Distribution and association of *Ficus* spp in the shrubs area of Gunung Ciremai National Park Indonesia

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Yayan Hendrayana, Toto Supartono, Ilham Adhya, Agus Yadi Ismail, Dede Kosasih

Faculty of Forestry Universitas Kuningan, Indonesia

*yayan.hendrayana@uniku.ac.id

Abstract. The existence of Ficus spp in shrubs areas which is a type of pioneer tree is not widely known so this research aims to obtain information on the distribution and association of Ficus spp. in the shrubs area of Gunung Ciremai National Park. Collecting data using purposive sampling method which then made sample plots with an area of 0.04 hectares each of 73 plots. The results of this study were there were 10 types of Ficus spp, including Ficus hispida, Ficus fistulosa, Ficus variegate, Ficus padana, Ficus septica, Ficus ribes, Ficus calophylla, Ficus benjamina, Ficus ampelas, and Ficus sp. They are spread from an altitude of 726 - 912 m asl. The most individuals found were Ficus hispida (77 individuals) and Ficus fistulosa (67 individuals). Of the 45 pairs there are 10 pairs that are significantly different or associated, 2 are positively associated and 8 pairs are negatively associated. This information is very important for area rehabilitation activities, especially in shrubs areas

1. Introduction

Gunung Ciremai National Park (TNGC) is one of the nature conservation areas in West Java Province. TNGC was designated as a national park based on the Decree of the Minister of Forestry No. 424 / Menhut-II / 2004 at 19 October 2004 concerning the change in the function of protected forest groups in the Gunung Ciremai forest group covering an area of ± 15,500 ha located in Kuningan and Majalengka Districts, West Java Province to become a National Park [1]. In the period 2008-2016 [2] in the TNGC area there were changes in land cover, especially in open land and shrubs of 1,907.91 hectares. Ficus spp. including one group of plants that have high species diversity and are generally found in lowland ecosystem types. Reported the number of Ficus species worldwide reaches 750 species [3]. Ficus spp. live in a variety of habitat types ranging from rainforests, under canopies, savanna, along streams and on steep cliffs [4].

The species of Ficus that are scattered in every island in Indonesia are generally known as pioneer species and grow fast [5]. Furthermore, Ficus spp has ecological functions, among others, is to maintain water systems and strengthen slopes naturally because of its root structure which is able to bind the soil well, then through the lush canopy of Ficus spp. has a high ability to absorb CO2 and other pollutant gases in the air [6] and to store carbon stocks [7]. Various types of plants found in a community will interact with other existing plants and their environment [8]. Association is a type of community that is usually characterized by having a relatively consistent fluorostic composition, having similar physiognomy despite different niches and distribution of organisms [9]. The

interactions that occur can be in the form of interactions between individuals of the same species, it can also be interactions between individuals of different species. The association of two interacting plant species can be positive or negative, where a positive value indicates a mutualistic or mutually beneficial relationship, while a negative value is the opposite [8]. Therefore, it is necessary to study the vegetation in this area. This study aims to gather information about the existence and association of Ficus spp in the bush area of Gunung Ciremai National Park.

2. Methodology

In this study, the tools used were: compass, measuring tape, altimeter, plastic mine, camera, stationery, tally sheet, ring finder, and GPS (Global Positioning Systems), while the materials used were a working map (Landsat Image Map, Map Thematic, alcohol, and other materials The sampling design used was purposive sampling method, namely sampling based on certain considerations such as population characteristics or previously known characteristics. to find out what other types of ficus are present. Association analysis was based on the presence and absence of Ficus species in a subsequent sampling plot using a 2x2 Contingency Table [10]. The 2x2 Contingency table form is for the following 2 types:

		Species B		
		presence	absence	total number
Species A	presence	a	b	a + b
	absence	c	d	c + d
	total number	a + c	b + d	N= a + b + c + d

Information:
a = Observation of the number of measurement points contained in species A and species B,
b = Observation of the number of measurement points that contain species A only,
c = Observation of the number of measurement points that contain species B only,
d = Observation of the number of measurement points where species A and species B are absent,
N = Number of observation points

To determine whether there is a tendency to associate or not, a Chi-square Test is used with the following formulations:

$$Chi\text{-}square\ count = \frac{N\,(ad-bc)^2}{(a+b)\,(a+c)\,(c+d)\,(b+d)}$$

The calculated Chi-square value is then compared with the Chi-square table value at degrees of freedom = 1, at the test level of 5% (value 1.678). If the calculated Chi-square value> the Chi-square table value, then the association is real. If the calculated Chi-square value <the Chi-square table value, then the association is not significant (Ludwig and Reynold, 1988). Furthermore, to find out the level or strength of the association the following formula is used:

$$E\,(a) = \frac{(a+b)\,(a+c)}{N}$$

The notation used contains the same meaning as the previous formulation. Based on this formula, there are 2 types of association, namely: (1) positive association, if the value a> E (a) means that type pairs occur together more often than expected (2) negative association, if the value a <E (a) means Species pairs occur less frequently than expected. The results of calculating the association of Ficus species are presented in the form of a matrix diagram.

3. Result and Discussion

The shrubs area of Gunung Ciremai National Park, which is the location of the study, is at an altitude below 1,000 m asl, meaning that this area is included in the lowland forest type. Tropical rain forests are divided into three zones; zone I, lower rain forest with an altitude of 2 - 1,000 m asl., zone II, central rain forest with an altitude of 1,000 - 3,000 m asl, and zone III, upper rain forest with a height

above 3,000 m asl [11]. The types of Ficus spp found in the bush area are spread from an altitude of 726-800 m above sea level there are 7 species and 71 individuals, an altitude of 801-900 m asl there are 7 species and 95 individuals and at an altitude of 912 m asl were found 3 types and 5 individuals so that the whole There are 10 types, namely: Ficus hispida, Ficus fistulosa, Ficus variegata, Ficus padana, Ficus septica, Ficus ribes, Ficus calophylla, Ficus benjamina, Ficus ampelas, and Ficus sp. Several ficuses that have a wide distribution include F. variegata, F.racemosa, F. microcarpa, F. hispida, F.septica, F.subulata, F.tinctoria, F.caulocarpa, F.virens, and F. benjamina. It can be concluded that the Ficus species are able to adapt to various environmental variations, especially areas experiencing disturbances and the distribution of the genus is very wide [12].

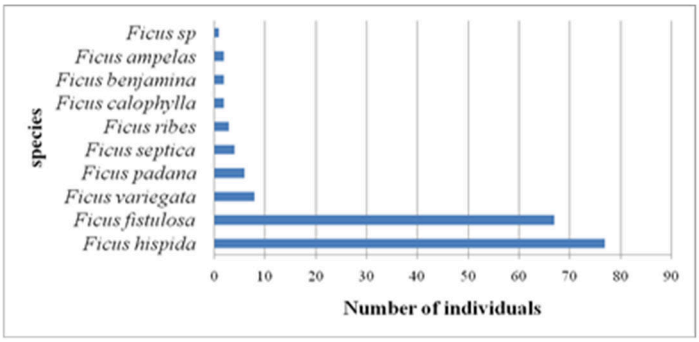

Figure 1. Number of species and number of individuals of Ficus spp

Ficus hispida and Ficus fistulosa were the most common species with 77 and 67 individuals, respectively. However, based on the results of the map study, it can be seen that the distribution of each of these species is uneven. The type of Ficus spp that was least found was the type of Ficus sp. that is, only 1 individual was found. Following are the characteristics of Ficus spp found in bush areas:

Ficus hispida has the characteristics of a tree habitus up to 15 meters high, branched brown trunk, white gummy, leaf shape resembling a heart, tapered tip, and hairy. Has a type of branching opposite to the top and bottom surface has a coarse white or brown fur, the fruit is clustered about 10-20 pieces in a bunch. Ficus fistulosa has the characteristics of tree up to 20 meters high, branched gray-brown trunk, white gummy, leaves, egg-shaped to oval or elliptical to lanceolate. the location of the leaves on the stem, alternating or sitting opposite, the fruit grows on the stems in clumps of light green when ripe and white spots. The research results of Ismail [13] for the category of Ficus fistulosa pole is the dominant type with an Important Value Index (IVI) of 33.5%. Meanwhile, types of Ficus fistulosa and Ficus ribes which are a modification of secondary forest [14].

Ficus variegata has the characteristics of tree berabitus which can reach a height of 40 meters, a grayish brown trunk, ovatus or ovalis-ellipticus, acuminatus, rotundatus, flat edge (integer) slightly wavy, smooth (laevis), dark green on the upper surface and paler on the lower surface. Fruit round, bare surface, yellowish green or red when ripe. In addition to conservation, this species can also play an important role in land rehabilitation because it is a pioneer group and is easily found in natural forest after fire [15]. Ficus padana with shrubs, up to 6-15 m high, with a broad crown, up to 30 cm in diameter. White gummy, scattered leaves; stem up to 18 cm long; egg circular to round the egg is upside down, the base is in the shape of a heart, the edges of the leaf sheet are flat or divided by 5-7 fingers, have shallow serrated teeth, the underside is covered with fine wool hairs of white or yellowish color. Inflorescences in the form of a pot (fig) in the armpit, rounded, up to 4-5 cm in diameter, red and black when ripe.

Ficus septica has the characteristics of trees up to 10 meters high, single leaf, alternating, protruding, rounded base, pointed tip, dark green upper surface, light green bottom surface, flat round fruit, ribbed lengthwise on its surface.

Ficus ribes is characterized by tree hides, up to 10 meters high, single leaf, spiral, lanceolate, not the same base, flat edge, dark green upper surface, yellowish green bottom surface, small rounded fruit.

Ficus calophylla has the characteristics of tree trunk with a grayish brown color, single leaf, broad leaf shape in the middle (obovate), pinnate leaves.

Ficus benjamina is characterized by tree habitus, tipping roots. Stems erect, round, rough surface, blackish brown, sympodial branching, on the stem out of aerial roots. Single leaf, short stem, crossed opposite, oval shape, flat edge, pointed tip, blunt base, single flower, coming out of the axilla, funnel shape petals, round crown, smooth, greenish yellow. Buni fruit, round, long, 0.5-1 cm, still young green, after dark red. Round seeds, hard, white. Ficus ampelas and pointed tip, jagged edges, dark green upper surface, light green under surface, solitary round fruit or paired under the axillary leaves or twigs. Ficus sp is characterized by tree habitus, up to 15 meters high, single leaf, circular, wide at the tip, not small in the axillary.

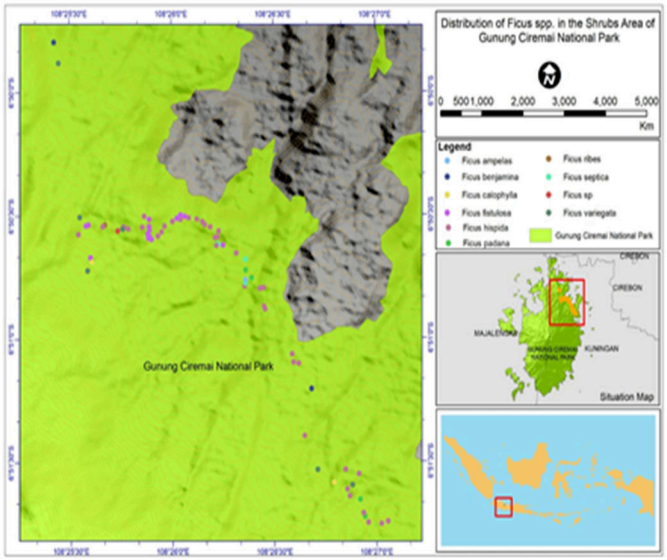

Figure 2. Pam of Distribution Ficus spp

The abundance of Ficus hispida and Ficus fistulosa species in the area is an indication that these species can survive in ecologically unsupportive conditions, so that these species can function as restoration plants in shrubs areas. Besides that, several types of Ficus spp (Ficus fistulosa, Ficus septica, Ficus ampelas Ficus variegata) are medicinal plants found in the Pasirbatang Rehabilitation Zone of TNGC [17].

3.1 Association of Ficus spp

The calculation result (Table 2) shows that 45 pairs of Ficus spp. which is associated and there are 35 pairs that are not significantly different (not associated) because the calculated Chi-square value is smaller than the Chi-square table, while 10 pairs show significantly different results (associated) meaning that the calculated Chi-square value is greater than Chi-square table. Of the 10 pairs are F. hispida with F. variegata (3,042), F. hispida with F. padana (2,555), F. hispida with F. benjamina (2,510), F. hispida with Ficus sp (2,510), F. fistulosa with F. padana (3,150), F. fistulosa with F. septica (2,483), F. fistulosa with F. ribes (3,503), F. variegata with F. ribes (19,388), F. padana with F. ampelas (6,001) and F. ribes with F. calophylla (17,236). This result is quite different from previous research conducted in Gunung Tilu, Kuningan Regency [16], from 12 types of Ficus spp which were found there were 55 pairs that were not significantly different and 11 pairs were different (associated) with 7 pairs positively associated and 4 pairs negatively associated.

Table 1. Associations of Ficus spp in shrubs areas

Association	X^2t (5%)	X^2t	Association type	E(a)
F. *hispida* with F. fistulosa	1,678	1.430^{ns}	td	7.767
F. *hispida* with F. *variegata*	1,678	3.042*	-	2.014
F. *hispida* with F. *padana*	1,678	2.555*	-	1.438
F. *hispida* with F. *septica*	1,678	0.931^{ns}	td	1.151
F. *hispida* with F. *ribes*	1,678	0.724^{ns}	td	0.521
F. *hispida* with F. *calophylla*	1,678	0.528^{ns}	td	0.548
F. *hispida* with F. *benjamina*	1,678	2.511*	+	0.288
F. *hispida* with F. *ampelas*	1,678	0.452^{ns}	td	0.575
F. *hispida* with *Ficus* sp	1,678	2.511*	+	0.288
F. *fistulosa* with F. *variegata*	1,678	1.350^{ns}	td	4.411
F. *fistulosa* with F. *padana*	1,678	3.151*	-	3.151
F. *fistulosa* with F. *septica*	1,678	2.484*	-	2.521
F. *fistulosa* with F. *ribes*	1,678	3.503*	-	1.260
F. *fistulosa* with F. *calophylla*	1,678	-	td	-
F. *fistulosa* with F. *benjamina*	1,678	0.561^{ns}	td	0.644
F. *fistulosa* with F. *ampelas*	1,678	0.186^{ns}	td	1.288
F. *fistulosa* with *Ficus* sp	1,678	0.561^{ns}	td	0.644
F. *variegata* with F. *padana*	1,678	0.522	td	4.726
F. *variegata* with F. *septica*	1,678	0.449	td	3.616
F. *variegata* with F. *ribes*	1,678	19.388*	-	1.808
F. *variegata* with F. *calophylla*	1,678	1.580^{ns}	td	3.671
F. *variegata* with F. *benjamina*	1,678	0.091^{ns}	td	0.918
F. *variegata* with F. *ampelas*	1,678	0.218^{ns}	td	1.808
F. *variegata* with *Ficus* sp	1,678	0.108^{ns}	td	0.904
F. *padana* with F. *septica*	1,678	0.311^{ns}	td	3.726
F. *padana* with F. *ribes*	1,678	0.151^{ns}	td	1.863
F. *padana* with F. *calophylla*	1,678	0.151^{ns}	td	1.863
F. *padana* with F. *benjamina*	1,678	0.075^{ns}	td	0.932
F. *padana* with F. *ampelas*	1,678	6.001*	-	1.863
F. *padana* with *Ficus* sp	1,678	0.075^{ns}	td	0.932
F. *septica* with F. *ribes*	1,678	0.119^{ns}	td	1.890
F. *septica* with F. *calophylla*	1,678	0.119^{ns}	td	1.890
F. *septica* with F. *benjamina*	1,678	0.059^{ns}	td	0.945
F. *septica* with F. *ampelas*	1,678	0.119^{ns}	td	1.890
F. *septica* with *Ficus* sp	1,678	0.059^{ns}	td	0.945
F. *ribes* with F. *calophylla*	1,678	17.236*	-	1.945
F. *ribes* with F. *benjamina*	1,678	0.029^{ns}	td	0.973
F. *ribes* with F. *ampelas*	1,678	0.058^{ns}	td	1.945
F. *ribes* with *Ficus* sp	1,678	0.029^{ns}	td	0.973
F. *calophylla* with F. *benjamina*	1,678	0.029^{ns}	td	0.973
F. *calophylla* with F. *ampelas*	1,678	0.058^{ns}	td	1.945
F. *calophylla* with *Ficus* sp	1,678	0.029^{ns}	td	0.973
F. *benjamina* with F. *ampelas*	1,678	0.029^{ns}	td	1.973
F. *benjamina* with *Ficus* sp	1,678	0.014^{ns}	td	0.986
F. *ampelas* with *Ficus* sp	1,678	0.029^{ns}	td	0.973

Information:
+: positive association, -: negative association, *: Significantly different at the 5% test level,
td: Not calculated, ns: Not significantly different

The results of the calculation of all species pairs can be found in the following facts: (1) The dominant pair is not necessarily associated or even said to be not significantly different, such as the F.

hispida and F. fistulosa pairs (1,430). (2) Couples with dominant and non-dominant species can have a positive association such as pairs of F. hispida with F. benjamina and pairs of F. hispida with Ficus sp. Thus the result of the calculation of the association index certainly strengthens the conclusion from the calculation of the Contingency table, that in general species show tolerance not to live together in the same area, or there is no mutually beneficial relationship, especially in the distribution of living space. Apart from the influence of the interaction on a community, each growth gives each other a place to live in the same area and habitat. Integrity in a community is a well-established phenomenon, the existence of mutual tolerance, resulting in a degree of cohesiveness [18].

This phenomenon is a characteristic of vegetation that is commonly found in a community when environmental conditions are relatively homogeneous [10]. Thus, based on the resulting interactions, this supports the view of the continuum (the individualistic concept of plants), meaning that the community is not bigger than the total share, because the evidence for the interaction presented is not strong enough to say that the community is an integrated unit. The level of interaction and interdependence between constituent species is low or nonspecific [9].

4. Conclusion

Distribution of Ficus spp. 10 species found in the TNGC shrubs area starting at an altitude of 726 - 800 m asl, 10 species were found, namely: Ficus hispida, Ficus fistulosa, Ficus variegata, Ficus padana, Ficus septica, Ficus ribes, Ficus calophylla, Ficus benjamina, Ficus ampelas, and Ficus sp. The most individuals found were Ficus hispida (77 individuals) and Ficus fistulosa (67 individuals). There are 45 pairs of associations but only 10 pairs are significantly different or associated, 2 are positively associated and 8 pairs are negatively associated.

References

[1] [Kementerian Kehutanan] Menteri Kehutanan. 2004. Keputusan Menteri Kehutanan Nomor 424/Menhut-II/2004 tentang Perubahan Fungsi Kelompok Hutan Lindung pada Kelompok Hutan Gunung Ciremai Seluas ± 15.500 Hektar yang Terletak di Kabupaten Kuningan dan Majalengka, Propinsi Jawa Barat Menjadi Taman Nasional

[2] Darmawan A.R, Puspaningsih N, Saleh MB, 2018, Kajian Perubahan Tutupan Lahan Dengan Menggunakan Metode Multi Layer Perceptron Dan Logistic Regression Di Taman Nasional Gunung Ciremai. Media Konservasi Vol. 22 No. 3 252-261

[3] Berg CC, 1989. Classification and Distribution of Ficus. Experientia 45: 605–611

[4] Burrows, J. and Burrows, S. 2003. Figs of Southern and South-Central Africa Umdaus Press, Hatfield.

[5] Nycvist N, 1996. Regrowth of Secondary Vegetation after The 'Borneo fire' of 1982–1983. Jour.Trop.Ecol. 12: 307–312.

[6] Ulum, S, 2009, Manfaat Beringin Putih Dalam Pembangunan Kawasan Hutan,Kabar Indonesia, Jakarta.

[7] Hendrayana, Y, Adhya I, Ismail, AY, 2018. Diversity and Carbon Stocks of Genus Ficus In Gunung Tilu Kuningan District, West Java Province, Indonesia. Journal of Forestry and Environment 01 (2018) 25 – 29.

[8] Ferianita, 2007 Metode sampling Bioekologi. Bumi Aksara. Jakarta

[9] Barbour, B.M., J.K. Burk, and W.D. Pitts. 1999. Terrestrial Plant Ecology. New York: The Benjamin/Cummings.

[10] Greg-Smith, P. 1983. Quantitative plant ecology. Third edition. Berkeley and Los Angeles, CA: University of California Press. 359 p.

[11] Kusmana C, dan Susanti S. 2015. Komposisi dan struktur tegakan hutan alam di hutan pendidikan gunung Walat, Sukabumi. Jurnal Silvikultur Tropika, 5(3): 210-217

[12] Yusuf, Rizali. 2011. Sebaran Ekologi Dan Keanekaragaman Ficus Spp. di Indonesia Berk. Penel. Hayati Edisi Khusus: 5A (83–91), 2011.

[13] Ismail, AY., Nasihin, I., Juhendar, D. 2015. Struktur Populasi Dan Sebaran Serta Karakteristik Habitat Huru Sintok (Cinnamomum Sintocbl) Di Resort Cilimus Taman Nasional Gunung Ciremai. Wanaraksa Vol. 9 No.2. 20-29.
[14] Supartono, T. Robi., Nurdin., 2018. Population Density Of Leaf-Eating Monkeys And Dominant Vegetation At The Ipukan, Gunung Ciremai National Park, Indonesia. Journal of Forestry and Environment 01 (01) 22 – 24.
[15] B. Kitchenham and S. Charters, "Guidelines for performing Systematic Literature reviews in Software Engineering Version 2.3," Engineering, vol. 45, no. 4ve, p. 1051, 2007.
[16] Hendrayana, Y., Karyaningsih, I., Herlina, N. 2020. Populasi Dan Asosiasi Marga Ficus Di Gunung Tilu Kabupaten Kuningan Provinsi Jawa Barat. Quagga: Jurnal Pendidikan dan Biologi. 12(2), 163-169.
[17] Herlina. N, Karyaningsih. I, Ismail. AY, Sukmadi. I., 2018. Inventory Of Medicinal Plant In The Rehabilitation Zone Of The Blok Pasir Batang Gunung Ciremai National Park. Journal of Forestry and Environment 01 (02) 22-24
[18] Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. New York: John Wiley and Sons