Flora Diversity At Danau Pulau Besar-Danau Bawah-Zambrud National Park Area, Riau Province

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Abstract. Research on flora diversity at Danau Pulau Besar-Danau Bawah, Zambrud National Park Area, Riau province has been done. The flora in this area had not much known and exposed. This study aimed to know the richness of flora in this national park. A total 65 species consisting of 48 genera and 35 family recorded from this area. They were 34 species of tree, 17 species of vines, and 14 species of bushes and herbs. There are 25 species of plant collection which is new collection or substitute collection that ever existed in Bogor Botanical Gardens. There were 4 species of flora have begun to decline in number in their natural habitat, such as: Chyrtotachys renda Blume, Nephenthes gracilis Karth, Nephenthes mirabilis Karth and Nephenthes ampularia Jack. The plant collection has been conserved or preserved in Bogor Botanical Gardens. The conservation aspect will be discussed in this paper.

1. Introduction
Indonesia is a large country with tropical rainforest and the fourth largest diversity of plant species in the world. The diversity of plant species is apparent throughout the forests scattered around Indonesia [1]. The rate of deforestation, land conversion, natural disasters and other human activities occurring in Indonesia was very high. The activities can endanger the sustainability of forest resources and cause to global climate change. One of the loss forest resources was causes by encroachment, forest use and irresponsible forest usage and illegal logging practices.

Geographically Zamrud National Park lies between 0°35'-0°45' North latitude and 102°10'-102°19' east longitude. This area is largely composed of peat swamp forest. Peat bogs occupy the area between the two great rivers, with shallow peat thickness of 0.5-1 m, or peat 1-2 m thick and deep and very deep peat, with the flow of acidic water from peat swamp forests and colored black or reddish with a low diversity of fauna [2]. The area is located in Siak District, Riau Province. This area covers 28,237.95 ha under the Ministry of Environmental and Forestry.

The change of function and expansion of Danau Pulau Besar-Danau Bawah wildlife sanctuary, into Zamrud National Park was proposed by Siak District Government in 2005 with letter of Bupati of Siak Regency no. 364/Dishut/205/2005 dated June 9, 2005. According to the regional government of Siak Regency, this is done with the consideration that there will be zoning division which among others consists of utilization zone. This zone is designated to research, education, tourism and other utilization. On May 4, 2016, through Decree of the Minister of LHK No. 350/Menhk/General Secretary/PLA.2/5/2016, stipulates changes to the function of the Danau Pulau Besar –Danau Bawah reserve as well as the permanent production forest area Tasik Besar Serkap into Zamrud National Park in Siak regency of Riau Province. The area covers 31,480 ha, derived from Danau Pulau Besar –Danau...
Bawah with an area of 28,238 ha and permanent production forest area Tasik Besar Serkap with an area of 3,242 ha.

Some plants in the forest area have an important role for the life of the people in Indonesia both for socio-cultural purposes, as well as for economic interests. However, the conservation forests have been degraded as a result of encroachment that occur in the region. Extensive encroachment during the period 1998 to 2012 in Danau Pulau Besar-Danau Bawah, Zamrud National Park reached ±2,339.73 hectares or 8.29% of the whole area [3]. Bogor Botanical Gardens as an institution that is obliged to conserve Indonesian plants, is the right institution to save, study and domesticate the potential plant. Therefore, research and exploration of plant diversity at the Danau Pulau Besar –Danau Bawah -Zamrud National Park area is very much supports both in-situ and ex-situ conservation efforts.

This study aimed to know the richness of flora at the Danau Pulau Besar –Danau Bawah, Zamrud National Park Area, Riau. Through the study of flora Diversity in this national park, the plant collection will be developed and conserved at the Bogor Botanical Gardens, as well as becomes a research material that will enrich the treasures of knowledge about plants and produce scientific information on the diversity of plants in the Zamrud National Park.

2. Material and Method
Exploration activities were conducted by random methods. Living plant materials of the important species were collected from the forest area. The materials including seeds, seedlings, tubers and stem cuttings or roots were selected base on rare status in nature, endemicities category of the flora, as well as the potential of the plant species as ornamental plants, medicinal plants, food stuffs or building materials.

Saplings or seedling were collected by rotating the surrounding soil and take a few the soil around the roots, then wrapped with plastic labeled in accordance with the collector code. The collected seeds were cleaned from the fruit flesh, dried, then wrapped with tissue paper, then inserted into plastic bag and labeled. The seedling taken from the forest handled after arriving at the resting placed. The seedling plus the soil, then wrapped with polybags and directly enclosed with plastic to keep the moisture.

For further identification, the herbarium specimen were taken if there is an unknown yet species name of some living plant collections. The complete plant material required to make herbarium including leaves, flowers and fruit. The material was wrapped in a neat newspaper and then inserted into a large plastic bag according to the size of the material and then given the spiritus or 70% alcohol sufficiently.

Next step, Plant material packing was done carefully. Plant living material were wrapped with plastic lid and given the air to keep the humidity and keep the collection damage. While for grains, the sample washed, wrapped in a tissue or newspaper, then wrapped in plastic bag. The last step, all plant material collection was wrapped in cardboard and packed with a strong rope. The plant collection then ship to Bogor Botanic Gardens to conserved ex situ.

3. Result and Discussion
Danau Pulau Besar-Danau Bawah, Zamrud National Park area is approximately 180 kilometers from Pekanbaru City. The location can be reached within about 3 hours by car. This National Park was previously a concession area of Caltex Pacific Indonesia (CPI) which was then managed by Bumi Siak Pusako and Pertamina Hulu. In Zamrud Lake, there are two unique lakes namely Danau Pulau Besar (2,416 ha) and Danau Bawah (360 ha). Data collection and research activities were done in this area with about 0-20 m above sea level. There are still many large tree stalks found with stem diameter above 50 cm.

The results of the exploration obtained 65 collection numbers of living material, consisting of 48 genera, and 36 families. The number of collections included 34 tree species (Table 1), 17 species of vines, and 10 species of bushes. There are 25 species of plant collections which were new collections or collections of replacements that have ever existed in the Bogor Botanical Gardens.
The species of plants that were successfully collected can be divided into 3 groups:

3.1 Tree species (T)

There are 11 of 34 tree species that become the new collection for Bogor Botanical Gardens, i.e. *Syzygium sexangulata* (Miq) Amsh, *Campnos macrophyllo* Hook.F., *Pandanus helicopus* Kurtz, *Pandanus gladiator* BC Stone, *Aporosa arborea* Blume, *Tetramirista glabra* Miq., *Eugenia cymosa* Lam., *Liisea lanceolata*, *Eugenia claviflora*, *Pandanus ellipsoides* Warb and *Eugenia cymosa* Lam. There are some species of trees produced the fruit that is used by the local community or some times the fruit is eaten by birds or monkeys. The species were *Durio carinata*, *Mangifera indica*, *Syzygium sexangulata*, *Eugenia cymosa*, *Eugenia claviflora* and *Garcinia* sp.

Table 1. Tree Species conserved at Bogor Botanical Garden.

| No. | Collector number | Name                                    | Family        | Habitus | Sum of material | propagating |
|-----|-----------------|-----------------------------------------|---------------|---------|----------------|-------------|
| 1.  | EM 507          | *Melicope latifolia*                    | Rutaceae      | T.      | 5 Pl, S>10     | S.          |
| 2.  | EM 508          | *Elaiocarpus sp.*                       | Elaiocarpaceae| T.      | 5 Pl, S>10     | S.          |
| 3.  | EM 509          | *Xylopia malayana*                      | Anonaceae     | T.      | S>10           | S.          |
| 4.  | EM 514          | *Syzygium sexangulata*                  | Myrtaceae     | T.      | 4 Pl           | S.          |
| 5.  | EM 516          | *Arthocarpus heterophyllus*             | Moraceae      | T.      | S>10           | S.          |
| 6.  | EM 517          | *Campnos macrophyllo*                   | Anacardiaceae | T.      | 3 Pl           | S.          |
| 7.  | EM 519          | *Pandanus helicopus*                    | Pandanaceae   | T.      | 3 Pl seedling/S|
| 8.  | EM 520          | *Pandanus gladiator*                    | Pandanaceae   | T.      | 3 Pl seedling/S|
| 9.  | EM 522          | *Knema sumatrana*                      | Myristicaceae | T.      | S>10           | S.          |
| 10. | EM 523          | *Licuala sp.*                          | Arecaceae     | T.      | 2 Pl           | S.          |
| 11. | EM 524          | *Pinanga sp.*                          | Arecaceae     | T.      | 5 Pl           | S.          |
| 12. | EM 525          | *Dehasia sp.*                          | Lauraceae     | T.      | 4 Pl           | S.          |
| 13. | EM 527          | *Cryptocarya carsinervia*               | Lauraceae     | T.      | 4 Pl           | S.          |
| 14. | EM 529          | *Actinodaphne macrophyllo*              | Lauraceae     | T.      | 4 Pl           | S.          |
| 15. | EM 530          | *Aporosa arborea*                      | Polygalaceae  | T.      | 10 Pl          | S.          |
| 16. | EM 531          | *Sapotaceae*                           | Sapotaceae    | T.      | S>10           | S.          |
| 17. | EM 532          | *Durio carinata*                        | Bombacaceae   | T.      | 1 Pl           | S.          |
| 18. | EM 536          | *Mangifera indica*                      | Anacardiaceae | T.      | 6 Pl           | S.          |
| 19. | EM 537          | *Diospyros sp.*                        | Ebenaceae     | T.      | 10 Pl          | S.          |
| 20. | EM 538          | *Tetramirista glabra*                  | Theaceae      | T.      | 4 Pl           | S.          |
| 21. | EM 542          | *Fabaceae*                             | Fabaceae      | T.      | 6 Pl           | S.          |
| 22. | EM 543          | *Santiria laevigata*                   | Burseraceae   | T.      | 5 Pl           | S.          |
| 23. | EM 544          | *Chyrtotachys renda*                   | Arecaceae     | T.      | 5 Pl           | S.          |
| 24. | EM 549          | *Myristica sp.*                        | Myristicaceae | T.      | 3 Pl           | S.          |
| 25. | EM 556          | *Eugenia cymosa*                       | Myrtaceae     | T.      | 4 Pl           | S.          |
26. EM 557  
{\textit{Litsea lanceolata}}  
(Blume)*  
\textit{Lauraceae}  
T.  
3 Pl.  
S.

27. EM 558  
{\textit{Eugenia claviflora}}  
Roxb.*  
\textit{Myrtaceae}  
T.  
3 Pl.  
S.

28. EM 559  
{\textit{Psychotria sp.}}  
\textit{Rubiaceae}  
T.  
3 Pl.  
S.

29. EM 560  
{\textit{Myrtaceae}}  
\textit{Myrtaceae}  
T.  
1 Pl.  
S.

30. EM 561  
{\textit{Myrtaceae}}  
\textit{Myrtaceae}  
T.  
5 Pl.  
S.

31. EM 562  
{\textit{Garcinia sp.}}  
\textit{Clusiaceae}  
T.  
1 Pl.  
S.

32. EM 563  
{\textit{Cinnamomum sp.}}  
\textit{Lauraceae}  
T.  
1 Pl.  
S.

33. EM 564  
{\textit{Pandanus ellipsoides}}  
Warb.*  
\textit{Pandanaceae}  
T.  
1 Pl.  
S.

34. EM 565  
{\textit{Palaquium xanthochymum}}  
\textit{Sabotaceae}  
T.  
S >10  
S.

*: a new collection for Bogor Botanical Garden  
T: tree, Pl: plant, S: seeds

The most dominant tree species from the Danau Pulau Besar-Danau Bawah - Zamrud which were successfully conserved in the Bogor Botanical Garden are the Pandanaceae Family, ie. \textit{Pandanus helicopus} Kurtz, \textit{Pandanus gladiator} B.C. Stone and \textit{Pandanus ellipsoides}. Pandanaceae (screw pines) is a monocot family composed of about 750 species widely distributed in the Paleotropics [4]. Previously, [5] reported that the paleotropical monocot Pandanaceae family comprises about 700 species distributed into five genera: \textit{Benstonea} (about 60 species), \textit{Freycinetia} (about 250 species), \textit{Martellidendron} (6 species), \textit{Pandanus} (about 450 species) and \textit{Sararanga} (2 species). \textit{Pandanus helicopus} was distributed in Thailand and Sumatra, while \textit{Pandanus gladiator} synonym with \textit{Benstonea celebica} was distributed in Central Sulawesi [6]. \textit{Pandanus ellipsoides} synonym with \textit{Benstonea ellipsoides} was distributer in Sulawesi (Warb.) [6,7].

In this area, there is one rare plants species that have begun to decrease in its natural habitat, ie \textit{Chyrtotachys rendra} Blume. The species also known as the common names red sealing wax palm or lipstick palm, is a palm that is native to Thailand, Malaysia, Sumatra and Borneo [8]. \textit{Cyrtostachys renda} was listed as "Vulnerable" on the IUCN Red List in 1995 [9] [10]. In 1999, the government of Indonesia protected it from harvest through implementing legislation [11,12]. In 2000, the IUCN removed \textit{Cyrtostachys renda} from its list of protected species.

3.2. Collection of plants climber / wood climber (CI / W.CI)
Species of climber plants (CI) or wood climber (W.Cl) were challenging to collect, because they have long, sometimes spiked, stems. The dominated vines in dry habitats and as undergrowth are from the Convolvulaceae and the Passifloraceae Tribe, while the Cecropiaceae and Fabaceae family are in wet habitats that grow around the lake. From several species of grown vines collected, there are 6 species of the new collections for Bogor Botanical Gardens, namely: \textit{Meremia tridentata} (L.) Hall.f.ssp.Hastata, \textit{Passiflora foetida} L, \textit{Uncaria glabra} DC., \textit{Piper arborescens} and \textit{Laucananthus frubescens} Jack. The climber plants that have been collected and conserved in Bogor Botanical Gardens are 17 species (Table 2).

| No. | Collector number | Name       | Family          | Habitus | Sum of material | propagation |
|-----|------------------|------------|-----------------|---------|----------------|-------------|
| 1   | EM 501           | \textit{Meremia tridentata} (L.) Hall.f.ssp.Hastata*| \textit{Convolvulaceae} | Cl.     | 4 Pl, S>10     | S           |
| 2   | EM 502           | \textit{Passiflora foetida} L.*| \textit{Passifloraceae} | Cl.     | 1 rmpn, S>10   | S/C         |
| 3   | EM 505           | \textit{Uncaria glabra} DC.*| \textit{Rubiaceae} | W.Cl.   | 5 Pl           | S           |
| 4   | EM 510           | \textit{Ipomia triloba} | \textit{Convolvulaceae} | Cl.     | 1 rmpn         | S           |
Collected vines that include the eroded status is the species of *Nepenthes ampullaria* Jack., *Nepenthes gracilis* Karth and *Nepenthes mirabilis*. The species are listed as least concern on the IUCN Red list [13,14]. *Nepenthes ampullaria* from Zamrud National Park (Nam Riau) has successfully propagated *in vitro* at Plant Tissue Culture Laboratory of Bogor Botanic Gardens [15,16]. *Nepenthes ampullaria* has a unique geographical range within *Nepenthes*, being widely distributed in the Sunda region (Borneo, Sumatra, Malay Peninsula), and also in New Guinea, but nowhere in between. It is primarily a species of lowland swamp forests, but has been found at altitudes as high as 2100 m [13]. *Nepenthes gracilis* are native from Brunei Darussalam, Indonesia (Sumatera, Sulawesi, Manado), Malaysia (Sarawak, Sabah, Peninsular Malaysia), Singapore, and Thailand [14]. *Nepenthes mirabilis* are native from Australia, Brunei Darussalam, Cambodia, China, Indonesia (Papua, Kalimantan), Laos People’s Democratic Republic, Malaysia (Sabah, Peninsular Malaysia, Sarawak), Papua New Guinea, Philippines, Thailand and Viet Nam. Now the species grow in Australia (Queensland), China (Guangdong, Hainan), Hong Kong, Indonesia (Sumatera, Sulawesi, Jawa, Maluku), Macao, Micronesia, Federated States of, Palau, and Papua New Guinea [17].

### 3.3. Collection of shrub and annual herbs (Sh and PH)

The diversity of bush and perennial herb in the area of the Danau Pulau Besar-Danau Bawah, Zamrud National Park, 14 species has been collected (Table 3), and 8 species are new collection for Bogor Botanical Gardens, namely *Lygodium microphyllum* (Cav) R.Br, *Trema canabna* Lour, *Lycopodium cernum* L, *Fimbristy pauciflora* R.Br, *Stenoclaena palustris* Bedd, *Tapeinidum acuminatum* Kramer and *Pandanus ellipsoides* Warb. The species of ferns collected were *Lygodium microphyllum*, *Lycopodium cernum*, *Stenoclaena palustris*, *Tapeinidum acuminatum* and *Blechnum orientale*. These species grow in mutual association and clustered on either side of the road to the area of Danau Pulau Besar-Danau Bawah, Zamrud National Park.

| No. | Collector number | Name | Family | Habitus | Sum of material | propagation |
|-----|------------------|------|--------|---------|-----------------|-------------|
| 1   | EM 503           | *Lygodium microphyllum* (Cav) R.Br.* | Schizaeaceae | Sh      | 1 rmpn          | Spora       |
| 2   | EM 504           | *Trema canabna* Lour.* | Ulmaceae | Sh.     | 5 Pl.           | S.          |

*: new collection for Bogor Botanical Garden
Cl / W.Cl: creeping / propagating woody, Pl: plant, Rmpn: clump, S: seeds, C: Cuttings

Table 3. Shrubs and Herbs (Sh and PH) conserved at the Bogor Botanical Gardens.
| No. | EM | Scientific Name            | Family       | Sh. | PH. | Pl. | Rmpn | S | C/S/Pl. |
|-----|----|----------------------------|--------------|-----|-----|-----|------|---|--------|
| 3.  | EM 506 | *Lycopodium cernum* | Lycopodiaceae | Sh. |      |     | 1 rmpn | Spora  |
| 4.  | EM 515 | *Hibiscus sabdarifa* | Malvaceae    | Sh. |      |     | 1 rmpn | S ≈ S. |
| 5.  | EM 533 | *Tacca sp1.*     | Taccaceae    | PH. | 4 Pl. |    |      | S/Pl.  |
| 6.  | EM 534 | *Fimbristy pasciflora* | Cyperaceae   | Sh. | 1 rmpn |    |      | S     |
| 7.  | EM 535 | *Curculigo latifolia* | Amaranthaceae | PH  | 4 Pl. |    |      | S     |
| 8.  | EM 545 | *Tacca sp2.*     | Taccaceae    | PH. | 5 Pl. |    |      | S/Pl.  |
| 9.  | EM 546 | *Pleomele godseffiana* | Agavaceae   | PH. | 1 Pl. |    |      | C/S/Pl.|
| 10. | EM 548 | *Amomum sp.* | Zingiberaceae | Sh.. |      | 3 Pl. |      | S/Pl.  |
| 11. | EM 551 | *Blechnum orientale* | Blechnaceae  | Sh. | 1 rmpn |    |      | Spora  |
| 12. | EM 552 | *Stenoclaena palustris* | Polypodiaceae | Sh. | 1 rmpn |    |      | Spora  |
| 13. | EM 553 | *Tapinoidium acuminatum* | Polypodiaceae | Sh. | 1 rmpn |    |      | Spora  |
| 14. | EM 564 | *Pandanus ellipsoides* | Pandanaceae  | Sh.. |      | 3 Pl. |      | S/Pl.  |

*: new species for Bogor Botanical Garden
Sh: Bush, PH: Annual herbs, Pl: Plant, Rmpn: Clump, S: Seeds, C: Cuttings

*Lygodium microphyllum* are native from Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Cambodia, Cameroon, Central African Republic, China (Yunnan), Congo, The Democratic Republic of the Ethiopia, Gabon, Guinea, Guinea-Bissau, Hong Kong, India (Kerala, Tamil Nadu), Indonesia, Lao People's Democratic Republic, Liberia, Madagascar, Malawi, Malaysia, Maldives, Mauritius, Mozambique, Myanmar, Nepal, Nigeria, Pakistan, Philippines, Rwanda, Singapore, South Africa, South Sudan, Sri Lanka, Sudan, Tanzania, Thailand, Timor-Leste, Togo, Uganda, Viet Nam, and Zimbabwe [18]. The species are listed as least concern on the IUCN Red list.

3.4. Conservation Aspects
Several ex-situ conservation activities have been undertaken by the Bogor Botanical Gardens, including re-planting and re-study of plant collection from exploration result and performing inventory results. After the plant material arrived at the nursery of the Bogor Botanical Gardens, species that include rare plants were successfully planted in places adapted to the natural conditions of their habitat. Continuous plant conservation efforts are carried out from year to year. Among them are always increasing research and exploration to another forest areas throughout Indonesia.

Another effort is to develop propagation techniques. For a long time, Bogor Botanical Gardens has performed multiplication of plants collection by propagation techniques through cuttings, grafts and seeds. The main priority to propagation was rare plant collection.

The results of research and exploration of plant biodiversity in some areas, have many benefits, especially in revealing the potential of plant species diversity that can be used as the beginning of further research in plant development.

4. Conclusion
The results of research in the area of Danau Pulau Besar-Danau Bawah, Zamrud National Park obtained 65 species consisting of 48 genera and 35 family. There are 25 species of plant collection are new collection of Bogor Botanical Garden.

Environmental units such as primary forests, secondary forests, residential environments, farming environments and protected areas, are vital areas of biodiversity. Important efforts to preserve the natural resources of plants does not only revolve around conserving biodiversity, but also in the conservation of the cultural diversity of local communities. Knowledge of the cultural diversity of an ethnic place in a place is essential for the management, utilization and conservation of biological diversity.
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