PEER REVIEW

A7

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW
KARYA ILMIAH : JURNAL ILMIAH

Judul Jurnal Ilmiah (Artikel) : Short Communication : Populaton and stand structure of Cinnamomum sintoc in the Low Land Forest of Mont Ciremai National Park, West Java, Indonesia.

Penulis Jurnal Ilmiah *) : 1 Agus Yadi Ismail (*nama pengusul dicetak tebal)
2 Cecep Kusmana P
3 **Eming Sudiana**
4 Pudji Widodo.

Jumlah Penulis : 4

Status Penulis : Penulis Ke-3

Identitas Jurnal Ilmiah :

a. Nama Jurnal : BIODIVERSITAS Journal of Biological Diversity
b. Nomor ISSN : ISSN: P-1412-033x E-ISSN: 2085-4722
c. Edisi/Volume, Nomor : EdisiApril 2019/Vol. 20 Nomor : 4
d. Penerbit : Department of Biology, FMNS, Universitas Sebelas
e. DOI artikel : https://doi.org/10.13057/biodiv/d200415
f. Alamat Web : https://smujo.id/biodiv/article/view/3453
g. Terindeks di : SCOPUS, Q3, SJR : 0,27

Kategori Publikasi Jurnal Ilmiah : ☐ Jurnal Ilmiah Internasional /Internasional Bereputasi
(beri v pada kategori yang tepat) ☐ Jurnal Ilmiah Nasional Terakreditasi
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b Ruang lingkup dan kedalaman pembahasan (30%)	30 % X40=	12					11.9
c Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	30 % X40=	12					11.6
d Kelengkapan unsur dan kualitas terbitan/jurnal (30%)	30 % X40=	12					11.9
Total = (100%)	**40**						39.2
Nilai Pengusul (40 % x Total)/3	**5.33**						5.23

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3. Kecukupan dan kemutahiran data serta metodologi : Cukup dan mutahir
4. Kelengkapan unsur kualitas penerbit : Lengkap
5. Indikasi plagiasi : Tidak ada
6. Kesesuaian bidang ilmu : Sesuai

Purwokerto, *) Wajib diisi

Reviewer 1

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4. Kelengkapan unsur kualitas penerbit : LENGKAP
5. Indikasi plagiasi : TIDAK ADA
6. Kesesuaian bidang ilmu : SESUAI

Purwokerto, 12 OKTOBER 2020 *) wajib diisi

Reviewer 1

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Unit Kerja : Fakultas Biologi Unsoed

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b Ruang lingkup dan kedalaman pembahasan (30%)	30 % X40= 12			12
c Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	30 % X40= 12			11,9
d Kelengkapan unsur dan kualitas terbitan/jurnal (30%)	30 % X40= 12			12
Total = (100%)	**40**			39,9
Nilai Pengusul (40 % x Total)/3	**5.33**			5,32

Catatan Penilaian artikel oleh Reviewer:

1. Tentang kelengkapan dan kesesuaian unsur : lengkap & sesuai
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4. Kelengkapan unsur kualitas penerbit : lengkap
5. Indikasi plagiasi : tidak ada
6. Kesesuaian bidang ilmu : sesuai

Purwokerto, 8-10-2020 *) wajib diisi

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ARTIKEL

ISSN: 1412-033X
E-ISSN: 2085-4722

BIODIVERSITAS

Journal of Biological Diversity

Volume 20 - Number 4 - April 2019

BIODIVERSITAS

Journal of Biological Diversity

Volume 20 – Number 4 – April 2019

ISSN/E-ISSN:
1412-033X (printed edition), 2085-4722 (electronic)

PUBLISHER:
The Society for Indonesian Biodiversity

CO-PUBLISHER:
Department of Biology, Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Surakarta

ADDRESS:
Jl. Ir. Sutami 36A Surakarta 57126. Tel. +62-271-7994097, Tel. & Fax.: +62-271-663375, Email: unsjournals@yahoo.com

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GUIDANCE FOR AUTHORS

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Article types The journal seeks original full-length research papers, reviews, and short communication. Manuscript of original research should be written in no more than 8,000 words (including tables and picture), or proportional with articles in this publication number. Review articles will be accommodated, while, short communication should be written at least 2,000 words, except for pre-study.

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Title of the article should be written in compact, clear, and informative sentence, preferably not more than 20 words. Name of author(s) should be completely written. **Name and institution** address should also be completely written with street name and number (location), postal code, telephone number, facsimile number, and email address. Manuscript written by a group, author for correspondence along with address is required. First page of the manuscript is used for writing above information.

Abstract should not be more than 200 words. **Keywords** is about five words, covering scientific and local name (if any), research theme, and special methods which used; and sorted from A to Z. All important **abbreviations** must be defined at their first mention. **Running title** is about five words. **Introduction** is about 400-600 words, covering the background and aims of the research. **Materials and Methods** should emphasize on the procedures and data analysis. **Results and Discussion** should be written as a series of connecting sentences, however, for manuscript with long discussion should be divided into subtitles. Thorough discussion represents the causal effect mainly explains for why and how the results of the research were taken place, and do not only re-express the mentioned results in the form of sentences. **Concluding** sentence should be given at the end of the discussion. **Acknowledgments** are expressed in a brief; all sources of institutional, private and corporate financial support for the work must be fully acknowledged, and any potential conflicts of interest are noted.

Figures and Tables of maximum of three pages should be clearly presented. Title of a picture is written down below the picture, while title of a table is written above the table. Colored figures can only be accepted if the information in the manuscript can lose without those images; chart is preferred to use black and white images. Author could consign any picture or photo for the front cover, although it does not print in the manuscript. All images property of others should be mentioned source. **There is no appendix**, all data or data analysis are incorporated into Results and Discussions. For broad data, it can be displayed on the website as a supplement.

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Journal:

Saharjo BH, Nurhayati AD. 2006. Domination and composition structure change at hemic peat natural regeneration following burning; a case study in Pelalawan, Riau Province. Biodiversitas 7: 154-158.

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds) Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of *Rhazya stricta***.** 50th annual symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.) Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from internet:

Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic *Escherichia coli* predator-prey ecosystem. Mol Syst Biol 4: 187. www.molecularsystemsbiology.com

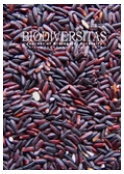
Front cover: **Black rice**
(PHOTO: M. ZAUPA)

Published monthly

PRINTED IN INDONESIA

ISSN: 1412-033X **E-ISSN: 2085-4722**

BIODIVERSITAS
Journal of Biological Diversity



Biodiversitas Vol. 20, No. 4, April 2019

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Print on demand [PDF]

BIODIVERSITAS
Volume 20, Number 4, April 2019
Pages: 1042-1047

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d200415

Short Communication: Population and stand structure of *Cinnamomum sintoc* in the Low Land Forest of Mount Ciremai National Park, West Java, Indonesia

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Manuscript received: 21 January 2019. Revision accepted: 19 March 2019.

Abstract. *Ismail AY, Kusmana C, Sudiana E, Widodo P. 2019. Short Communication: Population and stand structure of* Cinnamomum sintoc *in the Low Land Forest of Mount Ciremai National Park, West Java, Indonesia. Biodiversitas 20: 1042-1047. Cinnamomum sintoc (C. sintoc)* is one of the anthelmintic and anti-inflammatory medicinal plants which produces essential oils from its roots, skin, and leaves. This study aimed to analyze the population and stand structure of *C. sintoc* in Mount Ciremai National Park, West Java, Indonesia. Data collection was carried out using plots/ strips method. The plots were purposively placed and made at each altitude and direction of the slope. The research recorded 804 individual trees from each growth edge. Individual density between slope directions and altitudes was not significantly different for all diameter classes, but was significantly different between slope directions of stratum B (P = 0.001) and E (P = 0.012). These results indicate that sintoc population is spread evenly and can be cultivated at various slope and altitude directions and has no preference for the two topographic variables.

Keywords: *Cinnamomum sintoc*, Mount Ciremai National Park, population, stand structure

INTRODUCTION

Mount Ciremai National Park (MCNP) with an area of 15,500 ha is a natural conservation area functions as a protection area for plants and animals. Several types of local plants in MCNP are saninten (*Castanopsis argentea*), rasamala (*Altingia excelsa*), pasang (*Quercus sundaica*), puspa (*Schima wallichii*), teureup/tekalong/benda (*Artocarpus elasticus*), jamuju (*Podocarpus imbricatus*) and huru sintok (*Cinnamomum sintoc*). *C. sintoc* is one of the rare and endangered plant herbs (Kastolini 2018; Hidayat and Risna 2007). Sintoc can produces essential oils - as many as 30 components – out of roots, stem bark, and leaves. Bark extract from *C. sintoc* is source for anti-biofilm agents for treatment of infections caused by *Pseudomonas aeruginosa* and *Staphylococcus aereus* biofilm (Pratiwi et al. 2014). Wiart (2013) stated that sintoc was used by native of the Malay coast of New Guinea as a medicinal plant for chronic diarrhea and as an antipasmodic. Besides, *C. sintoc* is also used by local community in Poncokusumo Sub-district, Malang District, East Jawa Province, Indonesia for treating tuberculosis and vitality (Batoro dan Siswanto 2017).

Sintok can be found in Java, Sumatra and Kalimantan Islands (Lemmens and Soerianegara 1995). This plant tends to grow solitary and is rarely found in a cluster. There is a gap in number of populations between tree and seedling stage, so that *C. sintoc* has difficulty regenerating in its natural habitat (Hidayat 2006).

The population of *C. sintoc* in Java tends to decrease (Rifai et al. 1992). Although being classified as a rare plant, sintoc can still be found in MCNP forest ecosystems, but the population conditions are not yet widely known. Conservation of *C. sintoc* population in MCNP area requires studies on the abundance and distribution of *C. sintoc* population in MCNP. Based on that the above description, this study aimed to analyze the population and stand structure of *C. sintoc.* The results are expected to provide information about the population and become a reference for the use of species to prevent it from extinction and to further develop its cultivation

MATERIALS AND METHODS

Study site

This research was carried out during June to August 2017 in Mount Ciremai National Park (MCNP). The reserach sites covered two districts of Kuningan and Majalengka, West Jawa Province of Indonesia (Figure 1). Geographically, MCNP is located at $108^0$28'0" E-$108^0$21'35" East longitude, and $6^0$50'25" S - $6^0$58'26" South latitude. Ciremai Mountain is the highest mountain in West Java with the highest peak of of 3078 m asl and forms a cone on the north side as the remains of Geger Halang caldera of 4.5 x 5 km^2 area size. Based on Schmidt & Fergusson classification (1951), MCNP has a B and C

climate types with an average rainfall of 2,000-4,000 mm year^{-1}. The monthly temperatures of the research site ranged from 18^{o}C to 22^{o}C. The topography of MCNP was varied, ranging from ramps to steep slopes. The ramp slopes of MCNP area (0-8%) was about 26.52%, and the slopes above 8% was 73.48% of the total area.

Vegetation analysis

Data collection was permormed using plots/strips method. The plots/strips were placed at each direction of slopes and altitude interval above sea level. The starting point to place the sample of strips/plots in each slope direction and altitude was the point where *C. sintoc* was first encountered. The sample plots were made in a nested design, i.e., sample plots measuring 20 m x 20 m for tree inventory (woody plants with diameter at breast high of > 20 cm), 10 m x 10 m subplots for pole inventory (woody plants with diameter at breast high of 10-20 cm), 5 m x 5 m subplots for sapling inventory (wood plants with diameter at breast high <10 cm and height> 1.5 m), and 2 m x 2 m subplots for seedling inventory (woody plants with height ≤1.5 m) (Kusmana and Istomo, 1995). For vertical and horizontal structures, data were divided into stem diameter classes and tree height classes (Table 1).

Table 1. Classification of stem diameter and tree height

Vertical structure		Horizontal structure	
Tree height classes (m)	**Stratum**	**Stem diameter stage (cm)**	**Diameter class codes**
>30	A	10-20	A
20-30	B	21-30	B
4-20	C	30-40	C
1-4	D	41-50	D
< 1	E	>50	E

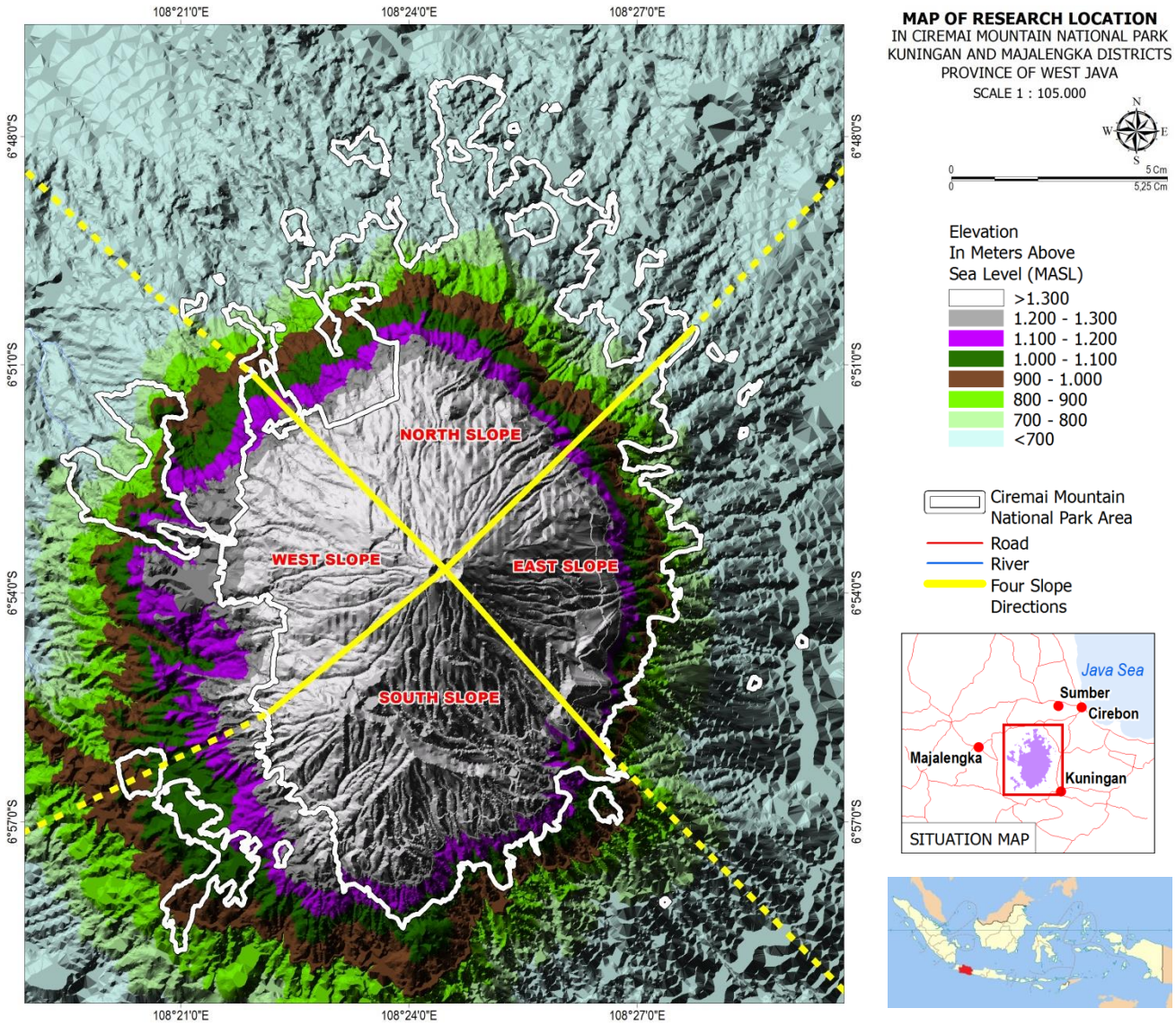


Figure 1. The research location in Mout Ciremai, West Java Province of Indonesia

Data analysis

Descriptive method was used in data analysis to determine the population condition, while the difference of means test was applied to find out the difference of tree density in some plant characteristics. First thing to do in before testing the difference of means was to perform data homogeneity test to determine data distribution and decide which test to be taken: parametric or non-parametric. t-tudent test was applied for homogeneous distribution data, while Mann-Whitney test was for heterogeneous distribution data. Both analysis approaches were performed by using SPSS 25 software assistance. The variables used were stem diameter class (cm) and tree height class (m) for dependent variables, and the place altitude (m asl) and slope direction for independent variables. Whereas, the density of trees and Import Value Index (IVI) of species were calculated using the formulas of Odum (1996).

RESULTS AND DISCUSSION

Dominant tree species

A total of 631 sample plots were observed in the present study. The sample pots spread across seven altitude classes from each of the four slope directions. The results of the study revealed that the tree species which dominated the habitat of *C. sintoc* were pine (*Pinus merkusii)*, african wood (*Maesopsis eminii*), weeping fig/ficus (*Ficus benjamina*), bishop wood (*Bischofia javanica*), and gnemon tree/melinjo (*Gnetum gnemon*) (Table 2).

Population density and distribution of *Cinnamomum sintoc*

C. sintoc was found in four slope classes, ranging in from the altitudes of 500 to 1200 m asl. Sintoc density of all slope and altitude classes was 163 ind ha^{-1} for tree growth stage and 306 ind ha^{-1} for pole growth stage (Table 3). The spatial distribution of *C. sintoc* in MCNP can be seen on Figure 2.

Horizontal structure of *Cinnamomum sintoc*

Diameter of *C. sintoc* species on the of tree growth stage, in general, ranged from 10 - 60 cm (Figure 3). The largest stem diameter class distribution of trees in all slope classes was in the 10-20 cm diameter class. Tree density decreased with the increase of diameter class.

The mean difference test was done to determine the level of density difference in each diameter class between altitudes and between slope directions. The result showed that there was no difference in density of *C. sintoc* at each stem diameter class (Table 4).

Vertical structure of *Cinnamomum sintoc*

C. sintoc was found on four slope directions, starting from stratum C, D, to E. No individual tree was found in strata A and B (Figure 4).

The mean difference test revealed that the tree density in each stratum was not significantly different of between altitudes, except for stratum B and E of between slope directions (Table 5).

Table 2. Dominant tree species at four slope directions of the study site

Name of species	IVI (%)
West slope direction	
Maesopsis eminii	29.21
Ficus benjamina	28.83
Cinnamomum sintoc	28.27
Swietenia mahagoni	27.12
Hibiscus macrophyllus	20.40
Sterculia oblongata.	15.68
Murraya paniculata	13.62
Artocarpus heterophyllus	12.43
East slope direction	
Pinus merkusii.	76.29
Swietenia mahagoni	19.05
Bischofia javanica	17.18
Alstonia scholaris	15.16
Zyzygium polyanthum	14.50
Cinnamomum sintoc	14.39
Hibiscus macrophyllus	14.38
Castanopsis argentea	12.82
South slope direction	
Pinus merkusii	44.88
Maesopsis eminii	30.66
Hibiscus macrophyllus	26.39
Persea Americana	18.97
Cinnamomum sintoc	16.28
Dysoxylum ramiflorum	12.47
Artocarpus heterophyllus	11.70
Ficus indica	10.21
North slope direction	
Pinus merkusii	121.55
Cinnamomum sintoc	16.89
Gnetum gnemon	13.10
Schima wallichii	9.38
Sterculia oblongata	8.14
Artocarpus sp.	7.11
Dillenia excelsa	6.76
Zyzygium polyanthum	6.72

Discussion

Data collection was conducted on 672 sample plots which recorded 7452 individual trees, 142 tree species, and habitat was dominated by cultivated trees such as *Pinus merkusii, Maesopsis eminii* and *Gnetum gnemon.* The results showed that *C. sintoc* was able to grow in secondary forest and disturbed habitat modification. This study also indicates that *C. sintoc* is a species able to adapt to the changing environment. Wuu Kuang (2006) stated that *Cinnamomum* species can live in primary or secondary forests. Our results are in line with Pesiu et al. (2016), who found *C. sintoc* in secondary forest in Pulau Bidong (Trengganu Island). Wuu-Kuang (2006) and Sujarwo and Arinasa (2014) reported that sintoc can live in an open area with adequate amount of sunlight**.** In addition, Putri et al. (2017) showed that *C. sintoc* was found in the karst ecosystem at Mt. Nyungcung, Bogor Regency at 193-218 m above sea level (asl).

In the presnt study, *C.sintoc* was found in altitude range of 500 to 1200 m asl, indicating that *C. sintoc* can grow in the lowland (0-1000 m asl) forest and sub-montana (1000-3300 m asl) forest. These results are in line with that of Susiarti et al. (2018), who found *C. sintoc* in the lowland forest at Bodogol, Mount Gede Pangrango National Park, West Java. Hidayat and Risna (2007) and Lemmens and Soerianegera (1995) found *C. sintoc* in altitude of 1036-2330 m asl and is commonly grown in hills and mountain forests up to an altitude of 2400 m. In Biodiversity Park in Sumedang Regency, *C. sintoc* was also found in hilly and mountainous area in altitude range 25 to 1667 m asl (Kastolini 2018).

Cinnamomum sintoc population can spread in the lowland forest (2-1000 m asl) and sub-mountain (1000-3000 m asl) ecosystems due to several factors. The pattern of plant distribution in a plant community can be caused by wind, water availability, light intensity, reproductive ability of organisms, social aspects involving plant phenology, co-active as effects of intraspecific interactions (Ludwig and Reynolds 1988), nutrient content, soil acidity, host rock, topography (Ewusie 1990; Kurniawan and Parekesit 2008; Yuanjie et al. 2010), moisture gradient (Zelnik and Carni 2008), slope gradient, slope aspect, and elevation (Yuanjie et al. 2010).

The results showed that *C. sintoc* was found mostly in the southwestern and eastern parts of the study site. Tree density of *C. sintoc* in the lowland forest of Ciremai is lower (1-17 ha^{-1}) than that in Ranu Pani, Senduro dan Pronojiwo Resort in Bromo-Tengger Semeru Taman Nasional (22 ind ha^{-1}) (Hidayat and Risna 2017). However, the density of sintoc for each diameter class between the altitudes and between the slope directions was not significantly different. This indicates that sintoc species is able to grow at various altitudes and is quite tolerant to the environments with different duration of direct sunlight exposure. Our results revealed that *C. sintoc* has any habitat preference to particular topographic variables , thus it can be classified as a generalist species.

Table 3. Density of tree pole boles and trees at each altitude class and slope direction

Slope direction	The altitude (m asl)	Density (ind ha^{-1})	
		Pole	Tree
West	600	13	8
	700	8	12
	800	4	8
	900	8	10
	1000	19	2
	Total	52	40
South	500	20	15
	800	16	5
	900	7	7
	1000	0	3
	1200	13	3
	Total	56	33
East	500	5	6
	600	13	6
	700	21	2
	800	19	5
	900	0	9
	1000	13	9
	1100	33	17
	Total	104	54
North	500	7	7
	600	27	8
	700	48	7
	800	6	6
	900	2	4
	1000	4	4
	Total	94	36
	Grand Total	306	163

Table 4. Mean sepatarions of *Cinnamomum sintoc* tree density in each diameter class between altitudes and between slope directions

Tree size stratification	Between altitude			Between slope direction		
	Name of test	P		Name of test	P	
A	t-student	0.251	(ns)	t-student	0.142	(ns)
B	Mann-Whitney	0.367	(ns)	t-student	0.072	(ns)
C	t-student	0.492	(ns)	t-student	0.441	(ns)
D	Mann-Whitney	0.069	(ns)	t-student	0.307	(ns)
E	Mann-Whitney	0.949	(ns)	t-student	0.069	(ns)

Note: ns = non-significant; s = significant (at α: 5%)

Table 5. Mean sepatarions of tree density at each stratum of between altitudes and between slope directions

Tree size stratification	Between altitude			Between slope direction		
	Name of test	P		Name of test	P	
A	Mann-Whitney	0,695	(ns)	Mann-Whitney	0,058	(ns)
B	Mann-Whitney	0,921	(ns)	Mann-Whitney	0,001	(s)
C	t-student	0,069	(ns)	t-student	0,258	(ns)
D	Mann-Whitney	0,880	(ns)	t-student	0,685	(ns)
E	Mann-Whitney	0,754	(ns)	Mann-Whitney	0,012	(s)

Description: ns = non-significant; s = significant (at α: 5%)

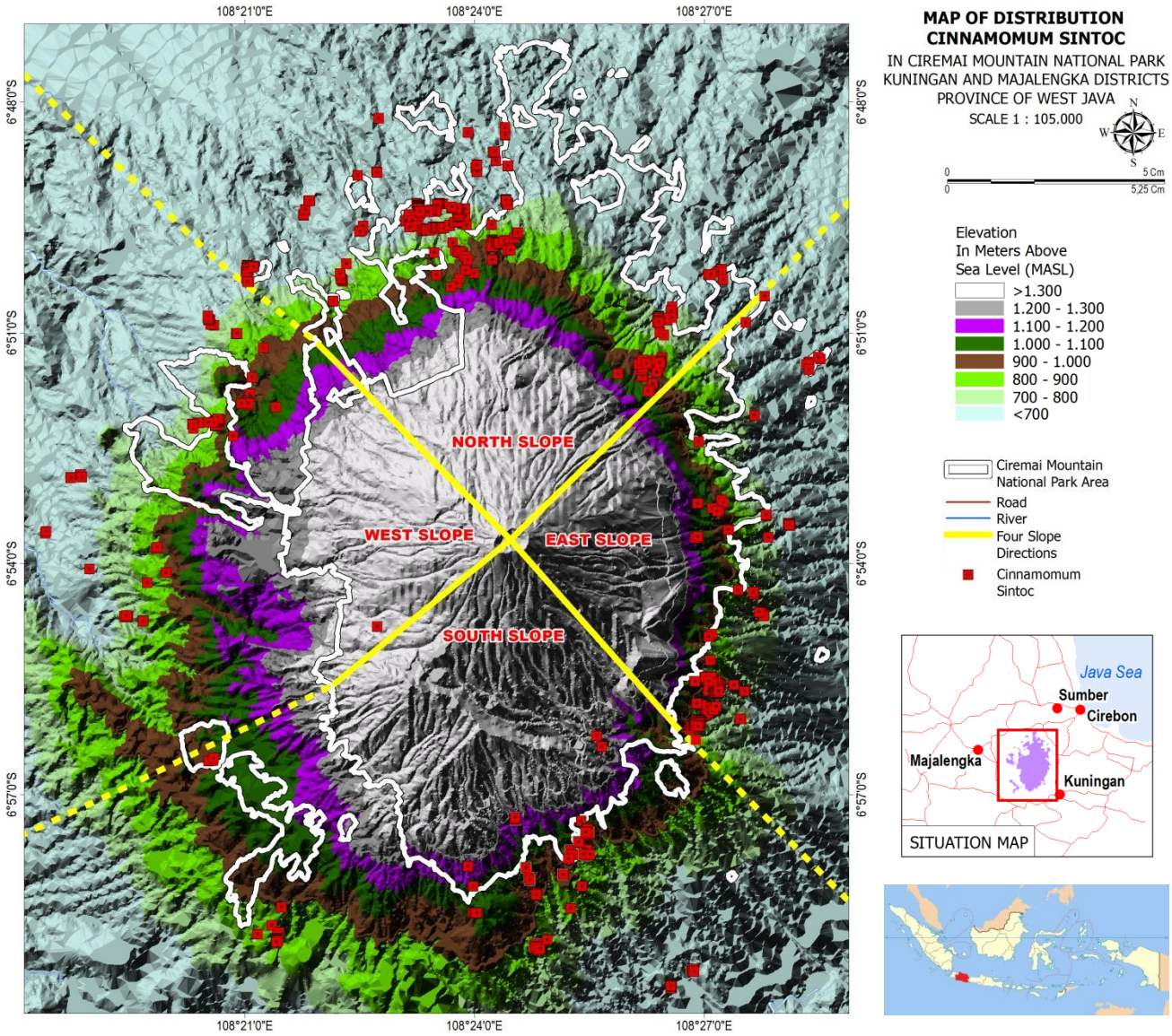
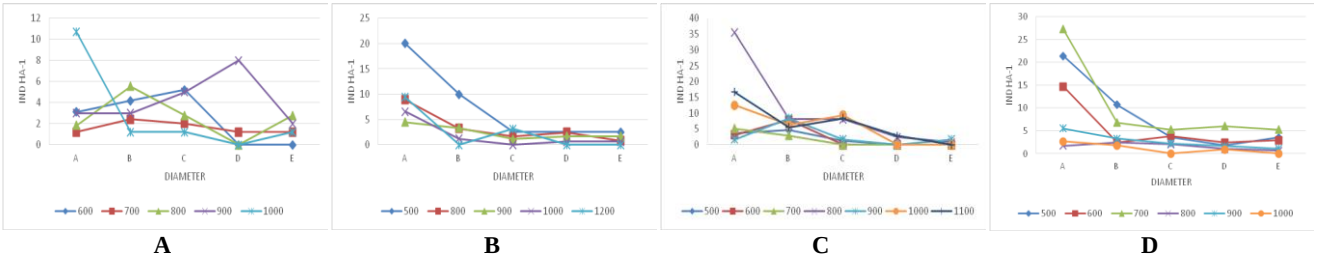
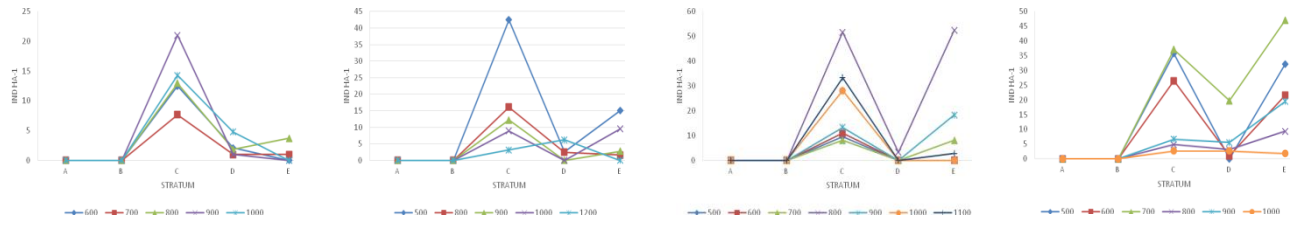


Figure 2. *Cinnamomum sintoc* spatial distribution at Mount Ciremai National Park, West Java Province of Indonesia



A **B** **C** **D**

Figure 3. Stem diameter class distribution of Cinnamomum sintoc tree stand (cm). A. West, B. South, C. East, D. North. Diameter Class: A= 10-20 cm, B= 21-30 cm, C=31-40 cm, D=41-50 cm, E = > 50 cm



A **B** **C** **D**

Figure 4. Crown height class of Cinnamomum sintoc tree stand (m). A. West, B. South, C. East, D. North

Stratification of vegetation is also known as stratum or strata. Strata is a grouping of plants based on height for vertical space and tree diameter for horizontal space. Stratification is determined based on crown height because each species has a different maximum height, in which crown of the same species lies in different strata (Baker and Wilson 2000). Vertical structure or stratification of a stand is seen from the stand height distribution. Based on vertical structure, *C. sintoc* stand was dominated by C stratum (4-20), suggesting that *C. sintoc* stand in the lowland forest of Mount Ciremai National Park was still in the growth phase.

In the horizontal structure, sintoc was found in the stem diameter class of 10-20 cm, 20-30 cm, and 30-40 cm. This phenomenon shows that *C. sintoc* is still able to regenerate even in a disturbed ecosystem that has undergone modification**.** In this study, sintoc density in 10-20 cm stem diameter class was higher than that of the individual density in the above stem diameter classes. This result is in line with that of Oladoye et al. (2014), who found that the number of individual trees decreased along with the increase of stem diameter of the trees. The result also indicates that the lowland forest of Mount Ciremai National Park was in the mid-level succession. This data also provides supporting information that *C. sintoc* has the capability to regenerate and its sustainability can be guaranteed as long as there is no logging activity on the species.

As a species with a high economic value since it is a medicinal plant, the presence of *C. sintoc* needs to be maintained and multiplied in population. The results of this study have provided information that *C. sintoc* can be developed or cultivated in diverse environments including cultivated lands ranging from lowlands to highlands.

In conclusion, the tree population of *C. sintoc* was found ain Mount Ciremai National Park at an altitude of 500-1200 m asl with the density ranged from 2 ind ha^{-1} to 17 ind ha^{-1}. The sintoc spread on stratification of C stratum (4 - 20 m), D stratum D (1-4 m), and E stratum (0-1 m) while horizontally, the species existed in diameter class distribution of 10-60 cm.

ACKNOWLEDGMENTS

We would like to thank the Head of Mount Ciremai National Park of the Ministry of Environment and Forestry Republic of Indonesia for his support during survey. We also thank Toto Supartono, Ilham Adhya, Yayan Hendrayana, Dian, Tito, Yudi, Abdul Hakim, Dedi, and Dasji for helping the data collecting during the research.

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TURNITIN

Population and stand structure of Cinnamomum sintoc in the Low Land Forest of Mount Ciremai National Park, West Java, Indonesia

by Eming Sudiana

Submission date: 23-Aug-2020 11:00PM (UTC+0700)
Submission ID: 1372909584
File name: BIODIVERSITAS_VOL_20_NO_4_2019__ARTIKEL.pdf (1.3M)
Word count: 3598
Character count: 18487

BIODIVERSITAS
Volume 20, Number 4, April 2019
Pages: 1042-1047

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d200415

Short Communication: Population and stand structure of *Cinnamomum sintoc* in the Low Land Forest of Mount Ciremai National Park, West Java, Indonesia

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Mount Ciremai National Park (MCNP) with an area of 15,500 ha is a natural conservation area functions as a protection area for plants and animals. Several types of local plants in MCNP are saninten (*Castanopsis argentea*), rasamala (*Altingia excelsa*), pasang (*Quercus sundaica*), puspa (*Schima wallichii*), teureup/tekalong/benda (*Artocarpus elasticus*), jamuju (*Podocarpus imbricatus*) and huru sintok (*Cinnamomum sintoc*). *C. sintoc* is one of the rare and endangered plant herbs (Kastolini 2018; Hidayat and Risna 2007). Sintoc can produces essential oils - as many as 30 components – out of roots, stem bark, and leaves. Bark extract from *C. sintoc* is source for anti-biofilm agents for treatment of infections caused by *Pseudomonas aeruginosa* and *Staphylococcus aereus* biofilm (Pratiwi et al. 2014). Wiart (2013) stated that sintoc was used by native of the Malay coast of New Guinea as a medicinal plant for chronic [28]rrhea and as an antipasmodic. Besides, *C. sintoc* is also used by local community in Poncokusumo Sub-district, Malang District, East Jawa Province, Indonesia for treating tuberculosis and vitality (Batoro dan Siswanto 2017).

Sintok can be found in Java, Sumatra and Kalimantan Islands (Lemmens and Soerianegara 1995). This plant tends to grow solitary and is rarely found in a cluster. There is a gap in number of populations between tree and seedling stage, so that *C. sintoc* has difficulty regenerating in its natural habitat (Hidayat 2006).

The population of *C. sintoc* in Java tends to decrease (Rifai et al. 1992). Although being classified as a rare plant, sintoc can still be found in MCNP forest ecosystems, but the population conditions are not yet widely known. Conservation of *C. sintoc* population in MCNP area requires studies on the abundance and distribution of *C. sintoc* population in MCNP. Based on that the above description, this study aimed to analyze the population and stand structure of *C. sintoc*. The results are expected to provide information about the population and become a reference for the use of species to prevent it from extinction and to further develop its cultivation

MATERIALS AND METHODS

Study site

This research was carried out during June to August 2017 in Mount Ciremai National Park (MCNP). The reserach sites covered two districts of Kuningan and Majalengka, West Jawa Province of Indonesia (Figure 1). Geographically, MCNP is located at $108^{0}28'0"$ E-$108^{0}21'35"$ East longitude, and $6^{0}50'25"$ S - $6^{0}58'26"$ South latitude. Ciremai Mountain is the highest mountain in West Java with the highest peak of of 3078 m asl and forms a cone on the north side as the remains of Geger Halang caldera of 4.5 x 5 km^2 area size. Based on Schmidt & Fergusson classification (1951), MCNP has a B and C

climate types with an average rainfall of 2,000-4,000 mm year^{-1}. The monthly temperatures of the research site ranged from 18°C to 22°C. The topography of MCNP was varied, ranging from ramps to steep slopes. The ramp slopes of MCNP area (0-8%) was about 26.52%, and the slopes above 8% was 73.48% of the total area.

Vegetation analysis

Data collection was permormed using plots/strips method. The plots/strips were placed at each direction of slopes and altitude interval above sea level. The starting point to place the sample of strips/plots in each slope direction and altitude was the point where *C. sintoc* was first encountered. The sample plots were made in a nested design, i.e., sample plots measuring 20 m x 20 m for tree inventory (woody plants with diameter at breast high of > 20 cm), 10 m x 10 m subplots for pole inventory (woody plants with diameter at breast high of 10-20 cm), 5 m x 5 m subplots for sapling inventory (wood plants with diameter at breast high <10 cm and height> 1.5 m), and 2 m x 2 m subplots for seedling inventory (woody plants with height ≤1.5 m) (Kusmana and Istomo, 1995). For vertical and horizontal structures, data were divided into stem diameter classes and tree height classes (Table 1).

Table 1. Classification of stem diameter and tree height

Vertical structure		Horizontal structure	
Tree height classes (m)	Stratum	Stem diameter stage (cm)	Diameter class codes
>30	A	10-20	A
20-30	B	21-30	B
4-20	C	30-40	C
1-4	D	41-50	D
< 1	E	>50	E

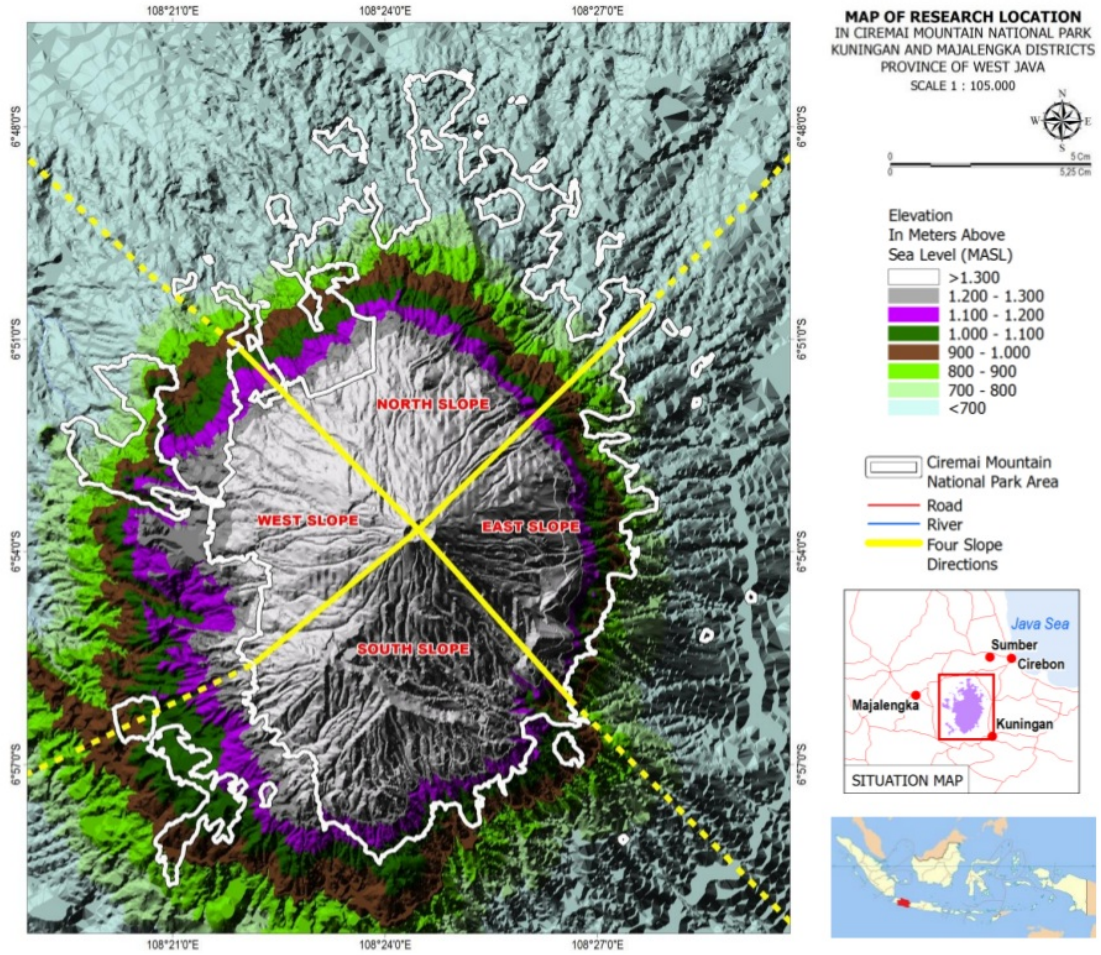

Figure 1. The research location in Mout Ciremai, West Java Province of Indonesia

Data analysis

Descriptive method was used in data analysis to determine the population condition, while the difference of means test was applied to find out the difference of tree density in some plant characteristics. First thing to do in before testing the difference of means was to perform data homogeneity test to determine data distribution and decide which test to be taken: parametric or non-parametric. t-tudent test was applied for homogeneous distribution data, while Mann-Whitney test was for heterogeneous distribution data. Both analysis approaches were performed by using SPSS 25 software assistance. The variables used were stem diameter class (cm) and tree height class (m) for dependent variables, and the place altitude (m asl) and slope direction for independent variables. Whereas, the density of trees and Import Value Index (IVI) of species were calculated using the formulas of Odum (1996).

RESULTS AND DISCUSSION

Dominant tree species

A total of 631 sample plots were observed in the present study. The sample pots spread across seven altitude classes from each of the four slope directions. The results of the study revealed that the tree species which dominated the habitat of *C. sintoc* were pine (*Pinus merkusii)*, african wood (*Maesopsis eminii*), weeping fig/ficus (*Ficus benjamina*), bishop wood (*Bischofia javanica*), and gnemon tree/melinjo (*Gnetum gnemon*) (Table 2).

Population density and distribution of *Cinnamomum sintoc*

C. sintoc was found in four slope classes, ranging in from the altitudes of 500 to 1200 m asl. Sintoc density of all slope and altitude classes was 163 ind ha^{-1} for tree growth stage and 306 ind ha^{-1} for pole growth stage (Table 3). The spatial distribution of *C. sintoc* in MCNP can be seen on Figure 2.

Horizontal structure of *Cinnamomum sintoc*

Diameter of *C. sintoc* species on the of tree growth stage, in general, ranged from 10 - 60 cm (Figure 3). The largest stem diameter class distribution of trees in all slope classes was in the 10-20 cm diameter class. Tree density decreased with the increase of diameter class.

The mean difference test was done to determine the level of density difference in each diameter class between altitudes and between slope directions. The result showed that there was no difference in density of *C. sintoc* at each stem diameter class (Table 4).

Vertical structure of *Cinnamomum sintoc*

C. sintoc was found on four slope directions, starting from stratum C, D, to E. No individual tree was found in strata A and B (Figure 4).

The mean difference test revealed that the tree density in each stratum was not significantly different of between altitudes, except for stratum B and E of between slope directions (Table 5).

Table 2. Dominant tree species at four slope directions of the study site

Name of species	IVI (%)
West slope direction	
Maesopsis eminii	29.21
Ficus benjamina	28.83
Cinnamomum sintoc	28.27
Swietenia mahagoni	27.12
Hibiscus macrophyllus	20.40
Sterculia oblongata.	15.68
Murraya paniculata	13.62
Artocarpus heterophyllus	12.43
East slope direction	
Pinus merkusii.	76.29
Swietenia mahagoni	19.05
Bischofia javanica	17.18
Alstonia scholaris	15.16
Zyzygium polyanthum	14.50
Cinnamomum sintoc	14.39
Hibiscus macrophyllus	14.38
Castanopsis argentea	12.82
South slope direction	
Pinus merkusii	44.88
Maesopsis eminii	30.66
Hibiscus macrophyllus	26.39
Persea Americana	18.97
Cinnamomum sintoc	16.28
Dysoxylum ramiflorum	12.47
Artocarpus heterophyllus	11.70
Ficus indica	10.21
North slope direction	
Pinus merkusii	121.55
Cinnamomum sintoc	16.89
Gnetum gnemon	13.10
Schima wallichii	9.38
Sterculia oblongata	8.14
Artocarpus sp.	7.11
Dillenia excelsa	6.76
Zyzygium polyanthum	6.72

Discussion

Data collection was conducted on 672 sample plots which recorded 7452 individual trees, 142 tree species, and habitat was dominated by cultivated trees such as *Pinus merkusii, Maesopsis eminii* and *Gnetum gnemon*. The results showed that *C. sintoc* was able to grow in secondary forest and disturbed habitat modification. This study also indicates that *C. sintoc* is a species able to adapt to the changing environment. Wuu Kuang (2006) stated that *Cinnamomum* species can live in primary or secondary forests. Our results are in line with Pesiu et al. (2016), who found *C. sintoc* in secondary forest in Pulau Bidong (Trengganu Island). Wuu-Kuang (2006) and Sujarwo and Arinasa (2014) reported that sintoc can live in an open area with adequate amount of sunlight. In addition, Putri et al. (2017) showed that *C. sintoc* was found in the karst ecosystem at Mt. Nyungcung, Bogor Regency at 193-218 m above sea level (asl).

In the presnt study, *C.sintoc* was found in altitude range of 500 to 1200 m asl, indicating that *C. sintoc* can grow in the lowland (0-1000 asl) forest and sub-montana (1000-3300 m asl) forest. These results are in line with that of Susiarti et al. (2018), who found *C. sintoc* in the lowland forest at Bodogol, Mount Gede Pangrango National Park, West Java. Hidayat and Risna (2007) and Lemmens and Soerianegera (1995) found *C. sintoc* in altitude of 1036-2330 m asl and is commonly grown in hills and mountain forests up to an altitude of 2400 m. In Biodiversity Park in Sumedang Regency, *C. sintoc* was also found in hilly and mountainous area in altitude range 25 to 1667 m asl (Kastolini 2018).

Cinnamomum sintoc population can spread in the lowland forest (2-1000 m asl) and sub-mountain (1000-3000 m asl) ecosystems due to several factors. The pattern of plant distribution in a plant community can be caused by wind, water availability, light intensity, reproductive ability of organisms, social aspects involving plant phenology, co-active as effects of intraspecific interactions (Ludwig and Reynolds 1988), nutrient content, soil acidity, host rock, topography (Ewusie 1990; Kurniawan and Parekesit 2008; Yuanjie et al. 2010), moisture gradient (Zelnik and Carni 2008), slope gradient, slope aspect, and elevation (Yuanjie et al. 2010).

The results showed that *C. sintoc* was found mostly in the southwestern and eastern parts of the study site. Tree density of *C. sintoc* in the lowland forest of Ciremai is lower (1-17 ha^{-1}) than that in Ranu Pani, Senduro dan Pronojiwo Resort in Bromo-Tengger Semeru Taman Nasional (22 ind ha^{-1}) (Hidayat and Risna 2017). However, the density of sintoc for each diameter class between the altitudes and between the slope directions was not significantly different. This indicates that sintoc species is able to grow at various altitudes and is quite tolerant to the environments with different duration of direct sunlight exposure. Our results revealed that *C. sintoc* has any habitat preference to particular topographic variables , thus it can be classified as a generalist species.

Table 3. Density of tree pole boles and trees at each altitude class and slope direction

Slope direction	The altitude (m asl)	Density (ind ha^{-1})	
		Pole	Tree
West	600	13	8
	700	8	12
	800	4	8
	900	8	10
	1000	19	2
	Total	52	40
South	500	20	15
	800	16	5
	900	7	7
	1000	0	3
	1200	13	3
	Total	56	33
East	500	5	6
	600	13	6
	700	21	2
	800	19	5
	900	0	9
	1000	13	9
	1100	33	17
	Total	104	54
North	500	7	7
	600	27	8
	700	48	7
	800	6	6
	900	2	4
	1000	4	4
	Total	94	36
	Grand Total	306	163

Table 4. Mean sepatarions of *Cinnamomum sintoc* tree density in each diameter class between altitudes and between slope directions

Tree size stratification	Between altitude			Between slope direction		
	Name of test	P		Name of test		
A	t-student	0.251	(ns)	t-student	0.142	(ns)
B	Mann-Whitney	0.367	(ns)	t-student	0.072	(ns)
C	t-student	0.492	(ns)	t-student	0.441	(ns)
D	Mann-Whitney	0.069	(ns)	t-student	0.307	(ns)
E	Mann-Whitney	0.949	(ns)	t-student	0.069	(ns)

Note: ns = non-significant; s = significant (at α: 5%)

Table 5. Mean sepatarions of tree density at each stratum of between altitudes and between slope directions

Tree size stratification	Between altitude			Between slope direction		
	Name of test	P		Name of test	P	
A	Mann-Whitney	0,695	(ns)	Mann-Whitney	0,058	(ns)
B	Mann-Whitney	0,921	(ns)	Mann-Whitney	0,001	(s)
C	t-student	0,069	(ns)	t-student	0,258	(ns)
D	Mann-Whitney	0,880	(ns)	t-student	0,685	(ns)
E	Mann-Whitney	0,754	(ns)	Mann-Whitney	0,012	(s)

Description: ns = non-significant; s = significant (at α: 5%)

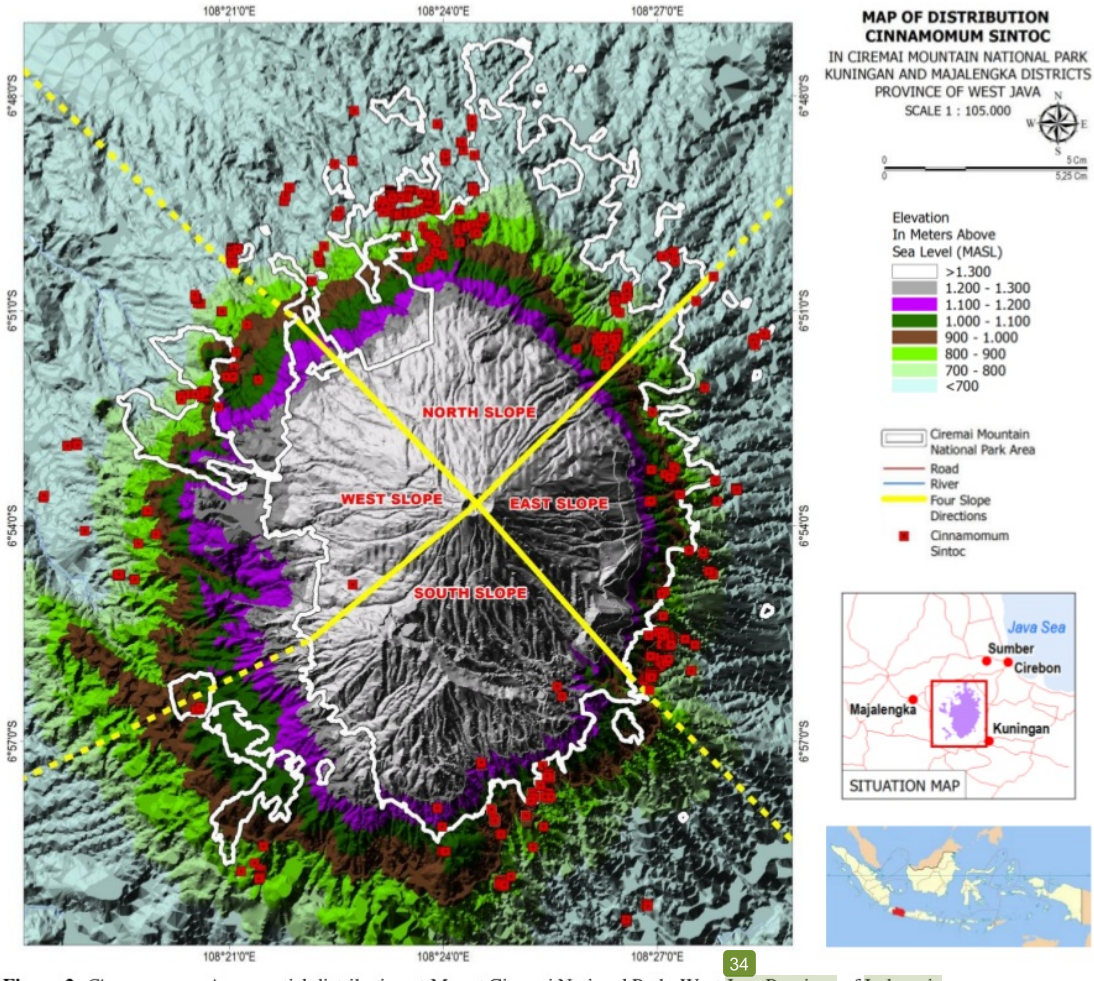

Figure 2. *Cinnamomum sintoc* spatial distribution at Mount Ciremai National Park, West Java Province of Indonesia

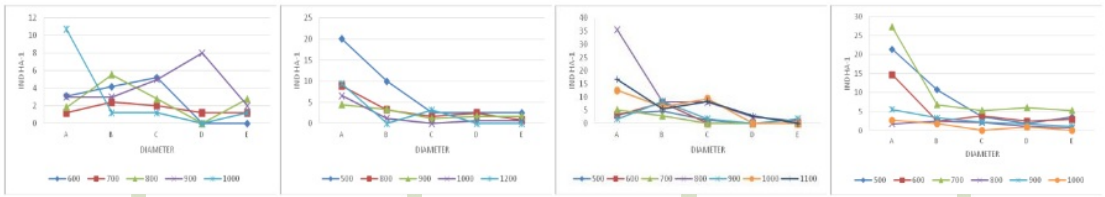

Figure 3. Stem diameter class distribution of Cinnamomum sintoc tree stand (cm). A. West, B. South, C. East, D. North. Diameter Class: A= 10-20 cm, B= 21-30 cm, C=31-40 cm, D=41-50 cm, E = > 50 cm

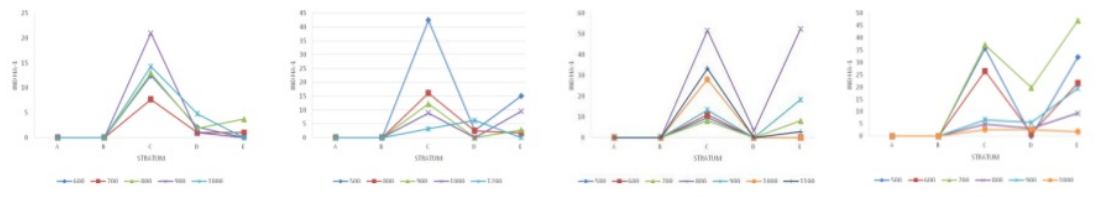

Figure 4. Crown height class of Cinnamomum sintoc tree stand (m). A. West, B. South, C. East, D. North

Stratification of vegetation is also known as stratum or strata. Strata is a grouping of plants based on height for vertical space and tree diameter for horizontal space. Stratification is determined based on crown height because each species has a different maximum height, in which crown of the same species lies in different strata (Baker and Wilson 2000). Vertical structure or stratification of a stand is seen from the stand height distribution. Based on vertical structure, *C. sintoc* stand was dominated by C stratum (4-11, suggesting that *C. sintoc* stand in the lowland forest of Mount Ciremai National Park was still in the growth phase.

In the horizon[22]structure, sintoc was found in the stem diameter class of 10-20 cm, 20-30 cm, and 30-40 cm. This phenomenon shows that *C. sintoc* is still able to regenerate even in a disturbed ecosystem that has undergone modification**.** In this study, sintoc density in 10-20 cm stem diameter class was higher than that of the individual density in the above stem diameter classes. This result is in line with that of Oladoye et al. (2014), who found that the number of individual trees decreased along with the increase of stem diameter of the[11]ees. The result also indicates that the lowland forest of Mount Ciremai National Park was in the mid-level succession. This data also provides supporting information that *C. sintoc* has the capability to regenerate and its sustainability can be guaranteed as long as there is no logging activity on the species.

As a species with a high economic value since it is a medicinal plant, the presence of *C. sintoc* needs to be maintained and multiplied in population. The results of this study have provided information that *C. sintoc* can be developed or cultivated in diverse environments including cultivated lands ranging from lowlands to highlands.

In conclusion, the tree population of *C. sintoc* was found ain Mount Ciremai National Park at an altitude of 500-1200 m asl with the density ranged from 2 ind ha^{-1} to 17 ind ha^{-1}. The sintoc spread on stratification of C stratum (4 - 20 m), D stratum D (1-4 m), and E stratum (0-1 m) while horizontally, the species existed in diameter class distribution of 10-60 cm.

ACKNOWLEDGMENTS

We would like to thank the Head of Mount[11] Ciremai National Park of the Ministry of Environment and Forestry Republic of Indonesia for his support during survey. We also thank Toto Supartono, Ilham Adhya, Yayan Hendrayana, Dian, Tito, Yudi, Abdul Hakim, Dedi, and Dasji for helping the data collecting during the research.

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