

# LBA-ECO ND-07 Microbial Biomass in Cerrado Soils, Brasilia, Brazil

Revision date: August 29, 2011

## Summary:

This data set reports the microbial biomass in soil samples collected from the Cerrado, a woodlands-savannah area, in Brasilia, Brazil. Microbial biomass was determined as the total concentration of phospholipid fatty acids (PLFAs). Soil samples (0-5 cm) were collected from June, 2000 to June, 2001 in two native areas of Cerrado that were subjected to a range of fire regimes. Two plots were protected from fire since 1973, another two plots were subjected to prescribed fires every two years since 1992, and a fifth plot was in a 20 year-old active pasture (*Brachiaria brizantha*). The analyses were conducted to determine the effects of fire regimes and changes in vegetation cover on the microbial communities of Cerrada soils. There is one comma-separated ASCII data file with this data set.

## Data Citation:

**Cite this data set as follows:**

Viana, L.T., M. Molina, M.M.C. Bustamante, A.S. Pinto, K. Kisselle, R.G. Zepp, and R.A. Burke. 2011. LBA-ECO ND-07 Microbial Biomass in Cerrado Soils, Brasilia, 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. <http://dx.doi.org/10.3334/ORNLDAAAC/1017>

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This data set was archived in August of 2011. Users who download the data between August 2011 and July 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:** Nutrient Dynamics

**Team ID:** ND-07 (Zepp / Bustamante)

The investigators were Viana, Laura Tillman; Molina, Marirosa; Bustamante, Mercedes M.C.; Pinto, Alexandre de Siqueira; Kisselle, Keith; Zepp, Richard G. and Burke, Roger A. You may contact Bustamante, Dr. Mercedes ([mercedes@unb.br](mailto:mercedes@unb.br)); Zepp, Dr. Richard G. ([zepp.richard@epa.gov](mailto:zepp.richard@epa.gov)) and Molina, Dr. Marirosa ([molina.marirosa@epa.gov](mailto:molina.marirosa@epa.gov)).

**LBA Data Set Inventory ID:** ND07\_PLFA\_Soils\_Microbial\_Biomass

The effects of fire regimes and changes in vegetation cover on the microbial communities of Cerrada soils were assessed through phospholipid fatty acid (PLFA) analysis. Soil samples (0-5 cm) were collected from June, 2000 to June, 2001 in two native areas of Cerrado, subjected to different fire regimes (two plots were protected from fire since 1973 and another two plots were subjected to prescribed fires every two years since 1992) and in a 20 year-old active pasture (*Brachiaria brizantha*). The native areas represent two different vegetation types: cerrado stricto sensu and campo sujo.

### Related Data sets

- [LBA-ECO ND-07 Trace Gas Fluxes Under Multiple Land Uses, Brazil: 1999-2004](#)
- [LBA-ECO ND-07 Hydrochemistry of Natural and Developed Land Cover, Brasilia, Brazil](#)

## 2. Data Characteristics:

Data are presented in one comma-separated ASCII file: **ND07\_PLFA\_summary.csv**

Column	Heading	Units/Format	Description
1	Year		Sample year (2000, 2001)
2	Month		Sample month
3	Vegetation_type		Vegetation type: Cerrado, Woodland (Campo Sujo) or Pasture ( <i>Brachiaria decubens</i> )
4	Treatment		Experimental treatment for the Cerrado and Open woodland vegetation types: control plots were protected from fire since 1973 and burned plots were subjected to prescribed fires every two years since 1992

5	Replicate		Starting in August 2000 replicate plots within a vegetation type and treatment are indicated by A or B
6	Compound_ID		Compound identity code. Fatty Acid Nomenclature: The total number of carbon atoms in the fatty acid is followed by the number of double bonds separated by a colon. For example: i15:0, a15:0, 15:0, i16:0, cy17:0, 17:00, 18:1w7 and cy19:0. The symbol "w" indicates the position of the first double bond from the aliphatic end of the molecule (e.g., 16:1w 7). Cis and trans geometry are indicated by the suffixes "c" and "t". The location of a methyl branch one or two carbons from the aliphatic end of the molecule is indicated by the prefixes "a" and "i" referring to anteiso- and iso-branching, respectively. Branching at other positions is indicated by the appropriate number, from the aliphatic end, as a prefix (e.g., 10Me16:0) or by the prefix "br" if the position is unknown. Cyclopropane fatty acids are designated by the prefix "cy". <b>FAME:</b> Phospholipids methylated using a mild alkaline methanolysis to form fatty acid methyl esters (FAMES). <b>not identified:</b> Compounds not present in the standard mixture
7	Compound_ret_time	decimal minutes	Point during the run at which the peak appeared, reported in decimal minutes
8	Peak_area	pico Amps * seconds	Peak area in pico Amps *seconds as measured by the gas chromatograph
9	Fractional_area	%	Peak area for each compound as a percent of the total area measured in the run
10	Mass_concentration	ug g-1	Micrograms per gram of soil of compound identified, calculated from the peak area and the known concentration of the 20:00 EE internal standard included in each individual sampling run
11	Molar_concentration	umol g-1	Micromoles per gram of soil of compound identified, calculated from micrograms per gram soil and compound molecular weight
12	Molar_proportion	%	Amount of the compound, identified as a percent of sum of molar concentrations of all compounds identified
13	Fungal_bacterial_ratio		Ratio of fungal to bacterial biomass, fungal is represented by 18:2w6 and bacterial biomass is represented by the sum of: i15:0, a15:0, 15:0, i16:0, cy17:0, 17:00, 18:1w7 and cy19:0
14	Bacme_peak_ID		Compound identity code for peaks detected in the Bacme standard
15	Bacme_ret_time	decimal minutes	Retention times for the individual compounds in the Bacme standard, reported in decimal minutes
16	IS_ret_time	decimal minutes	Retention time of run time for 20:00 EE run as an internal standard, reported in decimal minutes
17	IS_area	pico Amps * seconds	Peak area in pico Amps *seconds for 20:00 run as an internal standard

Missing data are reported as -9999

**Example data records:**

Year,Month,Vegetation\_type,Treatment,Replicate,Compound\_ID,Compound\_ret\_time,Peak\_area,Fractional\_area,Mass\_concentration,Molar\_concentration,Molar\_proportion,Fungal\_bacterial\_ratio,Bacme\_peak\_ID,Bacme\_ret\_time,IS\_ret\_time,IS\_area  
 2000,6,Cerrado,control,-9999,11:00,13.052,0,0,0,0,0,0.094,11:00,13.041,30.807,186.78375  
 2000,6,Cerrado,control,-9999,2 OH-10:0,13.332,0,0,0,0,0,-9999,2 OH-10:0,13.321,-9999,-9999  
 2000,6,Cerrado,control,-9999,12:00,14.778,0,0,0,0,0,-9999,12:00,14.768,-9999,-9999  
 2000,6,Cerrado,control,-9999,13:00,16.62,2.87519,0.125,0.019,0.0001,0.159,-9999,13:00,16.616,-9999,-9999  
 2000,6,Cerrado,control,-9999,2 OH-12:0,16.998,0,0,0,0,0,-9999,2 OH-12:0,16.988,-9999,-9999  
 2000,6,Cerrado,control,-9999,3 OH-12:0,17.533,0,0,0,0,0,-9999,3 OH-12:0,17.524,-9999,-9999

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Geodetic Datum
Brasilia - Reserva Ecologica do Roncador IBGE (Brasilia)	-47.85060	-47.85060	-15.93280	-15.93280	World Geodetic System, 1984 (WGS-84)
Brasilia - EMBRAPA Cerrados Pasture (Brasilia)	-47.70000	-47.70000	-15.58333	-15.58333	World Geodetic System, 1984 (WGS-84)

**Site Notes:** The coordinates for the specific sampling locations were not provided. The sampling locations are located within the IBGE and EMPRAPA sites.

**Time period:**

- The data set covers the period 2000/06/01 to 2001/06/01
- Temporal Resolution: daily

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

- FIELD INVESTIGATION / GC-FID (GAS CHROMATOGRAPH/FLAME IONIZATION DETECTOR) / BIOGEOCHEMICAL CYCLES
- FIELD INVESTIGATION / GC-FID (GAS CHROMATOGRAPH/FLAME IONIZATION DETECTOR) / BIOMASS

### 3. Data Application and Derivation:

Currently there is little information on the effect of land-use change on the structure and composition of the soil microbial community. Shifts in microbial community composition may have important implications for ecosystem processes including decomposition of organic material, mineralization of

organic compounds and nutrient retention which may in turn affect productivity of the system and the potential for recovery of the native vegetation.

Microbial biomass, as the total PLFAs (mg.g<sup>-1</sup> DW soil), was higher in native areas than in the pasture plot and the highest monthly values were observed during the rainy season in the native areas. Principal component analysis separated microbial communities by vegetation cover (native vs pasture) and seasonality (wet vs dry), explaining 45.8% and 25.6%, respectively, of the total PLFA variability. No significant differences were observed between communities from the two vegetation types (campo sujo and cerrado sensu stricto).

There was, however, significant difference between burned and unburned plots. Nitrogen mineralization rates were lower in the burned areas but significant differences in annual NO fluxes were observed only between burned and unburned campo sujo. There was no correlation between NO fluxes and total PLFA content in all the studied plots. On the other hand, the CO<sub>2</sub> fluxes in the burned plots were determined by soil temperature, soil humidity and total PLFA content. When all the plots were considered together, soil respiration in the dry season was explained by soil humidity and temperature but not by total PLFA content, while during rainy season, CO<sub>2</sub> emission was weakly determined by the total PLFA content.

## 4. Quality Assessment:

Multiple standards were run with each sample set on the gas chromatograph to verify peak retention time and identification. There are no known problems with these data.

## 5. Data Acquisition Materials and Methods:

### Soil Sample Collection

Soil samples (0-5 cm) were collected from the Cerrado, the most extensive woodlands-savannah region of Brazil and home to thousands of different vegetation types. The climate is usually hot and seasonal with rainy summers. Samples were collected from June 2000 to June 2001 in two native areas of Cerrado, subjected to different fire regimes (two plots were protected from fire since 1973 and another two plots were subjected to prescribed fires every two years since 1992) (IBGE site) and in a 20 year-old active pasture (*Brachiaria brizantha*) (EMBRAPA site). The native areas represent two different vegetation types: cerrado stricto sensu and campo sujo. For phospholipid fatty acid (PLFA) analyses, composited samples were obtained from 10 samples collected in two transects 5 meters apart from each other. Upon arrival at the laboratory, samples were sieved through a 2 mm mesh sieve to remove coarse fragments and roots and stored in a freezer (-19 degrees C) until lipid extraction and analysis.

### PLFA Analysis

Total lipids were extracted from soil samples using a modification of the Bligh-Dyer technique (Bligh and Dyer, 1959). A one phase solvent mixture of methanol/chloroform/phosphate buffer (2:1:0.8 ratio) was added to 20 g of dry soil in a teflon bottle and rotated on a roller mill (US Stoneware, East Palestine, OH) for two hours. The solvent mixture was decanted, extra volumes of buffer were added, and the mixture was allowed to separate overnight into two phases.

Lipids collected in the organic phase were fractionated with an activated silica gel column (BondElut, Varian, CA) into neutral lipids, glycolipids, and phospholipids with volumes of chloroform, acetone, and methanol, respectively. Phospholipids were methylated using a mild alkaline methanolysis (White et al., 1979) to form fatty acid methyl esters (FAMES). FAMES were purified using NH<sub>2</sub> aminopropyl columns (BondElut, Varian, CA) (Zelles and Bai, 1994). Lipid samples were analyzed using a Hewlett Packard

(HP) 6890 Series gas chromatograph (GC) equipped with a flame ionization detector (FID) and a 50 m DB-5 capillary column (film thickness, 0.33 microns, internal diameter, 0.2 mm; J&W Scientific, Folsom, CA). The oven temperature was programmed to hold at 70 degrees C for 2 min, ramp from 70 to 160 degrees C at 40 degrees C/min, then ramp from 160 to 280 degrees C at 5 degrees C/min, with a final isothermal period of 20 min. Individual compounds were quantified by Flame Ionization Detector (FID) response relative to an internal standard (20:0 ethyl ester) added prior to gas chromatograph analysis. Identification of individual compounds was based on relative retention times compared to a prepared standard mixture (Sigma, St Louis, MO; and Matreya, Pleasant Gap, PA) run with each batch of samples. Mass spectrometry was used to verify compound identification and to identify FAMEs not present in the standard mixture. The same temperature program and similar DB-5 column (30 m; film thickness, 0.25 micron; internal diameter, 0.25 mm) were used in an HP 5890 Series II GC interfaced to a HP 5972 mass selective detector. The interface was kept at 280 degrees C and the electron energy was 70 eV. Helium was used as carrier gas in both instruments.

## 6. Data Access:

This data is 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:

Bligh E.G. and W.J. Dyer. 1959. A rapid method of total lipid extraction and purification. *Journal of Biochemical Physiology*, 37, 911-917.

Jenkinson, D.S. and D.S. Powlson. 1976. The effects of biocidal treatments on metabolism in soil. A method for measuring soil biomass. *Soil Biology and Biochemistry*, 8(3), 209-213. [doi:10.1016/0038-0717\(76\)90005-5](https://doi.org/10.1016/0038-0717(76)90005-5)

White D.C., W.M. Davis, J.S. Nickels, J.D. King, R.J. Bobbie. 1979. Determination of the sedimentary microbial biomass by extractable lipid phosphate. *Oecologia*, 40,51-62. [doi:10.1007/BF00388810](https://doi.org/10.1007/BF00388810)

Zelles L., Q.Y. Bai. 1994. Fractionation of fatty acids derived from soil lipids by solid phase extraction and their quantitative analysis by GC-MS. *Soil Biology and Biochemistry*, 25, 495-507. [doi:10.1016/0038-0717\(93\)90075-M](https://doi.org/10.1016/0038-0717(93)90075-M)