Biomonitoring Guide

Biomonitoring Methodology: Vegetation Plots and Quadrat Sampling

(Revised: March 2006)

The biomonitoring program is a long-term project designed to monitor the cloud forest's recovery and biodiversity at Cloudbridge in planted areas, second growth forests and non-planted deforested regions. The sites are the same as those chosen for the photomonitoring study, thus the results can be matched up with the photographic database developed in that study. At each of the sites, four aspects of the ecosystem are documented: the surrounding flora; a species count in several quadrats around the site; ground conditions; and fauna (when known). The monitoring is repeated on a semi-annual basis if possible. Each new set of monitoring data is recorded in a database and is identified by a unique name referred to as a DATASET (a more complete discussion of the concept of a DATASET is included in the database instructions). This project was begun in 2003.

The Sites

Currently, there are **seven biomonitoring sites** each centered on a photomonitoring post (see map). At each site a vegetation plot is generally described and smaller sampling plots (quadrats) are detailed. The monitoring at the vegetation plots describes the major plant life within a 20 meter radius of the photomonitoring post.

Detailed vegetation sampling is performed at **2 to 4 quadrats in each site**. The name and coverage of each species present within each quadrat is recorded. Photos and a detailed description are taken of any new plant species that have not previously been encountered during the biomonitoring study (*i.e.* a species not already in the biomonitoring database).

Non-changing characteristics of each site were recorded in the first few years of the biomonitoring study. The characteristics include: slope; slope facing direction (to indicate light regime); drainage and whether the area has been reforested. These characteristics, in conjunction with the monitoring data, may be useful in determining factors that affect plant growth at a particular site.

Field Equipment Required

- Biomonitoring notebook with species photos/data and previous DATASET reports
- Camera with extra batteries
- Ruler and white backdrop for photos
- Forms (vegetation plot, quadrat sampling, species description checklist)
- Tape measure and tools to repair quadrat markers
- Clipboard
- Hand lens for viewing smaller plant features
- Plastic bag to protect biomonitoring notebook and camera from rain
- Plastic bag for collecting samples

Part 1: Vegetation Plots

With each DATASET, observations of present vegetation are recorded for an area within a 20 meter radius of the site post according to different **canopy levels**. Each story is defined as:

- Upper story — above 15 meters — Trees
- Mid story — 5 to 15 meters — Smaller trees
- Lower story — 0.5 to 5 meters — Bushes, treeferns (may include taller ferns and vines)
- Ground story — 0 to 0.5 meters — Normally herbaceous plants (herbs, grasses, ferns and vines)

For each story, the percent coverage of plants is recorded along with the major species (when known), epiphytes and any other notes of interest. This is not a detailed description of every plant species within the 20 meter radius of the plot, but rather a set of general observations to be used along with the photomonitoring photos to obtain a clear impression of the plant life in the biomonitoring site. Birds and insects observed at the site are also recorded, as well as any disturbances that have occurred since the last set of monitoring data was collected.

Tasks of the Researcher Part 1:

Observe and record the following information for the vegetation within 20 meters of the site post.

- Percent Cover: Estimate plant coverage for each story to the closest 5%
- Trees and Flora: List major species present in each story
- Epiphytes: List major species or types present
- Recent Disturbance: Record any recent disturbances such as ground shifts, standing water, plant removal, new planting or other unusual conditions
- Birds and Insects: Record any birds or insects observed at the site
- Date of Observations: Be certain to include day, month and year

Below is a **sample table** used for the vegetation plots.

Biomonitoring Form – Vegetation Plots – Sample Table
Site #: __3__ **Site Name:**____Big Rock / Cecropia___________ **Date:**_____2 May, 2005_____
By:____cas___

Level	Percent cover	Trees and flora	Epiphytes	Notes
Upper story (+15m)	0%		none	
Mid story (5-15m)	5%	Cecropia	none	
Lower story (0.5-5m)	20%	Flor de Niño, Alder		Alder planted
Ground (0-0.5m)	70%	Grasses, ferns, Flor Azul		
Recent disturbance:	Wind storm broke several planted Alder in this site (Jan 2005)			
Birds:	Silver-throated Tanager, hummingbird			
Insects:	katydid			
Notes:				

Part 2: Quadrat Monitoring

For each of the biomonitoring sites, 2 to 4 quadrats have been established. Each quadrat is located approximately 10m (unless otherwise noted) from the photomonitoring post. Each quadrat is a 2 meter by 2 meter square, roughly laid out on N-S and E-W axes. A metal rod with the quadrat number has been placed at the NE corner of each quadrat (unless otherwise noted). All other corners have been marked with a bamboo stake painted blaze orange. (Note: It is desired to replace these bamboo markers with more permanent markers.)

Quadrat sampling consists of recording the organic soil cover (in cm), the overall vegetative coverage of the quadrat (as a percentage of the quadrat's area), and the coverage for each plant story. Within each plant story, every plant species encountered in the quadrat is recorded along with each species' approximate coverage (using the Braun-Blanquet scale below).

Tasks of the Researcher Part 2:

Prior to beginning quadrat sampling, please ensure that the quadrat is still intact and replace any corner markers that are missing or rotted. Minimize disturbance to quadrat while sampling.

- Organic Cover - in cm, layer of organic cover over soil (organic litter and black layer over mineral soil)
- Overall Coverage – as % of quadrat area, estimate to the nearest 5%
  - Estimation of the percentage of the entire quadrat's area that is covered by plants.
  - This coverage should exclude any bare soil such as that covered by dead or fallen over plants. With this consideration the overall coverage often becomes smaller than it initially appears.
- Coverage by Story – as % of quadrat area, estimate to the nearest 5%
  - Estimation of percent coverage for each story within the quadrat. Should be nearly the sum of the coverages of each species within the story but the sum of the stories' coverages may exceed the Overall Coverage, as one story may overlap another.
  - Tree sapling coverage is not recorded because they grow quickly and the effects on the lower story coverages are transient.
- Individual Species Coverage – estimate using the Braun-Blanquet scale
  - The Braun-Blanquet scale is used to describe the individual species coverage as noted in the table below. The scale uses a series of codes to describe different combinations of percent coverage and number of plants found.

Symbol	Coverage	Number of Plants	Covered area for $4m^2$
r	< 5%	1 plant	< $0.2m^2$ (40cm x 45 cm)
+	< 5%	2 – 5	< $0.2m^2$ (40cm x 45 cm)
1	< 5%	6 – 50	< $0.2m^2$ (40cm x 45 cm)
2m	< 5%	> 50	< $0.2m^2$ (40cm x 45 cm)
2a	6 – 15 %	any	$0.2m^2$ - $0.6m^2$ (70cm x 80cm)
2b	16 – 25%	any	$0.6m^2$ - $1m^2$ (100cm x 100cm)
3	26 – 50 %	any	$1m^2$ - $2m^2$
4	51 – 75%	any	$2m^2$ - $3m^2$
5	76 – 100 %	any	$3m^2$ - $4m^2$

Below is a sample table used for the quadrat monitoring.

Quadrat Sampling Form		**Sample Table**	
Site/Quad. # 5/2	Date: May 3, 2005	Researcher Name: cas	
Organic Cover (cm): 3		Overall Coverage (%) 70	
	Cover		Cover
TREE STORY	5	HERBACEOUS PLANTS	60
Alnus (Tree -2?)	r	flor blanca – herb-1	3
		Indian paintbrush – herb-4	2b
TREE SAPLING	[redacted]	herb-11	2a
		herb-14	2a
		New Herb037	r
SHRUB STORY	15	New Herb038	+
Flor de nino – shrub-2	2a		
Mosote – shrub-4	2a		
MOSS STORY	0	OTHER	0

New Plant Species

Whenever a **new** plant species is found it is assigned a unique name, it is photographed and a detailed description is taken (see partial checklist below). The photos and description are then entered into the biomonitoring database, printed out and placed in the field notebook. When new information is identified or additional or better photos are taken for an existing species, the database must be updated along with the information in the field notebook.

When a new plant species is entered into the database, its name must use the following convention:

Catg000

Where: *Catg* = Life form category: *Tree, Shrb, Herb, Gras, Vine* or *Fern*
000 = Next 3-digit consecutive number for the chosen category

e.g.: Herb027.

Note: In writing, the format "Herb-027" is used for clarity, however within the database, the '**-**' is omitted.

Before going into the field it may be easiest to know which species name is next in the sequence for each life form category. It is often helpful to ask the locals for common names of any new plant species found.

There is a two-page checklist on the various plant attributes that provides for a detailed description of each plant species (below is a partial sample). This checklist must be filled out for every new species found. The information recorded will help researchers distinguish between similar looking plants and hopefully assist in future identification of unknown species.

Below is a partial species attribute checklist *to be used to describe **new** plant species*.

Name of Family, Genus or Species / Origin of Specimen:	#
New Herb037 - ? / Site 5 Quad 2	**1**
New Herb038 - similar to Herb2 / Site 5 Quad 2	**2**
	3

Plant #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
<character>Life form										
Epiphyte										
Fern										
Herb/wildflower	X	X								
Moss										
Palm-like										
Shrub										
Tree										
Vine										
<character>Leaf arrangement	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Absent at flowering										
Alternate	X									
Opposite		X								
Rosette at base										
Whorled										
<character>Leaf division	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Compound: pinnate 1 time										
Compound: pinnate 2 times										
Compound: pinnate over 2 times										
Palmate										
Simple: is not divided	X	X								
<character>Leaf shape	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Heart-shaped										
Linear										
Wider near base	X									
Wider near middle		X								
Wider near tip										

Tips on Taking Species Photos

Digital photos are taken for each new plant species found.

- Photos should be taken at high resolution.
- Take all photos landscape (the database is not set up for portrait photos).
- Photos should contain a ruler for scale.
- Photos for each species should include such features as an overall species shot, leaf top and bottom, flower close up and any other interesting or distinguishing features.
- Be sure that such attributes as leaf or stem hair, leaf venation and leaf margin detail are apparent.
- It may be helpful to practice taking species photos prior to going out in the field.
    - Some common problems include photos that are too dark or overexposed and photos that are out of focus, especially the smaller details.
    - The only way to be certain that the photos are good is to check them on the larger computer screen.
- Take several photos of each feature at varying light levels.
- Be sure that distinguishing features such as hair, venation, pistils, stamens etc. are in focus.
- Photos of flowers should be taken in the field to avoid flowers closing up.
- If taking photos in the field, be sure to take extra batteries and have plenty of space on the memory card.
- Record the following information for each new species photo:
    - Date photos are taken.
    - Location where specimen in photo is from.

Database Entry

See separate instructions on how to enter biomonitoring data in the database.