

Preliminary Report on PAI Measurements Brazil 2002 Field Campaign

Introduction

Estimations of the Plant Area Index (PAI) were made for the Brazil field campaign, June 10 through July 21, 2002. Transect and selected plant measurements were done by David Schaub. Benjamin Schaub did PAI measurements of biomass plots. Fernando Del Bon Espirito Santo did one transect at a forest regeneration site in Tapajos National Forest. This report discusses the preliminary results of the field data, but does not include estimations of actual LAI or relationships to other field data, such as fAPAR, percent cover, or NDVI.

Methods

PAI was measured directly with one or more Licor LAI2000 instruments. For all measurements the 90-degree cap was used. Because direct lighting will depress PAI values measurements were done before sunrise or when plants were shaded, naturally or artificially.

Transects. The predominant sampling method for total and overstory PAI was done along 100m or 250m transects. From the 0m to 100m mark measurements were taken at 2m intervals. From the 100m to 250m mark measurements were taken at 5m intervals. The instrument was configured to calculate a single PAI sample value from five measurements as shown in Table 1. Above readings were recorded at the first measurement point of each sample (e.g. 0, 10, 20,...) or with a cross calibrated remote LAI2000.

Table 1. Transect locations of measurements for total and overstory PAI.

Sample Number	Location of measurements (meters)
1	0, 2, 4, 6, 8
2	10, 12, 14, 16, 18
3	20, 22, 24, 26, 28
4	30, 32, 34, 36, 38
5	40, 42, 44, 46, 48
6	50, 52, 54, 56, 58
7	60, 62, 64, 66, 68
8	70, 72, 74, 76, 78
9	80, 82, 84, 86, 88

10	90, 92, 94, 96, 98
11	100, 105, 110, 115, 120
12	125, 130, 135, 140, 145
13	150, 155, 160, 165, 170
14	175, 180, 185, 190, 195
15	200, 205, 210, 215, 220
16	225, 230, 235, 240, 245

At some sites the PAI of the grass understory layer or shrub understory layer was sampled along the transects with a set of ‘above’ and ‘below’ readings at the each location of ceptometer readings (see Table 2). In forested areas wide-angle digital photographs were taken of the tree canopy at the same locations.

Table 2. Locations of measurements for understory PAI measurements.

Sample Number	Location of measurements (meters)
1	5
2	15
3	25
4	35
5	45
6	55
7	65
8	75
9	85
10	95
11	110
12	135
13	160
14	185
15	210
16	235

Biomass. For all biomass plots one above and four below readings were taken before clipping with the biomass frame removed. A single PAI value was calculated for each biomass plot.

Selected Plants. At two sites, AE_WC and CA_CW, individual shrubs and trees were selected. The PAI of these two plants were measured from two sides just below the lowest branches. Diameters were measured in orthogonal directions and averaged. Their heights and species names were also recorded. Wide-angle digital images were taken of each individual.

The type of PAI sampling performed at each site is given in Table 3. The boundary between overstory and understory was defined as the top of the grass layer for all locations excluding Tapajos. At the Tapajos sites the boundary was set at one meter above the ground.

Table 3. Study sites of PAI data collection.

Site	Geographic Location	Transect Sampling	Remote Used	Other Sampling
Brasilia National Park				
BNP SC	15.58936 S 48.00663 W	250m: Total	No	Biomass (3)
BNP CW	15.73285 S 48.00338 W	250m: Total, Overstory	No	Biomass (3)
BNP WC	15.60981 S 48.02948 W	250m: Total, Understory	Yes	Biomass (3)
Aguas Emendadas				
AE CW	15.57276 S 47.59092 W	250m: Total, Understory	Yes	Biomass (3)
AE WC	15.57845 S 47.62727 W	250m: Understory	No	Biomass (3), Selected Trees/Shrubs (16)
AE CG	15.54719 S 47.61507 W	200m: Total (no overstory)	No	Biomass (3)
Rio de Janeiro Farms				
RJ WOT	15.23455 S 47.69398 W	250m: Total, Overstory	No	Biomass (3)
RJ WT	15.23142 S 47.69372 W	2 x 50m: Total (no overstory present)	No	Biomass (2)
RJ BU	15.23003 S 47.69225 W	100m: Total (no overstory present)	No	Biomass (2)
Cangussu				
CA P8	10.04658 S 49.89980 W	250m: Total, Overstory, Understory	Yes	Biomass (3)
CA CW	10.06633 S 49.90696 W	250m: Overstory, Understory	Yes	Biomass (3), Selected Trees/Shrubs (6)
CA P3	10.06339 S 49.91322 W	250m: Total, Overstory	No	Biomass (3)
CA P1			No	5 A/B readings of grass along an informal 50m transect

Santana do Araguaia				
SA PA	9.71817 S 50.40072 W	100m: Total	No	Biomass (1)
SA F1			Yes	5 random samples of overstory
SA CP	9.74540 S 50.30674 W		No	A/B samples of overstory (17), and understory (16)
Tapajos				
TP 67U	2.8544 S 54.95977 W	250m: Total, Overstory, Understory	Yes	
TP 67L	2.84238 S 54.97889 W	250m: Total, Overstory, Understory	Yes	
TP 89U	3.12074 S 54.90156 W	250m: Total, Overstory, Understory	Yes	
TP 77RE	3.01520 S 54.90799 W	100m: Total, Overstory, Understory	Yes	
TP 93PA	3.12714 S 54.94476 W	250m: Total	No	Biomass (3)
TP 83SL1	3.04599 S 54.95298 W	250m: Total, Overstory, Understory	Yes	
TP 83SL2	3.03119 S 55.01072 W	250m: Total, Overstory, Understory	Yes	
TP 103U (Fernando)		250m: Total, Overstory, Understory	Yes	

Results

The results of PAI values are summarized in Table 4. For the transects the PAI values are given for Total, Understory, and Overstory layers. At sites where all three quantities were measured note that the Total PAI was approximately equal to the sum of the Understory and Overstory layers. Biomass values are given separately. A graphical representation of the data is given in Figure 1. Results for PAI by landcover type are given in Tables 5 and 6.

Table 4. Mean PAI values for transects and biomass plots. Standard deviations are given in parentheses. PAI values with * indicate that the value was estimated under the assumption that Total PAI = Understory PAI + Overstory PAI.

Site	Total PAI	Understory PAI	Overstory PAI	Biomass PAI
Brasilia National Park				
BNP SC	1.74 (0.52)			2.63 (0.37)
BNP CW	2.44 (0.48)	2.11*	0.33 (0.28)	2.48 (0.86)
BNP WC	1.90 (0.36)	1.33 (0.79)	0.57*	1.48 (1.27)
Aguas Emendadas				
AE CW	2.17 (0.35)	0.96 (0.98)	1.21*	1.76 (0.94)
AE WC		2.24 (1.17)		3.39 (1.34)
AE CG	2.12 (0.48)	2.12 (0.48)	0.00	2.04 (1.10)
Rio de Janeiro Farms				
RJ WOT	2.98 (1.15)	2.97*	0.01 (0.02)	3.76 (0.79)
RJ WT	3.76 (0.71)	3.76 (0.71)	0.00	3.54 (0.08)
RJ BU	0.89 (0.46)	0.89 (0.46)	0.00	0.89 (0.06)
Cangussu				
CA P8	1.42 (1.03)	1.32 (1.83)	0.10 (0.12)	0.89 (0.17)
CA CW	5.25*	4.42 (2.73)	0.83 (0.44)	6.24 (0.87)
CA P3	1.52 (0.53)	1.50*	0.02 (0.08)	2.28 (0.64)
CA P1	0.49 (0.33)	0.49 (0.33)	0.00	
Santana do Araguaia				
SA PA	3.46 (1.45)	3.46 (1.45)	0.00	3.74 (NA)
SA F1			5.58 (0.52)	
SA CP				
Tapajos				
TP 67U	7.43 (1.00)	1.39 (0.98)	5.89 (0.86)	
TP 67L	6.90 (0.85)	0.63 (0.41)	6.03 (0.72)	
TP 89U	6.66 (0.70)	1.75 (1.20)	5.36 (0.72)	
TP 77RE	5.41 (0.39)	0.86 (1.17)	4.32 (0.42)	
TP 93PA	3.74 (1.03)	3.72*	0.02 (0.06)	4.71 (0.41)
TP 83SL1	7.26 (0.71)	1.66 (0.60)	6.22 (0.85)	
TP 83SL2	6.37 (0.29)	0.45 (0.29)	5.91 (0.64)	
TP 103U (Fernando)	6.74 (0.98)	1.42 (1.47)	4.73 (0.60)	

Table 5. Summary of Total PAI values by landcover type.

Landcover	Mean Total PAI	Range	Number
Shrub Cerrado	1.74	1.74	1
Wooded Cerrado	1.90	1.90	1
Cerrado Grassland	2.12	2.12	1

Pasture	2.54	0.89-3.76	7
Cerrado Woodland	3.29	2.17-5.25	3
Gallery Forest	6.68	5.41-7.43	7

Table 6. Summary of Understory and Overstory PAI values by landcover type.

Landcover	Understory PAI	Overstory PAI
Wooded Cerrado	1.79	0.57
Cerrado Grassland	2.12	0.00
Pasture	2.52	0.02
Cerrado Woodland	2.50	0.79
Gallery Forest	1.17	5.49

It was expected that LAI of individual shrubs and trees would increase with the diameter of the crown, however this was not the case ($R = -0.199$, $P > 0.05$). PAI values for 19 of the plants were between 0.5 and 1.5. The shrub that had a PAI of >2.5 was a palm with a dense cluster of dead fronds surrounding the trunk.