HARV Site: BigFoot Field Data Documentation

Contents:

2000, 2001, 2002 HARV LAI FPAR README DOCUMENT

BIGFOOT PROJECT - HARV site (Harvard Forest)**********

(harv_2000_2001_lai_fpar_README.txt)

2000
- Data collected during two sampling dates (JUNE and AUGUST)
    -August was max LAI

2001
- Data collected during one sampling date (JULY)
    -July was max LAI

2002
- Data collected during one sampling date (AUGUST)
    -August was max LAI

Other Notes:
- The instrument used, LAI 2000, only measures short wave (<490 nm) radiation.
    -This instrument assumes a random distribution of the foliage. This is not necessarily the case in many ecosystems (see Gower et al., Remote Sensing Environment 70:29-51 (1999)). A site specific clumping factor (CF) is needed to correct for this non-random distribution of foliage. We have not yet obtained site specific clumping factors for this site. However, without using a clumping factor there is less than 10% error associated with eastern deciduous forests.

- LAI reported is actually plant area index (PAI), there has been no correction applied for woody material.

- Fpar was calculated using the LAI 2000 variable "difn". This variable indicates the fraction of sky that is not blocked by foliage. This values ranges from 0 to 1. We converted this value to reflect the amount of radiation intercepted by the foliage.

- Variable names '_se' are the standard errors of the mean.

- There are several plots and subplots missing fpar and LAI data. This is due to limitations associated with the instrumentation used (LAI 2000). There are differences in the sensitivity associated with each of the units. The sensitivity is variable depending on the production year of the particular unit. Trials were conducted at the end of the growing season and it was concluded that, below a particular light level, the unit was less sensitive. Data associated with this lower light level is compromised and is not being used.

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*updated 10/29/02 by AAK

2000 HARV ROOT BIOMASS README DOCUMENT

(harv_roots_2000_README.txt)

******** BIGFOOT PROJECT - HARV site (HARVARD LTER)**********

ROOT BIOMASS/BNPP DATA

- A 4.45 cm-diameter soil core was collected from 7 locations within each plot on 8/00 and 5 locations on 11/00

- Area sampled = 15.55 cm2 per core, depth 50 cm

- The first 5 locations were the center and the 4 cardinal directions; the remaining two were from randomly assigned locations within the plot

- Samples were collected in August (max root growth) and November (min root growth)

- Below ground net primary production (BNPP) was calculated by subtracting min root growth from max root growth

- BNPP is in kg/ha

2000 HARV BIOMASS README DOCUMENT

(harv_biomass_README.txt)

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ABOVEGROUND BIOMASS AT HARVARD FOREST
BIGFOOT PROJECT, DCF 2000

- DATA IS PRELIMINARY AND MAY CHANGE (e.g. if we find any allometric equations that we feel are better suited to our study plots)

- Variables:
    - wood_mass, evgn_folaige, dec_foliage are in kg/ha
    - basal = basal area in m2/ha
    - TPH = trees per ha
    - [var]_se = standard errors of plot means for that variable
    - understory_freq = number of samples averaged for plot
    - understory_biomass = total understory biomass (kg/ha)
    - understory_se = standard error of plot means for understory

- Tree biomass was estimated using published allometric equations relating wood biomass and conifer foliage to stem diameter at breast height (DBH).

- Foliage biomass for deciduous species was estimated using litterfall traps

- Tree diameters were collected using diameter tapes, November 2000

- Sample trees within each subplot were selected using a horizontal variable radius plot technique (a prism). Scaling factors (BAF's) were selected to include approximately 10-12 trees within each subplot

- Quercus rubra equations used for Quercus velutina

- Quercus rubra equations used for a couple of small Castanea dentata saplings

- Equations for the following species were designed to be used with basal diameter instead of DBH: havi, acpe, vial. These species are few and of small diameter within our plots. We may need to develop basal diameter-to-DBH relationships in 2001

- Understory biomass values are missing for three plots (37, 45, and 67).

- Equations with citations can be found at:
    ftp://alder.forest.wisc.edu/pub/BIGFOOT/data/harv/harv_allometric_equations_2000.txt

- Please email dcfeldki@facstaff.wisc.edu for additional information

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2000 HARV ALLOMETRIC EQUATIONS README DOCUMENT

(harv_allometric_equations_2000.txt)

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************************************************************
 EQUATIONS USED TO CALCULATE TREE BIOMASS AT HARVARD FOREST
              BIGFOOT PROJECT, 2000
************************************************************

        tree_dbh = DBH in cm
        individual mass components are in kg/tree

*************** Acer rubrum (6.3 - 52.4 cm) (Martin et al. 1998) *******
        wood     = 1.003 * 10**(-1.096 + 2.591 * LOG10(tree_dbh))
        foliage = 1.052 * 10**(-1.620 + 1.778 * LOG10(tree_dbh))

*************** Acer pensylvanicum (0.92 - 4.31 cm)(Telfer 1969) *******
        total       = 0.001 * 10**(-3.518 + 2.878 * LOG10(tree_dbh*10))
        foliage = 0.001 * 10**(-3.334 + 2.220 * LOG10(tree_dbh*10))
        wood     = total - foliage

*************** Acer saccharum (3-66 cm) (Ter-Mikaelian and Korzokhin '97 )*
*************** from Young et al. 1980 tree_dbh estimated ******************
        branch = 0.0104*(tree_dbh**2.5515)
        stem   = 0.1626*(tree_dbh**2.2894)
        foliage= 0.0164*(tree_dbh**1.8901)
        wood   = branch + stem

*************** Betula allegheniensis (3 - 66 cm)Ter-Mikaelian and Korzokhin '97 )*
*************** from Young et al. 1980 tree_dbh estimated **********************
        branch = 0.0216*(tree_dbh**2.3795)
        stem   = 0.1085*(tree_dbh**2.3412)
        foliage= 0.0155*(tree_dbh**1.9783)
        wood   = branch + stem

*************** Betula lenta (7.8 - 39.6 cm) (Martin et al. 1998)******
        wood     = 1.016 * 10**(-1.2540 + 2.7280 * LOG10(tree_dbh))
        foliage = 1.041 * 10**(-3.0860 + 2.628 * LOG10(tree_dbh))

*************** Betula papryifera (0-34 cm)(Ter-Mikaelian and Korzokhin '97 )*
*************** from Hocker and Earley 1983 ************************************
        branch = 1.210 * (0.0215*(tree_dbh**2.3000))
        stem   = 1.040 * (0.2044*(tree_dbh**2.1700))
        foliage= 1.024 * (0.0400*(tree_dbh**1.7700))
        wood   = branch + stem

*************** Carya spp. (8.2 - 52.3) (Martin et al. 1998) ********
        wood     = 1.005 * 10**(-1.349 + 2.773 * LOG10(tree_dbh))
        foliage = 1.217 * 10**(-2.595 + 2.356 * LOG10(tree_dbh))

*************** Fagus grandifolia (1-42)(Ter-Mikaelian and Korzokhin '97 )******
*************** from Hocker and Earley 1983 ************************************
        branch = 1.046 * (0.0421*(tree_dbh**2.4100))
        stem   = 1.016 * (0.0937*(tree_dbh**2.4700))
        foliage= 1.066 * (0.0250*(tree_dbh**1.8300))
        wood   = branch + stem

*************** Fraxinus americana (4-32)(Ter-Mikaelian and Korzokhin '97 )******
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********** from Perala and Alban 1994 ************************************
        total  = 0.1634*(tree_dbh**2.3480)
        foliage= 0.0026*(tree_dbh**2.4160) * 1.062
        wood   = total - foliage

********** Hamamalis virginiana ( cm) (Telfer 1969)**********
        total      = 0.001 * 10**(-3.037 + 2.900 * LOG10(tree_dbh*10))
        foliage = 0.001 * 10**(-2.729 + 2.162 * LOG10(tree_dbh*10))
        wood     = total - foliage

********** Kalmia latifolia (tree_dbh range?) (Day and Monk 1974) ******
        wood     = 0.001 * 10**(2.1533 + 2.0017 * LOG10(tree_dbh))
        foliage = 0.001 * 10**(0.9332 + 2.0744 * LOG10(tree_dbh))

********** Ostrya virginiana (5.2 - 20.6) (FASSNACHT, from Reiners) ******
        if tree_species = 'osvi' then do
          bark   = 0.001 * 10**(2.2127 + 1.8428 * LOG10(tree_dbh/2.54))
          branch = 0.001 * 10**(2.6856 + 1.6558 * LOG10(tree_dbh/2.54))
          stem   = 0.001 * 10**(0.0870 + 2.0463 * LOG10(tree_dbh/2.54))
          twig   = 0.001 * 10**(1.5823 + 0.7451 * LOG10(tree_dbh/2.54))
          wood   = bark + branch + stem + twig
          foliage = 1.028 * (0.0062*(tree_dbh**1.9350)) /*Ulmus americana equation*/
        end

********** Picea abies (12-44) (Ter-Mikaelian and Korzokhin '97 )******
********** from Jokela et al. 1986 ************************************
          branch          = 1.049 * (0.0052*(tree_dbh**2.7320))
          bark    = 1.019 * (0.0461*(tree_dbh**1.7800))
          stem    = 1.018 * (0.3832*(tree_dbh**1.8740))
          foliage= 1.048 * (0.0031*(tree_dbh**2.8310))
          wood            = branch + bark + stem

********** Picea rubens (1-31) (Ter-Mikaelian and Korzokhin '97 )******
********** from Freedman et al. 1982 **********************************
          branch = 1.227 * (0.0293*(tree_dbh**2.0955))
          stem   = 1.032 * (0.0960*(tree_dbh**2.3288))
          foliage= 1.225 * (0.0150*(tree_dbh**2.2167))
          wood   = branch + stem

********** Pinus resinosa (3-51 )Ter-Mikaelian and Korzokhin '97 )*
********** from Young et al. 1980 dbh estimated ********************
          branch= (0.0098*(dbh{i}**2.5011))
          stem    = (0.0631*(dbh{i}**2.4481))
          foliage= (0.0177*(dbh{i}**2.1803))
          wood            = branch + stem

********** Pinus strobus (3-66 ) Ter-Mikaelian and Korzokhin '97 )*
********** from Young et al. 1980 tree_dbh estimated ********************
          branch = 0.0030*(tree_dbh**2.4858)
          stem   = 0.0404*(tree_dbh**2.5459)
          foliage = 0.0183*(tree_dbh**1.9674)
          wood   = branch + stem

********** Pinus sylvestris (9.7 - 45.2 ) (Makela and Vanninen 1998) *
          branch          = EXP(-3.1296 + 2.0089 * LOG(tree_dbh))
          stemsap         = EXP(-3.9212 + 2.6680 * LOG(tree_dbh))
          stemhrt         = EXP(-13.575 + 5.2043 * LOG(tree_dbh))
          bark            = EXP(-4.6637 + 2.4282 * LOG(tree_dbh))
          wood            = branch + stemsap + stemhrt + bark
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```
          foliage= EXP(-0.7714 + 0.9513 * LOG(tree_dbh))

********** Prunus pensylvanica (3-24)Ter-Mikaelian and Korzokhin '97 )******
********** from Young et al. 1980 tree_dbh estimated **********************
          branch  = 0.0406*(tree_dbh**1.9197)
          stem    = 0.0951*(tree_dbh**2.2988)
          foliage = 0.0203*(tree_dbh**2.0380)
          wood    = branch + stem

********** Prunus virginiana (3-15)Ter-Mikaelian and Korzokhin '97 )******
********** from Young et al. 1980 tree_dbh estimated ********************
          branch  = 0.1196*(tree_dbh**1.1932)
          stem    = 0.1178*(tree_dbh**1.9936)
          foliage = 0.0319*(tree_dbh**1.3356)
          wood    = branch + stem

********** Prunus serotina (5-50, 5-40)Ter-Mikaelian and Korzokhin '97 )***
********** Total wood from Wiant et al. 1977 ******************************
          wood    = 0.1225*(tree_dbh**2.4253)
          foliage = 0.0155*(tree_dbh**1.9783) /*yellow birch folaige equation*/

********** Quercus alba (7.0 - 63.0) (Martin et al. 1998) *****************
          wood  = 1.021 * 10**(-1.317 + 2.640 * LOG10(tree_dbh))
          foliage          = 1.307 * 10**(-1.599 + 1.673 * LOG10(tree_dbh))

********** Quercus rubra (1.0 - 19.7) (Ter-Mikaelian and Korzokhin '97 )****
********** from Hocker and Earley 1983 *************************************
          branch  = 1.402 * (0.0122*(tree_dbh**2.6300))
          stem    = 1.024 * (0.1356*(tree_dbh**2.3600))
          foliage = 1.167 * (0.0238*(tree_dbh**1.8600))
          wood    = branch + stem

********** Quercus rubra (19.7 - 52.0) (Martin et al. 1998) ******
          wood    = 1.011 * 10**(-1.279 + 2.651 * LOG10(tree_dbh))
          foliage = 1.097 * 10**(-2.514 + 2.326 * LOG10(tree_dbh))
        end

********** Quercus velutina (1.0 - 19.7) (Ter-Mikaelian and Korzokhin '97 )***
********** from Hocker and Earley 1983 *************************************
                    /*Q rubra equations*/
        branch  = 1.402 * (0.0122*(tree_dbh**2.6300))
        stem    = 1.024 * (0.1356*(tree_dbh**2.3600))
        foliage = 1.167 * (0.0238*(tree_dbh**1.8600))
        wood    = branch + stem

********** Quercus velutina (19.7 - 52.0) (Martin et al. 1998) ******
              /*Q rubra equations*/
        wood    = 1.011 * 10**(-1.279 + 2.651 * LOG10(tree_dbh))
        foliage = 1.097 * 10**(-2.514 + 2.326 * LOG10(tree_dbh))

********** Tsuga canadensis (10.0 - 77.0) (Campbell and Gower 2000)*
        branch  = 1.018 * 10**(-1.791 + 2.349 * LOG10(tree_dbh))
        stem    = 1.031 * 10**(-1.344 + 2.341 * LOG10(tree_dbh))
        bark    = 1.016 * 10**(-1.531 + 2.004 * LOG10(tree_dbh))
        wood    = bark + branch + stem
        foliage = 1.061 * 10**(-2.048 + 2.081 * LOG10(tree_dbh))

********** Ulmus americana (4-29)(Ter-Mikaelian and Korzokhin '97 )****
********** from Perala and Alban 1994 **************************************
```

```
        total   = 1.011 * (0.0825*(tree_dbh**2.4680))
        foliage = 1.028 * (0.0062*(tree_dbh**1.9350))
        wood    = total - foliage

********** Viburnum alnifolium (0.28 - 1.59 cm) (Telfer 1969) **********
        total = 0.001 * 10**(-4.079 + 3.243 * LOG10(tree_dbh*10))
        foliage  = 0.001 * 10**(-4.347 + 2.679 * LOG10(tree_dbh*10))
        wood  = total - foliage
```

2000, 2001, 2002 HARV ANPP README DOCUMENT

(harv_anpp_2000_2001_2002_readme.txt)

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ABOVEGROUND NET PRIMARY PRODUCTIVITY AT HARVARD FOREST
BIGFOOT PROJECT, AAK 2003

- THE DATASET AND THIS README FILE WAS UPDATED July 28, 2003 TO INCLUDE 2002 GROWTH DATA, AS WELL AS TO CORRECT PREVIOUS ERRORS

- DETRITUS FOR YEAR 2002 WAS ESTIMATED BASED ON RATIOS FROM 2000 AND 2001, NO LEAF LITTER WAS COLLECTED FOR YEAR 2002

- Variables:

  - basal = basal area in m2/ha
  - TPH = trees per ha
  - wnpp_2000, wnpp_2001: wood increment (kg/ha/yr) (dry mass, not C)
  - leaf_det_00, leaf_det_01: deciduous foliage detritus (kg/ha/yr)
  - need_det_00, need_det_01: coniferous foliage detritus (kg/ha/yr)
  - other_det_00, other_det_01: other non-woody detritus (kg/ha/yr)
  - under_anpp_00, under_anpp_01: understory anpp (kg/ha/yr)
  - un_anpp_N_00, un_anpp_N_01: understory # of subplots

  - [var]_se = standard errors of plot means for that variable

- ANPP can be calculated as follows (must assume steady stasis for conifer foliage):
  Wood increment + foliage litterfall + reproductive tissue (other) litterfall

- Wood increment was estimated using published allometric equations relating wood biomass and conifer foliage to stem diameter at breast height (DBH).

- Detritus was estiamated using litterfall traps

- Tree diameters were collected using diameter tapes on the following dates: 5/2000, 11/2000, 11/2001, 11/2002

- Sample trees within each subplot were selected using a horizontal variable radius plot technique (a prism). Scaling factors (BAF's) were selected to include approximately 10-12 trees within each subplot

- Quercus rubra equations used for Quercus velutina

- Quercus rubra equations used for a couple of small Castanea dentata saplings

- Equations for the following species were designed to be used with basal diameter instead of DBH: havi, acpe, vial. These species are few and of small diameter within our plots. We may need to develop basal diameter-to-DBH relationships in the future

- Allometric equations are available in a separate file

- There is no understory ANPP data available for plot 0 in 2000

- PLEASE CONTACT AL KIRSCHBAUM (aakirsch@facstaff.wisc.edu) FOR ADDITIONAL INFORMATION

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2000 HARV VEGETATION COVER TYPE README DOCUMENT

(harv_cover_README.txt)

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OVERSTORY VEGETATION COVER TYPE AT HARVARD FOREST

BIGFOOT PROJECT 2000

DCF

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- 4 Cover type classifications were used:
  - Plantation (Pinus resinosa or Picea abies)
  - Hemlock
  - Hardwoods
  - Other_conifer (e.g. white pine)

- Values listed are % total plot basal area (sum of cross-sectional basal areas per tree)

- Please contact dcfeldki@facstaff.wisc.edu with questions or concerns

README for bf_harv_landcover_2000_igbp.tif**

This layer supercedes all versions released prior to Jan 01, 2003

1. General Information
Theme: Land Cover in IGBP Units
Theme Date: Year 2000
Project: BigFoot
Site: HARV (Massachussetts, USA)
Biome: Temperate mixed forest
Contact: Thomas.Maiersperger@orst.edu

2. Layer Information
Rows: 281
Cols: 281
Data Type: unsigned 8-bit thematic
Format: Geotiff

3. Map Information
ULX: 728707
ULY: 4715842
Pixel Size: 25
Units: meters
Projection: UTM
Spheroid: WGS84
Datum: WGS84
Zone: 18 North

4. Attribute Information

Value	Class Name
1	Evergreen Neddleleaf Forest
4	Deciduous Broadleaf Forest
5	Mixed Forest
8	Woody Savanna
9	Savanna
10	Grassland
11	Wetland
13	Urban/Built
17	Water

README for bf_harv_landcover_2001_igbp.tif**

This layer supercedes all versions released prior to Jan 01, 2003

1. General Information
Theme: Land Cover in IGBP Units
Theme Date: Year 2001
Project: BigFoot
Site: HARV (Massachussetts, USA)
Biome: Temperate mixed forest
Contact: Thomas.Maiersperger@orst.edu

2. Layer Information
Rows: 281
Cols: 281
Data Type: unsigned 8-bit thematic
Format: Geotiff

3. Map Information
ULX: 728707
ULY: 4715842
Pixel Size: 25
Units: meters
Projection: UTM
Spheroid: WGS84
Datum: WGS84
Zone: 18 North

4. Attribute Information

Value	Class Name
1	Evergreen Neddleleaf Forest
4	Deciduous Broadleaf Forest
5	Mixed Forest
8	Woody Savanna
9	Savanna
10	Grassland
11	Wetland
13	Urban/Built
17	Water

README for bf_harv_lai_aug_4_2000_x10_them_with_defaults.tif****

This layer supercedes all versions released prior to Jan 01, 2003

1. General Information
Theme: Land Cover in IGBP Units
Theme Date: Year 2000
Project: BigFoot
Site: HARV (Massachussetts, USA)
Biome: Temperate mixed forest
Contact: Thomas.Maiersperger@orst.edu

2. Layer Information
Rows: 281
Cols: 281
Data Type: unsigned 8-bit thematic
Format: Geotiff

3. Map Information
ULX: 728707
ULY: 4715842
Pixel Size: 25
Units: meters
Projection: UTM
Spheroid: WGS84
Datum: WGS84
Zone: 18 North

4. Attribute Information
Pixel values are LAI estimates multiplied by 10 (e.g. a value of 55 = 5.5 LAI)

5. Additional Information
Some land classes were not modeled. For these pixels, default LAI values were inserted based on literature estimates or other information.

README for bf_harv_lai_july_26-28_x10_them_with_defaults.tif****

This layer supercedes all versions released prior to Jan 01, 2003

1. General Information
Theme: Land Cover in IGBP Units
Theme Date: july 26-28, 2001
Project: BigFoot
Site: HARV (Massachussetts, USA)
Biome: Temperate mixed forest
Contact: Thomas.Maiersperger@orst.edu

2. Layer Information
Rows: 281
Cols: 281
Data Type: unsigned 8-bit thematic
Format: Geotiff

3. Map Information
ULX: 728707
ULY: 4715842
Pixel Size: 25
Units: meters
Projection: UTM
Spheroid: WGS84
Datum: WGS84
Zone: 18 North

4. Attribute Information
Pixel values are LAI estimates multiplied by 10 (e.g. a value of 55 = 5.5 LAI)

5. Additional Information
Some land classes were not modeled. For these pixels, default LAI values were inserted based on literature estimates or other information.