INDICATORS OF COMPETITION IN A NORTHWESTERN ONTARIO JACK PINE PLANTATION

by

Neil Stocker ©

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ABSTRACT

INDICATORS OF COMPETITION IN A NORTHWESTERN ONTARIO JACK PINE PLANTATION

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Competition in forestry is discussed as a prelude to the hypothesis that tree seedling growth is strongly related to that of other vegetation close to it. The hypothesis states that: a) the relationship is species-dependent; b) seedling growth is inversely proportional to the amount of other nearby vegetation; c) seedling growth is directly proportional to the distance separating the tree from other vegetation; and d) that the amount of competition is quantifiable by some measurement of the tree seedling. The study was conducted in a four-year-old *Pinus banksiana* plantation in Northwestern Ontario. Several non-crop plant species occupied the site: *Epilobium angustifolium, Calamagrostis canadensis, Carex* spp., *Rubus idaeus*, *Corylus cornuta*, *Prunus pensylvanica*, *Betula papyrifera*, *Acer spicatum* and *Alnus crispa*.. The author established in the study area 110 sample plots of 1.13 m radius (4 m^2) divided into 2 m^2 inner and 2 m^2 outer rings centred on jack pine (crop) tree seedlings. For each plot, a tally sheet was completed recording: (a) crop tree parameters (height, stem diameter, and crown width), and (b) non-crop species, average height, and ground cover as a percentage of the plot. Samples of jack pine from peripheral areas and non-crop species above-ground biomass samples were collected, dried, and weighed. The crop tree parameters were correlated to the non-crop species measurements and Towill and Archibald's (1991) Competition Index (T&A's CI) method was applied to assess the degree of competition. The correlation coefficients (**r**) for crop tree parameters with non-crop species vary from 0.852 for alder, 0.602 for natural jack pine, -0.572 for total plant species as a group, to 0.239 for fireweed. T&A's CIs correlate highly with the estimated dry weight for all plant species (**r** = 0.845), but poorly with the jack pine parameters (r = -0.259 to -0.377). The strengths and weaknesses of this CI are considered, and modifications are proposed, formulated and applied individually and in combination. The best correlations of the modified indices with jack pine dry weight and with any other parameters were not significantly different from the unmodified index.

<u>Key words</u>: Competition, Seedling growth, *Pinus banksiana*, Northwestern Ontario, *Epilobium angustifolium, Calamagrostis canadensis*, *Carex* spp., *Rubus idaeus*, *Acer spicatum*, *Corylus cornuta*, *Prunus pensylvanica*, *Betula papyrifera*, *Alnus crispa*.

TECHNICAL NOTE

This thesis was prepared on a Macintosh® LCIII personal computer using Microsoft Word® Version 5.1 word processing programme. Illustrations are presented in Claris MacDraw II®. Several other programmes were used in the preparation of this thesis as well, details of which are listed in the SOFTWARE USED section following LITERATURE CITED.

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This thesis has been prepared in partial fulfillment of the Master of Science in Forestry degree at Lakehead University. Accordingly, the author would like to acknowledge the following persons who contributed in various substantive degrees to the completion of this work. I am deeply indebted to the following persons: Professor Robert (Bob) J. Day, Doctor Dean H.Gjerstad, Professor Gerrit Hazenberg, Professor Robert Farmer, Dr. James Kayll, Chris Hollstedt, William (Bill) D.Towill, Lisa Buse, Wayne Bell, Brian Polhill, Robert Whaley, Ian Ross, Dr. Robert Wagner, Blake MacDonald, the Staff of the North West Ontario Forest Technology Development Unit for their help and permission to use the nearby Junior Forest Ranger Camp as a base of operations, the Staff of the School of Forestry, Lakehead University, my wife - Sarah Stocker, and my children, Kellie, Andrew and Christopher, who provided much of the motivation and (sometimes) the peace and quiet needed to complete this work.

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INTRODUCTION

The Nature of Competition

Competition, in forestry, is one of the most influential factors affecting the survival, growth and development of trees. It occurs when two or more occupants of a site make demands on site factors in excess of the supply (Figure 1; Toumey and Korstian, 1959; Hocker, 1979). Odum (1971) defines it as "the inter-action of two organisms striving for the same thing". Competition may be one-sided with large plants decreasing the growth of small neighbours but not *vice-versa* (Cannell *et al.*, 1984) or it may be two-sided, with competing plants inhibiting each other's growth mutually (Kozlowski *et al.*, 1991).

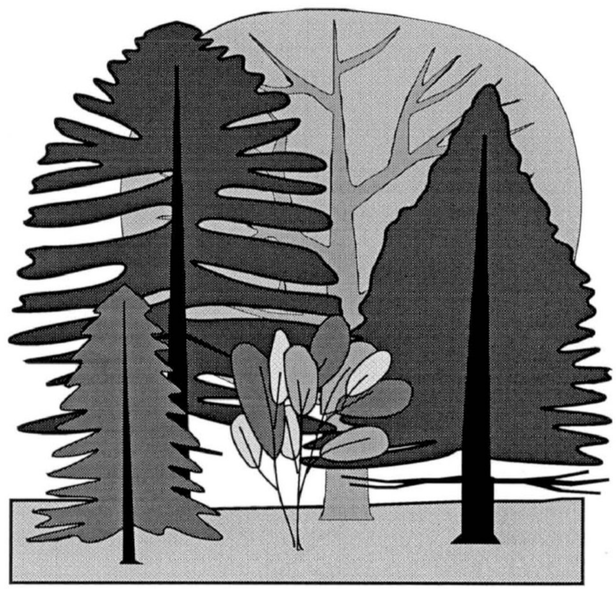


Figure 1. Competition

In 1855, the German organic chemist Justus von Liebig, while studying plant response to fertilizers, developed the concept of limiting factors. Originally, the rate of growth of an organism was thought to be controlled by that factor available in the smallest amount relative to its minimum requirement. However, it is now known that growth rates can be increased by changes in the supply of more abundant factors that can compensate for the limiting factor. This means that one or more factors may be more important than others in the overall success or failure of plants in a particular environment (Walstad and Kuch, 1987).

Competition is only one of a range of possible interactions between plants growing in a restricted environment (Table 1). Walstad and Kuch (1987) note that of the ten possible interactions listed in Table 1, only five result in a negative influence on one or both of the interacting populations. These are competition, amensalism and parasitism / predation / herbivory. Walstad and Kuch define plant competition as "the mutually adverse effects of two plants that utilize the same resource".

Table 1. A list of all the possible types of interactions between species X and Y (adapted from Burkholder (1952) and Odum (1971)); stimulation is symbolized as +, no effect as 0, and depression as –).

Name of Interaction	Species	
	X	Y
Mutualism / Symbiosis / Proto-cooperation	+	+
Commensalism	+	O
Neutralism	O	O
Parasitism / Predation / Herbivory	+	–
Amensalism (including allelopathy)	O	–
Competition	–	–

Amensalism is defined by those reviewers as "the interaction in which one of the plants is depressed, whereas the other is not". Allelopathy, the inhibition of one plant by the release of a selective toxicant from another, is described by them as a form of amensalism. Parasitism / predation / herbivory are special forms of interaction in which one organism derives its resources directly from the other. Amensalism and competition are often grouped together because, in both forms of interaction, the presence or growth of one species is usually suppressed. Most competition experiments only measure the response of one of the species in the study, making the differentiation between competition and amensalism impossible.

The Forms of Competition

Competition can take either of two forms. One of these forms is intra-specific competition (Figure 2). This is the mutually inhibitory (negative) interaction between members of the same species. It is usually very intense, because closely related individuals must occupy the same niche (Walstad and Kuch, 1987) and compete for exactly the same resources in

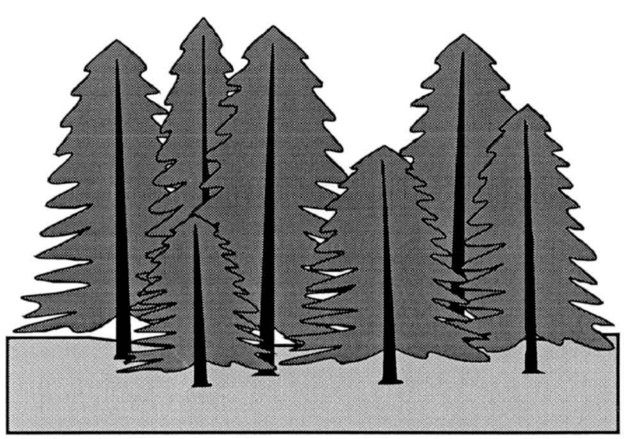


Figure 2. Intraspecific Competition

the same proportions. Intra-specific competition is the better understood of the two forms. Considerable efforts are still being made to understand all of the effects of this phenomenon, largely in the area of stand density studies. Reineke (1933) was one of the earliest researchers in this area. He developed a stand density index as a tool with which to gauge the natural limits of intraspecific competition. This index, formalized by Kira *et al.* (1953) and Shinozaki and Kira (1956) as the Reciprocal Yield Law, and further defined by Yoda *et al.* (1963) as the $-^{3}/_{2}$ Power Law (Day, 1992) is expressed as:

$$\mathbf{W} = \mathbf{aD^b}$$

where: **W** = mean plant dry weight,
a = a species-dependent coefficient,
D = plant density (stems per hectare), and
b = slope coefficient with a theoretical value of $-^{3}/_{2}$ for all species.

Intraspecific competition has some beneficial effects, however. It can keep a population healthy and well adapted to its physical environment by eliminating sick and poorly suited individuals. By selecting for fitness, such competition may make a population more successful in interspecific interactions (Kimmins, 1987).

Interspecific competition (Figure 3), on the other hand, is any interaction between members of two or more species which adversely affects their growth and/or survival (Odum, 1971). It occurs wherever more than one species attempt to occupy the same niche in which resources are inadequate. Competition does not usually occur when the species share a resource that exceeds their demands on it. Occasionally it can occur, however, when the resource is adequate but the species still interfere with each other's ability to use it (Kimmins, 1987). Interspecific competition is the focus of this thesis.

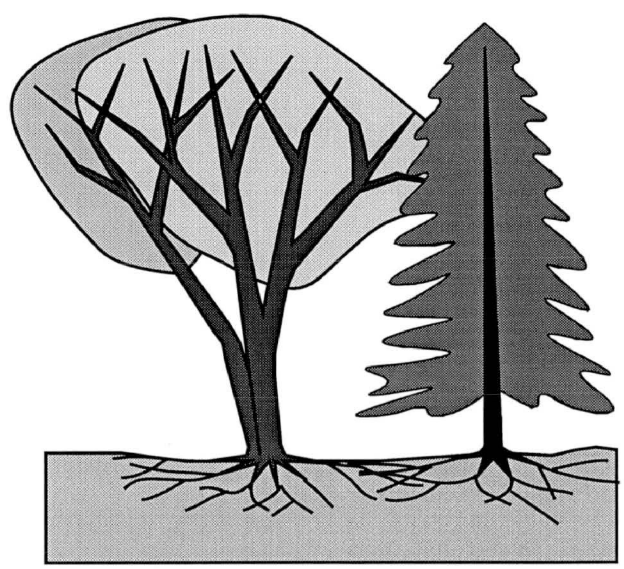


Figure 3. Interspecific Competition

Measurement of Competition

The amount of competitive stress on individual trees in forest stands has been estimated by a large assortment of competition indices (CI's). The earliest of these indices was developed by Staebler (1951). This index (Figure 4) is based on the hypothesis that competition is directly proportional to the amount of overlap of competing trees' areas of influence and inversely proportional to the radii of the subject tree's area of influence. It can be expressed as:

$$CI_j = \sum_{i=1}^{n} \left(\frac{L_{ij}}{2R_j} \right)$$

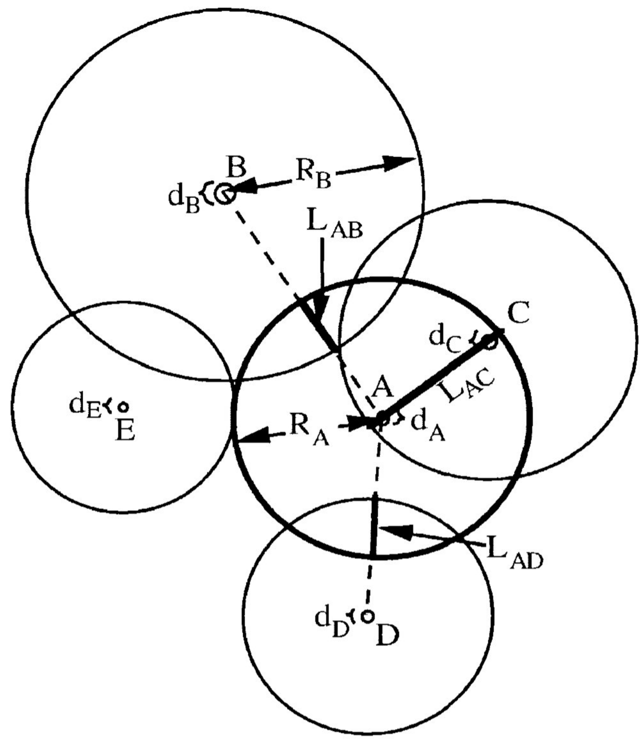


Figure 4. The elements of Staebler's (1951) Competition Index.

where: i = 1, 2, 3, ..., n,

n = the number of competitors around the j^{th} (subject) tree,

L_{ij} = the length of overlap between the area of influence of the subject tree and the area of influence of the i^{th} competitor along the axis joining the centres of these two trees,

j = subject trees A, B, C, ...

R_j = the radius of the area of influence of the subject tree which is proportional to its diameter,

= $a(d_j) + k$,

d_j = the diameter of the subject tree, and

a, k = constants.

Many other indices have been developed, of which the following is a partial listing:

(1) STEM MEASUREMENTS

Diameter Shao (1985), Biondi (1990), Hix and Lorimer (1990), Biondi, *et al.*

(1992);

Ring Width Peterson (1985);

Basal Area Opie (1968), Martin and Ek (1984), Smith and Scott (1984), Harrison, *et al.* (1986), LeBlanc (1990), Snowdon and Waring (1990);

Inter-Tree Distance Cottam and Curtis (1956), Collins and Klahr (1991), Smith, *et al.* (1992);

Density Bruchwald (1988);

Height Ford and Diggle (1981), Cannell *et al.* (1984); and

Sway Sugden (1962).

A typical example of this class of competition index is Martin and Ek's (1984) competition index (CI):

$$CI = \frac{\sum_{i=1}^{n} BA_i}{P}$$

where:
- i = 1, 2, 3, ..., n,
- n = the number of trees within the sample plot,
- BA_i = the basal area of the i^{th} tree, and
- P = the area of the sample plot (0.05782 to 0.08562 ha).

(2) CROWN MEASUREMENTS

Area Krajicek and Brinkman (1957), Krajicek, *et al.* (1961), Hatch, *et al.* (1975), Farr, *et al.* (1989);

Overlap Newnham (1964), Arney (1972, 1973), Ker (1975), Monserud (1975), Schooley (1976), Barclay and Layton (1990);

Height Brand (1987), Knowe (1991)

Volume Biging and Wensel (1990); and

Position, Length and Width Hatch (1971).

A representative of this group of competition indices is Newnham's (1964) competition index (CI), (Figure 5) and expressed as:

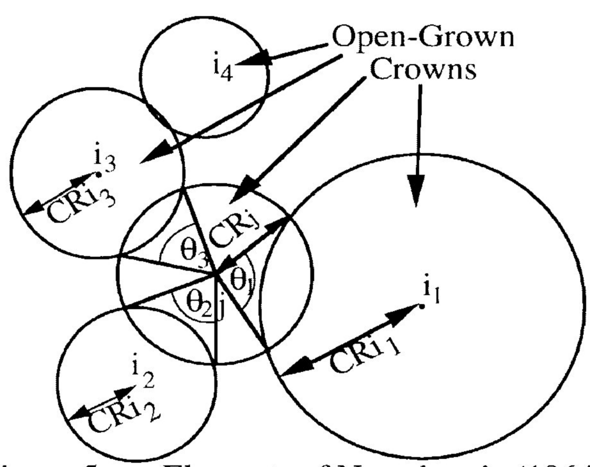


Figure 5. Elements of Newnham's (1964) competition index.

$$CI = \sum_{i=1}^{n} \left(\frac{\theta_i}{2\pi} \times \frac{CR_i}{CR_j} \right)$$

where: i = 1, 2, 3, ..., n,

n = the number of competitors around a subject tree,

θ_i = the angle (in radians) subtended at the point of the subject tree by the intersections of the open-grown crown of the subject tree and the open-grown crown of the competitor,

π = the ratio of the circumference of a circle to its diameter,

= 3.14159...,

CR_i = the open-grown crown radius of the competitor, and

CR_j = the open-grown crown radius of the subject tree.

(3) STEM, CROWN AND / OR ROOT MEASUREMENTS IN COMBINATION

Diameter and Distance Staebler (1951), Hegyi (1974), Daniels (1976), Ellis (1979), Squiers and Klosterman (1981), Magnussen and Yeatman (1987);

Diameter, Distance and Height Pukkala (1989);

Diameter and Crown Ganzlin and Lorimer (1983);

Basal Area and Distance van Laar (1973b), Liu (1981);

Basal Area, Distance, Height and Crown Gibbs (1970);

Basal Area, Diameter and Relative Position Holdaway (1984);

Height and Distance van Laar (1973a), Monserud and Ek (1977), Ellis, *et al.* (1987), Pukkala and Kolström (1987), Nystrom and Gemmel (1988);

Height and Crown / Cover Honer (1972), Wensel, *et al.* (1987), Hobson and de Ridder (1991), Wagner and Radosevich (1991), Morneault (1992);

Height, Crown and Position Ritchie and Hann (1986);

Height and Area Overlap Tomé and Burkhart (1989);

Distance and Crown Ward (1964), Assmann (1975), Tuskan and McKinley (1984), Welden, *et al.* (1988);

Crown and Density Schutz (1984); and

Crown and Root Holmes and Reed (1991).

In addition to the competition index defined by Staebler shown earlier, another illustrative example from this category is Nystrom and Gemmel's (1988) competition index (CI) which is defined as:

$$CI = \left(\sum_{i=1}^{n} \frac{H_i^2}{L_{ij}} \right) + H_j^2$$

where: i = 1, 2, 3, ..., n,

n = the number of trees taller than the subject tree within three metres of the subject tree,

H_i = the height (in metres) of the i^{th} competitor,

L_{ij} = the distance (in metres) between the subject tree and the i^{th} competitor, and

H_j = the height (in metres) of the subject tree.

(4) LEAF AREA MEASUREMENTS

Waring (1983), Bacon and Zedaker (1986), Zutter *et al.* (1986), and Hughes *et al.* (1990).

(5) MEASUREMENTS OF LIGHT

Interception Beauregard (1976), MacDonald, *et al.* (1990), Morris *et al.* (1990), Delong (1991), MacDonald (1991), Morris and Forslund (1991), Morris and MacDonald (1991);

Transmission Chan and Walstad (1987), Tullus, *et al.* (1988); and

Reflectance Carter, *et al.* (1989).

A specimen of this class of index is provided by Morris *et al.* (1990). Their competition index (CI), derived from hemispherical photographs, provides an estimate of incident radiation received by each seedling sampled, and takes the form:

$$\mathbf{CI = opaque\ area\ percentage + \left(\frac{2}{3} \times transparent\ area\ percentage\right)}$$

where: opaque area percentage equals the proportion of vertical hemispherical photographs occupied by the image of opaque (100% sunlight-blocking) canopy, and transparent area percentage equals the proportion of vertical hemispherical photographs occupied by the image of transparent (between 0% sunlight-blocking open sky and opaque) canopy. These areas are measured by planimeter.

(6) SPACE MEASUREMENTS

Influence Zone Bella (1969, 1971), Martynov (1976), Cancino and Garcia (1987);

Area Potentially Available Brown (1965), Moore, *et al.* (1973), Adlard (1974), Alemdag (1978), Harms (1981);

Area Overlap Newnham (1966), Keister (1967), Gerrard (1968), Keister (1972), Keister and Tidwell (1975), Ek and Dawson (1976), Monserud (1976), Smith and Bell (1983);

Land Equivalent Ratio Burley (1984); and

Area Between Bearings Ferrill and Woods (1966).

The index developed by Cancino and Garcia (1987) is typical of this class. It is based on the concept of 'spaces of influence', *i.e.* the tree obtains its resources from within a limited space (Figure 6). Competition is determined from the amount of interception of this space by a neighbouring tree, weighted by the relative size of each tree. This relationship can be expressed as:

$$CI = \frac{1}{VI}\sum_{i=1}^{n}\left[VIO_i\left(\frac{D_i}{D_j}\right)\right]^b$$

where:
- VI = the volume of influence (m^3) of the subject tree,
- i = 1, 2, 3, ..., n,
- n = the number of trees competing with the subject tree,
- VIO_i = the volume of influence overlap (m^3) of the i^{th} competitor with that of the subject tree,
- D_i = the diameter at breast height (cm) of the i^{th} competitor,
- D_j = the diameter at breast height (cm) of the subject tree, and
- b = an exponent.

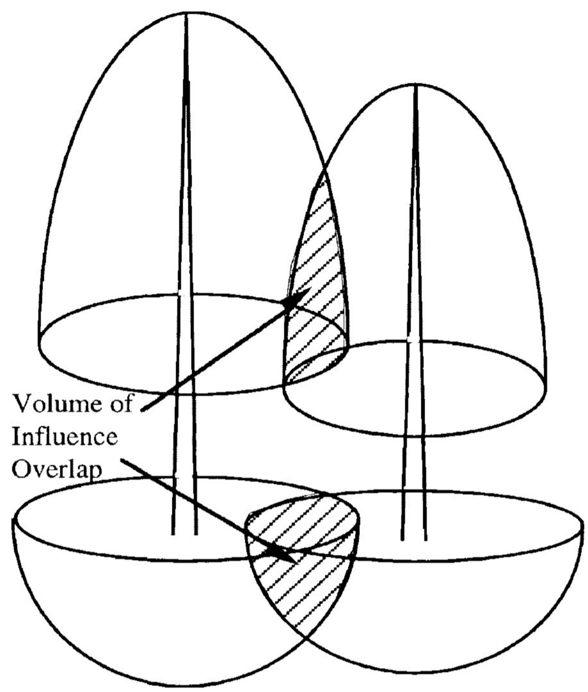


Figure 6. Cancino and Garcia's (1987) Spaces of Influence concept.

(7) GROUND COVER AND NEIGHBOURHOOD MEASURES

Ground Cover and Canopy Howard and Newton (1984), Brand (1986a and b), Towill and Archibald (1991, to be described later); and

Neighbourhood Measurements Wagner (1989).

Brand's (1986a and b) competition index is a typical representative of this group of indices. This competition index (CI) can be expressed as:

$$CI = \frac{\left(\frac{H_b}{H_t}\right)}{\left(\frac{L_b}{R_t}\right) + 1} (C\%)$$

where: H_b = the mean height of the brush canopy,
H_t = the sample tree height,
L_b = the mean distance to the brush foliage from the tree stem,
R_t = the tree crown radius, and
$C\%$ = the per cent cover of competing species around the tree.

A detailed description of each of the preceding competition indices has been compiled, reviewed and submitted for publication (Stocker, *et al.*, Unpubl.). This review shows that the success of each of these indices has been limited, owing to the complexity of the nature of competition and the inability of relatively simple indices to explain most of the variability of seedlings under competition. Consequently, there is, at present, no single competition index with a satisfactory level of confidence that can be applied to a broad range of competitive field conditions.

Models of Interspecific Competition

There are two models for interspecific competition based on the relative tolerance of the competing species. Relative tolerance is defined as the ability of a tree to grow and reproduce in the shade of, and in competition with other trees (Hocker, 1979). The two models are represented by intolerant and tolerant species characterized by factors listed in Table 2.

Intolerant tree species are those which gain dominance initially and must hold that advantage in order to survive. Tolerant species generally start beneath a canopy of intolerants and gradually grow through it. The two models described in Table 2 represent extreme situations. More commonly, trees express tolerance in a range of gradations.

Successful competitors (Figure 7) withdraw more light, water, and macro- or micro-nutrients from their niches than other species. Among seedlings germinating at the

Table 2. Factors characteristic of tolerant and intolerant models of interspecific plant competition (after Daniel, *et al.* 1979)

Factor	Intolerant Model	Tolerant Model
Light compensation point[1]:	Higher	Lower
Foliage density:	Thin foliage, open crowns	Thick, dense crowns
Juvenile height growth[2]:	Rapid	Slower
Self-pruning:	Rapid	Slow
Branch orders[3]:	Fewer	More
Natural thinning:	Faster (if stand not stagnated)	Slower
Capacity for release:	Sluggish response, often die out rapidly	Respond well, rapidly
Density of stems[4]:	Lesser	Greater
Stem taper:	Less	More

same time, an initial height advantage may become a lasting prevalence in growth for intolerant tree species. Neighbouring plants usually become over-topped and suppressed. Once established, plants can only be outdone by competitors that are able to grow in their shade, or that can grow at a faster rate through openings in the canopy and then reach a greater height. The sequence of plant species predominating in a plant community is termed succession.

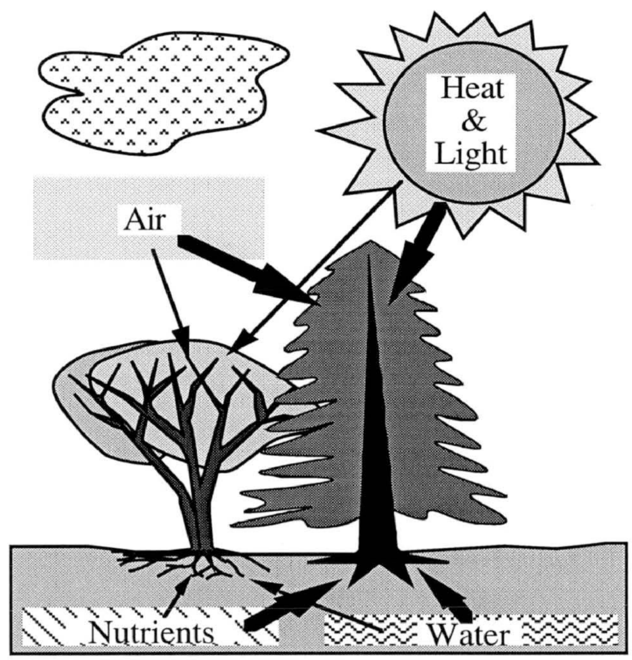


Figure 7. Successful Competitor.

1 The light intensities at which the amount of CO_2 taken up in photosynthesis exactly equals the amount concurrently given off in respiration.

2 In the open.

3 The number of years leaves are retained on conifers.

4 At full stocking.

Plant Succession

Succession can be described in two ways. It can refer to the sequence of plant, animal and microbial communities that successively occupy an area over a period of time, or it can refer to the process of change by which these biotic communities replace each other and by which the physical environment becomes altered over a period of time (Kimmins 1987). A typical model of plant succession after establishment of a plant community is illustrated in Figure 8.

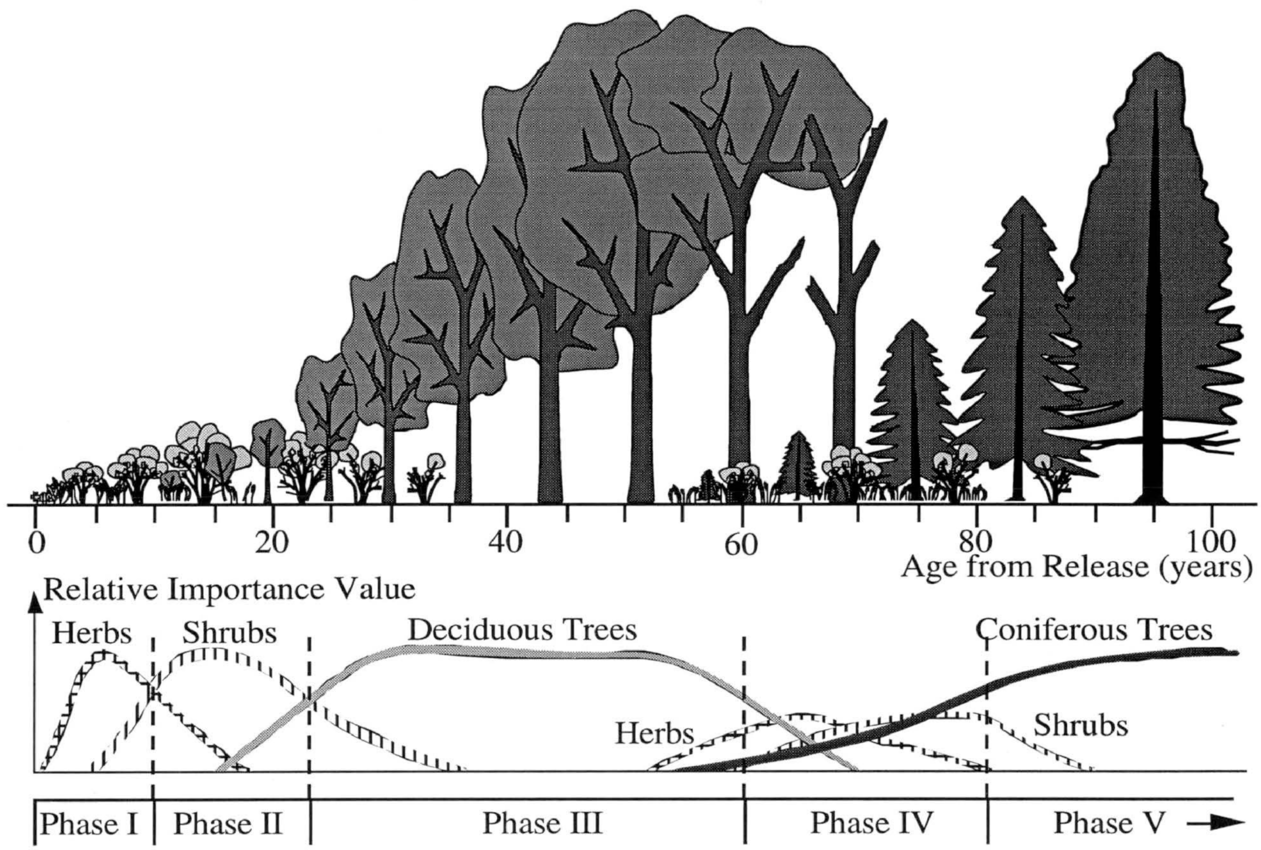


Figure 8. Typical pattern of succession that might be observed following a catastrophic disturbance (*e.g.* clear cutting, wind throw, forest fire, or release from agricultural use) modified from Kimmins (1987).

This model shows five distinct phases of competition. These are:

<u>Phase I</u>. Rapidly colonizing, herbaceous pioneer plants (mostly intolerant) establish on the site after a disturbance (e.g. fire, clearance or wind-throw). During the initial period following the disturbance, these plants grow rapidly, both above- and below-ground and dominate the site. These plants tend to be widely-spaced and short-lived. In the spaces between the pioneers, more tolerant

shrubs establish themselves and gradually displace the first colonists.

Phase II. As the intolerant pioneer plants decline in vigour and are suppressed, the more tolerant primary successors in the understory accelerate their development and dominate the site. Subsequently, even more tolerant successor plant species (pioneer trees) establish in the gaps between the shrubs and in their shade.

Phase III. The primary successor shrubs in the overstory decline and give way in turn to the arising secondary successors (deciduous trees). These plants dominate the site, above and below ground for a protracted period. In general, their own progeny cannot survive in their understory.

Phase IV. As the secondary successor trees age, intra-specific competition leads to mortality among the mature trees, causing large openings to form in the canopy. Herbs, shrubs and tolerant conifers establish themselves in and along the perimeters of these gaps. The deciduous trees are not able to re-occupy the site effectively because their reproductive vigour diminishes with age, and they are unable to produce and disperse enough viable seed. As in phase I, the herbs and shrubs become more prominent on the site, although they do not totally dominate it. Kimmins (1987) refers to this as the Nudum stage.

Phase V Tolerant conifers become dominant on the site. If these conifers can regenerate in their own understory, they can then form a climax state; if not, they will give way in turn to other, more tolerant plant species. As tolerant plants are normally long-lived they remain in dominant positions in the community until the next major site disturbance re-initiates the cycle.

Plant Competitiveness

The competitiveness of a plant species depends largely on the ability to achieve its genetic potential. This is expressed in its morphological structure and its physiological requirements. These are described in Table 3.

Table 3. Morphological and physiological factors affecting the competitiveness of plant species.

1.	**MORPHOLOGICAL STRUCTURE**	
a.	*Germination and early growth rate*	Experiments and field observations show that plants that emerge early appear to be the most effective competitors. This suggests that the timing of emergence or initial site occupancy is more important than the spatial arrangement of plants (Ross, 1968). Stewart, *et al.* (1984) observed that the largest gains in tree growth occurred when young trees never experienced, or were released early from the presence of overtopping species. This suggests that the avoidance of competition from the onset of plantation establishment is greatly beneficial
b.	*Photosynthetic duration and timing*	Species with the same photosynthetic rhythms are strong competitors; species with different rhythms are more-or-less complementary.
c.	*Height*	Final height, according to Boysen-Jensen (1949) is the most important factor in competition. The final stage in vegetation development is usually marked by the tallest plants. Smaller plants can only succeed eventually if they are able to grow in the shade of taller ones.
d.	*Longevity*	Longer living plants succeed (Knapp and Knapp, 1954).
e.	*Root development*	Root competition may be as important, or even more important than above-ground competition. Plants with healthy, vigorous, and fast-growing roots may have a strong advantage over less-favoured plants.
f.	*Means of reproduction*	Reproduction from seed promotes migration into other communities; vegetative reproduction favours the maintenance and enlargement of an already established growth position.
g.	*Shoot Regenerative capacity*	Shoot Regenerative capacity is of particular importance after temporary suppression and following mechanical disturbance (logging, fire, mowing, grazing, trampling, etc.).

Table 3. Morphological and physiological factors affecting the competitiveness of plant species (continued).

<table>
<tr><th>2.</th><th colspan="2">PHYSIOLOGICAL REQUIREMENTS</th></tr>
<tr><td>a.</td><td>Light.</td><td>

Light is the principal energy source for photosynthesis. Low light availability in forest environments, severely restricts the growth of trees. Competition for light occurs when one species casts shade on another, thereby limiting its growth. Plants with the ability to grow their crowns (shoots and foliage) more rapidly than their competitors can pre-empt resource supplies, produce more photosynthetic tissue, and shade out competitors (Walstad and Kuch, 1987). The amount of light available to the lower part of the tree canopy in dense stands (Figure 9) is greatly limited by the shading of neighbouring trees. The intensity of light that penetrates a forest canopy may approximate 50 to 80% of full sunlight in leafless deciduous forests, 10 to 15% in open even-aged pine stands, and less than 1% in some tropical rain forests (Spurr and Barnes, 1980). Light intensity decreases rapidly through the canopy and then more slowly below the level of the tree crowns, resulting in a decrease in photosynthesis typified in Figure 9.

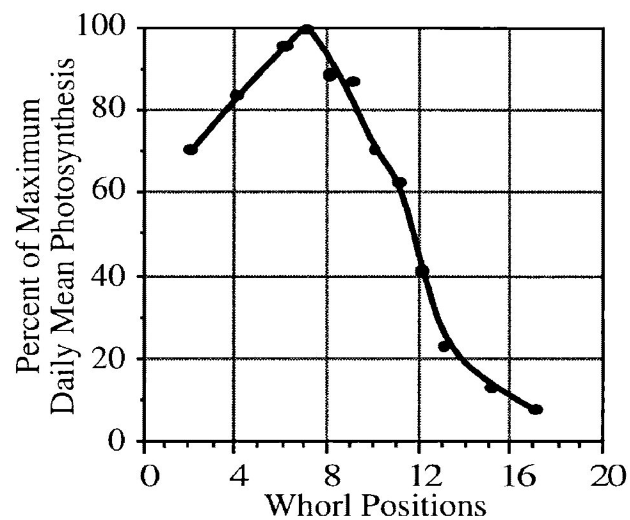


Figure 9. Photosynthetic rate variation at different whorl positions below the top of a 38-year-old Douglas fir growing in a closed canopy (after Woodman, 1971)

</td></tr>
<tr><td>b.</td><td>Heat</td><td>Germination, respiration, transpiration, photosynthesis, and almost all biochemical reactions occurring within plants are accelerated or attenuated by environmental heat. Plants that can cope with and perform well over wide ranges of temperature have competitive advantages over those which cannot.</td></tr>
</table>

Table 3. Morphological and physiological factors affecting the competitiveness of plant species (continued).

2.	PHYSIOLOGICAL REQUIREMENTS (continued)	
c.	*Water*	Water is a limiting factor in many forested regions. Experimental evidence indicates that interspecific competition for available soil moisture may pose a greater limitation to tree growth than light availability (Walstad and Kuch, 1987). Competition for water in dense forest stands is emphasized by the greater availability of soil moisture to residual trees following thinning (Kozlowski *et al.* 1991). Perhaps the most important process contributing to a plant's ability to compete for water is root growth. The ability to grow roots rapidly could affect the relative competitiveness of different species.
d.	*Nutrients*	In moderately to highly fertile sites, an ability to take up and assimilate nutrients rapidly confers an advantage over less exploitative species. The physiological traits that allow rapid exploitation of soil nutrients include high absorption capacity by roots, high photosynthetic rate, and high respiration rate, all of which contribute to rapid growth (Walstad and Kuch, 1987).
e.	*Space*	Plants expand to occupy all of the available growing space in competition with their neighbours (South and Barnett, 1986). The growing plant must pre-empt space / resources for its own use, thereby denying them to a neighbour.

Morphologically and physiologically, individuals within a species are very similar. They use the same specific niche and, as individuals, are the strongest competitors for resources. It follows, then, that the next strongest competitors for resources are species that are most similar (Mueller-Dombois and Ellenberg, 1974).

Successful capture of resources by an individual plant, therefore, depends on rapid colonization, adequate distance from neighbours, and rapid juvenile growth. Increased size can result from either a faster rate of growth or a longer period of initial growth than a neighbour. When two species are grown together, delaying the time of establishment of one will influence markedly the relative contribution of each to the total output (dominance). Differences in planting time, emergence, or establishment, according to

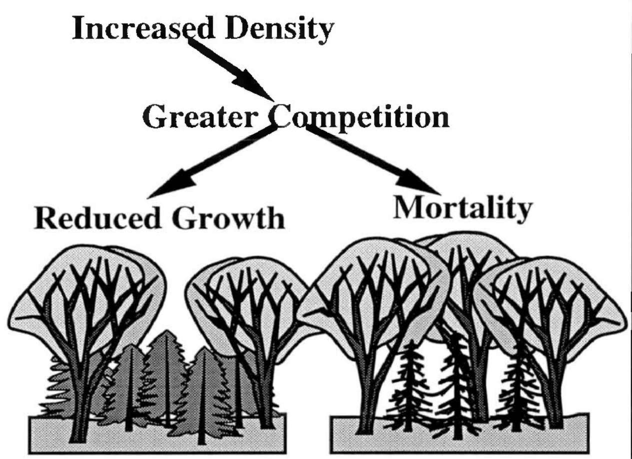


Figure 10. Interference Effects.

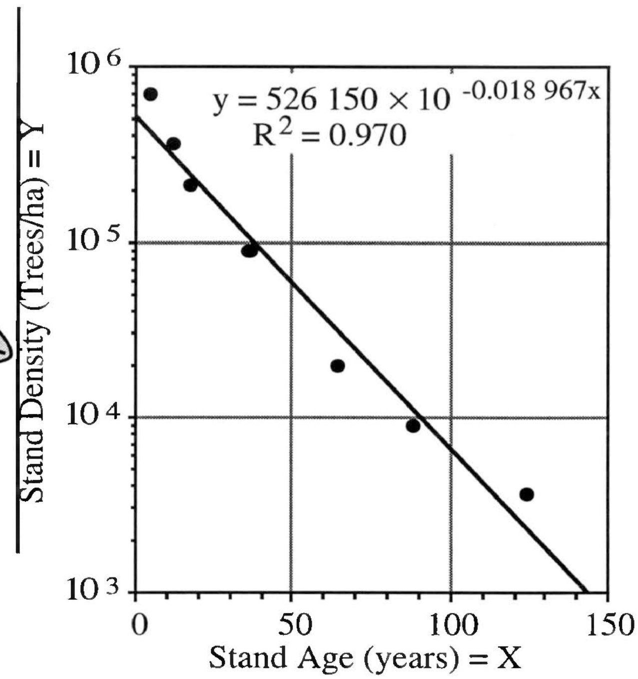


Figure 11. Self-thinning in *Abies* stands in Japan yields a diminishing rate of mortality (derived from Tadaki *et al.* 1977).

Walstad and Kuch (1987) will not affect the total vegetative growth on a site when it becomes fully occupied.

As tree density, or the number of individual plants per unit of area, increases, and / or as individuals grow, a level of stocking occurs at which neighbouring plants interfere with each other (Kira *et al.*, 1953, Shinozaki and Kira, 1956 and Yoda *et al.*, 1963). This interference is expressed as a reduction in growth and / or an increase in mortality (Figure 10). Plant populations self-thin as space or resources become more limited Figure (11).

Growth suppression or stagnation and loss of vigour are responses to less severe cases of overcrowding. Plants growing at high density quickly experience the stress created by the proximity of neighbours. At low density, plants undergo stress only as neighbouring plants get bigger and compete more intensely for resources (Walstad and Kuch, 1987).

For a fully occupied site, total biomass growth per unit of area is independent of density. The yield per unit of area is more-or-less the same over a broad range of densities, because plant size decreases as density increases. In its initial phase, or at very low densities, the yield of a population is determined by the number of individuals. Eventually, however, the limited amount of available resources determines the ultimate yield.

This relationship between density and productivity is similar for all plant species and mixtures of species. It is called the *Law of Constant Final Yield* (Walstad and Kuch, 1987).

Stewart *et al.* (1984) summarized over 260 studies on the effects of weed competition and on the response of commercially valuable tree species to weed control. In most of these studies, trees responded positively to relief from competition and the increased availability of resources brought about by the elimination of weeds. This response was usually a reduction in mortality and / or a substantial increase in growth. Sufficient information, however, is not presented about the levels of weed suppression necessary to achieve economically acceptable tree response (*i.e.* economic thresholds), or about the times in stand development when competition is most critical. As well, few studies have attempted to identify specific environmental resources for which competition occurs (Walstad and Kuch, 1987).

Experimental Designs for Competition Studies

In the study of plant competition, three critical elements must be considered: the total density of plants, the proportion of each species involved, and the spatial arrangement of the species to each other (Walstad and Kuch, 1987). The experimental designs that use these factors in the study of competitive interactions are termed the additive, substitutive and systematic designs (Radosevich and Holt, 1984).

A. <u>Additive Designs</u>

Experiments using the additive design, involve two species, usually a crop (desirable) species and a weed (undesirable) species, grown together. The density of one species, normally the crop, is maintained at a constant level while that of the other, the weed, is varied (the "additive" aspect of the design). The experiment thus becomes a form of bioassay, with the yield of the crop species indicating the relative aggressiveness of the weed species. This design corresponds to many field situations in which crops are established at fixed densities, and are subsequently subjected to invasion by weeds at variable densities (Walstad and Kuch, 1987). This technique can be used to determine the impact, in terms of yield loss, associated with the absence of weed control (Figure 12).

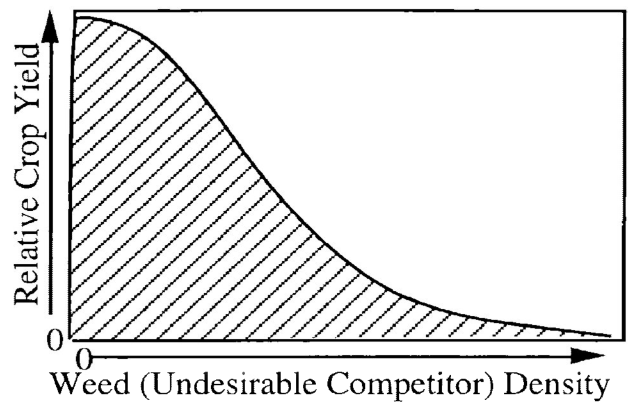


Figure 12. Typical sigmoidal relationship illustrating the effect of increasing weed density on relative crop yield (after Zimdahl, 1980).

Very little loss of yield occurs at low weed densities, but at higher densities, yield losses become significant. Zimdahl (1980), in his review of crop yield losses associated with weed densities from various additive experiments, observed in each case the effects of the *Law of Diminishing Returns*. As weed density increases, crop productivity decreases to a point at which no further addition of weeds substantially decreases yields (Radosevich and Holt 1984). This type of study can also be used to estimate the economic costs of varying degrees of weed infestation, the cost (crop loss) associated with the absence of weed control, and the "threshold" at which weed control becomes worthwhile or even necessary.

B. <u>Substitutive Designs</u>

DeWit (1960) proposed an alternative technique to assess competitiveness (interference) between species. The basic premise, derived from the law of constant final yield, is that the total yield of a mixture of species can be predicted from the yield of each species when grown separately. The substitutive design, or replacement series, examines the relationship between two species when grown together. It requires that the total density or biomass of the two species be held constant, but that they are established in varying proportions. Each species must also be grown alone to assess intra-specific competition. Harper (1977) describes four possible models of interference (Figures 13 to 16):

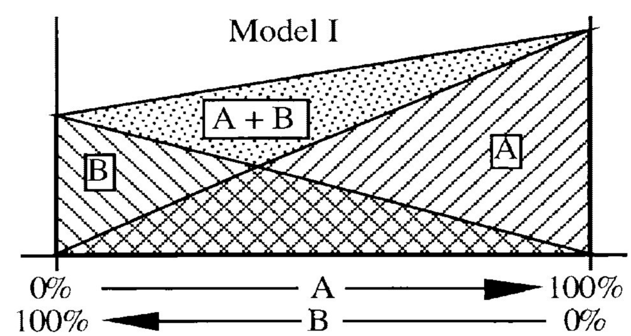


Figure 13. Interference Model I (from Harper, 1977).

<u>Model I</u> (Figure 13) - has two possible causes: (1) the density of the mixed population is so low that individuals do not interfere with each other, or (2) the density is great enough for interference, but the ability of the two species

to interfere with each other is equal. Both species make identical demands on environmental resources, and can therefore substitute for one another.

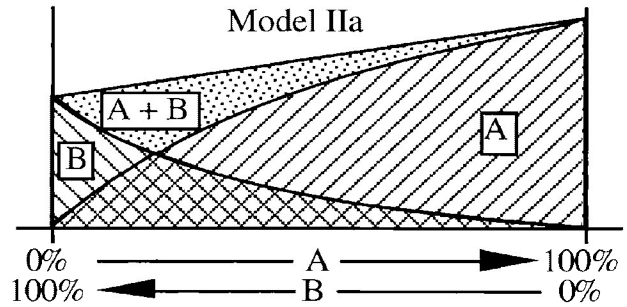


Figure 14. Interference Model IIa (from Harper, 1977).

Model II A more common situation; one species provides more to the total yield than is expected, and the other provides less. This is the model for negative interference (competition). In Model IIa (Figure 14) species A is more competitive for a resource than species B, and it will eventually dominate or replace species B. In Model IIb (Figure 15) species B is the more competitive.

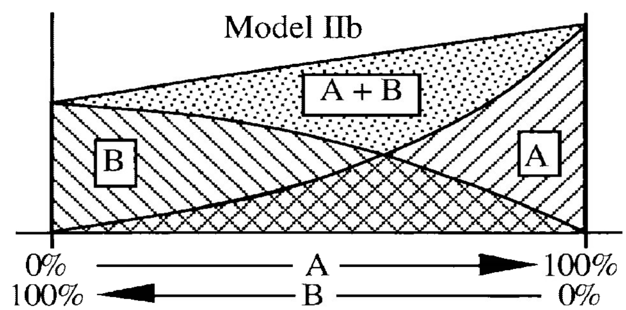


Figure 15. Interference Models IIb (from Harper, 1977).

Model III (Figure 16) - neither species contributes its expected share to the total yield. This is the case of mutual antagonism. Harper indicates that if each species damages the environment of the other more than its own, such a situation would exist.

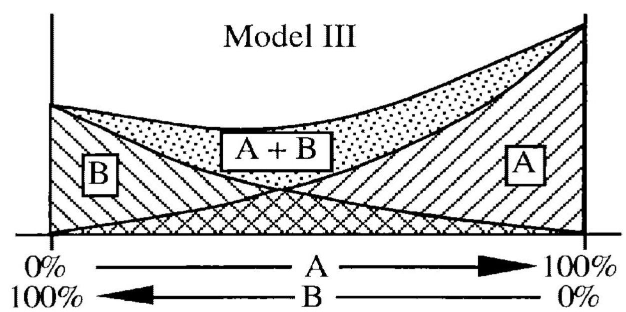


Figure 16. Interference Model III (from Harper, 1977).

Model IV (Figure 17) - both species provide more to the total yield than either one alone. This could be the result of symbiosis (mutual gain by each species), or it could indicate the escape of each species from competition with each other.

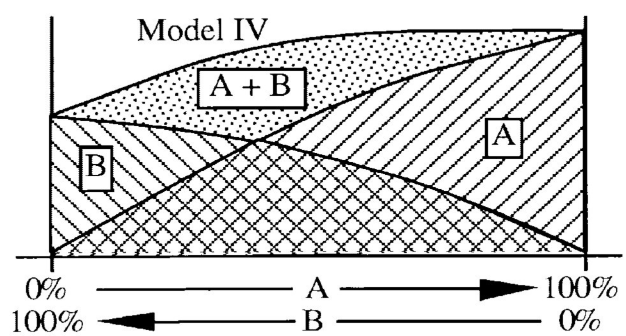


Figure 17. Interference Model IV (from Harper, 1977).

The advantage of the substitutive design is its predictiveness. This design, if properly implemented, can be used to determine which of two species grown in combination is the more aggressive. It can also be used to predict the approximate number of generations required for the more aggressive species to replace the other in a mixed stand.

A formal measure of aggressiveness of one species towards another can be derived from the results of a replacement series. This measure, the relative crowding coefficient (RCC), is expressed in terms of yield (equivalent to the net biomass of each competing plant) by (Harper, 1977):

$$RCC_{A:B} = \frac{Y_{Am}}{Y_{Bm}} * \frac{Y_{Ap}}{Y_{Bp}}$$

where: $RCC_{A:B}$ = The relative crowding coefficient of species A with respect to species B;

Y_{Am} = the mean yield per plant of species A in the mixture;

Y_{Bm} = the mean yield per plant of species B in the mixture;

Y_{Ap} = the mean yield per plant of species A in pure stand; and

Y_{Bp} = the mean yield per plant of species B in pure stand.

The RCC relationship exists when the yield in mixture can be determined from the yield of each grown separately. High values for the RCC indicate high degrees of competitiveness for one species with respect to the other (Radosevich and Holt, 1984).

If combined yields for both species in mixture cannot be predicted from pure stands of each, the relative crowding coefficient is inappropriate (Harper, 1977). A more appropriate measure would be Relative Yield (RY):

$$RY = \frac{Y_{Am}}{Y_{Ap}}$$

where Y_{Am} and Y_{Ap} are the same as in the RCC equation.

The RY values for both species are summed to comprise the RY total (RYT). This RYT predicts whether the two species are competing for the same resource(-s). RYT values of approximately 1.0 indicate that the same resource is being used by both species. Values less than 1.0 suggest mutual antagonism, and values greater than 1.0 suggest that the species either are not competing, are making different demands on resources, or have a symbiotic relationship with each other (Harper, 1977).

C. Systematic Designs

Systematic designs were first used by Nelder (1962) for single species spacing studies. In such designs, both the plant density and the arrangement of individuals in relation to each other is considered. Plants may be grown in a circular grid pattern (Figure 18) or in a series of parallel lines so that the area per plant (position) changes in a consistent fashion over the different parts of the grid (*i.e.* as they move outward radially from the centre). Both designs have the advantage of providing a wide range of plant densities without changing the pattern of arrangement (Radosevich and Holt, 1984). Nelder designs have not been widely used to study interspecific interactions. They may be used, however, to assess the effects of total plant density and single or multiple proportions of species with this design. These designs are particularly suited for competition studies in row crops which display definite spatial arrangements and for intercropping studies.

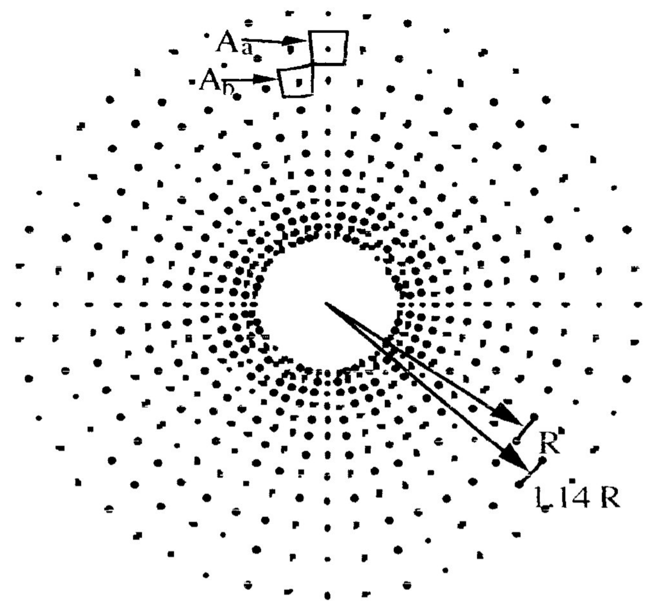


Figure 18. Typical 48-spoke Nelder plot with a 30% increase in area per plant per arc ($A_a = 1.3 \times A_b$).

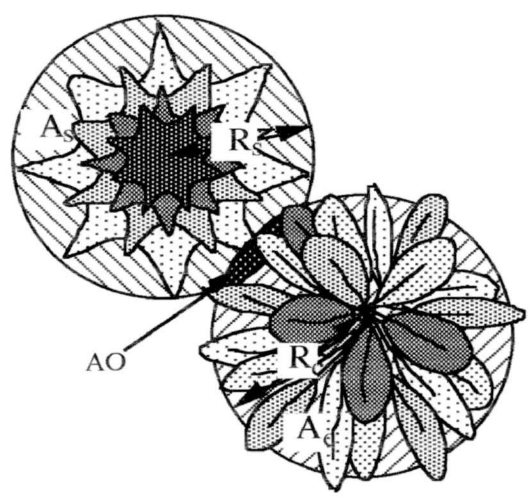
Economic Injury and Threshold

It is important to know the point at which the influence of competing vegetation becomes great enough to justify control measures. This condition is explained by two concepts: economic injury level and economic threshold level. The economic injury level is defined as the lowest density or size of a competitor population that will cause economic damage. The economic threshold refers to the level of competitor population at which control measures should be initiated to prevent an increasing competitor population from reaching the economic injury level.

HYPOTHESIS

Assumptions

- Plants growing in a restricted environment will interact in one of ten possible ways; competition is only one of those ways.
- The available resources required for plant growth at a given site are limited.
- If plants generate demands for more resources than their sites can provide, then the plants will compete with each other for these resources.
- The total demand for resources on a given site fluctuates with the species of competitor.
- Resource competition can inhibit the growth and development of individual plants or cause the death of one or more of the competitors.
- The degree of growth and development inhibition of an individual plant varies inversely with the amount of resources available to it (*i.e.* more resources ⇒ less inhibition).
- The distance at which a competitor begins to exert a significant effect on the survival, growth and/or development of a subject tree can be termed its radius of influence (Figure 19).
- The area of influence of a competitor is that centered on the plant exerting its influence over a particular resource or set of resources and for which the dimensions are determined by the radius of influence (Figure 19).
- Above-ground dry weight is a good estimator of total plant biomass.



Legend

Rs = the radius of influence of the subject tree
Rc = the radius of influence of the competitor
As = the area of influence of the subject tree
Ac = the area of influence of the competitor
AO = the area of influence overlap of the subject tree and the competitor

Figure 19. Radius of Influence

Hypothesis Statement

The growth of a juvenile tree is influenced by the growth and development of other vegetation close to it. This relationship is:

a) dependent on the species of the other vegetation,

b) affected by the size and relative abundance of the other vegetation nearby,

c) inversely proportional to the distance separating the tree from other vegetation, and

d) can be measured by its effect on a quantifiable characteristic of the tree.

MATERIALS AND METHODS

Concept

It was decided that a field survey would provide the best test for the hypothesis. Accordingly, the author approached the staff of the Northwest Ontario Forest Technology Development Unit (NWOFTDU; now the Northwest Region Science and Technology Unit) in Thunder Bay for advice and assistance. During a series of discussions in April, 1993, it was decided that the hypothesis could best be tested at a reasonably uniform site with a known management history.

Site

The NWOFTDU staff took the author to a herbicide efficacy trial established in 1989. This was located on Abitibi-Price Freehold land at 49° 23 North, 89° 17 West, (Grid Reference 345725 on map 52H/6 (Cheeseman Lake) of the National Topographic System), approximately eight kilometres east of highway 527 (Armstrong Road) and about 120 km north of Thunder Bay (Figure 20). Until 1986, this upland site had supported a very productive stand of mixed white spruce (*Picea glauca*), black spruce (*P. mariana*), white birch (*Betula papyrifera*) and balsam fir (*Abies balsamea*). Scattered throughout the stand were clusters of eastern white cedar (*Thuja occidentalis*). This site would most likely have been classified under the Northwestern Ontario Forest Ecosystem Classification (NWO FEC) system as vegetation type V14 (balsam fir – mixedwood) or V16 (balsam fir – white spruce mixedwood / feather moss) (Sims *et al.*, Undated). The soil is classified (NWO FEC) as S3 (fresh / coarse loamy) and SS6 (shallow to

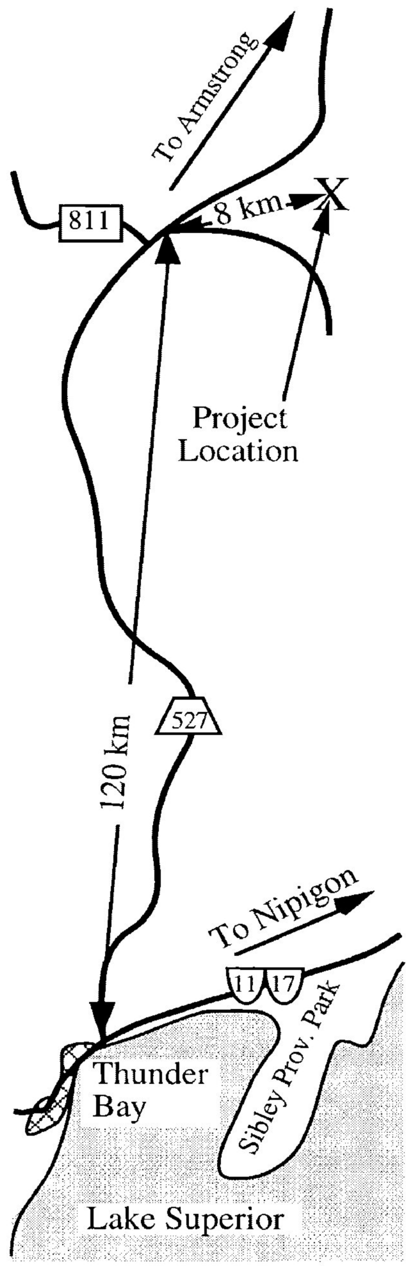


Figure 20. Location of the Project.

moderately deep / coarse loamy) on gently rolling terrain.

Most of the covering stand was clear-cut in the spring of 1986, and the balance in 1987. The site was prepared with a TTS disk trencher in August, 1988. Before the application of herbicides, the most abundant competitive species were raspberry, (*Rubus idaeus*), beaked hazel (*Corylus cornuta*), mountain maple (*Acer spicatum*), white birch, fireweed (*Epilobium angustifolium*), bluejoint grass, (*Calamagrostis canadensis*), and various sedges (*Carex* spp.) (Buse, 1992)

On this site a trial had been established to evaluate the effectiveness of various herbicides employed as site preparation agents for the planting and shelter seeding (under plastic cones) of black spruce and jack pine (*Pinus banksiana*). The trial was set up with five two-hectare treatment blocks. Within each block, three replicated rectangular plots, each divided into four quadrats, were established. Each quadrat contained 25 planting spots and 25 seeding spots for each of 1990 and 1991. The herbicides were applied in the summer of 1989, aerially and by skidder-mounted sprayers. Planting and shelter-seeding were carried out in mid-May 1990 and early June 1991.

Procedures

This study was carried out in four phases:

Phase 1 - (Preliminary preparation):

1) Prepared the plan of action, developed the procedures to be used, and devised an appropriate tally form (Appendix A).

2) Liaised with relevant TDU personnel for maps, background information, field assistance, logistic support, permission to sample (non-destructively and destructively), and access to raw data collected earlier.

3) Organized and collected the materials required for the survey.

Phase 2 - (In the Field):

4) Conducted a preliminary reconnaissance of all of the blocks.

5) Within each block, identified the existing plots.

6) Established 110 sample plots, each with a radius of 1.13 m and centred on subject jack pine (crop trees) within the treatment blocks but <u>outside the existing plots</u>. Similar procedures were used to those described by Towill and Archibald (1991). These plots were established on the basis of ten per treatment for each of replicates one and three. An additional ten plots were collected within one of the treatments in replicate two. A sketch of each plot was prepared on a tally form (Appendix A), showing the relative positions, area occupied, and height of each major plant species in the plot. Within each sample plot, the following data were recorded:

   a) The crop tree height (to the nearest cm), the stem diameter at $1/3^{rd}$ of the seedling height[1], the crown width (two perpendicular measures), and general remarks about the seedling (if any).

   b) The identity, average height, and per cent coverage of the plot of each of the non-crop species.

   c) Using a 31.6 cm × 31.6 cm (1 000 cm^2 or 0.1 m^2) "U" shaped plywood frame to delineate the sampling boundaries, one or two biomass samples of a principal non-crop species (one occupying more than 10% of the plot), were collected. The boundaries were extended vertically upwards from the ground, and all material crossing these vertical bounds were cut off. The non-crop species stems were then cut at ground level. All of the cut material was further sectioned into 10 to 15 cm lengths, put into brown paper bags and tagged. The tags and bags were then marked with a code of the form shown in Figure 21.

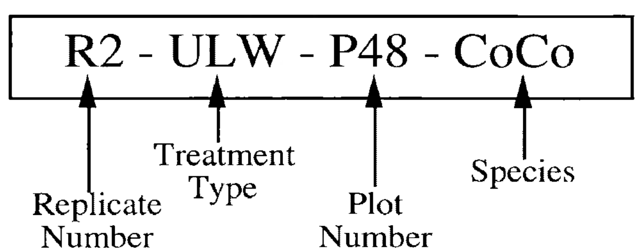


Figure 21. Specimen bag and tag coding as applied to biomass samples.

7) Because of a prohibition imposed by the NWOFTDU on destructive sampling of crop trees within the blocks, another ten sample plots were established around jack pine saplings established <u>outside</u> the peripheries of the treatment blocks. These plots were established in order to develop correlations between the

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1 On the advice of the staff at the Northwestern Ontario Forest Technical Development Unit. Explanation to follow.

jack pine height, height increment, stem diameter, stem volume, crown area, and crown volume with its dry weight. This number was limited by the infrequent occurrence of identifiable, suitable jack pine along the peripheries of the treatment blocks. In these plots, the same biomass collection procedures were followed as above, except that the entire crop trees were cut, bagged, tagged, and coded instead of the non-crop species.

8) All of the samples were subsequently taken to the laboratory.

<u>Phase 3</u> - <u>(In the Laboratory)</u>:

9) The samples were set out on a lab bench in their bags, and left to begin drying. Several samples were weighed in their fresh state and placed in a kiln at 70°C and weighed periodically until a steady (dry biomass) weight was achieved. This took from 10 to 14 hours per batch.

10) Each sample was then removed from the kiln and weighed, and the dry biomass weights were recorded.

11) The biomass data were then entered on an Excel® file in the computer.

<u>Phase 4</u> - <u>(Analysis):</u>

12) Stem volumes, crown areas and crown volumes for each jack pine crop tree were calculated. The stem volumes were determined by the procedure described later. Crown areas for each of the sample plot jack pines (A_C) in square metres were derived from modified area equations for a circle:

$$A_C = \frac{\pi \times \left(\frac{W_{CX}}{2}\right) \times \left(\frac{W_{CY}}{2}\right)}{10\ 000}$$

$$= 7.854 \times 10^{-5} \times W_{CX} \times W_{CY}$$

where: W_{CX} = a typical crown width of the jack pine in centimetres, and

W_{CY} = another crown width of the jack pine in centimetres set at right angles to the first.

The crown volumes for jack pine (V_C) in cubic decimetres are also calculated from the volume equations for a cone:

$$V_C = \frac{10 \times H \times A_C}{3}$$

where: H = the height (in centimetres) of the crop tree.

13) Correlation coefficients (**r**) based on simple linear correlations were calculated for each of the $15 \times 4 \times 3 \times 7$ or 1260 combinations of summarized field data shown in Table 4 using Cricket Graph®. The regressions were obtained with the jack pine parameters as dependent variables and the non-crop species measurement-ring combinations as independent variables. This arrangement was selected because the main concern is about the performance of jack pine as a function of the relative abundance of the non-crop species, not *vice versa.* The results are presented in Appendix D2.

Table 4. Combinations of data used for regressions in the project.

	SPECIES	MEASUREMENT	RING	SUBJECT TREE PARAMETER
1	*Epilobium angustifolium*	Average height	Inner	Height
2	*Calamagrostis canadensis*	Ground cover	Outer	Height increment
3	*Carex* spp.	Above ground volume	Both	Stem diameter
4	Minor herb species (MHS)	Dry weight		Stem volume
5	All Herb Species (AHS)			Crown area
6	*Rubus idaeus*			Crown volume
7	*Corylus cornuta*			Dry weight
8	*Prunus pensylvanica*			
9	Natural *Pinus banksiana*			
10	*Betula papyrifera*			
11	*Acer spicatum*			
12	*Alnus crispa*			
13	Minor woody species (MWS)			
14	All Woody Species (AWS)			
15	Total Plant Species (TPS)			

14) Last, the collected data were re-analyzed using Towill and Archibald's (1991) Competition Index methodology. This was done to determine if the procedure would accurately and effectively assess the degree of competition in the plantation.

Jack Pine Stem Measurement

Measuring and recording jack pine stem diameter at 1/3rd of the stem height from the ground as recommended for this study by the staff of the NWOFTDU has two reasons. For juvenile trees (less than six metres in height) growing on weed-infested sites with rough ground surfaces, measurement of tree diameters at 1/3rd of the stem height from the ground is easier than determining the diameter at the root collar, the only other reliable diameter measurement for stem volume estimation in juvenile trees. Secondly, the measurement at 1/3rd of the stem height from the ground avoids the effect of seedling basal swell at the root collar, which tends to inflate the stem volume estimates.

The relationship between the stem diameter at 1/3rd of the stem height from the ground to that at the base of the stem is a straight-forward mathematical one as illustrated in Figure 22. Assuming that the stem volume of a juvenile jack pine approximates that of a regular cone, then the formula for the volume of a cone (**V**) would apply, i.e.:

$$\mathbf{V} = \frac{\mathbf{H} \times \pi \times \mathbf{r^2}}{\mathbf{3}}$$

where: H = the overall height of the cone (stem),
π = the ratio of the circumference of a circle to its diameter,
= 3.14159..., and
r = the radius of the base of the cone
= 1/2 × Diameter of the base of the cone (D).

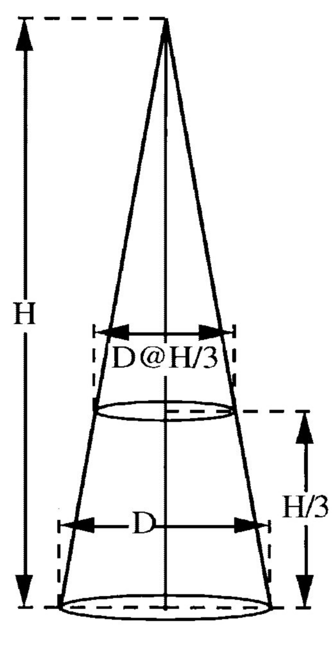

Figure 22. Proportions of a cone used for determining juvenile jack pine stem and crown volume.

The ratio of the diameter of the base of the cone (D) to its diameter at 1/3rd the height ($D_{@H/3}$) is constant at 3:2 (or 1.5:1). Substituting the diameter at 1/3rd the height for the diameter at the base, then, provides a volume for the stem in cubic centimetres (V_S):

$$\mathbf{V_s} = \frac{\mathbf{H} \times \pi \times \left(\frac{\mathbf{1.5} \times \mathbf{D_{@H/3}}}{\mathbf{2} \times \mathbf{10}}\right)^{\mathbf{2}}}{\mathbf{3}}$$

$$= \mathbf{0.00589} \times H \times \mathbf{D^2}_{@ H/3}$$

where: H = the overall height of the stem in centimetres, and

$D_{@H/3}$ = the diameter of the stem in millimetres at one-third of the height of the stem from the ground.

This is the volume equation that is applied to the field measurements to derive the stem volumes for the jack pine measured in the project.

For the crown volume, a different assumption prevails. Although also considered to be conical, it is recognized that the crown has diameters which are not measured at ground level, but at a point above the ground. For operational simplicity, vertical projections of the maximum extension of the crown down to the ground are used as the diameters. This may mean that a cone will not accurately estimate the volume of the crown. It is, however, the best readily obtained estimator for the above-ground volume of a juvenile conifer, and provides an approximation which is significant as a relative measure of above-ground crown volume for all of the jack pines in the project.

Towill and Archibald's (1991) Competition Index

It was decided to relate the data collected in this study to a locally developed measure of competition, Towill and Archibald's (1991) Competition Index (CI). This is an index designed for northwestern Ontario conditions by staff of the Northwestern Ontario Forest Technology Development Unit at Thunder Bay. Its purpose was to assess competition on recently-established juvenile stands in an objective, easily-understood and applied, crop tree-centred procedure.

Based on a 1.13 m radius plot (4 m^2) the CI requires the following measurements: (a) crop tree total height, (b) crop tree current height increment, (c) total heights for each non-crop species and the per cent coverage of the plot by each non-crop species. Because coverage is tallied by species and height classes and often overlaps, the total percentage may exceed 100.

The plot is divided into equal quadrants and the coverage of each species is estimated by quadrant and summed. The accuracy of the coverage is assumed to be within five per cent. Isolated individual non-crop species stems which might have less than one per cent of ground coverage are tallied as having one per cent ground cover. A representative plot is described in Figure 23.

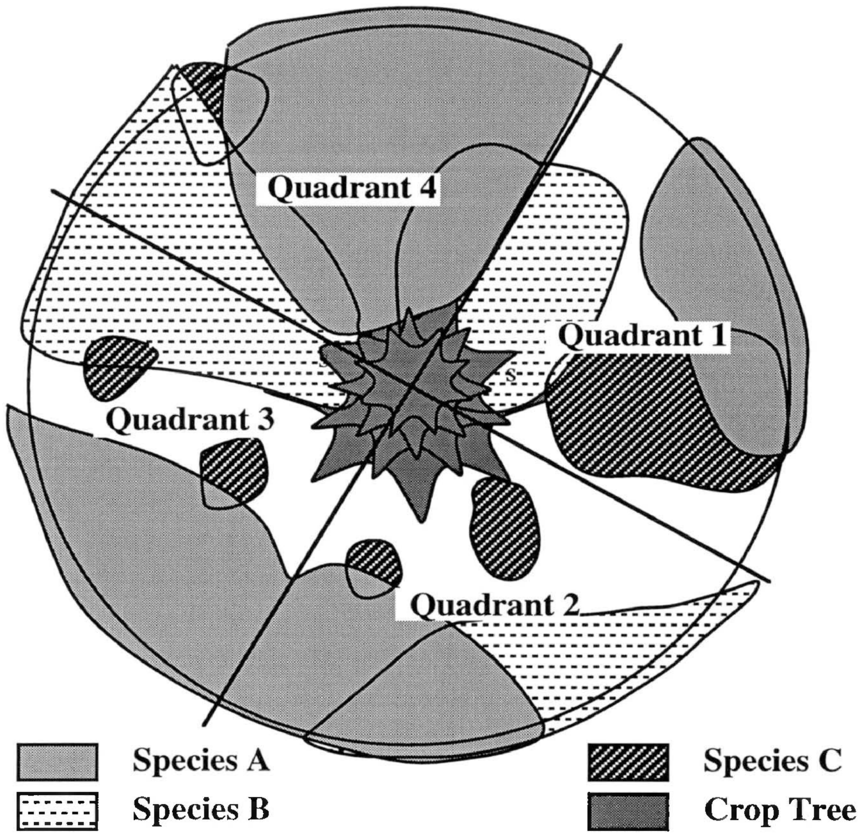

Figure 23. The relative abundance of non-crop species is determined from the per cent coverage of the plot (from Towill and Archibald, 1991).

Non-crop species heights are approximated and averaged from quick measurements of representative stems within the plots. An example taken verbatim from the methodology described by Towill and Archibald follows:

Trembling aspen:

Height (m)	Average (m)	Coverage (%)
1.5, 1.7, 1.9	1.7	35
1.0, 1.3, 0.7	1.0	10
0.3, 0.5, 0.4	0.4	3
Average:	"0.9"	"47"

For each plot and each non-crop species, its per cent cover and average height are multiplied to yield its growing space volume. This volume is termed the vegetation index. At the stand or plantation level, the vegetation index for each non-crop species (VI_i) is calculated from the average height and per cent cover for that species over all of the plots within the stand or plantation. The individual species competition index (CI) is derived by multiplying the VI_i by the B:C ratio of the average heights of the non-crop (B) species to the crop (C) species. The Towill and Archibald's (cumulative) competition index (CCI) for all of the non-crop species is the sum of the individual competition indices for each non-crop species. Proceeding from the example provided above (where the height of the crop tree may be taken as 0.39 m):

Vegetation Index for the i^{th} Non-Crop Species (VI_i)

	=	**Average Individual Non-Crop Species Height (H_i) × Its Per Cent Coverage (C_i)**
(*e.g.*)	=	**0.9 × 47**
	=	**42.3**

B:C ratio	=	**Average Individual Non-Crop Species Height (H_i) / Crop Tree Height (H_j)**
(*e.g.*)	=	**0.9 / 0.39**
	=	**2.3**

Individual Species Competition Index (CI_i)

	=	**Vegetation Index × B:C Ratio**
(*e.g.*)	=	**42.3 × 2.3**
	=	**97.3**

Towill and Archibald's (Cumulative) Competition Index (CCI)

$$= \sum_{i=1}^{n} CI_i$$

where: i = 1, 2, 3, ..., n, and

n = the number of non-crop species.

RESULTS

Jack Pine Measurements

The heights, height increments, stem diameters, stem volumes, and crown widths of the subject tree jack pine are presented in Appendix B1. The totals, counts, averages, and standard deviations of the jack pine measurements collected from the 110 ordinary sample plots established within the treatment blocks are presented in Table 5.

Table 5. Measurement statistics for jack pine in 110 ordinary sample plots established within the study area.

	Height (cm)	Height Incr. (cm)	Stem Diam.[1] (mm)	Stem Volume (cm^3)	Crown width X (cm)	Crown width Y (cm)	Crown Area (m^2)	Crown Volume (dm^3)
Total	13487	5094	1539	19391	7756	7074	44.65	20903
Count	110	110	110	110	110	110	110	110
Average	123	46	14.0	176	71	64	0.41	190
Std Dev	31	13	4.6	145	27	27	0.30	168

It should be noted that the averages of the derived values presented above (i.e. stem volume, crown area and crown volume) are not the same as the values that would be obtained using the averages of the measured parameters in the derivative equations. This is because the averages of the stem volume, crown area and crown volume in Table 5 are not derived from the other statistics, but are, as indicated, the averages of the derivations calculated for the individual crop trees.

Peripheral Jack Pine Measurements

Because of the non-destructive sampling constraint imposed upon the project, it was decided to use the dry weights of ten neighbouring plantation jack pine to represent those of the full (n = 110) sample. These saplings were located immediately outside the boundaries of the treatment blocks. The measured and derived parameter data are presented in Table 6.

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[1] at one-third height

Table 6. Field and Laboratory measurements of 10 jack pine (*Pinus banksiana*) saplings from the special plots established outside the treatment blocks but within the plantation.

Plot #	Height (cm)	Height Incr. (cm)	Stem Diam.[2] (mm)	Stem Vol. (cm^3)	Crown width X (cm)	Crown width Y (cm)	Crown Area (m^2)	Crown Vol. (dm^3)
SP - 1	187	55	23.0	583	135	135	1.43	891
SP - 2	175	46	21.5	477	100	110	0.86	502
SP - 3	144	60	18.0	275	95	95	0.71	341
SP - 4	181	43	18.0	345	70	90	0.49	296
SP - 5	148	53	20.0	349	80	80	0.50	247
SP - 6	131	55	14.9	171	80	80	0.50	218
SP - 7	157	52	21.9	444	100	100	0.79	413
SP - 8	143	50	15.5	202	90	70	0.49	234
SP - 9	178	30	26.5	736	120	110	1.04	617
SP - 10	126	48	20.2	303	70	70	0.38	160
Total	1570	492	199.5	3885	940	940	7.21	3919
Count	10	10	10	10	10	10	10	10
Average	157	49	20	389	94	94	0.72	392
Std Dev	22	8.3	3.5	175	21	21	0.32	225

In order to test whether the sample of peripheral jack pine adequately represents the within-block population, the test for the difference between two means described by Zar (1974) was applied. The null hypothesis for each case was that the averages for the large sample (n = 110) and the small sample (n = 10) data presented in Tables 5 and 6 respectively are equivalent to each other. The test consists of:

$$\textbf{Student's t} = \frac{\ddot{Y}_A - \ddot{Y}_B}{S_{\ddot{Y}_A - \ddot{Y}_B}}$$

where: $\ddot{Y}_i$ = the sample mean,

i = A, B

$S_{\ddot{Y}_A - \ddot{Y}_B}$ = the standard error of the difference between the means,

$$= \sqrt{s_p^2\left(\frac{1}{n_A} + \frac{1}{n_B}\right)},$$

2 at one-third height

s_p^2 = the pooled variance,

$$= \frac{SS_A + SS_B}{v_A + v_B},$$

n_i = the number of elements within the i^{th} sample,

SS_i = the sum of squares of the i^{th} value, and

v_i = the degree of freedom for the i^{th} value.

The data for the two samples are listed in Table 7.

Table 7. Summary data for the large (n = 110) and small (n = 10) samples of jack pine and pooled data for both samples.

	Height (cm)	Height Incr. (cm)	Stem Diam. (mm)	Stem Volume (cm^3)	Crown width X (cm)	Crown width Y (cm)	Crown Area (cm^2)	Crown Volume (dm^3)
	Sample A (Large; n = 110)							
Σ_A	13487	5094	1539	19391	7756	7074	44.65	20903
n_A	110	110	110	110	110	110	110	110
v_A	109	109	109	109	109	109	109	109
$\ddot{Y}_A$	123	46	14.0	176.3	70	64	0.41	190
σ_A	31.4	12.5	4.61	144.8	26.6	26.9	0.295	168
SS_A	107000	17000	2320	2290000	77100	78900	9.49	3080000
	Sample B (Small; n = 10)							
Σ_B	1570	492	199.5	3885	940	940	7.21	3919
n_B	10	10	10	10	10	10	10	10
v_B	9	9	9	9	9	9	9	9
$\ddot{Y}_B$	157	49	20	389	94	94	0.72	392
σ_B	22	8.3	3.5	175	21	21	0.32	225
SS_B	4320	620	110	276000	3970	3970	0.922	456000
	Pooled data							
s_p^2	943	149	20.6	21700	687	702	0.0882	30000
$s_{\ddot{Y}_A - \ddot{Y}_B}$	10.1	4.03	1.50	48.7	8.66	8.75	0.0981	57.2

The rejection regions for the null hypotheses, *i.e.* that the estimated parameter means for the small sample (n = 10) are equal to the estimated parameter means for the large sample (n = 110), at $v_A + v_B = 109 + 9 = 118$ degrees of freedom and various significance values of the confidence level (α) are presented in Table 8:

Table 8. Rejection regions ($t_{\alpha(2)}$) for 118 degrees of freedom and various significance values of the confidence level (α) (from Zar, 1974).

α:	0.500	0.200	0.100	0.050	0.020	0.010	0.005	0.002	0.001
$\|t\|$:	0.677	1.289	1.658	1.980	2.358	2.618	2.861	3.161	3.375

For our large and small samples, then (Table 9):

Table 9. Student's t values and deductions for specific measured parameters for the small sample (n = 10) of jack pine saplings compared to those from the large sample (n = 110).

Parameter	Student's t Value	Deduction	Conclusion
Tree Height	$\frac{123 - 157}{10.1} = -3.37$	$P(\|t\| \geq 3.37) < 0.002$ and > 0.001	Accept only at confidence levels ≥ 99.9%.
Height Increment	$\frac{46 - 49}{4.03} = -0.744$	$P(\|t\| \geq 0.744) < 0.500$ and > 0.200	Accept at confidence levels ≥ 80%.
Stem Diameter	$\frac{14.0 - 20}{1.50} = -4.00$	$P(\|t\| \geq 4.00) < 0.001$	Reject at all confidence levels
Stem Volume	$\frac{176.3 - 389}{48.7} = -4.36$	$P(\|t\| \geq 4.36) < 0.001$	Reject at all confidence levels
Crown Width X	$\frac{70 - 94}{8.66} = -2.77$	$P(\|t\| \geq 2.77) < 0.010$ and > 0.005	Accept only at confidence levels ≥ 99.5%.
Crown Width Y	$\frac{64 - 94}{8.75} = -3.43$	$P(\|t\| \geq 3.43) < 0.001$	Reject at all confidence levels
Crown Area	$\frac{0.41 - 0.72}{0.0981} = -3.16$	$P(\|t\| \geq 3.16) < 0.005$ and > 0.002	Accept only at confidence levels ≥ 99.8%.
Crown Volume	$\frac{190 - 392}{57.2} = -3.53$	$P(\|t\| \geq 3.53) < 0.001$	Reject at all confidence levels

Peripheral Jack Pine Sub-sampling

The preceding t- tests indicated very low levels of acceptance for almost all of the small sample (n = 10) parameters (except height increment) to represent the large sample (n = 110) appropriately. Consequently, in order to obtain a sub-sample of the peripheral jack pine which are more similar to the saplings comprising the large sample of jack pine, the small sample set was reconstituted. For each parameter, the five jack pine of the small sample with parameter values closest to those of the population mean were selected to form a sub-sample (n = 5). This yielded the following sub-samples (Table 10):

Table 10. Field measurements and derivatives of sub-samples of five jack pines selected from the small sample (n = 10) on the basis of proximity to the large sample (n = 110) means.

Plot #	Height (cm)	Height Incr. (cm)	Stem Diam. (mm)	Stem Vol. (cm^3)	Crown width X (cm)	Crown width Y (cm)	Crown Area (m^2)	Crown Vol. (dm^3)
$\ddot{Y}_{(n=110)}$	126	46.6	14.4	191.8	72.5	66.8	0.43	207
SP - 1								
SP - 2		46						
SP - 3	144		18.0	274.8				
SP - 4		43	18.0	345.4	70	90	0.49	296
SP - 5	148		20.0		80	80	0.50	247
SP - 6	131		14.9	171.3	80	80	0.50	218
SP - 7		52						
SP - 8	143	50	15.5	202.4	90	70	0.49	234
SP - 9								
SP - 10	126	48		302.8	70	70	0.38	160
Total	692	239	86.4	1296.7	390	390	2.36	1155
Count	5	5	5	5	5	5	5	5
Average	138	48	17.3	259.3	78	78	0.47	231
Std Dev	9.40	3.5	2.08	71.6	8.4	8.4	0.052	49.2

Reapplying Student's t-test to this selected data would then yield the results shown in Table 11.

Table 11. Summary data for the large (n = 110) sample and small (n = 5) sub-sample of jack pine and pooled data for both samples.

	Height (cm)	Height Incr. (cm)	Stem Diam. (mm)	Stem Volume (cm^3)	Crown width X (cm)	Crown width Y (cm)	Crown Area (m^2)	Crown Volume (dm^3)
	Sample A (Large; n = 110)							
Σ_A	13487	5094	1539	19391	7756	7074	44.65	20903
n_A	110	110	110	110	110	110	110	110
ν_A	109	109	109	109	109	109	109	109
$\ddot{Y}_A$	123	46	14.0	176.3	70	64	0.41	190
s_A	31.4	12.5	4.61	144.8	26.6	26.9	0.295	168
SS_A	107000	17000	2320	2290000	77100	78900	9.49	3080000

Table 11. Summary data for the large (n = 110) sample and small (n = 5) sub-sample of jack pine and pooled data for both samples (continued).

	Height (cm)	Height Incr. (cm)	Stem Diam. (mm)	Stem Volume (cm^3)	Crown width X (cm)	Crown width Y (cm)	Crown Area (m^2)	Crown Volume (dm^3)
	Sample C (n = 5)							
Σ_C	692	239	86.4	1296.7	390	390	2.36	1155
n_C	5	5	5	5	5	5	5	5
ν_C	4	4	4	4	4	4	4	4
$\ddot{Y}_C$	138	48	17.3	259.3	78	78	0.47	231
s_C	9.40	3.5	2.08	71.6	8.4	8.4	0.052	49.2
SS_C	353	49.0	17.3	20500	282	282	0.0108	9680
	Pooled data							
s_p^2:	950	151	20.7	20400	685	701	0.0841	27300
$S_{\ddot{Y}_A - \ddot{Y}_C}$:	14.1	5.62	2.08	65.3	12.0	12.1	0.133	75.6

The rejection regions for the null hypotheses, *i.e.* that the parameter means for the sub-sample (n = 5) are equal to the parameter means for the large sample (n = 110), at $\nu_A + \nu_C = 109 + 4 = 113$ degrees of freedom and various significance values of the confidence level (α) are presented in Table 12.

Table 12. Rejection regions ($t_{\alpha(2)}$) for 113 degrees of freedom and various significance values of the confidence level (α) (from Zar, 1974).

α:	0.500	0.200	0.100	0.050	0.020	0.010	0.005	0.002	0.001
$\lvert t \rvert$:	0.677	1.289	1.658	1.981	2.360	2.620	2.863	3.164	3.379

For the selected sub-samples, then (Table 13):

Table 13. Student's t values and deductions for specific measured parameters for the sub-samples (n = 5) of jack pine saplings compared to those from the large sample (n = 110).

Parameter	Student's t Value	Deduction	Conclusion
Height	$\frac{122.6 - 138.4}{14.1} = -1.12$	$P(\lvert t \rvert \geq 1.12) < 0.500$ and > 0.200	Accept at confidence levels ≥ 80%.
Height Increment	$\frac{46.3 - 47.8}{5.62} = -0.267$	$P(\lvert t \rvert \geq 0.267) > 0.500$	Accept at confidence levels ≥ 50%.
Stem Diameter	$\frac{14.0 - 17.3}{2.08} = -1.59$	$P(\lvert t \rvert \geq 1.59) < 0.200$ and > 0.100	Accept at confidence levels ≥ 90%.

Table 13. Student's t values and deductions for specific measured parameters for the sub-samples (n = 5) of jack pine saplings compared to those from the large sample (n = 110) (continued).

Parameter	Student's t Value	Deduction	Conclusion
Stem Volume	$\frac{176.3 - 259.3}{65.3} = -1.27$	$P(\lvert t\rvert \geq 1.27) < 0.500$ and > 0.200	Accept at confidence levels ≥ 80%
Crown Width X	$\frac{70.5 - 78.0}{12.0} = -0.625$	$P(\lvert t\rvert \geq 0.625) > 0.500$	Accept at confidence levels ≥ 50%
Crown Width Y	$\frac{64.3 - 78.0}{12.1} = -1.13$	$P(\lvert t\rvert \geq 1.13) < 0.500$ and > 0.200	Accept at confidence levels ≥ 80%
Crown Area	$\frac{0.41 - 0.47}{0.133} = -0.451$	$P(\lvert t\rvert \geq 0.451) > 0.500$	Accept at confidence levels ≥ 50%
Crown Volume	$\frac{190.0 - 234.0}{75.6} = -0.582$	$P(\lvert t\rvert \geq 0.582) > 0.500$	Accept at confidence levels ≥ 50%

Correlating Jack Pine Dry Weight to its Field Measurements

In order to compare individual parameter trends with dry weight for the different sample sizes, simple linear correlations were used. The dried weights of the small sample (n = 10) and selected sub-sample (n = 5) of jack pine (Appendix B-1) were correlated with their field measurements to yield a range of correlation coefficients (**r**). These correlations and their coefficients are presented in Figure 24.

The significance of the correlation coefficient values shown in the graphs of Figure 24 are illustrated by the graph shown in Figure 25. The critical $\mathbf{r}_{\alpha(2)}$ values at various significance values[3] (α) on which the graph in Figure 25 is based, are listed in Appendix D1. A graphic depiction of the critical **r** values *vs.* confidence levels for sample sizes n = 5 and n = 10 has been derived from the data in Figure 25 and is shown in Figure 26.

The dry weight *vs.* parameter equations, their correlation coefficients and confidence levels for each of the correlations presented in Figure 24 are listed in Table 14. Applying each of the equations derived from the parameters as standards for dry weight estimation to the small sample (n = 10) of jack pine yields estimates as shown in Table 15. The best (highest) correlated of these estimates is that based on stem volume. Since this

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[3] Here, 'significance value' (α) is used to describe the complement to confidence level, and is equal to 1 - (confidence level).

correlation does not extrapolate rationally for smaller stems (*i.e.* volumes < 150 cm^3), it was decided to use a linear correlation passing through the origin and Y = 194.3 g at X = 150 cm^3. The resulting conditional equation is the one which is applied to all of the large sample (n = 110) of jack pines as the determinant of their dry weights.

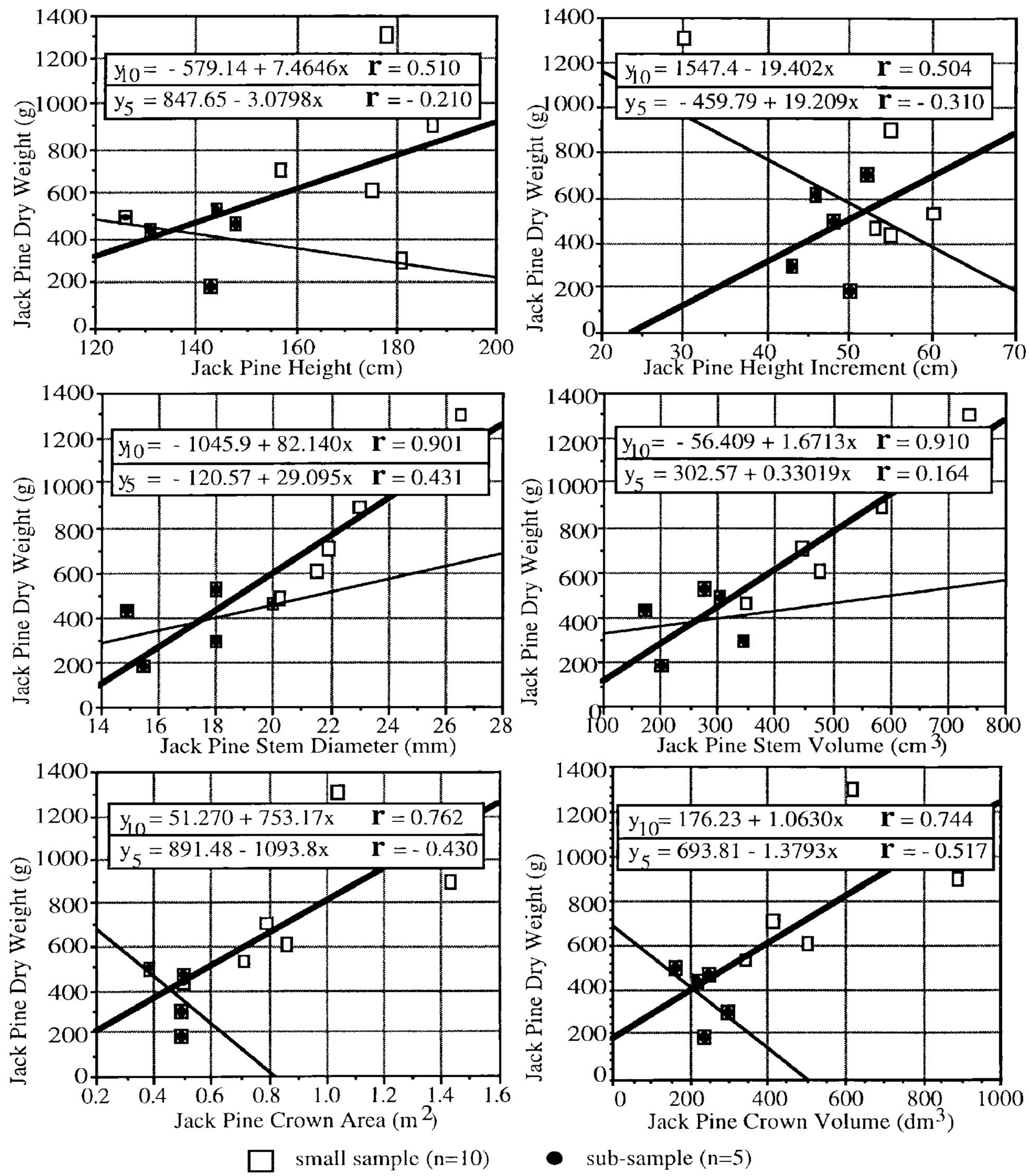


Figure 24. Best correlations for jack pine dry weight *vs.* various parameters for the small sample (n = 10) and selected sub-samples (n = 5).

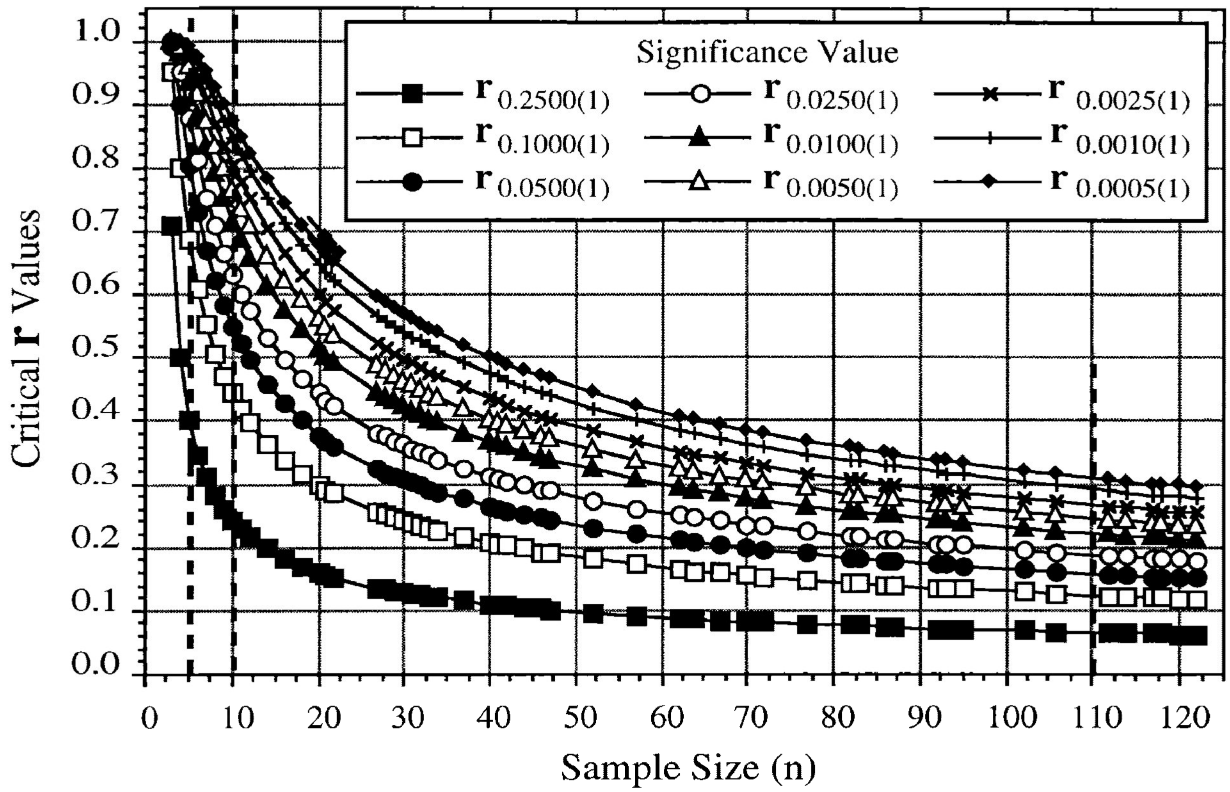


Figure 25 Correlation coefficients ($\mathbf{r}_{\alpha(1)}$) for sample sizes up to n = 122 at different significance values (α); sample sizes of 5, 10 and 110 delineated (derived from data tabulated in Zar, 1974).

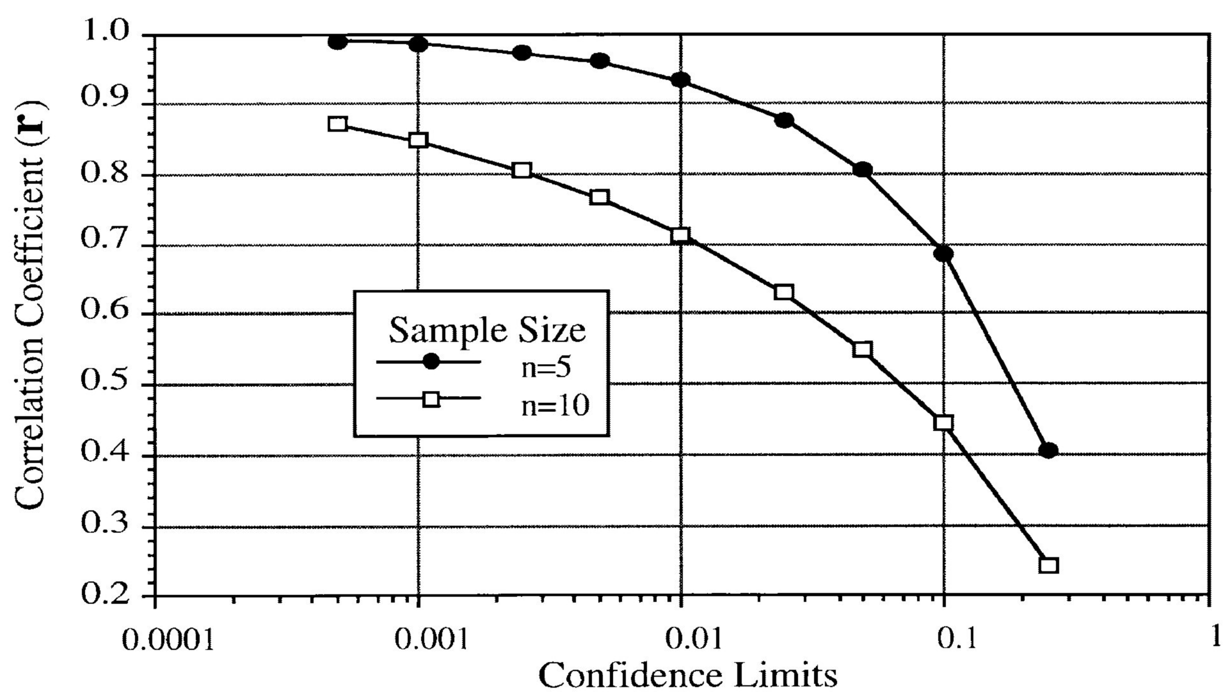


Figure 26. Correlation coefficients (**r**) *vs.* confidence limits for sample sizes of five and ten.

Table 14. Significance values and confidence limits for the best correlations of dry weight with measured and derived parameters for the small sample (y_{10}) and the sub-sample (y_5) of peripheral jack pine.

Parameter (x)	Jack pine Dry Weight (y_n) *vs.* Parameter (x_p)	r	Confidence Level
Height (x_1)	$y_{10} = -579.14 + 7.4646x_1$	0.510	90%
	$y_5 = 847.65 - 3.0798x_1$	-0.210	<75%
Height Increment (x_2)	$y_{10} = 1547.4 - 19.402x_2$	0.504	90%
	$y_5 = -459.79 + 19.209x_2$	- 0.310	<75%
Stem Diameter (x_3)	$y_{10} = -1045.9 + 82.140x_3$	0.901	99.95%
	$y_5 = -120.57 + 29.095x_3$	0.431	75%
Stem Volume (x_4)	$y_{10} = -56.409 + 1.6713x_4$	0.910	99.95%
	$y_5 = 302.57 + 0.33019x_4$	0.164	<<75%
Crown Area (x_5)	$y_{10} = 51.270 + 753.17x_5$	0.762	99%
	$y_5 = 891.48 - 1093.8x_5$	- 0.430	75%
Crown Volume (x_6)	$y_{10} = 176.23 + 1.0630x_6$	0.744	99%
	$y_5 = 693.81 - 1.3793x_6$	- 0.517	75%

Table 15. Dry weights estimated by indicated parameter standards for the small (n=10) sample of jack pine compared to the actual dry weights recorded in the laboratory (the weight estimate for each sample tree closest to the actual dry weight is emboldened).

Sample Tree Number	Actual Dry Wt. (g)	Parameter Standard Dry Weight Estimates (g)					
		Height	Height Incr.	Stem Diam.	Stem Volume	Crown Area	Crown Volume
1	**899**	817	480	843	**917**	1128	1123
2	**609**	727	**655**	720	740	699	710
3	**530**	496	383	433	403	586	**539**
4	**299**	772	713	433	521	**420**	491
5	**465**	526	519	597	526	428	**439**
6	**435**	399	480	178	230	**428**	408
7	**707**	593	538	753	**685**	646	615
8	**182**	488	577	**227**	282	420	425
9	**1307**	750	965	1131	**1174**	835	832
10	**495**	361	616	613	**450**	337	346
Total	**5928**	5929	5926	5928	5928	5927	5928
Count:	**10**	10	10	10	10	10	10
Average:	**593**	593	593	593	593	593	593
Std Dev:	**321**	164	162	289	**292**	245	239

Non-Crop Species Measurements

The field measurements for non-crop species are presented in Appendix B2. The collected measurements were very simple: average height, ground cover as a percentage of the four square metre plot area, and a product of average height and ground cover termed volume. Some samples of biomass were collected for each major non-crop species from a 0.1 m^2 ground area. These were subsequently dried, and weighed. The dry weight data are presented in Appendix C.

The crown volume (V_c) values for non-crop species plants (in dm^3) are calculated as if the plants' above-ground volumes approximate the shape of a cylinder:

$$\mathbf{V_c = H \times C \times 0.4}$$

where:

where:	H	=	the average height of the non-crop species plant in centimetres,
	C	=	the ground cover of the non-crop species plant as a percentage of the plot size, and
	0.4	=	the conversion factor from per cent of plot to dm^2 and cm (height) to dm.

Non-Crop Species Height - Dry Weight Correlations

Non-crop species dry weight estimates were calculated for each non-crop species and species group using equations derived from samples collected throughout the area. This procedure has been endorsed by practitioners in this region such as Ohmann *et al.* (1976, 1981), Grigal and Ohmann (1977), Ohmann (1982, 1984), Conolly and Grigal (1983), Smith and Brand (1983), Ohmann and Grigal (1985), Smith (1986), and several others.

Since the ground cover sample sizes were fixed (at 0.1 m^2), the only variable against which the dry weights could be regressed is the sample average height. The equations which best represent the height-dry weight correlations are illustrated in Figures 27, 28 and 29. Based on the various sample sizes, and critical **r** values listed in Appendix D1, the levels of confidence achieved for each of the correlations of height with dry weight are presented in Table 16.

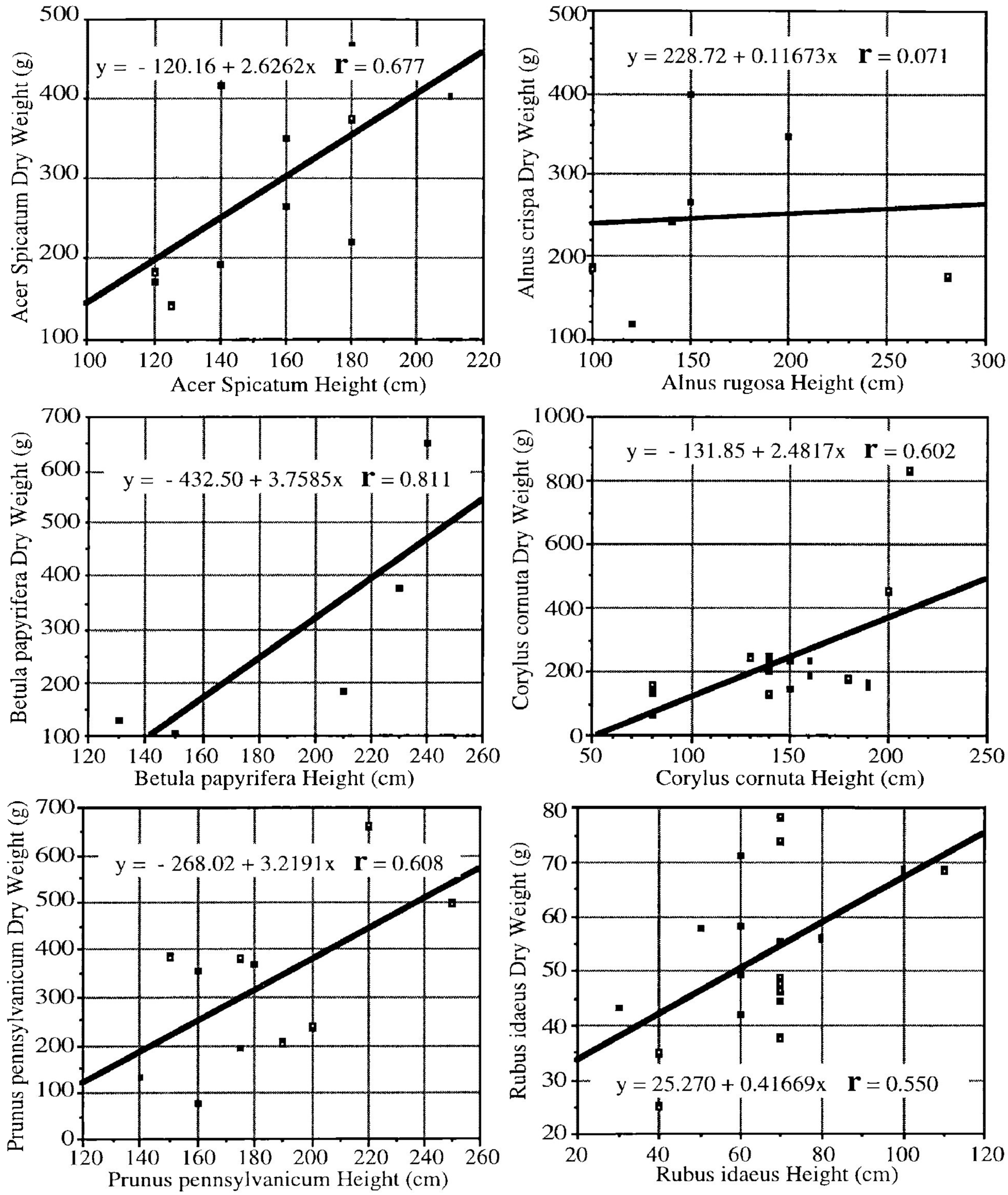


Figure 27. Height *vs.* dry weight for six non-crop woody species samples collected on the site.

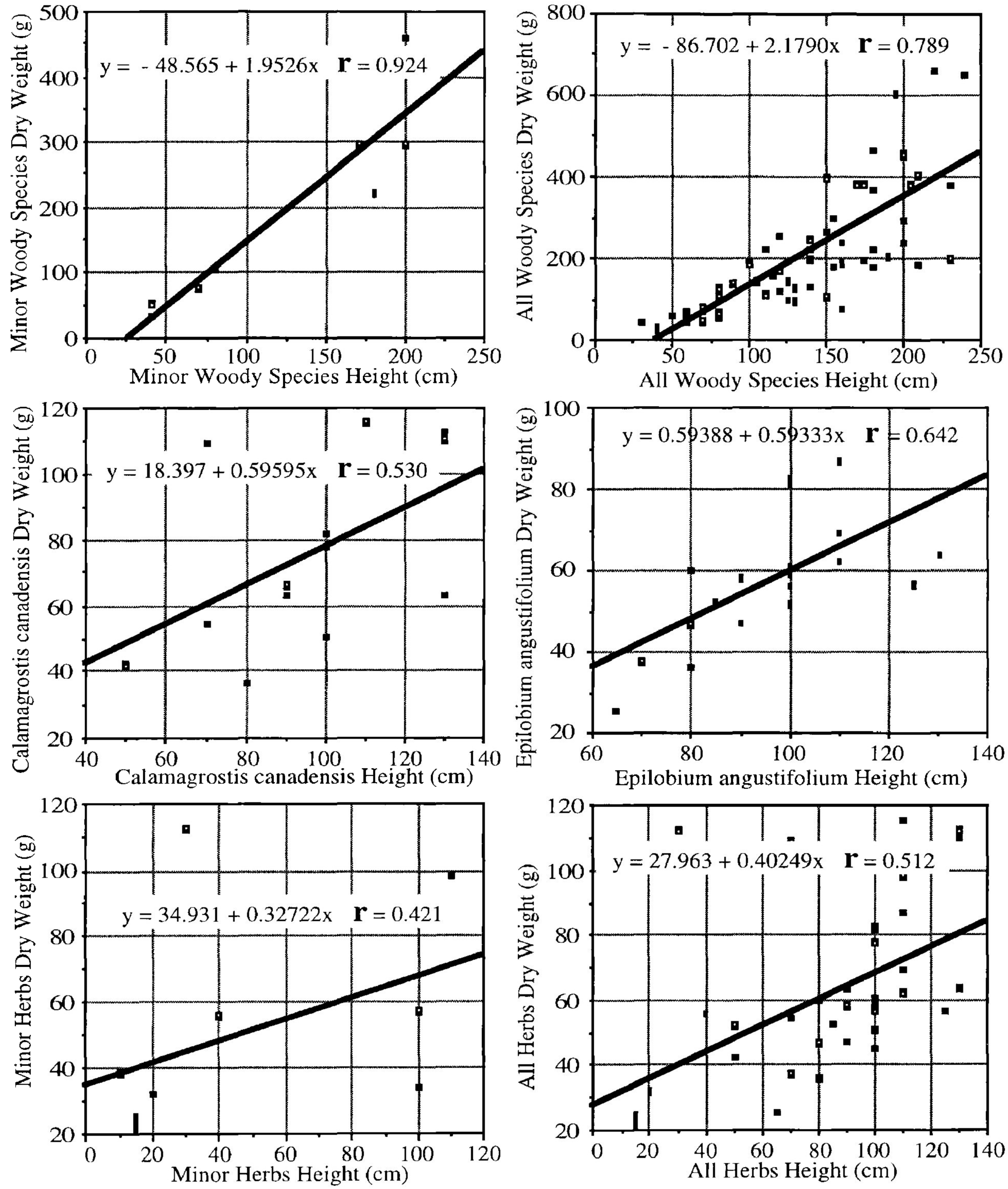


Figure 28. Height *vs.* dry weight for two herbaceous species and four species groups of non-crop samples collected on the site.

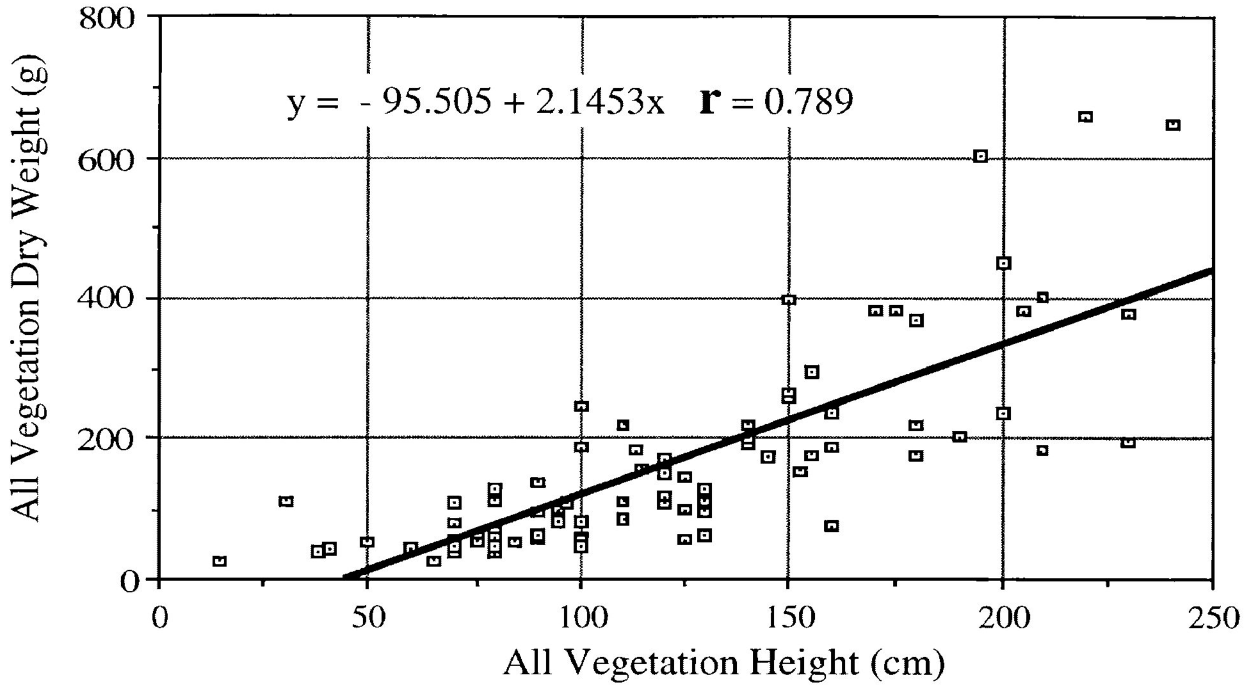


Figure 29. Height *vs.* dry weight for all of the non-crop species samples collected on the site.

Table 16. Simple linear regressions and confidence levels for dry weight *vs.* height for non-crop species and species group samples collected in the study.

Species/Species Group	**Dry Weight (y) *vs.* Height (x); y =**	r_{α}	**Sample Size**	**Confidence Level (α)**
Acer spicatum	- 120.16 + 2.6262x	0.677	11	97.5%
Alnus crispa	228.72 + 0.11673x	0.071	7	<75%
Betula papyrifera	- 432.50 + 3.7585x	0.811	5	97.5%
Corylus cornuta	- 131.85 + 2.4817x	0.602	19	99.75%
Prunus pensylvanica	- 268.02 + 3.2191x	0.608	11	97.5%
Rubus idaeus	25.270 + 0.41669x	0.550	20	99.5%
Minor woody species	- 48.565 + 1.9526x	0.924	8	99.95%
All woody species	- 86.702 + 2.1790x	0.789	65	99.95%
Calamagrostis canadensis	18.397 + 0.59595x	0.530	13	95%
Epilobium angustifolium	0.59388 + 0.59333x	0.642	19	99.75%
Minor herb species	34.931 + 0.32722x	0.421	10	75%
All herb species	27.963 + 0.40249x	0.512	40	99.95%
All vegetation	- 95.505 + 2.1453x	0.789	84	99.95%

The equations derived for the samples were applied to the balance of the non-crop species data to yield estimates of non-crop species dry weight in each plot. These are the data presented for dry weight in Appendix B-2.

Grouped Non-crop species Parameter Derivations

For non-crop species and species groups, ground cover (C), above-ground volume (V), and average height (H) values are determined as follows:

$$C = \sum_{i=1}^{n} C_i$$

$$V = \sum_{i=1}^{n} V_i$$

$$H = \frac{V}{0.4 \times C}$$

where: i = 1, 2, 3, ..., n, and

n = the number of individual plants of each non-crop species or the number of non-crop species present in the plot.

Non-crop species jack pines were assigned dry weight estimates based on crown volume in lieu of height, since the correlation confidence levels for the former were higher than those for the latter.

Jack Pine - Non-crop species Parameter Correlations

The next step was to determine the correlations between the average height, ground cover, above-ground volume and estimated dry weight of each of the non-crop species plants and non-crop species groups and the seven measured or estimated parameters (*i.e.* height, height increment, stem diameter, stem volume, crown area, crown volume, and dry weight) for the planted jack pine. These correlations were further defined on the basis of referring to non-crop plants in the inner-ring (area within 80 cm radius of the plot centre or 2 m^2), outer-ring (area between 80 cm and 113 cm radius of the plot centre, also 2 m^2) and both-ring (area within 113 cm radius of the plot centre or 4 m^2). The results of these calculations are presented in Appendix D-2. The three highest value correlations for each non-crop species / species group with jack pine is presented in Table 17. A "reliability index" (RI) is derived as a relative measure of the effectiveness of the jack pine non-crop species correlation coefficient as an indicator of competition.

$$\mathbf{RI} = |\mathbf{r}| \times \mathbf{F}$$

where: $|r|$ = the absolute value of the correlation coefficient, and

F = the frequency of occurrence of the non-crop species across the full sample of 120 plots (i.e. 110 ordinary plots + 10 special plots),

= $\frac{n_i}{120}$, and

n_i = the number of plots containing the i^{th} non-crop species or species group in the full sample of 120 plots.

Table 17. The three best correlations between each non-crop species / species group and corresponding jack pine (Pj) parameters, arranged in decreasing order of correlation coefficient (from Appendix D-2).

Pj Param. (y)	**Spp/SG-M-R (x)**	n_i	**Correlation Equation y =**	**r**	**Conf. Level**	**Rel. Index**
St. Vol.	Al cr - C - O	18	- 18.247 + 17.183x	0.852	99.95%	0.128
St. Vol.	Al cr - V - O	18	5.3554 + 0.244 4x	0.809	99.95%	0.121
Dry Wt.	Al cr - C - O	18	224.13 + 9.383 7x	0.789	99.95%	0.118
St. Vol.	Pi ba - H - I	20	- 24.249 + 1.724 6x	0.602	99.75%	0.100
St. Diam.	Pi ba - H - I	20	8.0344 + 0.051 277x	0.566	99.5%	0.094
Ht.	Pi ba - H - O	46	84.484 + 0.366 85x	0.549	99.95%	0.210
Cr. Area	All Veg - C - I	120	0.986 89 - 0.018 234x	-0.572	99.95%	0.572
Cr. Area	All Veg - C - B	120	1.103 9 - 0.009 927 9x	-0.545	99.95%	0.545
Ht. Incr.	All Veg - C - I	120	67.450 - 0.686 37x	-0.544	99.95%	0.544
St. Diam.	Ac sp - C - I	20	14.009 - 0.292 43x	-0.510	97.5%	0.085
Cr. Area	Ac sp - C - I	20	0.362 35 - 0.013 859x	-0.488	97.5%	0.081
Cr. Area	Ac sp - V - I	20	0.342 19 - 0.000 154 84x	-0.477	97.5%	0.080
Ht. Incr.	Ca ca - C - I	40	47.208 - 0.470 8x	-0.457	99.75%	0.152
Ht. Incr.	Ca ca - C - B	44	46.250 - 0.203 93x	-0.412	99.5%	0.151
Ht. Incr.	Ca ca - W - I	40	45.848 - 0.012 108x	-0.366	97.5%	0.122

Table 17. The three best correlations between each non-crop species / species group and corresponding jack pine (Pj) parameters, arranged in decreasing order of correlation coefficient (from Appendix D-2; continued).

Pj Param. (y)	Spp/SG-M-R (x)	n_i	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Carex - V - I	22	35.604 + 0.076 337x	0.445	97.5%	0.082
Ht. Incr.	Carex - W - O	21	49.618 - 0.058 379x	-0.395	95%	0.069
Cr. Area	Carex - V - I	22	0.20544 + 0.001 812 8x	0.352	90%	0.065
Cr. Area	Ru id - H - O	86	0.72446 - 0.005 290 8x	-0.437	99.95%	0.313
Cr. Vol.	Ru id - H - O	86	374.05 - 3.036 5x	-0.428	99.95%	0.307
Cr. Area	Ru id - H - B	93	0.71386 - 0.005 445 6x	-0.417	99.95%	0.323
Ht.	Min Hrb - C - I	41	136.50 - 1.789 9x	-0.437	99.75%	0.149
Ht.	Min Hrb - C - B	46	136.06 - 0.888 49x	-0.407	99.75%	0.156
Ht. Incr.	Min Hrb - C - B	46	50.033 - 0.309 04x	-0.373	99%	0.143
Cr. Area	All Wdy - C - I	118	0.601 67 - 0.010 185x	-0.359	99.95%	0.353
Cr. Area	All Wdy - C - B	120	0.635 34 - 0.005 291 4x	-0.345	99.95%	0.345
Dry Wt.	All Wdy - C - I	118	477.75 - 5.297x	-0.344	99.95%	0.338
Cr. Vol.	Be pa - H - O	31	433.97 - 1.110 6x	-0.332	95%	0.086
Cr. Area	Be pa - H - O	31	0.78181 - 0.001 774 3x	-0.327	95%	0.085
St. Diam.	Be pa - H - O	31	20.041 - 0.024 909x	-0.321	95%	0.083
Cr. Area	Pr pe - V - O	37	0.57150 - 0.000 200 96x	-0.311	95%	0.096
Cr. Area	Pr pe - W - O	37	0.55301 - 0.000 082 564x	-0.308	95%	0.095
Ht. Incr.	Pr pe - H - O	37	56.744 - 0.043 903x	-0.276	95%	0.085
St. Diam.	Min Wdy - W - O	60	15.282 - 0.004 374 8x	-0.288	97.5%	0.144
St. Diam.	Min Wdy - V - O	60	15.407 - 0.006 522 5x	-0.277	97.5%	0.139
Dry Wt.	Min Wdy - H - I	50	419.12 - 0.775 07x	-0.268	95%	0.112
St. Diam.	Co co - C - I	64	14.925 - 0.15634x	-0.285	97.5%	0.152
St. Diam.	Co co - V - I	64	14.321 - 0.001 448 4x	-0.192	90%	0.103
St. Diam.	Co co - C - B	70	14.347 - 0.049 383x	-0.184	90%	0.108
Ht. Incr.	All Hrb - C - I	114	50.675 - 0.303 11x	-0.251	99.5%	0.238
Ht. Incr.	All Hrb - H - I	114	37.774 + 0.101 3x	0.249	99.5%	0.237
Ht. Incr.	All Hrb - C - B	117	50.983 - 0.146 28x	-0.243	99.5%	0.237
St. Diam.	Ep an - C - O	102	13.466 + 0.131 61x	0.239	99%	0.203
St. Diam.	Ep an - W - O	102	13.644 + 0.004 959 9x	0.237	99%	0.201
St. Vol.	Ep an - W - O	102	152.69 + 0.149 31x	0.235	99%	0.200

Table 17. The three best correlations between each non-crop species / species group and corresponding jack pine (Pj) parameters, arranged in decreasing order of correlation coefficient (from Appendix D-2; continued).

LEGEND			
Pj Param.	Jack Pine Subject Tree Parameter	**Spp/SG**	Non-Crop Species / Species Group
Ht	Height	Ep an	*Epilobium angustifolium* (fireweed)
Ht Incr.	Height increment		
St. Diam.	Stem diameter	Ca ca	*Calamagrostis canadensis* (Canada blue-joint grass)
St. Vol.	Stem volume		
Cr. Area	Crown area	Carex	sedge species
Cr. Vol.	Crown volume	Min Hrb	minor herb species
Dry Wt.	Dry weight	All Hrb	all herb species
-M-	Measurement	Ru id	*Rubus idaeus* (raspberry)
-H-	Average height	Co co	*Corylus cornuta* (beaked hazel)
-C-	Ground cover	Pr pe	*Prunus pensylvanica* (pin cherry)
-V-	Crown volume	Pi ba	*Pinus banksiana* (non-crop jack pine)
-W-	Dry Weight		
-R	Ring	Be Pa	*Betula papyrifera* (paper birch)
–I	Inner	Ac sp	*Acer spicatum* (mountain maple)
–O	Outer	Al cr	*Alnus crispa* (green alder)
–B	Both	Min Wdy	minor woody species
Conf. Level	confidence level	All Wdy	all woody species
Rel.Index	reliability index	All Veg	all vegetation (non-crop) species
r	correlation coefficient	**n_i**	sample size (*i.e.* the number of plots containing the j^{th} non-crop species or species group)

Applying Towill and Archibald's Competition Index to the Data

The Towill and Archibald (T&A) plot corresponds in size to that of the plot used in this study. One difference between the study procedures and those used in the T&A method is that in the former, the total percentage ground cover may not exceed 100%; in the latter, because of the separation and overlapping of height classes, it may. For the purpose of this study, separation and overlapping of height classes will not be considered. As well, an average height weighted by the per cent coverage was developed for each non-crop species within each ring. These departures from the procedures described by the methodology are relatively minor, and could not be readily undone to yield a completely true picture of the effects of the T&A index application.

The results of the application of T&A's CI to the data are presented in Appendix E. The cumulative competition index (CCI) for each plot is shown in Table 18. These CCIs

Table 18. Cumulative Competition Indices (CCI) for the study data as derived by the Towill and Archibald (1991) Method.

Plot	CCI	Plot	CCI	Plot	CCI	Plot	CCI	Plot	CCI	Plot	CCI
1	54.8	**2**	136.3	**3**	110.0	**4**	63.7	**5**	121.1	**6**	216.9
7	98.0	**8**	79.0	**9**	125.4	**10**	27.8	**11**	58.9	**12**	21.5
13	66.0	**14**	53.5	**15**	113.9	**16**	289.1	**17**	150.7	**18**	78.2
19	54.2	**20**	48.2	**21**	78.6	**22**	86.2	**23**	130.6	**24**	47.5
25	63.2	**26**	109.0	**27**	42.8	**28**	76.4	**29**	79.0	**30**	77.5
31	532.4	**32**	52.6	**33**	52.5	**34**	68.8	**35**	26.7	**36**	22.9
37	40.3	**38**	265.2	**39**	99.9	**40**	178.3	**41**	127.0	**42**	51.9
43	104.0	**44**	29.4	**45**	122.2	**46**	54.8	**47**	162.8	**48**	217.1
49	431.1	**50**	32.0	**51**	48.5	**52**	84.8	**53**	43.8	**54**	183.6
55	17.3	**56**	39.3	**57**	58.9	**58**	25.5	**59**	67.6	**60**	39.3
61	11.3	**62**	16.1	**63**	14.7	**64**	14.8	**65**	59.3	**66**	40.0
67	33.5	**68**	53.6	**69**	18.7	**70**	34.7	**71**	29.8	**72**	19.0
73	44.5	**74**	30.1	**75**	69.9	**76**	65.3	**77**	72.7	**78**	20.5
79	49.5	**80**	68.5	**81**	21.9	**82**	67.6	**83**	62.0	**84**	30.9
85	6.6	**86**	17.7	**87**	57.8	**88**	41.0	**89**	190.0	**90**	65.2
91	64.5	**92**	189.8	**93**	358.7	**94**	136.9	**95**	38.3	**96**	36.3
97	49.5	**98**	52.0	**99**	49.6	**100**	66.4	**101**	101.6	**102**	57.1
103	247.2	**104**	73.7	**105**	278.9	**106**	176.6	**107**	133.3	**108**	179.8
109	197.4	**110**	63.1	**SP-1**	19.5	**SP-2**	19.6	**SP-3**	17.4	**SP-4**	80.5
SP-5	84.0	**SP-6**	31.8	**SP-7**	29.1	**SP-8**	192.2	**SP-9**	50.3	**SP10**	35.1

Total:	10476	**Count:**	120	**Average:**	87.3	**Standard Deviation:**	83.89

are graphically contrasted with the estimated dry weights for all of the vegetation within both rings of the plots in Figure 30. Similarly, the CCIs are also correlated to the assortment of jack pine parameters recorded for their respective plots in Table 19.

Modifications to the Towill and Archibald Competition Index

In an attempt to rectify some of the apparent weaknesses of the existing Towill and Archibald procedure (see Discussion), several amendments to the Competition index were postulated and developed. These modifications consisted of (a) averaging heights in proportion to their relative coverage, (b) weighting species within the inner ring so as to

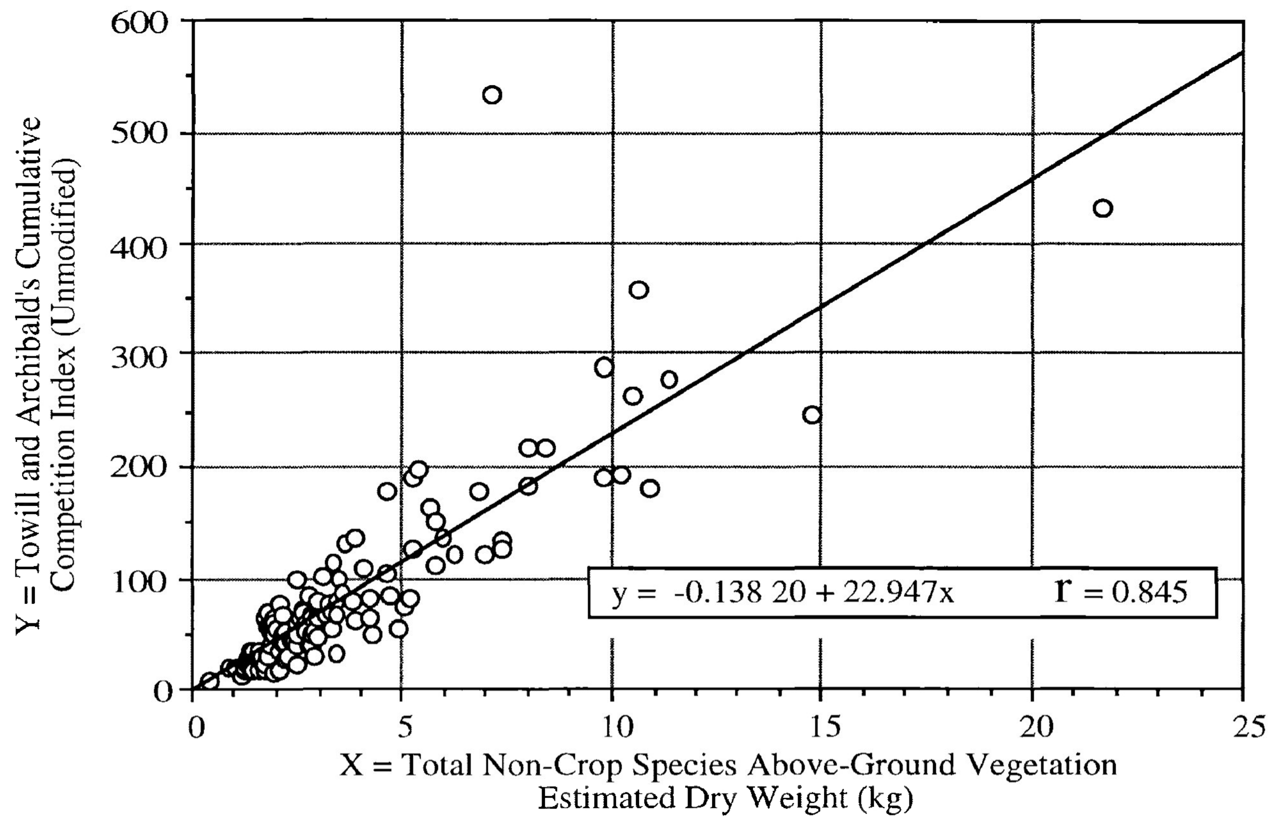


Figure 30. Towill and Archibald's Cumulative Competition Index (CCI) *vs.* the estimated total dry weight of all non-crop above-ground vegetation within both rings of the plots.

Table 19. Correlations between Towill and Archibald's Cumulative Competition Index (CCI) and the various jack pine parameter measurements recorded in the study.

CCI (y)	Jack Pine Parameter (x)	n_j	Highest Correlation Equation (y =)	r	Confidence level
	Crown Area	120	131.59 - 102.46x	-0.377	99.95%
	Stem Diameter	120	182.76 - 6.6038x	-0.371	99.95%
Towill	**Dry Weight**	120	153.51 - 0.16961x	-0.339	99.95%
and	**Crown Volume**	120	119.10 - 0.15332x	-0.332	99.95%
Archibald	**Height Increment**	120	178.11 - 1.9496x	-0.283	99.9%
	Height	120	178.61 - 0.72728x	-0.277	99.75%
	Stem Volume	120	114.61 - 0.15574x	-0.259	99.75%

acknowledge a greater influence than those in the outer ring, (c) using a B:C (volume) ratio in lieu of the B:C (height) ratio, (d) excluding all plots containing alder in order to offset the stimulative effects of that species, and (e) doing all combinations of these modifications. These variants were applied to the field data, producing arrays of index components shown in Appendices F-1, F-2 and F-3. The significant correlations are presented in Appendix F-4. Of these correlations, those between modifications to the competition index and the total estimated dry weight (biomass) are listed in Table 20. Of the balance, those correlations showing the highest coefficient values are shown in Table 21.

Table 20. Highest correlation coefficients for the Towill and Archibald Cumulative Competition Index (CCI) and its suggested modifications (Y)*vs.* the total non-crop species above-ground dry weight within the plots (X).

CCI (y)	n_j	Highest Correlation Equation (y =)*	r	Confidence level
Towill & Archibald (Unmodified)	120	- 0.138 20 + 22.947x	0.845	99.95%
Proximity-Weighted	120	- 3.0191 + 17.263x	0.854	99.95%
Height-Averaged and Proximity-Weighted	120	- 2.7645 + 17.200x	0.853	99.95%
Proximity-Weighted and Alder-Excluded	120	- 4.3171 + 17.511x	0.850	99.95%
Height-Averaged, Proximity-Weighted and Alder-Excluded	100	- 4.1350 + 17.456x	0.849	99.95%
Height-Averaged	120	0.580 92 + 22.757x	0.843	99.95%
Alder-Excluded	100	- 1.0762 + 22.931x	0.834	99.95%
Height-Averaged and Alder-Excluded	100	- 0.76998 + 22.853x	0.834	99.95%
Volume-Based, Proximity-Weighted and Alder-excluded	100	- 392.12 + 300.39x	0.305	99.95%
Volume-Based and Alder-Excluded	100	- 504.40 + 394.98x	0.303	99.95%
Volume-Based and Proximity-Weighted	120	- 340.43 + 268.02x	0.297	99.95%
Volume-Based	120	- 442.05 + 354.53x	0.297	99.95%

* X = Total non-crop species above-ground dry weight (both rings) in kg.

Table 21. Largest correlation coefficients for each cumulative competition index - jack pine parameter relation (from Appendix F4).

CCI (y)	Jack Pine Parameter (x)	n_j	Highest Correlation Equation (y =)	r	Confidence Level
Towill & Archibald (Unmodified)	**Crown Area**	120	131.59 - 102.46x	-0.377	99.95%
V and A	**Tree Height**	100	7 734.2 - 53.379x	-0.402	99.95%

Table 21. Largest correlation coefficients for each cumulative competition index - jack pine parameter relation (from Appendix F4).

CCI (y)	Jack Pine Parameter (x)	n_j	Highest Correlation Equation (y =)	r	Confidence Level
H and A	**Stem Diameter**	100	186.73 - 7.106 1x	-0.385	99.95%
Height-Averaged	**Crown Area**	120	131.63 - 102.57x	-0.379	99.95%
V, W and A	**Height Increment**	100	5 103.3 - 92.200x	-0.378	99.95%
Height-Averaged	**Dry Weight**	120	153.49 - 0.169 58x	-0.341	99.95%
Height-Averaged	**Crown Volume**	120	119.10 - 0.153 34x	-0.333	99.95%
H and A	**Stem Volume**	100	112.58 - 0.167 48x	-0.272	99.5%
V and A	**Tree Height**	100	7 734.2 - 53.379x	-0.402	99.95%
V, W and A	**Tree Height**	100	5 832.9 - 40.278x	-0.402	99.95%
H and A	**Stem Diameter**	100	186.73 - 7.106 1x	-0.385	99.95%
Alder-Excluded (A)	**Stem Diameter**	100	186.62 - 7.100 1x	-0.383	99.95%
Height-Averaged (H)	**Crown Area**	120	131.63 - 102.57x	-0.379	99.95%
H, W and A	**Stem Diameter**	100	135.76 - 5.203 1x	-0.375	99.95%
W and A	**Stem Diameter**	100	135.67 - 5.195 7x	-0.374	99.95%
H and W	**Crown Area**	120	95.297 - 75.236x	-0.373	99.95%
Proximity-Weighted (W)	**Crown Area**	120	95.204 - 75.059x	-0.370	99.95%
Volume-Based (V)	**Tree Height**	120	6142.9 - 41.706x	-0.362	99.95%
V and W	**Tree Height**	120	4 625.0 - 31.428x	-0.362	99.95%

DISCUSSION

Representativeness of the Jack Pine Sample Collected for Laboratory Analysis

The results of the Student's t test for the sample of peripheral jack pine collected for laboratory analysis *vs.* the treatment block population (Table 9) indicate that for all parameters except height increment (at the 80% confidence level), the sample was not representative of the population. This could be attributable to a number of factors, specifically:

a. the peripheral pines may have been of wild origin and not planted at the same time as the trees within the treatment blocks;

b. the peripheral trees were identified mostly by their predominating height over adjacent competition, whereas the trees within the treatment blocks were usually identified by their relatively uniform spacing (irrespective of size); and

c. most of the peripheral trees and their micro-sites were not subjected to chemical vegetation control, and were positioned adjacent to trails and roads. Hence, they may have experienced different growing conditions from those encountered by the saplings within the treatment blocks.

The fact that the peripheral jack pines are not truly representative of the treatment block population as a whole, does not necessarily mean that the measured parameter-dry weight correlations derived for the small (n = 10) sample are invalid or irrelevant. The correlations may indeed be relevant for the population, but there is an element of uncertainty based on this lack of representation.

Sub-sample Selection Effects

Selecting the five-specimen sub-sample with individual field measurements closer to the large (n = 110) sample average (Table 13) significantly improves the acceptance rate for all of the parameters, most notably height increment, crown width (x), crown area and crown volume (at the 50% confidence level); height, stem volume and crown width (y) (at the 80% confidence level); and stem diameter (at the 90% confidence level). Attempting to select sub-samples, however, has inherent costs as well. These costs are expressed in the confidence levels of the parameter-dry weight regressions (Table 14). Whereas the confidence levels for the relationships between each of the six parameters and dry weight for the small (n = 10) sample of jack pine are all ≥ 90%, with four of the six levels ≥ 99%; those for the same relationships for the selected (n = 5) sub-samples are all ≤ 75%. Notwithstanding the inherent tendency towards bias in the selection of representatives, there is no advantage to selecting the "best" specimens to represent all of the jack pine.

Of the small (n = 10) sample, the best (highest confidence level) correlation with jack pine dry weight proved to be for stem diameter, and stem volume (99.5%), followed closely by crown area and crown volume (99%). These, then, would be the most reliable field measurements upon which to estimate jack pine sapling dry weight. The correlation coefficients (**r** values) of 0.901, 0.910, 0.762 and 0.744 respectively, are sufficiently high to provide confidence that the jack pine sapling dry weights can be truly represented by these parameters.

It has been shown in Table 9 that of the four parameters against which jack pine sapling dry weight can be estimated with high levels of confidence, only crown area in the small (n = 10) sample provides any level of confidence as a representative of the full sample (n = 110). Accordingly, the principal estimator of dry weight for each jack pine in the full sample should be based on the parameter which has the confidence of representation and a high correlation with dry weight (*i.e.* crown area).

The comparison of estimated dry weights based on each of the six measurement parameters with the actual dry weights measured in the small (n = 10) sample (Table 15) shows that the closest estimates to the actual values occurred most frequently with the weights derived from the stem volume parameter, and second most frequently with those based on crown area and crown volume. In addition, the standard deviations for the dry weight estimates based on crown area were reasonably close, *i.e.* within:

$$\left(\frac{321 - 245}{245}\right) \times 100\% = 23.7\%$$

of the actual standard deviation of the dry weight measurements.

Non-Crop Species Dry Weight – Height Correlations

For the non-crop species the correlations between dry weight and height (Table 16) are quite variable, with **r** values ranging from a low of 0.071 for green alder to a high of 0.924 for minor woody species. The correlation coefficients for all herb species, all woody species, and all plant species were calculated as 0.512, 0.789, and 0.789 respectively. From this, we may infer that for woody species, and all plant species in general, height is a reliable indicator of dry weight, but for herb species, it is somewhat less reliable. The confidence levels for the correlation between dry weight and height is in all cases (except alder) ≥ 95%, being highest (*i.e.* ≥ 99.5%) for *Corylus cornuta*, *Rubus idaeus*, minor woody species, all woody species, *Calamagrostis canadensis*, *Epilobium angustifolium*, all herb species, and all plant species, despite the considerable variation in the composition of some of these species groups.

Jack Pine Non-Crop Species Correlations

The relationships between the jack pine subject tree and the non-crop species (Table 17) vary considerably. There are two critical measures of the effectiveness of non-crop species as indicators of competition, (a) the non-crop species frequency of occurrence (occurrence divided by the total number of plots sampled) and (b) the coefficient for a non-crop species attribute correlated with one of the crop-tree parameters. Consequently, the product of these two values should provide a single value term which can be called an "index of reliability" (RI).

A) Total Plant Species (All Vegetation)

The third highest set of correlation coefficients and the highest indices of reliability are those associated with Total Plant Species (All Vegetation). The correlations are for all vegetation ground cover (1) inner ring and jack pine crown area, (2) both rings and jack pine crown area, and (3) inner ring and jack pine height increment (Figure 31). The **r** values for these relationships are -0.572, -0.545, and -0.544 respectively. The confidence levels are 99.95% for each case.

The presence of non-crop ground-cover in all three correlations suggest that this factor is the most important of the measured characteristics in the determination of interactive effects with the crop tree. The negative signs for the correlations indicate that the

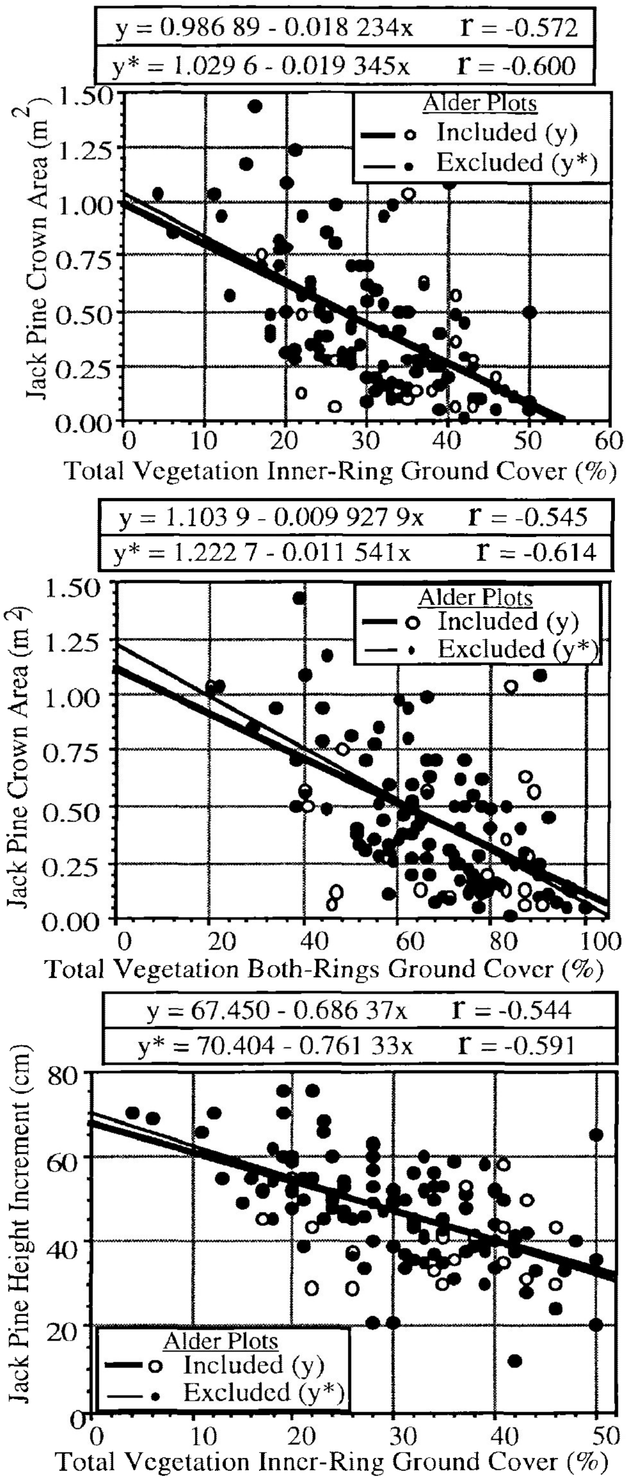


Figure 31. Highest value correlations between total plant species measurements and jack pine parameters.

relationship between the total plant species group and jack pine is a truly negative one. It is most apparent where the non-crop ground cover and jack pine crown areas interact. This relationship is typical of competition between the crop tree and non-crop species. The higher (absolute value) coefficient for the inner ring ground cover as compared to that for both rings ground cover implies that there is a proximity effect being displayed. This effect can be described as: the non-crop species ground cover nearer the crop tree has a greater adverse effect on the development of the crop tree crown than the non-crop species located slightly further away.

The reliability indices are highest for this set of relationships for two reasons: (a) the correlation coefficients are relatively high, and (b) the occurrence of this species group is universal for this plot data set. Every plot sampled has some woody or herbaceous species present within its perimeter. Consequently, the occurrence is derived as 100%, and the magnitudes of the reliability indices are the same as their corresponding correlation coefficients. This is the only species or species group for which this observation applies.

The effect of alder is clearly and consistently, if somewhat marginally expressed in the total plant species - jack pine relationships. The steeper slopes of the correlation lines for the ground cover *vs.* the jack pine parameters where the alder plot data have been excluded suggest that the negative effect of all of the other vegetation is somewhat mitigated by the alder influence. This supports the view that the effect of the alder, at least in its effect on jack pine crown area, is not competitive, but beneficial (*i.e.* commensal, mutualistic, symbiotic or proto-cooperative).

Review of the balance of the total plant species - jack pine relationships (Appendix D2) shows that the average correlation values occurring between total plant species ground cover and jack pine crown area can be summarized in Table 22.

Table 22. Means of all correlation values for total plant species and jack pine parameters.

Parameter	Correlation Coefficient (r) Most –	# –	Most +	# +	Mean*	Confidence Level
Jack Pine	**Jack Pine *vs.* any total plant species parameter**					
Crown Area	-0.572	10	0.045	1	**0.252**	<<75% - 99.95%
Dry Weight	-0.542	9	0.032	1	0.244	<<75% - 99.95%
Crown Volume	-0.537	9	0.084	2	0.230	<<75% - 99.95%
Height Increment	-0.544	8	0.182	3	0.207	<<75% - 99.95%
Stem Diameter	-0.452	10	0.032	1	0.184	<<75% - 99.95%
Height	-0.440	4	0.228	5	0.159	<<75% - 99.95%
Stem Volume	-0.400	9	0.126	3	**0.159**	75% - 99.95%
Total Plant Spp.	**Total Plant Species *vs.* any jack pine parameter**					
Ground Cover	**-0.572**	21	**-0.268**	0	**0.444**	99.75% - 99.95%
Volume	-0.272	19	0.000	0	0.165	<<75% - 99.75%
Dry Weight	-0.221	17	0.032	2	0.126	<<75% - 99%
Height	**-0.032**	2	**0.228**	14	**0.086**	<<75% - 99%
Inner Ring	-0.572	20	0.228	8	**0.228**	<75% - 99.95%
Both Rings	-0.545	19	0.224	5	0.215	<<75% - 99.95%
Outer Ring	-0.420	20	0.195	3	**0.173**	<<75% - 99.95%

* ... of largest absolute values for each relationship.

Worthy of note in this table are the following observations:

a) The most negative correlation values predominate for all jack pine parameters and all total plant species (TPS) parameters except for height. Exclusive of TPS outer ring height *vs.* jack pine stem diameter and crown area, both of which display weak negative (**r** = -0.032) correlations, the rest of the correlations (14 of 21) show positive values. This shows that non-crop species heights are stimulative or at least coincidental with most increasing crop tree parameter values.

b) The largest mean of the largest absolute correlation values for each relationship proved to be those for jack pine crown area, TPS ground cover and the inner ring. This indicates that these three parameters are the most critical in the determination of the crop-tree development. This assertion is supported by the highest absolute correlation value in the table (**r** = -0.572) which is the value for jack pine crown area *vs.* TPS inner ring ground cover.

c) Conversely, the smallest means are those for jack pine stem volume, TPS height, and outer ring. Therefore, it would be safe to assume that these are the least reliable parameters upon which to base estimates of crop-tree development.

d) The most consistent of all the parameters is for TPS ground cover. These correlations, ranging from **r** = -0.268 to **r** = -0.572, support the conclusion that TPS ground cover is the most reliable of the measured TPS parameters upon which to base forecasts of jack pine development.

e) The proximity (ring) effect displayed by the TPS follows a predictable pattern. The mean effect on the ack pine parameters of the TPS within the inner ring is significantly greater than the magnitude of that of the outer ring. The mean effect of both rings is between the values for the inner and outer rings. This suggests that the relative proximity of other vegetation within a 1.13 m radius is a significant factor on jack pine seedling development.

f) The jack pine parameters display several unanticipated correlation properties. Height, which is well known to be largely insensitive to the effects of competition, has a relatively low, largest coefficient (**r** = -0.440). Crown area and its derivatives, dry weight and crown volume, which have been ignored by most investigators developing measures of competition, show the largest coefficients (**r** = -0.572, -0.542, and -0.537 respectively). Stem diameter and its derivative, stem volume, used by many developers of competition indices, show relatively low largest coefficients of correlation (**r** = -0.452 and -0.400 respectively). Height increment has a reasonably large coefficient of correlation, and may provide a reasonably representative alternative reference parameter where crown area or crown volume are not usable.

g) The confidence limits for all parameters except TPS ground cover are extremely variable. Only those for TPS ground cover are consistently high, at 99.75% to 99.95% for all its possible combinations. This supports the contention that TPS ground cover is the most significant single parameter in the evaluation of jack pine development.

B) *Alnus crispa* (green alder)

The largest correlation coefficients of all species and species groups are those between green alder outer ring (1) ground cover and jack pine stem volume, (2) above-ground volume and jack pine stem volume, and (3) ground cover and jack pine dry weight. The coefficients are **r** = 0.852 0.809, and 0.789 respectively. These relationships are graphically illustrated in Figure 32. The confidence levels are 99.95% for each relationship.

These correlations, as well as the large majority of those between alder and jack pine listed in appendix D2, are positive. This positive association is representative of commensalism or mutualism / symbiosis / proto-cooperation, but not of competition. It is reasonable to conclude the existence of such a relationship because of the nitrogen-fixing capabilities of green alder. Similar relationships between alder and conifers have been reported by Vincent (1964), Watt

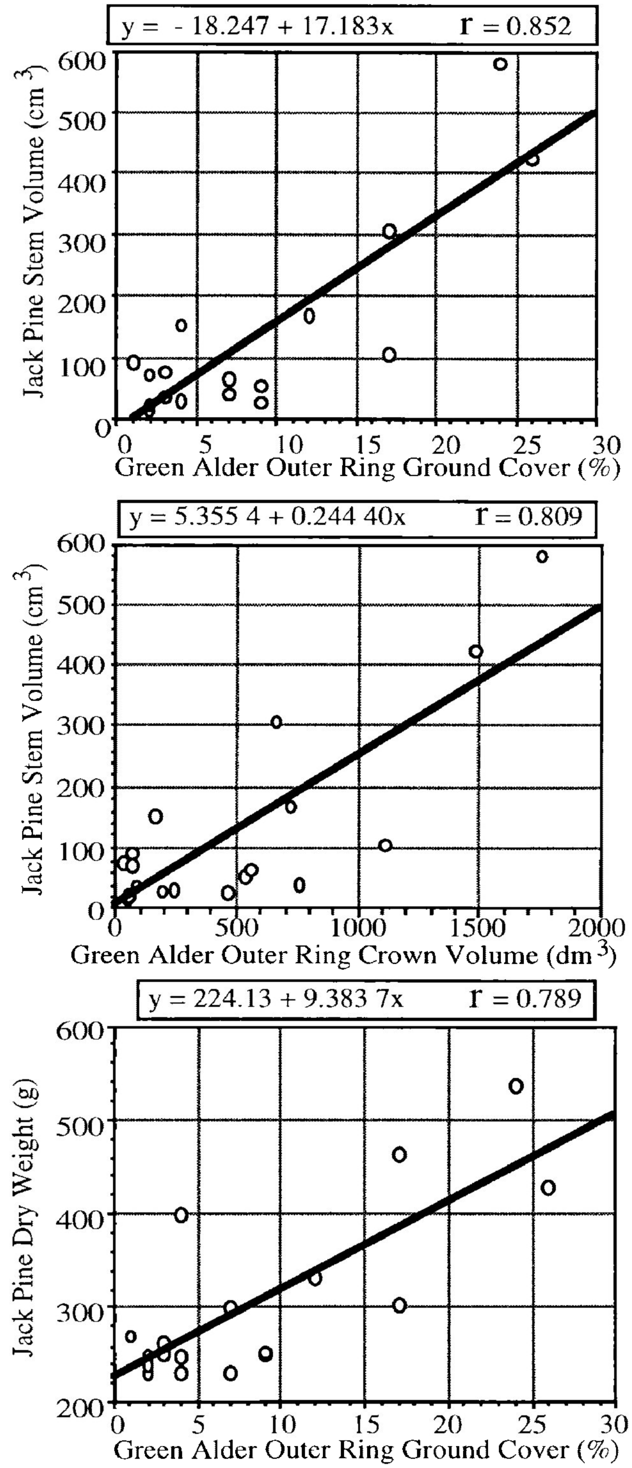


Figure 32. Highest value correlations between green alder measurements and jack pine parameters.

and Heinselman (1965), Healy and Gill (1974) and others. This relationship should be even more pronounced if alder were the only other species in close association with the subject jack pines in the specific plots.

The interesting phenomenon is that the three largest positive correlation values are for outer-ring alder cover and volume and jack pine stem volume and dry weight, and the three largest negative correlation values (**r** = -0.212, -0.184, -0.182) are for alder inner-ring height and jack pine (1) crown area, (2) crown volume, and (3) stem diameter, respectively. From these relationships, it is reasonable to deduce that there are inhibitory effects of alder height which are expressed when in close proximity to the jack pine. These inhibitory effects are balanced by the much greater stimulative effects of alder cover and volume on jack pine stem volume and dry weight. To paraphrase, this shrub, by its height, hinders jack pine growth when close to it, but promotes that growth much more from a distance.

The non-crop species data for the plots containing alder have been isolated and are listed in Appendix B3 along with the herbaceous and other woody ground species cover and mean heights in each and both rings. This data set allows for the discrimination between alder-inclusive and alder-exclusive plots in this study.

Although the confidence limits associated with the largest correlation coefficients are very significant (>99.95%), the frequency of occurrence of green alder in the plots is relatively low, at 16 to 20 occurrences in 120 plots (13.3% to 16.7%). Consequently, the alder is not sufficiently frequent to serve as a reliable indicator species for the growth of jack pine in this plantation. Accordingly, it has relatively low reliability indices (0.128, 0.121, and 0.118)

C) *Pinus banksiana* (non-crop jack pine)

The second highest value correlations occur between crop jack pine subject trees and non-crop jack pines (Figure 33). Specifically, the correlations are those between non-crop jack pine average height (1) inner ring and subject jack pine stem volume, (2) inner ring and subject jack pine stem diameter, and (3) outer ring and subject jack pine height. The **r** values for these relationships are 0.602, 0.566, and 0.549 respectively with confidence levels of 99.75%, 99.5% and 99.95% respectively.

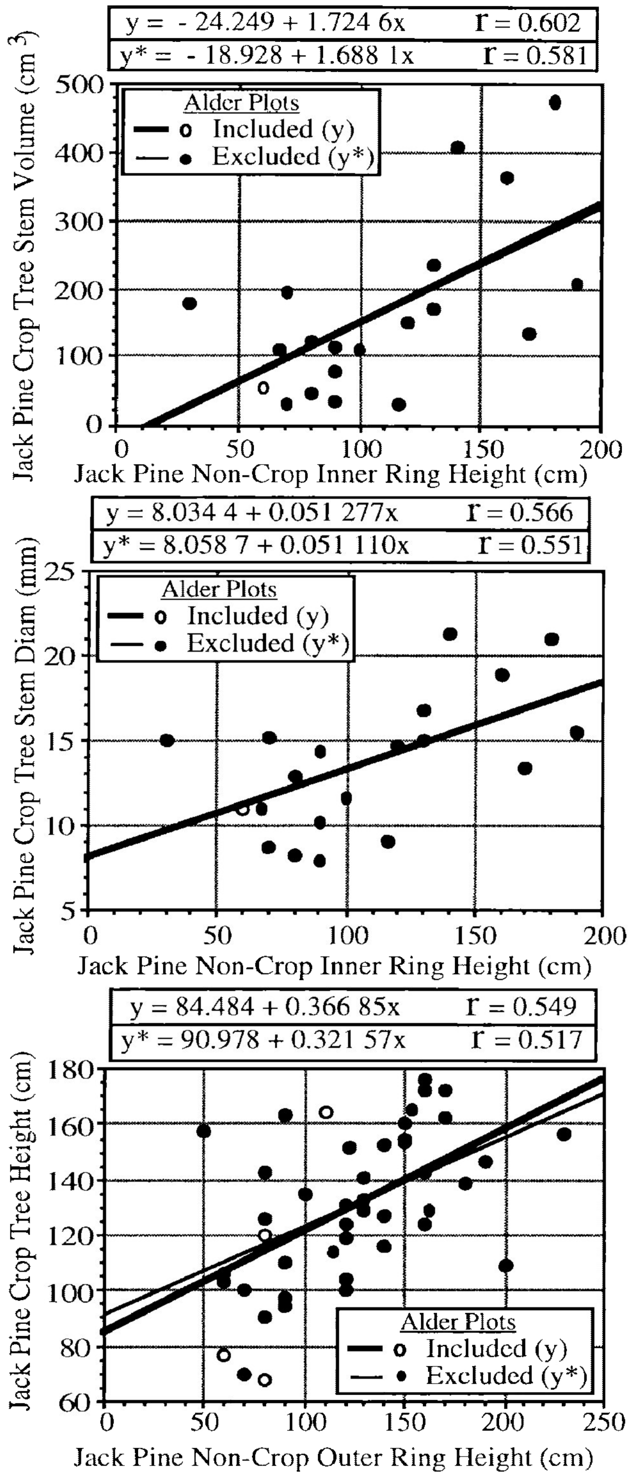


Figure 33. Highest value correlations between jack pine non-crop measurements and jack pine crop tree parameters.

The crop and non-crop jack pine relationships as presented in Appendix D2 are unexpected. Instead of showing the effects of competition which should be considerable for two members of the same species in close proximity to each other (i.e. a negative correlation in each instance), the relationship is positive in almost all cases. Therefore, it would appear that the non-crop and crop jack pines in this plantation are not in competition with each other to any significant degree. This may be attributed to either (a) the site's relative resource richness which has allowed the neighbouring trees to flourish without competing with each other, or (b) the result of a mutually beneficial relationship as is characterized by mutualism, symbiosis or proto-cooperation. Since mutually beneficial relationships are rarely, if ever, encountered between members of the same species, it is unlikely that this is the cause of the positive correlations.

The proximity of the planted and naturally distributed jack pines to each other does not appear to have any bearing on the development of the crop trees. The two highest positive correlations involve inner ring jack pine heights and crop tree jack pine stem volume and diameter parameters. Conversely, the only two negative correlations, inner ring cover and dry weight *vs.* crop tree stem diameter have very low correlations (**r** = -0.095 and

-0.045 respectively) with accompanying low levels of confidence (<75%).

The occurrence of non-crop jack pine, with 20 in the inner rings, 46 in the outer, and 52 in both rings is not sufficiently large to serve as an indicator of competition throughout this plantation. With these low occurrence frequencies, the indices of reliability are also low (highest values of 0.100, 0.094, and 0.210 respectively for the three highest value correlations). Indeed, jack pine will rarely, if ever, pose a significant competitive threat to the seedling / sapling stage of plantation development, as it would be highly unlikely for anyone to plant jack pine deliberately within a site that is likely to regenerate sufficient numbers of this species naturally. Consequently, in most cases, the occurrence of non-crop jack pine will be infrequent, and rarely, if ever, sufficiently high to constitute a serious threat to the planted jack pine seedlings.

The influence of green alder in this case is not demonstrable in the two largest value correlations, as illustrated by the nearly identical correlation slopes displayed by the graphs in Figure 33. This is due to there being only one plot in which the inner ring contained both a jack pine non-crop specimen and alder. This renders any difference between the two correlations insignificant. For the third largest value correlation (outer ring height *vs.* crop tree height), however, a different situation exists. There is a large enough difference in sample size between the alder-inclusive and alder-exclusive samples (4) to yield a correlation line with a different slope. The slope is less steep, and may or may not be significant. A less steep positive (rising) slope for the alder-exclusive correlation suggests that green alder has a stimulative effect on the crop trees.

D) Total (All) Woody Species

The second highest value indices of reliability are those associated with Total (All) Woody Species. The parameters showing the highest value correlations of all of the woody vegetation combined are for ground cover (1) inner ring and jack pine crown area, (2) both rings and jack pine crown area, and (3) inner ring and jack pine dry weight (Figure 34). The **r** values for these relationships are -0.359, -0.345, and -0.344 respectively, and the confidence values are also >99.95% for each case. Because of the near-100% occurrence of woody non-crop species in each of the plots, the reliability indices are similar

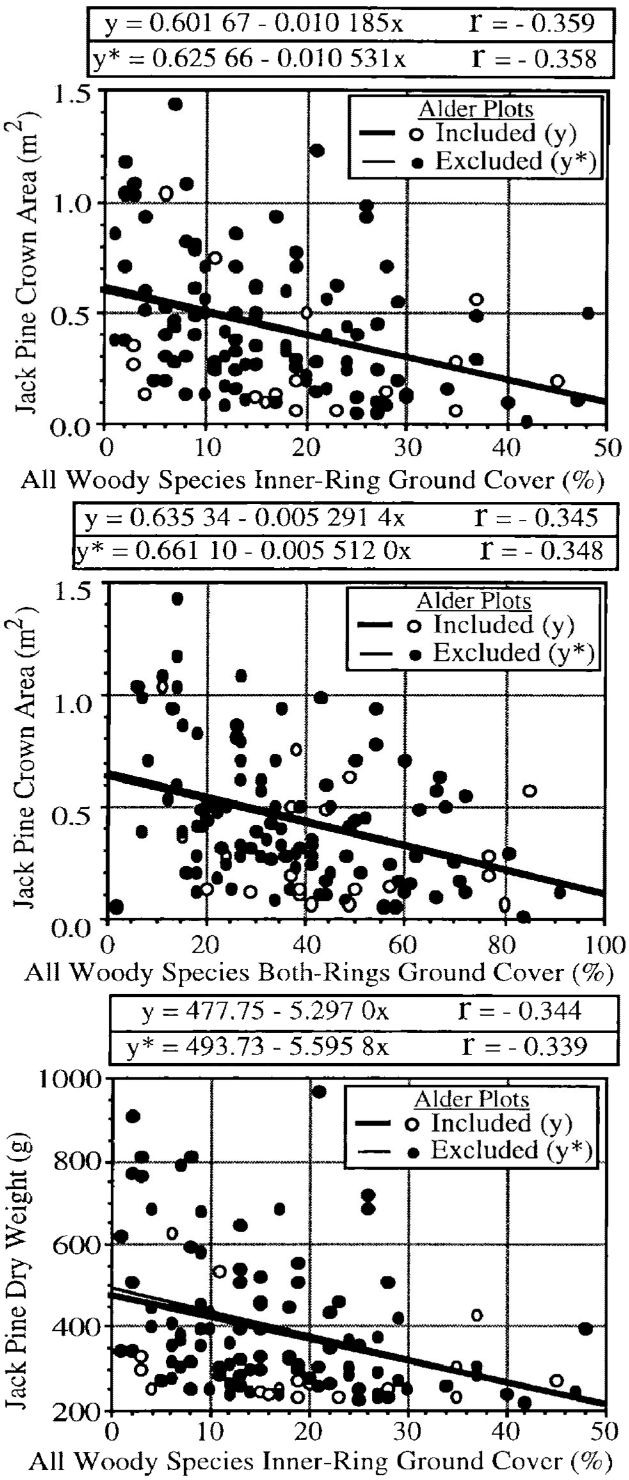


Figure 34. Highest value correlations between all woody vegetation measurements and jack pine parameters.

to the correlation coefficients at 0.353, 0.345, and 0.338 respectively.

The correlations for all woody species ground cover *vs.* jack pine crown area and dry weight also show the characteristic negative slopes associated with competition. The magnitudes of the **r** values, however, are much less than those derived for all of the vegetation. This suggests that the influence of the rest of the vegetation (*i.e.* the herbaceous vegetation) is also considerable, albeit somewhat less than that of the woody vegetation. This is confirmed by the data in Table 17.

The predominance of negative correlation coefficients, particularly among the inner ring correlations and, to a lesser extent, among the both-ring correlations indicates that proximity is a significant factor in the development of jack pine. Conversely, the smaller-sized highest positive correlation values for this species group, associated mainly with outer-ring, and some both-ring measurements, suggest that at greater distances, non-crop woody species do not compete with the crop trees, but provide some benefit to them. This is most likely in the form of protection from extreme weather conditions.

The effect of the green alder on these correlations is negligible.

E) *Rubus idaeus* (raspberry)

Raspberry is the individual non-crop species with the highest indices of reliability. This is due to the relative ubiquitousness of the species (occurring in 83 or 69% of the plots' inner rings, 86 or 72% of the plots' outer rings, and 93 or 78% of the plots' both rings) and to its reasonably strong correlations with jack pine development. This makes it the most reliable single species on the site to serve as an indicator of the development of the jack pine.

The largest correlation coefficients for the raspberry - jack pine interactions are those for average height (1) outer ring with jack pine crown area (**r** = -0.437), (2) outer-ring with jack pine crown volume (**r** = -0.428), and (3) both rings with jack pine crown area (**r** = -0.417) (Figure 35). The confidence values are also >99.95% for each case. The indices of reliability are 0.313, 0.307, and 0.323 respectively.

All of the raspberry-jack pine correlations listed in Appendix D2 have negative coefficients, ranging from -0.212 to -0.437, and their representative lines have a pronounced slope. This indicates a strongly inverse relationship between the raspberry measurements and the jack pine parameters characteristic of competition.

The mixture of inner, outer and both rings effects occurring in the

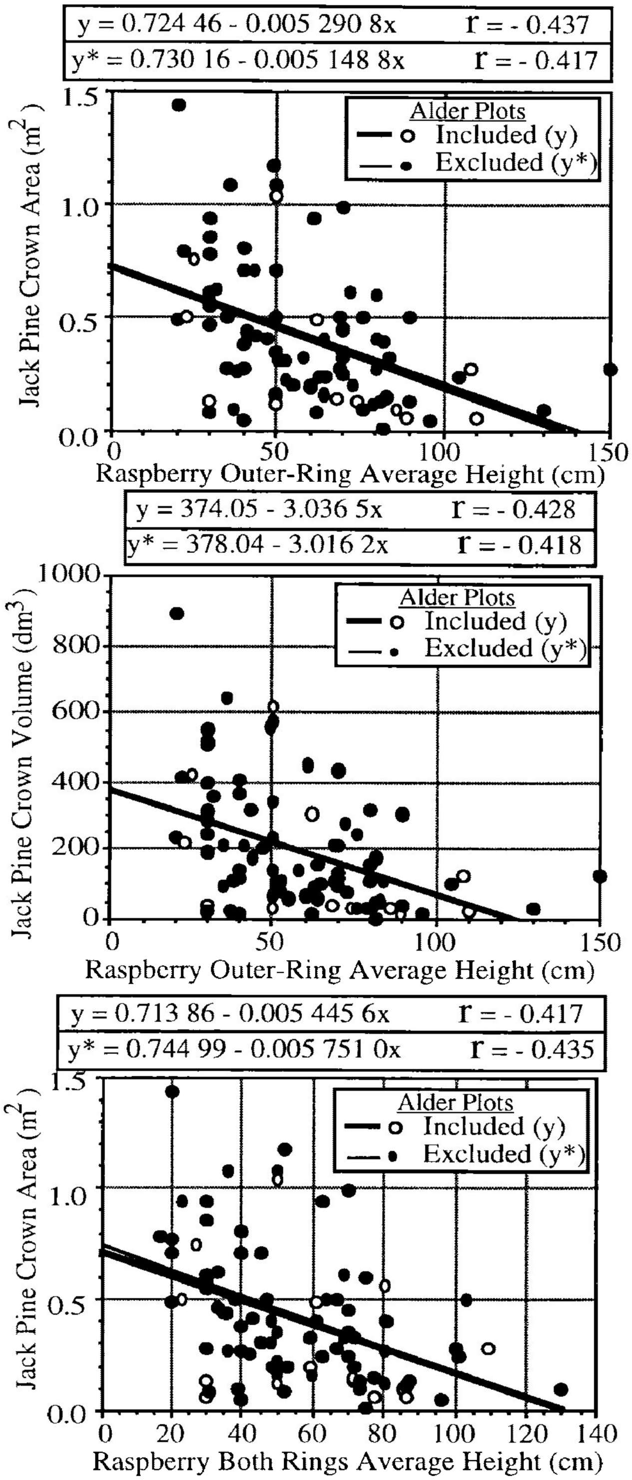


Figure 35 Highest value correlations between raspberry measurements and jack pine parameters.

decreasing order of correlation magnitude (Appendix D2) suggests that there is a minimal influence of raspberry proximity within the 1.13 m radius surrounding the jack pine crop trees. Whereas this degree of proximity is not significant, the dominance of raspberry height measurements among the largest correlation coefficients points to its being the most significant measure of raspberry with respect to its effect on jack pine.

The influence of green alder in the plots with raspberry is negligible. The trends for the data excluding the alder plots are almost identical with those inclusive of the alder. The similar correlation coefficients for the alder-inclusive (-0.437, -0.428, and -0.417) and exclusive (-0.417, -0.418, and -0.435) plots and the same confidence values for both categories (*i.e.* 99.95%) show that the influence of the alder on the jack pine in the presence of raspberry is insignificant.

F) Other Species and Species Groups

The rest of the species and species groups correlations with jack pine, by virtue of their low frequencies of occurrence and/or their low coefficients of correlation have relatively low indices of reliability. This suggests that in this plantation, they have relatively minor influence on the development of jack pine. Worthy of note, however, are some species that at a higher level of occurrence could have serious effects on that development. Mountain maple in the inner ring has significant influence, at a 97.5% confidence level: (1) ground cover on jack pine stem diameter (**r** = -0.510), (2) ground cover on jack pine crown area (**r** = -0.488), and (3) volume on jack pine crown area (**r** = -0.477). Canada bluejoint grass affects jack pine height increment by means of its (1) inner ring ground cover (**r** = -0.457 at 99.75% Confidence), (2) both rings ground cover (**r** = -0.412 at 99.5%), and (3) inner ring weight (**r** = -0.366 at 97.5%). Sedges (*Carex* Spp.) demonstrate a mixed response from jack pine. The majority of sedge - jack pine correlations (55 of 84) have positive coefficients with values up to 0.445 (inner-ring volume *vs.* jack pine height increment), and another 24 have negative correlations with values up to -0.395 (outer-ring dry weight *vs.* jack pine height increment). With confidence levels of 97.5% and 95% respectively, this suggests an anomalous response. Inner ring volume is positively correlated with height increment, while outer ring dry weight is negatively correlated with the same jack pine parameter.

A confounding factor which is particularly noteworthy with respect to *Carex* is the site quality on which it thrives. According to Bell (1991), "In N(orth) W(est) Ontario, sedges occur more commonly on fine-textured, silt and clay soils than on coarser-textured, sandy soils...(They) occur across the full range of nutrient regimes. Their distribution appears to be controlled more by soil moisture regime than soil nutrients...sedges show a strong preference for very moist to wet sites. Conversely, jack pine ... grows best on well-drained loamy or very fine sands where the mid-summer water table is 1.2 - 1.8 m below the soil surface (Rudolph and Laidly, 1990). Only rarely does it occur on poorly drained soils (Cayford *et al.*, 1967)." This suggests that the poor performance of jack pine in association with sedges may be more attributable to site unsuitability than to competition.

The minor herbs, despite relatively high coefficients of correlation (-0.437, -0.407, and -0.373) comprise too heterogeneous a mixture of species and are too infrequent in occurrence (present in only 41 to 46 or 34.1% to 38.3% of the 120 plots) to provide reliable indication of jack pine development. Of the woody species, white birch with **r** values of -0.332, -0.327, -0.321; pin cherry (**r** = -0.311, -0.308, -0.276); and beaked hazel (**r** = -0.285, -0.192.-0.184) have too low correlation coefficients to serve as reliable indicators of jack pine performance.

The last of the herbaceous species, fireweed, has its largest positive coefficients for outer ring at 99% confidence level (1) ground cover with jack pine stem diameter (**r** = 0.239), (2) dry weight with jack pine stem diameter (**r** = 0.237), and (3) dry weight with jack pine stem volume (**r** = 0.235). It occurs in 95 (79.2%) of the inner rings, 102 (86%) of the outer rings, and 106 (88.3%) of both rings of the 120 plots. The relationship is mostly positive, with dry weight, ground cover and volume in the outer and both rings displaying the strongest correlations. The few negative correlations, of which the largest value is **r** = -0.106, are dominated by the average heights in the outer and both rings. This shows that fireweed is not a competitor for jack pine, but has mild beneficial effects on the crop tree development, perhaps by preventing domination of the site by other, more competitive species, and by providing some limited protection from the weather.

The Application of Towill and Archibald's Competition Index

The application of Towill and Archibald's CI shows mixed results. The correlation between the Cumulative Competition Index (CCI) and the estimated dry weight for all plant species within both rings of the plots is very strong, as shown in Figure 30, with a coefficient of 0.845. This corresponds to a confidence limit far in excess of the 99.95% level. This high correlation inspires considerable confidence in the predictability of the data, and suggests that this is a very reliable indicator of the relative abundance of non-crop species in the immediate vicinity of the crop trees.

The weakness of the T&A Index is in its correlation with the various indicators of Jack pine performance (*i.e.* its parameters). The coefficients of correlation for CCI versus the individual parameters range from -0.259 (stem volume), -0.277 (height), -0.283 (height increment), -0.332 (crown volume), -0.339 (dry weight), -0.371 (stem diameter), to -0.377 (crown area). Still, most of these values are somewhat higher than the **r** = 0.296 value which corresponds to the 99.95% confidence level for a sample size of 120 (Appendix D-1). The difficulty with these coefficients is that the non-crop species, as characterized by this index, only account for 25.9% to 37.7% of the variation in the respective parameters. Consequently, it may be deduced that either (1) the competition index is inadequate to describe the level of competition effect on the crop tree species, or (2) competition has, at this stage of development of the plantation seedlings, only a minor influence on the variability of the jack pine development.

To address the first of these deductions, consider the strengths and weaknesses of the CCI. Specifically, the strengths are simple:

a) Being crop-tree centered, only the effects of non-crop species within the immediate vicinity of the crop trees are considered.

b) All non-crop species within the plot are identified, quantified and considered to be competitors.

c) Non-crop species ground coverage (per cent) and heights relative to that of the crop tree, two of the most significant competitor parameters, are used as the basis for determination of the index.

d) The plots are uncomplicated to establish, relatively quick and easy to tally and simple to analyze.

The weaknesses are also significant:

a) Only non-crop species within a 1.13 m radius are considered. This radius is arbitrary in size, corresponding only with the average planting density prescribed for most clear-cut pulpwood plantations. This radius may serve reasonably well where the established stands are very young, with all species averaging one metre or less in height, but it is unlikely that it will perform as satisfactorily for crop tree saplings with heights exceeding one metre. Similarly, it may be pointless to consider the competition between crop and non-crop species less than 30 cm in height when they are more than 60 cm apart. As well, plots of this size should not be expected to provide reliable indices when established near the perimeter of the stand, *i.e.* within one tree length of an adjacent residual stand.

b) Being crop-tree centred, the T&A procedure can only be applied effectively to an established, well-stocked stand. This means that sites in which seedlings have not yet been established or where an establishment has failed cannot be effectively assessed. The solution is quite simple, although based on an assumption. A surveyor could establish plots centred on appropriate micro-sites at the normal frequency for the site, record all of the non-crop tree data, as usual, and then estimate the average measurements for the largest stock that one could reasonably expect to plant, if the planting were to have been carried out on that particular day. This would provide a relative indication of the intensity of competition if there had been crop tree seedlings present.

c) The coverage (crown area) of the crop tree is not considered. If coverage, and its derivative volume, are considered to be the principal determinants of non-crop trees competitive abilities, then why are those same parameters not applied to the crop tree? A volume ratio, in lieu of the B:C ratio, would incorporate this coverage factor and should provide higher coefficients of correlation between crop and non-crop species measurements than otherwise.

d) The characteristics of individual non-crop species are ignored. All non-crop species are considered to have the same competitive ability, based on ground coverage and height. As we have just seen, this is not the case. Indeed, coverage and height can have correlations which counteract each other.

e) The proximity of the non-crop species to the crop tree is also disregarded. Again, this factor has been shown to be significant. Incorporating a measure of crop tree - competitor spacing by means of a series of concentric rings within the plot would resolve this problem.

f) The height-averaging method used in the 1991 report is woefully inadequate. A tall solitary stem occupying 1% coverage of the plot would have the same weight as a short shrub occupying the rest (99%) of the plot. The average height as described by the methodology would be considered the median of the two heights. This average height would be no different if the coverages were reversed. Such a contention is absurd. This shortcoming is easily remedied by multiplying each species height class by its coverage, summing the results, and dividing the yield by the total of the species height class coverages. This would result in more representative average heights based on weighted inputs. Coverage would then have an appropriate influence on the determination of average height.

g) Overlapping of non-crop species permits plots to have coverages greater than 100%. This factor suggests that the relative competitiveness of non-crop species is unaffected by mutual overlapping. If such were to be the case, then it could be reasonably concluded that overlapping would have little effect on the crop trees as well. Since that would negate the premise of competition, it would be reasonable to accept that the overlapping of non-crop species reduces their competitiveness to some degree. Accordingly, some reduction factor should be implemented for the overlapped coverage of non-crop species, or, failing that, only dominant species coverage should be considered where overlapping coverages occur. This would simplify data collection somewhat and maximize coverage for the plot at 100%.

h) Coverage is assumed to be a single dimension factor; one that is variable only in its area. There is no means in this procedure for determining the relative density or intensity of the coverage. Sparse coverage is accorded the same value per unit of area as dense or thick coverage. One means of overcoming this difficulty is to assign a relative density and/or thickness measure to the coverage with three options: dense/thick, moderate, or sparse/thin.

i) Using plots divided into quadrants alone, while simple, yields only crude precision of ground cover estimates. Taking a little more time in plot establishment, and sub-dividing the quadrants into sectors and concentric rings and recording the data on plot tally forms such as those used in this study (Appendix A) would yield results with much greater accuracy. It would also provide a means to confirm the data at a later time should that be necessary.

j) There is no discrimination between the azimuths of the non-crop species with respect to the crop trees. Non-crop species to the south of the crop trees (and possibly shading them from direct sunlight) are considered equal in competitive ability to those to the north. This may have some influence on crop tree development and should be considered for future investigation. This matter could be resolved by simple alignment of the plots along an east - west axis and distinguishing species in the southern quadrants from those in the north. Although the azimuth effect could not be reasonably extrapolated to all of the crop species within the plantation, the effect should explain some of the variability between crop trees within the sample.

The Modified Towill and Archibald Competition Indices

To address some of the foregoing issues, several modifications were made to the existing CI procedure. These modifications included:

a) a volume B:C ratio in place of the height B:C ratio;

b) the exclusion of plots containing green alder from the data set;

c) the outer ring non-crop species were given a weight of half that of the inner-ring species (expressed in the volume index);

d) non-crop species heights were averaged in proportion to their per cent coverage; and

e) specimen overlap was disregarded, that is, only the dominant species on a given micro-site was awarded the coverage, and, therefore, coverage within a plot did not exceed 100%.

Except for the last, these modifications were applied to the study data individually and in combination, and contrasted with the existing CI. The results, listed in Appendix F4 and summarized in Tables 20 and 21, can be described as follows:

A) Correlation with Total Estimated Non-Crop Species Biomass

Seven of the individual and combined modifications, W (proximity-weighted), HW (height-averaged and W), WA (W and alder-excluded), HWA, H, A, and HA display coefficients of correlation with all other vegetation dry weight (0.854 to 0.834) comparable with that of the unmodified T&A CI (Table 20). The first four of this series have marginally higher **r** values than that elicited by the unmodified form, and the latter three have lower values. This suggests that proximity weighting has a slightly beneficial effect on representing variability in the biomass, height-averaging is more-or less neutral, and exclusion of alder is slightly deleterious to the capability of the index to represent biomass. The other four modifications and groupings, *i.e.* (volume-based) VWA, VA, VW, and V, display much lower **r** values than the first seven and the unmodified T&A index. These coefficients, ranging from 0.305 to 0.297, suggest that volume-basing the index lowers its representativeness of the non-crop species biomass considerably. All eleven values, however, are still in excess of the 0.333 and 0.296 limits for 99.95% confidence with sample sizes of 100 and 120 respectively. This means that all of these modifications are still able to represent the total non-crop species biomass with high degrees of confidence, albeit with some diminishment of capability from the volume-based modification.

B) Correlation between Index Modifications and Jack Pine Parameters

The correlations between the index modifications and jack pine parameters are divided into two groupings, as shown in Table 21. Of the first grouping, based on a complete listing of the jack pine parameters, their sensitivity decreases from height, through stem diameter, crown area, height increment, dry weight, and crown volume to stem volume. Whereas tree height and height increment are markedly enhanced in their abilities to explain the variation in jack pine development by the modifications (volume-based - alder excluded, and volume-based - proximity weighted - alder excluded, respectively) from **r** = -0.277 and -0.283 to **r** = -0.402 and -0.378 respectively, the abilities of the rest of the jack pine parameters are relatively unaffected by the modifications to the T&A CI.

The second grouping, based on a complete listing of all the T&A modification variants, has as its largest-valued correlations, two of the four volume-based modifications, VA and VWA. These indices explain 16.1% of the variability ($\mathbf{r}^2 = 0.402^2$) in the height of the jack pine. This is a considerable amount of explanation for a crop tree parameter (*i.e.* height) which is usually considered to be relatively insensitive to the effects of competitors. One reason for the high sensitivity of the volume-based indices to the jack pine height is the dependency of the volume-based indices on the height and coverage of the jack pine crop tree. This means that the relationship is by no means independent and makes it unusable where a greater degree of independence is necessary. For that matter, since the unmodified T&A CI depends on the B:C (height) ratio anyway, complete independence of the index from the crop species is impossible.

The other modified competition indices are quite similar in their coefficients of correlation, explaining from 14.8% ($\mathbf{r}^2 = 0.385^2$) to 13.1% ($\mathbf{r}^2 = 0.362^2$) of the variability in the stem diameter, crown area, and tree height of the jack pines. From these the following effects should be noted:

1) tree height is the jack pine parameter with which all of the volume-based modifications have their largest correlations;

2) stem diameter and crown area are the only two other jack pine crop tree parameters with which the modifications have their largest correlation coefficients;

3) proximity weighting made no difference at all to the correlations between volume-based and alder-exclusive modifications, and little difference in any of the other modifications in which it participated; and

3) alder-exclusive modifications yielded the largest correlations (**r** = -0.402 to -0.383).

The final question with respect to these modifications is which ones are the best indicators of competition. To derive the answer to this question, it would be appropriate to reconsider the purpose of competition indices in general. CIs have been developed to measure the relative competitive effect of non-crop neighbours on crop trees. As such the degree of negative effect is the primary concern, and the representativeness of adjacent plant life is of secondary importance. The selection of the best indicators should reflect the following factors:

1) The indicator of ultimate economic concern *vis-a-vis* the crop tree is its biomass. This is best represented by its dry weight. Because dry weight is a difficult, if not impossible, measurement to acquire in the field from a non-destructively sampled specimen, an estimator is required. The best estimator of jack pine dry weight has been shown to be its stem volume.

2) The species / species group measurement which provides the largest negative correlations with jack pine is the total plant species ground cover (inner-ring and both-rings) *vs.* jack pine crown area and dry weight.

3) The unmodified Towill and Archibald Competition Index has a high coefficient of correlation with the dry weight of the vegetation it represents (**r** = 0.845), but relatively low correlations with jack pine parameters (-0.377 to -0.259).

4) The T&A CI modifications can be characterized by two values: (1) their representativeness (coefficient of correlation) with the dry weight of the total non-

crop plant species surrounding the crop trees (**r** = 0.854 to 0.297), and (2) the parameter effect (the largest correlation coefficient with crop tree parameters for each modification) (**r** = -0.402 to -0.362). The indicator that represents both the non-crop vegetation best and accounts for the greatest amount of variability in the most representative jack pine parameter, is the product of these two elements. These are presented in decreasing order of magnitude in Table 23:

Table 23. Products of non-crop species representativeness and jack pine parameter effects for Towill and Archibald's Cumulative Competition Index and each of its modifications in decreasing order.

CCI	Jack Pine Parameter	Representa-tiveness*	Parameter Effect (PE)**	Rep. × PE
HA	SD	0.834	-0.385	-0.321
A	SD	0.834	-0.383	-0.319
H	CA	0.843	-0.379	-0.319
T&A	**CA**	**0.845**	**-0.377**	**-0.319**
HWA	SD	0.849	-0.375	-0.318
WA	SD	0.850	-0.374	-0.318
HW	CA	0.853	-0.373	-0.318
W	CA	0.854	-0.370	-0.316
VWA	Ht	0.305	-0.402	-0.123
VA	Ht	0.303	-0.402	-0.122
VW	Ht	0.297	-0.362	-0.108
V	Ht	0.297	-0.362	-0.108

* coefficient of correlation with the total non-crop species above-ground dry weight within the plots

** coefficient of correlation between CCIs and the various jack pine parameter measurements recorded in the study.

Based on the foregoing factors, the best indicator of jack pine performance is provided by the HA (height-averaged, alder-excluded) modification to Towill and Archibald's competition index. This modification is slightly better than the unmodified form of the T&A Index, and has the advantage of having both elements of its modification defensible on practical grounds.

CONCLUSIONS AND RECOMMENDATIONS

The objective of this thesis has been met; the hypothesis has been shown to be true. Specifically, it has been shown that the growth of tree seedlings is influenced by the growth and development of other vegetation close to it. In the course of this study the following conclusions have been derived:

- The *Total Plant Species* (TPS) group has the highest index of reliability (correlation coefficient times occurrence) of any species or species group tested. The highest correlation is between TPS inner ring ground cover and jack pine crown area, followed closely by TPS both-rings ground cover and jack pine crown area.

- The *All Woody* species group has the second highest index of reliability, but it is considerably less than that of the TPS species group. This group correlates best with the same parameters and proximity range as the TPS group.

- The single best non-crop species indicator of crop tree performance is raspberry. Its reliability index is only slightly less than that of the All Woody species group, and correlates best for its height in the outer ring with jack pine crown area.

Specific Conclusions

- Non-crop species ground cover is the most significant measurement determining the development of jack pine; non-crop species height is the least significant. The order of significance is: ground cover >> volume > dry weight > height.

- The proximity of competitors has a directly proportional relationship with the degree of competition; *i.e.* inner ring competitors are more influential on jack pine development than both ring competitors, which, in turn, are more influential than outer ring competitors.

- Jack pine crown area, dry weight, and crown volume are the most sensitive of its parameters against which to measure the severity of competition; height increment is moderately sensitive; and height, stem diameter, and stem volume are the least sensitive parameters.

- Alder has the highest coefficients of correlation with jack pine of all of the species and groups examined. The impact of the alder is stimulative, not inhibitory and is primarily expressed by its ground cover and above-ground volume on the jack pine stem volume. The effect is greater at a short distance than immediately adjacent to the jack pine seedling / sapling.

- The Towill and Archibald competition index effectively represents the non-crop species biomass on a plot. It also correlates very significantly, but not with very large coefficients of correlation to the jack pine crop-tree parameters, explaining only a maximum of 14.2% ($r^2 = 0.377^2$) of the variability of the most sensitive indicator (crown area).

- A modified Towill and Archibald Competition Index which is height-averaged, and exclusive of alder provides a marginally more representative and more useful indicator of jack pine biomass than the unmodified form.

Specific Recommendations

This study would be worthwhile expanding to include a range of sites and conditions subject to the following guidelines:

- Allowances must be made for some destructive sampling of crop tree seedlings. Species parameter-dry weight correlations cannot be satisfactorily derived from specimens collected off-site.

- The study could be replicated for several years on the same and other sites in order to produce a time-series data base.

- The Towill and Archibald Competition Index (modified to reflect a more sensible height-averaging method, and exclusive of alder-containing plots) should be reformulated and tested with the following attributes:

    a) a larger plot size divided into sectors (*e.g.* 30°) and smaller concentric rings around the subject tree (*e.g.* encompassing 1.0 m^2, 1.5 m^2, 2.0 m^2, 2.5 m^2, 3.0 m^2, 4.0 m^2, 5.0 m^2, and 6.0 m^2);

    b) the optimum plot size should be derived for crop trees of different species and heights;

c) a simple relative-density parameter should be devised and implemented in accordance with ground cover so as to add an extra, possibly significant, dimension to the cover measurement; and

d) the true north-south line of the plot should be recorded so that the effect of non-crop species azimuth on the subject tree can be considered.

- A permanent record of the plot data (as described in Appendix A), either on paper or electronic, should be maintained in order to permit subsequent verification and re-analysis of the data.

LITERATURE CITED

Adlard, P.G. 1974. **Development of an empirical competition model for individual trees within a stand.** *In* J. Fries (Editor) 1974. Growth Models for tree and stand simulation. IUFRO Working Party S4.01.4. Proceedings of meetings in 1973. Rapporter och Uppsatser, Institutionen för Skogsproduktion No. 30, 379 pp.

Alemdag, I.S. 1978. **Evaluation of some competition indexes for the prediction of diameter increment in planted white spruce.** Information Report, Forest Management Institute, Canada. 1978, No. FMR-X-108, vi + 39 pp.

Arney, J.D. 1972. **Computer simulation of Douglas-fir tree and stand growth.** Ph.D. Thesis, Oregon State University, 79.pp.

Arney, J.D. 1973. **Tables for quantifying competitive stress on individual trees.** Information Report, Pacific Forest Research Centre, Canada. 1973, No. BC-X-78, 45 pp.

Assmann, E. 1975. **[On the methodology of forest trials (thinning and spacing)].** Forstwissenschaftliches Centralblatt 94(6): 255-264.

Bacon, C.G. and S.M. Zedaker. 1986. **Leaf area prediction equations for young southeastern hardwood stems.** Forest Science 32(3): 818-821.

Barclay, H.J., and C.R.Layton. 1990. **Growth and mortality in managed Douglas fir: relation to a competition index.** Forest Ecology and Management 36(2-4): 187-204.

Beauregard, M.J. 1976. **Simulated crown light interception as an index to competitive ability for uneven-aged mixed hardwoods.** Ph.D thesis, Michigan State University, 120 p. abstracted in Dissertation Abstracts International, B. 36(9): 4244-4245; Order No. 76-5519.

Bell, F.W. 1991. **Critical silvics of conifer crop species and selected competitive vegetation in Northwestern Ontario.** Forestry Canada, Ontario Region, Sault Ste. Marie, Ontario / Northwestern Ontario Forest Technology Development Unit, Ministry of Natural Resources, Thunder Bay, Ontario. COFRDA Report 3310 / NWOFTDU Technical Report 19. vi + 177 pp.

Bella, I.E. 1969. **Competitive influence-zone overlap: a competition model for individual trees.** Bi-monthly Research Notes, Ottawa 25(3): 24-25.

Bella , I.E. 1971. **A new competition model for individual trees.** Forest Science 17: 364-372.

Biging, G.S., and L.C.Wensel. 1990. **Estimation of crown form for six conifer species of northern California.** Canadian Journal of Forest Research 20(8): 1137-1142.

Biondi, F. 1990. **Confronto dendrocronologico fra indici di competizione.** [Dendro-chronological comparison of competition indices.] *Annali della Facolta di Agraria - Universita Cattolica del Sacro Cuore*, Milano, 30(2): 107-124.

Biondi, F., J.O.Klemmedson and R.O.Kuehl. 1992. **Dendrochronological analysis of single-tree interactions in mixed pine-oak stands of central Arizona, USA.** Forest Ecology and Management 48(3-4): 321-333.

Boysen-Jensen, P. 1949. **Causal plant-geography.** D. Kgl. Danske Vidensk. Selsk., Biol. Meddel. 21:1-19 *In* Mueller-Dombois and Ellenberg (1974).

Brand, D.G. 1986a. **A competition index for predicting the vigour of planted Douglas-fir in southwestern British Columbia.** Canadian Journal of Forest Research 16(1): 23-29.

Brand, D.G. 1986b. **Competition-induced changes in developmental features of planted Douglas-fir in southwestern British Columbia.** Canadian Journal of Forest Research. 16(2): 191-196.

Brand, D.G. 1987. **Early growth and development of Douglas-fir in relation to interspecific competition.**[Thesis summary]. *In* Dissertation Abstracts International Vol.47(4B): 1349-1350.

Brown, G.S. 1965. **Point density in stems per acre.** New Zealand Forest Research Note No. 38, 11 pp.

Bruchwald, A. 1988. **Przyrodiczne podstawy budowy modeli wzrostu.** [Natural bases for the construction of growth models.] Sylwan 132(11-12): 1-10.

Burkholder, P.R. 1952. **Cooperation and conflict among primitive organisms.** American Science 40:601-631.

Burley, J. 1984. **Keynote address for Commonwealth Science Council Workshop on Agro-forestry, Lilongwe, Malawi, June 27-July 1, 1983. Problems of design and analysis of agro-forestry experiments.** 9 pp.; Oxford, UK; Commonwealth Forestry Institute.

Burns, R.M. and B.H. Honkala (technical coordinators). 1990. **Silvics of North America: 1 Conifers.** Agriculture Handbook 654, U.S. Department of Agriculture, Forest Service, Washington, D.C. Volume 1, 675 pp.

Buse, L.J. 1992. **Chemical Site Preparation for planting and seeding: interim report 1991.** Internal report, Northwest Ontario Forest Technology Development Unit, Ontario Ministry of Natural Resources, RR#1, 25th Side Road, Thunder Bay, Ontario, P7C 4T9. iv + 22 p.

Cancino, C.J. and S.J. Garcia. 1987. **Modelo tridimensional para determinar competencia en plantaciones de *Pinus radiata* D. Don.** [Three-dimensional model for determining competition in *Pinus radiata* plantations.] Agro-Ciencia. 3(1): 59-66.

Cannell, M.G.R., P. Rothery, and E.D. Ford. 1984. **Competition within stands of *Picea sitchensis* and *Pinus contorta*.** Annals of Botany (London) 53: 349-362.

Carter, G.A., K.Paliwal, U.Pathre, T.H.Green, R.J.Mitchell, and D.H.Gjerstad. 1989. **Effect of competition and leaf age on visible and infrared reflectance in pine foliage.** Plant, Cell and Environment. 12(3): 309-315.

Cayford, J.H., Z. Chrosciewicz, and H.P. Sims. 1967. **A review of silvicultural research in jack pine.** Canadian Department of Forestry and Rural Development, Forestry Branch, Departmental Publication Number 1173. 30 pp *In* Bell, 1991.

Chan, S.S. and J.D. Walstad. 1987. **Correlations between overtopping vegetation and development of Douglas-fir saplings in the Oregon Coast Range**. Western Journal of Applied Forestry 2(4): 117-119.

Collins, S.L. and S.C. Klahr. 1991. **Tree dispersion in oak-dominated forests along an environmental gradient.** *Oecologia* 86(4): 471-477.

Conolly, B.J. and D.F. Grigal. 1983. **Biiomass estimation equations for wetland tall shrubs.** Minnesota Forestry Research Notes, No. 284, College of Forestry, University of Minnesota. 4 pp.

Cottam, G., and J.T.Curtis. 1956. **The use of distance measures in phytosociological sampling**. Ecology 37(3): 451-60.

Daniel, Theodore, W., John A. Helms, and Frederick S. Baker. 1979. **Principles of Silviculture, Second Edition.** McGraw-Hill Book Company, New York, NY, USA. xii + 500p.

Daniels, R.F. 1976. **Simple competition indices and their correlation with annual Loblolly Pine tree growth.** Forest Science, 22(4): 454-456

Day, R.J. 1992. **A Manual of Silviculture For Forestry 3210, 3214 and 4060, Fourteenth Edition.** School of Forestry, Lakehead University, Thunder Bay, Ontario. v + 332 p.

Delong, S.C. 1991. **The light interception index: a potential tool for assisting in vegetation management decisions.** Canadian Journal of Forest Research 21(7): 1037-1042.

Ek, A.R. and D.H. Dawson. 1976. **Actual and projected growths and yields of *Populus 'Tristis 1'* under intensive culture.** Canadian Journal of Forest Research, 6(2): 132-144.

Ellis, R.C. 1979. **Response of crop trees of sugar maple, white ash, and black cherry to release and fertilization.** Canadian Journal of Forest Research, 9(2): 179-188.

Ellis, R.C., D.A.Ratkowsky, J.P.Mattay, and A.F.Rout. 1987. **Growth of *Eucalyptus delegatensis* following partial harvesting of multi-aged stands.** Australian Forestry, 50(2): 95-105.

Farr, W.A., D.J.DeMars, and J.E.Dealy. 1989. **Height and crown width related to diameter for open-grown western hemlock and Sitka spruce.** Canadian Journal of Forest Research, 19(9): 1203-1207.

Ferrill, M.D. and F.W.Woods. 1966. **Root extension in a Longleaf Pine plantation.** Ecology 1966 47(1): 97-102.

Ford, E.D. and P.J. Diggle. 1981. **Competition for light in a plant monoculture modelled as a spatial stochastic process.** Annals of Botany.48: 481-500.

Ganzlin, W.K. and C.G.Lorimer. 1983. **Tests of a rapid field method for evaluating competition around individual trees.** Forestry Research Notes, Department of Forestry, University of Wisconsin. 1983., No. 253, 6 pp.

Gerrard, D.J. 1968. **Competition quotient: an index of the competitive stress affecting individual forest trees.** Abstract of thesis, *in* Dissertation Abstracts 29B(2): 426-7.

Gibbs, C.B. 1970. **The relationship of tree characteristics and competition to basal area growth in Appalachian hardwoods.** Abstract of Ph.D. thesis, in Dissertation Abstracts International. 30B(10): 4450-4451.

Grigal, D.F. and L.F. Ohmann. 1977. **Biomass estimation for some shrubs from northeastern Minnesota.** Research Note NC-226, North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture. 3 pp.

Harms, W.R. 1981. **A competition function for tree and stand growth models**. Pp.179-183 [9 ref.] *In* Quantification sessions. Barnett, J. P. (Editor): Proceedings of the First Biennial Southern Silvicultural Research Conference, Atlanta, Georgia, November 6-7, 1980. General Technical Report, Southern Forest Experiment Station, USDA Forest Service, No. SO-34.

Harper, J.L. 1977. **Population biology of plants.** Academic Press. New York, NY, USA. 892 p.

Harrison, W.C., T.E.Burk, and D.E.Beck. 1986. **Individual tree basal area increment and total height equations for Appalachian mixed hardwoods after thinning.** Southern Journal of Applied Forestry, 10(2): 99-104.

Hatch, C.R. 1971. **Simulation of an even-aged red pine stand in northern Minnesota.** Ph.D. Thesis, University of Minnesota.

Hatch, C.R., D.J.Gerrard, and J.C.Tappeiner II. 1975. **Exposed crown surface area: a mathematical index of individual tree growth potential.** Canadian Journal of Forest Research, 5(2): 224-228.

Healy, W.M. and J.D. Gill. 1974. **Alders.** Pp. 6-9 in Gill, J.D. and Healy, W.M. (eds) **Shrubs and Vines for Northeastern Wildlife.** US Department of Agriculture, Forest Service, General Technical Report NE-9; 180 pp.

Hegyi, F. 1974. **A simulation model for managing jack-pine stands.** Pp. 74 - 90 *In* Fries, J (Editor). 1974. Growth models for tree and stand simulation. IUFRO Working Party S4.01.4. Proceedings of meetings in 1973. Rapporter och Uppsatser, Institutionen for Skogsproduktion No. 30, 379 pp.

Hix, D.M. and C.G.Lorimer. 1990. **Growth-competition relationships in young hardwood stands on two contrasting sites in southwestern Wisconsin**. Forest Science 36(4): 1032-1049.

Hobson, F.O. and C.H. de Ridder. 1991. **Quantifying indices of potential competitiveness and browse productivity of single-stemmed *Acacia karoo* trees in south-eastern Africa.** Journal of the Grassland Society of Southern Africa 8(1): 1-8.

Hocker, Harold, W. Jr. 1979 **Introduction to Forest Biology.** John Wiley and Sons, Toronto, Canada. xi + 467 p.

Holdaway, M.R. 1984. **Modeling the effect of competition on tree diameter growth as applied in STEMS.** General Technical Report, North Central Forest Experiment Station, USDA Forest Service, No. NC-94, i + 9 pp.

Holmes, M.J., and D.D. Reed. 1991. **Competition indices for mixed species northern hardwoods.** Forest Science 37(5): 1338-1349.

Honer, T.G. 1972. **A height-density concept and measure.** Canadian Journal of Forest Research 2(4): 441-447.

Howard, K.M. and M.Newton. 1984. **Overtopping by successional Coast-Range vegetation slows Douglas-fir seedlings**. Journal of Forestry 82(3): 178-180.

Hughes, T.F., J.C.Tappeiner II and M.Newton. 1990. **Relationship of Pacific madrone sprout growth to productivity of Douglas-fir seedlings and understory vegetation.** Western Journal of Applied Forestry 5(1): 20-24.

Keister, T.D. 1967. **Thinning methods in Slash Pine [*Pinus elliottii*] plantations.** Abstract of thesis, in Dissertation Abstracts 1967 27B (9): 2946.

Keister, T.D. 1972. **Predicting individual tree mortality in simulated Southern Pine plantations.** Forest Science 18(3): 213-217.

Keister, T.D. and G.R.Tidwell. 1975. **Competition ratio dynamics for improved mortality estimates in simulated growth of forest stands**. Forest Science 21(1): 46-51.

Ker, M.F. 1975. **Competitive stress indices for Balsam Fir in Newfoundland.** Information Report, Newfoundland Forest Research Centre. 1975., No. N-X-131; 9 + 32 pp.

Kimmins, J.P. 1987. **Forest Ecology.** Macmillan Publishing Co., New York, NY, USA. xii + 531 p.

Kira, T., H.Ogawa, and K. Shinozaki. 1953. **Intraspecific competition amongst higher plants.** J. Inst. Polytech., Osaka City Univ., D.4:1-16 *In* Day (1992).

Knapp, G. and R. Knapp. 1954. **Über Möglichkeiten der Durchsetzung und Ausbreitung von Pflanzenindividuen auf Grund verschiedener Wuchsformen.** Ber. Deut. Botan. Ges. 67: 410-419 *In* Mueller-Dombois and Ellenberg (1974).

Knowe, S.A. 1991. **Simultaneous prediction of the development of loblolly pine and woody competitors in young plantations.** New Forests 5(3): 175-193.

Kozlowski, T.T., P.J. Kramer, and S.G. Pallardy. 1991. **The Physiological Ecology of Woody plants.** Academic Press, San Diego, CA, USA. xix + 657 p.

Krajicek, J.E. and K.A.Brinkman. 1957. **Crown development: an index of stand density.** Station Note, Central States Forest Experiment Station, No. 108, 2 pp.

Krajicek, J.E., K.A.Brinkman, and S.F.Gingrich. 1961. **Crown competition - a measure of density**. Forest Science 7(1): 35-42.

Laar, A. van. 1973a. **Needle-biomass, growth and growth distribution of *Pinus radiata* in South Africa, in relation to pruning and thinning.** Forschungsberichte, Forstliche Forschungsanstalt München, No. 9, x + 282 pp.

Laar, A. van. 1973b. **[Competition and increment of *Pinus radiata*.]** Forstwissen-schaftliches Centralblatt 92(5): 261-268.

LeBlanc, D.C. 1990. **Red spruce decline on Whiteface Mountain, New York. I. Relationships with elevation, tree age, and competition.** Canadian Journal of Forest Research 20(9): 1408-1414.

Liu, C.J. 1981. **Competition index and its relationship to individual tree growth.** *In* Fries,-J (Chairman) Proceedings, XVII IUFRO World Congress, Kyoto, Japan, Sept. 6-17, 1981. Congress Group 4.1: Mensuration, growth and yield. [Voluntary papers]. : Plochmann, R. (Coordinator): Division 4: Planning, economics, growth and yield, management and policy, and Division 6: General subjects. vii + 578 pp. Tsukuba, Ibaraki, Japan; Japanese IUFRO Congress Committee.

MacDonald, B, D.M.Morris and P.L.Marshall. 1990. **Assessing components of competition indices for young boreal plantations.** Canadian Journal of Forest Research 20(7): 1060-1068.

MacDonald, G.B. 1991. **A comparison of new proximity-based expressions of competing vegetation.** Ontario Ministry of Natural Resources, Forest Research Report No. 126. 17 p.

Magnussen, S. and C.W.Yeatman. 1987. **Adjusting for inter-row competition in a jack pine provenance trial.** Silvae Genetica 36(5-6): 206-214.

Martin, G.L.and A.R.Ek. 1984. **A comparison of competition measures and growth models for predicting plantation red pine diameter and height growth.** Forest Science 30(3): 731-743.

Martynov, A.N. 1976. **Dependence of the biometric indices of *Pinus sylvestris* on the growing space.** Lesovedenie 1976(5): 85-89.

Monserud, R.A. 1975. **Methodology for stimulating Wisconsin northern hardwood stand dynamics.** Ph.D. Thesis, University of Wisconsin - Madison, School of Agriculture, Forestry and Wildlife. 156 p.

Monserud, R.A. 1976. **Simulation of forest tree mortality.** Forest Science 22(4): 438-444.

Monserud, R.A. and A.R.Ek. 1977. **Prediction of understory tree height growth in northern hardwood stands.** Forest Science 23(3): 391-400.

Moore, J.A., C.A. Budelsky, and R.C. Schlesinger. 1973. **A new index representing individual tree competitive status.** Canadian Journal of Forest Research 3: 495-500.

Morneault, A.E. 1992. **Quantifying interspecific competition in young jack pine plantations in northern Ontario.** M.Sc.F. Thesis, University of Toronto, Graduate Department of Forestry. vii + 81 p.

Morris, D.M. and R.R.Forslund. 1991. **A field-oriented competition index for young jack pine plantations and a computerized decision tool for vegetation management.** New Forests 5(2): 93-107.

Morris, D.M., G.B.MacDonald and K.M.McClain. 1990. **Evaluation of morphological attributes as response variables to perennial competition for four-year-old black spruce and jack pine seedlings.** Canadian Journal of Forest Research 20(11): 1696-1703.

Morris, D.M. and G.B.MacDonald. 1991. **Development of a competition index for young conifer plantations established on boreal mixedwood sites.** Forestry Chronicle 67(4): 403-410.

Mueller-Dombois, D., and H. Ellenberg. 1974. **Aims and Methods of Vegetation Ecology.** John Wiley and Sons, New York, NY, USA. xx + 547 p.

Nelder, J.A. 1962. **New kinds of systematic designs for spacing studies.** Biometrics 18:283-307 *In* Walstad and Kuch, 1987.

Newnham, R.M. 1964. **The development of a stand model for Douglas-fir.** Ph.D. Thesis. Department of Forestry, University of British Columbia. 219 p. *In* Dissertations Abstracts (1966) 26(7): 3567 [Order No. 65-4535]*Cited in* Alemdag, 1978.

Newnham, R.M. 1966. **Stand structure and diameter growth of individual trees in a young Red Pine stand.** Bi-monthly Research Notes, Department of Forestry, Canada 22(4): 4-5.

Nystrom, K. and P.Gemmel. 1988. **Models for predicting height and diameter of individual trees in young *Picea abies* (L.) Karst. stands.** Scandinavian Journal of Forest Research 3(2): 213-228.

Odum, Eugene P. 1971. **Fundamentals of Ecology (3rd Ed).** W.B. Saunders Co, Philadelphia, PA, USA. xiv + 574 p.

Ohmann, L.F. 1982. **Tall shrub layer biomass in conifer plantations of northeastern Minnesota.** Research Paper NC-219. North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture, St. Paul, Minnesota. 30 p.

Ohmann, L.F. 1984. **Biomass in conifer plantations of northeastern Minnesota.** Research Paper NC-247. North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture, St. Paul, Minnesota. 25 p.

Ohmann, L.F. and D.F. Grigal. 1985. **Plant species biomass estimates for 13 upland community types of northeastern Minnesota.** Resource Bulletin NC-88. North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture, St. Paul, Minnesota. 52 p.

Ohmann, L.F., D.F. Grigal and R.B. Brander. 1976. **Biomass estimation for five shrubs from northeastern Minnesota.** Research Paper NC-133. North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture, St. Paul, Minnesota. 11 p.

Ohmann, L.F., D.F. Grigal and L.L. Rogers. 1981. **Estimating plant biomass for undergrowth species of northeastern Minnesota.** General Technical Report NC-61. North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture, St. Paul, Minnesota. 10 p.

Oliver, Chadwick Dearing, and Bruce C. Larson. 1990. **Forest Stand Dynamics.** McGraw-Hill Inc., New York, NY, USA. xvii + 467 p.

Opie, J.E. 1968. **Predictability of individual tree growth using various definitions of competing basal area.** Forest Science 14(3): 314-323

Peterson, D.L. 1985. **Evaluating the effects of air pollution and fire on tree growth by tree ring analysis.** Pp.124-131, *In* Donoghue, L.R. and R.E. Martin (Editors) **Weather - the drive train connecting the solar engine to forest ecosystems.** Proceedings of the Eighth Conference on Fire and Forest Meteorology. Detroit, Michigan. April 29-May 2, 1985, 31 ref. Bethesda, Maryland, USA; Society of American Foresters.

Pukkala, T. 1989. **Methods to describe the competition process in a tree stand.** Scandinavian Journal of Forest Research.4(2): 187-202.

Pukkala, T. and T. Kolström. 1987. **Competition indices and the prediction of radial growth in Scots pine.** Silva Fennica 21: 55-67.

Radosevich, S.R. and J.S.Holt. 1984. **Weed Ecology – Implications for Vegetation Management.** John Wiley and Sons, New York. x + 265 pp.

Reineke, L.H. 1933. **Perfecting a stand-density index for even-aged forests.** J. Agric. Res. 46: 627-638 *In* Daniel, *et al.*, 1979.

Ritchie, M.W., and D.W.Hann. 1986. **Development of a tree height growth model for Douglas-fir.** Forest Ecology and Management 15(2): 135-145.

Ross, M.A. 1968. **The establishment of seedlings and the development of patterns in grassland.** Ph.D. thesis, University of Wales *In* Walstad and Kuch, 1987.

Rudolph, T.D. and P.R. Laidly. 1990. ***Pinus banksiana*** **Lamb. Jack Pine.** Pp 280-293 *In* Burns and Honkala, 1990.

Schooley, H.O. 1976. **Quantifying competition stress on individual juvenile Balsam Fir trees.** Information Report, Newfoundland Forest Research Centre, No. N-X-144, 12 pp.

Schutz, J.P. 1984. **[Regulation of stand density and intensity of thinning].** Zur Kontrolle der Bestandesdichte und der Durchforstungsstärke. Schweizerische Zeitschrift für Forstwesen 135(2): 113-122

Shao, G.F. 1985. **[Study on individual tree growth model for Korean pine plantations].** Journal of North East Forestry University, China 13(3): 38-46.

Shinozaki, K, and T. Kira,. . 1956. **Intraspecific competition amongst higher plants. VII. logistic theory of the C-D effect.** Journal of the Institute of Polytechnics, Osaka City University, D.7:35-72 *In* Day (1992).

Sims, R.A., W.D, Towill, K.A. Baldwin, and G.M. Wickware. Undated. **Field Guide to the Forest Ecosystem Classification for Northwestern Ontario.** Northwestern Ontario Forest Technology Development Unit, Ontario Ministry of Natural Resources, RR#1, 25th Side Road, Thunder Bay, Ontario, P7C 4T9. viii + 191 p.

Smith, F.W. and D.R.M.Scott. 1984. **Derivation of a competitive index for individual trees from seasonal growth patterns.** Canadian Journal of Forest Research 14(2): 266-270.

Smith, S.H. and J.F.Bell. 1983. **Using competitive stress index to estimate diameter growth for thinned Douglas-fir stands.** Forest Science 29(3): 491-499.

Smith, W.B. 1986. **Biomass yields for small trees, shrubs and herbs in northern Lake States forests.** Research Paper NC-277. North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture, St. Paul, Minnesota. 11 p.

Smith, W.B. and G.J. Brand. 1983. **Allometric biomass equations for 98 species of herbs, shrubs and small trees.** Research Note NC-299. North Central Forest Experiment Station, Forest Service U.S. Department of Agriculture, St. Paul, Minnesota. 8 p.

Smith, W.R., R.M.Farrar Jr., P.A.Murphy, J.L.Yeiser, R.S.Meldahl, and J.S.Kush. 1992. **Crown and basal area relationships of open-grown southern pines for modelling competition and growth.** Canadian Journal of Forest Research 22(3): 341-347.

Snowdon, P. and H.D.Waring. 1990. **Growth responses by *Pinus radiata* to combinations of superphosphate, urea and thinning type.** Management of water and nutrient relations to increase forest growth. Proceedings of a seminar held 19-22 October 1987 at Canberra, Australia [edited by E.K.S.Nambiar, R.Squire, R.Cromer, J.Turner, and R.Boardman]. Forest Ecology and Management 30(1-4): 313-325.

South, D.B., and J.P. Barnett. 1986. **Herbicides and planting date affect early performance of container-grown and bare-root loblolly pine seedlings in Alabama.** New Forests 1:17-28 *In* Oliver and Larson, 1990.

Spurr, S.H and B.V.Barnes. 1980. **Forest Ecology.** Third Edition, John Wiley and Sons, New York *In* Kozlowski *et al.* 1991.

Squiers, E.R. and J.E.Klosterman. 1981. **Spatial patterning and competition in an aspen-white pine successional system.** American Journal of Botany 68(6): 790-794.

Staebler, G.R. 1951. **Growth and spacing in an even-aged stand of Douglas-fir.** M.F. thesis. School of Natural Resources, University of Michigan. 46 p.

Stewart, R.E., L.L. Gross, and B.H. Honkala. 1984. **Effects of competing vegetation on forest trees: a bibligraphy with abstracts.** USDA Forest Service, Washington, D.C. Gen. Tech. Rep. WO-43, 260 p *In* Walstad and Kuch, 1987.

Stocker, N, R.G. Wagner and B.MacDonald (Unpubl.) **Competition Indices - An Annotated Bibliography.** vii + 165 p.

Sugden, M.J. 1962. **Tree sway period - a possible new parameter for crown classification and stand competition.** Forestry Chronicle 38(3): 336-344.

Tadaki, Y, A.Sato, S.Sakurai, I Takeuchi, and T. Kawahara. 1977. **Studies on the production structure of forest XVII. Structure and primary production in subalpine dead tree strips *Abies* forest near Mt. A.Saki.** Japanese J. Ecol. 27: 83-90. *In* Kozlowski *et al.* 1991

Tomé, M, and H.E.Burkhart. 1989. **Distance-dependent competition measures for predicting growth of individual trees.** Forest Science 35(3): 816-831.

Toumey, James W. and Clarence F. Korstian. 1959. **Foundations of Silviculture upon an Ecological Basis.** John Wiley and Sons, New York, NY, USA. xxi + 468 p.

Towill, W.D. and D. Archibald. 1991. **A competition index methodology for Northwestern Ontario.** Ontario Ministry of Natural Resources, Northwestern Ontario Forest Technology Development Unit, Technical Note Number 10, 12 p.

Tullus, H.H., T.A.Nilson, and Yu.A.Tamm. 1988. **The regime of diffuse radiation in a middle-aged Scots pine stand after thinning.** Lesovedenie. 1988(3): 48-55.

Tuskan, G.A and C.R.McKinley. 1984. **The use of competition indices in advanced-generation selection.** Silvae-Genetica 33(6): 209-215.

Vincent, A.B. 1964. **Comparative growth of black spruce seedlings and layers under an alder canopy.** Pulp and Paper Magazine Canada, WR-8381-8383.

Wagner, R.G. (Unpublished) **Neighbourhood approaches for assessing weed impacts in young forests.** A paper presented at the International Weed Control Congress, 17-21 February, 1992, Melbourne, Australia. 4 p.

Wagner, R.G. 1989. **Interspecific Competition in Young Douglas-fir Plantations of the Oregon Coast Range.** Ph.D Thesis, Oregon State University.

Wagner, R.G.and S.R.Radosevich. 1991. **Neighbourhood predictors of interspecific competition in young Douglas-fir plantations.** Canadian Journal of Forest Research 21(6): 821-828.

Walstad, John D. and Peter J. Kuch. 1987. **Forest vegetation management for conifer production.** John Wiley and Sons, Toronto, Canada. xvi + 523 p.

Ward, W.W. 1964. **Live crown ratio and stand density in young, even-aged, Red Oak stands.** Forest Science 10(1): 56-65.

Waring, R.H. 1983. **Estimating forest growth and efficiency in relation to canopy leaf area.** Advances in Ecological Research 13: 327-354.

Watt, R.F. and M.L.Heinselman. 1965. **Foliar nitrogen and phosphorous levels related to site quality in a northern Minnesota spruce bog.** Ecology 40(2): 357-361.

Welden, C.W., W.L.Slauson, and R.T.Ward. 1988. **Competition and abiotic stress among trees and shrubs in northwest Colorado.** Ecology, USA 69(5): 1566-1577.

Wensel, L.C., W.J.Meerschaert, and G.S.Biging. 1987. **Tree height and diameter growth models for northern California conifers.** Hilgardia 55(8): 1-20.

Wit, C.T. De. 1960. **On Competition.** Versl. Landbouwk. Onderz. 66, p. 1-82 *In* Harper, 1977.

Woodman, J.N. 1971. **Variation of net photosynthesis within the crown of a large forest-grown conifer.** Photosynthetica 5: 50-54 *In* Kozlowski *et al.* 1991.

Yoda, K., T. Kira, H. Ogawa, and K. Hozumi. 1963. **Intraspecific competition amongst higher plants. XI. Self-thinning in overcrowded pure stands under cultivated and natural conditions.** Journal of Biology, Osaka City University, 14:107-129 *In* Day (1992).

Zar, J.H. 1974. **Biostatistical Analysis.** Prentice-Hall Inc., Englewood Cliffs, N.J. xiv + 620 p.

Zimdahl, R.L. 1980. **Weed crop competition: a review.** International Plant Protection Centre, Oregon State University, Corvallis, Oregon. 112 p *In* Radosevich and Holt, 1984.

Zutter, B.R., D.H.Gjerstad and G.R.Glover. 1986. **Effects of interfering vegetation on biomass, fascicle morphology and leaf area of loblolly pine seedlings.** Forest Science 32(4): 1016-1031.

SOFTWARE USED

Claris Corporation. 1988. **MacDraw II, Version 1.0.**

Cricket Software. 1986-89. **Cricket Graph, Version 1.3.1** 40 Valley Stream Parkway, Malvern, PA, 19355

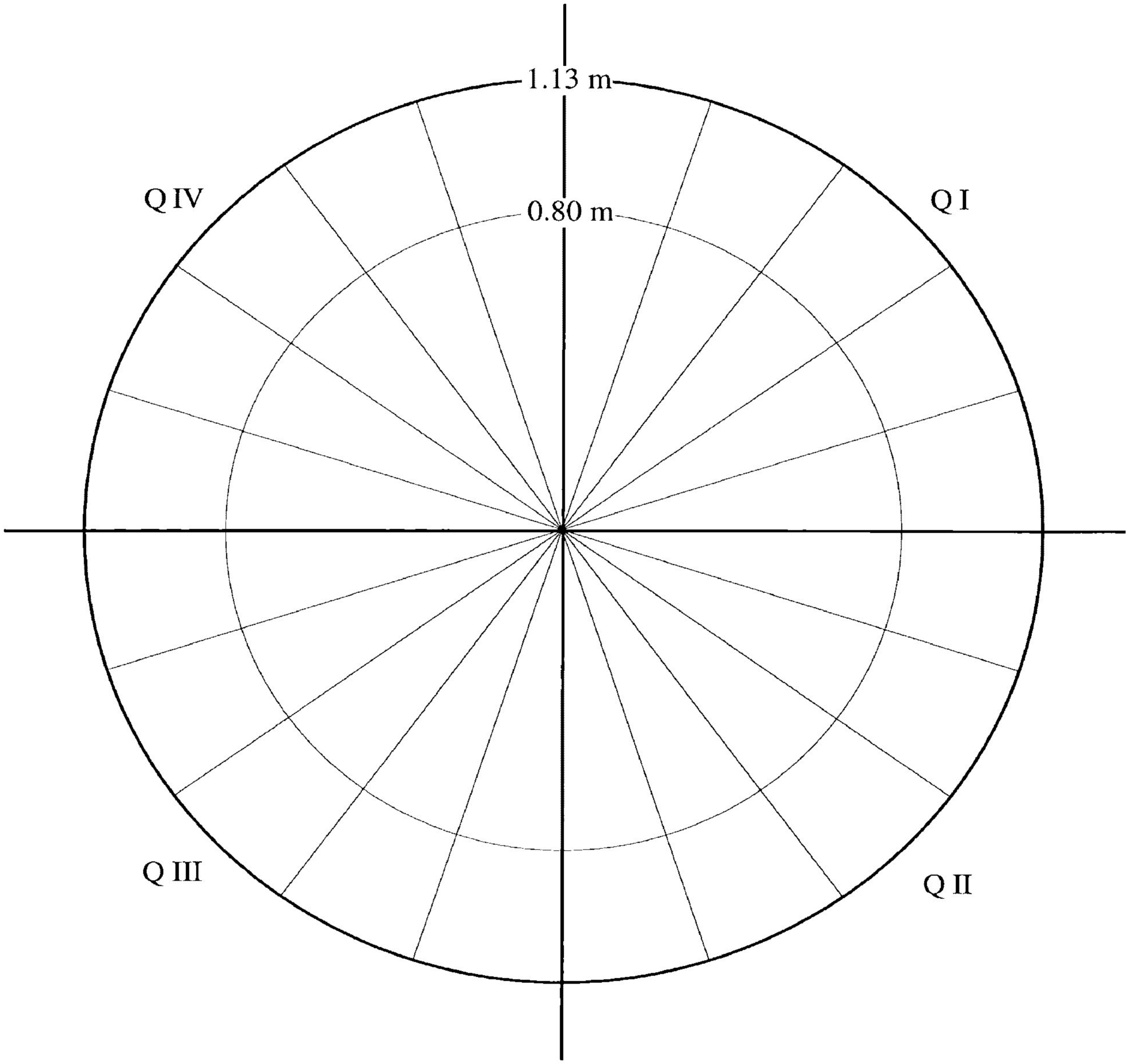
Microsoft. 1985-92. **Microsoft Excel, Version 4.0** One Microsoft Way, Redmond WA, USA 98052-6399.

Microsoft. 1991-92. **Microsoft Word, Version 5.1** One Microsoft Way, Redmond WA, USA 98052-6399.

APPENDIX A

PLOT TALLY FORM

Replicate #: ______ Block: ______ Plot: ______ Date: _______ Sampler: ________



Each individual section of this diagram represents
0.1 square metres = 1 000 square cm area

Crop Species: ______________________ Height (cm): ______________________

Diam @ 1/3rd Ht (mm).: _____________ Crown Width (cm): _______ x _______

Remarks: ____

____

____

____

(List tally data on reverse of this form)

(Reverse side of form)

	Competing Species	Hatch Code	Height (cm)	Per cent Cover	Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

APPENDIX B-1

JACK PINE FIELD MEASUREMENTS AND LABORATORY DATA

Plot #	Height		Stem		Crown				Dry Weight	
	Total (cm)	Incr. (cm)	Diam.[1] (mm)	Volume (cm^3)	Width X (cm)	Width Y (cm)	Area (m^2)	Volume (dm^3)	Est.[2] (g)	Actual (g)
1	123	57	14.3	148.2	70	50	0.27	113	192	
2	69	30	7.2	21.1	26	26	0.05	12	27	
3	160	47	19.5	358.4	100	90	0.71	377	543	
4	117	45	8.2	46.3	82	54	0.35	136	60	
5	182	60	21.0	472.8	100	125	0.98	596	734	
6	109	42	12.1	94.0	63	51	0.25	92	122	
7	122	56	10.3	76.2	58	35	0.16	65	99	
8	153	48	21.2	405.1	98	80	0.62	314	621	
9	110	38	8.3	44.6	52	39	0.16	58	58	
10	119	47	14.6	149.4	64	70	0.35	140	194	
11	160	52	22.3	468.7	120	115	1.08	578	727	
12	131	37	21.0	340.3	115	110	0.99	434	512	
13	147	75	14.6	184.6	105	100	0.82	404	252	
14	116	53	14.9	151.7	80	66	0.41	160	197	
15	90	38	10.9	63.0	70	50	0.27	82	82	
16	94	38	11.8	77.1	62	60	0.29	92	100	
17	104	38	13.2	106.7	72	48	0.27	94	138	
18	143	56	15.2	194.6	100	120	0.94	449	269	
19	68	29	8.7	30.3	42	36	0.12	27	39	
20	106	48	9.1	51.7	70	57	0.31	111	67	
21	64	20	9.1	31.2	37	26	0.08	16	40	
22	103	37	12.4	93.3	54	46	0.20	67	121	
23	78	39	7.8	28.0	46	23	0.08	22	36	
24	84	33	8.7	37.5	43	39	0.13	37	49	
25	53	29	7.0	15.3	26	28	0.06	10	20	
26	77	30	11.0	54.9	42	42	0.14	36	71	
27	138	41	16.2	213.3	76	76	0.45	209	300	
28	82	35	8.4	34.1	46	34	0.12	34	44	
29	100	42	11.2	73.9	43	45	0.15	51	96	
30	133	58	11.9	110.9	68	75	0.40	178	144	

[1] At one-third height.

[2] Estimated by $Y = -56.409 + 1.6713X$, where X = stem volume >150 cm^3 and by $Y = (X/150) \times 194.3$ elsewhere

Plot #	Height		Stem		Crown				Dry Weight	
	Total (cm)	Incr. (cm)	Diam.[1] (mm)	Volume (cm^3)	Width X (cm)	Width Y (cm)	Area (m^2)	Volume (dm^3)	Est.[2] (g)	Actual (g)
31	33	12	4.6	4.1	12	13	0.01	1	5	
32	113	49	12.8	109.1	46	55	0.20	75	141	
33	108	43	11.0	77.0	58	36	0.16	59	100	
34	136	50	15.2	185.1	80	98	0.62	279	253	
35	149	54	15.0	197.5	72	73	0.41	205	274	
36	179	60	23.4	577.3	115	120	1.08	647	909	
37	158	50	14.3	190.3	96	80	0.60	318	262	
38	98	35	8.3	39.8	30	26	0.06	20	52	
39	100	34	13.0	99.5	40	40	0.13	42	129	
40	90	33	10.2	55.2	38	42	0.13	38	71	
41	158	52	18.4	315.1	90	78	0.55	290	470	
42	128	55	15.5	181.1	100	73	0.57	245	246	
43	135	54	15.0	178.9	60	60	0.28	127	243	
44	176	75	20.8	448.5	120	100	0.94	553	693	
45	143	55	11.2	105.7	90	81	0.57	273	137	
46	172	68	18.9	361.9	100	80	0.63	360	548	
47	97	28	7.9	35.7	40	30	0.09	30	46	
48	98	52	8.5	41.7	53	30	0.12	41	54	
49	130	40	10.2	79.7	40	35	0.11	48	103	
50	152	70	11.0	108.3	110	90	0.78	394	140	
51	124	47	19.6	280.6	80	75	0.47	195	413	
52	100	51	9.6	54.3	70	60	0.33	110	70	
53	150	45	24.1	513.2	115	90	0.81	406	801	
54	127	46	17.1	218.7	64	54	0.27	115	309	
55	143	60	14.7	182.0	80	70	0.44	210	248	
56	97	41	14.1	113.6	45	48	0.17	55	147	
57	137	45	15.5	193.9	90	75	0.53	242	268	
58	155	62	16.4	245.6	70	90	0.49	256	354	
59	114	44	11.5	88.8	50	50	0.20	75	115	
60	141	60	16.8	234.4	80	80	0.50	236	335	

[1] At one-third height.

[2] Estimated by $Y = -56.409 + 1.6713X$, where X = stem volume >150 cm^3 and by $Y = (X/150) \times 194.3$ elsewhere

Plot #	Height: Total (cm)	Height: Incr. (cm)	Stem: Diam.[1] (mm)	Stem: Volume (cm^3)	Crown: Width X (cm)	Crown: Width Y (cm)	Crown: Area (m^2)	Crown: Volume (dm^3)	Dry Weight: Est.[2] (g)	Dry Weight: Actual (g)
61	100	39	12.6	93.5	60	60	0.28	94	121	
62	110	34	15.5	155.7	65	60	0.31	112	204	
63	94	21	14.3	113.2	63	63	0.31	98	147	
64	124	40	14.1	145.2	90	60	0.42	175	188	
65	113	45	14.2	134.2	60	60	0.28	106	174	
66	116	36	15.0	153.7	95	55	0.41	159	201	
67	118	39	15.4	164.8	60	50	0.24	93	219	
68	135	60	11.7	108.9	75	50	0.29	133	141	
69	131	49	13.7	144.8	55	60	0.26	113	188	
70	110	45	13.2	112.9	80	60	0.38	138	146	
71	87	34	10.5	56.5	65	40	0.20	59	73	
72	111	31	13.3	115.7	55	50	0.22	80	150	
73	126	39	12.9	123.5	60	50	0.24	99	160	
74	139	69	15.0	184.2	110	100	0.86	400	251	
75	127	50	15.0	168.3	70	60	0.33	140	225	
76	163	55	23.2	516.8	120	130	1.23	666	807	
77	139	52	23.7	459.9	90	100	0.71	328	712	
78	167	70	16.0	251.8	124	106	1.03	575	364	
79	129	59	13.4	136.4	80	80	0.50	216	177	
80	108	50	12.4	97.8	100	65	0.51	184	127	
81	165	70	17.5	297.7	120	100	0.94	518	441	
82	135	21	19.6	305.5	90	100	0.71	318	454	
83	129	53	15.0	171.0	80	80	0.50	216	229	
84	143	49	23.2	453.4	130	115	1.17	560	701	
85	180	66	23.1	565.8	115	115	1.04	623	889	
86	172	66	20.2	413.4	95	80	0.60	342	635	
87	162	53	21.4	437.0	70	70	0.38	208	674	
88	154	53	17.1	265.3	90	100	0.71	363	387	
89	147	59	15.5	208.0	60	60	0.28	139	291	
90	106	51	10.3	66.2	60	70	0.33	117	86	

[1] At one-third height.

[2] Estimated by $Y = -56.409 + 1.6713X$, where X = stem volume >150 cm^3 and by $Y = (X/150) \times 194.3$ elsewhere

Plot #	Height Total (cm)	Height Incr. (cm)	Stem Diam.[1] (mm)	Stem Volume (cm^3)	Crown Width X (cm)	Crown Width Y (cm)	Crown Area (m^2)	Crown Volume (dm^3)	Dry Weight Est.[2] (g)	Dry Weight Actual (g)
91	131	44	14.4	160.0	55	55	0.24	104	211	
92	84	31	8.2	33.3	30	25	0.06	16	43	
93	94	36	8.2	37.2	25	25	0.05	15	48	
94	101	41	10.9	70.7	35	35	0.10	32	92	
95	70	33	8.7	31.2	35	35	0.10	22	40	
96	101	40	14.4	123.4	55	45	0.19	65	160	
97	72	24	7.2	22.0	20	30	0.05	11	28	
98	80	41	6.8	21.8	40	40	0.13	34	28	
99	127	50	15.9	189.1	80	80	0.50	213	260	
100	88	35	10.0	51.8	35	35	0.10	28	67	
101	138	58	14.4	168.6	65	70	0.36	164	225	
102	95	37	8.2	37.6	40	35	0.11	35	49	
103	181	65	16.8	300.9	80	80	0.50	303	447	
104	168	45	24.2	579.5	100	95	0.75	418	912	
105	120	43	11.4	91.9	60	40	0.19	75	119	
106	135	50	11.5	105.2	60	60	0.28	127	136	
107	176	63	16.8	292.6	80	70	0.44	258	433	
108	156	43	21.5	424.8	80	90	0.57	294	654	
109	90	36	7.3	28.3	50	32	0.13	38	37	
110	164	53	17.8	306.1	80	100	0.63	343	455	
Total:	13487	5094	1539.3	19390.9	7756	7074	44.65	20903	27894	
Count:	110	110	110	110	110	110	110	110	110	
Average:	123	46	14.0	176.3	70	64	0.41	190	254	
Std Dev:	31.4	12.5	4.61	144.8	26.6	26.9	0.295	168	229	

[1] At one-third height.

[2] Estimated by Y = -56.409 + 1.6713X, where X = stem volume >150 cm^3 and by Y = (X/150) × 194.3 elsewhere

Plot #	Height: Total (cm)	Height: Incr. (cm)	Stem: Diam.[1] (mm)	Stem: Volume (cm^3)	Crown: Width X (cm)	Crown: Width Y (cm)	Crown: Area (m^2)	Crown: Volume (dm^3)	Dry Weight: Est.[2] (g)	Dry Weight: Actual (g)
SP-1	187	55	23.0	582.7	135	135	1.43	892	917	899
SP-2	175	46	21.5	476.5	100	110	0.86	504	740	609
SP-3	144	60	18.0	274.8	95	95	0.71	340	403	530
SP-4	181	43	18.0	345.4	70	90	0.49	299	521	299
SP-5	148	53	20.0	348.7	80	80	0.50	248	526	465
SP-6	131	55	14.9	171.3	80	80	0.50	219	230	435
SP-7	157	52	21.9	443.5	100	100	0.79	411	685	707
SP-8	143	50	15.5	202.4	90	70	0.49	236	282	182
SP-9	178	30	21.3	475.7	120	110	1.04	615	1174	1307
SP-10	126	48	20.2	302.8	70	70	0.38	162	450	495
Total:	1570	492	194.3	3624.0	940	940	7.21	3926	5928	5928
Count:	10	10	10	10	10	10	10	10	10	10
Average:	157	49	19.4	362.4	94	94	0.72	393	593	593
Std Dev:	21.9	8.34	2.74	131.1	21.1	20.5	0.323	224	292	321
Net Total:	15057	5586	1733.6	23014.8	8696	8014	51.86	24829	33823	5928
Count:	120	120	120	120	120	120	120	120	120	10
Average:	126	46.6	14.4	191.8	72.5	66.8	0.43	207	282	593
Std Dev:	32.1	12.2	4.72	152.3	26.9	27.6	0.308	181	252	321

[1] At one-third height. [2] Estimated by $Y = -56.409 + 1.6713X$, where X = stem volume >150 cm^3 and by $Y = (X/150) \times 194.3$ elsewhere

APPENDIX B-2

NON-CROP SPECIES DATA

Epilobium angustifolium (Fireweed)

Plot #	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
1	70	4	112	54.6	70	5	140	68.2	70	9	252	122.8
2	100	8	320	209.8	100	6	240	157.4	100	14	560	367.2
3	100	10	400	262.3	100	5	200	131.1	100	15	600	393.4
4	100	8	320	209.8	100	14	560	367.2	100	22	880	577.0
5	100	3	120	78.7	100	10	400	262.3	100	13	520	341.0
6	110	7	308	195.6	110	3	132	83.8	110	10	440	279.5
7	140	17	952	284.4	140	9	504	150.6	140	26	1456	435.0
8	130	17	884	405.2	130	13	676	309.9	130	30	1560	715.1
9	90	5	180	114.2	90	2	72	45.7	90	7	252	159.9
10	60	6	144	54.6	60	2	48	18.2	60	8	192	72.8
11	110	33	1452	922.3	110	39	1716	1090.0	110	72	3168	2012.2
12	100	12	480	314.7	100	7	280	183.6	100	19	760	498.3
13	110	11	484	307.4	110	21	924	586.9	110	32	1408	894.3
14	110	16	704	447.2	110	20	880	559.0	110	36	1584	1006.1
15	120	23	1104	629.4	120	11	528	301.0	120	34	1632	930.4
16	60	1	24	9.1	60	1	24	9.1	60	2	48	18.2
17	100	6	240	157.4	100	4	160	104.9	100	10	400	262.3
18					80	1	32	18.4	80	1	32	18.4
19					90	2	72	45.7	90	2	72	45.7
20	83	7	232	138.8	86	5	172	105.8	84	12	404.4	244.6
21					92	5	184	118.1	92	5	184	118.1
22	60	2	48	18.2	65	14	364	158.1	64	16	412	176.3
23	90	18	648	411.2	89	16	570	359.0	90	34	1217.6	770.2
24	75	2	60	32.1	77	7	216	119.1	77	9	275.6	151.1
25	30	1	12	3.4	70	2	56	27.3	57	3	68	30.7
26	90	1	36	22.8	84	5	168	101.4	85	6	204	124.2
27	66	5	132	58.8	74	17	503	264.6	72	22	635.2	323.3
28	80	3	96	55.3	80	1	32	18.4	80	4	128	73.7

Epilobium angustifolium (Fireweed)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
29	88	9	317	198.2	90	3	108	68.5	89	12	424.8	266.7
32					90	1	36	22.8	90	1	36	22.8
33	70	3	84	40.9	86	5	172	105.8	80	8	256	146.8
34	125	15	750	390.1	108	31	1339	860.8	114	46	2089.2	1250.9
35	97	12	466	304.3	104	20	832	543.0	101	32	1297.6	847.3
36	73	12	350	181.0	90	1	36	22.8	74	13	386.4	203.8
37	70	1	28	13.6	75	4	120	64.2	74	5	148	77.8
38	115	4	184	111.9	100	3	120	78.7	109	7	304	190.6
39					90	2	72	45.7	90	2	72	45.7
41					80	1	32	18.4	80	1	32	18.4
42	70	3	84	40.9	75	6	180	96.3	73	9	264	137.2
43	95	4	152	98.8	143	3	172	41.4	116	7	323.6	140.2
44	122	5	244	134.6	110	4	176	111.8	117	9	420	246.4
47	100	3	120	78.7	110	2	88	55.9	104	5	208	134.6
49	90	1	36	22.8					90	1	36	22.8
50					70	1	28	13.6	70	1	28	13.6
51	88	17	598	374.4	96	20	768	500.8	92	37	1366.4	875.2
52	99	10	396	259.5	92	5	184	118.1	97	15	580	377.7
53	85	13	442	269.5	94	16	602	389.7	90	29	1043.6	659.2
54	117	12	562	333.8	103	20	824	539.0	108	32	1385.6	872.8
55	80	5	160	92.2	69	10	276	131.6	73	15	436	223.8
56	70	4	112	54.6	80	12	384	221.2	78	16	496	275.8
57	97	26	1009	659.3	93	25	930	599.9	95	51	1938.8	1259.2
58	85	6	204	124.4	81	14	454	264.6	82	20	657.6	389.0
59	92	19	699	448.8	83	7	232	138.8	90	26	931.6	587.6
60	83	11	365	218.1	83	18	598	356.9	83	29	962.8	575.0
64					70	1	28	13.6	70	1	28	13.6
65	97	18	698	456.5	98	21	823	538.9	98	39	1521.6	995.4

Epilobium angustifolium (Fireweed)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
66	76	5	152	82.6	86	17	585	359.8	84	22	736.8	442.5
67	76	12	365	198.3	72	6	173	87.6	75	18	537.6	285.9
68	77	3	92	51.0	88	10	352	220.2	85	13	444.4	271.3
69	65	2	52	22.6	81	8	259	151.2	78	10	311.2	173.8
70	77	9	277	153.1	70	14	392	190.9	73	23	669.2	344.0
72	90	2	72	45.7	93	4	149	96.0	92	6	220.8	141.7
73	79	9	284	161.7	96	7	269	175.3	86	16	553.2	336.9
74	73	3	88	45.2	65	6	156	67.8	68	9	243.6	113.0
75	103	4	165	107.8	108	4	173	111.1	106	8	337.6	218.9
76					100	1	40	26.2	100	1	40	26.2
77	78	4	125	69.9	75	4	120	64.2	77	8	244.8	134.1
78	60	1	24	9.1	60	5	120	45.5	60	6	144	54.6
79	60	5	120	45.5	67	3	80	36.7	63	8	200.4	82.1
80	85	17	578	352.4	99	7	277	181.7	89	24	855.2	534.0
81	86	8	275	169.3	94	13	489	316.6	91	21	764	486.0
82	95	2	76	49.4	90	6	216	137.1	91	8	292	186.5
83	93	20	744	479.9	95	15	570	370.6	94	35	1314	850.5
84	106	13	551	357.5	93	18	670	431.9	98	31	1220.8	789.4
85	74	9	266	140.1	83	7	232	138.8	78	16	498.8	278.9
86	87	10	348	216.0	101	11	444	291.3	94	21	792.4	507.3
87	125	24	1200	624.2	122	32	1562	861.3	123	56	2761.6	1485.5
88	90	26	936	593.9	90	40	1440	913.8	90	66	2376	1507.7
89	120	12	576	328.4	120	24	1152	656.7	120	36	1728	985.1
90	118	19	897	526.2	120	21	1008	574.6	119	40	1904.8	1100.9
91	80	5	160	92.2	70	4	112	54.6	76	9	272	146.7
94	97	7	272	177.5	110	3	132	83.8	101	10	403.6	261.4
95					75	2	60	32.1	75	2	60	32.1
96	80	1	32	18.4					80	1	32	18.4

Epilobium angustifolium (Fireweed)

Plot #	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
97	80	2	64	36.9	77	3	92	51.0	78	5	156.4	87.9
98	79	10	316	179.6	86	8	275	169.3	82	18	591.2	349.0
99	84	12	403	243.4	93	10	372	240.0	88	22	775.2	483.3
100	85	6	204	124.4	91	12	437	278.9	89	18	640.8	403.2
101	130	33	1716	786.7	130	30	1560	715.1	130	63	3276	1501.8
102	97	18	698	456.5	100	9	360	236.1	98	27	1058.4	692.5
103	137	3	164	57.8	142	13	738	192.7	141	16	902.8	250.5
104	80	4	128	73.7	80	4	128	73.7	80	8	256	147.5
105	90	1	36	22.8	130	1	52	23.8	110	2	88	46.7
106	121	8	387	217.2	153	3	184	3.3	130	11	570.8	220.5
107	105	4	168	109.3	120	3	144	82.1	111	7	312	191.4
108	100	4	160	104.9					100	4	160	104.9
109	70	2	56	27.3	150	4	240	21.6	123	6	296	48.9
110	90	4	144	91.4	90	1	36	22.8	90	5	180	114.2
SP-1	87	9	313	194.4	94	16	602	389.7	91	25	914.8	584.1
SP-2	76	11	334	181.8	78	9	281	157.4	77	20	615.2	339.2
SP-4	84	7	235	142.0	74	12	355	186.8	78	19	590.4	328.7
SP-5	83	10	332	198.3	84	8	269	162.2	83	18	600.8	360.5
SP-7					60	1	24	9.1	60	1	24	9.1
SP-8	80	1	32	18.4	78	8	250	139.9	78	9	281.6	158.3
SP-9	60	1	24	9.1					60	1	24	9.1
SP-10	50	1	20	5.4	60	1	24	9.1	55	2	44	14.5
Total:	8510	822	32216	18704	9453	951	37120	21570	9604	1773	69336	40273
Count:	95	95	95	95	102	102	102	102	106	106	106	108
Average:	89.6	8.7	339	197	92.7	9.3	364	211	90.6	16.7	654	373
Std Dev:	19.9	7.23	332	189	20.4	8.49	371	225	18.6	14.9	670	393

Calamagrostis canadensis (Bluejoint) & Other Grasses

Plot #	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
19	80	4	128	99	80	7	224	173	80	11	352	271.2
21	50	23	460	438	50	19	380	362	50	42	840	800.5
26	80	17	544	419	80	18	576	444	80	35	1120	863.0
27	110	10	440	319	110	8	352	255	110	18	792	574.1
28	130	7	364	265	130	7	364	265	130	14	728	530.2
30	130	17	884	644	130	34	1768	1288	130	51	2652	1931.3
32					100	2	80	59	100	2	80	58.5
33	60	2	48	42					60	2	48	41.5
38	120	2	96	70	120	3	144	104	120	5	240	173.8
39	134	16	858	627	135	31	1674	1225	135	47	2531.6	1852.5
40	130	39	2028	1477	130	21	1092	795	130	60	3120	2272.1
48	130	3	156	114					130	3	156	113.6
51	90	1	36	27	80	1	32	25	85	2	68	51.5
53	100	4	160	117	100	3	120	88	100	7	280	204.9
55	72	10	288	230	72	10	288	230	72	20	576	460.4
56	100	9	360	263	100	3	120	88	100	12	480	351.3
59	120	3	144	104	112	5	224	162	115	8	368	266.5
61	90	1	36	27	90	3	108	81	90	4	144	107.5
64	60	11	264	228	80	3	96	74	64	14	360	302.4
65	112	10	448	324	98	10	392	288	105	20	840	612.2
67	65	11	286	238	68	12	326	267	67	23	612.4	505.4
68	60	2	48	42	60	5	120	104	60	7	168	145.4
69	60	7	168	145	60	7	168	145	60	14	336	290.7
70	72	6	173	138	77	9	277	216	75	15	450	354.4
71	100	5	200	146	105	14	588	428	104	19	788	574.2
72	84	5	168	128	90	3	108	81	86	8	276	208.2
73	96	16	614	453	99	9	356	261	97	25	970.8	713.8
74	130	2	104	76	90	1	36	27	117	3	140	102.6

Plot #	*Calamagrostis canadensis* (Bluejoint) & Other Grasses: Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm³)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm³)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm³)	Both Rings Dry Wt (g)
75	90	4	144	107	60	5	120	104	73	9	264	211.3
79	130	6	312	227	130	4	208	151	130	10	520	378.7
91					60	2	48	42	60	2	48	41.5
92	130	24	1248	909	115	14	644	466	124	38	1892	1375.0
93	130	25	1300	947	130	15	780	568	130	40	2080	1514.7
94					80	3	96	74	80	3	96	74.0
95	40	1	16	17	40	2	32	35	40	3	48	52.5
96	60	20	480	415	60	33	792	685	60	53	1272	1100.7
97	60	44	1056	914	60	45	1080	935	60	89	2136	1848.3
98	69	24	662	538	70	25	700	566	70	49	1362.4	1104.2
99	130	6	312	227	130	13	676	492	130	19	988	719.5
100					120	8	384	278	120	8	384	278.0
109	90	17	612	457	90	21	756	564	90	38	1368	1020.9
110	110	18	792	574	110	16	704	510	110	34	1496	1084.5
SP-9	110	27	1188	861	110	43	1892	1372	110	70	3080	2232.7
SP-10	119	9	428	310	103	6	247	180	113	15	675.6	490.3
Total:	3833	468	18054	13705	3914	503	19173	14556	4151	971	37227	28260
Count:	40	40	40	40	42	42	42	42	44	44	44	44
Average:	95.8	11.7	451	343	93.2	12.0	457	347	94.3	22.1	846	642
Std Dev:	28.2	10.3	434	321	25.9	11.3	466	346	27.1	20.8	842	626

Carex spp. (Sedges)

Plot	Inner Ring				Outer Ring				Both Rings			
#	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
1	100	2	80	47.3	100	5	200	118.2	100	7	280	165.5
2	40	4	64	122.1	10	1	4	34.7	34	5	68	156.8
3					10	1	4	34.7	10	1	4	34.7
4					10	1	4	34.7	10	1	4	34.7
5	100	4	160	94.6					100	4	160	94.6
7	20	4	32	132.9	20	2	16	66.5	20	6	48	199.4
8	40	11	176	335.8	40	4	64	122.1	40	15	240	457.9
10	100	3	120	70.9					100	3	120	70.9
11	80	3	96	77.2					80	3	96	77.2
16	50	4	80	117.0					50	4	80	117.0
17	107	3	128	68.9	80	1	32	25.7	100	4	160.4	94.6
18	80	6	192	154.5	90	1	36	24.7	81	7	228	179.2
20	90	5	180	123.4	83	6	199	152.5	86	11	379.2	275.9
24	60	2	48	56.1	60	4	96	112.1	60	6	144	168.2
25	60	2	48	56.1					60	2	48	56.1
29	110	5	220	113.3	110	4	176	90.7	110	9	396	204.0
59	60	3	72	84.1					60	3	72	84.1
63	35	4	56	124.7	35	8	112	249.5	35	12	168	374.2
64					40	3	48	91.6	40	3	48	91.6
66	50	2	40	58.5					50	2	40	58.5
67	110	4	176	90.7	110	4	176	90.7	110	8	352	181.3
69					100	2	80	47.3	100	2	80	47.3
70					110	4	176	90.7	110	4	176	90.7
72					30	4	48	127.4	30	4	48	127.4
74					90	2	72	49.4	90	2	72	49.4
91	40	3	48	91.6	40	1	16	30.5	40	4	64	122.1
102	80	2	64	51.5	80	11	352	283.2	80	13	416	334.7
SP-2	120	1	48	21.7	120	9	432	195.5	120	10	480	217.2

Carex spp. (Sedges)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm³)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm³)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm³)	Both Rings Dry Wt (g)
SP-3	100	5	200	118.2					100	5	200	118.2
Total:	1632	82	2328	2211	1368	78	2343	2072	2007	160	4672	4283
Count:	22	22	22	22	21	21	21	21	29	29	29	29
Average:	74.2	3.7	106	101	65.1	3.7	112	99	69.2	5.5	161	148
Std Dev:	29.7	2.05	61.7	62.4	37.9	2.83	115	72.5	33.4	3.74	134	104

Minor Herb species (listed below)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm³)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm³)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm³)	Both Rings Dry Wt (g)
1	5	8	16	93.7	5	6	12	70.3	5	14	28	164.0
6	5	9	18	105.4	5	1	2	11.7	5	10	20	117.1
8					15	2	12	25.5	15	2	12	25.5
10	10	2	8	24.4	10	6	24	73.3	10	8	32	97.7
11	20	1	8	13.3	20	3	24	39.8	20	4	32	53.1
12	30	14	168	201.8	30	26	312	374.7	30	40	480	576.5
14	10	9	36	109.9	14	17	96	214.8	13	26	132	324.6
17	12	17	84	211.6	15	4	24	50.9	13	21	108	262.5
19	15	3	18	38.2	15	2	12	25.5	15	5	30	63.6
20	43	2	34	32.0	62	5	124	94.0	56	7	158	126.0
32	15	10	60	127.3	18	5	36	65.2	16	15	96	192.5
33	10	5	20	61.0	10	7	28	85.5	10	12	48	146.5

Plot #	Minor Herb species (listed below)											
	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
37	10	12	48	146.5	10	2	8	24.4	10	14	56	170.9
39	30	5	60	72.1					30	5	60	72.1
41	30	1	12	14.4	20	2	16	26.5	23	3	28	40.9
43					20	3	24	39.8	20	3	24	39.8
52	20	1	8	13.3	20	1	8	13.3	20	2	16	26.5
55	10	6	24	73.3	10	4	16	48.8	10	10	40	122.1
56	11	8	35.2	98.5	14	15	84	189.3	13	23	119.2	287.8
58	15	3	18	38.2	15	3	18	38.2	15	6	36	76.4
59	15	10	60	127.3	15	11	66	140.0	15	21	126	267.2
60	18	3	21.6	39.1	37	7	104	107.1	31	10	125.6	146.2
61	25	9	90	124.4	18	16	114	208.4	20	25	204	332.9
62	15	15	90	190.9	19	17	128	223.3	17	32	218	414.2
63	15	16	96	203.6	17	14	94	180.8	16	30	190	384.4
64	33	5	66	73.9	43	8	138	128.6	39	13	204	202.5
70	110	1	44	28.0	70	3	84	60.3	80	4	128	88.3
71	10	29	116	354.0	10	26	104	317.4	10	55	220	671.5
72	15	9	54	114.5	15	10	60	127.3	15	19	114	241.8
73	90	1	36	23.7	90	2	72	47.4	90	3	108	71.1
77					15	3	18	38.2	15	3	18	38.2
80	10	3	12	36.6	10	7	28	85.5	10	10	40	122.1
86	15	9	54	114.5	15	14	84	178.2	15	23	138	292.7
93					70	4	112	80.4	70	4	112	80.4
94	47	12	223.6	198.5	46	7	130	115.6	47	19	353.6	314.1
95	10	26	104	317.4	10	16	64	195.3	10	42	168	512.8
99	90	3	108	71.1					90	3	108	71.1
101	20	5	40	66.3					20	5	40	66.3
104	30	2	24	28.8					30	2	24	28.8
SP-3	70	4	112	80.4	64	10	256	191.1	66	14	368	271.5

Minor Herb species (listed below)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
SP-5	60	3	72	55.5	60	6	144	110.9	60	9	216	166.4
SP-6					60	4	96	74.0	60	4	96	74.0
SP-7	70	11	308	221.0	70	5	140	100.4	70	16	448	321.4
SP-8	80	3	96	65.5	80	5	160	109.1	80	8	256	174.6
SP-9	15	1	6	12.7	15	1	6	12.7	15	2	12	25.5
SP-10	15	1	6	12.7	15	3	18	38.2	15	4	24	50.9
Total:	1178	297	2514	4035.3	1192	313	3100	4381.5	1355	610	5614	8416.7
Count:	41	41	41	41	42	42	42	42	46	46	46	46
Average:	28.7	7.2	61	98.4	28.4	7.5	74	104	29.5	13.3	122	183
Std Dev:	26.7	6.53	61.2	82.4	23.7	6.36	67.7	82.8	24.8	12.0	114	153

Minor Herb species

Aster macrophyllus	Large-leaf Aster	*Aralia nudicaulis*	Sarsaparilla
Clintonia borealis	Blue-bead lily	*Convulvus spinulosum*	Bindweed
Osmunda claytonia	Osmunda Fern	*Solidago spp.*	Goldenrod
Aster ciliolatus	Ciliolated Aster	*Dryopteris austriaca*	Spinulose woodfern

Total Herb Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
1	37	14	208	195.6	55	16	352	256.7	47	30	560	452.3
2	80	12	384	331.9	87	7	244	192.0	83	19	628	524.0
3	100	10	400	262.3	85	6	204	165.8	94	16	604	428.1
4	100	8	320	209.8	94	15	564	401.9	96	23	884	611.7
5	100	7	280	173.3	100	10	400	262.3	100	17	680	435.6
6	51	16	326	301.0	84	4	134	95.6	58	20	460	396.6
7	117	21	984	417.4	118	11	520	217.0	118	32	1504	634.4
8	95	28	1060	741.0	99	19	752	457.4	96	47	1812	1198.5
9	90	5	180	114.2	90	2	72	45.7	90	7	252	159.9
10	62	11	272	149.9	23	8	72	91.4	45	19	344	241.4
11	105	37	1556	1012.8	104	42	1740	1129.8	104	79	3296	2142.5
12	62	26	648	516.5	45	33	592	558.3	53	59	1240	1074.8
13	110	11	484	307.4	110	21	924	586.9	110	32	1408	894.3
14	74	25	740	557.0	66	37	976	773.7	69	62	1716	1330.8
15	120	23	1104	629.4	120	11	528	301.0	120	34	1632	930.4
16	52	5	104	126.1	60	1	24	9.1	53	6	128	135.2
17	44	26	452	437.9	60	9	216	181.6	48	35	668	619.4
18	80	6	192	154.5	85	2	68	43.1	81	8	260	197.6
19	52	7	146	136.8	70	11	308	243.7	63	18	454	380.5
20	80	14	446	294.1	77	16	495	352.4	78	30	942	646.5
21	50	23	460	438.4	59	24	564	480.2	54	47	1024	918.6
22	60	2	48	18.2	65	14	364	158.1	64	16	412	176.3
23	90	18	648	411.2	89	16	570	359.0	90	34	1218	770.2
24	68	4	108	88.2	71	11	312	231.2	70	15	420	319.4
25	50	3	60	59.4	70	2	56	27.3	58	5	116	86.7
26	81	18	580	442.0	81	23	744	545.2	81	41	1324	987.2
27	95	15	572	377.7	86	25	855	519.7	89	40	1427	897.5
28	115	10	460	320.4	124	8	396	283.5	119	18	856	603.9

Plot #	Total Herb Vegetation: Inner Ring Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Outer Ring Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Both Rings Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
29	96	14	537	311.5	101	7	284	159.2	98	21	821	470.7
30	130	17	884	643.8	130	34	1768	1287.5	130	51	2652	1931.3
32	15	10	60	127.3	48	8	152	146.6	29	18	212	273.9
33	38	10	152	143.5	42	12	200	191.3	40	22	352	334.8
34	125	15	750	390.1	108	31	1339	860.8	114	46	2089	1250.9
35	97	12	466	304.3	104	20	832	543.0	101	32	1298	847.3
36	73	12	350	181.0	90	1	36	22.8	74	13	386	203.8
37	15	13	76	160.1	53	6	128	88.6	27	19	204	248.7
38	117	6	280	181.4	110	6	264	182.9	113	12	544	364.4
39	109	21	918	699.1	132	33	1746	1271.1	123	54	2664	1970.2
40	130	39	2028	1476.9	130	21	1092	795.2	130	60	3120	2272.1
41	30	1	12	14.4	40	3	48	45.0	38	4	60	59.4
42	70	3	84	40.9	75	6	180	96.3	73	9	264	137.2
43	95	4	152	98.8	82	6	196	81.2	87	10	348	180.0
44	122	5	244	134.6	110	4	176	111.8	117	9	420	246.4
47	100	3	120	78.7	110	2	88	55.9	104	5	208	134.6
48	130	3	156	113.6					130	3	156	113.6
49	90	1	36	22.8					90	1	36	22.8
50					70	1	28	13.6	70	1	28	13.6
51	88	18	634	401.3	95	21	800	525.4	92	39	1434	926.7
52	92	11	404	272.8	80	6	192	131.4	88	17	596	404.2
53	89	17	602	386.5	95	19	722	477.5	92	36	1324	864.1
54	117	12	562	333.8	103	20	824	539.0	108	32	1386	872.8
55	56	21	472	395.6	60	24	580	410.7	58	45	1052	806.3
56	60	21	507	416.5	49	30	588	498.3	54	51	1095	914.8
57	97	26	1009	659.3	93	25	930	599.9	95	51	1939	1259.2
58	62	9	222	162.5	69	17	472	302.8	67	26	694	465.4
59	70	35	975	764.5	57	23	522	441.0	65	58	1498	1205.5

Plot #	Total Herb Vegetation											
	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
60	69	14	387	257.2	70	25	702	463.9	70	39	1088	721.2
61	32	10	126	151.3	29	19	222	289.0	30	29	348	440.3
62	15	15	90	190.9	19	17	128	223.3	17	32	218	414.2
63	19	20	152	328.3	23	22	206	430.3	21	42	358	758.6
64	52	16	330	302.3	52	15	310	307.8	52	31	640	610.1
65	102	28	1146	780.9	98	31	1215	826.7	100	59	2362	1607.6
66	69	7	192	141.1	86	17	585	359.8	81	24	777	501.0
67	77	27	827	527.4	77	22	675	445.2	77	49	1502	972.6
68	70	5	140	92.6	79	15	472	324.1	77	20	612	416.6
69	61	9	220	168.0	75	17	507	343.9	70	26	727	511.9
70	77	16	494	319.2	77	30	929	558.1	77	46	1423	877.3
71	23	34	316	500.4	43	40	692	745.2	34	74	1008	1245.6
72	46	16	294	287.8	43	21	365	431.2	45	37	659	719.1
73	90	26	935	637.9	97	18	697	483.9	93	44	1632	1121.8
74	96	5	192	121.0	73	9	264	144.0	81	14	456	265.0
75	97	8	309	215.3	81	9	293	214.9	88	17	602	430.2
76					100	1	40	26.2	100	1	40	26.2
77	78	4	125	69.9	49	7	138	102.4	60	11	263	172.3
78	60	1	24	9.1	60	5	120	45.5	60	6	144	54.6
79	98	11	432	272.7	103	7	288	188.1	100	18	720	460.8
80	74	20	590	389.0	55	14	305	267.1	66	34	895	656.1
81	86	8	275	169.3	94	13	489	316.6	91	21	764	486.0
82	95	2	76	49.4	90	6	216	137.1	91	8	292	186.5
83	93	20	744	479.9	95	15	570	370.6	94	35	1314	850.5
84	106	13	551	357.5	93	18	670	431.9	98	31	1221	789.4
85	74	9	266	140.1	83	7	232	138.8	78	16	499	278.9
86	53	19	402	330.5	53	25	528	469.5	53	44	930	800.0
87	125	24	1200	624.2	122	32	1562	861.3	123	56	2762	1485.5

Total Herb Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm³)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm³)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm³)	Both Rings Dry Wt (g)
88	90	26	936	593.9	90	40	1440	913.8	90	66	2376	1507.7
89	120	12	576	328.4	120	24	1152	656.7	120	36	1728	985.1
90	118	19	897	526.2	120	21	1008	574.6	119	40	1905	1100.9
91	65	8	208	183.7	63	7	176	126.6	64	15	384	310.4
92	130	24	1248	908.8	115	14	644	466.1	124	38	1892	1375.0
93	130	25	1300	946.7	117	19	892	648.4	125	44	2192	1595.1
94	65	19	495	376.0	69	13	358	273.4	67	32	853	649.4
95	11	27	120	334.9	20	20	156	262.4	15	47	276	597.3
96	61	21	512	433.8	60	33	792	685.3	60	54	1304	1119.1
97	61	46	1120	950.6	61	48	1172	985.6	61	94	2292	1936.2
98	72	34	978	718.1	74	33	975	735.1	73	67	1954	1453.1
99	98	21	823	541.7	114	23	1048	732.3	106	44	1871	1274.0
100	85	6	204	124.4	103	20	821	556.9	99	26	1025	681.3
101	116	38	1756	853.0	130	30	1560	715.1	122	68	3316	1568.1
102	95	20	762	507.9	89	20	712	519.3	92	40	1474	1027.2
103	137	3	164	57.8	142	13	738	192.7	141	16	903	250.5
104	63	6	152	102.6	80	4	128	73.7	70	10	280	176.3
105	90	1	36	22.8	130	1	52	23.8	110	2	88	46.7
106	121	8	387	217.2	153	3	184	3.3	130	11	571	220.5
107	105	4	168	109.3	120	3	144	82.1	111	7	312	191.4
108	100	4	160	104.9					100	4	160	104.9
109	88	19	668	484.0	100	25	996	585.8	95	44	1664	1069.8
110	106	22	936	665.5	109	17	740	533.2	107	39	1676	1198.7
SP-1	87	9	313	194.4	94	16	602	389.7	91	25	915	584.1
SP-2	80	12	382	203.5	99	18	713	352.8	91	30	1095	556.4
SP-3	87	9	312	198.6	64	10	256	191.1	75	19	568	389.7
SP-4	84	7	235	142.0	74	12	355	186.8	78	19	590	328.7
SP-5	78	13	404	253.7	74	14	413	273.2	76	27	817	526.9

Total Herb Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
SP-6					60	4	96	74.0	60	4	96	74.0
SP-7	70	11	308	221.0	68	6	164	109.5	69	17	472	330.5
SP-8	80	4	128	83.9	79	13	410	249.0	79	17	538	332.9
SP-9	105	29	1218	883.0	108	44	1898	1384.3	107	73	3116	2267.3
SP-10	103	11	454	328.3	72	10	289	227.5	89	21	744	555.8
Total:	9367	1669	55112	38654.6	9500	1845	61736	42579.4	9680	3514	116848	81233.9
Count:	114	114	114	114	114	114	114	114	117	117	117	117
Average:	82.2	14.6	483	339	83.3	16.2	542	374	82.7	30.0	999	694
Std Dev:	28.7	9.60	391	260	27.6	10.7	429	291	27.4	19.41	778	523

Rubus idaeus (Red Raspberry)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
1	80	3	96	68.8	80	4	128	91.7	80	7	224	160.5
2					40	8	128	129.9	40	8	128	129.9
4					70	4	112	84.1	70	4	112	84.1
6	70	3	84	63.1	70	12	336	252.4	70	15	420	315.5
7	50	2	40	35.4	50	2	40	35.4	50	4	80	70.8
8					30	3	36	44.7	30	3	36	44.7
9	50	4	80	70.8					50	4	80	70.8
10	50	1	20	17.7	50	3	60	53.1	50	4	80	70.8

Plot #	*Rubus idaeus* (Red Raspberry)											
	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm³)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm³)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm³)	Dry Wt (g)
11	50	1	20	17.7	50	4	80	70.8	50	5	100	88.5
12					70	4	112	84.1	70	4	112	84.1
14	80	9	288	206.3	80	4	128	91.7	80	13	416	298.0
17	40	1	16	16.2	35	4	56	62.2	36	5	72	78.5
18	64	16	410	319.6	61	9	220	175.2	63	25	629	494.7
19	50	1	20	17.7	50	3	60	53.1	50	4	80	70.8
21	40	4	64	65.0	62	5	124	98.2	52	9	188	163.1
22	42	6	101	99.1	60	4	96	77.2	49	10	197	176.3
23	31	7	87	105.2	30	3	36	44.7	31	10	123	149.9
24					30	1	12	14.9	30	1	12	14.9
25	30	6	72	89.4					30	6	72	89.4
26	75	12	360	263.5	68	13	354	268.7	71	25	714	532.3
27	70	23	644	483.7	70	21	588	441.7	70	44	1232	925.4
28	81	21	680	485.6	79	30	948	681.9	80	51	1628	1167.5
29	63	12	302	237.6	83	26	863	611.7	77	38	1166	849.3
30	80	5	160	114.6	82	6	197	139.9	81	11	357	254.6
31	70	19	532	399.6	82	13	426	303.2	75	32	958	702.8
32	70	10	280	210.3	73	11	321	237.4	72	21	601	447.7
33	56	17	381	316.9	64	21	538	419.4	60	38	918	736.3
34	67	6	161	123.0	72	5	144	107.0	69	11	305	230.0
35	50	3	60	53.1	47	9	169	155.2	48	12	229	208.3
36	35	2	28	31.1	36	5	72	78.4	36	7	100	109.6
37	64	5	128	99.9	80	12	384	275.1	75	17	512	375.0
38	68	11	299	227.4	110	3	132	89.1	77	14	431	316.5
39	62	10	248	196.3	81	15	486	346.9	73	25	734	543.2
40	83	3	100	70.6	90	5	180	125.0	87	8	280	195.5
41	30	11	132	163.9	30	3	36	44.7	30	14	168	208.6
42	30	1	12	14.9	30	1	12	14.9	30	2	24	29.8

	Rubus idaeus (Red Raspberry)											
	Inner Ring				Outer Ring				Both Rings			
Plot #	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
43	83	9	299	211.7	150	3	180	125.8	100	12	479	337.5
44	30	4	48	59.6	30	4	48	59.6	30	8	96	119.2
46	33	10	132	152.9	32	5	64	75.8	33	15	196	228.7
47	130	2	104	70.6	130	7	364	247.0	130	9	468	317.5
50	10	3	12	37.6	30	3	36	44.7	20	6	48	82.3
51	40	2	32	32.5	30	4	48	59.6	33	6	80	92.1
52	63	7	176	138.6	84	5	168	118.7	72	12	344	257.3
53	40	2	32	32.5	40	1	16	16.2	40	3	48	48.7
54					40	2	32	32.5	40	2	32	32.5
55	28	5	56	73.2	41	7	115	114.7	36	12	171	187.9
60	45	4	72	67.8	50	2	40	35.4	47	6	112	103.2
61	25	6	60	85.6	35	7	98	108.9	30	13	158	194.5
62	36	7	101	109.8	53	7	148	127.2	45	14	249	237.0
63	37	3	44	47.5	51	13	265	232.1	48	16	310	279.6
64	41	7	115	114.7	44	9	158	151.3	43	16	273	265.9
65	63	7	176	138.6	69	11	304	229.4	67	18	480	368.0
66	58	22	510	417.2	64	19	486	379.5	61	41	997	796.7
67	62	6	149	117.8	63	13	328	257.4	63	19	476	375.2
69	44	14	246	235.3	38	6	91	95.8	42	20	338	331.1
70					40	1	16	16.2	40	1	16	16.2
71	50	1	20	17.7	55	2	44	37.0	53	3	64	54.7
72	48	20	384	348.0	53	15	318	272.5	50	35	702	620.4
73	60	10	240	193.0	65	23	598	463.3	63	33	838	656.3
75	60	7	168	135.1	58	5	116	94.8	59	12	284	229.9
77	20	1	8	13.7					20	1	8	13.7
81	21	4	34	55.1	30	1	12	14.9	23	5	46	70.0
82	28	5	56	73.2	43	20	344	333.3	40	25	400	406.5
83	40	6	96	97.4	35	6	84	93.3	38	12	180	190.8

Rubus idaeus (Red Raspberry)

Plot #	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
84	65	2	52	40.3	49	8	157	140.4	52	10	209	180.7
86	30	1	12	14.9					30	1	12	14.9
88	40	2	32	32.5	40	2	32	32.5	40	4	64	65.0
90	68	18	490	372.1	70	6	168	126.2	69	24	658	498.3
91	93	15	558	384.7	105	25	1050	711.0	101	40	1608	1095.7
92	80	4	128	91.7	89	10	356	247.8	86	14	484	339.5
93					96	7	269	184.2	96	7	269	184.2
94	84	12	403	284.8	86	10	344	241.4	85	22	747	526.2
95	40	9	144	146.2	37	6	89	94.9	39	15	233	241.1
96	57	9	205	169.2	60	12	288	231.5	59	21	493	400.8
97					40	1	16	16.2	40	1	16	16.2
98	30	1	12	14.9	74	14	414	304.8	71	15	426	319.7
99	55	13	286	240.3	69	21	580	437.9	64	34	866	678.1
100	71	23	653	487.9	76	13	395	287.9	73	36	1048	775.9
102	86	7	241	169.0					86	7	241	169.0
103	110	2	88	59.4	90	1	36	25.0	103	3	124	84.4
104	30	1	12	14.9	25	2	20	28.5	27	3	32	43.4
106	109	10	436	294.4	108	10	432	291.9	109	20	868	586.2
107	35	4	56	62.2					35	4	56	62.2
108	80	2	64	45.9					80	2	64	45.9
SP-1					20	3	24	41.0	20	3	24	41.0
SP-2	30	13	156	193.7	30	3	36	44.7	30	16	192	238.4
SP-3	30	1	12	14.9	50	3	60	53.1	45	4	72	68.0
SP-4	60	5	120	96.5	62	6	149	117.8	61	11	269	214.3
SP-5	30	2	24	29.8	76	8	243	177.2	67	10	267	207.0
SP-6	23	3	28	42.1	23	3	28	42.1	23	6	55	84.2
SP-7	15	6	36	78.5	22	3	26	41.7	17	9	62	120.3
SP-8	20	1	8	13.7	20	1	8	13.7	20	2	16	27.3

Rubus idaeus (Red Raspberry)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm³)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm³)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm³)	Both Rings Dry Wt (g)
SP-9	50	1	20	17.7	50	1	20	17.7	50	2	40	35.4
Total:	4397	576	13551	11173	5015	656	17375	13591	5133	1232	30926	24764
Count:	83	83	83	83	86	86	86	86	93	93	93	93
Average:	53.0	6.9	163	135	58.3	7.6	202	158	55	13.2	333	266
Std Dev:	23.3	5.87	170	124	25.5	6.54	214	151	23	11.4	353	253

Corylus cornuta (Beaked Hazel)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm³)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm³)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm³)	Both Rings Dry Wt (g)
1	140	10	560	751.7	140	15	840	1127.5	140	25	1400	1879.1
2	120	26	1248	1639.0	120	16	768	1008.6	120	42	2016	2647.5
3	180	19	1368	2030.6	180	30	2160	3206.1	180	49	3528	5236.7
4	140	12	672	902.0	140	13	728	977.1	140	25	1400	1879.1
5	220	23	2024	3494.9	220	17	1496	2583.2	220	40	3520	6078.1
6	200	24	1920	3058.4	200	21	1680	2676.1	200	45	3600	5734.5
7	130	7	364	481.8	130	23	1196	1583.2	130	30	1560	2065.0
8	160	6	384	537.8	160	18	1152	1613.3	160	24	1536	2151.0
9	140	30	1680	2255.0	140	37	2072	2781.1	140	67	3752	5036.1
10	80	16	512	709.4	80	18	576	798.0	80	34	1088	1507.4
11	80	2	64	88.7	80	4	128	177.3	80	6	192	266.0
13	180	8	576	855.0	180	10	720	1068.7	180	18	1296	1923.7

Corylus cornuta (Beaked Hazel)

Plot	Inner Ring				Outer Ring				Both Rings			
#	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
15	80	1	32	44.3	80	8	256	354.7	80	9	288	399.0
16	250	16	1600	3165.6	250	16	1600	3165.6	250	32	3200	6331.2
17	216	5	432	733.5	194	17	1319	2055.0	199	22	1751	2788.4
18	195	8	624	975.6	199	13	1035	1642.1	197	21	1659	2617.7
19	97	9	349	463.4	106	5	212	278.7	100	14	561	742.1
20	110	6	264	346.4	115	11	506	663.6	113	17	770	1009.9
21	85	14	476	648.6	102	14	571	753.3	94	28	1047	1401.9
22	91	14	510	683.8	85	4	136	185.3	90	18	646	869.1
23					90	7	252	338.9	90	7	252	338.9
24	50	4	80	136.2	50	11	220	374.6	50	15	300	510.8
25	60	6	144	223.1	82	6	197	270.7	71	12	341	493.8
26	67	6	161	237.3	85	4	136	185.3	74	10	297	422.6
27	110	2	88	115.5	70	2	56	81.2	90	4	144	196.7
28					90	4	144	193.7	90	4	144	193.7
29	112	5	224	293.8	120	7	336	441.3	117	12	560	735.0
30	50	1	20	34.1	50	2	40	68.1	50	3	60	102.2
31	140	2	112	150.3	140	6	336	451.0	140	8	448	601.3
32	90	2	72	96.8	90	1	36	48.4	90	3	108	145.2
34	102	5	204	269.0	110	4	176	230.9	106	9	380	499.9
35	60	1	24	37.2					60	1	24	37.2
36	168	4	269	384.7	35	4	56	119.4	102	8	325	504.0
37					110	6	264	346.4	110	6	264	346.4
38	120	6	288	378.2	156	5	312	432.6	136	11	600	810.9
40	136	5	272	362.8	132	19	1003	1331.1	133	24	1275	1693.9
41	184	5	368	553.5	168	26	1747	2500.2	171	31	2115	3053.7
42	182	6	437	652.6	135	18	972	1294.7	147	24	1409	1947.4
43	161	8	515	723.4	154	36	2218	3060.7	155	44	2733	3784.0
44	103	8	330	434.2	60	4	96	148.7	89	12	426	583.0

Corylus cornuta (Beaked Hazel)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm³)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm³)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm³)	Both Rings Dry Wt (g)
45	164	16	1050	1485.4	177	33	2336	3434.9	173	49	3386	4920.3
46	96	11	422	561.4	179	25	1790	2648.4	154	36	2212	3209.8
47	155	36	2232	3087.7	165	16	1056	1498.5	158	52	3288	4586.2
48	158	19	1201	1673.2	160	31	1984	2778.4	159	50	3185	4451.6
49	251	22	2209	4391.2	256	19	1946	3962.9	253	41	4154	8354.1
50	98	13	510	675.3	104	27	1123	1478.5	102	40	1633	2153.8
51	82	5	164	225.6	130	5	260	344.2	106	10	424	569.8
52	177	6	425	624.5	158	17	1074	1497.1	163	23	1499	2121.6
53	110	1	44	57.7	110	3	132	173.2	110	4	176	230.9
54	90	4	144	193.7	90	2	72	96.8	90	6	216	290.5
55	70	2	56	81.2	90	2	72	96.8	80	4	128	178.0
56	103	9	371	488.5	88	8	282	380.5	96	17	652	869.1
57	100	6	240	317.2	240	6	576	1087.1	170	12	816	1404.3
58	70	3	84	121.8	82	5	164	225.6	78	8	248	347.4
59					50	2	40	68.1	50	2	40	68.1
60	140	3	168	225.5	145	4	232	314.2	143	7	400	539.7
61	20	1	8	26.2	70	2	56	81.2	53	3	64	107.4
62	73	4	117	166.7	81	12	389	536.7	79	16	506	703.5
63	40	2	32	62.4					40	2	32	62.4
64	30	1	12	28.6	90	4	144	193.7	78	5	156	222.2
66	150	3	180	246.2	150	4	240	328.3	150	7	420	574.5
68	150	15	900	1231.2	141	7	395	530.8	147	22	1295	1762.0
69					160	3	192	268.9	160	3	192	268.9
70					96	7	269	357.3	96	7	269	357.3
71	60	3	72	111.5	68	4	109	159.6	65	7	181	271.1
73	40	1	16	31.2					40	1	16	31.2
74	20	1	8	26.2	80	3	96	133.0	65	4	104	159.2
75	100	1	40	52.9	130	3	156	206.5	123	4	196	259.4

Corylus cornuta (Beaked Hazel)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
79	100	4	160	211.5	100	1	40	52.9	100	5	200	264.3
SP-3	70	3	84	121.8	70	4	112	162.4	70	7	196	284.2
Total:	7506	527	30214	45474	8288	741	43084	63713	8312	1268	73298	109187
Count:	64	64	64	64	67	67	67	67	70	70	70	70
Average:	117	8.2	472	711	124	11.1	643	951	119	18.1	1047	1560
Std Dev:	54.3	7.79	571	946	50.1	9.39	668	1041	49	15.7	1143	1852

Prunus pennsylvanica (Pin Cherry)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
6					180	4	288	483.1	180	4	288	483.1
7	160	3	192	297.4	160	3	192	297.4	160	6	384	594.7
8	30	1	12	41.6					30	1	12	41.6
18					200	3	240	437.5	200	3	240	437.5
28	40	1	16	40.9					40	1	16	40.9
31	250	3	300	670.2	250	8	800	1787.3	250	11	1100	2457.6
32	130	8	416	584.4	164	11	722	1135.0	150	19	1138	1719.4
33	120	4	192	264.3	178	12	854	1421.4	164	16	1046	1685.7
34	150	4	240	358.3	150	3	180	268.7	150	7	420	627.1
36	150	2	120	179.2	150	7	420	627.1	150	9	540	806.2
37	149	13	775	1152.8	143	8	458	667.3	147	21	1232	1820.0
41	240	7	672	1443.3	213	11	937	1803.4	224	18	1609	3246.8

	Prunus pennsylvanica (Pin Cherry)											
	Inner Ring				Outer Ring				Both Rings			
Plot #	Height (cm)	Cover (%)	Volume (dm³)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm³)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm³)	Dry Wt (g)
44	140	5	280	404.5					140	5	280	404.5
46					96	10	384	528.0	96	10	384	528.0
48					80	2	64	93.4	80	2	64	93.4
53	170	3	204	328.6	153	6	367	554.1	159	9	571	882.7
54	300	9	1080	2901.1	300	12	1440	3868.1	300	21	2520	6769.1
55					30	1	12	41.6	30	1	12	41.6
58					100	3	120	164.0	100	3	120	164.0
59	220	1	88	174.3	220	6	528	1045.8	220	7	616	1220.1
60	70	1	28	44.0	210	4	336	638.6	182	5	364	682.5
75	80	2	64	93.4					80	2	64	93.4
82	158	17	1074	1651.5	190	3	228	398.6	163	20	1302	2050.1
83	133	3	160	226.0	154	7	431	653.1	148	10	591	879.0
87					100	1	40	54.7	100	1	40	54.7
89	231	17	1571	3254.1	300	10	1200	3223.4	257	27	2771	6477.5
92	165	15	990	1563.2	178	12	854	1421.4	171	27	1844	2984.6
93	240	22	2112	4536.2	240	15	1440	3092.9	240	37	3552	7629.1
94					130	2	104	146.1	130	2	104	146.1
96	60	1	24	42.1					60	1	24	42.1
103	287	31	3559	9131.6	300	13	1560	4190.4	291	44	5119	13322.0
105	222	15	1332	2660.1	249	11	1096	2438.2	233	26	2428	5098.3
107	270	12	1296	3125.1	242	10	968	2095.7	257	22	2264	5220.8
108	242	11	1065	2305.2	221	17	1503	2988.9	229	28	2568	5294.1
SP-1	135	6	324	461.2	150	1	60	89.6	137	7	384	550.8
SP-2					53	3	64	123.9	53	3	64	123.9
SP-3					80	4	128	186.7	80	4	128	186.7
SP-4	230	8	736	1518.6	224	13	1165	2345.3	226	21	1901	3863.9
SP-5	200	10	800	1458.3	168	16	1075	1717.9	180	26	1875	3176.2
SP-6					30	1	12	41.6	30	1	12	41.6

Prunus pennsylvanica (Pin Cherry)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
SP-8	270	23	2484	5989.8	270	3	324	781.3	270	26	2808	6771.0
Total:	5242	258	22205	46901	6526	260	21026	42893	6755	518	43231	89794
Count:	30	30	30	30	37	37	37	37	42	42	42	42
Average:	175	8.60	740	1563	176	7.0	568	1159	161	12.3	1029	2138
Std Dev:	74.4	7.70	833	2054	73.3	4.75	481	1157	76	11.2	1172	2836

Pinus banksiana (Jack Pine)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
3					150	1	60	117.8	150	1	60	117.8
4	80	2	64	237.2					80	2	64	237.2
5	180	3	216	461.2					180	3	216	461.2
6					200	6	480	1448.0	200	6	480	1448.0
8	140	2	112	257.4	140	1	56	117.0	140	3	168	374.4
10	120	1	48	115.4	120	2	96	250.5	120	3	144	365.9
14					140	5	280	857.5	140	5	280	857.5
17					120	2	96	250.5	120	2	96	250.5
18	70	2	56	234.0					70	2	56	234.0
19					80	2	64	237.2	80	2	64	237.2
21	116	5	232	790.0					116	5	232	790.0
22					60	1	24	110.8	60	1	24	110.8

Pinus banksiana (Jack Pine)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
26	60	2	48	230.8	60	2	48	230.8	60	4	96	461.6
29					70	1	28	111.5	70	1	28	111.5
30					130	4	208	606.6	130	4	208	606.6
40					80	1	32	112.3	80	1	32	112.3
41					50	3	60	353.4	50	3	60	353.4
43	30	1	12	108.5					30	1	12	108.5
44					160	6	384	1229.0	160	6	384	1229.0
45					160	3	192	442.7	160	3	192	442.7
46	160	2	128	264.6	160	4	256	658.5	160	6	384	923.0
47	90	2	72	240.4	90	3	108	383.5	90	5	180	624.0
49	90	3	108	383.5					90	3	108	383.5
50	67	3	80	365.9	122	5	244	806.4	101	8	324	1172.3
51					160	6	384	1229.0	160	6	384	1229.0
55					80	3	96	375.8	80	3	96	375.8
58					150	2	120	261.0	150	2	120	261.0
59					114	5	228	784.6	114	5	228	784.6
60	130	2	104	254.0	130	3	156	416.3	130	5	260	670.3
61					120	2	96	250.5	120	2	96	250.5
62					90	4	144	543.8	90	4	144	543.8
63	90	1	36	113.1	90	4	144	543.8	90	5	180	656.9
64					120	2	96	250.5	120	2	96	250.5
68	100	1	40	113.8	100	4	160	558.9	100	5	200	672.7
73	80	2	64	237.2	80	1	32	112.3	80	3	96	349.5
74					180	4	288	695.4	180	4	288	695.4
75					140	3	168	424.9	140	3	168	424.9
76					90	4	144	543.8	90	4	144	543.8
79	170	5	340	950.0	162	9	583	2590.6	165	14	923	3540.6
81					153	8	490	1962.6	153	8	490	1962.6

Pinus banksiana (Jack Pine)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
83	130	1	52	116.2	130	6	312	1086.8	130	7	364	1203.0
84					160	4	256	658.5	160	4	256	658.5
86					170	3	204	451.9	170	3	204	451.9
87					170	2	136	268.2	170	2	136	268.2
88					150	4	240	640.7	150	4	240	640.7
89	190	3	228	470.8	190	7	532	1846.2	190	10	760	2317.0
90					60	3	72	360.7	60	3	72	360.7
91					120	2	96	250.5	120	2	96	250.5
95	70	1	28	111.5	70	3	84	368.1	70	4	112	479.7
105					80	1	32	112.3	80	1	32	112.3
110					110	2	88	247.1	110	2	88	247.1
SP-7					230	6	552	1637.5	230	6	552	1637.5
Total:	2163	44	2068	6056	5691	159	8649	27796	6239	203	10717	33852
Count:	20	20	20	20	46	46	46	46	52	52	52	52
Average:	108	2.2	103	303	124	3.5	188	604	120	3.9	206	651
Std Dev:	43.7	1.20	85.7	225	42.0	1.95	151	550	44	2.46	182	627

Betula papyrifera (Paper Birch)

Plot	Inner Ring				Outer Ring				Both Rings			
#	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
63	100	2	80	51.5	100	1	40	25.8	100	3	120	77.3
75	147	3	176	147.4	202	16	1293	1673.6	193	19	1469	1820.9
76	155	21	1302	1151.5	141	25	1410	1131.0	147	46	2712	2282.5
77	195	12	936	1140.1	194	13	1009	1218.2	194	25	1945	2358.3
78	170	3	204	202.2	170	7	476	471.7	170	10	680	673.8
80	165	4	264	251.6	147	18	1058	884.3	150	22	1322	1135.9
82	108	6	259	172.5	127	9	457	335.9	119	15	716	508.4
85	30	1	12	9.8	110	3	132	88.6	90	4	144	98.5
86					90	1	36	22.4	90	1	36	22.4
89	50	4	80	51.8					50	4	80	51.8
91	119	8	381	267.5	197	6	473	585.9	152	14	854	853.4
93	200	3	240	305.3	200	9	720	915.9	200	12	960	1221.1
94	300	2	240	804.2	300	9	1080	3618.9	300	11	1320	4423.1
95	44	5	88	59.7	40	2	32	22.6	43	7	120	82.2
96	66	5	132	80.7	80	4	128	78.3	72	9	260	159.0
97					60	1	24	14.9	60	1	24	14.9
98	47	3	56	37.3					47	3	56	37.3
102	100	3	120	77.3					100	3	120	77.3
103	90	5	180	112.2	90	1	36	22.4	90	6	216	134.7
104					30	1	12	9.8	30	1	12	9.8
105	210	20	1680	2335.0	193	9	695	831.9	205	29	2375	3166.9
106	203	19	1543	2014.9	205	11	902	1199.0	204	30	2445	3213.9
107	200	7	560	712.3	173	15	1038	1053.3	182	22	1598	1765.6
108	230	2	184	307.4	230	5	460	768.4	230	7	644	1075.7
109	176	14	986	1024.5	220	9	792	1205.5	193	23	1778	2230.0
110	100	2	80	51.5	162	14	907	845.2	154	16	987	896.7
SP-1					60	3	72	44.6	60	3	72	44.6
SP-2					98	5	196	125.3	98	5	196	125.3

Betula papyrifera (Paper Birch)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
SP-3	54	5	108	68.4	59	8	189	117.3	57	13	297	185.7
SP-4	130	1	52	38.9	158	5	316	285.7	153	6	368	324.6
SP-7	90	2	72	44.9	82	5	164	100.6	84	7	236	145.4
SP-8	100	2	80	51.5	93	3	112	70.2	96	5	192	121.7
SP-9					67	3	80	49.1	67	3	80	49.1
SP-10	83	11	365	224.3	68	11	299	182.5	76	22	664	406.8
Total:	3662	175	10460	11796	4146	232	14638	17999	4258	407	25098	29795
Count:	28	28	28	28	31	31	31	31	34	34	34	34
Average:	131	6.3	374	421	134	7.5	472	581	125	12.0	738	876
Std Dev:	66.9	5.84	468	605	66.6	5.82	433	746	65	10.4	790	1136

Acer spicatum (Mountain Maple)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
1	110	1	44	67.9	110	1	44	67.9	110	2	88	135.8
7					80	2	64	100.7	80	2	64	100.7
12					110	3	132	203.7	110	3	132	203.7
15					140	6	336	549.1	140	6	336	549.1
16	150	11	660	1112.2	147	18	1058	1766.4	148	29	1718	2878.5
17	168	4	269	483.8	170	12	816	1480.6	170	16	1085	1964.4
20					120	4	192	300.0	120	4	192	300.0
29	80	2	64	100.7					80	2	64	100.7

Acer spicatum (Mountain Maple)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
30	40	1	16	33.8					40	1	16	33.8
31	158	18	1138	1970.8	139	15	834	1359.3	149	33	1972	3330.1
32					100	2	80	122.9	100	2	80	122.9
33	90	1	36	55.6	90	1	36	55.6	90	2	72	111.3
38	174	17	1183	2182.8	177	27	1912	3571.9	176	44	3095	5754.7
40					160	3	192	335.1	160	3	192	335.1
41	125	6	300	473.0					125	6	300	473.0
43					130	2	104	165.7	130	2	104	165.7
44					120	4	192	300.0	120	4	192	300.0
45	100	2	80	122.9	100	1	40	61.5	100	3	120	184.4
48	200	11	880	1829.7	200	9	720	1497.0	200	20	1600	3326.8
49	250	22	2200	6020.5	250	25	2500	6841.4	250	47	4700	12861.9
53					110	3	132	203.7	110	3	132	203.7
62	50	1	20	37.4	50	4	80	149.4	50	5	100	186.8
63					60	3	72	123.8	60	3	72	123.8
64	60	3	72	123.8	60	5	120	206.3	60	8	192	330.1
73					110	2	88	135.8	110	2	88	135.8
74					40	2	32	67.6	40	2	32	67.6
83	120	5	240	375.0	124	5	248	390.2	122	10	488	765.2
95	110	2	88	135.8	116	13	603	936.9	115	15	691	1072.7
96					140	2	112	183.0	140	2	112	183.0
100	130	4	208	331.4	130	4	208	331.4	130	8	416	662.8
105	200	4	320	665.4	208	10	832	1801.3	206	14	1152	2466.7
SP-5	140	3	168	274.6	140	6	336	549.1	140	9	504	823.7
SP-8	200	3	240	499.0	200	11	880	1829.7	200	14	1120	2328.7

Acer spicatum (Mountain Maple)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
Total:	2655	121	8226	16896	3831	205	12995	25687	4081	326	21221	42583
Count:	20	20	20	20	30	30	30	30	33	33	33	33
Average:	133	6.1	411	845	128	6.8	433	856	124	9.9	643	1290
Std Dev:	55.7	6.32	554	1391	48.3	6.86	577	1388	49	12.1	1012	2459

Alnus crispa (Green alder)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
15	200	2	160	324.2	200	7	560	1134.6	200	9	720	1458.7
19	120	3	144	233.7	120	4	192	311.6	120	7	336	545.3
24	107	23	984	1590.7	70	3	84	147.8	103	26	1068	1738.5
25					60	2	48	89.9	60	2	48	89.9
26	150	7	420	717.7	150	9	540	922.8	150	16	960	1640.6
38	270	1	108	307.7	270	7	756	2154.0	270	8	864	2461.7
92					150	4	240	410.1	150	4	240	410.1
94	90	2	72	118.4	90	2	72	118.4	90	4	144	236.8
96	40	4	64	149.8					40	4	64	149.8
98					70	2	56	98.6	70	2	56	98.6
101	150	3	180	307.6	150	12	720	1230.4	150	15	900	1538.0
104	190	10	760	1479.0	183	24	1757	3329.2	185	34	2517	4808.2

Alnus crispa (Green alder)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
105	110	3	132	213.3	180	1	72	135.0	128	4	204	348.2
106	175	4	280	515.7	164	17	1115	1981.5	166	21	1395	2497.2
108	128	22	1126	1844.1	143	26	1487	2500.4	136	48	2614	4344.5
109	130	3	156	256.1	130	9	468	768.4	130	12	624	1024.5
110	95	12	456	743.5	97	17	660	1072.8	96	29	1116	1816.4
SP-4					100	4	160	259.5	100	4	160	259.5
SP-6	28	4	45	134.2	27	3	32	99.7	28	7	77	233.9
SP-9	80	1	32	54.0					80	1	32	54.0
Total:	2063	104	5120	8990	2354	153	9019	16765	2451	257	14139	25754
Count:	16	16	16	16	18	18	18	18	20	20	20	20
Average:	129	6.5	320	562	131	8.5	501	931	123	12.9	707	1288
Std Dev:	61.0	6.95	345	573	58.8	7.72	515	973	58	12.7	767	1386

Minor Woody Species (listed below)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
1					20	2	16	30.0	20	2	16	30
2	150	1	60	75.3	150	7	420	527.4	150	8	480	603
4	50	1	20	21.8					50	1	20	22
7	15	1	6	14.1	15	1	6	14.1	15	2	12	28

Minor Woody Species (listed below)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
16	50	10	200	217.7	60	10	240	246.5	55	20	440	464
17	50	1	20	21.8	70	2	56	55.8	63	3	76	78
18					160	3	192	255.9	160	3	192	256
19	80	2	64	63.2					80	2	64	63
20					160	2	128	170.6	160	2	128	171
21	56	5	111.6	117.0	60	1	24	24.7	56	6	136	142
22	170	9	612	869.2	175	13	912	1342.3	173	22	1524	2212
23	200	5	400	700.8	200	12	960	1681.9	200	17	1360	2383
24	70	3	84	83.7	134	5	268	308.9	110	8	352	393
25	80	11	352	347.6	137	10	548	641.2	107	21	900	989
26	70	1	28	27.9	70	1	28	27.9	70	2	56	56
27	70	2	56	55.8	60	2	48	49.3	65	4	104	105
28	30	3	36	51.0	30	1	12	17.0	30	4	48	68
29	160	2	128	170.6	160	6	384	511.8	160	8	512	682
30	41	15	245.2	291.6	30	1	12	17.0	40	16	257	309
33					20	3	24	45.0	20	3	24	45
35	60	2	48	49.3	110	4	176	183.4	93	6	224	233
36					100	3	120	121.5	100	3	120	122
38					250	3	300	782.2	250	3	300	782
40					130	1	52	58.8	130	1	52	59
42	50	3	60	65.3	50	2	40	43.5	50	5	100	109
43	70	3	84	83.7					70	3	84	84
45	140	4	224	266.2	140	7	392	465.8	140	11	616	732
53	60	3	72	74.0	73	4	116.8	115.9	67	7	189	190
54	40	2	32	38.5					40	2	32	38
56	60	3	72	74.0	40	2	32	38.5	52	5	104	112
58	150	6	360	452.1					150	6	360	452
59	100	4	160	162.0					100	4	160	162

Minor Woody Species (listed below)

Plot	Inner Ring				Outer Ring				Both Rings			
#	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
60					90	1	36	35.8	90	1	36	36
61	55	4	88	92.7	46	5	92.4	103.8	50	9	180	197
64	40	1	16	19.2	50	1	20	21.8	45	2	36	41
66					70	1	28	27.9	70	1	28	28
67	70	5	140	139.5					70	5	140	140
68	80	3	96	94.8	105	8	336	344.8	98	11	432	440
69	30	5	60	84.9	34	5	68	89.3	32	10	128	174
70	60	2	48	49.3	66	5	132	132.8	64	7	180	182
71	55	2	44	46.3	53	4	84.8	90.4	54	6	129	137
72					30	3	36	51.0	30	3	36	51
73					30	2	24	34.0	30	2	24	34
74					190	5	380	619.0	190	5	380	619
75					60	1	24	24.7	60	1	24	25
76					70	3	84	83.7	70	3	84	84
77					130	1	52	58.8	130	1	52	59
78					90	4	144	143.1	90	4	144	143
79					40	1	16	19.2	40	1	16	19
85	20	1	8	15.0	30	1	12	17.0	25	2	20	32
86	40	3	48	57.7	50	6	120	130.6	47	9	168	188
87	60	1	24	24.7	60	3	72	74.0	60	4	96	99
91	100	1	40	40.5					100	1	40	41
92					100	4	160	162.0	100	4	160	162
95					30	2	24	34.0	30	2	24	34
102	180	4	288	437.4	60	4	96	98.6	120	8	384	536
103	140	10	560	665.5	140	5	280	332.7	140	15	840	998
105	100	3	120	121.5					100	3	120	122
106	130	2	104	117.6	115	4	184	195.2	120	6	288	313
107	150	1	60	75.3	150	1	60	75.3	150	2	120	151

Minor Woody Species (listed below)

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
110	90	1	36	35.8	90	1	36	35.8	90	2	72	72
SP-1	80	1	32	31.6					80	1	32	32
SP-2					70	2	56	55.8	70	2	56	56
SP-3	70	1	28	27.9	70	5	140	139.5	70	6	168	167
SP-4	160	1	64	85.3	160	1	64	85.3	160	2	128	171
SP-6	131	13	682.8	776.6	130	10	520.8	589.3	131	23	1204	1366
SP-7	20	1	8	15.0	25	4	40	63.9	24	5	48	79
SP-8	114	8	364	384.3	73	8	232	230.3	93	16	596	615
SP-9	43	4	68	79.3	80	1	32	31.6	50	5	100	111
SP-10	75	2	60	59.4	175	6	420	616.6	150	8	480	676
Total:	4164	182	6622	7971	5366	226	9613	12624	6151	408	16234	20596
Count:	50	50	50	50	60	60	60	60	70	70	70	70
Average:	83	3.6	132	159	89	3.8	160	210	88	5.8	232	294
Std Dev:	46.6	3.34	160	208	53.8	2.95	200	311	50	5.43	308	442

Minor Woody species

Acer spicatum:	Mountain maple	*Sorbus americana*	American mountain ash
Alnus rugosa:	Speckled alder	*Cornus stolonifera:*	Red osier dogwood
Betula papyrifera:	Paper birch	*Diervilla lonicera:*	Bush honeysuckle
Corylus cornuta:	Beaked hazel	*Rubus idaeus*	Red raspberry
Prunus pennsylvanicum:	Pin cherry	*Viburnum edule:*	Squashberry
Salix spp.:	Willow species		

Total Woody Vegetation

Plot #	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
1	125	14	700	888	117	22	1028	1317	120	36	1728	2205
2	121	27	1308	1714	106	31	1316	1666	113	58	2624	3380
3	180	19	1368	2031	179	31	2220	3324	179	50	3588	5354
4	126	15	756	1161	124	17	840	1061	125	32	1596	2222
5	215	26	2240	3956	220	17	1496	2583	217	43	3736	6539
6	186	27	2004	3121	162	43	2784	4860	171	70	4788	7981
7	116	13	602	829	121	31	1498	2031	119	44	2100	2859
8	141	9	508	837	141	22	1244	1775	141	31	1752	2612
9	129	34	1760	2326	140	37	2072	2781	135	71	3832	5107
10	81	18	580	842	80	23	732	1102	80	41	1312	1944
11	70	3	84	106	65	8	208	248	66	11	292	355
12					87	7	244	288	87	7	244	288
13	180	8	576	855	180	10	720	1069	180	18	1296	1924
14	80	9	288	206	113	9	408	949	97	18	696	1156
15	160	3	192	369	137	21	1152	2038	140	24	1344	2407
16	166	37	2460	4496	165	44	2898	5178	165	81	5358	9674
17	167	11	737	1255	158	37	2343	3904	160	48	3080	5159
18	105	26	1090	1529	151	28	1686	2511	129	54	2776	4040
19	96	15	577	778	94	14	528	881	95	29	1105	1659
20	110	6	264	346	121	17	826	1134	118	23	1090	1481
21	79	28	884	1621	90	20	719	876	83	48	1603	2497
22	105	29	1222	1652	133	22	1168	1716	117	51	2390	3368
23	101	12	487	806	142	22	1248	2066	128	34	1735	2872
24	96	30	1148	1811	73	20	584	846	87	50	1732	2657
25	62	23	568	660	110	18	793	1002	83	41	1361	1662
26	91	28	1017	1477	95	29	1106	1636	93	57	2122	3113
27	73	27	788	655	69	25	692	572	71	52	1480	1227
28	73	25	732	578	79	35	1104	893	77	60	1836	1470

Total Woody Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
29	86	21	718	803	101	40	1611	1676	95	61	2330	2479
30	50	22	441	474	88	13	457	832	64	35	898	1306
31	124	42	2082	3191	143	42	2396	3901	133	84	4478	7092
32	96	20	768	892	116	25	1159	1544	107	45	1927	2435
33	69	22	609	637	98	37	1452	1941	87	59	2061	2578
34	101	15	605	750	104	12	500	607	102	27	1105	1357
35	55	6	132	140	66	13	345	339	63	19	477	478
36	130	8	417	595	88	19	668	946	100	27	1085	1541
37	125	18	903	1253	106	26	1106	1289	114	44	2008	2541
38	134	35	1878	3096	190	45	3412	7030	165	80	5290	10126
39	62	10	248	196	81	15	486	347	73	25	734	543
40	116	8	372	433	126	29	1459	1962	124	37	1831	2396
41	127	29	1472	2634	162	43	2780	4702	148	72	4252	7335
42	127	10	509	733	122	21	1024	1353	124	31	1533	2086
43	108	21	910	1127	153	41	2502	3352	138	62	3412	4479
44	97	17	658	898	100	18	720	1737	98	35	1378	2636
45	154	22	1354	1875	168	44	2960	4405	163	66	4314	6279
46	74	23	682	979	142	44	2494	3911	119	67	3176	4889
47	151	40	2408	3399	147	26	1528	2129	149	66	3936	5528
48	173	30	2081	3503	165	42	2768	4369	168	72	4849	7872
49	240	47	4517	10795	253	44	4446	10804	246	91	8962	21600
50	79	19	602	1079	100	35	1403	2330	93	54	2005	3408
51	70	7	196	258	115	15	692	1633	101	22	888	1891
52	116	13	601	763	141	22	1242	1616	132	35	1844	2379
53	98	9	352	493	112	17	764	1063	107	26	1116	1556
54	209	15	1256	3133	241	16	1544	3997	226	31	2800	7131
55	40	7	112	154	57	13	295	629	51	20	407	783
56	92	12	443	562	78	10	314	419	86	22	756	981

Total Woody Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
57	100	6	240	317	240	6	576	1087	170	12	816	1404
58	123	9	444	574	101	10	404	651	112	19	848	1224
59	124	5	248	336	153	13	796	1899	145	18	1044	2235
60	93	10	372	591	143	14	800	1440	122	24	1172	2031
61	35	11	156	204	54	16	342	544	46	27	498	749
62	50	12	238	314	70	27	761	1357	64	39	999	1671
63	60	8	192	274	62	21	521	925	62	29	714	1200
64	45	12	215	286	64	21	538	824	57	33	753	1110
65	63	7	176	139	69	11	304	229	67	18	480	368
66	69	25	690	663	79	24	754	736	74	49	1445	1399
67	66	11	289	257	63	13	328	257	64	24	616	515
68	136	19	1036	1440	117	19	891	1434	127	38	1927	2874
69	40	19	306	320	63	14	351	454	50	33	658	774
70	60	2	48	49	80	13	417	506	77	15	465	556
71	57	6	136	176	59	10	238	287	58	16	374	463
72	48	20	384	348	49	18	354	323	49	38	738	671
73	62	13	320	461	66	28	742	745	65	41	1062	1207
74	20	1	8	26	142	14	796	1515	134	15	804	1541
75	86	13	448	429	157	28	1757	2424	134	41	2205	2853
76	155	21	1302	1152	128	32	1638	1758	139	53	2940	2910
77	182	13	944	1154	189	14	1061	1277	186	27	2005	2431
78	170	3	204	202	141	11	620	615	147	14	824	817
79	139	9	500	1161	145	11	639	2663	142	20	1139	3824
80	165	4	264	252	147	18	1058	884	150	22	1322	1136
81	21	4	34	55	139	9	502	1977	103	13	535	2033
82	124	28	1390	1897	80	32	1029	1068	101	60	2419	2965
83	91	15	548	815	112	24	1075	2223	104	39	1623	3038
84	65	2	52	40	86	12	413	799	83	14	465	839

Plot #	Total Woody Vegetation											
	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
85	25	2	20	25	90	4	144	106	68	6	164	130
86	38	4	60	73	90	10	360	605	75	14	420	678
87	60	1	24	25	103	6	248	397	97	7	272	421
88	40	2	32	32	113	6	272	673	95	8	304	706
89	196	24	1879	3777	255	17	1732	5070	220	41	3611	8846
90	68	18	490	372	67	9	240	487	68	27	730	859
91	102	24	979	693	123	33	1619	1547	114	57	2598	2240
92	147	19	1118	1655	134	30	1610	2241	139	49	2728	3896
93	235	25	2352	4841	196	31	2429	4193	213	56	4781	9034
94	112	16	715	1207	174	23	1600	4125	148	39	2315	5332
95	51	17	348	453	80	26	832	1457	69	43	1180	1910
96	56	19	425	442	73	18	528	493	64	37	953	935
97					50	2	40	31	50	2	40	31
98	43	4	68	52	74	16	470	403	67	20	539	456
99	55	13	286	240	69	21	580	438	64	34	866	678
100	80	27	861	819	89	17	603	619	83	44	1464	1439
101	150	3	180	308	150	12	720	1230	150	15	900	1538
102	116	14	649	684	60	4	96	99	103	18	745	782
103	228	48	4387	9969	239	20	1912	4571	232	68	6299	14539
104	175	11	772	1494	166	27	1789	3368	168	38	2561	4861
105	199	45	3584	5995	213	32	2726	5319	205	77	6310	11314
106	169	35	2363	2942	157	42	2633	3668	162	77	4996	6610
107	205	24	1972	3975	199	26	2066	3224	202	50	4038	7199
108	165	37	2439	4503	180	48	3450	6258	173	85	5889	10760
109	168	17	1142	1281	192	22	1692	3016	182	39	2834	4296
110	95	15	572	831	124	34	1691	2201	115	49	2263	3032
SP-1	127	7	356	493	56	7	156	175	91	14	512	668
SP-2	30	13	156	194	68	13	352	350	49	26	508	543

Total Woody Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
SP-3	58	10	232	233	66	24	629	659	63	34	861	892
SP-4	162	15	972	1739	160	29	1854	3094	161	44	2826	4833
SP-5	165	15	992	1763	138	30	1654	2444	147	45	2646	4207
SP-6	94	20	755	953	87	17	593	773	91	37	1348	1726
SP-7	32	9	116	138	109	18	782	1844	83	27	898	1982
SP-8	215	37	3176	6938	150	26	1556	2925	188	63	4732	9863
SP-9	50	6	120	151	66	5	132	98	57	11	252	249
SP-10	82	13	425	284	106	17	719	799	95	30	1144	1083
Total:	12780.7	1987	98465	155256	14476.2	2632	136399	221068	13940.3	4619	234864	376325
Count:	118	118	118	118	120	120	120	120	120	120	120	120
Average:	108	16.8	834	1316	121	21.9	1137	1842	116	38.5	1957	3136
Std Dev:	52.5	10.7	853	1766	48.1	11.0	848	1681	46.3	20.0	1600	3258

Total Woody and Herbaceous Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
1	81	28	908	1084	91	38	1380	1574	87	66	2288	2658
2	108	39	1692	2046	103	38	1560	1858	106	77	3252	3904
3	152	29	1768	2293	164	37	2424	3490	159	66	4192	5783
4	117	23	1076	1371	110	32	1404	1463	113	55	2480	2834

Total Woody and Herbaceous Vegetation

Plot #	Inner Ring Height (cm)	Inner Ring Cover (%)	Inner Ring Volume (dm^3)	Inner Ring Dry Wt (g)	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring Volume (dm^3)	Outer Ring Dry Wt (g)	Both Rings Height (cm)	Both Rings Cover (%)	Both Rings Volume (dm^3)	Both Rings Dry Wt (g)
5	191	33	2520	4129	176	27	1896	2845	184	60	4416	6975
6	135	43	2330	3423	155	47	2918	4955	146	90	5248	8378
7	117	34	1586	1246	120	42	2018	2248	119	76	3604	3494
8	106	37	1568	1578	122	41	1996	2232	114	78	3564	3810
9	124	39	1940	2440	137	39	2144	2827	131	78	4084	5267
10	73	29	852	992	65	31	804	1193	69	60	1656	2185
11	103	40	1640	1119	97	50	1948	1378	100	90	3588	2497
12	62	26	648	517	52	40	836	846	56	66	1484	1363
13	139	19	1060	1162	133	31	1644	1656	135	50	2704	2818
14	76	34	1028	763	75	46	1384	1723	75	80	2412	2486
15	125	26	1296	998	131	32	1680	2339	128	58	2976	3337
16	153	42	2564	4622	162	45	2922	5188	158	87	5486	9809
17	80	37	1189	1693	139	46	2559	4086	113	83	3748	5779
18	100	32	1282	1684	146	30	1754	2554	122	62	3036	4237
19	82	22	723	915	84	25	836	1124	83	47	1559	2039
20	89	20	710	641	100	33	1321	1487	96	53	2032	2127
21	66	51	1344	2059	73	44	1283	1356	69	95	2627	3415
22	102	31	1270	1670	106	36	1532	1874	105	67	2802	3544
23	95	30	1135	1217	120	38	1818	2425	109	68	2952	3642
24	92	34	1256	1899	72	31	896	1077	83	65	2152	2976
25	60	26	628	720	106	20	849	1029	80	46	1477	1749
26	87	46	1597	1919	94	34	1274	2181	86	133	4566	4100
27	81	42	1360	1033	77	50	1547	1092	79	92	2907	2125
28	85	35	1192	898	87	43	1500	1176	86	78	2692	2074
29	90	35	1255	1114	101	47	1895	1835	96	82	3150	2950
30	85	39	1325	1118	118	47	2225	2119	103	86	3550	3237
31	124	42	2082	3191	143	42	2396	3901	133	84	4478	7092
32	69	30	828	1019	99	33	1311	1690	85	63	2139	2709

Plot #	Total Woody and Herbaceous Vegetation											
	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
33	59	32	761	780	84	49	1652	2133	74	81	2413	2913
34	113	30	1355	1140	107	43	1839	1467	109	73	3194	2608
35	83	18	598	444	89	33	1177	882	87	51	1775	1326
36	96	20	767	776	88	20	704	969	92	40	1471	1745
37	79	31	979	1413	96	32	1234	1377	88	63	2212	2790
38	132	41	2158	3278	180	51	3676	7213	159	92	5834	10490
39	94	31	1166	895	116	48	2232	1618	108	79	3398	2513
40	128	47	2400	1910	128	50	2551	2757	128	97	4951	4668
41	124	30	1484	2648	154	46	2828	4747	142	76	4312	7395
42	114	13	593	774	111	27	1204	1449	112	40	1797	2223
43	106	25	1062	1226	143	47	2697	3433	131	72	3759	4659
44	102	22	902	1033	102	22	896	1849	102	44	1798	2882
45	154	22	1354	1875	168	44	2960	4405	163	66	4314	6279
46	74	23	682	979	142	44	2494	3911	119	67	3176	4889
47	147	43	2528	3477	144	28	1616	2185	146	71	4144	5662
48	169	33	2237	3617	165	42	2768	4369	167	75	5005	7985
49	237	48	4553	10818	253	44	4446	10804	245	92	8998	21622
50	79	19	602	1079	99	36	1431	2343	92	55	2033	3422
51	83	25	830	659	104	36	1492	2158	95	61	2322	2818
52	105	24	1005	1036	128	28	1434	1747	117	52	2440	2783
53	92	26	954	879	103	36	1486	1541	98	62	2440	2420
54	168	27	1818	3467	164	36	2368	4536	166	63	4186	8003
55	52	28	584	550	59	37	875	1040	56	65	1459	1590
56	72	33	950	979	56	40	902	917	63	73	1852	1896
57	98	32	1249	977	121	31	1506	1687	109	63	2755	2664
58	93	18	666	736	81	27	876	953	86	45	1542	1690
59	76	40	1223	1101	92	36	1318	2340	84	76	2542	3440
60	79	24	759	848	96	39	1502	1904	90	63	2260	2753

Total Woody and Herbaceous Vegetation

Plot	Inner Ring				Outer Ring				Both Rings			
#	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
61	34	21	282	356	40	35	564	833	38	56	846	1189
62	30	27	328	505	51	44	889	1580	43	71	1217	2085
63	31	28	344	603	42	43	727	1356	38	71	1072	1958
64	49	28	545	589	59	36	848	1131	54	64	1393	1720
65	94	35	1323	920	90	42	1519	1056	92	77	2842	1976
66	69	32	882	805	82	41	1339	1096	76	73	2222	1900
67	73	38	1116	785	72	35	1003	703	73	73	2118	1487
68	123	24	1176	1532	100	34	1363	1759	109	58	2539	3291
69	47	28	526	488	69	31	858	798	59	59	1385	1286
70	75	18	542	368	78	43	1346	1064	77	61	1888	1433
71	28	40	452	676	46	50	930	1032	38	90	1382	1708
72	47	36	678	636	46	39	719	755	47	75	1397	1390
73	80	39	1255	1099	78	46	1439	1229	79	85	2694	2329
74	83	6	200	147	115	23	1060	1659	109	29	1260	1806
75	90	21	757	644	138	37	2050	2639	121	58	2807	3283
76	155	21	1302	1152	127	33	1678	1785	138	54	2980	2936
77	157	17	1069	1224	143	21	1199	1379	149	38	2268	2603
78	143	4	228	211	116	16	740	660	121	20	968	872
79	117	20	932	1434	129	18	928	2851	122	38	1860	4285
80	89	24	854	641	107	32	1364	1151	99	56	2218	1792
81	64	12	309	224	113	22	990	2294	96	34	1299	2519
82	122	30	1466	1947	82	38	1245	1205	100	68	2711	3151
83	92	35	1292	1294	105	39	1645	2594	99	74	2937	3888
84	101	15	603	398	90	30	1082	1231	94	45	1686	1629
85	65	11	286	165	86	11	376	244	75	22	663	409
86	50	23	462	403	63	35	888	1074	58	58	1350	1478
87	122	25	1224	649	119	38	1810	1258	120	63	3034	1907
88	86	28	968	626	93	46	1712	1587	91	74	2680	2213

	Total Woody and Herbaceous Vegetation											
	Inner Ring				Outer Ring				Both Rings			
Plot #	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
89	170	36	2455	4105	176	41	2884	5726	173	77	5339	9831
90	94	37	1386	898	104	30	1248	1062	98	67	2634	1960
91	93	32	1187	876	112	40	1795	1674	104	72	2982	2550
92	138	43	2366	2564	128	44	2254	2707	133	87	4620	5271
93	183	50	3652	5788	166	50	3321	4841	174	100	6973	10630
94	86	35	1210	1583	136	36	1958	4398	112	71	3168	5982
95	27	44	468	788	54	46	988	1719	40	90	1456	2507
96	59	40	937	876	65	51	1320	1178	62	91	2257	2054
97	61	46	1120	951	61	50	1212	1017	61	96	2332	1967
98	69	38	1047	770	74	49	1446	1138	72	87	2492	1909
99	82	34	1109	782	92	44	1628	1170	88	78	2737	1952
100	81	33	1065	944	96	37	1424	1176	89	70	2489	2120
101	118	41	1936	1161	136	42	2280	1946	127	83	4216	3106
102	104	34	1411	1192	84	24	808	618	96	58	2219	1809
103	223	51	4551	10027	201	33	2650	4763	214	84	7202	14790
104	136	17	924	1596	155	31	1917	3441	148	48	2841	5038
105	197	46	3620	6018	210	33	2778	5342	202	79	6398	11361
106	160	43	2750	3160	156	45	2817	3671	158	88	5567	6831
107	191	28	2140	4084	191	29	2210	3306	191	57	4350	7391
108	158	41	2599	4608	180	48	3450	6258	170	89	6049	10865
109	126	36	1810	1765	143	47	2688	3601	135	83	4498	5366
110	102	37	1508	1496	119	51	2431	2734	112	88	3939	4230
SP-1	105	16	669	687	82	23	758	565	91	39	1427	1252
SP-2	54	25	538	397	86	31	1064	703	72	56	1603	1100
SP-3	72	19	544	432	65	34	885	850	67	53	1429	1282
SP-4	137	22	1207	1881	135	41	2209	3280	136	63	3416	5161
SP-5	125	28	1396	2016	117	44	2067	2717	120	72	3463	4734
SP-6	94	20	755	953	82	21	689	847	88	41	1444	1800

Plot #	Total Woody and Herbaceous Vegetation											
	Inner Ring				Outer Ring				Both Rings			
	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)	Height (cm)	Cover (%)	Volume (dm^3)	Dry Wt (g)
SP-7	53	20	424	359	99	24	946	1953	78	44	1370	2313
SP-8	201	41	3304	7022	126	39	1965	3174	165	80	5269	10196
SP-9	96	35	1338	1034	104	49	2030	1483	100	84	3368	2517
SP-10	92	24	880	612	93	27	1008	1027	93	51	1888	1639
Total:	12259	3656	153578	193911	13236	4477	198135	263648	12819	8133	351712	457558
Count:	120	120	120	120	120	120	120	120	120	120	120	120
Average:	102	30.5	1280	1616	110	37.3	1651	2197	107	67.8	2931	3813
Std Dev:	41.1	9.70	807	1695	38.5	8.95	742	1569	38.5	17.0	1460	3088

APPENDIX B-3
GREEN ALDER PLOT DATA

Ring:	Inner						Outer						Both					
Species	Al cr		Hb		Wd		Al cr		Hb		Wd		Al cr		Hb		Wd	
	GC	Ht	GC	Ht	GC	Ht	GC	Ht	GC	Ht	GC	Ht	GC	Ht	GC	Ht	GC	Ht
Plot	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm
15	2	200	23	120	1	80	7	200	11	120	14	106	9	200	34	120	15	104
19	3	120	7	52	11	91	4	120	11	72	10	84	7	120	18	64	21	88
24	23	107	4	70	7	59	3	70	8	75	17	79	26	102	12	73	24	73
25			3	50	21	60	2	60	2	70	16	136	2	60	5	58	37	93
26	7	150	18	81	21	71	9	150	21	81	20	70	16	150	39	81	41	70
38	1	270	6	117	34	130	7	270	6	110	38	175	8	270	12	113	72	154
92			24	130	19	147	4	150	14	115	26	132	4	150	38	124	45	138
94	2	90	19	60	14	115	2	90	13	69	21	182	4	90	32	64	35	155
96	4	40	21	61	15	60			33	60	18	73	4	40	54	60	33	67
98			34	72	4	43	2	70	33	74	14	74	2	70	67	73	18	67
101	3	150	38	116			12	150	30	130			15	150	68	122		
104	10	190	6	63	1	30	24	183	4	80	3	27	34	185	10	70	4	28
105	3	110	1	90	42	198	1	180	1	130	31	214	4	128	2	110	73	205
106	4	175	8	121	31	168	17	164	3	153	25	152	21	166	11	130	56	161
108	22	128	4	100	13	255	26	143			22	223	48	136	4	100	35	235
109	3	130	19	88	14	176	9	130	25	100	13	235	12	130	44	95	27	204
110	12	95	22	106	3	77	17	96	17	109	17	152	29	96	39	107	20	141
sp4			7	84	15	162	4	100	12	74	25	169	4	100	19	78	40	167
sp6	4	28			16	111	3	23	4	60	14	100	7	26	4	60	30	106
sp9	1	80	31	100	3	53			44	108	5	66	1	80	75	105	8	61
Total:	104	2063	295	1681	285	2086	153	2349	292	1789	349	2450	257	2448	587	1807	634	2317
Count:	16	16	19	19	19	19	18	18	19	19	19	19	20	20	20	20	19	19
Average:	6.50	128.9	15.53	88.45	15.00	109.8	8.50	130.5	15.37	94.18	18.37	128.9	12.85	122.4	29.35	90.37	33.37	121.9
Std Dev:	6.95	60.99	11.38	25.40	11.36	60.95	7.72	59.17	12.42	27.30	8.48	60.03	12.72	57.74	23.26	24.76	18.83	57.21

Legend

Hb: Herbaceous Competition	Wd: Woody Competition	GC: Ground Cover	Ht: Mean Height

APPENDIX C
NON-CROP SPECIES DRY WEIGHTS

	Rubus idaeus			*Corylus cornuta*			*Epilobium angustifolium*			*Calamagrostis canadensis*			*Acer spicatum*	
Plot #	**Height (cm)**	**Dry Wt (g)**	**Plot #**	**Height (cm)**	**Dry Wt (g)**	**Plot #**	**Height (cm)**	**Dry Wt (g)**	**Plot #**	**Height (cm)**	**Dry Wt (g)**	**Plot #**	**Height (cm)**	**Dry Wt (g)**
2	40	25.20	1	140	246.33	2	100	51.46	21	50	42.11	15	140	415.76
6	70	44.53	3	180	178.33	4	100	81.65	26	80	36.56	16	120	170.24
11	50	57.72	8	160	236.50	5	100	56.22	28	110	115.53	17	180	464.80
14	80	56.12	9	140	200.67	11	110	69.42	30	100	78.14	31	160	264.09
18	70	37.88	10	80	129.98	13	110	86.94	39	130	63.18	38	180	220.97
21	30	43.13	18	190	151.69	22	90	58.23	40	100	50.35	40	160	350.79
26	70	47.81	36	150	236.59	23	100	60.82	64	70	54.76	45	120	183.32
27	70	48.61	40	80	156.66	27	110	62.23	71	90	66.27	48	180	373.26
28	70	73.88	41	140	240.77	34	100	82.96	73	100	81.71	49	210	402.07
29	70	47.90	42	200	451.75	35	100	58.69	79	130	110.31	83	125	143.41
32	70	55.27	43	130	247.73	51	125	56.56	92	130	112.77	95	140	193.49
33	70	78.38	45	190	169.64	54	130	63.91	96	70	109.38			
39	70	46.06	46	160	187.39	57	70	37.41	109	90	63.03			
41	40	34.81	47	140	127.61	58	65	25.31						
43	100	68.66	48	210	831.57	60	80	36.05						
47	110	68.64	52	140	220.40	65	80	60.06						
63	60	49.42	56	80	64.68	66	90	47.01						
66	60	71.07	57	80	68.27	67	85	52.49						
69	60	42.07	68	150	148.20	80	80	46.69						
72	60	58.27												
Total:	1320	1055.4		2740	4294.8		1825	1094.1		1250	984.1		1715	3182.2
Count:	20	20		19	19		19	19		13	13		11	11
Average	66.0	52.8		144.2	226.0		96.1	57.6		96.2	75.7		155.9	289.3
Std Dev:	18.47	13.98		41.00	168.79		17.13	15.84		25.01	28.11		29.57	114.68

Plot #	*Prunus pennsylvanica* Height (cm)	*Prunus pennsylvanica* Dry Wt (g)	Plot #	*Alnus rugosa* Height (cm)	*Alnus rugosa* Dry Wt (g)	Plot #	*Betula papyrifera* Height (cm)	*Betula papyrifera* Dry Wt (g)	Plot #	*Carex spp.* Height (cm)	*Carex spp.* Dry Wt (g)	Plot #	*Aster macrophyllus* Height (cm)	*Aster macrophyllus* Dry Wt (g)
7	160	75.00	15	200	347.28	74	230	377.81	1	100	57.15	62	15	25.02
31	250	497.31	19	120	117.74	76	130	129.08	5	100	34.18	63	15	23.39
32	150	386.09	24	100	186.44	77	240	649.45	20	30	112.45	72	15	21.68
34	140	132.47	26	140	243.67	91	150	105.88	70	110	98.01			
36	160	355.18	38	280	175.08	105	210	183.43	91	40	55.90			
37	180	370.15	104	150	266.35									
53	175	381.01	106	150	397.53									
59	220	658.49												
82	190	204.60												
89	200	235.52												
92	175	194.22												
Total:	2000	3490.0		1140	1734.1		960	1445.7		380	357.69		45	70.09
Count:	11	11		7	7		5	5		5	5		3	3
Average	181.8	317.3		162.9	247.7		192.0	289.1		76.0	71.5		15.0	23.4
Std Dev:	32.11	170.07		60.20	98.86		49.19	228.07		37.82	32.49		0.00	1.67

Plot #	*Sorbus americana* Height (cm)	*Sorbus americana* Dry Wt (g)	Plot #	*Diervilla lonicera* Height (cm)	*Diervilla lonicera* Dry Wt (g)	Plot #	*Clintonia borealis* Height (cm)	*Clintonia borealis* Dry Wt (g)	Plot #	*Cornus stolonifera* Height (cm)	*Cornus stolonifera* Dry Wt (g)
22	200	293.68	30	40	32.76	17	20	32.10	70	80	102.42
23	200	458.45	68	70	73.11						
25	180	220.25									
Total:	580	972.38		110	105.87						
Count:	3	3		2	2		1	1		1	1
Average	193.3	324.1		55.0	52.9						
Std Dev:	11.55	121.98		21.21	28.53						

Plot #	Herb spp. Height (cm)	Herb spp. Dry Wt (g)	Plot #	*Salix* spp Height (cm)	*Salix* spp Dry Wt (g)	Plot #	*Viburnum edule* Height (cm)	*Viburnum edule* Dry Wt (g)
71	10	38.32	29	170	293.46	16	40	50.86
Count	1	1		1	1		1	1

* Minor Herb species Includes		** Minor Woody species Includes	
Aster macrophyllus	Large-leaf aster	*Cornus stolonifera:*	Red osier dogwood
Clintonia borealis	Blue-bead lily	*Diervilla lonicera:*	Bush honeysuckle
Dryopteris austriaca	Spinulose woodfern	*Salix species*	Willows
Aster ciliolatus	Ciliolated aster	*Sorbus americana*	American mountain ash
Aralia nudicaulis	Sarsaparilla	*Viburnum edule:*	Wild cranberry
Convulvus spinulosum	Bindweed		
Solidago spp.	Goldenrod		
Osmunda claytonia	Osmunda fern		

APPENDIX D-1

CRITICAL CONFIDENCE LEVELS

Sample Size (n)	Confidence Level[1] ($r_{\alpha(1)}$)								
	0.2500	**0.1000**	**0.0500**	**0.0250**	**0.0100**	**0.0050**	**0.0025**	**0.0010**	**0.0005**
3	0.707	0.951	0.988	0.997	1.000	1.000	1.000	1.000	1.000
4	0.500	0.800	0.900	0.950	0.980	0.990	0.995	0.998	0.999
5	0.404	0.687	0.805	0.878	0.934	0.959	0.974	0.986	0.991
6	0.347	0.608	0.729	0.811	0.882	0.917	0.942	0.963	0.974
7	0.309	0.551	0.669	0.754	0.833	0.875	0.906	0.935	0.951
8	0.281	0.507	0.621	0.707	0.789	0.834	0.870	0.905	0.925
9	0.260	0.472	0.582	0.666	0.750	0.798	0.836	0.875	0.898
10	0.242	0.443	0.549	0.632	0.715	0.765	0.805	0.847	0.872
11	0.228	0.419	0.521	0.602	0.685	0.735	0.776	0.820	0.847
12	0.216	0.398	0.497	0.576	0.658	0.708	0.750	0.795	0.823
13	0.206	0.380	0.476	0.553	0.634	0.684	0.726	0.772	0.801
14	0.197	0.365	0.457	0.532	0.612	0.661	0.703	0.750	0.780
16	0.182	0.338	0.426	0.497	0.574	0.623	0.664	0.711	0.742
18	0.170	0.317	0.400	0.468	0.543	0.590	0.631	0.678	0.708
19	0.165	0.308	0.389	0.456	0.529	0.575	0.616	0.662	0.693
20	0.160	0.299	0.378	0.444	0.516	0.561	0.602	0.648	0.679
21	0.156	0.291	0.369	0.433	0.503	0.549	0.589	0.635	0.665
22	0.152	0.284	0.360	0.423	0.492	0.537	0.576	0.622	0.652
27	0.136	0.255	0.323	0.381	0.445	0.487	0.524	0.568	0.597
28	0.133	0.250	0.317	0.374	0.437	0.479	0.515	0.559	0.588
29	0.131	0.245	0.311	0.367	0.430	0.471	0.507	0.550	0.579
30	0.128	0.241	0.306	0.361	0.423	0.463	0.499	0.541	0.570
31	0.126	0.237	0.301	0.355	0.416	0.456	0.491	0.533	0.562
32	0.124	0.233	0.296	0.349	0.409	0.449	0.484	0.526	0.554
33	0.122	0.229	0.291	0.344	0.403	0.442	0.477	0.518	0.546
34	0.120	0.225	0.287	0.339	0.397	0.436	0.470	0.511	0.539
37	0.115	0.216	0.275	0.325	0.381	0.418	0.452	0.492	0.519
40	0.110	0.207	0.264	0.312	0.367	0.403	0.435	0.474	0.501
41	0.108	0.204	0.261	0.308	0.362	0.398	0.430	0.469	0.495
42	0.107	0.202	0.257	0.304	0.358	0.393	0.425	0.463	0.490

[1] Derived from Zar, J.H. 1974. **Biostatistical Analysis.** Prentice-Hall Inc., Englewood Cliffs, N.J. xiv + 620 pp.(Table D.21)

Sample Size (n)	Confidence Level[1] ($r_{\alpha(1)}$)								
	0.2500	0.1000	0.0500	0.0250	0.0100	0.0050	0.0025	0.0010	0.0005
44	0.104	0.197	0.251	0.297	0.350	0.384	0.416	0.453	0.479
46	0.102	0.192	0.246	0.291	0.342	0.376	0.407	0.444	0.469
47	0.101	0.190	0.243	0.288	0.338	0.372	0.403	0.439	0.465
50	0.098	0.184	0.235	0.279	0.328	0.361	0.391	0.427	0.451
52	0.096	0.181	0.231	0.273	0.322	0.354	0.384	0.419	0.443
57	0.091	0.172	0.220	0.261	0.308	0.339	0.367	0.401	0.425
60	0.089	0.168	0.214	0.254	0.300	0.330	0.358	0.391	0.414
62	0.087	0.165	0.211	0.250	0.295	0.325	0.352	0.385	0.408
64	0.086	0.162	0.207	0.246	0.290	0.320	0.347	0.379	0.402
65	0.085	0.161	0.206	0.244	0.288	0.318	0.345	0.377	0.399
67	0.084	0.159	0.203	0.241	0.284	0.313	0.340	0.371	0.393
70	0.082	0.155	0.198	0.235	0.278	0.306	0.332	0.363	0.385
72	0.081	0.153	0.195	0.232	0.274	0.302	0.327	0.358	0.380
77	0.079	0.148	0.189	0.225	0.265	0.292	0.317	0.347	0.368
82	0.076	0.143	0.183	0.217	0.257	0.283	0.307	0.336	0.357
83	0.076	0.142	0.182	0.216	0.255	0.282	0.306	0.335	0.355
84	0.075	0.141	0.181	0.215	0.253	0.280	0.304	0.333	0.353
86	0.074	0.140	0.179	0.212	0.251	0.276	0.300	0.329	0.349
87	0.074	0.139	0.178	0.211	0.250	0.275	0.299	0.327	0.347
92	0.071	0.135	0.173	0.205	0.242	0.267	0.290	0.318	0.338
93	0.071	0.134	0.172	0.204	0.241	0.266	0.289	0.317	0.336
95	0.070	0.133	0.170	0.202	0.239	0.263	0.286	0.314	0.333
100	0.068	0.129	0.165	0.197	0.232	0.256	0.279	0.305	0.324
102	0.068	0.128	0.164	0.196	0.230	0.254	0.276	0.303	0.321
106	0.066	0.126	0.161	0.191	0.226	0.249	0.271	0.297	0.315
112	0.064	0.122	0.156	0.186	0.220	0.242	0.264	0.289	0.307
114	0.064	0.121	0.155	0.184	0.218	0.240	0.262	0.287	0.304
117	0.063	0.119	0.153	0.182	0.215	0.237	0.258	0.283	0.300
118	0.063	0.119	0.152	0.181	0.214	0.236	0.257	0.282	0.299
120	0.062	0.118	0.151	0.180	0.212	0.234	0.255	0.279	0.296

[1] Derived from Zar, J.H. 1974. **Biostatistical Analysis.** Prentice-Hall Inc., Englewood Cliffs, N.J. xiv + 620 pp. (Table D.21)

APPENDIX D-2

RANKED CORRELATIONS BY SPECIES / GROUPS

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	Ep an - C - O	102	13.466 + 0.131 61x	0.239	99%	0.203
St. Diam.	Ep an - W - O	102	13.644 + 0.004 959 9x	0.237	99%	0.201
St. Vol.	Ep an - W - O	102	152.69 + 0.149 31x	0.235	99%	0.200
Ht. Incr.	Ep an - V - O	102	44.877 + 0.007 206x	0.230	99%	0.196
Ht. Incr.	Ep an - V - B	106	44.592 + 0.003 911 5x	0.228	99%	0.201
Ht.	Ep an - C - O	102	119.43 + 0.83841x	0.228	97.5%	0.194
Ht.	Ep an - V - O	102	120.22 + 0.019 296 x	0.228	97.5%	0.194
St. Vol.	Ep an - V - O	102	152.59 + 0.087 029x	0.226	97.5%	0.192
Ht. Incr.	Ep an - C - B	106	44.288 + 0.171 19x	0.221	97.5%	0.195
St. Diam.	Ep an - V - O	102	13.667 + 0.002 819x	0.221	97.5%	0.188
St. Vol.	Ep an - C - O	102	149.84 + 3.691 7x	0.219	97.5%	0.186
Ht. Incr.	Ep an - C - O	102	44.796 + 0.290 06x	0.212	97.5%	0.180
Ht.	Ep an - W - O	102	121.05 + 0.029 304x	0.210	97.5%	0.179
St. Vol.	Ep an - W - B	106	157.14 + 0.073 927x	0.205	97.5%	0.181
St. Vol.	Ep an - C - B	106	152.99 + 1.927 4x	0.202	97.5%	0.178
Ht. Incr.	Ep an - W - O	102	45.294 + 0.010 43x	0.202	97.5%	0.172
Ht. Incr.	Ep an - W - B	106	44.915 + 0.005 884 7x	0.200	97.5%	0.177
St. Vol.	Ep an - V - B	106	157.89 + 0.041 797x	0.197	97.5%	0.174
Cr. Area	Ep an - W - O	102	0.38903 + 0.000 274 88x	0.197	97.5%	0.167
St. Diam.	Ep an - C - B	106	13.761 + 0.060 612x	0.192	97.5%	0.170
Cr. Area	Ep an - C - O	102	0.38212 + 0.006 975 2x	0.190	95%	0.162
St. Diam.	Ep an - W - B	106	13.939 + 0.002 199 7x	0.184	95%	0.163
Cr. Vol.	Ep an - W - O	102	184.74 + 0.145 19x	0.176	95%	0.150
Ht. Incr.	Ep an - V - I	95	45.440 + 0.005 935 5x	0.176	95%	0.139
Ht. Incr.	Ep an - C - I	95	45.137 + 0.267 63x	0.173	95%	0.137
St. Vol.	Ep an - C - I	95	158.18 + 3.441 3x	0.173	95%	0.137
Ht.	Ep an - C - B	106	121.85 + 0.35403x	0.170	95%	0.150
St. Diam.	Ep an - V - B	106	13.985 + 0.001 207 5x	0.170	95%	0.150
Cr. Vol.	Ep an - C - O	102	180.91 + 3.703x	0.170	95%	0.145
Cr. Area	Ep an - V - O	102	0.39633 + 0.000 139 67x	0.167	75%	0.142
Ht.	Ep an - V - B	106	122.72 + 0.007 718 6x	0.164	95%	0.145
Ht.	Ep an - H - I	95	106.38 + 0.24987x	0.164	90%	0.130

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Ep an - H - I	95	37.748 + 0.108 34x	0.164	90%	0.130
St. Vol.	Ep an - W - I	95	163.70 + 0.123 2x	0.164	90%	0.130
Cr. Area	Ep an - W - B	106	0.40052 + 0.000 125 76x	0.158	90%	0.140
St. Vol.	Ep an - V - I	95	164.78 + 0.068 354x	0.158	90%	0.134
Cr. Area	Ep an - C - B	106	0.39336 + 0.003 284 7x	0.155	90%	0.137
Ht.	Ep an - W - B	106	123.19 + 0.012 061x	0.152	90%	0.134
Cr. Vol.	Ep an - V - O	102	188.00 + 0.075 39x	0.152	90%	0.129
St. Diam.	Ep an - C - I	95	13.993 + 0.098 133x	0.152	90%	0.120
Ht. Incr.	Ep an - W - I	95	45.720 + 0.008 801 7x	0.148	90%	0.117
St. Vol.	Ep an - H - I	95	92.686 + 1.063 5x	0.148	90%	0.117
Cr. Area	Ep an - C - I	95	0.38991 + 0.006 251 5x	0.148	90%	0.117
Dry Wt.	Ep an - W - O	102	377.75 + 0.112 25x	0.145	90%	0.123
Dry Wt.	Ep an - C - I	95	367.93 + 3.232 2x	0.141	90%	0.112
Cr. Area	Ep an - W - I	95	0.39978 + 0.000 224 6x	0.138	90%	0.109
Dry Wt.	Ep an - W - I	95	372.74 + 0.117 59x	0.134	90%	0.106
Cr. Vol.	Ep an - C - B	106	190.12 + 1.605 1x	0.130	90%	0.115
Cr. Vol.	Ep an - W - B	106	193.89 + 0.060 722x	0.130	90%	0.115
St. Diam.	Ep an - W - I	95	14.193 + 0.003 294 8x	0.130	75%	0.103
Ht. Incr.	Ep an - H - B	106	40.028 + 0.078 621x	0.126	90%	0.111
Cr. Area	Ep an - V - B	106	0.40894 + 0.000 060 177x	0.126	90%	0.111
Dry Wt.	Ep an - C - O	102	377.03 + 2.623 4x	0.126	75%	0.107
St. Diam.	Ep an - V - I	95	14.234 + 0.001 792 9x	0.126	75%	0.100
Dry Wt.	Ep an - W - B	106	380.72 + 0.053 748x	0.122	75%	0.108
Dry Wt.	Ep an - C - B	106	378.99 + 1.324 4x	0.114	75%	0.101
Cr. Area	Ep an - V - I	95	0.40877 + 0.000 103 89x	0.114	75%	0.090
Dry Wt.	Ep an - V - O	102	382.71 + 0.051 614x	0.110	75%	0.094
Cr. Vol.	Ep an - C - I	95	191.09 + 2.770 6x	0.110	75%	0.087
Cr. Vol.	Ep an - V - B	106	197.82 + 0.029 273x	0.105	75%	0.093
Dry Wt.	Ep an - V - I	95	378.08 + 0.052 54x	0.105	75%	0.083
St. Vol.	Ep an - H - B	106	114.31 + 0.782 74x	0.100	75%	0.088
Cr. Vol.	Ep an - W - I	95	196.41 + 0.094 754x	0.100	75%	0.079
Dry Wt.	Ep an - V - B	106	385.80 + 0.023 453x	0.089	75%	0.079

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Ep an - H - O	102	42.699 + 0.051 807x	0.089	75%	0.076
Ht.	Ep an - C - I	95	125.46 + 0.38130x	0.089	75%	0.070
Ht.	Ep an - V - I	95	126.03 + 0.008 055 8x	0.089	75%	0.070
Ht.	Ep an - H - B	106	115.64 + 0.13391x	0.077	75%	0.068
Ht.	Ep an - H - O	102	116.19 + 0.11931x	0.077	75%	0.065
Ht.	Ep an - W - I	95	126.40 + 0.011 957x	0.077	75%	0.061
Cr. Vol.	Ep an - V - I	95	200.35 + 0.043 4x	0.077	75%	0.061
St. Vol.	Ep an - H - O	102	137.66 + 0.502 86x	0.071	75%	0.060
St. Diam.	Ep an - H - I	95	13.707 + 0.012 673x	0.055	<75%	0.044
Dry Wt.	Ep an - H - O	102	485.87 - 0.910 46x	-0.105	75%	0.089
Dry Wt.	Ep an - H - B	106	482.51 - 0.898 09x	-0.095	75%	0.084
Cr. Area	Ep an - H - O	102	0.57176 - 0.001 344 5x	-0.089	75%	0.076
Cr. Area	Ep an - H - B	106	0.56870 - 0.001 328 9x	-0.077	75%	0.068
Cr. Vol.	Ep an - H - B	106	275.16 - 0.642 38x	-0.063	<75%	0.056
Cr. Vol.	Ep an - H - O	102	267.73 - 0.564 17x	-0.063	<75%	0.054
St. Diam.	Ep an - H - O	102	15.729 - 0.011 176x	-0.045	<75%	0.038
St. Diam.	Ep an - H - B	106	15.471 - 0.007 691 6x	-0.032	<75%	0.028
Cr. Area	Ep an - H - I	95	0.42353 + 0.000 228 46x	0.000	<<75%	0.000
Cr. Vol.	Ep an - H - I	95	201.62 + 0.150 04x	0.000	<<75%	0.000
Dry Wt.	Ep an - H - I	95	402.98 - 0.079 123x	-0.000	<<75%	0.000
Ht. Incr.	Ca ca - C - I	40	47.208 - 0.470 8x	-0.457	99.75%	0.152
Ht. Incr.	Ca ca - C - B	44	46.250 - 0.203 93x	-0.412	99.5%	0.151
Ht. Incr.	Ca ca - W - I	40	45.848 - 0.012 108x	-0.366	97.5%	0.122
Ht. Incr.	Ca ca - C - O	41	45.230 - 0.313 47x	-0.344	97.5%	0.117
Ht. Incr.	Ca ca - V - I	40	45.402 - 0.008 202x	-0.335	97.5%	0.112
Ht. Incr.	Ca ca - W - B	44	45.248 - 0.005 446 7x	-0.333	97.5%	0.122
Ht. Incr.	Ca ca - V - B	44	44.898 - 0.003 720 5x	-0.305	97.5%	0.112
Ht. Incr.	Ca ca - W - O	41	44.191 - 0.007 832x	-0.261	95%	0.089
St. Vol.	Ca ca - C - I	40	145.94 - 2.231 4x	-0.243	90%	0.081
Ht. Incr.	Ca ca - V - O	41	43.888 - 0.005 282 5x	-0.237	90%	0.081
St. Diam.	Ca ca - C - I	40	13.864 - 0.092 453x	-0.235	90%	0.078
Ht.	Ca ca - C - I	40	116.76 - 0.535 01x	-0.205	90%	0.068

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Vol.	Ca ca - W - I	40	140.66 - 0.060 796x	-0.205	75%	0.068
St. Vol.	Ca ca - C - O	41	139.34 - 1.562 2x	-0.190	75%	0.065
St. Vol.	Ca ca - C - B	44	135.96 - 0.821x	-0.184	75%	0.068
St. Diam.	Ca ca - W - I	40	13.586 - 0.002 346 8x	-0.184	75%	0.061
St. Vol.	Ca ca - V - I	40	138.03 - 0.040 311x	-0.184	75%	0.061
Cr. Area	Ca ca - C - I	40	0.33783 - 0.003 746 5x	-0.167	75%	0.056
St. Diam.	Ca ca - V - I	40	13.458 - 0.001 496 3x	-0.161	75%	0.054
Dry Wt.	Ca ca - C - I	40	341.94 - 1.674 6x	-0.161	75%	0.054
St. Diam.	Ca ca - C - B	44	13.360 - 0.029 279x	-0.155	75%	0.057
St. Vol.	Ca ca - W - B	44	131.68 - 0.021 541x	-0.148	75%	0.054
St. Diam.	Ca ca - C - O	41	13.446 - 0.049 336x	-0.141	75%	0.048
St. Vol.	Ca ca - W - O	41	133.79 - 0.037 993x	-0.141	75%	0.048
Ht.	Ca ca - C - B	44	113.92 - 0.164 2x	-0.130	75%	0.048
St. Vol.	Ca ca - V - B	44	129.58 - 0.013 874x	-0.126	75%	0.046
St. Vol.	Ca ca - V - O	41	131.71 - 0.024 29x	-0.122	75%	0.042
Ht.	Ca ca - W - I	40	113.88 - 0.009 864 1x	-0.118	75%	0.039
Cr. Area	Ca ca - W - I	40	0.32278 - 0.000 084 008x	-0.118	75%	0.039
St. Diam.	Ca ca - W - B	44	13.129 - 0.000 646 74x	-0.105	75%	0.038
Dry Wt.	Ca ca - W - I	40	334.58 - 0.035 715x	-0.105	<75%	0.035
Ht.	Ca ca - C - O	41	113.10 - 0.205 19x	-0.089	<75%	0.031
Cr. Area	Ca ca - V - I	40	0.31573 - 0.000 048 151x	-0.089	<75%	0.030
Cr. Vol.	Ca ca - C - I	40	138.88 - 1.139 4x	-0.089	<75%	0.030
Ht.	Ca ca - V - I	40	112.79 - 0.005 075 3x	-0.084	<75%	0.028
Dry Wt.	Ca ca - V - I	40	331.43 - 0.020 125x	-0.084	<75%	0.028
St. Diam.	Ca ca - V - B	44	13.026 - 0.000 368 82x	-0.077	<75%	0.028
St. Diam.	Ca ca - W - O	41	13.170 - 0.000 909 82x	-0.077	<75%	0.026
St. Diam.	Ca ca - V - O	41	13.071 - 0.000 472 7x	-0.055	<75%	0.019
Dry Wt.	Ca ca - C - B	44	321.90 - 0.237 51x	-0.045	<<75%	0.016
Cr. Vol.	Ca ca - W - I	40	131.09 - 0.016 178x	-0.045	<<75%	0.015
Ht.	Ca ca - W - B	44	111.30 - 0.001 562 8x	-0.032	<<75%	0.012
Cr. Area	Ca ca - C - B	44	0.28961 - 0.000 353 02x	-0.032	<<75%	0.012
Dry Wt.	Ca ca - C - O	41	323.14 - 0.296 38x	-0.032	<<75%	0.011

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Dry Wt.	Ca ca - H - I	40	232.01 + 0.942 8x	0.247	90%	0.082
Ht. Incr.	Ca ca - H - I	40	33.274 + 0.087 936x	0.232	90%	0.077
Ht.	Ca ca - H - I	40	90.775 + 0.205 84x	0.217	90%	0.072
Dry Wt.	Ca ca - H - B	44	243.14 + 0.779 08x	0.202	90%	0.074
Cr. Vol.	Ca ca - H - I	40	36.684 + 0.927 36x	0.202	75%	0.067
Cr. Area	Ca ca - H - I	40	0.13765 + 0.001 631 7x	0.200	75%	0.067
Cr. Vol.	Ca ca - H - B	44	46.394 + 0.775 43x	0.170	75%	0.062
Cr. Vol.	Ca ca - V - O	41	101.75 + 0.046 285x	0.170	75%	0.058
Ht. Incr.	Ca ca - H - B	44	35.941 + 0.061 563x	0.161	75%	0.059
Cr. Area	Ca ca - H - B	44	0.15526 + 0.001 341 2x	0.161	75%	0.059
Ht.	Ca ca - H - B	44	96.716 + 0.143 91x	0.148	75%	0.054
Ht.	Ca ca - H - O	41	96.649 + 0.150 16x	0.145	75%	0.050
Cr. Vol.	Ca ca - W - O	41	104.81 + 0.052 121x	0.141	75%	0.048
Dry Wt.	Ca ca - H - O	41	265.95 + 0.575 65x	0.141	75%	0.048
Cr. Vol.	Ca ca - H - O	41	60.390 + 0.670 55x	0.138	75%	0.047
Cr. Area	Ca ca - H - O	41	0.18638 + 0.001 096 6x	0.126	75%	0.043
Cr. Vol.	Ca ca - V - B	44	104.23 + 0.018 132x	0.122	75%	0.045
St. Diam.	Ca ca - H - I	40	11.317 + 0.015 294x	0.105	<75%	0.035
Cr. Area	Ca ca - V - O	41	0.26687 + 0.000 047 543x	0.100	<75%	0.034
Cr. Vol.	Ca ca - W - B	44	107.34 + 0.019 029x	0.095	<75%	0.035
St. Vol.	Ca ca - H - I	40	90.970 + 0.301 23x	0.089	<75%	0.030
Cr. Area	Ca ca - W - O	41	0.27275 + 0.000 045 65x	0.071	<75%	0.024
Cr. Vol.	Ca ca - C - O	41	113.13 + 0.814 41x	0.071	<75%	0.024
Ht. Incr.	Ca ca - H - O	41	39.251 + 0.023 878x	0.063	<75%	0.022
St. Diam.	Ca ca - H - B	44	11.957 + 0.008 023 5x	0.055	<75%	0.020
Cr. Area	Ca ca - V - B	44	0.27017 + 0.000 013 765x	0.055	<75%	0.020
St. Diam.	Ca ca - H - O	41	12.143 + 0.007 639 6x	0.055	<75%	0.019
Dry Wt.	Ca ca - V - O	41	313.67 + 0.012 987x	0.055	<75%	0.019
St. Vol.	Ca ca - H - B	44	103.75 + 0.149 33x	0.045	<<75%	0.016
Ht.	Ca ca - V - O	41	109.36 + 0.002 808 1x	0.045	<<75%	0.015
St. Vol.	Ca ca - H - O	41	107.53 + 0.140 57x	0.045	<<75%	0.015
Cr. Area	Ca ca - W - B	44	0.27606 + 0.000 008 964x	0.032	<<75%	0.012

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Cr. Vol.	Ca ca - C - B	44	114.78 + 0.216 97x	0.032	<<75%	0.012
Dry Wt.	Ca ca - V - B	44	313.13 + 0.004 169 8x	0.032	<<75%	0.012
Dry Wt.	Ca ca - W - O	41	316.29 + 0.009 536 8x	0.032	<<75%	0.011
Ht.	Ca ca - V - B	44	110.35 - 0.000 060 764x	-0.000	<<75%	0.000
Dry Wt.	Ca ca - W - B	44	315.75 + 0.001 410 2x	0.000	<<75%	0.000
Ht.	Ca ca - W - O	41	110.26 + 0.001 116 8x	0.000	<<75%	0.000
Cr. Area	Ca ca - C - O	41	0.28864 - 0.000 005 958x	-0.000	<<75%	0.000
Cr. Vol.	Ca ca - V - I	40	127.47 - 0.004 248 3x	-0.000	<<75%	0.000
Ht. Incr.	Carex - V - I	22	35.604 + 0.076 337x	0.445	97.5%	0.082
Cr. Area	Carex - V - I	22	0.20544 + 0.001 812 8x	0.352	90%	0.065
Ht. Incr.	Carex - H - B	29	36.608 + 0.112 35x	0.351	95%	0.085
Ht. Incr.	Carex - H - I	22	34.375 + 0.125 47x	0.351	90%	0.064
St. Vol.	Carex - C - I	22	68.231 + 22.551x	0.348	90%	0.064
Cr. Vol.	Carex - H - I	22	24.088 + 2.17x	0.344	90%	0.063
Ht.	Carex - H - I	22	90.485 + 0.372 76x	0.342	90%	0.063
Cr. Area	Carex - H - I	22	0.13760 + 0.003 500 5x	0.327	90%	0.060
St. Vol.	Carex - W - I	22	83.614 + 0.683 27x	0.321	90%	0.059
Ht.	Carex - V - I	22	100.66 + 0.165 18x	0.315	90%	0.058
St. Diam.	Carex - H - I	22	10.200 + 0.049 639x	0.315	90%	0.058
Cr. Vol.	Carex - V - I	22	84.333 + 0.951 9x	0.313	90%	0.057
Ht. Incr.	Carex - H - O	21	38.222 + 0.086 5x	0.305	90%	0.053
Dry Wt.	Carex - H - I	22	243.69 + 1.762 7x	0.300	90%	0.055
St. Diam.	Carex - V - I	22	11.506 + 0.022 448x	0.295	90%	0.054
St. Vol.	Carex - V - I	22	87.708 + 0.610 28x	0.283	75%	0.052
St. Diam.	Carex - C - I	22	11.626 + 0.605 35x	0.265	75%	0.049
Dry Wt.	Carex - V - I	22	296.38 + 0.737 81x	0.261	75%	0.048
Ht. Incr.	Carex - C - I	22	38.912 + 1.279 8x	0.247	75%	0.045
St. Diam.	Carex - H - B	29	11.677 + 0.031 783x	0.245	90%	0.059
Cr. Vol.	Carex - H - B	29	103.76 + 1.236 9x	0.239	75%	0.058
Cr. Area	Carex - H - B	29	0.27034 + 0.002 044x	0.230	75%	0.056
Ht.	Carex - C - I	22	104.60 + 3.630 7x	0.230	75%	0.042
Dry Wt.	Carex - H - B	29	301.65 + 1.107 7x	0.228	75%	0.055

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Cr. Area	Carex - C - I	22	0.26678 + 0.035 01x	0.226	75%	0.041
St. Diam.	Carex - W - I	22	12.204 + 0.016 693x	0.221	75%	0.041
Dry Wt.	Carex - H - O	21	307.94 + 0.792 66x	0.217	75%	0.038
Ht.	Carex - H - B	29	108.07 + 0.177 89x	0.202	75%	0.049
St. Diam.	Carex - H - O	21	12.052 + 0.020 546x	0.192	75%	0.034
Cr. Area	Carex - H - O	21	0.28858 + 0.001 315 6x	0.187	75%	0.033
Cr. Vol.	Carex - C - I	22	122.03 + 16.911x	0.184	75%	0.034
Cr. Vol.	Carex - H - O	21	120.16 + 0.713 94x	0.184	75%	0.032
Ht.	Carex - W - I	22	108.92 + 0.091 679x	0.176	75%	0.032
St. Vol.	Carex - H - I	22	98.167 + 0.729 56x	0.164	75%	0.030
Ht. Incr.	Carex - W - I	22	40.948 + 0.027 202x	0.161	75%	0.030
Cr. Area	Carex - W - I	22	0.31613 + 0.000 807 32x	0.158	75%	0.029
Ht.	Carex - H - O	21	112.63 + 0.105 04x	0.155	<75%	0.027
Dry Wt.	Carex - C - I	22	328.40 + 12.355 x	0.145	<75%	0.027
St. Diam.	Carex - V - O	21	12.861 + 0.004 747x	0.138	<75%	0.024
Cr. Vol.	Carex - V - O	21	148.67 + 0.161 37x	0.126	<75%	0.022
Cr. Vol.	Carex - W - I	22	148.00 + 0.368 71x	0.122	<75%	0.022
St. Diam.	Carex - V - B	29	13.253 + 0.003 866 3x	0.118	<75%	0.029
Ht.	Carex - V - B	29	116.37 + 0.024 871x	0.114	<75%	0.028
Ht.	Carex - V - O	21	116.72 + 0.024 718x	0.110	<75%	0.019
Dry Wt.	Carex - V - O	21	345.63 + 0.124 97x	0.105	<75%	0.018
Dry Wt.	Carex - W - I	22	348.88 + 0.254 44x	0.089	<75%	0.016
St. Vol.	Carex - H - B	29	132.50 + 0.306 78x	0.084	<75%	0.020
Cr. Vol.	Carex - V - B	29	171.27 + 0.112 06x	0.084	<75%	0.020
Ht. Incr.	Carex - V - B	29	43.500 + 0.005 457 7x	0.071	<75%	0.017
Dry Wt.	Carex - V - B	29	365.55 + 0.079 019x	0.063	<<75%	0.015
Cr. Area	Carex - V - O	21	0.35832 + 0.000 143 07x	0.063	<<75%	0.011
St. Diam.	Carex - C - B	29	13.511 + 0.066 103x	0.055	<<75%	0.013
Cr. Area	Carex - V - B	29	0.39186 + 0.000 123 29x	0.055	<<75%	0.013
St. Diam.	Carex - C - O	21	13.165 + 0.060 784x	0.045	<<75%	0.008
St. Diam.	Carex - W - B	29	13.686 + 0.001 284 1x	0.032	<<75%	0.008
Ht. Incr.	Carex - W - O	21	49.618 - 0.058 379x	-0.395	95%	0.069

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Carex - C - O	21	48.002 - 1.115 9x	-0.295	90%	0.052
Ht. Incr.	Carex - W - B	29	47.555 - 0.021 498x	-0.210	75%	0.051
Ht.	Carex - W - O	21	124.74 - 0.053 294x	-0.152	<75%	0.027
Ht. Incr.	Carex - C - B	29	46.688 - 0.418 39x	0.145	75%	0.035
St. Vol.	Carex - C - O	21	156.15 - 4.734 7x	-0.138	<75%	0.024
St. Vol.	Carex - W - O	21	157.02 - 0.187x	-0.138	<75%	0.024
Cr. Area	Carex - W - O	21	0.42296 - 0.000 493 22x	-0.134	<75%	0.023
Dry Wt.	Carex - W - O	21	382.34 - 0.230 76x	-0.122	<75%	0.021
Cr. Area	Carex - W - B	29	0.45807 - 0.000 313 78x	-0.110	<75%	0.027
Cr. Vol.	Carex - W - O	21	188.65 - 0.222 75x	-0.110	<75%	0.019
Dry Wt.	Carex - W - B	29	402.89 - 0.166 65x	-0.105	<75%	0.025
Cr. Vol.	Carex - W - B	29	213.44 - 0.163 27x	-0.100	<75%	0.024
St. Vol.	Carex - V - O	21	148.04 - 0.084 938x	-0.100	<75%	0.018
Cr. Area	Carex - C - O	21	0.40242 - 0.007 575 8x	-0.084	<75%	0.015
Ht.	Carex - C - O	21	122.07 - 0.699 64x	-0.077	<<75%	0.013
Cr. Area	Carex - C - B	29	0.44311 - 0.005 689 2x	-0.071	<75%	0.017
Dry Wt.	Carex - C - B	29	394.16 - 2.878 4x	-0.063	<<75%	0.015
Ht.	Carex - W - B	29	122.78 - 0.016 25x	-0.055	<<75%	0.013
Cr. Vol.	Carex - C - B	29	203.02 - 2.482 6x	-0.055	<<75%	0.013
Dry Wt.	Carex - C - O	21	369.90 - 2.779 9x	-0.055	<<75%	0.010
Cr. Vol.	Carex - C - O	21	174.77 - 2.18x	-0.045	<<75%	0.008
St. Vol.	Carex - V - B	29	157.79 - 0.025 296x	-0.032	<<75%	0.008
St. Vol.	Carex - H - O	21	143.93 - 0.082 342x	-0.032	<<75%	0.006
St. Vol.	Carex - W - B	29	152.93 + 0.005 306 7x	0.000	<<75%	0.000
Ht.	Carex - C - B	29	121.02 - 0.116 78x	-0.000	<<75%	0.000
St. Vol.	Carex - C - B	29	154.64 - 0.166 8x	-0.000	<<75%	0.000
St. Diam.	Carex - W - O	21	13.372 + 0.000 184 89x	0.000	<<75%	0.000
Ht. Incr.	Carex - V - O	21	44.077 - 0.001 970 5x	-0.000	<<75%	0.000
Ht.	Min Hrb - C - I	41	136.50 - 1.789 9x	-0.437	99.75%	0.149
Ht.	Min Hrb - C - B	46	136.06 - 0.888 49x	-0.407	99.75%	0.156
Ht. Incr.	Min Hrb - C - B	46	50.033 - 0.309 04x	-0.373	99%	0.143
Ht.	Min Hrb - W - B	46	135.69 - 0.062 366x	-0.365	99%	0.140

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Min Hrb - C - I	41	50.171 - 0.636 35x	-0.407	99.5%	0.139
Ht.	Min Hrb - W - I	41	136.02 - 0.126 82x	-0.390	99%	0.133
Ht. Incr.	Min Hrb - W - I	41	50.238 - 0.047 52x	-0.383	99%	0.131
Ht. Incr.	Min Hrb - W - B	46	50.061 - 0.022 549x	-0.346	99%	0.133
Ht.	Min Hrb - C - O	42	133.38 - 1.334 9x	-0.324	97.5%	0.113
Cr. Vol.	Min Hrb - C - I	41	238.78 - 6.963 6x	-0.313	97.5%	0.107
Cr. Area	Min Hrb - C - I	41	0.49688 - 0.011 32x	-0.298	95%	0.102
Ht. Incr.	Min Hrb - C - O	42	49.368 - 0.471 07x	-0.297	95%	0.104
St. Diam.	Min Hrb - C - I	41	16.235 - 0.177 89x	-0.295	95%	0.101
Ht.	Min Hrb - W - O	42	132.48 - 0.086 72x	-0.274	95%	0.096
Ht. Incr.	Min Hrb - W - O	42	49.178 - 0.031 834x	-0.263	95%	0.092
Cr. Vol.	Min Hrb - W - I	41	233.39 - 0.457 73x	-0.259	90%	0.088
St. Vol.	Min Hrb - C - I	41	193.48 - 4.395 1x	-0.247	90%	0.084
St. Vol.	Min Hrb - W - I	41	194.91 - 0.338x	-0.241	90%	0.082
Cr. Vol.	Min Hrb - C - B	46	227.24 - 2.832 1x	-0.239	90%	0.092
Cr. Area	Min Hrb - W - I	41	0.48584 - 0.000 721x	-0.239	90%	0.082
Dry Wt.	Min Hrb - C - I	41	413.17 - 5.016 1x	-0.239	90%	0.082
St. Diam.	Min Hrb - W - I	41	16.037 - 0.011 079x	-0.230	90%	0.079
St. Vol.	Min Hrb - W - B	46	202.34 - 0.180 99x	-0.221	90%	0.085
St. Diam.	Min Hrb - C - B	46	16.129 - 0.075 663x	-0.217	90%	0.083
St. Vol.	Min Hrb - C - B	46	198.67 - 2.220 1x	-0.212	90%	0.081
Cr. Area	Min Hrb - C - B	46	0.46887 - 0.003 931 4x	-0.190	75%	0.073
St. Vol.	Min Hrb - H - O	42	186.32 - 0.904 12x	-0.190	75%	0.066
Cr. Vol.	Min Hrb - W - B	46	221.72 - 0.175 12x	-0.187	75%	0.072
St. Diam.	Min Hrb - W - B	46	15.995 - 0.004 749 1x	-0.173	75%	0.066
Dry Wt.	Min Hrb - W - I	41	405.46 - 0.290 89x	-0.173	75%	0.059
Ht. Incr.	Min Hrb - V - I	41	47.120 - 0.025 423x	-0.152	75%	0.052
St. Vol.	Min Hrb - V - B	46	189.04 - 0.162 32x	-0.148	75%	0.057
Cr. Vol.	Min Hrb - C - O	42	212.45 - 3.305 8x	-0.145	75%	0.051
Ht. Incr.	Min Hrb - V - B	46	47.346 - 0.011 561x	-0.134	75%	0.051
St. Vol.	Min Hrb - H - B	46	189.20 - 0.678 08x	-0.134	75%	0.051
Cr. Area	Min Hrb - W - B	46	0.45636 - 0.000 216 53x	-0.134	75%	0.051

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Dry Wt.	Min Hrb - C - B	46	393.57 - 1.467 9x	-0.130	75%	0.050
St. Vol.	Min Hrb - V - I	41	173.09 - 0.186 68x	-0.100	<75%	0.034
Cr. Vol.	Min Hrb - W - O	42	205.00 - 0.164 7x	-0.095	<75%	0.033
Dry Wt.	Min Hrb - W - B	46	386.78 - 0.069 242x	-0.077	<75%	0.030
St. Diam.	Min Hrb - C - O	42	15.324 - 0.048 859x	-0.077	<75%	0.027
St. Vol.	Min Hrb - W - O	42	171.93 - 0.107 98x	-0.077	<75%	0.027
Cr. Area	Min Hrb - C - O	42	0.43770 - 0.003 045 8x	-0.077	<75%	0.027
Ht.	Min Hrb - V - B	46	126.28 - 0.016 358x	-0.071	<75%	0.027
St. Vol.	Min Hrb - V - O	42	169.20 - 0.115 65x	-0.071	<75%	0.025
Ht. Incr.	Min Hrb - V - O	42	46.564 - 0.009 579 8x	-0.063	<75%	0.022
St. Vol.	Min Hrb - C - O	42	169.41 - 1.174x	-0.063	<75%	0.022
Ht.	Min Hrb - V - I	41	125.17 - 0.026 632x	-0.063	<75%	0.022
Dry Wt.	Min Hrb - C - O	42	380.99 - 0.979 3x	-0.045	<<75%	0.016
St. Diam.	Min Hrb - W - O	42	15.157 - 0.001 888 6x	-0.032	<<75%	0.011
St. Vol.	Min Hrb - H - I	41	164.73 - 0.107 56x	-0.032	<<75%	0.011
Cr. Area	Min Hrb - V - O	42	0.36321 + 0.000 701 68x	0.190	75%	0.066
Ht.	Min Hrb - H - I	41	118.59 + 0.172 02x	0.170	75%	0.058
Cr. Area	Min Hrb - H - I	41	0.37162 + 0.001 504 3x	0.161	75%	0.055
Dry Wt.	Min Hrb - V - B	46	351.96 + 0.181 44x	0.155	75%	0.059
St. Diam.	Min Hrb - H - I	41	14.305 + 0.022 316x	0.152	75%	0.052
Dry Wt.	Min Hrb - V - O	42	352.15 + 0.291 79 x	0.145	75%	0.051
Dry Wt.	Min Hrb - V - I	41	357.92 + 0.308 4x	0.138	75%	0.047
Cr. Vol.	Min Hrb - H - I	41	167.14 + 0.737 2x	0.134	75%	0.046
Cr. Area	Min Hrb - V - B	46	0.38191 + 0.000 285 33x	0.130	75%	0.050
Ht.	Min Hrb - H - O	42	119.70 + 0.131 55x	0.118	75%	0.041
Cr. Vol.	Min Hrb - V - O	42	169.56 + 0.247 27x	0.118	75%	0.041
St. Diam.	Min Hrb - V - O	42	14.454 + 0.006 843 6x	0.114	75%	0.040
Ht.	Min Hrb - H - B	46	120.86 + 0.116 31x	0.110	75%	0.042
Ht. Incr.	Min Hrb - H - I	41	44.347 + 0.042 225x	0.110	75%	0.037
St. Diam.	Min Hrb - V - I	41	14.555 + 0.006 384 8x	0.100	<75%	0.034
Dry Wt.	Min Hrb - H - I	41	362.18 + 0.509 54x	0.100	<75%	0.034
Ht. Incr.	Min Hrb - H - B	46	44.879 + 0.035 835x	0.089	<75%	0.034

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Min Hrb - H - O	42	44.800 + 0.037 262x	0.089	<75%	0.031
Cr. Area	Min Hrb - H - B	46	0.39234 + 0.000 828 4x	0.084	<75%	0.032
Cr. Area	Min Hrb - V - I	41	0.39611 + 0.000 306x	0.077	<75%	0.026
Cr. Vol.	Min Hrb - H - B	46	177.89 + 0.400 33x	0.071	<75%	0.027
Cr. Vol.	Min Hrb - V - B	46	178.66 + 0.090 266x	0.071	<75%	0.027
St. Diam.	Min Hrb - V - B	46	14.861 + 0.002 168 9x	0.063	<75%	0.024
Cr. Area	Min Hrb - H - O	42	0.39564 + 0.000 682 04x	0.063	<75%	0.022
Cr. Vol.	Min Hrb - H - O	42	177.42 + 0.366 31x	0.063	<75%	0.022
Cr. Vol.	Min Hrb - V - I	41	181.90 + 0.104 97x	0.045	<<75%	0.015
St. Diam.	Min Hrb - H - B	46	15.011 + 0.003 921 2x	0.032	<<75%	0.012
Ht.	Min Hrb - V - O	42	123.86 - 0.005 817 5x	-0.000	<<75%	0.000
Cr. Area	Min Hrb - W - O	42	0.42127 - 0.000 060 08x	-0.000	<<75%	0.000
Dry Wt.	Min Hrb - H - O	42	373.76 - 0.002 606 9x	-0.000	<<75%	0.000
Dry Wt.	Min Hrb - W - O	42	374.81 - 0.010 771x	-0.000	<<75%	0.000
Dry Wt.	Min Hrb - H - B	46	371.67 + 0.082 872x	0.000	<<75%	0.000
St. Diam.	Min Hrb - H - O	42	14.940 + 0.000 696 7x	0.000	<<75%	0.000
Ht. Incr.	All Hrb - C - I	114	50.675 - 0.303 11x	-0.251	99.5%	0.238
Ht. Incr.	All Hrb - C - B	117	50.983 - 0.146 28x	-0.243	99.5%	0.237
Ht.	All Hrb - C - I	114	136.34 - 0.766 49x	-0.237	99%	0.225
Ht. Incr.	All Hrb - W - I	114	49.697 - 0.010 206x	-0.228	99%	0.217
Ht. Incr.	All Hrb - W - B	117	50.000 - 0.004 911 2x	-0.219	99%	0.214
Ht.	All Hrb - W - I	114	133.15 - 0.023 686x	-0.197	97.5%	0.188
Ht.	All Hrb - C - B	117	135.08 - 0.311 6x	-0.195	97.5%	0.190
Ht. Incr.	All Hrb - C - O	114	50.036 - 0.210 36x	-0.190	97.5%	0.180
Ht. Incr.	All Hrb - W - O	114	49.210 - 0.006 903 5x	-0.170	95%	0.162
Cr. Vol.	All Hrb - C - I	114	244.16 - 2.938 9x	-0.158	95%	0.150
Ht.	All Hrb - W - B	117	132.05 - 0.009 114 7x	-0.155	95%	0.151
Cr. Vol.	All Hrb - C - B	117	246.82 - 1.328 6x	-0.141	90%	0.138
Cr. Area	All Hrb - C - I	114	0.48745 - 0.004 487 5x	-0.141	90%	0.134
Cr. Vol.	All Hrb - W - I	114	232.47 - 0.092 427x	-0.134	90%	0.127
Dry Wt.	All Hrb - C - B	117	424.07 - 1.117 6x	-0.130	90%	0.127
Dry Wt.	All Hrb - C - I	114	416.63 - 2.153 6x	-0.130	90%	0.124

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Cr. Area	All Hrb - C - B	117	0.49302 - 0.002 018 6x	-0.126	90%	0.123
Cr. Area	All Hrb - W - I	114	0.47214 - 0.000 148 59x	-0.126	90%	0.120
Ht.	All Hrb - C - O	114	131.30 - 0.348 88x	-0.118	75%	0.112
St. Diam.	All Hrb - W - I	114	15.169 - 0.002 056 1x	-0.114	75%	0.108
St. Vol.	All Hrb - C - I	114	198.03 - 1.645 9x	-0.114	75%	0.108
Cr. Vol.	All Hrb - W - B	117	233.42 - 0.038 179x	-0.110	75%	0.107
St. Diam.	All Hrb - C - I	114	15.242 - 0.052 598x	-0.110	75%	0.104
St. Vol.	All Hrb - W - I	114	193.72 - 0.058 358x	-0.110	75%	0.104
Dry Wt.	All Hrb - W - I	114	408.39 - 0.068 678x	-0.110	75%	0.104
Cr. Area	All Hrb - W - B	117	0.47539 - 0.000 061 922x	-0.105	75%	0.102
Dry Wt.	All Hrb - W - B	117	414.06 - 0.033 921x	-0.105	75%	0.102
Dry Wt.	All Hrb - C - O	114	419.49 - 1.655 7x	-0.105	75%	0.100
Cr. Vol.	All Hrb - C - O	114	236.07 - 1.672 9x	-0.100	75%	0.095
St. Vol.	All Hrb - C - B	117	196.41 - 0.697 2x	-0.095	75%	0.092
Ht. Incr.	All Hrb - V - I	114	47.547 - 0.002 711 1x	-0.089	75%	0.085
Ht. Incr.	All Hrb - V - B	117	47.849 - 0.001 261 1x	-0.084	75%	0.082
St. Vol.	All Hrb - W - B	117	191.48 - 0.023 069x	-0.084	75%	0.082
Ht.	All Hrb - V - I	114	128.22 - 0.006 434 1x	-0.084	75%	0.079
Cr. Area	All Hrb - C - O	114	0.47647 - 0.002 454x	-0.084	75%	0.079
Ht.	All Hrb - W - O	114	128.88 - 0.008 616 5x	-0.077	75%	0.074
Dry Wt.	All Hrb - W - O	114	409.73 - 0.045 607x	-0.077	75%	0.074
St. Diam.	All Hrb - C - B	117	14.950 - 0.014 313x	-0.063	75%	0.062
St. Diam.	All Hrb - W - B	117	14.920 - 0.000 575 56x	-0.063	75%	0.062
St. Vol.	All Hrb - C - O	114	188.36 - 0.807 11x	-0.063	<75%	0.060
Cr. Area	All Hrb - W - O	114	0.46035 - 0.000 063 184x	-0.063	<75%	0.060
Cr. Vol.	All Hrb - V - I	114	214.43 - 0.027 495x	-0.063	<75%	0.060
Cr. Vol.	All Hrb - W - O	114	223.48 - 0.038 777x	-0.063	<75%	0.060
Dry Wt.	All Hrb - V - B	117	401.63 - 0.011 142x	-0.055	<75%	0.053
Cr. Area	All Hrb - V - I	114	0.44276 - 0.000 043 459x	-0.055	<75%	0.052
Cr. Area	All Hrb - V - B	117	0.44951 - 0.000 017 143x	-0.045	<75%	0.044
Cr. Vol.	All Hrb - V - B	117	216.77 - 0.009 866 7x	-0.045	<75%	0.044
Ht. Incr.	All Hrb - V - O	114	47.280 - 0.001 197 1x	-0.045	<75%	0.042

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	All Hrb - V - I	114	14.708 - 0.000 487 93x	-0.045	<75%	0.042
St. Vol.	All Hrb - W - O	114	183.87 - 0.022 964x	-0.045	<75%	0.042
Dry Wt.	All Hrb - V - I	114	394.32 - 0.019 072x	-0.045	<75%	0.042
Ht.	All Hrb - V - B	117	127.14 - 0.001 426 1x	-0.032	<75%	0.031
St. Vol.	All Hrb - V - I	114	178.80 - 0.010 075x	-0.032	<75%	0.030
Dry Wt.	All Hrb - V - O	114	400.27 - 0.013 992x	-0.032	<75%	0.030
Ht. Incr.	All Hrb - H - I	114	37.774 + 0.101 3x	0.249	99.5%	0.237
Ht.	All Hrb - H - I	114	106.57 + 0.224 75x	0.205	97.5%	0.195
Ht. Incr.	All Hrb - H - B	117	39.635 + 0.084 054x	0.195	97.5%	0.190
Ht.	All Hrb - H - O	114	107.26 + 0.220 68x	0.195	97.5%	0.185
Ht.	All Hrb - H - B	117	107.90 + 0.215 34x	0.190	97.5%	0.185
Ht. Incr.	All Hrb - H - O	114	40.426 + 0.074 445x	0.173	95%	0.165
Cr. Vol.	All Hrb - H - I	114	141.96 + 0.719 87x	0.114	75%	0.108
St. Vol.	All Hrb - H - I	114	133.23 + 0.495 15x	0.105	75%	0.100
Dry Wt.	All Hrb - H - I	114	339.49 + 0.554 98x	0.100	75%	0.095
St. Vol.	All Hrb - H - B	117	135.33 + 0.485 07x	0.095	75%	0.092
Cr. Vol.	All Hrb - H - B	117	154.24 + 0.636 53x	0.095	75%	0.092
St. Vol.	All Hrb - H - O	114	135.05 + 0.482 76x	0.095	75%	0.090
Cr. Area	All Hrb - H - I	114	0.33938 + 0.001 002 1x	0.095	75%	0.090
Cr. Vol.	All Hrb - H - O	114	155.22 + 0.645 2x	0.095	75%	0.090
Dry Wt.	All Hrb - H - B	117	352.68 + 0.457 11x	0.071	75%	0.069
Cr. Area	All Hrb - H - B	117	0.37494 + 0.000 694 37x	0.063	75%	0.062
Dry Wt.	All Hrb - H - O	114	360.32 + 0.388 35x	0.063	<75%	0.060
St. Diam.	All Hrb - H - I	114	13.778 + 0.008 421 6x	0.055	<75%	0.052
Cr. Area	All Hrb - H - O	114	0.38653 + 0.000 602 47x	0.055	<75%	0.052
St. Diam.	All Hrb - V - O	114	14.320 + 0.000 425 23x	0.045	<75%	0.042
Ht.	All Hrb - V - O	114	124.41 + 0.002 313 3x	0.032	<75%	0.030
St. Diam.	All Hrb - H - B	117	14.239 + 0.003 402 3x	0.000	<<75%	0.000
St. Diam.	All Hrb - V - B	117	14.527 - 0.000 006 602x	-0.000	<<75%	0.000
St. Vol.	All Hrb - V - B	117	177.86 - 0.002 400 3x	-0.000	<<75%	0.000
St. Diam.	All Hrb - H - O	114	14.518 + 0.000 380 97x	0.000	<<75%	0.000
St. Diam.	All Hrb - C - O	114	14.614 - 0.003 963 7x	-0.000	<<75%	0.000

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	All Hrb - W - O	114	14.626 - 0.000 202 83x	-0.000	<<75%	0.000
St. Vol.	All Hrb - V - O	114	172.67 + 0.004 851 4x	0.000	<<75%	0.000
Cr. Area	All Hrb - V - O	114	0.44029 - 0.000 006 527x	-0.000	<<75%	0.000
Cr. Vol.	All Hrb - V - O	114	209.73 - 0.001 345 9x	-0.000	<<75%	0.000
Cr. Area	Ru id - H - O	86	0.72446 - 0.005 290 8x	-0.437	99.95%	0.313
Cr. Vol.	Ru id - H - O	86	374.05 - 3.036 5x	-0.428	99.95%	0.307
Cr. Area	Ru id - H - B	93	0.71386 - 0.005 445 6x	-0.417	99.95%	0.323
St. Diam.	Ru id - H - O	86	18.719 - 0.075 588x	-0.415	99.95%	0.297
Cr. Vol.	Ru id - H - B	93	369.55 - 3.135 4x	-0.411	99.95%	0.319
St. Diam.	Ru id - H - B	93	18.861 - 0.081 298x	-0.394	99.95%	0.305
Cr. Area	Ru id - H - I	83	0.66422 - 0.004 782 8x	-0.392	99.95%	0.271
Dry Wt.	Ru id - H - O	86	518.32 - 2.390 1x	-0.375	99.95%	0.269
Cr. Area	Ru id - V - I	83	0.51230 - 0.000 621 43x	-0.373	99.95%	0.258
Cr. Vol.	Ru id - H - I	83	334.31 - 2.635 1x	-0.373	99.95%	0.258
Cr. Vol.	Ru id - V - I	83	253.39 - 0.359 4x	-0.371	99.95%	0.257
St. Diam.	Ru id - V - I	83	16.104 - 0.009 974 9x	-0.367	99.95%	0.254
Cr. Area	Ru id - V - O	86	0.52184 - 0.000 524 22x	-0.363	99.95%	0.260
Cr. Vol.	Ru id - V - O	86	258.88 - 0.306 37x	-0.362	99.95%	0.259
Dry Wt.	Ru id - H - B	93	512.76 - 2.455 5x	-0.361	99.95%	0.279
St. Diam.	Ru id - H - I	83	18.244 - 0.071 134x	-0.358	99.95%	0.247
Cr. Vol.	Ru id - V - B	93	255.91 - 0.178 96x	-0.355	99.95%	0.275
St. Vol.	Ru id - H - O	86	267.64 - 1.797 9x	-0.355	99.95%	0.254
Cr. Area	Ru id - V - B	93	0.51423 - 0.000 304 06x	-0.354	99.95%	0.274
Cr. Area	Ru id - W - I	83	0.51863 - 0.000 800 72x	-0.351	99.9%	0.243
Cr. Vol.	Ru id - W - I	83	256.97 - 0.462 52x	-0.349	99.9%	0.242
Cr. Vol.	Ru id - W - O	86	262.59 - 0.415 13x	-0.346	99.9%	0.248
Cr. Area	Ru id - W - O	86	0.52701 - 0.000 702 84x	-0.344	99.9%	0.246
Cr. Vol.	Ru id - W - B	93	259.58 - 0.237 26x	-0.338	99.95%	0.262
St. Vol.	Ru id - H - B	93	276.50 - 1.952 1x	-0.335	99.9%	0.259
Cr. Area	Ru id - W - B	93	0.51967 - 0.000 400 14x	-0.333	99.9%	0.258
Dry Wt.	Ru id - V - B	93	424.21 - 0.141 53x	-0.315	99.75%	0.244
St. Diam.	Ru id - V - B	93	15.786 - 0.004 256x	-0.311	99.75%	0.241

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	Ru id - W - I	83	16.208 - 0.012 870x	-0.345	99.9%	0.239
Dry Wt.	Ru id - H - I	83	493.87 - 2.225 3x	-0.338	99.9%	0.234
St. Vol.	Ru id - V - I	83	214.10 - 0.264 33x	-0.332	99.75%	0.229
Dry Wt.	Ru id - V - I	83	423.99 - 0.294 07x	-0.326	99.75%	0.225
St. Vol.	Ru id - W - I	83	218.60 - 0.354 03x	-0.324	99.75%	0.224
Ht. Incr.	Ru id - C - O	86	49.104 - 0.592 95x	-0.322	99.75%	0.231
Dry Wt.	Ru id - V - O	86	428.00 - 0.242 83x	-0.319	99.75%	0.229
Ht.	Ru id - V - I	83	133.99 - 0.061 197x	-0.319	99.75%	0.221
Ht. Incr.	Ru id - W - O	86	48.506 - 0.024 830x	-0.311	99.75%	0.223
Cr. Vol.	Ru id - C - O	86	262.14 - 8.541 8x	-0.310	99.75%	0.222
Cr. Area	Ru id - C - I	83	0.51493 - 0.014 998x	-0.310	99.75%	0.214
Cr. Vol.	Ru id - C - I	83	255.06 - 8.696x	-0.310	99.75%	0.214
St. Vol.	Ru id - V - B	93	208.01 - 0.118 22x	-0.307	99.75%	0.238
St. Diam.	Ru id - C - I	83	16.147 - 0.240 8x	-0.305	99.5%	0.211
St. Diam.	Ru id - V - O	86	15.644 - 0.006 596 9x	-0.303	99.75%	0.217
Dry Wt.	Ru id - W - I	83	426.43 - 0.374 84x	-0.303	99.5%	0.210
Ht.	Ru id - W - I	83	134.73 - 0.079 674x	-0.303	99.5%	0.210
Cr. Vol.	Ru id - C - B	93	258.89 - 4.717 1x	-0.302	99.75%	0.234
Dry Wt.	Ru id - W - O	86	430.33 - 0.325 15x	-0.302	99.75%	0.216
St. Vol.	Ru id - C - I	83	219.44 - 6.988 1x	-0.302	99.5%	0.209
Ht. Incr.	Ru id - V - O	86	47.994 - 0.016 894x	-0.300	99.75%	0.215
Cr. Area	Ru id - C - O	86	0.52310 - 0.014 049x	-0.298	99.5%	0.214
Dry Wt.	Ru id - W - B	93	426.45 - 0.185 16x	-0.295	99.75%	0.229
St. Vol.	Ru id - W - B	93	210.82 - 0.158 2x	-0.293	99.75%	0.227
Ht.	Ru id - H - O	86	144.05 - 0.369 62x	-0.293	99.5%	0.210
Cr. Area	Ru id - C - B	93	0.51640 - 0.007 796 4x	-0.292	99.75%	0.226
St. Diam.	Ru id - W - B	93	15.838 - 0.005 509 1x	-0.290	99.75%	0.225
Ht.	Ru id - V - B	93	131.90 - 0.026 864x	-0.288	99.5%	0.223
Ht.	Ru id - W - B	93	132.51 - 0.035 818x	-0.274	99.5%	0.212
Ht.	Ru id - H - B	93	144.11 - 0.382 83x	-0.270	99.5%	0.209
Ht. Incr.	Ru id - W - B	93	48.194 - 0.012 922x	-0.270	99.5%	0.209
Ht. Incr.	Ru id - C - B	93	48.539 - 0.285 83x	-0.268	99.5%	0.208

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht.	Ru id - V - O	86	131.30 - 0.043 577x	-0.290	99.5%	0.208
Ht.	Ru id - W - O	86	131.95 - 0.059 771x	-0.281	99.5%	0.201
St. Vol.	Ru id - V - O	86	197.08 - 0.169 7x	-0.281	99.5%	0.201
Ht.	Ru id - C - I	83	134.77 - 1.551 7x	-0.279	99%	0.193
St. Diam.	Ru id - W - O	86	15.666 - 0.008 568 5x	-0.277	99.5%	0.199
Ht. Incr.	Ru id - V - B	93	47.817 - 0.009 213 7x	-0.268	99.5%	0.208
St. Vol.	Ru id - H - I	83	253.89 - 1.565 6x	-0.268	99%	0.186
St. Vol.	Ru id - C - B	93	210.92 - 3.187 5x	-0.266	99.5%	0.207
Ht.	Ru id - C - O	86	132.37 - 1.294 2x	-0.265	99%	0.190
Dry Wt.	Ru id - C - I	83	424.06 - 6.928 8x	-0.265	99%	0.183
Ht. Incr.	Ru id - V - I	83	48.443 - 0.019 025x	-0.263	99%	0.182
Dry Wt.	Ru id - C - O	86	428.35 - 6.476 7x	-0.261	99%	0.187
St. Vol.	Ru id - W - O	86	197.92 - 0.222 27x	-0.259	99%	0.186
Ht. Incr.	Ru id - W - I	83	48.784 - 0.025 601x	-0.259	99%	0.179
Dry Wt.	Ru id - C - B	93	424.53 - 3.576 4x	-0.257	99%	0.199
Ht.	Ru id - C - B	93	132.75 - 0.738 44x	-0.255	99%	0.198
Ht. Incr.	Ru id - C - I	83	48.960 - 0.521 97x	-0.249	97.5%	0.172
St. Diam.	Ru id - C - B	93	15.755 - 0.104 44x	-0.247	99%	0.191
Ht. Incr.	Ru id - H - B	93	51.582 - 0.123 67x	-0.239	95%	0.185
Ht.	Ru id - H - I	83	141.23 - 0.325 21x	-0.232	97.5%	0.161
St. Diam.	Ru id - C - O	86	15.542 - 0.161 24x	-0.228	97.5%	0.163
Ht. Incr.	Ru id - H - I	83	51.683 - 0.119 79x	-0.226	97.5%	0.156
St. Vol.	Ru id - C - O	86	195.70 - 4.313 7x	-0.219	97.5%	0.157
Ht. Incr.	Ru id - H - O	86	50.458 - 0.100 77x	-0.212	97.5%	0.152
St. Diam.	Co co - C - I	64	14.925 - 0.15634x	-0.285	97.5%	0.152
St. Diam.	Co co - V - I	64	14.321 - 0.001 448 4x	-0.192	90%	0.103
St. Diam.	Co co - C - B	70	14.347 - 0.049 383x	-0.184	90%	0.108
Cr. Area	Co co - C - I	64	0.45223 - 0.006 286 x	-0.179	90%	0.095
St. Vol.	Co co - C - I	64	183.60 - 2.8566x	-0.170	90%	0.091
St. Diam.	Co co - W - I	64	14.152 - 0.000 723 4x	-0.158	75%	0.084
Dry Wt.	Co co - C - I	64	390.38 - 2.38x	-0.130	75%	0.070
Cr. Vol.	Co co - C - I	64	205.58 - 2.5371x	-0.122	75%	0.065

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	Co co - C - O	67	14.023 - 0.054 043x	-0.118	75%	0.066
St. Diam.	Co co - V - B	70	13.865 - 0.000 393 51x	-0.105	75%	0.061
Ht. Incr.	Co co - C - I	64	47.894 - 0.17306x	-0.100	75%	0.053
Cr. Area	Co co - V - I	64	0.42161 - 0.000 044 785x	-0.095	75%	0.051
St. Diam.	Co co - W - B	70	13.753 - 0.000 192 32x	-0.084	75%	0.049
St. Vol.	Co co - C - B	70	167.56 - 0.69802x	-0.084	75%	0.049
St. Vol.	Co co - V - I	64	169.18 - 0.019 273x	-0.084	<75%	0.045
Cr. Area	Co co - C - B	70	0.41359 - 0.001 325 7x	-0.077	<75%	0.045
Cr. Area	Co co - W - I	64	0.41618 - 0.000 022 109x	-0.077	<75%	0.041
Ht.	Co co - C - I	64	122.98 - 0.28607x	-0.071	<75%	0.038
St. Vol.	Co co - W - I	64	166.29 - 0.008 736x	-0.063	<75%	0.034
Dry Wt.	Co co - C - B	70	374.13 - 0.48887x	-0.055	<75%	0.032
St. Diam.	Co co - V - O	67	13.647 - 0.000 344 4x	-0.055	<75%	0.031
St. Vol.	Co co - C - O	67	162.87 - 0.67762x	-0.045	<75%	0.025
Dry Wt.	Co co - C - O	67	374.31 - 0.62546x	-0.045	<75%	0.025
Ht. Incr.	Co co - V - I	64	46.999 - 0.001 123 7x	-0.045	<75%	0.024
Ht. Incr.	Co co - W - I	64	46.950 - 0.000 677 9x	-0.045	<75%	0.024
Cr. Vol.	Co co - V - I	64	190.30 - 0.011 879x	-0.045	<75%	0.024
Dry Wt.	Co co - V - I	64	376.35 - 0.011 786x	-0.045	<75%	0.024
Cr. Vol.	Co co - C - B	70	185.77 - 0.38165x	-0.032	<<75%	0.018
St. Diam.	Co co - W - O	67	13.576 - 0.000 158 88x	-0.032	<<75%	0.018
Cr. Area	Co co - C - O	67	0.40492 - 0.001 105 7x	-0.032	<<75%	0.018
Cr. Vol.	Co co - W - I	64	188.13 - 0.004 838x	-0.032	<<75%	0.017
Dry Wt.	Co co - W - I	64	374.22 - 0.004 839 5x	-0.032	<<75%	0.017
Ht.	Co co - H - B	70	106.54 + 0.11244x	0.179	90%	0.104
Ht.	Co co - W - O	67	114.83 + 0.005 188 8x	0.173	90%	0.097
Ht.	Co co - V - O	67	114.80 + 0.007 708 2x	0.164	90%	0.092
Ht.	Co co - H - I	64	109.77 + 0.092 592x	0.161	75%	0.086
Ht.	Co co - H - O	67	109.74 + 0.081 034x	0.130	75%	0.073
Cr. Vol.	Co co - H - I	64	139.95 + 0.38145x	0.130	75%	0.070
Dry Wt.	Co co - H - I	64	330.32 + 0.34499x	0.130	75%	0.070
Ht.	Co co - W - B	70	116.76 + 0.002 010 5x	0.122	75%	0.071

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Co co - H - B	70	42.353 + 0.032 628x	0.122	75%	0.071
Cr. Vol.	Co co - H - B	70	133.99 + 0.37772x	0.118	75%	0.069
St. Vol.	Co co - H - I	64	125.82 + 0.29215x	0.118	75%	0.063
Ht.	Co co - V - B	70	116.71 + 0.003 045 3x	0.114	75%	0.067
Dry Wt.	Co co - H - B	70	327.57 + 0.31738x	0.110	75%	0.064
Ht. Incr.	Co co - H - I	64	43.436 + 0.025 855x	0.105	75%	0.056
St. Vol.	Co co - H - B	70	124.02 + 0.26013x	0.100	75%	0.058
Cr. Area	Co co - H - B	70	0.32412 + 0.000 550 97x	0.100	75%	0.058
Ht.	Co co - C - O	67	116.12 + 0.32927x	0.100	75%	0.056
Ht. Incr.	Co co - V - O	67	45.402 + 0.001 858x	0.100	75%	0.056
Cr. Area	Co co - H - I	64	0.34116 + 0.000 505 7x	0.100	75%	0.053
Ht. Incr.	Co co - C - O	67	45.384 + 0.10964x	0.084	75%	0.047
Ht. Incr.	Co co - W - O	67	45.633 + 0.001 013 7x	0.084	75%	0.047
Ht. Incr.	Co co - V - B	70	45.592 + 0.000 607 71x	0.055	<75%	0.032
Ht. Incr.	Co co - W - B	70	45.776 + 0.000 289 96x	0.045	<75%	0.026
Cr. Vol.	Co co - W - O	67	174.57 + 0.006 621 4x	0.045	<75%	0.025
Ht.	Co co - W - I	64	119.61 + 0.001 431 9x	0.045	<75%	0.024
Ht.	Co co - C - B	70	118.72 + 0.065 011x	0.032	<<75%	0.018
Ht. Incr.	Co co - C - B	70	45.827 + 0.022 177x	0.032	<<75%	0.018
St. Diam.	Co co - H - B	70	13.144 + 0.002 596x	0.032	<<75%	0.018
Cr. Vol.	Co co - W - B	70	174.95 + 0.002 508 2x	0.032	<<75%	0.018
Ht. Incr.	Co co - H - O	67	45.654 + 0.007 623x	0.032	<<75%	0.018
St. Vol.	Co co - W - O	67	152.44 + 0.003 084x	0.032	<<75%	0.018
Cr. Vol.	Co co - V - O	67	175.65 + 0.008 118x	0.032	<<75%	0.018
Ht.	Co co - V - I	64	119.90 + 0.001 54x	0.032	<<75%	0.017
St. Diam.	Co co - H - I	64	13.372 + 0.002 262 4x	0.032	<<75%	0.017
St. Vol.	Co co - V - B	70	156.59 - 0.001 599 9x	-0.000	<<75%	0.000
St. Vol.	Co co - W - B	70	154.97 - 0.000 035 17x	-0.000	<<75%	0.000
Cr. Area	Co co - V - B	70	0.39371 - 0.000 003 948x	-0.000	<<75%	0.000
Cr. Area	Co co - W - B	70	0.39114 - 0.000 001 007x	-0.000	<<75%	0.000
Cr. Vol.	Co co - V - B	70	175.86 + 0.002 863 3x	0.000	<<75%	0.000
Dry Wt.	Co co - V - B	70	364.88 + 0.000 369 19x	0.000	<<75%	0.000

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Dry Wt.	Co co - W - B	70	363.58 + 0.001 081 3x	0.000	<<75%	0.000
St. Diam.	Co co - H - O	67	13.611 - 0.001 497 5x	-0.000	<<75%	0.000
St. Vol.	Co co - H - O	67	151.90 + 0.028 054x	0.000	<<75%	0.000
St. Vol.	Co co - V - O	67	153.72 + 0.002 566 7x	0.000	<<75%	0.000
Cr. Area	Co co - H - O	67	0.38018 + 0.000 101 06x	0.000	<<75%	0.000
Cr. Area	Co co - V - O	67	0.39051 + 0.000 003 381x	0.000	<<75%	0.000
Cr. Area	Co co - W - O	67	0.38850 + 0.000 004 403x	0.000	<<75%	0.000
Cr. Vol.	Co co - H - O	67	172.64 + 0.066 515x	0.000	<<75%	0.000
Cr. Vol.	Co co - C - O	67	183.36 - 0.22561x	-0.000	<<75%	0.000
Dry Wt.	Co co - H - O	67	364.88 + 0.020 243x	0.000	<<75%	0.000
Dry Wt.	Co co - V - O	67	367.01 + 0.000 590 89x	0.000	<<75%	0.000
Dry Wt.	Co co - W - O	67	365.48 + 0.002 006 4x	0.000	<<75%	0.000
Cr. Area	Pr pe - V - O	37	0.57150 - 0.000 200 96x	-0.311	95%	0.096
Cr. Area	Pr pe - W - O	37	0.55301 - 0.000 082 564x	-0.308	95%	0.095
Ht. Incr.	Pr pe - H - O	37	56.744 - 0.043 903x	-0.276	95%	0.085
Cr. Area	Pr pe - H - O	37	0.66276 - 0.001 164 9x	-0.276	95%	0.085
Cr. Vol.	Pr pe - V - O	37	290.32 - 0.100 25x	-0.257	90%	0.079
Cr. Area	Pr pe - C - O	37	0.57405 - 0.016 615x	-0.255	90%	0.079
Cr. Vol.	Pr pe - W - O	37	280.68 - 0.040 826x	-0.253	90%	0.078
Dry Wt.	Pr pe - W - O	37	428.25 - 0.033 58x	-0.253	90%	0.078
Cr. Vol.	Pr pe - H - O	37	344.31 - 0.629 13x	-0.247	90%	0.076
Dry Wt.	Pr pe - V - O	37	430.85 - 0.073 082x	-0.228	90%	0.070
Dry Wt.	Pr pe - H - O	37	472.42 - 0.471 11x	-0.226	90%	0.070
St. Diam.	Pr pe - H - O	37	17.795 - 0.013 733x	-0.207	75%	0.064
Cr. Vol.	Pr pe - C - O	37	290.34 - 8.110 8x	-0.205	75%	0.063
Dry Wt.	Pr pe - W - I	30	417.41 - 0.015 356x	-0.197	75%	0.049
Dry Wt.	Pr pe - V - I	30	420.77 - 0.036 974x	-0.195	75%	0.049
Dry Wt.	Pr pe - W - B	42	411.98 - 0.010 236x	-0.187	75%	0.065
Cr. Area	Pr pe - H - B	42	0.57152 - 0.000 722 77x	-0.179	75%	0.063
Cr. Area	Pr pe - V - B	42	0.50265 - 0.000 046 06x	-0.173	75%	0.061
Cr. Area	Pr pe - W - B	42	0.49559 - 0.000 018 876x	-0.173	75%	0.061
Dry Wt.	Pr pe - V - B	42	413.77 - 0.023 003x	-0.173	75%	0.061

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Dry Wt.	Pr pe - C - I	30	422.75 - 3.412 6x	-0.164	75%	0.041
Ht. Incr.	Pr pe - H - B	42	53.178 - 0.025 527x	-0.161	75%	0.056
St. Diam.	Pr pe - H - B	42	17.064 - 0.010 078x	-0.158	75%	0.055
Ht. Incr.	Pr pe - V - O	37	51.184 - 0.003 844x	-0.158	75%	0.049
Ht.	Pr pe - H - O	37	148.65 - 0.070 034x	-0.155	75%	0.048
Dry Wt.	Pr pe - H - I	30	450.14 0.324 74x	-0.152	75%	0.038
Cr. Area	Pr pe - C - B	42	0.50448 - 0.003 992 2x	-0.145	75%	0.051
Cr. Vol.	Pr pe - H - B	42	289.71 - 0.359 31x	-0.145	75%	0.051
Dry Wt.	Pr pe - C - O	37	421.49 - 4.577 4x	-0.141	75%	0.043
Dry Wt.	Pr pe - H - B	42	435.03 - 0.279 27x	-0.138	75%	0.048
Cr. Vol.	Pr pe - V - B	42	252.92 - 0.020 414x	-0.126	75%	0.044
Dry Wt.	Pr pe - C - B	42	411.51 - 1.736 1x	-0.126	75%	0.044
Cr. Vol.	Pr pe - W - B	42	249.52 - 0.008 241x	-0.122	75%	0.043
Ht. Incr.	Pr pe - C - O	37	51.144 - 0.305 05x	-0.122	75%	0.038
Cr. Area	Pr pe - H - I	30	0.54507 - 0.000 530 75x	-0.122	<75%	0.031
Ht. Incr.	Pr pe - W - O	37	50.336 - 0.001 152 3x	-0.114	<75%	0.035
Cr. Area	Pr pe - V - I	30	0.48539 - 0.000 044 664x	-0.114	<75%	0.029
Cr. Area	Pr pe - W - I	30	0.48042 - 0.000 017 968x	-0.114	<75%	0.029
Ht. Incr.	Pr pe - C - B	42	50.402 - 0.107 91x	-0.100	<75%	0.035
Cr. Vol.	Pr pe - C - B	42	253.04 - 1.713 6x	-0.100	<75%	0.035
St. Vol.	Pr pe - C - I	30	226.16 - 1.913 3x	-0.100	<75%	0.025
Cr. Area	Pr pe - C - I	30	0.48645 - 0.003 966 9x	-0.095	<75%	0.024
St. Diam.	Pr pe - W - O	37	15.797 - 0.000 366 1x	-0.089	<75%	0.027
St. Diam.	Pr pe - V - O	37	15.838 - 0.000 818 56x	-0.084	<75%	0.026
St. Vol.	Pr pe - H - O	37	220.27 - 0.148 98x	-0.077	<75%	0.024
Cr. Vol.	Pr pe - V - I	30	246.53 - 0.018 317x	-0.077	<75%	0.019
St. Vol.	Pr pe - V - I	30	218.72 - 0.012 173x	-0.071	<75%	0.018
Cr. Vol.	Pr pe - H - I	30	267.57 - 0.198 05x	-0.071	<75%	0.018
Cr. Vol.	Pr pe - W - I	30	243.99 - 0.007 052x	-0.071	<75%	0.018
St. Vol.	Pr pe - H - B	42	217.88 - 0.117 46x	-0.063	<75%	0.022
St. Diam.	Pr pe - C - I	30	15.989 - 0.042 092x	-0.063	<<75%	0.016
Cr. Vol.	Pr pe - C - I	30	247.35 - 1.671 9x	-0.063	<<75%	0.016

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Pr pe - V - B	42	49.694 - 0.000 604 53x	-0.055	<75%	0.019
Ht.	Pr pe - H - B	42	138.33 - 0.018 939x	-0.045	<<75%	0.016
St. Diam.	Pr pe - V - B	42	15.626 - 0.000 178 31x	-0.045	<<75%	0.016
St. Diam.	Pr pe - W - B	42	15.584 - 0.000 066 197x	-0.045	<<75%	0.016
St. Diam.	Pr pe - V - I	30	15.841 - 0.000 290 07x	-0.045	<<75%	0.011
St. Vol.	Pr pe - W - I	30	214.68 - 0.003 178 6x	-0.045	<<75%	0.011
St. Diam.	Pr pe - C - B	42	15.583 - 0.011 393x	-0.032	<<75%	0.011
Ht.	Pr pe - V - O	37	137.32 - 0.001 806x	-0.032	<<75%	0.010
St. Diam.	Pr pe - H - I	30	16.063 - 0.002 495 4x	-0.032	<<75%	0.008
St. Diam.	Pr pe - W - I	30	15.752 - 0.000 080 199x	-0.032	<<75%	0.008
St. Vol.	Pr pe - H - I	30	221.42 - 0.067 021x	-0.032	<<75%	0.008
Ht.	Pr pe - W - I	30	129.65 + 0.003 614 5x	0.212	75%	0.053
Ht.	Pr pe - V - I	30	129.12 + 0.008 347 9x	0.197	75%	0.049
Ht.	Pr pe - C - I	30	128.49 + 0.792 34x	0.173	75%	0.043
Ht. Incr.	Pr pe - W - I	30	46.250 + 0.000 906 13x	0.148	75%	0.037
Ht.	Pr pe - H - I	30	124.44 + 0.062 153x	0.130	75%	0.033
Ht.	Pr pe - W - B	42	132.22 + 0.001 435 7x	0.122	75%	0.043
Ht.	Pr pe - C - B	42	131.31 + 0.322 16x	0.110	75%	0.039
Ht.	Pr pe - V - B	42	132.10 + 0.003 097 1x	0.110	75%	0.039
Ht. Incr.	Pr pe - V - I	30	46.538 + 0.001 524 3x	0.100	<75%	0.025
St. Vol.	Pr pe - C - O	37	181.85 + 1.727 6x	0.055	<<75%	0.017
Ht. Incr.	Pr pe - C - I	30	47.296 + 0.043 093x	0.032	<<75%	0.008
Ht. Incr.	Pr pe - W - B	42	49.159 - 0.000 041 125x	-0.000	<<75%	0.000
St. Vol.	Pr pe - C - B	42	199.96 - 0.079 501x	-0.000	<<75%	0.000
St. Vol.	Pr pe - V - B	42	200.25 - 0.001 236 9x	-0.000	<<75%	0.000
St. Vol.	Pr pe - W - B	42	199.20 - 0.000 103 84x	-0.000	<<75%	0.000
Ht.	Pr pe - C - O	37	136.04 + 0.036 536x	0.000	<<75%	0.000
Ht.	Pr pe - W - O	37	136.61 - 0.000 270 76x	-0.000	<<75%	0.000
St. Diam.	Pr pe - C - O	37	15.508 - 0.019 156x	-0.000	<<75%	0.000
St. Vol.	Pr pe - V - O	37	191.14 + 0.005 017 2x	0.000	<<75%	0.000
St. Vol.	Pr pe - W - O	37	192.42 + 0.001 357 4x	0.000	<<75%	0.000
Ht. Incr.	Pr pe - H - I	30	47.771 - 0.000 595 94x	-0.000	<<75%	0.000

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Vol.	Pi ba - H - I	20	- 24.249 + 1.724 6x	0.602	99.75%	0.100
St. Diam.	Pi ba - H - I	20	8.0344 + 0.051 277x	0.566	99.5%	0.094
Ht.	Pi ba - H - O	46	84.484 + 0.366 85x	0.549	99.95%	0.210
Ht. Incr.	Pi ba - H - O	46	30.030 + 0.156 14x	0.523	99.95%	0.201
St. Diam.	Pi ba - H - B	52	8.8930 + 0.049 121x	0.521	99.95%	0.226
St. Diam.	Pi ba - H - O	46	8.9064 + 0.049 29x	0.514	99.95%	0.197
Ht.	Pi ba - H - B	52	90.973 + 0.322 87x	0.487	99.95%	0.211
Ht. Incr.	Pi ba - V - O	46	41.767 + 0.040 321x	0.487	99.95%	0.187
Cr. Area	Pi ba - H - O	46	7.5478e-2 + 0.003 087x	0.468	99.9%	0.179
Cr. Vol.	Pi ba - H - O	46	- 2.5560 + 1.777 3x	0.467	99.9%	0.179
Ht.	Pi ba - H - I	20	88.914 + 0.339 22x	0.466	97.5%	0.078
Ht. Incr.	Pi ba - C - O	46	39.292 + 2.909 3x	0.454	99.9%	0.174
St. Vol.	Pi ba - H - B	52	28.913 + 1.351 9x	0.445	99.95%	0.193
Cr. Vol.	Pi ba - H - B	52	14.335 + 1.702 8x	0.444	99.9%	0.192
Ht. Incr.	Pi ba - H - B	52	33.603 + 0.127 84x	0.440	99.9%	0.191
Cr. Area	Pi ba - H - B	52	0.11494 + 0.002 853 5x	0.430	99.9%	0.186
Ht. Incr.	Pi ba - W - O	46	43.596 + 0.009 518 4x	0.418	99.75%	0.160
St. Vol.	Pi ba - H - O	46	35.427 + 1.283 6x	0.415	99.75%	0.159
Dry Wt.	Pi ba - H - O	46	200.14 + 1.635 2x	0.414	99.75%	0.159
Ht. Incr.	Pi ba - V - B	52	43.204 + 0.027 843x	0.399	99.75%	0.173
Cr. Area	Pi ba - V - O	46	0.32199 + 0.000 720 16x	0.392	99.5%	0.150
Dry Wt.	Pi ba - H - B	52	220.95 + 1.527 7x	0.391	99.75%	0.169
Cr. Vol.	Pi ba - H - I	20	37.496 + 1.412 4x	0.387	95%	0.065
Cr. Vol.	Pi ba - V - O	46	141.56 + 0.402 95x	0.382	99.5%	0.146
Dry Wt.	Pi ba - V - O	46	324.88 + 0.412 48x	0.375	99%	0.144
Ht. Incr.	Pi ba - H - I	20	33.711 + 0.127 5x	0.370	90%	0.062
Cr. Area	Pi ba - C - O	46	0.27682 + 0.052 241x	0.367	99%	0.141
Dry Wt.	Pi ba - C - O	46	299.48 + 29.787x	0.351	99%	0.134
Ht.	Pi ba - V - O	46	117.69 + 0.064 752x	0.349	99%	0.134
Cr. Vol.	Pi ba - C - O	46	118.76 + 28.517x	0.348	99%	0.133
Ht. Incr.	Pi ba - W - B	52	44.542 + 0.006 759 3x	0.335	99%	0.145
Cr. Area	Pi ba - H - I	20	0.18052 + 0.002 061 8x	0.329	90%	0.055

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Pi ba - C - B	52	42.518 + 1.645 6x	0.319	97.5%	0.138
Cr. Area	Pi ba - W - O	46	0.36082 + 0.000 159 81x	0.318	97.5%	0.122
Cr. Vol.	Pi ba - W - O	46	163.70 + 0.088 743x	0.307	97.5%	0.118
Dry Wt.	Pi ba - W - O	46	346.73 + 0.092 179x	0.305	97.5%	0.117
St. Diam.	Pi ba - V - O	46	13.528 + 0.007 852 6x	0.295	97.5%	0.113
Dry Wt.	Pi ba - H - I	20	270.07 + 0.945 7x	0.292	75%	0.049
St. Vol.	Pi ba - V - I	20	121.25 + 0.396 72x	0.272	75%	0.045
Cr. Area	Pi ba - V - B	52	0.37011 + 0.000 423 07x	0.266	95%	0.115
Ht.	Pi ba - V - B	52	121.10 + 0.041 801x	0.263	95%	0.114
Cr. Vol.	Pi ba - V - B	52	169.11 + 0.240 28x	0.261	95%	0.113
Ht.	Pi ba - C - O	46	116.89 + 3.755 5x	0.261	95%	0.100
Ht.	Pi ba - W - O	46	121.98 + 0.013 05x	0.257	95%	0.098
Dry Wt.	Pi ba - V - B	52	356.99 + 0.229 3x	0.243	95%	0.105
St. Diam.	Pi ba - V - B	52	13.705 + 0.005 248 7x	0.230	90%	0.100
Cr. Vol.	Pi ba - V - I	20	146.10 + 0.427 03x	0.230	75%	0.038
St. Diam.	Pi ba - V - I	20	12.572 + 0.009 748 5x	0.212	75%	0.035
Cr. Area	Pi ba - W - B	52	0.39443 + 0.000 096 594x	0.210	90%	0.091
Ht.	Pi ba - V - I	20	117.58 + 0.077 567x	0.210	75%	0.035
Cr. Vol.	Pi ba - W - B	52	184.01 + 0.053 186x	0.200	90%	0.087
Ht. Incr.	Pi ba - V - I	20	43.925 + 0.034 577x	0.197	75%	0.033
Cr. Area	Pi ba - C - B	52	0.36814 + 0.022 840x	0.195	90%	0.084
Dry Wt.	Pi ba - W - B	52	369.60 + 0.053 232x	0.195	90%	0.084
St. Diam.	Pi ba - W - O	46	14.149 + 0.001 414 8x	0.192	90%	0.074
St. Vol.	Pi ba - V - O	46	163.31 + 0.164 43x	0.192	90%	0.074
St. Diam.	Pi ba - C - O	46	13.657 + 0.389 75x	0.190	75%	0.073
Dry Wt.	Pi ba - V - I	20	340.51 + 0.307 97x	0.187	75%	0.031
Cr. Vol.	Pi ba - C - B	52	170.46 + 12.34x	0.182	90%	0.079
Cr. Area	Pi ba - V - I	20	0.34330 + 0.000 582 17x	0.182	75%	0.030
Dry Wt.	Pi ba - C - B	52	356.82 + 12.149x	0.176	75%	0.076
Ht.	Pi ba - W - B	52	124.56 + 0.007 912 3x	0.170	75%	0.074
St. Vol.	Pi ba - V - B	52	167.61 + 0.114 06x	0.155	75%	0.067
Ht.	Pi ba - C - B	52	123.47 + 1.599 8x	0.134	75%	0.058

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	Pi ba - W - B	52	14.224 + 0.000 864 84x	0.130	75%	0.056
St. Vol.	Pi ba - C - O	46	164.58 + 8.577 8x	0.130	75%	0.050
St. Vol.	Pi ba - W - O	46	178.62 + 0.025 82x	0.110	75%	0.042
Cr. Vol.	Pi ba - C - I	20	159.84 + 13.824x	0.105	<75%	0.017
Dry Wt.	Pi ba - C - I	20	345.29 + 12.301x	0.105	<75%	0.017
Cr. Vol.	Pi ba - W - I	20	169.93 + 0.067 122x	0.095	<75%	0.016
Dry Wt.	Pi ba - W - I	20	355.34 + 0.056 18x	0.089	<75%	0.015
St. Diam.	Pi ba - C - B	52	14.281 + 0.129 43x	0.077	<75%	0.034
Cr. Area	Pi ba - C - I	20	0.36743 + 0.016 397x	0.071	<<75%	0.012
Cr. Area	Pi ba - W - I	20	0.37794 + 0.000 084 427x	0.071	<<75%	0.012
St. Vol.	Pi ba - W - B	52	182.24 + 0.013 638x	0.063	<75%	0.027
St. Vol.	Pi ba - C - B	52	182.69 + 2.158 9x	0.045	<<75%	0.019
Ht. Incr.	Pi ba - W - I	20	46.492 + 0.003 330 7x	0.045	<<75%	0.007
Ht. Incr.	Pi ba - C - I	20	46.853 + 0.294 12x	0.032	<<75%	0.005
St. Diam.	Pi ba - C - I	20	14.261 - 0.309 56x	-0.095	<75%	0.016
St. Diam.	Pi ba - W - I	20	13.799 - 0.000 722 36x	-0.045	<<75%	0.007
Ht.	Pi ba - C - I	20	125.15 + 0.205 88x	0.000	<<75%	0.000
Ht.	Pi ba - W - I	20	125.22 + 0.001 271x	0.000	<<75%	0.000
St. Vol.	Pi ba - C - I	20	164.70 - 1.105 9x	-0.000	<<75%	0.000
St. Vol.	Pi ba - W - I	20	159.25 + 0.009 962 2x	0.000	<<75%	0.000
Cr. Vol.	Be pa - H - O	31	433.97 - 1.110 6x	-0.332	95%	0.086
Cr. Area	Be pa - H - O	31	0.78181 - 0.001 774 3x	-0.327	95%	0.085
St. Diam.	Be pa - H - O	31	20.041 - 0.024 909x	-0.321	95%	0.083
Cr. Vol.	Be pa - W - O	31	339.06 - 0.092 373x	-0.308	95%	0.080
St. Diam.	Be pa - W - O	31	17.921 - 0.002 085 8x	-0.300	90%	0.078
Cr. Area	Be pa - W - O	31	0.62820 - 0.000 144 13x	-0.298	90%	0.077
Dry Wt.	Be pa - H - O	31	557.90 - 0.827 73x	-0.281	90%	0.073
Ht.	Be pa - W - O	31	146.58 - 0.011 61x	-0.249	90%	0.064
Dry Wt.	Be pa - W - O	31	483.56 - 0.062 639x	-0.239	90%	0.062
Cr. Vol.	Be pa - W - B	34	307.01 - 0.046 384x	-0.237	90%	0.067
Cr. Area	Be pa - W - B	34	0.57247 - 0.000 069 277x	-0.219	75%	0.062
Cr. Vol.	Be pa - H - B	34	358.25 - 0.734 06x	-0.214	75%	0.061

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	Be pa - W - B	34	17.010 - 0.001 001 8x	-0.210	75%	0.059
Cr. Area	Be pa - H - B	34	0.65326 - 0.001 130 4x	-0.205	75%	0.058
St. Diam.	Be pa - H - B	34	17.948 - 0.014 501x	-0.176	75%	0.050
Dry Wt.	Be pa - H - B	34	493.59 - 0.498 86x	-0.167	75%	0.047
St. Diam.	Be pa - V - O	31	17.657 - 0.002 006 8x	-0.167	75%	0.043
Ht.	Be pa - W - B	34	141.51 - 0.005 182 2x	-0.164	75%	0.047
Cr. Vol.	Be pa - V - O	31	324.84 - 0.083 468x	-0.161	75%	0.042
Dry Wt.	Be pa - W - B	34	454.75 - 0.026 933x	-0.158	75%	0.045
Ht.	Be pa - H - O	31	150.88 - 0.082 571x	-0.158	75%	0.041
St. Vol.	Be pa - W - O	31	237.67 - 0.028 997x	-0.134	75%	0.035
Ht.	Be pa - V - O	31	144.36 - 0.009 583 9x	-0.118	<75%	0.031
St. Diam.	Be pa - W - I	28	15.805 - 0.000 970 13x	-0.118	<75%	0.028
St. Vol.	Be pa - H - O	31	257.66 - 0.275 4x	-0.114	<75%	0.029
Cr. Area	Be pa - V - O	31	0.58945 - 0.000 095 155x	-0.114	<75%	0.029
Cr. Area	Be pa - H - I	28	0.52220 - 0.000 532 93x	-0.114	<75%	0.027
Cr. Vol.	Be pa - H - I	28	265.27 - 0.315 64x	-0.114	<75%	0.027
Cr. Vol.	Be pa - V - B	34	289.11 - 0.030 811x	-0.110	<75%	0.031
St. Diam.	Be pa - H - I	28	16.439 - 0.007 973 6x	-0.105	<75%	0.024
St. Diam.	Be pa - V - B	34	16.605 - 0.000 640 02x	-0.095	<75%	0.027
Cr. Vol.	Be pa - W - I	28	235.86 - 0.028 166x	-0.095	<75%	0.022
Dry Wt.	Be pa - H - I	28	442.93 - 0.274 97x	-0.095	<75%	0.022
Cr. Area	Be pa - W - I	28	0.47114 - 0.000 044 236x	-0.084	<75%	0.020
Ht.	Be pa - V - B	34	139.25 - 0.003 083 1x	-0.071	<75%	0.020
St. Vol.	Be pa - W - B	34	217.83 - 0.009 840 5x	-0.071	<75%	0.020
Ht.	Be pa - H - B	34	141.31 - 0.034 668x	-0.063	<75%	0.018
Cr. Area	Be pa - V - B	34	0.53348 - 0.000 029 414x	-0.063	<75%	0.018
Ht. Incr.	Be pa - H - I	28	48.657 - 0.011 028x	-0.063	<<75%	0.015
Ht.	Be pa - C - B	34	138.65 - 0.14x	-0.045	<<75%	0.013
St. Vol.	Be pa - H - B	34	222.71 - 0.107 83x	-0.045	<<75%	0.013
Ht.	Be pa - W - I	28	133.34 - 0.002 415 2x	-0.045	<<75%	0.010
St. Diam.	Be pa - V - I	28	15.565 - 0.000 450 79x	-0.045	<<75%	0.010
Cr. Vol.	Be pa - C - B	34	274.61 - 0.688 96x	-0.032	<<75%	0.009

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht.	Be pa - C - O	31	141.10 - 0.167 94x	-0.032	<<75%	0.008
Dry Wt.	Be pa - V - O	31	453.80 - 0.014 001x	-0.032	<<75%	0.008
Ht.	Be pa - C - I	28	133.57 - 0.2x	-0.032	<<75%	0.007
Dry Wt.	Be pa - W - I	28	411.48 - 0.010 718x	-0.032	<<75%	0.007
Ht. Incr.	Be pa - C - O	31	43.462 + 0.446 87x	0.202	75%	0.052
Dry Wt.	Be pa - C - O	31	402.68 + 5.947 5x	0.176	75%	0.045
Dry Wt.	Be pa - C - I	28	376.67 + 4.846 9x	0.152	75%	0.035
Dry Wt.	Be pa - C - B	34	397.84 + 2.782 4x	0.148	75%	0.042
Ht. Incr.	Be pa - V - O	31	44.838 + 0.004 169 7x	0.141	75%	0.037
Ht. Incr.	Be pa - C - B	34	44.705 + 0.167 19x	0.138	75%	0.039
Ht. Incr.	Be pa - V - B	34	45.498 + 0.001 636 2x	0.100	<75%	0.028
St. Vol.	Be pa - C - I	28	178.63 + 2.367x	0.089	<75%	0.021
St. Vol.	Be pa - V - I	28	182.87 + 0.028 272x	0.089	<75%	0.021
Dry Wt.	Be pa - V - I	28	394.20 + 0.034 179x	0.084	<75%	0.020
St. Vol.	Be pa - C - B	34	194.72 + 1.210 1x	0.077	<75%	0.022
St. Vol.	Be pa - C - O	31	204.38 + 2.198 3x	0.077	<75%	0.020
Cr. Area	Be pa - C - O	31	0.51164 + 0.004 393 1x	0.071	<75%	0.018
St. Vol.	Be pa - V - B	34	201.68 + 0.010 2x	0.055	<<75%	0.016
Cr. Area	Be pa - C - I	28	0.43579 + 0.002 673x	0.045	<<75%	0.010
Ht. Incr.	Be pa - H - B	34	46.044 + 0.005 284 8x	0.032	<<75%	0.009
Ht. Incr.	Be pa - W - B	34	46.481 + 0.000 256 41x	0.032	<<75%	0.009
Cr. Area	Be pa - C - B	34	0.49793 + 0.001 155 5x	0.032	<<75%	0.009
Ht. Incr.	Be pa - H - O	31	46.200 + 0.004 531 2x	0.032	<<75%	0.008
Ht. Incr.	Be pa - V - I	28	46.993 + 0.000 591 13x	0.032	<<75%	0.007
Cr. Vol.	Be pa - C - O	31	286.01 - 0.076 772x	-0.000	<<75%	0.000
Ht.	Be pa - H - I	28	132.84 - 0.003 962x	-0.000	<<75%	0.000
Ht.	Be pa - V - I	28	132.51 - 0.000 511 87x	-0.000	<<75%	0.000
St. Diam.	Be pa - C - B	34	16.077 + 0.004 657x	0.000	<<75%	0.000
Dry Wt.	Be pa - V - B	34	427.38 + 0.005 108 5x	0.000	<<75%	0.000
Ht. Incr.	Be pa - W - O	31	46.736 + 0.000 120 75x	0.000	<<75%	0.000
St. Diam.	Be pa - C - O	31	16.677 + 0.004 385 8x	0.000	<<75%	0.000
St. Vol.	Be pa - V - O	31	217.63 + 0.006 769 5x	0.000	<<75%	0.000

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Be pa - C - I	28	46.980 + 0.037 449x	0.000	<<75%	0.000
Ht. Incr.	Be pa - W - I	28	47.167 + 0.000 111 32x	0.000	<<75%	0.000
St. Diam.	Be pa - C - I	28	15.348 + 0.007 734 1x	0.000	<<75%	0.000
St. Vol.	Be pa - H - I	28	190.38 + 0.023 301x	0.000	<<75%	0.000
St. Vol.	Be pa - W - I	28	191.66 + 0.004 198 2x	0.000	<<75%	0.000
Cr. Area	Be pa - V - I	28	0.44813 + 0.000 011 695x	0.000	<<75%	0.000
Cr. Vol.	Be pa - C - I	28	219.96 + 0.644 96x	0.000	<<75%	0.000
Cr. Vol.	Be pa - V - I	28	224.10 - 0.000 29x	-0.000	<<75%	0.000
St. Diam.	Ac sp - C - I	20	14.009 - 0.292 43x	-0.510	97.5%	0.085
Cr. Area	Ac sp - C - I	20	0.362 35 - 0.013 859x	-0.488	97.5%	0.081
Cr. Area	Ac sp - V - I	20	0.342 19 - 0.000 154 84x	-0.477	97.5%	0.080
Ht. Incr.	Ac sp - C - I	20	48.078 - 0.814 48x	-0.467	97.5%	0.078
St. Diam.	Ac sp - V - I	20	13.474 - 0.003 001 2x	-0.458	97.5%	0.076
St. Diam.	Ac sp - C - B	33	14.672 - 0.149x	-0.431	99%	0.119
Cr. Area	Ac sp - W - I	20	0.325 11 - 0.000 055 177x	-0.428	95%	0.071
Cr. Vol.	Ac sp - C - I	20	156.61 - 6.252 7x	-0.425	95%	0.071
Cr. Vol.	Ac sp - V - I	20	147.30 - 0.069 339x	-0.414	95%	0.069
St. Diam.	Ac sp - C - O	30	14.844 - 0.249 91x	-0.405	97.5%	0.101
Dry Wt.	Ac sp - V - I	20	333.70 - 0.058 727x	-0.400	95%	0.067
Dry Wt.	Ac sp - C - I	20	340.17 - 5.061 7x	-0.394	95%	0.066
St. Diam.	Ac sp - V - B	33	14.225 - 0.001 593 5x	-0.387	97.5%	0.107
Cr. Area	Ac sp - C - B	33	0.421 91 - 0.008 168 9x	-0.385	97.5%	0.106
St. Diam.	Ac sp - W - I	20	13.084 - 0.000 998 72x	-0.383	95%	0.064
Ht. Incr.	Ac sp - C - B	33	48.262 - 0.385 41x	-0.373	97.5%	0.103
Cr. Area	Ac sp - C - O	30	0.435 39 - 0.014 154x	-0.369	97.5%	0.092
St. Diam.	Ac sp - V - O	30	14.304 - 0.002 694 6x	-0.366	97.5%	0.092
Cr. Vol.	Ac sp - W - I	20	139.47 - 0.024 488x	-0.366	90%	0.061
Cr. Area	Ac sp - V - B	33	0.400 49 - 0.000 092 188x	-0.365	97.5%	0.100
Dry Wt.	Ac sp - W - I	20	327.59 - 0.021 35x	-0.365	90%	0.061
Ht. Incr.	Ac sp - V - I	20	46.110 - 0.007 196 8x	-0.362	90%	0.060
Cr. Area	Ac sp - V - O	30	0.409 12 - 0.000 162 65x	-0.356	95%	0.089
St. Vol.	Ac sp - C - I	20	126.63 - 3.810 1x	-0.355	90%	0.059

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Ac sp - C - O	30	48.274 - 0.649 87x	-0.349	95%	0.087
Ht.	Ac sp - C - I	20	122.41 - 1.605 8x	-0.348	90%	0.058
Cr. Vol.	Ac sp - C - B	33	188.24 - 3.936 8x	-0.346	97.5%	0.095
Cr. Area	Ac sp - H - O	30	0.579 36 - 0.001 884 8x	-0.345	95%	0.086
St. Vol.	Ac sp - C - B	33	167.10 - 3.259x	-0.344	95%	0.094
St. Vol.	Ac sp - V - I	20	120.82 - 0.041 908x	-0.342	90%	0.057
St. Vol.	Ac sp - C - O	30	170.82 - 5.719 2x	-0.342	95%	0.086
Ht.	Ac sp - C - B	33	123.70 - 0.782 81x	-0.341	95%	0.094
Dry Wt.	Ac sp - H - O	30	469.99 - 0.980 33x	-0.339	95%	0.085
Cr. Vol.	Ac sp - C - O	30	193.84 - 6.856 2x	-0.336	95%	0.084
Dry Wt.	Ac sp - C - O	30	391.34 - 6.811x	-0.335	95%	0.084
Dry Wt.	Ac sp - C - B	33	381.48 - 3.732 9x	-0.335	95%	0.092
St. Diam.	Ac sp - W - B	33	13.925 - 0.000 561 65x	-0.332	95%	0.091
Dry Wt.	Ac sp - V - O	30	379.44 - 0.079 971x	-0.330	95%	0.083
Cr. Area	Ac sp - W - B	33	0.384 99 - 0.000 033 927x	-0.326	95%	0.090
Cr. Vol.	Ac sp - V - B	33	177.29 - 0.043 445x	-0.321	95%	0.088
Dry Wt.	Ac sp - V - B	33	372.07 - 0.042 714x	-0.321	95%	0.088
Cr. Area	Ac sp - W - O	30	0.390 95 - 0.000 061 062x	-0.321	95%	0.080
Dry Wt.	Ac sp - H - I	20	371.40 - 0.465 92x	-0.319	90%	0.053
St. Diam.	Ac sp - W - O	30	13.966 - 0.000 968 64x	-0.316	95%	0.079
Cr. Area	Ac sp - H - B	33	0.544 94 - 0.001 647 4x	-0.316	95%	0.087
Cr. Vol.	Ac sp - V - O	30	180.09 - 0.076 413x	-0.315	95%	0.079
Ht.	Ac sp - C - O	30	123.18 - 1.265 8x	-0.313	95%	0.078
St. Vol.	Ac sp - V - O	30	158.65 - 0.062 143x	-0.313	95%	0.078
St. Vol.	Ac sp - V - B	33	157.33 - 0.034 87x	-0.308	95%	0.085
Cr. Area	Ac sp - H - I	20	0.410 24 - 0.000 992 36x	-0.308	90%	0.051
Dry Wt.	Ac sp - H - B	33	447.10 - 0.828 76x	-0.303	95%	0.083
Dry Wt.	Ac sp - W - O	30	370.70 - 0.030 246x	-0.300	90%	0.075
St. Vol.	Ac sp - H - I	20	150.65 - 0.354 54x	-0.292	75%	0.049
Dry Wt.	Ac sp - W - B	33	365.03 - 0.015 825x	-0.290	90%	0.080
St. Vol.	Ac sp - W - I	20	115.45 - 0.014 045x	-0.288	75%	0.048
Cr. Vol.	Ac sp - H - O	30	253.78 - 0.836 29x	-0.288	90%	0.072

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Ac sp - V - B	33	46.707 - 0.003 502 8x	-0.285	90%	0.078
Cr. Vol.	Ac sp - W - B	33	169.72 - 0.015 787x	-0.283	90%	0.078
Cr. Vol.	Ac sp - W - O	30	171.16 - 0.028 231x	-0.279	90%	0.070
St. Diam.	Ac sp - H - O	30	16.136 - 0.023 489x	-0.268	90%	0.067
St. Vol.	Ac sp - W - O	30	150.71 - 0.022 162x	-0.268	90%	0.067
Ht. Incr.	Ac sp - W - I	20	44.950 - 0.002 130 7x	-0.268	75%	0.045
St. Vol.	Ac sp - W - B	33	150.68 - 0.012 224x	-0.263	90%	0.072
Cr. Vol.	Ac sp - H - B	33	239.28 - 0.727 21x	-0.261	90%	0.072
St. Vol.	Ac sp - H - O	30	210.61 - 0.617 61x	-0.261	90%	0.065
Ht. Incr.	Ac sp - V - O	30	46.258 - 0.005 598 3x	-0.253	90%	0.063
Cr. Vol.	Ac sp - H - I	20	172.21 - 0.402 48x	-0.241	75%	0.040
Ht.	Ac sp - V - I	20	117.67 - 0.012 076x	-0.228	75%	0.038
St. Diam.	Ac sp - H - I	20	14.212 - 0.014 856x	-0.228	75%	0.038
St. Diam.	Ac sp - H - B	33	15.562 - 0.019 097x	-0.226	75%	0.062
Ht.	Ac sp - V - B	33	119.89 - 0.006 091 5x	-0.221	75%	0.061
Ht. Incr.	Ac sp - W - B	33	45.894 - 0.001 115 2x	-0.219	75%	0.060
St. Vol.	Ac sp - H - B	33	196.54 - 0.498 38x	-0.214	75%	0.059
Ht. Incr.	Ac sp - W - O	30	45.358 - 0.001 780 5x	-0.195	75%	0.049
Ht.	Ac sp - V - O	30	118.29 - 0.008 669 9x	-0.182	75%	0.045
Ht. Incr.	Ac sp - H - B	33	49.724 - 0.042 609x	-0.167	75%	0.046
Ht. Incr.	Ac sp - H - I	20	46.784 - 0.027 372x	-0.138	<75%	0.023
Ht.	Ac sp - W - B	33	117.81 - 0.001 426 6x	-0.126	75%	0.035
Ht.	Ac sp - H - B	33	124.03 - 0.065 148x	-0.114	<75%	0.031
Ht.	Ac sp - W - I	20	114.74 - 0.002 416 7x	-0.114	<75%	0.019
Ht. Incr.	Ac sp - H - O	30	47.363 - 0.027 644x	-0.105	<75%	0.026
Ht.	Ac sp - H - O	30	120.87 - 0.049 607x	-0.084	<75%	0.021
Ht.	Ac sp - W - O	30	115.99 - 0.001 701 8x	-0.084	<75%	0.021
Ht.	Ac sp - H - I	20	116.71 - 0.030 21x	-0.055	<<75%	0.009
St. Vol.	Al cr - C - O	18	- 18.247 + 17.183x	0.852	99.95%	0.128
St. Vol.	Al cr - V - O	18	5.3554 + 0.244 4x	0.809	99.95%	0.121
Dry Wt.	Al cr - C - O	18	224.13 + 9.383 7x	0.789	99.95%	0.118
St. Vol.	Al cr - W - O	18	16.540 + 0.119 47x	0.747	99.95%	0.112

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Vol.	Al cr - V - B	20	28.546 + 0.146 01x	0.754	99.95%	0.126
St. Diam.	Al cr - C - O	18	8.1227 + 0.492 1x	0.739	99.95%	0.111
St. Vol.	Al cr - W - B	20	30.827 + 0.078 389x	0.732	99.95%	0.122
St. Vol.	Al cr - C - B	20	23.687 + 8.411 1x	0.721	99.95%	0.120
Dry Wt.	Al cr - V - O	18	240.24 + 0.127 03x	0.713	99.95%	0.107
Cr. Area	Al cr - C - O	18	0.10447 + 0.020 193x	0.708	99.95%	0.106
Cr. Vol.	Al cr - C - O	18	25.257 + 11.903x	0.698	99.9%	0.105
St. Diam.	Al cr - V - O	18	8.9518 + 0.006 693 4x	0.671	99.75%	0.101
Dry Wt.	Al cr - W - O	18	247.40 + 0.060 65x	0.643	99.75%	0.097
Ht.	Al cr - C - O	18	86.439 + 3.020 2x	0.612	99.5%	0.092
St. Vol.	Al cr - W - I	16	55.527 + 0.169 42x	0.612	99%	0.082
Cr. Area	Al cr - V - O	18	0.14640 + 0.000 258 87x	0.606	99.5%	0.091
St. Diam.	Al cr - W - O	18	9.3384 + 0.003 185 8x	0.603	99.5%	0.090
Cr. Vol.	Al cr - V - O	18	49.498 + 0.153 54x	0.602	99.5%	0.090
St. Vol.	Al cr - V - I	16	67.285 + 0.260 78x	0.567	97.5%	0.076
Cr. Vol.	Al cr - W - O	18	58.946 + 0.072 458x	0.536	97.5%	0.080
Ht.	Al cr - V - O	18	92.286 + 0.039 567x	0.535	97.5%	0.080
Cr. Area	Al cr - W - O	18	0.16354 + 0.000 120 86x	0.534	97.5%	0.080
St. Diam.	Al cr - C - B	20	10.169 + 0.209 43x	0.505	97.5%	0.084
St. Diam.	Al cr - V - B	20	10.409 + 0.003 467 1x	0.504	97.5%	0.084
Ht.	Al cr - W - O	18	94.439 + 0.018 974x	0.485	97.5%	0.073
St. Diam.	Al cr - W - B	20	10.525 + 0.001 813 2x	0.476	97.5%	0.079
St. Vol.	Al cr - C - I	16	87.150 + 9.779 8x	0.429	95%	0.057
Dry Wt.	Al cr - V - B	20	276.32 + 0.059 378x	0.402	95%	0.067
St. Diam.	Al cr - W - I	16	11.547 + 0.003 609x	0.400	90%	0.053
Dry Wt.	Al cr - C - B	20	273.71 + 3.469 7x	0.390	95%	0.065
Ht. Incr.	Al cr - C - O	18	36.856 + 0.454 81x	0.390	90%	0.058
Ht.	Al cr - C - B	20	99.712 + 1.178x	0.383	95%	0.064
Dry Wt.	Al cr - W - B	20	278.59 + 0.030 841x	0.378	95%	0.063
Ht.	Al cr - V - B	20	101.44 + 0.018 974x	0.373	90%	0.062
St. Diam.	Al cr - V - I	16	11.814 + 0.005 504 4x	0.367	90%	0.049
Ht.	Al cr - W - B	20	102.00 + 0.009 981 4x	0.354	90%	0.059

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Cr. Area	Al cr - C - B	20	0.21502 + 0.007 391 3x	0.348	90%	0.058
Cr. Area	Al cr - V - B	20	0.22811 + 0.000 115 83x	0.329	90%	0.055
Ht. Incr.	Al cr - C - B	20	37.329 + 0.219 51x	0.315	90%	0.052
Cr. Vol.	Al cr - C - B	20	94.794 + 4.129 1x	0.315	90%	0.052
Cr. Vol.	Al cr - V - B	20	101.23 + 0.065 944x	0.303	90%	0.051
Cr. Area	Al cr - W - B	20	0.23402 + 0.000 059x	0.302	90%	0.050
Ht. Incr.	Al cr - V - O	18	38.152 + 0.005 129 7x	0.293	75%	0.044
Dry Wt.	Al cr - W - I	16	294.85 + 0.060 336x	0.290	75%	0.039
St. Diam.	Al cr - C - I	16	12.177 + 0.215 06x	0.288	75%	0.038
Cr. Vol.	Al cr - W - B	20	104.26 + 0.033 849x	0.281	75%	0.047
Dry Wt.	Al cr - V - I	16	299.02 + 0.092 917x	0.268	75%	0.036
Ht. Incr.	Al cr - V - B	20	38.037 + 0.002 989 1x	0.259	75%	0.043
Ht. Incr.	Al cr - W - O	18	38.618 + 0.002 259x	0.245	75%	0.037
Ht. Incr.	Al cr - W - B	20	38.173 + 0.001 535 5x	0.241	75%	0.040
Ht.	Al cr - W - I	16	110.67 + 0.014 276x	0.232	75%	0.031
Ht.	Al cr - V - I	16	111.84 + 0.021 41x	0.210	75%	0.028
Cr. Area	Al cr - W - I	16	0.28472 + 0.000 100 61x	0.205	75%	0.027
Cr. Vol.	Al cr - W - I	16	127.87 + 0.060 938x	0.200	75%	0.027
Cr. Area	Al cr - V - I	16	0.29288 + 0.000 151 2x	0.184	75%	0.025
Cr. Vol.	Al cr - V - I	16	132.88 + 0.091 381x	0.182	75%	0.024
Dry Wt.	Al cr - C - I	16	308.30 + 3.146 4x	0.182	75%	0.024
St. Vol.	Al cr - H - O	18	66.718 + 0.467 15x	0.176	75%	0.026
Ht.	Al cr - C - I	16	113.47 + 0.803 18x	0.158	<75%	0.021
Cr. Area	Al cr - C - I	16	0.30354 + 0.005 801 1x	0.145	<75%	0.019
St. Vol.	Al cr - H - B	20	89.566 + 0.344 24x	0.134	<75%	0.022
Cr. Vol.	Al cr - C - I	16	140.30 + 3.355 9x	0.134	<75%	0.018
Dry Wt.	Al cr - H - O	18	280.22 + 0.180 98x	0.114	<75%	0.017
Ht.	Al cr - H - O	18	104.66 + 0.057 006x	0.089	<75%	0.013
St. Diam.	Al cr - H - O	18	11.542 + 0.005 836 4x	0.063	<<75%	0.009
St. Vol.	Al cr - H - I	16	128.33 + 0.173 67x	0.063	<<75%	0.008
Cr. Area	Al cr - H - I	16	0.46744 - 0.000 978 66x	-0.212	75%	0.028
Cr. Vol.	Al cr - H - I	16	230.21 - 0.528 17x	-0.184	75%	0.025

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	Al cr - H - I	16	15.574 - 0.015 504x	-0.182	75%	0.024
Ht. Incr.	Al cr - H - I	16	44.031 - 0.022 052x	-0.148	<75%	0.020
Cr. Area	Al cr - H - B	20	0.38435 - 0.000 606 47x	-0.130	<75%	0.022
Ht.	Al cr - H - I	16	127.85 - 0.071 067x	-0.122	<75%	0.016
Cr. Vol.	Al cr - H - B	20	189.11 - 0.336 49x	-0.114	<75%	0.019
Ht. Incr.	Al cr - H - O	18	42.816 - 0.016 01x	-0.105	<75%	0.016
Ht. Incr.	Al cr - H - B	20	41.676 - 0.012 45x	-0.084	<75%	0.014
St. Diam.	Al cr - H - B	20	13.503 - 0.005 248 5x	-0.055	<<75%	0.009
Cr. Area	Al cr - H - O	18	0.30100 - 0.000 190 32x	-0.055	<<75%	0.008
Dry Wt.	Al cr - H - I	16	343.47 - 0.114 15x	-0.055	<<75%	0.007
Cr. Vol.	Al cr - H - O	18	136.23 - 0.074 944x	-0.032	<<75%	0.005
Ht. Incr.	Al cr - C - I	16	41.021 + 0.025 552x	0.000	<<75%	0.000
Ht. Incr.	Al cr - W - I	16	41.102 + 0.000 152 22x	0.000	<<75%	0.000
Ht.	Al cr - H - B	20	114.97 - 0.000 988 01x	-0.000	<<75%	0.000
Dry Wt.	Al cr - H - B	20	320.01 - 0.013 988x	-0.000	<<75%	0.000
Ht. Incr.	Al cr - V - I	16	41.235 - 0.000 149 07x	-0.000	<<75%	0.000
St. Diam.	Min Wdy - W - O	60	15.282 - 0.004 374 8x	-0.288	97.5%	0.144
St. Diam.	Min Wdy - V - O	60	15.407 - 0.006 522 5x	-0.277	97.5%	0.139
Dry Wt.	Min Wdy - H - I	50	419.12 - 0.775 07x	-0.268	95%	0.112
Ht.	Min Wdy - W - O	60	131.32 - 0.028 928x	-0.266	97.5%	0.133
St. Vol.	Min Wdy - W - O	60	190.99 - 0.119 19x	-0.261	97.5%	0.130
St. Vol.	Min Wdy - V - O	60	195.06 - 0.181 93x	-0.257	97.5%	0.128
St. Diam.	Min Wdy - W - B	70	15.103 - 0.002 642 4x	-0.251	97.5%	0.146
Ht.	Min Wdy - V - O	60	132.01 - 0.042 301x	-0.251	95%	0.125
Dry Wt.	Min Wdy - V - I	50	382.51 - 0.211 07x	-0.251	95%	0.105
St. Diam.	Min Wdy - H - I	50	16.189 - 0.024 216x	-0.249	95%	0.104
Dry Wt.	Min Wdy - W - I	50	380.03 - 0.159 79x	-0.247	95%	0.103
St. Vol.	Min Wdy - C - O	60	210.38 - 11.806x	-0.245	95%	0.122
St. Vol.	Min Wdy - W - B	70	184.66 - 0.072 228x	-0.237	97.5%	0.138
St. Diam.	Min Wdy - V - B	70	15.141 - 0.003 515 7x	-0.235	97.5%	0.137
St. Diam.	Min Wdy - C - O	60	15.767 - 0.373 08x	-0.235	95%	0.117
Ht.	Min Wdy - C - O	60	135.20 - 2.645 5x	-0.230	95%	0.115

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Vol.	Min Wdy - V - B	70	186.71 - 0.100 45x	-0.230	95%	0.134
Dry Wt.	Min Wdy - C - I	50	387.93 - 9.167 3x	-0.228	90%	0.095
St. Vol.	Min Wdy - C - B	70	196.06 - 5.601 0x	-0.226	95%	0.132
Dry Wt.	Min Wdy - C - B	70	419.84 - 6.872 0x	-0.221	95%	0.129
St. Vol.	Min Wdy - H - I	50	201.73 - 0.579 19x	-0.217	90%	0.090
Cr. Area	Min Wdy - W - O	60	0.466 18 - 0.000 209 98x	-0.214	95%	0.107
St. Diam.	Min Wdy - W - I	50	14.918 - 0.004 681 9x	-0.214	90%	0.089
Cr. Vol.	Min Wdy - W - O	60	229.59 - 0.122 53x	-0.212	90%	0.106
Cr. Area	Min Wdy - H - I	50	0.486 80 - 0.001 250 9x	-0.210	90%	0.087
St. Diam.	Min Wdy - C - B	70	15.358 - 0.177 12x	-0.207	95%	0.121
Ht.	Min Wdy - W - B	70	130.05 - 0.015 401x	-0.205	95%	0.120
Dry Wt.	Min Wdy - V - B	70	405.09 - 0.109 09x	-0.200	95%	0.117
St. Diam.	Min Wdy - C - I	50	15.160 - 0.271 31x	-0.200	90%	0.083
St. Vol.	Min Wdy - C - I	50	180.57 - 7.443 5x	-0.200	90%	0.083
Dry Wt.	Min Wdy - W - B	70	401.68 - 0.074 404x	-0.195	90%	0.114
St. Diam.	Min Wdy - V - I	50	14.909 - 0.005 563 5x	-0.195	90%	0.081
St. Vol.	Min Wdy - W - I	50	172.05 - 0.116 48x	-0.195	90%	0.081
St. Vol.	Min Wdy - V - I	50	173.25 - 0.149 31x	-0.192	90%	0.080
Cr. Area	Min Wdy - W - B	70	0.455 96 - 0.000 135 34x	-0.192	90%	0.112
Cr. Area	Min Wdy - V - O	60	0.468 45 - 0.000 289 94x	-0.192	90%	0.096
Cr. Vol.	Min Wdy - V - O	60	231.40 - 0.172 18x	-0.192	90%	0.096
Cr. Vol.	Min Wdy - C - O	60	246.90 - 11.438x	-0.190	90%	0.095
Dry Wt.	Min Wdy - C - O	60	426.32 - 10.899 x	-0.190	90%	0.095
Ht.	Min Wdy - C - B	70	132.05 - 1.121 0x	-0.184	90%	0.108
Cr. Vol.	Min Wdy - W - B	70	225.02 - 0.078 791x	-0.184	90%	0.108
Ht.	Min Wdy - V - B	70	130.05 - 0.019 572x	-0.182	90%	0.106
Cr. Vol.	Min Wdy - C - B	70	237.40 - 6.101 2x	-0.176	90%	0.103
Cr. Area	Min Wdy - C - O	60	0.490 51 - 0.018 188x	-0.176	90%	0.088
Cr. Area	Min Wdy - V - B	70	0.456 59 - 0.000 174 40x	-0.173	90%	0.101
Dry Wt.	Min Wdy - W - O	60	404.93 - 0.093 474x	-0.170	90%	0.085
Cr. Area	Min Wdy - C - B	70	0.472 53 - 0.009 673 6x	-0.167	90%	0.098
Cr. Vol.	Min Wdy - V - B	70	225.77 - 0.103 18x	-0.167	90%	0.098

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Dry Wt.	Min Wdy - V - O	60	408.12 - 0.142 63x	-0.167	75%	0.084
St. Diam.	Min Wdy - H - B	70	15.599 - 0.014 499x	-0.158	90%	0.092
Cr. Vol.	Min Wdy - H - I	50	234.93 - 0.599 40x	-0.158	75%	0.066
Cr. Area	Min Wdy - W - I	50	0.415 30 - 0.000 205 11x	-0.152	75%	0.063
St. Diam.	Min Wdy - H - O	60	15.493 - 0.012 647x	-0.145	75%	0.072
Cr. Vol.	Min Wdy - W - I	50	204.15 - 0.120 13x	-0.141	75%	0.059
Ht.	Min Wdy - C - I	50	130.15 - 1.404 7x	-0.134	75%	0.056
Cr. Area	Min Wdy - V - I	50	0.413 55 - 0.000 233 68x	-0.134	75%	0.056
Cr. Vol.	Min Wdy - C - I	50	210.94 - 7.128 6x	-0.134	75%	0.056
Cr. Vol.	Min Wdy - V - I	50	203.72 - 0.141 41x	-0.130	75%	0.054
Cr. Area	Min Wdy - C - I	50	0.419 39 - 0.010 106x	-0.122	75%	0.051
St. Vol.	Min Wdy - H - B	70	190.46 - 0.307 87x	-0.114	75%	0.067
St. Vol.	Min Wdy - H - O	60	192.79 - 0.300 62x	-0.114	75%	0.057
Ht.	Min Wdy - W - I	50	127.71 - 0.016 728x	-0.100	75%	0.042
Ht. Incr.	Min Wdy - W - O	60	47.382 - 0.003 635 7x	-0.095	75%	0.047
Ht.	Min Wdy - V - I	50	127.41 - 0.017 917x	-0.084	<75%	0.035
Ht. Incr.	Min Wdy - V - O	60	47.265 - 0.004 048 1x	-0.071	<75%	0.035
Ht. Incr.	Min Wdy - W - B	70	46.977 - 0.001 476 1x	-0.055	<75%	0.032
Cr. Area	Min Wdy - H - B	70	0.443 99 - 0.000 317 03x	-0.055	<75%	0.032
Cr. Vol.	Min Wdy - H - B	70	215.54 - 0.155 90x	-0.045	<75%	0.026
Ht.	Min Wdy - H - O	60	127.73 - 0.027 864x	-0.045	<75%	0.022
Ht. Incr.	Min Wdy - C - O	60	47.234 - 0.163 90x	-0.045	<75%	0.022
Cr. Area	Min Wdy - H - O	60	0.442 37 - 0.000 227 73x	-0.045	<75%	0.022
Ht.	Min Wdy - H - I	50	127.62 - 0.030 952x	-0.045	<<75%	0.019
Ht.	Min Wdy - H - B	70	127.30 - 0.020 367x	-0.032	<<75%	0.018
Ht. Incr.	Min Wdy - C - B	70	46.952 - 0.070 123x	-0.032	<<75%	0.018
Ht. Incr.	Min Wdy - V - B	70	46.812 - 0.001 158 5x	-0.032	<<75%	0.018
Dry Wt.	Min Wdy - H - B	70	389.18 - 0.106 92x	-0.032	<<75%	0.018
Cr. Vol.	Min Wdy - H - O	60	212.98 - 0.102 57x	-0.032	<<75%	0.016
Ht. Incr.	Min Wdy - V - I	50	45.313 + 0.004 436 1x	0.063	<75%	0.026
Ht. Incr.	Min Wdy - H - B	70	45.651 + 0.010 153x	0.045	<75%	0.026
Ht. Incr.	Min Wdy - W - I	50	45.523 + 0.002 364 7x	0.045	<<75%	0.019

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Ht. Incr.	Min Wdy - C - I	50	45.618 + 0.077 357x	0.032	<<75%	0.013
Ht. Incr.	Min Wdy - H - O	60	46.595 + 0.000 245 6x	0.000	<<75%	0.000
Dry Wt.	Min Wdy - H - O	60	388.29 - 0.033 838x	-0.000	<<75%	0.000
Ht. Incr.	Min Wdy - H - I	50	46.202 - 0.003 623 9x	-0.000	<<75%	0.000
Cr. Area	All Wdy - C - I	118	0.601 67 - 0.010 185x	-0.359	99.95%	0.353
Cr. Area	All Wdy - C - B	120	0.635 34 - 0.005 291 4x	-0.345	99.95%	0.345
Dry Wt.	All Wdy - C - I	118	477.75 - 5.297x	-0.344	99.95%	0.338
St. Diam.	All Wdy - C - I	118	16.914 - 0.146 16x	-0.335	99.95%	0.329
Dry Wt.	All Wdy - C - B	120	496.08 - 2.755 6x	-0.330	99.95%	0.330
Cr. Vol.	All Wdy - C - I	118	295.99 - 5.299x	-0.315	99.95%	0.309
Cr. Vol.	All Wdy - C - B	120	314.69 - 2.797 3x	-0.310	99.95%	0.310
St. Diam.	All Wdy - C - B	120	17.215 - 0.071 911x	-0.305	99.95%	0.305
Ht. Incr.	All Wdy - C - I	118	52.466 - 0.335 2x	-0.297	99.95%	0.292
Cr. Area	All Wdy - C - O	120	0.603 91 - 0.007 853x	-0.281	99.9%	0.281
Dry Wt.	All Wdy - C - O	120	477.78 - 4.001 2x	-0.263	99.75%	0.263
Cr. Vol.	All Wdy - C - O	120	301.41 - 4.303 4x	-0.261	99.75%	0.261
St. Vol.	All Wdy - C - I	118	231.53 - 3.362 4x	-0.259	99.75%	0.255
St. Diam.	All Wdy - C - O	120	16.708 - 0.103 12x	-0.241	99.5%	0.241
St. Vol.	All Wdy - C - B	120	238.20 - 1.641 6x	-0.237	99.5%	0.237
Ht. Incr.	All Wdy - C - B	120	52.054 - 0.143x	-0.235	99.5%	0.235
Cr. Area	All Wdy - V - B	120	0.518 11 - 0.000 044 165x	-0.230	99%	0.230
Dry Wt.	All Wdy - V - B	120	435.09 - 0.023 03x	-0.219	99%	0.219
Cr. Area	All Wdy - V - O	120	0.521 24 - 0.000 078 805x	-0.217	99%	0.217
Cr. Area	All Wdy - V - I	118	0.494 52 - 0.000 077 12x	-0.217	99%	0.213
Ht.	All Wdy - C - I	118	136.54 - 0.633 26x	-0.212	99%	0.209
Dry Wt.	All Wdy - V - I	118	422.82 - 0.041 066x	-0.212	99%	0.209
Dry Wt.	All Wdy - V - O	120	434.86 - 0.039 455x	-0.200	97.5%	0.200
St. Diam.	All Wdy - V - B	120	15.554 - 0.000 565 81x	-0.192	97.5%	0.192
Cr. Area	All Wdy - W - O	120	0.496 77 - 0.000 035 34x	-0.192	97.5%	0.192
Cr. Area	All Wdy - W - B	120	0.488 91 - 0.000 018 254x	-0.192	97.5%	0.192
Dry Wt.	All Wdy - W - B	120	421.12 - 0.009 916 7x	-0.192	97.5%	0.192
St. Diam.	All Wdy - V - I	118	15.333 - 0.001 054 7x	-0.192	97.5%	0.189

Pj Param. (y)	Spp/SG-M-R (x)	nj	Correlation Equation y =	r	Conf. Level	Rel. Index
Cr. Vol.	All Wdy - V - B	120	248.07 - 0.020 974x	-0.184	97.5%	0.184
St. Vol.	All Wdy - C - O	120	225.40 - 2.297 2x	-0.182	97.5%	0.182
Cr. Vol.	All Wdy - V - O	120	251.46 - 0.039 091x	-0.182	97.5%	0.182
Dry Wt.	All Wdy - W - O	120	423.17 - 0.017 998x	-0.182	97.5%	0.182
Dry Wt.	All Wdy - W - I	118	411.09 - 0.017 133x	-0.182	97.5%	0.179
Ht.	All Wdy - C - B	120	136.51 - 0.286 66x	-0.179	95%	0.179
Ht. Incr.	All Wdy - C - O	120	50.926 - 0.199 49x	-0.179	95%	0.179
St. Diam.	All Wdy - V - O	120	15.551 - 0.000 971 97x	-0.173	95%	0.173
Cr. Area	All Wdy - W - I	118	0.469 66 - 0.000 030 012x	-0.173	95%	0.170
Cr. Vol.	All Wdy - V - I	118	236.36 - 0.035 469x	-0.167	95%	0.165
Cr. Vol.	All Wdy - W - O	120	237.97 - 0.016 796x	-0.155	95%	0.155
Cr. Vol.	All Wdy - W - B	120	232.70 - 0.008 187 7x	-0.148	90%	0.148
Ht.	All Wdy - C - O	120	134.62 - 0.416 74x	-0.141	90%	0.141
St. Diam.	All Wdy - W - B	120	15.089 - 0.000 204 97x	-0.141	90%	0.141
St. Diam.	All Wdy - W - O	120	15.161 - 0.000 387 92x	-0.138	90%	0.138
St. Diam.	All Wdy - W - I	118	14.919 - 0.000 354 8x	-0.134	90%	0.132
Cr. Vol.	All Wdy - W - I	118	223.55 - 0.012 763x	-0.126	90%	0.124
Ht. Incr.	All Wdy - V - I	118	48.169 - 0.001 614 6x	-0.114	75%	0.112
St. Vol.	All Wdy - V - B	120	191.67 - 0.008 513 7x	-0.100	75%	0.100
St. Vol.	All Wdy - V - I	118	188.85 - 0.016 709x	-0.100	75%	0.098
St. Vol.	All Wdy - V - O	120	190.43 - 0.013 565x	-0.084	75%	0.084
Ht. Incr.	All Wdy - V - B	120	47.637 - 0.000 555 49x	-0.071	75%	0.071
St. Vol.	All Wdy - W - B	120	183.19 - 0.002 607 6x	-0.063	75%	0.063
St. Vol.	All Wdy - W - I	118	181.20 - 0.004 782x	-0.063	75%	0.062
Dry Wt.	All Wdy - H - I	118	409.74 - 0.195 68x	-0.063	75%	0.062
St. Vol.	All Wdy - W - O	120	183.41 - 0.004 558 2x	-0.055	<75%	0.055
Ht. Incr.	All Wdy - W - I	118	47.299 - 0.000 362 51x	-0.055	<75%	0.054
St. Diam.	All Wdy - H - I	118	14.984 - 0.004 906 1x	-0.055	<75%	0.054
Cr. Area	All Wdy - H - I	118	0.466 06 - 0.000 331 45x	-0.055	<75%	0.054
Ht. Incr.	All Wdy - V - O	120	47.327 - 0.000 683 27x	-0.045	<75%	0.045
Cr. Area	All Wdy - H - O	120	0.463 51 - 0.000 263 9x	-0.045	<75%	0.045
Cr. Area	All Wdy - H - B	120	0.456 08 - 0.000 210 21x	-0.032	<75%	0.032

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
Dry Wt.	All Wdy - H - O	120	404.73 - 0.121 94x	-0.032	<75%	0.032
Dry Wt.	All Wdy - H - B	120	404.43 - 0.124 14x	-0.032	<75%	0.032
Cr. Vol.	All Wdy - H - I	118	215.84 - 0.083 85x	-0.032	<75%	0.031
Ht. Incr.	All Wdy - H - O	120	40.017 + 0.054 146x	0.214	99%	0.214
Ht. Incr.	All Wdy - H - B	120	40.787 + 0.049 629x	0.190	97.5%	0.190
Ht.	All Wdy - H - O	120	112.03 + 0.111 44x	0.167	95%	0.167
Ht.	All Wdy - H - B	120	112.20 + 0.114 28x	0.164	95%	0.164
Ht.	All Wdy - H - I	118	119.44 + 0.059 449x	0.100	75%	0.098
St. Vol.	All Wdy - H - O	120	143.46 + 0.261 52x	0.089	75%	0.089
St. Vol.	All Wdy - H - B	120	146.87 + 0.242 3x	0.077	75%	0.077
Ht. Incr.	All Wdy - H - I	118	45.348 + 0.013 614x	0.055	<75%	0.054
Ht.	All Wdy - W - B	120	124.05 + 0.000 455 03x	0.045	<75%	0.045
Ht.	All Wdy - W - I	118	124.77 + 0.000 844 07x	0.045	<75%	0.044
Ht.	All Wdy - W - O	120	124.36 + 0.000 607 89x	0.032	<75%	0.032
St. Vol.	All Wdy - H - I	118	165.71 + 0.084 892x	0.032	<75%	0.031
Ht.	All Wdy - V - B	120	125.79 - 0.000 158 87x	-0.000	<<75%	0.000
Ht. Incr.	All Wdy - W - O	120	46.473 + 0.000 041 755x	0.000	<<75%	0.000
Ht. Incr.	All Wdy - W - B	120	46.739 - 0.000 060 222x	-0.000	<<75%	0.000
St. Diam.	All Wdy - H - O	120	14.567 - 0.001 000 9x	-0.000	<<75%	0.000
St. Diam.	All Wdy - H - B	120	14.669 - 0.001 917 9x	-0.000	<<75%	0.000
Cr. Vol.	All Wdy - H - O	120	214.23 - 0.059 756x	-0.000	<<75%	0.000
Cr. Vol.	All Wdy - H - B	120	208.39 - 0.011 788x	-0.000	<<75%	0.000
Ht.	All Wdy - V - I	118	126.39 - 0.000 604 09x	-0.000	<<75%	0.000
Ht.	All Wdy - V - O	120	125.96 - 0.000 430 61x	-0.000	<<75%	0.000
Cr. Area	All Veg - C - I	120	0.986 89 - 0.018 234x	-0.572	99.95%	0.572
Cr. Area	All Veg - C - B	120	1.103 9 - 0.009 927 9x	-0.545	99.95%	0.545
Ht. Incr.	All Veg - C - I	120	67.450 - 0.686 37x	-0.544	99.95%	0.544
Dry Wt.	All Veg - C - I	120	676.27 - 9.400 6x	-0.542	99.95%	0.542
Cr. Vol.	All Veg - C - I	120	513.81 - 10.075x	-0.537	99.95%	0.537
Ht. Incr.	All Veg - C - B	120	72.531 - 0.383 67x	-0.532	99.95%	0.532
Dry Wt.	All Veg - C - B	120	745.21 - 5.245 3x	-0.529	99.95%	0.529
Cr. Vol.	All Veg - C - B	120	588.75 - 5.637 2x	-0.525	99.95%	0.525

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	All Veg - C - I	120	21.166 - 0.220 67x	-0.452	99.95%	0.452
Ht.	All Veg - C - I	120	170.04 - 1.463 7x	-0.440	99.95%	0.440
Ht. Incr.	All Veg - C - O	120	67.990 - 0.575 33x	-0.420	99.95%	0.420
Dry Wt.	All Veg - C - O	120	682.39 - 7.845 5x	-0.416	99.95%	0.416
Cr. Vol.	All Veg - C - O	120	522.47 - 8.464 7x	-0.415	99.95%	0.415
Cr. Area	All Veg - C - O	120	0.965 61 - 0.014 328x	-0.414	99.95%	0.414
Ht.	All Veg - C - B	120	177.99 - 0.775 52x	-0.409	99.95%	0.409
St. Vol.	All Veg - C - I	120	351.04 - 5.781x	-0.400	99.95%	0.400
St. Diam.	All Veg - C - B	120	22.001 - 0.111 57x	-0.399	99.95%	0.399
St. Vol.	All Veg - C - B	120	388.31 - 3.149 8x	-0.381	99.95%	0.381
Ht.	All Veg - C - O	120	165.45 - 1.072 8x	-0.297	99.95%	0.297
St. Vol.	All Veg - C - O	120	344.60 - 4.550 6x	-0.290	99.9%	0.290
Cr. Area	All Veg - V - B	120	0.600 07 - 0.000 057 457x	-0.272	99.75%	0.272
Cr. Area	All Veg - V - I	120	0.564 05 - 0.000 103 44x	-0.270	99.75%	0.270
St. Diam.	All Veg - C - O	120	19.752 - 0.142 37x	-0.268	99.75%	0.268
Dry Wt.	All Veg - V - B	120	479.47 - 0.030 521x	-0.266	99.75%	0.266
Dry Wt.	All Veg - V - I	120	460.10 - 0.054 76x	-0.265	99.75%	0.265
Cr. Area	All Veg - V - O	120	0.596 94 - 0.000 100 1x	-0.241	99.5%	0.241
Dry Wt.	All Veg - V - O	120	478.18 - 0.053 399x	-0.237	99.5%	0.237
Cr. Vol.	All Veg - V - B	120	289.02 - 0.027 974x	-0.226	99%	0.226
Cr. Area	All Veg - W - B	120	0.515 55 - 0.000 021 998x	-0.221	99%	0.221
Cr. Vol.	All Veg - V - I	120	270.57 - 0.049 656x	-0.221	99%	0.221
Dry Wt.	All Veg - W - B	120	435.59 - 0.011 952x	-0.221	99%	0.221
St. Diam.	All Veg - V - I	120	16.037 - 0.001 243x	-0.212	99%	0.212
Cr. Area	All Veg - W - O	120	0.523 65 - 0.000 041 866x	-0.212	99%	0.212
Dry Wt.	All Veg - W - I	120	424.01 - 0.021 035x	-0.212	99%	0.212
Cr. Area	All Veg - W - I	120	0.491 68 - 0.000 037 138x	-0.205	97.5%	0.205
Cr. Vol.	All Veg - V - O	120	288.88 - 0.049 575x	-0.202	97.5%	0.202
Dry Wt.	All Veg - W - O	120	437.79 - 0.021 747x	-0.202	97.5%	0.202
St. Diam.	All Veg - V - B	120	16.344 - 0.000 647 34x	-0.200	97.5%	0.200
Cr. Vol.	All Veg - W - O	120	251.51 - 0.020 247x	-0.176	95%	0.176
Cr. Vol.	All Veg - W - B	120	245.87 - 0.010 188x	-0.173	95%	0.173

Pj Param. (y)	Spp/SG-M-R (x)	n_j	Correlation Equation y =	r	Conf. Level	Rel. Index
St. Diam.	All Veg V O	120	16.157 0.001 036 2x	0.164	95%	0.164
St. Diam.	All Veg - W - B	120	15.358 - 0.000 238 95x	-0.155	95%	0.155
Cr. Vol.	All Veg - W - I	120	233.63 - 0.016 467x	-0.155	95%	0.155
St. Diam.	All Veg - W - I	120	15.124 - 0.000 418 96x	-0.152	95%	0.152
Ht. Incr.	All Veg - V - I	120	49.439 - 0.002 257 6x	-0.148	90%	0.148
St. Diam.	All Veg - W - O	120	15.406 - 0.000 436 67x	-0.145	90%	0.145
St. Vol.	All Veg - V - I	120	202.55 - 0.021 519x	-0.122	90%	0.122
Ht. Incr.	All Veg - V - B	120	49.476 - 0.000 998 24x	-0.118	90%	0.118
St. Vol.	All Veg - V - B	120	206.31 - 0.010 679x	-0.110	75%	0.110
St. Vol.	All Veg - V - O	120	201.26 - 0.015 9x	-0.084	75%	0.084
St. Vol.	All Veg - W - I	120	185.64 - 0.006 575 2x	-0.077	75%	0.077
St. Vol.	All Veg - W - B	120	188.41 - 0.003 513 5x	-0.077	75%	0.077
Ht. Incr.	All Veg - V - O	120	48.522 - 0.001 194 5x	-0.071	75%	0.071
Ht. Incr.	All Veg - W - I	120	47.401 - 0.000 526 51x	-0.071	75%	0.071
St. Vol.	All Veg - W - O	120	188.06 - 0.005 937 9x	-0.063	75%	0.063
Ht. Incr.	All Veg - W - B	120	47.317 - 0.000 201 17x	-0.055	<75%	0.055
Ht.	All Veg - V - I	120	127.83 - 0.001 841 5x	-0.045	<75%	0.045
St. Diam.	All Veg - H - O	120	14.775 - 0.002 975 4x	-0.032	<75%	0.032
Cr. Area	All Veg - H - O	120	0.455 30 - 0.000 214 31x	-0.032	<75%	0.032
Ht.	All Veg - H - I	120	107.29 + 0.177 96x	0.228	99%	0.228
Ht.	All Veg - H - B	120	105.51 + 0.186 85x	0.224	99%	0.224
Ht.	All Veg - H - O	120	107.48 + 0.163 17x	0.195	97.5%	0.195
Ht. Incr.	All Veg - H - B	120	40.398 + 0.057 579x	0.182	97.5%	0.182
Ht. Incr.	All Veg - H - O	120	40.348 + 0.056 244x	0.179	95%	0.179
Ht. Incr.	All Veg - H - I	120	41.741 + 0.047 074x	0.158	95%	0.158
St. Vol.	All Veg - H - I	120	131.67 + 0.424 2x	0.126	90%	0.126
St. Vol.	All Veg - H - B	120	130.90 + 0.412 8x	0.114	75%	0.114
St. Vol.	All Veg - H - O	120	138.11 + 0.334 65x	0.095	75%	0.095
Cr. Vol.	All Veg - H - I	120	170.44 + 0.358 09x	0.084	75%	0.084
Cr. Area	All Veg - H - I	120	0.401 46 + 0.000 295 63x	0.045	<75%	0.045
Cr. Vol.	All Veg - H - B	120	182.74 + 0.227 31x	0.045	<75%	0.045
Ht.	All Veg - W - I	120	124.64 + 0.000 515 32x	0.032	<75%	0.032

Pj Param. (y)	**Spp/SG-M-R (x)**	**nj**	**Correlation Equation y =**	**r**	**Conf. Level**	**Rel. Index**
Ht.	All Veg - W - B	120	124.45 + 0.000 269 95x	0.032	<75%	0.032
St. Diam.	All Veg - H - I	120	14.104 + 0.003 350 7x	0.032	<75%	0.032
Dry Wt.	All Veg - H - I	120	376.07 + 0.136 49x	0.032	<75%	0.032
Ht.	All Veg - V - O	120	124.91 + 0.000 341 28x	0.000	<<75%	0.000
Ht.	All Veg - V - B	120	126.86 - 0.000 473 77x	-0.000	<<75%	0.000
Ht.	All Veg - W - O	120	124.50 + 0.000 443 19x	0.000	<<75%	0.000
Ht. Incr.	All Veg - W - O	120	46.913 - 0.000 165 32x	-0.000	<<75%	0.000
St. Diam.	All Veg - H - B	120	14.397 + 0.000 464 97x	0.000	<<75%	0.000
Cr. Area	All Veg - H - B	120	0.428 51 + 0.000 029 508x	0.000	<<75%	0.000
Cr. Vol.	All Veg - H - O	120	198.00 + 0.081 796x	0.000	<<75%	0.000
Dry Wt.	All Veg - H - O	120	398.89 - 0.080 449x	-0.000	<<75%	0.000
Dry Wt.	All Veg - H - B	120	388.62 + 0.013 065x	0.000	<<75%	0.000

LEGEND

Pj Param.	Jack Pine Subject Tree Parameter	**Spp/SG**	Non-Crop Species / Species Group
Ht	Height	Ep an	*Epilobium angustifolium* (fireweed)
Ht Incr.	Height increment		
St. Diam.	Stem diameter	Ca ca	*Calamagrostis canadensis* (Canada blue-joint grass)
St. Vol.	Stem volume		
Cr. Area	Crown area	Carex	sedge species
Cr. Vol.	Crown volume	Min Hrb	minor herb species
Dry Wt.	Dry weight	All Hrb	all herb species
-M-	Measurement	Ru id	*Rubus idaeus* (raspberry)
-H-	Average height	Co co	*Corylus cornuta* (beaked hazel)
-C-	Ground cover	Pr pe	*Prunus pensylvanica* (pin cherry)
-V-	Crown volume	Pi ba	*Pinus banksiana* (non-crop jack pine)
-W-	Dry Weight		
-R	Ring	Be Pa	*Betula papyrifera* (paper birch)
–I	Inner	Ac sp	*Acer spicatum* (mountain maple)
–O	Outer	Al cr	*Alnus crispa* (green alder)
–B	Both	Min Wdy	minor woody species
Conf. Level	confidence level	All Wdy	all woody species
Rel. Index	reliability index	All Veg	all vegetation (non-crop) species
nj	sample size	**r**	correlation coefficient

APPENDIX E

TOWILL AND ARCHIBALD'S (1991) COMPETITION INDEX

Plot #	*Pi ba* Ht (cm)	*Epilobium angustifolium*					*Calamagrostis canadensis*					*Carex* spp				
		Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
1	123	70	9	6.3	0.57	3.6						100	7	7.0	0.81	5.7
2	69	100	14	14.0	1.45	20.3						25	5	1.3	0.36	0.5
3	160	100	15	15.0	0.63	9.4						10	1	0.1	0.06	0.0
4	117	100	22	22.0	0.85	18.8						10	1	0.1	0.09	0.0
5	182	100	13	13.0	0.55	7.1						100	4	4.0	0.55	2.2
6	109	110	10	11.0	1.01	11.1										
7	122	140	26	36.4	1.15	41.8						20	6	1.2	0.16	0.2
8	153	130	30	39.0	0.85	33.1						40	15	6.0	0.26	1.6
9	110	90	7	6.3	0.82	5.2										
10	119	60	8	4.8	0.50	2.4						100	3	3.0	0.84	2.5
11	160	110	72	79.2	0.69	54.5						80	3	2.4	0.50	1.2
12	131	100	19	19.0	0.76	14.5										
13	147	110	32	35.2	0.75	26.3										
14	116	110	36	39.6	0.95	37.6										
15	90	120	34	40.8	1.33	54.4										
16	94	60	2	1.2	0.64	0.8						50	4	2.0	0.53	1.1
17	104	100	10	10.0	0.96	9.6						93.5	4	3.7	0.90	3.4
18	143	80	1	0.8	0.56	0.4						85	7	6.0	0.59	3.5
19	68	90	2	1.8	1.32	2.4	80	11	8.8	1.18	10.4					
20	106	84.5	12	10.1	0.80	8.1						86.5	11	9.5	0.82	7.8
21	64	92	5	4.6	1.44	6.6	50	42	21.0	0.78	16.4					

Plot	Pi ba	*Epilobium angustifolium*					*Calamagrostis canadensis*					*Carex spp*				
#	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
22	103	62.5	16	10.0	0.61	6.1										
23	78	89.5	34	30.4	1.15	34.9										
24	84	76	9	6.8	0.90	6.2						60	6	3.6	0.71	2.6
25	53	50	3	1.5	0.94	1.4						60	2	1.2	1.13	1.4
26	77	87	6	5.2	1.13	5.9	80	35	28.0	1.04	29.1					
27	138	70	22	15.4	0.51	7.8	110	18	19.8	0.80	15.8					
28	82	80	4	3.2	0.98	3.1	130	14	18.2	1.59	28.9					
29	100	89	12	10.7	0.89	9.5						110	9	9.9	1.10	10.9
30	133						130	51	66.3	0.98	64.8					
31	33															
32	113	90	1	0.9	0.80	0.7	100	2	2.0	0.88	1.8					
33	108	78	8	6.2	0.72	4.5	60	2	1.2	0.56	0.7					
34	136	116.5	46	53.6	0.86	45.9										
35	149	100.5	32	32.2	0.67	21.7										
36	179	81.5	13	10.6	0.46	4.8										
37	158	72.5	5	3.6	0.46	1.7										
38	98	107.5	7	7.5	1.10	8.3	120	5	6.0	1.22	7.3					
39	100	90	2	1.8	0.90	1.6	134.5	47	63.2	1.35	85.0					
40	90						130	60	78.0	1.44	112.7					
41	158	80	1	0.8	0.51	0.4										
42	128	72.5	9	6.5	0.57	3.7										

Plot	*Pi ba*	*Epilobium angustifolium*					*Calamagrostis canadensis*					*Carex* spp				
#	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
43	135	119	7	8.3	0.88	7.3										
44	176	116	9	10.4	0.66	6.9										
45	143															
46	172															
47	97	105	5	5.3	1.08	5.7										
48	98						130	3	3.9	1.33	5.2					
49	130	90	1	0.9	0.69	0.6										
50	152	70	1	0.7	0.46	0.3										
51	124	92	37	34.0	0.74	25.3	85	2	1.7	0.69	1.2					
52	100	95.5	15	14.3	0.96	13.7										
53	150	89.5	29	26.0	0.60	15.5	100	7	7.0	0.67	4.7					
54	127	110	32	35.2	0.87	30.5										
55	143	74.5	15	11.2	0.52	5.8	72	20	14.4	0.50	7.3					
56	97	75	16	12.0	0.77	9.3	100	12	12.0	1.03	12.4					
57	137	95	51	48.5	0.69	33.6										
58	155	83	20	16.6	0.54	8.9										
59	114	87.5	26	22.8	0.77	17.5	116	8	9.3	1.02	9.4	60	3	1.8	0.53	0.9
60	141	83	29	24.1	0.59	14.2										
61	100						90	4	3.6	0.90	3.2					
62	110															
63	94											35	12	4.2	0.37	1.6

Plot	*Pi ba*	*Epilobium angustifolium*					*Calamagrostis canadensis*					*Carex* spp				
#	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
64	124	70	1	0.7	0.56	0.4	70	14	9.8	0.56	5.5	40	3	1.2	0.32	0.4
65	113	97.5	39	38.0	0.86	32.8	105	20	21.0	0.93	19.5					
66	116	81	22	17.8	0.70	12.4						50	2	1.0	0.43	0.4
67	118	74	18	13.3	0.63	8.4	66.5	23	15.3	0.56	8.6	110	8	8.8	0.93	8.2
68	135	82.5	13	10.7	0.61	6.6	60	7	4.2	0.44	1.9					
69	131	73	10	7.3	0.56	4.1	60	14	8.4	0.46	3.8	100	2	2.0	0.76	1.5
70	110	73.5	23	16.9	0.67	11.3	74.5	15	11.2	0.68	7.6	110	4	4.4	1.00	4.4
71	87						102.5	19	19.5	1.18	22.9					
72	111	91.5	6	5.5	0.82	4.5	87	8	7.0	0.78	5.5	30	4	1.2	0.27	0.3
73	126	87.5	16	14.0	0.69	9.7	97.5	25	24.4	0.77	18.9					
74	139	69	9	6.2	0.50	3.1	110	3	3.3	0.79	2.6	90	2	1.8	0.65	1.2
75	127	105.5	8	8.4	0.83	7.0	75	9	6.8	0.59	4.0					
76	163	100	1	1.0	0.61	0.6										
77	139	76.5	8	6.1	0.55	3.4										
78	167	60	6	3.6	0.36	1.3										
79	129	63.5	8	5.1	0.49	2.5	130	10	13.0	1.01	13.1					
80	108	92	24	22.1	0.85	18.8										
81	165	90	21	18.9	0.55	10.3										
82	135	92.5	8	7.4	0.69	5.1										
83	129	94	35	32.9	0.73	24.0										
84	143	99.5	31	30.8	0.70	21.5										

Plot	*Pi ba*	*Epilobium angustifolium*					*Calamagrostis canadensis*					*Carex* spp				
#	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
85	180	78.5	16	12.6	0.44	5.5										
86	172	94	21	19.7	0.55	10.8										
87	162	123.5	56	69.2	0.76	52.7										
88	154	90	66	59.4	0.58	34.7										
89	147	120	36	43.2	0.82	35.3										
90	106	119	40	47.6	1.12	53.4										
91	131	75	9	6.8	0.57	3.9	60	2	1.2	0.46	0.5	40	4	1.6	0.31	0.5
92	84						122.5	38	46.6	1.46	67.9					
93	94						130	40	52.0	1.38	71.9					
94	101	103.5	10	10.4	1.02	10.6	80	3	2.4	0.79	1.9					
95	70	75	2	1.5	1.07	1.6	40	3	1.2	0.57	0.7					
96	101	80	1	0.8	0.79	0.6	60	53	31.8	0.59	18.9					
97	72	78.5	5	3.9	1.09	4.3	60	89	53.4	0.83	44.5					
98	80	82.5	18	14.9	1.03	15.3	69.5	49	34.1	0.87	29.6					
99	127	88.5	22	19.5	0.70	13.6	130	19	24.7	1.02	25.3					
100	88	88	18	15.8	1.00	15.8	120	8	9.6	1.36	13.1					
101	138	130	63	81.9	0.94	77.2										
102	95	98.5	27	26.6	1.04	27.6						80	13	10.4	0.84	8.8
103	181	139.5	16	22.3	0.77	17.2										
104	168	80	8	6.4	0.48	3.0										
105	120	110	2	2.2	0.92	2.0										

Plot	*Pi ba*	*Epilobium angustifolium*					*Calamagrostis canadensis*					*Carex* spp				
#	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
106	135	137	11	15.1	1.01	15.3										
107	176	112.5	7	7.9	0.64	5.0										
108	156	100	4	4.0	0.64	2.6										
109	90	110	6	6.6	1.22	8.1	90	38	34.2	1.00	34.2					
110	164	90	5	4.5	0.55	2.5	110	34	37.4	0.67	25.1					
SP-1	187	90.5	25	22.6	0.48	10.9										
SP-2	175	77	20	15.4	0.44	6.8						120	10	12.0	0.69	8.2
SP-3	144											100	5	5.0	0.69	3.5
SP-4	181	79	19	15.0	0.44	6.6										
SP-5	148	83.5	18	15.0	0.56	8.5										
SP-6	131															
SP-7	157	60	1	0.6	0.38	0.2										
SP-8	143	79	9	7.1	0.55	3.9										
SP-9	178	60	1	0.6	0.34	0.2	110	70	77.0	0.62	47.6					
SP10	126	55	2	1.1	0.44	0.5	111	15	16.7	0.88	14.7					
Tot:	15057	9595	1773	1734.3	79.875	1375	4148.5	971	930.28	39.22	925.8	1995	160	116.36	17.219	84.29
Cnt:	120	106	106	106	106	106	44	44	44	44	44	29	29	29	29	29
Avg:	125	90.5	16.7	16.4	0.8	13.0	94.3	22.1	21.1	0.9	21.0	68.8	5.5	4.0	0.6	2.9
SD:	32.10	18.81	14.93	16.78	0.24	14.67	26.71	20.75	21.02	0.31	25.11	33.68	3.74	3.36	0.30	3.08

	Pi ba	Minor Herb species					*Rubus idaeus*					*Corylus cornuta*				
Plot #	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
1	123	5	14	0.7	0.04	0.0	80	7	5.6	0.65	3.6	140	25	35.0	1.14	39.8
2	69						40	8	3.2	0.58	1.9	120	42	50.4	1.74	87.7
3	160											180	49	88.2	1.13	99.2
4	117						70	4	2.8	0.60	1.7	140	25	35.0	1.20	41.9
5	182											220	40	88.0	1.21	106.4
6	109	5	10	0.5	0.05	0.0	70	15	10.5	0.64	6.7	200	45	90.0	1.83	165.1
7	122						50	4	2.0	0.41	0.8	130	30	39.0	1.07	41.6
8	153	15	2	0.3	0.10	0.0	30	3	0.9	0.20	0.2	160	24	38.4	1.05	40.2
9	110						50	4	2.0	0.45	0.9	140	67	93.8	1.27	119.4
10	119	10	8	0.8	0.08	0.1	50	4	2.0	0.42	0.8	80	34	27.2	0.67	18.3
11	160	20	4	0.8	0.13	0.1	50	5	2.5	0.31	0.8	80	6	4.8	0.50	2.4
12	131	30	40	12.0	0.23	2.7	70	4	2.8	0.53	1.5					
13	147											180	18	32.4	1.22	39.7
14	116	12	26	3.1	0.10	0.3	80	13	10.4	0.69	7.2					
15	90											80	9	7.2	0.89	6.4
16	94											250	32	80.0	2.66	212.8
17	104	14	21	2.9	0.13	0.4	37.5	5	1.9	0.36	0.7	205	22	45.1	1.97	88.9
18	143						62.5	25	15.6	0.44	6.8	197	21	41.4	1.38	57.0
19	68	15	5	0.8	0.22	0.2	50	4	2.0	0.74	1.5	101.5	14	14.2	1.49	21.2
20	106	52	7	3.7	0.49	1.8						112.5	17	19.1	1.06	20.3
21	64						51	9	4.6	0.80	3.7	93.5	28	26.2	1.46	38.2

Plot	*Pi ba*	Minor Herb species					*Rubus idaeus*					*Corylus cornuta*				
Plot #	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
22	103						51	10	5.1	0.50	2.5	88	18	15.8	0.85	13.5
23	78						30.5	10	3.1	0.39	1.2	90	7	6.3	1.15	7.3
24	84						30	1	0.3	0.36	0.1	50	15	7.5	0.60	4.5
25	53						30	6	1.8	0.57	1.0	71	12	8.5	1.34	11.4
26	77						71.5	25	17.9	0.93	16.6	76	10	7.6	0.99	7.5
27	138						70	44	30.8	0.51	15.6	90	4	3.6	0.65	2.3
28	82						80	51	40.8	0.98	39.8	90	4	3.6	1.10	4.0
29	100						73	38	27.7	0.73	20.3	116	12	13.9	1.16	16.1
30	133						81	11	8.9	0.61	5.4	50	3	1.5	0.38	0.6
31	33						76	32	24.3	2.30	56.0	140	8	11.2	4.24	47.5
32	113	17	15	2.5	0.15	0.4	71.5	21	15.0	0.63	9.5	90	3	2.7	0.80	2.2
33	108	10	12	1.2	0.09	0.1	60	38	22.8	0.56	12.7					
34	136						69.5	11	7.6	0.51	3.9	106	9	9.5	0.78	7.4
35	149						48.5	12	5.8	0.33	1.9	60	1	0.6	0.40	0.2
36	179						35.5	7	2.5	0.20	0.5	101.5	8	8.1	0.57	4.6
37	158	10	14	1.4	0.06	0.1	72	17	12.2	0.46	5.6	110	6	6.6	0.70	4.6
38	98						89	14	12.5	0.91	11.3	138	11	15.2	1.41	21.4
39	100	30	5	1.5	0.30	0.5	71.5	25	17.9	0.72	12.8					
40	90						86.5	8	6.9	0.96	6.7	134	24	32.2	1.49	47.9
41	158	25	3	0.8	0.16	0.1	30	14	4.2	0.19	0.8	176	31	54.6	1.11	60.8
42	128						30	2	0.6	0.23	0.1	158.5	24	38.0	1.24	47.1

Plot	*Pi ba*	Minor Herb species					*Rubus idaeus*					*Corylus cornuta*				
#	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
43	135	20	3	0.6	0.15	0.1	116.5	12	14.0	0.86	12.1	157.5	44	69.3	1.17	80.9
44	176						30	8	2.4	0.17	0.4	81.5	12	9.8	0.46	4.5
45	143											170.5	49	83.5	1.19	99.6
46	172						32.5	15	4.9	0.19	0.9	137.5	36	49.5	0.80	39.6
47	97						130	9	11.7	1.34	15.7	160	52	83.2	1.65	137.2
48	98											159	50	79.5	1.62	129.0
49	130											253.5	41	103.9	1.95	202.7
50	152						20	6	1.2	0.13	0.2	101	40	40.4	0.66	26.8
51	124						35	6	2.1	0.28	0.6	106	10	10.6	0.85	9.1
52	100	20	2	0.4	0.20	0.1	73.5	12	8.8	0.74	6.5	167.5	23	38.5	1.68	64.5
53	150						40	3	1.2	0.27	0.3	110	4	4.4	0.73	3.2
54	127						40	2	0.8	0.31	0.3	90	6	5.4	0.71	3.8
55	143	10	10	1.0	0.07	0.1	34.5	12	4.1	0.24	1.0	80	4	3.2	0.56	1.8
56	97	13	23	2.9	0.13	0.4						95.5	17	16.2	0.98	16.0
57	137											170	12	20.4	1.24	25.3
58	155	15	6	0.9	0.10	0.1						76	8	6.1	0.49	3.0
59	114	15	21	3.2	0.13	0.4						50	2	1.0	0.44	0.4
60	141	28	10	2.8	0.20	0.5	47.5	6	2.9	0.34	1.0	142.5	7	10.0	1.01	10.1
61	100	21	25	5.4	0.21	1.1	30	13	3.9	0.30	1.2	45	3	1.4	0.45	0.6
62	110	17	32	5.4	0.15	0.8	44.5	14	6.2	0.40	2.5	77	16	12.3	0.70	8.6
63	94	16	30	4.8	0.17	0.8	44	16	7.0	0.47	3.3	40	2	0.8	0.43	0.3

	Pi ba	Minor Herb species					*Rubus idaeus*					*Corylus cornuta*				
Plot #	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
64	124	38	13	4.9	0.31	1.5	42.5	16	6.8	0.34	2.3	60	5	3.0	0.48	1.5
65	113						66	18	11.9	0.58	6.9					
66	116						61	41	25.0	0.53	13.2	150	7	10.5	1.29	13.6
67	118						62.5	19	11.9	0.53	6.3					
68	135											145.5	22	32.0	1.08	34.5
69	131						41	20	8.2	0.31	2.6	160	3	4.8	1.22	5.9
70	110	90	4	3.6	0.82	2.9	40	1	0.4	0.36	0.1	96	7	6.7	0.87	5.9
71	87	10	55	5.5	0.11	0.6	52.5	3	1.6	0.60	1.0	64	7	4.5	0.74	3.3
72	111	15	19	2.9	0.14	0.4	50.5	35	17.7	0.45	8.0					
73	126	90	3	2.7	0.71	1.9	62.5	33	20.6	0.50	10.2	40	1	0.4	0.32	0.1
74	139											50	4	2.0	0.36	0.7
75	127						59	12	7.1	0.46	3.3	115	4	4.6	0.91	4.2
76	163															
77	139	15	3	0.5	0.11	0.0	20	1	0.2	0.14	0.0					
78	167															
79	129											100	5	5.0	0.78	3.9
80	108	10	10	1.0	0.09	0.1										
81	165						25.5	5	1.3	0.15	0.2					
82	135						35.5	25	8.9	0.26	2.3					
83	129						37.5	12	4.5	0.29	1.3					
84	143						57	10	5.7	0.40	2.3					

Plot #	*Pi ba* Ht (cm)	Minor Herb species Av Ht (cm)	Cover (%)	VI	B:C	CI	*Rubus idaeus* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Corylus cornuta* Av Ht (cm)	Cover (%)	VI	B:C	CI
85	180															
86	172	15	23	3.5	0.09	0.3	30	1	0.3	0.17	0.1					
87	162															
88	154						40	4	1.6	0.26	0.4					
89	147															
90	106						69	24	16.6	0.65	10.8					
91	131						99	40	39.6	0.76	29.9					
92	84						84.5	14	11.8	1.01	11.9					
93	94	70	4	2.8	0.74	2.1	96	7	6.7	1.02	6.9					
94	101	47	19	8.8	0.46	4.1	85	22	18.7	0.84	15.7					
95	70	10	42	4.2	0.14	0.6	38.5	15	5.8	0.55	3.2					
96	101						58.5	21	12.3	0.58	7.1					
97	72						40	1	0.4	0.56	0.2					
98	80						52	15	7.8	0.65	5.1					
99	127	45	3	1.4	0.35	0.5	62	34	21.1	0.49	10.3					
100	88						73.5	36	26.5	0.84	22.1					
101	138	10	5	0.5	0.07	0.0										
102	95						86	7	6.0	0.91	5.4					
103	181						100	3	3.0	0.55	1.7					
104	168	15	2	0.3	0.09	0.0	27.5	3	0.8	0.16	0.1					
105	120															

Plot #	Pi ba Ht (cm)	Minor Herb species Av Ht (cm)	Minor Herb species Cover (%)	Minor Herb species VI	Minor Herb species B:C	Minor Herb species CI	*Rubus idaeus* Av Ht (cm)	*Rubus idaeus* Cover (%)	*Rubus idaeus* VI	*Rubus idaeus* B:C	*Rubus idaeus* CI	*Corylus cornuta* Av Ht (cm)	*Corylus cornuta* Cover (%)	*Corylus cornuta* VI	*Corylus cornuta* B:C	*Corylus cornuta* CI
106	135						108.5	20	21.7	0.80	17.4					
107	176						35	4	1.4	0.20	0.3					
108	156						80	2	1.6	0.51	0.8					
109	90															
110	164															
SP-1	187						20	3	0.6	0.11	0.1					
SP-2	175						30	16	4.8	0.17	0.8					
SP-3	144	67	14	9.4	0.47	4.4	40	4	1.6	0.28	0.4	70	7	4.9	0.49	2.4
SP-4	181						61	11	6.7	0.34	2.3					
SP-5	148	60	9	5.4	0.41	2.2	53	10	5.3	0.36	1.9					
SP-6	131	60	4	2.4	0.46	1.1	23	6	1.4	0.18	0.2					
SP-7	157	70	16	11.2	0.45	5.0	18.5	9	1.7	0.12	0.2					
SP-8	143	80	8	6.4	0.56	3.6	20	2	0.4	0.14	0.1					
SP-9	178	15	2	0.3	0.08	0.0	50	2	1.0	0.28	0.3					
SP10	126	15	4	0.6	0.12	0.1										
Tot:	15057	1290.3	610	138.22	10.618	42.70	5109.5	1232	767.56	46.810	524.6	8265	1268	1830.3	74.193	2500
Cnt:	120	46	46	46	46	46	93	93	93	93	93	70	70	70	70	70
Avg:	125	28.1	13.3	3.0	0.2	0.9	54.9	13.2	8.3	0.5	5.6	118.1	18.1	26.1	1.1	35.7
SD:	32.10	23.81	12.00	2.89	0.20	1.29	23.60	11.38	8.78	0.32	8.69	49.91	15.66	28.61	0.60	48.51

Plot #	*Pi ba* Ht (cm)	*Prunus pensylvanica* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Pinus banksiana* (wild) Av Ht (cm)	Cover (%)	VI	B:C	CI	*Betula papyrifera* Av Ht (cm)	Cover (%)	VI	B:C	CI
1	123															
2	69															
3	160						150	1	1.5	0.94	1.4					
4	117						80	2	1.6	0.68	1.1					
5	182						180	3	5.4	0.99	5.3					
6	109	180	4	7.2	1.65	11.9	200	6	12.0	1.83	22.0					
7	122	160	6	9.6	1.31	12.6										
8	153	30	1	0.3	0.20	0.1	140	3	4.2	0.92	3.8					
9	110															
10	119						120	3	3.6	1.01	3.6					
11	160															
12	131															
13	147															
14	116						140	5	7.0	1.21	8.4					
15	90															
16	94															
17	104						120	2	2.4	1.15	2.8					
18	143	200	3	6.0	1.40	8.4	70	2	1.4	0.49	0.7					
19	68						80	2	1.6	1.18	1.9					
20	106															
21	64						116	5	5.8	1.81	10.5					

Plot #	*Pi ba* Ht (cm)	*Prunus pensylvanica* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Pinus banksiana* (wild) Av Ht (cm)	Cover (%)	VI	B:C	CI	*Betula papyrifera* Av Ht (cm)	Cover (%)	VI	B:C	CI
22	103						60	1	0.6	0.58	0.3					
23	78															
24	84															
25	53															
26	77						60	4	2.4	0.78	1.9					
27	138															
28	82	40	1	0.4	0.49	0.2										
29	100						70	1	0.7	0.70	0.5					
30	133						130	4	5.2	0.98	5.1					
31	33	250	11	27.5	7.58	208.3										
32	113	147	19	27.9	1.30	36.3										
33	108	149	16	23.8	1.38	32.9										
34	136	150	7	10.5	1.10	11.6										
35	149															
36	179	150	9	13.5	0.84	11.3										
37	158	146	21	30.7	0.92	28.3										
38	98															
39	100															
40	90						80	1	0.8	0.89	0.7					
41	158	226.5	18	40.8	1.43	58.4	50	3	1.5	0.32	0.5					
42	128															

	Pi ba	*Prunus pensylvanica*					*Pinus banksiana* (wild)					*Betula papyrifera*				
Plot #	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
43	135						30	1	0.3	0.22	0.1					
44	176	140	5	7.0	0.80	5.6	160	6	9.6	0.91	8.7					
45	143						160	3	4.8	1.12	5.4					
46	172	96	10	9.6	0.56	5.4	160	6	9.6	0.93	8.9					
47	97						90	5	4.5	0.93	4.2					
48	98	80	2	1.6	0.82	1.3										
49	130						90	3	2.7	0.69	1.9					
50	152						94.5	8	7.6	0.62	4.7					
51	124						160	6	9.6	1.29	12.4					
52	100															
53	150	161.5	9	14.5	1.08	15.6										
54	127	300	21	63.0	2.36	148.8										
55	143	30	1	0.3	0.21	0.1	80	3	2.4	0.56	1.3					
56	97															
57	137															
58	155	100	3	3.0	0.65	1.9	150	2	3.0	0.97	2.9					
59	114	220	7	15.4	1.93	29.7	114	5	5.7	1.00	5.7					
60	141	140	5	7.0	0.99	7.0	130	5	6.5	0.92	6.0					
61	100						120	2	2.4	1.20	2.9					
62	110						90	4	3.6	0.82	2.9					
63	94						90	5	4.5	0.96	4.3	100	3	3.0	1.06	3.2

Plot	Pi ba	*Prunus pensylvanica*					*Pinus banksiana* (wild)					*Betula papyrifera*				
#	Ht (cm)	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
64	124						60	2	1.2	0.48	0.6					
65	113															
66	116															
67	118															
68	135						100	5	5.0	0.74	3.7					
69	131															
70	110															
71	87															
72	111															
73	126						80	3	2.4	0.63	1.5					
74	139						180	4	7.2	1.29	9.3					
75	127	80	2	1.6	0.63	1.0	140	3	4.2	1.10	4.6	174.5	19	33.2	1.37	45.6
76	163						90	4	3.6	0.55	2.0	148	46	68.1	0.91	61.8
77	139											194.5	25	48.6	1.40	68.0
78	167											170	10	17.0	1.02	17.3
79	129						166	14	23.2	1.29	29.9					
80	108											156	22	34.3	1.44	49.6
81	165						153	8	12.2	0.93	11.3					
82	135	174	20	34.8	1.29	44.9						117.5	15	17.6	0.87	15.3
83	129	143.5	10	14.4	1.11	16.0	130	7	9.1	1.01	9.2					
84	143						160	4	6.4	1.12	7.2					

Plot #	*Pi ba* Ht (cm)	*Prunus pensylvanica* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Pinus banksiana* (wild) Av Ht (cm)	Cover (%)	VI	B:C	CI	*Betula papyrifera* Av Ht (cm)	Cover (%)	VI	B:C	CI
85	180											70	4	2.8	0.39	1.1
86	172						170	3	5.1	0.99	5.0	90	1	0.9	0.52	0.5
87	162	100	1	1.0	0.62	0.6	170	2	3.4	1.05	3.6					
88	154						150	4	6.0	0.97	5.8					
89	147	265.5	27	71.7	1.81	129.5	190	10	19.0	1.29	24.6	50	4	2.0	0.34	0.7
90	106						60	3	1.8	0.57	1.0					
91	131						120	2	2.4	0.92	2.2	158	14	22.1	1.21	26.7
92	84	171.5	27	46.3	2.04	94.5										
93	94	240	37	88.8	2.55	226.7						200	12	24.0	2.13	51.1
94	101	130	2	2.6	1.29	3.3						300	11	33.0	2.97	98.0
95	70						70	4	2.8	1.00	2.8	42	7	2.9	0.60	1.8
96	101	60	1	0.6	0.59	0.4						73	9	6.6	0.72	4.7
97	72											60	1	0.6	0.83	0.5
98	80											47	3	1.4	0.59	0.8
99	127															
100	88															
101	138															
102	95											100	3	3.0	1.05	3.2
103	181	293.5	44	129.1	1.62	209.4						90	6	5.4	0.50	2.7
104	168											30	1	0.3	0.18	0.1
105	120	235.5	26	61.2	1.96	120.2	80	1	0.8	0.67	0.5	201.5	29	58.4	1.68	98.1

Plot #	*Pi ba* Ht (cm)	*Prunus pensylvanica* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Pinus banksiana* (wild) Av Ht (cm)	Cover (%)	VI	B:C	CI	*Betula papyrifera* Av Ht (cm)	Cover (%)	VI	B:C	CI
106	135											204	30	61.2	1.51	92.5
107	176	256	22	56.3	1.45	81.9						186.5	22	41.0	1.06	43.5
108	156	231.5	28	64.8	1.48	96.2						230	7	16.1	1.47	23.7
109	90	270	4	10.8	3.00	32.4						198	23	45.5	2.20	100.2
110	164						110	2	2.2	0.67	1.5	131	16	21.0	0.80	16.7
SP-1	187	142.5	7	10.0	0.76	7.6						60	3	1.8	0.32	0.6
SP-2	175	53	3	1.6	0.30	0.5						98	5	4.9	0.56	2.7
SP-3	144	80	4	3.2	0.56	1.8						56.5	13	7.3	0.39	2.9
SP-4	181	227	21	47.7	1.25	59.8						144	6	8.6	0.80	6.9
SP-5	148	184	26	47.8	1.24	59.5										
SP-6	131	30	1	0.3	0.23	0.1										
SP-7	157						230	6	13.8	1.46	20.2	86	7	6.0	0.55	3.3
SP-8	143	270	26	70.2	1.89	132.5						96.5	5	4.8	0.67	3.3
SP-9	178											67	3	2.0	0.38	0.8
SP10	126											75.5	22	16.6	0.60	10.0
Tot:	15057	6733.5	518	1084.5	56.675	1954	6173.5	203	266.34	48.328	289.5	4205	407	622.26	33.096	857.6
Cnt:	120	42	42	42	42	42	52	52	52	52	52	34	34	34	34	34
Avg:	125	160.3	12.3	25.8	1.3	46.5	118.7	3.9	5.1	0.9	5.6	123.7	12.0	18.3	1.0	25.2
SD:	32.10	76.94	11.20	29.60	1.18	62.96	44.53	2.46	4.56	0.32	6.32	65.09	10.43	19.75	0.61	33.03

Plot #	*Pi ba* Ht (cm)	*Acer spicatum* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Alnus crispa* Av Ht (cm)	Cover (%)	VI	B:C	CI	Minor Woody Species Av Ht (cm)	Cover (%)	VI	B:C	CI
1	123	110	2	2.2	0.89	2.0						20	2	0.4	0.16	0.1
2	69											150	8	12.0	2.17	26.1
3	160															
4	117											50	1	0.5	0.43	0.2
5	182															
6	109															
7	122	80	2	1.6	0.66	1.0						15	2	0.3	0.12	0.0
8	153															
9	110															
10	119															
11	160															
12	131	110	3	3.3	0.84	2.8										
13	147															
14	116															
15	90	140	6	8.4	1.56	13.1	200	9	18.0	2.22	40.0					
16	94	148.5	29	43.1	1.58	68.0						55	20	11.0	0.59	6.4
17	104	169	16	27.0	1.63	43.9						60	3	1.8	0.58	1.0
18	143											80	3	2.4	0.56	1.3
19	68						120	7	8.4	1.76	14.8	80	2	1.6	1.18	1.9
20	106	120	4	4.8	1.13	5.4						160	2	3.2	1.51	4.8
21	64											58	6	3.5	0.90	3.1

Plot #	*Pi ba* Ht (cm)	*Acer spicatum* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Alnus crispa* Av Ht (cm)	Cover (%)	VI	B:C	CI	Minor Woody Species Av Ht (cm)	Cover (%)	VI	B:C	CI
22	103											173	22	38.0	1.68	63.7
23	78											200	17	34.0	2.56	87.2
24	84						88.5	26	23.0	1.05	24.2	102	8	8.2	1.21	9.9
25	53						60	2	1.2	1.13	1.4	109	21	22.8	2.05	46.6
26	77						150	16	24.0	1.95	46.8	70	2	1.4	0.91	1.3
27	138											65	4	2.6	0.47	1.2
28	82											30	4	1.2	0.37	0.4
29	100	80	2	1.6	0.80	1.3						160	8	12.8	1.60	20.5
30	133	40	1	0.4	0.30	0.1						35	16	5.7	0.27	1.5
31	33	148.5	33	49.0	4.50	220.5										
32	113	100	2	2.0	0.88	1.8										
33	108	90	2	1.8	0.83	1.5						20	3	0.6	0.19	0.1
34	136															
35	149											85	6	5.1	0.57	2.9
36	179											100	3	3.0	0.56	1.7
37	158															
38	98	175.5	44	77.2	1.79	138.3	270	8	21.6	2.76	59.5	250	3	7.5	2.55	19.1
39	100															
40	90	160	3	4.8	1.78	8.5						130	1	1.3	1.44	1.9
41	158	125	6	7.5	0.79	5.9										
42	128											50	5	2.5	0.39	1.0

Plot #	*Pi ba* Ht (cm)	*Acer spicatum*					*Alnus crispa*					Minor Woody Species				
		Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI	Av Ht (cm)	Cover (%)	VI	B:C	CI
43	135	130	2	2.6	0.96	2.5						70	3	2.1	0.52	1.1
44	176	120	4	4.8	0.68	3.3										
45	143	100	3	3.0	0.70	2.1						140	11	15.4	0.98	15.1
46	172															
47	97															
48	98	200	20	40.0	2.04	81.6										
49	130	250	47	117.5	1.92	226.0										
50	152															
51	124															
52	100															
53	150	110	3	3.3	0.73	2.4						67	7	4.7	0.44	2.1
54	127											40	2	0.8	0.31	0.3
55	143															
56	97											50	5	2.5	0.52	1.3
57	137															
58	155											150	6	9.0	0.97	8.7
59	114											100	4	4.0	0.88	3.5
60	141											90	1	0.9	0.64	0.6
61	100											51	9	4.6	0.51	2.3
62	110	50	5	2.5	0.45	1.1										
63	94	60	3	1.8	0.64	1.1										

Plot #	*Pi ba* Ht (cm)	*Acer spicatum* Av Ht (cm)	Cover (%)	VI	B:C	CI	*Alnus crispa* Av Ht (cm)	Cover (%)	VI	B:C	CI	Minor Woody Species Av Ht (cm)	Cover (%)	VI	B:C	CI
64	124	60	8	4.8	0.48	2.3						45	2	0.9	0.36	0.3
65	113															
66	116											70	1	0.7	0.60	0.4
67	118											70	5	3.5	0.59	2.1
68	135											93	11	10.2	0.69	7.0
69	131											32	10	3.2	0.24	0.8
70	110											63	7	4.4	0.57	2.5
71	87											54	6	3.2	0.62	2.0
72	111											30	3	0.9	0.27	0.2
73	126	110	2	2.2	0.87	1.9						30	2	0.6	0.24	0.1
74	139	40	2	0.8	0.29	0.2						190	5	9.5	1.37	13.0
75	127											60	1	0.6	0.47	0.3
76	163											70	3	2.1	0.43	0.9
77	139											130	1	1.3	0.94	1.2
78	167											90	4	3.6	0.54	1.9
79	129											40	1	0.4	0.31	0.1
80	108															
81	165															
82	135															
83	129	122	10	12.2	0.95	11.5										
84	143															

Plot #	Pi ba Ht (cm)	Acer spicatum Av Ht (cm)	Cover (%)	VI	B:C	CI	Alnus crispa Av Ht (cm)	Cover (%)	VI	B:C	CI	Minor Woody Species Av Ht (cm)	Cover (%)	VI	B:C	CI
85	180											25	2	0.5	0.14	0.1
86	172											45	9	4.1	0.26	1.1
87	162											60	4	2.4	0.37	0.9
88	154															
89	147															
90	106															
91	131											100	1	1.0	0.76	0.8
92	84						150	4	6.0	1.79	10.7	100	4	4.0	1.19	4.8
93	94															
94	101						90	4	3.6	0.89	3.2					
95	70	113	15	17.0	1.61	27.4						30	2	0.6	0.43	0.3
96	101	140	2	2.8	1.39	3.9	40	4	1.6	0.40	0.6					
97	72															
98	80						70	2	1.4	0.88	1.2					
99	127															
100	88	130	8	10.4	1.48	15.4										
101	138						150	15	22.5	1.09	24.5					
102	95											120	8	9.6	1.26	12.1
103	181											140	15	21.0	0.77	16.2
104	168						186.5	34	63.4	1.11	70.4					
105	120	204	14	28.6	1.70	48.6	145	4	5.8	1.21	7.0	100	3	3.0	0.83	2.5

Plot #	Pi ba Ht (cm)	Acer spicatum Av Ht (cm)	Acer spicatum Cover (%)	Acer spicatum VI	Acer spicatum B:C	Acer spicatum CI	Alnus crispa Av Ht (cm)	Alnus crispa Cover (%)	Alnus crispa VI	Alnus crispa B:C	Alnus crispa CI	Minor Woody Species Av Ht (cm)	Minor Woody Species Cover (%)	Minor Woody Species VI	Minor Woody Species B:C	Minor Woody Species CI
106	135						169.5	21	35.6	1.26	44.7	123	6	7.4	0.91	6.7
107	176											150	2	3.0	0.85	2.6
108	156						135.5	48	65.0	0.87	56.5					
109	90						130	12	15.6	1.44	22.5					
110	164						96	29	27.8	0.59	16.3	90	2	1.8	0.55	1.0
SP-1	187											80	1	0.8	0.43	0.3
SP-2	175											70	2	1.4	0.40	0.6
SP-3	144											70	6	4.2	0.49	2.0
SP-4	181						100	4	4.0	0.55	2.2	160	2	3.2	0.88	2.8
SP-5	148	140	9	12.6	0.95	11.9										
SP-6	131						27.5	7	1.9	0.21	0.4	131	23	30.1	1.00	30.0
SP-7	157											23	5	1.1	0.14	0.2
SP-8	143	200	14	28.0	1.40	39.2						93	16	14.9	0.65	9.7
SP-9	178						80	1	0.8	0.45	0.4	61	5	3.1	0.34	1.1
SP10	126											125	8	10.0	0.99	9.9
Tot:	15057	4075.5	326	529.54	39.208	996.6	2459	257	351	24	447	6025	408	399	53	477
Cnt:	120	33	33	33	33	33	20	20	20	20	20	70	70	70	70	70
Avg:	125	123.5	9.9	16.0	1.2	30.2	122.9	12.9	17.6	1.2	22.4	86.1	5.8	5.7	0.8	6.8
SD:	32.10	48.97	12.05	25.28	0.77	57.95	58.40	12.72	19.12	0.65	22.74	48.97	5.43	7.69	0.54	14.45

APPENDIX F-1

JACK PINE HEIGHTS, CROWN AREAS AND VEGETATION INDICES

Jack Pine Heights, Crown Areas and Vegetation Indices

Plot #	Height (cm)	Crown Area (m^2)	Crown Area (%)	Veg Index	Plot #	Height (cm)	Crown Area (m^2)	Crown Area (%)	Veg Index	Plot #	Height (cm)	Crown Area (m^2)	Crown Area (%)	Veg Index
1	123	0.27	6.9	8.5	22	103	0.20	4.9	5.0	43	135	0.28	7.1	9.5
2	69	0.05	1.3	0.9	23	78	0.08	2.1	1.6	44	176	0.94	23.6	41.5
3	160	0.71	17.7	28.3	24	84	0.13	3.3	2.8	45	143	0.57	14.3	20.5
4	117	0.35	8.7	10.2	25	53	0.06	1.4	0.8	46	172	0.63	15.7	27.0
5	182	0.98	24.5	44.7	26	77	0.14	3.5	2.7	47	97	0.09	2.4	2.3
6	109	0.25	6.3	6.9	27	138	0.45	11.3	15.7	48	98	0.12	3.1	3.1
7	122	0.16	4.0	4.9	28	82	0.12	3.1	2.5	49	130	0.11	2.7	3.6
8	153	0.62	15.4	23.6	29	100	0.15	3.8	3.8	50	152	0.78	19.4	29.5
9	110	0.16	4.0	4.4	30	133	0.40	10.0	13.3	51	124	0.47	11.8	14.6
10	119	0.35	8.8	10.5	31	33	0.01	0.3	0.1	52	100	0.33	8.2	8.2
11	160	1.08	27.1	43.4	32	113	0.20	5.0	5.6	53	150	0.81	20.3	30.5
12	131	0.99	24.8	32.5	33	108	0.16	4.1	4.4	54	127	0.27	6.8	8.6
13	147	0.82	20.6	30.3	34	136	0.62	15.4	20.9	55	143	0.44	11.0	15.7
14	116	0.41	10.4	12.0	35	149	0.41	10.3	15.4	56	97	0.17	4.2	4.1
15	90	0.27	6.9	6.2	36	179	1.08	27.1	48.5	57	137	0.53	13.3	18.2
16	94	0.29	7.3	6.9	37	158	0.60	15.1	23.8	58	155	0.49	12.4	19.2
17	104	0.27	6.8	7.1	38	98	0.06	1.5	1.5	59	114	0.20	4.9	5.6
18	143	0.94	23.6	33.7	39	100	0.13	3.1	3.1	60	141	0.50	12.6	17.7
19	68	0.12	3.0	2.0	40	90	0.13	3.1	2.8	61	100	0.28	7.1	7.1
20	106	0.31	7.8	8.3	41	158	0.55	13.8	21.8	62	110	0.31	7.7	8.4
21	64	0.08	1.9	1.2	42	128	0.57	14.3	18.3	63	94	0.31	7.8	7.3

Plot #	Height (cm)	Crown Area (m^2)	Crown Area (%)	Veg Index	Plot #	Height (cm)	Crown Area (m^2)	Crown Area (%)	Veg Index	Plot #	Height (cm)	Crown Area (m^2)	Crown Area (%)	Veg Index
64	124	0.42	10.6	13.1	85	180	1.04	26.0	46.7	106	135	0.28	7.1	9.5
65	113	0.28	7.1	8.0	86	172	0.60	14.9	25.7	107	176	0.44	11.0	19.4
66	116	0.41	10.3	11.9	87	162	0.38	9.6	15.6	108	156	0.57	14.1	22.1
67	118	0.24	5.9	7.0	88	154	0.71	17.7	27.2	109	90	0.13	3.1	2.8
68	135	0.29	7.4	9.9	89	147	0.28	7.1	10.4	110	164	0.63	15.7	25.8
69	131	0.26	6.5	8.5	90	106	0.33	8.2	8.7	SP-1	187	1.43	35.8	66.9
70	110	0.38	9.4	10.4	91	131	0.24	5.9	7.8	SP-2	175	0.86	21.6	37.8
71	87	0.20	5.1	4.4	92	84	0.06	1.5	1.2	SP-3	144	0.71	17.7	25.5
72	111	0.22	5.4	6.0	93	94	0.05	1.2	1.2	SP-4	181	0.49	12.4	22.4
73	126	0.24	5.9	7.4	94	101	0.10	2.4	2.4	SP-5	148	0.50	12.6	18.6
74	139	0.86	21.6	30.0	95	70	0.10	2.4	1.7	SP-6	131	0.50	12.6	16.5
75	127	0.33	8.2	10.5	96	101	0.19	4.9	4.9	SP-7	157	0.79	19.6	30.8
76	163	1.23	30.6	49.9	97	72	0.05	1.2	0.8	SP-8	143	0.49	12.4	17.7
77	139	0.71	17.7	24.6	98	80	0.13	3.1	2.5	SP-9	178	1.04	25.9	46.1
78	167	1.03	25.8	43.1	99	127	0.50	12.6	16.0	SP-10	126	0.38	9.6	12.1
79	129	0.50	12.6	16.2	100	88	0.10	2.4	2.1	Total	15057	52	1296	1862
80	108	0.51	12.8	13.8	101	138	0.36	8.9	12.3	Count	120	120	120	120
81	165	0.94	23.6	38.9	102	95	0.11	2.7	2.6	Avg	125	0.43	10.8	15.5
82	135	0.71	17.7	23.9	103	181	0.50	12.6	22.7	Std.Dev	32.10	0.31	7.71	13.60
83	129	0.50	12.6	16.2	104	168	0.75	18.7	31.3					
84	143	1.17	29.4	42.0	105	120	0.19	4.7	5.7					

APPENDIX F-2

MODIFIED T&A'S COMPETITION INDICES (NON-CROP SPECIES DATA)

Modified Towill and Archibald Competition Index Data

Epilobium angustifolium

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
1	70	4	2.8	70	5	3.5	6.3	4.55	70.0	0.6	3.6	2.6	0.7	0.5	4.7	2.4
2	100	8	8	100	6	6	14	11	100.0	1.4	20.3	15.9	15.3	12.0	214.0	132.1
3	100	10	10	100	5	5	15	12.5	100.0	0.6	9.4	7.8	0.5	0.4	8.0	5.5
4	100	8	8	100	14	14	22	15	100.0	0.9	18.8	12.8	2.2	1.5	47.6	22.1
5	100	3	3	100	10	10	13	8	100.0	0.5	7.1	4.4	0.3	0.2	3.8	1.4
6	110	7	7.7	110	3	3.3	11	9.35	110.0	1.0	11.1	9.4	1.6	1.4	17.6	12.7
7	140	17	23.8	140	9	12.6	36.4	30.1	140.0	1.1	41.8	34.5	7.5	6.2	272.5	186.3
8	130	17	22.1	130	13	16.9	39	30.55	130.0	0.8	33.1	26.0	1.7	1.3	64.6	39.6
9	90	5	4.5	90	2	1.8	6.3	5.4	90.0	0.8	5.2	4.4	1.4	1.2	9.1	6.7
10	60	6	3.6	60	2	1.2	4.8	4.2	60.0	0.5	2.4	2.1	0.5	0.4	2.2	1.7
11	110	33	36.3	110	39	42.9	79.2	57.75	110.0	0.7	54.4	39.7	1.8	1.3	144.7	76.9
12	100	12	12	100	7	7	19	15.5	100.0	0.8	14.5	11.8	0.6	0.5	11.1	7.4
13	110	11	12.1	110	21	23.1	35.2	23.65	110.0	0.7	26.3	17.7	1.2	0.8	40.9	18.5
14	110	16	17.6	110	20	22	39.6	28.6	110.0	0.9	37.6	27.1	3.3	2.4	130.4	68.0
15	120	23	27.6	120	11	13.2	40.8	34.2	120.0	1.3	54.4	45.6	6.6	5.5	269.1	189.1
16	60	1	0.6	60	1	0.6	1.2	0.9	60.0	0.6	0.8	0.6	0.2	0.1	0.2	0.1
17	100	6	6	100	4	4	10	8	100.0	1.0	9.6	7.7	1.4	1.1	14.2	9.1
18				80	1	0.8	0.8	0.4	80.0	0.6	0.4	0.2	0.0	0.0	0.0	0.0
19				90	2	1.8	1.8	0.9	90.0	1.3	2.4	1.2	0.9	0.4	1.6	0.4
20	83	7	5.81	86	5	4.3	10.11	7.96	84.3	0.8	8.0	6.3	1.2	1.0	12.3	7.6
21				92	5	4.6	4.6	2.3	92.0	1.4	6.6	3.3	3.8	1.9	17.5	4.4
22	60	2	1.2	65	14	9.1	10.3	5.75	64.4	0.6	6.4	3.6	2.1	1.1	21.1	6.6
23	90	18	16.2	89	16	14.2	30.44	23.32	89.5	1.1	34.9	26.8	18.8	14.4	571.8	335.6
24	75	2	1.5	77	7	5.39	6.89	4.195	76.6	0.9	6.3	3.8	2.5	1.5	17.2	6.4
25	30	1	0.3	70	2	1.4	1.7	1	56.7	1.1	1.8	1.1	2.2	1.3	3.8	1.3
26	90	1	0.9	84	5	4.2	5.1	3	85.0	1.1	5.6	3.3	1.9	1.1	9.8	3.4
27	66	5	3.3	74	17	12.6	15.88	9.59	72.2	0.5	8.3	5.0	1.0	0.6	16.1	5.9
28	80	3	2.4	80	1	0.8	3.2	2.8	80.0	1.0	3.1	2.7	1.3	1.1	4.1	3.1
29	88	9	7.92	90	3	2.7	10.62	9.27	88.5	0.9	9.4	8.2	2.8	2.4	29.7	22.6
32				90	1	0.9	0.9	0.45	90.0	0.8	0.7	0.4	0.2	0.1	0.1	0.0
33	70	3	2.1	86	5	4.3	6.4	4.25	80.0	0.7	4.7	3.1	1.4	1.0	9.3	4.1
34	125	15	18.8	108	31	33.5	52.23	35.49	113.5	0.8	43.6	29.6	2.5	1.7	130.3	60.2

Epilobium angustifolium

Plot	Inner Circle			Outer Ring												
#	Height (cm)	Cover (%)	VI	Height (cm)	Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
35	97	12	11.6	104	20	20.8	32.44	22.04	101.4	0.7	22.1	15.0	2.1	1.4	68.4	31.6
36	73	12	8.76	90	1	0.9	9.66	9.21	74.3	0.4	4.0	3.8	0.2	0.2	1.9	1.7
37	70	1	0.7	75	4	3	3.7	2.2	74.0	0.5	1.7	1.0	0.2	0.1	0.6	0.2
38	115	4	4.6	100	3	3	7.6	6.1	108.6	1.1	8.4	6.8	5.1	4.1	38.5	24.8
39				90	2	1.8	1.8	0.9	90.0	0.9	1.6	0.8	0.6	0.3	1.0	0.3
41				80	1	0.8	0.8	0.4	80.0	0.5	0.4	0.2	0.0	0.0	0.0	0.0
42	70	3	2.1	75	6	4.5	6.6	4.35	73.3	0.6	3.8	2.5	0.4	0.2	2.4	1.0
43	95	4	3.8	143	3	4.29	8.09	5.945	115.6	0.9	6.9	5.1	0.8	0.6	6.9	3.7
44	122	5	6.1	110	4	4.4	10.5	8.3	116.7	0.7	7.0	5.5	0.3	0.2	2.7	1.7
47	100	3	3	110	2	2.2	5.2	4.1	104.0	1.1	5.6	4.4	2.3	1.8	11.8	7.4
49	90	1	0.9				0.9	0.9	90.0	0.7	0.6	0.6	0.3	0.3	0.2	0.2
50				70	1	0.7	0.7	0.35	70.0	0.5	0.3	0.2	0.0	0.0	0.0	0.0
51	88	17	15.0	96	20	19.2	34.16	24.56	92.3	0.7	25.4	18.3	2.3	1.7	79.9	41.3
52	99	10	9.9	92	5	4.6	14.5	12.2	96.7	1.0	14.0	11.8	1.8	1.5	25.5	18.0
53	85	13	11.1	94	16	15.0	26.09	18.57	90.0	0.6	15.6	11.1	0.9	0.6	22.3	11.3
54	117	12	14.0	103	20	20.6	34.64	24.34	108.3	0.9	29.5	20.7	4.0	2.8	139.2	68.7
55	80	5	4	69	10	6.9	10.9	7.45	72.7	0.5	5.5	3.8	0.7	0.5	7.6	3.5
56	70	4	2.8	80	12	9.6	12.4	7.6	77.5	0.8	9.9	6.1	3.0	1.8	37.4	14.0
57	97	26	25.2	93	25	23.3	48.47	36.845	95.0	0.7	33.6	25.6	2.7	2.0	129.4	74.8
58	85	6	5.1	81	14	11.3	16.44	10.77	82.2	0.5	8.7	5.7	0.9	0.6	14.1	6.0
59	92	19	17.5	83	7	5.81	23.29	20.385	89.6	0.8	18.3	16.0	4.2	3.6	96.9	74.3
60	83	11	9.13	83	18	14.9	24.07	16.6	83.0	0.6	14.2	9.8	1.4	0.9	32.7	15.6
64				70	1	0.7	0.7	0.35	70.0	0.6	0.4	0.2	0.1	0.0	0.0	0.0
65	97	18	17.5	98	21	20.6	38.04	27.75	97.5	0.9	32.8	24.0	4.8	3.5	181.2	96.4
66	76	5	3.8	86	17	14.6	18.42	11.11	83.7	0.7	13.3	8.0	1.5	0.9	28.5	10.4
67	76	12	9.12	72	6	4.32	13.44	11.28	74.7	0.6	8.5	7.1	1.9	1.6	26.0	18.3
68	77	3	2.31	88	10	8.8	11.11	6.71	85.5	0.6	7.0	4.2	1.1	0.7	12.4	4.5
69	65	2	1.3	81	8	6.48	7.78	4.54	77.8	0.6	4.6	2.7	0.9	0.5	7.1	2.4
70	77	9	6.93	70	14	9.8	16.73	11.83	72.7	0.7	11.1	7.8	1.6	1.1	27.0	13.5
72	90	2	1.8	93	4	3.72	5.52	3.66	92.0	0.8	4.6	3.0	0.9	0.6	5.1	2.2
73	79	9	7.11	96	7	6.72	13.83	10.47	86.4	0.7	9.5	7.2	1.9	1.4	25.8	14.8
74	73	3	2.19	65	6	3.9	6.09	4.14	67.7	0.5	3.0	2.0	0.2	0.1	1.2	0.6

Epilobium angustifolium

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
75	103	4	4.12	108	4	4.32	8.44	6.28	105.5	0.8	7.0	5.2	0.8	0.6	6.8	3.8
76				100	1	1	1	0.5	100.0	0.6	0.6	0.3	0.0	0.0	0.0	0.0
77	78	4	3.12	75	4	3	6.12	4.62	76.5	0.6	3.4	2.5	0.2	0.2	1.5	0.9
78	60	1	0.6	60	5	3	3.6	2.1	60.0	0.4	1.3	0.8	0.1	0.0	0.3	0.1
79	60	5	3	67	3	2.01	5.01	4.005	62.6	0.5	2.4	1.9	0.3	0.2	1.5	1.0
80	85	17	14.5	99	7	6.93	21.38	17.915	89.1	0.8	17.6	14.8	1.6	1.3	33.2	23.3
81	86	8	6.88	94	13	12.2	19.1	12.99	91.0	0.6	10.5	7.2	0.5	0.3	9.4	4.3
82	95	2	1.9	90	6	5.4	7.3	4.6	91.3	0.7	4.9	3.1	0.3	0.2	2.2	0.9
83	93	20	18.6	95	15	14.3	32.85	25.725	93.9	0.7	23.9	18.7	2.0	1.6	66.6	40.8
84	106	13	13.8	93	18	16.7	30.52	22.15	98.5	0.7	21.0	15.2	0.7	0.5	22.2	11.7
85	74	9	6.66	83	7	5.81	12.47	9.565	77.9	0.4	5.4	4.1	0.3	0.2	3.3	2.0
86	87	10	8.7	101	11	11.1	19.81	14.255	94.3	0.5	10.9	7.8	0.8	0.6	15.3	7.9
87	125	24	30	122	32	39.0	69.04	49.52	123.3	0.8	52.5	37.7	4.4	3.2	305.8	157.3
88	90	26	23.4	90	40	36	59.4	41.4	90.0	0.6	34.7	24.2	2.2	1.5	129.7	63.0
89	120	12	14.4	120	24	28.8	43.2	28.8	120.0	0.8	35.3	23.5	4.2	2.8	179.6	79.8
90	118	19	22.4	120	21	25.2	47.62	35.02	119.1	1.1	53.5	39.3	5.4	4.0	259.4	140.3
91	80	5	4	70	4	2.8	6.8	5.4	75.6	0.6	3.9	3.1	0.9	0.7	5.9	3.7
94	97	7	6.79	110	3	3.3	10.09	8.44	100.9	1.0	10.1	8.4	4.2	3.5	41.9	29.3
95				75	2	1.5	1.5	0.75	75.0	1.1	1.6	0.8	0.9	0.4	1.3	0.3
96	80	1	0.8				0.8	0.8	80.0	0.8	0.6	0.6	0.2	0.2	0.1	0.1
97	80	2	1.6	77	3	2.31	3.91	2.755	78.2	1.1	4.2	3.0	4.6	3.2	18.0	8.9
98	79	10	7.9	86	8	6.88	14.78	11.34	82.1	1.0	15.2	11.6	5.9	4.5	86.9	51.2
99	84	12	10.1	93	10	9.3	19.38	14.73	88.1	0.7	13.4	10.2	1.2	0.9	23.5	13.6
100	85	6	5.1	91	12	10.9	16.02	10.56	89.0	1.0	16.2	10.7	7.6	5.0	121.2	52.7
101	130	33	42.9	130	30	39	81.9	62.4	130.0	0.9	77.2	58.8	6.6	5.1	544.1	315.8
102	97	18	17.5	100	9	9	26.46	21.96	98.0	1.0	27.3	22.7	10.1	8.4	268.1	184.7
103	137	3	4.11	142	13	18.5	22.57	13.34	141.1	0.8	17.6	10.4	1.0	0.6	22.4	7.8
104	80	4	3.2	80	4	3.2	6.4	4.8	80.0	0.5	3.0	2.3	0.2	0.2	1.3	0.7
105	90	1	0.9	130	1	1.3	2.2	1.55	110.0	0.9	2.0	1.4	0.4	0.3	0.9	0.4
106	121	8	9.68	153	3	4.59	14.27	11.975	129.7	1.0	13.7	11.5	1.5	1.3	21.3	15.0
107	105	4	4.2	120	3	3.6	7.8	6	111.4	0.6	4.9	3.8	0.4	0.3	3.1	1.9
108	100	4	4				4	4	100.0	0.6	2.6	2.6	0.2	0.2	0.7	0.7

Epilobium angustifolium

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
109	70	2	1.4	150	4	6	7.4	4.4	123.3	1.4	10.1	6.0	2.6	1.6	19.4	6.8
110	90	4	3.6	90	1	0.9	4.5	4.05	90.0	0.5	2.5	2.2	0.2	0.2	0.8	0.6
SP-1	87	9	7.83	94	16	15.0	22.87	15.35	91.5	0.5	11.2	7.5	0.3	0.2	7.8	3.5
SP-2	76	11	8.36	78	9	7.02	15.38	11.87	76.9	0.4	6.8	5.2	0.4	0.3	6.3	3.7
SP-4	84	7	5.88	74	12	8.88	14.76	10.32	77.7	0.4	6.3	4.4	0.7	0.5	9.7	4.8
SP-5	83	10	8.3	84	8	6.72	15.02	11.66	83.4	0.6	8.5	6.6	0.8	0.6	12.1	7.3
SP-7				60	1	0.6	0.6	0.3	60.0	0.4	0.2	0.1	0.0	0.0	0.0	0.0
SP-8	80	1	0.8	78	8	6.24	7.04	3.92	78.2	0.5	3.9	2.1	0.4	0.2	2.8	0.9
SP-9	60	1	0.6				0.6	0.6	60.0	0.3	0.2	0.2	0.0	0.0	0.0	0.0
SP-10	50	1	0.5	60	1	0.6	1.1	0.8	55.0	0.4	0.5	0.3	0.1	0.1	0.1	0.1
Total	8510	822	805	9453	951	928	1733	1269	9604	80	1374	1013	213	158	5390	3056
Count	95	95	95	102	102	102	106	106	106	106	106	106	106	106	106	106
Avg	89.6	8.7	8.48	92.7	9.3	9.10	16.35	11.98	90.6	0.76	12.96	9.56	2.01	1.49	50.85	28.83
StdDev	19.93	7.23	8.29	20.36	8.49	9.27	16.74	12.36	18.6	0.25	14.60	11.04	2.85	2.22	98.60	58.43

Calamagrostis canadensis & Grass

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
19	80	4	3.2	80	7	5.6	8.8	6	80.0	1.2	10.4	7.1	4.4	3.0	38.4	17.8
21	50	23	11.5	50	19	9.5	21	16.25	50.0	0.8	16.4	12.7	17.4	13.4	364.8	218.4
26	80	17	13.6	80	18	14.4	28	20.8	80.0	1.0	29.1	21.6	10.5	7.8	294.0	162.2
27	110	10	11.0	110	8	8.8	19.8	15.4	110.0	0.8	15.8	12.3	1.3	1.0	25.0	15.2
28	130	7	9.1	130	7	9.1	18.2	13.65	130.0	1.6	28.9	21.6	7.2	5.4	131.5	74.0
30	130	17	22.1	130	34	44.2	66.3	44.2	130.0	1.0	64.8	43.2	5.0	3.3	330.0	146.7
32				100	2	2.0	2	1	100.0	0.9	1.8	0.9	0.4	0.2	0.7	0.2
33	60	2	1.2				1.2	1.2	60.0	0.6	0.7	0.7	0.3	0.3	0.3	0.3
38	120	2	2.4	120	3	3.6	6	4.2	120.0	1.2	7.3	5.1	4.0	2.8	24.0	11.8
39	134	16	21.4	135	31	41.9	63.29	42.365	134.7	1.3	85.2	57.0	20.1	13.5	1275	571.3
40	130	39	50.7	130	21	27.3	78	64.35	130.0	1.4	112.7	93.0	27.7	22.8	2157	1468.2
48	130	3	3.9				3.9	3.9	130.0	1.3	5.2	5.2	1.3	1.3	5.0	5.0
51	90	1	0.9	80	1	0.8	1.7	1.3	85.0	0.7	1.2	0.9	0.1	0.1	0.2	0.1
53	100	4	4.0	100	3	3.0	7	5.5	100.0	0.7	4.7	3.7	0.2	0.2	1.6	1.0
55	72	10	7.2	72	10	7.2	14.4	10.8	72.0	0.5	7.3	5.4	0.9	0.7	13.2	7.4
56	100	9	9.0	100	3	3.0	12	10.5	100.0	1.0	12.4	10.8	2.9	2.6	35.0	26.8
59	120	3	3.6	112	5	5.6	9.2	6.4	115.0	1.0	9.3	6.5	1.6	1.1	15.1	7.3
61	90	1	0.9	90	3	2.7	3.6	2.25	90.0	0.9	3.2	2.0	0.5	0.3	1.8	0.7
64	60	11	6.6	80	3	2.4	9	7.8	64.3	0.5	4.7	4.0	0.7	0.6	6.2	4.6
65	112	10	11.2	98	10	9.8	21	16.1	105.0	0.9	19.5	15.0	2.6	2.0	55.2	32.5
67	65	11	7.2	68	12	8.2	15.31	11.23	66.6	0.6	8.6	6.3	2.2	1.6	33.7	18.1
68	60	2	1.2	60	5	3.0	4.2	2.7	60.0	0.4	1.9	1.2	0.4	0.3	1.8	0.7
69	60	7	4.2	60	7	4.2	8.4	6.3	60.0	0.5	3.8	2.9	1.0	0.7	8.3	4.7
70	72	6	4.3	77	9	6.9	11.25	7.785	75.0	0.7	7.7	5.3	1.1	0.8	12.2	5.8
71	100	5	5.0	105	14	14.7	19.7	12.35	103.7	1.2	23.5	14.7	4.4	2.8	87.4	34.3
72	84	5	4.2	90	3	2.7	6.9	5.55	86.3	0.8	5.4	4.3	1.2	0.9	7.9	5.1
73	96	16	15.4	99	9	8.9	24.27	19.815	97.1	0.8	18.7	15.3	3.3	2.7	79.4	52.9
74	130	2	2.6	90	1	0.9	3.5	3.05	116.7	0.8	2.9	2.6	0.1	0.1	0.4	0.3
75	90	4	3.6	60	5	3.0	6.6	5.1	73.3	0.6	3.8	2.9	0.6	0.5	4.2	2.5
79	130	6	7.8	130	4	5.2	13	10.4	130.0	1.0	13.1	10.5	0.8	0.6	10.4	6.7
91				60	2	1.2	1.2	0.6	60.0	0.5	0.5	0.3	0.2	0.1	0.2	0.0
92	130	24	31.2	115	14	16.1	47.3	39.25	124.5	1.5	70.1	58.2	38.2	31.7	1809	1245.4

Calamagrostis canadensis & Grass

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
93	130	25	32.5	130	15	19.5	52	42.25	130.0	1.4	71.9	58.4	45.1	36.6	2344	1547.4
94				80	3	2.4	2.4	1.2	80.0	0.8	1.9	1.0	1.0	0.5	2.4	0.6
95	40	1	0.4	40	2	0.8	1.2	0.8	40.0	0.6	0.7	0.5	0.7	0.5	0.9	0.4
96	60	20	12.0	60	33	19.8	31.8	21.9	60.0	0.6	18.9	13.0	6.5	4.5	206.0	97.7
97	60	44	26.4	60	45	27.0	53.4	39.9	60.0	0.8	44.5	33.3	63.0	47.0	3362	1876.9
98	69	24	16.6	70	25	17.5	34.06	25.31	69.5	0.9	29.6	22.0	13.6	10.1	461.6	254.9
99	130	6	7.8	130	13	16.9	24.7	16.25	130.0	1.0	25.3	16.6	1.5	1.0	38.2	16.5
100				120	8	9.6	9.6	4.8	120.0	1.4	13.1	6.5	4.5	2.3	43.5	10.9
109	90	17	15.3	90	21	18.9	34.2	24.75	90.0	1.0	34.2	24.8	12.1	8.8	413.7	216.6
110	110	18	19.8	110	16	17.6	37.4	28.6	110.0	0.7	25.1	19.2	1.5	1.1	54.3	31.8
SP-9	110	27	29.7	110	43	47.3	77	53.35	110.0	0.6	47.6	33.0	1.7	1.2	128.5	61.7
SP-10	119	9	10.7	103	6	6.2	16.89	13.8	112.6	0.9	15.1	12.3	1.4	1.1	23.5	15.7
Total	3833	468	451	3914	503	479	931	691	4151	39	928	694	315	240	13907	8279
Count	40	40	40	42	42	42	44	44	44	44	44	44	44	44	44	44
Avg	95.8	11.7	11.3	93.2	12.0	11.4	21.15	15.70	94.3	0.89	21.09	15.76	7.16	5.45	316.1	188.17
StdDev	28.23	10.33	10.9	25.91	11.34	11.6	21.05	15.70	27.0	0.31	25.23	19.52	13.09	10.23	727.7	447.93

Carex spp

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
1	100	2	2	100	5	5	7	4.5	100.0	0.8	5.7	3.7	0.8	0.5	5.8	2.4
2	40	4	1.6	10	1	0.1	1.7	1.65	34.0	0.5	0.8	0.8	1.9	1.8	3.2	3.0
3				10	1	0.1	0.1	0.05	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
4				10	1	0.1	0.1	0.05	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
5	100	4	4				4	4	100.0	0.5	2.2	2.2	0.1	0.1	0.4	0.4
7	20	4	0.8	20	2	0.4	1.2	1	20.0	0.2	0.2	0.2	0.2	0.2	0.3	0.2
8	40	11	4.4	40	4	1.6	6	5.2	40.0	0.3	1.6	1.4	0.3	0.2	1.5	1.1
10	100	3	3				3	3	100.0	0.8	2.5	2.5	0.3	0.3	0.9	0.9
11	80	3	2.4				2.4	2.4	80.0	0.5	1.2	1.2	0.1	0.1	0.1	0.1
16	50	4	2				2	2	50.0	0.5	1.1	1.1	0.3	0.3	0.6	0.6
17	107	3	3.21	80	1	0.8	4.01	3.61	100.3	1.0	3.9	3.5	0.6	0.5	2.3	1.8
18	80	6	4.8	90	1	0.9	5.7	5.25	81.4	0.6	3.2	3.0	0.2	0.2	1.0	0.8
20	90	5	4.5	83	6	4.98	9.48	6.99	86.2	0.8	7.7	5.7	1.1	0.8	10.8	5.9
24	60	2	1.2	60	4	2.4	3.6	2.4	60.0	0.7	2.6	1.7	1.3	0.9	4.7	2.1
25	60	2	1.2				1.2	1.2	60.0	1.1	1.4	1.4	1.6	1.6	1.9	1.9
29	110	5	5.5	110	4	4.4	9.9	7.7	110.0	1.1	10.9	8.5	2.6	2.0	25.8	15.6
59	60	3	1.8				1.8	1.8	60.0	0.5	0.9	0.9	0.3	0.3	0.6	0.6
63	35	4	1.4	35	8	2.8	4.2	2.8	35.0	0.4	1.6	1.0	0.6	0.4	2.4	1.1
64				40	3	1.2	1.2	0.6	40.0	0.3	0.4	0.2	0.1	0.0	0.1	0.0
66	50	2	1				1	1	50.0	0.4	0.4	0.4	0.1	0.1	0.1	0.1
67	110	4	4.4	110	4	4.4	8.8	6.6	110.0	0.9	8.2	6.2	1.3	0.9	11.1	6.3
69				100	2	2	2	1	100.0	0.8	1.5	0.8	0.2	0.1	0.5	0.1
70				110	4	4.4	4.4	2.2	110.0	1.0	4.4	2.2	0.4	0.2	1.9	0.5
72				30	4	1.2	1.2	0.6	30.0	0.3	0.3	0.2	0.2	0.1	0.2	0.1
74				90	2	1.8	1.8	0.9	90.0	0.6	1.2	0.6	0.1	0.0	0.1	0.0
91	40	3	1.2	40	1	0.4	1.6	1.4	40.0	0.3	0.5	0.4	0.2	0.2	0.3	0.3
102	80	2	1.6	80	11	8.8	10.4	6	80.0	0.8	8.8	5.1	4.0	2.3	41.4	13.8
SP-2	120	1	1.2	120	9	10.8	12	6.6	120.0	0.7	8.2	4.5	0.3	0.2	3.8	1.2
SP-3	100	5	5				5	5	100.0	0.7	3.5	3.5	0.2	0.2	1.0	1.0
Total	1632	82	58	1368	78	59	117	88	2007	17	85	63	19	15	123	62
Count	22	22	22	21	21	21	29	29	29	29	29	29	29	29	29	29
Avg	74.2	3.7	2.65	65.1	3.7	2.79	4.03	3.02	69.2	0.60	2.93	2.16	0.66	0.50	4.23	2.13
StdDev	29.69	2.05	1.54	37.88	2.83	2.89	3.34	2.29	33.4	0.30	3.07	2.14	0.90	0.64	8.88	3.82

Minor Herb Species

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
1	5	8	0.4	5	6	0.3	0.7	0.55	5.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0
6	5	9	0.45	5	1	0.05	0.5	0.475	5.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
8				15	2	0.3	0.3	0.15	15.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
10	10	2	0.2	10	6	0.6	0.8	0.5	10.0	0.1	0.1	0.0	0.1	0.0	0.1	0.0
11	20	1	0.2	20	3	0.6	0.8	0.5	20.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
12	30	14	4.2	30	26	7.8	12	8.1	30.0	0.2	2.7	1.9	0.4	0.2	4.4	2.0
14	10	9	0.9	14	17	2.4	3.3	2.1	12.7	0.1	0.4	0.2	0.3	0.2	0.9	0.4
17	12	17	2.1	15	4	0.6	2.7	2.4	12.9	0.1	0.3	0.3	0.4	0.3	1.0	0.8
19	15	3	0.45	15	2	0.3	0.75	0.6	15.0	0.2	0.2	0.1	0.4	0.3	0.3	0.2
20	43	2	0.85	62	5	3.1	3.95	2.4	56.4	0.5	2.1	1.3	0.5	0.3	1.9	0.7
32	15	10	1.5	18	5	0.9	2.4	1.95	16.0	0.1	0.3	0.3	0.4	0.3	1.0	0.7
33	10	5	0.5	10	7	0.7	1.2	0.85	10.0	0.1	0.1	0.1	0.3	0.2	0.3	0.2
37	10	12	1.2	10	2	0.2	1.4	1.3	10.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
39	30	5	1.5				1.5	1.5	30.0	0.3	0.5	0.5	0.5	0.5	0.7	0.7
41	30	1	0.3	20	2	0.4	0.7	0.5	23.3	0.1	0.1	0.1	0.0	0.0	0.0	0.0
43				20	3	0.6	0.6	0.3	20.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0
52	20	1	0.2	20	1	0.2	0.4	0.3	20.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
55	10	6	0.6	10	4	0.4	1	0.8	10.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0
56	11	8	0.88	14	15	2.1	2.98	1.93	13.0	0.1	0.4	0.3	0.7	0.5	2.2	0.9
58	15	3	0.45	15	3	0.45	0.9	0.675	15.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
59	15	10	1.5	15	11	1.65	3.15	2.325	15.0	0.1	0.4	0.3	0.6	0.4	1.8	1.0
60	18	3	0.54	37	7	2.6	3.14	1.84	31.4	0.2	0.7	0.4	0.2	0.1	0.6	0.2
61	25	9	2.25	18	16	2.85	5.1	3.675	20.4	0.2	1.0	0.7	0.7	0.5	3.7	1.9
62	15	15	2.25	19	17	3.2	5.45	3.85	17.0	0.2	0.8	0.6	0.6	0.5	3.5	1.8
63	15	16	2.4	17	14	2.35	4.75	3.575	15.8	0.2	0.8	0.6	0.6	0.5	3.1	1.7
64	33	5	1.65	43	8	3.45	5.1	3.375	39.2	0.3	1.6	1.1	0.4	0.3	2.0	0.9
70	110	1	1.1	70	3	2.1	3.2	2.15	80.0	0.7	2.3	1.6	0.3	0.2	1.0	0.4
71	10	29	2.9	10	26	2.6	5.5	4.2	10.0	0.1	0.6	0.5	1.2	0.9	6.8	4.0
72	15	9	1.35	15	10	1.5	2.85	2.1	15.0	0.1	0.4	0.3	0.5	0.4	1.4	0.7
73	90	1	0.9	90	2	1.8	2.7	1.8	90.0	0.7	1.9	1.3	0.4	0.2	1.0	0.4
77				15	3	0.45	0.45	0.225	15.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
80	10	3	0.3	10	7	0.7	1	0.65	10.0	0.1	0.1	0.1	0.1	0.0	0.1	0.0

Minor Herb Species

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
86	15	9	1.35	15	14	2.1	3.45	2.4	15.0	0.1	0.3	0.2	0.1	0.1	0.5	0.2
93				70	4	2.8	2.8	1.4	70.0	0.7	2.1	1.0	2.4	1.2	6.8	1.7
94	47	12	5.59	46	7	3.25	8.84	7.215	46.5	0.5	4.1	3.3	3.6	3.0	32.2	21.4
95	10	26	2.6	10	16	1.6	4.2	3.4	10.0	0.1	0.6	0.5	2.5	2.0	10.5	6.9
99	90	3	2.7				2.7	2.7	90.0	0.7	1.9	1.9	0.2	0.2	0.5	0.5
101	20	5	1				1	1	20.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
104	30	2	0.6				0.6	0.6	30.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
SP-3	70	4	2.8	64	10	6.4	9.2	6	65.7	0.5	4.2	2.7	0.4	0.2	3.3	1.4
SP-5	60	3	1.8	60	6	3.6	5.4	3.6	60.0	0.4	2.2	1.5	0.3	0.2	1.6	0.7
SP-6				60	4	2.4	2.4	1.2	60.0	0.5	1.1	0.5	0.1	0.1	0.3	0.1
SP-7	70	11	7.7	70	5	3.5	11.2	9.45	70.0	0.4	5.0	4.2	0.4	0.3	4.1	2.9
SP-8	80	3	2.4	80	5	4	6.4	4.4	80.0	0.6	3.6	2.5	0.4	0.2	2.3	1.1
SP-9	15	1	0.15	15	1	0.15	0.3	0.225	15.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
SP-10	15	1	0.15	15	3	0.45	0.6	0.375	15.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Total	1178	297	63	1192	313	78	140	102	1355	11	44	32	21	15	100	57
Count	41	41	41	42	42	42	46	46	46	46	46	46	46	46	46	46
Avg	28.7	7.2	1.53	28.4	7.5	1.85	3.05	2.21	29.5	0.24	0.96	0.69	0.45	0.33	2.18	1.24
StdDev	26.65	6.53	1.53	23.72	6.36	1.69	2.86	2.12	24.8	0.20	1.27	0.95	0.71	0.54	5.02	3.29

Rubus idaeus

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
1	80	3	2.4	80	4	3.2	5.6	4	80.0	0.7	3.6	2.6	0.7	0.5	3.7	1.9
2				40	8	3.2	3.2	1.6	40.0	0.6	1.9	0.9	3.5	1.7	11.2	2.8
4				70	4	2.8	2.8	1.4	70.0	0.6	1.7	0.8	0.3	0.1	0.8	0.2
6	70	3	2.1	70	12	8.4	10.5	6.3	70.0	0.6	6.7	4.0	1.5	0.9	16.0	5.8
7	50	2	1.0	50	2	1.0	2	1.5	50.0	0.4	0.8	0.6	0.4	0.3	0.8	0.5
8				30	3	0.9	0.9	0.45	30.0	0.2	0.2	0.1	0.0	0.0	0.0	0.0
9	50	4	2.0				2	2	50.0	0.5	0.9	0.9	0.5	0.5	0.9	0.9
10	50	1	0.5	50	3	1.5	2	1.25	50.0	0.4	0.8	0.5	0.2	0.1	0.4	0.1
11	50	1	0.5	50	4	2.0	2.5	1.5	50.0	0.3	0.8	0.5	0.1	0.0	0.1	0.1
12				70	4	2.8	2.8	1.4	70.0	0.5	1.5	0.7	0.1	0.0	0.2	0.1
14	80	9	7.2	80	4	3.2	10.4	8.8	80.0	0.7	7.2	6.1	0.9	0.7	9.0	6.4
17	40	1	0.4	35	4	1.4	1.8	1.1	36.0	0.3	0.6	0.4	0.3	0.2	0.5	0.2
18	64	16	10.2	61	9	5.5	15.73	12.985	62.9	0.4	6.9	5.7	0.5	0.4	7.3	5.0
19	50	1	0.5	50	3	1.5	2	1.25	50.0	0.7	1.5	0.9	1.0	0.6	2.0	0.8
21	40	4	1.6	62	5	3.1	4.7	3.15	52.2	0.8	3.8	2.6	3.9	2.6	18.3	8.2
22	42	6	2.5	60	4	2.4	4.92	3.72	49.2	0.5	2.4	1.8	1.0	0.7	4.8	2.8
23	31	7	2.2	30	3	0.9	3.07	2.62	30.7	0.4	1.2	1.0	1.9	1.6	5.8	4.2
24				30	1	0.3	0.3	0.15	30.0	0.4	0.1	0.1	0.1	0.1	0.0	0.0
25	30	6	1.8				1.8	1.8	30.0	0.6	1.0	1.0	2.4	2.4	4.3	4.3
26	75	12	9.0	68	13	8.8	17.84	13.42	71.4	0.9	16.5	12.4	6.7	5.0	119.3	67.5
27	70	23	16.1	70	21	14.7	30.8	23.45	70.0	0.5	15.6	11.9	2.0	1.5	60.6	35.1
28	81	21	17.0	79	30	23.7	40.71	28.86	79.8	1.0	39.6	28.1	16.2	11.5	658.1	330.8
29	63	12	7.6	83	26	21.6	29.14	18.35	76.7	0.8	22.3	14.1	7.7	4.8	223.5	88.6
30	80	5	4.0	82	6	4.9	8.92	6.46	81.1	0.6	5.4	3.9	0.7	0.5	6.0	3.1
31	70	19	13.3	82	13	10.7	23.96	18.63	74.9	2.3	54.4	42.3	237.0	184.3	5679	3433.7
32	70	10	7.0	73	11	8.0	15.03	11.015	71.6	0.6	9.5	7.0	2.7	2.0	40.2	21.6
33	56	17	9.5	64	21	13.4	22.96	16.24	60.4	0.6	12.8	9.1	5.2	3.7	119.1	59.6
34	67	6	4.0	72	5	3.6	7.62	5.82	69.3	0.5	3.9	3.0	0.4	0.3	2.8	1.6
35	50	3	1.5	47	9	4.2	5.73	3.615	47.8	0.3	1.8	1.2	0.4	0.2	2.1	0.8
36	35	2	0.7	36	5	1.8	2.5	1.6	35.7	0.2	0.5	0.3	0.1	0.0	0.1	0.1
37	64	5	3.2	80	12	9.6	12.8	8	75.3	0.5	6.1	3.8	0.5	0.3	6.9	2.7
38	68	11	7.5	110	3	3.3	10.78	9.13	77.0	0.8	8.5	7.2	7.2	6.1	77.4	55.5

Rubus idaeus

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
39	62	10	6.2	81	15	12.2	18.35	12.275	73.4	0.7	13.5	9.0	5.8	3.9	107.2	48.0
40	83	3	2.5	90	5	4.5	6.99	4.74	87.4	1.0	6.8	4.6	2.5	1.7	17.3	8.0
41	30	11	3.3	30	3	0.9	4.2	3.75	30.0	0.2	0.8	0.7	0.2	0.2	0.8	0.6
42	30	1	0.3	30	1	0.3	0.6	0.45	30.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
43	83	9	7.5	150	3	4.5	11.97	9.72	99.8	0.7	8.8	7.2	1.3	1.0	15.0	9.9
44	30	4	1.2	30	4	1.2	2.4	1.8	30.0	0.2	0.4	0.3	0.1	0.0	0.1	0.1
46	33	10	3.3	32	5	1.6	4.9	4.1	32.7	0.2	0.9	0.8	0.2	0.2	0.9	0.6
47	130	2	2.6	130	7	9.1	11.7	7.15	130.0	1.3	15.7	9.6	5.1	3.1	59.9	22.4
50	10	3	0.3	30	3	0.9	1.2	0.75	20.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0
51	40	2	0.8	30	4	1.2	2	1.4	33.3	0.3	0.5	0.4	0.1	0.1	0.3	0.1
52	63	7	4.4	84	5	4.2	8.61	6.51	71.8	0.7	6.2	4.7	1.0	0.8	9.0	5.1
53	40	2	0.8	40	1	0.4	1.2	1	40.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0
54				40	2	0.8	0.8	0.4	40.0	0.3	0.3	0.1	0.1	0.0	0.1	0.0
55	28	5	1.4	41	7	2.9	4.27	2.835	35.6	0.2	1.1	0.7	0.3	0.2	1.2	0.5
60	45	4	1.8	50	2	1.0	2.8	2.3	46.7	0.3	0.9	0.8	0.2	0.1	0.4	0.3
61	25	6	1.5	35	7	2.5	3.95	2.725	30.4	0.3	1.2	0.8	0.6	0.4	2.2	1.1
62	36	7	2.5	53	7	3.7	6.23	4.375	44.5	0.4	2.5	1.8	0.7	0.5	4.6	2.3
63	37	3	1.1	51	13	6.6	7.74	4.425	48.4	0.5	4.0	2.3	1.1	0.6	8.2	2.7
64	41	7	2.9	44	9	4.0	6.83	4.85	42.7	0.3	2.4	1.7	0.5	0.4	3.5	1.8
65	63	7	4.4	69	11	7.6	12	8.205	66.7	0.6	7.1	4.8	1.5	1.0	18.0	8.4
66	58	22	12.8	64	19	12.2	24.92	18.84	60.8	0.5	13.1	9.9	2.1	1.6	52.2	29.8
67	62	6	3.7	63	13	8.2	11.91	7.815	62.7	0.5	6.3	4.2	1.7	1.1	20.4	8.8
69	44	14	6.2	38	6	2.3	8.44	7.3	42.2	0.3	2.7	2.4	1.0	0.9	8.4	6.3
70				40	1	0.4	0.4	0.2	40.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0
71	50	1	0.5	55	2	1.1	1.6	1.05	53.3	0.6	1.0	0.6	0.4	0.2	0.6	0.2
72	48	20	9.6	53	15	8.0	17.55	13.575	50.1	0.5	7.9	6.1	2.9	2.3	51.4	30.7
73	60	10	6.0	65	23	15.0	20.95	13.475	63.5	0.5	10.6	6.8	2.8	1.8	59.1	24.5
75	60	7	4.2	58	5	2.9	7.1	5.65	59.2	0.5	3.3	2.6	0.7	0.5	4.8	3.0
77	20	1	0.2				0.2	0.2	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
81	21	4	0.8	30	1	0.3	1.14	0.99	22.8	0.1	0.2	0.1	0.0	0.0	0.0	0.0
82	28	5	1.4	43	20	8.6	10	5.7	40.0	0.3	3.0	1.7	0.4	0.2	4.2	1.4
83	40	6	2.4	35	6	2.1	4.5	3.45	37.5	0.3	1.3	1.0	0.3	0.2	1.2	0.7

Rubus idaeus

Plot #	Inner Circle Height (cm)	Cover (%)	VI	Outer Ring Height (cm)	Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
84	65	2	1.3	49	8	3.9	5.22	3.26	52.2	0.4	1.9	1.2	0.1	0.1	0.6	0.3
86	30	1	0.3				0.3	0.3	30.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
88	40	2	0.8	40	2	0.8	1.6	1.2	40.0	0.3	0.4	0.3	0.1	0.0	0.1	0.1
90	68	18	12.2	70	6	4.2	16.44	14.34	68.5	0.6	10.6	9.3	1.9	1.6	30.9	23.5
91	93	15	14.0	105	25	26.3	40.2	27.075	100.5	0.8	30.8	20.8	5.2	3.5	207.7	94.2
92	80	4	3.2	89	10	8.9	12.1	7.65	86.4	1.0	12.4	7.9	9.8	6.2	118.4	47.3
93				96	7	6.7	6.72	3.36	96.0	1.0	6.9	3.4	5.8	2.9	39.1	9.8
94	84	12	10.1	86	10	8.6	18.68	14.38	84.9	0.8	15.7	12.1	7.7	5.9	143.6	85.1
95	40	9	3.6	37	6	2.2	5.82	4.71	38.8	0.6	3.2	2.6	3.5	2.8	20.1	13.2
96	57	9	5.1	60	12	7.2	12.33	8.73	58.7	0.6	7.2	5.1	2.5	1.8	31.0	15.5
97				40	1	0.4	0.4	0.2	40.0	0.6	0.2	0.1	0.5	0.2	0.2	0.0
98	30	1	0.3	74	14	10.4	10.66	5.48	71.1	0.9	9.5	4.9	4.2	2.2	45.2	11.9
99	55	13	7.2	69	21	14.5	21.64	14.395	63.6	0.5	10.8	7.2	1.4	0.9	29.3	13.0
100	71	23	16.3	76	13	9.9	26.21	21.27	72.8	0.8	21.7	17.6	12.4	10.0	324.6	213.7
102	86	7	6.0				6.02	6.02	86.0	0.9	5.4	5.4	2.3	2.3	13.9	13.9
103	110	2	2.2	90	1	0.9	3.1	2.65	103.3	0.6	1.8	1.5	0.1	0.1	0.4	0.3
104	30	1	0.3	25	2	0.5	0.8	0.55	26.7	0.2	0.1	0.1	0.0	0.0	0.0	0.0
106	109	10	10.9	108	10	10.8	21.7	16.3	108.5	0.8	17.4	13.1	2.3	1.7	49.3	27.8
107	35	4	1.4				1.4	1.4	35.0	0.2	0.3	0.3	0.1	0.1	0.1	0.1
108	80	2	1.6				1.6	1.6	80.0	0.5	0.8	0.8	0.1	0.1	0.1	0.1
SP-1				20	3	0.6	0.6	0.3	20.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
SP-2	30	13	3.9	30	3	0.9	4.8	4.35	30.0	0.2	0.8	0.7	0.1	0.1	0.6	0.5
SP-3	30	1	0.3	50	3	1.5	1.8	1.05	45.0	0.3	0.6	0.3	0.1	0.0	0.1	0.0
SP-4	60	5	3.0	62	6	3.7	6.72	4.86	61.1	0.3	2.3	1.6	0.3	0.2	2.0	1.1
SP-5	30	2	0.6	76	8	6.1	6.68	3.64	66.8	0.5	3.0	1.6	0.4	0.2	2.4	0.7
SP-6	23	3	0.7	23	3	0.7	1.38	1.035	23.0	0.2	0.2	0.2	0.1	0.1	0.1	0.1
SP-7	15	6	0.9	22	3	0.7	1.56	1.23	17.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
SP-8	20	1	0.2	20	1	0.2	0.4	0.3	20.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
SP-9	50	1	0.5	50	1	0.5	1	0.75	50.0	0.3	0.3	0.2	0.0	0.0	0.0	0.0
Total	4397	576	338.8	5015	656	434.4	773	556	5133	47	529	380	400	300	8593	4935
Count	83	83	83.0	86	86	86.0	93	93	93	93	93	93	93	93	93	93
Avg	53.0	6.9	4.1	58.3	7.6	5.1	8.31	5.98	55.2	0.51	5.68	4.09	4.30	3.23	92.40	53.06
StdDev	23.25	5.87	4.2	25.46	6.54	5.3	8.83	6.39	23.3	0.31	8.62	6.37	24.56	19.09	591.6	357.08

Corylus cornuta

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
1	140	10	14.0	140	15	21.0	35	24.5	140.0	1.1	39.8	27.9	4.1	2.9	144.9	71.0
2	120	26	31.2	120	16	19.2	50.4	40.8	120.0	1.7	87.7	71.0	55.0	44.5	2774	1817.6
3	180	19	34.2	180	30	54.0	88.2	61.2	180.0	1.1	99.2	68.9	3.1	2.2	275.1	132.5
4	140	12	16.8	140	13	18.2	35	25.9	140.0	1.2	41.9	31.0	3.4	2.5	120.4	65.9
5	220	23	50.6	220	17	37.4	88	69.3	220.0	1.2	106.4	83.8	2.0	1.6	173.4	107.5
6	200	24	48.0	200	21	42.0	90	69	200.0	1.8	165.1	126.6	13.1	10.0	1178	692.4
7	130	7	9.1	130	23	29.9	39	24.05	130.0	1.1	41.6	25.6	8.0	4.9	312.8	118.9
8	160	6	9.6	160	18	28.8	38.4	24	160.0	1.0	40.2	25.1	1.6	1.0	62.6	24.5
9	140	30	42.0	140	37	51.8	93.8	67.9	140.0	1.3	119.4	86.4	21.4	15.5	2009	1052.6
10	80	16	12.8	80	18	14.4	27.2	20	80.0	0.7	18.3	13.4	2.6	1.9	70.7	38.2
11	80	2	1.6	80	4	3.2	4.8	3.2	80.0	0.5	2.4	1.6	0.1	0.1	0.5	0.2
13	180	8	14.4	180	10	18.0	32.4	23.4	180.0	1.2	39.7	28.7	1.1	0.8	34.6	18.1
15	80	1	0.8	80	8	6.4	7.2	4	80.0	0.9	6.4	3.6	1.2	0.6	8.4	2.6
16	250	16	40.0	250	16	40.0	80	60	250.0	2.7	212.8	159.6	11.7	8.7	932.1	524.3
17	216	5	10.8	194	17	33.0	43.78	27.29	199.0	1.9	83.8	52.2	6.2	3.9	271.6	105.5
18	195	8	15.6	199	13	25.9	41.47	28.535	197.5	1.4	57.3	39.4	1.2	0.8	51.0	24.2
19	97	9	8.7	106	5	5.3	14.03	11.38	100.2	1.5	20.7	16.8	6.9	5.6	97.5	64.1
20	110	6	6.6	115	11	12.7	19.25	12.925	113.2	1.1	20.6	13.8	2.3	1.6	44.6	20.1
21	85	14	11.9	102	14	14.3	26.18	19.04	93.5	1.5	38.2	27.8	21.7	15.8	567.0	299.9
22	91	14	12.7	85	4	3.4	16.14	14.44	89.7	0.9	14.1	12.6	3.2	2.9	51.9	41.5
23				90	7	6.3	6.3	3.15	90.0	1.2	7.3	3.6	3.9	1.9	24.5	6.1
24	50	4	2.0	50	11	5.5	7.5	4.75	50.0	0.6	4.5	2.8	2.7	1.7	20.3	8.2
25	60	6	3.6	82	6	4.9	8.52	6.06	71.0	1.3	11.4	8.1	11.2	8.0	95.8	48.5
26	67	6	4.0	85	4	3.4	7.42	5.72	74.2	1.0	7.2	5.5	2.8	2.1	20.6	12.3
27	110	2	2.2	70	2	1.4	3.6	2.9	90.0	0.7	2.3	1.9	0.2	0.2	0.8	0.5
28				90	4	3.6	3.6	1.8	90.0	1.1	4.0	2.0	1.4	0.7	5.1	1.3
29	112	5	5.6	120	7	8.4	14	9.8	116.7	1.2	16.3	11.4	3.7	2.6	51.6	25.3
30	50	1	0.5	50	2	1.0	1.5	1	50.0	0.4	0.6	0.4	0.1	0.1	0.2	0.1
31	140	2	2.8	140	6	8.4	11.2	7	140.0	4.2	47.5	29.7	110.8	69.3	1241	484.8
32	90	2	1.8	90	1	0.9	2.7	2.25	90.0	0.8	2.2	1.8	0.5	0.4	1.3	0.9
34	102	5	5.1	110	4	4.4	9.5	7.3	105.6	0.8	7.4	5.7	0.5	0.3	4.3	2.5
35	60	1	0.6			0.0	0.6	0.6	60.0	0.4	0.2	0.2	0.0	0.0	0.0	0.0

Corylus cornuta

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
36	168	4	6.7	35	4	1.4	8.12	7.42	101.5	0.6	4.6	4.2	0.2	0.2	1.4	1.1
37				110	6	6.6	6.6	3.3	110.0	0.7	4.6	2.3	0.3	0.1	1.8	0.5
38	120	6	7.2	156	5	7.8	15	11.1	136.4	1.4	20.9	15.4	10.0	7.4	149.9	82.1
40	136	5	6.8	132	19	25.1	31.88	19.34	132.8	1.5	47.1	28.5	11.3	6.9	360.4	132.6
41	184	5	9.2	168	26	43.7	52.88	31.04	170.6	1.1	57.1	33.5	2.4	1.4	128.4	44.2
42	182	6	10.9	135	18	24.3	35.22	23.07	146.8	1.1	40.4	26.4	1.9	1.3	67.6	29.0
43	161	8	12.9	154	36	55.4	68.32	40.6	155.3	1.2	78.6	46.7	7.2	4.3	489.1	172.7
44	103	8	8.2	60	4	2.4	10.64	9.44	88.7	0.5	5.4	4.8	0.3	0.2	2.7	2.1
45	164	16	26.2	177	33	58.4	84.65	55.445	172.8	1.2	102.3	67.0	4.1	2.7	350.1	150.2
46	96	11	10.6	179	25	44.8	55.31	32.935	153.6	0.9	49.4	29.4	2.0	1.2	113.2	40.1
47	155	36	55.8	165	16	26.4	82.2	69	158.1	1.6	134.0	112.4	36.0	30.2	2956	2083.1
48	158	19	30.0	160	31	49.6	79.62	54.82	159.2	1.6	129.4	89.1	26.0	17.9	2072	982.3
49	251	22	55.2	256	19	48.6	103.9	79.54	253.3	1.9	202.4	155.0	29.1	22.3	3019	1770.4
50	98	13	12.7	104	27	28.1	40.82	26.78	102.1	0.7	27.4	18.0	1.4	0.9	56.4	24.3
51	82	5	4.1	130	5	6.5	10.6	7.35	106.0	0.9	9.1	6.3	0.7	0.5	7.7	3.7
52	177	6	10.6	158	17	26.9	37.48	24.05	163.0	1.6	61.1	39.2	4.5	2.9	170.3	70.1
53	110	1	1.1	110	3	3.3	4.4	2.75	110.0	0.7	3.2	2.0	0.1	0.1	0.6	0.2
54	90	4	3.6	90	2	1.8	5.4	4.5	90.0	0.7	3.8	3.2	0.6	0.5	3.4	2.3
55	70	2	1.4	90	2	1.8	3.2	2.3	80.0	0.6	1.8	1.3	0.2	0.1	0.7	0.3
56	103	9	9.3	88	8	7.0	16.31	12.79	95.9	1.0	16.1	12.7	4.0	3.1	64.7	39.8
57	100	6	6.0	240	6	14.4	20.4	13.2	170.0	1.2	25.3	16.4	1.1	0.7	22.9	9.6
58	70	3	2.1	82	5	4.1	6.2	4.15	77.5	0.5	3.1	2.1	0.3	0.2	2.0	0.9
59				50	2	1.0	1	0.5	50.0	0.4	0.4	0.2	0.2	0.1	0.2	0.0
60	140	3	4.2	145	4	5.8	10	7.1	142.9	1.0	10.1	7.2	0.6	0.4	5.6	2.8
61	20	1	0.2	70	2	1.4	1.6	0.9	53.3	0.5	0.9	0.5	0.2	0.1	0.4	0.1
62	73	4	2.9	81	12	9.7	12.64	7.78	79.0	0.7	9.1	5.6	1.5	0.9	19.0	7.2
63	40	2	0.8				0.8	0.8	40.0	0.4	0.3	0.3	0.1	0.1	0.1	0.1
64	30	1	0.3	90	4	3.6	3.9	2.1	78.0	0.6	2.5	1.3	0.3	0.2	1.2	0.3
66	150	3	4.5	150	4	6.0	10.5	7.5	150.0	1.3	13.6	9.7	0.9	0.6	9.3	4.7
68	150	15	22.5	141	7	9.9	32.37	27.435	147.1	1.1	35.3	29.9	3.3	2.8	105.4	75.7
69				160	3	4.8	4.8	2.4	160.0	1.2	5.9	2.9	0.6	0.3	2.7	0.7
70				96	7	6.7	6.72	3.36	96.0	0.9	5.9	2.9	0.6	0.3	4.4	1.1

Corylus cornuta

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
71	60	3	1.8	68	4	2.7	4.52	3.16	64.6	0.7	3.4	2.3	1.0	0.7	4.6	2.2
73	40	1	0.4				0.4	0.4	40.0	0.3	0.1	0.1	0.1	0.1	0.0	0.0
74	20	1	0.2	80	3	2.4	2.6	1.4	65.0	0.5	1.2	0.7	0.1	0.0	0.2	0.1
75	100	1	1.0	130	3	3.9	4.9	2.95	122.5	1.0	4.7	2.8	0.5	0.3	2.3	0.8
79	100	4	4.0	100	1	1.0	5	4.5	100.0	0.8	3.9	3.5	0.3	0.3	1.5	1.2
SP-3	70	3	2.1	70	4	2.8	4.9	3.5	70.0	0.5	2.4	1.7	0.2	0.1	0.9	0.5
Total	7506	527	755.3	8288	741	1077	1832	1294	8312	74	2492	1776	462	328	20843	11552
Count	64	64	64	67	67	68	70	70	70	70	70	70	70	70	70	70
Avg	117.3	8.2	11.8	123.7	11.1	15.8	26.18	18.48	118.7	1.06	35.61	25.38	6.60	4.68	297.8	165.02
StdDev	54.30	7.79	14.3	50.10	9.39	16.7	28.58	20.92	48.8	0.59	48.27	36.13	15.73	10.76	688.8	420.38

Prunus pensylvanica

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
6				180	4	7.2	7.2	3.6	180.0	1.7	11.9	5.9	1.0	0.5	7.5	1.9
7	160	3	4.8	160	3	4.8	9.6	7.2	160.0	1.3	12.6	9.4	2.0	1.5	19.0	10.7
8	30	1	0.3				0.3	0.3	30.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
18				200	3	6	6	3	200.0	1.4	8.4	4.2	0.2	0.1	1.1	0.3
28	40	1	0.4				0.4	0.4	40.0	0.5	0.2	0.2	0.2	0.2	0.1	0.1
31	250	3	7.5	250	8	20	27.5	17.5	250.0	7.6	208.3	132.6	272.1	173.1	7482	3029.8
32	130	8	10.4	164	11	18.04	28.44	19.42	149.7	1.3	37.7	25.7	5.1	3.5	144.1	67.2
33	120	4	4.8	178	12	21.36	26.16	15.48	163.5	1.5	39.6	23.4	5.9	3.5	154.6	54.1
34	150	4	6	150	3	4.5	10.5	8.25	150.0	1.1	11.6	9.1	0.5	0.4	5.3	3.3
36	150	2	3	150	7	10.5	13.5	8.25	150.0	0.8	11.3	6.9	0.3	0.2	3.8	1.4
37	149	13	19.37	143	8	11.44	30.81	25.09	146.7	0.9	28.6	23.3	1.3	1.1	39.8	26.4
41	240	7	16.8	213	11	23.43	40.23	28.515	223.5	1.4	56.9	40.3	1.8	1.3	74.3	37.3
44	140	5	7				7	7	140.0	0.8	5.6	5.6	0.2	0.2	1.2	1.2
46				96	10	9.6	9.6	4.8	96.0	0.6	5.4	2.7	0.4	0.2	3.4	0.9
48				80	2	1.6	1.6	0.8	80.0	0.8	1.3	0.7	0.5	0.3	0.8	0.2
53	170	3	5.1	153	6	9.18	14.28	9.69	158.7	1.1	15.1	10.2	0.5	0.3	6.7	3.1
54	300	9	27	300	12	36	63	45	300.0	2.4	148.8	106.3	7.3	5.2	460.5	235.0
55				30	1	0.3	0.3	0.15	30.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
58				100	3	3	3	1.5	100.0	0.6	1.9	1.0	0.2	0.1	0.5	0.1
59	220	1	2.2	220	6	13.2	15.4	8.8	220.0	1.9	29.7	17.0	2.8	1.6	42.4	13.8
60	70	1	0.7	210	4	8.4	9.1	4.9	182.0	1.3	11.7	6.3	0.5	0.3	4.7	1.4
75	80	2	1.6				1.6	1.6	80.0	0.6	1.0	1.0	0.2	0.2	0.2	0.2
82	158	17	26.86	190	3	5.7	32.56	29.71	162.8	1.2	39.3	35.8	1.4	1.2	44.4	37.0
83	133	3	3.99	154	7	10.78	14.77	9.38	147.7	1.1	16.9	10.7	0.9	0.6	13.5	5.4
87				100	1	1	1	0.5	100.0	0.6	0.6	0.3	0.1	0.0	0.1	0.0
89	231	17	39.27	300	10	30	69.27	54.27	256.6	1.7	120.9	94.7	6.7	5.2	461.8	283.4
92	165	15	24.75	178	12	21.36	46.11	35.43	170.8	2.0	93.7	72.0	37.3	28.6	1719	1014.8
93	240	22	52.8	240	15	36	88.8	70.8	240.0	2.6	226.7	180.8	77.0	61.4	6836	4345.4
94				130	2	2.6	2.6	1.3	130.0	1.3	3.3	1.7	1.1	0.5	2.8	0.7
96	60	1	0.6				0.6	0.6	60.0	0.6	0.4	0.4	0.1	0.1	0.1	0.1
103	287	31	88.97	300	13	39	128	108.47	290.8	1.6	205.6	174.3	5.6	4.8	720.0	517.3
105	222	15	33.3	249	11	27.39	60.69	46.995	233.4	1.9	118.1	91.4	10.7	8.3	651.3	390.6

Prunus pensylvanica

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
107	270	12	32.4	242	10	24.2	56.6	44.5	257.3	1.5	82.7	65.0	2.9	2.3	165.5	102.3
108	242	11	26.62	221	17	37.57	64.19	45.405	229.3	1.5	94.3	66.7	2.9	2.1	186.8	93.5
109				270	4	10.8	10.8	5.4	270.0	3.0	32.4	16.2	3.8	1.9	41.3	10.3
SP-1	135	6	8.1	150	1	1.5	9.6	8.85	137.1	0.7	7.0	6.5	0.1	0.1	1.4	1.2
SP-2				53	3	1.59	1.59	0.795	53.0	0.3	0.5	0.2	0.0	0.0	0.1	0.0
SP-3				80	4	3.2	3.2	1.6	80.0	0.6	1.8	0.9	0.1	0.1	0.4	0.1
SP-4	230	8	18.4	224	13	29.12	47.52	32.96	226.3	1.3	59.4	41.2	2.1	1.5	100.9	48.5
SP-5	200	10	20	168	16	26.88	46.88	33.44	180.3	1.2	57.1	40.7	2.5	1.8	118.2	60.1
SP-6				30	1	0.3	0.3	0.15	30.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
SP-8	270	23	62.1	270	3	8.1	70.2	66.15	270.0	1.9	132.5	124.9	4.0	3.7	278.6	247.4
Total	5242	258	555	6526	260	526	1081	818	6755	57	1941	1457	462	318	19793	10646
Count	30	30	30	37	37	37	42	42	42	42	42	42	42	42	42	42
Avg	174.7	8.6	18.50	176.4	7.0	14.21	25.73	19.48	160.8	1.35	46.22	34.68	11.00	7.57	471.3	253.48
StdDev	74.40	7.70	20.82	73.31	4.75	12.03	29.31	24.11	76.3	1.17	62.25	48.74	43.23	28.10	1545	812.20

Pinus banksiana

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
3				150	1	1.5	1.5	0.75	150.0	0.9	1.4	0.7	0.1	0.0	0.1	0.0
4	80	2	1.6				1.6	1.6	80.0	0.7	1.1	1.1	0.2	0.2	0.3	0.3
5	180	3	5.4				5.4	5.4	180.0	1.0	5.3	5.3	0.1	0.1	0.7	0.7
6				200	6	12.0	12	6	200.0	1.8	22.0	11.0	1.7	0.9	20.9	5.2
8	140	2	2.8	140	1	1.4	4.2	3.5	140.0	0.9	3.8	3.2	0.2	0.1	0.7	0.5
10	120	1	1.2	120	2	2.4	3.6	2.4	120.0	1.0	3.6	2.4	0.3	0.2	1.2	0.6
14				140	5	7.0	7	3.5	140.0	1.2	8.4	4.2	0.6	0.3	4.1	1.0
17				120	2	2.4	2.4	1.2	120.0	1.2	2.8	1.4	0.3	0.2	0.8	0.2
18	70	2	1.4				1.4	1.4	70.0	0.5	0.7	0.7	0.0	0.0	0.1	0.1
19				80	2	1.6	1.6	0.8	80.0	1.2	1.9	0.9	0.8	0.4	1.3	0.3
21	116	5	5.8				5.8	5.8	116.0	1.8	10.5	10.5	4.8	4.8	27.8	27.8
22				60	1	0.6	0.6	0.3	60.0	0.6	0.3	0.2	0.1	0.1	0.1	0.0
26	60	2	1.2	60	2	1.2	2.4	1.8	60.0	0.8	1.9	1.4	0.9	0.7	2.2	1.2
29				70	1	0.7	0.7	0.35	70.0	0.7	0.5	0.2	0.2	0.1	0.1	0.0
30				130	4	5.2	5.2	2.6	130.0	1.0	5.1	2.5	0.4	0.2	2.0	0.5
40				80	1	0.8	0.8	0.4	80.0	0.9	0.7	0.4	0.3	0.1	0.2	0.1
41				50	3	1.5	1.5	0.75	50.0	0.3	0.5	0.2	0.1	0.0	0.1	0.0
43	30	1	0.3				0.3	0.3	30.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
44				160	6	9.6	9.6	4.8	160.0	0.9	8.7	4.4	0.2	0.1	2.2	0.6
45				160	3	4.8	4.8	2.4	160.0	1.1	5.4	2.7	0.2	0.1	1.1	0.3
46	160	2	3.2	160	4	6.4	9.6	6.4	160.0	0.9	8.9	6.0	0.4	0.2	3.4	1.5
47	90	2	1.8	90	3	2.7	4.5	3.15	90.0	0.9	4.2	2.9	2.0	1.4	8.9	4.3
49	90	3	2.7				2.7	2.7	90.0	0.7	1.9	1.9	0.8	0.8	2.0	2.0
50	67	3	2.0	122	5	6.1	8.11	5.06	101.4	0.7	5.4	3.4	0.3	0.2	2.2	0.9
51				160	6	9.6	9.6	4.8	160.0	1.3	12.4	6.2	0.7	0.3	6.3	1.6
55				80	3	2.4	2.4	1.2	80.0	0.6	1.3	0.7	0.2	0.1	0.4	0.1
58				150	2	3.0	3	1.5	150.0	1.0	2.9	1.5	0.2	0.1	0.5	0.1
59				114	5	5.7	5.7	2.85	114.0	1.0	5.7	2.9	1.0	0.5	5.8	1.5
60	130	2	2.6	130	3	3.9	6.5	4.55	130.0	0.9	6.0	4.2	0.4	0.3	2.4	1.2
61				120	2	2.4	2.4	1.2	120.0	1.2	2.9	1.4	0.3	0.2	0.8	0.2
62				90	4	3.6	3.6	1.8	90.0	0.8	2.9	1.5	0.4	0.2	1.5	0.4
63	90	1	0.9	90	4	3.6	4.5	2.7	90.0	1.0	4.3	2.6	0.6	0.4	2.8	1.0

Pinus banksiana

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
64				120	2	2.4	2.4	1.2	120.0	1.0	2.3	1.2	0.2	0.1	0.4	0.1
68	100	1	1.0	100	4	4.0	5	3	100.0	0.7	3.7	2.2	0.5	0.3	2.5	0.9
73	80	2	1.6	80	1	0.8	2.4	2	80.0	0.6	1.5	1.3	0.3	0.3	0.8	0.5
74				180	4	7.2	7.2	3.6	180.0	1.3	9.3	4.7	0.2	0.1	1.7	0.4
75				140	3	4.2	4.2	2.1	140.0	1.1	4.6	2.3	0.4	0.2	1.7	0.4
76				90	4	3.6	3.6	1.8	90.0	0.6	2.0	1.0	0.1	0.0	0.3	0.1
79	170	5	8.5	162	9	14.6	23.08	15.79	164.9	1.3	29.5	20.2	1.4	1.0	32.9	15.4
81				153	8	12.2	12.24	6.12	153.0	0.9	11.3	5.7	0.3	0.2	3.9	1.0
83	130	1	1.3	130	6	7.8	9.1	5.2	130.0	1.0	9.2	5.2	0.6	0.3	5.1	1.7
84				160	4	6.4	6.4	3.2	160.0	1.1	7.2	3.6	0.2	0.1	1.0	0.2
86				170	3	5.1	5.1	2.55	170.0	1.0	5.0	2.5	0.2	0.1	1.0	0.3
87				170	2	3.4	3.4	1.7	170.0	1.0	3.6	1.8	0.2	0.1	0.7	0.2
88				150	4	6.0	6	3	150.0	1.0	5.8	2.9	0.2	0.1	1.3	0.3
89	190	3	5.7	190	7	13.3	19	12.35	190.0	1.3	24.6	16.0	1.8	1.2	34.7	14.7
90				60	3	1.8	1.8	0.9	60.0	0.6	1.0	0.5	0.2	0.1	0.4	0.1
91				120	2	2.4	2.4	1.2	120.0	0.9	2.2	1.1	0.3	0.2	0.7	0.2
95	70	1	0.7	70	3	2.1	2.8	1.75	70.0	1.0	2.8	1.8	1.7	1.0	4.7	1.8
105				80	1	0.8	0.8	0.4	80.0	0.7	0.5	0.3	0.1	0.1	0.1	0.0
110				110	2	2.2	2.2	1.1	110.0	0.7	1.5	0.7	0.1	0.0	0.2	0.0
SP-7				230	6	13.8	13.8	6.9	230.0	1.5	20.2	10.1	0.4	0.2	6.2	1.5
Total	2163	44	51.7	5691	159	216.2	268	160	6239	49	292	174	28	19	203	94
Count	20	20	20.0	46	46	46.0	52	52	52	52	52	52	52	52	52	52
Avg	108.2	2.2	2.6	123.7	3.5	4.7	5.15	3.07	120.0	0.94	5.61	3.34	0.54	0.36	3.91	1.81
StdDev	43.66	1.20	2.1	41.97	1.95	3.8	4.54	2.87	43.7	0.31	6.27	3.93	0.77	0.70	7.73	4.71

Betula papyrifera

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	Inner Circle VI	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
63	100	2	2.0	100	1	1.0	3	2.5	100.0	1.1	3.2	2.7	0.4	0.3	1.2	0.9
75	147	3	4.4	202	16	32.3	36.73	20.57	193.3	1.5	55.9	31.3	3.5	2.0	128.8	40.4
76	155	21	32.6	141	25	35.3	67.8	50.175	147.4	0.9	61.3	45.4	1.4	1.0	92.1	50.4
77	195	12	23.4	194	13	25.2	48.62	36.01	194.5	1.4	68.0	50.4	2.0	1.5	96.2	52.8
78	170	3	5.1	170	7	11.9	17	11.05	170.0	1.0	17.3	11.2	0.4	0.3	6.7	2.8
80	165	4	6.6	147	18	26.5	33.06	19.83	150.3	1.4	46.0	27.6	2.4	1.4	79.3	28.5
82	108	6	6.5	127	9	11.4	17.91	12.195	119.4	0.9	15.8	10.8	0.8	0.5	13.4	6.2
85	30	1	0.3	110	3	3.3	3.6	1.95	90.0	0.5	1.8	1.0	0.1	0.0	0.3	0.1
86				90	1	0.9	0.9	0.45	90.0	0.5	0.5	0.2	0.0	0.0	0.0	0.0
89	50	4	2.0				2	2	50.0	0.3	0.7	0.7	0.2	0.2	0.4	0.4
91	119	8	9.5	197	6	11.8	21.34	15.43	152.4	1.2	24.8	18.0	2.7	2.0	58.5	30.6
93	200	3	6.0	200	9	18.0	24	15	200.0	2.1	51.1	31.9	20.8	13.0	499.3	195.0
94	300	2	6.0	300	9	27.0	33	19.5	300.0	3.0	98.0	57.9	13.6	8.0	448.3	156.5
95	44	5	2.2	40	2	0.8	3	2.6	42.9	0.6	1.8	1.6	1.8	1.5	5.3	4.0
96	66	5	3.3	80	4	3.2	6.5	4.9	72.2	0.7	4.6	3.5	1.3	1.0	8.6	4.9
97				60	1	0.6	0.6	0.3	60.0	0.8	0.5	0.3	0.7	0.4	0.4	0.1
98	47	3	1.4				1.41	1.41	47.0	0.6	0.8	0.8	0.6	0.6	0.8	0.8
102	100	3	3.0				3	3	100.0	1.1	3.2	3.2	1.1	1.1	3.4	3.4
103	90	5	4.5	90	1	0.9	5.4	4.95	90.0	0.5	2.7	2.5	0.2	0.2	1.3	1.1
104				30	1	0.3	0.3	0.15	30.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
105	210	20	42.0	193	9	17.4	59.37	50.685	204.7	1.7	101.3	86.5	10.5	9.0	623.3	454.3
106	203	19	38.6	205	11	22.6	61.12	49.845	203.7	1.5	92.2	75.2	6.4	5.2	391.5	260.4
107	200	7	14.0	173	15	26.0	39.95	26.975	181.6	1.0	41.2	27.8	2.1	1.4	82.5	37.6
108	230	2	4.6	230	5	11.5	16.1	10.35	230.0	1.5	23.7	15.3	0.7	0.5	11.8	4.9
109	176	14	24.6	220	9	19.8	44.44	34.54	193.2	2.1	95.4	74.2	15.7	12.2	698.5	421.9
110	100	2	2.0	162	14	22.7	24.68	13.34	154.3	0.9	23.2	12.5	1.0	0.5	23.6	6.9
SP-1				60	3	1.8	1.8	0.9	60.0	0.3	0.6	0.3	0.0	0.0	0.0	0.0
SP-2				98	5	4.9	4.9	2.45	98.0	0.6	2.7	1.4	0.1	0.1	0.6	0.2
SP-3	54	5	2.7	59	8	4.7	7.42	5.06	57.1	0.4	2.9	2.0	0.3	0.2	2.2	1.0
SP-4	130	1	1.3	158	5	7.9	9.2	5.25	153.3	0.8	7.8	4.4	0.4	0.2	3.8	1.2
SP-7	90	2	1.8	82	5	4.1	5.9	3.85	84.3	0.5	3.2	2.1	0.2	0.1	1.1	0.5
SP-8	100	2	2.0	93	3	2.8	4.79	3.395	95.8	0.7	3.2	2.3	0.3	0.2	1.3	0.7

Betula papyrifera

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
SP-9				67	3	2.0	2.01	1.005	67.0	0.4	0.8	0.4	0.0	0.0	0.1	0.0
SP-10	83	11	9.1	68	11	7.5	16.61	12.87	75.5	0.6	10.0	7.7	1.4	1.1	22.8	13.7
Total	3662	175	261.5	4146	232	366.0	627	444	4258	33	866	613	93	66	3308	1782
Count	28	28	28.0	31	31	31.0	34	34	34	34	34	34	34	34	34	34
Avg	130.8	6.3	9.3	133.7	7.5	11.8	18.45	13.07	125.2	0.98	25.48	18.03	2.74	1.93	97.28	52.42
StdDev	66.85	5.84	11.7	66.57	5.82	10.8	19.75	15.10	65.2	0.61	32.96	24.72	4.95	3.42	191.5	114.39

Acer spicatum

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
1	110	1	1.1	110	1	1.1	2.2	1.65	110.0	0.9	2.0	1.5	0.3	0.2	0.6	0.3
7				80	2	1.6	1.6	0.8	80.0	0.7	1.0	0.5	0.3	0.2	0.5	0.1
12				110	3	3.3	3.3	1.65	110.0	0.8	2.8	1.4	0.1	0.1	0.3	0.1
15				140	6	8.4	8.4	4.2	140.0	1.6	13.1	6.5	1.4	0.7	11.4	2.9
16	150	11	16.5	147	18	26.5	42.96	29.73	148.1	1.6	67.7	46.9	6.3	4.3	268.8	128.7
17	168	4	6.7	170	12	20.4	27.12	16.92	169.5	1.6	44.2	27.6	3.8	2.4	104.2	40.6
20				120	4	4.8	4.8	2.4	120.0	1.1	5.4	2.7	0.6	0.3	2.8	0.7
29	80	2	1.6				1.6	1.6	80.0	0.8	1.3	1.3	0.4	0.4	0.7	0.7
30	40	1	0.4				0.4	0.4	40.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0
31	158	18	28.4	139	15	20.9	49.29	38.865	149.4	4.5	223.1	175.9	487.6	384.5	24035	14943.4
32				100	2	2.0	2	1	100.0	0.9	1.8	0.9	0.4	0.2	0.7	0.2
33	90	1	0.9	90	1	0.9	1.8	1.35	90.0	0.8	1.5	1.1	0.4	0.3	0.7	0.4
38	174	17	29.6	177	27	47.8	77.37	53.475	175.8	1.8	138.8	95.9	51.5	35.6	3988	1905.2
40				160	3	4.8	4.8	2.4	160.0	1.8	8.5	4.3	1.7	0.9	8.2	2.0
41	125	6	7.5				7.5	7.5	125.0	0.8	5.9	5.9	0.3	0.3	2.6	2.6
43				130	2	2.6	2.6	1.3	130.0	1.0	2.5	1.3	0.3	0.1	0.7	0.2
44				120	4	4.8	4.8	2.4	120.0	0.7	3.3	1.6	0.1	0.1	0.6	0.1
45	100	2	2.0	100	1	1.0	3	2.5	100.0	0.7	2.1	1.7	0.1	0.1	0.4	0.3
48	200	11	22.0	200	9	18.0	40	31	200.0	2.0	81.6	63.3	13.1	10.1	523.0	314.1
49	250	22	55.0	250	25	62.5	117.5	86.25	250.0	1.9	226.0	165.9	32.9	24.1	3863	2081.7
53				110	3	3.3	3.3	1.65	110.0	0.7	2.4	1.2	0.1	0.1	0.4	0.1
62	50	1	0.5	50	4	2.0	2.5	1.5	50.0	0.5	1.1	0.7	0.3	0.2	0.7	0.3
63				60	3	1.8	1.8	0.9	60.0	0.6	1.1	0.6	0.2	0.1	0.4	0.1
64	60	3	1.8	60	5	3.0	4.8	3.3	60.0	0.5	2.3	1.6	0.4	0.3	1.8	0.8
73				110	2	2.2	2.2	1.1	110.0	0.9	1.9	1.0	0.3	0.1	0.7	0.2
74				40	2	0.8	0.8	0.4	40.0	0.3	0.2	0.1	0.0	0.0	0.0	0.0
83	120	5	6.0	124	5	6.2	12.2	9.1	122.0	0.9	11.5	8.6	0.8	0.6	9.2	5.1
95	110	2	2.2	116	13	15.1	17.28	9.74	115.2	1.6	28.4	16.0	10.3	5.8	177.3	56.3
96				140	2	2.8	2.8	1.4	140.0	1.4	3.9	1.9	0.6	0.3	1.6	0.4
100	130	4	5.2	130	4	5.2	10.4	7.8	130.0	1.5	15.4	11.5	4.9	3.7	51.1	28.7
105	200	4	8.0	208	10	20.8	28.8	18.4	205.7	1.7	49.4	31.5	5.1	3.3	146.7	59.9
SP-5	140	3	4.2	140	6	8.4	12.6	8.4	140.0	0.9	11.9	7.9	0.7	0.5	8.5	3.8

Acer spicatum

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
SP-8	200	3	6.0	200	11	22.0	28	17	200.0	1.4	39.2	23.8	1.6	1.0	44.3	16.3
Total	2655	121	205.6	3831	205	324.9	531	368	4081	39	1002	713	627	481	33256	19596
Count	20	20	20.0	30	30	30.0	33	33	33	33	33	33	33	33	33	33
Avg	132.8	6.1	10.3	127.7	6.8	10.8	16.08	11.15	123.7	1.19	30.35	21.60	19.00	14.57	1008	593.83
StdDev	55.70	6.32	13.9	48.33	6.86	14.4	25.31	18.46	49.1	0.77	58.25	43.82	84.78	66.82	4241	2620.57

Alnus crispa

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	Inner Circle VI	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
15	200	2	4.0	200	7	14.0	18.0	11.0	200	2.22	40.0	24.4	2.91	1.8	52.4	32.0
19	120	3	3.6	120	4	4.8	8.4	6.0	120	1.76	14.8	10.6	4.16	3.0	35.0	25.0
24	107	23	24.6	70	3	2.1	26.7	25.7	103	1.22	32.7	31.4	9.66	9.3	257.9	247.8
25				60	2	1.2	1.2	0.6	60	1.13	1.4	0.7	1.58	0.8	1.9	1.0
26	150	7	10.5	150	9	13.5	24.0	17.3	150	1.95	46.8	33.6	9.00	6.5	216.0	155.2
38	270	1	2.7	270	7	18.9	21.6	12.2	270	2.76	59.5	33.5	14.39	8.1	310.9	174.9
92				150	4	6.0	6.0	3.0	150	1.79	10.7	5.4	4.85	2.4	29.1	14.6
94	90	2	1.8	90	2	1.8	3.6	2.7	90	0.89	3.2	2.4	1.48	1.1	5.3	4.0
96	40	4	1.6				1.6	1.6	40	0.40	0.6	0.6	0.33	0.3	0.5	0.5
98				70	2	1.4	1.4	0.7	70	0.88	1.2	0.6	0.56	0.3	0.8	0.4
101	150	3	4.5	150	12	18.0	22.5	13.5	150	1.09	24.5	14.7	1.82	1.1	41.1	24.6
104	190	10	19.0	183	24	43.9	62.9	41.0	185	1.10	69.3	45.1	2.01	1.3	126.3	82.2
105	110	3	3.3	180	1	1.8	5.1	4.2	128	1.06	5.4	4.5	0.90	0.7	4.6	3.8
106	175	4	7.0	164	17	27.9	34.9	20.9	166	1.23	42.9	25.8	3.66	2.2	127.5	76.5
108	128	22	28.2	143	26	37.2	65.3	46.8	136	0.87	57.0	40.8	2.96	2.1	193.6	138.5
109	130	3	3.9	130	9	11.7	15.6	9.8	130	1.44	22.5	14.1	5.52	3.4	86.1	53.8
110	95	12	11.4	97	17	16.5	27.9	19.6	96	0.59	16.4	11.5	1.08	0.8	30.2	21.3
SP-4				100	4	4.0	4.0	2.0	100	0.55	2.2	1.1	0.18	0.1	0.7	0.4
SP-6	28	4	1.1	27	3	0.8	1.9	1.5	28	0.21	0.4	0.3	0.12	0.1	0.2	0.2
SP-9	80	1	0.8				0.8	0.8	80	0.45	0.4	0.4	0.02	0.0	0.0	0.0
Total	2063	104	128.0	2354	153	225.5	353.5	240.7	2451	23.59	451.9	301.4	67.18	45.4	1520.0	1056.6
Count	16	16	16	18	18	18	20	20	20	20	20	20	20	20	20	20
Avg	128.9	6.5	8.0	130.8	8.5	12.5	17.7	12.0	123	1.18	22.6	15.1	3.36	2.3	76.0	52.8
StdDev	60.97	6.95	8.6	58.77	7.72	12.9	19.2	13.3	58	0.65	22.8	15.2	3.78	2.7	97.0	71.8

Minor Woody Species

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
1				20	2	0.4	0.4	0.2	20.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
2	150	1	1.5	150	7	10.5	12	6.75	150.0	2.2	26.1	14.7	13.1	7.4	157.2	49.7
4	50	1	0.5				0.5	0.5	50.0	0.4	0.2	0.2	0.0	0.0	0.0	0.0
7	15	1	0.15	15	1	0.15	0.3	0.225	15.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
16	50	10	5	60	10	6	11	8	55.0	0.6	6.4	4.7	1.6	1.2	17.6	9.3
17	50	1	0.5	70	2	1.4	1.9	1.2	63.3	0.6	1.2	0.7	0.3	0.2	0.5	0.2
18				160	3	4.8	4.8	2.4	160.0	1.1	5.4	2.7	0.1	0.1	0.7	0.2
19	80	2	1.6				1.6	1.6	80.0	1.2	1.9	1.9	0.8	0.8	1.3	1.3
20				160	2	3.2	3.2	1.6	160.0	1.5	4.8	2.4	0.4	0.2	1.2	0.3
21	56	5	2.79	60	1	0.6	3.39	3.09	56.5	0.9	3.0	2.7	2.8	2.6	9.5	7.9
22	170	9	15.3	175	13	22.8	38.1	26.7	173.2	1.7	64.1	44.9	7.6	5.3	289.0	141.9
23	200	5	10	200	12	24	34	22	200.0	2.6	87.2	56.4	21.0	13.6	713.4	298.7
24	70	3	2.1	134	5	6.7	8.8	5.45	110.0	1.3	11.5	7.1	3.2	2.0	28.0	10.7
25	80	11	8.8	137	10	13.7	22.5	15.65	107.1	2.0	45.5	31.6	29.7	20.7	668.2	323.3
26	70	1	0.7	70	1	0.7	1.4	1.05	70.0	0.9	1.3	1.0	0.5	0.4	0.7	0.4
27	70	2	1.4	60	2	1.2	2.6	2	65.0	0.5	1.2	0.9	0.2	0.1	0.4	0.3
28	30	3	0.9	30	1	0.3	1.2	1.05	30.0	0.4	0.4	0.4	0.5	0.4	0.6	0.4
29	160	2	3.2	160	6	9.6	12.8	8	160.0	1.6	20.5	12.8	3.4	2.1	43.1	16.8
30	41	15	6.13	30	1	0.3	6.43	6.28	40.2	0.3	1.9	1.9	0.5	0.5	3.1	3.0
33				20	3	0.6	0.6	0.3	20.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0
35	60	2	1.2	110	4	4.4	5.6	3.4	93.3	0.6	3.5	2.1	0.4	0.2	2.0	0.8
36				100	3	3	3	1.5	100.0	0.6	1.7	0.8	0.1	0.0	0.2	0.0
38				250	3	7.5	7.5	3.75	250.0	2.6	19.1	9.6	5.0	2.5	37.5	9.4
40				130	1	1.3	1.3	0.65	130.0	1.4	1.9	0.9	0.5	0.2	0.6	0.1
42	50	3	1.5	50	2	1	2.5	2	50.0	0.4	1.0	0.8	0.1	0.1	0.3	0.2
43	70	3	2.1				2.1	2.1	70.0	0.5	1.1	1.1	0.2	0.2	0.5	0.5
45	140	4	5.6	140	7	9.8	15.4	10.5	140.0	1.0	15.1	10.3	0.8	0.5	11.6	5.4
53	60	3	1.8	73	4	2.92	4.72	3.26	67.4	0.4	2.1	1.5	0.2	0.1	0.7	0.3
54	40	2	0.8				0.8	0.8	40.0	0.3	0.3	0.3	0.1	0.1	0.1	0.1
56	60	3	1.8	40	2	0.8	2.6	2.2	52.0	0.5	1.4	1.2	0.6	0.5	1.6	1.2
58	150	6	9				9	9	150.0	1.0	8.7	8.7	0.5	0.5	4.2	4.2
59	100	4	4				4	4	100.0	0.9	3.5	3.5	0.7	0.7	2.9	2.9

Minor Woody Species

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	Inner Circle VI	Outer Ring Height (cm)	Outer Ring Cover (%)	Outer Ring VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
60				90	1	0.9	0.9	0.45	90.0	0.6	0.6	0.3	0.1	0.0	0.0	0.0
61	55	4	2.2	46	5	2.31	4.51	3.355	50.1	0.5	2.3	1.7	0.6	0.5	2.9	1.6
64	40	1	0.4	50	1	0.5	0.9	0.65	45.0	0.4	0.3	0.2	0.1	0.0	0.1	0.0
66				70	1	0.7	0.7	0.35	70.0	0.6	0.4	0.2	0.1	0.0	0.0	0.0
67	70	5	3.5				3.5	3.5	70.0	0.6	2.1	2.1	0.5	0.5	1.8	1.8
68	80	3	2.4	105	8	8.4	10.8	6.6	98.2	0.7	7.9	4.8	1.1	0.7	11.7	4.4
69	30	5	1.5	34	5	1.7	3.2	2.35	32.0	0.2	0.8	0.6	0.4	0.3	1.2	0.7
70	60	2	1.2	66	5	3.3	4.5	2.85	64.3	0.6	2.6	1.7	0.4	0.3	2.0	0.8
71	55	2	1.1	53	4	2.12	3.22	2.16	53.7	0.6	2.0	1.3	0.7	0.5	2.3	1.1
72				30	3	0.9	0.9	0.45	30.0	0.3	0.2	0.1	0.2	0.1	0.1	0.0
73				30	2	0.6	0.6	0.3	30.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0
74				190	5	9.5	9.5	4.75	190.0	1.4	13.0	6.5	0.3	0.2	3.0	0.8
75				60	1	0.6	0.6	0.3	60.0	0.5	0.3	0.1	0.1	0.0	0.0	0.0
76				70	3	2.1	2.1	1.05	70.0	0.4	0.9	0.5	0.0	0.0	0.1	0.0
77				130	1	1.3	1.3	0.65	130.0	0.9	1.2	0.6	0.1	0.0	0.1	0.0
78				90	4	3.6	3.6	1.8	90.0	0.5	1.9	1.0	0.1	0.0	0.3	0.1
79				40	1	0.4	0.4	0.2	40.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0
85	20	1	0.2	30	1	0.3	0.5	0.35	25.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
86	40	3	1.2	50	6	3	4.2	2.7	46.7	0.3	1.1	0.7	0.2	0.1	0.7	0.3
87	60	1	0.6	60	3	1.8	2.4	1.5	60.0	0.4	0.9	0.6	0.2	0.1	0.4	0.1
91	100	1	1				1	1	100.0	0.8	0.8	0.8	0.1	0.1	0.1	0.1
92				100	4	4	4	2	100.0	1.2	4.8	2.4	3.2	1.6	12.9	3.2
95				30	2	0.6	0.6	0.3	30.0	0.4	0.3	0.1	0.4	0.2	0.2	0.1
102	180	4	7.2	60	4	2.4	9.6	8.4	120.0	1.3	12.1	10.6	3.7	3.2	35.3	27.0
103	140	10	14	140	5	7	21	17.5	140.0	0.8	16.2	13.5	0.9	0.8	19.4	13.5
105	100	3	3				3	3	100.0	0.8	2.5	2.5	0.5	0.5	1.6	1.6
106	130	2	2.6	115	4	4.6	7.2	4.9	120.0	0.9	6.4	4.4	0.8	0.5	5.4	2.5
107	150	1	1.5	150	1	1.5	3	2.25	150.0	0.9	2.6	1.9	0.2	0.1	0.5	0.3
110	90	1	0.9	90	1	0.9	1.8	1.35	90.0	0.5	1.0	0.7	0.1	0.1	0.1	0.1
SP-1	80	1	0.8				0.8	0.8	80.0	0.4	0.3	0.3	0.0	0.0	0.0	0.0
SP-2				70	2	1.4	1.4	0.7	70.0	0.4	0.6	0.3	0.0	0.0	0.1	0.0
SP-3	70	1	0.7	70	5	3.5	4.2	2.45	70.0	0.5	2.0	1.2	0.2	0.1	0.7	0.2

Minor Woody Species

Plot #	Inner Circle Height (cm)	Inner Circle Cover (%)	VI	Outer Ring Height (cm)	Outer Ring Cover (%)	VI	CVI	CVI(W)	Av Ht (cm)	B:C(H)	CI(H)	CI(HW)	B:C(V)	B:C(VW)	CI(V)	CI(VW)
SP-4	160	1	1.6	160	1	1.6	3.2	2.4	160.0	0.9	2.8	2.1	0.1	0.1	0.5	0.3
SP-6	131	13	17.07	130	10	13.02	30.09	23.58	130.8	1.0	30.1	23.5	1.8	1.4	55.0	33.8
SP-7	20	1	0.2	25	4	1	1.2	0.7	24.0	0.2	0.2	0.1	0.0	0.0	0.0	0.0
SP-8	114	8	9.1	73	8	5.8	14.9	12	93.1	0.7	9.7	7.8	0.8	0.7	12.6	8.1
SP-9	43	4	1.7	80	1	0.8	2.5	2.1	50.0	0.3	0.7	0.6	0.1	0.0	0.1	0.1
SP-10	75	2	1.5	175	6	10.5	12	6.75	150.0	1.2	14.3	8.0	1.0	0.6	11.9	3.8
Total	4164.2	182	166	5366.3	226	240	406	286	6151	54	488	332	114	77	2180	996
Count	50	50	50	60	60	60	70	70	70	70	70	70	70	70	70	70
Avg	83.3	3.6	3.31	89.4	3.8	4.01	5.80	4.08	87.9	0.77	6.98	4.74	1.63	1.10	31.15	14.23
StdDev	46.61	3.34	3.99	53.83	2.95	5.01	7.71	5.54	50.1	0.54	14.44	9.71	4.60	3.08	120.7	54.52

APPENDIX F-3

MODIFIED T&A'S CUMULATIVE COMPETITION INDICES

Appendix F.3 Modified Towill and Archibald Cumulative Competition Indices (CCIs)

Plot	Modified CCI				Plot	Modified CCI				Plot	Modified CCI				Plot	Modified CCI			
#	(H)	(HW)	(V)	(VW)	#	(H)	(HW)	(V)	(VW)	#	(H)	(HW)	(V)	(VW)	#	(H)	(HW)	(V)	(VW)
1	45.5	32.0	149.2	73.2	33	54.1	33.7	274.4	114.1	65	7.1	4.8	18.0	8.4	97	0.7	0.4	0.6	0.2
2	115.6	86.6	2942	1870	34	22.8	17.7	12.4	7.4	66	27.1	19.8	61.5	34.6	98	10.3	5.7	46.0	12.7
3	100.6	69.6	275.2	132.5	35	5.6	3.5	4.2	1.6	67	8.4	6.2	22.2	10.5	99	10.8	7.2	29.3	13.0
4	44.9	33.1	121.5	66.4	36	18.1	12.3	5.4	2.6	68	46.8	36.9	119.7	81.0	100	37.0	29.1	375.7	242.5
5	111.7	89.1	174.0	108.2	37	39.3	29.4	48.5	29.6	69	9.4	5.9	12.3	7.6	101	0.0	0.0	0.0	0.0
6	205.8	147.6	1222	705.3	38	187.3	128.1	4253	2052	70	8.6	4.7	6.3	1.9	102	20.7	19.2	52.6	44.3
7	56.1	36.2	333.1	130.2	39	13.5	9.0	107.2	48.0	71	6.3	4.3	7.5	3.5	103	226.3	191.8	741.1	532.1
8	44.2	28.4	63.4	25.0	40	65.0	38.7	386.7	142.8	72	8.2	6.3	51.5	30.8	104	0.2	0.1	0.0	0.0
9	120.3	87.3	2010	1054	41	121.2	80.7	206.2	84.8	73	14.3	9.2	60.6	25.2	105	271.7	212.2	1423	906.3
10	22.8	16.4	72.3	38.9	42	41.5	27.3	68.0	29.2	74	23.8	11.9	5.0	1.3	106	116.1	92.7	446.3	290.7
11	3.2	2.1	0.7	0.3	43	91.1	56.3	505.3	183.3	75	69.9	40.3	137.9	45.0	107	126.8	95.1	248.6	140.3
12	4.3	2.1	0.6	0.1	44	23.3	16.6	6.8	4.1	76	64.2	46.8	92.4	50.5	108	118.9	82.8	198.7	98.5
13	39.7	28.7	34.6	18.1	45	124.8	81.7	363.2	156.2	77	69.3	51.0	96.3	52.8	109	127.8	90.4	739.7	432.3
14	15.6	10.3	13.1	7.5	46	64.6	38.8	120.9	43.1	78	19.2	12.2	7.0	2.9	110	25.7	14.0	24.0	7.0
15	19.5	10.1	19.8	5.4	47	153.8	125.0	3025	2110	79	33.5	23.7	34.4	16.6	SP-1	8.0	7.2	1.4	1.2
16	286.9	211.1	1219	662.4	48	212.3	153.0	2596	1297	80	46.0	27.6	79.3	28.5	SP-2	4.6	2.6	1.4	0.7
17	132.5	82.3	377.6	146.7	49	430.2	322.7	6884	3854	81	11.5	5.8	3.9	1.0	SP-3	9.7	6.1	4.3	1.9
18	78.6	52.7	60.2	29.7	50	33.0	21.5	58.7	25.2	82	58.1	48.3	62.1	44.6	SP-4	72.3	49.4	107.1	51.1
19	25.9	20.5	102.0	66.5	51	22.0	12.9	14.3	5.4	83	38.9	25.6	29.0	12.9	SP-5	72.0	50.3	129.1	64.6
20	30.8	18.9	48.6	21.1	52	67.3	43.9	179.3	75.3	84	9.1	4.8	1.6	0.5	SP-6	30.4	23.8	55.1	33.8
21	55.6	43.6	622.6	343.8	53	23.2	15.2	8.5	3.8	85	1.9	1.0	0.3	0.1	SP-7	23.7	12.4	7.4	2.1
22	80.8	59.4	345.7	186.2	54	153.1	109.9	464.1	237.4	86	6.7	3.5	1.7	0.5	SP-8	184.7	158.8	336.8	272.5
23	95.7	61.1	743.7	309.1	55	4.3	2.7	2.2	0.9	87	5.1	2.6	1.2	0.3	SP-9	1.7	1.2	0.2	0.1
24	16.1	10.0	48.4	18.9	56	17.5	13.8	66.3	40.9	88	6.3	3.2	1.4	0.4	SP-10	24.2	15.7	34.6	17.4
25	57.9	40.8	768.3	376.0	57	25.3	16.4	22.9	9.6	89	146.1	111.4	496.9	298.5	Total	7610	5445	88176	49601
26	26.8	20.3	142.9	81.4	58	16.6	13.2	7.2	5.4	90	11.6	9.8	31.3	23.6	Count	120	120	120	120
27	19.2	14.7	61.9	35.9	59	39.4	23.6	51.2	18.2	91	58.6	40.6	267.1	125.1	Avg	63.42	45.37	734.8	413.3
28	44.2	30.6	663.9	332.5	60	29.4	18.8	13.2	5.7	92	111.0	82.3	1850	1065	StdDev	82.95	61.91	3639	2078
29	60.9	39.8	319.0	131.5	61	7.2	4.4	6.3	3.0	93	284.7	216.1	7374	4550					
30	13.1	8.9	11.3	6.7	62	15.7	9.5	25.9	10.1	94	117.1	71.7	594.7	242.3					
31	533.3	380.5	38437	21892	63	13.0	8.4	12.7	4.7	95	36.6	22.1	207.7	75.4					
32	51.1	35.4	186.3	89.9	64	9.8	6.0	7.0	3.1	96	16.1	10.9	41.3	20.9					

APPENDIX F-4

MODIFIED T&A'S CUMULATIVE COMPETITION INDEX CORRELATIONS

Modified CCI (y)	Jack Pine Parameter (x)	n_j	Highest Correlation Equation (y =)	r	Confidence Level
Height Averaged	Height	120	178.85 - 0.729 17x	-0.281	99.9%
	Height Increment	120	177.65 - 1.939 7x	-0.285	99.9%
	Stem Diameter	120	182.96 - 6.617 8x	-0.374	99.95%
	Stem Volume	120	114.70 - 0.156 23x	-0.261	99.75%
	Crown Area	120	131.63 - 102.57x	-0.379	99.95%
	Crown Volume	120	119.10 - 0.153 34x	-0.333	99.95%
	Dry Weight	120	153.49 - 0.169 58x	-0.341	99.95%
Volume-Based	Height	120	6142.9 - 41.706x	-0.362	99.95%
	Height Increment	120	5914.8 - 107.52x	-0.355	99.95%
	Stem Diameter	120	4623.1 - 257.04x	-0.329	99.95%
	Stem Volume	120	1927.6 - 5.8157x	-0.219	99%
	Crown Area	120	2259.4 - 3126.6x	-0.261	99.75%
	Crown Volume	120	1855.8 - 4.5695x	-0.224	99%
	Dry Weight	120	2702.7 - 4.5970x	-0.210	97.5%
Proximity-Weighted	Height	120	127.75 - 0.51762x	-0.266	99.75%
	Height Increment	120	129.19 - 1.4261x	-0.279	99.9%
	Stem Diameter	120	132.69 - 4.8376x	-0.366	99.95%
	Stem Volume	120	82.767 - 0.11407x	-0.255	99.75%
	Crown Area	120	95.204 - 75.059x	-0.370	99.95%
	Crown Volume	120	85.900 - 0.11156x	-0.324	99.95%
	Dry Weight	120	111.59 - 0.12508x	-0.336	99.95%

Modified CCI (y)	Jack Pine Parameter (x)	n_j	Highest Correlation Equation (y =)	r	Confidence Level
Alder-Excluded	Height	100	192.26 - 0.865 71x	-0.310	99.9%
	Height Increment	100	174.86 - 1.945 9x	-0.286	99.75%
	Stem Diameter	100	186.62 - 7.100 1x	-0.383	99.95%
	Stem Volume	100	112.49 - 0.167 17x	-0.270	99.75%
	Crown Area	100	127.23 - 99.646x	-0.366	99.5%
	Crown Volume	100	114.28 - 0.148 47x	-0.321	99.9%
	Dry Weight	100	146.70 - 0.160 52x	-0.329	99.95%
Height-Averaged and Proximity-Weighted	Height	120	128.02 - 0.519 64x	-0.268	99.75%
	Height Increment	120	129.11 - 1.424 0x	-0.279	99.9%
	Stem Diameter	120	132.90 - 4.851 2x	-0.367	99.95%
	Stem Volume	120	82.863 - 0.114 52x	-0.257	99.75%
	Crown Area	120	95.297 - 75.236x	-0.373	99.95%
	Crown Volume	120	85.964 - 0.111 79x	-0.326	99.95%
	Dry Weight	120	111.69 - 0.125 30x	-0.338	99.95%
Volume-Based and Proximity-Weighted	Height	120	4 625.0 - 31.428x	-0.362	99.95%
	Height Increment	120	4 464.9 - 81.275x	-0.356	99.95%
	Stem Diameter	120	3 484.2 - 194.00x	-0.329	99.95%
	Stem Volume	120	1 449.6 - 4.388 8x	-0.219	99%
	Crown Area	120	1 698.6 - 2 356.1x	-0.261	99.75%
	Crown Volume	120	1 393.9 - 3.441 2x	-0.224	99%
	Dry Weight	120	2 032.2 - 3.463 1x	-0.207	97.5%

Modified CCI (y)	Jack Pine Parameter (x)	nj	Highest Correlation Equation (y =)	r	Confidence Level
Proximity-Weighted and Alder-Excluded	Height	100	137.28 - 0.613 72x	-0.293	99.75%
	Height Increment	100	127.92 - 1.441 7x	-0.283	99.75%
	Stem Diameter	100	135.67 - 5.195 7x	-0.374	99.95%
	Stem Volume	100	81.308 - 0.121 65x	-0.263	99.5%
	Crown Area	100	92.405 - 73.334x	-0.359	99.95%
	Crown Volume	100	82.649 - 0.108 22x	-0.311	99.9%
	Dry Weight	100	107.06 - 0.118 95x	-0.326	99.95%
Height-Averaged and Alder-Excluded	Height	100	192.40 - 0.866 61x	-0.311	99.9%
	Height Increment	100	174.57 - 1.939 2x	-0.285	99.75%
	Stem Diameter	100	186.73 - 7.106 1x	-0.385	99.95%
	Stem Volume	100	112.58 - 0.167 48x	-0.272	99.5%
	Crown Area	100	127.33 - 99.814x	-0.367	99.95%
	Crown Volume	100	114.35 - 0.148 64x	-0.322	99.9%
	Dry Weight	100	146.77 - 0.160 64x	-0.330	99.95%
Volume-Based and Alder-Excluded	Height	100	7 734.2 - 53.379x	-0.402	99.95%
	Height Increment	100	6747.3 - 121.77x	-0.377	99.95%
	Stem Diameter	100	5 438.9 - 305.87x	-0.348	99.95%
	Stem Volume	100	2 156.7 - 6.717 5x	-0.230	97.5%
	Crown Area	100	2 483.9 - 3 423.1x	-0.265	99.5%
	Crown Volume	100	2 012.1 - 4.976 6x	-0.226	97.5%
	Dry Weight	100	2 887.7 - 4.858 8x	-0.210	97.5%

Modified CCI (y)	Jack Pine Parameter (x)	n_j	Highest Correlation Equation (y =)	r	Confidence Level
Height-	Height	100	137.39 - 0.614 76x	-0.295	99.75%
Averaged,	Height Increment	100	127.66 - 1.436 7x	-0.281	99.75%
Proximity-	Stem Diameter	100	135.76 - 5.203 1x	-0.375	99.95%
Weighted,	Stem Volume	100	81.343 - 0.121 95x	-0.265	99.5%
and	Crown Area	100	92.435 - 73.442x	-0.361	99.95%
Alder-	Crown Volume	100	82.653 - 0.108 33x	-0.313	99.9%
Excluded	Dry Weight	100	107.08 - 0.119 04x	-0.326	99.95%
Volume-	Height	100	5 832.9 - 40.278x	-0.402	99.95%
Based,	Height Increment	100	5 103.3 - 92.200x	-0.378	99.95%
Proximity-	Stem Diameter	100	4 109.5 - 231.38x	-0.349	99.95%
Weighted,	Stem Volume	100	1 626.4 - 5.080 1x	-0.230	99.75%
and	Crown Area	100	1 873.2 - 2 587.2x	-0.265	99.95%
Alder-	Crown Volume	100	1 515.9 - 3.757 8x	-0.226	99.95%
Excluded	Dry Weight	100	2 177.6 - 3.670 5x	-0.210	99.95%