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Floristic composition of a logged-over lowland dipterocarp forest in Southern Leyte, Philippines

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ABSTRACT— A comprehensive assessment to determine species composition of a logged-over dipterocarp forest in Kahupian, Sogod, Southern Leyte was conducted as contribution in documenting vegetation in remaining dipterocarp forest patches of the Philippines. The species composition was described by way of [1] methodology. The study had three sampling sites. Ten plots per sites were taken, at plot size of 20m x 20m and total area of sampled stands of 1.2ha. A total of 154 species, in 60 families and 104 genera, were recorded in the inventory. Of these, 131 are tree species and 23 are non-tree. The 131 tree species belong to 44 families and 84 genera. The 23 non-tree species were in 17 families and 22 genera. The highly represented tree families were the Dipterocarpaceae, with 13 species. Tanguile (*Shorea polysperma*), mayapis (*Shorea palosapis*) and white lauan (*Shorea contorta*) were the most frequently dominating and widespread within the site. The Jaccard similarity index in comparing the 3 sampling sites was 0.39 to 0.44, which indicated less than half of the species occurred commonly in any two sites. This suggests high variation in species composition from site to site and that intensive and extensive data collection is needed before a final assessment on floral diversity in Southern Leyte should be attempted.

KEYWORDS: Braun-Blanquet Methodology, Site and Vegetation, Species Inventory

1. INTRODUCTION

Inventory of species and their abundance status in remaining forest patches is essential in monitoring for conservation so that resources are managed and given priority for protection and greatest conservation [9]. In the Philippines, much of the natural forests had been transformed into secondary forest. Secondary forest includes logged-over areas undergoing natural regeneration, logged-over areas experiencing different levels of continued pressure towards vegetative degradation and former cultivated open lands reverting back to varied ages of woody vegetation through ecological succession. Secondary forest is now the dominant form of vegetation in the country and the focus in forest resource conservation and development. Currently, government figures on forest lands are based on broad categories, such as old-growth, secondary forest, plantation forest and grassland [3]. This can be due to lack of established procedure to differentiate vegetation types in secondary forest. Vegetation types can be characterized and differentiated based on physiognomic structure and species composition, a practice that is widely applied in forest development planning in many European countries [4]. Species composition in secondary forests vary from area to area and also within an area. Physiognomy and floristics (species composition) are among the basic parameters in vegetation classification [8] and vegetation ecology [5]. At broader scale, it is sufficient to classify forests based on dominant large species. At lower level of classification, physiognomy and floristics are used in differentiation and classification vegetation units into vegetation types. Boundaries of vegetation types can be delineated on the ground and can be mapped. Maps that use vegetation types as mapping units are useful tool in planning. It is in this premise that this study was conceptualized, which generation of data to eventually classify local secondary forests into vegetation types. In the process, this type of study can also

contribute to literature on species distribution and level of diversity in forests at different parts of the country. Hence, this study was conducted to determine species composition of sample forest stands in Kahupian, Sogod, Southern Leyte, Philippines

2. Material and Methods

The sampling procedure was purposive in approach by following the [1] methodology. Field work started with reconnaissance survey within the target forest to select sample points, or stands, that show representative characteristics of vegetation in the area. The study has selected the sample stands with the intent of showing the general character as well as the observed range of variation in species composition within sampling sites. The study had three sampling sites. The sampling sites were located least 1.5 km away from each other. Ten plots were taken from each sampling site. Within sampling site, plots were scattered to at least 50 meters from each other. Plots were also assigned to represent stands in ridges, upper slopes, mid-slopes and foot-slopes. At plot size was 20mx20m, the total area of sampled stands was 1.2ha. In each plot, basic information such as plot number, location, date, slope within plot, physiography or position in the slope, percent surface rock cover, soil type canopy height, overall percent canopy plot cover, percent canopy cover at three strata (tree layer, understory and ground layer) and presence of recent disturbance to forest stand were recorded. These records are 'plot data,' which were also intended to be used in describing sites in the study area.

Data on species composition, referred to here as 'vegetation data' in contrast to 'plot data' already discussed above, started with the listing of species in three vegetative strata. These strata were tree layer, understory and ground layer. Plants with leaf canopy height reaching over 7m were listed in tree layer; those in height of 2-7m as understory; and those plants below 2m were listed as species at ground layer. Listing of species starts with the tree layer, followed by listing for the understory and then ground layer. The recording of plot cover dominance of species was based on the scale established by [1], which is shown in Table 1. The process of recording dominance involves putting the scale code before the name of species in the species list in tree layer and the same was done species list in the understory and ground layer. Two copies of herbarium specimen were collected from unidentified species. Herbarium collection was done during the reconnaissance survey and also during collection of data in plots. One copy stays as personal collection while the other one was used for identification. Identification books such as of [10], [2] were used and the assistance for the identification of unknown species was sought from experts.

Table 1. Cover dominance scale established by [1]

SCALE	PLOT COVER DOMINANCE
5	75 – 100 % plot cover
4	50 – 75 % plot cover
3	25 – 50 % plot cover
2A	15 – 25 % plot cover
2B	5 – 15 % plot cover
2M	< 5 % plot cover, over 50 individuals
1	< 5 % plot cover, 6 – 50 individuals
+	< 5 % plot cover, 3 – 5 individuals
R	< 5 % plot cover, 1 - 2 individuals

Data on site factors were used to assess suitability of site conditions to growth of forest in the area. Species composition was determined based on the recorded tree species present in the established plots. The highly dominant tree species, in terms of plot cover dominance, were identified as potential 'character species' or 'ecological species group' for the logged-over forests in Southern Leyte. A vegetation table that show the

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cover dominance of species in plots, as well as the frequency of occurrence of species in the plots, was prepared using Excel and printed in Word. The main feature of the vegetation table is having the list of species at left-hand side and opposite each species are their dominance indicated by putting their dominance scale in all the 30 plots. Each plot is represented by one column, so that by simple visual inspection it would be easy to see the plots where each species occurred and at what cover dominance scale. The vegetation table allowed the identification of species that showed high level of constancy of occurrence and at what canopy cover scale. It also allowed assessment of range of distribution in three sites, with some recorded as widespread by being present in all three sites and others that were present in only one or two sites.

Jaccard index was used to compare the level of similarity in species composition in three sampling sites, with the formula:

$$J = c/(a + b - c)$$

where: J = Jaccard index
a = number of species in site 1
b = number of species in site 2
c = number of species present in both sites 1 and 2

While many appreciate the use of diversity indices, such as the Shannon-Weiner, it cannot be applied here in the absence of individual counts on species. Nevertheless, considering the high diversity in tropical forests, data in 30 plots is still a too miniscule representation to serve in the assessment of total diversity in the study area.

3. Results and Discussion

The vegetation table showing the occurrence of species in plots of the three sampling sites and cover dominance where they occurred are presented in Table 2. A total of 154 species, in 60 families and 104 genera, were recorded in the study. Of these, 131 species are trees and 23 non-tree. The 131-tree species belong to 44 families and 84 genera. In trees, 21 species are categorized as large, 8 medium to large, 28 medium, 15 small to medium and 59 small based on [10], duly indicated in Table 9. The highly represented families of trees were the Dipterocarpaceae with 13 species, Meliaceae 9, Myrtaceae 9, Clusiaceae 8, Lauraceae 8, Moraceae 7, Myristicaceae 5, Rubiaceae 5, Anacardiaceae 4, Annonaceae 4, Burseraceae 4, Phyllanthaceae 4, Sapotaceae 4, Apocynaceae 3, Cornaceae 3, Euphorbiaceae 3, Fagaceae 3, Rutaceae 3, and Sapindaceae 3 species. The 23 non-tree species were in 17 families and 22 genera.

Species considered widely distributed by having high frequency in plots of the three sites at high frequency and had plot cover of at least 25% (scale of 3, 4 and 5) were *Shorea palosapis*, *Shorea polysperma*, *Shorea contorta*, *Calophyllum blancoi*, *Sterculia rubiginosa*, *Canarium luzonicum*, *Lithocarpus llanosii*, *Diospyros* sp., *Strombosia philippinensis*, *Syzygium brevistylum*, *Guioa koelreuteria*, *Garcinia binucao*, *Lithocarpus* sp. (Ulayan Pula), *Syzygium subcaudatum*, *Hopea philippinensis*, *Shorea negrosensis*, *Buchanania arborescens*, *Alangium longiflorum*, *Neolitsea vidalii*, *Syzygium oblongifolia*, *Syzygium longiflorum*, *Ormosia calavensis*, *Dillenia philippinensis*, and *Garcinia rubra*. Among the dipterocarps, *S. palosapis*, *S. polysperma*, and *S. contorta* were consistently high in frequency and cover dominance. These three species can be considered as the character species of forest in the study area. 'Character species' are those that show high cover dominance, high frequency and widespread distribution within the forest patch. Moreover, *S. palosapis, S. polysperma, and S. contorta*. Shorea species have the potential to qualify as characteristic

species in logged-over forest of Southern Leyte. Procedure-wise, analysis for the identification of 'character species with finality would still require data from varied vegetation types under different site condition in different locations.

The other species that more or less always also occur where these character species occur can be considered as 'companion species.' Companion species are associated to character species by being always together or occurring in common sites, though companion species have comparatively less in frequency and cover dominance as compared to the character species. Species that showed medium to high frequency and high cover dominance and identified as having potential to be considered companion species, with Shorea as character species, included *L. llanosii, Lithocarpus sp., H. philippinensis, S. negrosensis, C. blancoi, S. rubiginosa, C. luzonicum, Diospyrus sp., S. philippinensis, S. brevistylum, G. koelreuteria, G. binucao, S. subcaudatum, B. arborescens* and *A. longiflorum.*

Some tree species was recorded in specific site only and with low canopy cover of less than 10%: In site 1, *Dehaasia cairocan*, *Shorea assamica, Osmoxylon trilobatum, Anaxogorea luzonensis, Antidesma montanum, Artocarpus ovatus, Myrica sp., Osmelia philippina, Planchonella nitida, Radermachera pinnata,* and *Reinwardtiodendron humile*; in site 2, *Canarium gracile* and *Drypetes littoralis* were the only recorded species; and in site 3, *Litsea glutinosa, Buchanania nitida, Albizia butarek, Knema mindanensis, Hopea malibato, Ficus pubinervis,* and *Dipterocarpus grandiflorus* were recorded. Among the tree species showing confinement to certain sampling sites, only the two of the dipterocarp species, *Shorea assamica* and *Dipterocarpus grandiflorus*, were included. Species showing confined distribution are 'potential differentiating species.' These are the group of species that could bear the difference in species composition of one site as compared to other sites. When occurrence of certain differentiating species can be established as associated to a certain site factor, than such differentiating species can be used as a good site indicator for variation within a forest patch. In comparison, widespread species that occurred in almost all plots or site, such as the character species, can have differentiating power when comparing forests from region to region.

Table 2. Vegetation table showing range of occurrence of species, across 3 sites. Percent canopy cover dominance scale used: 5=75-100%, 4=50-75%, 3 = 25-50%, 2A=15-25%, 2B=5-15%, 2M=< 5 % plot cover, over 50 individuals, 1=< 5 % plot cover, 6 – 50 individuals, +=< 5 % plot cover, 3 – 5 individuals, R=< 5 % plot cover, 1 - 2 individuals. Species grouped in box shares the same frequency and extent cover in the sites. Tree species category / lifeform based on [10]: lt = large trees, mt= medium trees, st = small trees.

Plot No			0000000001 1234567890	1111111112 1234567890	2222222223 1234567890
Site No.			1111111111	22222222222	33333333333
TREE SPECIES					
a. Widespread species occurring in all 3 sites and with plot cover of at least 5% (Cov- er scale of A, B, 3, 4 & 5.)					
	freq	lifeform			
Shorea palosapis	20	lt	3A55B.3.A.	555AA33A3.	3.4A..3...
Shorea polysperma	23	lt	3B3AB1BA..	3BA3.A3BBB	B1MMB.A...
Shorea contorta	9	lt	..M. 34.B	.33..3...A	.....B
Calophyllum blancoi	21	st	1.M1.B..B3	B11ABB111R	BABB..1...
Sterculia rubiginosa	19	st	+MA..BBB.B	111.B111.B	BB.1..B...
Canarium luzonicum	18	lt	+111..+B+.	R++..++++.	1B1+.....
Lithocarpus llanosii	17	st-mt	R1RR.....	+++1....1.	R11+RBB1..
Diospyros sp.	14	st	BBA1.3R.+.	.11..1.+..	B.BB.....
Strombosia philippinensis	14	mt	.....BR.R.	.++.B+RR..	.R+.1+...1
Syzygium brevistylum	14	mt	R.1..A...1	.++..+11..	.1+M.1...+
Guioa koelreuteria	13	st	11M1.11...	...R.....	+.+.B.1BB.
Garcinia binucao	6	st	....R.....A	.1B..B....	....1.....
Lithocarpus sp. (U.Pula)	6	st-mt	.....R.	..+..+BR..	A.....

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Syzygium subcaudatum	11	st	.+.+.....	B.BB.B....	.B..+.BBB.
Hopea philippinensis	9	st	..R...1...	.....R	.BAB1...AR
Shorea negrosensis	10	lt	....1.....	.B.+.....BB	..1..A1.11
Buchanania arborescens	10	mt-lt	..1.....	B11R.1R...	1...1R....
Alangium longiflorum	11	mt	.....+	....RRR..R	...RRRRB.B
Neolitsea vidalii	4	st	..M.....	...B.....	+B.....
Syzygium oblongifolia	6	mt	11.1...R..	.....+.	B.....
Syzygium longiflorum	8	mt	1+M1..1.1.	.....+	..M.....
Ormosia calavensis	8	mt	.11.R1....	R.....	..11.....1
Dillenia philippinensis	8	mt	+1B.....+.	B.....+.	B.B.....
Garcinia rubra	5	st	.....B.1..	.....1.	.....1..B.

b. Species present in all sites but low in frequency and plot cover.

Podocarpus rumphiana	11	mt-lt	R.+R.1R...	....R...R.	.R.+.RR...
Tabernaemontana pandacaqui	10	st	R.1.11.1+.	....+....1	11.....
Siphonodon celastrineus	7	mt	.....R....	....RRR...	.1...R.R..
Astronia cadolleana	7	mt	+....1....	..1..111..	+.....
Cryptocaria sp.	3	mt	..R.....	.....R	.....R....
Canarium asperum	8	lt	+...1.R...	..+..+RR..	..1.....
Tabernaemontana globosa	8	st	1.1.....+.	1..RR.....	.+. .....R.
Gomphandra luzoniensis	6	st-mt	...1+..1..	.....R.	....1...+.
Helicia robusta	5	st	R.1.....	1...R.....	.....M..
Glochidion album	5	st	R1.....	M.....	...1.R....
Myristica philippinensis	4	st	....1.....	.....11..	...1.....
Cordia dichotoma	3	st	..1.....	...R.....	.+.....
Aphanamixis polystachya	6	mt-lt	....R.....	.....RRR..	.R.....R.

c. Species with confined occurrences, in just one or two of the 3 sites.

Shorea almon	*10*	lt	BB1A. 1	.....	43AA.3....
Parashorea malaanonan	*9*	lt	4A31A...AA	.....	.....1A
Shorea astylosa	*6*	lt	..R.....	.....	.BBB..1.1.
Litsea philippinensis	*10*	mt	+.1+.....+	.....	+1..1RR.1.
Cinamumum mercadoi	*8*	mt	.R...+1...	.....	+11+1.....
Lithocarpus sp. (U.puti)	*5*	st-mt	....+...R1	.....	.B.1.....
Pometia pinnata	*5*	lt	..+.+1..R.	.....	...1.....
Chisocheton cumingianus	*4*	lt	1. .....R..	.....	+R.....
Artocarpus blancoi	*2*	lt	R.....	.....	.R.....
Vitex quinata	*6*	mt	.R.1..... +	.....	M. .....11.
Goniothalamus elmeri	*2*	st	....R.....	.....	.....R..
Calophyllum sp. (sibat)	*2*	st	.+....R...	.....	.....1..
Chisocheton cauliflorus	*2*	st	..+.....	.....	.....R.
Hopea acuminata	*3*	mt	..1...R...	.....	.....R.
Brackenridgea palustris	*2*	st	.....R..	.....	.....R...
Ficus linearfolia	*6*	st	.....R....	.11..R11..	.....
Mangifera altissima	*4*	mt-lt	.....+1R.	...R.....	.....
Calophyllum sp. (laparan)	*6*	st	.1M..+..+.	.....1+...	.....
Litsea cf. megacarpa	*2*	st	....R.....	.....R.	.....
Dimocarpus fumatus	*3*	st	1R.....	1.....	.....
Aglaia sp.	*2*	st	.....R....	.+.....	.....
Carallia brachiata	*12*	lt	.....	.MBR.11..R	.1M..+.RR1
Alangium sp.	*2*	st	.....	.+.R.RRR.R	.....1R.R
Astronia cumingiana	*7*	st	.....	.11..111..	..BR.....
Palaquium luzoniense	*6*	lt	.....	...+B.....	.+...B.1.M
Derris sp.	*7*	vine	.....	.....1M	.....1M111
Ixora sp.	*3*	shrub	.....	.....R	....R. ..... R
Neonauclea formicaria	*3*	st	.....	.....+.	1.R.....
Canthium dicocum	*3*	st	.....	.....RR...	.....R..
Calophyllum sp. (liitan)	*2*	st	.....	1	....R.....
Dehaasia cairocan	*5*	mt	...+B3.BB.	.....	.....
Shorea assamica	*7*	lt	1+1.+.R1.R	.....	.....
Osmoxylon trilobatum	*4*	st	...R1+.+..	.....	.....
Anaxogorea luzonensis	*3*	st	.....+R+..	.....	.....
Antidesma montanum	*3*	st	...+R..... R	.....	.....
Artocarpus ovatus	*3*	lt	+. .....+R.	.....	.....
Myrica sp.	*2*	st	....R...R.	.....	.....
Osmelia philippina	*2*	st	....R..... R	.....	.....
Planchonella nitida	*2*	lt	..1+.....	.....	.....
Radermachera pinnata	*2*	st-mt	....R+....	.....	.....
Reinwardtiodendron humile	*2*	st-mt	..+. ..... R	.....	.....

Canarium gracile	*2*	mt-lt	.....	...RR.....	.....
Drypetes littoralis	*3*	st	.....	1....RR...	.....
Litsea glutinosa	*4*	st	.....	.....	.BM1+...+.
Buchanania nitida	*3*	st-mt	.....	.....	.1+. .....R.
Albizia butarek	*2*	st-mt	.....	.....	..+.1.....
Knema mindanensis	*4*	st	.....	.....	.1+1.R....
Hopea malibato	*3*	mt	.....	.....	..B.1.1...
Ficus pubinervis	*2*	st-mt	.....	.....	.....R.R.
Dipterocarpus grandiflorus	*3*	lt	.....	.....	.....BRR
d. *Non-Tree Species*					
Heterosphate elata scheff.	25	palm	RB1+1.++++	+RR+.RR++.	1.1.++++++
Calamus sp.	19	palm	+11+1..111	....+11.M1	111111
Pandanus sp.	14	shrub	1BB.1..111	11111	1.B.....
Cyrtandra oblongata	11	herb	..+.111...	A. 11.1	1+...1....
Amphineuron terminans	12	fern	....1.1R..	...111.1..	....1.1111
Angiopteris palmiformis	10	fern	1..1.11..1	+.....	1111
Phrynium interruptum	10	herb	+M.....	M.....11..	11111
Leea aculeata	5	shrub	.1..1.1.++	.....	.....
Oleandra maquilingensis	2	fern	1.....	.....	..B.....
Alocasia sp.	4	herb	.....	...11...1.	.....1....
Dinochloa pubiramea Gamble	5	grass	.....	.....	11111
Phaleria capitata	2	shrub	.....	.....	.....R.1.

The Jaccard similarity indices on species composition in 3 sites are shown in Table 3. The Jaccard index values ranged from 0.39 – 0.44. This means that less than half of species in any two of the sampling sites was common or occurring in both of the two sites being compared. This implies that only 39% to 44% of species in any two sites will be preserved if one site is lost through destruction. Low similarity or high degree of dissimilarity in species composition among sites suggests the importance of preserving stands in all sites to avoid high loss in species. High degree of dissimilarity also suggests that high number of species remains to be discovered and listed through intensive and extensive inventories. This also indicated it is still premature to use the data in this study for the appraisal of diversity level in the area.

Table 3. Jaccard similarity indices among sites. Figures above diagonal are Jaccard indices; below are ratios representing number of species present in both sites over total number of species in the two sites being compared.

SITES	A	B	C	Total no. of Species
A	-	0.39	0.43	100
B	50/128	-	0.44	78
C	59/136	53/120	-	95
Total no. of Species	100	78	95	273

4. Conclusion and Recommendation

Based on results, the following conclusions and recommendations are hereby presented.

1. Species composition of the forest in Kahupian, Sogod, Southern Leyte is a lowland dipterocarp forest, with 13 dipterocarp species recorded in the study. The Shorea species, particularly tanguile (*Shorea polysperma*), mayapis (*Shorea palosapis*) and white lauan (*Shorea contorta*) were the most widespread and frequent dominant big trees and identified as potential character species for the forest in the study area. Basically, the dominant components of the forest were mostly Shorea species.

2. The forest was still highly diverse in species, 154 species, in 60 families and 104 genera recorded in the study. Of the 131 tree species listed in 44 families and 84 genera, 21 species are large trees and 36 are medium to large trees. The most highly represented families were Dipterocarpaceae, Meliaceae, Myrtaceae, Clusiaceae, Lauraceae and Moraceae. The 23 non-tree species were in 17 families and 22 genera.
3. The high number of species that occurred in only one or two of the three sampling sites resulted to difference in species composition among sites. The Jaccard similarity index of 0.39 to 0.44 indicated that less than half the number of species was common to any two sites. This points to the need for more data from more plots and more sites before most species would be capture for recording in the species inventory. This also hinted that it is entirely premature for any attempt to assess level of species diversity in the area on the basis of the current amount of data generated in this study.
4. These findings point to one general recommendation, which is on the need for more intensive and more extensive data collection for the differentiation and, ultimately, classification of secondary forest into vegetation types.

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