Walker Branch Watershed Vegetation Inventory, 1967-2006

Summary

The original objectives of the long-term vegetation survey of Walker Branch Watershed in eastern Tennessee (WBW; Curlin and Nelson 1968) were to quantify the standing crop of vegetation through time including measures of tree/plant size distribution, species composition, above-ground biomass, and chemical balance. Field studies of permanent vegetation plots using one sample design were conducted over a 40-year period (1967 to 2006), and observations continue with funding from the U.S. Department of Energy*. This data set consists of long-term measurements of diameter at breast height (DBH) determined on randomly located permanent inventory plots within the 4 different vegetation types located on WBW in 1967. In addition, the lignin to nitrogen content in leaves (g lignin / g N of leaf tissue) for species present in WBW was obtained from the literature.

More information can be found at: http://walkerbranch.ornl.gov/

* Funding for long-term data collection efforts on Walker Branch was provided by the U.S. Department of Energy (DOE), Office of Science, Biological and Environmental Research (BER).

Walker Branch Watershed Vegetation Inventory data set revision notice

This updated vegetation inventory data set includes results of the 2006 survey and updates to previous results based on the latest survey. The 1967-2006 data set completely supersedes the 1967-1997 data set. If you downloaded the 1967-1997 data set before July 15, 2010 you should download the 1967-2006 version at your earliest convenience.

If you need access to or have a question about the superseded data, please contact ORNL DAAC User Services (uso@daac.ornl.gov).

Superseded Data Set:
Huston, M.A., D.W. Johnson, D.E. Todd, J.W. Curlin, and F.W. Harris. 2005. Walker Branch Watershed Vegetation Inventory, 1967-1997. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/819

Background Information

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Curlin, J.W. Retired
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Site: Walker Branch, Tennessee, USA

Westernmost Longitude: -84.3
Easternmost Longitude: -84.3
Northernmost Latitude: 35.90
Southernmost Latitude 35.90

Data Set Citation:

Huston, M.A., D.W. Johnson, D.E. Todd, J.W. Curlin, and F.W. Harris. 2010. Walker Branch Watershed Vegetation Inventory, 1967-2006. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Sample Design and Methods

A stratified random design with sample plots assigned to each overstory stratum in proportion to its area contribution was used as the basis for development of stand tables and species-frequency data. On the basis of variance estimates calculated from forest management data collected on Oak Ridge Reservation (Curlin and Nelson, 1968; Harris et al., 1973) plus practical considerations, it was determined that approximately 300 plots were needed to estimate the required stand information within plus/minus 15% on the watershed. The 95-acre West Fork subwatershed received 123 plots while the 146-acre East Fork received 183 plots.

Plots were assigned by a computer randomizing routine in conjunction with the forest cover map developed by MIACS (Amidon 1964).(ref in Curlin and Nelson). The routine generated random numbers which were referenced to a two dimensional array in which the coded forest cover map was stored. If a sample was needed in the stratum covering the generated position, a plot was allocated, and the coordinates of the selected point were listed. This sequence was repeated on each subwatershed separately until the number of plots needed in each stratum was filled. Location of the plots superimposed over the cover map is shown

in Fig. 1. Sample plot allocation per stratum is listed in Table 1. Plots were not assigned to strata of less than 0.6 total acres.

Concentric circular plots were established at each sample point. Configuration, dimensions, and sampling criteria are shown in Fig. 2. Plot radii were corrected for maximum slope at the sample point. Plot centers were marked with orange fluorescent stakes tagged with the grid coordinates of the sample point. The nested concentric plot design permits sampling of the various tree diameter classes with approximately the same precision. Since the number of stems per unit area is proportional to stem diameter, sample plot area is directly proportional to stem diameter so that trees greater than or equal to 9.6 in (24 .4 cm) DBH (diameter at breast height) were sampled on 0.2 acres (0.81 ha) while stems less than or equal to 0.5 in (12.7 mm) DBH were sampled on 0.001 acre (0.004 ha). Stems in other size classes were sampled on intermediate size plots. Each woody stem greater than or equal to 0.6 in DBH was assigned a number and tagged at 4.5 feet above the ground (DBH). Diameter and species were recorded on forms for subsequent computer processing and tabulation. Tree height was measured in 1967. In that year, stems less than or equal to 0.5 in are recorded by frequency within 2-ft height classes by species.

Measurements of diameter breast height were taken in 1967, 1970, 1973, 1979, 1983, 1987, 1991, 1997 and 2006. Not all plots were measured every year.

Figure 1. Sample plot locations superimposed on forest cover map (Curlin and Nelson, 1968).

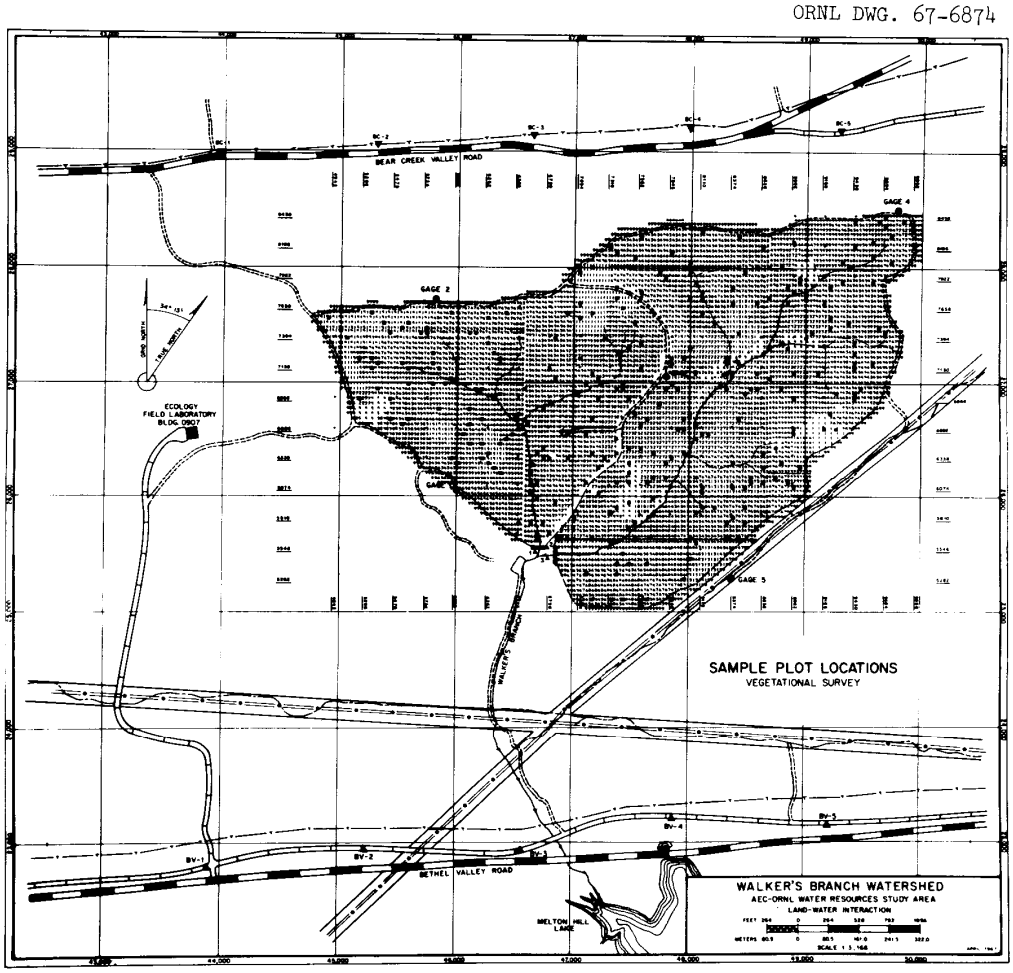
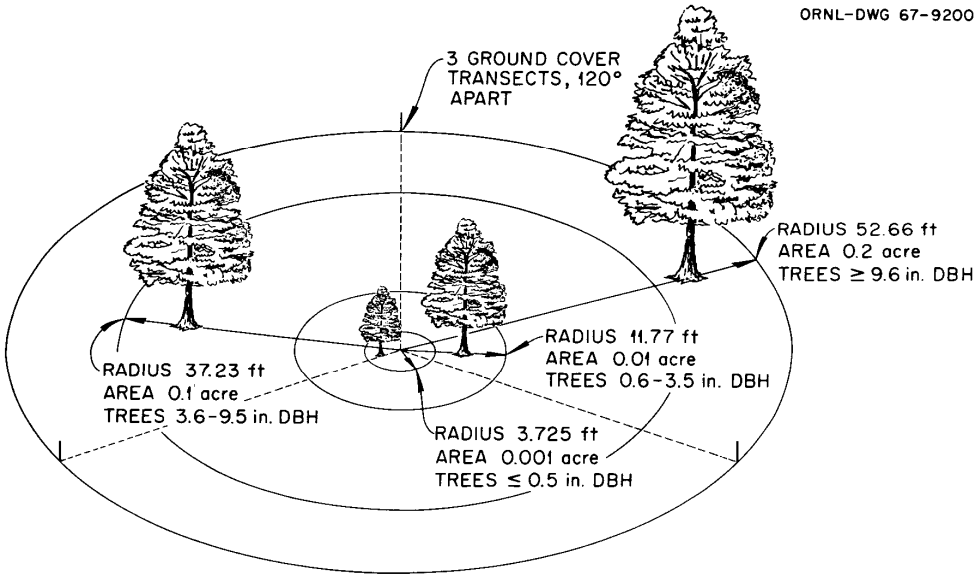


Table 1. Number of Sample Points allocated in each stratum (from Curlin and Nelson 1968).

West Fork Subwatershed						East Fork Subwatershed					
Density (Basal Area ft^2)	Average Stand Height (ft) 0–20	21–40	41–80	≧81	Total	Density (Basal Area ft^2)	Average Stand Height (ft) 0–20	21–40	41–80	≧81	Total
Pine											
0–40					0	0–40					0
41–80					0	41–80					0
81–100			5		5	81–100		2	2		4
≧101			8		8	≧101		2	2		4
Total	0	0	13	0	13	Total	0	4	4	0	8
Pine – Oak – Hickory											
0–40					0	0–40					0
41–80			2		2	41–80		3	20		23
81–100			2		2	81–100		3	15		18
≧101					0	≧101			9		9
Total	0	0	4	0	4	Total	0	6	44	0	50
Oak – Hickory											
0–40		2	2		4	0–40		2			2
41–80		12	7		19	41–80		2	15	2	19
81–100		2	15	2	19	81–100			31	4	35
≧101			12	2	14	≧101			18	7	25
Total	0	16	36	4	56	Total	0	4	64	13	81
Mesophytic Hardwoods											
0–40		2	7		9	0–40	2	6	5		13
41–80			9	2	11	40–80		2			2
81–100			15		15	81–100			2		2
≧101				15	15	≧101			6	21	27
Total	0	2	31	17	50	Total	2	8	13	21	44
			Grand Total		123				Grand Total		183

Figure 2. Sample plot configuration (from Curlin and Nelson 1968).



Vegetation Inventory Data File Description

Total number of observations: 139,806 (15,534 / inventory year, 9 inventories)

Number of observations with non-zero or non-missing DBH values: 66,581

Data Files:

Vegetation species in WBW inventory plots

WBW_veg_species_2006.txt

Complete set of inventory records

WBW_veg_inventory_all_20100629.csv (139,806 observations)

Inventory records subset by plot for spreadsheet import

WBW_veg_inv_1_100_20100629.csv (52,110 observations)
WBW_veg_inv_101_200_20100629.csv (48,231 observations)
WBW_veg_inv_201_298_20100629.csv (39,465 observations)

Vegetation Inventory Data File Structure, Column Descriptions, and Possible Values

Column Name	Description	Range of Values	Missing Value
PLOT	ID number of field sampling plot	1-298	none
TAG	ID tag number attached to individual vegetation stem within a plot	0-9996 (not continuous)	-999
CODE	Numeric vegetation species code	1-103, 700, 800, 900	800 Unknown 999 Missing
SPECIES	Vegetation species name	Character values	Unknown Missing
SPCGRP	Grouping of species by genus and miscellaneous categories	Acer, Carya, Cercis, Cornus, Fagus, Juniperus, Liriodendron, Misc., Nyssa, Oxydendrum, Pinus, Prunus, Quercus,	
YEAR	Measurement year (YYYY)	1967, 1970, 1973, 1979, 1983, 1987, 1991, 1997, 2006	none
DBH_cm	Diameter (centimeters) at breast height (1.3 meters above the ground)	0.0 - 102.9	-999
STATUS	Status code of tagged individual	0 = live 1 = standing dead 2 = dead on ground 9999 = missing Merged Stem STATUS Values: • 3xxx = stems merged, measurements for TAG xxx continue • 4yyy = stems merged, measurements for TAG yyy end; record contains missing values hereafter New ID TAG STATUS Values: • 5zzz = Previous TAG lost; data transferred to new TAG number zzz	-999

Discussion of Vegetation Inventory Data:

Missing DBH Data:

Data can be missing for several reasons.

- The plot was not sampled that year, so the DBH was not measured.
- Plot was sampled, but that tree was missed.
- Since trees of STATUS 1 and 2 are not measured, a value of zero was sometimes assigned. A value of zero is obviously not a real value, any more than a value of -999.

Trees with STATUS=1 and STATUS=2:

Note that after trees die, there still needs to be an entry in that record, so all the trees will have the same number of entries. Since trees of STATUS 1 and 2 were not measured, there is no true diameter for them. However, they are not actually missing since they were observed. Unfortunately, there may be differences between years in how the diameters for such trees were entered. One should interpret the trees with a DBH of zero as observed but not measured, and the DBH of -999 as not observed (for any one of several reasons mentioned above) and therefore not measured

There may be some inconsistency with the use of STATUS = 2, since once a tree falls it will be dead and decomposing on the ground for several years. The value of this STATUS is in recording the approximate length of time a dead tree remains standing. The first entry of STATUS = 2 is the critical one, since it marks the first time the tree was observed not to be standing. One may assume that for all subsequent inventories the tree will also be dead on the ground. Although this information is not particularly useful, it is true, and the tree is not actually missing, but we know it's dead and on the ground.

There appears to have been a change in the way 'standing dead' (STATUS=1) and 'dead on the ground' (STATUS=2) trees were identified in 1997. In previous years these two classes were a small proportion of the total recorded and were listed as STATUS = missing (-999). In 1997, there are many dead trees listed with DBH of zero.

For analyses, treat DBH = 0 and -999 as equivalent, and use the STATUS to determine if the tree is dead or alive. Ultimately, all trees end up as STATUS 2.

Adding a Tree:

Each stem has an inventory record that starts in 1967 and continues through 2006. Any tree that was recorded after the 1967 inventory will have a record that should list missing DBH data from the 1967 inventory until the time it was first measured.

A tree added in 2006 was given a complete record (all missing) back to 1967. Therefore, each tree (TAG) has the same number of records and each year's inventory has the same number of observations – currently 15,534

Merged Stem STATUS Example:

TAG=27 and STATUS=3028: This indicates that the stem with TAG number "27" has merged with the stem with TAG number "28". TAG 27 will continue to be measured.

TAG=28 and STATUS=4027: This indicates that the stem with TAG number "28" will no longer be measured and the record will contain missing values hereafter. DBH is -999 and STATUS is -999.

PLOT	TAG	CODE	SPECIES	YEAR	DBH	STATUS
27	27	25	White Oak	1967	6.2	0
27	27	25	White Oak	1970	6.4	0
27	27	25	White Oak	1973	6.9	0
27	**27**	**25**	**White Oak**	**1979**	**12.7**	**3028**
27	27	25	White Oak	1983	13.1	0
27	27	25	White Oak	1987	13.7	0
27	27	25	White Oak	1991	13.9	0
27	27	25	White Oak	1997	15	0
27	28	25	White Oak	1967	6.5	0
27	28	25	White Oak	1970	6.6	0
27	28	25	White Oak	1973	7.1	0
27	**28**	**25**	**White Oak**	**1979**	**-999**	**4027**
27	28	25	White Oak	1983	-999	-999
27	28	25	White Oak	1987	-999	-999
27	28	25	White Oak	1991	-999	-999
27	28	25	White Oak	1997	-999	-999

New ID TAG STATUS Example:

TAG=79 and STATUS=5121 indicates that the ID tag number "79" was lost. The stem has been assigned a new TAG of 121. The complete measurement record has been transferred to TAG =121. DBH and STATUS for TAG = 79 have all been set to missing.

PLOT	TAG	CODE	SPECIES	YEAR	DBH	STATUS
288	79	34	Red Maple	1967	-999	-999
288	79	34	Red Maple	1970	-999	-999
288	79	34	Red Maple	1973	-999	-999
288	79	34	Red Maple	1979	-999	-999
288	79	34	Red Maple	1983	-999	-999
288	79	34	Red Maple	1987	-999	-999
288	79	34	Red Maple	1991	-999	-999
288	**79**	**34**	**Red Maple**	**1997**	**-999**	**5121**
288	121	34	Red Maple	1967	-999	-999

288	121	34	Red Maple	1970	5.1	0
288	121	34	Red Maple	1973	5.8	0
288	121	34	Red Maple	1979	-999	-999
288	121	34	Red Maple	1983	-999	-999
288	121	34	Red Maple	1987	-999	-999
288	121	34	Red Maple	1991	8.7	0
288	**121**	**34**	**Red Maple**	**1997**	**9.5**	**0**

Example Data Records:

Selected data records from WBW_veg_inv_1_100_20100629.csv data file:

```
PLOT,TAG,CODE,SPECIES,SPCGRP,YEAR,DBH_cm,STATUS
1,1,3,Virginia Pine,Pinus,1967,36.8,0
1,1,3,Virginia Pine,Pinus,1970,-999.0,-999
1,1,3,Virginia Pine,Pinus,1973,-999.0,-999
1,1,3,Virginia Pine,Pinus,1979,40.4,0
1,1,3,Virginia Pine,Pinus,1983,42.2,0
1,1,3,Virginia Pine,Pinus,1987,-999.0,-999
1,1,3,Virginia Pine,Pinus,1991,43.9,0
1,1,3,Virginia Pine,Pinus,1997,46.5,0
1,1,3,Virginia Pine,Pinus,2006,0.0,1
1,2,2,Shortleaf Pine,Pinus,1967,26.2,0
…
100,864,34,Red Maple,Acer,2006,9.4,0
100,865,34,Red Maple,Acer,1967,-999.0,
100,865,34,Red Maple,Acer,1970,-999.0,
100,865,34,Red Maple,Acer,1973,-999.0,
100,865,34,Red Maple,Acer,1979,-999.0,
100,865,34,Red Maple,Acer,1983,-999.0,
100,865,34,Red Maple,Acer,1987,-999.0,
100,865,34,Red Maple,Acer,1991,-999.0,
100,865,34,Red Maple,Acer,1997,-999.0,
100,865,34,Red Maple,Acer,2006,10.4,0
```

Vegetation Species Data File Description

A separate file, WBW_veg_species_2006.csv, contains the WBW field plot species names, the numeric species code for each species, a species group designation, the scientific name for each species, along with the literature-derived ratio of g lignin / g N for each species leaves.

Vegetation Species

DBH measurements were made on 65 different species.

Ailanthus
Apple
Aralia
Ash
Basswood
Beech
Black Cherry
Black Gum
Black Jack Oak
Black Locust
Black Oak
Black Walnut
Black Willow
Blueberry
Box Elder
Buckeye
Buckthorn
Chestnut
Chestnut Oak
Cucumber Magnolia
Dogwood
E. Red Cedar
Elm
Euonymus
Hazelnut
Hemlock
Hickory
Hornbeam(Carpinus)
Huckleberry
Hydrangea
Ironwood(Ostrya)
Laurel
Loblolly Pine
Magnolia spp
Missing
Mulberry
Northern Red Oak
Oak Species
Paulonia
Persimmon
Plum
Post Oak
Red Maple
Redbud
Sassafras
Scarlet Oak
Serviceberry
Shortleaf Pine
Shumard Oak
Silverbell
Sourwood
Southern Red Oak
Spicebush
Sugar Maple
Sumac
Sweet Gum
Sweetbay Magnolia
Sycamore
Tulip Poplar
Unknown
Virginia Pine
White Oak
White Pine
Winged Elm
Witch Hazel

Selected data records from WBW_veg_species_2006.csv data file:

Species Code	Species Name	Species Group	Leaf Lignin / N Ratio	Scientific Name

```
CODE,SPECIES,SPCGRP,Leaf_Lignin_N_Ratio,Scientific_Name
1,Loblolly Pine,Pinus,50,Pinus taeda L.
2,Shortleaf Pine,Pinus,63,Pinus echinata Mill.
3,Virginia Pine,Pinus,63,Pinus virginiana Mill.
4,White Pine,Pinus,50,Pinus strobus L.
5,E. Red Cedar,Juniperus,63,Juniperus virginiana L.
6,Hemlock,Misc.,25,Eastern Hemlock (Tsuga canadensis (L.) Carr.)
7,Black Oak,Quercus,29,Quercus velutina Lam.
9,Northern Red Oak,Quercus,29,Quercus rubra L.
10,Shumard Oak,Quercus,29,Quercus shumardii Buckl.
…
…
…
92,Hydrangea,Misc.,12,Hydrangea arborescens L.
93,Euonymus,Misc.,12,Euonymus atropurpureas Jacq.
95,Sumac,Misc.,12,Rhus glabra L.
96,Huckleberry,Misc.,12,Gaylussacia spp.
99,Hazelnut,Misc.,12,Corylus americana Walt.
102,Laurel,Misc.,35,Kalmia latifolia L.
103,Aralia,Misc.,12,Aralia spinosa L.
700,Oak Species,Quercus,30,Quercus spp.
800,Unknown,Misc.,12,
999,Missing,Misc.,12,
```

Data Processing to Prepare 2010 Version

A data file containing the 1997-2006 survey measurement data for field plots was obtained from the data custodian, Pat Mulholland, in February 2010. Files for 1967-1997 and 2006 were read into SAS™ and quality checks performed. Files were combined, reviewed, and updated in MSExcel™ using the complete set of field measurement forms as necessary. Processing notes were added to edited observations and this file is available for future reference. During the 2006 field work, particular attention was given to verifying measured tree species identification. This resulted in the correction of several misidentifications. As a result, 10 species were removed from the observed species list. These changes impact all years of measurement results. It is possible that a tree first (mis) identified in 1967 has now been corrected and all measurements are now linked to a different species. Updates to 1997 measurement results were also made during the preparation of the 2006 data by the field team. The data custodian resolved several quality issues.

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Kardol, P., D. E.Todd, P. J. Hanson, and P. J. Mulholland. 2010. Long-term successional forest dynamics: species and community responses to climatic variability. Journal of Vegetation Science 21:627-642.

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