Media Konservasi Vol.27 No.2 Desember 2022: 83-90 **ISSN: 0215-1677**
DOI: 10.29244/medkon.27.3.83-90 **E-ISSN: 2502-6313**

EVALUATION ON THE POPULATION OF STRANGLER FIGS (Ficus subgenus Urostigma) IN MOUNT UNGARAN, CENTRAL JAVA

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Accepted December 10, 2021 / Approved September 22, 2022

ABSTRACT

A group of the Ficus genus, the strangler figs (Ficus subgenus, Urostigma), are known as more potential as frugivores feed in Mount Ungaran. While the land clearance of the forest into monoculture plantations threats their existence. This study aims to evaluate strangler figs' condition by the population study, i.e., densities, distribution, and the demography of each strangler fig species. A total of 25 ha area of Gentong Hill (Northwest part of Mount Ungaran) have been surveyed in January-May 2018. We conducted a census and recorded the life stages of the figs within the sampled area. As well as explain the current condition of the host tree used by strangler figs in such area. We recorded 36 individuals belonging to seven species of strangler figs that equal 1.44 individual/ha in the value of density. F. kerkhovenii and the Javan endemic F. involucrata were the commonest species by their densities and abundance. Most of the host trees were found dead and we recorded only 16 individuals of living host trees that included three species, i.e., Syzygium antisepticum (14 individuals), Weinmannia fraxinea (1 individual), and Engelhardtia spicata (1 individual). Most of the strangler figs found were reached in stage 5 of their life demography, while stage 1 was the rarest by only 1 individual found. The distribution of strangler figs showed a tendency for random patterns. Both densities and distribution are reasoned by the availability of the host tree.

Key words: *demography, Ficus, population, strangler fig, Ungaran*

INTRODUCTION

Taxonomically, figs are included in the genus *Ficus*, the family of Moraceae. Figs have a high value of species richness with 735 species. A total of 75 species are represented by the island of Java, some of them are known to be endemic (Yusuf 2011). Fig species exhibit various habits such as hemi-epiphytes, trees, shrubs, or lianas. Nevertheless, members of this genus are easy to be known by their fruit characters. The group of figs has pot flowering known as *syconia*, which is compound interest in fleshy receptacle protection (Poonswad 2012; Rahayuningsih et al. 2020).

Figs have been studied for a long time, especially their potential role as food providers for many animals (Hadi 2012; Lambert & Marshall 1991; Rahayuningsih et al. 2020). Lok et al. (2013) found that as many as 92 species of birds, 12 species of mammals, and 8 species of insects consumed figs in Singapore. In the global scope, figs are consumed by at least 990 bird species and 523 mammal species, not including fish and reptiles (Shanahan & Compton 2001). Figs can provide thousands, and even millions of fruit during their fruiting period (Aryanto et al. 2016; Hadiprakarsa & Kinnaird 2004; Kinnaird & O'Brien 2007). It is not surprising that fig species are known as keystone resources in tropical forest ecosystems due to their ability to provide food (Bamotiwa et al. 2014). As a keystone resource for forest ecosystems, the study of fig species in a specific area is essential (Budiman et al. 2017).

Previous works on *Ficus* have been conducted in mount Ungaran such as the determination of species and how their potential for frugivores, as well as the number of frugivores that use figs as their niche (Febriyanto 2019; Rahayuningsih et al. 2020). Based on these studies, strangler figs, in terms of *Ficus* subgen. *Urostigma*, have more potential abilities as a food provider for wildlife. In contrast, the figs of Ungaran had a threat such as land clearing in such area. Despite being designated as an Important Bird Area and Biodiversity (Birdlife International 2021), some forested areas in Mount Ungaran have been changed (up to 31.5- 40.1%) during the 2000-2005 periods into agricultural and settlement development (Rahayuningsih et al. 2015).

As the next step of our study on figs species, we evaluated the condition of potential figs whereas most of them are strangler figs in the subgenus Urostigma. This study is necessary for understanding the current condition of potential figs that occurred in Mount Ungaran. The evaluation is referred to determination of ecological aspects at the population level such as densities of each species, distribution, and demography. As well as explain the current condition of host tree used by strangler figs in such area studied.

RESEARCH METHOD

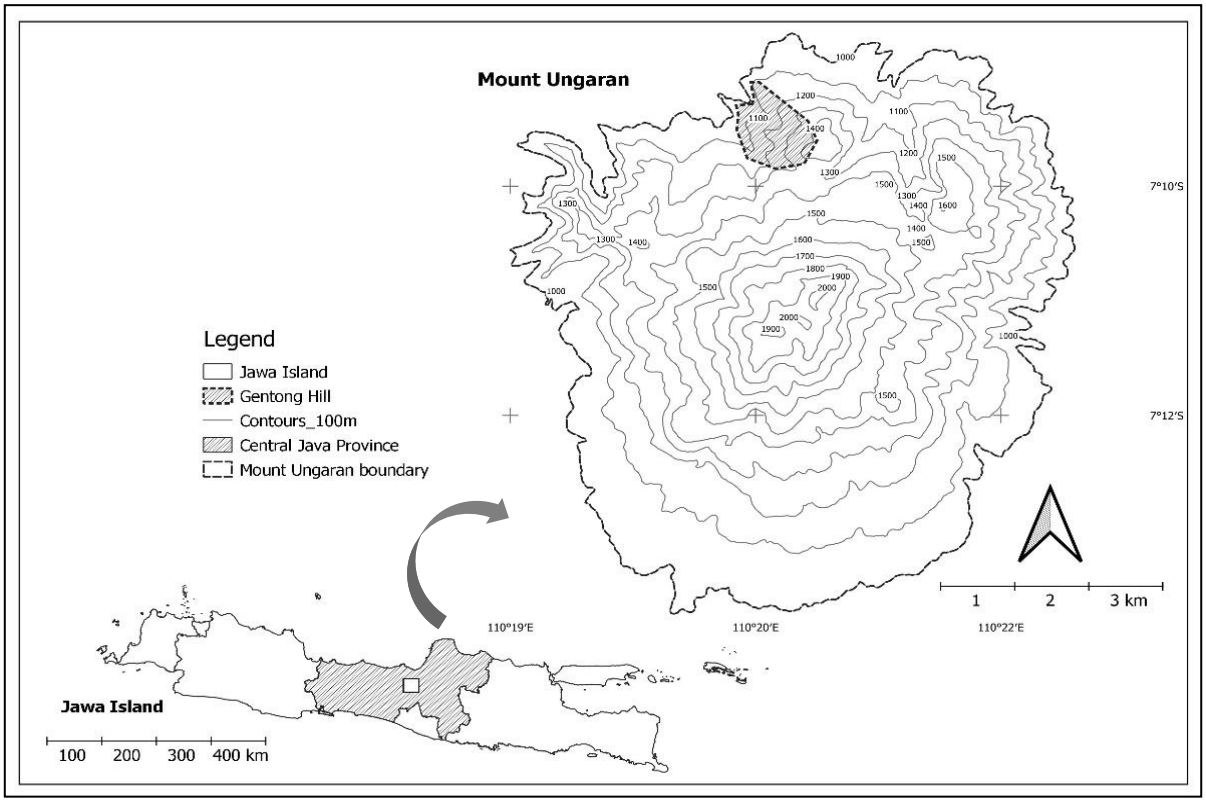
Mount Ungaran (S 7°12' E 110°20') one of the remaining forest areas in Java island which is managed by Perhutani. Mount Ungaran has a total of 5500 ha which is covered by two regencies, i.e., Kendal and Semarang, province of Central Java, Indonesia. Mount Ungaran has range of altitude between 900-2050 m asl with several habitat type, i.e., primary dry forest, secondary dry forest with coffe plantation under the canopy. This study only covered Gentong Hill, in northwest of Ungaran forest. This area belongs to Ngesrep Balong village, Limbangan District, Kendal Regency (Figure 1).

The area is included as sub-montane forest with ranges of altitudes between 900-1500 m asl., represent the secondary forest with domination of *Syzygium antisepticum*, *Weinmannia fraxinea* and some of Lauraceae and Euphorbiaceae families (Kurniawan et al. 2021). Under the canopy of the area is commonly used by localities as coffee plantation (Figure 2b). The data were collected during rainy season in January-May 2018.

We used term hemi-epiphytic or strangler figs as referred to *Ficus* subgen. *Urostigma.* A total of 25 ha area of Gentong Hill was sampled using transect method. We used 3 pathways as transects observation with a total of 5 km length and 50 m wide. Census of strangler figs species within the transect were conducted. Each individual was tagged with GPS, and collected as dry herbarium specimen without any time dependent observation. The collection of the herbarium was conducted for identification at the Laboratory of Plant Morphology and Taxonomy, Department of Biology, Universitas Negeri Semarang.

Identification of strangler figs and the host tree were carried out according to Berg & Corner (2005), Desitarani et al. (2014), and GBIF online data (GBIF 2021). The accepted name of both figs and host trees in accordance to World Checklist Selected Plant Species and Families online data (WCSP 2021). While, the density of each species was determined according to (Barbour et al. 1987), where the value of individual found were divided by sampled area.

For demography data, we checked several life stages of strangler figs according to Hao et al. (2016) to which categorized the life of strangler figs as 4 main stages and we modified it into 5 stages as follow: 1. Germination stage, as our modification to sign the first step of figs life; 2. The epiphytic growth phase, with elongated main root reaches the ground; 3. Terrestrial growth stage, showing multiple "pseudo-stems"; 4. Fig strangling a tree, showed the remaining of dead host tree; and 5. A free-standing stage, showed by tangled architecture of aerial roots defining the space occupied by a host tree that has been strangled and decomposed.



. Figure 1. Map showed the position of Gentong Hill on Mount Ungaran, Central Java Province.

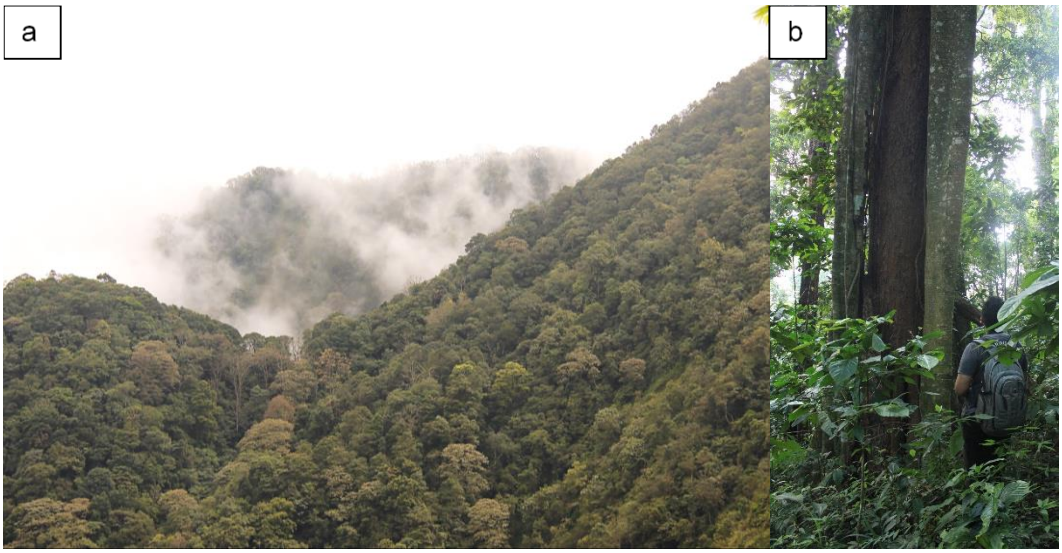


Figure 2. Research area at Gentong Hill, Mount Ungaran: a. vegetation characteristic, b. Figs strangles the host among coffee plantation.

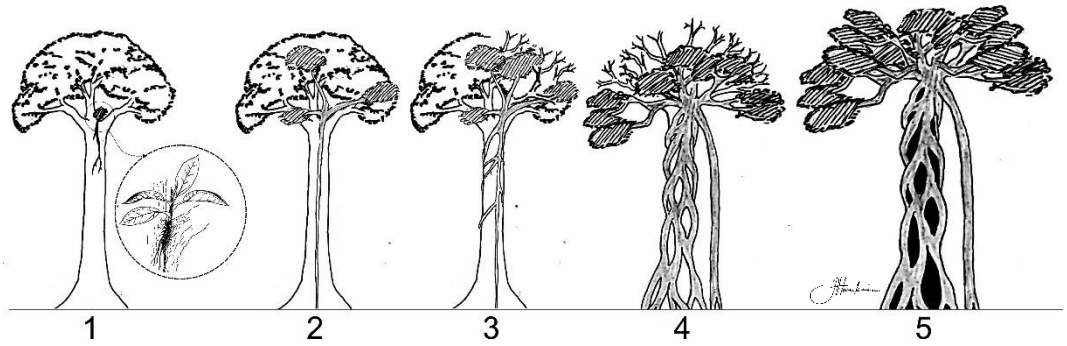


Figure 3. the Strangler fig (shaded picture) life stages: 1. Germination, 2. The epiphytic growth phase, 3. multiple "pseudo-stems" formed by fused aerial roots, 4. Fig strangling a tree, dead host tree, 5. Free standing, host tree decomposed. (Drawn by Firman H. Kurniawan).

The distribution was analyzed according to Tohir & Siregar (2021) by overlaying the coordinates from tagged each individual strangler figs into the study area map. The visualization was conducted using QGIS Desktop 3.16.16 as simple map that support the development of Essential Ecosystem Area in Mount Ungaran. All data were descriptively discussed based on the findings in this study and compared with other area in such topics of study.

RESULT AND DISCUSSION

1. Composition and Densities

This study found 36 individuals belonging to seven species of strangler figs in the sampled area. Based on the number of individuals, the value of strangler figs densities was equal to 1.44 individual/ha. F. kerkhovenii and F. involucrata were the most common based on their number of individuals and species density (Table 1).

Gentong Hill represented 25% out of all identified *Ficus* subgen. *Urostigma* in Java Island (28 species). According to WCSP (2021) and Yusuf (2011), one of our founding, *F. involucrata* is Javan endemic species. Surprisingly, *F. involucrata* had the most abundant species with 17 individuals, followed by *F. kerkhovenii* with 13 individuals. It indicated indicated that Gentong Hill had potential as suitable habitat to supports both species.

In addition, *F. kerkhovenii* and *F. involucrata,* both have medium sized syconia (1.5-2 cm) with orange and red color growing axillary on the branches (Figure 4). These characters become the preferences of various types of frugivores with various body sizes, both large and small (Tan et al. 2014). Apart from being the beneficiary of getting food, frugivores also provide services for their forage trees as seed dispersers (Lomáscolo et al. 2008). The more seed dispersal agents, of course, their presence will increasingly exist in the ecosystem where they live (Machado et al. 2018).

2. Host tree

Out of 36, only 16 individuals occurred the host tree. The identity of host tree included as 3 species, i.e., *Syzygium antisepticum* (Myrtaceae), *Weinmannia fraxinea,* and *Engelhardtia spicata.* The *Syzygium antisepticum* had the highest number that was used by strangler figs as host tree. While *Weinmannia fraxinea* and *Engelhardtia spicata* was used by only a single individual in each. Most of the individual found in this study were observed as standing tree.

Some of the strangler fig hosts tree were observed to be dead and identification was not possible. The dead host is caused by losing in competition with the strangling fig that rides it in the struggle for sunlight and for nutrients (Yulia et al. 2011). Strangler figs have a large crown character and will usually dominate the host canopy. The same thing happened to the roots, strangling figs are able to produce hanging roots in extraordinary numbers and of course will reduce the supply of nutrients for the host tree. Over time the host will die because of some of these things. After that the host will rot and become a nutrient supply for the strangler fig which of course accelerates its growth (Harrison et al. 2003).

Table 1. NumberNumber of individuals and densities of each *Ficus* species found in Gentong Hill Mount Ungaran

No	Species name	Number individuals	Species Density (individual/ha)
1	*Ficus benjamina* L.	2	0.08
2	*Ficus caulocarpa* (Miq.) Miq.	1	0.04
3	*Ficus drupacea* Thun.	1	0.04
4	*Ficus involucrata* Blume	17	0.68
5	*Ficus kerkhovenii* Koord. & Valeton	13	0.52
6	*Ficus microcarpa* L.f.	1	0.04
7	*Ficus virens* Aiton	1	0.04
Total		**36**	**1.44**
Average			**0.21**

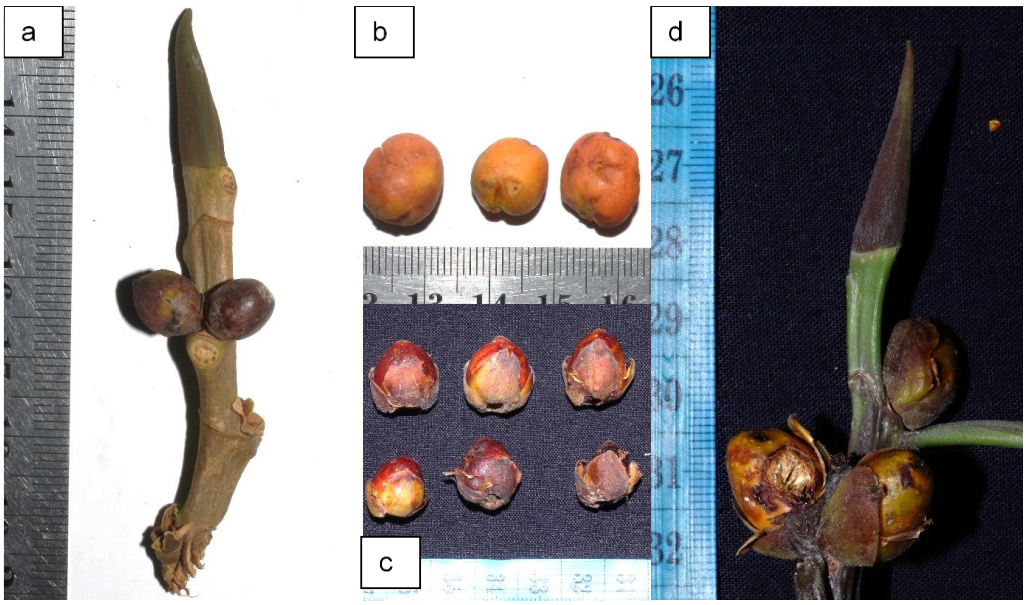


Figure 4. a-b. *Ficus kerkhovenii*: a. Fruit position on leafy twigs, b. syconia. c-d. *Ficus involucrata*: c. syconia, d. fruit position on leafy twigs (Photo by Bayu Dwi Hadmoko).

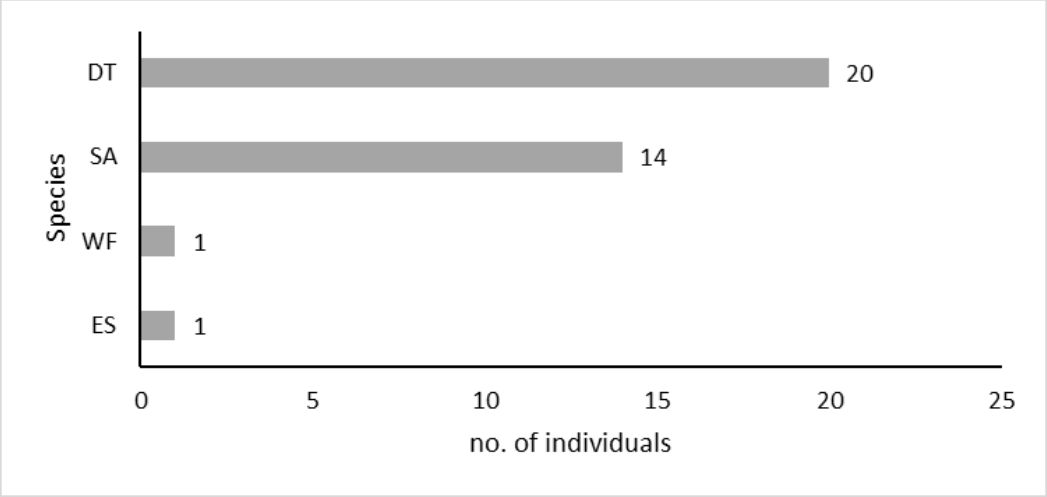


Figure 5. NumberNumber of individual each host tree species that is used by strangler figs at Gentong Hill, Mount Ungaran: DT=Dead host tree, unidentified; SA=*Syzygium antisepticum*; WF=*Weinmannia fraxinea*; ES=*Engelhardtia spicata.*

It should be underlined that host tree plays an important role for strangler figs. Most of this kind of figs begin their early life phase from the host tree. At stage 1 to stage 3 of their life cycle, the development is highly dependent on the availability of the host tree to support it standing. If this host tree falls, the strangler fig with it will also fall and die (Poonswad 2012). In general, strangler figs choose the Dipterocarpaceae family as their host tree as found in Borneo and Thailand (Laman 1996; Poonswad 2012). However, this study found 3 host tree species, none of which were from the Dipterocarpaceae family. This is due to Mount Ungaran is known to only have a single species from the Dipterocarpaceae family, namely *Dipterocarpus hasseltii* whose existence is quite rare, and even has never been recorded in Gentong Hill.

Instead of Dipterocarpaceae family, *Syzygium antisepticum* (Family Myrtaceae) was the most widely used by strangler fig as a host in this study. This species has a fairly large stature with up to ±1.75 m of diameter, ±30 m of heightheight, and has a fissured stem surface type (Rahayuningsih et al. 2017). The cracks in the bark allow for the accumulation of humus and the fig seeds that are spread by frugivores and fall into these cracks are possible to survive. These were the reason why *Syzygium antisepticum* used by strangler fig as a substitute host for the absence of the Dipterocarpaceae family in the area studied.

3. Distribution

Based on the distribution map, the strangler figs in the studied tend to be randomly distributed (Figure 6).This isis contrast to the general opinion that the distribution of plants will tend to clumped (Beckman et al. 2012). The normal plant distribution pattern is due to the micro-environmental conditions around the parent tree which are suitable for seedlings germination (Musciano et al. 2018). While, the strangler figs have an additional of special conditions such as availability of the hosts tree, have more influence on their distribution in nature as well as for natural epiphytic plant species. Research from Rahayuningsih & Kartijono (2013) showed that the availability of *Syzygium antisepticum* in Gentong Hills was quite abundant with high density. This could be the reason why the distribution of strangler figs in the area tends to be random.

Based on the elevation, the strangler figs have been recorded from altitude 1000–1400 m asl. The highest number of individuals was found at an altitude of 1100 – 1200 m asl (15 individuals), followed by 1200 – 1300 m asl (14 individuals), and 1300 – 1400 m asl being the least (5 individuals). Based on the species richness, the altitude of 1000 - 1100 m asl became the most abundant with five species. Plants will experience a reduction in species along with the increase in elevation of a location (Steenis 2006). Changes in environmental conditions i.e., the decrease of temperature and the increase of air pressure in the higher elevation can only be tolerated by certain plant species. Generally, *Ficus* species have a tendency to live in areas with elevation of less than 1500 m asl, and few can survive above that altitude (Berg & Corner 2005).

4. Demography

Most of strangler figs found in this study was observed as stage 5 with 18 individuals recorded. While the stage 1 was the rarest with only one individual represented by *F. kerkhovenii* (Figure 7). As common figs in the study area, *F. involucrata* and *F. kerkhovenii* showed more than three stages out of five stages known. While the other species were showed only one stage in its demography life stages.

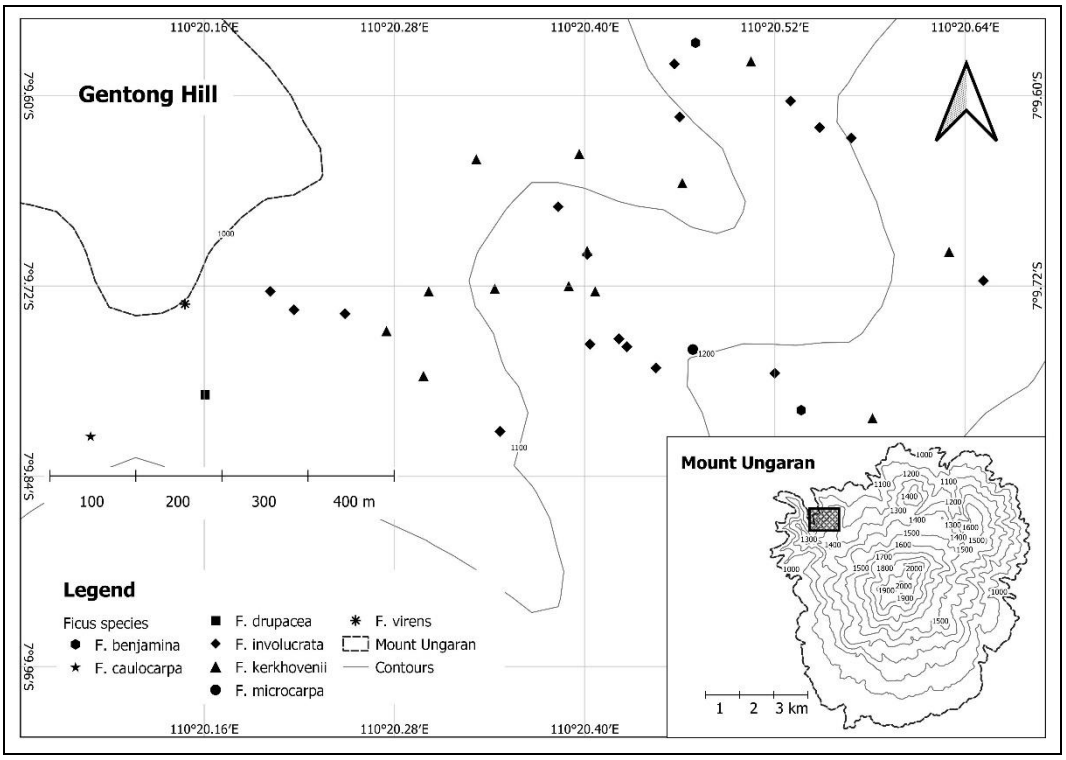


Figure 6. The distribution map of strangler figs found in Gentong Hill, Mount Ungaran.

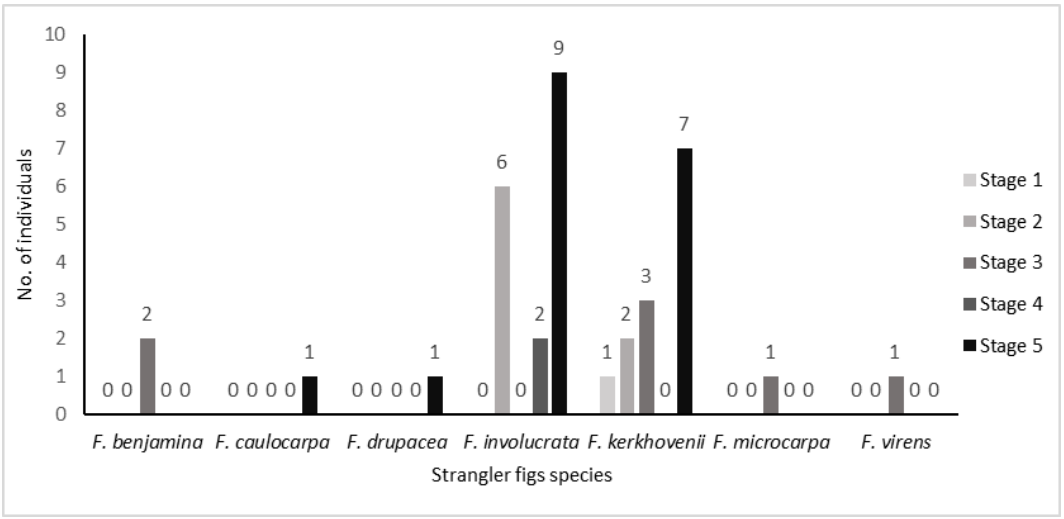


Figure 7. NumberNumber of individual strangler figs in each stage of life found in this study.

A normal plant demography must be shown by J-shape curve, with the more abundant of the earlier stages (Barbour et al. 1987). While our founding showed a random pattern. The demographic pattern that we found illustrates that the regeneration of the strangler fig in Gentong Hill is less than optimal. This is not due to the lack of host trees in the study area, it has been explained that the availability of strangler fig host trees in the study area is quite abundant. Poor regeneration is possible due to the very low success rate of natural germination. It waswas feared that the strangling fig at the study site will disappear in the future. Planting or propagation activities in the area can be used as recommendation for maintenance it. Given that the strangler fig is an important source of food for various animals in Gentong Hill, it is very important to take care of its existence

CONCLUSION

This studystudy of strangler fig study on the population level in Mount Ungaran. As a data base for management area, this study supports the increase of Mount Ungaran into Ecosystem Essential Area that the process is being conducted. We found 36 individual belongs to seven species of potential strangler figs for frugivores feed that equal with 1.44 individual/ha in the value of density. The common species was *F. kerkhovenii* and the Javan endemic *F. involucrata* that the densities and abundance showed the highest value. Out of 36 individuals, there were only 16 species showed their host tree. The host tree that was used by strangler figs included in three species namely *Syzygium antisepticum*, *Weinmannia fraxinea*, and *Engelhardtia spicata*. Most of the strangler figs found was reached in stage 5 of their life demography where in these stages, the host tree could not be observed. While the stage 1 was the rarest that occurred by only 1 individual found. The distribution showed a tendency of random pattern. Both of densities and distribution is reasoned by the availability of host tree.

ACKNOWLEDGMENTS

We would like to thank Indonesia Power for giving the financial support in this study, PT Perhutani for giving the research permission in their area, and Suparmin family for providing lodging. We would also like to thank Mensen van Ecologie, the ecology research team of Biology Department Unnes, especially Solichin, Mahendra Noor Febriyanto, Rini Anjarwati, and Muhammad Kurnia Ramadhan who helped in the data collection, preparation of herbarium and identification process. Bayu Dwi Hadmoko and Ifan Syahputra for their assistance in each part of the research and beautiful picture of *F. kerkhovenii* and *F. involucrata*.

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