Short Communication:
The composition of undergrowth vegetation in the Gendol Riverbank, Sleman District, Yogyakarta, Indonesia

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Abstract. Syahbudin A, Meinata A, Arifriana R, Wiyono. 2020. The composition of undergrowth vegetation in the Gendol Riverbank, Sleman District, Yogyakarta, Indonesia. Biodiversitas 21: 1786-1792. Gendol river is one of the rivers affected by a pyroclastic blast from Mount Merapi eruption in 2010. This river flows through several villages, such as Glagaharjo, Kepuharjo, Wukirsari, and Argomulyo. On this riverbank, vegetation has grown naturally post-eruption of Mount Merapi and is continues to change. Some vegetation was also planted by the community. This study aims to find out the composition of the undergrowth vegetation on the Gendol riverbank in Cangkringan Sub-district. The data was obtained systematically by marking 10 sample plots of 5 m x 5 m and 2 m x 2 m size, on each side of the bank. A total of 68 species were recorded in this study which consisted of 29 trees species in seedlings and saplings stage, 34 species of herbs and shrubs, and 6 species of grasses. The dominant non-tree species are Chromolaena odorata (L.) R.M.King & H.Rob. with an IVI of 43.78%, Alternanthera brasiliana (L.) Kuntze with IVI of 16.6% and Asystasia gangetica (L.) T. Anderson with IVI of 15.78%. Saplings are dominated by Falcataria moluccana (Miq.) Barneby & J.W. Grimes with IVI of 32.81%, followed by Leucaena leucocephala (Lam.) De Wit (IVI-24.41%) and Melia azedarach (IVI-14.28%).

Keywords: Gendol Riverbank, seedlings, species composition, understorey

INTRODUCTION

Yogyakarta City is the capital of Yogyakarta Special Province, situated in Central Java, Indonesia and it's located at a distance of about 30 km from Mount Merapi (Karnawati 2006). Mount Merapi is a place well-known for its 'firing mountain', which is among the identified 129 most active volcanoes found in Java (Dove 2008). Mount Merapi is located on the border of cities namely, Sleman, Magelang, Boyolali, and Klaten (Geology Department 2011). This mountain has many rivers and one of them is Gendol river flowing in Sleman Regency, a part of the Opak Water Catchment Area. This finally joins the Opak river in the Sajaran Sub-villelage, Bimomartani Village, Ngemplak Sub-district, Sleman, Yogyakarta. Downstream part of the river does not reach the foot of Mount Merapi. River length from Gadingan Sub-village to Kayen Sub-village is approximately 7 km. The coordinates of the Gendol river in that section are 7°39′30″ LS-7°43′0″ LS and 110°27′0″ BT-110°29′0″ BT (Sari 2014).

Mount Merapi is included in the most active volcanoes in Indonesia (Sutikno et al. 2007). Big explosion caused massive catastrophic impact in 2010 (Jenkins et al. 2014; Baxter et al. 2017). After the eruption, some areas of Sleman, mainly the surrounding of Opak, Boyong, Kuning and Gendol River, experienced lahars disaster (Suharyadi and Tuladhar 2010) which destroyed various important infrastructures such as settlements, bridge, agricultural and irrigation infrastructures, and so forth. One of them was pyroclastic blast in Cangkringan Sub-district (Rijal et al. 2010), which destroyed the rivers (Murwanto et al. 2013) and burnt whole vegetation on the riverbank (Jenkins et al. 2014). After the eruption, vegetation grew back naturally. The pioneers will determine the climax ecosystem of the future. If vegetation is well developed, it can protect the community around the Gendol river from pyroclastic blast material (Setyowati 2013). Vegetation has significant role in both environment and economy (Suharti 2015). Economically, the community can use the products for drugs, household equipment, green manure, cattle food, and others (Syahbudin et al. 2009, Farooque and Saxena 1996). In mountain forests, vegetation regulates water systems, prevent erosion, keep cool air and mountainous landscapes (Listyaningrum et al. 2019). Riverside vegetation is a significant factor influencing the occurrence and progress of soil erosion, at the same time it also can regenerate the land productivity (Bruno et al. 2014). The increase of vegetation cover increases surface roughness, and reduces the size of bare crusted areas in between the vegetation (Cammeraat 2005). If the vegetation conditions are relatively poor, then tree enrichment is needed to overcome the problem. Therefore, data on the composition of the undergrowth vegetation on Gendol river is needed to support the activities.
MATERIALS AND METHODS

Study site
The study was conducted in the Gendol riverbank in the Cangkingan Sub-district, Sleman District, Yogyakarta, Indonesia (Figure 1). Data collection period was from March 2017 to July 2017. Total riverbank distance studied was 1500 m.

Data collection
The research was carried out by employing systematic sampling method which involved a total of 10 sampling quadrats established on either side of the river bank. The quadrat size was determined based on growth form, as described by Mueller-Dombois and Ellenberg (1974). 1, quadrats of 5 m x 5 m was marked for saplings, and 2 m x 2 m for lower plants (herbs and shrubs), and seedlings. Saplings are young trees that have height more than 1.5 m, but less than 10 cm in diameter breast height. Lower plant is ranging from grass, herb, and tree that have less than 1.5 m in height. The placing of the quadrats was not in a straight line and was based on the nature of the study site (Bartos et al. 1994), as shown in Figure 2.

Data analysis
The research data obtained from the quadrats were analyzed to obtain species composition and abundance of species in the plot. Each species was analyzed using the Important Value Index (IVI) and interpreted descriptively to understand the vegetation dynamics. Parameter observed was density and frequency with the formula:

Figure 1. A. Study site Gendol river in Cangkingan Sub-district, Sleman District, Yogyakarta, Indonesia saw from above, B. Gendol river bank

Figure 2. Location of research plots along Gendol Riverbank in Cangkingan Sub-district, Sleman District, Yogyakarta, Indonesia
RESULTS AND DISCUSSION

In this study, undergrowth means all those plants that have herbaceous and shrub habits, including seedlings and saplings of tree species. The saplings and seedlings indicate regeneration status of forest (Septiawan et al. 2017). Connell (1989), is of the opinion that the seedlings can represent forest gaps which reflect the status of forest health. The composition of the vegetation of the Gendol river banks in the Cangkringan Sub-district can be seen in Table 1.

A total of 68 undergrowth species have been recorded, including herbaceous plants, shrubs, grasses, and trees. It consists of 29 species of trees in seedling and sapling stages, 33 species of herbs and shrubs, and 6 species of grasses. Vegetation that survived in the area may be re-established after volcanic eruption (Dale et al. 2005). Habitat loss can cause a threat to biodiversity to eliminate some important species in the area (With 2002). Optimally a disturbed area such as post-eruption area should be restored with native plants to maintain the biodiversity in the area (Matsumoto et. al. 2015). Some of the exotic species can be established, namely needlewood tree (Schima wallichii), hopbush (Dodonaea viscosa), dappad (Erythrina lithosperma), and arngoni (Vaccinium varingiaefolium) (Umay 2013). But some of the plants can be risky since they are invasive species (Meekins and McCarthy 2001).

Invasive species can threaten biodiversity in the area especially in ecosystem service to maintain the surroundings (Charles and Dukes 2008).

The IVI values for herbs, shrubs, and seedlings, along with their frequency, relative frequency, density, and relative density is provided in Table 2. The highest IVI value of 43.7% was obtained for Chromolaena odorata. Next two species are Alternanthera brasiliiana with IVI of 16.61% and Asystasia gangetica with 15.78%. All of the tree saplings had low IVI than herbs, shrubs, and seedlings (Table 3). Shrub was found in the least amount but the number of individuals was quite large, especially for C. odorata.

Among the saplings, Falcataria moluccana and Leucaena leucocephala showed the highest IVI. The IVI for F. moluccana was 32.81%, L. leucocephala was 24.14%, and M. azedarach was 14.28%. They are followed by Muntingia calabura, Senna siamea, Melochia umbellata, F. hispida, and Talipariti simile all of which have IVI of 9.52%.

Table 1. Composition of undergrowth vegetation in Gendol riverbank, Indonesia post-eruption of Mount Merapi 2010

| Species                        | Family     | Habit    |
|--------------------------------|------------|----------|
| Albizia lebbeck (L.) Benth.    | Fabaceae   | Tree     |
| Albizia procera (Roxb.) Benth. | Fabaceae   | Tree     |
| Annona muricata L.             | Annonaceae | Tree     |
| Antidesma bunius (L.) Spreng.  | Euphorbiaceae | Tree   |
| Artocarpus heterophyllus Lam.  | Moraceae   | Tree     |
| Senna siamea (Lam.) H.S.Irwin & Barneby | Fabaceae | Tree |
| Cocos nucifera L.              | Arecaceae  | Tree     |
| Dalbergia latifolia Roxb.      | Fabaceae   | Tree     |
| Durio zibethinus Murray        | Bombacaceae | Tree |
| Dysosyrium gaudichaudianum (A.Juss.) Miq | Meliaceae | Tree |
| Lepisanthes rubiginosa (Roxb.) Leenh. | Sapindaceae | Tree |
| Eugenia polyantha Barb. Rodr.  | Myrtaceae  | Tree     |
| Falcataria moluccana (Miq.) Barneby & J.W.Grimes | Fabaceae | Tree |
| Ficus grossularioides Burm.f.  | Moraceae   | Tree     |
| Ficus hispida L.f.              | Moraceae   | Tree     |
| Ficus septica Burm.f.           | Moraceae   | Tree     |
| Gliricidia sepium (Jacq.) Walp. | Fabaceae   | Tree     |
| Talipariti simile (Blume) Fryxell | Malvaceae | Tree |
| Leucaena leucocephala (Lam.) de Wit | Fabaceae | Tree |
| Mangifera indica L.             | Anacardiaceae | Tree |
| Melia azedarach L.              | Meliaceae  | Tree     |
| Melochia umbellata (Houtt.) Stupf | Malvaceae | Tree |
| Muntingia calabara L.           | Muntingiaceae | Tree |
| Parkia speciosa Hassk.          | Fabaceae   | Tree     |
| Pterospermum javanicum Jung.    | Sterculiaceae | Tree |
| Albizia saman (Jacq.) Merr.     | Fabaceae   | Tree     |
| Syzygium aqueum (Burm.f.) Alston | Myrtaceae | Tree |
| Syzygium cumini (L.) Skeels.    | Myrtaceae  | Tree     |
| Swietenia macrophylla King.     | Meliaceae  | Tree     |
| Calotropis gigantea (L.) Dryand. | Apocynaceae | Shrub |
| Chromolaena odorata (L.) R.M.King & H.Rob. | Verbenaceae | Shrub |
| Lantana camara L.               | Asteraceae  | Shrub    |
| Manihot esculenta Crantz.       | Euphorbiaceae | Shrub |
| Sida rhombifolia L.             | Malvaceae  | Shrub    |
| Urena lobata L.                 | Malvaceae  | Shrub    |
| Aeschynomene indica L.          | Fabaceae   | Herb     |
| Asystasia gangetica (L.) T.Anderson | Acanthaceae | Herb |
| Axonopus compressus (Sw.) P. Beauv. | Poaceae | Herb |
| Ageratum conyoides (L.) L.      | Asteraceae | Herb |
| Cassosyrum crepidioides (Benth.) S.Moore | Asteraceae | Herb |
| Blumea balsamifera (L.) DC.     | Asteraceae | Herb |
| Spermacoce alata Aubl.          | Rubiaceae  | Herb     |
| Cylea barbara Miers.            | Menispermaceae | Herb |
| Dicksonia sp.                   | Polypodiaceae | Herb |
| Drymaria querocifolia (L.) J. Sm. | Polypodiaceae | Herb |
| Crociophyllum sp.               | Asteraeae  | Herb     |
| Stachyarthipha indica (L.) Vahl | Verbenaceae | Herb |
| Brachiaria matica (Forsk.) Stapf | Poaceae   | Herb     |
| Plectranthus monostachius (P. Beauv.) B.J. Pollard | Lamiaceae | Herb |
| Mikania micrantha Kunth         | Asteraceae  | Herb     |
| Syngonium podophyllum Schott    | Araceae    | Herb     |
| Pyrrosypamma sp.                | Polypodiaceae | Herb |
| Pteris sp.                      | Polypodiaceae | Herb |
| Gleicheina sp.                  | Gleicheniaceae | Herb |
| Carica papaya L.                | Caricaceae | Herb     |
| Musa paradisiaca L.             | Musaceae   | Herb     |
| Pteris sp.                      | Polypodiaceae | Herb |
| Musa pudica L.                  | Musaceae   | Herb     |
| Centrostema pubescens Benth.    | Fabaceae   | Herb     |
| Alternanthera brasiliiana (L.) Kuntze | Amananthaceae | Herb |
| Solanum torvum Sw.              | Solanaceae | Herb |
| Tridax procumbens (L.) L.       | Asteraceae | Herb |
| Imperata cylindrica (L.) Raensch. | Poaceae | Grass |
| Melinis sp.                     | Poaceae    | Grass    |
| Sporobolus sp.                  | Lamiaceae  | Grass    |
| Melinis repens (Willd.) Zizka    | Poaceae    | Grass    |
| Opismenus burmannii (Retz.) P.Beaув. | Poaceae | Grass |
| Themeda argusens (L.) Hack.     | Poaceae    | Grass    |

Frequency (%) = \( \frac{Number \ of \ transsects \ in \ which \ the \ species \ occur}{Total \ number \ of \ transsects \ studied} \times 100 \)

Density = \( \frac{Total \ number \ of \ individuals \ of \ the \ species}{Total \ number \ of \ transsects \ studied} \)}
### Table 2. Frequency, relative frequency, density, relative density and important value index (IVI) for herbs, shrubs and saplings in Gendol river bank in Cangkringan Sub-district, Sleman District, Yogyakarta, Indonesia post-eruption of Mount Merapi in 2010

| Species | F | FR (%) | K | KR (%) | IVI |
|---------|---|--------|---|--------|-----|
| Chromolaena odorata (L.) R.M.King & H.Rob. | 0.90 | 12.59 | 32125.00 | 31.19 | 43.78 |
| Alternanthera barbatiolina (L.) Kunze | 0.45 | 6.29 | 10625.00 | 10.32 | 16.61 |
| Asystasia gangetica (L.) T.Anderson | 0.20 | 2.80 | 13375.00 | 12.99 | 15.78 |
| Plectranthus monostachyus (F.Beauv.) B.J POLLARD | 0.20 | 2.80 | 6250.00 | 6.07 | 8.87 |
| Urena lobata L. | 0.30 | 4.20 | 4125.00 | 4.00 | 8.20 |
| Centrosema pubescens Bentham | 0.30 | 4.20 | 2875.00 | 2.79 | 6.99 |
| Brachiaria mutica (Forssk.) Stapf | 0.25 | 3.50 | 2875.00 | 2.79 | 6.29 |
| Melinis repens (Willd.) Zizka | 0.20 | 2.80 | 3375.00 | 3.28 | 6.07 |
| Cricocephalum sp. | 0.20 | 2.80 | 1875.00 | 1.82 | 4.62 |
| Manihot esculenta Crantz. | 0.20 | 2.80 | 3625.00 | 3.52 | 4.22 |
| Pteris sp. | 0.05 | 0.70 | 1250.00 | 1.21 | 4.01 |
| Leucaena leucocephala (Lam.) de Wit | 0.20 | 2.80 | 1250.00 | 1.21 | 4.01 |
| Musa paradisiaca L. | 0.20 | 2.80 | 1125.00 | 1.09 | 3.89 |
| Blumea balsamifera (L.) DC. | 0.10 | 1.40 | 1875.00 | 1.82 | 3.22 |
| Ficus septica Burm.f. | 0.10 | 1.40 | 1875.00 | 1.82 | 3.22 |
| Ageratum conyzodes (L.) L. | 0.10 | 1.40 | 1250.00 | 1.21 | 2.61 |
| Mimosa pudica L. | 0.15 | 2.10 | 375.00 | 0.36 | 2.46 |
| Dacksonia sp. | 0.10 | 1.40 | 1000.00 | 0.97 | 2.37 |
| Stachytarpheta indica (L.) Vahl | 0.10 | 1.40 | 625.00 | 0.61 | 2.01 |
| Lantana camara L. | 0.10 | 1.40 | 500.00 | 0.49 | 1.88 |
| Melia azedarach L. | 0.10 | 1.40 | 500.00 | 0.49 | 1.88 |
| Gliricidia sepium (Jacq.) Walp. | 0.10 | 1.40 | 500.00 | 0.49 | 1.88 |
| Swietenia macrophylla King. | 0.10 | 1.40 | 375.00 | 0.36 | 1.76 |
| Sida rhombifolia L. | 0.10 | 1.40 | 250.00 | 0.24 | 1.64 |
| Ficus hispida L. | 0.10 | 1.40 | 250.00 | 0.24 | 1.64 |
| Melochia umbellata (Houtt.) Stapf | 0.10 | 1.40 | 250.00 | 0.24 | 1.64 |
| Axonopus compressus (Sw.) P.Beaup. | 0.10 | 1.40 | 250.00 | 0.24 | 1.64 |
| Spermacoce alata Aubl. | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Dario zibethinus Murray | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Cricocephalum crepidioides (Benth.) S.Moore | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Pterygopiluma sp. | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Annona muricata L. | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Muntingia calabura L. | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Artocarpus heterophyllus Lam. | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Pteris sp. | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Pterygopiluma sp. | 0.10 | 1.40 | 125.00 | 0.12 | 1.52 |
| Imperata cylindrica (L.) Raesusch. | 0.05 | 0.70 | 750.00 | 0.73 | 1.43 |
| Themeda argens (L.) Hack. | 0.05 | 0.70 | 625.00 | 0.61 | 1.31 |
| Triadix procumbens (L.) L. | 0.05 | 0.70 | 625.00 | 0.61 | 1.31 |
| Dalbergia latifolia Roxb. | 0.05 | 0.70 | 625.00 | 0.61 | 1.31 |
| Drynaria quercifolia (L.) J. Sm. | 0.05 | 0.70 | 375.00 | 0.36 | 1.06 |
| Monstera sp. | 0.05 | 0.70 | 375.00 | 0.36 | 1.06 |
| Lepisanthes rubiginosa (Roxb.) Leenh. | 0.05 | 0.70 | 250.00 | 0.24 | 0.94 |
| Sporobolus sp. | 0.05 | 0.70 | 250.00 | 0.24 | 0.94 |
| Gleichenia sp. | 0.05 | 0.70 | 250.00 | 0.24 | 0.94 |
| Calotropis gigantea (L.) Dryand. | 0.05 | 0.70 | 250.00 | 0.24 | 0.94 |
| Cocos nucifera L. | 0.05 | 0.70 | 250.00 | 0.24 | 0.94 |
| Albizia lebbek (L.) Benth. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Ciceria barbata Miers. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Mikania micrantha Kunth | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Aeschynomene indica L. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Melinis repens (Willd.) Zizka | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Mangifera indica L. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Carica papaya L. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Eugenia polyantha Barb. Rodr. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Oplismenus burmanni (Rez.) P.Beauv. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Pterospermum javanicum Jung. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |
| Solanum torvum Sw. | 0.05 | 0.70 | 125.00 | 0.12 | 0.82 |

| Sum | 7.15 | 100.00 | 103000.00 | 100.00 | 200.00 |

Note: F : Frequency, FR: Frequency Relative, K: Density, KR: Density Relative, IVI: Important Value Index
Table 3. Frequency, relative frequency, density, relative density and important value index (IVI) for saplings in Gendol riverbank in Cangkringan Sub-district, Sleman District, Yogyakarta, Indonesia, post-eruption of Mount Merapi 2010

| Species                                      | F    | FR (%) | FR (%) | K     | KR (%) | IVI  |
|----------------------------------------------|------|--------|--------|-------|--------|------|
| Falcata moluccana (Miq.) Barney & J.W.Grimes | 0.30 | 15.79  | 160.00 | 17.02 | 32.81  |
| Leucaena leucocephala (Lam.) de Wit           | 0.10 | 5.26   | 180.00 | 19.15 | 24.41  |
| Melia azedarach L.                            | 0.15 | 7.89   | 60.00  | 6.38  | 14.28  |
| Muntingia calabura L.                         | 0.10 | 5.26   | 40.00  | 4.26  | 9.52   |
| Senna siamea (Lam.) H.S.Irwin & Barney        | 0.10 | 5.26   | 40.00  | 4.26  | 9.52   |
| Melochia umbellata (Houtt.) Stapf             | 0.10 | 5.26   | 40.00  | 4.26  | 9.52   |
| Ficus hispida L.                              | 0.10 | 5.26   | 40.00  | 4.26  | 9.52   |
| Talipariti simile (Blume) Fryxell             | 0.10 | 5.26   | 40.00  | 4.26  | 9.52   |
| Syzygium cumini (L.) Skeels.                  | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Antidesma bunius (L.) Spreng.                 | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Syzygium aquaeum (Burn.f.) Alston             | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Ficus septica Burm.f.                         | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Ficus grossularioides Burm.f.                 | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Cocos nucifera L.                             | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Durio zibethinus Murray                       | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Gliricidia sepium (Jacq.) Walp.               | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Albizia lebbeck (L.) Benth.                   | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Dalbergia latifolia Roxb.                     | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Albizia saman (Jacq.) Merr.                   | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Dysoxylum gaudichaudianum (A.Juss.) Miq        | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Lepisanthes rubiginosa (Roxb.) Leenh.          | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Parkia speciosa Hassk.                        | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Swietenia macrophylla King.                   | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Artocarpus heterophyllus Lam.                 | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Albizia procera (Roxb.) Benth.                | 0.05 | 2.63   | 20.00  | 2.13  | 4.76   |
| Sum                                          | 1.9  | 100.00 | 940.00 | 100   | 200.00 |

Seven years after the eruption of Mount Merapi, the banks of the Gendol river in the Cangkringan Sub-district has undergrowth vegetation consisting of herbs, shrubs, grasses, and seedlings and saplings of trees. The cause of the destruction was high pyroclastic material that emerged from the mountain (Jenkins et al. 2013). The population of saplings was very low. On the other hand, herbs appear to dominate. Herbs are plants that grow quickly, but also die quickly. The presence of saplings, herbs, shrubs, and grasses is an indication that succession is in progress (Vázquez-Yanes and Orozco-Segovia 1982), and the climax level is yet to be reached (Yusuf and Sukardjo 2016). However, the climax condition can be predicted from the present condition. Saplings of species such as F. moluccana and L. leucocephala dominate the undergrowth. This indicates that the seedlings of both of these species were able to live and adapt well. Both are considered as the most suitable and desirable species by the community because they have high economic value. Undergrowth vegetation also plays important role in nutrient cycling. It adds significant amounts of N, Ca, and Mn, and there was more than twice the amount of K in the litter fall under herbs than when these undergrowth layers were absent (Tappeiner and Alm 1975).

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