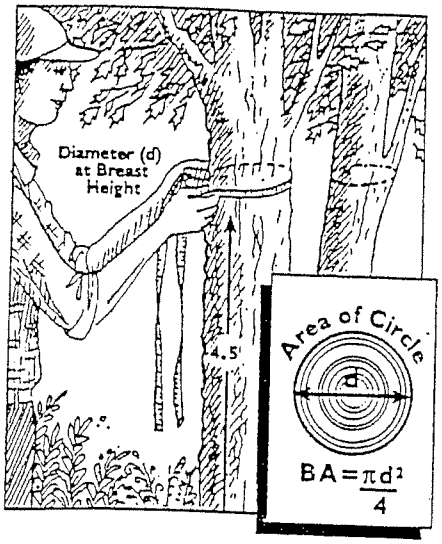
Measuring Basal Area

Basal area may be used to estimate percent dominance of trees for vegetative analysis. Trees are woody plants with a diameter at breast height (dbh) of 5 inches or greater and a height of 20 feet or more. Basal area is the cross-sectional area of a tree trunk at breast height (measured 4.5 feet from the ground). To visualize basal area, imagine a tree trunk cut off 4.5 feet above the ground; basal area is the surface area of the top of the stump. Basal area can be added for a number of trees and used like any other unit of measure in analyses of vegetative communities. Trees with multiple trunks that originate below 4.5 feet should be counted as two or more trees (depending on the number of trunks). Each trunk of a multiple trunk tree should be counted separately when determining total basal area for a plant species. For instance, each trunk of a three-trunk red maple would be measured individually to determine basal area for that species.



One method for calculating basal area involves measuring diameter at breast height (dbh) for each tree in a sampling plot and then using a formula for the area of a circle to calculate basal area (basal area = $\pi d^2 \div 4$). (Note: $\pi = 3.1416$.) Diameter at breast height is measured using a diameter tape or calipers or is calculated from measurements of circumference at breast height (d = circumference $\div \pi$). Each conversion of circumference to dbh, or dbh to basal area, must be done separately for each tree trunk before basal areas are added for analysis. See page 54 for a Basal Area Conversion Table that converts circumference (in inches) or dbh (in inches) to basal area (in square inches) for use in vegetative analyses.

Example:
Calculating Basal Area for Trees When the Circumference at Breast Height is Measured

Tree 1 with circumference of 42 inches
diameter = circumference $\div \pi$
diameter = $42 \div 3.1416 = 13.37$ inches
basal area = $\pi d^2 \div 4$
basal area = $3.1416 \times (13.37)^2 \div 4 = 140.4$ square inches (sq. in.)

Tree 2 with circumference of 31 inches
diameter = 31 inches $\div 3.1416 = 9.87$ inches
basal area = $3.1416 \times (9.87)^2 \div 4 = 76.5$ sq. in.

Tree 3 with circumference of 27 inches
diameter = $27 \div 3.1416 = 8.59$ inches
basal area = $3.1416 \times (8.59)^2 \div 4 = 58$ sq. in.

Basal area of all three trees:
140.4 sq. in. + 76.5 sq. in. + 58 sq. in. = 274.9 or 275 sq. in.

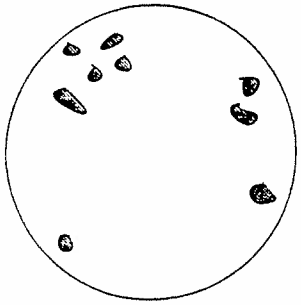
[redacted] use basal area calculations in a dominance test analysis.

(converts circumference or dbh in inches to basal area in square inches for use in vegetative analyses; note: $\pi = 3.1416$ for these calculations)

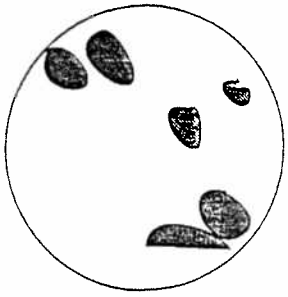
Circumference in Inches	Diameter in Inches	Basal Area Sq. Inches	Circumference in Inches	Diameter in Inches	Basal Area Sq. Inches
15.7	5.0	19.6	71.0	22.6	401.1
16.0	5.1	20.4	72.0	22.9	412.5
17.0	5.4	23.0	73.0	23.2	424.1
18.0	5.7	25.8	74.0	23.6	435.8
19.0	6.0	28.7	75.0	23.9	447.6
20.0	6.4	31.8	76.0	24.2	459.6
21.0	6.7	35.1	77.0	24.5	471.8
22.0	7.0	38.5	78.0	24.8	484.1
23.0	7.3	42.1	79.0	25.1	496.6
24.0	7.6	45.8	80.0	25.5	509.3
25.0	8.0	49.7	81.0	25.8	522.1
26.0	8.3	53.8	82.0	26.1	535.1
27.0	8.6	58.0	83.0	26.4	548.2
28.0	8.9	62.4	84.0	26.7	561.5
29.0	9.2	66.9	85.0	27.1	574.9
30.0	9.5	71.6	86.0	27.4	588.6
31.0	9.9	76.5	87.0	27.7	602.3
32.0	10.2	81.5	88.0	28.0	616.2
33.0	10.5	86.7	89.0	28.3	630.3
34.0	10.8	92.0	90.0	28.6	644.6
35.0	11.1	97.5	91.0	29.0	659.0
36.0	11.5	103.1	92.0	29.3	673.5
37.0	11.8	108.9	93.0	29.6	688.3
38.0	12.1	114.9	94.0	29.9	703.1
39.0	12.4	121.0	95.0	30.2	718.2
40.0	12.7	127.3	96.0	30.6	733.4
41.0	13.1	133.8	97.0	30.9	748.7
42.0	13.4	140.4	98.0	31.2	764.3
43.0	13.7	147.1	99.0	31.5	779.9
44.0	14.0	154.1	100.0	31.8	795.8
45.0	14.3	161.1	101.0	32.1	811.8
46.0	14.6	168.4	102.0	32.5	827.9
47.0	15.0	175.8	103.0	32.8	844.2
48.0	15.3	183.3	104.0	33.1	860.7
49.0	15.6	191.1	105.0	33.4	877.3
50.0	15.9	198.9	106.0	33.7	894.1
51.0	16.2	207.0	107.0	34.1	911.1
52.0	16.6	215.2	108.0	34.4	928.2
53.0	16.9	223.5	109.0	34.7	945.5
54.0	17.2	232.0	110.0	35.0	962.9
55.0	17.5	240.7	111.0	35.3	980.5
56.0	17.8	249.6	112.0	35.7	998.2
57.0	18.1	258.5	113.0	36.0	1016.1
58.0	18.5	267.7	114.0	36.3	1034.2
59.0	18.8	277.0	115.0	36.6	1052.4
60.0	19.1	286.5	116.0	36.9	1070.8
61.0	19.4	296.1	117.0	37.2	1089.3
62.0	19.7	305.9	118.0	37.6	1108.0
63.0	20.1	315.8	119.0	37.9	1126.9
64.0	20.4	325.9	120.0	38.2	1145.9
65.0	20.7	336.2	121.0	38.5	1165.1
66.0	21.0	346.6	122.0	38.8	1184.4
67.0	21.3	357.2	123.0	39.2	1203.9
68.0	21.6	368.0	124.0	39.5	1223.6
69.0	22.0	378.9	125.0	39.8	1243.4
70.0	22.3	389.9	126.0	40.1	1263.4

Examples of Percent Cover, Cover Ranges, and Midpoint Values

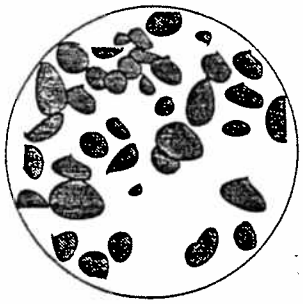
The following are examples of percent cover estimates with the associated cover range and midpoint value noted.



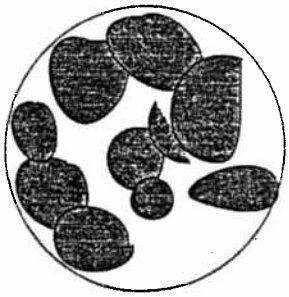
3% cover or
1-5% cover range
(use 3.0 midpoint value)



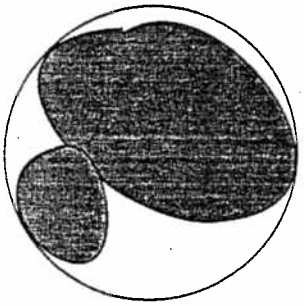
12% cover or
6-15% cover range
(use 10.5 midpoint value)



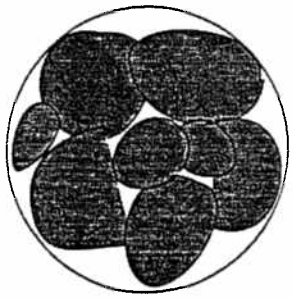
32% cover or
26-50% cover range
(use 38.0 midpoint value)



58% cover or
51-75% cover range
(use 63.0 midpoint value)



68% cover or
51-75% cover range
(use 63.0 midpoint value)



83% cover or
76-95% cover range
(use 85.5 midpoint value)

Observation Plots

Observation plots are used for measuring or estimating plant abundance. The number of plots should be based on the complexity of the site. Plots generally should be located in vegetative communities that are not clearly wetland or upland. Plot locations should be chosen so that the vegetation within the plot is representative of the vegetation within the community as a whole. Circular plots with the following dimensions are recommended:

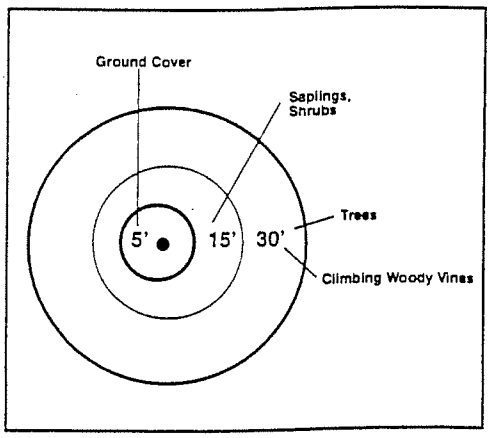
Circular plot dimensions:

Ground cover:	5 foot radius
Shrubs:	15 foot radius
Saplings:	15 foot radius
Climbing woody vines:	30 foot radius
Trees:	30 foot radius

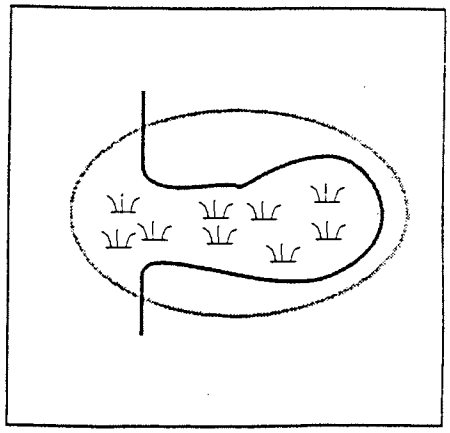
However, plot size and shape may be varied when site conditions warrant. Plot locations may need to be adjusted to ensure that the vegetative layer being sampled is representative of the plant community.

At the site, do a quick check of the vegetation and identify the layers involved. When choosing your plots, be sure that the vegetation in your sample is representative of the vegetation in that layer as a whole. From a central location (using a tape measure), measure circular plots to the size noted for each layer. Tie flags in the vegetation to mark the boundaries of your circular plots.

As you become more comfortable and experienced doing this analysis, you will be able to estimate plot sizes. You should begin your assessment with the ground cover layer (if present) before you trample the vegetation. With the observation plots marked, you can now evaluate plant abundance for each layer and species in the plot using percent cover.



Standard circular plots



Plot locations may need to be adjusted to reflect site conditions, such as in the case of an oblong wetland.