Research article

Floristic Inventory of the Proposed Site for Tarsier Tourism Center in Villa Aurora, Bilar, Bohol, Philippines

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Abstract. The study assessed the present vegetation composition of the proposed site for the Tarsier Tourism Center (PTTC) at Villa Aurora, Bilar, Bohol and performed comparative analysis with the existing Tarsier Sanctuary (TS) at Canapnapan, Corella, Bohol. The bases for comparison were the computed importance values, species richness, species dominance, and percent distribution of plants according to self-defined diameter at breast height DBH classes. Results showed that both sites had very high species richness and evenness values. Common overstorey and understorey plant species found in both areas were katagpo (*Psychotria* sp.), sagimsim (*Syzygium brevistylum* [C.B. Rob] Merr.) and bagauak (*Clerodendrum minahassae* Teijsm. & Binn.). Apart from sagimsim (*S. brevistylum* [C.B. Rob.] Merr.), selaginella (*Selaginella cuppresina* Lin.), and lunas (*Lunasia amara* Blanco) were also common in the ground vegetation of both areas. Percent distribution of trees according to self-defined DBH classes revealed that PTTC had 87.55% of the total recorded plants with DBH measurements of ≤10 cm. This was found lower by almost 10% from TS. Considerable percentages of trees were also shared in other DBH classes for PTTC. DBH class range of 10-20 cm had 6.88%, while 5.58% was computed for DBH class of >20 cm. Percent distribution of trees on these DBH ranges (especially on DBH class >20 cm) indicated the presence of medium and large trees. The largest DBH measured in PTTC was 70 cm, while in TS was only 22 cm. Based on the findings of the study, it has been concluded that the proposed 10 ha site in Villa Aurora, Bilar is suited to be utilized as Tarsier Tourism Center. In case the proposed project is to be pursued, enclosure similar to what has been constructed in Canapnapan, Corella, Bohol, Philippines should also be established to prevent stray animals from predating the captive tarsiers.

Keywords floristic inventory, Philippine tarsier, Bohol

INTRODUCTION

The Philippine tarsier *(Carlitos syrichta* (L.) Shykelle) has attracted a lot of attention of scientists and collectors because of its interesting physical features and habits. It is often fancied as a crossbreed of a bat and a rat. The name "tarsier" is derived from the fact that the tarsal region is elongated, a trait of both tarsiers and gala goes (Embury, 1994 as cited by Villamor, 1995). Its size is not bigger than two fists held together. Undeniably, the Philippine tarsier, with three subspecies: *syrichta*, *fraterculus* and *carbonarius*, is one of the smallest among the different known species (Goodwin, 1991; Embury, 1994 as cited by Villamor, 1995; Neri-Arboleda, et al., 2002). This trait and its rarity status would be the reason why this creature is on the CITES endangered list. It was once then considered as "lower risk conservation dependent" based on the IUCN 2004, then became "data deficient" in 2006, and now under the "near-threatened" category since 2008.

The Philippine tarsier habitats are primarily located in secondary lowland rainforest of early- to mid-succession stage (Neri-Arboleda, et al., 2002; Reyes, 2006). In Bohol, it generally occurs in hilly areas with patches of second-growth forest (PAWB-DENR, 1992; Lagapa, 1993; Villamor, 1995; Reyes, 2006), bushes, bamboos, palms and some grasses (Karnain, et al., 1997 as cited by Reyes, 2006). The short trees, as well as bamboos, are good for the arboreal adaptation by the tarsiers. The dense nature of the undergrowth supports a wide variety of insects and small vertebrates which are vital to the survival of tarsiers. The close distance in between small diameter trees, on the other hand, appears to be a necessary condition which favors the locomotive behavior of tarsiers thus enabling them to have a firm grasp of the small trunks and branches making this type forest a favorable place to live (Villamor, 1995; Karnain, et al., 1997 as cited by Reyes, 2006). It is also found in abandoned clearings with signs of new growth of medium-high plants in lands of both low and medium elevations (Hoogstraal, 1947). These types of clearing were believed to be the tarsier's feeding sites (Rabor, 1977; Villamor, 1995) until they were disproved by Neri-Arbodela et al., (2002).

Habitat characterization of the Philippine tarsier has been conducted in Bohol by several local researchers and research institutions (Madulid [undated]; PAWB-DENR, 1992; Lagapa, 1993; Villamor, 1995; Neri-Arboleda, et al., 2002; Reyes, 2000, 2006; and ERDS, 2009). Among the researchers, Neri-Arboleda, et al., (2002) and Reyes (2006) provided detailed discussions on several habitat classifications. Reyes (2006), in particular, described 11 variants of the tarsier's roosting territories based on species composition and thicket structure. He also correlated the presence of tarsiers and its scent-markings on abundance of small diameter plants in his study sites. The findings of the study of Reyes (2006), on this aspect, were used as the basis in evaluating the suitability of proposed Tarsier Tourism Area in Villa Aurora, Bilar, apart from the usual species richness and dominance assessment.

The study assessed the present vegetation composition of the proposed tarsier tourism site at Villa Aurora, Bilar, Bohol, Philippines and compared with the existing tarsier sanctuary at Canapnapan, Corella, Bohol, Philippines in terms of plant species composition.

METHODOLOGY

Study Site

The Proposed Tarsier Tourism Center (PTTC) is planned to be established at barangay Villa Aurora in the municipality of Bilar. The total area of the proposed tourism site is 10.194 ha (CENRO-Tagbilaran, 2013). It is located along the stretch of the prominent winding road of barangay Villa Aurora, a kilometer away from the famous Bilar-Loboc Man-made Mahogany Plantation. This will serve as an extension of the 6 ha Tarsier Tourism Area established at Upper Bonbon, Loboc, Bohol, Philippines.

The Tarsier Sanctuary and Conservation Site (TS), on the other hand, which is used for comparison is situated at barangay Canapnapan in the municipality of Corella, Bohol, Philippines. This 134-ha conservation site is managed by the Philippine Tarsier Foundation Incorporated (PTFI) and is open to public, since 1990s, for recreation and research.

Field Data Collection

Quadrat sampling was used in the collection of data. Twenty quadrats were established preferentially within the 10-hectare PTTC in Villa Aurora, Bilar. The 10 m x 10 m plots were laid selectively on thickets of small diameter trees and shrubs which could be identified as potential roosting sites of the Philippine tarsier. All plants with diameter at breast height (DBH) of $\geq$ 1 cm were recorded. Small nested subplot with a dimension of 1 m x 1 m was also established at the middle of each plot to facilitate the identification of the ground vegetation.

For comparative analysis, 10 plots and subplots were also established at TS in Canapnapan, Corella. The first five plots and subplots were laid in the PTFI tarsier enclosure where visitors are allowed to enter and see the captive tarsiers, and the remaining plots and subplots were laid outside the enclosure, about 30 m away from the PTFI building.

Data Analysis

Analysis of data was mainly concentrated on the determination of species abundance parameters such as density, frequency, and dominance values of each plant species. These parameters were used in the calculation of importance value (IV) of all encountered plants in the overstorey, understorey, and ground vegetation. IV is a measure of species abundance in an area. It is the summation of the relative values of density (number of species per unit area), frequency (number of occurrences of species relative to the number of plots established), and dominance (basal area of species relative to the total computed basal areas).

For the purpose of comparison of the two sites, species richness and dominance indices like diversity (Shannon-Wiener diversity index), evenness (Evenness index), and dominance (Simpson's index) were computed based on IV. The Shannon-Weiner diversity index assumes that individuals were randomly sampled from an indefinitely large population and also assumed that all species were represented in the sample. Evenness index, on the other hand, is the ratio of observed diversity to maximum diversity, while Simpson's index is the probability of any two individuals drawn at random from an infinitely large community belonging to same species.

Density of plants, in percent (%), on each pre-defined diameter class was also calculated to evaluate the suitability of the proposed site for tarsier conservation as the project proponents (wildlife permitees from Loboc) claimed its very purpose. This was based on the work of Reyes (2006) who tested the relationship of DBH to the number of tarsiers seen in the wild. DBH classes used in this study were: $\leq$10 cm; 10-20 cm; and >20 cm.

Formulas used in this study and presented below were adopted from Gruezo (1997), Fernando et al., (1998), Reyes (2000, 2006), and ERDS (2009).

For Tree and Shrub Layer:

Density = total number of individuals of a species/unit area
Relative Density = density of a species/total densities X 100
Dominance = basal area of a species/total area sampled
Relative Dominance = dominance of a species/total dominances X 100
Occurrence = number of times a species appeared/total number of established plots X 100
Frequency = number of occurrence of a species/total number of occurrences X 100
Relative Frequency = frequency of a species/total frequencies X 100
Importance Value = Relative Density + Relative Dominance + Relative Frequency

For the Understorey Plants and Grasses (weeds and broadleaves):

Species Dominance = Cumulative crown cover (%) of a species

For the Diversity and Evenness Indices:

Shannon Diversity (H') = $-\sum$ pi * (LNpi) where pi = species proportion

Evenness Index (E) = H'/ LN(s) where s = number of species

RESULTS AND DISCUSSION

Vegetation Composition

Overstorey and understorey plants: A total of 112 species of overstorey and understorey plants were identified in the PTTC at Villa Aurora, Bilar. These belonged to 82 genera under 44 families (Fig. 1). The recorded plant species and genera in PTTC were roughly twice than those in TS. Tables 1 and 2 show the summary lists of common overstorey and understorey plants in both areas. From the list in Table 1, the first three most common species were katagpo (*Psychotria* sp.), bayukbok (*Elaeocarpus macranthus* Merr.), and langin (*Micromelum caudatum* Merr.) based on the computed IV of 28.96, 10.94, and 10.62, respectively. The three most common species in Table 2, on the other hand, were alabihig (*Arthrophyllum diversifolium* Blume), tagoang uak (*Croton leiophyllus* Muell.-Arg.), and katagpo (*Psychotria* sp.) with IVs of 29.70, 19.91, and 19.77, respectively.

As shown in Tables 1 and 2, the species of plants which were found in both areas, apart from katagpo, were sagimsim (*Syzygium brevistylum* (C.B. Rob.) Merr.) and bagauak (*Clerodendrum minahassae* Teijsm. & Binn.).

There were also 52 species, 43 genera, and 35 families of ground vegetation in the PTTC. Same with the overstorey and understorey vegetation, its ground cover was more than twice species rich that the recorded ground vegetation in TS. Table 3 presents the summary list of common plants species identified on the ground based on the number of individuals. The most common species recorded with more than 30 individuals each, in decreasing order, were sagimsim (*S. brevistylum* [C. B. Rob.] Merr.), selaginella (*Selaginella cuppresina*), and lunas (*Lunasia amara* Blanco). These species were also listed common in TS, as shown in Table 4.

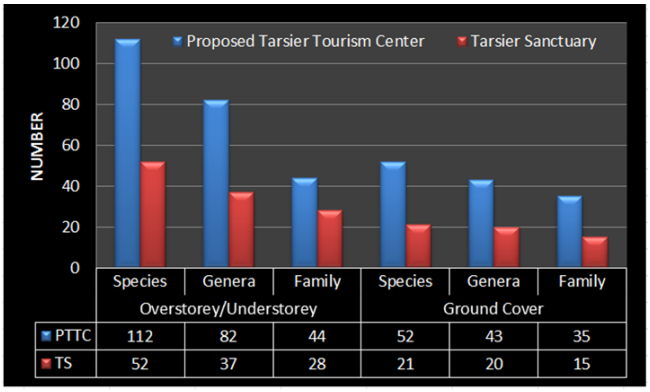

Fig. 1 Bar graph showing the taxonomic information of the Proposed Tarsier Tourism Center, Villa Aurora, Bilar and Tarsier Sanctuary, Canapnapan, Corella, Bohol, Philippines

Table 1 List of common overstorey and understorey plants arranged based on importance values (IV) in PTTC, Villa Aurora, Bilar, Bohol, Philippines

Common Name	Scientific Name	Family Name	IV
Katagpo	*Psychotria* sp.	Rubiaceae	28.96
Bayukbok	*Elaeocarpus macranthus* Merr.	Elaeocarpaceae	10.94
Langin	*Micromelum caudatum* Merr.	Rutaceae	10.62
Sagimsim	*Syzygium brevistylum* (C. B. Rob.) Merr.	Myrtaceae	9.89
Paginga	*Discocalyx cybianthoides* (A. DC.) Mez.	Myrsinaceae	7.80
Katong matsin	*Chisocheton pentandrus* (Blanco) Merr.	Meliaceae	7.18
Bagauak	*Clerodendrum minahassae* Teijsm. & Binn.	Lamiaceae	6.98
Batino	*Alstonia macrophylla* Wall. ex DC.	Apocynaceae	6.72
Malak-malak	*Palaquium philippense* (Perr.) C. B. Rob.	Sapotaceae	6.52
Big-leaf mahogany	*Swietenia macrophylla* King.	Meliaceae	6.44
Aniam-gubat	*Antidesma subolivaceum* Elm.	Euphorbiaceae	6.35
Malaikmo	*Celtis philippensis* Blanco	Ulmaceae	6.05
Talang gubat	*Diospyros copelandii* Merr.	Ebenaceae	5.79
Alahan	*Guioa koelreuteria* (Blanco) Merr.	Sapindaceae	5.74
Lunas	*Lunasia amara* Blanco	Rutaceae	5.62
Duguan	*Myristica philippensis* Lam.	Myristicaceae	5.51
Palosapis	*Anisoptera thurifera* (Blanco) Blume	Dipterocarpaceae	5.23

Table 2 List of common overstorey and understorey plants arranged based on importance values (IV) in TS, Canapnapan, Corella, Bohol, Philippines

Common Name	Scientific Name	Family Name	IV
Alabihig	*Arthrophyllum diversifolium* Blume	Araliaceae	29.70
Tagoang uak	*Croton leiophyllus* Muell.-Arg.	Euphorbiaceae	19.91
Katagpo	*Psychotria* sp.	Rubiaceae	19.77
Sagimsim	*Syzygium brevistylum* (C. B. Rob) Merr.	Myrtaceae	19.50
Balinghasai	*Buchanania arborescens* Blume	Anacardiaceae	18.30
Bagauak	*Clerodendrum minahassae* Teijsm. & Binn.	Lamiaceae	14.04
Matang arau	*Melicope triphylla* (Lam.) Merr	Rutaceae	13.74
Takip asin	*Macaranga grandifolia* (Blanco) Merr.	Euphorbiaceae	10.08
Sudiang	*Ctenolophon philippinense* Hallier F.	Linaceae	8.19
	Mussaenda sp.	Rubiaceae	8.01
Niog-niogan	*Ficus pseudopalma* Blanco	Moraceae	7.93
Pandan gubat	*Freycinetia* sp.	Pandanaceae	7.83
Kubi	*Artocarpus nitida* Trec. subsp. *nitida*	Moraceae	6.77
Molave	*Vitex parviflora* Juss.	Lamiaceae	5.66
Tambo	*Thysonolaena latifolia* (Roxb. ex Hornem.) Honda	Poaceae	5.23
Ficus	*Ficus* sp.	Moraceae	5.14

Table 3 List of common plants species comprising the ground vegetation arranged based on the number of individuals in PTTC, Villa Aurora, Bilar, Bohol, Philippines

Common Name	Scientific Name	Family Name	Individuals
Sagimsim	*Syzygium brevistylum* (C. B. Rob.) Merr.	Myrtaceae	53
Selaginella	*Selaginella cuppresina*	Selaginellaceae	40
Lunas	*Lunasia amara* Blanco	Rutaceae	38
	Flacourtia sp.	Flacourtiaceae	27
Langin	*Micromelum caudatum* Merr.	Rutaceae	22
Tubli	*Derris* sp.	Fabaceae	20
Paginga	*Discocalyx cybianthoides* (A. DC.) Mez.	Myrsinaceae	17
Takipan	*Caryota rumphiana* Mart. var. *philippinensis* Becc	Arecaceae	11
White nato	*Pouteria macrantha* (Merr.) Baehni	Sapotaceae	11

Table 4 List of common plants species composing the ground vegetation arranged based on the number of individuals in TS, Canapnapan, Corella, Bohol, Philippines

Common Name	Scientific Name	Family Name	Individuals
Sagimsim	*Syzygium brevistylum* (C. B. Rob) Merr.	Myrtaceae	49
Selaginella	*Selaginella cuppresina*	Selaginellaceae	40
Langin	*Micromelum caudatum* Merr.	Rutaceae	27
Tagpo	*Ardisia squamulosa* Presl.	Myrsinaceae	15
Nino	*Morinda bracteata* Roxb.	Rubiaceae	10

Species Richness and Dominance

The results of species richness and dominance computations (Fig. 2) revealed that both sites were species rich given by Shannon-Weiner diversity index values of 4.26 for PTTC and 3.56 for TS. According to Fernando et al., (1998), diversity index values above 3.5 are considered very high. Values of the dominance indices such as evenness and Simpson's dominance index also supported this finding. Evenness value of almost 1.0 (0.9031 for PTTC and 0.9012 for TS) means that the observed (or computed) diversity value is almost equal to the expected maximum diversity value (Gruezo, 1997; Fernando et al., 1998; Reyes, 2000).

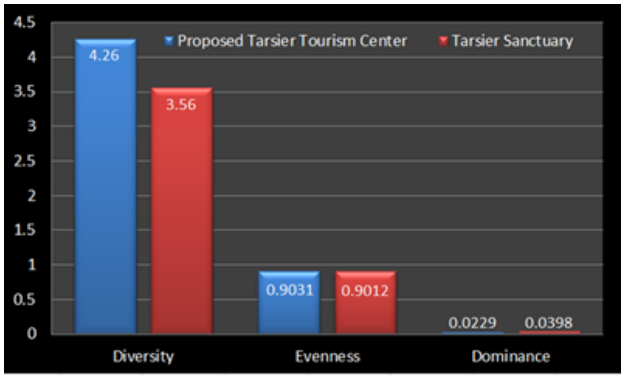

Fig. 2 Species richness and dominance index values for the Proposed Tarsier Tourism Center, Villa Aurora, Bilar and Tarsier Sanctuary, Canapnapan, Corella, Bohol, Philippines

Very high evenness index is always accompanied by very low dominance index. For both sites, Simpson's dominance index values were computed less than 0.04. This only means that there is only less than 4% chance that two individual plants to be selected in both sites would belong to the same species.

Reyes (2000) reported that the species diversity in the identified six roosting territories of the Philippine tarsier in barangay Cabacnitan, Bilar ranged from 2.01 (low) to 3.125 (high).

Self-defined DBH Classes

The computation on percent distribution of plants in three different self-defined DBH classes showed that PTTC had 87.55% of the total recorded plants with DBH measurements of ≤10 cm. This was found lower by almost 10% from TS. Considerable percentages of trees were also shared in other DBH classes for PTTC. DBH class ranged of 10-20 cm had 6.88%, while 5.58% was computed for DBH class of >20 cm. Percent distribution of trees on these DBH ranges (especially on DBH class >20 cm) indicated the presence of medium and large trees. The largest DBH measured in PTTC was 70 cm.

For TS, only less than 3% combined was computed for DBH classes of >10 cm. The largest DBH measured was 22 cm (Table 5).

Table 5 Percent distribution of plants in self-defined DBH classes

Study Site	DBH Class (cm)		
	≤10	10-20	>20
Proposed Tarsier Tourism Center	87.55	6.88	5.58
Tarsier Sanctuary and Conservation Site	97.13	2.01	0.86

CONCLUSION AND RECOMMENDATION

Based on the findings of the study, it is concluded that the proposed 10-ha site in Villa Aurora, Bilar is suited to be utilized as Tarsier Tourism Center. Apart from the site's inherent diversity in plant species, the current vegetation composition and the presence of medium and large size trees in PTTC suggests its similarity to one of the variants described by Reyes (2006) as advance thickets of many small diameter trees, few medium- and large-sized trees and dense undergrowth. However, in case the proposed project will be pursued, enclosure similar with what has been constructed in Canapnapan, Corella should also be established to prevent stray cats and other animals from predating the captive tarsiers.

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