Autecology of Begonia in Several Locations of Flores Island
(Autokologi Begonia di Beberapa Lokasi di Pulau Flores)

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HASIL PENELITIAN

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ABSTRACT

Human activities in forest areas such as over-harvesting of Begonia species without being balanced with their cultivation activities can threaten the existence of Begonia in nature. Autecological studies of species in their natural habitat are the initial activities for the conservation of plant species. The purpose of this study was to study the distribution of Begonia on Flores and environmental/microclimate characteristics in several locations on Flores Island. The 10x10 m plots were placed with purposive sampling with a minimum interval of 50 m. Multivariate analysis using Canonical Correspondence Analysis (CCA) was employed to determine the effect of microclimatic factors on the composition of vegetation. Begonia kelimutuensis is endemic in Kelimutu National Park, Flores lives at an altitude of 1,527 asl, at soil pH 5.8 and soil moisture of 75%, with a slope of 10° on the forest floor and light intensity 4,640 klux. In addition, five types of Begonia that we estimate have not been identified and two of them are identified as Begonia sambawaensis Girm. and Begonia branqobosangensis Girm. Begonia kelimutuensis is distributed at a higher altitude than Begonia branqobosangensis. B. sambawaensis is influenced by the slope factor while B. longifolia tends to be related to the air humidity factor. B. kelimutuensis is also often found living with Macaranga sp., and Litsea sp. B. branqobosangensis, also found near Homalanthus sp. and Calliandra callothyrsus.

INTISARI

Aktivitas manusia di kawasan hutan seperti pemanenan berlebihan spesies Begonia tanpa diimbangi dengan kegiatan budidaya dapat mengancam keberadaan Begonia di alam. Studi autokologi spesies di habitat aslinya merupakan kegiatan awal untuk konservasi spesies tanaman. Tujuan penelitian ini adalah mempelajari distribusi Begonia di Flores dan karakteristik lingkungan/iklim mikro di beberapa lokasi di Pulau Flores. Plot 10x10 m ditempatkan dengan purposive sampling dengan interval minimum 50 m. Analisis multivariat (DCCA) untuk mengetahui pengaruh faktor mikroklimatik terhadap komposisi vegetasi. Begonia kelimutuensis endemik di Taman Nasional Kelimutu, Flores pada ketinggian 1.527 dpl, pada pH tanah 5.8 dan kelembaban tanah 75%, dengan tingkat kelerengan 10° di lantai hutan dan intensitas cahaya 4.640 klux. Selain itu, ditemukan juga lima jenis Begonia
Introduction

The name Flores comes from the Portuguese language "cabó de flores" which means "Cape of flowers". Flores is included in the cluster of the Lesser Sunda Islands with Bali and NTB, with an area of about 14,300 km². Flores is one of the island in the Eastern parts of Indonesia where Begonia studies are still scantily conducted. However, Flores currently holds one endemic begonia species namely Begonia kelimutuensis. The genus Begonia was first introduced by Charles Plumier (1646-1704) in the 17th century, to commemorate and perpetuate the name Michael Begon (1638-1710), a French Governor in Santo Domingo (Pietsch 2019). Begonia is one of the six largest genera of flowering plants in the world. A total of ± 1,700 species of natural Begonia have been reported (Tebbitt 2005). The number and distribution of the Begonia clan turned out to be very broad, found in the tropics and subtropics in lowland forests and cold mountainous forests. Since the 17th century many types of Begonia have been found in many countries such as Mexico, Central America, South America, Asia and Africa. Begonia’s highest diversity is in Southeast Asia (Hughes 2008). In Indonesia, wild Begonia (Begonia which grow in the wild naturally) is estimated to be in the approximate amount of 213 species (Undaharta et al. 2012). Begonia distribution in Indonesia are in Kalimantan, Sulawesi, Sumatra, Java, Bali, East Nusa Tenggara, West Nusa Tenggara, Maluku and Papua (Hughes 2008).

Several Begonia species is now under threat. Begonia (Begoniaceae) is a ornamental because of the uniqueness of its leaves, both in shape, color and size. Human activities in forest areas such as excessive harvesting of Begonia species without being balanced with adequate cultivation activities can threaten the existence of Begonia in nature. Currently there are 64 species of Begonia are in the IUCN redlist category (IUCN 2018), ranging from least concerned, vulnerable, near-threatened, critically endangered, endangered even extinct (Begonia eiromischa Ridl./Woolly-stalked Begonia).

Understanding the characteristics of each individual plant species is very important to have knowledge related to the habitat of each species. The number of taxonomic studies has greatly increased in Indonesia but when the autecological data of each species of individual is questioned in particular the Begonia autecology, it is very limited in the available literature, especially for eastern islands of Indonesia such as Flores. However, several reports and studies has been conducted in other parts of Indonesia. (Efendi et al. 2017) study the wild begonias preference habitat in the forest remnant of Cibodas Botanical Garden in West Java. Sutarno (2009) reviews autecology and utilization of Begonia in Manokwari Papua. Undaharta and Sutomo (2016) review autecology in three species of Begonia in part Mount Merapi area. Previously, Satyanti and Siregar (2012) conducts ecological studies Begonia in two locations
of forests, nature reserves and forests reforestation to describe the microclimate and habitat preference in several Begonia species in Bedugul Bali found that air humidity has important roles in Begonia. Flores Island is an important constituent of the Lesser Sunda Island. There is not much research regarding the ecology of Begonias in this Island although it has the endemic species (*Begonia kelimutuensis*). Hence, this research objectives is to study the distribution of Begonia in Flores and to understand their environmental/microclimate characteristics which influence their distribution and abundance.

**Method**

This research was conducted in 16-29 April 2018. Due to time constraint, desktop pre-study was conducted previously in order to make prediction of the suitable locations. Begonia is usually found in edge of forest, riverbanks or near waterfall from lowland to highland, but mostly at a median altitude to 1,500’s m above sea level. A habitat suitability index was explored using the apps Biodiversity and Climate Change/BCCVL (BCCVL 2017). Based on this investigation several locations were visited on Flores Island, namely the Manggarai Barat, Tengah, Timur, Bajawa and Ende Regencies in the Komodo National Park, Borong KPH, Ngada KPH and Kelimutu National Park (Figure 1).

Plots of 10 x 10 m were placed by a purposive sampling with a minimum interval of 50 m in the habitat where Begonia is found. In total there were 10 plots of Begonia’s habitat. Topographic and microclimate data collection was then carried out. The location coordinate and elevation or altitude of the place is recorded from GPS (global positioning System), while the land slope is recorded by measuring the clinometer. The soil pH and soil moisture were measured with a soil tester instrument while the data on the intensity of the light intensity, temperature and humidity were carried out by a portable device to measure light intensity, humidity and air temperature named Lutron (Sutomo & Fardilla 2013).

We conducted canonical correspondence analysis (CCA) ordination to see the influence of microclimatic factors on vegetation composition and especially Begonia species. CCA was conducted using CANOCO program V.4.5 (Lepš and ˇSmilauer 2003).
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**Result and Discussion**

*Begonia kelimutuensis* was found at an altitude of 1,527 asl, in 5.8 soil Ph and 75% of soil humidity (Table 1). The soils in the sampling areas are all of young volcanic form so it has the acid of soil Ph. *Begonia kelimutuensis* was found not at a steep slope but rather flat terrain with slopiness level only 10° on the forest floor with light intensity of 4,640 klux. *Begonia kelimutuensis* (Figure 2) is an endemic species from Mt. Kelimutu in Ende District, Flores Island Indonesia. In this study we also found five Begonia which we still can not identified. Begonia identification was done by direct consultation with Begonia experts from Bogor Botanical garden. Two Begonias we estimated to be identified as *Begonia sumbawaensis* Girm. and *Begonia brangbosangensis* Girm. (Table 1). Habitat notes and morphological features of the Begonias also appeared in table 1. Figure 3 give clear information regarding the distribution of the Begonias found in the field survey.

![Figure 2](image2.png)

*Figure 2.* An endemic plant species from Kelimutu East Nusa Tenggara Indonesia: *Begonia kelimutuensis* (“Uta Onga”/local name) at Kelimutu National Park. Photo credit: Sutomo, 2018

![Figure 3](image3.png)

*Figure 3.* Map showing the distribution of the Begonia (Based on our field survey)

*Gambar 2.* Jenis tanaman endemik dari Kelimutu Nusa Tenggara Timur Indonesia: *Begonia kelimutuensis* (“Uta Onga”/nama lokal) di Taman Nasional Kelimutu. Foto oleh: Sutomo, 2018

*Gambar 3.* Peta distribusi Begonia (Berdasarkan survey lapangan kami)
Based on consultation with Begonia expert from Bogor Botanical Garden, there are two unidentified Begonias that were predicted to be *Begonia sumbawaensis* and *Begonia branbosaengensis* (Hartutiningsih, 2018, pers.comm.). *Begonia sumbawaensis* is an endemic species belongs to West Sumbawa, Sumbawa Island West Nusa Tenggara Indonesia. According Girmansyah (2016) this species of Begonia is a terrestrial herb which lives on steep slopes of tropical forest at an altitude of up to 1,300 m asl. Furthermore, Girmansyah (2016) noted that *Begonia sumbawaensis* is a very attractive species with bright red petioles and leaf undersides, and with the inflorescence being longer than the petioles and bearing many flowers. As such the plant has potential for ornamental use. This species is found on steep slopes and hence was very difficult to collect. This is in support to our findings of the habitat where we found the species. Based on our results, the species can also be found in Flores Island, in Faobasa Village, in Bajawa District and indeed it lives on a steep landscape near a waterfall of about 38° of slope level. *Begonia branbosaengensis* is also an endemic species in West Sumbawa, West Nusa Tenggara, Indonesia. *Begonia branbosaengensis* lives terrestrial on forest floor on wet and moist substrates especially it is usually found along stream margins and river banks at an altitude between 1,300–1,700 m altitude (Girmansyah 2016). Our expedition found this species in Rana Mese Lake Nature Reserve in Borong, Manggarai District, in Flores, East Nusa Tenggara. It supports Girmansyah findings of its habitat description.

**Figure 4.** (a) *Begonia* sp.(1); (b) *Begonia* sp. (2); (c) *Begonia* sp. (3) (Probably *Begonia sumbawaensis*); (d) *Begonia* sp. (4); (e) *Begonia* sp. (5); (f) *Begonia* sp. (6); and (g) *Begonia* sp. (7) (Probably *Begonia branbosaengensis*).

**Gambar 4 a.** *Begonia* sp.(1); (b) *Begonia* sp. (2); (c) *Begonia* sp. (3) (Kemungkinan *Begonia sumbawaensis*); (d) *Begonia* sp. (4); (e) *Begonia* sp. (5); (f) *Begonia* sp. (6); and (g) *Begonia* sp. (7) (Kemungkinan *Begonia branbosaengensis*).
This species is found on steep slopes of tropical forest at an altitude of up to 1,300 m. According to Girmansyah (2016), this species is terrestrial and lives on steep slopes near waterfalls. It is also an endemic species in West Nusa Tenggara, Sumbawa, Indonesia, and is also found in Flores Island, in Faobasa Village, in Bajawa District and in Detusoko, Ende, NTT.

Table 1. Habitat and short morphological description of Begonia found at the study sites and are yet to be identified

| No | Species | Location | Notes on morphological and habitat | Image code |
|----|---------|----------|-----------------------------------|------------|
| 1  | Begonia sp. (1) | Saga Village, Detusoko, Ende, NTT | Terrestrial, leaves circular green. Rocky environment. Andesite rocks decay, elevation 788 mdpl, soil pH: 6.2, soil moisture 92%, dark brown ground color, clay texture on the sidelines of rock fracture, land slope 38°. Leaves can be eaten as vegetable. | Figure 4. (a) |
| 2  | Begonia sp. (2) | Saga Village, Detusoko, Ende, NTT | Terrestrial. Leaf circular. Colour under the leaves is red. Growing on the sidelines of a rock fracture or crevic, with a slope of 38°. The surroundings habitat are rocky, weathered andesite rock, elevation 788 mdpl, soil pH: 6.2, soil moisture 92%, dark brown ground color, clay texture. | Figure 4. (b) |
| 3  | Begonia sp. (3) (Probably Begonia sumbawaensis) | Igo Waterfall, FaoBasa Village, Bajawa, District Ngada, NTT | Terrestrial on andesitic rocks, elevation of 782 meters above sea level, soil pH: 5.6, blackish brown color, loose soil texture, slope of 38°. Latitude: 8° 46' 22.750" S, and longitude: 121° 0' 48.589" E
Light green leaves, petioles to young feathered shoots. | Figure 4. (c) |
| 4  | Begonia sp. (4) | Rata Beke, Sokoria Village, NdonaTimur, Ende District, NTT | Young shoots are light green and the leaves are green, elongated serrated. Terrestrial grows around the water runoff area, elevation 1360 mdpl, soil pH: 6.2 | Figure 4. (d) |
| 5  | Begonia sp. (5) | TWA Ranamese Lake, Gololoni Village, Borong, East Manggarai District NTT | Terrestrial, elevation of 1217 masl, soil pH: 6.5, soil moisture 90%, brown soil color, rocky soil texture, slope of land 33°, latitude: 8° 38' 26.696" S, and longitude: 121° 0' 48.589" E
"Large leaves with green leaves, leaves with fur," | Figure 4. (e) |
| 6  | Begonia sp. (6) | Igo Waterfall, FaoBasa Village, Bajawa, District Ngada, NTT | Terrestrial, elevation 778 masl, soil pH: 5.8, ground color blackish brown, loose soil texture, slope of 3°, Latitude: 8° 46' 25.950" S, and longitude: 121° 0' 42.728" E
Light green leaves, short stalks | Figure 4. (f) |
| 7  | Begonia sp. (7) (Probably Begonia brangbosangensis) | TWA Ranamese Lake, Gololoni Village, Borong, East Manggarai District NTT | Terrestrial, elevation of 1217 meters above sea level, soil pH: 5.9, soil moisture 85%, brown soil color, rocky soil texture, slope of 33°, Latitude: 8° 38' 26.509" S, and longitude: 120° 33' 39.236" E | Figure 4. (g) |
One form of early activity for plant species conservation is by conducting an autecological study of the species in its natural habitat. Autecology study takes the specificity of one species and studies its relation to the environment/microclimate in which it lives, both its abiotic and biotic factors (Sutomo & Fardilla 2013). Hence, ecological information, as well as microclimate conditions and habitat characteristics (pH, temperature, and light intensity) is very important to support Begonia conservation. For ex-situ conservation program, it is very useful data as it can be used for its acclimatization program before it can be used as propagation materials and finally planted in a botanic garden (Sutomo & Fardilla 2013).

The analysis of CCA showed that the first axis is capable to explain 85% of the total variations whereas second axis explains 17.3% (Table 2). Begonia kelimituensis and Begonia brangbosangensis are distributed mainly along the elevational gradient. Begonia kelimituensis is distributed at higher altitude than Begonia brangbosangensis. From our analysis, Begonia sumbawaensis appear to be influenced mainly by slope factor whereas Begonia longifolia tends to be related with air humidity factor (i.e. prefer more humid and moist locations). This description of Begonia longifolia habitat in our result matches with what Hughes & Girmansyah report (Hughes & Girmansyah 2011) which states that B. Longifolia commonly found in humid places. In terms of altitude factor, on Mt. Merapi in Central Java, (Undaharta & Sutomo 2016) found that the distribution of Begonia multingula is located closer to the altitude axis and soil moisture compared to the pH axis of the environment. Their analysis also revealed that the altitude axis was more significant in the distribution of Begonia at the study site than the environmental axis of soil moisture. Begonia kelimituensis is also found living together with several other species of plants such as pioneer tree species Macaranga sp., and also Litsea sp. on the altitude axis (Figure 5). Begonia brangbosangensis, was also found near a pioneer tree species Homalanthus sp. and fabaceae family member: Calliandra callothryrsus. This phenomenon might indicates the existence of some degree of forest disturbance which is shown by canopy openness in the field and the growing of pioneer tree species such as Homalanthus and Macaranga. The clearing of tree canopy create gap which would give way to pioneer (fast growing, sun loving or intolerant) tree species. As stated by Satyanti, (Satyanti & Siregar 2012) one of the main threat to species loss (including Begonias) is perhaps conversion of forest and land use change. Gap creation in the forest due to forest clearance and climate change may alter and create uncertainty in the microclimate conditions and may modify groundcover plant germination and therefore change the composition of forest understorey which would impacted the Begonias species as well (Babasa et al. 2004; Brewer 2016). Gap creation increase temperature and decrease soil moisture, this will decrease the number of Begonias as this species need high soil moisture and cool shade.

**Table 2.** Summary table statistic for the graph Figure 1. Method: DCCA with supplementary variables. Total variation was 4.99239, supplementary variables accounted for 76.1%

| Statistic              | Axis 1   | Axis 2  |
|------------------------|----------|---------|
| Eigenvalues            | 0.8580   | 0.7310  |
| Pseudo-canonical correlation | 0.9973   | 0.9902  |

Acknowledgement
Conclusion

Begonias in Flores are distributed on hill to mountain topography at 778 – 1,527 Asl. *Begonia kelimituensis* distributes at a higher elevation than *Begonia brangbosangensis*. The distribution of *Begonia longifolia* is depend on air moisture (humidity). They also grow at sheltered areas. *Begonia kelimituensis* is also found living together with *Macaranga* sp., and also *Litsea* sp. *Begonia brangbosangensis* is also found near *Homalanthus* sp. and *Calliandra callothyrsus*.

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References

BCCVL. 2017. Biodiversity and Climate Change Virtual Laboratory. http://bccvl.org.au/ (accessed July 2018).
Babaasa D, Eilu G, Kasangaki A, Bitariho R, & McNeilage A. 2004. Gap characteristics and regeneration in Bwindi Impenetrable National Park, Uganda. African Journal of Ecology 42(3):217-224.
Brewer JS. 2016. Natural canopy damage and the ecological restoration of fire-indicative groundcover vegetation in an oak-pine forest. Fire Ecology 12(2):105-126.
Efendi M, Azizah N, Supriyatna A, Destri D. 2017. Keragaman jenis dan preferensi ekologi begonia liar di kawasan remnant forest Kebun Raya Cibodas. Berita Biologi 16(3):233-241.
Girmansyah D. 2016. Three new species of Begonia (Begoniaceae) from Sumbawa Island, Indonesia. Garden’s Bulletin Singapore 68(1):77-86.
Hughes M. 2008. An annotated checklist of Southeast Asian Begonia. Edinburgh: Royal Botanic Garden Edinburgh.
Hughes M, Girmansyah, D. 2011. Searching for Sumatran Begonia described by William Jack: following in the footsteps of a 19th century Scottish botanist. Garden’s Bulletin Singapore: 63(1&2):83-96.
IUCN. 2018. The IUCN Red List of threatened species. www.iucnredlist.org, Diakses 17 Juli 2018
Lepš J, Šmilauer P. 2003. Multivariate analysis of ecological data using CANOCO. Cambridge: Cambridge University Press.
Pietsch TW. 2019. Charles Plumier (1646-1704) and his drawings of French and Caribbean fishes: Paris: Publications scientifiques du Museum.
Satyanti A, Siregar HM. 2012. Microclimate preference and habitat of begonia in Bedugul, Bali. Biotropia 19(2):80-91.
Sutarno S. 2009. Autokologi Begonia spp. (Begoniaceae) dan manfaatnya bagi Suku Afrak di Daerah Mokwam Manokwari. Tesis. Bogor: Institut Pertanian Bogor.
Sutomo, Fardilla D. 2013. Autecology of traditional medicine plant of Selaginella doederleinii Hieron in some areas of Mount Pohen Forest Batukahau Nature Reserve Bedugul, Bali. Jurnal Penelitian Hutan dan Konservasi Alam 10(2):353-361.
Tebbit MC. 2005. Begonias: cultivation, identification, and natural history. California: Timber Press.
Undaharta, NKE, Sutomo. 2016. Autokologi Begonia di Sebagian Kawasan Taman Nasional Gunung Merapi. Jurnal Biologi Universitas Udayana 20(1):29-34.
Undaharta NKE, Sutomo, Tirta IG, Ardaka IM. 2012. Autecology begonia di sebagian Kawasan Taman Nasional Manusa Lela Maluku. Jurnal PHKA 9(1):1-11.