Species Composition in the Habitat of *Dipterocarpus gracilis*
Ulolanang Kecubung Nature Reserve

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**Abstract.** This study aims to determine the flora diversity of *Dipterocarpus gracilis* habitat in the Ulolanang Kecubung Nature Reserve. The information obtained is expected to be a reference for the restoration of dipterocarps, especially *D. gracilis*. In 1998, the species was declared as Critically Endangered with criteria A1cd + 2cd ver 2.3. Eighty-seven sample plots of 20 x 20 m were laid down to conduct vegetation inventory. The plots were distributed in *D. gracilis* native habitat. The study showed that at the tree level the dominating species was *D. gracilis*, *Pometia pinnata*, and *Donax canniformis*. While at the pole levels were *D. gracilis*, *Pometia pinnata*, and *Horsfieldia glabra*. At the sapling level, the composition of vegetation was dominated by *Gelonium glomerulatum*, *Alchornea rugosa*, and *Plectronia horrida*. Where the seedling and understory levels were dominated by *D. gracilis*, *Horsfieldia glabra*, and *Aglaia odoratissima*. The population of *D. gracilis* in the Reserve was satisfying with excellent regeneration. The Reserve should be used as a gene bank for ex-situ conservation of *D. gracilis*.

1. **Introduction**

Dipterokarps is a plant family composes the main structure of tropical forests and is the main source of wood to meet domestic needs in Indonesia. Dipterocarp wood is used for various purposes starting from the roof, floor, pole of houses, door and window frames, bridges, harbor ports, and boats. Currently, there are 96 species of Dipterocarp that have been listed as endangered species on the IUCN Red List (International Union for Conservation of Nature). The list includes dipterocarps in Java island such as *Vatica pauciflora* (Korth.) Blume, *Dipterocarpus gracilis* Blume, *Dipterocarpus hasseltii* Blume, *Dipterocarpus littoralis* Blume, and *Dipterocarpus retusus* Blume.

Referring to Budiharta [1], the main causes of extinction were biological factors and over-exploitation (82%). A lack of comprehension of species biology has led many species to extinction. Therefore to preserve an endangered species, conservation programs must be based on biological knowledge of the species.

Ecological interactions between plants and their environment influence the population through their effects on the growth and survival of individuals [2]. Thus studying ecology to see the suitability of the habitat of a species is important for conservation [3].

*D. gracilis* is increasingly difficult to find, especially in Java. In the Leuweung Sancang Nature Reserve, for example, only one adult tree was found without any seedlings [4]. In the secondary natural forest of Perum Perhutani Cisujen Forest Resort, Sukabumi Forest Protection Unit, West Java only 4 adult trees were found with no regeneration seedlings [5]. Therefore studying the *D. gracilis* habitat is important as the basis of ecosystem restoration, especially to restore the *D. gracilis* habitat. This paper present the result of the study on the diversity of flora composing the *Dipterocarpus*
gracillis habitat in Ulolanang Kecubung Nature Reserve, Central Jawa. The information presented is expected to be a reference for the restoration of the D. gracillis habitat.

2. The Method
2.1. The study site
Ulolanang Kecubung Nature Reserve is located in Gondang Village, Subah District, Batang Regency covering an area of 69.07 ha. Ulolanang Kecubung Nature Reserve is a natural forest area adjoining teak forest area of Perum Perhutani on the East and North, while on the West and South was bordered by a river. Administratively, the Ulolanang Kecubung Nature Reserve is included in the area of Gondang Village, Subah District, Batang Regency, Central Java Province.

![Figure 1. Map of the research plots at Ulolanang Kecubung Nature Reserve](https://rebunas.com/gambar/images/direktorat-pemolaan-informasi-konservasi-alam-peta-kawasan-gambar-cagar-keteranganannya)

In the west, the nature reserve was bordered by a large river. This river water continues to flow throughout the year leading into the Java Sea. To the East of the nature reserve, there is a community-owned agricultural area consisting of fields and rice fields. This agriculture works throughout the year.
2.2. The procedure
To study the flora forming the *D. gracilis* habitat in the Ulolanang Kecubung nature reserve, 87 plots of 20 x 20 m were randomly distributed in the *D. gracilis* habitat. Each plot is placed purposively so that each plot always has one mature *D. gracilis* tree. Each plot is then divided into rectangular subplots with the following sizes: 20 x 20 m, 10 x 10 m, 5 x 5 m and 2 x 2m to record tree, pole, sapling, and seedling-level vegetation respectively.

The criteria for trees, sapling, and seedlings are as follows [6]:

- **Tree** is a plant with a diameter at breast height (1.3 m) > 20 cm, for the buttressed tree diameter was measured at 20 cm above the buttresses.
- **Pole** is a plant with < 10 cm dbh < 20 cm
- **Sapling** is a plant with high > 1.5 m to young trees with a diameter <10 cm.
- **Seedling** is a regeneration plant from sprouts to plant high < 1.5 m.

Tree to sapling inventory was carried out by recording species, diameter and height while seedling is carried out by recording species and counting the stems. To get proper scientific name voucher herbarium of each species were collected and identified at the Herbarium of the Forest Research and Development Center, Bogor.

The collected data were analysed to determine the dominant species. Dominant species is the species with the highest importance value (IVI) in the vegetation community [7]. Dominant species can be obtained by analysis of important value index (%) which is the sum of relative density, relative frequency and relative dominance of each species in the sample plots as shown by the following formula [6]:

\[
\text{Density (D)} = \frac{\text{Number of Individual}}{\text{Total Plot area}}
\]

\[
\text{Relative Density (RD)} = \frac{\text{Density of a species}}{\text{Density of all species}} \times 100\%
\]

\[
\text{Frequency (F)} = \frac{\text{Number of Plot with a certain species}}{\text{Total Number of Plots}}
\]

\[
\text{Relative Frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100\%
\]
3. Result and Discussion

3.1 species composition in the habitat of D. gracilis

From 87 sample plots scattered randomly in the D. Gracilis habitat, 11 species from 10 families were recorded. The dominant species were D. Gracilis, Pometia pinnata and Donax canniformis. At the pole level, 11 species from 10 families were recorded. The species dominant in the pole level were D. Gracilis, Pometia pinnata and Horsfieldia glabra. In the sapling level 37 species from 23 families were recorded. The dominant species were Gelonium glomerulatum, Alchornea rugosa, and Plectronia horrida. In the seedling level, 25 species from 19 families were recorded. The dominant species were D. Gracilis, H. glabra, Aglaia odoratissima (Table 1.).

Tabel 1. Species composition at the tree level in the habitat of D. gracilis

| No | Scientific Name        | Family        | RD (%) | RF (%) | RDo (%) | IVI   |
|----|------------------------|---------------|--------|--------|---------|-------|
| 1  | Dipterocarpus gracilis | Dipterocarpaceae | 45.18  | 35.22  | 29.87   | 110.27|
| 2  | Pometia pinnata        | Sapindaceae   | 7.46   | 9.96   | 25.73   | 43.14 |
| 3  | Donax canniformis      | Marantaceae   | 10.96  | 12.95  | 7.42    | 31.33 |
| 4  | Alpinia cf. malaccensis| Zingiberaceae | 3.51   | 5.21   | 19.45   | 28.16 |
| 5  | Mallotus philippensis  | Euphorbiaceae | 4.82   | 6.30   | 13.40   | 24.52 |
| 6  | Alchornea rugosa       | Euphorbiaceae | 4.21   | 10.32  | 1.23    | 20.76 |
| 7  | Archidendron ellipticum| Leguminosae   | 6.58   | 8.40   | 0.63    | 15.61 |
| 8  | Sterculia coccinea     | Malvaceae     | 6.14   | 4.23   | 0.42    | 10.79 |
| 9  | Dysoxylum cf. cauliflorum| Meliaceae | 3.07   | 3.63   | 0.22    | 6.92  |
| 10 | Polyalthia sp.         | Annonaceae    | 1.75   | 2.51   | 0.26    | 4.53  |
| 11 | Gelonium glomerulatum  | Euphorbiaceae | 1.32   | 1.27   | 1.37    | 3.96  |

Tabel 2. Species composition at the pole level in the habitat of D. gracilis

| No | Scientific Name        | Family        | RD (%) | RF (%) | RDo (%) | IVI   |
|----|------------------------|---------------|--------|--------|---------|-------|
| 1  | Dipterocarpus gracilis | Dipterocarpaceae | 32.63  | 32.17  | 45.38   | 110.18|
| 2  | Pometia pinnata        | Sapindaceae   | 8.42   | 7.94   | 14.91   | 31.28 |
| 3  | Horsfieldia glabra     | Myristicaceae | 12.63  | 13.97  | 3.72    | 30.32 |
| 4  | Vitex sp.              | Lamiales      | 9.47   | 9.95   | 8.56    | 27.98 |
| 5  | Plectronia horrida     | Rubiales      | 3.16   | 3.97   | 19.6    | 26.73 |
| 6  | Ficus hispida          | Moraceae      | 12.63  | 10.08  | 0.26    | 22.97 |
| 7  | Lygodium circinatum    | Lygodiaceae   | 6.32   | 6      | 3.78    | 16.1  |
| 8  | Pleomele elliptica     | Asparagaceae  | 3.16   | 3.97   | 2.43    | 9.56  |
| 9  | Sterculia coccinea     | Malvaceae     | 4.26   | 3.99   | 0.03    | 9.29  |
| 10 | Alchornea rugosa       | Euphorbiaceae | 3.16   | 3.97   | 1.25    | 8.37  |
Tabel 3. Species composition at the sapling level in the habitat of *D. gracilis*

| No. | Scientific Name         | Family         | RD (%) | RF (%) | IVI (%) |
|-----|-------------------------|----------------|--------|--------|---------|
| 1   | *Gelonium glomerulatum* | Euphorbiaceae  | 9.39   | 9.21   | 18.6    |
| 2   | *Alchornea rugosa*      | Euphorbiaceae  | 8.48   | 7.46   | 15.94   |
| 3   | *Plectronia horrida*    | Rubiaceae      | 8.79   | 6.58   | 15.37   |
| 4   | *Xanthophyllum excelsum*| Polygalaceae   | 7.88   | 7.46   | 15.33   |
| 5   | *Sterculia coccinea*    | Malvaceae      | 7.58   | 7.46   | 15.03   |
| 6   | *Horsfieldia glabra*    | Myristicaceae  | 8.79   | 5.7    | 14.49   |
| 7   | *Dipterocarpus gracilis*| Dipterocarpaceae| 6.67  | 7.46   | 14.12   |
| 8   | *Ficus subulata*        | Moraceae       | 5.45   | 6.58   | 12.3    |
| 9   | *Cassia fistula*        | Leguminosae    | 4.85   | 4.39   | 9.23    |
| 10  | *Aglaia* sp2            | Meliaceae      | 3.33   | 3.07   | 6.4     |
| 11  | *Ficus* sp.             | Moraceae       | 2.73   | 3.51   | 6.24    |
| 12  | *Polyalthia* sp1        | Annonaceae     | 2.73   | 3.07   | 5.8     |
| 13  | *Gelonium* sp1          | Euphorbiaceae  | 2.42   | 3.07   | 5.49    |
| 14  | *Ardisia* sp.           | Myrsinaceae    | 2.12   | 2.63   | 4.75    |
| 15  | *Dysoxylum* cf. cauliflorum | Meliaceae    | 2.42   | 2.19   | 4.62    |
| 16  | *Zingiber* sp.          | Zingiberaceae  | 1.82   | 2.63   | 4.45    |
| 17  | *Salacia* sp.           | Celastraceae   | 1.82   | 2.19   | 4.01    |
| 18  | *Homalium* sp.          | Flacourtiaceae | 1.82   | 1.75   | 3.57    |
| 19  | *Salacia* macrophylla   | Celastraceae   | 1.21   | 1.75   | 2.97    |
| 20  | *Lygodium* circinatum   | Lygodiaceae    | 1.52   | 1.32   | 2.83    |
| 21  | *Mallotus philippensis* | Euphorbiaceae  | 1.21   | 1.32   | 2.53    |
| 22  | *Aglaia* odoratissima   | Meliaceae      | 0.91   | 1.32   | 2.22    |
| 23  | *Polyalthia* sp2        | Annonaceae     | 1.21   | 0.88   | 2.09    |
| 24  | *Harpullia* cupanioides | Sapindaceae    | 0.91   | 0.88   | 1.79    |
| 25  | *Archidendron* ellipticum| Leguminosae   | 0.61   | 0.88   | 1.48    |
| 26  | *Pleomele* elliptica    | Asparagaceae   | 0.3    | 0.44   | 0.74    |
| 27  | *Vitex* sp.             | Lamiaceae      | 0.3    | 0.44   | 0.74    |
| 28  | *Donax* canniformis     | Marantaceae    | 0.3    | 0.44   | 0.74    |
| 29  | *Aglaia* sp             | Meliaceae      | 0.3    | 0.44   | 0.74    |
| 30  | *Streblus asper*        | Moraceae       | 0.3    | 0.44   | 0.74    |
| 31  | *Donax* sp.             | Marantaceae    | 0.3    | 0.44   | 0.74    |
| 32  | *Ziziphus* horsfieldii  | Rhamnaceae     | 0.3    | 0.44   | 0.74    |
| 33  | *Lantana* camara        | Verbenaceae    | 0.3    | 0.44   | 0.74    |
| 34  | *Tectona* grandis       | Verbenaceae    | 0.3    | 0.44   | 0.74    |
| 35  | *Leea* indica           | Vitaceae       | 0.3    | 0.44   | 0.74    |
| 36  | *Alpinia* cf. malaccensis | Zingiberaceae | 0.3    | 0.44   | 0.74    |
| 37  | *Ficus* hispida         | Moraceae       | 0      | 0.44   | 0.44    |
Tabel 4. Species composition at the seedling level in the habitat of *D. gracilis*

| No | Scientific Name       | Family            | RD (%) | RF (%) | IVI (%) |
|----|-----------------------|-------------------|--------|--------|---------|
| 1  | *Dipterocarpus gracilis* | Dipterocarpaceae  | 21.13  | 13.71  | 34.83   |
| 2  | *Horsfieldia glabra*   | Myristicaceae     | 21.13  | 13.20  | 34.32   |
| 3  | *Aglaia odoratissima*  | Meliaceae         | 10.92  | 12.18  | 23.10   |
| 4  | *Vitex* sp.            | Lamiaceae         | 11.62  | 11.17  | 22.79   |
| 5  | *Pleomele elliptica*   | Asparagaceae      | 3.52   | 3.05   | 6.57    |
| 6  | *Harpullia cupanioides*| Sapindaceae       | 2.82   | 3.55   | 6.37    |
| 7  | *Gelonium glomerulatum*| Euphorbiaceae     | 2.46   | 3.55   | 6.02    |
| 8  | *Homalium* sp.         | Flacourtiae       | 2.82   | 3.05   | 5.86    |
| 9  | *Salacia macrophylla*  | Celastraceae      | 1.76   | 3.05   | 4.81    |
| 10 | *Garcinia* sp.         | Clusiaceae        | 2.11   | 2.54   | 4.65    |
| 11 | *Mallotus philippensis*| Euphorbiaceae     | 2.11   | 2.54   | 4.65    |
| 12 | *Polyalthia* sp.       | Annonaceae        | 1.76   | 2.54   | 4.30    |
| 13 | *Alchornea rugosa*     | Euphorbiaceae     | 1.41   | 2.54   | 3.95    |
| 14 | *Pometia pinnata*      | Sapindaceae       | 1.41   | 2.03   | 3.44    |
| 15 | *Donax canniformis*    | Marantaceae       | 1.76   | 1.52   | 3.28    |
| 16 | *Alpinia cf. malaccensis* | Zingiberaceae     | 1.76   | 1.52   | 3.28    |
| 17 | *Mallotus philippensis*| Euphorbiaceae     | 1.41   | 1.52   | 2.93    |
| 18 | *Ziziphus horsfieldii* | Rhamnaceae        | 0.70   | 1.52   | 2.23    |
| 19 | *Leea indica*          | Vitaceae          | 0.70   | 1.52   | 2.23    |
| 20 | *Dysoxylum cf. cauliflorum* | Meliaceae        | 0.70   | 1.52   | 2.23    |
| 21 | *Piper cubeba*         | Piperaceae        | 1.76   | 2.04   | 3.79    |
| 22 | *Polyalthia* sp.       | Annonaceae        | 0.70   | 1.02   | 1.72    |
| 23 | *Gelonium glomerulatum*| Euphorbiaceae     | 0.70   | 1.02   | 1.72    |
| 24 | *Vitex* sp.            | Lamiaceae         | 0.35   | 1.02   | 1.37    |
| 25 | *Piper cf. betle*      | Piperaceae        | 0.35   | 1.02   | 1.37    |
| 26 | *Zingiber* sp.         | Zingiberaceae     | 0.35   | 1.02   | 1.37    |
| 27 | *Lantana camara*       | Verbenaceae       | 0.35   | 1.02   | 1.37    |
| 28 | *Ficus hispida*        | Moraceae          | 0.35   | 1.02   | 1.37    |
| 29 | *Lygodium circinatum*  | Lygodiaceae       | 0.35   | 1.02   | 1.37    |
| 30 | *Pleomele elliptica*   | Asparagaceae      | 0.35   | 1.02   | 1.37    |
| 31 | *Donax canniformis*    | Marantaceae       | 0.35   | 1.02   | 1.37    |

On the 87 plot covering 3.48 ha, 2,253 individuals were listed consisting of 42 species from 31 genera of the 24 families. The most common families were Moraceae (3 species), Euphorbiaceae (3 species), and Annonaceae (3 species). The number of species recorded at the study site was lower than the others. Sidiyasa [8] listed 72 species and Susilo [4] listed 79 species of the lowland dipterocarp forest of the Leuwung Sancang Nature Reserve. Saridan and Fajri [10] recorded 76 species of trees in the Labanan research forest, Berau Regency and finally, Partomihardjo & Ismail [11] listed 282 tree species grown in the Nusabarong Nature Reserve, Jember. The low tree species diversity in the research site might be due to the shape of the reserve as long-narrow-snake like as implied in the name of Ulolanang (male snake). Furthermore, the Ulolanang Kecubung Nature Reserve is only covering a single vegetation type, riparian forest. Still, the *D. gracilis* survive well in the site as shown by the existence and domination of the species in all vegetation levels from tree to seedling. The result of the study proved that Ulolanang Kecubung Nature Reserve is a suitable habitat for *D. gracilis*. Besides *D. gracilis*, *H. glabra* is also considered dominant species in the site as indicated by the high IVI. However, the regeneration is quite low as no seedlings of *H. glabra* were found. On the contrary,
Aglaia odoratissima, Garcinia sp, Sterculia coccinea, Aglaia spp, and Ficus spp may not be able to survive well since no adult tree level were found.

3.2. The Density of the D. gracilis

*D. gracilis* is increasingly difficult to find. A surprising research study revealed that from 75 plots of 20 x 20 m in Leuweng Sancang Nature Reserve, only one adult tree and one sapling were found without any regeneration [4]. On the contrary, in the 1980s the species were still common [8], [9], [12]. In the secondary natural forest of Perum Perhutani Cisujen Forest Resort, Sukabumi Forest Protection Unit, West Java only 4 adult trees were found with no seedling [5].

Regeneration of *D. gracilis* is an obstacle to the survival of the species. The absence of regeneration suggests that there may no suitable microsites for seed germination or too many natural enemies to prevent natural regeneration. The obstacle starts from pre-dispersal seed predators, namely seed predation when the seeds are still in the tree and have not been dispersed from the parent tree. Potential pre-dispersal seed predators for dipterocarps are parquet, rodent and insect species [13].

After dispersing from the parent tree and scattered on the forest floor, the seeds of dipterocarp faces another enemy, namely, post dispersal seed predators. Dipterocarp seeds contain nutrients that are very good for preparing germination so that it attracts a lot of wildlife to eat it. The potential seed predator is vertebrates, especially wild boar (Sus barbatus) [13], [15] and rodents [14]. Pigs are ferocious consumers of dipterocarp seeds but ignore them after they grow into seedlings [15]. If there are only a few mature trees in the site, it is very likely that the seeds produced will be consumed by the seed predator, especially the wild boar, so there will be no regeneration left. Dipterocarp seedlings are also eaten by mammals [13] but wild boar only eat seeds and do not disturb germinated seeds.

The result of this study shows better regeneration. At least 87 adult trees present in the sample plots. Comparison between seedling, sapling, pole and tree level of the *D. gracilis* were 23: 1: 1: 8 (Table 4). The structure of the stand class diameter and number of trees form an inverted letter J. It showed that the regeneration is in an excellent condition. The other species in the site did not show strong vigor as *D. gracilis* (Table 4). Many species do not have regeneration or inversely no adult trees available. Seedling of *D. gracilis* in the site was common and easily be found. It implies that *D. gracilis* in the Ulolanang Kecubung Nature Reserve does not have many obstacles.

Because dipterocarps behave masting [16], [17], healthy adult tree populations are needed to guarantee the regeneration. During the masting season, all the individual dipterocarp trees together bear very heavy fruit. So that natural enemies will not be able to destroy all seeds that have been scattered on the forest floor leaving some seeds to survive for the next regeneration [16], [17], [18]. Dipterocarp seeds are recalcitrant, germinating immediately after dispersed [15]. Thus, seeds that have germinated will be escaped from seed predators, especially pigs because pigs only eat seeds and do not touch them after germination. With a masting strategy together with dense fruit at the same time, there are always available seeds escape from seed predators for natural regeneration.

**Table 5.** Species composition at the tree, pole, sapling and seedling level in the habitat of *D. gracilis*

| No. | Nama Botani          | Tree  | Pole  | Sapling | Seedling |
|-----|----------------------|-------|-------|---------|----------|
|     |                      | Kr (%)| INP (%)| Kr (%)| INP (%)| Kr (%)| INP (%)|
| 1   | *Aglaia odoratissima*| -     | -     | -      | -       | -     | 10.92 | 23.1  |
| 2   | *Aglaia* sp          | -     | -     | -      | -       | 0.3   | 0.74  |
| 3   | *Aglaia* sp.2        | -     | -     | -      | -       | 3.33  | 6.4   |
| 4   | *Alchornea rugosa*   | -     | -     | 3.16   | 8.37    | 8.48  | 15.94 | 1.41  | 3.95  |
| 5   | *Alpinia cf. malaccensis* | 3.51 | 28.16 | -      | -       | 0.3   | 0.74  |
| 6   | *Archidendron ellipticum* | -     | -     | -      | -       | 0.61  | 1.48  |
| No. | Species                  | Length | Width | Height | Diameter | Heartwood | Sapwood | Total | Other |
|-----|-------------------------|--------|-------|--------|----------|-----------|---------|-------|-------|
| 7   | Ardisia sp.             | -      | -     | -      | 2.12     | 4.75      | -       | -     | -     |
| 8   | Cassia fistula          | -      | -     | -      | 4.85     | 9.23      | -       | -     | -     |
| 9   | Dipterocarpus gracilis  | 45.18  | 110.27| 32.63  | 110.18   | 6.67      | 14.12   | 21.13 | 34.83 |
| 10  | Donax canniformis       | 10.96  | 31.33 | -      | 0.3      | 0.74      | 1.76    | 3.28  | -     |
| 11  | Donax canniformis       | -      | -     | -      | -        | -         | -       | -     | -     |
| 12  | Dyssoxylum cf. cauliforum | 3.07  | 6.92  | -      | 2.42     | 4.62      | 0.7     | 2.23  | -     |
| 13  | Ficus hirsuta           | -      | -     | -      | 12.63    | 22.97     | 0       | 0.44  | 0.35  |
| 14  | Ficus sp.               | -      | -     | -      | 3.16     | 7.24      | 2.73    | 6.24  | -     |
| 15  | Ficus subulata          | -      | -     | -      | 5.45     | 12.3      | -       | -     | -     |
| 16  | Garcinia sp.            | -      | -     | -      | -        | -         | -       | -     | 2.11  |
| 17  | Gelonium glomeratum     | 1.32   | 3.96  | -      | 9.39     | 18.6      | 2.46    | 6.02  | -     |
| 18  | Gelonium sp.            | -      | -     | -      | 2.42     | 5.49      | -       | -     | -     |
| 19  | Harpullia cupanioides   | -      | -     | -      | 0.91     | 1.79      | 2.82    | 6.37  | -     |
| 20  | Homalium sp.            | -      | -     | -      | 1.82     | 3.57      | 2.82    | 5.86  | -     |
| 21  | Horsfieldia glabra      | -      | -     | 12.63  | 30.32    | 8.79      | 14.49   | 21.13 | 34.32 |
| 22  | Lantana camara          | -      | -     | -      | 0.3      | 0.74      | 0.35    | 1.37  | -     |
| 23  | Leea indica             | 6.58   | 15.61 | -      | 0.3      | 0.74      | 0.7     | 2.23  | -     |
| 24  | Lygodium circinatum     | -      | -     | 6.32   | 16.1     | 1.52      | 2.83    | 0.35  | 1.37  |
| 25  | Mallotus philippensis   | 4.82   | 24.52 | -      | 1.21     | 2.53      | 2.11    | 4.65  | -     |
| 26  | Piper cf. betle         | -      | -     | -      | 0.91     | 1.79      | 2.82    | 6.37  | -     |
| 27  | Piper cubeba            | -      | -     | -      | -        | -         | 1.06    | 2.07  | -     |
| 28  | Piper sp.               | -      | -     | -      | 0.91     | 2.22      | -       | -     | -     |
| 29  | Plectonia horrida       | -      | -     | 3.16   | 26.73    | 8.79      | 15.37   | -     | -     |
| 30  | Pleomele elliptica      | -      | -     | 3.16   | 9.56     | 0.3       | 0.74    | 3.52  | 6.57  |
| 31  | Polyalthia sp.          | 1.75   | 4.53  | -      | 2.73     | 5.8       | 1.76    | 4.3   | -     |
| 32  | Polyalthia sp. 1        | -      | -     | -      | 1.21     | 2.09      | -       | -     | -     |
| 33  | Pometia pinnata         | 7.46   | 43.14 | 8.42   | 31.28    | -         | -       | 1.41  | 3.44  |
| 34  | Salacia macrophylla     | -      | -     | -      | 1.21     | 2.97      | 1.76    | 4.81  | -     |
| 35  | Salacia sp.             | -      | -     | -      | 1.82     | 4.01      | -       | -     | -     |
| 36  | Sterculia cocinea       | -      | -     | 5.26   | 9.29     | 7.58      | 15.03   | -     | -     |
| 37  | Streblus asper          | -      | -     | -      | 0.3      | 0.74      | -       | -     | -     |
| 38  | Tectona grandis         | -      | -     | -      | 0.3      | 0.74      | -       | -     | -     |
| 39  | Vitex pubescens.        | -      | -     | 9.47   | 27.98    | 0.3       | 0.74    | 11.62 | 22.79 |
| 40  | Xanthophyllum exsulsum  | -      | -     | -      | 7.88     | 15.33     | -       | -     | -     |
| 41  | Zingiber sp.            | -      | -     | -      | 1.82     | 4.45      | 0.35    | 1.37  | -     |
| 42  | Ziziphus hortfieldii     | -      | -     | -      | 0.3      | 0.74      | 0.7     | 2.23  | -     |

### 3.3. Implication for conservation

*D. gracilis* may extinct locally in many forest areas as shown by recent studies [4], [5]. Since *D. gracilis* is increasingly difficult to be found in many other forest areas, ex-situ conservation of *D. gracilis* is needed to conserve the species. Ulolang Kecubung Nature Reserve offers many regeneration seedlings to be planted for ex-situ conservation. The Reserve should be protected strictly for the gene bank of *D. gracilis*. 
4. Conclusion

Ulolanang Kecubung Nature Reserve is a suitable habitat for *D. gracilis* as the species dominant in all but sapling levels. The regeneration of this endangered species was excellent. The Reserve should be used as a source *D. gracilis* gene bank.

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