THE PLANT DIVERSITY OF MT. ULAP ECO-TRAIL IN CORDILLERA CENTRAL RANGE, PHILIPPINES: AN INSIGHT ON THE EFFECT OF ECOTOURISM IN A SECONDARY FOREST

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Abstract: The empirical evidence on ecotourism achieving biodiversity conservation goals is limited, particularly in developing countries like the Philippines, that makes ecotourism planning as more of a guesswork. To contribute to this, the study documented the floral diversity in Mt. Ulap Eco-Trail in Itogon, Benguet to determine the possible effects of the ecotourism activities in the area. A total of 127 species of vascular plants under 112 genus and 60 families have been documented in Mt. Ulap Eco-Trail, Itogon. Family Poaceae is most represented with 12 species followed by Asteraceae with 8 and Rubiaceae with 7. Majority of the rest of the families are represented by 1 to 3 species. Pine forest stations have the least number of species at 52 while broad-leaf stations have the highest at 72. Herb species were highest in summit stations at 41, while tree species were highest in broad-leaf stations at 27. The area registered moderate to high diversity, which could be attributed to the variability of floral species between the sampling stations. Several indigenous and endemic species as well as some vulnerable, endangered, critically endangered and other threatened species were also noted. This is an encouraging sign on the efficacy of the management of the area amidst the presence of ecotourism activities and protection of the area from extractive activities like mining, forest conversion to vegetable gardens and poaching that are prevalent in nearby mountain sites. Our result provides empirical evidences that the protective and economic functions of ecotourism claimed by previous studies are also true in successioning secondary forest like Mt. Ulap. We strongly recommend that the managers of the eco-trail stay vigilant in protecting the area.

Keywords: diversity indices, ecotourism, endangered species, floral diversity, Mt. Ulap Eco-Trail, secondary forest

Introduction:

The International Ecotourism Society (TIES) in 1990 defined ecotourism as “responsible travel to natural areas that conserves the environment and improves the well-being of local people”. This ecotourism principle fits into the sustainable management of the

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ecosystem. Due to this, ecotourism is proliferating in many biodiversity hotspots, and its proponents claim it can achieve both conservation and economic development goals. Ecotourism has become a major driver of economic growth and socioeconomic transformation in many areas. The amount spent on ecotourism is estimated to be 10 times more than that spent by official aid agencies and the UN Global Environment Facility on conservation projects (Kirkby et al. 2011; Waldron et al. 2017). Ecotourism accounts for as much as 40% of gross domestic product (GDP) in some countries and is growing 10% per year in other countries (WTTC 2014). Despite this major investment, there is limited empirical evidence that ecotourism achieves biodiversity conservation goals in the long term and at the landscape scale.

It is difficult to ascertain whether ecotourism actually achieves biodiversity goals. In developing regions, ecotourism and its cumulative effects on biodiversity are unclear. Ecotourism may generate the same or more income in an area than the consumption of natural resources (Kirkby et al. 2010; 2011). Thus, ecotourism can provide an economic incentive to protect ecosystems and the species therein (Nagendra et al. 2005; Buckley 2009; Wyman and Stein 2010). In contrast, ecotourism may lead to biodiversity loss because it can require or encourages economic development, which often entails strong, negative environmental outcomes (Mather et al. 1999). Ecotourism usually requires improved transportation networks (e.g., roads and airports), which can result in intensive natural resource exploitation, such as logging and poaching, because of increased accessibility to the area (Laurance et al. 2014; MoCTCA 2015; Shui and Xu 2016). Increased local wealth can change residents' consumption patterns, adding pressure on local forest resources (Liu et al. 2001; Brandt et al. 2019). Tourism also stimulates population growth, in the form of seasonal tourists and economic immigrants, which can raise demand for forest resources (Hall and Lew 2009). Finally, tourism inherently leads to an integration of local and regional markets, another factor strongly associated with increased resource extraction (Hall and Lew 2009; Wang and Buckley 2010; Lambin and Meyfroidt 2011).

The empirical evidences on the effects of ecotourism were mostly documented in protected primary forest. These include the studies of Brandt et al. (2019) in Himalayan biodiversity hotspot, Broadbent et al. (2012) in Manuel Antonio, Costa Rica, Pickering and Hill (2007) in protected areas in Australia, and Zarghi and Hosseini (2014) in Tandurah National Park, Iran. In the Philippines, however, very few studies were conducted to determine the effect of ecotourism on forest sites, and if there are, these are mostly based on perceptions. These include the study of Jalani (2012) in Sabang, Palawan and of Dulnuan (2005) in Sagada, Mt. Province. These limited studies on the effect of ecotourism in the country is consistent with the conclusion of Doan (2000) and Ignacio (2019) that very few empirical studies are available in developing nations which makes ecotourism planning as more of a guesswork. This highlights the need to conduct more empirical studies in ecotourism sites of the country that could indicate the actual effects of ecotourism. These are also important inputs in formulating ecotourism plans.

Also, it is not yet known if the effects of ecotourism are also true in not-so-pristine ecosystems, like for example secondary forest that are being offered as ecotourism sites. To date, no study yet was cited documenting the effects of ecotourism in secondary forests that are undergoing ecological succession. This makes the case of Mt. Ulap Eco-Trail in Itogon, Benguet interesting. The area is a predominantly secondary forest and is being offered for ecotourism activities like hiking and camping. It would be interesting to know the existing plant diversity in area vis-à-vis such ecotourism activities. This would provide insights on the effects of ecotourism on secondary successioning forests. This consideration prompted the conduct of this study.

The study is also an important contribution on adequately inventorying the biodiversity of the country. Amidst its biodiverse and biodiversity hotspot status, the country's biodiversity is poorly studied (Langerberger 2004; Napaldet and Buot 2019). Moreover, there is a global call for more empirical biodiversity studies (Ríos-Saldaña et al. 2018). Several authors noted that the role of empirical field research has faded appreciably in the past decades (Noss 1996; Tewksbury et al. 2014). This is worrisome, because of the potential repercussions that can percolate through the scientific sphere, where these data help describe and better understand the functioning of biological systems, into the policy-making arena, where they are used to inform decisions on which human interventions will delay biodiversity loss (Dijkstra 2016; Mihoub et al. 2017). While synthetic analyses and big data approaches are instrumental to help set national and global priorities in biodiversity conservation (e.g., Brum et al. 2017; Knox et al. 2016), they can be severely handicapped by a lack of sound observational data, including those collected through fieldwork. These show that field-based studies on biodiversity, even local-scale such as this study, are globally important.

Materials and methods:

The study site

Mt. Ulap Eco-Trail is a newly opened hiking site in Itogon, Benguet (Fig. 1). It was first opened in September 2015 and quickly became popular. The trail offers sea of pine trees, endless slopes of grasslands ideal as camping site, a marvelous 360° view of the surrounding mountain ranges, and a steep 80-degree cliff descent to the summit. Also, the eco-trail provides a glimpse of the local culture with villages, burial caves, and hanging bridges. Spanning an estimated 20 kilometres through several peaks along the Ampucao - Sta. Fe Ridge, the trail is easy enough to be completed in 4-6 hours, making it feasible as a dayhike or even a half-dayhike for hikers of all levels. Three major peaks, namely the grassland slopes of (1)Ambunao Paoay to (2)Gungal Rock to the highest point (3)Mt. Ulap (officially 1846 m asl), and other points of attraction are traversed via this trail. The descent from Mt. Ulap to Pong-ol Burial Caves is akin to the descent from Mt. Ugo summit to Tinongdan, with its steep, pine-forested terrain. The Burial Caves themselves are a nice attraction, and at Sta. Fe there are hanging bridge and cemented footpath that complete the experience. Another factor that contributes to the popularity of Mt. Ulap Eco-Trail is its accessibility, just 40 minutes away from Baguio City by public jeepney.

The sampling method

Nine (9) sampling stations were established along the Mt. Ulap Eco-Trail. During the reconnaissance, we observed three major types of vegetation in the area namely pine forest, broad-leaf forest and summit vegetation. Thus, the sampling stations were distributed equally in three types of vegetation. Three stations were established each in the pine forest stand and broad-leaf forest stand while one each in the three summit stations. Figure 1 shows the study site and the location of the sampling stations.

Plot method was employed in data gathering. This method is simple to use and the materials needed are readily available. Aside from its convenience, the uniform shapes of the plots together with the randomized distribution throughout the sampling area makes it straight forward. Although physically demanding, this method is not destructive (Napaldet and Buot 2019). In the pine and broadleaf forest stations, four 1x1 m quadrats were established for low-lying herbs and grasses, two 5x5 m for shrubs and one 20x20 m for trees. On the other hand, only 1x1 m quadrats for low-lying herbs and grasses and 5x5 m for shrubs were established in the summit stations. The inclusion of herbs and shrubs in the inventory is in response to the claim of Langenberger (2004) that low-lying vegetation account for the bulk of species richness. Overall, 36 1x1 m quadrats, 18 5x5m quadrats and six 20x20 m plots were established in the study.

Plants within the plots were taxonomically identified. Tree seedlings were included in the 1x1 quadrat inventory while tree saplings (<5cm dbh), tall grass and lianas were included in the 5x5 quadrats. Several taxonomic references were used to verify the plants such as the published works of Pancho (1983), Rojo (1999) and Pancho and Gruezo (2006; 2009). On-line databases generated by Pelser et al. (2011 onwards) and that of tropicos.org (2013) were also consulted. Scientific names and classification were checked and verified in the Kew website: www.theplantlist.org.

Density and frequency were the primary parameters used to determine the importance value for low-lying plants. For shrubs, coverage was included while basal area for trees. The different parameters were computed as follows:

Density (D*i*)

$$\mathrm{D}i = \frac{ni}{A}$$

where:
n*i* = number of individual of species *i*;
A = total area sampled (m^2)

Frequency (F*i*)

$$\mathrm{F}i = \frac{\mathrm{J}i}{\mathrm{K}} \text{ x } 100$$

where:
J*i* = number of plot where the species occur;
K = total number of plots

Basal Area (BA*i*)

$$\mathrm{BA}i = \sum(0.005454 \text{ x DBH})$$

where
DBH = diameter at breast height, measured in centimetres

Coverage (C*i*)

$$\mathrm{C}i = \frac{\sum(\pi \, x \, r^2)}{10000}$$

where:
r = radius (cm) of foliar canopy of species *i*
π = is the constant 3.1416

Relative Density (RD*i*)

$$\mathrm{RD}i = \frac{\mathrm{D}i}{\mathrm{TD}} \text{ x } 100$$

where:
D*i* = density of species *i*
TD = total density of all species

Relative Frequency (FR*i*)

$$\mathrm{RF}i = \frac{\mathrm{F}i}{\mathrm{TF}} \text{ x } 100$$

where:
F*i* = frequency of species *i*
TF = total frequency of all species

Relative Coverage (RC*i*)

$$\mathrm{RC}i = \frac{\mathrm{C}i}{\mathrm{TC}} \text{ x } 100$$

where:
C*i* = coverage of species *i*;
TC = total coverage of all species

Relative Basal Area (RBA*i*)

$$\mathrm{RBA}i = \frac{\mathrm{BA}i}{\mathrm{TBA}} \text{ x } 100$$

where:
BA*i* = Basal Area of species *i*;
TBA = Total Basal Area of all species

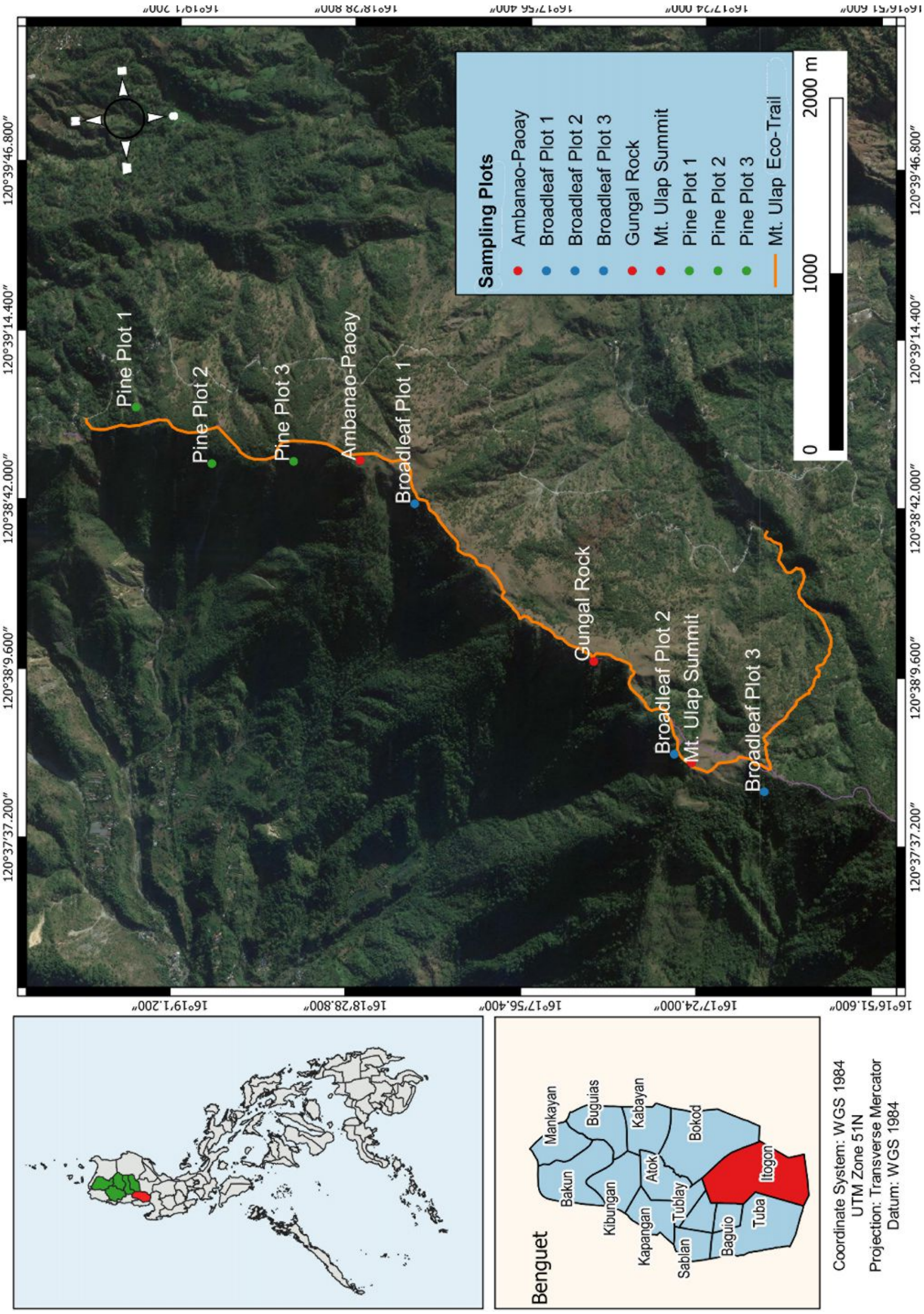


Figure no. 1 Map of Mt. Ulap Eco-Trail showing the sampling stations

Importance Value for herbs (IV*hi*)

$$\text{IV}hi = \frac{\text{RD}i + \text{RF}i}{2}$$

where:
RD*i* = Relative Density of species *i*
RF*i* = Relative Frequency of species *i*

Importance Value for shrubs (IV*shi*)

$$\text{IV}shi = \frac{\text{RD}i + \text{RF}i + \text{RC}i}{3}$$

where:
RD*i* = Relative Density of species *i*
RF*i* = Relative Frequency of species *i*
RC*i* = Relative Coverage of species *i*

Importance Value for tree (IV*tri*)

$$\text{IV}tri = \frac{\text{RD}i + \text{RBA}i + \text{RF}i}{3}$$

where:
RD*i* = Relative Density of species *i*
RBA*i* = Relative Basal Area of species *i*
RF*i* = Relative Frequency of species *i*

Diversity indices

Additionally, diversity indices such as Shannon, Simpsons, Margalef and Jaccard's index of similarity were computed. There were calculated as follows:

Shannon-Wiener diversity index (H)

$$H = \sum_{i=l}^{S} pi(lnpi)$$

where:
p*i* = Number of individuals of species *i*/ total number of samples
S = Number of species or species richness
ln = the natural logarithm

Evenness (E)

$$E = \frac{H}{Hmax}$$

where:
H = Shannon-Wiener diversity index
H_{max}(max diversity possible) = ln(N)

Simpson's diversity index (D)

$$D = 1 - \sum_{i=1}^{s} \frac{ni(ni-1)}{N\,(N-1)}$$

where:
ni = total individual of species i
N = total number of individual of all species
S = number of species or species richness

Richness (R)

$$R = \frac{(S-1)}{\ln(N)}$$

where:
S = # of species
N = # of individuals (of all species)
ln = the natural logarithm

To compare the diversity among sampling stations, Jaccard index (J) of similarity was used. It was computed as:

$$J = \frac{Sc}{Sa + Sb + Sc}\ x\ 100$$

where:
Sc = number of species common to the two samples
Sa = number of species unique to station a
Sb = number of species unique to station b

Determination of the Endemic and Indigenous Species

Lastly, the study looked into the ecologically important species in the area. This includes identifying the indigenous, endemic and endangered species in the mountain sites. Several experts contend that these species are more important information for conservation purposes (Merrill and Meritt 1910; Killeen et al. 1998; Malabrigo 2013; Guron et al. 2019). The classification of the plants as endemic or indigenous was based on the plant distribution given in Co's Digital Flora (Pelser et al. 2011 onwards) while the conservation status was based on DENR (2017).

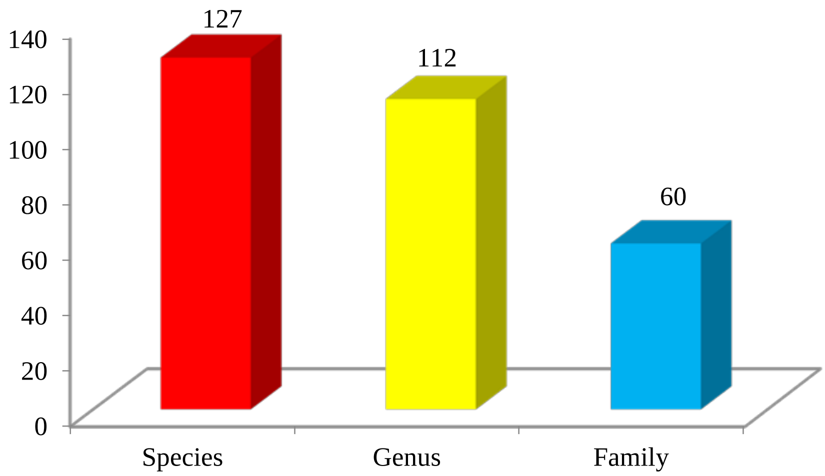
Results and discussion:

Species richness

A total of 127 species of vascular plants under 112 genus and 60 families were recorded in Mt. Ulap Eco-Trail, Itogon, Benguet (Fig. 2). Of these, 11 species are pteridophytes, 1 gymnosperm, 26 monocots and 89 dicots. Families Poaceae is the most represented with 12 species followed by Asteraceae with 8, Rubiaceae with 7, families Cyperaceae, Lamiaceae and Rutaceae with 6 each and Fabaceae with 5 species. Majority of the rest of the families are represented by 1 to 3 species (Fig. 3, Annexes).

In terms of species richness by stations, pine forest stations have the least number of species at 52 while broad-leaf stations have the highest at 72 (Fig. 4). Interestingly, summit stations have higher number of species than pine forest stations even if the latter do not have tree species. Herb species were highest in summit stations at 41, while tree species were highest in broad-leaf stations at 27. Shrub species were generally the same between sampling stations ranging from 17-22 species. Pine forest stations have low number of tree species at 7 and this could be attributed to the dominance of *Pinus kesiya*.

Figure no. 2 The species, genera and family richness of Mt. Ulap Eco-Trail in Itogon, Benguet

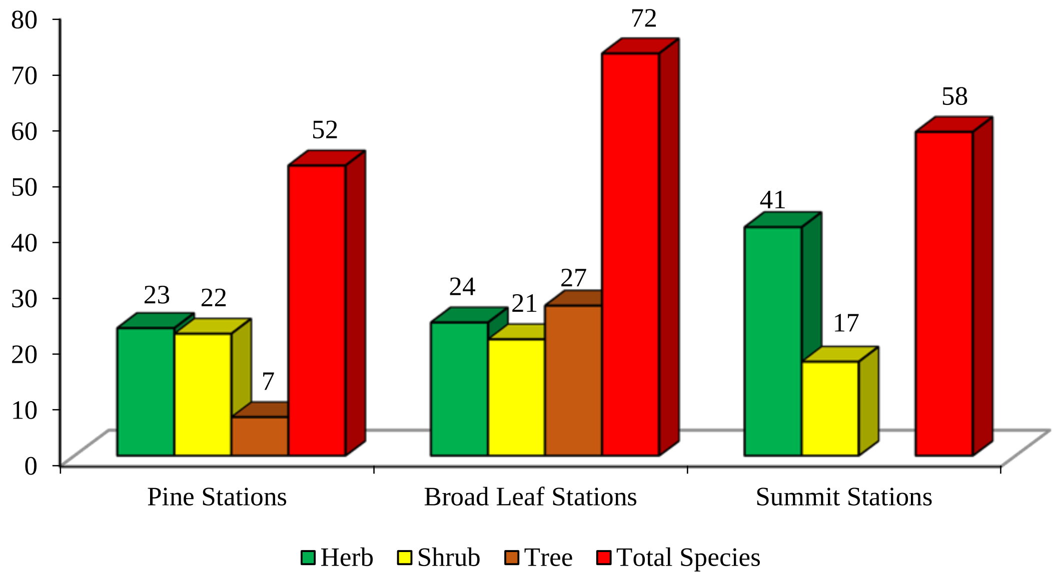


Population Counts and the Dominant Species along Mt. Ulap Eco-Trail

The herbs, shrubs and trees in the sampling stations of Mt. Ulap Eco-Trail are presented in Tables 1 to 3 (Annexes). Table 1a to 1c (Annexes) presents the detailed population counts of herb, shrub and trees in the pine forest stations; Table 2a to c (Annexes) the herb, shrub and trees in the broad-leaf stations; and, Table 3a and b (Annexes) the herb and shrubs in the summit stations.

In the pine forest stations, the dominant herbs are *Ageratina riparia*, *Themeda triandra*, *Pteridium aquilinum*, *Elephantopus tomentosus*, *Gonostegia hirta*, *Imperata cylindrica* and *Rubus luzoniensis*. The dominant shrubs are *Maesa indica*, *Rubus fraxinifolius* and *Melastoma malabathricum* while *Pinus kesiya* thoroughly dominate in the tree stations with few interspersed other tree species. It is interesting to note that some indigenous herbs such as *T. triandra*, *P. aquilinum* and *R. luzoniensis* were still dominant in the pine forest floor together with the exotic and obnoxious weeds. Also, the dominant shrubs and *P. kesiya* are also indigenous in the area.

Figure no. 4 The species richness by sampling stations in Mt. Ulap Eco-Trail



On the other hand, *A. riparia* is thoroughly dominant as forest floor cover in the broadleaf stations. Only few individuals of other herb and grass species were observed interspersed with this exotic species. The shrub and tree species were diverse in this station where no species is clearly dominating. The dominant shrubs are *M. indica*, *Eurya coriacea*, *Clethra canescens* var. *luzonica*, *Viburnum odoratissimum*, *M. malabathricum* and *Vaccinium barandanum* – all are indigenous or endemic species. The dominant trees are large individuals of *E. coriacea*, *Adinandra luzonica* and *C. canescens* var. *luzonica*.

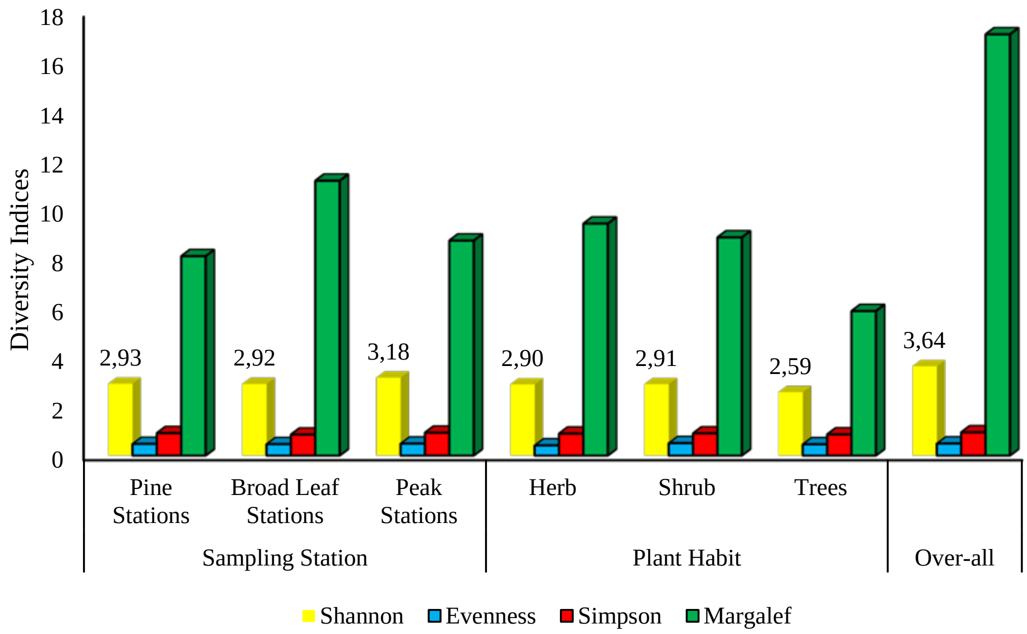
Summit stations have a different set of dominant herb cover namely *Axonopus compressus*, *T. triandra*, *Drosera lunata*, *G. hirta* and *P. aquilinum*. Except for *P. aquilinum*, these dominant herbs of the summit stations are generally creepers or prostrate and are able to withstand trampling. The summit stations are generally used as camping site. The dominant shrubs are *Rubus fraxinifolius*, *Miscanthus floridulus* and *C. canescens* var. *luzonica*. The shrubs in the summit stations are generally found at the slopes adjacent to the grass-covered summit.

Diversity indices

The diversity indices of Mt. Ulap Eco-Trail are presented in Figure 5. The Shannon-Wiener indices between stations are relatively similar at 2.92 to 3.18 with summit stations having the highest and broad-leaf stations being the lowest. Using the diversity scale of Fernando (2009), summit stations would fall under high diversity while pine forest and broad-leaf stations would fall under moderate diversity. On the other hand, in terms of plant habit, shrub and herb has the highest Shannon-Wiener index of 2.91 and 2.90 (moderate diversity) while tree is the lowest at 2.59, though still interpreted as moderate diversity.

Evenness ranges from 0.41 to 0.51 among stations and plant habit while Simpson's index ranges from 0.86 to 0.93. The trend follows the same trend in the Shannon-Weiner index where broad leaf stations has the lower values while higher in summit stations. Among plant habits, shrub has the highest evenness and Simpson's index - indicative of a more even distribution of individuals among the shrub species - while the tree has the lowest values. This could be directly attributed to the dominance of *P. kesiya* as the overstory cover. Margalef's index, on the other hand, ranges from 8.11 to 11.17 among the stations and 5.89 to 9.43 in the plant habit. It can be deduced from these results that Margalef's index is directly proportional with species richness – the higher the number of species, the higher the index.

Figure no. 5 The diversity indices of the sampling stations in Mt. Ulap Eco-Trail



Overall, Mt. Ulap Eco-Trail has Shannon-Weiner index of 3.64, evenness of 0.49, Simpson's index of 0.95 and Margalef's index of 17.10. These values show that, amidst the presence of ecotourism activities, the area is still highly diverse primarily due to the presence of several native and endemic herbs, shrubs and small trees.

The high diversity of Mt. Ulap Eco-Trail could also be attributed to the low index of similarity between stations (Tab. 4). The Jaccard index of similarity between stations is low ranging from 12.12 to 18.52% only. This result demonstrates that species composition between stations is highly variable. The few species that occur in all stations are common weeds such as *A. adenophora*, *A. riparia*, *Elephantopus tomentosus*, and *Gonostegia hirta* as well as some indigenous species like *Arisaema polyphyllum*, *Oplismenus hirtellus P. aqualinum*, *P. kesiya*, *R. fraxinifolius* and *Vaccinium barandanum***.** Between stations, it is interesting that pine station is more similar to summit station than to broad-leaf stations even if they both have tree species. The higher similarity between pine and summit stations could be attributed to the higher number of similar shrub and herb species. On the other hand, the lowest similarity between summit and broad-leaf stations could be directly attributed to their difference in exposure. The exposed and trampling conditions of summit stations allow the survival of herb species adapted to these. This is very different with the much shaded condition of the forest floor under the broad-leaf. Common species between summit and broad-leaf stations are generally shrub species.

Table no. 4 The Jaccard's Index of Similarity among Sampling Stations in Mt. Ulap Eco-Trail

	Pine Stations	Broad Leaf Stations
Broad Leaf Stations	16.13	
Peak Stations	18.52	12.12

Ecological Status of Floral Diversity in Mt. Ulap

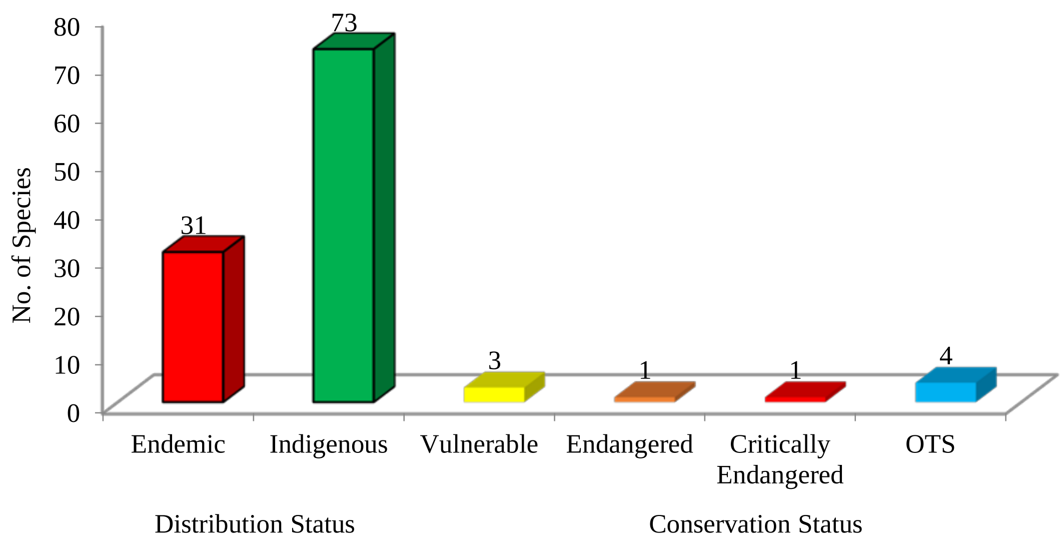
Of the total 127 species in Mt. Ulap Eco-Trail, 73 are indigenous species and 31 are endemic species (Fig. 6). This means that 79.53% of the total species in the area are natives. Moreover, 1 critically endangered, 1 endangered, 3 vulnerable and 4 other threatened species are recorded in the area. These include the critically endangered *Medinilla magnifica*; the endangered *Cyathea contaminans*; the vulnerable *Cyathea fuliginosa*, *Saurauia bontocensis* and *Lithocarpus jordanae*; and, the other threatened species *Dinochloa acutiflora*, *Lithocarpus luzoniensis*, *Machilus philippinensis* and *Pittosporum resiniferum*.

Species richness

The total 127 species in Mt. Ulap Eco-Trail documented in this study is much higher than the inventory conducted in nearby areas such as the 68 species documented in Talinguroy Research Station in La Trinidad by Guron et al (2019), the 78 species documented in Alno Communal Forest, La Trinidad by Lumbres et al. (2014), and the 109 species in Mt. Kili-kili (Batani et al. in press). This result hints the variability and heterogeneity of species composition and diversity in different sites even if these are located in the same southern slope of the Cordillera Central Range (CCR). This also hints the need for continuous inventories in different sites of the CCR for proper accounting and for monitoring.

The high representation of families Asteraceae and Poaceae in the sampling stations, particularly as understory, is expected since these are two of the largest plant families (Pancho and Gruezo 2012). These families harbour species of considerable importance and enjoy wide distribution. Asteraceae or sunflower family consists of 1,911 genera and 32,205 species worldwide (Royal Botanic Gardens Kew and Missouri Botanic Garden, n.d.) while Poaceae displays 759 genera and 11, 554 species. Asteraceae has affinity to temperate conditions and these are offered by the high elevations of the CCR. Also, this result provides evidence for the claim of Gruezo (2008) that CCR could be the center of diversity for Asteraceae in the Philippines. However, in terms of shrub and tree species, Families Rubiaceae, Rutaceae and Lamiaceae are the most represented. The species of these families are characteristics of mid to high elevation areas (Pelser et al. 2011 onwards) which is consistent with the elevation of Mt. Ulap. These shrub and tree species were also observed in Alno Communal Forest, La Trinidad by Lumbres et al. (2014) and in Mt. Kili-kili, Kibungan by Batani et al. (in press).

Figure no. 6 The distribution and conservation status of the plants in Mt. Ulap Eco-Trail



The high species richness in the broad-leaf stations is attributed primarily to the diverse shrubs and trees. Except for the exotic *A. riparia*, herb and grass species in the forest floor are generally few due to the shaded condition. It seems that the shaded condition under broad-leaf stations is preferred by the exotic *A. riparia* as it thoroughly dominates the area. The same observation was also noted under pine forest stations where *A. riparia* is also dominant but not as dominant as those in the broad-leaf stations. On the other hand, herb and grass species account for the majority in the summit stations.

The high herb and grass species in the summit stations is encouraging amidst the trampling brought by ecotourism activities and by the grazing of cows and wildlife. According to the trail managers, they regularly transfer trails to allow previously beaten trail to rejuvenate. The grassy summit, in turn, is being maintained by constant grazing of cattle set loose in the area and by wild herd of Philippine deer.

The high species richness of Mt. Ulap could also be attributed to the variable set of plants among the sampling stations. This is seen in the low index of similarity between stations. In particular, broad-leaf stations have the least similar species composition with the rest of the sampling stations. This could be attributed to the shaded condition of the forest floor. Also, it was observed that broad-leaf forest stand were generally located along depressed slopes which usually has moist soils and the usual location of springs. It is interesting to note that the tree species here are much different from the pine forest stand even if they are just adjacent to each other. Pine forest stands are generally observed at exposed ridge. This shows the presence of several different microhabitats in the mountains, which allows different plants to grow and thrive in different sites.

Population counts and the dominant species

Pinus kesiya is the dominant tree cover in the pine forest stations while broad-leaf small trees and large shrubs in the depressed slopes. The dominant shrub species in the stations are characteristics of mid to high elevation areas. It was also noted that the dominant shrubs and trees in the area are either indigenous or endemic species but not exotic species. This is a welcome discovery amidst the rampant introduction of exotic tree species in several sites in CCR (Guron et al. 2019; Antonio et al. 2020) and in the country in general (Malabrigo 2018). However, it is a different story in the case of herb diversity. The dominance of *A. riparia* in the pine and broad-leaf stations reflects the general trend observed in different sites of the CCR (Pelser et al. 2011 onwards). This exotic species was also found dominant in Talinguroy Research Station, La Trinidad (Guron et al. 2019). This plant is a native of South America (Turner 1997) but is now pantropical in distribution. According to the locals, the dominance of *A. riparia* in the area is a recent development. It can be deduced from our results that the dominance of *A. riparia* is correlated with lower species richness in the forest floor. This is observed particularly in the broad-leaf stations which has a highly dominant *A. riparia* and has the lowest herb species at 21. In contrast, *A. riparia* has lower dominance in pine forest stations which could help explain its higher species richness amidst the common notion that pine forest generally has lower forest floor diversity due to its allelopathic effect. These results affirm the observed invasive of this species even in relatively protected areas. The eco-trail is protected from any agricultural activities, only pasturing of livestock is allowed.

Biodiversity indices

In most ecological studies, Shannon-Wiener’s (*H*) index is generally between 1.5 and 3.5 with higher number indicating greater species richness and evenness (Fernando 1998). The lowest Shannon-Weiner index the broad-leaf station is unexpected because of its highest species richness among the stations. During the field data gathering, we observed this to be the most diverse particularly in terms of shrub and tree species but when we compute for the Shannon-Weiner index, it has the lowest value among the sampling stations. This could be attributed to the very high dominance of *A. riparia* in the forest floor, to such an extent that it has 1/3 of the total individuals in these stations. One major attribute of Shannon-Wiener diversity index is that it takes into account species richness and the proportion of each species within the local community.

On the other hand, the moderate diversity of the pine forest stations supports the claim of Batani et al. (in press) that pine forest may not be as poorly diverse as previously thought. They observed that the pine forest in Mt. Kili-kili, Kibungan harbors 109 species which shows that pine forest in CCR may not be as highly diverse as the mossy forest and the lowland evergreen forest with which it shares its boundary but could still be moderately diverse. An alternative explanation for the relatively high diversity of Mt. Kili-kili and Mt. Ulap in this study is that both are undergoing secondary succession wherein it could eventually become a broad-leaf forest. Previous theory of Whitford (1911) mentions that prior to human impacts, the Philippines is predominantly a broad-leaf forest of one type or another. The dominance of *P. kesiya* in CCR is seen to be anti-climax and is a by-product of the annual forest fires that kills sapling and seedling of broad-leaf species thereby maintaining the dominance of the pine. In Mt. Kili-kili and Mt Ulap, the surrounding communities aggressively protect them from forest fires and this allows the growth of varied understory flora and not just the hardy, weedy types. This may account for their relative high species richness and better than expected diversity.

Another general trend on the H-index is observed in terms of plant habit. Trees have lower diversity while shrub and herbs are more diverse. The higher diversity in herbs could be directly attributed to the species richness but this is not the case in shrubs since it has lower number of species. On the other hand, the higher H-index in shrubs is attributed to the more proportional distribution of individuals among the shrub species. In fact, shrub has the highest evenness at 0.51. This shows the major factor that evenness has on the overall *H-index*.

The overall Shannon-Wiener's index of Mt. Ulap Eco-Trail of 3.64 (very high diversity) is higher than those recorded in Talinguroy Research Station at 2.96 and in Alno Communal Forest at 3.21. This could be attributed to the presence of several indigenous and endemic species in the understorey of Mt. Ulap that were not recorded in the other two areas. In Alno Communal Forest by Lumbres et al. (2014), the authors generally focused on tree species, thus, relatively fewer understorey species were recorded. Unfortunately, this is the general trend in forest inventory in the country. Another inventory in CCR by Rabena et al. (2015) also focused on tree species with lesser emphasis on understory vegetation. Our results, together with the results of Guron et al. (2019) and Batani et al. (in press), show the significant contribution of understory herbs and shrubs in the overall diversity of the forest. Therefore, we support the claim of Langenberger (2004) that understory herbs and shrubs should be included in any forest inventory to adequately account for its biodiversity.

Ecologically important species amidst the ecotourism activities

The presence of several indigenous and endemic species as well as some vulnerable, endangered, critically endangered and other threatened species in Mt. Ulap is an encouraging sign on the efficacy of the management of the area amidst the presence of ecotourism activities. It could be easily deduced that the presence of ecotourism activities actually provides ample protection for the area against extractive activities like mining, forest conversion to vegetable gardens and poaching that are prevalent in many other parts of CCR (Navarro and Saldo 2000). The tourist guides also mentioned that they actively guard the floral diversity by preventing their collection. This result supports the claims of Kirkby et al. (2010; 2011) that ecotourism can protect an area by preventing other extractive land-uses while generating income to the local community. Our result also shows affirmative evidence that the positive benefits of ecotourism documented in more pristine biodiverse areas are also true in successioning forest secondary such as Mt. Ulap. Our result is also an important baseline information for monitoring purposes. These would provide a good comparison for future inventory to check if the floral diversity of the area is declining or improving due to ecotourism activities.

Conclusion

The study was able to document 127 species of vascular plants under 112 genus and 60 families in Mt. Ulap Eco-Trail, Itogon. The area registered moderate to high diversity which could be attributed to the variability of floral species between the sampling stations. This shows the presence of several microhabitats in the area that allows different sets of plants to grow and thrive. Several indigenous and endemic species as well as some vulnerable, endangered, critically endangered and other threatened species were also noted in the area. This is an encouraging sign on the efficacy of the management of the area amidst the presence of ecotourism activities and protection of the area from extractive activities like mining, forest conversion to vegetable gardens and poaching that are prevalent in nearby mountain sites. Our result provides empirical evidences that the protective vis-à-vis economic functions of ecotourism claimed by previous studies are also true in successioning secondary forest like Mt. Ulap. Our result is also an important baseline information for monitoring purposes. These would provide a good comparison for future inventory to check if the floral diversity of the area is declining or improving due to the ecotourism activities. We strongly recommend that the managers of the eco-trail stay vigilant in protecting the area.

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Rezumat:

DIVERSITATEA PLANTELOR DIN MUNTELE ULAP ECO-TRAIL ÎN RAZA CORDILIEREI CENTRALE, FILIPINE: O INTRODUCERE PRIVIND EFECTUL ECOTURISMULUI ÎNTR-O PĂDURE SECUNDARĂ

Dovezile empirice asupra ecoturismului privind atingerea obiectivelor de conservare a biodiversității sunt limitate, în special în țările în curs de dezvoltare precum Filipine, ceea ce face ca planificarea ecoturismului să fie mai mult o presupunere. Pentru a contribui la aceasta, studiul a documentat diversitatea florală a Muntele Ulap Eco-Trail din Itogon, Benguet pentru a determina posibilele efecte ale activităților de ecoturism din zonă. Un total de 127 de specii de plante vasculare din 112 genuri și 60 de familii au fost documentate în Muntele Ulap Eco-Trail, Itogon. Familia Poaceae este cea mai reprezentată cu 12 specii, urmată de Asteraceae cu 8 și Rubiaceae cu 7. Majoritatea celorlalte familii sunt reprezentate de 1 până la 3 specii. Stațiile pădurilor de pin au cel mai mic număr de specii, respectiv 52, în timp ce stațiile cu foioase au cel mai mare număr, respectiv 72. Speciile de ierburi au fost cele mai multe în stațiile de vârf, respectiv 41, în timp ce speciile de arbori au fost cele mai multe în stațiile cu foioase, respectiv 27. Suprafața a înregistrat o diversitate moderată până la una ridicată, care ar putea fi atribuită variabilității speciilor florale între stațiile de prelevare. Au fost de asemenea observate mai multe specii indigene și endemice, precum și unele specii vulnerabile, pe cale de dispariție, în pericol critic și alte specii amenințate. Acesta este un semn încurajator cu privire la eficacitatea managementului zonei pe fondul prezenței activităților de ecoturism și al protecției zonei de activități extractive precum minerit, transformarea pădurilor în grădini de legume și braconaj, care sunt predominante în zonele montane din apropiere. Rezultatul nostru oferă dovezi empirice că funcțiile de protecție și economice ale ecoturismului susținute de studiile anterioare sunt valabile și în succesiunea pădurilor secundare precum cele de pe Muntele Ulap. Recomandăm cu tărie ca administratorii traseului ecologic să rămână vigilenți în protejarea zonei.

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Annexes:

Figure no. 3 The species richness in Mt. Ulap Eco-Trail by plant families

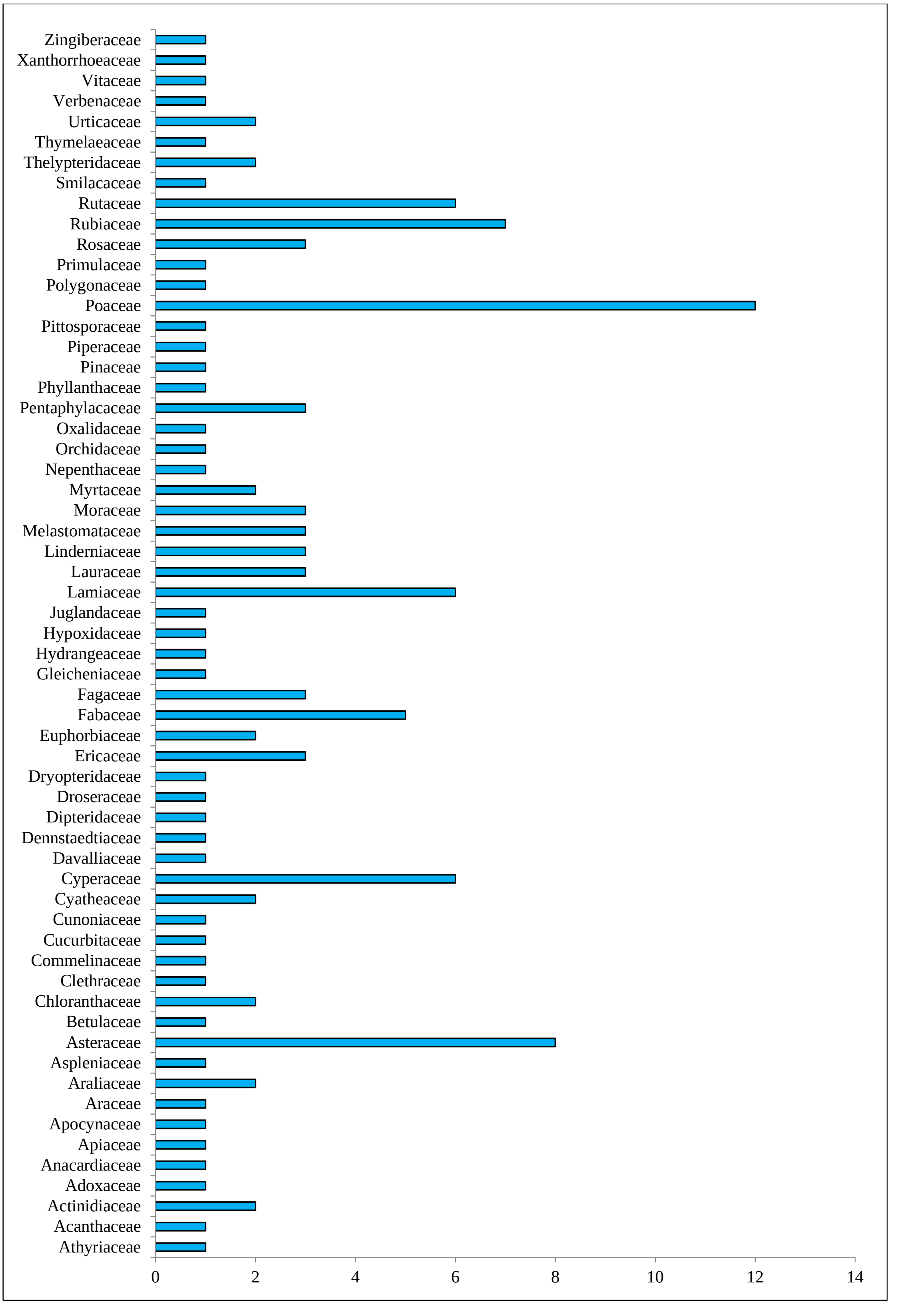

Table no. 1a Population counts and dominance index of herb and grass species in the Pine Stations of Mt. Ulap Eco-Trail

Plant Species	ni	Ji	Di	Fi	RDi	RFi	IV
Ageratina adenophora (Spreng.) R.M. King et H. Rob.	3	2	0.25	16.67	1.09	2.63	1.86
Ageratina riparia (Regel) R.M. King et H. Rob.	70	10	5.83	83.33	25.53	13.16	19.34
Arisaema polyphyllum (Blanco) Merr.	4	3	0.33	25.00	1.46	3.95	2.70
Bolbitis rhizophylla (Kaulf.) Hennipman	1	1	0.08	8.33	0.36	1.32	0.84
Carex crinita Lam.	1	1	0.08	8.33	0.36	1.32	0.84
Chromolaena odorata (L.) R.M. King et H.Rob.	1	1	0.08	8.33	0.36	1.32	0.84
Coelorachis rottboellioides (R.Br.) A. Camus	14	6	1.17	50.00	5.11	7.89	6.50
Desmodium procumbens (Mill.) Hitchc.	1	1	0.08	8.33	0.36	1.32	0.84
Desmodium velutinum (Willd.) DC.	1	1	0.08	8.33	0.36	1.32	0.84
Dianella ensifolia (L.) DC.	2	2	0.17	16.67	0.73	2.63	1.68
Dicranopteris curranii Copel.	1	1	0.08	8.33	0.36	1.32	0.84
Drosera lunata Buch.-Ham. ex DC.	1	1	0.08	8.33	0.36	1.32	0.84
Elephantopus tomentosus L.	29	5	2.42	41.67	10.57	6.58	8.58
Gonostegia hirta (Blume ex Hassk.) Miq.	20	5	1.67	41.67	7.29	6.58	6.94
Imperata cylindrica (L.) Raeusch	16	5	1.33	41.67	5.83	6.58	6.21
Melastoma malabathricum L.	1	1	0.08	8.33	0.36	1.32	0.84
Oplismenus hirtellus (L.) P. Beauv	4	3	0.33	25.00	1.46	3.95	2.70
Paspalum conjugatum P.J. Bergius	1	1	0.08	8.33	0.36	1.32	0.84
Pneumatopteris nitidula Holttum	1	1	0.08	8.33	0.36	1.32	0.84
Pteridium aquilinum (L.) Kuhn	24	8	2.00	66.67	8.75	10.53	9.64
Rubus fraxinifolius Poir.	1	1	0.08	8.33	0.36	1.32	0.84
Rubus luzoniensis Merr.	11	5	0.92	41.67	4.01	6.58	5.30
Themeda triandra Forssk.	57	8	4.75	66.67	20.78	10.53	15.66
Torenia violacea (Azaola ex Blanco) Pennell	4	2	0.33	16.67	1.46	2.63	2.05
Youngia japonica (L.) DC.	2	1	0.17	8.33	0.73	1.32	1.02

Table no. 1b Population counts and dominance index of shrub and tall grass species in the Pine Stations of Mt. Ulap Eco-Trail

Plant Species	ni	Ji	Ci	Di	Fi	RCi	RDi	RFi	IV
Aralia bipinnata Blanco	1	1	1.77	0.02	16.67	1.79	0.93	2.86	1.86
Bridelia glauca Blume	3	1	1.31	0.06	16.67	1.33	2.80	2.86	2.33
Callicarpa micrantha S. Vidal	2	1	4.42	0.04	16.67	4.47	1.87	2.86	3.07
Chingia ferox (Blume) Holttum	6	1	6.99	0.11	16.67	7.08	5.61	2.86	5.18
Diplospora fasciculiflora (Elmer) Elmer	1	1	0.53	0.02	16.67	0.54	0.93	2.86	1.44
Eurya coriacea Merr.	2	2	1.42	0.04	33.33	1.44	1.87	5.71	3.01
Ficus benguetensis Merr.	1	1	0.34	0.02	16.67	0.34	0.93	2.86	1.38
Ficus ulmifolia Lam.	1	1	0.36	0.02	16.67	0.36	0.93	2.86	1.38
Gmelina arborea Roxb	2	2	7.51	0.04	33.33	7.61	1.87	5.71	5.06
Lantana camara L.	1	1	1.33	0.02	16.67	1.35	0.93	2.86	1.71
Maesa indica (Roxb.) A. DC.	29	4	10.48	0.54	66.67	10.61	27.10	11.43	16.38
Melastoma malabathricum L.	19	3	15.54	0.35	50.00	15.73	17.76	8.57	14.02
Millettia pachycarpa Benth.	3	3	2.03	0.06	50.00	2.06	2.80	8.57	4.48
Miscanthus floridulus (Labill.) Warb.	2	1	3.96	0.04	16.67	4.01	1.87	2.86	2.91
Mussaenda benguetensis Elmer	1	1	1.65	0.02	16.67	1.67	0.93	2.86	1.82
Pinus kesiya Royle ex Gordon	5	1	1.73	0.09	16.67	1.75	4.67	2.86	3.09
Pogostemon velatus Benth.	2	1	2.45	0.04	16.67	2.48	1.87	2.86	2.40
Rubus fraxinifolius Poir.	18	3	18.45	0.33	50.00	18.68	16.82	8.57	14.69
Saurauia bontocensis Merr.	1	1	0.39	0.02	16.67	0.40	0.93	2.86	1.40
Saurauia elegans Fern.-Vill.	3	1	3.55	0.06	16.67	3.59	2.80	2.86	3.08
Tibouchina heteromalla (D. Don) Cogn.	1	1	2.14	0.02	16.67	2.17	0.93	2.86	1.99
Vaccinium barandanum S. Vidal	1	1	1.55	0.02	16.67	1.57	0.93	2.86	1.79
Viburnum odoratissimum Ker Gawl.	1	1	6.47	0.02	16.67	6.55	0.93	2.86	3.45
Weinmannia luzoniensis S. Vidal	1	1	2.39	0.02	16.67	2.42	0.93	2.86	2.07

Table no. 1c Population counts and dominance index of tree species in the Pine Stations of Mt. Ulap Eco-Trail

Plant Species	ni	BA	Ji	Di	Fi	RBAi	Rdi	Rfi	IV
Alnus japonica (Thunb.) Steud.	5	31.39	3	0.04	100.00	0.52	5.10	21.43	9.02
Calliandra calothyrsus Meisn.	1	0.14	1	0.01	33.33	0.00	1.02	7.14	2.72
Cyathea contaminans (Wall. ex Hook.) Copel.	2	3.90	1	0.02	33.33	0.06	2.04	7.14	3.08
Ficus benguetensis Merr.	3	1.38	1	0.03	33.33	0.02	3.06	7.14	3.41
Mallotus mollissimus (Geiseler) Airy Shaw	1	0.60	1	0.01	33.33	0.01	1.02	7.14	2.72
Mussaenda benguetensis Elmer	2	0.43	2	0.02	66.67	0.01	2.04	14.29	5.44
Pinus kesiya Royle ex Gordon	80	5989.15	3	0.67	100.00	99.33	81.63	21.43	67.46
Saurauia elegans Fern.-Vill.	4	2.54	2	0.03	66.67	0.04	4.08	14.29	6.14

Table no. 2a Population counts and dominance index of herb and grass species in the Broad Leaf Stations of Mt. Ulap Eco-Trail

Plant Species	ni	Ji	Di	Fi	Rdi	Rfi	IV
Ageratina adenophora (Spreng.) R.M. King et H. Rob.	3	2	0.25	16.67	1.12	3.70	2.41
Ageratina riparia (Regel) R.M. King et H. Rob.	186	12	15.50	100.00	69.40	22.22	45.81
Alpinia flabellata Ridl.	1	1	0.08	8.33	0.37	1.85	1.11
Arisaema polyphyllum (Blanco) Merr.	7	5	0.58	41.67	2.61	9.26	5.94
Asplenium caudatum G. Forst.	4	2	0.33	16.67	1.49	3.70	2.60
Carex indica L.	1	1	0.08	8.33	0.37	1.85	1.11
Cyathea contaminans (Wall. ex Hook.) Copel.	3	1	0.25	8.33	1.12	1.85	1.49
Davallia hymenophylloides (Blume) Kuhn	1	1	0.08	8.33	0.37	1.85	1.11
Diplazium dilatatum Blume	1	1	0.08	8.33	0.37	1.85	1.11
Dipteris conjugata Reinw.	1	1	0.08	8.33	0.37	1.85	1.11
Elatostema benguetense C.B. Rob.	1	1	0.08	8.33	0.37	1.85	1.11
Elephantopus tomentosus L.	2	1	0.17	8.33	0.75	1.85	1.30
Gonostegia hirta (Blume ex Hassk.) Miq.	2	2	0.17	16.67	0.75	3.70	2.22
Hedyotis benguetensis (Elmer) Elmer	1	1	0.08	8.33	0.37	1.85	1.11
Hypoestes cumingiana Benth. et Hook.	4	2	0.33	16.67	1.49	3.70	2.60
Melastoma malabathricum L.	2	2	0.17	16.67	0.75	3.70	2.22
Oberonia costeriana J.J. Sm.	1	1	0.08	8.33	0.37	1.85	1.11
Odontosoria chinensis (L.) J. Sm.	1	1	0.08	8.33	0.37	1.85	1.11
Oplismenus hirtellus (L.) P. Beauv	3	2	0.25	16.67	1.12	3.70	2.41
Paspalum conjugatum P.J. Bergius	2	1	0.17	8.33	0.75	1.85	1.30
Persicaria chinensis (L.) H. Gross	2	1	0.17	8.33	0.75	1.85	1.30
Piper curtifolium C.DC.	1	1	0.08	8.33	0.37	1.85	1.11
Pteridium aquilinum (L.) Kuhn	18	2	1.50	16.67	6.72	3.70	5.21
Sarcandra glabra (Thunb.) Nakai	16	6	1.33	50.00	5.97	11.11	8.54
Scleria oblata S.T. Blake ex J. Kern.	2	1	0.17	8.33	0.75	1.85	1.30
Tetrastigma harmandii Planch.	1	1	0.08	8.33	0.37	1.85	1.11
Zehneria mucronata (Blume) Miq.	1	1	0.08	8.33	0.37	1.85	1.11

Table no. 2b Population counts and dominance index of shrub and tall grass species in the Broad Leaf Stations of Mt. Ulap Eco-Trail

Plant Species	ni	Ji	Ci	Di	Fi	RCi	RDi	RFi	IV
Actinodaphne intermedia (Elmer)	7	2	1.76	0.13	33.33	3.33	8.14	4.65	5.37
Antirhea benguetensis (Elmer) Valeton	1	1	0.43	0.02	16.67	0.82	1.16	2.33	1.44
Bridelia glauca Blume	4	3	0.90	0.07	50.00	1.70	4.65	6.98	4.44
Callicarpa japonica Thunb.	1	1	0.02	0.02	16.67	0.05	1.16	2.33	1.18
Chloranthus oldhamii Solms	4	2	2.90	0.07	33.33	5.51	4.65	4.65	4.94
Citrus maxima (Burm.) Merr.	1	1	0.80	0.02	16.67	1.52	1.16	2.33	1.67
Clethra canescens var. *luzonica* (Merr.) Sleumer	6	4	3.36	0.11	66.67	6.38	6.98	9.30	7.55
Deutzia pulchra S.Vidal	1	1	0.85	0.02	16.67	1.61	1.16	2.33	1.70
Dinochloa acutiflora (Munro) Soenarko	1	1	2.12	0.02	16.67	4.03	1.16	2.33	2.50
Eurya coriacea Merr.	11	4	6.81	0.20	66.67	12.92	12.79	9.30	11.67
Ficus benguetensis Merr.	1	1	0.22	0.02	16.67	0.41	1.16	2.33	1.30
Ficus septica Burm.f.	1	1	1.52	0.02	16.67	2.89	1.16	2.33	2.13
Machilus philippinensis Merr.	1	1	0.47	0.02	16.67	0.88	1.16	2.33	1.46
Maesa indica (Roxb.) A. DC.	18	2	11.44	0.33	33.33	21.69	20.93	4.65	15.76
Medinilla magnifica Lindl.	1	1	1.84	0.02	16.67	3.49	1.16	2.33	2.33
Melastoma malabathricum L.	7	2	3.14	0.13	33.33	5.96	8.14	4.65	6.25
Melicope latifolia (DC.) T.G. Hartley	1	1	0.11	0.02	16.67	0.21	1.16	2.33	1.23
Melicope semecarpifolia (Merr.) T.G.Hartley	1	1	1.14	0.02	16.67	2.16	1.16	2.33	1.88
Melicope triphylla (Lam.) Merr.	1	1	0.17	0.02	16.67	0.31	1.16	2.33	1.27
Micromelum minutum var. *curranii* (Elmer) Tanaka	1	1	0.53	0.02	16.67	1.00	1.16	2.33	1.50
Ophiorrhiza biflora Elmer	1	1	0.88	0.02	16.67	1.67	1.16	2.33	1.72
Pavetta brachyantha Merr.	1	1	0.71	0.02	16.67	1.34	1.16	2.33	1.61
Rubus fraxinifolius Poir.	2	1	0.75	0.04	16.67	1.42	2.33	2.33	2.03
Semecarpus cuneiformis Blanco	1	1	0.19	0.02	16.67	0.37	1.16	2.33	1.28
Skimmia japonica Thunb.	1	1	1.01	0.02	16.67	1.91	1.16	2.33	1.80
Vaccinium barandanum S. Vidal	5	2	4.28	0.09	33.33	8.12	5.81	4.65	6.20
Viburnum odoratissimum Ker Gawl.	4	3	4.15	0.07	50.00	7.86	4.65	6.98	6.50
Wikstroemia lanceolata Merr.	1	1	0.23	0.02	16.67	0.44	1.16	2.33	1.31

Table no. 2c Population counts and dominance index of tree species in the Broad Leaf Stations of Mt. Ulap Eco-Trail

Plant Species	ni	BA	Ji	Di	Fi	RBAi	Rdi	Rfi	IV
Actinodaphne intermedia (Elmer)	4	32.66	1	0.03	33.33	2.20	2.30	2.17	2.22
Adinandra luzonica Merr.	31	378.43	3	0.26	100.00	25.49	17.82	6.52	16.61
Alstonia scholaris (L.) R. Br.	4	7.38	1	0.03	33.33	0.50	2.30	2.17	1.66
Bridelia glauca Blume	7	14.66	3	0.06	100.00	0.99	4.02	6.52	3.84
Castanopsis philipensis (Blanco) S. Vidal	4	7.19	1	0.03	33.33	0.48	2.30	2.17	1.65
Clethra canescens var. *luzonica* (Merr.) Sleumer	19	147.11	2	0.16	66.67	9.91	10.92	4.35	8.39
Cyathea contaminans (Wall. ex Hook.) Copel.	1	4.66	2	0.01	66.67	0.31	0.57	4.35	1.75
Cyathea fuliginosa (Christ) Copel.	1	3.90	1	0.01	33.33	0.26	0.57	2.17	1.00
Deutzia pulchra S. Vidal	1	0.68	1	0.01	33.33	0.05	0.57	2.17	0.93
Diplospora fasciculiflora (Elmer) Elmer	1	0.27	1	0.01	33.33	0.02	0.57	2.17	0.92
Engelhardtia spicata Lechen ex Blume	5	24.91	2	0.04	66.67	1.68	2.87	4.35	2.97
Eurya coriacea Merr.	42	578.26	3	0.35	100.00	38.95	24.14	6.52	23.20
Ficus septica Burm.f.	3	3.40	2	0.03	66.67	0.23	1.72	4.35	2.10
Ficus ulmifolia Lam.	1	0.64	1	0.01	33.33	0.04	0.57	2.17	0.93
Leucaena leucocephala (Lam.) de Wit	1	0.16	1	0.01	33.33	0.01	0.57	2.17	0.92
Lithocarpus jordanae (Villanueva) Rehder	7	67.44	2	0.06	66.67	4.54	4.02	4.35	4.30
Lithocarpus luzoniensis (Merr.) Rehder	6	28.50	1	0.05	33.33	1.92	3.45	2.17	2.51
Machilus philippinensis Merr.	1	1.33	1	0.01	33.33	0.09	0.57	2.17	0.95
Mallotus mollissimus (Geiseler) Airy Shaw	7	20.33	3	0.06	100.00	1.37	4.02	6.52	3.97
Melicope triphylla (Lam.) Merr.	2	2.48	1	0.02	33.33	0.17	1.15	2.17	1.16
Mussaenda benguetensis Elmer	1	0.24	1	0.01	33.33	0.02	0.57	2.17	0.92
Omalanthus fastuosus (Linden) Fern.-Vill.	1	3.11	1	0.01	33.33	0.21	0.57	2.17	0.99
Pinus kesiya Royle ex Gordon	3	19.69	2	0.03	66.67	1.33	1.72	4.35	2.47
Saurauia bontocensis Merr.	1	12.95	1	0.01	33.33	0.87	0.57	2.17	1.21
Semecarpus cuneiformis Blanco	2	1.33	1	0.02	33.33	0.09	1.15	2.17	1.14
Syzygium subcaudatum (Merr.) Merr.	2	1.34	2	0.02	66.67	0.09	1.15	4.35	1.86
Vaccinium barandanum S. Vidal	5	15.06	1	0.04	33.33	1.01	2.87	2.17	2.02
Vaccinium indutum S. Vidal	1	1.93	1	0.01	33.33	0.13	0.57	2.17	0.96
Viburnum odoratissimum Ker Gawl.	3	8.23	1	0.03	33.33	0.55	1.72	2.17	1.48
Weinmannia luzoniensis S. Vidal	7	96.31	2	0.06	66.67	6.49	4.02	4.35	4.95

Table no. 3a Population counts and dominance index of herb and grass species in the Peak Stations of Mt. Ulap Eco-Trail

Plant Species	ni	Ji	Di	Ji	RDi	RFi	IV
Ageratina adenophora (Spreng.) R.M. King et H. Rob.	15	1	1.25	8.33	2.69	0.99	1.84
Ageratina riparia (Regel) R.M. King et H. Rob.	18	5	1.50	41.67	3.23	4.95	4.09
Arisaema polyphyllum (Blanco) Merr.	2	1	0.17	8.33	0.36	0.99	0.67
Avena fatua L.	12	2	1.00	16.67	2.15	1.98	2.07
Axonopus compressus (Sw.) P.Beauv.	99	10	8.25	83.33	17.77	9.90	13.84
Bidens pilosa L.	1	1	0.08	8.33	0.18	0.99	0.58
Bolbitis rhizophylla (Kaulf.) Hennipman	1	1	0.08	8.33	0.18	0.99	0.58
Carex indica L.	2	2	0.17	16.67	0.36	1.98	1.17
Centella asiatica (L.) Urb.	12	4	1.00	33.33	2.15	3.96	3.06
Clinopodium umbrosum (M.Bieb.) K.Koch	3	1	0.25	8.33	0.54	0.99	0.76
Coelorachis rottboellioides (R.Br.) A.Camus	1	1	0.08	8.33	0.18	0.99	0.58
Crassocephalum crepidioides (Benth.) S.Moore	1	1	0.08	8.33	0.18	0.99	0.58
Cyperus cyperinus (Retz.) Suringar	9	5	0.75	41.67	1.62	4.95	3.28
Cyperus michelianus subsp. *pygmaeus* (Rottb.) Asch. et Graebn.	7	4	0.58	33.33	1.26	3.96	2.61
Desmodium velutinum (Willd.) DC.	1	1	0.08	8.33	0.18	0.99	0.58
Dianella ensifolia (L.) DC.	1	1	0.08	8.33	0.18	0.99	0.58
Drosera lunata Buch.-Ham. ex DC.	72	4	6.00	33.33	12.93	3.96	8.44
Elephantopus tomentosus L.	11	1	0.92	8.33	1.97	0.99	1.48
Fimbristylis acuminata Vahl	1	1	0.08	8.33	0.18	0.99	0.58
Galinsoga parviflora Cav.	7	1	0.58	8.33	1.26	0.99	1.12
Gaultheria leucocarpa var. *cumingiana* (S.Vidal) T.Z. Hsu	1	1	0.08	8.33	0.18	0.99	0.58
Gonostegia hirta (Blume ex Hassk.) Miq.	28	7	2.33	58.33	5.03	6.93	5.98
Hydrocotyle benguetensis Elmer	7	2	0.58	16.67	1.26	1.98	1.62
Hypoxis aurea Lour.	4	2	0.33	16.67	0.72	1.98	1.35
Imperata cylindrica (L.) Raeusch.	17	4	1.42	33.33	3.05	3.96	3.51
Lindernia crustacea (L.) F.Muell.	3	2	0.25	16.67	0.54	1.98	1.26
Murdannia nudiflora (L.) Brenan	8	3	0.67	25.00	1.44	2.97	2.20
Nepenthes alata Blanco	1	1	0.08	8.33	0.18	0.99	0.58
Oldenlandia corymbosa var. *linearis* (DC.) Verdc.	14	3	1.17	25.00	2.51	2.97	2.74
Oplismenus hirtellus (L.) P.Beauv.	1	1	0.08	8.33	0.18	0.99	0.58
Oxalis corniculata L.	2	1	0.17	8.33	0.36	0.99	0.67
Paspalum scrobiculatum L.	5	1	0.42	8.33	0.90	0.99	0.94
Plectranthus scutellarioides (L.) R.Br.	1	1	0.08	8.33	0.18	0.99	0.58
Pogonatherum crinitum (Thunb.)	22	2	1.83	16.67	3.95	1.98	2.96
Pteridium aquilinum (L.) Kuhn	46	3	3.83	25.00	8.26	2.97	5.61
Rubus benguetensis Elmer	5	1	0.42	8.33	0.90	0.99	0.94
Rubus luzoniensis Merr.	5	2	0.42	16.67	0.90	1.98	1.44
Smilax china L.	1	1	0.08	8.33	0.18	0.99	0.58
Sporobolus indicus (L.) R.Br.	17	3	1.42	25.00	3.05	2.97	3.01
Tetrastigma harmandii Planch.	2	1	0.17	8.33	0.36	0.99	0.67
Themeda triandra Forssk.	84	8	7.00	66.67	15.08	7.92	11.50
Youngia japonica (L.) DC.	7	3	0.58	25.00	1.26	2.97	2.11

Table no. 3b Population counts and dominance index of shrub and tall grass species in the Peak Stations of Mt. Ulap Eco-Trail

Plant Species	ni	Ji	Ci	Di	Fi	RCi	RDi	RFi	IV
Alseodaphne longipes Quisumb. et Merr	3	1	0.97	0.06	16.67	1.47	2.48	3.85	2.60
Clethra canescens var. luzonica (Merr.) Sleumer	27	2	11.97	0.50	33.33	18.12	22.31	7.69	16.04
Eurya coriacea Merr.	8	2	5.18	0.15	33.33	7.84	6.61	7.69	7.38
Eurya japonica Thunb.	4	1	5.06	0.07	16.67	7.66	3.31	3.85	4.94
Lantana camara L.	2	1	0.96	0.04	16.67	1.46	1.65	3.85	2.32
Lithocarpus jordanae (Villanueva) Rehder	2	2	2.45	0.04	33.33	3.70	1.65	7.69	4.35
Melastoma malabathricum L.	1	1	0.08	0.02	16.67	0.11	0.83	3.85	1.60
Melicope triphylla (Lam.) Merr.	2	2	1.78	0.04	33.33	2.70	1.65	7.69	4.01
Miscanthus floridulus (Labill.) Warb. ex K. Schum. et Lauterb.	4	2	10.25	0.07	33.33	15.51	3.31	7.69	8.84
Pinus kesiya Royle ex Gordon	1	1	0.25	0.02	16.67	0.39	0.83	3.85	1.69
Pittosporum resiniferum Hemsl.	1	1	0.08	0.02	16.67	0.12	0.83	3.85	1.60
Psidium guajava L.	3	1	3.14	0.06	16.67	4.75	2.48	3.85	3.69
Rubus fraxinifolius Poir.	50	4	10.14	0.93	66.67	15.35	41.32	15.38	24.02
Saurauia elegans Fern.-Vill.	1	1	0.63	0.02	16.67	0.96	0.83	3.85	1.88
Syzygium subcaudatum (Merr.) Merr.	2	2	2.14	0.04	33.33	3.24	1.65	7.69	4.19
Vaccinium barandanum S. Vidal	10	2	10.99	0.19	33.33	16.63	8.26	7.69	10.86