	ka
B3	3	8.5	ar	gb
B3	3	9	ar	amel,va
B3	3	9.5		ar
B3	3	10	pa	gb
B3	3	10.5	gb	gb
B3	3	11		va
B3	3	11.5		va
B3	3	12		va
B3	3	12.5		gb,va
B3	3	13	ar	gb
B3	3	13.5		gb
B3	3	14		gb
B3	3	14.5		gb
B3	3	15	pa	gb
B3	3	15.5	pa	vp
B3	3	16	gb	gb
B3	3	16.5	pa	gb
B3	3	17		pa
B3	3	17.5		pa,gb
B3	3	18		gb
B3	3	18.5	pa	gb
B3	3	19		pa,gb
B3	3	19.5		gb
B3	3	20		
B3	3	20.5		gb
B3	3	21		gb
B3	3	21.5		gb
B3	3	22		gb
B3	3	22.5		gb,gp
B3	3	23		gb
B3	3	23.5	gb	gb
B3	3	24		gb
B3	3	24.5	amel	gb
B3	3	25		gp
B3	3	25.5		gb,gp
B3	3	26		
B3	3	26.5		
B3	3	27		gb,gp
B3	3	27.5		nm
B3	3	28	pa	nm
B3	3	28.5		ar,gp
B3	3	29	ar	ar
B3	3	29.5	pa	pa
B3	3	30	cd	
B3	3	30.5	ar,gb	
B3	3	31	cd	amel
B3	3	31.5	amel	amel
B3	3	32		va
B3	3	32.5		va
B3	3	33		gb
B3	3	33.5		cd,va
B3	3	34	cd	gb
B3	3	34.5		va
B3	3	35		pa
B3	3	35.5		

Unit	T	Point	Above	Below
B3	3	36		gb
B3	3	36.5		pa
B3	3	37		va
B3	3	37.5		gb,pa
B3	3	38		gb
B3	3	38.5		
B3	3	39		amel,tb
B3	3	39.5		
B3	3	40		
B3	3	40.5		
B3	3	41		aa
B3	3	41.5		
B3	3	42		
B3	3	42.5		
B3	3	43		gb
B3	3	43.5		
B3	3	44		aa
B3	3	44.5		va
B4	1	5		
B4	1	5.5	gb	gb
B4	1	6		
B4	1	6.5		gb,pa
B4	1	7		pa
B4	1	7.5		pa,gp
B4	1	8		gb
B4	1	8.5		gb
B4	1	9		gb
B4	1	9.5		
B4	1	10		pa
B4	1	10.5		gp
B4	1	11		gb,va,ka
B4	1	11.5	gb	
B4	1	12		gb
B4	1	12.5		gb
B4	1	13	gb	
B4	1	13.5		
B4	1	14	cd	
B4	1	14.5		gb
B4	1	15	ga	gb
B4	1	15.5		pa,gb
B4	1	16		va,gb
B4	1	16.5		va
B4	1	17		gb
B4	1	17.5		va
B4	1	18		
B4	1	18.5		va,gp
B4	1	19		
B4	1	19.5		
B4	1	20		
B4	1	20.5		va
B4	1	21		gb,vp
B4	1	21.5		pa,va,tb
B4	1	22		
B4	1	22.5		gb
B4	1	23		
B4	1	23.5		gb
B4	1	24		gb
B4	1	24.5	gb	gb
B4	1	25	gb	gb
B4	1	25.5		gb
B4	1	26		gb
B4	1	26.5	gb	va
B4	1	27		
B4	1	27.5		gb
B4	1	28		gb
B4	1	28.5		gb
B4	1	29	amel	gb
B4	1	29.5	pa,amel	gb
B4	1	30	amel	gb
B4	1	30.5		gb

Unit	T	Point	Above	Below
B4	1	31	gb	gb
B4	1	31.5		gb,gp
B4	1	32		gb,gp
B4	1	32.5	pa	gb
B4	1	33	pa	pa,gb,tb
B4	1	33.5	gb	gb,gp
B4	1	34	gb	gb
B4	1	34.5	gb	gb
B4	1	35	gb	gb
B4	1	35.5		gb
B4	1	36		gb
B4	1	36.5	gb	
B4	1	37		
B4	1	37.5		
B4	1	38		gb
B4	1	38.5	gb	gb
B4	1	39		gb,pa
B4	1	39.5	gb	
B4	1	40	gb	
B4	1	40.5	gb	
B4	1	41		gb,vp
B4	1	41.5		
B4	1	42		amel
B4	1	42.5		
B4	1	43	pa	gb
B4	1	43.5		
B4	1	44		pa
B4	1	44.5		pa,gb
B4	2	5		gb
B4	2	5.5		pa,gb
B4	2	6		
B4	2	6.5	pa	
B4	2	7		
B4	2	7.5	gb	
B4	2	8		pa
B4	2	8.5		
B4	2	9	cd,gb	
B4	2	9.5	cd,gb	gb
B4	2	10	gb	gp
B4	2	10.5	gb	rock
B4	2	11	gb	
B4	2	11.5	amel	gp
B4	2	12	gb	gb
B4	2	12.5		
B4	2	13		gb,va,gp
B4	2	13.5		gb
B4	2	14	gb	gb
B4	2	14.5		gb,pa
B4	2	15		gb
B4	2	15.5		ja
B4	2	16		gb
B4	2	16.5		gb
B4	2	17		gb
B4	2	17.5	pa,gb	gb
B4	2	18		
B4	2	18.5	gb	gb,va
B4	2	19	gb	gb,va
B4	2	19.5	amel,gb	
B4	2	20		
B4	2	20.5		
B4	2	21		gb
B4	2	21.5		gb
B4	2	22		gb
B4	2	22.5		
B4	2	23		
B4	2	23.5	gb,amel	
B4	2	24		
B4	2	24.5		gb
B4	2	25		gb
B4	2	25.5		gp

Unit	T	Point	Above	Below
B4	2	26		gb
B4	2	26.5		gb
B4	2	27		gb
B4	2	27.5		gb
B4	2	28	gb	gp
B4	2	28.5		gb,gp
B4	2	29		gb
B4	2	29.5	pa	gb
B4	2	30		gb,ka
B4	2	30.5	amel	gb,gp
B4	2	31	gb	gb,gp
B4	2	31.5	gb	gb
B4	2	32	gb	gb,vc
B4	2	32.5	gb	va
B4	2	33	gb	va
B4	2	33.5	gb	gb,gp
B4	2	34	gb	
B4	2	34.5	pa	gp
B4	2	35	gb	gb
B4	2	35.5	cd	gb
B4	2	36	cd	gb,va
B4	2	36.5		gb
B4	2	37	gb	gb
B4	2	37.5		gb
B4	2	38	cd	gp
B4	2	38.5		gb
B4	2	39		gp,gp
B4	2	39.5		gp
B4	2	40	pa	gb
B4	2	40.5	pa	gb
B4	2	41	gb	gb
B4	2	41.5		gb
B4	2	42		gb
B4	2	42.5	cd,gb	ka
B4	2	43		gb,gp
B4	2	43.5	gb	pa
B4	2	44		gb
B4	2	44.5		gb,pa
B4	3	5		
B4	3	5.5		gb
B4	3	6	cd	va
B4	3	6.5	cd	gb,gp
B4	3	7		gb
B4	3	7.5		gb
B4	3	8	gb	gb
B4	3	8.5		gb,pa
B4	3	9	pa	
B4	3	9.5	cd	gb,ka,va
B4	3	10		gb
B4	3	10.5		gb,pa
B4	3	11		tb,gp
B4	3	11.5		pa,gb,gp,nm
B4	3	12	nm	gb
B4	3	12.5	nm	pa,gb
B4	3	13	pa	gb
B4	3	13.5		
B4	3	14	gb	gp
B4	3	14.5		tb
B4	3	15	pa	gb
B4	3	15.5	pa	
B4	3	16		ka,gb
B4	3	16.5	pa	va
B4	3	17	pa	gb,ka
B4	3	17.5	pa	gb,ka
B4	3	18	gb	ka
B4	3	18.5	pa	ar
B4	3	19	gb	gb
B4	3	19.5		
B4	3	20	gb	ka
B4	3	20.5		

Unit	T	Point	Above	Below
B4	3	21	pa	gb
B4	3	21.5	gb	va
B4	3	22	pa	gb
B4	3	22.5		gb
B4	3	23	gb	gb
B4	3	23.5		gb
B4	3	24	gb	gb
B4	3	24.5	gb	gp
B4	3	25		
B4	3	25.5		gb,gp
B4	3	26		gb
B4	3	26.5		gb
B4	3	27		gb
B4	3	27.5	pa	gb
B4	3	28		gb
B4	3	28.5		
B4	3	29		
B4	3	29.5		gb
B4	3	30	gb	
B4	3	30.5	cd,gb	
B4	3	31		
B4	3	31.5	cd,gb	
B4	3	32	cd	gb
B4	3	32.5		
B4	3	33	gb	pv
B4	3	33.5		vp
B4	3	34		
B4	3	34.5	gb	gb
B4	3	35		tb
B4	3	35.5		gb
B4	3	36		gb
B4	3	36.5		
B4	3	37		pa
B4	3	37.5	pa	gb
B4	3	38		gb
B4	3	38.5		
B4	3	39		gb
B4	3	39.5	pa	
B4	3	40		gb,vace
B4	3	40.5		
B4	3	41		gb
B4	3	41.5	amel,pa	gb
B4	3	42		gb,amel
B4	3	42.5	gb	
B4	3	43		gb
B4	3	43.5		gb,gp
B4	3	44		gb
B4	3	44.5		gb
B5	1	5		gb
B5	1	5.5		pa,gb
B5	1	6		gb
B5	1	6.5		pa,gb
B5	1	7		gb,gp
B5	1	7.5		gb,va
B5	1	8		gb
B5	1	8.5		ka,amel
B5	1	9		gb,ka
B5	1	9.5		gb
B5	1	10		pa,gb
B5	1	10.5		vp
B5	1	11		
B5	1	11.5		ka
B5	1	12		
B5	1	12.5	qa	gp,va,ka
B5	1	13		gb
B5	1	13.5		
B5	1	14		gb
B5	1	14.5		
B5	1	15		gb
B5	1	15.5		

Unit	T	Point	Above	Below
B5	1	16	gb	gb
B5	1	16.5	gb	gb
B5	1	17	gb	gb,va
B5	1	17.5		gp
B5	1	18		gb,va
B5	1	18.5		gb
B5	1	19		
B5	1	19.5		
B5	1	20		
B5	1	20.5		
B5	1	21		
B5	1	21.5		
B5	1	22		pa
B5	1	22.5		
B5	1	23		gb,gp
B5	1	23.5		
B5	1	24		
B5	1	24.5		qa,va
B5	1	25		
B5	1	25.5		
B5	1	26		gb
B5	1	26.5		gb,gp
B5	1	27	gb	gb
B5	1	27.5		gb
B5	1	28		
B5	1	28.5		gb
B5	1	29		
B5	1	29.5		
B5	1	30		
B5	1	30.5		gb
B5	1	31	qa	
B5	1	31.5	qa	gb
B5	1	32		gb
B5	1	32.5		pa,rr
B5	1	33		gb
B5	1	33.5		gb
B5	1	34		
B5	1	34.5		gb
B5	1	35		gb,gp
B5	1	35.5		gb
B5	1	36		gb,va
B5	1	36.5	amel	va
B5	1	37		gp
B5	1	37.5		pa
B5	1	38		pa,gb
B5	1	38.5		
B5	1	39		gb
B5	1	39.5		
B5	1	40		pa,gb,gp,va
B5	1	40.5		
B5	1	41		
B5	1	41.5		va
B5	1	42		gb,ka
B5	1	42.5		
B5	1	43	vc	
B5	1	43.5	vc	
B5	1	44		gb
B5	1	44.5		
B5	2	5		gb
B5	2	5.5		pa
B5	2	6		gb
B5	2	6.5		pa,gb
B5	2	7		vc,ka
B5	2	7.5		pa,amel
B5	2	8		pa,amel
B5	2	8.5		gb
B5	2	9		gb
B5	2	9.5		va
B5	2	10		
B5	2	10.5		gp

Unit	T	Point	Above	Below
B5	2	11		gb
B5	2	11.5		gb,pa
B5	2	12		gp
B5	2	12.5		gb
B5	2	13		gb
B5	2	13.5		
B5	2	14		gb
B5	2	14.5	gb	pa,ka
B5	2	15		
B5	2	15.5		gb
B5	2	16		gp
B5	2	16.5		gp
B5	2	17	qc	va
B5	2	17.5		gb,gp
B5	2	18		gb
B5	2	18.5	gb	gb
B5	2	19		
B5	2	19.5		
B5	2	20	pa	
B5	2	20.5		
B5	2	21		va
B5	2	21.5		pa
B5	2	22		
B5	2	22.5		
B5	2	23		
B5	2	23.5		
B5	2	24		pa
B5	2	24.5		gb
B5	2	25		gb
B5	2	25.5		gb
B5	2	26		gb
B5	2	26.5		gb
B5	2	27		pa,gb
B5	2	27.5		
B5	2	28		
B5	2	28.5		
B5	2	29		va
B5	2	29.5		va
B5	2	30		pa,gb
B5	2	30.5		
B5	2	31		gb
B5	2	31.5		pa,vp
B5	2	32		
B5	2	32.5	cd	cd,gb
B5	2	33	cd	qc,gp
B5	2	33.5	qa	gb,moss
B5	2	34	qa	gb
B5	2	34.5		
B5	2	35		gb
B5	2	35.5		gb
B5	2	36		vc,gb
B5	2	36.5		gb,va,gp
B5	2	37		gb
B5	2	37.5		
B5	2	38		gb
B5	2	38.5		
B5	2	39		
B5	2	39.5		gp
B5	2	40		
B5	2	40.5		qi
B5	2	41	cd	va
B5	2	41.5		pa,ka
B5	2	42		pa
B5	2	42.5		va
B5	2	43		
B5	2	43.5		gb
B5	2	44		pa,gb,gp
B5	2	44.5		gb
B5	3	5		
B5	3	5.5		gb

Unit	T	Point	Above	Below
B5	3	6		gb
B5	3	6.5		gb
B5	3	7		sa
B5	3	7.5	pa	gb
B5	3	8		
B5	3	8.5		
B5	3	9		ka,gb
B5	3	9.5		gb
B5	3	10		
B5	3	10.5		
B5	3	11		gb
B5	3	11.5		gb
B5	3	12		
B5	3	12.5		gb
B5	3	13		
B5	3	13.5		gb,gp
B5	3	14		tb,va
B5	3	14.5		
B5	3	15		gp
B5	3	15.5		gb
B5	3	16		va
B5	3	16.5		gb
B5	3	17		
B5	3	17.5	pa	gb,qc
B5	3	18		
B5	3	18.5		
B5	3	19		
B5	3	19.5		gb
B5	3	20		pa
B5	3	20.5		gb
B5	3	21		
B5	3	21.5		gb
B5	3	22	pa	gb
B5	3	22.5		
B5	3	23		gb
B5	3	23.5		gb
B5	3	24		gb
B5	3	24.5		
B5	3	25		
B5	3	25.5		
B5	3	26		pa
B5	3	26.5		gb
B5	3	27		
B5	3	27.5		gb,ka
B5	3	28	pa	gb
B5	3	28.5		
B5	3	29		
B5	3	29.5		
B5	3	30		
B5	3	30.5		
B5	3	31		gb
B5	3	31.5		
B5	3	32		gb
B5	3	32.5	cd	gb
B5	3	33		
B5	3	33.5		gb,va
B5	3	34		ka
B5	3	34.5		ka
B5	3	35		gb
B5	3	35.5		gb,amel
B5	3	36		ka,amel
B5	3	36.5		
B5	3	37		va
B5	3	37.5		ka,gp
B5	3	38		gp
B5	3	38.5		ka
B5	3	39		
B5	3	39.5		
B5	3	40		pa,gb
B5	3	40.5		

Unit	T	Point	Above	Below
B5	3	41		vp,gp
B5	3	41.5		ka,gp
B5	3	42		gb
B5	3	42.5		vp
B5	3	43		
B5	3	43.5		pa
B5	3	44		gb,tb
B5	3	44.5		
B6	1	5		gb
B6	1	5.5		va
B6	1	6		
B6	1	6.5		
B6	1	7		qv
B6	1	7.5		va
B6	1	8		gb
B6	1	8.5		gb
B6	1	9	hm	hm
B6	1	9.5		pa,gb,va
B6	1	10		nm,va
B6	1	10.5		gb,va
B6	1	11		pa,ka
B6	1	11.5		pa
B6	1	12		va,pa
B6	1	12.5		gb
B6	1	13	ar	ar,va
B6	1	13.5	ar	ar
B6	1	14	ar	ar,pa,vp
B6	1	14.5		va
B6	1	15		gb,va
B6	1	15.5		gb
B6	1	16	ar	pa,ar,va
B6	1	16.5		ka
B6	1	17		
B6	1	17.5		gb,va
B6	1	18		ka,va,ns
B6	1	18.5		ns
B6	1	19		va
B6	1	19.5		ns,va
B6	1	20		gb,ns
B6	1	20.5		va
B6	1	21		va
B6	1	21.5		va
B6	1	22		gb
B6	1	22.5		va
B6	1	23	cd	cd
B6	1	23.5		va
B6	1	24		
B6	1	24.5		pa
B6	1	25		gb,va
B6	1	25.5		gb,va
B6	1	26	ar	
B6	1	26.5	ar	
B6	1	27		gb
B6	1	27.5		gb
B6	1	28		
B6	1	28.5		pa
B6	1	29		vp
B6	1	29.5		
B6	1	30		vp
B6	1	30.5		gb
B6	1	31		gb
B6	1	31.5		va
B6	1	32		ar,gb
B6	1	32.5		gb,va,pa
B6	1	33		va,gb
B6	1	33.5		va
B6	1	34		gb
B6	1	34.5		gb
B6	1	35		
B6	1	35.5		gb

Unit	T	Point	Above	Below
B6	1	36	anek	amel,gb
B6	1	36.5		amel
B6	1	37		
B6	1	37.5		
B6	1	38		gb,va
B6	1	38.5		va
B6	1	39		gb,va
B6	1	39.5		
B6	1	40		pa,nm
B6	1	40.5		tb
B6	1	41	ar	pa
B6	1	41.5		rs
B6	1	42		
B6	1	42.5		nm
B6	1	43		nm,gb
B6	1	43.5		nm,gb
B6	1	44		
B6	1	44.5		
B6	2	5		ka,gb
B6	2	5.5		pa
B6	2	6	ar	gb
B6	2	6.5	ar	
B6	2	7		va
B6	2	7.5		
B6	2	8		
B6	2	8.5		nm,gb
B6	2	9		pa,nm
B6	2	9.5	pa	pa,gb
B6	2	10		va,ka
B6	2	10.5	pa	gb,amel,va
B6	2	11		va
B6	2	11.5		va
B6	2	12		gb,va
B6	2	12.5		gb
B6	2	13	pa	gb,ka
B6	2	13.5	pa	pa
B6	2	14		pa,ka
B6	2	14.5	pa	gp
B6	2	15	pa	va
B6	2	15.5		gb,ka
B6	2	16	pa	ka
B6	2	16.5	pa	pa,ka
B6	2	17		ka,gp
B6	2	17.5		ka
B6	2	18		va,amel
B6	2	18.5		ka,gp
B6	2	19	pa	ka,va
B6	2	19.5		ka,va
B6	2	20		pa,gp
B6	2	20.5		gb,ka
B6	2	21		gb
B6	2	21.5		ka
B6	2	22		sa,gb
B6	2	22.5		
B6	2	23		
B6	2	23.5		ka
B6	2	24		
B6	2	24.5		
B6	2	25		ka
B6	2	25.5		nm,gb,va
B6	2	26		nm,gb
B6	2	26.5		pa
B6	2	27		
B6	2	27.5		
B6	2	28		
B6	2	28.5		gb,amel
B6	2	29		gb
B6	2	29.5		rr,gb
B6	2	30		gb
B6	2	30.5		gp

Unit	T	Point	Above	Below
B6	2	31		ar,gb
B6	2	31.5		
B6	2	32		gp
B6	2	32.5		gb,ka,va,gp
B6	2	33		
B6	2	33.5		kb,ka
B6	2	34		nm,gb
B6	2	34.5		ka
B6	2	35	nm	nm,gb,ka
B6	2	35.5		gb
B6	2	36	nm	vp,nm,ka
B6	2	36.5		nm
B6	2	37		vp,ka,gp
B6	2	37.5		vp
B6	2	38		gb,vp
B6	2	38.5		ka
B6	2	39		nm
B6	2	39.5		rr
B6	2	40		gb,va,ka
B6	2	40.5		rr
B6	2	41		nm,ka
B6	2	41.5		ka
B6	2	42		ka,va
B6	2	42.5		ka
B6	2	43		va
B6	2	43.5		va
B6	2	44	ar	ar,va
B6	2	44.5		va
B6	3	5	pa	nm,gb
B6	3	5.5		va
B6	3	6	pa	pa,gb
B6	3	6.5		nm,vc
B6	3	7		gp,ka
B6	3	7.5		aa
B6	3	8		
B6	3	8.5		
B6	3	9		
B6	3	9.5	cd	
B6	3	10	cd	pa
B6	3	10.5	pa	gb
B6	3	11		
B6	3	11.5	cd	gb,ka
B6	3	12		
B6	3	12.5		
B6	3	13		amel,ka
B6	3	13.5	gb,amel	pa,gb,ka
B6	3	14		gb,qi
B6	3	14.5	pa	ka
B6	3	15		pa,ka
B6	3	15.5	pa	pa,gb,ka
B6	3	16		vcass,ka
B6	3	16.5		
B6	3	17		gp,ar,pa,ka
B6	3	17.5	ar	ar,pa,ka
B6	3	18		gp,gb
B6	3	18.5		gb
B6	3	19		gb
B6	3	19.5		gb
B6	3	20		gb,ka,va
B6	3	20.5		gb,va
B6	3	21		ka,gb
B6	3	21.5		gb
B6	3	22		gb
B6	3	22.5	pa	pa
B6	3	23		gb
B6	3	23.5	ar	ar,gb
B6	3	24		pa
B6	3	24.5		gb,lo
B6	3	25		gb,ka
B6	3	25.5	cd	gb

Unit	T	Point	Above	Below
B6	3	26		gp,ka
B6	3	26.5		qi,pa,gb,gp
B6	3	27		ka
B6	3	27.5		pa,ka
B6	3	28		pa,gb
B6	3	28.5		nm
B6	3	29		
B6	3	29.5		gb
B6	3	30		gb
B6	3	30.5	ns	ns,gp
B6	3	31	ns	ns,ka,gp
B6	3	31.5		
B6	3	32		
B6	3	32.5		gp,pa
B6	3	33		bp,gp
B6	3	33.5		bp
B6	3	34		bp
B6	3	34.5		gb,amel
B6	3	35	qc	
B6	3	35.5		
B6	3	36		
B6	3	36.5		
B6	3	37		
B6	3	37.5		gb
B6	3	38		
B6	3	38.5		
B6	3	39		gb
B6	3	39.5		
B6	3	40		
B6	3	40.5		pa
B6	3	41		gb
B6	3	41.5		gb,ka
B6	3	42		gb
B6	3	42.5		nm,gp
B6	3	43		amel
B6	3	43.5		gb
B6	3	44		
B6	3	44.5		gp
C1	1	5		bpap
C1	1	5.5		gp
C1	1	6		
C1	1	6.5		gp
C1	1	7		
C1	1	7.5		
C1	1	8	hv	gp
C1	1	8.5	hv	amel
C1	1	9		
C1	1	9.5		
C1	1	10		
C1	1	10.5		
C1	1	11		ar
C1	1	11.5		hv,gp
C1	1	12		
C1	1	12.5	hv	
C1	1	13		
C1	1	13.5	hv	
C1	1	14		gb
C1	1	14.5		
C1	1	15	hv	vp
C1	1	15.5		
C1	1	16		
C1	1	16.5		gb
C1	1	17		
C1	1	17.5		gb
C1	1	18		
C1	1	18.5		
C1	1	19		gb
C1	1	19.5	gb	an
C1	1	20		
C1	1	20.5		

Unit	T	Point	Above	Below
C1	1	21		
C1	1	21.5		an
C1	1	22		
C1	1	22.5		
C1	1	23		
C1	1	23.5	bl	pa
C1	1	24		
C1	1	24.5		qr
C1	1	25		
C1	1	25.5		
C1	1	26		
C1	1	26.5		
C1	1	27		vace,gp
C1	1	27.5		vace
C1	1	28		vp
C1	1	28.5		vp
C1	1	29		vp
C1	1	29.5		qr,mc
C1	1	30		
C1	1	30.5		vp
C1	1	31		hv
C1	1	31.5	hv,ap	
C1	1	32	cd	
C1	1	32.5	cd	
C1	1	33		
C1	1	33.5		pa,tb
C1	1	34		
C1	1	34.5		
C1	1	35		
C1	1	35.5		vp
C1	1	36		vp
C1	1	36.5		vp
C1	1	37		
C1	1	37.5		
C1	1	38		
C1	1	38.5		
C1	1	39		
C1	1	39.5		cd
C1	1	40		
C1	1	40.5		
C1	1	41		
C1	1	41.5	cd	mc
C1	1	42	cd	
C1	1	42.5	cd	
C1	1	43	cd	gb
C1	1	43.5	pa	va
C1	1	44	cd	va,pa,vace
C1	1	44.5	cd	gb
C1	2	5		
C1	2	5.5		
C1	2	6	cd	gb,va
C1	2	6.5		gb
C1	2	7		va
C1	2	7.5		
C1	2	8		vp
C1	2	8.5		
C1	2	9		
C1	2	9.5		hv,gb
C1	2	10		
C1	2	10.5		gb
C1	2	11		gb
C1	2	11.5		gb
C1	2	12		va
C1	2	12.5		pa
C1	2	13		cd,gp
C1	2	13.5		
C1	2	14		cd
C1	2	14.5		vp
C1	2	15		
C1	2	15.5		

Unit	T	Point	Above	Below
C1	2	16		
C1	2	16.5		pa
C1	2	17		
C1	2	17.5		
C1	2	18		mr
C1	2	18.5		
C1	2	19		mr
C1	2	19.5		
C1	2	20		
C1	2	20.5		gp
C1	2	21		
C1	2	21.5		vace
C1	2	22	hv	
C1	2	22.5		
C1	2	23		
C1	2	23.5		
C1	2	24	bl	qr
C1	2	24.5	bl	
C1	2	25		pa
C1	2	25.5		
C1	2	26		
C1	2	26.5		cs
C1	2	27		gb
C1	2	27.5		cs
C1	2	28		
C1	2	28.5	cd	va
C1	2	29	cd	va
C1	2	29.5		amel
C1	2	30		
C1	2	30.5	hv	
C1	2	31		va
C1	2	31.5		
C1	2	32	hv	
C1	2	32.5	hv	
C1	2	33	vace	
C1	2	33.5		
C1	2	34		
C1	2	34.5		
C1	2	35		
C1	2	35.5		
C1	2	36		
C1	2	36.5		
C1	2	37		vp
C1	2	37.5		va,us
C1	2	38		us,va
C1	2	38.5		us
C1	2	39		us
C1	2	39.5		hv
C1	2	40		va
C1	2	40.5		
C1	2	41		va
C1	2	41.5		va
C1	2	42		va
C1	2	42.5		va
C1	2	43		va
C1	2	43.5	hv	va
C1	2	44		va
C1	2	44.5		va
C1	3	5		
C1	3	5.5		gp
C1	3	6		
C1	3	6.5	cd	
C1	3	7	cd,hv	hv
C1	3	7.5	cd	
C1	3	8		
C1	3	8.5		
C1	3	9		
C1	3	9.5		
C1	3	10		
C1	3	10.5		

Unit	T	Point	Above	Below
C1	3	11		moss
C1	3	11.5		mc
C1	3	12		
C1	3	12.5		
C1	3	13		cd
C1	3	13.5		
C1	3	14		
C1	3	14.5	pa	vp
C1	3	15		
C1	3	15.5		va,gp
C1	3	16		pa,tb
C1	3	16.5	vace	
C1	3	17		gp
C1	3	17.5		gp
C1	3	18		
C1	3	18.5		
C1	3	19		
C1	3	19.5		us
C1	3	20	cd	
C1	3	20.5	cd	
C1	3	21		
C1	3	21.5		
C1	3	22		
C1	3	22.5		
C1	3	23		
C1	3	23.5		
C1	3	24		
C1	3	24.5		
C1	3	25	hv	cs
C1	3	25.5	hv	
C1	3	26	hv	
C1	3	26.5		
C1	3	27		
C1	3	27.5		
C1	3	28		
C1	3	28.5		moss
C1	3	29		
C1	3	29.5		gp
C1	3	30		pa
C1	3	30.5		va
C1	3	31		va
C1	3	31.5		gb,va
C1	3	32		
C1	3	32.5		
C1	3	33		
C1	3	33.5		
C1	3	34		
C1	3	34.5		
C1	3	35	hb	
C1	3	35.5		va
C1	3	36		va
C1	3	36.5		cd
C1	3	37	cd	cd
C1	3	37.5	cd,qa	
C1	3	38		
C1	3	38.5		va
C1	3	39		mc
C1	3	39.5		va
C1	3	40		
C1	3	40.5	gb	va
C1	3	41		tb
C1	3	41.5		gb
C1	3	42		
C1	3	42.5		
C1	3	43		
C1	3	43.5		
C1	3	44		
C1	3	44.5	cd	
C2	1	5		
C2	1	5.5		vp
C2	1	6	pa	hv
C2	1	6.5	qa	hv
C2	1	7		
C2	1	7.5		
C2	1	8		gp
C2	1	8.5		va,ar,qr
C2	1	9	ar	va,rh
C2	1	9.5		ar
C2	1	10	hv	pa,va
C2	1	10.5		pa,va
C2	1	11		pa
C2	1	11.5	cd,pa	va
C2	1	12	cd	va,pa
C2	1	12.5	hv,pa	va
C2	1	13		hv
C2	1	13.5		pa
C2	1	14	ar	pa
C2	1	14.5		pa
C2	1	15		
C2	1	15.5	hv	
C2	1	16		
C2	1	16.5		
C2	1	17		
C2	1	17.5		pa
C2	1	18		
C2	1	18.5		
C2	1	19		
C2	1	19.5		pa
C2	1	20		
C2	1	20.5		
C2	1	21		
C2	1	21.5		
C2	1	22		
C2	1	22.5		
C2	1	23		va
C2	1	23.5		
C2	1	24		
C2	1	24.5		qr
C2	1	25		gp,ar
C2	1	25.5	pa	dd
C2	1	26		ar
C2	1	26.5	ar	
C2	1	27		va
C2	1	27.5		pa
C2	1	28		
C2	1	28.5	hv	pa
C2	1	29	pa	
C2	1	29.5	hv	
C2	1	30		
C2	1	30.5		va
C2	1	31		hv
C2	1	31.5	cd	cd
C2	1	32	cd	
C2	1	32.5	cd	
C2	1	33	ar	ar
C2	1	33.5		gb
C2	1	34		pa
C2	1	34.5		pa,gp
C2	1	35		gb
C2	1	35.5		cd
C2	1	36	hv	
C2	1	36.5	hv	
C2	1	37		
C2	1	37.5		va
C2	1	38	ka	pa,ka
C2	1	38.5	vcas	va
C2	1	39		pa,va
C2	1	39.5		
C2	1	40	hv	hv,va
C2	1	40.5		va

Unit	T	Point	Above	Below
C2	1	41	hv	pa
C2	1	41.5	pa	pa
C2	1	42		
C2	1	42.5		
C2	1	43		
C2	1	43.5	pa	
C2	1	44		va
C2	1	44.5	pa	pa,hv,ka
C2	2	5		gb
C2	2	5.5		
C2	2	6		dp,tb
C2	2	6.5		pa,dp
C2	2	7		pa,aa
C2	2	7.5	hv	va
C2	2	8		
C2	2	8.5		dp
C2	2	9		gp
C2	2	9.5	cd	dp
C2	2	10	cd	
C2	2	10.5	pa	dp
C2	2	11		
C2	2	11.5		pa
C2	2	12		
C2	2	12.5		ka
C2	2	13		ka,rock,lichen
C2	2	13.5		ka,gp
C2	2	14		
C2	2	14.5		
C2	2	15		gp
C2	2	15.5		pa
C2	2	16		lh
C2	2	16.5		gp
C2	2	17		dp
C2	2	17.5		dp
C2	2	18		dp
C2	2	18.5		dp
C2	2	19		dp,if,va
C2	2	19.5		dp
C2	2	20		hv,va
C2	2	20.5		hv
C2	2	21		pa,hv
C2	2	21.5		
C2	2	22		
C2	2	22.5		hv
C2	2	23		
C2	2	23.5		
C2	2	24		
C2	2	24.5		ka
C2	2	25		pa,ka
C2	2	25.5		ka
C2	2	26		gb
C2	2	26.5		va,rb
C2	2	27		
C2	2	27.5	pa	us
C2	2	28		pa
C2	2	28.5		
C2	2	29		ka
C2	2	29.5		va
C2	2	30		hv
C2	2	30.5		ka
C2	2	31		ar,ka
C2	2	31.5	hv	pa
C2	2	32	hv	amel
C2	2	32.5		
C2	2	33	amel	pa,cs
C2	2	33.5		
C2	2	34		cs
C2	2	34.5		rh,va
C2	2	35		
C2	2	35.5		

Unit	T	Point	Above	Below
C2	2	36		va
C2	2	36.5		va
C2	2	37	hv	ar,va
C2	2	37.5	ar	va,hv
C2	2	38	cd	cd
C2	2	38.5	cd	cd,tb
C2	2	39		va
C2	2	39.5		va
C2	2	40		hv
C2	2	40.5		va,hv,us
C2	2	41		rh,qr,hv,gp
C2	2	41.5		va
C2	2	42	qr	qr,pa
C2	2	42.5		
C2	2	43		
C2	2	43.5		
C2	2	44		hv,cd
C2	2	44.5	cd	cd,vcas
C2	3	5	pa	va
C2	3	5.5		va
C2	3	6		ka
C2	3	6.5		aa,ka
C2	3	7		gb
C2	3	7.5		gp
C2	3	8		gb
C2	3	8.5		vcas
C2	3	9		va
C2	3	9.5	hv	gb
C2	3	10	hv	hv
C2	3	10.5		
C2	3	11	hv	hv
C2	3	11.5	hv	gb
C2	3	12	hv	
C2	3	12.5		pa,amel
C2	3	13		pa
C2	3	13.5		ka
C2	3	14		gp
C2	3	14.5		pa
C2	3	15		gb
C2	3	15.5	hv,cd	cd
C2	3	16		cd,hv
C2	3	16.5	hv	gp
C2	3	17	hv	pa
C2	3	17.5		
C2	3	18		pa,va
C2	3	18.5		hv
C2	3	19	cd	cd,us
C2	3	19.5		cd,va
C2	3	20	cd	pa
C2	3	20.5		
C2	3	21		hv,va
C2	3	21.5		
C2	3	22		
C2	3	22.5		
C2	3	23		va
C2	3	23.5		
C2	3	24		
C2	3	24.5		
C2	3	25		hv
C2	3	25.5	hv	
C2	3	26	hv	hv
C2	3	26.5		
C2	3	27		rock
C2	3	27.5		tb
C2	3	28		ka,va
C2	3	28.5		
C2	3	29		
C2	3	29.5		
C2	3	30	ar	ar
C2	3	30.5	ar	ar

Unit	T	Point	Above	Below
C2	3	31	ar	
C2	3	31.5	hv	
C2	3	32	hv	pa
C2	3	32.5	hv	
C2	3	33	hv,ar	dp
C2	3	33.5	hv	hv
C2	3	34	cd	qa,dp,vace
C2	3	34.5	cd	cd,ka
C2	3	35	cd	
C2	3	35.5		
C2	3	36		va, fern
C2	3	36.5		
C2	3	37		hv
C2	3	37.5	hv	
C2	3	38		gp
C2	3	38.5		
C2	3	39		
C2	3	39.5		
C2	3	40		cs
C2	3	40.5		
C2	3	41		va
C2	3	41.5	cd	gp
C2	3	42	cd	cs
C2	3	42.5		va
C2	3	43		pa
C2	3	43.5		
C2	3	44		
C2	3	44.5	hv	
C3	1	5		
C3	1	5.5		rock
C3	1	6		vp
C3	1	6.5		rock
C3	1	7		
C3	1	7.5		
C3	1	8		
C3	1	8.5		va
C3	1	9		
C3	1	9.5		kl
C3	1	10		
C3	1	10.5		kl
C3	1	11		
C3	1	11.5		ar
C3	1	12	ar	ar
C3	1	12.5		kl
C3	1	13	hv	hv
C3	1	13.5		ar
C3	1	14		
C3	1	14.5		
C3	1	15		kl
C3	1	15.5		kl
C3	1	16		
C3	1	16.5		
C3	1	17		kl
C3	1	17.5		
C3	1	18		
C3	1	18.5		
C3	1	19		ar
C3	1	19.5		
C3	1	20		
C3	1	20.5		
C3	1	21		
C3	1	21.5		
C3	1	22		va
C3	1	22.5		
C3	1	23		
C3	1	23.5	cd	cd
C3	1	24		gb,gp
C3	1	24.5		
C3	1	25		gp
C3	1	25.5		va

Unit	T	Point	Above	Below
C3	1	26		
C3	1	26.5		
C3	1	27		kl
C3	1	27.5		
C3	1	28		vp
C3	1	28.5		ar
C3	1	29		ar
C3	1	29.5	ar	ar
C3	1	30		
C3	1	30.5		dp
C3	1	31		
C3	1	31.5		bl
C3	1	32		
C3	1	32.5	cd	
C3	1	33	cd	
C3	1	33.5		
C3	1	34		
C3	1	34.5		
C3	1	35		amel
C3	1	35.5		hv
C3	1	36		hv
C3	1	36.5		
C3	1	37		
C3	1	37.5		
C3	1	38		
C3	1	38.5		ar
C3	1	39		
C3	1	39.5	ar	ar
C3	1	40		va
C3	1	40.5		va
C3	1	41		
C3	1	41.5		
C3	1	42	ar	cd
C3	1	42.5	ar	
C3	1	43	ar	
C3	1	43.5		rock
C3	1	44		
C3	1	44.5		
C3	2	5		ka
C3	2	5.5		rh
C3	2	6		
C3	2	6.5		
C3	2	7		ka
C3	2	7.5		va
C3	2	8		
C3	2	8.5		ka
C3	2	9		amel
C3	2	9.5		
C3	2	10		gp
C3	2	10.5		
C3	2	11		ka
C3	2	11.5	amel	
C3	2	12		hv
C3	2	12.5		
C3	2	13		
C3	2	13.5		
C3	2	14		
C3	2	14.5		
C3	2	15		va
C3	2	15.5		gp
C3	2	16		
C3	2	16.5		
C3	2	17		gp
C3	2	17.5		
C3	2	18		
C3	2	18.5		
C3	2	19		gp
C3	2	19.5		
C3	2	20		
C3	2	20.5		

Unit	T	Point	Above	Below
C3	2	21		
C3	2	21.5		va
C3	2	22		va
C3	2	22.5		
C3	2	23		gp
C3	2	23.5		ar
C3	2	24		
C3	2	24.5		
C3	2	25		cd
C3	2	25.5		
C3	2	26		gp
C3	2	26.5		
C3	2	27		ar,gp
C3	2	27.5	hv	
C3	2	28		pa,va
C3	2	28.5		
C3	2	29	hv,cd	
C3	2	29.5	hv	hv
C3	2	30		cs
C3	2	30.5		va,cs
C3	2	31		va,gp
C3	2	31.5		
C3	2	32		
C3	2	32.5		va
C3	2	33		ka
C3	2	33.5		va
C3	2	34		gp,cd
C3	2	34.5	hv	hv,va
C3	2	35	hv	hv
C3	2	35.5		
C3	2	36		gp
C3	2	36.5		
C3	2	37		
C3	2	37.5		cs,va
C3	2	38		cs
C3	2	38.5		
C3	2	39		
C3	2	39.5		
C3	2	40		va
C3	2	40.5		
C3	2	41		
C3	2	41.5		
C3	2	42		kl
C3	2	42.5		kl
C3	2	43		
C3	2	43.5		
C3	2	44		
C3	2	44.5	cd	
C3	3	5		qa
C3	3	5.5		qa
C3	3	6		
C3	3	6.5		
C3	3	7		
C3	3	7.5		
C3	3	8		gp
C3	3	8.5		
C3	3	9		
C3	3	9.5		
C3	3	10		ar
C3	3	10.5		qa
C3	3	11		qa
C3	3	11.5		qa
C3	3	12		cs
C3	3	12.5		cs
C3	3	13		
C3	3	13.5		va
C3	3	14		qa,hv,va
C3	3	14.5	qa	qa
C3	3	15		
C3	3	15.5		

Unit	T	Point	Above	Below
C3	3	16		va,gp
C3	3	16.5		
C3	3	17		qr
C3	3	17.5		pa
C3	3	18		
C3	3	18.5		
C3	3	19		
C3	3	19.5		
C3	3	20		gb
C3	3	20.5		
C3	3	21		
C3	3	21.5		va
C3	3	22		
C3	3	22.5		
C3	3	23		
C3	3	23.5		cd
C3	3	24		
C3	3	24.5		
C3	3	25		
C3	3	25.5		ka
C3	3	26		amel
C3	3	26.5	cd	cd
C3	3	27	cd	
C3	3	27.5	cd	cd,va
C3	3	28	ar	
C3	3	28.5		va
C3	3	29		
C3	3	29.5		
C3	3	30		
C3	3	30.5		ar
C3	3	31	ar	ar
C3	3	31.5	ar	ar,va
C3	3	32		va
C3	3	32.5		va
C3	3	33		hv
C3	3	33.5		
C3	3	34		
C3	3	34.5		
C3	3	35		
C3	3	35.5		
C3	3	36		va
C3	3	36.5		
C3	3	37		
C3	3	37.5		ar
C3	3	38		ar
C3	3	38.5		
C3	3	39		
C3	3	39.5		
C3	3	40		cd
C3	3	40.5		
C3	3	41		
C3	3	41.5		
C3	3	42		qr
C3	3	42.5		qa
C3	3	43		va
C3	3	43.5		gb
C3	3	44	cd	gb
C3	3	44.5		
C4	1	5		
C4	1	5.5		
C4	1	6		
C4	1	6.5		
C4	1	7		
C4	1	7.5		gp
C4	1	8		
C4	1	8.5		
C4	1	9		ar
C4	1	9.5		
C4	1	10	cd	
C4	1	10.5		vp

Unit	T	Point	Above	Below
C4	1	11		
C4	1	11.5		
C4	1	12		
C4	1	12.5	cd	gp
C4	1	13		vp
C4	1	13.5		vp
C4	1	14		
C4	1	14.5		ka
C4	1	15		
C4	1	15.5		
C4	1	16		gb
C4	1	16.5		
C4	1	17		
C4	1	17.5		
C4	1	18		
C4	1	18.5		
C4	1	19		va
C4	1	19.5		amel
C4	1	20		
C4	1	20.5		
C4	1	21		
C4	1	21.5		
C4	1	22		
C4	1	22.5		
C4	1	23		
C4	1	23.5		
C4	1	24		
C4	1	24.5		
C4	1	25		
C4	1	25.5		
C4	1	26		
C4	1	26.5		
C4	1	27		
C4	1	27.5		
C4	1	28		va
C4	1	28.5		
C4	1	29		
C4	1	29.5		
C4	1	30		
C4	1	30.5		
C4	1	31		
C4	1	31.5		ka
C4	1	32		
C4	1	32.5		ar
C4	1	33		
C4	1	33.5	cd	
C4	1	34	cd	va
C4	1	34.5		
C4	1	35		
C4	1	35.5		ka
C4	1	36		
C4	1	36.5		
C4	1	37		cd
C4	1	37.5		
C4	1	38		
C4	1	38.5		
C4	1	39		
C4	1	39.5		
C4	1	40		
C4	1	40.5		
C4	1	41		
C4	1	41.5	cd	
C4	1	42		
C4	1	42.5		
C4	1	43		
C4	1	43.5		vp
C4	1	44		
C4	1	44.5		va
C4	2	5		
C4	2	5.5		moss

Unit	T	Point	Above	Below
C4	2	6		va
C4	2	6.5		ka
C4	2	7		
C4	2	7.5		va
C4	2	8		
C4	2	8.5		
C4	2	9		
C4	2	9.5		vp,va
C4	2	10		
C4	2	10.5		
C4	2	11		gp
C4	2	11.5		
C4	2	12		
C4	2	12.5	hv	hv
C4	2	13		hv
C4	2	13.5		
C4	2	14		
C4	2	14.5		
C4	2	15		
C4	2	15.5		rock
C4	2	16		
C4	2	16.5		
C4	2	17		
C4	2	17.5		
C4	2	18		
C4	2	18.5		
C4	2	19		
C4	2	19.5		ka
C4	2	20		gb
C4	2	20.5		
C4	2	21		gb
C4	2	21.5		us
C4	2	22		
C4	2	22.5		
C4	2	23		
C4	2	23.5		ar
C4	2	24		
C4	2	24.5	cd	
C4	2	25	cd	
C4	2	25.5	cd	
C4	2	26		
C4	2	26.5		
C4	2	27		
C4	2	27.5		
C4	2	28		
C4	2	28.5		va
C4	2	29		
C4	2	29.5		
C4	2	30		
C4	2	30.5		
C4	2	31		hv
C4	2	31.5		hv
C4	2	32		
C4	2	32.5	cd	
C4	2	33		
C4	2	33.5		
C4	2	34		
C4	2	34.5		
C4	2	35		hv
C4	2	35.5		
C4	2	36		
C4	2	36.5		hv
C4	2	37	hv	
C4	2	37.5		
C4	2	38	cd	cd
C4	2	38.5	cd	
C4	2	39		
C4	2	39.5		
C4	2	40		vp
C4	2	40.5		

Unit	T	Point	Above	Below
C4	2	41		
C4	2	41.5		
C4	2	42		
C4	2	42.5		
C4	2	43		cd
C4	2	43.5		
C4	2	44		
C4	2	44.5		cd
C4	3	5		va
C4	3	5.5		qa
C4	3	6		gb
C4	3	6.5		
C4	3	7		
C4	3	7.5		
C4	3	8		
C4	3	8.5		
C4	3	9		amel,vp
C4	3	9.5		
C4	3	10		
C4	3	10.5		
C4	3	11		va
C4	3	11.5		
C4	3	12		cd,tb
C4	3	12.5		mc
C4	3	13		
C4	3	13.5		
C4	3	14		
C4	3	14.5	cd	cd
C4	3	15		
C4	3	15.5		va
C4	3	16		
C4	3	16.5		hv
C4	3	17		hv
C4	3	17.5		
C4	3	18		
C4	3	18.5		cd
C4	3	19		cd
C4	3	19.5		
C4	3	20		gb
C4	3	20.5		moss
C4	3	21		
C4	3	21.5		
C4	3	22		
C4	3	22.5		
C4	3	23		
C4	3	23.5		
C4	3	24	cd	cd
C4	3	24.5		
C4	3	25		va
C4	3	25.5	cd	
C4	3	26		
C4	3	26.5		
C4	3	27		
C4	3	27.5		
C4	3	28		
C4	3	28.5		
C4	3	29		
C4	3	29.5		
C4	3	30		
C4	3	30.5		ka
C4	3	31		
C4	3	31.5		
C4	3	32		ka
C4	3	32.5		va
C4	3	33		ka
C4	3	33.5		hv
C4	3	34		
C4	3	34.5		vp,va
C4	3	35		va
C4	3	35.5		

Unit	T	Point	Above	Below
C4	3	36		
C4	3	36.5		gp
C4	3	37		gp
C4	3	37.5		
C4	3	38		
C4	3	38.5		
C4	3	39		
C4	3	39.5		cs
C4	3	40		
C4	3	40.5		ka
C4	3	41		
C4	3	41.5		
C4	3	42		
C4	3	42.5		gp
C4	3	43		vp,va
C4	3	43.5		hv
C4	3	44		
C4	3	44.5		
C5	1	5		
C5	1	5.5		
C5	1	6		
C5	1	6.5		ar
C5	1	7		
C5	1	7.5		hv
C5	1	8		
C5	1	8.5		va
C5	1	9		va
C5	1	9.5		
C5	1	10	ar	
C5	1	10.5		ps
C5	1	11		
C5	1	11.5		
C5	1	12		
C5	1	12.5		
C5	1	13	qr	
C5	1	13.5		cs
C5	1	14		va
C5	1	14.5	hv	hv
C5	1	15	hv	
C5	1	15.5		gp
C5	1	16		
C5	1	16.5		vp
C5	1	17		
C5	1	17.5		
C5	1	18		vp
C5	1	18.5		qa,vp
C5	1	19		qr
C5	1	19.5		va
C5	1	20		va
C5	1	20.5		
C5	1	21		
C5	1	21.5		va
C5	1	22		qr
C5	1	22.5	ar	ar
C5	1	23		va
C5	1	23.5		
C5	1	24		qr,rh
C5	1	24.5		
C5	1	25		
C5	1	25.5		
C5	1	26		va
C5	1	26.5		
C5	1	27		
C5	1	27.5		gp
C5	1	28	hv	hv
C5	1	28.5	hv	
C5	1	29		gp,us
C5	1	29.5		gp
C5	1	30		
C5	1	30.5		vace

Unit	T	Point	Above	Below
C5	1	31		
C5	1	31.5		vp
C5	1	32		vp
C5	1	32.5		amel
C5	1	33		vp
C5	1	33.5		vp
C5	1	34		vp
C5	1	34.5	hv	qr,cs
C5	1	35		
C5	1	35.5		
C5	1	36		va
C5	1	36.5		
C5	1	37		rock
C5	1	37.5		
C5	1	38		
C5	1	38.5		
C5	1	39		hv
C5	1	39.5		
C5	1	40	hv	
C5	1	40.5		
C5	1	41	hv	
C5	1	41.5	hv	cs
C5	1	42		cs
C5	1	42.5		
C5	1	43		
C5	1	43.5	cd	
C5	1	44	cd	
C5	1	44.5	qr	hv
C5	2	5		
C5	2	5.5		
C5	2	6		
C5	2	6.5		
C5	2	7		
C5	2	7.5		va
C5	2	8		va
C5	2	8.5		cs
C5	2	9		
C5	2	9.5		
C5	2	10		hv
C5	2	10.5		qr
C5	2	11		hv
C5	2	11.5		hv
C5	2	12		
C5	2	12.5	ar	
C5	2	13	ar	ar
C5	2	13.5		ar
C5	2	14		
C5	2	14.5	hv	gp
C5	2	15		cd,hv
C5	2	15.5	qa	qa
C5	2	16	cd	qa
C5	2	16.5		cs
C5	2	17	qr	cs
C5	2	17.5		cs
C5	2	18		qr,gp
C5	2	18.5		vace,gp
C5	2	19		
C5	2	19.5		
C5	2	20	hv	gp
C5	2	20.5		cs
C5	2	21	hv	
C5	2	21.5	hv	cs
C5	2	22		
C5	2	22.5	hv	ar,vp
C5	2	23	cd	va
C5	2	23.5		
C5	2	24		
C5	2	24.5	hv	va
C5	2	25		
C5	2	25.5	cd	gp

Unit	T	Point	Above	Below
C5	2	26		rock,moss
C5	2	26.5		hv,cs
C5	2	27		
C5	2	27.5		hv
C5	2	28		
C5	2	28.5		gb
C5	2	29		gp
C5	2	29.5		gb
C5	2	30		
C5	2	30.5		
C5	2	31		
C5	2	31.5		va
C5	2	32	hv	
C5	2	32.5	hv	
C5	2	33	hv	amel
C5	2	33.5	hv	hv
C5	2	34	hv	us
C5	2	34.5	hv	hv
C5	2	35		
C5	2	35.5		gp
C5	2	36		va
C5	2	36.5		
C5	2	37		
C5	2	37.5		
C5	2	38		
C5	2	38.5		
C5	2	39		
C5	2	39.5		gp
C5	2	40		va
C5	2	40.5		va
C5	2	41		
C5	2	41.5		
C5	2	42		vp
C5	2	42.5		
C5	2	43		
C5	2	43.5		cs
C5	2	44		
C5	2	44.5		
C5	3	5	cd	
C5	3	5.5		hv
C5	3	6		
C5	3	6.5		
C5	3	7		
C5	3	7.5		
C5	3	8		
C5	3	8.5		
C5	3	9		
C5	3	9.5		
C5	3	10		
C5	3	10.5		
C5	3	11		
C5	3	11.5		
C5	3	12		
C5	3	12.5		ka
C5	3	13		
C5	3	13.5		
C5	3	14		gp
C5	3	14.5		
C5	3	15		gp
C5	3	15.5		va
C5	3	16		gp
C5	3	16.5		
C5	3	17		
C5	3	17.5		cs
C5	3	18		gp,cs
C5	3	18.5		
C5	3	19		va
C5	3	19.5	ar	ar
C5	3	20	ar	
C5	3	20.5	ar	ar

Unit	T	Point	Above	Below
C5	3	21	hv	hv
C5	3	21.5	qr	hv
C5	3	22	qr	qr,vp
C5	3	22.5	qr	gp
C5	3	23		bl
C5	3	23.5		
C5	3	24		
C5	3	24.5		
C5	3	25	ar	ar
C5	3	25.5	ar	ar,va,cs
C5	3	26		ar
C5	3	26.5		ar
C5	3	27		
C5	3	27.5		va
C5	3	28		
C5	3	28.5		vp
C5	3	29		
C5	3	29.5		
C5	3	30		vp
C5	3	30.5		
C5	3	31	amel	amel
C5	3	31.5		vp
C5	3	32		vp
C5	3	32.5		va
C5	3	33	cd	cd
C5	3	33.5	cd	cd
C5	3	34	cd	cd
C5	3	34.5		qr
C5	3	35		va
C5	3	35.5		
C5	3	36		
C5	3	36.5	qr	qr
C5	3	37	qr	
C5	3	37.5	qr	qr
C5	3	38	qr	qr
C5	3	38.5	qr	
C5	3	39	hv	hv
C5	3	39.5		
C5	3	40		va
C5	3	40.5		
C5	3	41		va
C5	3	41.5		va
C5	3	42		va
C5	3	42.5		rh
C5	3	43		rh
C5	3	43.5		gp
C5	3	44		
C5	3	44.5		vp
C6	1	5	qa	qa,va
C6	1	5.5		gb
C6	1	6	ar	va
C6	1	6.5		ar
C6	1	7	ar	gb
C6	1	7.5	ar	vp
C6	1	8	ar	
C6	1	8.5		
C6	1	9		gb
C6	1	9.5		gb
C6	1	10	qr	qr
C6	1	10.5	qr	
C6	1	11	qr	
C6	1	11.5	qr	qr
C6	1	12	qr	
C6	1	12.5	qr	qr,va
C6	1	13	ar,qr	ar
C6	1	13.5	ar	
C6	1	14	ar	
C6	1	14.5	ar	ar
C6	1	15		
C6	1	15.5		ar,va

Unit	T	Point	Above	Below
C6	1	16		va
C6	1	16.5		
C6	1	17		us
C6	1	17.5	qr	
C6	1	18	qr	qr
C6	1	18.5	qr	
C6	1	19	qr	cs
C6	1	19.5		
C6	1	20		vp
C6	1	20.5		
C6	1	21		
C6	1	21.5		
C6	1	22		
C6	1	22.5		vp,us
C6	1	23		gb
C6	1	23.5		vp
C6	1	24		vp
C6	1	24.5	ar	ar
C6	1	25	ar	ar
C6	1	25.5		ar,va
C6	1	26		va
C6	1	26.5		qa,va
C6	1	27		
C6	1	27.5		gp
C6	1	28	hv	
C6	1	28.5	hv	
C6	1	29	hv	hv
C6	1	29.5	hv	
C6	1	30		va,hv
C6	1	30.5		
C6	1	31		va,gp
C6	1	31.5	bl	hv,va
C6	1	32	hv	bl
C6	1	32.5	hv	bl
C6	1	33		va
C6	1	33.5		bl
C6	1	34		
C6	1	34.5		gp
C6	1	35		va
C6	1	35.5	hv	hv,va
C6	1	36		va,gp
C6	1	36.5		
C6	1	37		va
C6	1	37.5		
C6	1	38		
C6	1	38.5		cd,us
C6	1	39	ar	us
C6	1	39.5		vp
C6	1	40		
C6	1	40.5		us,va
C6	1	41		va
C6	1	41.5		
C6	1	42		gp
C6	1	42.5		
C6	1	43		vp
C6	1	43.5		va
C6	1	44	ar	cs
C6	1	44.5	ar	ar
C6	2	5	cd	cd,va
C6	2	5.5	hv	hv
C6	2	6	hv	va
C6	2	6.5	cd	
C6	2	7	cd	
C6	2	7.5	cd	
C6	2	8	cd	cd
C6	2	8.5	cd	va
C6	2	9		ar
C6	2	9.5	ar	
C6	2	10		vp
C6	2	10.5		

Unit	T	Point	Above	Below
C6	2	11		
C6	2	11.5	hv	hv
C6	2	12	hv	hv
C6	2	12.5		
C6	2	13		
C6	2	13.5		us
C6	2	14		ar
C6	2	14.5		us
C6	2	15	hv	us
C6	2	15.5		gp
C6	2	16		ar,vp
C6	2	16.5		vp
C6	2	17		
C6	2	17.5		
C6	2	18		
C6	2	18.5		cs
C6	2	19		cs
C6	2	19.5		qa
C6	2	20	ar	ar
C6	2	20.5		ar
C6	2	21		hv,va
C6	2	21.5		hv
C6	2	22	qa	
C6	2	22.5		qa
C6	2	23		
C6	2	23.5	qa	qa,gp
C6	2	24		
C6	2	24.5		mc
C6	2	25		gb
C6	2	25.5		
C6	2	26		vp
C6	2	26.5		vp
C6	2	27	ar	
C6	2	27.5	ar	
C6	2	28		us
C6	2	28.5		us
C6	2	29		
C6	2	29.5		amel
C6	2	30		
C6	2	30.5		cd,gp
C6	2	31		va
C6	2	31.5		
C6	2	32		
C6	2	32.5		
C6	2	33		va
C6	2	33.5		vp
C6	2	34		vp
C6	2	34.5		tb,mc
C6	2	35	ar	
C6	2	35.5		va
C6	2	36	ar	va
C6	2	36.5	ar	
C6	2	37	cd	
C6	2	37.5	cd	qr
C6	2	38	cd	
C6	2	38.5	cd	va
C6	2	39		va
C6	2	39.5		
C6	2	40		
C6	2	40.5	cd	
C6	2	41	hv	gp
C6	2	41.5		va
C6	2	42	hv	
C6	2	42.5	hv	
C6	2	43	hv	
C6	2	43.5		hv
C6	2	44		
C6	2	44.5	qr	
C6	3	5	hv	gp
C6	3	5.5	hv	hv

Unit	T	Point	Above	Below
C6	3	6	ar	gp
C6	3	6.5		va
C6	3	7		
C6	3	7.5		cs
C6	3	8		
C6	3	8.5		va
C6	3	9		va
C6	3	9.5		
C6	3	10	ar	
C6	3	10.5	ar	hv,va
C6	3	11	ar	ar
C6	3	11.5	ar	
C6	3	12		gp
C6	3	12.5		va
C6	3	13	hv	hv
C6	3	13.5	hv	va
C6	3	14		gp
C6	3	14.5		
C6	3	15		
C6	3	15.5		
C6	3	16		
C6	3	16.5		gp,va
C6	3	17		cd,gp
C6	3	17.5	hv	us
C6	3	18	cd,hv	cd,hv
C6	3	18.5	ar	cd,cs,va
C6	3	19	ar	cs,va
C6	3	19.5	ar	cs
C6	3	20	ar	cs
C6	3	20.5	ar	va
C6	3	21	ar	hv
C6	3	21.5	hv,ar	
C6	3	22		
C6	3	22.5	hv	
C6	3	23	hv	
C6	3	23.5		us
C6	3	24	cd	
C6	3	24.5	cd	cd
C6	3	25	cd	
C6	3	25.5		
C6	3	26		va,mc
C6	3	26.5		
C6	3	27		
C6	3	27.5		
C6	3	28		
C6	3	28.5	cd	
C6	3	29	cd	gp
C6	3	29.5	cd	cs
C6	3	30		gp
C6	3	30.5		cs
C6	3	31		gp
C6	3	31.5		
C6	3	32		
C6	3	32.5		amel
C6	3	33		cs
C6	3	33.5		
C6	3	34		cs
C6	3	34.5		amel
C6	3	35	ar	ar
C6	3	35.5	ar	
C6	3	36		
C6	3	36.5		
C6	3	37		
C6	3	37.5		cs
C6	3	38		
C6	3	38.5		
C6	3	39		vace
C6	3	39.5		va
C6	3	40		va
C6	3	40.5		va

Unit	T	Point	Above	Below
C6	3	41		va
C6	3	41.5		
C6	3	42		mc
C6	3	42.5		
C6	3	43	ar	
C6	3	43.5		hv,gp
C6	3	44		
C6	3	44.5	ar	

Pre-Burn Fuel Loading

Spring 2001, Cadwell Memorial Forest, Pelham, MA

Down and standing fuels, g/40x40cm plot

			Down dead					Standing Live									Standing dead		
Unit	Plot	Date	1 hr	10 hr	100 hr	Litter leaves	Needles	Other woody 1hr	Other woody 10hr	Other woody leaves	Vac 1hr	Vac lvs	Gay bac 1hr	Gay bac 10hr	Gay bac leaves	Non-woody	1 hour	10hr	Non-woody
A2	1	28-Apr	59.19	52.86	0.00	92.38	0.00	0.00	0.00	0.00	0.00	0.00	12.95	0.00	0.00	0.00	4.29	0.00	0.00
A2	2	28-Apr	50.90	7.67	0.00	115.07	0.00	1.69	0.00	0.00	0.00	0.00	50.54	0.00	0.00	0.34	0.00	0.00	0.00
A2	3	28-Apr	19.20	3.64	0.00	88.76	0.00	0.00	0.00	0.00	7.15	0.00	44.03	0.00	0.00	1.75	0.00	0.00	0.00
A2	4	28-Apr	70.43	147.30	0.00	107.00	0.00	0.00	0.00	0.00	0.18	0.00	2.26	0.00	0.00	2.21	0.00	0.00	0.00
A2	5	28-Apr	12.25	2.29	0.00	86.39	0.00	0.00	0.00	0.00	0.00	0.00	11.32	0.00	0.00	1.16	0.00	0.00	0.00
A3	1	24-Apr	92.43	313.62	0.00	149.20	0.00	0.00	0.00	0.00	9.96	0.00	11.32	0.00	0.00	1.44	0.00	0.00	0.00
A3	2	24-Apr	31.66	104.80	0.00	99.80	0.00	2.04	0.00	0.00	25.68	0.00	21.94	0.00	0.00	0.77	6.96	0.00	0.00
A3	3	24-Apr	127.33	120.50	87.78	97.94	0.00	0.00	0.00	0.00	12.18	0.00	0.00	0.00	0.00	0.75	1.16	0.00	0.00
A3	4	24-Apr	25.70	39.77	0.00	85.46	0.00	20.09	0.00	0.00	11.00	0.00	6.12	0.00	0.00	0.74	1.37	0.00	0.00
A3	5	24-Apr	89.70	162.03	0.00	93.77	0.00	0.98	0.00	0.00	14.42	0.00	1.93	0.00	0.00	0.56	1.81	0.00	0.00
A6	1	28-Apr	25.06	1.60	0.00	58.00	0.00	0.00	0.00	0.00	0.42	0.00	38.47	0.00	0.00	0.00	0.00	0.00	0.00
A6	2	28-Apr	102.69	283.31	215.62	114.42	54.34	0.00	0.00	0.00	0.00	0.00	9.21	0.00	0.00	0.23	0.00	0.00	0.00
A6	3	28-Apr	63.65	44.01	0.00	77.80	0.00	0.00	0.00	0.00	0.00	0.00	2.76	0.00	0.00	0.10	0.00	0.00	0.00
A6	4	28-Apr	23.88	22.77	75.35	126.00	0.00	0.00	0.00	0.00	0.00	0.00	7.95	0.00	0.00	0.39	0.00	0.00	0.00
A6	5	28-Apr	50.65	181.88	0.00	80.64	0.00	0.00	0.00	0.00	3.00	0.00	3.03	0.00	0.00	0.00	0.00	0.00	0.00
B2	1	31-May	83.11	126.64	0	95.89	0	0.55	0	0.9	0.73	0.07	4.06	0	0.4	0	2.44	0	0
B2	2	31-May	15.35	12.55	308.2	103.79	0	17.7	3.75	6.88	0	0	0.07	0	0.02	1.07	0	0	0
B2	3	31-May	68.16	6.41	27.56	105.92	0	1.63	0	1.75	5.05	1.45	1.35	0	0.25	0.75	0	0	0
B2	4	31-May	43.06	39.37	0	99.76	0	19.5	13.52	1.51	0.65	0	15.1	0	0.8	1.56	12.23	0	0
B2	5	31-May	7.19	0	0	79.7	0	58.1	21.38	12.15	0	0	0	0	0	0.66	18.81	8.99	0

Unit	Plot	Date	1 hr	10 hr	100 hr	Litter leaves	Needles	Other woody 1hr	Other woody 10hr	Other woody leaves	Vac 1hr	Vac lvs	Gay bac 1hr	Gay bac 10hr	Gay bac leaves	Non-woody	1 hour	10hr	Non-woody
B5	1	31-May	22.1	83.78	28.13	67.87	0	2.23	0	0.31	0.85	0.47	19.49	0	4.55	0.04	39.12	99.52	0
B5	2	31-May	21.52	5.18	0.00	84.92	0	0.13	0	0.06	1.01	0.4	0.58	0	0.06	2.36	0	0.00	0.00
B5	3	31-May	17.47	18.61	0.00	88.09	0	2.2	0	1.83	2.57	0.17	2.91	0	0.48	5.89	0	0.00	0.00
B5	4	31-May	18.15	0.00	0.00	80.19	0	0.00	0	0	0.00	0.00	180.69	7.23	28.56	5.39	20.79	12.47	0
B5	5	31-May	25.88	50.18	0.00	92.87	0	0.40	0.00	0.47	0.15	0.00	0	0.00	0.00	3.08	3.67	0.00	0.00
B6	1	31-May	39.28	81.18	0	63.23	0	0.32	0	0.21	1.36	0.36	26.72	1.16	1.22	0.92	4.86	4.55	0
B6	2	31-May	82.19	151.61	29.04	80.92	0	2.07	0	0.05	0	0	2.21	0	0.28	0.58	0	0	0
B6	3	31-May	51.89	60.02	0	126.25	0	23.8	4.41	7.92	0.18	0.01	56.55	0	3.5	6.55	0	0.00	0
B6	4	31-May	72.86	134.14	0.00	104.34	0	0.00	239.10	0.00	0.33	0.00	8.55	0.00	0	2.17	0.00	0.00	0
B6	5	31-May	14.05	13.37	0	79.53	0	0.96	0	1.02	9.78	3.19	0	0	0	2.28	5.27	0	0
C3	1	19-May	44.5	234.16	19.82	92.15	0	0	0	0	0	0	0	0	0	0.04	0	0	0
C3	2	19-May	45.58	221.02	0	55.96	0	25.1	13.29	0	0	0	0	0	0	2.16	0.64	0	0
C3	3	19-May	78.35	30.35	0	62.61	0	10.5	0	2.11	0.21	0	62.82	0	0	0.94	1.41	0	0
C3	4	19-May	19.2	40.93	0	59.29	0	3.23	0	0	5.7	0	0	0	0	0.99	0	0	0
C3	5	19-May	36.75	102.39	0	96.77	0	13.8	12.08	1.95	0	0	0	0	0	0.5	0	0	0
C4	1	19-May	9.07	0	0	72.16	0	4.37	0	0	3.65	0	0	0	0	3.15	1.84	0	0
C4	2	19-May	22.68	60.39	0	80.49	0	28.8	22.2	15.92	0.09	0	0	0	0	2.55	0	0	0
C4	3	19-May	7.84	0	0	64.08	0	0	0	0	6.39	0	4.92	0	0	0	0	0	0
C4	4	19-May	25.12	2.26	0	76.02	0	0.55	0	0	0	0	0	0	0	0.14	0	0	0
C4	5	19-May	19.22	33.31	0	76.78	0	2.77	0	0	0	0	0	0	0	4.03	0	0	0
C5	1	19-May	28.49	133.93	0	86.99	0	0	0	0	4.29	0	0	0	0	3.66	0	0	0
C5	2	19-May	114.94	228.72	295.49	77.96	0	0.28	0	0	0.43	0	0	0	0	1.21	0	0	0
C5	3	19-May	67.72	1.82	0	91.41	0	0	0	0	0.76	0	0	0	0	3.93	0	0	0
C5	4	19-May	74.74	88.52	0	79.31	0	0	0	0	0	0	0	0	0	3	0	0	0
C5	5	19-May	23.69	46.03	0	67.51	0	1.69	0	0	1.75	0	0	0	0	1.93	0	0	0

Pre-Burn Fuel Loading (Brown's Lines)

Down-woody fuel lines. Measurements are in inches.

					Low shrub			No. of intersects above litter			No. of intersects within litter			Duff		3+ diameter (S=Sound, R=Rotten)						Fuel Depth			High Shrub		
Unit	Plot	Unit Aspect	Unit Slope	Line slope	10	20	30	1 hr	10 hr	100 hr	1 hr	10 hr	100 hr	1st	2nd	S	S	S	R	R	R	1st	2nd	3rd	10	20	30
A2	1	320	10%	2%	18	0	6	62.0	8.0	1.0	17.0	4.0	0.0	2.0	3.0							4.0	2.0	4.0	8.0	12.0	2
A2	2	320	10%	8%	8	12	2	61.0	11.0	0.0	17.0	8.0	0.0	3.0	4.0				6.0	4.0		3.0	2.0	5.0	0.0	0.0	0
A2	3	320	10%	9%	12	11	19	44.0	5.0	2.0	15.0	7.0	0.0	3.0	2.0							3.5	1.0	4.0	120.0	0.0	144
A2	4	320	10%	13%	12	14	13	39.0	9.0	0.0	22.0	5.0	1.0	2.5	3.5	4.0			5.0			4.0	5.0	2.0	0.0	144.0	0
A3	1	330	12%	7%	16.5	2	0	193.0	61.0	8.0	29.0	4.0	0.0	2.0	2.5	3.5						2.0	11.5	3.0	0.0	0.0	0
A3	2	330	12%	10%	17	10.5	0	100.0	30.0	6.0	25.0	6.0	0.0	2.0	1.5				6.0			2.5	8.4	3.0	0.0	24.3	0
A3	3	330	12%	10%	4	4	25	120.0	18.0	8.0	19.0	12.0	0.0	2.0	2.0				4.0			11.5	2.0	6.0	0.0	0.0	0
A3	4	330	12%	11%	3	0	0	204.0	62.0	3.0	7.0	1.0	0.0	2.0	1.5	5.0						12.0	3.0	8.5	0.0	0.0	68
A6	1	300	13%	4%	0	0	0	131.0	23.0	3.0	24.0	5.0	0.0	1.5	3.0				3.5	3.1		0.5	3.0	2.5	0.0	0.0	0
A6	2	300	13%	9%	18	6	0	156.0	26.0	6.0	24.0	7.0	2.0	2.0	2.0	5.0			6.0	4.0		3.5	6.0	3.0	0.0	43.0	0
A6	3	300	13%	11%	2	0	0	154.0	30.0	8.0	18.0	5.0	1.0	2.5	3.0	5.1			4.0			5.0	4.5	8.0	0.0	0.0	0
A6	4	300	13%	7%	0	0	0	123.0	40.0	7.0	14.0	5.0	1.0	5.0	1.5	3.9						9.5	1.5	1.5	0.0	0.0	0
B2	1	30	8%	4%	0	9.5	3.7	336	86	18	37	8	0	7	3							5	3.2	6.5	0	0	0
B2	2	30	8%	9%	0	6	0	164	64	4	15	6	0	4.2	3	3.5						3	6.4	3.1	0	41	0
B2	3	30	8%	3%	0	11	2	295	92	13	27	11	2	3.8	3.5				7			9.1	4	13	0	0	0
B2	4	30	8%	4%	9	4	0	273	49	12	9	5	1	3.5	4				5.5			3	2	9	0	0	0
B5	1	80	8%	7%	7	37	23	135	12	3	29	6	0	5.5	5.5				3.2			3	3	4.5	0	0	0
B5	2	80	8%	5%	9	0	16	125	6	0	16	2	1	5.3	3.5	3	4.1		3.5	5.5		6.5	2.5	2.5	0	60	0
B5	3	80	8%	5%	18	16	31	100	17	1	30	0	0	3.5	2							2.5	2.5	4	0	0	60
B5	4	80	8%	5%	12	21	4	78	15	0	14	0	0	6	4.5	3						6	8.5	3.5	80	0	80

Unit	Plot	Unit Aspect	Unit Slope	Line slope	10	20	30	1 hr	10 hr	100 hr	1 hr	10 hr	100 hr	1st	2nd	S	S	S	R	R	R	1st	2nd	3rd	10	20	30
B6	1	40	4%	8%	22	0	0	148	37	9	11	2	0	5	4	7	3.5	3	4			2	6	2	0	0	0
B6	2	40	4%	2%	2	9	10	199	32	12	15	3	1	4.5	3.5	3.2			3.5	4.5		2.5	7	6	0	0	0
B6	3	40	4%	4%	16	4	0	256	33	11	30	0	0	4.5	5.5	5			3.5	5		7	8.5	7.5	0	0	0
B6	4	40	4%	3%	0	24	27	301	34	14	0	0	0	6	4.5				4	3.5		7	9.5	6.5	0	0	0
C3	1	143	13%	14%	0	5.4	0	195	86	22	19	2	2	1.4	1	4	3.9					5.8	1.5	1	0	0	0
C3	2	143	13%	7%	17	0	0	127	35	5	13	4	0	1.4	2.1				9	3	4.6	2.1	1.9	1.6	0	0	0
C3	3	143	13%	4%	3	0	5	156	44	4	18	12	0	3.2	4.5	3			4.2			6.1	4	3	0	0	0
C3	4	143	13%	8%	10	6	4.2	63	22	3	16	6	1	1.6	2.2				3.7			1.5	3.9	2.8	0	0	0
C4	1	126	19%	17%	0	0	0	34	10	0	25	5	0	1.5	0							1.9	3	2.5	0	0	0
C4	2	126	19%	17%	0	13	0	26	5	0	16	9	0	3.3	2				3.7			2.7	2.2	1.9	0	0	0
C4	3	126	19%	3%	0	5	8	53	11	2	20	9	0	2.1	3				3.5	4.5		1.5	2	2.5	68	37	58
C4	4	126	19%	16%	4	10.2	0	33	8	4	20	11	0	1.8	1.9	5.8						4.3	3.5	2.8	0	0	0
C5	1	118	17%	17%	0	0	0	125	38	6	14	3	0	1.5	0.2	4.1	4.2					6	4	4	0	0	0
C5	2	118	17%	10%	0	0	0	154	63	7	31	13	1	2.9	1.6	3.5	3.6	3.4	3.2	3.6		8.9	7.3	1.5	0	0	0
C5	3	118	17%	8%	0	0	0	142	33	4	12	1	0	0.1	0.3				4.5			1	0.5	1.5	0	0	0
C5	4	118	17%	5%	0	0	5.4	130	31	10	21	10	0	0.1	0.4	4.5			6.5	3.5		0.7	1.2	2.3	0	0	0

Relevés: Cover by Species

Cover classes after thinning and burning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA, July 2001.
Data are sorted by decreasing constancy.
Cover classes:
1=0-1%, 2=1-5%, 3=5-25%. 4=25-50%, 5=50-100%, r=rare

Unit	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	Constancy	% constancy
Total spp	15	12	12	17	14	11	17	13	15	11	12	13	20	23	15	10	15	16		
GAUPRO	2	2	2	2	2	2	2	1	2	3	2	2	2	2	2	1	1	2	18	100%
GAYBAC	5	3	4	5	5	3	5	3	5	5	3	5	3	3	3	1	2	2	18	100%
CASDEN	2	2	2	3	3	2	2	2	2	3		2	3	2	2	2	2	3	17	94%
ACERUB	2	1	2	3	2		3	2	2			2	2	2	2	2	2	3	15	83%
AMESPP	2	1	1		2	2	2	1	1	3	1	3		r		r	2	1	15	83%
PTEAQU	2	2	4	5	4	3	2	2	3	3	1	4	4	3	2				15	83%
VACANG	2	1		3		2	3		2	2	2	2	2	3	1	1	2	2	15	83%
HAMVIR	1	1	1	2		2	1						2	2	1	1	2	2	12	67%
VACPAL	4	2	3		3	3	2		2		2	2	3				1	2	12	67%
CARPEN		1	1	1		2			1				r	2	1	r	3	2	11	61%
KALANG	2			2	2		3		3	3	2	3		1					9	50%
VIBCAS	2		r		2		1	1	2		1			r					8	44%
NEMMUC				2	2			3	2	2		2	2						7	39%
QUESPP	2		3		2	2	2				2	2							7	39%
QUEALB													1	r	2	1	2	2	6	33%
QUEILI				2				1	1	2	r								5	28%
UVUSES		r		r									1	2				r	5	28%
ARANUD					1						r		1			r			4	22%
BETPOP				2	1		1	1											4	22%
MEDVIR	1			r	1		1												4	22%

Unit	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	Constancy	% constancy
QUERUB													2		2		2	2	4	22%
RUBHIS								2						1	r		1		4	22%
SASALB				1			3			1		1							4	22%
VIBACE													1		r		r	r	4	22%
ACEPEN						2							2					2	3	17%
DIPDIG	1												2	1					3	17%
PINSTR				r									r	r					3	17%
PRUSER														r	r			1	3	17%
QUEVEL		1						2	2										3	17%
TRIBOR													r	1			r		3	17%
BETLEN															1		r		2	11%
KALLAT							1				2								2	11%
LYCOBS	1													1					2	11%
MAICAN													1					r	2	11%
QUECOC				3				2											2	11%
VACCOR							1		1										2	11%
ASTSPP			1																1	6%
BETALL															r				1	6%
CHIMAC														r					1	6%
DENPUN														2					1	6%
Grass 1														r					1	6%
MITREP														2					1	6%
NYSSYL												1							1	6%
UNKNOWN										4									1	6%

<u>Relevés: Browsed Species</u>

Browsing after thinning and burning treatments in three blocks at Cadwell Memorial Forest, Pelham, MA, July 2001

Data are grouped into species with more than 25% and less than 25% constancy, then sorted by browse percentage (relative browse frequency).

Unit	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	Constancy	% constancy	Browse	No-browse	Browse pct
QUERUB													n		y		y	y	4	22%	3	1	75.0%
QUESPP	n		y		y	y	y				n	y							7	39%	5	2	71.4%
CASDEN	n	n	y	y	y	y	n	y	y	n		y	n	n	y	n	y	y	17	94%	10	7	58.8%
QUEALB													n	y	y	n	y	n	6	33%	3	3	50.0%
BETPOP				y	n		n	y											4	22%	2	2	50.0%
SASALB				n			y			n		y							4	22%	2	2	50.0%
HAMVIR	n	n	n	n		y	y						n	y	y	n	y	n	12	67%	5	7	41.7%
QUEILI				y				y	n	n	n								5	28%	2	3	40.0%
ACERUB	n	n	n	n	n		y	y	n			n	n	n	y	n	y	y	15	83%	5	10	33.3%
PTEAQU	n	y	n	n	n	y	n	y	n	n	n	y	n	y	n				15	83%	5	10	33.3%
VIBACE													n		n		n	y	4	22%	1	3	25.0%
AMESPP	n	n	n		n	n	y	n	y	n	n	n		n		n	n	y	15	83%	3	12	20.0%
VIBCAS	n		n		n		n	n	y		n			n					8	44%	1	7	12.5%
VACPAL	n	n	n		n	y	n		n		n	n	n				n	n	12	67%	1	11	8.3%
GAUPRO	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	18	100%	0	18	0.0%
GAYBAC	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	18	100%	0	18	0.0%
VACANG	n	n		n		n	n		n	n	n	n	n	n	n	n	n	n	15	83%	0	15	0.0%
CARPEN		n	n	n		n			n				n	n	n	n	n	n	11	61%	0	11	0.0%
KALANG	n			n	n		n		n	n	n	n		n					9	50%	0	9	0.0%
NEMMUC				n	n			n	n	n		n	n						7	39%	0	7	0.0%
UVUSES		n		n									n	n				n	5	28%	0	5	0.0%

Unit	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	Constancy	% constancy	Browse	No-browse	Browse pct
ASTSPP			y																1	6%	1	0	100.0%
BETALL															y				1	6%	1	0	100.0%
QUEVEL		n						y	y										3	17%	2	1	66.7%
BETLEN															y		n		2	11%	1	1	50.0%
QUECOC				y				n											2	11%	1	1	50.0%
ACEPEN						y							n					n	3	17%	1	2	33.3%
PRUSER														y	n			n	3	17%	1	2	33.3%
ARANUD					n						n		n			n			4	22%	0	4	0.0%
MEDVIR	n			n	n		n												4	22%	0	4	0.0%
RUBHIS								n						n	n		n		4	22%	0	4	0.0%
DIPDIG	n												n	n					3	17%	0	3	0.0%
PINSTR				n									n	n					3	17%	0	3	0.0%
TRIBOR													n	n			n		3	17%	0	3	0.0%
KALLAT							n				n								2	11%	0	2	0.0%
LYCOBS	n													n					2	11%	0	2	0.0%
MAICAN													n					n	2	11%	0	2	0.0%
VACCOR							n		n										2	11%	0	2	0.0%
CHIMAC														n					1	6%	0	1	0.0%
DENPUN														n					1	6%	0	1	0.0%
Grass 1														n					1	6%	0	1	0.0%
MITREP														n					1	6%	0	1	0.0%
NYSSYL												n							1	6%	0	1	0.0%
UNKNOWN										n									1	6%	0	1	0.0%

Light Measurements

Measurements with LAI-2000, July 2001, Cadwell Memorial Forest, Pelham, MA

DATE	TIME	BLOCK	UNIT	Unit	LAIait	SEL	DIFN	MTA	SEM	SMP
24-Jul	10:26:02	A	1	A1	2.87	0.09	0.082	40	1	21
24-Jul	10:14:53	A	2	A2	2.42	0.11	0.123	41	2	21
24-Jul	10:03:38	A	3	A3	1.24	0.16	0.337	42	3	21
24-Jul	09:49:29	A	4	A4	0.61	0.15	0.594	50	7	21
24-Jul	10:45:44	A	5	A5	1.17	0.14	0.365	41	2	21
24-Jul	10:34:58	A	6	A6	0.63	0.06	0.59	0	24	21
24-Jul	11:56:35	B	1	B1	0.51	0.09	0.644	0	26	21
24-Jul	11:02:47	B	2	B2	0.89	0.14	0.475	50	4	21
24-Jul	11:10:18	B	3	B3	1.37	0.08	0.308	48	7	21
24-Jul	11:23:37	B	4	B4	2.97	0.15	0.075	39	2	21
24-Jul	11:33:25	B	5	B5	2.07	0.13	0.177	53	7	21
24-Jul	11:42:40	B	6	B6	0.26	0.07	0.799	0	32	21
25-Jul	15:10:16	C	1	C1	3.74	0.11	0.041	42	2	21
25-Jul	15:18:32	C	2	C2	1.36	0.07	0.341	64	8	21
25-Jul	15:30:06	C	3	C3	1.7	0.06	0.243	42	3	21
25-Jul	15:40:13	C	4	C4	3.56	0.1	0.048	44	4	21
25-Jul	15:47:12	C	5	C5	1.15	0.1	0.414	63	7	21
25-Jul	15:56:09	C	6	C6	1.08	0.15	0.41	59	6	21

Measurements with LAI-2000, June 2002, Cadwell Memorial Forest, Pelham, MA

DATE	TIME	BLOCK	UNIT	Unit	LAIait	SEL	DIFN	MTA	SEM	SMP
14-Jun	12:47:36	A	1	A1	2.82	0.11	0.088	41	1	21
14-Jun	12:41:46	A	2	A2	2.68	0.09	0.101	40	1	21
14-Jun	12:19:57	A	3	A3	1.79	0.16	0.218	46	6	21
14-Jun	12:12:33	A	4	A4	1	0.09	0.427	42	7	21
14-Jun	12:26:37	A	5	A5	1.57	0.16	0.269	42	1	21
14-Jun	12:36:28	A	6	A6	0.98	0.08	0.437	0	34	21
14-Jun	11:32:09	B	1	B1	0.83	0.11	0.495	40	3	21
14-Jun	10:24:25	B	2	B2	1.84	0.2	0.209	43	3	21
14-Jun	10:43:33	B	3	B3	1.75	0.08	0.225	47	6	21
14-Jun	10:57:14	B	4	B4	3	0.1	0.077	41	1	21
14-Jun	11:12:15	B	5	B5	2.62	0.18	0.109	43	2	21
14-Jun	11:24:19	B	6	B6	0.28	0.04	0.814	49	20	21
18-Jun	12:05:07	C	1	C1	3.91	0.09	0.035	39	1	21
18-Jun	11:49:09	C	2	C2	1.43	0.04	0.319	59	6	21
18-Jun	11:30:21	C	3	C3	1.82	0.14	0.226	49	5	21
18-Jun	11:13:15	C	4	C4	2.97	0.05	0.078	43	4	21
18-Jun	11:01:36	C	5	C5	1.55	0.12	0.295	61	5	21
18-Jun	10:47:42	C	6	C6	1.53	0.19	0.295	61	5	21

Measurements with LAI-2000, September 2002, Perkins Farm, Worcester, MA

DATE	TIME	Block	Point	LAIait	SEL	DIFN	MTA	SEM	SMP
4-Sep	11:54:42	PKNS FA	131	4.04	0.03	0.043	52	6	3
4-Sep	12:05:44	PKNS FA	132	3.39	0.14	0.071	49	4	3
4-Sep	12:17:56	PKNS FA	133	3.75	0.1	0.089	67	6	3
4-Sep	12:26:03	PKNS FA	134	3.42	0.04	0.085	61	4	3
4-Sep	12:32:37	PKNS FA	135	3.99	0.04	0.043	49	2	3
4-Sep	12:38:56	PKNS FA	136	4.24	0.07	0.048	60	5	3
4-Sep	12:46:00	PKNS FA	137	3.97	0.07	0.052	51	4	3
4-Sep	12:54:35	PKNS FA	138	4.41	0.06	0.029	47	3	3
4-Sep	12:59:34	PKNS FA	139	3.7	0.02	0.07	56	4	3
4-Sep	13:07:34	PKNS FA	140	3.52	0.04	0.091	62	3	3

Canopy Cover Measurements

Canopy cover by spherical densiometer, Cadwell Forest, Pelham, MA, 8-20-2002

Unit	Quadrant/Plot center	N	E	S	W	Canopy cover
		Canopy cover in indicated direction				
A1	SW	69%	71%	72%	66%	70%
A1	NW	66%	61%	64%	79%	68%
A1	NE	57%	52%	62%	64%	59%
A1	SE	68%	71%	69%	72%	70%
A1	Center	50%	72%	69%	71%	66%
A2	SW	52%	49%	48%	47%	49%
A2	NW	63%	49%	46%	66%	56%
A2	NE	60%	55%	54%	48%	54%
A2	SE	64%	66%	66%	68%	66%
A2	Center	72%	71%	66%	67%	69%
A3	SW	48%	49%	31%	42%	43%
A3	NW	33%	34%	34%	29%	33%
A3	NE	35%	34%	38%	37%	36%
A3	SE	32%	31%	52%	50%	41%
A3	Center	43%	64%	45%	62%	54%
A4	SW	0%	48%	45%	21%	29%
A4	NW	24%	24%	49%	61%	40%
A4	NE	34%	21%	25%	38%	30%
A4	SE	25%	46%	29%	42%	36%
A4	Center	1%	30%	24%	34%	22%
A5	SW	36%	46%	54%	38%	44%
A5	NW	42%	53%	39%	51%	46%
A5	NE	29%	40%	44%	41%	39%
A5	SE	5%	53%	50%	54%	41%
A5	Center	28%	48%	43%	43%	41%
A6	SW	11%	39%	48%	36%	34%
A6	NW	34%	31%	21%	51%	34%
A6	NE	35%	29%	40%	23%	32%
A6	SE	32%	40%	48%	41%	40%
A6	Center	32%	53%	40%	36%	40%
B1	SW	47%	55%	53%	30%	46%
B1	NW	50%	17%	49%	34%	38%
B1	NE	41%	33%	13%	31%	30%
B1	SE	18%	33%	37%	24%	28%
B1	Center	30%	44%	42%	18%	34%
B2	SW	31%	34%	10%	39%	29%
B2	NW	43%	56%	51%	58%	52%
B2	NE	44%	61%	60%	57%	56%
B2	SE	56%	58%	56%	74%	61%
B2	Center	59%	43%	65%	63%	58%
B3	SW	69%	68%	53%	69%	65%
B3	NW	62%	54%	67%	75%	65%
B3	NE	60%	67%	59%	62%	62%
B3	SE	52%	56%	52%	53%	53%
B3	Center	59%	50%	49%	50%	52%

Unit	Quadrant/Plot center	N	E	S	W	Canopy cover
B4	SW	59%	58%	63%	58%	60%
B4	NW	70%	72%	72%	70%	71%
B4	NE	66%	69%	72%	50%	64%
B4	SE	66%	78%	59%	74%	69%
B4	Center	63%	72%	74%	72%	70%
B5	SW	60%	72%	74%	72%	70%
B5	NW	73%	72%	66%	72%	71%
B5	NE	72%	70%	72%	59%	68%
B5	SE	64%	70%	58%	70%	66%
B5	Center	68%	60%	57%	65%	63%
B6	SW	18%	1%	60%	13%	23%
B6	NW	35%	15%	28%	41%	30%
B6	NE	38%	27%	9%	15%	22%
B6	SE	0%	38%	29%	23%	23%
B6	Center	10%	17%	6%	17%	13%
C1	SW	72%	72%	72%	73%	72%
C1	NW	73%	72%	71%	72%	72%
C1	NE	72%	72%	71%	72%	72%
C1	SE	72%	69%	71%	73%	71%
C1	Center	73%	72%	66%	71%	71%
C2	SW	40%	52%	54%	57%	51%
C2	NW	36%	48%	39%	50%	43%
C2	NE	42%	51%	41%	47%	45%
C2	SE	37%	53%	47%	36%	43%
C2	Center	53%	48%	50%	51%	51%
C3	SW	62%	57%	50%	70%	60%
C3	NW	55%	38%	44%	61%	50%
C3	NE	57%	47%	46%	50%	50%
C3	SE	49%	48%	66%	50%	53%
C3	Center	41%	54%	44%	64%	51%
C4	SW	74%	65%	71%	70%	70%
C4	NW	70%	69%	72%	73%	71%
C4	NE	72%	72%	72%	73%	72%
C4	SE	71%	53%	68%	76%	67%
C4	Center	71%	72%	72%	72%	72%
C5	SW	41%	41%	39%	57%	45%
C5	NW	36%	43%	53%	51%	46%
C5	NE	68%	41%	32%	57%	50%
C5	SE	52%	56%	50%	45%	51%
C5	Center	54%	50%	33%	55%	48%
C6	SW	64%	10%	67%	54%	49%
C6	NW	58%	39%	41%	46%	46%
C6	NE	68%	45%	38%	22%	43%
C6	SE	28%	47%	39%	52%	42%
C6	Center	63%	39%	41%	54%	49%

Canopy cover by spherical densiometer, Perkins Farm, Worcester, MA 9-4-2002

Note: readings were taken of the canopy opening, and converted to cover

		Canopy **opening** from spherical densiometer				Canopy cover
GPS Point	Photo	N	E	S	W	
130	21	Clearing along RR tracks				
131	22	13%	6%	7%	38%	84%
132	23, 24	34%	12%	14%	12%	82%
133	25	20%	66%	19%	20%	69%
134	26	18%	16%	19%	20%	82%
135	27	12%	28%	25%	17%	80%
136	28	13%	16%	23%	15%	83%
137	29	14%	14%	16%	8%	87%
138	30, 31	13%	20%	34%	12%	80%
139	32, 33	18%	20%	34%	12%	79%
140	34, 35	22%	12%	14%	11%	85%

Horizontal Foliar Density

Percent of target obscured. N/A indicates that target was obscured by something other than vegetation.									
		AT 35 METERS				AT 15 METERS			
unit	corner	0.5-m	1-m	1.5-m	2-m	0.5-m	1-m	1.5-m	2-m
A1	SW	100	100	30	80	100	50	0	20
A1	NW	100	70	70	50	100	40	30	20
A1	NE	100	80	70	50	100	90	30	0
A1	SE	100	20	30	10	100	30	10	10
A2	SW	100	30	10	10	40	20	0	0
A2	NW	100	10	20	70	60	10	10	20
A2	NE	100	60	10	0	90	0	0	0
A2	SE	100	60	40	60	100	10	10	50
A3	SW	100	100	90	20	100	40	70	20
A3	NW	100	90	100	50	100	80	6	0
A3	NE	100	90	60	80	100	90	50	20
A3	SE	100	100	70	20	100	90	60	0
A4	SW	100	100	50	0	40	40	30	0
A4	NW	100	80	0	0	100	50	0	0
A4	NE	100	100	60	20	100	90	50	20
A4	SE	100	90	40	0	80	20	0	0
A5	SW	100	70	60	70	100	30	0	0
A5	NW	100	100	90	90	100	80	70	60
A5	NE	100	100	90	50	100	50	30	10
A5	SE	100	100	90	70	100	70	40	30
A6	SW	100	50	10	0	100	50	10	0
A6	NW	100	100	10	0	100	60	0	0
A6	NE	100	90	50	0	100	60	50	0
A6	SE	100	40	0	0	100	60	0	0
B1	SW	100	100	80	10	100	80	80	20
B1	NW	100	100	80	0	100	30	40	0
B1	NE	100	100	30	0	100	80	30	0
B1	SE	100	10	0	0	100	50	0	0
B2	SW	100	90	30	0	100	70	0	0
B2	NW	100	50	5	0	90	10	0	0
B2	NE	100	30	0	0	100	30	0	0
B2	SE	100	70	70	0	100	5	0	0
B3	SW	100	100	40	0	100	30	20	0
B3	NW	100	100	90	10	100	90	40	10
B3	NE	100	50	30	10	100	90	60	0
B3	SE	100	80	90	50	100	20	10	0

unit	corner	0.5-m	1-m	1.5-m	2-m	0.5-m	1-m	1.5-m	2-m
B4	SW	100	80	70	60	100	10	10	30
B4	NW	100	90	80	60	100	50	20	10
B4	NE	100	90	80	90	100	70	10	20
B4	SE	100	90	100	50	100	90	40	10
B5	SW	100	90	80	90	100	80	50	60
B5	NW	100	20	40	100	80	0	0	10
B5	NE	100	90	70	10	100	30	50	10
B5	SE	100	100	100	90	80	10	0	40
B6	SW	100	70	0	0	100	50	10	0
B6	NW	100	100	60	0	50	20	0	0
B6	NE	100	100	30	0	100	80	0	0
B6	SE	100	10	0	0	100	0	0	0
C1	SW	100	70	80	60	100	40	20	20
C1	NW	100	90	50	60	90	50	40	20
C1	NE	#N/A	70	80	70	100	40	60	70
C1	SE	#N/A	90	100	40	100	70	30	80
C2	SW	100	50	0	0	90	40	0	0
C2	NW	100	100	90	60	100	80	60	20
C2	NE	100	80	50	30	100	80	20	30
C2	SE	100	90	20	0	100	70	20	0
C3	SW	100	80	0	0	100	40	0	0
C3	NW	100	20	20	0	100	20	20	10
C3	NE	#N/A	#N/A	90	0	70	10	0	0
C3	SE	100	20	0	0	80	10	0	0
C4	SW	10	0	0	0	0	0	0	0
C4	NW	20	10	10	20	20	10	10	20
C4	NE	#N/A	10	10	10	10	0	0	0
C4	SE	0	20	0	0	0	20	0	0
C5	SW	50	20	0	0	100	50	0	0
C5	NW	100	100	10	0	100	90	10	0
C5	NE	100	100	10	0	100	100	20	0
C5	SE	100	60	0	0	100	90	10	0
C6	SW	100	100	100	60	100	80	40	0
C6	NW	100	100	100	60	100	60	20	0
C6	NE	100	100	100	60	100	80	50	70
C6	SE	100	100	90	50	100	90	70	30

Vaccinium Flower and Stem Density

Stems and flowers of *Vaccinium angustifolium* and *V. pallidum*
Each quadrat is 1-m x 0.2-m

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
A1	1	1	8	0	
A1	1	2	5	0	
A1	1	3	0	0	
A1	1	4	3	1	3
A1	1	5	2	0	
A1	1	6	3	0	
A1	1	7	7	0	
A1	1	8	2	0	
A1	1	9	12	0	
A1	2	1	2	0	
A1	2	2	4	0	
A1	2	3	4	0	
A1	2	4	3	0	
A1	2	5	7	0	
A1	2	6	5	0	
A1	2	7	14	0	
A1	2	8	7	0	
A1	2	9	7	0	
A1	3	1	5	0	
A1	3	2	16	0	
A1	3	3	10	0	
A1	3	4	13	0	
A1	3	5	13	0	
A1	3	6	6	0	
A1	3	7	8	0	
A1	3	8	14	0	
A1	3	9	5	0	
A1	4	1	13	0	
A1	4	2	7	0	
A1	4	3	4	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
A1	4	4	7	0	
A1	4	5	3	0	
A1	4	6	2	0	
A1	4	7	8	0	
A1	4	8	4	0	
A1	4	9	7	0	
A1	5	1	18	0	
A1	5	2	5	0	
A1	5	3	5	0	
A1	5	4	4	0	
A1	5	5	6	0	
A1	5	6	6	0	
A1	5	7	2	0	
A1	5	8	1	0	
A1	5	9	4	0	
A2	1	1	15	2	23 14
A2	1	2	0	0	
A2	1	3	1	0	
A2	1	4	4	0	
A2	1	5	9	0	
A2	1	6	1	0	
A2	1	7	2	0	
A2	1	8	1	0	
A2	1	9	8	0	
A2	2	1	0	0	
A2	2	2	0	0	
A2	2	3	13	0	
A2	2	4	2	0	
A2	2	5	5	0	
A2	2	6	0	0	
A2	2	7	5	0	
A2	2	8	12	0	
A2	2	9	9	0	
A2	3	1	11	1	4
A2	3	2	17	0	
A2	3	3	8	0	
A2	3	4	3	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
A2	3	5	4	0	
A2	3	6	16	0	
A2	3	7	1	0	
A2	3	8	5	0	
A2	3	9	2	0	
A2	4	1	17	0	
A2	4	2	14	1	9
A2	4	3	1	0	
A2	4	4	2	0	
A2	4	5	3	0	
A2	4	6	3	0	
A2	4	7	0	0	
A2	4	8	2	0	
A2	4	9	2	0	
A2	5	1	2	0	
A2	5	2	15	0	
A2	5	3	8	0	
A2	5	4	14	0	
A2	5	5	15	0	
A2	5	6	8	0	
A2	5	7	16	0	
A2	5	8	0	0	
A2	5	9	0	0	
A3	1	1	1	1	1
A3	1	2	12	1	15
A3	1	3	3	0	
A3	1	4	2	1	7
A3	1	5	16	4	7 7 17 28
A3	1	6	15	3	21 18 6
A3	1	7	6	0	
A3	1	8	0	0	
A3	1	9	1	0	
A3	2	1	5	1	6
A3	2	2	3	1	2
A3	2	3	4	1	6
A3	2	4	4	2	2 3
A3	2	5	15	1	1

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem																					
A3	2	6	26	11	17	12	3	8	26	10	80	27	34	20	7											
A3	2	7	10	6	2	5	13	13	8	6																
A3	2	8	9	1	6																					
A3	2	9	4	1	6																					
A3	3	1	2	0																						
A3	3	2	14	3	4	5	6																			
A3	3	3	11	0																						
A3	3	4	14	1	6																					
A3	3	5	4	0																						
A3	3	6	3	1	17																					
A3	3	7	4	3	9	15	16																			
A3	3	8	2	0																						
A3	3	9	6	0																						
A3	4	1	1	0																						
A3	4	2	24	9	15	10	30	35	17	22	11	116	23													
A3	4	3	0	0																						
A3	4	4	20	10	24	14	23	8	12	12	7	34	6	6												
A3	4	5	30	13	5	10	6	5	7	15	8	16	16	6	4	12	5									
A3	4	6	1	0																						
A3	4	7	9	4	5	13	6	8																		
A3	4	8	40	2	5	5																				
A3	4	9	9	1	5																					
A3	5	1	12	3	24	32	17																			
A3	5	2	40	22	13	15	38	10	8	5	36	6	29	30	15	13	24	7	8	20	18	3	41	9	27	18
A3	5	3	22	11	8	4	6	5	4	6	7	9	6	16	9											
A3	5	4	6	2	9	18																				
A3	5	5	6	1	1																					
A3	5	6	7	4	6	8	16	5																		
A3	5	7	0	0																						
A3	5	8	0	0																						
A3	5	9	0	0																						
A4	1	1	6	0																						
A4	1	2	3	0																						
A4	1	3	10	7	35	53	44	12	83	192	41															
A4	1	4	15	2	8	72																				
A4	1	5	5	0																						
A4	1	6	7	0																						

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
A4	1	7	2	0	
A4	1	8	3	0	
A4	1	9	1	0	
A4	2	1	5	1	2
A4	2	2	2	0	
A4	2	3	8	0	
A4	2	4	10	0	
A4	2	5	5	0	
A4	2	6	2	1	9
A4	2	7	5	1	12
A4	2	8	0	0	
A4	2	9	0	0	
A4	3	1	3	0	
A4	3	2	10	0	
A4	3	3	1	0	
A4	3	4	12	5	7 53 44 7 104
A4	3	5	6	0	
A4	3	6	4	1	7
A4	3	7	6	0	
A4	3	8	10	0	
A4	3	9	8	0	
A4	4	1	7	0	
A4	4	2	6	1	29
A4	4	3	7	4	5 7 13 20
A4	4	4	13	0	
A4	4	5	9	0	
A4	4	6	0	0	
A4	4	7	6	1	17
A4	4	8	0	0	
A4	4	9	1	0	
A4	5	1	0	0	
A4	5	2	2	0	
A4	5	3	1	1	6
A4	5	4	0	0	
A4	5	5	1	0	
A4	5	6	9	1	8
A4	5	7	20	1	19

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
A4	5	8	10	0	
A4	5	9	12	0	
A5	1	1	2	0	
A5	1	2	0	0	
A5	1	3	1	0	
A5	1	4	3	0	
A5	1	5	2	0	
A5	1	6	4	1	3
A5	1	7	1	0	
A5	1	8	5	1	4
A5	1	9	5	0	
A5	2	1	0	0	
A5	2	2	0	0	
A5	2	3	4	0	
A5	2	4	0	0	
A5	2	5	1	0	
A5	2	6	0	0	
A5	2	7	0	0	
A5	2	8	10	0	
A5	2	9	4	3	36 7 12
A5	3	1	1	0	
A5	3	2	7	2	2 7
A5	3	3	1	0	
A5	3	4	5	0	
A5	3	5	6	0	
A5	3	6	3	0	
A5	3	7	1	0	
A5	3	8	1	0	
A5	3	9	7	0	
A5	4	1	0	0	
A5	4	2	1	0	
A5	4	3	0	0	
A5	4	4	0	0	
A5	4	5	3	0	
A5	4	6	1	0	
A5	4	7	3	0	
A5	4	8	5	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
A5	4	9	1	0	
A5	5	1	8	0	
A5	5	2	11	0	
A5	5	3	11	0	
A5	5	4	4	0	
A5	5	5	10	0	
A5	5	6	11	0	
A5	5	7	4	0	
A5	5	8	0	0	
A5	5	9	6	0	
A6	1	1	10	1	14
A6	1	2	21	9	6 14 6 6 6 5 7 4 12
A6	1	3	15	4	8 4 4 5
A6	1	4	26	6	12 6 7 4 10 15
A6	1	5	12	3	7 6 11
A6	1	6	2	0	
A6	1	7	0	0	
A6	1	8	0	0	
A6	1	9	2	0	
A6	2	1	8	1	5
A6	2	2	2	0	
A6	2	3	4	0	
A6	2	4	2	2	7 2
A6	2	5	6	3	8 16 23
A6	2	6	3	3	4 4 2
A6	2	7	33	21	2 18 18 6 3 18 6 9 6 4 5 5 12 22 26 9 18 8 41 17 12
A6	2	8	15	4	6 3 25 21
A6	2	9	16	2	9 6
A6	3	1	6	1	7
A6	3	2	0	0	
A6	3	3	4	0	
A6	3	4	18	8	7 5 15 16 8 7 4 3
A6	3	5	3	1	6
A6	3	6	5	4	4 24 12 11
A6	3	7	2	0	
A6	3	8	16	13	6 16 15 4 43 7 12 9 9 10 16 19 12
A6	3	9	9	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
A6	4	1	2	1	54
A6	4	2	2	0	
A6	4	3	19	2	4 4
A6	4	4	7	5	14 14 6 6 5
A6	4	5	5	4	22 7 6 43
A6	4	6	4	1	7
A6	4	7	2	2	17 12
A6	4	8	1	1	28
A6	4	9	6	1	19
A6	5	1	5	0	
A6	5	2	0	0	
A6	5	3	2	2	6 7
A6	5	4	7	3	17 20 8
A6	5	5	0	0	
A6	5	6	2	1	12
A6	5	7	13	6	4 3 6 5 5 6
A6	5	8	5	0	
A6	5	9	7	0	
B1	1	1	3	0	
B1	1	2	8	0	
B1	1	3	7	0	
B1	1	4	3	2	25 8
B1	1	5	6	3	74 54 7
B1	1	6	2	0	
B1	1	7	2	0	
B1	1	8	9	0	
B1	1	9	5	0	
B1	2	1	12	1	16
B1	2	2	1	0	
B1	2	3	7	0	
B1	2	4	1	1	6
B1	2	5	0	0	
B1	2	6	9	1	8
B1	2	7	7	0	
B1	2	8	9	0	
B1	2	9	4	1	4
B1	3	1	0	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
B1	3	2	0	0	
B1	3	3	0	0	
B1	3	4	10	1	9
B1	3	5	7	0	
B1	3	6	30	1	7
B1	3	7	0	0	
B1	3	8	12	0	
B1	3	9	1	0	
B1	4	1	6	0	
B1	4	2	12	1	7
B1	4	3	2	1	2
B1	4	4	29	3	21 5 6
B1	4	5	4	0	
B1	4	6	11	0	
B1	4	7	4	0	
B1	4	8	0	0	
B1	4	9	4	0	
B1	5	1	8	0	
B1	5	2	1	1	11
B1	5	3	3	1	6
B1	5	4	15	1	13
B1	5	5	7	2	6 4
B1	5	6	8	0	
B1	5	7	5	0	
B1	5	8	2	0	
B1	5	9	4	0	
B2	1	1	1	0	
B2	1	2	8	0	
B2	1	3	1	0	
B2	1	4	7	0	
B2	1	5	0	0	
B2	1	6	2	1	6
B2	1	7	2	2	7 21
B2	1	8	0	0	
B2	1	9	6	0	
B2	2	1	4	0	
B2	2	2	6	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
B2	2	3	3	0	
B2	2	4	5	0	
B2	2	5	2	0	
B2	2	6	0	0	
B2	2	7	3	1	15
B2	2	8	7	0	
B2	2	9	5	0	
B2	3	1	23	0	
B2	3	2	9	1	7
B2	3	3	2	0	
B2	3	4	0	0	
B2	3	5	0	0	
B2	3	6	0	0	
B2	3	7	6	0	
B2	3	8	1	0	
B2	3	9	4	0	
B2	4	1	11	1	4
B2	4	2	1	0	
B2	4	3	4	0	
B2	4	4	5	0	
B2	4	5	0	0	
B2	4	6	4	0	
B2	4	7	2	0	
B2	4	8	1	0	
B2	4	9	0	0	
B2	5	1	0	0	
B2	5	2	1	0	
B2	5	3	1	0	
B2	5	4	0	0	
B2	5	5	4	0	
B2	5	6	5	0	
B2	5	7	0	0	
B2	5	8	5	0	
B2	5	9	27	0	
B3	1	1	0	0	
B3	1	2	2	0	
B3	1	3	13	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
B3	1	4	5	0	
B3	1	5	8	0	
B3	1	6	2	0	
B3	1	7	7	0	
B3	1	8	7	0	
B3	1	9	3	0	
B3	2	1	4	0	
B3	2	2	6	0	
B3	2	3	5	0	
B3	2	4	2	0	
B3	2	5	0	0	
B3	2	6	9	1	1
B3	2	7	13	0	
B3	2	8	2	0	
B3	2	9	2	0	
B3	3	1	2	1	29
B3	3	2	12	9	47 10 12 26 107 5 7 23 5
B3	3	3	3	0	
B3	3	4	3	1	18
B3	3	5	6	0	
B3	3	6	0	0	
B3	3	7	2	1	3
B3	3	8	7	1	6
B3	3	9	1	0	
B3	4	1	8	1	7
B3	4	2	12	9	145 107 67 4 90 22 5 58 32
B3	4	3	8	0	
B3	4	4	3	0	
B3	4	5	5	1	9
B3	4	6	1	0	
B3	4	7	9	1	5
B3	4	8	0	0	
B3	4	9	11	2	7 81
B3	5	1	4	0	
B3	5	2	8	1	12
B3	5	3	1	0	
B3	5	4	1	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
B3	5	5	4	2	5 15
B3	5	6	4	0	
B3	5	7	2	0	
B3	5	8	21	1	2
B3	5	9	14	0	
B4	1	1	0	0	
B4	1	2	7	0	
B4	1	3	3	0	
B4	1	4	4	0	
B4	1	5	5	0	
B4	1	6	10	0	
B4	1	7	10	0	
B4	1	8	1	0	
B4	1	9	5	0	
B4	2	1	0	0	
B4	2	2	12	0	
B4	2	3	16	0	
B4	2	4	6	0	
B4	2	5	6	0	
B4	2	6	4	0	
B4	2	7	2	0	
B4	2	8	7	0	
B4	2	9	14	0	
B4	3	1	8	0	
B4	3	2	0	0	
B4	3	3	4	0	
B4	3	4	1	0	
B4	3	5	0	0	
B4	3	6	0	0	
B4	3	7	4	0	
B4	3	8	2	0	
B4	3	9	3	0	
B4	4	1	6	0	
B4	4	2	5	0	
B4	4	3	0	0	
B4	4	4	0	0	
B4	4	5	0	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
B4	4	6	4	0	
B4	4	7	0	0	
B4	4	8	1	0	
B4	4	9	0	0	
B4	5	1	0	0	
B4	5	2	4	0	
B4	5	3	0	0	
B4	5	4	5	0	
B4	5	5	11	0	
B4	5	6	10	0	
B4	5	7	10	0	
B4	5	8	11	0	
B4	5	9	4	0	
B5	1	1	12	0	
B5	1	2	20	0	
B5	1	3	9	0	
B5	1	4	1	0	
B5	1	5	0	0	
B5	1	6	0	0	
B5	1	7	4	0	
B5	1	8	1	0	
B5	1	9	6	0	
B5	2	1	2	0	
B5	2	2	6	0	
B5	2	3	11	0	
B5	2	4	4	0	
B5	2	5	2	0	
B5	2	6	8	0	
B5	2	7	8	0	
B5	2	8	5	0	
B5	2	9	3	0	
B5	3	1	8	0	
B5	3	2	3	0	
B5	3	3	5	0	
B5	3	4	10	0	
B5	3	5	7	0	
B5	3	6	5	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
B5	3	7	1	0	
B5	3	8	14	0	
B5	3	9	3	0	
B5	4	1	6	0	
B5	4	2	2	0	
B5	4	3	5	0	
B5	4	4	1	0	
B5	4	5	8	0	
B5	4	6	1	0	
B5	4	7	5	0	
B5	4	8	1	0	
B5	4	9	7	0	
B5	5	1	6	0	
B5	5	2	13	0	
B5	5	3	7	0	
B5	5	4	11	0	
B5	5	5	8	0	
B5	5	6	6	0	
B5	5	7	0	0	
B5	5	8	7	0	
B5	5	9	4	0	
B6	1	1	0	0	
B6	1	2	7	4	15 35 11 6
B6	1	3	5	1	6
B6	1	4	17	6	7 26 14 17 8 13
B6	1	5	7	1	2
B6	1	6	0	0	
B6	1	7	2	0	
B6	1	8	3	0	
B6	1	9	3	0	
B6	2	1	20	8	9 19 6 13 8 19 16 6
B6	2	2	4	1	28
B6	2	3	8	2	7 25
B6	2	4	7	3	7 34 47
B6	2	5	15	5	5 5 13 17 4
B6	2	6	4	3	8 6 7
B6	2	7	17	5	18 14 4 12 4

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
B6	2	8	2	0	
B6	2	9	3	0	
B6	3	1	14	7	7 7 6 8 6 15 18
B6	3	2	0	0	
B6	3	3	5	0	
B6	3	4	10	6	72 4 5 30 27 27
B6	3	5	0	0	
B6	3	6	9	6	4 7 5 18 5 4
B6	3	7	17	3	8 6 14
B6	3	8	21	3	6 17 29
B6	3	9	13	6	6 15 12 11 28 6
B6	4	1	11	3	9 8 8
B6	4	2	27	13	5 9 10 5 6 7 6 8 5 6 9 6 4
B6	4	3	23	5	15 7 8 13 4
B6	4	4	8	4	5 16 6 11
B6	4	5	36	11	6 7 15 26 12 14 6 5 24 8 4
B6	4	6	0	0	
B6	4	7	7	3	1 7 25
B6	4	8	7	0	
B6	4	9	6	0	
B6	5	1	9	0	
B6	5	2	18	1	7
B6	5	3	0	0	
B6	5	4	5	0	
B6	5	5	17	7	7 8 5 7 4 5 5
B6	5	6	2	0	
B6	5	7	16	4	17 19 26 3
B6	5	8	3	2	5 4
B6	5	9	1	1	11
C1	1	1	8	0	
C1	1	2	3	0	
C1	1	3	2	0	
C1	1	4	9	0	
C1	1	5	6	0	
C1	1	6	3	0	
C1	1	7	4	0	
C1	1	8	15	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
C1	1	9	6	0	
C1	2	1	7	0	
C1	2	2	3	0	
C1	2	3	5	0	
C1	2	4	3	0	
C1	2	5	1	0	
C1	2	6	5	0	
C1	2	7	1	0	
C1	2	8	5	0	
C1	2	9	2	0	
C1	3	1	4	0	
C1	3	2	1	0	
C1	3	3	4	0	
C1	3	4	8	0	
C1	3	5	8	0	
C1	3	6	2	0	
C1	3	7	6	0	
C1	3	8	4	0	
C1	3	9	0	0	
C1	4	1	7	0	
C1	4	2	8	0	
C1	4	3	0	0	
C1	4	4	6	0	
C1	4	5	2	0	
C1	4	6	1	0	
C1	4	7	5	0	
C1	4	8	0	0	
C1	4	9	4	0	
C1	5	1	4	0	
C1	5	2	0	0	
C1	5	3	4	0	
C1	5	4	0	0	
C1	5	5	0	0	
C1	5	6	0	0	
C1	5	7	7	0	
C1	5	8	5	0	
C1	5	9	3	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
C2	1	1	7	0	
C2	1	2	12	2	8 4
C2	1	3	1	0	
C2	1	4	4	0	
C2	1	5	10	1	14
C2	1	6	4	1	6
C2	1	7	7	2	12 26
C2	1	8	7	1	17
C2	1	9	8	0	
C2	2	1	17	0	
C2	2	2	17	2	8 4
C2	2	3	4	0	
C2	2	4	12	0	
C2	2	5	6	1	14
C2	2	6	0	1	6
C2	2	7	1	2	12 26
C2	2	8	4	1	17
C2	2	9	0	0	
C2	3	1	0	0	
C2	3	2	8	2	4 3
C2	3	3	8	3	35 15 18
C2	3	4	5	3	4 5 3
C2	3	5	10	0	
C2	3	6	3	0	
C2	3	7	3	1	3
C2	3	8	3	2	4 3
C2	3	9	4	0	
C2	4	1	8	0	
C2	4	2	7	2	4 6
C2	4	3	3	1	9
C2	4	4	5	0	
C2	4	5	4	3	5 7 12
C2	4	6	4	1	8
C2	4	7	13	7	6 2 8 5 16 3 3
C2	4	8	1	0	
C2	4	9	11	1	8
C2	5	1	21	1	13

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
C2	5	2	17	2	13 35
C2	5	3	11	6	21 5 11 8 11 19
C2	5	4	12	1	5
C2	5	5	5	0	
C2	5	6	9	0	
C2	5	7	5	1	13
C2	5	8	3	0	
C2	5	9	0	0	
C3	1	1	9	7	1 9 6 10 7 7 1
C3	1	2	12	0	
C3	1	3	3	2	3 5
C3	1	4	12	4	7 4 6 11
C3	1	5	2	0	
C3	1	6	7	2	3 7
C3	1	7	2	0	
C3	1	8	8	2	5 10
C3	1	9	4	0	
C3	2	1	5	1	6
C3	2	2	10	5	22 13 22 8 8
C3	2	3	4	1	6
C3	2	4	4	3	13 13 7
C3	2	5	5	0	
C3	2	6	10	1	8
C3	2	7	7	4	6 5 6 8
C3	2	8	0	0	
C3	2	9	7	1	5
C3	3	1	19	1	3
C3	3	2	6	4	2 2 1 5
C3	3	3	17	2	4 6
C3	3	4	18	1	9
C3	3	5	6	2	5 7
C3	3	6	9	3	16 4 9
C3	3	7	5	0	
C3	3	8	18	2	12 10
C3	3	9	6	1	7
C3	4	1	3	0	
C3	4	2	13	1	7

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
C3	4	3	1	0	
C3	4	4	14	9	5 7 5 12 6 26 4 5 6
C3	4	5	29	15	4 18 5 15 10 6 5 10 14 15 10 14 6 8 10
C3	4	6	0	0	
C3	4	7	0	0	
C3	4	8	5	3	8 9 4
C3	4	9	14	2	7 6
C3	5	1	10	1	6
C3	5	2	19	2	6 5
C3	5	3	0	0	
C3	5	4	4	4	3 13 7 6
C3	5	5	0	0	
C3	5	6	0	0	
C3	5	7	5	0	
C3	5	8	14	1	6
C3	5	9	5	0	
C4	1	1	9	0	
C4	1	2	11	0	
C4	1	3	4	0	
C4	1	4	5	0	
C4	1	5	10	0	
C4	1	6	2	0	
C4	1	7	5	0	
C4	1	8	5	0	
C4	1	9	7	0	
C4	2	1	8	0	
C4	2	2	10	0	
C4	2	3	6	0	
C4	2	4	0	0	
C4	2	5	2	0	
C4	2	6	10	0	
C4	2	7	7	0	
C4	2	8	5	0	
C4	2	9	3	0	
C4	3	1	0	0	
C4	3	2	1	0	
C4	3	3	14	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
C4	3	4	0	0	
C4	3	5	6	0	
C4	3	6	2	0	
C4	3	7	6	0	
C4	3	8	2	0	
C4	3	9	10	0	
C4	4	1	8	0	
C4	4	2	13	0	
C4	4	3	0	0	
C4	4	4	4	0	
C4	4	5	1	0	
C4	4	6	5	0	
C4	4	7	5	0	
C4	4	8	2	0	
C4	4	9	3	0	
C4	5	1	5	0	
C4	5	2	1	0	
C4	5	3	3	0	
C4	5	4	1	0	
C4	5	5	1	0	
C4	5	6	2	0	
C4	5	7	9	0	
C4	5	8	11	0	
C4	5	9	3	0	
C5	1	1	7	0	
C5	1	2	3	1	6
C5	1	3	8	1	2
C5	1	4	14	3	5 10 4
C5	1	5	3	3	9 75 20
C5	1	6	14	8	7 9 10 8 7 7 13 13
C5	1	7	25	7	11 18 13 8 18 6 8
C5	1	8	10	1	5
C5	1	9	14	1	5
C5	2	1	1	1	8
C5	2	2	3	1	7
C5	2	3	3	1	8
C5	2	4	0	0	

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem														
C5	2	5	1	0															
C5	2	6	2	2	5	8													
C5	2	7	3	1	2														
C5	2	8	25	7	3	5	2	4	10	14	12								
C5	2	9	13	2	6	4													
C5	3	1	3	1	11														
C5	3	2	0	0															
C5	3	3	2	1	43														
C5	3	4	18	4	6	5	8	5											
C5	3	5	11	0															
C5	3	6	0	0															
C5	3	7	9	4	6	3	12	10											
C5	3	8	8	5	14	16	26	17	5										
C5	3	9	11	1	1														
C5	4	1	2	2	7	9													
C5	4	2	7	4	12	3	6	9											
C5	4	3	4	1	45														
C5	4	4	8	3	16	20	6												
C5	4	5	4	2	11	19													
C5	4	6	6	0															
C5	4	7	31	15	8	4	7	14	13	6	10	4	11	5	2	2	7	5	18
C5	4	8	31	12	6	3	3	7	6	7	7	10	9	9	8	22			
C5	4	9	0	0															
C5	5	1	0	0															
C5	5	2	3	0															
C5	5	3	4	0															
C5	5	4	3	0															
C5	5	5	2	1	3														
C5	5	6	0	0															
C5	5	7	0	0															
C5	5	8	0	0															
C5	5	9	6	3	7	14	14												
C6	1	1	8	4	13	5	52	7											
C6	1	2	11	5	26	47	13	12	18										
C6	1	3	12	4	15	14	20	4											
C6	1	4	2	2	14	13													
C6	1	5	13	12	19	14	29	7	16	25	18	14	44	24	12	55			

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
C6	1	6	10	3	6 4 15
C6	1	7	6	1	11
C6	1	8	19	3	11 6 4
C6	1	9	0	0	
C6	2	1	4	0	
C6	2	2	1	1	57
C6	2	3	0	0	
C6	2	4	5	1	16
C6	2	5	5	4	11 16 6 7
C6	2	6	4	3	18 16 10
C6	2	7	14	10	82 5 16 26 9 12 10 6 18 52
C6	2	8	11	9	3 82 7 8 18 23 76 10 62
C6	2	9	5	4	13 8 2 102
C6	3	1	10	7	3 8 8 2 8 12 25
C6	3	2	17	6	44 6 6 8 6 6
C6	3	3	0	0	
C6	3	4	0	0	
C6	3	5	10	0	
C6	3	6	6	1	12
C6	3	7	3	1	5
C6	3	8	10	3	38 46 11
C6	3	9	2	1	18
C6	4	1	5	1	9
C6	4	2	13	8	3 5 11 15 8 5 20 5
C6	4	3	13	3	6 26 8
C6	4	4	0	0	
C6	4	5	21	5	7 4 6 4 9
C6	4	6	7	1	8
C6	4	7	5	2	8 30
C6	4	8	5	3	4 10 4
C6	4	9	8	8	96 266 5 88 40 32 51 53
C6	5	1	7	3	94 7 88
C6	5	2	13	0	
C6	5	3	9	3	14 5 11
C6	5	4	7	5	9 10 24 5 4
C6	5	5	9	5	1 4 4 19 17
C6	5	6	6	1	18

Unit	Transect	Quadrat	Stems	Stems w/ flowers	# flowers on each flowering stem
C6	5	7	1	0	
C6	5	8	6	1	1
C6	5	9	5	0	

Vaccinium Berry Sub-Samples

Approximately 50-g subsamples for calculating fresh-dry and green-ripe ratios									Calculated values:									
Unit	Ripe fresh (g)	Ripe count	Ripe tare	Ripe dry+tare	Green fresh (g)	Green count	Green tare	Green dry+tare	Ripe dry (g)	Ripe fresh per berry (g)	Ripe dry per berry (g)	Ripe fresh-dry ratio	Green dry (g)	Green fresh per berry (g)	Green dry per berry (g)	Green fresh-dry ratio	Ripe to Green ratio per berry, fresh	Ripe to Green ratio per berry, dry
A1	0.0	0			0.0	0			0				0					
A2	0.0	0			0.0	0			0				0					
A3	46.3	208	1.61	7.55	31.0	382	1.27	6.45	5.94	0.223	0.029	7.79	5.18	0.08	0.014	5.98	2.74	2.11
A4	50.6	188	1.62	7.87	35.1	464	1.62	7.88	6.25	0.269	0.033	8.10	6.26	0.08	0.013	5.61	3.56	2.46
A5	2.6	11	1.6	1.93	2.1	28	1.28	1.65	0.33	0.236	0.030	7.88	0.37	0.08	0.013	5.68	3.15	2.27
A6	51.9	189	1.59	8.17	43.8	618	1.61	8.56	6.58	0.275	0.035	7.89	6.95	0.07	0.011	6.30	3.87	3.10
B1	47.5	207	1.59	8.48	41.4	459	1.59	8.47	6.89	0.229	0.033	6.89	6.88	0.09	0.015	6.02	2.54	2.22
B2	0.0	0			2.9	51	1.27	1.84	0				0.57	0.06	0.011			
B3	7.9	40	1.59	2.75	5.2	92	1.28	2.21	1.16	0.198	0.029	6.81	0.93	0.06	0.010	5.59	3.49	2.87
B4	2.8	13	1.6	2.00	1.3	30	1.26	1.6	0.4	0.215	0.031	7.00	0.34	0.04	0.011	3.82	4.97	2.71
B5	0.0	0			0.0	1	1.28	1.3	0				0.02	0.00	0.020			
B6	48.3	184	1.61	8.48	31.2	379	1.28	6.84	6.87	0.263	0.037	7.03	5.56	0.08	0.015	5.61	3.19	2.55
C1	0.3	2	1.58	1.62	1.2	17	1.59	1.8	0.04	0.150	0.020	7.50	0.21	0.07	0.012	5.71	2.13	1.62
C2	38.8	123	1.61	6.65	39.8	430	1.6	8.67	5.04	0.315	0.041	7.70	7.07	0.09	0.016	5.63	3.41	2.49
C3	44.3	185	1.6	7.67	41.3	596	1.6	8.73	6.07	0.239	0.033	7.30	7.13	0.07	0.012	5.79	3.46	2.74
C4	4.1	13	1.61	2.00	2.1	26	1.59	1.89	0.39	0.315	0.030	10.51	0.3	0.08	0.012	7.00	3.90	2.60
C5	62.0	192	1.63	9.98	56.0	660	1.62	11.11	8.35	0.323	0.043	7.43	9.49	0.08	0.014	5.90	3.81	3.02
C6	58.0	229	1.59	8.78	49.0	568	1.59	10.24	7.19	0.253	0.031	8.07	8.65	0.09	0.015	5.66	2.94	2.06

Vaccinium Berry Sampling

July 2002, Cadwell Memorial Forest, Pelham, MA
Weight of all berries of Vaccinium angustifolium
Each quadrat is 40-m x 1-m

Unit	Quadrat	Ripe wet wt (g)	Green wet wt (g)
A1	1	0	0
A1	2	0	0
A1	3	0	0
A1	4	0	0
A2	1	0	0
A2	2	0	0
A2	3	0	0
A2	4	0	0
A3	1	129.8	82.7
A3	2	129.1	56.5
A3	3	35.6	14.5
A3	4	107.4	65.5
A4	1	109.7	43.4
A4	2	397.7	195
A4	3	84.4	129.7
A4	4	3	44
A5	1	1.7	1.2
A5	2	0.3	0.1
A5	3	0.6	0.8
A5	4	0	0
A6	1	136.7	93
A6	2	113.4	108.5
A6	3	70.4	25.4
A6	4	13.9	11.3
B1	1	15.1	16.2
B1	2	16	10
B1	3	2.1	3.3
B1	4	14.6	11.2
B2	1	0	1.9
B2	2	0	0
B2	3	0	0
B2	4	0	1
B3	1	0	1.3
B3	2	0.3	0.1
B3	3	0.4	0.8
B3	4	7.2	3
B4	1	2.8	1.3
B4	2	0	0
B4	3	0	0
B4	4	0	0

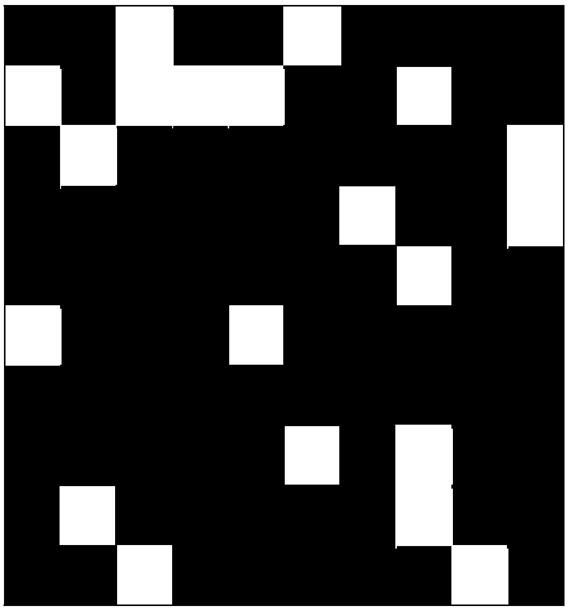
Unit	Quadrat	Ripe wet wt (g)	Green wet wt (g)
B5	1	0	0
B5	2	0	0.1
B5	3	0	0
B5	4	0	0
B6	1	99.3	85.3
B6	2	190	242.7
B6	3	63.2	95.4
B6	4	6.6	10.8
C1	1	0	0.1
C1	2	0	0
C1	3	0	1.1
C1	4	0.3	0.1
C2	1	133.8	82.7
C2	2	51.2	21.9
C2	3	53.7	58.6
C2	4	50	31
C3	1	38.8	19.4
C3	2	22.2	11.6
C3	3	87.3	75
C3	4	66	50.1
C4	1	0.8	0
C4	2	0	0.3
C4	3	2.3	1.2
C4	4	1	0.6
C5	1	84	34
C5	2	53	50
C5	3	125	85
C5	4	52	32
C6	1	177	162
C6	2	80	72
C6	3	158	113
C6	4	190	85

APPENDIX B

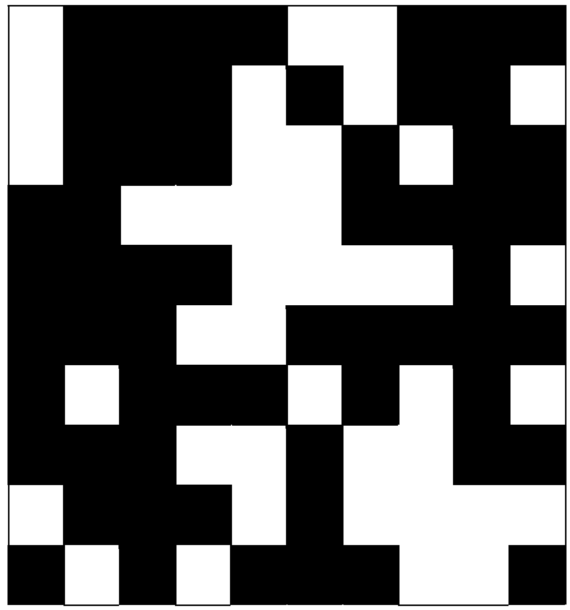
HORIZONTAL FOLIAR DENSITY COMPARISON SHEET

Estimate percent of target obscured by vegetation
to the nearest 10%

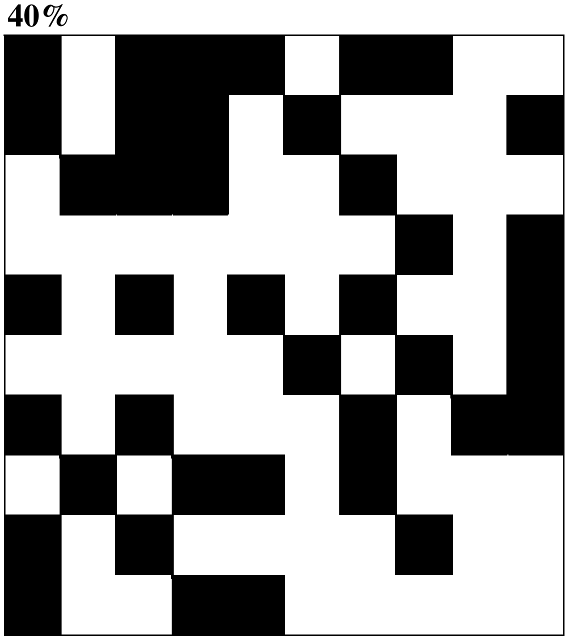
80%



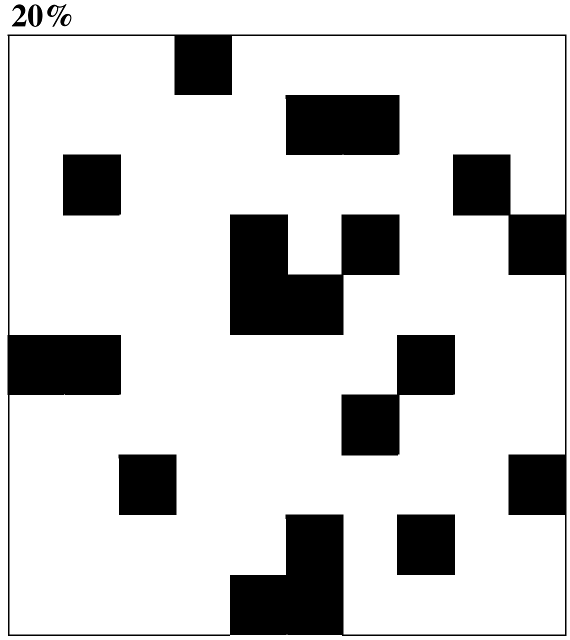
60%



40%



20%



Percent cover comparator for use with Vegetation Profile Board in vegetation with large broad leaves.