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# Vascular Flora of the Tropical Montane Forests in Balbalasang-Balbalan National Park, Kalinga Province, Northern Luzon, Philippines

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***Abstract*** - This paper provides a preliminary report on the different types of habitats including ecology and species diversity of Balbalasang-Balbalan National Park (BBNP) based on the Rapid Site Assessment (RSA) conducted along various microhabitat gradients in 2009. A total of 84 families, 206 genera and 319 taxa were recorded, including a new species of *Rafflesia*, a very rare parasitic plant. There are 106 Philippine endemics reported, 38 of which are Luzon endemics. 18 taxa were listed under either the Philippine Red List (Fernando et al., 2008) or on the IUCN Red List of Threatened Species (IUCN 2010). Result of the RSA conforms with previous studies revealing high, yet poorly understood biological diversity in this part of Cordillera. It further implies that BBNP support a large percentage of the country's threatened, endemic, and unknown flora. A more comprehensive biodiversity assessment is therefore necessary to better account for the floral diversity of BBNP.

***Keywords*** - Balbalasang-Balbalan National Park, Rapid Site Assessment, *Rafflesia*, Philippine endemics

## INTRODUCTION

Philippines, despite its very small land area, is one of the mega diversity countries in the world and considered as the most important country for conserving diversity of life on earth (Altoverros & Borromeo, 2007). The unique Philippine landscape consisting of a complex ecosystems and habitat types, attributed to varying exposures to shifting winds and typhoons, great heights of numerous mountains and peculiar distribution of rainfall contributes to the surprising number of endemic plant and animal diversity in the country (Whitmore, 1984). Plant endemism in the Philippines ranges from 45% to 60% (Mittermeier et al., 1999). However, certain families and genera reach 70% to 80% endemism, especially those confined to primary forest (Merrill, 1923-26). Philippine rattans (Arecaceae) in particular recorded a high of 75% endemism (Malabrigo & Fernando, 2004; 2003).

The mountains of northern Luzon were sites of some of the first biological inventories conducted in the Philippines. However, these early inventories were mostly focused in faunal assessment and concentrated in the southern portion of the Central Cordillera. The Balbalasang-Balbalan National Park (BBNP) in Kalinga is one of the least biologically explored portions of the Central Cordillera. Despite its proclamation as a protected area in 1974, BBNP remained almost entirely unknown until the Haribon Foundation spearheaded a comprehensive wildlife survey that confirmed the existence of major tracts of evergreen forest. Previous faunal inventories (Diesmos et al., 2003; Heaney et al., 2003) revealed not only high diversity but also significant number of endemic species. However, except for the survey of pteridoflora conducted by Barcelona in 2003, there is no other published comprehensive study on the floristic and vegetation ecology of the area. This paper provides a preliminary report on the different types of habitats including ecology and species diversity of BBNP, particularly the tropical montane forests.

## OBJECTIVES OF THE STUDY

The general objective of the study is to assess the vascular plant diversity of Balbalasang-Balbalan Natural Park. Specifically, it aims

to inventory and characterize floral composition within the tropical montane forests of BBNP, and evaluate the ecological value of the area based on species diversity and the presence of threatened and endemic species.

## MATERIALS AND METHODS

Rapid vegetation assessment was conducted along the different microhabitat gradients in Balbalasang-Balbalan National Park, Kalinga Province, Northern Luzon, Philippines (950-1800 masl at N 028728 – N 0295292, E 1934981 – E 1938372). Several vegetation types occur in the study area. Focused, however was given to old-growth tropical montane forests which presumably contain the majority of native plant species. This included the old growth forests (mostly virgin forests) of Sitios Nabanderahan, Bulak, Binulgan, Maatok, Tsagadyag, Cafcafulao, and Kamkamintu of Barangay Balbalasang.

Nested quadrat sampling technique (Fig. 1) was used to assess and characterize the structure and species composition of the different habitats and plant communities. This is one of the most applicable methods for areas where almost all of the major plant groups are present. Seven sampling quadrats (Table 1) were randomly established to quantitatively describe the forest structure of the areas surveyed. More importantly, a lot of time (6 days) was spent for non-systematic general collection in order to cover larger area and greater number of species. As compared with the number of species collected from the sampling plots, significantly higher number of species was recorded from this opportunistic survey.

Multivariate Statistical Package (MVSP) software was used to compute for the diversity indices (Shannon, Evenness, and Simpson's) of the different quadrats. The software also provided distance matrix based on species composition and abundance of the sampling quadrats for further comparison and characterization. Endemism and ecological status of the different species were assessed to determine the ecological importance of the vegetation in the area. Nomenclature followed the latest Angiosperm Phylogeny Group classification (Stevens, 2001).

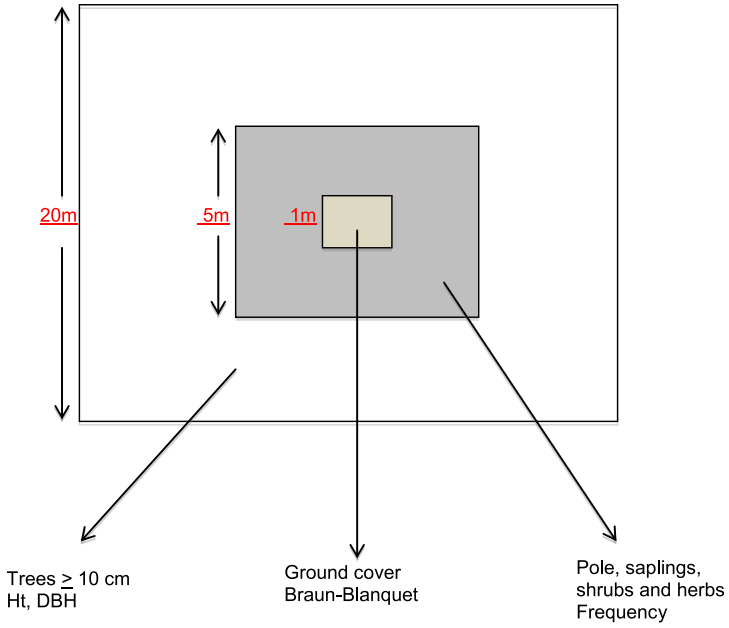


Fig. 1. Nested quadrat sampling design used in the survey

Table 1. Geographical Locations and General Vegetation Characters of the Sampling Quadrats

| Quadrat | GPS Coordinates | Elevation (m) | Location | General vegetation character |
|---|---|---|---|---|
| Q1 | N 0287693<br>E 1934981 | 1596 | Sitio Nabanderahan, boundary of Kalinga and Abra | Tropical lower montane forest, very much adjacent to a virgin mossy forest, dominated by *Lithocarpus spp*. and *Syzygium spp*. |
| Q2 | N 0287728<br>E 1935122 | 1640 | Sitio Bulak | Tropical lower montane forest, very much adjacent to a virgin mossy forest, dominated by *Cryptocarya spp*. and *Syzygium spp*. |

| Quadrat | GPS Coordinates | Elevation (m) | Location | General vegetation character |
|---|---|---|---|---|
| Q3 | N 0293132<br>E 1936436 | 1305 | Sitio Binulgan | Old growth forest with very diverse medium size trees. |
| Q4 | N 0293294<br>E 1937344 | 1405 | Sitio Maatop | Tropical lower montane forest, very much adjacent to a virgin mossy forest, with very diverse medium size trees. |
| Q5 | N 0294034<br>E 1938205 | 1565 | Sitio Tsagadyag | Virgin mossy forest without a single individual reaching 10cm diameter. |
| Q6 | N 0295241<br>E 1938372 | 1406 | Sitio Cafcafulao | Slightly disturbed old-growth forest near Mapangal creek heavily dominated by *Beilschmiedia gemmiflora*. |
| Q7 | N 0295292<br>E 19387204 | 1145 | Sitio Kamkamintu | Secondary growth forest adjacent to a kaingin area, dominated by pioneer species *Ficus spp*. |

## RESULTS AND DISCUSSION

### General Vegetation

The entire Balbalasang-Balbalan National Park is thickly forested except for some cultivated and built-up areas. The recent forest survey showed that old-growth forests cover more than 85% of the total BBNP area.

BBNP's elevations range from 700 masl to a high of 2,456 masl and provide varying microclimate, resulting in the development of different forest formation, physiognomy, ecosystems, and habitats. Following the scheme and nomenclature used by Whitmore (1984), BBNP has three major forest formations: 1) tropical lowland evergreen rainforest (≈ 700-900 masl) characterized by the presence of dipterocarp species; 2) tropical lower montane forest (≈ 800-1800 masl) consisting of broad-leaf forest and pine forest dominated by the endemic Benguet

pine (*Pinus kesiya* Royle *ex* Gordon s*sp. insularis* (Endl.) DZ Li); and 3) tropical upper montane rainforest or the mossy forest (≈ 1600-2456 masl) where the group of Philippine oaks (*Lithocarpus spp*.) and other ericaceous plants dominate. The vegetation survey conducted was focused on the less explored and less studied forest types; the tropical lower montane forests and the mossy forest.

**Tropical lower montane forest - Pine forest**

Much of the vegetation are dominated by Benguet Pine forest. It is important to note that the recent botanical classification found Benguet Pine to be taxonomically different from the original species, *Pinus kesiya*. The earlier classification treated Benguet pine as the same taxon with widely distributed *Pinus kesiya*. In the most recent revision of Flora Malesiana (Li, 1997) Benguet Pine was classified as a subspecies of *P. kesiya*. This increases the biodiversity value of the taxon since it became an island endemic (Luzon endemic).

In this study, Pine forests were not given much survey attention due to its very low species diversity. Benguet Pine tends to be monotypic since it restricts the growth of other indigenous tree species because of its thick, acidic leaf litters. Moreover, the almost regular occurrence of fire underneath the Pine forest canopy prevented broad-leaf trees from co-existing over the area and allows pantropic weeds and grasses (i.e. *Imperata cylindrical (*L.) P. Beauv.*, Paspalum conjugatum* PJ Bergius and *Chromolaena odorata* L.*)* to dominate the understorey as well as the ground cover.

**Tropical lower montane forest - Broad-leaf fore**st

Broad-leaf forests in BBNP are comparable in extent if not even larger than what is covered by the Pine forests. The old growth broad-leaf forests that persist in the study area have relatively large trees and are characterised by high species diversity. The dominant canopy species in this community are the common montane species such as *Lithocarpus spp*. (Fagaceae), *Syzygium spp*. (Myrtaceae), *Palaquium spp*. (Sapotaceae), *Saurauia spp*. (Actinidiaceae), *Astronia spp*., *Melastoma spp*. (Melastomataceae) and the premium Almaciga (*Agathis philippinensis*

Warb.), locally known as Lita-o.

The understorey is mostly dominated by a number of palm species including rattan/uay (*Calamus* and *Daemonorops*) and *Pinanga spp*. The forest floor is commonly covered by thick forest litter with some fern and allies such as *Selaginella spp*. (Selaginellaceae), *Adiantum spp.* (Pteridaceae), *Agalaomorpha spp*. (Polypodiaceae) among others. The most common epiphytes are *Freycinetia spp*. (Pandanaceae), *Piper spp*. (Piperaceae), and the filmy ferns (Hymenophyllaceae).

**Tropical upper montane rainforest – Mossy forest**

Tropical upper montane rainforest also known as mossy forest are forest stands found principally on high elevations and very rough mountainous regions. Most of the mossy forests in BBNP are still untouched. They occur at above 1600 masl and are characterized by very rugged terrain. Trees in this area hardly reach 10 cm in diameter. Vegetation is dominated by tree species of Podocarpaceae, Myrtaceae, Theaceae and Fagaceae, and the epiphytes include lichens, mosses, begonias, orchids, aroids, and ferns. Tropical upper montane rainforest in BBNP is such an amazing assemblage of native plant species. A significant number of endemic and threatened species thrive in this truly precious ecosystem.

**Stand Structure**

***Diversity Indices***

All of the quadrats surveyed obtained relatively high biodiversity indices (Table 2). Though, some quadrats recorded only few individuals (i.e. Q5 because of the absence of trees has only 10 individuals), diversity indices are still high because of the very even distribution of the species inside the quadrat – each individual belongs to different species. Old growth forest in Sitio Binulgan (Q3) obtained the highest Shannon and Simpson's index because it has the most number of species. On the other hand, Sitio Cafcafulao (Q6) despite the highest number of individuals, obtained the lowest Simpson's and Evenness index because of the overdominance of the species *Beilschmiedia gemmiflora*.

Table 2. Diversity Indices and Number of Species and Individuals for Each Quadrat

| Sample | Diversity Indices | | | No. of Species | No. of Individuals |
|---|---|---|---|---|---|
| | Shannon (H′) | Simpson's (D) | Evenness (J′) | | |
| Q1 | 2.97 | 0.94 | 0.96 | 20 | 31 |
| Q2 | 2.65 | 0.90 | 0.90 | 19 | 35 |
| Q3 | 3.25 | 0.96 | 0.97 | 29 | 41 |
| Q4 | 3.09 | 0.95 | 0.96 | 25 | 36 |
| Q5 | 2.30 | 0.90 | 1.00 | 10 | 10 |
| Q6 | 2.58 | 0.89 | 0.86 | 20 | 51 |
| Q7 | 2.47 | 0.89 | 0.89 | 16 | 35 |

### *Distance Matrix/Cluster Analysis*

Based on the species composition and abundance of each sampling quadrat, the MVSP software provided the distance matrix (Table 3). The matrix shows the percentage dissimilarities among sampling quadrats. Only one quadrat combination (Q1 and Q2) obtained lower than 60% dissimilarity, while two quadrat combinations are 100% different (no species in common). The results imply that in terms of species composition, each quadrat has their unique floral characteristics and is very much different from the other quadrats. These information can be very helpful in the protection and management of biodiversity in the area. For instance, on deciding what particular area or quadrat can be given up for some development activities, clearing Q1 will not significantly affect the overall diversity of the area since most of its species can also be found in Q2. In the same manner, similar management strategies can be applied to related quadrats/habitats. However, we also need to consider the biological value of the species in the area.

Table 3. Percentage Dissimilarity of Each Quadrat Combination

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 |
|---|---|---|---|---|---|---|
| **Q1** | - | | | | | |
| **Q2** | 0.57 | - | | | | |
| **Q3** | 0.82 | 0.77 | - | | | |
| **Q4** | 0.72 | 0.86 | 0.74 | - | | |
| **Q5** | 0.84 | 0.94 | 0.91 | 0.90 | - | |
| **Q6** | 0.77 | 0.77 | 0.91 | 0.67 | 0.95 | - |
| **Q7** | 0.94 | 0.96 | 0.90 | 0.96 | 1.00 | |

## Species Diversity

Results of the RSA indicated that BBNP has tremendous plant diversity, with nearly half (43%) of the total species recorded in the northern part of Luzon. At least 319 morpho-species belonging to the seed plants (Angiosperms and Gymnosperms), ferns and their allies were recorded from the area (Table 4). This excludes cultivated and introduced species since the survey sites are all natural forests, thus, all the species recorded are native to the area. Some specimens were not able to be identified to the species level and have therefore been tentatively assigned to the most probable taxon (family or genus). Most of these are in their juvenile stage (seedlings/saplings) and/or are sterile specimens (without flowers or spores), as identification of flora species is very much dependent on the variation exhibited by the reproductive structures. These resulted to some sort of underestimation of plant diversity because some genera are so complex that can be hardly distinguished from one another by just looking at the vegetative characters (i.e. *Freycinetia spp*., *Calamus spp*., *Piper spp*. *Cyathea spp*., among others).

Table 4. Number of families, genera and species recorded from the study area

| Taxon | Family | Genera | Species |
|---|---|---|---|
| Angiosperm | 67 | 170 (1) | 264 (45) |
| Gymnosperm | 3 | 5 | 5 |
| Pteridophytes | 14 | 31 | 50 (9) |
| Total | 84 | 206 | 319 (54) |

*Numbers inside parentheses are number of taxa that have not been identified to the corresponding level.

The most speciose (having several species) of all genera is *Syzygium* with 18 species followed by *Ficus* (12), *Medinilla* (8), *Asplenium* (6) and *Elaeocarpus* and *Piper* (5 each). In terms of Family, the most speciose are: Myrtaceae (19), Melastomataceae and Rubiaceae (17 each), Orchidaceae (14) and Polypodiaceae and Moraceae (12 each). This species assemblage/ranking is very much similar with the results of floral inventory studies conducted by the author in tropical lower montane forests of Tampakan, South Cotabato (2010), Mt. Talines, Negros Oriental (2009), and Mt. Kanlaon, Negros Occidental (2007) which support initial characterization of the area as mostly a tropical lower montane forest.

***Noteworthy Species***

New Species

The most interesting result and probably the greatest highlight of the resource inventory is the discovery of a new species of *Rafflesia* (Rafflesiaceae), a very rare parasitic flowering plant (Fig. 1). The species was named *Rafflesia banaoana* Malabrigo in honor of the very hospitable and environment friendly people in Kalinga, the Banao Tribe, whose traditional forest management practice is exemplary in keeping the pristine status of BBNP. It is the tenth endemic *Rafflesia* species, thus far described from the Philippines, and the sixth reported from the Luzon island (Malabrigo, 2010). It is worth mentioning that the species

was treated as synonym of *Rafflesia leonardi* (Barcelona et al., 2011) based solely on the photos from the author's publication (Malabrigo, 2010, p. 141-143). However, careful examination of *R. leonardi* photos (Barcelona et al., 2008, p. 226; 2009, p. 81; 2011, p. 13.) showed obvious and enormous morphological differences (size, color, shape of the disk, number of processes, column layering *etc*.) with *R. banaoana*. It is interesting to learn how these experts arrived at a conclusion that the two species are conspecific and those morphological differences are only developmental and/or environmental variations, where in fact not anyone from them have seen actual specimen of *R. banaoana*. Being the person who observed its natural population and carefully examined the species, the author strongly upholds the identity of *Rafflesia banaoana* as unique and different from the rest of the *Rafflesia* in the world.

Fig. 2. Fully-bloomed flower of the newly described *Rafflesia banaoana* Malabrigo discovered in BBNP

- Island Endemics Thirty eight (38) species belonging to 25 families have been recognized as island endemics (Table 5). Island endemics referred to in this paper are those species found only in mainland Luzon. Some of these species are confined to just few provinces, and some are new records to the province of Kalinga. For instance, *Callicarpa albido-tomentella* (Lamiaceae/Verbenaceae) is known to exist only in Abra but was encountered in this RSA.

Table 5. List of Luzon endemics found in the study area.

| Code | Species | Family |
|---|---|---|
| PT | *Aeschynanthus philippinensis* (Kuntze) CB Clarke | Gesneriaceae |
| APA 479 | *Alocasia micholitziana* Sander | Araceae |
| APA 204 | *Ardisia cumingiana* A DC | Myrsinaceae |
| APA 433 | *Ardisia darlingii* Merr. var. *darlingii* | Myrsinaceae |
| RMM 612 | *Argyreia pedicellata* Ooststr | Convolvulaceae |
| APA 406 | *Arisaema polyphyllum* (Blanco) Merr. var. *angustifolium* Merr. | Araceae |
| APA 299 | *Callicarpa albido-tomentella* Merr. | Lamiaceae |
| APA 416 | *Clethra canescens* Reinw. ex Bl. var. *luzonica* (Merr.) Sleum. | Clethraceae |
| APA 359 | *Discocalyx pachyphylla* Merr. | Myrsinaceae |
| APA 431 | *Elaeocarpus argenteus* Merr. var. *elmeri* (A DC) Weibel | Elaeocarpaceae |
| RMM 575 | *Firmiana philippinensis* Kosterm. | Malvaceae |
| APA 334 | *Garcinia celebica* L. | Clusiaceae |
| APA 081 | *Glyptopetalum euonymoides* Merr. | Celastraceae |
| APA 429 | *Lithocarpus ovalis* (Blanco) Rehder | Fagaceae |
| PT | *Medinilla compressicaulis* Merr. | Melastomataceae |
| PT | *Medinilla cumingii* Naudin | Melastomataceae |
| PT | *Medinilla dolichophylla* Merr. | Melastomataceae |
| APA 251 | *Memecylon brachybotrys* Merr. | Melastomataceae |
| APA 384 | *Memecylon subfurfuraceum* Merr. var. *depauperatum* Merr. | Melastomataceae |

| | | |
|---|---|---|
| APA 470 | *Microsorum heterolobum* (C. Chr.) Copel. | Polypodiaceae |
| APA 250 | *Mussaenda benguetensis* Elmer | Rubiaceae |
| PT | *Nepenthes ventricosa* Blanco | Nepenthaceae |
| APA 224 | *Oldenlandia ciliata* Elmer | Rubiaceae |
| APA 467 | *Palaquium foxworthyi* Merr. | Sapotaceae |
| APA 388 | *Palaquium globosum* HJ Lam | Sapotaceae |
| APA 175 | *Pilea benguetensis* C Robinson | Urticaceae |
| PT | *Pinus kesiya* Royle ex Gordon subsp. *insularis* (Endl.) DZ Li | Pinaceae |
| RMM 591 | *Piper multistigmum* C DC | Piperaceae |
| APA 219 | *Praravinia sablanensis* (Elmer) Bremek. | Rubiaceae |
| PT | *Rafflesia banaoana* Malabrigo | Rafflesiaceae |
| APA 240 | *Saurauia bontocensis* Merr. | Actinidiaceae |
| APA 220 | *Schefflera angilogensis* Merr. | Araliaceae |
| APA 208 | *Syzygium abbreviatum* Merr. | Myrtaceae |
| APA 432 | *Syzygium longissimum* (Merr.) Merr. | Myrtaceae |
| RMM 516 | *Urophyllum subglabrum* Merr. | Rubiaceae |
| APA 203 | *Vernonia bontocensis* Merr. | Asteraceae |
| APA 430 | *Weinmannia luzonensis* Vidal | Cunoniaceae |
| APA 304 | *Wendlandia luzoniensis* DC var. *membranifolia* (Elmer) Cowan | Rubiaceae |

*Code refers to the collection number for the samples collected, specimens are soon to be deposited at College of Forestry and Natural Resources Herbarium (LBC); PT means photo taken

**Philippine Endemics**

There are at least 106 Philippine endemics (including 38 island endemics) that are found in BBNP (Table 6). The reported endemism for the different taxonomic groups; Angiosperm, Gymnosperm and Pteridophytes are 46%, 20% and 10%, respectively (Table 7). This is relatively low compared to the country endemism reported to be 60% based on Merrill's Enumeration of Philippine Flowering Plants.

However, more recent estimates place the country's plant endemism at around 25-30%. The reduction in percentage values can be attributed to the changes in nomenclature as well as delineation of the geographical distribution of plants which in turn reflects new appreciation of evidences coming from various sources.

With regards to the flora of Northern Luzon, the reported endemism for the seed plants (Angiosperm and Gymnosperm) is significantly higher than what is reported by Merrill (21.56%) and definitely far better than the recent estimate.

Table 6. List of Philippine endemics found in the study area

| Family | Species | Endemicity |
|---|---|---|
| 1 Actinidiaceae | *Saurauia bontocensis* Merr. | IE |
| 2 Anacardiaceae | *Parishia malabog* Merr. | PE |
| 3 Annonaceae | *Artabotrys luteus* Elmer | PE |
| Annonaceae | *Orophea cumingiana* Vidal | PE |
| 4 Araceae | *Alocasia micholitziana* Sander | IE |
| Araceae | *Arisaema polyphyllum* (Blanco) Merr. var. *angustifolium* Merr. | IE |
| Araceae | *Pothos inaequilaterus* (C Presl) Engl. | PE |
| Araceae | *Rhaphidophora korthalsii* Schott | PE |
| 5 Araliaceae | *Schefflera angilogensis* Merr. | IE |
| 6 Arecaceae | *Daemonorops mollis* (Blanco) Merr. | PE |
| Arecaceae | *Pinanga philippinensis* Becc. | PE |
| 7 Asteraceae | *Vernonia bontocensis* Merr. | IE |
| 8 Burseraceae | *Canarium gracile* Engl. | PE |
| 9 Celastraceae | *Glyptopetalum euonymoides* Merr. | IE |
| 10 Clethraceae | *Clethra canescens* Reinw. ex Bl. var. *luzonica* (Merr.) Sleum. | IE |
| 11 Clusiaceae | *Garcinia celebica* L. | IE |
| Clusiaceae | *Kayea paniculata* (Blanco) Merr. | PE |
| 12 Convolvulaceae | *Argyreia pedicellata* Ooststr | IE |
| 13 Cunoniaceae | *Weinmannia luzonensis* Vidal | IE |

| | | |
|---|---|---|
| 14 Elaeocarpaceae | *Elaeocarpus argenteus* Merr. var. *elmeri* (A DC) Weibel | IE |
| Elaeocarpaceae | *Elaeocarpus culminicola* Warb. var. *pendulus* (Merr.) Weibel | PE |
| Elaeocarpaceae | *Elaeocarpus macranthus* Merr. | PE |
| 15 Ericaceae | *Vaccinium barandanum* Vidal var. *barandanum* | PE |
| 16 Fabaceae | *Spatholobus macropterus* Miq. | PE |
| 17 Fagaceae | *Lithocarpus castellarnauianus* (Vidal) A Camus | PE |
| Fagaceae | *Lithocarpus ovalis* (Blanco) Rehder | IE |
| Fagaceae | *Lithocarpus solerianus* (Vidal) Rehder | PE |
| 18 Gesneriaceae | *Aeschynanthus philippinensis* (Kuntze) CB Clarke | IE |
| 19 Lamiaceae | *Callicarpa albido-tomentella* Merr. | IE |
| Lamiaceae | *Callicarpa caudata* Maxim. | PE |
| 20 Lauraceae | *Alseodaphne longipes* Quisumb. & Merr. | PE |
| Lauraceae | *Cinnamomum mercadoi* Vidal | PE |
| Lauraceae | *Cryptocarya ampla* Merr. | PE |
| Lauraceae | *Litsea garciae* Vidal | PE |
| 21 Malvaceae | *Firmiana philippinensis* Kosterm. | IE |
| 22 Melastomataceae | *Astronia acuminatissima* Merr. var. *acuminatissima* | PE |
| Melastomataceae | *Medinilla compressicaulis* Merr. | IE |
| Melastomataceae | *Medinilla cumingii* Naudin | IE |
| Melastomataceae | *Medinilla dolichophylla* Merr. | IE |
| Melastomataceae | *Medinilla pendula* Merr. | PE |
| Melastomataceae | *Medinilla ramiflora* Merr. | PE |
| Melastomataceae | *Melastoma crinitum* Naudin | PE |
| Melastomataceae | *Memecylon brachybotrys* Merr. | IE |
| Melastomataceae | *Memecylon subfurfuraceum* Merr. var. *depauperatum* Merr. | IE |
| 23 Menispermaceae | *Parabaena denudata* Diels | PE |
| 24 Moraceae | *Ficus fiskei* Elmer | PE |
| Moraceae | *Ficus linearifolia* Elmer | PE |
| 25 Myrsinaceae | *Ardisia cumingiana* A DC | IE |
| Myrsinaceae | *Ardisia darlingii* Merr. var. *darlingii* | IE |

| | | |
|---|---|---|
| Myrsinaceae | *Discocalyx linearifolia* Elmer | PE |
| Myrsinaceae | *Discocalyx minor* Mez var. *minor* | PE |
| Myrsinaceae | *Discocalyx pachyphylla* Merr. | IE |
| Myrsinaceae | *Embelia whitfordii* Merr | PE |
| Myrsinaceae | *Myrsine peregrina* (Mez) Pipoly | PE |
| 26 Myrtaceae | *Decaspermum blancoi* Vidal | PE |
| Myrtaceae | *Syzygium abbreviatum* Merr. | IE |
| Myrtaceae | *Syzygium alvarezii* (C Robinson) Merr. | PE |
| Myrtaceae | *Syzygium astronioides* (C Robinson) Merr. | PE |
| Myrtaceae | *Syzygium calubcob* (C Robinson) Merr. | PE |
| Myrtaceae | *Syzygium densinervium* (Merr.) Merr. | PE |
| Myrtaceae | *Syzygium longissimum* (Merr.) Merr. | IE |
| Myrtaceae | *Syzygium luzonense* (Merr.) Merr. | PE |
| Myrtaceae | *Syzygium mainitense* (Elmer) Merr. | PE |
| Myrtaceae | *Syzygium simile* (Merr.) Merr. | PE |
| Myrtaceae | *Syzygium striatulum* (C Robinson) Merr. | PE |
| Myrtaceae | *Syzygium xanthophyllum* (C Robinson) Merr. | PE |
| 27 Nepenthaceae | *Nepenthes alata* Blanco | PE |
| Nepenthaceae | *Nepenthes ventricosa* Blanco | IE |
| 28 Orchidaceae | *Calanthe macgregorii* Ames | PE |
| 29 Phyllanthaceae | *Antidesma digitaliforme* Tul. | PE |
| Phyllanthaceae | *Aporosa symplocifolia* Merr. | PE |
| Phyllanthaceae | *Glochidion coronulatum* C Robinson | PE |
| 30 Pinaceae | *Pinus kesiya* Royle ex Gordon sub*sp. insularis* (Endl.) DZ Li | IE |
| 31 Piperaceae | *Piper aurilimbum* C DC | PE |
| Piperaceae | *Piper brevistigmum* C DC | PE |
| Piperaceae | *Piper merrillii* C DC | PE |
| Piperaceae | *Piper multistigmum* C DC | IE |
| 32 Polypodiaceae | *Aglaomorpa cornucopia* (Copel.) Roos | PE |
| Polypodiaceae | *Belvisia platyrhynchos* (Kunze) Copel. | PE |

| | | |
|---|---|---|
| Polypodiaceae | *Goniophlebium benguetense* (Copel.) Copel. | PE |
| Polypodiaceae | *Microsorum heterolobum* (C. Chr.) Copel. | IE |
| 33 Rafflesiaceae | *Rafflesia banaoana* Malabrigo | IE |
| 34 Rubiaceae | *Gardenia pseudopsidium* (Blanco) Fern.-Villar | PE |
| Rubiaceae | *Greeniopsis multiflora* (Elmer) Merr. | PE |
| Rubiaceae | *Lasianthus cyaneus* (Elmer) Merr. | PE |
| Rubiaceae | *Mussaenda benguetensis* Elmer | IE |
| Rubiaceae | *Neonauclea bartlingii* (DC) Merr. var. *cumingiana* (Vidal) Ridsd. | PE |
| Rubiaceae | *Oldenlandia ciliata* Elmer | IE |
| Rubiaceae | *Praravinia sablanensis* (Elmer) Bremek. | IE |
| Rubiaceae | *Urophyllum subglabrum* Merr. | IE |
| Rubiaceae | *Wendlandia luzoniensis* DC var. *membranifolia* (Elmer) Cowan | IE |
| 35 Salicaceae | *Casearia fuliginosa* (Blanco) Blanco | PE |
| 36 Sapotaceae | *Palaquium foxworthyi* Merr. | IE |
| Sapotaceae | *Palaquium globosum* HJ Lam | IE |
| Sapotaceae | *Palaquium luzoniense* (Fern.-Villar) Vidal | PE |
| 37 Theaceae | *Adinandra elliptica* C Robinson | PE |
| Theaceae | *Adinandra luzonica* Merr. | PE |
| Theaceae | *Eurya flava* Merr. ex Melchior | PE |
| Theaceae | *Ternstroemia toquian* (Blanco) Fern.-Villar | PE |
| 38 Urticaceae | *Elatostema acrophilum* C Robinson | PE |
| Urticaceae | *Elatostema podophyllum* Wedd. | PE |
| Urticaceae | *Pilea benguetensis* C Robinson | IE |
| 39 Zingiberaceae | *Adelmeria paradoxa* (Ridl.) Merr. | PE |
| Zingiberaceae | *Alpinia elegans* (C Presl) K Schum. | PE |
| Zingiberaceae | *Alpinia flabellata* Ridl. | PE |
| Zingiberaceae | *Alpinia haenkei* C Presl | PE |

Table 7. Number of endemic species and percentage endemism for the different taxonomic groups

| Taxonomic group | Number of Philippine endemics | Total number of species identified | Percent endemism |
|---|---|---|---|
| Angiosperm | 101 | 219 | 46 |
| Gymnosperm | 1 | 5 | 20 |
| Pteridophytes | 4 | 41 | 10 |

Threatened Species

Eighteen (18) species recorded during the field survey are listed under either the Philippine Red List (Fernando et al., 2008) or on the IUCN Red List of Threatened Species (IUCN, 2010). Fourteen (14) of which are Philippine endemics and six (6) are Island endemics (Table 8). Noteworthy among the list are the critically endangered (CR) Bagarilau (*Cryptocarya ampla*), and the island endemics Dagwey (*Saurauia bontocensis*), *Alocasia micholitziana*, *Lithocarpus ovalis*, *Medinilla compressicaulis*, *Medinilla dolichophylla*, and *Nepenthes ventricosa*. Considering the island endemic and threatened status of these species, it is justified to conclude that BBNP is an ecologically critical area and therefore a very sound protection, conservation and management program is very much urgent.

Table 8. List of threatened species in the study area.

| Species | Family | Endemicity | Fernando *et al.*, (2008) | IUCN (2010) |
|---|---|---|---|---|
| *Aglaomorpa cornucopia* (Copel.) Roos | Polypodiaceae | PE | VU | |
| *Agathis philippinensis* Warb. | Araucariaceae | NE | VU | VU |
| *Alocasia micholitziana* Sander | Araceae | IE | VU | |
| *Antidesma montanum* Blume | Phyllanthaceae | NE | OTS | VU |
| *Antidesma tomentosum* Blume *var. tomentosum* | Phyllanthaceae | NE | OTS | VU |
| *Aporosa symplocifolia* Merr. | Phyllanthaceae | PE | OWS | VU |
| *Cinnamomum mercadoi* Vidal | Lauraceae | PE | VU | VU |
| *Cryptocarya ampla* Merr. | Lauraceae | PE | VU | CR |

| | | | | |
|---|---|---|---|---|
| *Goniophlebium subauriculatum* (Blume) C. Presl. | Polypodiaceae | NE | VU | |
| *Lithocarpus ovalis* (Blanco) Rehder | Fagaceae | IE | OTS | VU |
| *Medinilla compressicaulis* Merr. | Melastomataceae | IE | EN | |
| *Medinilla dolichophylla* Merr. | Melastomataceae | IE | VU | |
| *Medinilla pendula* Merr. | Melastomataceae | PE | EN | |
| *Nepenthes ventricosa* Blanco | Nepenthaceae | IE | EN | |
| *Orophea cumingiana* Vidal | Annonaceae | PE | VU | VU |
| *Palaquium luzoniense* (Fern.-Villar) Vidal | Sapotaceae | PE | VU | VU |
| *Saurauia bontocensis* Merr. | Actinidiaceae | IE | VU | |
| *Syzygium densinervium* (Merr.) Merr. | Myrtaceae | PE | OTS | |

*OWS-other wildlife species; OTS-other threatened species; VU-vulnerable; EN-endangered; CR-critically endangered

## CONCLUSION

Results of the rapid site assessment revealed that BBNP has very high biodiversity value. Despite the limited survey time and efforts, the number of island endemics, Philippine endemics and threatened species recorded in the area are found to be significantly higher than most of the declared Key Biodiversity Areas (KBAs) in the Philippines (Ambal et al., 2012). A significant number of threatened species are found to be exclusive in the Northern Luzon, Cordillera Administrative Region. It is therefore highly justified to conclude that BBNP is an ecologically critical area.

The discovery of new species in the area implies that BBNP, and perhaps other adjacent forests in CAR such as that of Malibcong in Abra still support a large percentage of the country's threatened, endemic, and unknown flora. It is very important to note that the area covered by the survey is a very small fraction of BBNP, yet a significant number of ecologically important species were recorded. A more comprehensive biodiversity assessment is therefore necessary to better account for the floral diversity of BBNP.

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