

# **LBA-ECO TG-07 Fallen and Standing Necromass, Tapajos, Cauaxi, Juruena Forests, Brazil**

Revision date: March 1, 2011

## **Summary:**

This data set reports the characterization of fallen necromass as the volume and density of coarse woody debris (CWD), and standing necromass as the volume and density of standing dead trees. Measurements were made in undisturbed and logged forest areas of the Tapajos National Forest, and Cauaxi Forest, Para, Brazil, and Juruena Forest, Mato Grosso, Brazil from 2002-2004. Fallen and standing necromass were classified into one of five categories according to its state of decomposition. There are two comma-delimited ASCII data files with this data set: two files contain the sampling information, decomposition state, and DBH measurements. There are also two files provided as companion data files which provide sampling transect descriptions.

## **Data Citation:**

### **Cite this data set as follows:**

Keller, M.M. and M.W. Palace. 2011. LBA-ECO TG-07 Fallen and Standing Necromass, Tapajos, Cauaxi, Juruena Forests, Brazil. 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/998](https://doi.org/10.3334/ORNLDAAC/998)

## **Implementation of the LBA Data and Publication Policy by Data Users:**

The LBA Data and Publication Policy [[http://daac.ornl.gov/LBA/lba\\_data\\_policy.html](http://daac.ornl.gov/LBA/lba_data_policy.html)] is in effect for a period of five (5) years from the date of archiving and should be followed by data users who have obtained LBA data sets from the ORNL DAAC. Users who download LBA data in the five years after data have been archived must contact the investigators who collected the data, per provisions 6 and 7 in the Policy.

This data set was archived in March of 2011. Users who download the data between March 2011 and February 2016 must comply with the LBA Data and Publication Policy.

Data users should use the Investigator contact information in this document to communicate with the data provider. Alternatively, the LBA Web Site [<http://lba.inpa.gov.br/lba/>] in Brazil will have current contact information.

Data users should use the Data Set Citation and other applicable references provided in this document to acknowledge use of the data.

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## 1. Data Set Overview:

**Project:** LBA (Large-Scale Biosphere-Atmosphere Experiment in the Amazon)

**Activity:** LBA-ECO

**LBA Science Component:** Carbon Dynamics

**Team ID:** TG-07 (Keller / de Mello)

The investigators were Palace, Michael William. You may contact Palace, Michael William (palace@kaos.sr.unh.edu) and Keller, Michael M. (michael.keller@unh.edu)

**LBA Data Set Inventory ID:** TG07\_Fallen\_Standing\_Necromass

### Fallen Necromass Sampling

Coarse woody debris (CWD) was sampled in three Amazonian forests in Brazil, two in Para: the Tapajos National Forest and the Fazenda Cauaxi, and one in Mato Grosso: Juruena. Measurements were conducted in an undisturbed forest [Control] and under two logging practices (reduced-impact logging [RIL] and conventional logging [CL]. Line intercept sampling was utilized (also termed planar intercept sampling). CWD was defined as fallen dead woody material with diameter greater than 2 cm. The material was divided into three classes according to diameter and classified according to its decomposition state into five classes (Harmon et al., 1995).

### Standing Necromass Sampling

Standing dead biomass data were taken from the Juruena National Park as a one time survey (July 2003), and also from the Tapajos National Forest, collected from two surveys (January 2002, November 2004). We used strip plots that were ten meters wide and the length of the intersect line transect. The total area sampled for standing dead necromass using the strip plots was 23.3 ha. This was broken down into 6 ha at Juruena for each treatment, reduced impact logging (RIL) and undisturbed forest (UF). At Tapajos, previously presented in Keller et al. (2004), 5.3 ha were sampled in the RIL treatment and 6 ha were sampled in the undisturbed

forest. We used the same five-group decay class dependent on the degree of decomposition and used average densities for each decay class as was used for the fallen necromass sampling. A laser ranger finder with built-in clinometer was used to estimate the heights of snags.

## Data Characteristics:

There are two comma-delimited ASCII data files with this data set: two files contain the sampling information, decomposition state, and DBH measurements. There are also two files provided as companion data files which provide sampling transect descriptions.

**File name: TG07\_Fallen\_Necromass.csv**

Column	Heading	Units/Format	Description
1	Location		Study site; either Tapajos, Juruena, or Cauaxi
2	Treatment		Management treatment class: Control= no logging, RIL= reduced impact logging, or Conventional= traditional logging
3	DB_ID		Original Access database record identification number
4	Sample_date	yyyy/mm/dd	Sample date (yyyy/mm/dd); for some sites only the year is available
5	Sample_year	yyyy	Sample year (yyyy)
6	Sample_month	mm	Sample month (mm)
7	Sample_day	dd	Sample day (dd)
8	Line_ID		Line ID code: Identification labels varied across sites taking advantage of previously established sampling grids but included at a minimum line ID, and at Juruena also included date surveyed, treatment class, block (distance in meters from origin and distance within subblock)
9	Dist_start	m	Distance in meters to the start of the subsection along transect
10	Dist_end	m	Distance in meters to the end of the subsection along transect
11	Small_CWD		Count of pieces of coarse woody debris between 2 and 5 cm diameter encountered on the transect in this subsection
12	Medium_CWD		Count of pieces of coarse woody debris between 5 and 10 cm diameter encountered on the transect in this subsection
13	DBH	cm	Diameter at intersection in centimeters (cm) for all coarse woody debris > 10cm diameter at transect intersection
14	DBH_sq	cm <sup>2</sup>	Diameter squared (cm <sup>2</sup> ) for coarse woody debris > 10 cm diameter
15	Decay_class		Decay class (1- 5): Class 1 - newly fallen solid wood with some leaves and/or fine twigs still attached; Class 2 - solid wood/ bark still intact/ no leaves or fine twigs; Class 3 - still solid/ some bark falling off; Class 4 - somewhat rotten/ will break when kicked/ bark falling off or lost ; Class 5 - rotten/ can break with fingers

16	Field_notes		Field notes recorded by the survey crew
17	Field_notes2		Additional field notes recorded by the survey crew
Missing or no data are indicated with -9999. Null text fields (Field notes) are indicated as none.			

**Example Data Records:**

```

Location,Treatment,DB_ID,Sample_date,Sample_year,Sample_month,Sample_day,Line_ID,Dist_
start,Dist_end,Small_CWD,
Medium_CWD,DBH,DBH_sq,Decay_class,Field_notes,Field_notes2
Juruena,RIL,1,2002/11/07,2002,11,7,20021107_ril_ut01_400,0,10,-9999,-
9999,13,169,4,None,None
Juruena,RIL,2,2002/11/07,2002,11,7,20021107_ril_ut01_400,10,20,-9999,-
9999,51,2601,4,None,None
Juruena,RIL,3,2002/11/07,2002,11,7,20021107_ril_ut01_400,20,30,-9999,-
9999,23,529,2,None,None
...
Cauaxi,Conventional,1,-9999,2001,-9999,-9999,CbL1,0,10,-9999,-9999,-9999,-9999,-
9999,None,None
Cauaxi,Conventional,2,-9999,2001,-9999,-9999,CbL1,10,20,-9999,-9999,-9999,-9999,-
9999,None,None
Cauaxi,Conventional,3,9999,2001,-9999,-9999,CbL1,20,30,-9999,-9999,-9999,-9999,-
9999,None,None
...

```

**Corresponding Transect Line ID Information is provided in a companion file:  
TG07\_Fallen\_Necromass\_Line\_Descriptions.csv**

Column Number	Column Heading	Variable Description
1	Location	Study site; either Tapajos, Juruena, or Cauaxi
2	Treatment	Management treatment class: Control= no logging, RIL= reduced impact logging, or Conventional= traditional logging
3	Line_ID	Line ID code: Identification labels varied across sites taking advantage of previously established sampling grids but included at a minimum line ID, and at Juruena
4	Line_length	Line length in meters

**Example Data Records:**

```

Location,Treatment,Line_ID,Line_length
Cauaxi,Control,ConaL1,500
Cauaxi,Control,ConaL2,500
Cauaxi,Control,ConaL3,600
Cauaxi,Control,ConaL4,500
...
Cauaxi,Control,control1a,650
Cauaxi,Conventional,CbL1,560
Cauaxi,Conventional,CbL2,400

```

...  
 Tapajos,RIL,km83b6a,310  
 Tapajos,RIL,km83b6b,1000  
 Tapajos,RIL,km83b6c,1000  
 ...

Data file name: TG07\_Standing\_Necromass.csv

Column	Heading	Units/Format	Description
1	Location		Study site: Tapajos Nations Forest (TNF km 83) or Juruena
2	Treatment		Management treatment class: RIL= reduced impact logging, UF= undisturbed forest
3	DB_ID		Original Access database record identification number
4	Sample_date	yyyy/mm/dd	Sample date (yyyy/mm/dd); for some sites only the year is available
5	Sample_year	yyyy	Sample year (yyyy)
6	Sample_month	mm	Sample month (mm)
7	Sample_day	dd	Sample day (dd)
8	Transect_ID		Transect identification code
9	Distance	m	Distance in meters (m) from transect origin to beginning of 50-meter block, e.g. where Distance=250, the block begins at 250 m and extends to 300 m from transect origin
10	Tree_ID		Tree tag number
11	Height	m	Height in meters (m) to top of snag height if there are no branchings or to the top to the first branching in the case of multiple branching
12	DBH	cm	Diameter in centimeters (cm) measured at 1.3 meters above the ground or above the buttresses
13	Decay_class	1 through 5	Decay class (1- 5): Class 1 - newly fallen solid wood with some leaves and/or fine twigs still attached; Class 2 - solid wood/ bark still intact / no leaves or fine twigs; Class 3 - still solid/ some bark falling off; Class 4 - somewhat rotten/ will break when kicked/ bark falling off or lost ; Class 5 - rotten/ can break with fingers
14	Branching	1-9, S, U	Number of branchings (1= single pole, 2= secondary branches present, etc; S= stump no branching and U= undetermined due to canopy or vines obscuring the view)
15	Side	L,R,C,U	Side of transect on which the individual was located: R= right, L= left, C= Center, U= Undetermined
16	Prev_tree_ID		Tree ID number from previous survey if resurveyed
17	Top	m	For dead trees with multiple branchings, top is the distance to the top of the whole crown in meters (m)
18	Angle	degrees	Angle measured in degrees off vertical if snag is leaning
19	Field_notes	m	Field notes recorded by the survey crew
Missing or no data are indicated with -9999. Null text fields (Field notes) are indicated as none.			

**Example Data Records:**

```

Location,Treatment,DB_ID,Sample_date,Sample_year,Sample_month,Sample_day,Transect_ID,Distance,Tree_ID,Height,
DBH,Decay_class,Branching,Side,Prev_tree_ID,Top,Angle,Field_notes
TNF km 83,UF,1,2002/01/20,2002,1,20,ca1,0,1,1.2,20,4,1,L,-9999,-9999,-9999,None
TNF km 83,UF,2,2002/01/20,2002,1,20,ca1,0,2,0.83,52,4,S,L,-9999,-9999,-9999,None
TNF km 83,UF,3,2002/01/20,2002,2002,1,20,ca1,0,3,2.54,83,4,1,R,-9999,-9999,-9999,None
TNF km 83,UF,4,2002/01/20,2002,2002,1,20,ca1,50,4,0.87,10,2,1,L,-9999,-9999,-9999,None
...
Juruena,UF,1174,2003/07/12,2003,7,12,uf1_150,0,3,12.67,27.7,3,1,L,-9999,-9999,-9999,None
Juruena,UF,1175,2003/07/12,2003,7,12,uf1_150,0,4,0.05,13.8,4,1,L,-9999,-9999,-9999,palm
stump with roots
Juruena,UF,1176,2003/07/12,2003,7,12,uf1_150,0,5,1.21,14.4,4,1,R,-9999,-9999,-9999,None
...

```

**Corresponding Transect Line ID Information is provided in a companion file:  
TG07\_Standing\_Necromass\_Transect\_Descriptions.csv**

Column Number	Column Heading	Variable Description
1	Location	Study site: either Tapajos National Forest as TNF km 83, or Juruena
2	Treatment	Treatment class: RIL= reduced impact logging, UF= undisturbed forest
3	Transect_ID	Transect identifier: for the standing dead measurements, we defined strip plots (called transects) that varied in total length and included 5 meters on either side of the transect line. Identification labels varied across sites taking advantage of previously established sampling grids
4	Transect_length	Transect length in meters

**Example data records**

```

Location,Treatment,Transect_ID,Transect_length
Juruena,RIL,ril_ut01_200,950
Juruena,RIL,ril_ut01_400,900
Juruena,RIL,ril_ut01_900,950
...
TNF km 83,RIL,b61,300
TNF km 83,RIL,b62,1000
TNF km 83,RIL,b63,1000
...

```

**Site boundaries:** (All latitude and longitude given in degrees and fractions)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Geodetic Datum
Mato Grosso - Juruena (Mato Grosso)	-58.75969	-58.75969	-10.42492	-10.42492	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - km 83 Logged Forest Tower Site (Para Western (Santarem))	-54.97070	-54.97070	-3.01700	-3.01700	World Geodetic System, 1984 (WGS-84)
Para Eastern (Belem) - Fazenda Cauaxi (Para Eastern (Belem))	-48.29060	-48.29060	-3.73130	-3.73130	World Geodetic System, 1984 (WGS-84)

**Time period:**

- The data set covers the period 2001/06/10 to 2004/11/14.
- Temporal Resolution: The data from Juruena are from a one time survey (July 2003), the Tapajos data was collected in two surveys (January 2002, November 2004).

**Platform/Sensor/Parameters measured include:**

- FIELD INVESTIGATION / STEEL MEASURING TAPE / BIOMASS
- FIELD INVESTIGATION / HUMAN OBSERVER / DECOMPOSITION
- FIELD INVESTIGATION /HUMAN OBSERVER / LITTER CHARACTERISTICS

### 3. Data Application and Derivation:

Measurements of the forest necromass pool allow for the calculation of rates of necromass creation and decay, based on the assumption of steady-state dynamics. These fluxes contribute to our understanding of the role of necromass in the forest carbon cycle.

### 4. Quality Assessment:

Standard error was calculated using weighted means from each block (Keller 2004).

### 5. Data Acquisition Materials and Methods:

**Fallen Necromass Sampling**

Coarse woody debris (CWD) was sampled in three Amazonian forests in Brazil, two in Para: the Tapajos National Forest and the Fazenda Cauaxi, and one in Mato Grosso: Juruena. Measurements were conducted in an undisturbed forest [Control] and under two logging practices (reduced-impact logging [RIL] and conventional logging [CL]. Line intercept sampling was utilized (also termed planar intercept

sampling). Three or more lines were selected at random locations along an edge of each rectangular study block. Parallel lines separated by at least 100 m ran perpendicular to the block edge. In the case of logging blocks, we oriented the lines so that they crossed logging roads at approximately right angles. As previously shown, damage is concentrated along the roads and log storage decks bordering the roads (Pereira et al., 2002). The sampling lines were thus oriented to cross both high and low damage areas in order to avoid a sampling bias.

CWD was defined as fallen dead woody material with diameter greater than 2 cm. The material was divided into three classes according to diameter: 2 - 5 cm, 5 - 10 cm, and >10 cm. Each transect was divided into 50 m segments. A measuring tape was used to demarcate the transects. In each 50 m segment, a 10 m subsample was selected at random and the small diameter (2 - 5 cm) and medium diameter (5 - 10 cm) classes were counted only in that segment. Diameter was measured to the nearest cm for all pieces of CWD greater than 10 cm. This material was classified according to its decomposition state into five classes (Harmon et al., 1995). The classes 1 to 5 from freshest to most rotten were defined according to the following criteria: Class 1 material was newly fallen solid wood with some leaves and/or fine twigs still attached. Class 2 material was still solid and had intact bark but no fine twigs or leaves. Class 3 material resembled class 2 except that bark for this class was rotten or sloughing. Class 4 material is somewhat rotten and could be broken when kicked. Class 5 material was rotten and friable and it could be broken apart with bare hands.

For Cauaxi, there were two conventional logging blocks, with 12 line intersect samples (LIS) totaling 5.51 km. Also for Cauaxi, there were two RIL logging blocks, with 10 LIS totaling 5.88 km, and two control blocks, with 10 LIS totaling 6.19 km. For Tapajos, there were two control blocks, with 7 LIS totaling 6.05 km, and two RIL logging blocks, with 6 LIS totaling 5.31 km. For Juruena, there were two RIL logging blocks, with 6 LIS totaling 6.1 km.

#### Logging Blocks:

	Conventional	Control	Reduced Impact Logging (RIL)	Total Number of LIS
Cauxi	2	2	2	32
Tapajos National Forest		2	2	13
Juruena	1	2	2	16

#### Standing Necromass Sampling

Standing dead biomass measurements were taken from the Juruena National Park as a one time survey (July 2003), and also from the Tapajos National Forest, collected from two surveys (January 2002, November 2004). Tree volume estimates for standing dead trees used strip plots that were ten meters wide and the length of the intersect line transect. The total area sampled for standing dead necromass using the strip plots was 23.3 ha. This was broken down into 6 ha at Juruena for each treatment, reduced impact logging (RIL) and undisturbed forest (UF). At Tapajos, previously presented in Keller et al. (2004), 5.3 ha were sampled in the RIL treatment and 6 ha were sampled in the undisturbed forest. The same five-group decay class dependent on the degree of decomposition and used average densities for each decay class as was used (Harmon et al. 1995, Keller et al. 2004) as for CWD. A laser ranger finder with built-in clinometer was used to estimate the heights of snags. The diameter at breast height (DBH) was recorded. If the snag was a stump or shorter than the appropriate height to measure DBH, the highest point was measured for the diameter. Volume estimate for a snag was done using a taper function, height, and diameter measurements. The taper function is from Chambers et al. (2000).

$$Dh=1.59*D*(h-0.091)$$

Where DH is the diameter at specific height based on the diameter (D) and height(h) of the snag.



Using the disc method of integration, the solid volume of each disc was determined. This method is more realistic than the use of a frustum of a cone, because it does not over-estimate the volume of a snag due to the curve of the trunk by developing straight line between the top and the bottom of the snag. Mass can be determined using the decay class density averages and multiplying by the volume snag. See table below.

### Density of Decay Classes for Calculating Biomass

Table 3 from Keller et al., 2004. Mean (S.E.) wood plug densities, void proportions, and corrected densities for 5 decay classes of CWD (dia.>10 cm) and medium (5-10 cm) and small (2-5 cm) debris.

Debris class	Plug density (Mg m <sup>-3</sup> )	Void proportion	Corrected density (Mg m <sup>-3</sup> )	Number of pieces sampled
1	0.61 (0.02)	0.02 (0.01)	0.60 (0.02)	88
2	0.71 (0.03)	0.71 (0.03)	0.70 (0.03)	35
3	0.63 (0.02)	0.08 (0.02)	0.58 (0.03)	48
4	0.58 (0.03)	0.21 (0.03)	0.45 (0.03)	52
5	0.32 (0.03)	0.09 (0.02)	0.28 (0.03)	60
Medium (5–10 cm)			0.45 (0.02)	86
Small (2–5 cm)			0.36 (0.01)	103

## 6. Data Access:

Data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

### Data Archive Center:

#### Contact for Data Center Access Information:

E-mail: [uso@daac.ornl.gov](mailto:uso@daac.ornl.gov)

Telephone: +1 (865) 241-3952

## 7. References:

Brown, J.K. 1974. Handbook for Inventorying Downed Woody Material. USDA Forest Service, Ogden Utah pp 1-24.

Chambers, J.Q., Higuchi, N., Schimel, J.P., Ferreira, L.V. and Melack J.M. 2000. Decomposition and carbon cycling of dead trees in tropical forests of the central Amazon. *Oecologia* 122: 380-388. [doi:10.1007/s004420050044](https://doi.org/10.1007/s004420050044)

de Vries, P.G. 1986. Sampling Theory for Forest Inventory. A Teach-yourself Course. Springer-Verlag, Berlin, Heidelberg, Wageningen 399.

Harmon, M.E., Whigham, D.F. Sexton, J. and Olmsted, I. 1995. Decomposition and mass of woody detritus in the dry tropical forests of the northeastern Yucatan peninsula, Mexico. *Biotropica* 27: 305-316. [doi:10.2307/2388916](https://doi.org/10.2307/2388916)

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Pereira, R. J.C. Zweede, G.P. Asner, and M.M. Keller. 2002. Forest canopy damage and recovery in reduced impact and conventional logging in eastern Para, Brazil. *Forest Ecol. Manage.* 168: 77-89. [doi:10.1016/S0378-1127\(01\)00732-0](https://doi.org/10.1016/S0378-1127(01)00732-0)

Ringvall, A. and G. Stahl. 1999. Field aspects of line intersect sampling for assessing coarse woody debris. *Forest Ecol. Manage.* 119: 163-170. [doi:10.1016/S0378-1127\(98\)00521-0](https://doi.org/10.1016/S0378-1127(98)00521-0)