Vegetation Survey and Habitat Assessment of the Tesso Nilo Forest Complex

Pekanbaru, Riau Province
Sumatra, Indonesia

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Executive summary

A critical lack of baseline data coupled with an apparent inability of the international community and national governments to control exploitation continues to be a serious impediment to conserving the world's remaining tropical forests. The island of Sumatra supports lowland forests that are among the world's richest sources of terrestrial biodiversity. Yet the current rate of land conversion suggests that virtually all remaining lowland forests in Sumatra will disappear by the year 2004. This will result in an irreparable and highly significant loss of biodiversity to the global community. In Central Sumatra, in consultation with the Indonesian Government and other stakeholders with an interest in these forests, WWF's Asian Rhino and Elephant Action Strategy (AREAS) project is currently exploring ways of achieving an equitable balance between conservation and exploitation. AREAS is developing a conservation landscape for the Sumatran Elephant that will result in protecting the192,000 ha Tesso Nilo Forest Complex in the province of Riau as a core area. The forest complex is central to global conservation issues as it constitutes one of the last remaining patches of lowland Sumatran forest. In order to provide necessary baseline data, a rapid appraisal of the Tesso Nilo (TN) reserve was conducted by WWF staff supported by the Center for Biodiversity Management (CBM) between the 28 October and 10 November 2001. This appraisal followed a training workshop in some of the latest rapid survey methods and an earlier faunal survey conducted by WWF in 1992. Existing information and data were used in conjunction with recent remotely sensed imagery to locate representative sites and to assist with subsequent habitat assessment and extrapolation for mapping and conservation planning. The high rate of current and ongoing rapid forest conversion by pulp mills, oil palm plantations and illegal logging added an urgency that meant that only a limited number of 'intensive' 40 x 5m plots could be used to record all vascular plant species, plant functional types (PFTs), vegetation structure and site physical variables. These were complemented by a greater number of plots in which vegetation structure and site physical variables alone were recorded. Statistical analyses in other areas of Sumatra confirmed certain vegetation structural attributes were highly correlated with species and PFT richness. This meant the 'structure' plots were potentially useful as indicators of biodiversity and as a basis for extrapolating habitat via remotely sensed imagery. To support this contention as well as to compare TN forests with other areas of lowland Sumatra, the TN data were analysed together with data from a previous multi-taxa survey in lowland Jambi Province of Central Sumatra. Despite considerable logistical problems due to poor access, 24 'structural' and 9 'intensive' sites (including an *Acacia* and a rubber plantation site) were recorded using a standard field method. The highest prior record of 114 species in Jambi, was exceeded by an extraordinary 218 species in one TN plot (more than 10% of the number of native plant species of the UK). In that plot 26 plant families, 48 genera and 66 species occurred in the first 5 x 5m quadrat of the 40 x 5m transect There are no published records available that indicate similar levels of plant species richness anywhere else in the world's lowland forests. Using the same recording method for plant-based biodiversity, the TN species richness is well above that of the richest sites so far recorded in tropical lowland forests between sea level and 550m elevation in 20 countries or island dependencies including Australia, Bolivia, Brazil and Peru (East and West Amazon basin), Cameroon (Congo Basin), Costa Rica, Fiji, Guyana, France (French Guyana and Martinique), Kenya, Indonesia (Borneo and Java), Malaysia, Mexico, Papua New Guinea, Panama, Philippines, Thailand, Vanuatu and Vietnam. A comparison of 7 TN forest sites with an equal number from Jambi revealed a total of 326 genera, with 159 genera shared and 244 and 243 from TN and Jambi respectively. Confirmation of identification at species level is ongoing at the time of writing but numbers are unlikely to change significantly. In TN forest plots, plant diversity corresponded generally with that of birds and mammals. The extraordinary richness of lowland Sumatran forests is, ironically, matched by the speed with which land conversion is taking place. The present report provides new and critical data and information that will support a strong national and international case for immediate conservation of one of the world's most valuable remaining biodiversity resources.

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1. Aims and objectives

The four primary objectives for this work were to:

1. **1.** Plan and implement a training workshop for Rapid Biodiversity Assessment to be conducted in Riau, Sumatra[1].
2. **2.** Prepare a survey design for the rapid assessment of the Tesso Nilo Forest Complex, Sumatra, Indonesia.
3. **3.** Identify forest areas with highest biodiversity values, past and present human impact, and sites with significant elephant feeding signs. Coordinate and implement an intensive habitat assessment of a representative range of forest types in the Tesso Nilo forest area.
4. **4.** Assist with the design of a wider-ranging, less intensive, complementary survey of the remaining forest reserve area.

2. Background

2.1 The Tesso Nilo Forest Complex (TN)

The forest complex of some 192,000 ha lies to the south and west of the city of Pekanbaru in the Province of Riau, Central Sumatra. TN West consists of about 37,000 ha of conversion forest leased by several companies to be converted to timber and rubber estates. That conversion has not yet happened. TN Central is about 120,000 ha of limited production forest leased by three companies for selective logging. TN East is about 35,000 ha of production forest leased by Inhutani for rehabilitation. WWF proposed TN Central to be declared a protected area in April 2001. The decision on this change of status by the Ministry of Forestry is still outstanding.

2.2 Climate

The eastern plains of Central Sumatra can be classed as superhumid with annual rainfall ranging from 2000- 3000 mm. Although rainfall is high overall, monthly mean averages can drop below 60mm with an annual average number of rainy days varying from 120-150. This seasonality can be further modified by extreme events such as El Niño droughts, where normally humid closed forest may become extensively defoliated and where trees may die. Episodic droughts of this kind facilitate forest removal by human-induced fire as has been the case in recent years and this contributes to extensive regional smoke hazes with significant health impacts on humans and other biota (Gillison, 2000a,b).

2.3 Geology and soils

Areas to the West and East of Pekanbaru have been classified by Verstappen (1973) as the Eastern peneplain and Eastern swamp lowlands respectively. The regional lithology is characterised by semi-decomposed organic matter derived from Quaternary tropical peats and kaolinitc sandstones, claystones and acid tuffs, with sediments arising from Quaternary sedimentary strata (Laumonier, 1997). Prior to the Quaternary the region was composed of early and mid-to-late Miocene sediments (de Coster, 1974). Under the USDA soil classification the regional soils are listed as mainly Tropohemists (now Haplohemists) and Paleudults (Atlas LRD,

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[1] Training Workshop on Vegetation Survey and Habitat Assessment, Pekanbaru, Sumatra, Indonesia, 22 – 26 October 2001. Submitted as a separate report.

ODA, Minister of transmigration, GOI (1990)). This classification is generally consistent with observations throughout most of the areas visited within the Tesso Nilo Forest Complex where conditions ranged from forests on deep swampy peats to dryland elevations from 25 –100m areas with peat or 'duff' layers of varying thickness overlying sands and sandy clays.

2.4 Phytogeography

In Sumatra six floristic sectors occur repeatedly, almost regardless of whatever classification methods are used. Sectors in the plains of Riau, Jambi, Palembang are quite distinct, as is the North-East coastal plain. Floristic affinities indicate close ecological relationships between Jambi and Riau when considered against surrounding units in Malesia (Malesian elements only), (Laumonier, 1997). According to Laumonier (1990, 1997) the flora of Sumatra and peninsular Malaysia exhibit many similarities. Earlier Corner (1978) proposed the existence of a "Riow pocket": a floristic region that corresponds to the former Sundaland. Laumonier (1997) also found evidence to suggest all sectors of the 'Riau pocket flora' are at the same floristic hierarchical level thus supporting the existence of this phytogeographic unit - " The boundaries of the 'Riau pocket' are not clear in Sumatra and Borneo; it is as if today one finds elements of this flora disseminated all over the eastern plain, with however, a higher concentration of species in the region of the Tigapuluh Mountains and Upper Indragiri at the borders of the provinces of Jambi and Riau". The massive regional impact of forest conversion on this unique phytogeographic unit provides another argument for urgent conservation. Despite inherently high species richness, levels of generic and specific endemism are surprisingly low in Sumatra compared with nearby peninsular Malaysia (Laumonier, 1997; (Ng, *et al.,* (1990) quoted by Laumonier (*l.c*.)). But this could be due to extinction of endemics or to a historical connection with continental Asia or, possibly to the low intensity of botanical collecting in Sumatra compared with peninsular Malaysia. Based on the geological and evolutionary diversity of the Sumatran flora one would expect higher endemism than is currently reported (*cf.* Laumonier, 1997).

3. Methods

3.1 Survey design

As with any natural resource assessment, survey design for biodiversity assessment should be tailored to purpose and operational scale. This usually differs from methods applied for example to commercial forestry surveys where the purpose may be to estimate merchantable volume of trees per hectare. Under such conditions random sampling is necessary to support a statistical design based on probability theory. Traditional methods of survey therefore require that plots be located according to a purely random or purely systematic (e.g. grid) design or some stratified modification of these. For biodiversity surveys such designs may not be necessary and can be shown to be counter-productive where information is required quickly and where the main purpose is usually to acquire information about the spatial and occasionally temporal distribution of biota (but not in terms of numbers per unit area). In natural resource surveys where the distribution of biota is mainly controlled by non-random environmental factors such as solar radiation, temperature, rainfall, soil type etc., random sampling is unsuitable from both a logistic and theoretical viewpoint. For these reasons a sample design based on the purposive selection of a series of hierarchically nested environmental gradients was developed by Gillison and Brewer (1985) as a more efficient approach for detecting meaningful taxonomic and ecological patterns within a landscape mosaic. By using a different statistical model to exploit the fact that the performance of biota is controlled by mostly non-random environmental factors, gradientoriented transects or ‘gradsects’ have been used to improve sample efficiency over the more traditional probability-based statistical models. The method has been trialed successfully by others for plants (Austin and Heyligers, 1989, 1991) and for fauna (Wessels *et al.*, 1998).

For biodiversity surveys to be meaningful, it is essential that range distributions of key taxa be considered. Truncated range distributions resulting from isolated samples of ‘wide’ taxa are likely to result in misinformed management and in ineffective models of species performance under varying environments. For example, the range of many so-called ‘forest-dwelling’ birds and ground animals frequently includes non-forest vegetation types. The use of gradsects within a landscape context and along a range of land use gradients therefore helps to improve sample efficiency of range distributions and may increase the likelihood of locating rarities (Gillison and Brewer, 1985). For the Tesso Nilo Forest Complex, available information was used to locate gradsects according to gradients of elevation, drainage and land cover via visual interpretation of remotely sensed land cover (Landsat, March 2001) and topographic map coverage at 1:50,000. These idealised gradsects were then modified according to logistic constraints (e.g. location and suspected condition of logging roads) and from subsequent ground-truthing in the field.

3.2 Plot location

Sample locations were determined beforehand in Pekanbaru and subsequently refined in the field, in particular taking into account the level of access via logging roads many of which had been abandoned some years earlier. In the Inhutani IV concession access was complicated by misinformation from local informants and by heavy road damage inflicted by illegal logging. Loss of time due to frequent bogging of four-wheel drive vehicles (Annex IV, Fig.1) reduced the number of sample plots and the extent of forest coverage. While road access in Central TN improved significantly in areas close to recent forest conversion for plantation, the team experienced difficulty in accessing forest at higher elevations. The location of plots in areas being actively logged also presented problems. In one location the team had almost completed measurements when a logging team arrived and commenced felling trees on the plot. The WWF team departed with what could only be described as historical data. In the second phase of the survey in the northern sector of Central TN access was much more restricted and vehicles suffered significant damage in attempting to access remote inland sites. Within a location, and following local reconnaissance, plots were intuitively positioned to represent as far as possible the existing forest type. In logged areas preference was given to locations where logging was minimal and, where time permitted, paired with plots where logging was maximal (including snig tracks and large canopy gaps).

3.3 Plot size

In all cases a standard plot size of 40 x 5m was applied. Experience in a wide variety of sampling conditions suggests this size is adequate for most purposes and provides an acceptable balance between logistic demands and the level of information needed. For biodiversity surveys a plot with these dimensions can be located to detect significant differences in animal habitat, especially for cryptic fauna. Fine scale habitat sensitivity is likely to remain undetected in larger (e.g. 1 or 10 ha plots). A number of studies indicate that for plant diversity, useful information can be recorded from plots as small as 50 x 2m (Parker and Bailey 1992, Parker and Carr 1992, Parker *et al.* 1993) and 40 x 5m. (Gillison *et al.* 1996). The advantage of ‘small and many’ *vs*. ‘few and large’ is that the former is likely to be more cost-effective when sampling variation in biodiversity at landscape level (*cf.* Keel *et al.* 1992). Variation of this kind demands cost-effective survey techniques (*cf.* Margules and Haila 1996). Additional rationale for the use of this plot size is included in Gillison (2000a,b).

3.4 Vegetation classification

Most vegetation classification and survey methods incorporate a combination of broad structural variables coupled with seasonality (as reflected by the level of deciduousness) and a list of dominant species - e.g. *'Very tall evergreen Dipterocarp forest'*. While this is useful for mainly geographic purposes it is rarely sufficiently diagnostic for management. In addition, structurally similar vegetation types are usually annotated by plant species that may differ between regions. Within a region, vegetation described according to vegetation structure may be adequate for describing animal habitat but vegetation types with similar structure in separate global ecoregions are not necessarily ecologically equivalent. For ecologically sensitive classifications additional, response-based attributes based on adaptive features or plant functional attributes (PFAs) provide added value. As PFAs are generic and largely independent of species they can be used to construct plant functional types (PFTs) as a means of describing a plant individual (Box 1). This can facilitate ecological comparisons between geographically remote areas where environments and adaptive features may be similar but where species differ. As PFTs are genetically determined they add a potentially useful complementary dimension to Linnean taxa.

Box 1

Plant Functional types

As described by Gillison and Carpenter (1997) Plant Functional Types or PFTs or functional *modi* are combinations of essentially adaptive morphological or functional attributes or for example, leaf size class, leaf inclination class, leaf form and type (distribution of chlorophyll tissue) coupled with a modified Raunkiaerean life form and type of above-ground rooting system. PFTs are derived according to a specific grammar or rule set from a minimum set of 35 functional attributes. An individual with <u>mi</u>crophyll-sized, vertically inclined, <u>do</u>rsiventral leaves supported by a <u>ph</u>anerophyte life form would be a PFT expressed as MI-VE-DO-PH. Although for an individual the PFTs tend to match species one-for-one, they are independent of species in that more than one species can occur in one PFT and more than one PFT in a species. PFTs allow the recording of genetically determined, adaptive responses of plant individuals that may reveal infraspecific as well as interspecific response to environment (e.g. a specific land use type) in a way that is not usually contained in a species name. They have a major advantage in that because they are generic they can be used to record and compare data sets derived from geographically remote regions where, for example, adaptive responses and environments may be similar but where species differ. The data are recorded along a 40x5m strip transect located along the contour.

A field proforma (modified from Gillison, 1988 and updated by Gillison and Carpenter, 1997) was used to record site physical features (georeference by GPS in degrees, minutes and seconds; slope percent (clinometer); elevation (m) (digital aneroid altimeter); aspect in degrees (compass); parent rock type; soil type; land use history; vegetation structure, (mean canopy height (m)), crown cover percent (total, woody plant, non-woody plant), basal area (m^2ha^{-1}); litter depth (cm); Domin scale cover-abundance estimates of wood plants <2m tall and Domin estimates of bryophytes; all vascular plant species and plant functional types (PFTs). The proforma layout matched that of a software program VegClass (Gillison, 2001a) used for data entry and metadata analysis (see 3.9 below).

A typical lowland forest complex rain forest plot usually takes about three hours using this recording method. Due to severe logistic limitations the team was unable to undertake any systematic soil collection. Photographic records were made of each plot. Four observers (ecologist, botanist and up to three assistants) collected plant voucher material to be identified and curated at the *Herbarium Bogoriense*. Preliminary identifications of species and associated PFTs are listed in Annex III, Tables 1-9.

3.5 'Intensive' and 'structural' plots

The urgency of the operation required that information gathering be maximised within the time available. To record a sufficient range of forest types using the complete proforma would have been beyond the capacity of the teams. Previous surveys in Jambi Province indicated that certain structural variables (e.g. mean canopy height, crown cover %, basal area) were highly correlated with certain biota, (in particular, plants species and PFTs) (Gillison, 2000a,b). For this reason it was considered that by combining a baseline set of 'intensive' plots (comprising site physical features, plant species and PFTs and vegetation structure) with a larger number of rapidly acquired 'structural' plots (site physical features and structure only), an indication of plant-based biodiversity pattern might be achieved for the TN forest complex using the more rapidly recordable structural attributes as correlative indicators. To this end, 9 intensive and 24 structural plots were recorded over ten days (Tables 1,2,3).

3.6 Comparison of Tesso Nilo plant-based biodiversity within and outside Sumatra

In order to provide both a regional and a global perspective for the TN forest complex, a comparative analysis of species and PFT richness was undertaken at both these levels. For the former, seven forest sites from TN were compared with seven others from the Pasir Mayang area of Jambi Province in similar lowland conditions in Central Sumatra (Table 4). Because final species identifications are not yet available at the time of writing, plant genera only are used for this analysis. Pattern analysis using the PATN software package (Belbin, 1992) was used to generate a classification dendrogram constructed using a polythetic agglomerative fusion strategy (UPGMA, Belbin, 1992) based on a Gower similarity association measure[2]. Indirect gradient analysis was performed using a semi-strong, hybrid, multi-dimensional scaling approach (SSH, Belbin, 1992) for which a two-vector solution was sought.

Global data sets that allow comparative assessment of species richness for the world's tropical lowland forests are remarkably sparse. This is because the methods used for data collection differ, being based, for example, on varying plot sizes (e.g. 200m^2 to 50 ha) or because in many cases trees rather than other life forms are the primary focus. For the present global comparison therefore, a list was compiled for a range of variable, tropical lowland forest types (from sea level to 550m elevation) for which data had been acquired using the same sampling protocol and plot size (40 x 5m). Species richness and PFT richness data were extracted from 27 plots from a total of 20 countries and some of their island dependencies. Where the data formed part of an ecoregional series of plots as in the ICRAF/ ASB sites or were part of a systematic survey undertaken for other purposes, only the richest plot was selected for comparison in each of these cases. These data are listed in Table 6.

[2] Gower, J., (1967). A comparison of some methods of cluster analysis. *Biometrics* **23**, 623-637.

3.7 Fauna

Faunal data in the vicinity of each 'intensive' plot were recorded by Mr Andjar Rafiastanto (WWF-BBS). Indications of local fauna were obtained via visual sightings, aural records, tracks and faeces, and signs of foraging. Particular attention was given to locating elephant signs.

3.8 Team structure and timing

The survey was conducted in two stages. The first stage (27 Oct to 2 Nov.) was coordinated by the consulting ecologist (AG) assisted by another ecologist, Mr Edi Permana, from the Agricultural University (IPB), Bogor and a field botanist (Mr Ismail Arief-Rachman) from the *Herbarium Bogoriense*. During this first stage, several WWF personnel who had attended the training workshop on survey methods also assisted (Annex IV Fig. 3). Three 4wd vehicles were used to convey the team that surveyed Inhutani IV, a section of TN Central and two forest plantations (*Acacia mangium* and Rubber). Due to other project demands this team returned to Pekanbaru and was replaced by a five-person team led by Edi Permana accompanied by Ismail Arief-Rachman and three WWF personnel. Despite considerable logistic difficulties this team completed the second stage of the survey (3-10 Nov.) focussing on remaining unsampled areas in TN Central and TN West.

3.9 Data storage and analysis

The data were compiled using a laptop computer and a recently developed software package VegClass (Gillison, 2001a; Gillison and Carpenter, unpublished). VegClass facilitates compilation according to the rule set developed by Gillison and Carpenter (1997) and also facilitates the summary analysis of meta-data as well as producing graphs of relationships between different plant and vegetation variables. Using VegClass, data recorded for each 5x5m quadrat within the 40 x 5m transect can be used to generate cumulative species and PFT totals per unit area and provides for subjective inspection of asymptotic curves that can indicate whether or not a plot represents an adequate sample of the vegetation or landscape unit. In addition to summarising site physical data, totals of species, PFTs and vegetation structural variables, VegClass can be used to generate a range of functional diversity indices for PFTs (Shannon-Wiener, Simpson and Fisher's alpha) (Gillison, 2001c; Gillison *et al.*, unpublished). As well as these a Plant Functional Complexity (PFC) index was generated by VegClass (Gillison *et al.*, unpublished) . The PFC value is estimated as the total length of a minimum spanning tree distance passing through all PFT combinations where 'distance' between PFTs is a function of an algorithm used to assign a value to any PFT according to a predefined rule set (Gillison and Carpenter, 1997; Gillison, 2000a). The PFC index provides a useful comparative measure of PFT variability, for example between two or more plots where PFT richness is the same but where composition differs.

4. Results

4.1 Plant biodiversity pattern in Tesso Nilo

Levels of plant species and PFT richness (number per unit area) recorded for the nine 'intensive' sites were unexpectedly high. In nine 40 x 5m plots with a total sample area of 1800 m^2 including two (much less rich) plantation plots, the teams recorded approximately 238 vascular plant families, 267 genera and in excess of 900 species (Annex III, Tables 1-9)[3]. Other summary information including taxonomic, plant functional and structural data are listed in Tables 4 and 5. Confirmed totals for all taxa are not yet available at the time of writing as further identification is proceeding at the *Herbarium Bogoriense.* However they are not expected to vary significantly from those listed in Annex III. Plot TN02 in the Inhutani IV sector contained an extraordinarily high 218 species and 73 PFTs. In the first 5 x 5m quadrat the team recorded 66 mostly woody, plant species and 35 PFTs. For this plot, in addition to species and PFTs, a plant functional complexity (PFC) index of 842 (Table 4) indicates unusually high variability in functional types that, compared with other global sites (Table 6), is exceeded only by another Sumatran forest plot in the foothills of the Bukit Barisan range (Gillison *et al.,* 1996).

With the exception of TN02, vegetation structure for the nine sites was within expected bounds. Exceptions to the norm were an unusually widespread, peat layer in many dryland sites. This so-called 'duff' or mor layer tends to be more commonly encountered in cooler, moister forests at elevations in excess of 1500m at this latitude. Coupled with this phenomenon was a relatively high incidence of Fagaceae (*Castanopsis, Lithocarpus*) that also tends to be more dominant at higher elevations. At plot TN02, the extraordinarily high number of species and PFTs was matched by dense, regenerating vegetation under canopy gaps (Annex IV Fig. 4). Another unusual feature at this site and others like it, was the conspicuous absence of abundant 'pioneer' species such as *Macaranga, Mallotus, Omalanthus, Trema* etc. that normally dominate within two to three years following logging or a severe canopy disturbance. While some of these genera did occur, they were swamped by other genera and species more typical of the mature forest canopy.

4.2 Comparison of Tesso Nilo and Jambi forest types

In accord with the study objectives, a comparative analysis was undertaken of an equal number of forested sites in Tesso Nilo and Jambi (Table 1). As with TN, the Jambi (BS) sites were recorded using the same sampling protocol. The results (Table 4) provide a quantitative means of assessing similarities and differences between the two areas. The Jambi data were part of a broader survey of 16 land use types that were used as a gradsect sample for an in-depth, multi-taxa assessment (Gillison, 2000a,b). Because identification of TN species is currently ongoing, plant genera only were used for comparison. The results of a classification of all 326 genera are displayed in Figures 3 and 4. The dendrogram (Fig. 3) indicates a predominantly three-level hierarchy consisting of a joint cluster of TN (TN01, 03) and BS (BS01,02,03,04,05) plots that indicates similarity between these forest types, a cluster of TN plots alone (TN02,04,07,08,09) that separate due to high levels of richness and two BS plots (10,11) that were managed 'jungle rubber' sites. The ordination (Fig. 4) on the other hand reflects a more general separation of TN and BS sites.

4.3 A global comparison of plant-biodiversity richness with respect to Tesso Nilo

When species and PFT richness are compared with data acquired using the same sampling technique in tropical lowland forests in other countries, TN is by far the richest area documented thus far. Table 6 lists comparative data from lowland forest between sea level and 550m in forest complexes in 20 countries and island dependencies (Fig. 4a). The elevational limit of 550m is

[3] All data are available in Excel format and as *.pfa files that can be readily accessed using VegClass software.

arbitrary, approximating a lower limit of ‘cloud layer’ in a number of countries. While data exist for forest types above this limit, the ‘lowland’ sector is designed to place the TN forest complex within this narrower zone to provide a more realistic ecological comparison. The standard plot size of 40 x 5 and the recording method provide a uniform basis for comparing forests within and between countries. Comparisons within data sets in which the data types and the sampling method are non-conformable do not offer a valid means of comparing sites either in terms of richness or composition.

4.4 Correlation between vegetation structure, plant species and plant functional types

As outlined in the foregoing, logistic constraints dictated a need for more rapidly observable surrogates for overall biodiversity than could be achieved via intensive counts of plant species and PFTs. This was reinforced during the survey when the teams encountered levels of species richness that required up to 5.5 hours continuous recording (compared with a more usual 2.5 –3 hours for complex lowland tropical forest). Previous studies in Jambi (Gillison, 2000a,b) showed some structural variables such as mean canopy height, crown cover % and basal area were in many cases highly correlated with certain animal and plant taxa. For this reason vegetation structural data were recorded for 24 TN sites and these are listed in Table 7. In accepting that structure might be a potentially useful biodiversity surrogate, it is necessary to establish an acceptable empirical and theoretical basis for such use in both TN and Jambi. Accordingly site data were pooled from both areas that included 9 intensively sampled TN plots and 16 land use types (forest and non-forest) from Jambi (Gillison, 2000a). The resulting correlates for eight most significant structural correlates with plant-based biodiversity are listed in Table 8. Of these canopy height was the most significant with an r-squared linear correlation coefficient of 71.8% for species richness and 71.0 % for PFTs as predicted by canopy height alone (Figs. 5,6). Multiple, step-wise regressions did not significantly improve this prediction.

The correlative model outlined above was used to estimate richness for species and PFTs for the 24 ‘structural’ plots. These preliminary estimates are listed in Table 7 but without confidence limits. This is presented as a cautious estimate at best given the limited data and the need for further investigation using combinations of other predictive variables, preferably with additional plot data.

4.5. Correlation between fauna and plant-based biodiversity in Tesso Nilo

While no systematic faunal surveys were possible in the time available, limited field observations were taken in the immediate vicinity of each of six intensively surveyed plots including plantations (Table 9, see Table 9a for an earlier faunal survey of Tesso Nilo). These observations, together with others made on road traverses suggest a close relationship exists between bird and mammalian fauna and plant species and PFT richness. Near TN02 we observed tracks of several large mammals (Elephant, Tapir (Annex IV Fig. 5) and wild Pig). The teams paid particular attention to any sign of Elephant activity. Elephant sign was most conspicuous in secondary growth areas and along plantation peripheries especially *Acacia mangium* plantations (locations 00° 10’ 39’’ S; 101° 59’ 08’’.1 E and 00°10’ 43.1” S; 102° 00’ 10.7 “E). Fresh faeces were observed around the latter on the northern fringes of Inhutani IV (Annex IV Fig. 6). Feeding sign was most conspicuous in mid-stage forest succession, especially on woody, fast-growing, pioneer species of Euphorbiaceae (*Macaranga, Mallotus* spp.) (Annex IV Fig. 7). There was only very limited evidence of within-forest activity in the sites visited. Nocturnal contact was made with Elephant along road systems in oil palm plantations to the south of Inhutani IV. These and other observations suggest that while Elephant may use forest as a refuge, most activity is focused along forest and plantation margins where easy-to-reach and presumably more palatable vegetation occurs.

5. Discussion

The relatively low number of plots recorded in the field and their positioning reflects both the logistic difficulties experienced by the field teams and the unexpectedly high level of species richness found throughout most locations in the TN area. As a result of these largely unforeseen factors the teams achieved only about half the intended number of samples. These difficulties notwithstanding, the general patterns of richness and structure generated by the analyses are supported by other non-systematic, field observations over a range of forest conditions traversed by vehicle and on foot both within and the periphery of the TN forest complex.

The ecological implications from extraordinarily high species and PFT richness recorded in several plots, especially plot TN02, present a challenge to understanding the ecosystem dynamics. The alpha- or within-plot diversity is of a level previously unrecorded for any tropical forest site using this sampling method. While the data in Table 6 do not represent all forest types in the world's tropical lowlands, the extraordinary differential in plant species richness between Sumatran sites overall and those recorded so far in all other countries suggests an outstanding level of plant-based biodiversity of the lowland forests in Sumatra. The question of what has generated this richness has no ready answer. It is generally accepted that intermediate levels of disturbance contribute to higher transient levels of biodiversity and while this may be the case in TN02 it does not satisfy the primary question. It can also be speculated that the long period of separation from continental Asia may have increased speciation. But if this is the case then one might expect a commensurate increase in endemism that is not evident so far in the Sumatran section of the 'Riau Pocket'. Clearly soil analyses are needed to help shed light on the nutrient dynamics in such an ecosystem. There are some rather unique or at least unusual substrates in TN; for example, TN02, a dryland site, has a fibrous, peaty 'mor' organic 'ectohumus' litter layer overlying a very sandy clay that is suggestive of a low nutrient podsol.

The number of basidiomycete fungi observed on the forest floor may also indicate that a rich soil or litter mycoflora could be controlling a relatively closed nutrient system with a strong dependency on mycorrhizal nutrient capture and transfer. Other forest types observed in the leached, siliceous sandy soils in the blackwater systems of the eastern Amazon basin exhibit some similarities with this vegetation type, but records so far suggest these do not support the same levels of plant species richness. If 'closed-cycle' nutrient systems of this kind are operating in TN02 and similar sites, then removal of the nutrient capital by excessive logging cab be expected to progressively degrade the forest ecosystem. This speculation may not be supported by the currently rich store of regenerating species in the canopy gaps. But it may well be that continuing removal of vegetation through logging and land conversion could create an ecological threshold beyond which a nutrient collapse could severely limit the recovery of former species richness and composition.

As noted earlier, in plot TN02, the number of regenerating woody species that typify mid-successional pioneers such as *Commersonia, Macaranga, Mallotus, Melanochila, Omalanthus, Trema*, (the 'biological nomads' of van Steenis, 1958) are largely absent in the regeneration gaps. Although they tend to dominate in other lowland Sumatran sites with fewer species, in TN02 these pioneer types constitute less than 2% of woody species overall. Why this should be the case is currently unknown. One can only speculate further that inter-plant and inter-species competition at this level of richness may differ from conventional competition models derived in temperate regions with relatively few species. Most forest ecological literature is influenced by research in temperate regions in North America and Europe. A typical broadleaf-conifer (Oak-Hemlock) old-growth forest in the Appalachian mountains of north-east USA contains about 14 vascular plant species and 10 PFTs in a 40 x 5m plot. There, the first 5 x 5m quadrat may contain 5 species and 5 PFTs and the species:area curve can saturate after the third quadrat (Gillison, unpublished data). By comparison, TN02 has 66 species and 35 PFTs in the first quadrat and the species:area curve continues to climb after the final eighth quadrat, indicating the forest was undersampled. Questions of ecosystem stability, resilience and population viability are at the forefront of conservational issues and, despite continuing debate, evidence that biodiversity improves ecosystem productivity, is on the increase (Naeem and Li 1997; Hector *et al.* 1999; Tilman 1996,1999a,b; Huston *et al.* 2000; Sala 2001, Loreau *et al.*, 2001). In this respect most conceptual and theoretical approaches and experimental studies have their origins in the relatively species-poor, temperate countries and then in communities dominated by herbaceous species and related functional types. Against this background one may be forgiven for speculating that such models that have taken decades to construct and test in temperate ecosystems, may not apply in the hyper-rich forest of TN02. Should this be the case then the potential for unlocking new insights into the ecosystem behaviour of tropical forests adds yet another reason for conserving these rapidly disappearing forest types.

The use of the less intensive, rapid recording of ‘structural plots’ as an indicator of plant-based biodiversity is supported by the preliminary regression analysis in Table 7. The estimates derived from the regression equations from the pooled TN and Jambi sites lend weight to the overall finding that the TN forests are extraordinarily rich. At the very least the estimates provide a basis for preliminary mapping of biodiversity pattern and a testable model that could be readily evaluated with additional sampling.

Although the number of sample plots was much less than anticipated, the data from this rapid appraisal provide hard evidence for the existence of one of the world’s richest terrestrial ecosystems. This raises the question about the possible existence of other forest ecosystems in Indomalesia with similar alpha diversity in plant species and PFTs – and possibly faunal assemblages. It is generally considered that the foothill forests of the main ranges (e.g. the Bukit Barisan range in Sumatra) contain some of the richest species assemblages. A plot record from an intact forest at 900m elevation in a forest concession near the Kerinci Seblat NP in Jambi Province, for example, revealed a total of 169 species and 71 PFTs and a PFC of 939 (Gillison *et al.*, 1996). Field reconnaissance by the author in the moist, cloudy foothill (500-900m) zones of the Bulungan area of East Kalimantan, Borneo also suggests these forests may support high plant biodiversity. Unlike the TN forests, those of the Kerinci Seblat foothills contain a rich, orchidaceous, epiphytic flora. In the TN forests the incidence of succulent epiphytes was conspicuously low overall thereby raising yet another question about the nature of the Sumatran forest dynamics.

The poorly controlled logging practices that are evident throughout the entire Tesso Nilo area visited, have resulted in widespread damage to standing vegetation, changes in local hydrology and extensive in-filling of streams. The statutory 500m limit to clearfelling either side of a main road network in the RAPP (a subsidiary of Asia Pacific Resources International Limited) plantation concession has been exceeded in many cases, with the road networks promoting access by illegal loggers. The fact that in some localities high levels of biodiversity still exist does not necessarily indicate that logging has no negative impact. As outlined above, intermediate levels of disturbance can contribute to high, transient species richness. The location and assessment of intact forests in this area would be a useful benchmark for a comparative study of logging impact.

Site and substrate conditions suggest continued removal of significant amounts of nutrient capital in logged stems will progressively degrade these forests. Casual observations of fauna showed these were generally correlated with plant species richness. Larger mammals and birds were least frequent in the more actively logged road networks, the highest number being recorded near TN02. This is consistent with observations in Jambi where mammalian diversity was highest in the least impacted forests.

6. Strategies for further work

The present survey has laid the foundations for much needed mapping of actual and potential patterns of biodiversity. Regression analyses support the use of vegetation structure as a potentially useful indicator of plant-based biodiversity and, by association, animals. With a limited number of additional, intensively recorded plots, the predictive value of structural attributes could be readily tested. One advantage is that, apart from supporting rapid appraisal, attributes such as height and crown cover have a good chance of being detected by remote sensing and may thus offer a feasible means of extrapolating (and ground-truthing) biodiversity pattern. Existing remotely sensed imagery should be supported by a digital elevation model to facilitate potential mapping of key taxa. Discussion with Martin Hardiono suggests it may be possible to acquire DEM coverage for Tesso Nilo at 30m resolution or at least 100m. Existing spatially referenced data are sufficient to model exclusion zones of varying width (e.g. 100 – 500m) along existing road networks that can be used to indicate existing and likely severe zones of impact from present and future logging. By overlaying these against potential maps of biodiversity pattern it should be possible to identify key biodiversity exclusion corridors that could play a key role in future conservation. At the very least these could provide a science-based platform for negotiation with stakeholders.

International concern over the parlous state of Sumatran forests is reflected in recent pleas for protecting the remnants of what was previously an extensive area of tropical forest (Jepson *et al.*, 2001). Sundaland has been listed as one of the top three biodiversity 'hotspots' by Myers *et al.*, (2000) (see also Given, (1998) for conservation priorities in Sundaland). It is listed by WWF among its Global 200 Ecoregions (Sumatran Islands Lowland and Montane Forests, Sundaland Rivers and Swamps), and increasing concern is being echoed by other agencies. The findings from this study will add significant, hard ground-based data to illuminate a debate about biodiversity loss. So far most quantitative data have been sourced from mostly sequential, remotely sensed imagery. This has been used to document an extraordinary rate of land conversion, especially to oil palm. This report will give some credence to the critical loss of biodiversity associated with largely uncontrolled land clearing.

There are few if any published accounts about the dynamics of forest ecosystems in these hyper-rich species and PFT assemblages and little is known of the impact of logging and clearfelling on these and on nutrient removal. Further scientific study of the ecosystem dynamics in the TN forest complex is therefore indicated, particularly with respect to nutrient dynamics and the relationship between nutrient flow and plant and animal biodiversity.

Although it is not within the purview of the present TOR to consider the socio-political aspects of conservation, the prospect of compensation payments for protecting forests in lieu of logging may be more costly than presently supposed. At one overnight camp in Inhutani IV we camped alongside a group of illegal loggers. They informed Martin Hardiono that cut flitches of timber returned R.500,000 per cubic meter. Loggers typically obtain from 3 to 6 cubic meters per tree and produce about 3 cubic meters per day with seven people in a one logging group. This does not include and capital equipment or other costs. We encountered many such groups along the road networks often in semi-permanent housing. Given the relatively poorly paid options in the local town-based labour markets, a financial return of this kind provides strong incentive to engage in illegal logging so long as the market exists. Quite apart from compensating logging and plantation companies, this level of 'informal' income would have to be factored into any conservation payment given the current management and socio-economic realities in the Inhutani IV sector at least.

7. Conclusions

The survey achieved its four main objectives. While more sample plots would have been desirable, our data produced evidence that the TN forest complex contains some of the richest sources of plant-based biodiversity in the world with highest counts in species richness and PFTs recorded so far from any lowland forest type using this method of sampling. In itself this should provide a strong argument for conserving one of the last forest remnants of its kind. The ecological nature of the hyper-rich forests of Tesso Nilo also indicates that conventional models of ecosystem stability and competition based on relatively species-poor, temperate ecosystems in the northern hemisphere may be difficult to apply. This, together with an observed exclusion of so-called pioneer forest tree species by mature canopy species in early to mid-stage regenerating canopy gaps, presents an immediate challenge to explore further the successional dynamics in Tesso Nilo. In the time taken to complete this report several hundred more hectares of TN forest will have been lost. While more data on Tesso Nilo will be needed to develop further conservation prospects, present findings suggest an immediate moratorium on logging should be implemented while other management options are considered.

The findings from this report should be communicated as rapidly as possible to the Indonesian Government and to the international conservation community as a whole. While the field survey could have been more comprehensive in its coverage, there is sufficient material available for the findings to be published in science literature, preferably in those journals with online distribution.

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Annex I

Vegetation Survey and Habitat Assessment of the
Tesso Nilo Forest Complex
By Andrew N. Gillison

Tables

Table 1. Site localities and lowland forest types for which intensive data were recorded[#], Tesso Nilo (also see Fig. 1 and 2) and Jambi

No.	Plot ID	Locality*	Latitude	Longitude	Elev'n	Forest type
1	BS01	Pasir Mayang	01-04-47 S	102-06-02 E	76m	Intact complex mesophyll vine forest
2	BS02	Pasir Mayang	01-04-45 S	102-05-53 E	60	Intact complex mesophyll vine forest
3	BS03	Pasir Mayang	01-04-43 S	102-05-55 E	85	CMVF logged 1984
4	BS04	Pasir Mayang	01-04-53 S	102-06-09 E	60	CMVF Logged 1979/80
5	BS05	Pasir Mayang	01-04-56 S	102-06-05 E	75	CMVF Partially logged 1980
6	BS10	Pancuran Gading	01-10-12 S	102-06-50 E	30	Mesophyll vine forest + Jungle rubber
7	BS11	Pancuran Gading	01-10-13 S	102-06-46 E	30	Mesophyll vine forest + Jungle rubber
8	TN01	Inhutani IV	00-12-30 S	101-51-08 E	25	Mesophyll swamp forest
9	TN02	Inhutani IV	00-14-51 S	101-58-16 E	50	CMVF Logged 1997
10	TN03	Inhutani IV	00-16-10 S	101-59-19 E	50	CMVF Logged 1997
11	TN04	TN Central	00-06-09 S	101-33-29 E	100	Mesophyll vine forest logged 1996 (?)
12	TN07	TN West	00-06-05 S	101-31-19 E	110	Mesophyll vine forest logged 1996 (?)
13	TN08	TN Central	00-05-11 S	101-47-54 E	88	Intact meso. vine forest in logged area
14	TN09	TN Central	00-05-19 S	101-39-17 E	114	Mesophyll vine forest, logged

* BS = Jambi baseline site, Central Sumatra; TN = Tesso Nilo site

[#] Including vegetation structure, species, PFTs and site physical data.

Table 2. Plantation reference sites in Tesso Nilo area, also see Fig. 1 and 2.*

No.	Plot ID	Locality*	Latitude	Longitude	Elev'n	Forest type
1	TN05	Situgal village	00-15-53 S	101-40-45 E	100m	30 yr, tended Rubber (*Hevea brasiliensis*) plantation
2	TN06	Segati vill. RAPP	00-16-00 N	101-31-46 E	80	6 yr, *Acacia mangium* plantation

* Intensive data recorded as for sites in Table 1

Table 3. Forest sites for which vegetation structure* alone was recorded

No.	Plot ID	Locality*	Latitude	Longitude	Elev'n	Forest type
1	TNS01	TN West	00-07-34 S	101-33-20 E	99m	Disturbed, logged forest
2	TNS02	TN West	00-06-44 S	101-30-20E	151	Disturbed, logged forest
3	TNS03	TN West	00-04-33 S	101-30-52 E	99	Disturbed, logged forest
4	TNS04	TN West	00-05-55 S	101-31-17 E	161	Partly degraded logged forest
5	TNS05	TN West	00-06-23 S	101-31-25 E	156	Disturbed, logged forest
6	TNS06	TN Central	00-01-09 S	101-44-46 E	94	Highly disturbed, logged forest
7	TNS07	TN Central	00-01-09 S	101-44-46 E	105	Intact forest in logged area
8	TNS08	TN Central	00-05-01 S	101-47-54 E	96	Intact forest in logged area
9	TNS09	TN Central	00-04-56 S	101-47-50 E	108	Intact forest in logged area
10	TNS10	TN Central	00-05-19 S	101-46-59 E	130	Intact forest in logged area
11	TNS11	TN Central	00-05-22 S	101-46-58 E	126	Logged over forest
12	TNS12	TN Central	00-05-15 S	101-46-41 E	120	Logged over forest
13	TNS13	TN Central	00-05-12 S	101-46-35 E	120	Intact forest in logged area
14	TNS14	TN Central	00-05-14 S	101-39-26 E	131	Intact forest in logged area
15	TNS15	TN Central	00-04-56 S	101-39-20 E	117	Intact forest in logged area
16	TNS16	TN Central	00-04-45 S	101-39-27 E	117	Intact forest in logged area
17	TNS17	TN Inhut IV	00-12-28 S	101-59-8 E	25	Swamp forest on peat, logged
18	TNS18	TN Central	00-04-35 S	101-40-12 E	121	Highly degraded, logged forest
19	TNS19	TN Inhut IV	00-14-58 S	101-58-13 E	50	Highly disturbed, logged forest
20	TNS20	TN Central	00-05-56 S	101-33-32 E	100	Intact forest in logged area
21	TNS21	TN Inhut IV	00-16-10 S	101-59-19 E	100	Heavily logged forest
22	TNS22	TN Central	00-02-34 S	101-32-38 E	100	Heavily logged forest

23	TNS23	TN Central	00-02-33 S 101-37-37 E	100	Heavily logged forest
24	TNS24	TN Central	00-00-16 S 101-31-46 E	90	*Acacia mangium* plantation

* Mean canopy height (m); Crown cover % total; Crown cover % woody plants; Crown cover % non-woody plants; basal area (m^2); Canopy tree furcation index; Litter depth (cm); cover abundance of bryophytes ; cover abundance of woody plants < 1.5 m tall; litter depth; plus site physical features (see proforma, Annex I for additional detail).

Table 4. Plant diversity and structure for Tesso Nilo and Jambi forest sites

Plot Id.	Spp. Rich.	PFT Rich.	Spp:PFT	PFC	Ht.	CCov	Basal area	Furc. index	Litt.	Bryo.	Wdy Pl.
BS01	103	37	2.78	286	21	75	27.33	13.50	10	2	7
BS02	99	36	2.75	392	20	65	32.67	15.50	10	5	5
BS03	50	20	2.50	189	10	35	13.33	10.25	15	3	6
BS04	111	39	2.85	286	24	80	32.67	9.50	6	3	7
BS05	112	38	2.95	372	28	70	27.33	9.75	8	4	6
BS10	112	47	2.38	532	14	50	18.00	38.50	8	3	6
BS11	97	41	2.37	438	14	50	20.67	40.25	6	3	7
TN01	82	51	1.61	460	35	90	31.33	14.00	30	4	4
TN02	218	73	2.97	842	30	90	20.67	20.00	10	4	9
TN03	109	38	2.87	264	25	90	30.67	16.25	12	4	8
TN04	171	59	2.90	630	35	90	39.33	7.50	3	4	7
TN07	200	53	3.77	550	30	98	41.50	13.50	14	5	7
TN08	173	54	3.20	585	30	98	19.00	20.75	12	2	8
TN09	177	50	3.54	531	24	90	23.67	13.25	15	4	6

Spp. rich. = plant species richness; PFT rich. = Plant Functional Type richness; Spp:PFT = ratio; PFC = plant functional complexity index; Ht = mean canopy height (m); Ccov = crown cover %; Basal area (m^2); Bryo = cover-abundance of bryophytes; Furc. Index = furcation index of nearest 20 canopy trees; Wdy Pl. = cover-abundance of woody plants <1.5m tall; Litt. = litter depth (cm);. (refer Annex I).

Table 5. Plant diversity and structure for plantation sites in the Tesso Nilo area

Plot Id.	Spp. Rich.	PFT Rich.	Spp:PFT	PFC	Ht.	CCov	Basal area	Furc. index	Litt.	Bryo.	Wdy Pl.
TN05	59	29	2.03	231	12	75	21.33	7.50	3.00	2	6
TN06	80	40	2.00	422	11	85	22.67	49.00	12.00	1	7

Table 6. Comparison of richness in vascular plant species and plant functional types between humid lowland tropical forests in 20 countries (also see Fig. 4a) *

Country	Location	Georeference	Plot ID	Condition	Species richness	PFT richness
Indonesia	Tesso Nilo, Riau Province, Sumatra	0º 14' 51" S 101º 58' 16" E	TN02	Mesophyll vine forest, Heavily logged 1997	218	73
Indonesia	Pasir Mayang, Sumatra	1º 4' 56" S 102º 6' 5" E	BS05	Complex mesophyll forest, partially logged, 1985	112	38
Indonesia	Pancuran Gading, Jambi Province, Sumatra	1º 10' 12" S 102º 06' 50" E	BS10	Lowland forest interplanted with 15-38 year *Hevea brasiliensis*)	112	47
Indonesia	Gunung Banalang, Long Puak, Pujungan, East Kalimantan, Borneo	2º 43' 32" N 115º 39' 46" E	BUL02	Disturbed complex mesophyll forest along ridge	104	44
Cameroon	Awae Village	3º 36' 5" N 11º 36' 15" E	CAM 01	Secondary mesophyll vine forest. Logged > 15 years ago. Not previously gardened; very disturbed;	103	43
Papua New Guinea	Kuludagi / WNBP	5º 38' 46" S 150º 06' 14" E	KIMBE2	Intact complex mesophyll forest.	99	52
Costa Rica	Braulio Carillo NP	10º 9' 42" N 83º 56' 18" W	CR001	Partially disturbed mesophyll forest, palm dominated.	94	71
Brazil	Pedro Peixoto, Acré (W. Amazon basin)	10º 01' 13" S 67º 09' 39" W	BRA19	ICRAF ASB Site, Secondary forest (Capoeira) 3-4 years after abandonment	82	43
Perú	Jenaro Herrera, Ucayali river (W.Amazon basin)	4º 58' 0" S 73º 45' 0"W	PE02	'High terrace' complex mesophyll vine forest - selected logging	72	39
Vietnam	Cuc Phuong National Park	20º 48' 33" N 105 42' 44" E	FSIV02	Mesophyll vine forest partly disturbed	69	46
Perú	Von Humboldt forest reserve, Pucallpa, (W. Amazon basin)	8º 48' 01" S 75º 03' 54" W	PUC01	Complex mesophyll vine forest. Selectively logged, 1960	63	31
Fiji	Bua, Vanua Levu	16º 47' 36" S 178º 36' 45"	FJ55	Disturbed mesophyll, notophyll vine forest	60	37

		E				
Thailand	Ban Huay Bong, Mae Chaem watershed	18º 30’ 42” N 98º 24’ 13 ”E	MC18	Dry deciduous dipterocarp forest fallow system	58	44
Kenya	Shimba Hills near Mombasa	4º 11’ 33” S 39º 25 34” E	K01	Semi-deciduous microphyll vine forest in game park area. Disturbed (logged).	56	33
Malaysia	Danum Valley, Sabah	4º 53’ 03” N 117º 57’ 48” E	DANUM3	Complex mesophyll forest subject to reduced impact logging, Nov 1993.	56	34
Guyana	Iwokrama forest reserve	4º 35’ 02” N 58º 44’ 51” W	IWOK01	Simple mesophyll swamp forest in blackwater system.	52	34
Philippines	Mt Makiling, Luzon	14º 8’ 46” N 131º 13’ 50” E	Pclass1	Regenerating forest planted in 1968 with *Swietenia macrophylla*, *Parashorea*, and *Pterocarpus indicus* .	52	26
Panama	Barro Colorado island	9º 9’ 43” N 79º 50’ 46” W	BARRO1	Semi-evergreen, mesophyll vine forest, ground layer heavily grazed by native animals	43	30
Brazil	Reserva Biologica da Campiña (INPA), BR174, Km 50 near Manaus (E. Amazon basin)	2º 35’ 21” S 60º 1’ 55” W	BRA24	Moderately disturbed, microphyllous, evergreen vine forest on siliceous sands	42	27
Vanuatu	Yamet, Nr Umetch, Aneityum Is.	20º 12’ 32” S 169º 52’ 33” E	VAN11	Mesophyll, notophyll vine forest, logged with *Agathis macrophylla* (Kauri) overstorey on basaltic soils.	38	22
Mexico	Zona Maya, Yucatan peninsula	19º 2’ 26” N 88º 3’ 20” E	YUC02	Logged ,secondary, mesophyll vine forest.	37	26
Indonesia	Batu Ampar, Central Kalimantan, Borneo	0º 47’ 48” N 117º 6’ 23” E	BA07	Mesophyll forest, heavily logged 1991/92	35	23
France	Near Mt Peleé, Martinique	14º 49’ 23” N 61º 7’ 37” W	MQUE1	Complex mesophyll vine forest, heavily disturbed.	32	24
Bolivia	Las Trancas, (Santa Cruz)	16º 31’ 40” N 61º 50’ 48” W	BOL02	Semi-evergreen, simple notophyll vine forest,. Logged 1996	31	25
Australia	NQ coastal lowlands, Tully area	17º 54’ 53” S 146º 4’ 21” E	DPI012	Simple mesophyll palm forest in coastal swamp margin	28	24
French Guyana	B.E.C. 16 km from Kourou	5º 10’ 0” N 53º 6’ 0” W	FRG05	*Tierra firme* simple evergreen forest on white sand	28	18
Indonesia	Mandor Nature Reserve,	0º 17’ 12 N	PA02	Low microphyll evergreen forest in blackwater	25	21

N of Pontianak, Borneo	109º 33’ 0 E	system on siliceous sand

* Data are from those plots with the highest number of vascular plant species and Plant Functional Type (PFT) counts extracted from a series of global, ecoregional surveys and restricted to ‘lowland’ (0-550m elevation) forests. All data collected using a standard proforma method (Gillison, 1988, 2001). Forest conditions range from relatively intact to highly disturbed. *Source:* International Centre for Agroforestry Research, Alternatives to Slash and Burn Programme (ICRAF/ASB); Center for International Forestry Research (CIFOR); WWF AREAS project and CBM (Center for Biodiversity Management).. All data summaries held by CBM

Table 7. Vegetation structural data for less intensive, 'Structural' forest plots showing estimates of species and PFT richness based on correlative modelling.

Plot Id	Ht.	Ccov Tot	Ccov Wdy	Ccov Nwdy	Wdy Plt	Bryo	Litt.	B.Area	MFi	FICv %	Spp. Est.	PFT Est.
TNS01	29	96	94	2	8	4	12	38.00	18.00	52.08	147	51
TNS02	29	98	97	1	5	2	15	47.80	18.25	60.47	147	51
TNS03	27	90	88	2	6	2	7	34.00	13.25	52.34	138	49
TNS04	25	98	93	5	5	2	15	39.33	7.50	95.51	128	47
TNS05	25	80	75	5	6	3	10	38.00	8.75	71.5	128	47
TNS06	28	80	80	0	6	2	10	15.67	10.50	72.3	142	50
TNS07	30	85	80	5	7	2	12	46.67	7.50	102.6	151	53
TNS08	30	95	85	10	6	1	10	28.67	15.25	56.76	151	53
TNS09	28	94	92	2	10	2	2	42.40	19.00	61.33	142	50
TNS10	27	85	83	2	9	5	12	36.67	11.75	55.7	138	49
TNS11	25	80	77	3	7	4	10	29.67	15.00	63.98	128	47
TNS12	25	90	87	3	7	2	8	23.00	15.50	61.83	128	47
TNS13	30	90	87	3	5	3	10	40.00	10.50	63.51	151	53
TNS14	28	95	90	5	5	3	10	52.67	9.00	79.8	142	50
TNS15	32	95	93	2	6	3	12	51.33	15.25	56.76	160	55
TNS16	28	92	90	2	8	2	10	41.00	15.50	58.18	142	50
TNS17	30	90	90	0	5	4	30	29.33	15.50	78.95	151	53
TNS18	30	98	95	2	9	4	10	40.00	15.75	49.69	151	53
TNS19	25	85	83	2	8	4	10	30.67	19.50	66.5	128	47
TNS20	30	90	90	0	5	3	8	37.00	16.75	104.88	151	53
TNS21	25	90	90	0	8	4	12	30.67	15.75	93.99	128	47
TNS22	20	90	90	0	8	4	10	34.33	21.50	78.08	106	40
TNS23	17	65	65	0	7	5	5	17.67	17.00	39.8	92	37
TNS24	8	90	80	0	7	1	10	30.00	44.50	48.07	51	26

Ht. = Mean canopy height (m); CcovTot = Total crown cover %; Ccov Wdy = crown cover % woody plants; Ccov Nwdy = crown cover% Non-woody plants; Wdy Plt = cover abundance of woody plants <1.5m tall; Bryo = cover abundance of bryophytes; Litt = litter depth (cm); B.Area = basal area woody plants (m^2 ha^{-1}); MFi = Mean furcation index canopy trees; FICv% = coefficient of variation % Furcation Index. Spp. Est. and PFT Est. are indicative richness values based on linear correlates with mean canopy height alone for intensive plots (Figs. 5,6).

Table 8. Correlations* between vegetation structural variables and species and PFTs from 25 mainly forested sites in Tesso Nilo and Jambi

Spp & PFTs	Ht	CCTot	Wplts	Bryo	Litt	Barea	MFI	FICV
PFTs	0.842	0.413	0.695	0.622	0.539	0.707	-0.320	0.212
	0.000	0.040	0.000	0.001	0.005	0.000	0.119	0.309
Spp	0.847	0.475	0.654	0.655	0.453	0.749	-0.410	0.118
	0.000	0.016	0.000	0.000	0.023	0.000	0.042	0.576
Spp:PFT	0.772	0.354	0.593	0.679	0.435	0.798	-0.471	0.261
	0.000	0.083	0.002	0.000	0.030	0.000	0.017	0.207
PFC	0.756	0.355	0.641	0.573	0.467	0.603	-0.284	0.165
	0.000	0.082	0.001	0.003	0.019	0.001	0.169	0.430

* Upper line is Pearson linear correlation; lower line is P value.

Table 9. Bird and mammal species recorded in vicinity of Tesso Nilo 'intensive' forest plots *

Date	Plot ID	Scientific name	Common name	Remarks
29 Oct 01	TN01	*Elephas maximus sumatrensis*	Sumatran elephant	Tracks apparently >3 months old
30 Oct.		*Hylobates agilis*	Agile gibbon	Vocalization
		Lariscus insignis	Three Striped Ground squirrel	Sighting
		Buceros rhinoceros	Rhinoceros Hornbill	Sighting
30 Oct.	TN02	*Elephas maximus sumatrensis*	Sumatran elephant	Tracks
		Felis sp. */Felidae*	Small cat	Tracks
		Hylobates agilis	Agile gibbon	Vocalization
		Hylopetes sp.	Giant Flying Squirrel	Vocalization
		Hystrix brachyura	Porcupine	Food remnants
		Macaca nemestrina	Pig-tailed Macaque	Tracks
		Muntiacus muntjak	Muntjak	Tracks and faeces
		Sus sp.	Wild pig	Tracks
		Tapirus indicus	Malayan Tapir	Tracks
		Tragulus napu	Napu	Tracks
		Viverrid	Civet	Faeces
		Aceros undulatus	Wreathed Hornbill	Sighting
		Centropus sinensis	Greater Coucal	Vocalization
30 Oct.	TN03	*Muntiacus muntjak*	Muntjak	Track
		Sus sp.	Wild Pig	Tracks and faeces
		Tragulus napu	Napu	Track
31 Oct.	TN04	*Felis* sp.	Small cat	Faeces
		Macaca fascicularis	Long Tailed Macaque	Sighting
		Macaca nemestrina	Pig Tailed Macaque	Track
		Viverrid	Civet	Track
1 Nov.	TN05	*Hylobates agilis*	Agile gibbon	Vocalization
1 Nov.	TN06	*Buceros rhinoceros*	Rhinoceros Hornbill	Sighting

* Data recorded by Andjar Rafiastanto WWF - BBS

Table 9a. Bird and mammal species recorded in Tesso Nilo Forest Complex during a Riau Province Forest Department survey in June 1992.

Asian elephant	*Elephas maximus*
Sumatran tiger	*Panthera tigris sumatrensis*
Sun bear	*Helarctos malayanus*
Timor deer	*Cervus timorensis*
Muntjak	*Muntiacus muntjak*
Tapir	*Tapirus indicus*
Gibbon	*Hylobates syndactilus*
Slow loris	*Nycticebus coucang*
Long-tailed macaque	*Macaca fascicularis*
Leopard cat	*Felis bengalensis*
Porcupine	*Hystrix brachyura*
Pig-tailed macaque	*Macaca nemestrina*
Wild boar	*Sus* sp.
Mousedeer	*Tragulus napu*
Civet	*Cynogale* sp.
Squirrel	*Loriscus* sp.
Great argus pheasant	*Argusianus argus*
Hornbill	*Bucheros rinoceros*
Kingfisher	*Halycon sancta*
Crow	*Corvus inca*
Owl	*Tyto alba*
Jungle fowl	*Gallus gallus*
Drongo	*Dicrurus hotenlotus*
Black-naped oriole	*Oriolus chinensis*
Javan kingfisher	*Halcyon cyanoventris*
Mynah	*Graculla relegiosa*
Brahminy kite	*Haliastur indus*
Kestrel	*Falco tininculus*
Walik	*Ptilinopsis* sp.
Turtle dove	*Geofelia striata*
Crow-pheasant/coucal	*Centropus cinensis*
Tuwur/bubut	*Endynomis sclopaceae*
Bulbul	*Pycnonotus aurigaster*
Murai batu	*Copysicus delivura*
Barred buttonquail	*Turnix suscitator*
Parrot	*Loriculus calculus*
Anhinga	*Anhinga* sp.
Crocodile	*Tomistoma schiegeli*
Monitor lizard	*Varanus salvator*
Python	*Phyton reticulatus*
Asian arowana	*Sclerophages formosus*
Skin head barb	*Cyclocheilichthys* sp.

Annex II

Vegetation Survey and Habitat Assessment of the
Tesso Nilo Forest Complex
By Andrew N. Gillison

Figures

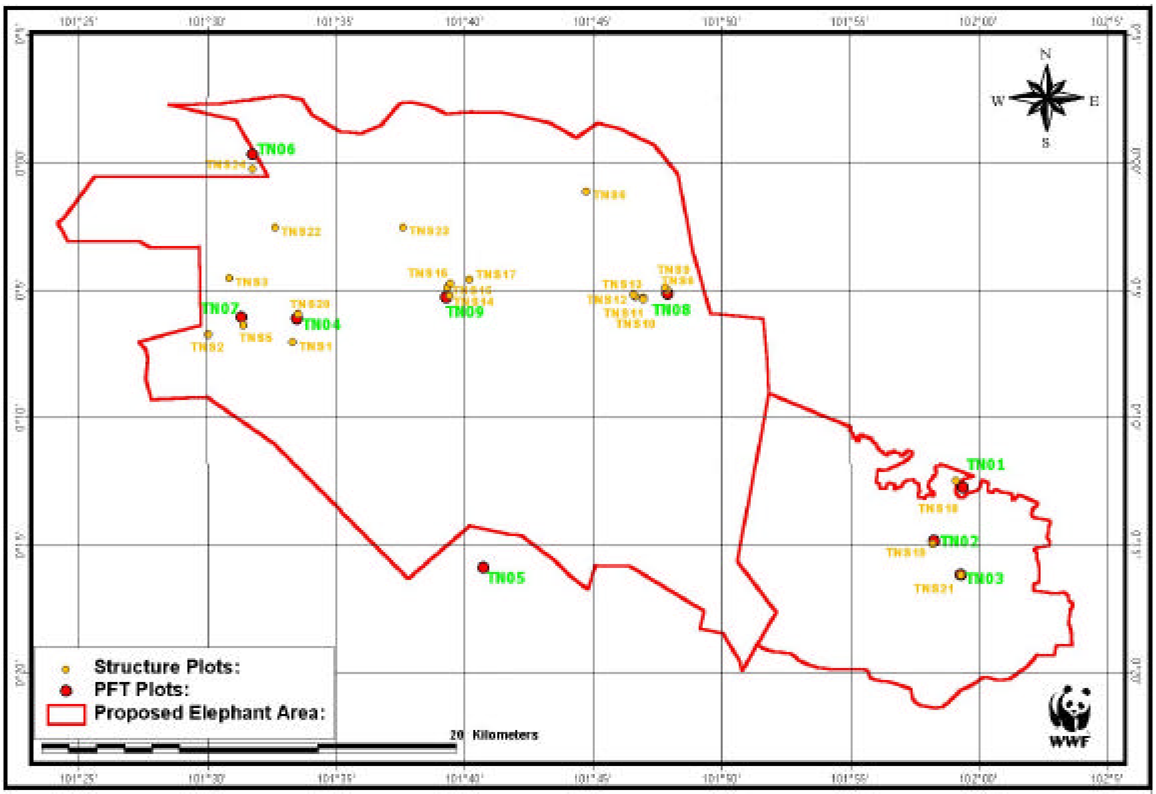


Figure 1. Overview of plot locations in the Tesso Nilo Forest Complex showing pattern of 'intensive' PFT (TN) and less intensive 'structural' (TNS) sampling

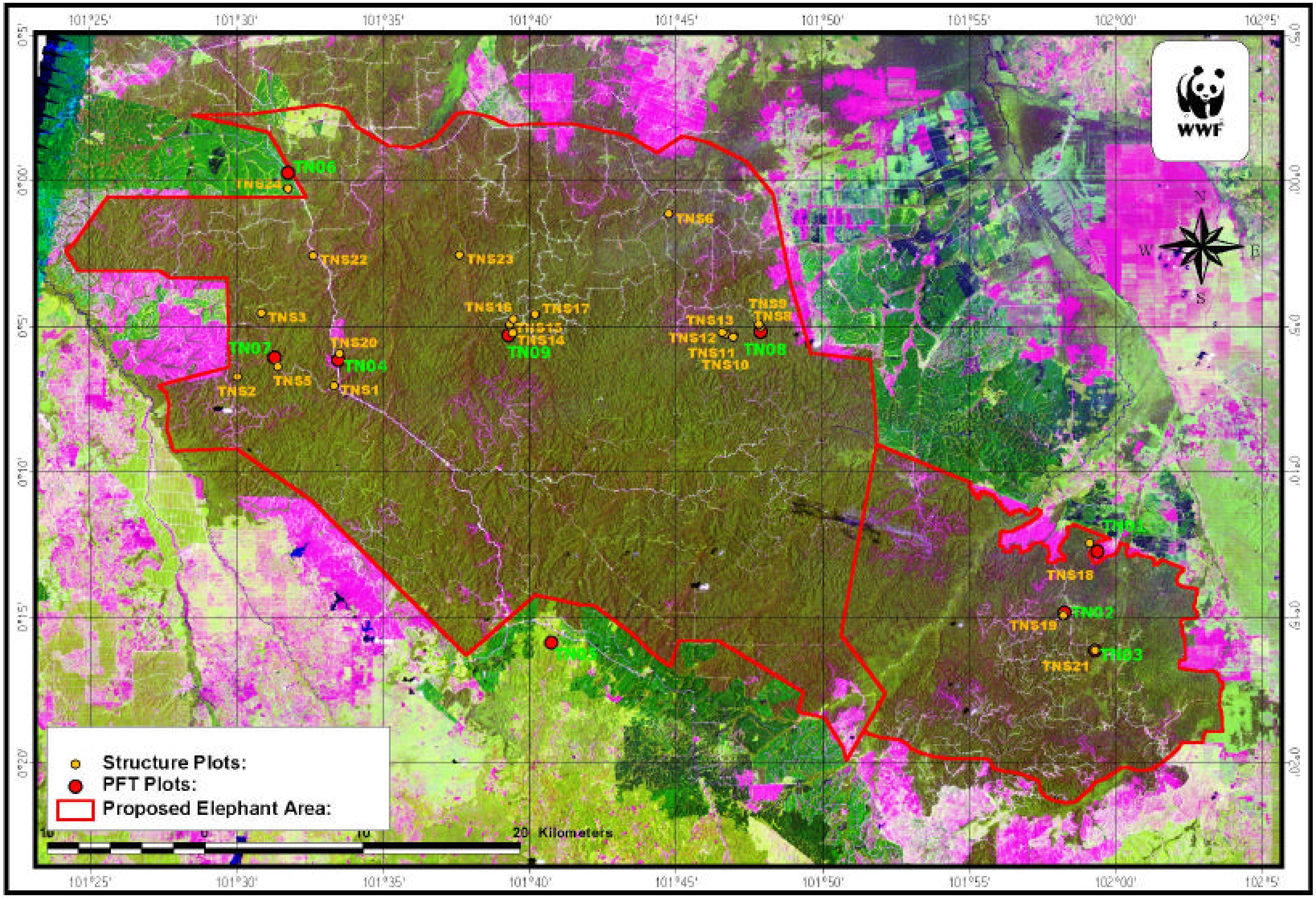


Figure 2. Plot locations overlaid on Landsat 7 (March 2001) image of land cover in the Tesso Nilo Forest Complex.

Figure 3. Comparative classification of forest sites Jambi and Tesso Nilo, Sumatra based on 326 vascular plant genera

```
BS01  _____
BS05  ____|____
TN03  ________|_
BS03  _        |
TN01  |______  |
BS04  ______|__|___
BS02  ____________|_________________________________
TN02  ________________________                     |
TN04  ____________________   |                     |
TN08  ___________________|___|____                 |
TN07  _______________            |                 |
TN09  ______________|____________|_________________|________________
BS10  __                                                           |
BS11  _|___________________________________________________________|
       |           |           |           |           |           |
    0.1810      0.2494      0.3178      0.3862      0.4546      0.5230
```

Increasing dissimilarity ->

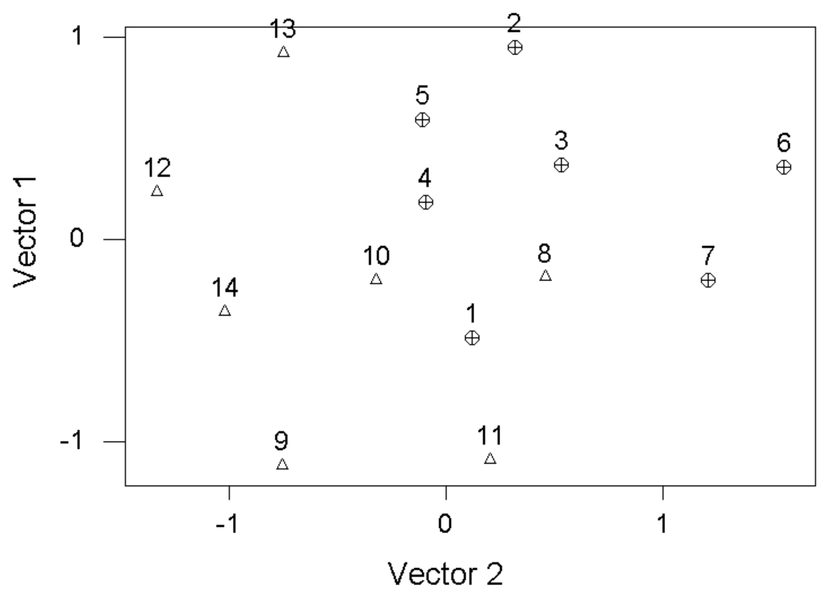


Figure 4. Multi-dimensional scaling ordination of lowland forest plots in Tesso Nilo and Jambi, Sumatra based on 326 vascular plant genera. Circles with crosses indicate Jamb sites; open diamonds with crosses indicate Tesso Nilo. Refer to Table 1 for site number information

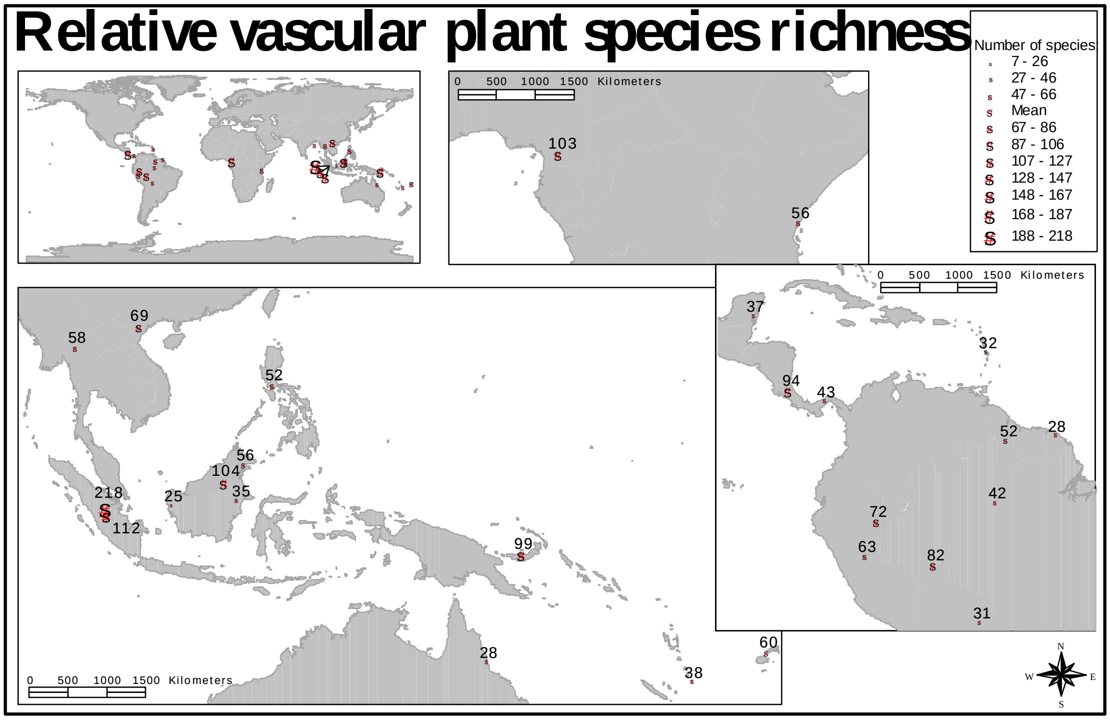


Figure 4a. Relative vascular plant species richness in plots surveyed with the same method around the world (plot numbers refer to Table 6).

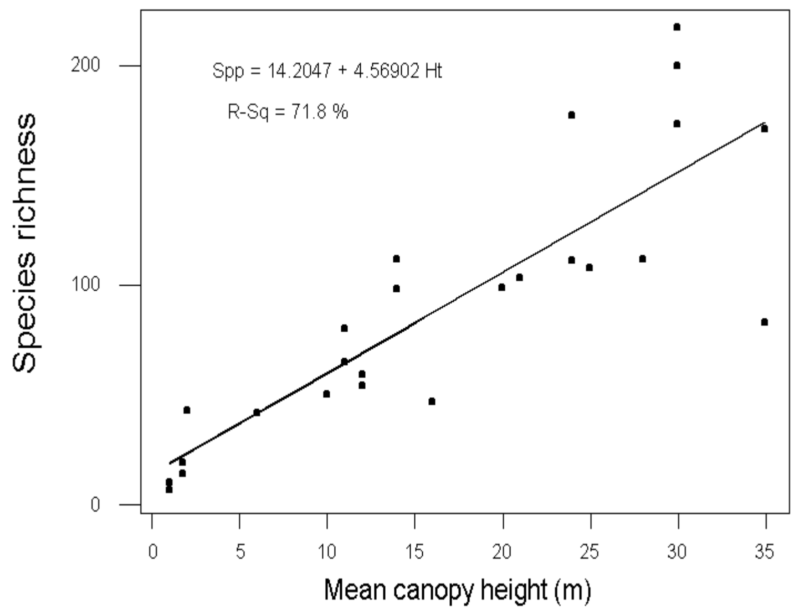


Figure 5. Correlation between Species richness and mean canopy height for a combination of 9 Tesso Nilo and 16 Jambi sites along a range of mainly forested vegetation types

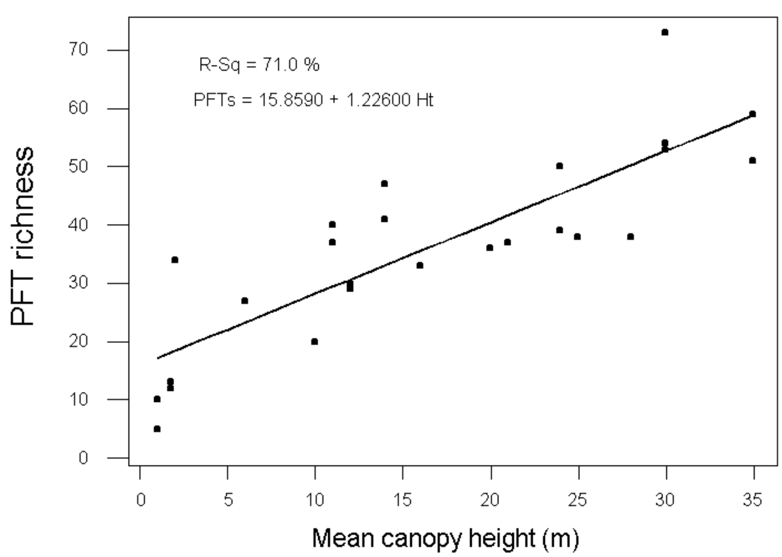


Figure 6. As for Figure 5 but showing "PFT" and canopy height relationship.

Annex III

Vegetation Survey and Habitat Assessment of the
Tesso Nilo Forest Complex
By Andrew N. Gillison

Provisional listing of all species and
Plant Functional Types

Tesso Nilo 'Intensive' Plots 1-9
as at 2 Dec. 2001
(Listed according to 5 x 5m quadrat sequence in each 40 x 5m plot)

Table 1. Plant species and functional types Plot TN01 Tesso Nilo

Rec.	PFT	Family	Genus	Species	Code	Quad
1	na-la-do-fi-hc-ad	Adiantaceae	Lindsaea	sp01	LIND0001	1
2	mi-la-do-ct-ph-ad	Euphorbiaceae	Macaranga	triloba	MACATRIL	1
3	pl-la-do-ct-ro-pv-ph-ad	Arecaceae	Pinanga	sp03	PINASP03	1
4	pi-la-do-ct-ro-ph-ad	Arecaceae	Pinanga	sp04	PINASP04	1
5	me-la-do-ro-pv-ph-li-ad	Arecaceae	Calamus	sp05	CALASP05	1
6	no-la-do-ct-ph-ad	Annonaceae	Xylopia	malayana	XYLOMALA	1
7	pi-la-do-ct-ph	Burseraceae	Santiria	laevigata	SANTLAEV	1
8	me-la-do-ct-ph	Myristicaceae	Knema	cinerea	KNEMCINE	1
9	no-la-do-ct-ch	Lecythidaceae	Barringtonia	sp09	BARRSP09	1
10	me-co-do-ph-li	Connaraceae	Agelaea	macrophylla	AGELMACR	1
11	me-la-do-ct-ph	Lauraceae	Litsea	sp11	LITSSP11	1
12	me-la-do-ph-li	Annonaceae	Uvaria	sp12	UVARSP12	1
13	no-co-do-ro-pv-ph-li-ad	Arecaceae	Calamus	sp13	CALASP13	1
14	me-la-do-ct-ph	Euphorbiaceae	Mallotus	oblongifolius	MALLOBLO	1
15	pi-la-do-ct-ch	Verbenaceae	Clerodendrum	sp15	CLERSP15	1
16	mi-co-do-ph-li	Rubiaceae	Lasianthus	sp16	LASISP16	1
17	me-ve-do-ct-ph-ae	Myristicaceae	Horsfieldia	sp17	HORSSP17	1
18	me-co-do-ph	Tiliaceae	Pentace	sp18	PENTSP18	1
19	me-co-do-ct-ph	Polygalaceae	Xanthophyllum	sp19	XANTSP19	1
20	me-la-do-ct-ph-ad	Sapindaceae	Xerospermum	noronhianum	XERONORO	2
21	no-co-do-ph-li	Fabaceae	Phanera	sp21	PHANSP21	2
22	na-la-do-fi-ch	Aspleniaceae	Diplazium	esculentum	DIPLESCU	2
23	me-la-do-ph-li	Annonaceae	Friesodielsia	sp23	FRIESP23	2
24	no-la-do-ct-ph-ae	Annonaceae	Mezzettia	parviflora	MEZZPARV	2
25	no-co-do-ct-ph	Melastomataceae	Memecylon	sp25	MEMESP25	2
26	no-co-do-ct-ch	Euphorbiaceae	Antidesma	sp26	ANTISP26	2
27	mg-la-do-ct-ph	Moraceae	Artocarpus	elasticus	ARTOELAS	2
28	mi-co-do-ph	Podocarpaceae	Podocarpus	neriifolius?	PODONERI	2
29	no-co-do-fi-ph-li-ep	Polypodiaceae	Stenochlaena	palustris	STENPALU	2
30	no-la-do-ph	Clusiaceae	Mesua	sp30	MESUSP30	3
31	no-la-do-ct-ph	Aquifoliaceae	Ilex	sp31	ILEXSP31	3
32	me-la-do-ph	Burseraceae	Dacryodes	rostrata	DACRROST	3
33	me-la-do-ph-li	Convolvulaceae	Erycibe	sp33	ERYCSP33	3
34	me-la-do-ph	Rubiaceae	Urophyllum	corymbosum	UROPCORY	3
35	no-ve-do-su-hc-ad	Zingiberaceae	Globba	sp35	GLOBSP35	3
36	no-co-do-de-ct-ph	Burseraceae	Canarium	sp36	CANASP36	3
37	no-la-do-ph-li	Gnetaceae	Gnetum	cuspidatum	GNETCUSP	4
38	me-la-do-ph-li	Vitaceae	Cissus	sp38	CISSSP38	4
39	me-la-do-ct-ph-ad	Burseraceae	Santiria	laevigata	SANTLAEV	4
40	me-la-do-ct-ph	Melastomataceae	Memecylon	sp40	MEMESP40	4
41	me-la-do-ct-ph	Euphorbiaceae	Drypetes	sp41	DRYPSP41	4
42	no-la-do-ph	Dipterocarpaceae	Vatica	sp42	VATISP42	4
43	me-la-do-ph-li	Annonaceae	Oxymitra	leucophylla	OXYMLEUC	5
44	pl-la-do-ph-li-ad	Smilacaceae	Smilax	sp44	SMILSP44	5
45	me-la-do-ct-ph	Oleaceae	Chionanthus	sp45	CHIOSP45	5
46	no-la-do-ct-ph-ad	Indet	Indet			5
47	mi-co-do-ph	Sapindaceae	Lepisanthes	sp47	LEPISP47	5

48	no-co-do-ph-li	Connaraceae	Rourea	mimosoides	ROURMIMO	5
49	no-la-do-ch	Dipterocarpaceae	Shorea	ovalis	SHOROVAL	5
50	me-la-do-ct-ph	Anacardiaceae	Mangifera	sp50	MANGSP50	5
51	me-la-do-ph	Sapindaceae	Nephelium	sp51	NEPHSP51	5
52	mi-la-do-ph-li	Annonaceae	Artabotrys	sp52	ARTASP52	5
53	no-la-do-ph-li	Fabaceae	Spatholobus	sp53	SPATSP53	5
54	pl-la-do-ph	Sterculiaceae	Scaphium	macropodum	SCAPMACR	6
55	na-la-do-fi-hc-ep	Adianthaceae	Lindsaea	sp55	LINDSP55	6
56	no-la-do-ct-ph-ad	Polygalaceae	Xanthophyllum	sp56	XANTSP56	6
57	no-la-do-ct-ph-ad	Melastomataceae	Pternandra	caerulescens	PTERCAER	6
58	mi-la-do-ph-li	Convolvulaceae	Erycibe	sp58	ERYCSP58	6
59	mi-la-do-ct-ph	Lauraceae	Litsea	oppositifolia	LITSOPPO	6
60	pl-la-do-ct-ph-ad	Euphorbiaceae	Baccaurea	macrocarpha	BACCMACR	6
61	no-la-do-ct-ph-ad	Tiliaceae	Microcos	sp61	MICRSP61	6
62	no-la-do-ct-ph	Lauraceae	Litsea	sp62	LITSSP62	6
63	me-la-do-ct-ph-ae	Anacardiaceae	Gluta	rengas	GLUTRENG	6
64	me-la-do-ch-li-ad	Piperaceae	Piper	sp64	PIPESP64	7
65	me-co-do-ro-pv-hc-ad	Cyperaceae	Mapania	sp65	MAPASP65	7
66	me-la-do-ct-ch	Melastomataceae	Memecylon	sp66	MEMESP66	7
67	no-la-do-ct-ph-ad	Clusiaceae	Garcinia	sp67	GARCSP67	7
68	no-la-do-ph-li-ep	Araceae	Anadendrum	sp68	ANODSP68	7
69	no-la-do-ph	Clusiaceae	Mesua	sp69	MESUSP69	7
70	me-la-do-ph	Bombacaceae	Durio	sp70	DURISP70	7
71	me-la-do-ph	Clusiaceae	Calophyllum	sp71	CALOSP71	7
72	no-la-do-ph-li	Apocynaceae	Willughbeia	coriacea	WILLCORI	7
73	me-la-do-ph-ad	Elaeocarpaceae	Elaeocarpus	sp73	ELAESP73	7
74	me-la-do-ct-ph-ad	Myrtaceae	Syzygium	sp74	SYZYSP74	7
75	me-la-do-ct-ph	Lauraceae	Litsea	sp75	LITSSP75	7
76	mi-la-do-ch	Rubiaceae	Urophyllum	hirsutum	UROPHIRS	7
77	no-co-do-ph-ae	Dipterocarpaceae	Shorea	ovalis	SHOROVAL	7
78	no-co-do-ct-ph	Clusiaceae	Garcinia	sp78	GARCSP78	8
79	mi-la-do-ct-ch	Burseraceae	Santiria	rubiginosa	SANTRUBI	8
80	pi-co-do-ct-ph-ad	Lauraceae	Cryptocarya	sp80	CRYPSP80	8
81	mi-la-do-ct-ph-ad	Fagaceae	Lithocarpus	sp81	LITHSP81	8
82	na-co-do-ph-li	Connaraceae	Roureopsis	emarginata	ROUREMAR	8
83	mi-co-do-ph-li-ep	Araceae	Raphidophora	sp83	RAPHSP83	8
84	mi-la-do-ct-ph	Fabaceae	Koompassia	malaccensis	KOOMMALA	8

Table 2. Plant species and functional types Plot TN02

Rec.	PFT	Family	Genus	Species	code	quad
1	mi-co-do-ct-ph	Myrtaceae	Syzygium	1	SYZY0001	1
2	me-co-do-ct-ph	Diptercarpaceae	Shorea	seminis	SHORSEMI	1
3	pi-la-do-ch	Sterculiaceae	Scaphium	macropodum	SCAPMACR	1
4	me-co-do-ct-ph	Dipterocarpaceae	Dipterocarpus	crinitis	DIPTCRIN	1
5	me-la-do-ct-ph	Moraceae	Artocarpus	dadah	ARTODADA	1
6	mi-la-do-ch-li	Loganiaceae	Strychnos	6	STRY0006	1
7	no-la-do-ph-li	Vitaceae	Tetrastigma	7	TETR0007	1
8	mi-co-do-ct-ph	Myrtaceae	Syzygium	8	SYZY0008	1
9	ma-la-do-ct-ph	Rubiaceae	Gardenia	anisophylla	GARDANIS	1
10	na-la-do-su-hc-li-ad-ep	Asclepiadacae	Dischidia	10	DISC0010	1
11	me-co-do-ct-ph	Sapindaceae	Aglaia	11	AGLA0011	1
12	mi-la-do-su-ch-li	Araceae	Scindapsus	12	SCIN0012	1
13	mi-la-do-ph-li	Annonaceae	Artabotrys	rosea	ARTAROSE	1
14	no-la-do-ct-ph	Myrsinaceae	Ardisia	14	ARDI0014	1
15	no-co-do-ct-ph	Lauraceae	Litsea	machilifolia	LITSMACH	1
16	me-la-do-su-pv-hc-ad	Zingiberaceae	Indet	16	TN020016	1
17	no-co-do-ph-li	Convolvulaceae	Erycibe	17	ERYC0017	1
18	me-la-do-ct-ch	Rubiaceae	Lasianthus	18	LASI0018	1
19	me-co-do-ph-li	Annonaceae	Uvaria	19	UVAR0019	1
20	me-la-do-ct-ph	Rubiaceae	Ixora	20	IXOR0020	1
21	no-pe-do-fi-hc-ad	Blechnaceae	Taenitis	blechnoides	TAENBLEC	1
22	mi-co-do-ct-ph	Myrtaceae	Eugenia	spicata	EUGESPIC	1
23	me-co-do-ct-ph	Euphorbiaceae	Drypetes	24	DRYP0024	1
24	no-la-do-ct-hc	Sabiaceae	Polyosma	integrifolia	POLYINTE	1
25	mi-co-do-ph-li	Myrsinaceae	Embelia	ribes	EMBERIBE	1
26	me-la-do-ct-ph	Euphorbiaceae	Macaranga	tanarius	MACATANA	1
27	no-la-do-ct-ch	Rubiaceae	Lasianthus	27	LASI0027	1
28	no-co-do-pv-fi-ph-ep	Fern01	Indet	28	TN020028	1
29	no-la-do-ct-hc	Euphorbiaceae	Antidesma	neurocarpum	ANTINEUR	1
30	me-la-do-so-ch	Myrsinaceae	Ardisia	30	ARDI0030	1
31	me-la-do-ct-ph	Clusiaceae	Mesua	macrantha	MESUMACR	1
32	me-co-do-ct-ph	Dipterocarpaceae	Shorea	macrocarpa	SHORMACR	1
33	na-la-do-ct-ch	Anisophylleaceae	Anisophyllea	disticha	ANISDIST	1
34	no-la-do-ph-li	Annonaceae	Friesodielsia	canthii	FRIECANT	1
35	mi-la-do-ph-li	Rubiaceae	Psychotria	sarmentosa	PSYCSARM	1
36	mi-la-do-ph-li	Connaraceae	Rourea	minor	ROURMINO	1
37	no-la-do-ph-li	Fabaceae	Dalbergia	37	DALB0037	1
38	me-ve-do-ct-ph	Lauraceae	Litsea	firma	LITSFIRM	1
39	mi-co-do-ct-ph	Lauraceae	Actinodaphne	39	ACTI0039	1
40	me-la-do-ph-li	Fabaceae	Spatholobus	ferrugnieus	SPATFERR	1
41	no-la-do-ct-ph	Anacardiaceae	Swintonia	41	SWIN0041	1
42	me-co-do-ct-ph	Lauraceae	Dehaasia	42	DEHA0042	1
43	no-co-do-ct-ph	Sterculiaceae	Indet	43	TN020043	1
44	me-co-do-ct-ph	Myrtaceae	Syzygium	44	SYZY0044	1
45	me-la-do-ph	Euphorbiaceae	Ptychopyxis	45	PTYC0045	1
46	pl-co-do-ct-ph	Euphorbiaceae	Baccaurea	46	BACC0046	1
47	mi-la-do-ch	Cusiaceae	Garcinia	graminifolia	GARCGRAM	1

48	no-la-do-ro-su-pv-hc-ad	Hanguanaceae	Hanguana	malayana	HANGMALA	1
49	mi-la-do-ct-ph	Myrtaceae	Syzygium	49	SYZY0049	1
50	mi-la-do-ch	Euphorbiaceae	Glochidion	50	GLOC0050	1
51	mi-la-do-ct-ph	Fabaceae	Koompassia	malaccensis	KOOMMALA	1
52	mi-la-do-ct-ph-li	Connaraceae	Agelaea	macrophylla	AGELMACR	1
53	mi-la-do-ct-ph	Lauraceae	Litsea	oppositifolia	LITSOPPO	1
54	no-la-do-ct-ph	Fagaceae	Lithocarpus	54	LITH0054	1
55	no-la-do-ph-li	Burseraceae	Canarium	56	CANA0056	1
56	no-la-do-ph-li	Apocynaceae	Willughbeia	coriaceae	WILLCORI	1
57	no-la-do-ph-li	Indet	Indet	57	TN020057	1
58	mi-la-do-ph	Rubiaceae	Gardenia	pterocalyx	GARDPTER	1
59	mi-la-do-ph-li	Connaraceae	Roureopsis	emarginata	ROUREMAR	1
60	me-co-do-ch-li	Annonaceae	Friesodielsia	ferruginea	FRIEFERR	1
61	me-la-do-ct-ch	Clusiaceae	Calophyllum	61	CALO0061	1
62	no-la-do-ch	Myrtaceae	Syzygium	62	SYZY0062	1
63	no-la-do-ro-pv-ph-li	Arecaceae	Calamus	63	CALA0063	1
64	no-la-do-ph-li	Rhamnaceae	Ventilago	oblongifolia	VENTOBLO	1
65	me-la-do-ph-li	Vitaceae	Ampelocissus	65	AMPE0065	1
66	me-la-do-ct-ph	Burseraceae	Santiria	laevigata	SANTLAEV	1
67	me-co-do-ph-li	Rubiaceae	Uncaria	67	UNCA0067	2
68	me-la-do-ct-ph	Flacourtiaceae	Hydnocarpus	kunstleri	HYDNKUNS	2
69	no-co-do-ct-ph	Connaraceae	Ellipanthus	tomentosus	ELLITOME	2
70	me-co-do-ct-ph	Lauraceae	Alseodaphne	70	ALSE0070	2
71	no-co-do-fi-hc-ep	Aspleniaceae	Asplenium	nidus	ASPLNIDU	2
72	no-co-do-ct-ph	Euphorbiaceae	Aporusa	72	APOR0072	2
73	na-la-do-ph-li	Connaraceae	Rourea	mimosoides	ROURMIMO	2
74	me-la-do-ph-li	Annonaceae	Oxymitra	74	OXYM0074	2
75	no-la-do-ct-ph	Dipterocarpaceae	Shorea	acuminata	SHORACUM	2
76	no-co-do-ct-ph	Rubiaceae	Psychotria	77	PSYC0077	2
77	na-la-do-hc-li-ad-ep	Araceae	Scindapsus	76	SCIN0076	2
78	me-la-do-ct-ph	Burseraceae	Canarium	78	CANA0078	2
79	no-co-do-ct-ph	Anacardiaceae	Mesua	79	MESU0079	2
80	no-la-do-ct-ph	Icacinaceae	Goniothalamus	80	GONI0080	2
81	me-co-do-ct-ph	Burseraceae	Santiria	oblongifolia	SANTOBLO	2
82	me-la-do-ph-li	Connaraceae	Connarus	82	CONN0082	2
83	me-co-do-ph	Barringtoniaceae	Barringtonia	83	BARR0083	2
84	me-la-do-su-hc-li-ep	Araceae	Amydrium	medium	AMYDMEDI	2
85	me-la-do-ch	Rhamnaceae	Zizyphus	calophylla	ZIZYCALO	2
86	no-la-do-ct-ph	Clusiaceae	Garcinia	86	GARC0086	2
87	me-co-do-ph	Myrtaceae	Syzygium	87	SYZY0087	2
88	no-la-do-ct-ph	Clusiaceae	Garcinia	88	GARC0088	2
89	me-la-do-ct-ph	Bombaceae	Durio	griffithii	DURIGRIF	2
90	no-la-do-ct-ph	Fabaceae	Archidendron	90	ARCH0090	2
91	no-la-do-ct-ch	Melastomataceae	Memecylon	opacum	MEMEOPAC	2
92	me-co-do-ct-ph	Symplocaceae	Symplocos	92	SYMP0092	2
93	me-la-do-ct-ph	Aquifoliaceae	Ilex	93	ILEX0093	2
94	mi-la-do-ct-ph	Myrsinaceae	Ardisia	94	ARDI0094	2
95	me-la-do-pv-hc-ad	Zingiberaceae	Alpinia	95	ALPI0095	2
96	me-co-do-ct-ph	Sapotaceae	Madhuca	96	MADH0096	2
97	me-la-do-ph-li	Dilleniaceae	Tetracera	97	TETR0097	2
98	mi-co-do-ct-ph	Sapindaceae	Aglaia	98	AGLA0098	2

99	no-la-do-ct-ch	Indet	Indet	99	TN020099	2
100	me-co-do-ct-ch	Tiliaceae	Microcos	100	MICR0100	2
101	me-la-do-ph-li	Annonaceae	Oxymitra	101	OXYM0101	2
102	no-la-do-ph-li	Connaraceae	Connarus	102	CONN0102	2
103	me-la-do-ph-li	Oxalidaceae	Dapania	racemosa	DAPARACE	2
104	no-la-do-ph-li	Gnetaceae	Gnetum	cuspidatum	GNETCUSP	2
105	me-co-do-ph	Myristicaceae	Horsfieldia	semiglobosa	HORSSEMI	2
106	no-la-do-ct-ph	Rubiaceae	Saprosma	106	SAPR0106	2
107	no-la-do-ct-ph	Rosaceae	Atuna	107	ATUN0107	2
108	na-la-do-ph	Annonaceae	Xylopia	108	XYLO0108	2
109	no-la-do-ct-ph	Rosaceae	Atuna	107	ATUN0107	2
110	me-la-do-ph-li	Icacinaceae	Sarcostigma	109	SARC0109	2
111	no-co-do-ct-ph	Moraceae	Stemonurus	111	STEM0111	2
112	no-co-do-ph	Euphorbiaceae	Aporusa	subcaudata	APORSUBC	2
113	no-co-do-ct-ph	Clusiaceae	Calophyllum	113	CALO0113	2
114	no-ve-do-ph	Euphorbiaceae	Baccaurea	114	BACC0114	2
115	no-la-do-su-hc-ad	Myrsinaceae	Labisia	pumila	LABIPUMI	2
116	me-la-do-ph	Euphorbiaceae	Pimelodendron	griffithii	PIMEGRIF	2
117	no-la-do-ph-li	Loganiaceae	Strychnos	ignatii	STRYIGNA	2
118	no-pe-do-ph	Ulmaceae	Gironniera	subaequalis	GIROSUBA	2
119	me-la-do-ph	Annonaceae	Goniothalamus	119	GONI0119	3
120	mi-la-do-ct-ph	Elaeocarpaceae	Elaeocarpus	120	ELAE0120	3
121	me-la-do-ct-ph	Annonaceae	Monocarpia	marginalis	MONOMARG	3
122	no-la-do-ph	Fabaceae	Dialium	122	DIAL0122	3
123	no-co-do-ct-ph-ad	Euphorbiaceae	Baccaurea	minor	BACCMINO	3
124	no-la-do-ct-ph	Elaeocarpaceae	Elaeocarpus	mastersii	ELAEMAST	3
125	no-la-do-ph-li	Connaraceae	Connarus	borneensis	CONNBORN	3
126	me-la-do-ct-ph	Apocynaceae	Hunteria	128	HUNT0128	3
127	me-la-do-ct-ph	Trigoniaceae	Trigoniastrum	hypoleucum	TRIGHYPO	3
128	me-la-do-ct-ph	Moraceae	Artocarpus	elasticus	ARTOELAS	3
129	me-la-do-ph	Myrtaceae	Syzygium	130	SYZY0130	3
130	me-la-do-ph	Tiliaceae	Microcos	129	MICR0129	3
131	pi-la-do-ct-ph	Rosaceae	Prunus	polystachya	PRUNPOLY	3
132	no-co-do-ct-ph	Lauraceae	Dehaasia	132	DEHA0132	3
133	no-co-do-ct-ph	Dipterocarpaceae	Shorea	parvifolia	SHORPARV	3
134	no-co-do-ct-ph	Myrtaceae	Syzygium	134	SYZY0134	3
135	no-la-do-ct-ph	Myrsinaceae	Ardisia	135	ARDI0135	3
136	no-co-do-ct-ph	Clusiaceae	Garcinia	parvifolia	GARCPARV	3
137	no-la-do-ct-ph	Ochnaceae	Gomphia	serrata	GOMPSERR	3
138	no-pe-do-ph-li	Connaraceae	Connarus	monocarpa	CONNMONO	3
139	no-la-do-ph-li	Fabaceae	Spatholobus	139	SPAT0139	3
140	mi-ve-do-so-su-pv-hc-ad-ep	Orchidaceae	Bulbophyllum	140	BULB0140	3
141	no-la-do-ph-li	Apocynaceae	Willughbeia	141	WILL0141	3
142	me-co-do-ph-li	Convolvulaceae	Erycibe	143	ERYC0143	3
143	me-la-do-ph-li	Annonaceae	Oxymitra	142	OXYM0142	3
144	no-co-do-ct-ph	Annonaceae	Mezzettia	144	MEZZ0144	3
145	mi-la-do-ct-ch	Dipterocarpaceae	Hopea	mangarawan	HOPEMANG	3
146	pl-la-do-ph-li	Vitaceae	Parthenocissus	146	PART0146	3
147	no-la-do-ct-ph	Moraceae	Artocarpus	nitidus	ARTONITI	3
148	ma-la-do-ph	Euphorbiaceae	Blumeodendron	tokbraii	BLUMTOKB	3
149	me-la-do-ct-ph	Fabaceae	Archidendron	149	ARCH0149	3

150	mi-la-do-ct-ph	Clusiaceae	Calophyllum	150	CALO0150	3
151	no-la-do-ct-ph	Dipterocrpaceae	Shorea	151	SHOR0151	3
152	no-la-do-ct-ph	Euphorbiaceae	Galearia	filiformis	GALEFILI	3
153	me-la-do-ph-li	Menispermaceae	Indet	153	TN020153	4
154	me-co-do-ct-ph	Clusiaceae	Calophyllum	154	CALO0154	4
155	me-la-do-ct-ph	Ulmaceae	Gironniera	hirta	GIROHIRT	4
156	me-la-do-ct-ph	Lauraceae	Litsea	155	LITS0155	4
157	mi-co-do-ct-ph	Burseraceae	Santiria	griffithii	SANTGRIF	4
158	no-la-do-su-hc-ad	Myrsinaceae	Labisia	158	LABI0158	4
159	me-pe-do-ct-ph	Myristicaceae	Horsfieldia	159	HORS0159	4
160	me-pe-do-ct-ph	Sapindaceae	Xerospermum	noronhianum	XERONORO	4
161	me-la-do-ph-li	Loganiaceae	Strychnos	160	STRY0160	4
162	pi-co-do-ct-ph	Lauraceae	Litsea	noronhae	LITSNORO	4
163	pl-co-do-ct-ph	Annonaceae	Cyathocalyx	bancana	CYATBANC	4
164	me-co-do-ct-ph	Sapindaceae	Aglaia	164	AGLA0164	4
165	me-co-do-ct-ph	Dipterocarpaceae	Shorea	atrinervosa	SHORATRI	4
166	me-la-do-ct-ph	Dipterocarpaceae	Vatica	umbonata	VATIUMBO	4
167	no-la-do-ct-ph	Burseraceae	Dacryodes	rugosa	DACRRUGO	4
168	no-la-do-ct-ph	Myrtaceae	Syzygium	168	SYZY0168	4
169	me-pe-do-ct-ph	Dipterocarpaceae	Parashorea	lucida	PARALUCI	4
170	ma-la-do-ro-su-hc-ad	Araceae	Homalomena	caudata	HOMACAUD	4
171	no-la-do-ct-ph	Ebenaceae	Diospyros	171	DIOS0171	4
172	me-co-do-ct-ph	Sapotaceae	Palaquium	gutta	PALAGUTT	4
173	me-pe-do-ct-ph	Ebenaceae	Diospyros	173	DIOS0173	4
174	me-co-do-ct-ro-pv-ph	Liliaceae	Dracaena	elliptica	DRACELLI	4
175	me-co-do-ro-pv-ph-li-ad	Arecaceae	Korthalsia	175	KORT0175	4
176	me-ve-do-ro-pv-ph-li-ad	Arecaceae	Calamus	javensis	CALAJAVE	4
177	me-ve-do-ct-ph	Rubiaceae	Lasianthus	scabridus	LASISCAB	4
178	no-co-do-ph	Ebenaceae	Diospyros	clementium	DIOSCLEM	4
179	no-la-do-ph-li	Dichapetalaceae	Dichapetalum	179	DICH0179	4
180	no-co-do-ct-ph	Euphorbiaceae	Neoscortechinia	kingii	NEOSKING	5
181	me-la-do-ct-ph	Ixonanthaceae	Ixonanthes	icosandra	IXONICOS	5
182	no-la-do-ph-li	Rhamnaceae	Zizyphus	182	ZIZY0182	5
183	me-pe-do-ph	Sapotaceae	Palaquium	183	PALA0183	5
184	no-la-do-ro-pv-ph-li-ad-ep	Pandanaceae	Freycinetia	184	FREY0184	5
185	me-la-do-ct-ph	Icacinaceae	Indet	185	TN020185	5
186	mg-co-do-ct-ph	Lauraceae	Actinodaphne	procera	ACTIPROC	5
187	mi-ve-do-pv-hc-ad-ep	Orchidaceae	Agrostophyllum	187	AGRO0187	5
188	me-la-do-ch	Smilacaceae	Smilax	calophylla	SMILCALO	5
189	no-la-do-ph-li	Gnetaceae	Gnetum	189	GNET0189	6
190	me-pe-do-ph	Thymeliaceae	Gonystylus	macrophyllus	GONYMACR	6
191	me-la-do-ct-ph	Myrtaceae	Syzygium	191	SYZY0191	6
192	me-co-do-ph-li	Annonaceae	Artabotrys	192	ARTA0192	6
193	no-co-do-ct-ph	Sapindaceae	Aglaia	193	AGLA0193	6
194	no-ve-do-ct-ph	Fagaceae	Lithocarpus	lucidus	LITHLUCI	6
195	mi-co-do-ph-li	Apocynaceae	Alyxia	195	ALYX0195	6
196	me-pe-do-ct-ph	Myrsinaceae	Ardisia	teysmannii	ARDITEYS	6
197	me-la-do-ph	Myristicaceae	Gymnacranthera	bancana	GYMNBANC	6
198	me-co-do-ct-ph	Sapindaceae	Aglaia	198	AGLA0198	6
199	pl-la-do-ct-ch	Anacardiaceae	Melanochyla	199	MELA0199	6
200	me-la-do-ph	Lauraceae	Dehaasia	200	DEHA0200	6

201	me-la-do-ch	Rubiaceae	Cephaelis	201	CEPH0201	6
202	no-co-do-ph	Sapotaceae	Indet	202	TN020202	6
203	no-co-do-ct-ph	Proteaceae	Helicia	203	HELI0203	7
204	no-co-do-ct-ph	Connaraceae	Mastixia	rostrata	MASTROST	7
205	no-co-do-ct-ph	Myrtaceae	Syzygium	tetraptera	SYZYTETR	7
206	no-la-do-ct-ph	Euphorbiaceae	Baccaurea	206	BACC0206	7
207	me-co-do-ct-ph	Fabaceae	Indet	207	TN020207	7
208	me-la-do-ct-ph	Fabaceae	Sindora	velutina	SINDVELU	7
209	na-ve-do-su-hc-li-ad-ep	Asclepiadaceae	Dischidia	209	DISC0209	7
210	me-la-do-ph-li	Loganiaceae	Fagraea	210	FAGR0210	7
211	pl-co-do-ct-ph	Dipterocarpaceae	Anisoptera	211	ANIS0211	8
212	no-co-do-ct-ph	Melastomataceae	Memecylon	212	MEME0212	8
213	mi-la-do-ct-ph-ad	Aquifoliaceae	Ilex	213	ILEX0213	8
214	me-la-do-ph-li	Indet	Indet	214	TN020214	8
215	no-co-do-ph-ad	Fagaceae	Lithocarpus	215	LITH0215	8
216	me-pe-do-ph-li-ad-ep	Piperaceae	Piper	216	PIPE0216	8
217	no-la-do-ro-pv-ph-li-ad	Arecaceae	Calamus	217	CALA0217	8
218	mi-co-do-ph-li	Fabaceae	Dalbergia	218	DALB0218	8

Table 3. Plant species and functional types. Plot TN03

Rec.	PFT	Family	Genus	Species	code	quad
1	no-la-do-ct-ph	Annonaceae	Xylopia	ferruginea	XYLOFERR	1
2	pl-la-do-ph-ad	Euphorbiaceae	Agrostistachys	sessilifolia	AGROSESS	1
3	no-la-do-ph-li-ad	Clusiaceae	Garcinia	sp03	GARCSP03	1
4	me-la-do-ct-ph	Rubiaceae	Ixora	sp04	IXORSP04	1
5	me-la-do-ph-li	Fabaceae	Phanera	sp05	PHANSP05	1
6	me-la-do-ph	Burseraceae	Santiria	oblongifolia	SANTOBLO	1
7	pl-co-do-ct-ph	Lauraceae	Alseodaphne	sp07	ALSESP07	1
8	me-la-do-ct-ph	Euphorbiaceae	Blumeodendron	elateriospermum	BLUMELAT	1
9	no-la-do-ct-ph	Euphorbiaceae	Neoscortechinia	kingii	NEOSKING	1
10	me-la-do-ct-ph	Rhamnaceae	Zizyphus	calophylla	ZIZYCALO	1
11	mi-la-do-ct-ph	Myrtaceae	Syzygium	sp11	SYZYSP11	1
12	me-la-do-ct-ph	Polygalaceae	Xanthophyllum	sp12	XANTSP12	1
13	no-la-do-ph	Dipterocarpaceae	Shorea	leprosula	SHORLEPR	1
14	mi-la-do-ct-ph	Sapindaceae	Nephelium	eriopetalum	NEPHERIO	1
15	pl-la-do-ct-ph	Rubiaceae	Timonius	sp15	TIMOSP15	1
16	no-la-do-ct-ph	Lauraceae	Endiandra	rubescens	ENDIRUBE	1
17	me-la-do-ct-ph	Fagaceae	Lithocarpus	conocarpus	LITHCONO	1
18	me-la-do-ch	Olacaceae	Scorodocarpus	borneensis	SCORBORN	1
19	no-la-do-ct-ph	Fabaceae	Archidendron	sp19	ARCHSP19	1
20	pl-la-do-ph-li	Vitaceae	Parthenocissus	sp20	PARTSP20	1
21	mi-la-do-ct-ph	Burseraceae	Santiria	rubiginosa	SANTRUBI	1
22	me-la-do-ct-ph	Myrtaceae	Syzygium	sp22	SYZYSP22	1
23	me-la-do-ch	Lauraceae	Litsea	machilifolia	LITSMACH	1
24	na-la-do-ph-li	Connaraceae	Rourea	mimosoides	ROURMIMO	1
25	no-la-do-ct-ph	Clusiaceae	Calophyllum	sp25	CALOSP25	2
26	na-la-do-ch	Anisophyleaceae	Anisophyllea	disticha	ANISDIST	2
27	me-la-do-ch	Euphorbiaceae	Baccaurea	sp27	BACCSP27	2
28	me-la-do-ct-ph	Sapindaceae	Nephelium	cuspidatum	NEPHCUSP	2
29	me-la-do-ph	Dipterocarpaceae	Shorea	macroptera	SHORMACR	2
30	no-la-do-ch	Rubiaceae	Chassalia	curviflora?	CHASCURV	2
31	no-pe-do-ph-li	Sterculiaceae	Byttneria	sp31	BYTTSP31	2
32	me-la-do-ct-ph	Myrtaceae	Syzygium	sp32	SYZYSP32	2
33	ma-ve-do-ct-ph	Dilleniaceae	Dillenia	eximia	DILLEXIM	2
34	me-co-do-ct-ph	Lecythidaceae	Barringtonia	sp34	BARRSP34	2
35	no-ve-do-ch	Rubiaceae	Prismatomeris	sp35	PRISSP35	2
36	me-la-do-ct-ph	Ixonanthaceae	Ixonanthes	icosandra	IXONICOS	2
37	me-la-do-ch	Linaceae	Indorouchera	griffithii	INDOGRIF	2
38	na-la-do-ph-li	Apocynaceae	Willughbeia	coriacea	WILLCORI	2
39	no-la-do-hc-li	Vitaceae	Pterisanthes	sp39	PTERSP39	2
40	me-la-do-ct-ph	Burseraceae	Canarium	hirsutum	CANAHIRS	3
41	no-la-do-ph-li-ad-ep	Rubiaceae	Psychotria	sarmentosa	PSYCSARM	3
42	no-la-do-su-ph-li-ad-ep	Piperaceae	Piper	sp42	PIPESP42	3
43	me-la-do-ct-ph	Burseraceae	Canarium	sp43	CANASP43	3
44	me-la-do-ph	Clusiaceae	Calophyllum	sp44	CALOSP44	3
45	no-la-do-ch	Sterculiaceae	Leptonychia	heteroclita	LEPTHETE	3
46	me-la-do-ph-li	Connaraceae	Rourea	minor	ROURMINO	3
47	me-la-do-ro-su-pv-hc-ad	Hanguanaceae	Hanguana	malayana	HANGMALA	3

48	pl-la-do-ct-ph	Rubiaceae	Gardenia	pterocalyx	GARDPTER	3
49	no-la-do-ct-ph	Burseraceae	Santiria	apiculata	SANTAPIC	3
50	no-la-do-ct-ph	Euphorbiaceae	Aporusa	subcaudata	APORSUBC	3
51	mi-la-do-ph	Ebenaceae	Diospyros	sp51	DIOSSP51	3
52	me-la-do-ct-ph	Dipterocarpaceae	Shorea	leprosula	SHORLEPR	3
53	mi-co-do-ph	Fabaceae	Koompassia	malaccensis	KOOMMALA	3
54	no-la-do-ch	Fagaceae	Lithocarpus	sp54	LITHSP54	3
55	no-co-do-ph	Dipterocarpaceae	Shorea	acuminata	SHORACUM	3
56	me-pe-do-ch	Dipterocarpaceae	Parashorea	lucida	PARALUCI	3
57	no-la-do-ct-ph	Fagaceae	Lithocarpus	lucidus	LITHLUCI	3
58	no-la-do-ct-ph	Myrtaceae	Syzygium	sp58	SYZYSP58	4
59	me-la-do-ch	Aquifoliaceae	Ilex	sp59	ILEXSP59	4
60	no-la-do-ph-li	Malphigiaceae	Indet	sp60	INDESP60	4
61	pl-la-do-ph-li	Fabaceae	Spatholobus	ferrugineus	SPATFERR	4
62	no-la-do-ph	Burseraceae	Santiria	oblongifolia	SANTOBLO	4
63	me-la-do-ph	Euphorbiaceae	Baccaurea	macrophylla	BACCMACR	4
64	me-co-do-ph	Burseraceae	Dacryodes	incurvata	DACRINCU	4
65	mi-la-do-ct-ph	Clusiaceae	Garcinia	havilandii	GARCHAVI	4
66	me-co-do-ct-ph	Euphorbiaceae	Aporusa	lucida	APORLUCI	4
67	me-la-do-ct-ph	Fagaceae	Lithocarpus	sp67	LITHSP67	4
68	me-la-do-ch	Fabaceae	Dialium	sp68	DIALSP68	4
69	mi-la-do-ct-ph	Annonaceae	Xylopia	malayana	XYLOMALA	4
70	mi-ve-do-ct-ph	Fabaceae	Parkia	speciosa	PARKSPEC	5
71	no-co-do-ch	Bombacaceae	Durio	griffithii	DURIGRIF	5
72	no-ve-do-ch	Smilaxaceae	Smilax	calophylla	SMILCALO	5
73	me-la-do-ct-ph	Euphorbiaceae	Pimelodendron	griffithianum	PIMEGRIF	5
74	me-la-do-ct-ph	Sapotaceae	Palaquium	rostratum	PALQROST	5
75	me-co-do-ct-ph	Icacinaceae	Gonocaryum	gracile	GONOGRAC	5
76	me-la-do-ct-ph	Melastomataceae	Memecylon	costatum	MEMECOST	5
77	me-co-do-ph	Euphorbiaceae	Ptychopyxis	costata	PTYCCOST	5
78	me-ve-do-ct-ph	Rubiaceae	Tarenna	sp78	TARESP78	5
79	mi-la-do-ph	Sapindaceae	Nephelium	uncinatum	NEPHUNCI	5
80	no-co-do-ph-li-ad	Indet	Indet			5
81	me-la-do-ct-ph	Alangiaceae	Alangium	sp81	ALANSP81	5
82	me-la-do-ph-li	Annonaceae	Uvaria	sp82	UVARSP82	5
83	me-la-do-hc-ad	Myrsinaceae	Labisia	pumila	LABIPUMI	5
84	me-co-do-ph	Thymelaeaceae	Gonystylus	sp84	GONYSP84	6
85	me-co-do-ct-ph	Dipterocarpaceae	Vatica	sp85	VATISP85	6
86	me-la-do-ch	Tiliaceae	Microcos	paniculata	MICRPANI	6
87	pl-la-do-ph	Sapindaceae	Xerospermum	noronhianum	XERONORO	6
88	me-co-do-ct-ph	Myristicaceae	Knema	sp88	KNEMSP88	6
89	me-la-do-ph-li	Dilleniaceae	Tetracera	fagifolia?	TETRFAGI	6
90	me-la-do-ct-ph	Inder	Indet	sp90	SP90	6
91	no-la-do-ph-li	Connaraceae	Connarus	sp91	CONNSP91	6
92	me-la-do-ct-ph	Dipterocarpaceae	Shorea	seminis	SHORSEMI	7
93	me-pe-do-ct-ph	Lauraceae	Actinodaphne	sp93	ACTISP93	7
94	me-la-do-ch	Rubiaceae	Gaertnera	vaginans?	GAERVAGI	7
95	me-la-do-ph-li	Fabaceae	Millettia	splendidissima	MILLSPLE	7
96	no-la-do-ph	Myristicaceae	Knema	cinerea	KNEMCINE	7
97	me-la-do-ct-ph	Sapindaceae	Nephelium	lappaceum	NEPHLAPP	7
98	me-la-do-ch	Euphorbiaceae	Baccaurea	sp98	BACCSP98	7

99	no-ve-do-ch	Rubiaceae	Tarenna	sp99	TARESP99	7
100	me-la-do-ct-ph	Burseraceae	Canarium	sp100	CANASP10	7
101	me-la-do-ph-li	Menispermaceae	Cocculus	sp101	COCCSP10	7
102	no-la-do-ch	Violaceae	Rinorea	anguifera	RINOANGU	7
103	pl-la-do-ph	Rubiaceae	Nauclea	sp103	NAUCSP10	8
104	me-co-do-ph	Dipterocarpaceae	Shorea	parvifolia	SHORPARV	8
105	pl-la-do-ph	Anacardiaceae	Melanochyla	caesia?	MELACAES	8
106	me-la-do-ph	Myrtaceae	Rhodamnia	cinerea	RHODCINE	8
107	me-la-do-ct-ph	Rubiaceae	Urophyllum	sp107	UROPSP10	8
108	no-co-do-ct-ph-ad	Sapindaceae	Nephelium	juglandifolia?	NEPHJUGL	8
109	me-la-do-ph-li	Celastraceae	Salacia	sp109	SALASP10	8
110	no-la-do-ph-li	Indet	Indet	sp110	SP11	8
111	me-co-do-ct-ph-ad	Indet	Indet	sp111	SP11	8

Table 4. Plant species and functional types Plot TN04

Rec.	PFT	Family	Genus	Species	code	quad
1	me-co-do-ct-ph	Euphorbiaceae	Aporusa	lucida	APORLUCI	1
2	me-co-do-ct-ph	Dipterocarpaceae	Shorea	macroptera	SHORMACR	1
3	no-la-do-ct-ph	Euphorbiaceae	Aporusa	subcaudata	APORSUBC	1
4	pl-la-do-ct-ph	Clusiaceae	Garcinia	sp04	GARCSP04	1
5	no-la-do-ct-ph	Flacourtiaceae	Hydnocarpus	kunstleri	HYDNKUNS	1
6	no-la-do-ct-ph	Burseraceae	Santiria	apiculata	SANTAPIC	1
7	pl-la-do-ct-ph	Myristicaceae	Gymnacranthera	sp07	GYMNSP07	1
8	me-co-do-ct-ph	Annonaceae	Griffithianthus	merrillii	GRIFMERR	1
9	me-la-do-ct-ph	Euphhorbiaceae	Galearia	fulva	GALEFULV	1
10	no-co-do-ph-li	Fabaceae	Phanera	coccinea	PHANCOCC	1
11	me-la-do-ph	Polygalaceae	Xanthophyllum	sp11	XANTSP11	1
12	no-co-do-ph-li	Convolvulaceae	Erycibe	sp12	ERYCSP12	1
13	no-co-do-ph	Fabaceae	Archidendron	microcarpum	ARCHMICR	1
14	no-la-do-ct-ph	Lauraceae	Actinodaphne	sp14	ACTISP14	1
15	me-la-do-ct-ph	Lecythidaceae	Barringtonia	macrostachya	BARRMACR	1
16	pi-la-do-fi-hc-ad	Selaginellaceae	Selaginella	sp16	SELASP16	1
17	no-la-do-fi-hc-ad	Polypodiaceae	Taenitis	blechnoides	TAENBLEC	1
18	me-la-do-su-ch-ad-ep	Araceae	Anadendrum	sp18	ANODSP18	1
19	no-co-do-ph-ad	Euphorbiaceae	Baccaurea	sumatrana	BACCSUMA	1
20	me-la-do-ct-ph	Dipterocarpaceae	Shorea	acuminata	SHORACUM	1
21	na-la-do-ph-li	Fabaceae	Dalbergia	sp21	DALBSP21	1
22	no-la-do-ct-ph	Euphorbiaceae	Antidesma	neurocarpum	ANTINEUR	1
23	na-co-do-ph	Myristicaceae	Gymnacranthera	bancana	GYMNBANC	1
24	me-la-do-ph	Myrsinaceae	Ardisia	sp24	ARDISP24	1
25	no-la-do-ph-ad	Rhizophoraceae	Carallia	brachiata	CARABRAC	1
26	no-la-do-ph	Rubiaceae	Tricalysia	malaccensis	TRICMALA	1
27	no-la-do-ph	Indet	Indet	sp27	TN04SP27	1
28	ma-la-do-ro-ch	Arecaceae	Licuala	sp28	LICUSP28	1
29	no-la-do-ph-li-ad-ep	Araceae	Pothos	scandens?	POTHSCAN	1
30	me-pe-do-ct-ph	Euphorbiaceae	Aporusa	sp30	APORSP30	1
31	me-la-do-ph	Meliaceae	Chisocheton	sp31	CHISSP31	1
32	no-la-do-ph	Myrtaceae	Syzygium	sp32	SYZYSP32	1
33	me-co-do-ct-ph	Icacinaceae	Gonocaryum	gracile	GONOGRAC	1
34	me-la-do-ph	Fabaceae	Indet	sp34	INDESP34	1
35	me-co-do-ct-ph	Euphorbiaceae	Pimelodendron	griffithianum	PIMEGRIF	1
36	no-la-do-ct-ph-ad	Burseraceae	Canarium	sp36	CANASP36	1
37	na-la-do-ph	Dipterocarpaceae	Parashorea	lucida?	PARALUCI	1
38	mi-la-do-ph	Annonaceae	Xylopia	sp38	XYLOSP38	1
39	no-la-do-ph	Fagaceae	Lithocarpus	sp39	LITHSP39	1
40	me-co-do-ph	Sapotaceae	Palaquium	gutta	PALAGUTT	1
41	no-la-do-ct-ph	Rubiaceae	Urophyllum	glabrum	UROPGLAB	1
42	me-la-do-ct-ph	Rubiaceae	Urophyllum	hirsutum	UROPHIRS	1
43	na-la-do-fi-hc-li-ad-ep	Adianthaceae	Lindsaea	sp43	LINDSP43	1
44	no-la-do-ct-ph	Sap[indaceae	Xerospermum	laevigatum	XEROLAEV	1
45	me-la-do-ph	Burseraceae	Santiria	laevigata	SANTLAEV	1
46	me-la-do-ct-ph	Anacardiaceae	Buchanania	arborescens	BUCHARBO	1
47	no-la-do-ct-ph	Apocynaceae	Hunteria	zeylanica	HUNTZEYL	1
48	mi-ve-do-pv-ro-ph-li-ad	Arecaceae	Calamus	sp48	CALASP48	1

49	me-co-do-ro-pv-ph-li-ad	Arecaceae	Calamus	javensis	CALAJAVE	1
50	no-la-do-ch	Rhamnaceae	Zizyphus	calophylla	ZIZYCALO	1
51	me-co-do-ph-li	Annonaceae	Uvaria	sp51	UVARSP51	2
52	me-co-do-pv-ro-ph-li-ad	Arecaceae	Calamus	caesius	CALACAES	2
53	le-la-do-fi-ph-li-ad	Gleicheniaceae	Dicranopteris	linearis	DICRLINE	2
54	me-pe-do-ct-ph	Olacaceae	Ochanostachys	amentacea	OCHAAMEN	2
55	mi-la-do-ct-ph	Dipterocarpaceae	Hopea	sp55	HOPESP55	2
56	me-co-do-ph-li	Convolvulaceae	Erycibe	sp56	ERYCSP56	2
57	me-co-do-ct-ph	Ulmaceae	Gironniera	subaequalis	GIROSUBA	2
58	me-la-do-ph	Euphorbiaceae	Drypetes	sp58	DRYPSP58	2
59	me-la-do-ph	Euphorbiaceae	Baccaurea	sp59	BACCSP59	2
60	me-co-do-ph	Clusiaceae	Calophyllum	sp60	CALOSP60	2
61	no-la-do-ph-li	Connaraceae	Rourea	minor	ROURMINO	2
62	no-la-do-ph-li	Smilaxaceae	Smilax	sp62	SMILSP62	2
63	me-la-do-ph	Sapindaceae	Nephelium	sp63	NEPHSP63	2
64	pl-co-do-pv-hc-ad	Zingiberaceae	Curcuma	sp64	CURCSP64	2
65	no-la-do-ct-ph	Myrtaceae	Syzygium	sp65	SYZYSP65	2
66	ma-la-do-ct-ph	Dipterocarpaceae	Anisoptera	marginata	ANISMARG	2
67	me-la-do-ct-ph	Myristicaceae	Gymnacranthera	contracta	GYMNCONT	2
68	me-co-do-ph-li	Dilleniaceae	Tetracera	fagifolia?	TETRFAGI	2
69	me-pe-do-ct-ph	Euphorbiaceae	Aporusa	sp69	APORSP69	2
70	me-la-do-pv-ro-ph-li-ad	Arecaceae	Korthalsia	sp70	KORTSP70	2
71	pl-la-do-ph	Rubiaceae	Gardenia	pterocalyx	GARDPTER	2
72	me-pe-do-ct-ph	Verbenaceae	Clerodendrum	laevifolium	CLERLAEV	2
73	me-la-do-ct-ph	Clusiaceae	Mesua	sp73	MESUSP73	2
74	me-la-do-ph-li	Loganiaceae	Srychnos	ignatii	SRYCIGNA	2
75	me-co-do-ph	Moraceae	Artocarpus	heterophyllus	ARTOHETE	2
76	mi-co-do-ph	Ebenaceae	Diospyros	sp76	DIOSSP76	2
77	mi-la-do-ph	Annonaceae	Xylopia	sp77	XYLOSP77	2
78	no-la-do-ph-li	Gnetaceae	Gnetum	cuspidatum	GNETCUSP	2
79	me-la-do-ct-ph	Sapotaceae	Madhuca	sericea	MADHSERI	2
80	me-la-do-ph-li	Apocynaceae	Indet	sp80	INDESP80	3
81	no-la-do-so-su-hc-ad	Orchidaceae	Indet	sp81	INDESP81	3
82	me-la-do-ct-ph	Sabiaceae	Meliosma	nitida	MELINITI	3
83	me-la-do-ct-ph	Simaroubaceae	Eurycoma	longifolia	ERYCLONG	3
84	no-la-do-ph-li	Annonaceae	Friesodielsia	kentii	FRIEKENT	3
85	no-la-do-pv-hc-ad	Zingiberaceae	Globba	pendula	GLOBPEND	3
86	me-ve-do-pv-hc-ad	Zingiberaceae	Alpinia	sp86	ALPISP86	3
87	na-la-do-ch	Anisophylleaceae	Anisophyllea	disticha	ANISDIST	3
88	me-la-do-ph	Aquifoliaceae	Ilex	sp88	ILEXSP88	3
89	no-la-do-ph-li	Apocynaceae	Willughbeia	coriacea	WILLCORI	3
90	no-la-do-ct-ph	Clusiaceae	Calophyllum	sp90	CALOSP90	3
91	no-co-do-ct-ph	Theaceae	Ternstroemia	sp91	TERNSP91	3
92	me-la-do-ct-ph	Euphorbiaceae	Baccaurea	sp92	BACCSP92	3
93	pl-co-do-ct-ph	Elaeocarpaceae	Elaeocarpus	sp93	ELAESP93	3
94	pl-la-do-pv-hc-ad	Zingiberaceae	Indet	sp94	TN04SP94	3
95	no-la-do-ph-li	Myrsinaceae	Embelia	ribes?	EMBERIBE	3
96	mi-la-do-ph-li	Apocynaceae	Indet	sp96	INDESP96	3
97	me-la-do-ph-li	Smilaxaceae	Smilax	leucophylla	SMILLEUC	3
98	me-la-do-ct-ph	Myristicaceae	Myristica	sp98	MYRISP98	3
99	me-la-do-ro-su-pv-hc-ad	Hanguanaceae	Hanguana	malayana	HANGMALA	4

100	me-la-do-ph-li	Connaraceae	Connarus	sp100	CONNSP10	4
101	me-la-do-ph	Dilleniacedae	Dillenia	sp101	DILLSP10	4
102	pl-la-do-ct-ph	Rubiaceae	Timonius	stipulaceus	TIMOSTIP	4
103	me-co-do-ct-ph	Fagaceae	Lithocarpus	sp103	LITHSP10	4
104	pl-co-do-ct-ph	Fagaceae	Lithocarpus	sp104	LITHSP10	4
105	mi-la-do-ct-ph	Fabaceae	Koompassia	malaccensis	KOOMMALA	4
106	mi-la-do-ph-li	Loganiaceae	Strychnos	sp106	STRYSP10	4
107	mi-la-do-ph-li	Celastraceae	Salacia	sp107	SALASP10	4
108	me-co-do-ct-ph	Symplocaceae	Symplocaceae	rubiginosa	SYMPRUBI	4
109	na-la-do-ct-ph	Fabaceae	Parkia	sp109	PARKSP10	4
110	no-la-do-ph	Verbenaceae	Teijsmanniodendron	coriaceum	TEIJCORI	4
111	pl-co-do-ro-pv-ph-li-ad-ep	Pandanaceae	Freycinetia	sp111	FREYSP11	4
112	pl-la-do-ph-li	Annonaceae	Oxymitra	sp112	OXYMSP11	4
113	no-la-do-ct-ph	Burseraceae	Santiria	oblongifolia	SANTOBLO	4
114	me-co-do-ct-ph	Magnoliaceae	Talauma	candollei?	TALACAND	4
115	me-la-do-ct-ph	Myristicaceae	Knema	sp115	KNEMSP11	4
116	pl-co-do-ph-ad	Sapotaceae	Pouteria	malaccensis	POUTMALA	4
117	no-la-do-ph	Myristicaceae	Myristica	sp1	MYRISP1	4
118	no-la-do-su-ph-li-ep	Araceae	Scindapsus	sp118	SCINSP11	4
119	no-la-do-ct-ph	Rutaceae	Zanthoxylum	sp119	ZANTSP11	4
120	me-co-do-ph	Dipterocarpaceae	Vatica	sp120	VATISP12	4
121	pl-co-do-ct-ph	Rubiaceae	Lasianthus	scabridus	LASISCAB	4
122	no-la-do-ct-ph	Euphorbiaceae	Neoscortechinia	kingii	NEOSKING	4
123	me-co-do-ct-ph	Sterculiaceae	Sterculia	sp123	STERSP12	5
124	me-la-do-ct-ph	Ebenaceae	Diospyros	wallichianus?	DIOSWALL	5
125	me-la-do-ph	Indet	Indet	sp125	TN04SP12	5
126	no-la-do-ct-ph	Annonaceae	Xylopia	malayana	XYLOMALA	5
127	no-la-do-ph-li	Loganiaceae	Strychnos	ignatii?	SRYCIGNA	5
128	me-la-do-ct-ph	Myrtaceae	Syzygium	sp128	SYZYSP12	5
129	me-co-do-ph	Lauraceae	Beilschmiedia	maingayi	BEILMAIN	5
130	no-la-do-ph-li	Vitaceae	Cissus	discolor	CISSDISC	5
131	me-la-do-ph	Anacardiaceae	Melanochyla	caesia	MELACAES	5
132	me-la-do-ct-ph	Moraceae	Artocarpus	nitidus	ARTONITI	5
133	no-la-do-ph-li	Apocynaceae	Indet	sp133	INDESP13	5
134	no-co-do-ct-ph	Lauraceae	Litsea	firma	LITSFIRM	5
135	no-co-do-ct-ph	Euphorbiaceae	Trigonopleura	malayana	TRIGMALA	6
136	me-la-do-ph-li	Fabaceae	Spatholobus	ferrugineus	SPATFERR	6
137	no-la-do-ph-li	Connaraceae	Agelaea	borneensis	AGELBORN	6
138	me-co-do-ct-ph	Ebenaceae	Diospyros	sp138	DIOSSP13	6
139	no-la-do-su-hc-ad	Myrsinaceae	Labisia	pumila	LABIPUMI	6
140	pl-la-do-ph-ad	Euphorbiaceae	Baccaurea	sp140	BACCSP14	6
141	me-co-do-ph	Anacardiaceae	Mangifera	sp141	MANGSP14	6
142	no-la-do-ct-ph	Clusiaceae	Calophyllum	sp142	CALOSP14	6
143	no-la-do-ct-ph	Burseraceae	Canarium	littorale	CANALITT	6
144	no-la-do-ph-li	Connaraceae	Roureopsis	emarginata	ROUREMAR	6
145	me-la-do-ph	Dipterocarpaceqae	Vatica	sp145	VATISP14	7
146	no-la-do-ct-ph	Rubiaceae	Canthium	spinosum?	CANTSPIN	7
147	me-la-do-ct-ph	Euphorbiaceae	Baccaurea	sp147	BACCSP14	7
148	me-co-do-ct-ph	Lauraceae	Dehaasia	sp148	DEHASP14	7
149	no-la-do-ph	Euphorbiaceae	Aporusa	sp149	APORSP14	7
150	pl-la-do-ph	Annonaceae	Cyathocalyx	bancana	CYATBANC	7

151	no-la-do-ph	Melastomataceae	Pternandra	sp151	PTERSP15	7
152	pl-la-do-ro-pv-ph-li-ad	Arecaceae	Korthalsia	sp152	KORTSP15	7
153	no-pe-do-ph-li	Melastomataceae	Dissochaeta	sp153	DISSSP15	7
154	mi-la-do-ph-li	Malphigiaceae	Indet	sp154	INDESP15	7
155	me-la-do-ct-ph	Sapindaceae	Nephelium	sp155	NEPHSP15	7
156	mi-co-do-ct-ph	Fabaceae	Dialium	sp156	DIALSP15	7
157	me-la-do-ph	Myrtaceae	Syzygium	sp157	SYZYSP15	7
158	me-co-do-ph	Sapotaceae	Palaquium	sp158	PALASP15	7
159	no-la-do-pv-hc-li-ad	Orchidaceae	Indet	sp159	INDESP15	7
160	no-la-do-hc-ad	Myrsinaceae	Labisia	sp160	LABISP16	7
161	no-la-do-ph-ad	Indet	Indet	sp161	TN04SP16	7
162	me-pe-do-ct-ph	Fabaceae	Indet	sp162	INDESP16	8
163	no-la-do-ph-li	Apocynaceae	Indet	sp163	INDESP16	8
164	no-co-do-ph-li	Fagaceae	Quercus	sp164	QUERSP16	8
165	me-la-do-ct-ph	Sapindaceae	Xerospermum	noronhianum	XERONORO	8
166	me-la-do-ct-ph	Apocynaceae	Dyera	costulata	DYERCOST	8
167	me-pe-do-su-pv-ph-li-ep	Araceae	Scindapsus	sp167	SCINSP16	8
168	me-la-do-ph	Moraceae	Artocarpus	sp168	ARTOSP16	8
169	no-la-do-ph	Thymelaeaceae	Gonystylus	velutinus	GONYVELU	8
170	no-co-do-ph-li	Oxalidaceae	Dapania	racemosa	DAPARACE	8
171	na-la-do-ph-li	Connaraceae	Rourea	mimosoides	ROURMIMO	8

Table 5. Plant species and functional types Plot TN05

Rec.	modus	family	genus	species	code	quad
1	no-la-do-ch	Euphorbiaceae	Indet	sp01	INDESP01	1
2	no-la-do-ch	Euphorbiaceae	Aporusa	sp02	APORSP02	1
3	no-pe-do-ct-ph	Euphorbiaceae	Hevea	brasiliensis	HEVEBRAS	1
4	pl-co-do-ct-ph	Moraceae	Artocarpus	elasticus	ARTOELAS	1
5	mi-co-do-ph-li	Fabaceae	Dalbergia	sp05	DALBSP05	1
6	me-la-do-cr-li	Dioscoreaceae	Dioscorea	sp06	DIOSSP06	1
7	me-la-do-ch	Rubiaceae	Indet	sp07	INDESP07	1
8	me-co-do-ch	Annonaceae	Gonocaryum	gracile	GONOGRAC	1
9	mi-la-do-ch	Sapindaceae	Guioa	diplopetala	GUIODIPL	1
10	no-la-do-ph-li	Fabaceae	Derris	elliptica	DERRELLI	1
11	mi-la-do-pv-hc-ad	Cyperaceae	Scleria	purpurescens	SCLEPURP	1
12	mi-la-do-pv-hc-ad	Poaceae	Axonopus	compressus	AXONCOMP	1
13	me-ve-do-ro-pv-cr	Hypoxidaceae	Curculigo	latifolia	CURCLATI	1
14	no-la-do-ch	Myrtaceae	Rhodamnia	cinerea	RHODCINE	1
15	me-la-do-ch	Anacardiaceae	Vernonia	arborescens	VERNARBO	1
16	no-la-do-ch	Symplocaceae	Symplocos	fasciculata	SYMPFASC	1
17	no-la-do-ch	Melastomataceae	Melastoma	polyanthum	MELAPOLY	1
18	mi-la-do-pv-hc-ad	Poaceae	Centotheca	lappacea	CENTLAPP	1
19	mi-la-do-pv-hc-ad	Poaceae	Oplismenus	sp19	OPLISP19	1
20	no-la-do-ch	Myrtaceae	Decaspermum	sp20	DECASP20	1
21	no-la-do-ch	Euphorbiaceae	Bridelia	sp21	BRIDSP21	1
22	me-la-do-ch	Euphorbiaceae	Macaranga	sp22	MACASP22	1
23	mi-la-do-hc	Rubiaceae	Borreria	sp23	BORRSP23	1
24	mi-la-do-pv-hc	Poaceae	Isachne	sp24	ISACSP24	1
25	mi-la-do-pv-hc-ad	Orchidaceae	Orchid	sp25	ORCHSP25	1
26	mi-la-do-pv-hc-ad	Poaceae	Axonopus	sp26	AXONSP26	1
27	me-la-do-pv-hc-ad	Zingiberaceae	Zingiber	sp278	ZINGSP27	2
28	na-la-do-fi-hc-li-ad	Blechniaceae	Dicranopteris	linearis	DICRLINE	2
29	pi-la-do-fi-hc-ad	Selaginelaceae	Selaginella	sp29	SELASP29	2
30	no-la-do-ch-li	Apocynaceae	Indet	sp30	INDESP30	2
31	mi-la-do-ch-li	Connaraceae	Roureopsis	emarginata	ROUREMAR	2
32	mi-la-do-ch	Indet	Indet	sp32	INDESP32	2
33	me-la-do-pv-cr	Zingiberaceae	Curcuma	sp33	CURCSP33	3
34	no-la-do-ch	Violaceae	Rinorea	anguifera	RINOANGU	3
35	no-la-do-ch	Sympllocaceae	Symplocos	cochinchinensis	SYMPCOCH	3
36	mi-la-do-ch	Theaceae	Eurya	sp36	EURYSP36	3
37	me-la-do-ch-li	Rubiaceae	Canthium	spinosum	CANTSPIN	4
38	me-la-do-ch	Rubiaceae	Psychotria	sp38	PSYCSP38	4
39	no-la-do-ct-ph	Verbenaceae	Vitex	pinnata	VITEPINN	4
40	no-co-do-ch-li	Gnetaceae	Gnetum	sp40	GNETSP40	4
41	me-la-do-ch	Menispermaceae	Cocculus	sp41	COCCSP41	4
42	mi-la-do-ch	Euphorbiaceae	Sauropus	sp42	SAURSP42	4
43	me-co-do-ct-ph	Asteraceae	Vernonia	arborea	VERNARBO	5
44	no-la-do-ch-li	Connaraceae	Connarus	sp44	CONNSP44	5
45	me-la-do-ph	Euphorbiaceae	Macaranga	sp45	MACASP45	5
46	pi-la-do-ch	Dilleniaceae	Dillenia	excelsa	DILLEXCE	6
47	me-la-do-ch	Moraceae	Ficus	subulata	FICUSUBU	6

48	pl-la-do-ch	Moraceae	Ficus	hirta	FICUHIRT	7
49	ma-la-do-ch	Dilleniaceae	Dillenia	obovata	DILLOBOV	7
50	me-co-do-ch	Lecythidaceae	Barringtonia	sp50	BARRSP50	7
51	mi-la-do-ch	Myrtaceae	Syzygium	sp51	SYZYSP51	7
52	no-la-do-ch	Polygalaceae	Xanthophyllum	flavescens	XANTFLAV	8
53	no-co-do-ch	Euphorbiaceae	Microdesmis	caseariifolia	MICRCASE	8
54	me-la-do-ch	Sapotaceae	Pouteria	malaccensis	POUTMALA	8
55	me-la-do-ch	Verbenaceae	Clerodendrum	laevis	CLERLAEV	8
56	no-la-do-ch	Melastomataceae	Clidemia	hirta	CLIDHIRT	8
57	me-la-do-ph-li	Menispermaceae	Fibraurea	chloroleuca	FIBRCHLO	8
58	no-la-do-ch	Rosaceae	Prunus	arborea	PRUNARBO	8
59	me-la-do-ch	Euphorbiaceae	Galearia	filiformis	GALEFILI	8

Table 6. Plant species and functional types Plot TN06

Rec.	PFT	Family	Genus	Species	code	quad
1	me-co-is-ct-ph	Fabaceae	Acacia	mangium	ACACMANG	1
2	me-co-do-ph-li	Vitaceae	Parthenocissus	sp02	PARTSP02	1
3	no-la-do-ct-ph	Trigoniaceae	Trigoniastrum	hypoleucum	TRIGHYPO	1
4	me-co-do-ch	Lauraceae	Cryptocarya	sp04	CRYPSP04	1
5	no-la-do-ph-li	Apocynaceae	Willughbeia	coriacea	WILLCORI	1
6	na-la-do-ch	Anisophylleaceae	Anisophyllea	disticha	ANISDIST	1
7	me-la-do-ct-ph	Euphorbiaceae	Baccaurea	sp07	BACCSP07	1
8	me-la-do-ch	Simaroubaceae	Eurycoma	longifolia	EURYLONG	1
9	me-la-do-hc-ad	Myrsinaceae	Labisia	pumila	LABIPUMI	1
10	me-la-do-pv-hc-ad	Zingiberaceae	Indet	sp10	INDESP10	1
11	mi-la-do-ph-li	Connaraceae	Roureopsis	emarginata	ROUREMAR	1
12	me-la-do-ch	Rubiaceae	Chassalia	sp12	CHASSP12	1
13	me-la-do-ph-li	Connaraceae	Connarus	sp13	CONNSP13	1
14	me-la-do-ch	Rubiaceae	Gardenia	pterocalyx	GARDPTER	1
15	me-la-do-ph-li	Annonaceae	Artabotrys	rosea	ARTAROSE	1
16	no-la-do-ch-li	Fabaceae	Spatholobus	ferrugineus	SPATFERR	1
17	me-la-do-ch	Sapindaceae	Nephelium	ramboutan-ake	NEPHRAMB	1
18	no-co-do-pv-hc-ad	Zingiberaceae	Globba	pendula	GLOBPEND	1
19	pi-co-do-ro-pv-hc-ad	Hangunaceae	Hanguana	malayana	HANGMALA	1
20	me-la-do-ch	Linaceae	Ixonanthes	icosandra	IXONICOS	1
21	me-la-do-ch	Annonaceae	Monocarpia	marginalis	MONOMARG	1
22	me-la-do-ch-li	Menispermaceae	Cocculus	sp22	COCCSP22	1
23	mi-la-do-ch	Polygalaceae	Xanthophyllum	sp23	XANTSP23	1
24	me-la-do-ch	Euphorbiaceae	Baccaurea	sumatrana	BACCSUMA	1
25	no-la-do-ph	Myrtaceae	Syzygium	sp25	SYZYSP25	1
26	me-la-do-ct-ph	Ulmaceae	Gironniera	sp26	GIROSP26	1
27	pi-la-do-ch	Euphorbiaceae	Baccaurea	sp27	BACCSP27	1
28	me-la-do-ch	Anacardiaceae	Semecarpus	sp28	SEMESP28	2
29	me-la-do-ch	Euphorbiaceae	Galearia	filiformis	GALEFILI	2
30	mi-la-do-fi-hc-ad	Nephrolepidaceae	Nephrolepis	exaltata	NEPHEXAL	2
31	me-la-do-pv-hc-ad	Poaceae	Imperata	cylindrica	IMPECYLI	2
32	me-la-do-ch	Symplocaceae	Symplocos	rubiginosa	SYMPRUBI	2
33	mi-la-do-ch	Ebenaceae	Diospyros	sp33	DIOSSP33	2
34	me-co-do-ch	Polygalaceae	Xanthophyllum	sp34	XANTSP34	2
35	pl-la-do-ch-li	Dilleniaceae	Tetracera	scandens	TETRSCAN	2
36	me-la-do-ch-li	Vitaceae	Tetrastigma	sp36	TETRSP36	3
37	me-la-do-ch	Fabaceae	Spatholobus	sp37	SPATSP37	3
38	pl-la-do-ct-ph	Euphorbiaceae	Macaranga	sp38	MACASP38	3
39	me-la-do-ch-li	Rubiaceae	Uncaria	glabrata	UNCAGLAB	3
40	me-la-do-ch	Rubiaceae	Gaertnera	sp40	GAETSP40	3
41	no-la-do-ch-li	Rhamnaceae	Zizyphus	horsfieldii	ZIZYHORS	3
42	me-la-do-ch	Moraceae	Ficus	sp42	FICUSP42	3
43	pl-la-do-ro-su-hc-ad	Araceae	Alocasia	longiloba	ALOCLONG	3
44	no-la-do-fi-hc-ad	Blechnaceae	Blechnum	orientalis	BLECORIE	4
45	me-la-do-ch-li	Rhamnaceae	Ventilago	oblongifolia	VENTOBLO	4
46	me-la-do-ch	Myrtaceae	Syzygium	sp46	SYZYSP46	4
47	no-la-do-ch	Sterculiaceae	Leptonychia	heteroclita	LEPTHETE	4
48	me-la-do-ct-ph	Burseraceae	Canarium	littorale	CANALITT	4

49	mi-la-do-ct-ph	Elaeocarpaceae	Elaeocarpus	mastersii	ELAEMAST	4
50	no-la-do-ch	Rhizophoraceae	Gynotroches	axillaris	GYNOAXIL	4
51	me-la-do-ph-li	Annonaceae	Uvaria	sp51	UVARSP51	4
52	me-la-do-ph	Rubiaceae	Gardenia	sp52	GARDSP52	4
53	ma-la-do-ch	Dilleniaceae	Dillenia	obovata	DILLOBOV	4
54	pl-la-do-ch-li	Menispermaceae	Fibraurea	chloroleuca	FIBRCHLO	4
55	mi-pe-do-ch-li	Fabaceae	Dalbergia	sp55	DALBSP55	4
56	no-la-do-fi-hc-ad	Polypodiaceae	Tectaria	sp56	TECTSP56	5
57	pi-la-do-pv-hc-ad	Zingiberaceae	Zingiber	sp57	ZINGSP57	5
58	no-la-do-fi-hc-li-ad	Polypodiaceae	Stenochlaena	palustris	STENPALU	5
59	pi-la-do-ro-su-hc-ad	Araceae	Homalomena	cordata	HOMACORD	5
60	me-la-do-ch	Fagaceae	Lithocarpus	sp60	LITHSP60	5
61	me-la-do-ch	Rutaceae	Euodia	sp61	EUODSP61	5
62	mi-la-do-ch-li	Myrsinaceae	Embelia	ribes	EMBERIBE	5
63	na-la-do-fi-hc-li-ad	Gleicheniaceae	Dicranopteris	linearis	DICRLINE	6
64	me-ve-do-ro-su-pv-hc-ad	Araceae	Homalomena	sagitttifolia	HOMASAGI	6
65	no-co-do-ch-li	Annonaceae	Friesodielsia	kentii	FRIEKENT	6
66	mi-ve-do-fi-hc-ad	Pteridaceae	Pteris	sp66	PTERSP66	6
67	pl-co-do-fi-hc-li-ad	Lycopodiaceae	Lycopodium	cernuum	LYCOCERN	6
68	mi-la-do-ch	Burseraceae	Santiria	rubiginosa	SANTRUBI	7
69	me-la-do-ch-li	Rhamnaceae	Zizyphus	sp69	ZIZYSP69	7
70	me-la-do-hc-ad	Myrsinaceae	Labisia	sp70	LABISP70	7
71	me-la-do-ph	Burseraceae	Santiria	oblongifolia	SANTOBLO	7
72	me-la-do-ph-li	Connaraceae	Agelaea	macrophylla	AGELMACR	7
73	me-la-do-ph-li	Apocynaceae	Indet	sp73	INDESP73	7
74	na-la-do-ct-ph	Fabaceae	Parkia	speciosa	PARKSPEC	7
75	pl-la-do-ch	Lauraceae	Litsea	sp75	LITSSP75	8
76	me-la-do-ch	Sterculiaceae	Scaphium	macropodum	SCAPMACR	8
77	me-la-do-ct-ph	Dipterocarpaceae	Shorea	macroptera	SHORMACR	8
78	me-la-do-ct-ph	Euphorbiaceae	Macaranga	gigantea	MACAGIGA	8
79	no-la-do-ch	Elaeocarpaceae	Elaeocarpus	sp79	ELAESP79	8
80	me-la-do-ct-ph	Euphorbiaceae	Pimelodendron	griffithianum	PIMEGRIF	8

Table 7. Plant species and functional types Plot TN07

Rec.	PFT	Family	Genus	Species	code	quad
1	no-la-do-ct-ph	Dipterocarpaceae	Shorea	acuminata	SHORACUM	1
2	no-la-do-ct-ph	Dipterocarpaceae	Shorea	macroptera	SHORMACR	1
3	no-la-do-ph	Burseraceae	Santiria	tnb4/3	SANTTNB4	1
4	me-la-do-ph	Annonaceae	Griffithianthus	merillii	GRIFMERI	1
5	me-la-do-ph	Euphorbiaceae	Ptychopyxis	costata	PTYCCOST	1
6	me-la-do-ct-ph	Moracaeae	Sloetia	elongata	SLOEELON	1
7	me-la-do-ph	Clusiaceae	Mesua	tnb4/7	MESUTNB4	1
8	pl-la-do-ph	Euphorbiaceae	Agrostistachys	sessilifolia	AGROSESS	1
9	mi-la-do-ct-ph	Aannonaceae	Polyalthia	hypoleuca	POLYHYPO	1
10	no-la-do-ph	Anacardiaceae	Bouea	oppositifolia	BOUEOPPO	1
11	me-la-do-ph	Burseraceae	Canarium	tnb4/11	CANATNB4	1
12	me-la-do-ph-li	Gnetaceae	Gnetum	cuspidatum	GNETCUSP	1
13	mi-co-do-ct-ph	Melastomataceae	Memecylon	tnb4/13	MEMETNB4	1
14	me-la-do-ct-ph	Verbenaceae	Teijsmanniodendron	coriaceum	TEIJCORI	1
15	me-la-do-ph-li	Convolvulaceae	Erycibe	aenea	ERYCAENE	1
16	mi-la-do-ph-li	Loganiaceae	Strychnos	ignatii	STRYIGNA	1
17	me-la-do-ct-ph	Burseraceae	Santiria	apiculata	SANTAPIC	1
18	no-la-do-ph-li	Annonaceae	Artabotrys	tnb4/18	ARTATNB4	1
19	me-la-do-ph	Magnoliaceae	Magnolia	candolii	MAGNCAND	1
20	no-la-do-ph-li	Apocynaceae	Willughbeia	coriacea	WILLCORI	1
21	me-la-do-ph	Fabaceae	Dialium	tnb4/21	DIALTNB4	1
22	no-la-do-ph	Myristicaceae	Knema	tnb4/22	KNEMTNB4	1
23	me-co-do-ro-pv-hc-ad	Pandanaceae	Pandanus	tnb4/23	PANDTNB4	1
24	no-la-do-ph-li	Annonaceae	Oxymitra	tnb4/24	OXYMTNB4	1
25	me-la-do-ph	Annonaceae	Polyalthia	tnb4/25	POLYTNB4	1
26	me-la-do-ct-ph	Myrsinaceae	Ardisia	teysmanii	ARDITEYS	1
27	me-la-do-ph	Sapotaceae	Palaquium	gutta	PALAGUTT	1
28	me-co-do-ph	Urticaceae	Hulletia	dumosa	HULLDUMO	1
29	no-la-do-ph-li	Fabaceae	Phanera	tnb4/29	PHANTNB4	1
30	me-co-do-ph-ad	Myrtaceae	Syzygium	tnb4/30	SYZYTNB4	1
31	me-la-do-ph	Ochnaceae	Gomphia	serrata	GOMPSERR	1
32	me-co-do-ph	Flacourtiaceae	Hydnocarpus	kunstleri	HYDNKUNS	1
33	me-la-do-ph-li	Menispermaceae	Cocculus	tnb4/33	COCCTNB4	1
34	me-la-do-ph-li	Connaraceae	Connarus	tnb4/34	CONNTNB4	1
35	me-la-do-ro-pv-ph-li	Arecaceae	Calamus	javensis	CALAJAVE	1
36	pl-la-do-ct-ph	Burseraceae	Dacryodes	rostrata	DACRROST	1
37	no-la-do-ph-li	Celastraceae	Salacia	tnb4/37	SALATNB4	1
38	no-la-do-ph-li	Convolvulaceae	Erycibe	tnb4/38	ERYCTNB4	1
39	mi-la-do-su-pv-hc-li-ad-ep	Orchidaceae	Coelogyne	tnb4/39	COELTNB4	1
40	na-la-do-fi-hc-ad-ep	Aspleniaceae	Asplenium	nidus	ASPLNIDU	1
41	na-la-do-fi-hc-ad		Trichomanes	javanica	TRICJAVA	1
42	no-la-do-ct-ph	Sapindaceae	Nephelium	tnb4/42	NEPHTNB4	1
43	me-la-do-ph	Polygalaceae	Xanthophyllum	tnb4/43	XANTTNB4	1
44	mi-la-do-ct-ph	Myrtaceae	Syzygium	tnb4/44	SYZYTNB4	1
45	me-la-do-ct-ph	Ebenaceae	Diospyros	tnb4/45	DIOSTNB4	1
46	no-la-do-ct-ph	Rubiaceae	Urophyllum	tnb4/46	UROPTNB4	1
47	no-la-do-ct-ph	Fabaceae	Archidendron	bubalinum	ARCHBUBA	1

48	me-la-do-ph	Ebenaceae	Diospyros	rigida	DIOSRIGI	1
49	me-la-do-ct-ph	Euphorbiaceae	Antidesma	tnb4/49	ANTITNB4	2
50	mi-la-do-ct-ph	Lauraceae	Litsea	tnb4/50	LITSTNB4	2
51	no-la-do-ph	Anisophylleaceae	Anisophyllea	disticha	ANISDIST	2
52	me-la-do-ph-li-ep	Araceae	Pothos	scandens	POTHSCAN	2
53	pl-la-do-pv-hc-ad	Zingiberaceae	Curcuma	tnb4/53	CURCTNB4	2
54	na-la-do-ph-li	Fabaceae	Dalbergia	tnb4/54 (kecil)	DALBTNB4	2
55	no-la-do-ph-li	Connaraceae	Rourea	minor	ROURMINO	2
56	me-la-do-ph-li	Fabaceae	Millettia	sericea c.f.	MILLSERI	2
57	no-la-do-ct-ph	Saxifragaceae	Polyosma	lateriflora	POLYLATE	2
58	me-la-do-ct-ph	Icacinaceae	Gonocaryum	gracille	GONOGRAC	2
59	no-la-do-ct-ph	Myrtaceae	Syzygium	tnb4/59	SYZYTNB4	2
60	no-la-do-pv-hc-ad	Flagelariaceae	Flagellaria	indica	FLAGINDI	2
61	me-co-do-ph	Myrtaceae	Tristaniopsis	tnb4/61	TRISTNB4	2
62	me-co-do-ct-ph-ad	Fagaceae	Castanopsis	tnb4/62	CASTTNB4	2
63	me-la-do-hc-ad	Smilacaceae	Smilax	calophylla	SMILCALO	2
64	pl-co-do-ph	Annonaceae	Cyathocalyx	bancana	CYATBANC	2
65	me-la-do-ph	Rhizophoraceae	Gynotroches	axillaris	GYNOAXIL	2
66	no-la-do-hc-ad	Myrsynaceae	Labisia	tnb4/66	LABITNB4	2
67	no-la-do-ct-ph	Oleaceae	Chionanthus	tnb4/67	CHIOTNB4	2
68	no-la-do-ct-ph	Euphorbiaceae	Aporusa	tnb4/68	APORTNB4	2
69	me-la-do-ph	Sapindaceae	Nephelium	tnb4/69	NEPHTNB4	2
70	me-la-do-ct-ph	Polygalaceae	Xanthophyllum	rufum	XANTRUFU	2
71	me-la-do-ct-ph	Rubiaceae	Urophyllum	glabrum	UROPGLAB	2
72	me-la-do-ph-li	Menispermaceae	Fibraurea	cloroleuca	FIBRCLOR	2
73	no-la-do-ph	Burseraceae	Dacryodes	costata	DACRCOST	2
74	me-la-do-ph	Myristicaceae	Horsfieldia	polyspherulla	HORSPOLY	2
75	me-la-do-ph-li	Fabaceae	Spatholobus	ferruginea	SPATFERR	2
76	me-co-do-ro-pv-ph-li-ad	Arecaceae	Daemonorops	tnb4/76	DAEMTNB4	2
77	me-la-do-ct-ph	Lauraceae	Actinodaphne	tnb4/77	ACTITNB4	3
78	pl-co-do-hc-ad	Hanguanaceae	Hanguana	malayana	HANGMALA	3
79	me-la-do-ph	Sterculiaceae	Sterculia	tnb4/79	STERTNB4	3
80	no-la-do-ct-ph	Gnetaceae	Gnetum	tnb4/80	GNETTNB4	3
81	pl-la-do-ph	Euphorbiaceae	Baccaurea	tnb4/81	BACCTNB4	3
82	ma-co-do-ph-ad	Lauraceae	Litsea	grandis	LITSGRAN	3
83	pl-co-do-ph	Lecythidaceae`	Barringtonia	macrostachya	BARRMACR	3
84	pl-co-do-ph-li	Menispermaceae	Coscinium	fenestratum	COSCFENE	3
85	me-la-do-ph	Burseraceae	Canarium	littorale	CANALITT	3
86	pl-la-do-ct-ph-ad	Sapotaceae	Pouteria	malaccense	POUTMALA	3
87	me-la-do-ph	Tiliaceae	Celtis	philippinensis	CELTPHIL	3
88	me-co-do-ph-li	Convolvulaceae	Erycibe	tnb4/88	ERYCTNB4	3
89	me-co-do-ph-li	Apocynaceae	Willughbeia	coriaceum	WILLCORI	3
90	pl-la-do-ph	Burserceae	Santiria	laevigata	SANTLAEV	3
91	me-co-do-ph	Euphorbiaceae	Aporusa	lucida	APORLUCI	3
92	me-la-do-ct-ph	Verbenaceae	Vitex	gamopetala	VITEGAMO	3
93	me-la-do-ph	Lauraceae	Cryptocarya	ferrea	CRYPFERR	3
94	pi-la-do-ph	Lauraceae	Litsea	firma	LITSFIRM	3
95	pl-la-do-ch	Rubiaceae`	Prismatomeris	tnb4/95	PRISTNB4	3
96	me-la-do-ph	Clusiaceae	Calophyllum	tnb4/95	CALOTNB4	3
97	pl-la-do-ct-ph	Euphorbiaceae	Indet	tnb4/97	INDETNB4	3
98	me-la-do-ph-li	Rubiaceae	Timonius	tnb4/98	TIMOTNB4	3

99	me-co-do-ct-ph	Cornaceae	Mastixia	dichotoma	MASTDICH	3
100	me-la-do-ph	Burseraceae	Santiria	rubiginosa	SANTRUBI	3
101	mi-la-do-ph	Burseraceae	Santiria	griffithii	SANTGRIF	3
102	mi-la-do-ph	Melastomataceae	Memecylon	tnb4/102	MEMETNB4	3
103	me-la-do-ct-ph	Lauraceae	Dehaasia	caesia	DEHACAES	3
104	mg-co-do-ro-pv-ch-ad	Arecaceae	Licuala	valida cf.	LICUVALI	3
105	me-la-do-ct-ph	Aquifoliaceae	Ilex	macrophylla	ILEXMACR	3
106	no-la-do-ph	Dipterocarpaceae	Shorea	atrinervosa	SHORATRI	4
107	pl-co-do-ro-pv-hc-ad	Pandanaceae	Pandanus	tnb4/`07	PANDTNB4	4
108	no-co-do-ph	Euphorbiaceae	Neoscortechinia	kingii	NEOSKING	4
109	me-la-do-ph	Clusiaceae	Calophyllum	tnb4/109	CALOTNB4	4
110	me-la-do-ph	Sapindaceae	Xerospermum	laevigatum	XEROLAEV	4
111	no-la-do-ph	Clusiaceae	Mesua	tnb4/111	MESUTNB4	4
112	me-co-do-ph	Euphorbiaceae	Baccaurea	sumatrana	BACCSUMA	4
113	me-la-do-ph-li	Annonaceae	Friesodielsia	feruginea	FRIEFERU	4
114	no-la-do-ph	Clusiaceae	Calophyllum	tnb4/114	CALOTNB4	4
115	no-la-do-ph	Clusiaceae	Garcinia	petandra	GARCPETA	4
116	me-la-do-ph	Bombacaceae	Durio	tnb4/116	DURITNB4	4
117	mi-la-do-ph-li	Fabaceae	Derris	tnb4/117	DERRTNB4	4
118	pl-la-do-ct-ph	Fabaceae	Millettia	splendidisima	MILLSPLE	4
119	no-la-do-ph-li	Smilacaceae	Smilax	tnb4/119	SMILTNB4	4
120	mi-la-do-ph	Rosaceae	Atuna	tnb4/120	ATUNTNB4	4
121	mi-la-do-ct-ph	Euphorbiaceae	Glochidion	colmanianum	GLOCCOLM	4
122	me-co-do-ph	Anacardiaceae	Semecarpus	tnb4/122	SEMETNB4	4
123	no-la-do-ph	Dipterocarpaceae	Shorea	tnb4/123	SHORTNB4	4
124	no-la-do-ph	Euphorbiaceae	Antidesma	pentandrum	ANTIPENT	4
125	me-la-do-ph	Burseraceae	Canarium	denticulatum	CANADENT	4
126	pl-co-do-ph-ad	Sterculiaceae	Scaphium	macropodum	SCAPMACR	4
127	pl-la-do-ph	Lauraceae	Beilschmiedia	tnb4/127	BEILTNB4	4
128	mi-co-do-ph-li	Dilleniaceae	Tetracera	scandens	TETRSCAN	4
129	no-la-do-su-pv-hc-ad	Zingiberaeae	Globba	pendula	GLOBPEND	4
130	no-la-do-fi-hc-ad	Polypodiaceae	Taenitis	blechnoides	TAENBLEC	4
131	me-la-do-ph	Polygalaceae	Xanthophyllum	tnb4/131	XANTTNB4	5
132	mi-la-do-ph	Celastraceae	Euonymus	javanicus	EUONJAVA	5
133	no-la-do-ph-li	Olacaceae	Sarcostigma	paniculata	SARCPANI	5
134	me-co-do-ph-li	Moraceae	Ficus	tnb4/134	FICUTNB4	5
135	me-la-do-ct-ph	Melastomataceae	Memecylon	costatum	MEMECOST	5
136	no-la-do-ct-ph	Annonaceae	Xylopia	malayana	XYLOMALA	5
137	me-co-do-ph	Ixonanthaceae	Ixonanthes	icosandra	IXONICOS	5
138	me-la-do-ph-ad	Myristicaceae	Gymnacranthera	compacta	GYMNCOMP	5
139	no-la-do-ph-li	Rhamnaceae	Ventilago	oblongifolia	VENTOBLO	5
140	me-la-do-ph-li	Annonaceae	Uvaria	tnb4/140	UVARTNB4	5
141	no-la-do-ct-ph	Lauraceae	Cryptocarya	densiflora	CRYPDENS	5
142	no-la-do-ct-ph	Dipterocarpaceae	Hopea	tnb4/142	HOPETNB4	5
143	mi-la-do-ph	Annonaceae	Xylopia	cordata	XYLOCORD	5
144	me-la-do-ct-ph	Anacardiaceae	Gluta	walichii	GLUTWALI	5
145	pl-la-do-ph-ad	Burseraceae	Santiria	tomentosa	SANTTOME	5
146	na-la-do-ph-li	Rubiaceae	Uncaria	glabra	UNCAGLAB	5
147	me-la-do-ph	Moraceae	Sloetia	tnb4/147	SLOETNB4	5
148	no-la-do-ph	Elaeocarpaceae	Elaeocarpus	mastersii	ELAEMAST	5
149	no-la-do-ct-ph	Trigoniaceae	Trigoniastrum	hypoleucum	TRIGHYPO	5

150	me-la-do-ph	Fagaceae	Lithocarpus	tnb4/150	LITHTNB4	5
151	me-co-do-pv-ph	Liliaceae	Dracaena	angustifolia	DRACANGU	5
152	me-co-do-ph	Theaceae	Gardenia	tnb4/152	GARDTNB4	5
153	no-la-do-ct-ph	Euphorbiaceae	Mallotus	tnb4/153	MALLTNB4	6
154	me-la-do-ct-ph	Ulmaceae	Gironniera	hirta	GIROHIRT	6
155	me-la-do-ct-ph	Polygalaceae	Xanthophyllum	rufum	XANTRUFU	6
156	me-la-do-ct-ph	Melastomataceae	Pternandra	rostrata	PTERROST	6
157	me-la-do-ct-ph	Olacaceae	Ochanostachys	amentacea	OCHAAMEN	6
158	me-co-do-ph	Myristicaceae	Knema	tnb4/158	KNEMTNB4	6
159	me-ve-do-ph	Meliaceae	Aglaia	tnb4/159	AGLATNB4	6
160	mi-la-do-ph	Myrtaceae	Syzygium	tnb4/160	SYZYTNB4	6
161	me-la-do-ph	Ebenaceae	Diospyros	tnb4/161	DIOSTNB4	6
162	me-la-do-ct-ph	Euphorbiaceae	Pimelodendron	griffithianum	PHIMGRIF	6
163	me-la-do-ct-ph	Dipterocarpaceae	Vatica	tnb4/163	VATITNB4	6
164	no-la-do-pv-ch	Liliaceae	Dracaena	eliptica	DRACELIP	7
165	mi-la-do-ct-ph	Myrtaceae	Syzygium	tnb4/165	SYZYTNB4	7
166	pi-la-do-ph-li	Icacinaceae	Phytocrene	tnb4/166	PHYTTNB4	7
167	ma-pe-do-ct-ph	Myristicaceae	Myristica	maxima	MYRIMAXI	7
168	me-pe-do-ct-ph	Euphorbiaceae	Baccaurea	tnb4/168	BACCTNB4	7
169	mi-la-do-ph-li	Apocynaceae	Alyxia	tnb4/169	ALYXTNB4	7
170	me-la-do-ct-ph	Euphorbiaceae	Galearia	fulva	GALEFULV	7
171	pl-la-do-ct-ph	Lauraceae	Cryptocarya	crassinervia	CRYPCRAS	7
172	mi-la-do-ph-li	Loganiaceae	Strychnos	tnb4/172	STRYTNB4	7
173	mi-la-do-ph	Myrtaceae	Syzygium	tnb4/173	SYZYTNB4	7
174	me-la-do-ct-ph	Euphorbiaceae	Galearia	filiforme	GALEFILI	7
175	me-la-do-ph	Rubiaceae	Ixora	tnb4/175	IXORTNB4	7
176	no-la-do-ct-ph	Rubiaceae	Saprosma	tnb4/176	SAPRTNB4	7
177	me-la-do-cr-li	Dioscoreaceae	Dioscorea	tnb4/177	DIOSTNB4	7
178	no-la-do-ct-ph	Fabaceae	Archidendron	microcarpum	ARCHMICR	7
179	mi-la-do-ct-ph	Polygalaceae	Xanthophyllum	eurhyncum	XANTEURH	7
180	mi-la-do-ph	Myrtaceae	Syzygium	spicatum	SYZYSPIC	7
181	me-la-do-ph	Elaeocarpaceae	Elaeocarpus	stipularis	ELAOSTIP	7
182	me-la-do-ct-ph	Burseraceae	Canarium	denticulatum	CANADENT	7
183	me-la-do-ct-ph	Euphorbiceae	Drypetes	tnb4/183	DRYPTNB4	7
184	pl-la-do-ph-li	Annonaceae	Uvaria	tnb4/184	UVARTNB4	7
185	me-co-do-ph	Myristicaceae	Myristica	iners	MYRIINER	7
186	no-la-do-ph-li	Annonaceae	Artabotrys	rosea	ARTAROSE	8
187	no-la-do-ph-li	Rubiaceae	Psychotria	sarmentosa	PSYCSARM	8
188	me-la-do-ct-ph	Ixonanthaceae	Ctenolophon	parviflora	CTENPARV	8
189	no-la-do-ph-li	Rhamnaceae	Zizyphus	tnb4/189	ZIZYTNB4	8
190	me-la-do-ph-li	Menispermaceae	Albertisia	papuana	ALBEPAPU	8
191	me-co-do-ct-ph	Fabaceae	Ormosia	sumatrana	ORMOSUMA	8
192	me-la-do-ph	Moraceae	Artocarpus	integer	ARTOINTE	8
193	me-la-do-ct-ph	Verbenaceae	Clerodendrum	tnb4/193	CLERTNB4	8
194	no-la-do-ph	Melastomataceae	Memecylon	oligoneurum	MEMEOLIG	8
195	no-la-do-ct-ph	Polygalaceae	Xanthophyllum	tnb4/195	XANTTNB4	8
196	me-la-do-ct-ph	Sapindaceae	Nephelium	ramboutan-ake	NEPHRAMB	8
197	me-la-do-ph	Ulmaceae	Gironniera	subaequalis	GIROSUBA	8
198	no-la-do-ct-ph	Rubiaceae	Lasianthus	tnb4/198	LASITNB4	8
199	me-la-do-ct-ph	Lauraceae	Litsea	ferruginea	LITSFERR	8
200	pl-la-do-ct-ph	Sterculiaceae	Sterculia	oblongifolia	STEROBLO	8

201	pl-la-do-ct-ph	Annonaceae	Goniothalamus	macrophyllus	GONIMACR	8
202	mi-la-do-ct-ph	Clusiaceae	Calophyllum	tnb4/202	CALOTNB4	8

Table 8. Plant species and functional types Plot TN08

Rec.	modus	family	genus	species	code	quad
1	me-co-do-ct-ph-li	Fabaceae	Millettia	tnt2/01	MILLTNT2	1
2	me-la-do-ph-li	Loganiaceae	Strychnos	ignatii	STRYIGNA	1
3	me-la-do-ct-ph	Fagaceae	Lithocarpus	tnt2/03	LITHTNT2	1
4	me-la-do-ct-ph	Polygalaceae	Xanthophyllum	tnt2/04	XANTTNT2	1
5	me-la-do-ph	Meliaceae	Aglaia	glabriflora	AGLAGLAB	1
6	me-la-do-ct-ph	Ulmaceae	Gironniera	subaequalis	GIRRSUBA	1
7	me-la-do-ph	Euphorbiaceae	Aporusa	subcaudata	APORSUBC	1
8	pl-co-do-ph	Burseraceae	Dacryodes	rostrata	DACRROST	1
9	me-la-do-ph	Myristicaceae	Knema	tnt2/09	KNEMTNT2	1
10	no-co-do-ph	Fabaceae	Sindora	tnt2/10	SINDTNT2	1
11	me-la-do-ph	Annonaceae	Polyalthia	tnt2/11	POLYTNT2	1
12	no-co-do-ph-li	Fabaceae	Dalbergia	tnt2/12	DALBTNT2	1
13	me-la-do-ph	Fabaceae	Dialium	tnt2/13	DIALTNT2	1
14	me-la-do-ph-li	Menispermaceae	Cocculus	tnt2/14	COCCTNT2	1
15	no-la-do-ct-ph	Euphorbiaceae	Antidesma	tnt2/15	ANTITNT2	1
16	me-co-do-ro-pv-ph	Liliaceae	Dracaena	tnt2/16	DRACTNT2	1
17	me-la-do-ph-li	Convolvulaceae	Erycibe	tnt2/17	ERYCTNT2	1
18	no-la-do-ct-ph	Olacaceae	Ochanostachys	amentacea	OCHAAMEN	1
19	no-la-do-ph	Rosaceae	Atuna	tnt2/19	ATUNTNT2	1
20	no-la-do-ro-pv-ph-li-ad	Arecaceae	Calamus	tnt2/20	CALATNT2	1
21	no-co-do-fi-hc-ad	Polypodiaceae	Taenitis	blechnoides	TAENBLEC	1
22	no-co-do-hc-ad-ep	Gesneriaceae	Aeschynanthus	tnt2/22	AESCTNT2	1
23	me-co-do-pv-hc-ad	Pandanaceae	Pandanus	tnt2/23	PANDTNT2	1
24	mg-co-do-ro-pv-hc-ad	Arecaceae	Licuala	tnt2/24	LICUTNT2	1
25	me-la-do-ct-ph	Dipterocarpaceae	Hopea	mengarawan	HOPEMENG	1
26	me-co-do-ph-ad	Lauraceae	Cinnamomum	javanicum	CINNJAVA	1
27	me-la-do-ct-ph	Rubiaceae	Chassalia	curviflora	CHASCURV	1
28	no-la-do-fi-hc-ad	Sapindaceae	Xerospermum	laevigatum	XEROLAEV	1
29	me-la-do-ct-ph	Euphorbiaceae	Aporusa	tnt2/29	APORTNT2	2
30	me-la-do-su-pv-hc	Commelinaceae	Forrestia	mollissima	FORRMOLL	2
31	me-la-do-ct-ph	Sapindaceae	Nephelium	ramboutan-ake	NEPHRAMB	2
32	no-co-do-ct-ph	Lauraceae	Actinodaphne	tnt2/32	ACTITNT2	2
33	me-la-do-pv-hc-ad	Zingiberaceae	Alpinia	tnt2/33	ALPITNT2	2
34	no-la-do-ph	Anacardiaceae	Bouea	oppositifolia	BOUEOPPO	2
35	me-la-do-ph-li	Apocynaceae	Willughbeia	coriacea	WILLCORI	2
36	me-la-do-ct-ph	Euphorbiaceae	Drypetes	laevis	DRYPLAEV	2
37	me-la-do-ph-li-ad	Rubiaceae	Psychotria	sarmentosa	PSYCSARM	2
38	me-la-do-ct-ph	Clusiaceae	Calophyllum	tnt2/38	CALOTNT2	2
39	me-la-do-ct-ph	Myrtaceae	Syzygium	tnt2/39	SYZYTNT2	2
40	no-la-do-ct-ph	Myrtaceae	Syzygium	tnt2/40	SYZYTNT2	2
41	no-la-do-ct-ph	Rubiaceae	Prismatomeris	tnt2/41	PRISTNT2	2
42	me-la-do-ro-pv-ph-li-ad	Arecaceae	Calamus	tnt2/42	CALATNT2	2
43	me-la-do-hc-ep	Araceae	Anodendrum	tnt2/43	ANODTNT2	2
44	no-co-do-ct-ph	Meliaceae	Aglaia	tnt2/44	AGLATNT2	2
45	me-la-do-ct-ph	Dipterocarpaceae	Shorea	leprosula	SHORLEPR	2
46	no-la-do-ct-ph	Fabaceae	Archidendron	tnt2/46	ARCHTNT2	2
47	no-co-do-ph-li	Connaraceae	Roureopsis	emarginata	ROUREMAR	2
48	me-co-do-ct-ph	Anacardiaceae	Mangifera	tnt2/48	MANGTNT2	2

49	no-la-do-ro-pv-hc-li-ad	Arecaceae	Daemonorops	sabut	DAEMSABU	3
50	me-la-do-ct-ph	Cornaceae	Mastixia	trichotoma	MASTTRIC	3
51	no-la-do-cr-ad	Dioscoreaceae	Dioscorea	tnt2/51	DIOSTNT2	3
52	na-la-do-ph	Anisophylleaceae	Anisophyllea	disticha	ANISDIST	3
53	me-la-do-ct-ph	Sapindaceae	Indet	tnt2/53	INDETNT2	3
54	no-la-do-ct-ph	Clusiaceae	Calophyllum	tnt2/54	CALOTNT2	3
55	no-la-do-ph	Dipterocarpaceae	Shorea	parvifolia	SHORPARV	3
56	me-la-do-ct-ph	Tiliaceae	Microcos	tnt2/56	MICRTNT2	3
57	me-la-do-ct-ph	Thymelaeaceae	Gonystylus	tnt2/57	GONYTNT2	3
58	me-la-do-ph-li	Connaraceae	Rourea	minor	ROURMINO	3
59	me-co-do-ph-ad	Sapotaceae	Madhuca	sericea	MADHSERI	3
60	me-la-do-ph-ad	Meliaceae	Aglaia	tnt2/60	AGLATNT2	3
61	me-la-do-ct-ph	Meliaceae	Aglaia	tnt2/61	AGLATNT2	3
62	me-la-do-ct-ph	Burseraceae	Santiria	rubiginosa	SANTRUBI	3
63	me-la-do-ph-li	Dilleniaceae	Tetracera	scandens	TETRSCAN	3
64	no-la-do-ph	Clusiaceae	Mesua	tnt2/64	MESUTNT2	3
65	no-la-do-ph	Flacourtiaceae	Hydnocarpus	kunstleri	HYDNKUNS	3
66	me-la-do-ph	Ebenaceae	Diospyros	tnt2/66	DIOSTNT2	4
67	me-la-do-ct-ph	Rubiaceae	Lasianthus	scabridus	LASISCAB	4
68	me-la-do-ph	Polygalaceae	Xanthophyllum	tnt2/68	XANTTNT2	4
69	me-la-do-ct-ph	Annonaceae	Polyalthia	hypoleuca	POLYHYPO	4
70	no-la-do-su-hc-li-ep	Araceae	Scindapsus	tnt2/70	SCINTNT2	4
71	me-la-do-hc-li	Vitaceae	Parthenocissus	tnt2/71	PARTTNT2	4
72	me-la-do-ph	Myrtaceae	Syzygium	tnt2/72	SYZYTNT2	4
73	no-co-do-ro-pv-ph-li-ad	Arecaceae	Calamus	tnt2/73	CALATNT2	4
74	me-la-do-ph	Sapindaceae	Nephelium	lappaceum	NEPHLAPP	4
75	me-la-do-ph-li	Loganiaceae	Strychnos	tnt2/75	STRYTNT2	4
76	no-la-do-ct-ph	Melastomataceae	Pternandra	coerulescens	PTERCOER	4
77	no-la-do-ct-ph	Rubiaceae	Tricalysia	malaccensis	TRICMALA	4
78	me-la-do-ph-li	Fabaceae	Spatholobus	ferrugineus	SPATFERR	4
79	me-la-do-ch-li	Piperaceae	Piper	caninum	PIPECANI	4
80	me-la-do-ro-su-pv-hc-ad	Hanguanaceae	Hanguana	malayana	HANGMALA	4
81	me-la-do-ct-ph	Icacinaceae	Stemonurus	tnt2/811	STEMTNT2	4
82	me-la-do-ph-li	Annonaceae	Friesodielsia	kentii	FRIEKENT	4
83	no-la-do-ph	Burseraceae	Santiria	griffithii	SANTGRIF	4
84	me-la-do-ph	Meliaceae	Chisocheton	tnt2//84	CHISTNT2	4
85	me-la-do-ph	Myrsinaceae	Ardisia	teysmanii	ARDITEYS	4
86	me-la-do-ct-ph	Ulmaceae	Gironniera	hirta	GIRRHIRT	4
87	me-la-do-ct-ph	Laquraceae	Litsea	tnt2/87	LITSTNT2	4
88	me-la-do-ph	Cornaceae	Mastixia	rostrata	MASTROST	4
89	me-la-do-ph	Annonaceae	Trivalvaria	macrophyllla	TRIVMACR	4
90	no-la-do-ph-li	Apocynaceae	Indet	tnt2/90	INDETNT2	4
91	no-la-do-ct-ph	Sterculiaceae	Leptonychia	heteroclita	LEPTHETE	4
92	me-la-do-ph	Melastomataceae	Memecylon	tnt2/92	MEMETNT2	4
93	me-la-do-ph	Annonaceae	Mitrephora	tnt2/93	MITRTNT2	4
94	me-la-do-ph	Burseraceae	Dacryodes	tnt2/94	DACRTNT2	4
95	me-la-do-ro-hc-li-ad	Pandanaceae	Freycinetia	tnt2/95	FREYTNT2	4
96	me-co-do-ph	Myrtaceae	Syzygium	tnt2/96	SYZYTNT2	4
97	me-la-do-ph-li	Connaraceae	Connarus	tnt2/97	CONNTNT2	4
98	no-la-do-ct-ph	Trigoniaceae	Trigoniastrum	hypoleucum	TRIGHYPO	4
99	me-co-do-ro-pv-ph-li-ad	Arecaceae	Calamus	javensis	CALAJAVE	4

100	me-la-do-ct-ph	Annonaceae	Xylopia	caudata	XYLOCAUD	4
101	me-la-do-ct-ph	Burseraceae	Canarium	littorale	CANALITT	4
102	na-la-do-hc-li	Rubiaceae	Psychotria	tnt2/102	PSYCTNT2	4
103	me-la-do-ph	Dilleniaceae	Dillenia	pentagyna cf	DILLPENT	5
104	no-la-do-ph	Euphorbiaceae	Neoscortechinia	kingii	NEOSKING	5
105	mi-la-do-ch-li-ad	Moraceae	Ficus	pumila	FICUPUMI	5
106	no-la-do-ph	Euphorbiaceae	Antidesma	tnt2/106	ANTITNT2	5
107	pl-la-do-ph	Annonaceae	Polyalthia	tnt2/107	POLYTNT2	5
108	no-la-do-ph	Burseraceae	Santiria	apiculata	SANTAPIC	5
109	no-la-do-ct-ph	Sterculiaceae	Sreculia	tnt2/109	SRECTNT2	5
110	me-la-do-ph	Moraceae	Artocarpus	rigidus	ARTORIGI	5
111	nc-la-do-ct-ph	Sabiaceae	Meliosma	nitida	MELINITI	5
112	me-la-do-ph-li	Connaraceae	Connarus	tnt2/112	CONNTNT2	5
113	me-la-do-ph	Bombacaceae	Durio	griffithii	DURIGRIF	5
114	me-la-do-ph	Anacardiaceae	Semecarpus	tnt2/114	SEMETNT2	5
115	me-la-do-ct-ph	Rubiaceae	Indet	tnt2/115	INDETNT2	5
116	me-la-do-ct-ph	Annonaceae	Goniothalamus	malayanus	GONIMALA	5
117	me-la-do-ct-ph	Myristicaceae	Gymnacranthera	contracta	GYMNCONT	5
118	no-la-do-ct-ph	Rubiaceae	Saprosma	arborea	SAPRARBO	5
119	pl-la-do-ph	Myristicaceae	Gymnacranthera	bancana	GYMNBANC	5
120	mi-la-do-ph-li	Fabaceae	Phanera	tnt2/120	PHANTNT2	5
121	mi-la-do-ch-li	Vitaceae	Tetrastigma	tnt2/121	TETRTNT2	5
122	me-co-do-ct-ph	Sterculiaceae	Sterculia	coccinea	STERCOCC	6
123	no-la-do-ph	Meliaceae	Aglaia	tnt2/123	AGLATNT2	6
124	mi-la-do-ct-ph	Fabaceae	Dialium	tnt2/124	DIALTNT2	6
125	mi-la-do-ph-li	Connaraceae	Cnestis	platantha	CNESPLAT	6
126	mi-co-do-ct-ph	Fabaceae	Parkia	tnt2/126	PARKTNT2	6
127	nc-co-do-ph	Euphorbiaceae	Baccaurea	tnt2/127	BACCTNT2	6
128	mi-la-do-ct-ph	Celastraceae	Kokoona	tnt2/128	KOKOTNT2	6
129	mi-la-do-ct-ph	Clusiaceae	Mesua	tnt2/129	MESUTNT2	6
130	no-la-do-ph	Sapindaceae	Nephelium	tnt2/130	NEPHTNT2	6
131	me-la-do-ct-ph	Rubiaceae	Urophyllum	corymbosum	UROPCORY	6
132	me-la-do-ph	Annonaceae	Monocarpia	marginalis	MONOMARG	6
133	me-la-do-ph	Fagaceae	Lithocarpus	tnt2/133	LITHTNT2	6
134	no-la-do-ct-ph	Euphorbiaceae	Drypetes	tnt2/134	DRYPTNT2	6
135	ma-la-do-ph	Sterculiaceae	Scaphium	macropodum	SCAPMACR	7
136	no-la-do-ph	Lauraceae	Beilschmiedia	tnt2/136	BEILTNT2	7
137	mi-la-do-ph-li	Gnetaceae	Gnetum	tnt2/137	GNETTNT2	7
138	mi-la-do-ct-ph	Euphorbiaceae	Glochidion	tnt2/138	GLOCTNT2	7
139	me-la-do-ph	Burseraceae	Santiria	laevigata	SANTLAEV	7
140	me-la-do-ph	Euphorbiaceae	Baccaurea	kunstleri	BACCKUNS	7
141	mi-la-do-ct-ph	Rubiaceae	Randia	tnt2/141	RANDTNT2	7
142	me-la-do-ph-li	Rubiaceae	Uncaria	tnt2/142	UNCATNT2	7
143	no-la-do-ph	Euphorbiaceae	Antidesma	tnt2/143	ANTITNT2	7
144	no-la-do-ro-pv-ph-li-ad	Arecaceae	Calamus	tnt2/144	CALATNT2	7
145	pl-la-do-ph	Annonaceae	Indet	tnt2/145	INDETNT2	7
146	me-la-do-ph	Myristicaceae	Horsfieldia	tnt2/146	HORSTNT2	7
147	me-la-do-ct-ph	Euphorbiaceae	Galearia	fulva	GALEFULV	8
148	no-la-do-ph	Fabaceae	Sindora	velutina	SINDVELU	8
149	me-la-do-ct-ph	Thymelaeaceae	Gonystylus	macrophyllus	GONYMACR	8
150	na-la-do-ph-li	Connaraceae	Rourea	mimosoides	ROURMIMO	8

151	me-la-do-ph	Poplygalaceae	Xanthophyllum	rufum	XANTRUFU	8
152	no-la-do-ph	Melatomataceae	Memecylon	costratum	MEMECOST	8
153	no-la-do-ph-li	Menispermacaeae	Indet	tnt2/153	INDETNT2	8
154	ma-co-do-ro-hc-ad	Panadanaceae	Pandanus	tnt2/154	PANDTNT2	8
155	me-la-do-ph	Dipterocarpaceae	Cotylelobium	tnt2/155	COTYTNT2	8
156	mi-la-do-ct-ph	Lauraceae	Dehaasia	tnt2/156	DEHATNT2	8
157	me-la-do-ct-ph	Tiliaceae	Microcos	tnt2/157	MICRTNT2	8
158	no-la-do-ph-li	Thymeleaceae	Indet	malaccensis	INDEMALA	8
159	me-la-do-ct-ph	Fabaceae	Archidendron	tnt2/159	ARCHTNT2	8
160	no-la-do-ct-ph	Symplocaceae	Symplocos	tnt2/160	SYMPTNT2	8
161	no-la-do-ct-ph	Meliaceae	Aglaia	tnt2/161	AGLATNT2	8
162	me-la-do-ct-ph	Fagaceae	Lithocarpus	tnt2/162		8
163	me-ve-do-ct-ph	Euphorbiaceae	Baccaurea	sumatrana	BACCSUMA	8
164	pl-la-do-ct-ph	Sapindaceae	Nephelium	eriopetalum	NEPHERIO	8
165	no-la-do-ct-ph	Celastraceae	Kokoona	tnt2/165	KOKOTNT2	8
166	me-la-do-ct-ph	Tiliaceae	Microcos	opaca	MICROPAC	8
167	me-la-do-ch-ad	Myrinaceae	Labisia	pumila	LABIPUMI	8
168	mi-la-do-ch-li	Melastomataceae	Dissochaeta	tnt2/168	DISSTNT2	8
169	no-pe-do-ph-li	Oxalidaceae	Dapania	racemosa	DAPARACE	8
170	no-la-do-ph-li	Rhamnaceae	Ventilago	oblongifolia	VENTOBLO	8
171	me-co-do-ph	Fagaceae	Lithocarpus	lucidus	LITHLUCI	8
172	me-la-do-ph-li	Fabaceae	Phanera	tnt2/172	PHANTNT2	8
173	me-co-do-fi-hc-ad	Polyppodiaceae	Polypodium	tnt2/173	POLYTNT2	8

Table 9. Plant species and functional types Plot TN09

Rec.	PFT	Family	Genus	Species	code	quad
1	no-la-do-ph	Dipterocarpaceae	Shorea	acuminata	SHORACUM	1
2	no-la-do-ct-ph	Euphorbiaceae	Aporusa	tnt10/2	APORTNT1	1
3	no-la-do-ct-ph	Dipterocarpaceae	Shorea	macroptera	SHORMACR	1
4	me-la-do-ph	Dipterocarpaceae	Shorea	atrinervosa	SHORATRI	1
5	me-la-do-su-pv-hc-ad	Zingiberaceae	Zingiber	tnt10/5	ZINGTNT1	1
6	me-co-do-su-pv-hc-ad	Hanguanaceae	Hanguana	malayana	HANGMALA	1
7	mi-la-do-ph-li	Myrsinaceae	Embelia	ribes	EMBERIBE	1
8	me-la-do-ct-ph	Myrtaceae	Syzygium	tnt10/8	SYZYTNT1	1
9	me-la-do-ct-ph	Rubiaceae	Urophyllum	glabrum	UROPGLAB	1
10	no-la-do-ph-li-ad	Rubiaceae	Psychotria	sarmentosa	PSYCSARM	1
11	no-la-do-ct-ph	Burseraceae	Santiria	laevigata	SANTLAEV	1
12	me-la-do-ct-ph	Rubiaceae	Tarenna	tnt10/12	TARETNT1	1
13	me-la-do-ph-li	Gnetaceae	Gnetum	cuspidatum	GNETCUSP	1
14	no-la-do-ct-ph	Melastomataceae	Pternandra	tnt10/14	PTERTNT1	1
15	me-la-do-ct-ph	Euphorbiaceae	Drypetes	laevis	DRYPLAEV	1
16	me-la-do-ct-ph	Burseraceae	Canarium	denticulatum	CANADENT	1
17	me-la-do-ph	Dipterocarpaceae	Vatica	tnt10/17	VATITNT1	1
18	me-la-do-hc-ad	Commelinaceae	Forrestia	molissima	FORRMOLI	1
19	me-la-do-ph	Bombacaceae	Durio	griffithii	DURIGRIF	1
20	me-la-do-ph	Dipterocarpaceae	Shorea	parvifolia	SHORPARV	1
21	mi-la-do-ch-li	Annonaceae	Artabotrys	tnt10/21	ARTATNT1	1
22	me-la-do-ch-li	Fabaceae	Spatholobus	ferrugineus	SPATFERR	1
23	me-la-do-ph-li	Fabaceae	Phanera	tnt10/23	PHANTNT1	1
24	me-la-do-ph-ad	Fagaceae	Lithocarpus	tnt10/24	LITHTNT1	1
25	me-la-do-ph-li	Connaraceae	Agelaea	borneensis	AGELBORN	2
26	no-la-do-ct-ph	Polygalaceae	Xanthophyllum	tnt10/26	XANTTNT1	2
27	no-la-do-ph-li	Annonaceae	Friesodielsia	kentii	FRISKENT	2
28	no-la-do-ph-li	Melastomataceae	Dissochaeta	tnt10/28	DISSTNT1	2
29	me-la-do-ph-li	Menispermaceae	Cocculus	tnt10/29	COCCTNT1	2
30	no-la-do-ct-ph	Rhizophoraceae	Gynotroches	axillaris	GYNOAXIL	2
31	me-co-do-su-hc-li	Piperaceae	Piper	caninum	PIPECANI	2
32	pi-co-do-ct-ph	Euphorbiaceae	Endospermum	malaccense	ENDOMALA	2
33	nc-la-do-ct-ph	Anacardiaceae	Swintonia	tnt10/33	SWINTNT1	3
34	na-la-do-ro-pv-ph-li	Pandanaceae	Freycinetia	tnt10/34	FREYTNT1	3
35	me-la-do-ct-ph	Lauraceae	Litsea	oppositiolia	LITSOPPO	3
36	me-la-do-ct-ph	Verbenaceae	Vitex	gamopetala	VITEGAMO	3
37	me-la-do-ph-li	Apocynaceae	Indet	tnt10/37	INDETNT1	3
38	pl-la-do-ct-ph	Euphorbiaceae	Agrostistachys	sessilifolia	AGROSESS	3
39	me-la-do-ct-ph	Dipterocarpaceae	Parashorea	lucida	PARALUCI	3
40	pl-la-do-ct-ph	Rubiaceae	Lasianthus	tnt10/40	LASITNT1	3
41	me-la-do-ph	Fagaceae	Lithocarpus	tnt10/41	LITHTNT1	3
42	me-co-do-fi-ph-ad	Blechnaceae	Blechnum	orientale	BLECORIE	3
43	me-la-do-ph-li	Fabaceae	Dalbergia	tnt10/43	DALBTNT1	3
44	me-la-do-ct-ph	Rubiaceae	Tarenna	tnt10/44	TARETNT1	4
45	me-la-do-ph	Lecythidaceae	Barringtonia	macrostachya	BARRMACR	4
46	no-la-do-ct-ph	Tiliaceae	Pentace	erectinervia	PENTEREC	4

47	me-la-do-ph-li	Sterculiaceae	Byttneria	curtisii	BYTTCURT	4
48	no-la-do-ph-li	Menispermaceae	Albertisia	tnt10/48	ALBETNT1	4
49	me-la-do-ct-ph	Ulmaceae	Gironniera	subaequalis	GIROSUBA	4
50	ma-pe-do-ct-ph	Euphorbiaceae	Baccaurea	tnt10/50	BACCTNT1	4
51	me-la-do-ct-ph	Burseraceae	Dacryodes	rugosa	DACRRUGO	4
52	me-la-do-ct-ph	Magnoliaceae	Magnolia	candolii	MAGNCAND	4
53	me-la-do-ph	Burseraceae	Santiria	oblongifolia	SANTOBLO	4
54	me-la-do-ct-ph	Polygalaceae	Xanthophyllum	tnt10/54	XANTTNT1	4
55	no-la-do-ct-ph	Dipterocarpaceae	Hopea	mengarawan	HOPEMENG	4
56	mi-la-do-fi-hc-ad	Aspleniaceae	Asplenium	tnt10/56	ASPLTNT1	4
57	no-la-do-ct-ph	Verbenaceae	Teijsmanniodendron	coriaceum	TEIJCORI	4
58	na-la-do-ph-li	Connaraceae	Rourea	mimosoides	ROURMIMO	4
59	me-la-do-ph	Dipterocarpaceae	Dipterocarpus	tnt10/59	DIPTTNT1	4
60	pl-la-do-ct-ph	Rubiaceae	Timonius	stipulaceus	TIMOSTIP	4
61	no-la-do-ph-li	Connaraceae	Rourea	minor	ROURMINO	4
62	pl-co-do-ph-li	Annonaceae	Uvaria	tnt10/;62	UVARTNT1	4
63	me-co-do-su-pv-hc-ad	Zingiberaceae	Alpinia	tnt10/63	ALPITNT1	4
64	no-la-do-ct-ph	Euphorbiaceae	Neoscortechinia	kingii	NEOSKING	4
65	ma-la-do-ph	Sapotaceae	Madhuca	tnt10/65	MADHTNT1	4
66	le-la-do-ph	Fabaceae	Parkia	speciosa	PARKSPEC	4
67	me-la-do-ct-ph	Rubiaceae	Gardenia	pterocalyx	GARDPTER	4
68	me-co-do-ro-pv-ph-li	Arecaceae	Calamus	tnt10/68	CALATNT1	4
69	me-la-do-ct-ph	Moraceae	Artocarpus	nitidus	ARTONITI	5
70	me-co-do-ph-li	Dilleniaceae	Tetracera	scandens	TETRSCAN	5
71	no-la-do-ph	Clusiaceae	Garcinia	tnt10/71	GARCTNT1	5
72	me-la-do-ph	Rubiaceae	Timonius	tnt10/72	TIMOTNT1	5
73	no-la-do-ro-pv-ph-li	Arecaeae	Calamus	tnt10/73	CALATNT1	5
74	me-la-do-ph	Myrtaceae	Syzygium	tnt10/74	SYZYTNT1	5
75	mi-la-do-ct-ph	Fabaceae	Archidendron	clypearia	ARCHCLYP	5
76	me-la-do-ph	Sapotaceae	Palaquium	gutta	PALAGUTT	5
77	me-la-do-ph	Lauraceae	Beilschmiedia	tnt10/77	BEILTNT1	5
78	me-la-do-ph	Myrtaceae	Syzygium	tnt10/78	SYZYTNT1	5
79	no-la-do-ct-ph	Lauraceae	Actinodaphne	tnt10/79	ACTITNT1	5
80	me-la-do-ph	Ebenaceae	Diospyros	tnt10/80	DIOSTNT1	5
81	pl-la-do-ph	Burseraceae	Canarium	tnt10/81	CANATNT1	5
82	me-la-do-ph	Urticaceae	Hulletia	dumosa	HULLDUMO	5
83	me-la-do-ph-li	Loganiaceae	Strychnos	ignatii	STRYIGNA	5
84	me-la-do-ct-ph	Melastomataceae	Memecylon	costatum	MEMECOST	5
85	no-la-do-ph	Polygalaceae	Xanthophyllum	eurhyncum	XANTEURH	5
86	mi-la-do-ph-li	Fabaceae	Dalbergia	tnt10/86	DALBTNT1	5
87	na-la-do-ph	Ebenaceae	Diospyros	buxifolia	DIOSBUXI	5
88	me-la-do-ct-ph	Annonaceae	Trivalvaria	macrophylla	TRIVMACR	5
89	no-la-do-ph-li	Fabaceae	Phanera	coccinea	PHANCOCC	5
90	no-la-do-ct-ph	Clusiaceae	Calophyllum	tnt10/90	CALOTNT1	5
91	no-la-do-ph-li	Rhamnaceae	Ventilago	oblongifolia	VENTOBLO	5
92	me-la-do-ph	Celastraceae	Kokoona	ochracea	KOKOOCHR	5
93	me-la-do-ph-li	Loganiaceae	Strychnos	tnt10/93	STRYTNT1	5
94	me-la-do-fi-hc-ad	Polypodiaceae	Taenitis	blechnoides	TAENBLEC	5
95	me-la-do-ct-ph	Annonaceae	Goniothalamus	macrophyllus	GONIMACR	5
96	no-la-do-fi-hc-ad	Hymenophylaceae	Trichomanes	javanica	TRICJAVA	5

97	me-la-do-ph	Euphorbiaceae	Baccaurea	tnt10/97	BACCTNT1	5
98	no-la-do-ct-ph	Annonaceae	Polyalthia	tnt10/98	POLYTNT1	5
99	me-la-do-ph-li	Rhamnaceae	Zizyphus	calophylla	ZIZYCALO	5
100	mg-la-do-ro-pv-ph-ad	Arecaceae	Licuala	tnt10/100	LICUTNT1	6
101	me-la-do-ph	Euphorbiaceae	Aporusa	subcaudata	APORSUBC	6
102	no-la-do-ph	Euphorbiaceae	Aporusa	frutescens cf.	APORFRUT	6
103	me-la-do-ph	Ixonanthaceae	Ixonanthes	icosandra	IXONICOS	6
104	no-la-do-ct-ph	Annonaceae	Polyalthia	hypoloeuca	POLYHYPO	6
105	me-la-do-ph	Euphorbiaceae	Ptychopyxis	costata	PTYCCOST	6
106	no-la-do-ph	Fabaceae	Archidendron	microcarpum	ARCHMICR	6
107	no-la-do-ct-ph	Rubiaceae	Urophyllum	hirsutum	UROPHIRS	6
108	pl-la-do-ct-ph	Myristicaceae	Horsfieldia	grandis	HORSGRAN	6
109	me-la-do-ct-ph	Loganiaceae	Fagraea	racemosa	FAGRRACE	6
110	pl-la-do-ct-ph	Rosaceae	Atuna	racemosa	ATUNRACE	6
111	me-la-do-ph	Rosaceae	Prunus	arborea	PRUNARBO	6
112	me-la-do-ct-ph	Clusiaceae	Calophyllum	tnt10/112	CALOTNT1	6
113	mi-la-do-ph-li	Connaraceae	Cnestis	platanta	CNESPLAT	6
114	na-co-do-fi-ch-ad	Adiantaceae	Lindsaea	tnt10/114	LINDTNT1	6
115	me-la-do-ct-ph	Burseraceae	Canarium	littoralle	CANALITT	6
116	pl-la-do-ph	Myristicaceae	Myristica	maxima	MYRIMAXI	6
117	no-la-do-ct-ph	Myrtaceae	Syzygium	tnt10/117	SYZYTNT1	6
118	me-la-do-ph-li	Annonaceae	Uvaria	hirsuta	UVARHIRS	6
119	no-la-do-ct-ph	Fabaceae	Koompassia	malaccensis	KOOMMALA	6
120	me-la-do-ct-ph	Annonaceae	Goniothalamus	macrophyllus	GONIMACR	6
121	mi-la-do-ph-li	Myrsinaceae	Embelia	tnt10/121	EMBETNT1	6
122	me-la-do-ph	Polygalaceae	Xanthophyllum	tnt10/122	XANTTNT1	6
123	me-la-do-ph	Lauraceae	Indet	tnt10/123	INDETNT1	6
124	me-la-do-ct-ph	Myristicaceae	Myristica	iners	MYRIINER	6
125	me-la-do-ph	Ebenaceae	Diospyros	tnt10/125	DIOSTNT1	6
126	me-la-do-ct-ph	Annonaceae	Polyalthia	tnt10/126	POLYTNT1	6
127	na-la-do-ph	Rhamnaceae	Zizyphus	horsfeldii	ZIZYHORS	7
128	no-la-do-ct-ph	Oleaceae	Chionanthus	montanus	CHIOMONT	7
129	me-la-do-ct-ro-ph	Liliaceae	Dracaena	elliptica	DRACELLI	7
130	pl-la-do-ct-ro-pv-ph	Liliaceae	Dracaena	angustifolia	DRACANGU	7
131	me-la-do-ph	Ochnaceae	Gomphia	serrata	GOMPSERR	7
132	mi-la-do-ch-li	Cucurbitaceae	Melothria	tnt10/132	MELOTNT1	7
133	me-la-do-ct-ph	Burseraceae	Dacryodes	rostrata	DACRROST	7
134	mi-la-do-ph	Myrtaceae	Syzygium	tnt10/134	SYZYTNT1	7
135	me-la-do-ct-ph	Euphorbiaceae	Aporusa	tnt10/135	APORTNT1	7
136	me-la-do-ct-ph	Burseraceae	Santiria	apiculata	SANTAPIC	7
137	me-la-do-ct-ph	Euphorbiaceae	Pimelodendron	griffithianum	PIMEGRIF	7
138	no-la-do-ct-ph	Elaeocarpus	Elaeocarpus	tnt10/138	ELAETNT1	7
139	mi-la-do-ph	Clusiaceae	Mesua	tnt10/140	MESUTNT1	7
140	mi-la-do-ct-ph	Melastommataceae	Memecylon	myrsinoides	MEMEMYRS	7
141	me-la-do-ro-pv-hc-ad	Arecaceae	Calamus	javensis	CALAJAVE	7
142	me-la-do-ct-ph	Annonaceae	Cyathocalyx	bancana	CYATBANC	7
143	me-la-do-ct-ph	Icacinaceae	Gonocaryum	gracille		7
144	no-la-do-ph	Annonaceae	Popowia	pisocarpa	POPOPISO	7
145	no-la-do-ct-ph	Rubiaceae	Indet	tnt10/145	INDETNT1	7
146	me-la-do-ct-ph	Euphorbiaceae	Antidesma	tnt10/146	ANTITNT1	7

147	no-la-do-ct-ph	Annonaceae	Xylopia	malayana	XYLOMALA	7
148	pl-la-do-ct-ph	Annonaceae	Cyathocalyx	bancana	CYATBANC	7
149	no-la-do-ct-ph	Clusiaceae	Calophyllum	tnt10/149	CALOTNT1	7
150	me-ve-do-ro-pv-ph-li-ad	Arecaceae	Calamus	tnt10/150	CALATNT1	7
151	me-co-do-ro-pv-ph-li-ad	Arecaceae	Calamus	tnt10/151	CALATNT1	7
152	me-la-do-ct-ph	Rosaceae	Prunus	tnt10/152	PRUNTNT1	7
153	me-la-do-ct-ph	Sapindaceae	Nephelium	cuspidatum	NEPHCUSP	7
154	me-la-do-ct-ph	Lauraceae	Cryptocarya	tnt10/154	CRYPTNT1	8
155	me-la-do-ct-ph	Tiliaceae	Microcos	opaca	MICROPAC	8
156	mi-la-do-ct-ph	Annonaceae	Xylopia	caudata	XYLOCAUD	8
157	no-la-do-ct-ph	Myrtaceae	Syzygium	tnt10/157	SYZYTNT1	8
158	no-la-do-ph-li	Smilacaceae	Smilax	tnt10/158	SMILTNT1	8
159	me-la-do-ct-ph	Euphorbiaceae	Macaranga	tanarius	MACATANA	8
160	me-la-do-ph-li	Annonaceae	Friesodielsia	tnt10/160	FRIETNT1	8
161	no-la-do-ph-li	Annonaceae	Oxymitra	tnt10/161	OXYMTNT1	8
162	no-la-do-ph	Ebenaceae	Diospyros	tnt10/162	DIOSTNT1	8
163	na-la-do-fi-hc-li	Glecheniaceae	Dicranopteris	linearis	DICRLINE	8
164	me-la-do-ph	Ebenaceae	Diospyros	tnt10/164	DIOSTNT1	8
165	me-la-do-ct-ph	Sapindaceae	Nephelium	cuspidatum	NEPHCUSP	8
166	me-pe-do-ct-ph	Euphorbiaceae	Macaranga	trichocarpa	MACATRIC	8
167	mg-co-do-ct-ph	Rutaceae	Euodia	glabra	EUODGLAB	8
168	pl-la-do-ct-ph	Sterculiaceae	Scaphium	macropodum	SCAPMACR	8
169	me-la-do-ct-ph	Myrtaceae	Rhodamnia	cinerea	RHODCINE	8
170	no-la-do-ph-li	Apocynaceae	Willughbeia	coriacea	WILLCORI	8
171	me-la-do-ct-ph	Myristicaceae	Knema	tnt10/171	KNEMTNT1	8
172	me-la-do-ph-li	Vitaceae	Parthenocissus	tnt10/172	PARTTNT1	8
173	no-co-do-ro-pv-ph-li-ad	Arecaceae	Daemonorops	sabut	DAEMSABU	8
174	me-la-do-ct-ph	Sapindaceae	Xerospermum	laevigatum	XEROLAEV	8
175	me-la-do-ph-li	Annonaceae	Artabotrys	tnt10/175	ARTATNT1	8
176	me-la-do-ro-pv-ph-li	Flagellariaceae	Flagellaria	indica	FLAGINDI	8
177	mg-la-do-ct-ph	Myristicaceae	Knema	tnt10/177	KNEMTNT1	8
178	me-co-do-ct-ph	Aquifoliaceae	Ilex	macrophylla	ILEXMACR	8
179	me-la-do-ct-ph	Polygalaceae	Xanthophyllum	tnt10/179	XANTTNT1	8
180	me-la-do-ct-ph-ad	Sapotaceae	Palaquium	ridleyi	PALARIDL	8

Annex IV

Vegetation Survey and Habitat Assessment of the
Tesso Nilo Forest Complex
By Andrew N. Gillison

Pictures [4]

1. Access in Tesso Nilo
2. WWF personnel at plot TN01
3. Canopy opening following illegal logging, TN02
4. Dense regeneration layer of mostly mature forest canopy species in plot TN02.
5. Plot observers almost totally obscured.
6. Tapir tracks in sand near plot TN02
7. Fresh Elephant sign next to *Acacia mangium* plantation near Inhutani IV.
8. Typical feeding locality for Elephant consisting of many fast-growing Euphorbiaceae such as *Macaranga* and *Mallotus* spp.
9. Illegal logging is rampant in Inhutani IV
10. Clearfelling and illegal logging in Inhutani IV
11. The sun sets on one of the world's richest forests
12. Andy Gillison teaches data entry to biodiversity survey team at WWF AREAS office in Pekanbaru, Riau, Sumatra
13. Andy Gillison teaches biodiversity survey team in Riau, Sumatra
14. Logging gang stacks illegally felled logs along road in Tesso Nilo Forest, Riau, Sumatra
15. A line of 91 logging trucks waiting to leave Tesso Nilo Forest on a ferry to RAPP pulp mill in Riau, Sumatra

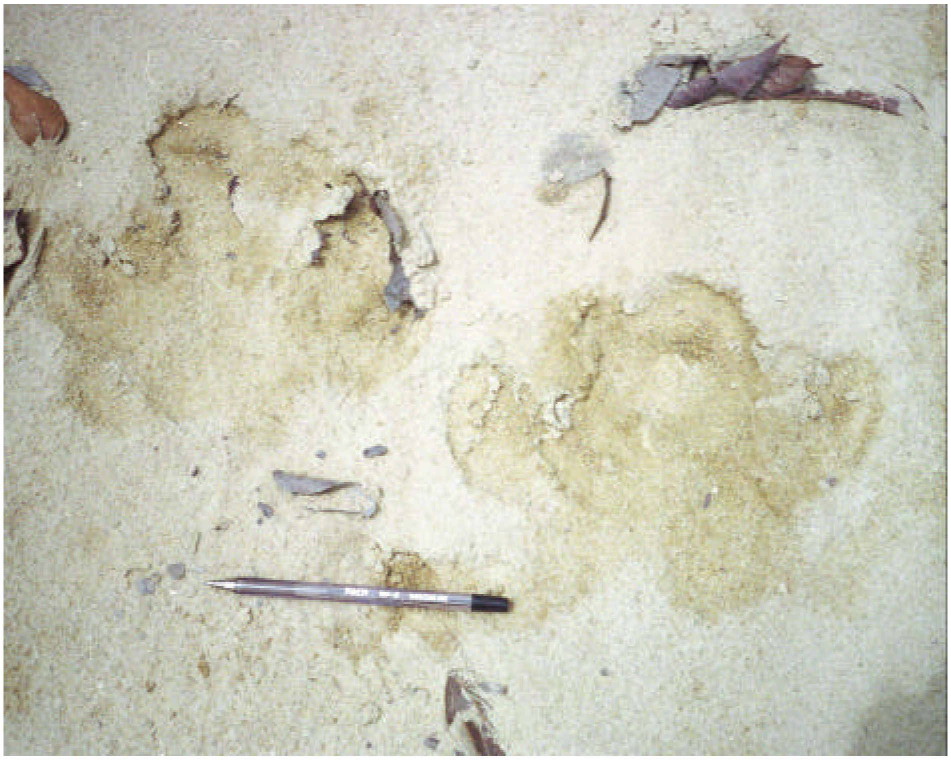
[4] Pictures 1-10, digital photographs © A.N. Gillison, Center for Biodiversity Management
Pictures 11-14, photographs © Michael Stüwe, WWF AREAS

Picture 1. Access in Tesso Nilo

Picture 2. WWF personnel at plot TN01

Picture 3. Canopy opening following illegal logging, TN02

Picture 4. Dense regeneration layer of mostly mature forest canopy species in plot TN02. Plot observers almost totally obscured.



Picture 5. Tapir tracks in sand near plot TN02

Picture 6. Fresh Elephant sign next to *Acacia mangium* plantation near Inhutani IV.

Picture 7. Typical feeding locality for Elephant consisting of many fast-growing Euphorbiaceae such as *Macaranga* and *Mallotus* spp.

Picture 8. Illegal logging is rampant in Inhutani IV

Picture 9. Clearfelling and illegal logging in Inhutani IV

Picture 10. The sun sets on one of the world's richest forests

Picture 11. Andy Gillison teaches data entry to biodiversity survey team at WWF AREAS office in Pekanbaru, Riau, Sumatra

Picture 12. Andy Gillison teaches biodiversity survey team in Riau, Sumatra

Picture 13. Logging gang stacks illegally felled logs along road in Tesso Nilo Forest, Riau, Sumatra

Picture 14. A line of 91 logging trucks waiting to leave Tesso Nilo Forest on a ferry to RAPP pulp mill in Riau, Sumatra