

BIOMASS AND FLORISTICS OF SAYAP-KINABALU PARK, SABAH

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The biomass and floristic composition of forest in Sayap-Kinabalu area were measured. Five plots of 20x10m each were established. The mean diameter at breast height (DBH) was 14.9cm and the total above ground biomass of the forest was 497.8t/ha, consisting of 378.9t stem, 73.1t branches and twigs and 45.8t leaves. Most biomass on the site was accounted for by tree stem; leaf biomass was relatively low. Comparison is made, to the estimates for Cameron Highlands and Liwagui river basin, Sabah

INTRODUCTION

The tropical rainforest is said to be one the most diverse, complex and productive terrestrial ecosystem in the world. Generally, the forest is stratified by stands of trees of various height, sizes, with the shrubs and the herbs predominate in the ground level. The presence of woody lianes, epiphytes and parasites make the forest more complex in term of primary productivity. The forests of Gunung Kinabalu area are characterised by lower montane and montane forests. Studies by Smith (1980) showed that the tropical rainforests are about one and a half times more productive than the temperate forest and the mangrove swamp forests. Several studies are available for comparisons, such as Kira (1969), Lim and Tagat (1983) and Lim (1986, 1988).

In the tropical rainforest nutrient cycling is probably one of the most significant ecological processes. In order to quantify nutrient cycling and to estimate the rate of turn over, it is essential to obtain some estimate of the biomass of some components of the forest such as tree stands and litter layer. The nett rate of photosynthesis, the concentration of various nutrient in the tissue as well as the rate of organic degradation would give us some estimate of the primary productivity of a forest.

A major study on the total above ground biomass in a primary rainforest in Malaysia was undertaken by Kato *et al.* (1978) in Pasoh Forest Reserve, Negeri Sembilan. In that study the biomass was estimated to be 475t/ha, a value double that of the known quantity for temperate forest. For the submontane rainforest ecosystem in Cameron Highlands, Peninsular Malaysia, Kira(1969) stated that the biomass was about 288t/ha. In Sabah, the only estimate of biomass available was that of the Liwagu river basin area (Anon, 1989).

The present study is part of an effort to obtain some estimate of biomass in a submontane forest so that comparison can be made with other forest types in Malaysia

MATERIALS AND METHODS

Study Site

The study was conducted along the Sungai Lumutuk Kecil and Sungai Lumutuk Besar, Sayap-Kinabalu area at elevation of about 1000m in the foothills of the Kinabalu mountains (Fig. I.) The general area is underlain by sandstones and the plots were established on the narrow ridge along the river. On one side of the ridge is the river (Sungai Lumutuk Besar) and the other side is undulating valleys. The vegetation was of the lower montane type with the ground area dominated by ferns, bryophytes, lichens and other herbaceous elements.

Methods

An area on 1000sq.m. which consists of five plots of 20m by 10m each were established at random and all trees measuring 5cm DBH or more were measured. The total biomass was calculated using the following simple equation which was developed by Crow (1978) and modified by Ahmad Judin (1981).

$$\log (\text{biomass}) = 2.1517 + 2.4423 \log (\text{DBH})$$

The estimate for biomass was given in gm/ha and for the purpose of this presentation was converted to kg/ha. Negi et al. (1988) provided a more extensive methods of estimating the biomass.

RESULTS AND DISCUSSION

Tree Biomass

A total of 143 trees were enumerated in the five study plots of 20x10m each, giving an overall density of about 1400 trees per ha. The DBH of the trees range from 5.1 cm for *Antidesma neurocarpum* (Euphorbiaceae) to 109.5 cm for *Koompassia excelsa* (Leguminosae) with the mean of 149 cm. Generally, it can be concluded that most of the trees in the study area are small, 83.2% are less than 24cm in DBH (Table 1). The above ground biomass ranges from 86.6cu.m. to 106.6cu.m. per plot giving a total of 497.8t/ha.

Table 1
Characteristics of trees in the surveyed area

Total number of trees	143
Size classes (DBH in cm)	
<14	101
15-24	18
25-34	12
35-44	4
45-54	4
55-64	2
65-74	0
75-84	1
85-94	0
>95	1
<i>Diameter at breast height</i>	
Mean	14.9
Minimum	5.1
Maximum	109.5

Table 2
Biomass of trees with DBH >5cm in the sampling plots (kg/ha).
Size of each plot is 0.1 ha.

Plot/item	Bole (76.1%)	Branches and Twigs (14.7%)	Leaves (9.2%)	Total
1	77.70	15.01	9.39	102.10
2	81.15	15.67	9.81	106.63
3	65.13	12.58	7.87	85.89
4	74.02	14.30	8.95	97.27
5	80.86	15.62	9.78	106.25
Total	378.86	73.18	45.80	497.84

Floristic

A brief discussion of each plot with respect to its floristic composition is given below.

Plot 1

The area is dominated by ground flora and the ferns are the most dense and conspicuous plants. Among the ferns present include *Colysis heterophylla*, *Diplazium speciosa*, *D.cordifolium*, *Pteris* sp, *Asplenium phyllitidis*, *A.tenerum*, *Mesophlebion* sp, *Davalloides burbigeei*, *Pleocnemia irregularis*, *Humata repens* and *Trichomanes maxima*.

There are 29 trees in the plots, the smallest was 5.2cm and the biggest was 57.6cm. With the mean of 13.8cm. It is obvious that more than 72% of the trees are less than 15cm DBH (Table 2). Among the flowering plants observed in the plot included *Aneilema* sp., *Tetrastigma glabratum*, *Diospyros* and *Litsea*.

Plot 2

The flowering plants are represented by many angiosperms which include species of *Litsea*, *Diospyros*, *Zingiber*, *Anisophyllea*, *Cinnamomun*, *Allomorphophallus*, *Ardisia*, *Dioscorea*, *Tetrastigma leucostaphylum*, *Sonerila*, and *Bauhinia*. There are 30 trees in this plot, the smallest was 5.1cm and the biggest was 41.7cm, and the mean was 13.1cm. Like in plot 1 the trees in this plot are also comparatively small (Table 2).

Among the dominant ferns and fern-allies observed include *Diplazium tomentosum*, *D.cordifolium*, *Cephalomanes javanica*, *Pteris* sp., *Mesophlebion* sp, *Antrophyum callifolium*, *Asplenium tenerum*, *Colysis heterophylla*, and *Selaginella* sp.

Plot 3

Among the flowering plants present in this plot include species of *Artocarpus*, *Dendrobium*, *Goniothalamus*, *Bauhinia*, *Pipei*, *Zizyphus*, *Begonia*, *Costus*, *Pinanga*, *Anisophyllea*, *Dracaena*, *Alpinia*, *Calamus*, and *Lasianthus*. There are only 24 trees in the plot, the smallest was 5.2cm and the biggest was 57.7cm giving the mean of 16.0cm. In this plot, however, there are about 21% of the trees having DBH more than 30cm (Table 2). Among the ferns species observed in this plot are *Loxogramme avenia*, *Asplenium phyllitis*, *Asplenium* sp., *Diplazium cordifolium*, *Mesophlebion*, *Colysis triloba* and *Pteris*.

Plot 4

The ferns and fern allies observed in this plot are *Asplenium phyllitidis*, *Diplazium cordifolium*, *D. tomentosum*, *Colysis heterophylla*, *Mesophlebion* sp., and *Selaginella*.

Among the flowering plants observed in this plot include *Polyalthia insignis*, *Dacryoides*, *Eugenia*, *Zingibe*, *Aglaonema*, *Pinanga*, *Ampelocissus ochracea*, *Bauhinia*, *Goniothalamus*, *Piper* spp, *Ardisia* and *Tetrastigma leucostaphylum*. There are 28 trees in the plot, the smallest was 5.5cm, the biggest was 49.0cm and the mean was 13.19cm (Table 3).

Plot 5

In this plot the flowering plants were represented by *Calamus*, *Ficus* spp, *Zizyphus*, *Begonia*, *Ardisia*, *Alpinia*, *Polyalthia insignis*, and *Tetrastigma leucostaphylum*. There are 32 trees in the plot; the smallest was 5.1cm, the biggest was 109.5cm and the mean was 18.1cm. Among the largest and most conspicuous trees present in this plot are *Polyalthia insignis* (Annonaceae). The purplish large flowers are borne near the trunk base. The largest tree, *Koompassia excelsa* (Leguminosae-Menggaris) found in the surveyed area is in this plot.

The ground ferns are represented by *Colysis heterophylla*, *Asplenium* sp., *A.tenerum*, *A.Phyllitidis*, *Mesophlebion* sp, *Diplazium ccordifolium*, *Davalloides* and *Araiostegia hymenophylloides*.

Table 3
Class size of trees in the surveyed area

Class Size/Plot (DBH in cm)	1	2	3	4	5
	Number of Trees				
< 14	21	21	17	20	22
15-24	5	5	2	5	1
25-34	1	2	1	2	7
35-44	1	2	3	0	0
45-54	0	0	0	1	0
> 55	1	0	1	0	2
Total	29	30	24	28	32

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APPENDIX 1

Diameter at breast height of individual trees in the plots.

Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
10.9	2.4712	22.4	4.2335	7.5	3.0747	14.8	3.7056	14.6	3.7956
8.3	3.1822	8.5	3.2076	9.9	3.3691	32.0	4.6135	27.6	2.6862
7.7	3.1026	7.5	2.3873	7.6	3.0887	8.0	3.1429	15.8	3.0293
26.1	4.3974	5.5	2.7457	30.0	4.5451	7.0	3.0015	27.8	4.4643
13.4	3.6901	21.4	4.1868	6.9	2.9862	13.2	3.6743	6.2	2.8728
16.7	3.9238	7.6	3.0887	35.4	4.7206	5.5	2.7457	8.1	3.1563
7.2	3.0314	25.2	4.3601	7.5	3.0747	15.7	3.8583	5.7	2.7836
8.0	3.1424	8.0	3.1424	11.2	3.500	26.3	4.4055	8.2	3.1693
9.7	3.3476	7.7	3.1026	7.1	3.0165	10.0	3.3798	6.2	2.8928
8.5	3.2076	18.7	4.0437	41.3	4.8841	19.8	4.1044	25.0	4.3517
13.7	3.7138	6.8	2.9707	10.0	3.3798	5.5	2.7457	5.1	1.1058
10.9	3.4712	41.7	4.8944	16.0	3.8783	5.8	2.8020	6.8	2.9707
17.0	3.9426	8.2	3.1693	11.0	3.5809	49.0	5.0655	11.6	3.5372
9.8	3.3584	32.9	4.6430	15.0	3.8099	13.2	3.6743	5.5	2.7457
17.9	3.9973	6.4	2.9064	5.2	2.6862	6.4	2.9064	14.3	3.7592
11.6	3.5372	7.8	3.1163	57.7	5.2388	7.3	3.0460	9.7	3.3476
9.7	3.3476	7.1	3.0165	11.7	3.5463	15.9	3.8717	25.4	4.3685
5.6	2.748	10.2	3.4008	7.6	3.0887	8.4	3.1949	7.2	3.0314
8.3	3.1822	6.7	2.9550	7.6	3.0887	8.0	3.1429	5.9	2.8202
18.5	4.0323	6.5	2.9229	10.1	3.3901	9.3	3.028	8.7	3.2321
18.5	4.0323	8.2	3.1693	6.3	2.8897	7.8	3.1163	27.5	4.4527
57.6	5.2370	7.3	3.0460	39.5	4.8369	7.5	3.0747	10.0	3.3798
9.1	3.2748	37.1	4.7761	12.9	3.6499	10.4	4.0827	5.4	2.7262
7.3	3.0460	21.0	4.1668	9.6	3.3650	6.9	2.9862	8.2	3.1691
5.2	2.6862	6.4	2.9064			11.2	3.5000	80.5	5.5920
7.6	3.0887	5.5	2.7457			5.6	2.7648	11.3	3.5094
41.3	4.8841	7.1	3.00165			8.1	3.1563	109.5	5.984
10.1	3.33903	5.1	1.1058			21.8	4.2064	26.3	4.4055
5.2	2.6862	18.8	4.0494					8.3	3.1822
		8.2	3.1693					6.5	2.9229
								5.8	2.8020
Total	102.10	106.63		86.59		97.27		106.25	
Mean	13.84	13.04		13.19		16.03		18.08	