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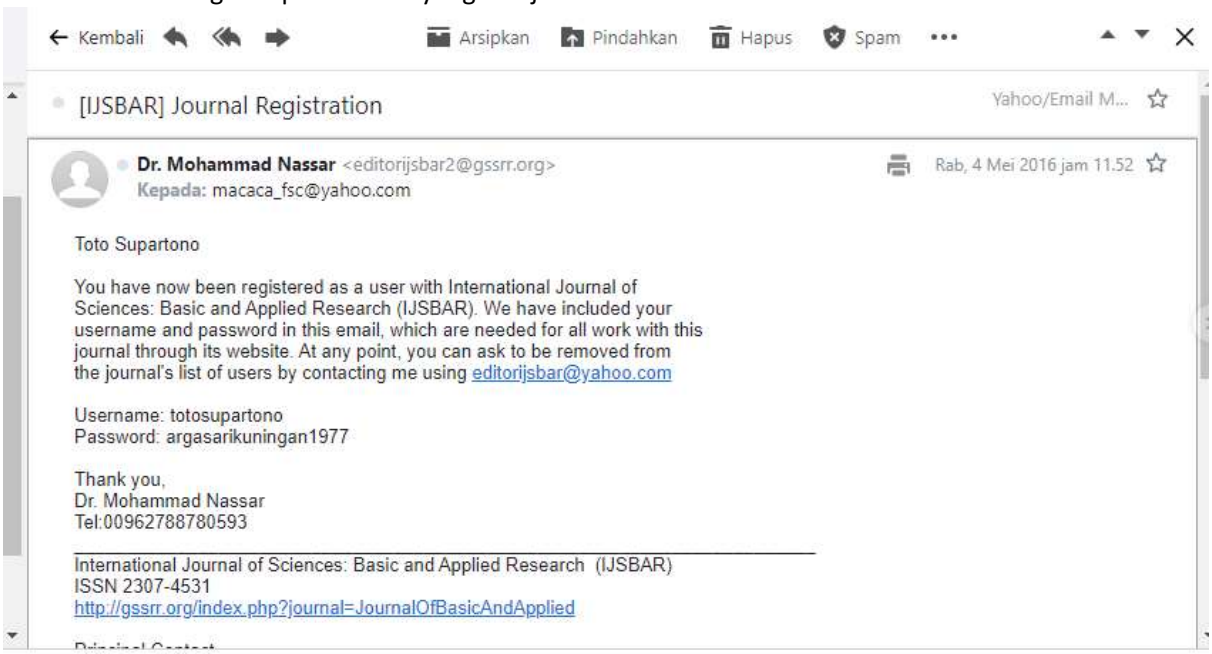

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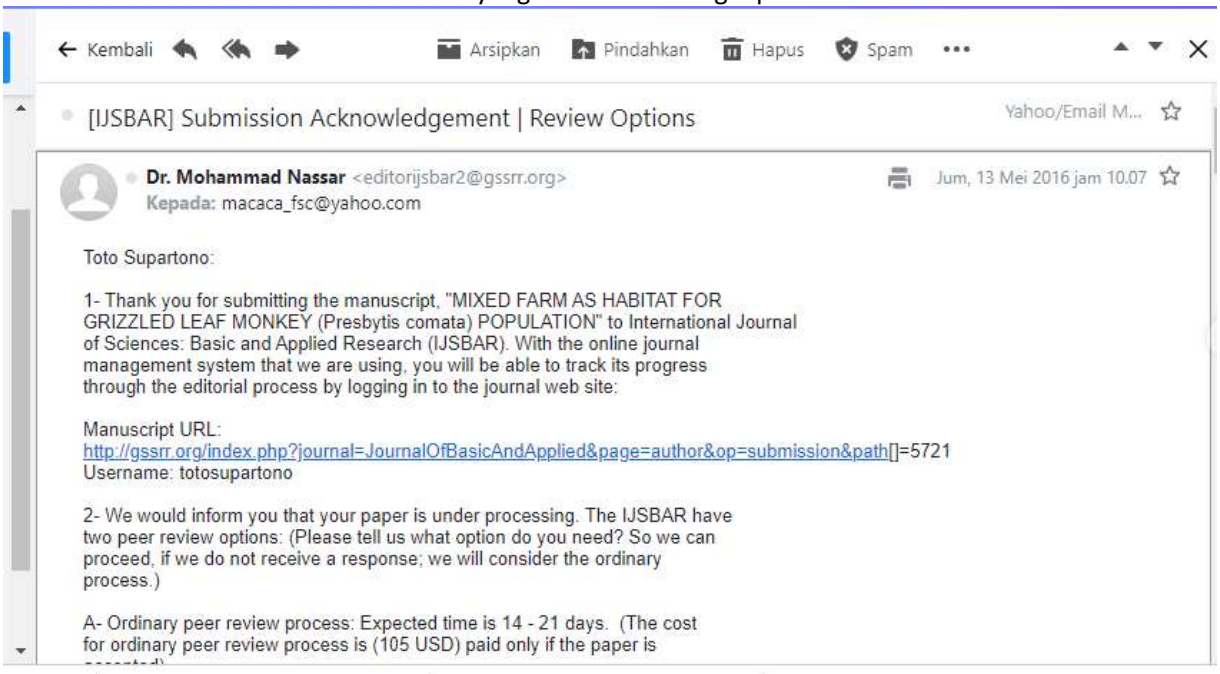

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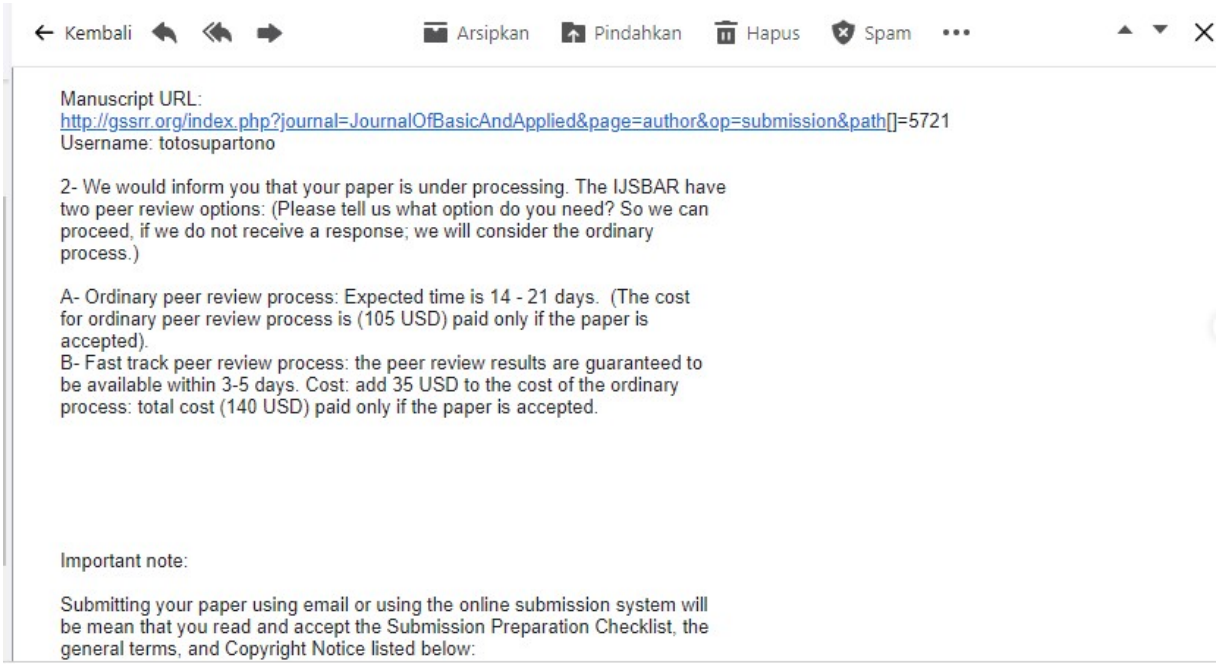

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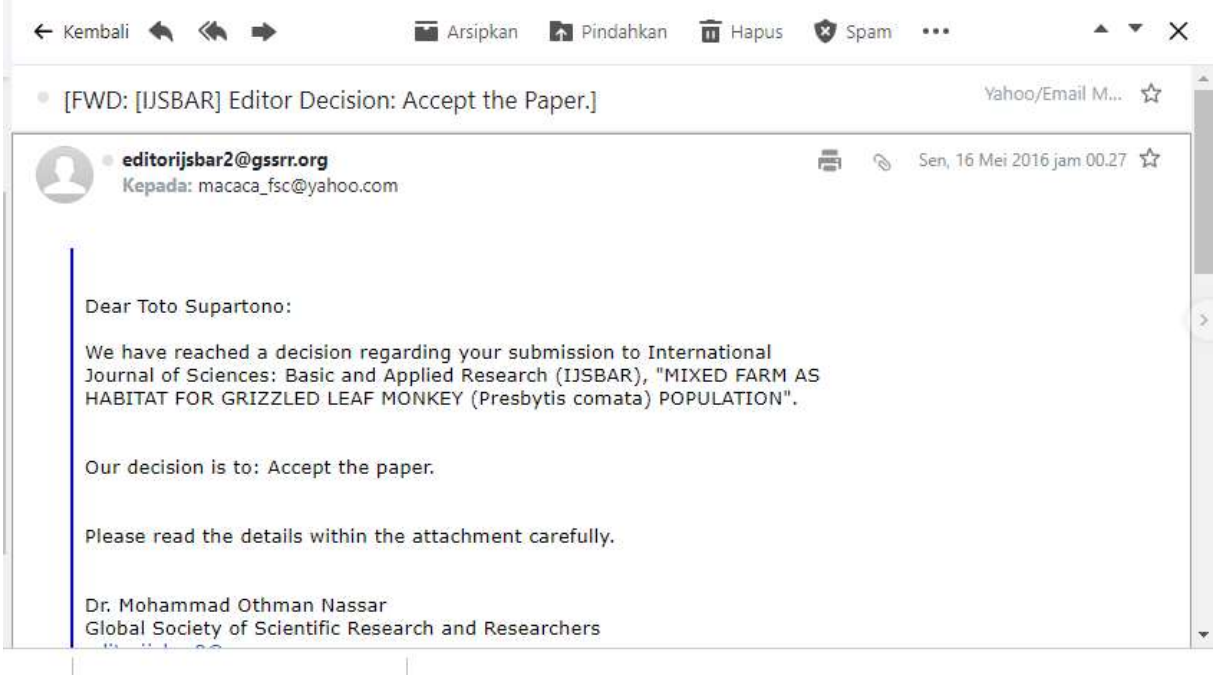

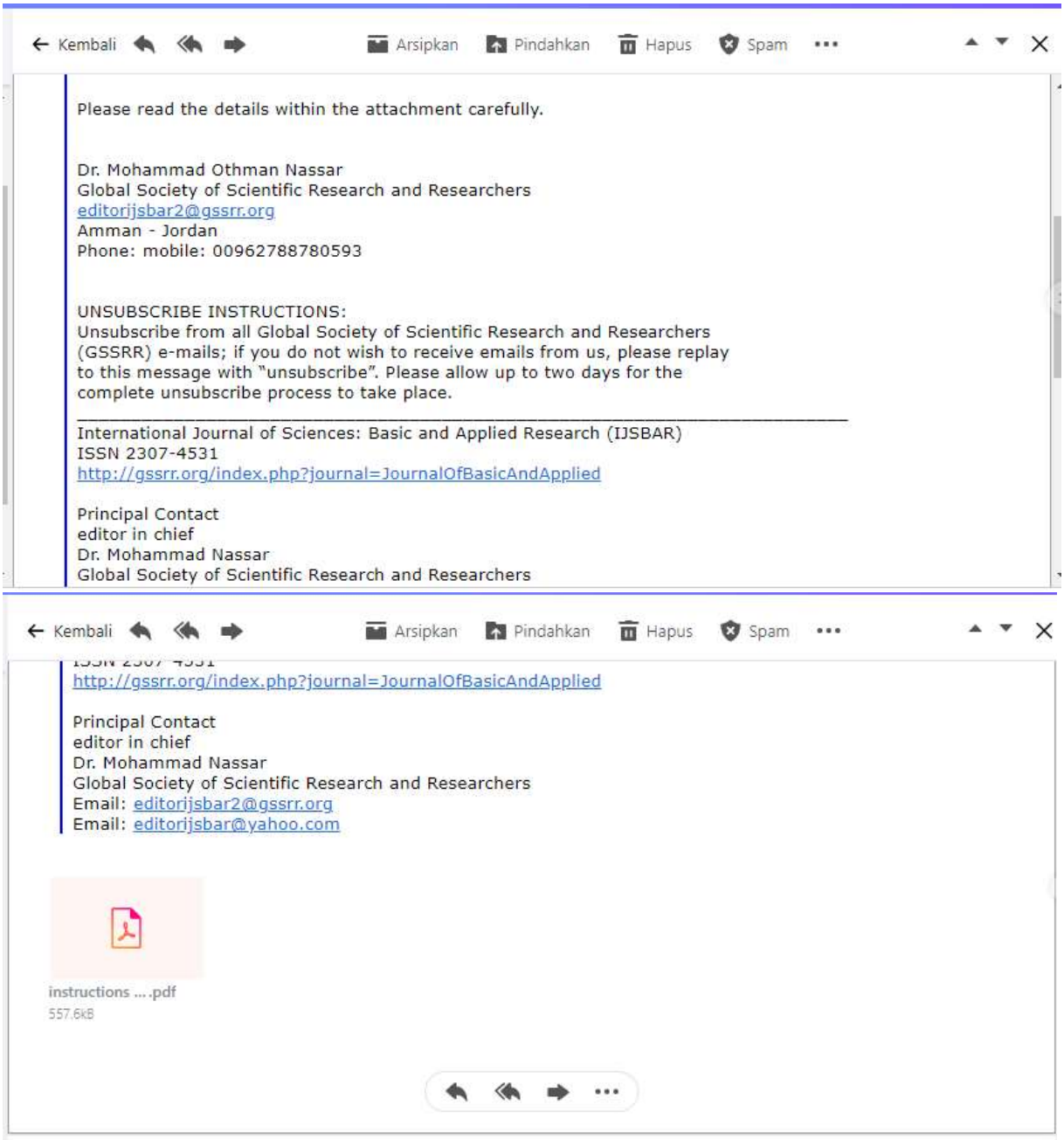

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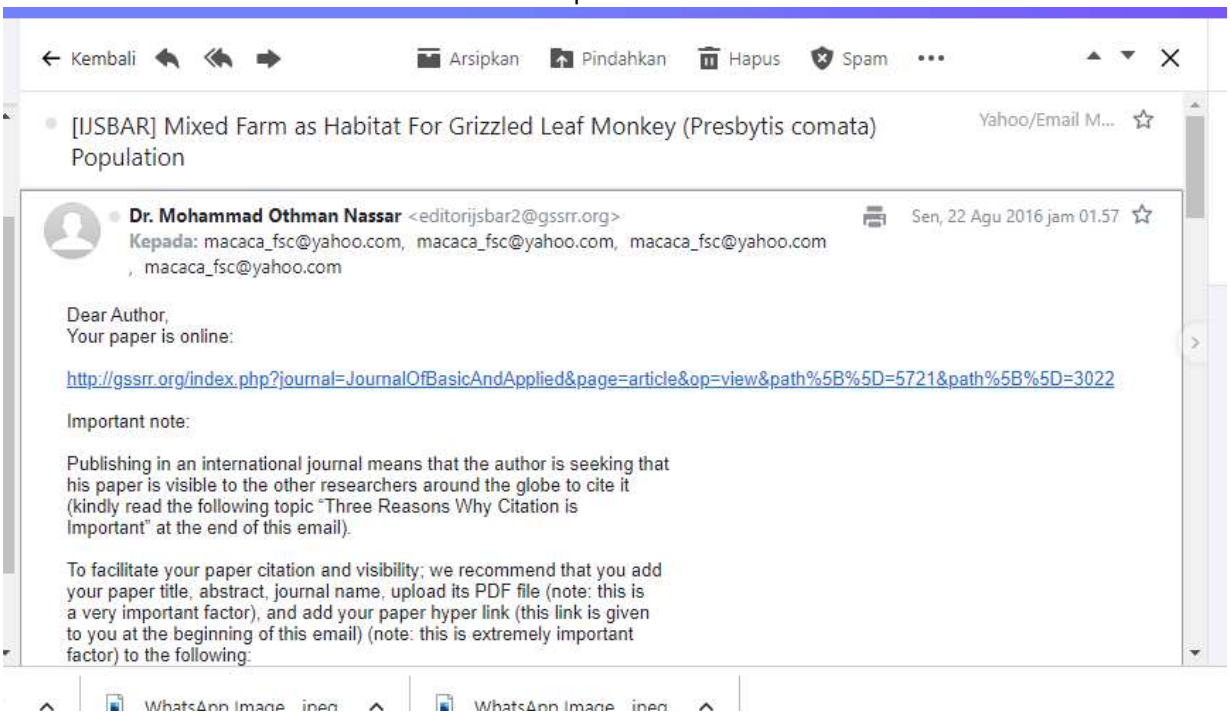

Artikel yang dipublikasikan secara online (Lampiran 5)

MIXED FARM AS HABITAT FOR GRIZZLED LEAF MONKEY (*Presbytis comata*) POPULATION

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Abstract

There is limited evidence of mixed farm area as a habitat of grizzled leaf monkey. In this study we found an important finding of small suriligroup in a mixed farm area.This study also examines the vegetation charasteristic, presence of other animals and disturbances that influence presence of the monkey. Vegetation data was collected on 57 sample plots. Information about disturbances and other animals were obtained by interviewing the locals. Data were analyzed using standard descriptive analysis. Number of trees and food tree species were 42 and 28 with density of 305.79 and 113.58treeha^{-1}respectively. Stratum C trees with 4-20 m height and 10-20 cm in diameterwere dominating this farm. Other animals found were *Macaca fascicularis, Trachypitecus auratus,* some species of eagles, and phytons. We suggest that the vegetation and relatively secureenvironment have enable occupancy of mixed farm as a habitat of grizzled leaf monkey.

Keywords: food tree, primate, density, stratum, *Trachypitecus auratus.*

Introduction

Conservation of wild animal in mixed farm are rare due to current conservation efforts are limited to protection areas including national parks and wildlife reserves.Mixed farms mostly dominated by multipurpose trees, which mainly harvested of woods and fruits [1] and located in private land. We propose that the land ownership status was one of factors reasons why the areas are yet to be included on conservation activities. Whereas, some farms have shown an important role on wildlife conservation, for example orangutan in Sumatera [2] and Japanese macaques at Kameyama and Nabari in Japan [3]

Grizzled leaf monkey has been listed as endangered species with a limited area of distribution, shy[4] and sensitive to human presence [5]. Themonkeypopulation was estimated approximately 2285 individuals [6] and continued to decrease[7]. Indonesian Government has included grizzled leaf monkey as one of priorities in species conservation. The natural habitat of grizzled leaf monkeyis lowland forest ecosystem [8]. However, the decreasing of lowland forest due to land conversionsaffecting grizzled leaf monkey population to be more common at hill and mountainforests. Therefore, many conservationprogramsweredone in the mountain forest, which mainlydesignated alsoas conservation area.

Althoughgrizzled leaf monkeys occupied hill and mountain forests, in some places they could be found in artificial ecosystems. [9] found group of surili consuming

fruit of a treeinafarm area. Other study recorded surili entering a tea farm and consuming the leaves [4]. However, the existence of grizzled leaf monkey on mixed farm received less attention from researchers. Researchers tend to focus the population studies in conservations areas ([10]; [11]; [5]). The information about grizzled leaf monkey population on mixed farm is still limited while it may provide opportunity for the population conservation.

No study has been conducted to examine grizzled leaf monkey occupied a mixed farm in Kuningan District.Thus, we analyzed variables ofa mixed farm that can explain the existence of the monkey. According to previous studies the presence of a species in an area influenced by several factors, such as distance to settlements, size of area[12], tree density[13], tree diameter, the presence of pioneer and non-pioneer trees, basal area of food tree [14] and domination of food tree [15]. This study examines the explanatory factors of grizzled leaf monkeyoccupancy in a mixed farms according with particular focus on vegetation characteristics, the presence of other species and existing disturbances.

Methods

Research Location

This study was conductedat forest area of Ciberung Village, Selajambe Sub-District, Kuningan District. Research site consisted of two blocks including PasirArgasari in the south and PasirTanggulun in the north. Both blocks surrounded by paddy fields and bordering with settlement at some points. The areas between block were divided with road. However, the crown cover of both areas were almost connected and fully covered by vegetation. The northern part of PasirTanggulun block was less dense and connected to a wider forest area (Bukit Pembarisan block). The research site was mixed farm owned by local community mainly planted with trees producing timber and fruit. The species which commonly planted on mixed farms at Kuningan District weresengon (*Paraserianthes falcataria*), mahogany (*Swietenia mahagoni*), kihiyang, jeungjing, coconut (*Cocos nucifera*), melinjo (*Gnetum gnemon*), rambutan (*Nephelium mutabile*), and bamboo[1].

Data Collecting

Vegetation

The vegetation parameters observed in this study were number of tree and food tree species, total tree density, total food tree density,food tree distribution, dominating tree species and tree height. We collected vegetation data using transect method [16]. Sample plots of 20 x 20 were established every 100 meters [17]. We recorded species name, diameter at breast height for all tree with diameter ≥ 10 cm[18], and tree height. Trees with diameter ≥ 10 cm considered strong and capable of supporting primate activities in particular feedingactivities [19]. We did not record trees with diameter less than 10 cm due to the arboreal characterist of grizzled leaf monkey[4];[20]. Food tree species of grizzled leaf monkeys could be identified using three approachments: studies of previous research ([4], [9], [21], interview with local local community and direct observations.

Grizzled Leaf Monkey Group and Other Animals

The measured parametersof grizzled leaf monkey group ware the number of individuals and their activities. Data were obtained by interviewing local communityand followed by a field survey using a transect method. We visited places in mixed farms where community observe the monkey. During this observation we also collected data of other animals.

Disturbance to Grizzled Leaf Monkey

We recorded the disturbances of the research site including hunting and logging. We interviewed the local communityto collect hunting data. Logging datawere identified from the number of stumps on sample plots collected during vegetation survey.

Data Analysis

We calculated the frequency, relative frequency, tree density, relative density, tree dominance, relative dominance and importance value index. Each variable wasusing the following formula :

Frequency of each species	=	number of sample plot of each species/ total sample plots
Relative frequency of each species (%)	=	frequency of each species/ total frequency x 100%
Density of each species (ind/ha)	=	number of each species from entire plots/ total area of sample plots
Relative density of each species (100%)	=	density of each species/ total density x 100%
Dominance of each species (m^2/ha)	=	basal area of each species/ total area of sample plots
Relative dominance of each species (m^2/ha)	=	domination of each species/ total domination entire species x 100%
Importance Value Index (%)	=	relative frequency + relative domination + relative density

Food tree distribution pattern was estimated using theformula [22]:

$$\lambda^2 = (\Sigma(x_i - \bar{x})^2)/\bar{x}\text{ , then } d = \sqrt{2\lambda^2} - \sqrt{2(n-1)-1}$$

nisthe number of sample plots. If |d| < 1.96,randomdistribution pattern. If d < -1.96, uniformdistribution pattern. If d > 1.96,aggregated distribution pattern. Other data was analyzed descriptively.

Result

Tree species and density

We recorded 679 treesoriginated from 42 tree species. Total tree density was 305.70 ind ha^{-1} and basal area approximately 18.68 m^2ha^{-1}. The most dominant and

dense species were mahagony(*Swietenia macrophylla*), teak (*Tectona grandis*) and sengon (*Paraserianthes falcataria*) (Table 1).Other plant were also recorded including coconut (5.26 treeha^{-1}), sugar plum (2.19 treeha^{-1}), bamboo (8.33 clusterha^{-1}), and banana (67.11 clusterha^{-1}).

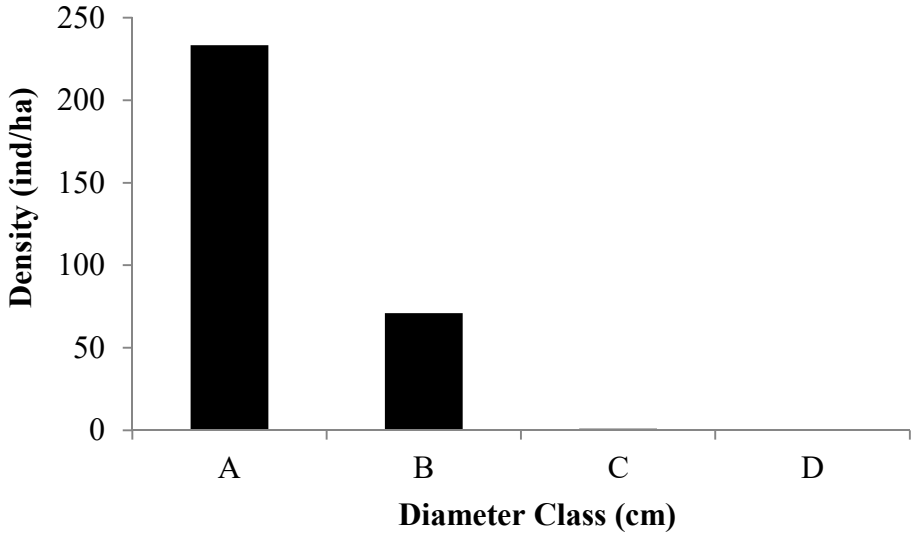
Tabel 1. Frequency, basal area, and density of ten trees with the highestImportance Value Index in the mixed farm

Name	Family	F	BA (m^2ha^{-1})	D ($indha^{-1}$)	IVI (%)
Swietenia macrophylla	Meliaceae	45	5.32	93.42	75.35
Tectona grandis	Verbenaceae	45	3.82	70.61	59.85
*Paraserianthes falcataria**	Fabaceae	34	1.98	39.47	35.82
*Michelia velutina**	Magnoliaceae	11	1.33	10.53	14.55
*Albizia procera**	Fabaceae	15	0.71	9.21	12.25
*Artocarpus heterophyllus**	Moraceae	14	0.38	6.58	9.25
*Cassia siamea**	Fabaceae	10	0.62	7.02	9.24
Gmelina arborea	Verbenaceae	8	0.43	10.09	8.50
Casearia vellutina	Salicaceae	8	0.59	5.26	7.76
*Mangifera foetida**	Anacardiaceae	10	0.45	5.26	7.75

Note: *tree food ; F = frequency; BA = basal area; D = density; IVI = Importance Value Index

Stand Structure

Most of tree species were 10 to 20 cm in diameter while those with 40 cm diameter were the less one (Figure 1). Mixed farms were occupied by many trees of stratum C (302 indha^{-1}), followed by stratum D (1.75 indha^{-1}) and B (1.32 indha^{-1}). We found no A and E in our research site.



Picture 1. Tree density distribution at four diameter classes. A = 10 - <20 cm; B = 20 - < 40 m; C = 40 - < 50 cm; and D = > 50 cm

Food Tree

This research found 28 potential food trees with a total of 258 individuals. Total density of food trees was 113.58 indha^{-1}and the density of ten most dominance species was 90.71 indha^{-1}. Total basal area was 7.62 m^{2}ha^{-1} and basal area of ten most dominance species was 6.43 m^{2}ha^{-1}. The food trees showed an aggregated pattern of distribution(d = 12.06).

Group Size, History of Existenceand Activity

Through field observation we recorded a group of grizzled leaf monkey consisted of 3 individuals at PasirArgasari block on January 2014. Local community also observed a group of grizzled leaf monkeyaround March 2014. Grizzled leaf monkey has never been observed in the location since 1960's. On mid 2015 the community also reported a different group of grizzled leaf monkey consisted of 7 individuals entered the research site during dry season. This group left the site to a larger forest area (Bukit Pembarisan forest block). Another group consisted of 6-8 individuals reported seen at PasirTanggulun block but left the area beforeour field observation. There were no information when grizzled leaf monkey first seen at PasirTanggulun block.

We conducted a direct observation and found grizzled leaf monkey groupon *Parkia speciosa* trees consuming its fruits. The local people reported that the group was also eat white leadtree fruits and *Paraserianthes* shoots.

Disturbance

Grizzled leaf monkey was not subject to hunting of the local community. The activity that could potentially cause disturbance was tree logging. Stump density was found in 10 out of 57 sample plots with a total of 81 stumps and density 35.52 stumpsha^{-1}. Mixed farms were also crossed by a road. Therefore, all mixed farms along the road have potential disturbance from vehicles.

Other species and Their Presence History

Other primates found on the site were long tail monkey and langur. By the time we collected vegetation data, we found a group consisted of 38 individuals of long tail monkey at PasirArgasari block. The local community informed thatthere were three groups of long tail monkey on research site. The first group of long tail monkey seen on the site was on 1997, consisted of 4-5 individuals.

We found a group of langur consisted of 10 individuals at PasirArgasari block. Local community informed that there were three groups of langur with 10-17 individuals. First observation of langur at research site was on 1997, when onecommunity member was biten by two individuals while sawing wood. In the period of 1960-1996, there were no long tail monkey nor langur observed at PasirArgasari block. It is unclear when both species started occupying PasirTanggulun block. According to information, potential predators especially for infant of grizzled leaf monkeywere phytons and eagles.

Discussion

Grizzled leaf monkeyhas arboreal characteristic [4] and used trees and canopies for movement. Thus, tree and canopy densities were important vegetation parameter. Our study found tree density on research site was close to tree density of grizzled leaf monkey habitat on Situ Patenggang Conservancy Area which was 380 indha^{-1}[23]. As a comparison, tree density of *Presbytis fredericae*in rubber plantation at Pekalongan District was 1361,22 indha^{-1}[24] and inGunungSalak National Park was 630 indha^{-1}[11]. Tree lower density in mixed farm was due to logging activities. In the contrary,logging was forbidden on both conservancy areas. Tree logging was also low at rubber plantation. We could calculated a denser land coverage by including data of bamboo, sugar plum, coconut and banana on tree density measurement. However, we ovoid the calculation since the plans are not categorized as timber species.

Our result showed that tree density on mixed farm was dominated by trees with diameter 10-19 cm followed by trees with diameter 20-39 cm. Larger trees were very rare. We found 3 species with diameter >40 cm which are kedondong (*Spondias dulcis)* around 46 cm, sengon (*Paraserianthes falcataria)* around 51 cm, andmanglid (*Michelia velutina)*around 107 cm.[23] reported grizzled leaf monkey natural habitat at Situ PatenggangConservation Area composed by trees with diameter above 12 cm. According to diameter class density, we concluded that mixed farms were feasible as habitatforgrizzled leaf monkey. [14] also reported that trees with large diameter were influencing the presence of howler monkey (*Alouatta palliata mexicana*) on fragmented habitats. For this reason, we propose to preserve trees with large diameter on mixed farms.

Mixed farms commonly dominated by timber trees, but we also recorded some fruit-bearing trees. Five out of ten most dominating tree with highest density were mahagony (*Swietenia macrophylla*), teak (*Tectona grandis*), andsengon (*Paraserianthes falcataria*), followed by fruit-bearing species jackfruit (*Artocarpus heterophyllus*) and pakel (*Mangifera foetida*).A study by [24]on rekrekan habitat(rubber plantation and other purposes) found the most dominating tree on sapling stage were pine (*Pinus merkusii*), mbagan (*Syzygium attenuatum*), pucung (*Pangium edule*) and durian (*Durio zibethinus*); as for tree stage were pine, rubber (*Hevea brasiliensis*), and kondang (*Ficus variegata*). Another habitat of grizzled leaf monkey was GunungSalak National Park, where the most dominating species on sapling stage were huru (*Litsea* sp.), mara (*Macaranga triloba*), and jirak (*Symplocos fasciculata*) while on tree stage were pasang (*Quercus sundaicus*), huru, and kisireum (*Syzygium teneicuspis*) [11].According to these results, we concluded that grizzled leaf monkeys were not only occupy natural forest but also able to live and adapt to production forests with high human activities.

[25] reported that canopy height has important role for primates. Our research showed that mixed farms were dominated by trees with stratum C (4-20 m) while stratum C and D were rarely found. Stratum A was not found and stratum E was not recorded. The density of trees at Situ Patenggang Conservancy Area with a height 5-15m wasaround 40,13%, height>15m around 49,34% while those with a height less than 5m was around 10,53% [23].Previous study showed that grizzled leaf monkey activities mainly occur on these stratums [4]. [5] also reported that grizzled leaf monkey mainly observed on a 5-20 meters height inGunungHalimun National Park, where 62,06% of them found on undisturbed forest and 68,42% found on disturbed forest. Trees of stratum C at Situ Patenggang Conservancy Area were used for feeding activities [23]. Although stratum A and B were rare or non-exist, previous studies showed that canopy

height at mixed farm was sufficient to support movement and activities of grizzled leaf monkey.

Grizzled leaf monkey mainly consumes leaves [4]. Our study recorded 28 species of food trees both producing leaves and fruit. Thus, we compared this study with previous studies conducted in other places. However, our result was lower than that in Resort Bedogol atGunung Gede Pangrango National Park which was 58 species [26]. On the site of Situ Patenggang Conservation Area, [23]reported there were 25 food trees and [4] found 34 food trees, both excluding lianas and bushes. [24] recorded 45 species originated from 29 families at rubber plantation which can be used as potential food source for rekrekan. We suspected primary and secondary natural forests and concervationareashave the feasibility to support more tree species.

Food were abundant on mixed farmsince6 out of 10 species found were food trees, including*Paraserianthes falcataria*, *Michelia velutina*, and*Artocarpus heterophyllus.*According to a study by [24], rekrekan'sfeeding time on *Paraserianthes falcataria*was 1,63% and 0,28% on *Michelia velutina*but one of the most consumed was *Nephelium lappaceum.* In the contrary, we found*N. lappaceum* was not dominant on mixed farm.In natural habitat, dominant trees which can be used as a potential food souce were pasang, huru, and puspa (*Schima walichii*) [11].[23] also reported that at Situ Patenggang Conservation Area the species which their leaves and fruits commonly eaten were cerem (*Macropanax dispermum*), kikopi (*Canthium glabrum*), pasang (*Lithocarpus* sp.) and kijambe (*Memecylon costatum*). Total density of food trees of our result was lower than on research of [27] at lowland forest ecosystem of GunungCiremai National Park (225 indha^{-1}).

Grizzled leaf monkeycan use timber, fruit including unripen bananas as the source of food. [9] reported similar findings at RawaDanau Conservancy Area and TukungGede Mountain. According to previous studies on different locations, other species found consuming cultivated plants were red tail monkey (*Cercopithecus ascanius*), chimpanzee (*Pan troglodytes*), black and white monkey (*Colobus guereza*) at Kibale Uganda National Park area (Naughton-Treves 1998), bale monkey (*Chlorocebus djamdjamensis*) at fragmented forests of South Ethiopia [29], olive baboons (*Papio anubis*), vervet monkeys (*Chlorocebus aethiops*), and blue monkeys (*Cercopithecus mitis stuhlmanni*) at Budongo Forest Reserve Western Uganda [30].

Our result showed that the food trees has aggregated dispersal pattern. Group size grows parallelly with Variant Coefficient (VC) of food tree's basal area and larger CV means food tree disperse more aggregated [31]. Aggregated food tree allows primates to have a large group size. On area with aggregated food trees, grizzled leaf monkey group travels far to one food tree to another and facing many risks. The larger group size, the ability to detect threats is better [32]. Thus, grizzled leaf monkey needs a large group size to raise awareness and lower the risk of predation while gathering food.

We recorded three groups of grizzled leaf monkey on mixed farm, two groups were live in the farm and others were not. We suspect the third group entered the mixed farm on dry season, due to food scarcity on their main habitat. [3] reported on their study atKameyama and Nabari Japan that a group of macaques(*Macaca fuscata*) entered farm area to steal food due to similar reason. Thus, we conclude that the presence of trees along highway and river is important for grizzled leaf monkey movement. We also conclude that mixed farm contributes as food reserve when food on monkey's main habitat is scarce.

Groups of langur had already occupied the mixed farm before grizzled leaf monkey. Langurs and grizzled leaf monkeys consume leaves as their main food ([33]; [34]. Two species will compete if they share similar diet resources but the availability is limited. [9]) found both langur and grizzled leaf monkey consume teureup (*Artocarpus elastica*), peusar (*Artocarpus rigida*), purut (*Parartocarpus venenosa*) and duku (*Lansium domesticum*). However, there was no sufficient information about food tree species both primates consume and whether they compete.Long tail monkeys had also occupied the mixed farm even longer than langurs and grizzled leaf monkeys. Long tail monkey has already been considered as pest due to their disturbing activities to cultivation such as nut, cassava, corn, and ripen paddy. Long tail monkey will consume leaves when its food source has become rare [35]. Thus, this will lead to competition with grizzled leaf monkey. We propose further study about langur, long tail monkey and grizzled leaf monkeycompetition on food source. The information would be needed for habitat management and preservation of those species.

Mixed farms were also on eagles range. [36]reported two eagle species *Accipiter henstii* and*Polyboroides radiatus*preyed some primates such as *Microcebus rufus*, *Cheirogaleus major*, and*Avahi laniger*.Other predator species that was seen on research site was a large phyton. We suggest further research is needed to examine predator threats of grizzled leaf monkey on mixed farm.

Although potentially disturb grizzled leaf monkey, loggings were not conducted on many spots at the same time. Selective loggings were also applied. Therefore, grizzled leaf monkey were able to move to surrounding places when its previous tree was cut down. Grizzled leaf monkey was not subject of hunting because locals can tolerate their presence and their feeding activities has not been considered as harm.

Conclusion

Tree density, stratum, diameter class distribution, tree food availability and potential predatorare the influencing factors for grizzled leaf monkey to live at a mixed farm. Further study is needed to examine the competition of food source between grizzled leaf monkey, langur and long tail monkey. Further research about predatorsthreats of grizzled leaf monkey by eagles and snakes is also needed. Overall, mixed farm is feasible to be used as an alternative habitat for grizzled leaf monkey population conservation outside protection area.

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International Journal of Sciences: Basic and Applied Research (IJSBAR)

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Manuscript Number (ID)	5721
Title	MIXED FARM AS HABITAT FOR GRIZZLED LEAF MONKEY (Presbytis comata) POPULATION

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Mixed Farm as Habitat For Grizzled Leaf Monkey (*Presbytis comata*) Population

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Abstract

There is limited evidence of mixed farm area as a habitat of grizzled leaf monkey. In this study we found an important finding of small grizzled group in a mixed farm area. This study also examines the vegetation characteristic, presence of other animals and disturbances that influence presence of the monkey. Vegetation data was collected on 57 sample plots. Information about disturbances and other animals were obtained by interviewing the locals. Data were analyzed using standard descriptive analysis. Number of trees and food tree species were 42 and 28 with density of 305.79 and 113.58 tree ha^{-1} respectively. Stratum C trees with 4-20 m height and 10-20 cm in diameter were dominating this farm. Other animals found were *Macaca fascicularis, Trachypitecus auratus,* eagles, and phytons. We suggest that the vegetation and relatively secure environment have enable occupancy of mixed farm as a habitat of grizzled leaf monkey.

Keywords: food tree; primate; density; stratum; *Presbytis comata*

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1. Introduction

Conservation of wildlife in mixed farm are rare due to current conservation efforts are limited to protection areas including national parks and wildlife reserves. Mixed farms mostly dominated by multipurpose trees, which mainly harvested of woods and fruits [1] and located in private land. We propose that the land ownership status was one of factors reasons why the areas are yet to be included on conservation activities. Whereas, some

farms have shown an important role on wildlife conservation, for example orangutan in Sumatera [2] and Japanese macaques at Kameyama and Nabari in Japan [3]

Grizzled leaf monkey has been listed as endangered species with a limited area of distribution, shy [4] and sensitive to human presence [5]. The monkey population was estimated approximately 2285 individuals [6] and continued to decrease [7]. Indonesian Government has included grizzled leaf monkey as one of priorities in species conservation. The natural habitat of grizzled leaf monkey is lowland forest ecosystem [8]. However, the decreasing of lowland forest due to land conversions affecting grizzled leaf monkey population to be more common at hill and mountain forests. Therefore, many conservation programs were done in the mountain forest, which mainly designated also as conservation area.

Although grizzled leaf monkeys occupied hill and mountain forests, in some places they could be found in artificial ecosystems. [9] found group of surili consuming fruit of a tree in a farm area. Other study recorded surili entering a tea farm and consuming the leaves [4]. However, the existence of grizzled leaf monkey on mixed farm received less attention from researchers. Researchers tend to focus the population studies in conservations areas ([10]; [11]; [5]). The information about grizzled leaf monkey population on mixed farm is still limited while it may provide opportunity for the population conservation.

No study has been conducted to examine grizzled leaf monkey occupied a mixed farm in Kuningan District. Thus, we analyzed variables of a mixed farm that can explain the existence of the monkey. According to previous studies the presence of a species in an area influenced by several factors, such as distance to settlements, size of area[12], tree density[13], tree diameter, the presence of pioneer and non-pioneer trees, basal area of food tree [14] and domination of food tree [15]. This study examines the explanatory factors of grizzled leaf monkey occupancy in a mixed farms according with particular focus on vegetation characteristics, the presence of other species and existing disturbances.

2. Methods

2.1. Research Location

This study was conducted at forest area of Ciberung Village, Selajambe Sub-District, Kuningan District. Research site consisted of two blocks including Pasir Argasari in the south and Pasir Tanggulun in the north. Both blocks surrounded by paddy fields and bordering with settlement at some points. The areas between block were divided with road. However, the crown cover of both areas were almost connected and fully covered by vegetation. The northern part of Pasir Tanggulun block was less dense and connected to a wider forest area (Bukit Pembarisan block). The research site was mixed farm owned by local community mainly planted with trees producing timber and fruit. The species which commonly planted on mixed farms at Kuningan District were sengon (*Paraserianthes falcataria*), mahogany (*Swietenia mahagoni*), kihiyang, jeungjing, coconut (*Cocos nucifera*), melinjo (*Gnetum gnemon*), rambutan (*Nephelium mutabile*), and bamboo[1].

2.2. Data Collecting

2.2.1. Vegetation

The vegetation parameters observed in this study were number of tree and food tree species, total tree density, total food tree density,food tree distribution, dominating tree species and tree height. We collected vegetation data using transect method [16]. Sample plots of 20 x 20 were established every 100 meters [17]. We recorded species name, diameter at breast height for all tree with diameter ≥ 10 cm[18], and tree height. Trees with diameter ≥ 10 cm considered strong and capable of supporting primate activities in particular feeding activities [19]. We did not record trees with diameter less than 10 cm due to the arboreal characterist of grizzled leaf monkey[4];[20]. Food tree species of grizzled leaf monkeys could be identified using three approachments: studies of previous research [4], [9], [21], interview with local local community and direct observations.

2.2.2. Grizzled Leaf Monkey Group and Other Animals

The measured parametersof grizzled leaf monkey group ware the number of individuals and their activities. Data were obtained by interviewing local community and followed by a field survey using a transect method. We visited places in mixed farms where community observe the monkey. During this observation we also collected data of other animals.

2.2.3. Disturbance to Grizzled Leaf Monkey

We recorded the disturbances of the research site including hunting and logging. We interviewed the local community to collect hunting data. Logging data were identified from the number of stumps on sample plots collected during vegetation survey.

2.3. Data Analysis

We calculated the frequency, relative frequency, tree density, relative density, tree dominance, relative dominance and importance value index. Each variable was using the following formula :

Frequency of each species	=	number of sample plot of each species/ total sample plots
Relative frequency of each species (%)	=	frequency of each species/ total frequency x 100%
Density of each species (ind/ha)	=	number of each species from entire plots/ total area of sample plots
Relative density of each species (100%)	=	density of each species/ total density x 100%
Dominance of each species (m^2/ha)	=	basal area of each species/ total area of sample plots
Relative dominance of each species (m^2/ha)	=	domination of each species/ total domination entire species x 100%
Importance Value Index (%)	=	relative frequency + relative domination + relative density

Food tree distribution pattern was estimated using theformula [22]:

$$\lambda^2 = \left(\Sigma(x_i - \bar{x})^2\right)/\bar{x}, \text{ then } d = \sqrt{2\lambda^2} - \sqrt{2(n-1)-1}$$

where n is the number of sample plots. If |d| < 1.96, random distribution pattern. If d < -1.96, uniform distribution pattern. If d > 1.96, aggregated distribution pattern. Other data was analyzed descriptively.

3. Result

3.1. Tree Species and Density

We recorded 679 trees originated from 42 tree species. Total tree density was 305.70 ind ha^{-1} and basal area approximately 18.68 m^2ha^{-1}. The most dominant and dense species were mahagony (*Swietenia macrophylla*), teak (*Tectona grandis*) and sengon (*Paraserianthes falcataria*) (Table 1). Other plant were also recorded including coconut (5.26 tree ha^{-1}), sugar plum (2.19 tree ha^{-1}), bamboo (8.33 cluster ha^{-1}), and banana (67.11 cluster ha^{-1}).

Table 1: Frequency, basal area, and density of ten trees with the highest Importance Value Index in the mixed farm

Name	Family	F	BA (m^2ha^{-1})	D ($indha^{-1}$)	IVI (%)
Swietenia macrophylla	Meliaceae	45	5.32	93.42	75.35
Tectona grandis	Verbenaceae	45	3.82	70.61	59.85
*Paraserianthes falcataria**	Fabaceae	34	1.98	39.47	35.82
*Michelia velutina**	Magnoliaceae	11	1.33	10.53	14.55
*Albizia procera**	Fabaceae	15	0.71	9.21	12.25
*Artocarpus heterophyllus**	Moraceae	14	0.38	6.58	9.25
*Cassia siamea**	Fabaceae	10	0.62	7.02	9.24
Gmelina arborea	Verbenaceae	8	0.43	10.09	8.50
Casearia vellutina	Salicaceae	8	0.59	5.26	7.76
*Mangifera foetida**	Anacardiaceae	10	0.45	5.26	7.75

Note: *tree food ; F = frequency; BA = basal area; D = density; IVI = Importance Value Index

3.2. Stand Structure

Most of tree species were 10 to 20 cm in diameter while those with 40 cm diameter were the less one (Figure 1). Mixed farms were occupied by many trees of stratum C (302 indha^{-1}), followed by stratum D (1.75 indha^{-1}) and B (1.32 indha^{-1}). We found no A and E in our research site.

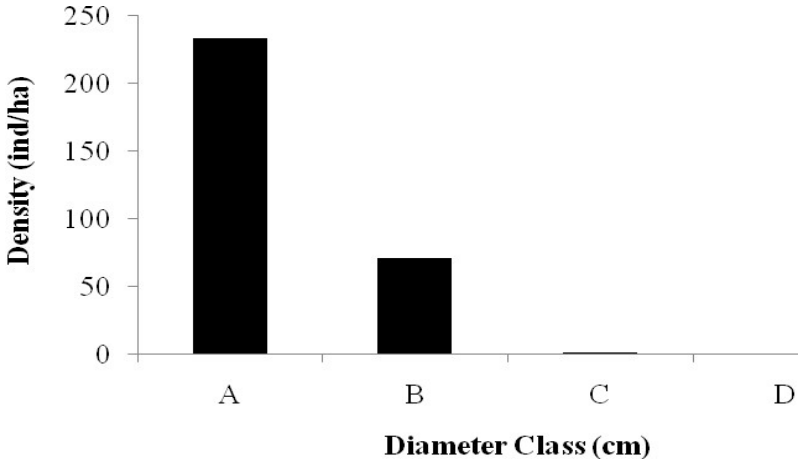

Figure 1: Tree density distribution at four diameter classes. A = 10 - <20 cm; B = 20 - < 40 m; C = 40 - < 50 cm; and D = > 50 cm

3.3. Food Tree

This research found 28 potential food trees with a total of 258 individuals. Total density of food trees was 113.58 ind ha^{-1}and the density of ten most dominance species was 90.71 ind ha^{-1}. Total basal area was 7.62 m^2 ha^{-1} and basal area of ten most dominance species was 6.43 m^{2}ha^{-1}. The food trees showed an aggregated pattern of distribution (d = 12.06).

3.4. Group Size, History of Existence and Activity

Through field observation we recorded a group of grizzled leaf monkey consisted of 3 individuals at Pasir Argasari block on January 2014. Local community also observed a group of grizzled leaf monkey around March 2014. Grizzled leaf monkey has never been observed in the location since 1960's. On mid 2015 the community also reported a different group of grizzled leaf monkey consisted of 7 individuals entered the research site during dry season. This group left the site to a larger forest area (Bukit Pembarisan forest block). Another group consisted of 6-8 individuals reported seen at Pasir Tanggulun block but left the area before our field observation. There were no information when grizzled leaf monkey first seen at Pasir Tanggulun block.

We conducted a direct observation and found grizzled leaf monkey group on *Parkia speciosa* trees consuming its fruits. The local people reported that the group was also eat white lead tree fruits and *Paraserianthes* shoots.

3.5. Disturbance

Grizzled leaf monkey was not subject to hunting of the local community. The activity that could potentially cause disturbance was tree logging. Stump density was found in 10 out of 57 sample plots with a total of 81 stumps and density 35.52 stumps ha^{-1}. Mixed farms were also crossed by a road. Therefore, all mixed farms along the road have potential disturbance from vehicles.

3.6. Other Species and Their Presence History

Other primates found on the site were long tail monkey and langur. By the time we collected vegetation data, we found a group consisted of 38 individuals of long tail monkey at Pasir Argasari block. The local community informed that there were three groups of long tail monkey on research site. The first group of long tail monkey seen on the site was on 1997, consisted of 4-5 individuals.

We found a group of langur consisted of 10 individuals at Pasir Argasari block. Local community informed that there were three groups of langur with 10-17 individuals. First observation of langur at research site was on

1997, when one community member was biten by two individuals while sawing wood. In the period of 1960-1996, there were no long tail monkey nor langur observed at Pasir Argasari block. It is unclear when both species started occupying Pasir Tanggulun block. According to information, potential predators especially for infant of grizzled leaf monkey were phytons and eagles.

4. Discussion

Grizzled leaf monkey has arboreal characteristic [4] and used trees and canopies for movement. Thus, tree and canopy densities were important vegetation parameter. Our study found tree density on research site was close to tree density of grizzled leaf monkey habitat on Situ Patenggang Conservancy Area which was 380 ind ha^{-1}[23]. As a comparison, tree density of *Presbytis fredericae* in rubber plantation at Pekalongan District was 1361.22 ind ha^{-1}[24] and in Gunung Salak National Park was 630 ind ha^{-1}[11]. Tree lower density in mixed farm was due to logging activities. In the contrary, logging was forbidden on both conservancy areas. Tree logging was also low at rubber plantation. We could calculated a denser land coverage by including data of bamboo, sugar plum, coconut and banana on tree density measurement. However, we avoid the calculation since the plans are not categorized as timber species.

Our result showed that tree density on mixed farm was dominated by trees with diameter 10-19 cm followed by trees with diameter 20-39 cm. Larger trees were very rare. We found 3 species with diameter >40 cm which are kedondong (*Spondias dulcis)* around 46 cm, sengon (*Paraserianthes falcataria)* around 51 cm, and manglid (*Michelia velutina)* around 107 cm. [23] reported grizzled leaf monkey natural habitat at Situ Patenggang Conservation Area composed by trees with diameter above 12 cm. According to diameter class density, we concluded that mixed farms were feasible as habitat for grizzled leaf monkey. [14] also reported that trees with large diameter were influencing the presence of howler monkey (*Alouatta palliata mexicana*) on fragmented habitats. For this reason, we propose to preserve trees with large diameter on mixed farms.

Mixed farms commonly dominated by timber trees, but we also recorded some fruit-bearing trees. Five out of ten most dominating tree with highest density were mahagony (*Swietenia macrophylla*), teak (*Tectona grandis*), and sengon (*Paraserianthes falcataria*), followed by fruit-bearing species jackfruit (*Artocarpus heterophyllus*) and pakel (*Mangifera foetida*). A study by [24]on rekrekan habitat (rubber plantation and other purposes) found the most dominating tree on sapling stage were pine (*Pinus merkusii*), mbagan (*Syzygium attenuatum*), pucung (*Pangium edule*) and durian (*Durio zibethinus*); as for tree stage were pine, rubber (*Hevea brasiliensis*), and kondang (*Ficus variegata*). Another habitat of grizzled leaf monkey was Gunung Salak National Park, where the most dominating species on sapling stage were huru (*Litsea* sp.), mara (*Macaranga triloba*), and jirak (*Symplocos fasciculata*) while on tree stage were pasang (*Quercus sundaicus*), huru, and kisireum (*Syzygium teneicuspis*) [11]. According to these results, we concluded that grizzled leaf monkeys were not only occupy natural forest but also able to live and adapt to production forests with high human activities.

Pozo-Montuy et al. [25] reported that canopy height has important role for primates. Our research showed that mixed farms were dominated by trees with stratum C (4-20 m) while stratum C and D were rarely found. Stratum A was not found and stratum E was not recorded. The density of trees at Situ Patenggang Conservancy Area with a height 5-15m was around 40,13%, height>15m around 49,34% while those with a height less than 5m was around 10,53% [23]. Previous study showed that grizzled leaf monkey activities mainly occur on these stratums [4]. [5] also reported that grizzled leaf monkey mainly observed on a 5-20 meters height in Gunung Halimun National Park, where 62,06% of them found on undisturbed forest and 68,42% found on disturbed forest. Trees of stratum C at Situ Patenggang Conservancy Area were used for feeding activities [23]. Although stratum A and B were rare or non-exist, previous studies showed that canopy height at mixed farm was sufficient to support movement and activities of grizzled leaf monkey.

Grizzled leaf monkey mainly consumes leaves [4]. Our study recorded 28 species of food trees both producing leaves and fruit. Thus, we compared this study with previous studies conducted in other places. However, our result was lower than that in Resort Bedogol at Gunung Gede Pangrango National Park which was 58 species [26]. On the site of Situ Patenggang Conservation Area, [23] reported there were 25 food trees and [4] found 34 food trees, both excluding lianas and bushes. [24] recorded 45 species originated from 29 families at rubber plantation which can be used as potential food source for rekrekan. We suspected primary and secondary natural forests and concervation area shave the feasibility to support more tree species.

Food were abundant on mixed farm since 6 out of 10 species found were food trees, including *Paraserianthes falcataria*, *Michelia velutina*, and *Artocarpus heterophyllus.* According to a study by [24], rekrekan's feeding time on *Paraserianthes falcataria* was 1,63% and 0,28% on *Michelia velutina* but one of the most consumed was *Nephelium lappaceum.* In the contrary, we found *N. lappaceum* was not dominant on mixed farm. In natural habitat, dominant trees which can be used as a potential food souce were pasang, huru, and puspa (*Schima walichii*) [11]. [23] also reported that at Situ Patenggang Conservation Area the species

which their leaves and fruits commonly eaten were cerem (*Macropanax dispermum*), kikopi (*Canthium glabrum*), pasang (*Lithocarpus* sp.) and kijambe (*Memecylon costatum*). Total density of food trees of our result was lower than on research of [27] at lowland forest ecosystem of Gunung Ciremai National Park (225 ind ha^{-1}).

Grizzled leaf monkey can use timber, fruit including unripen bananas as the source of food. [9] reported similar findings at Rawa Danau Conservancy Area and Tukung Gede Mountain. According to previous studies on different locations, other species found consuming cultivated plants were red tail monkey (*Cercopithecus ascanius*), chimpanzee (*Pan troglodytes*), black and white monkey (*Colobus guereza*) at Kibale Uganda National Park area (Naughton-Treves 1998), bale monkey (*Chlorocebus djamdjamensis*) at fragmented forests of South Ethiopia [29], olive baboons (*Papio anubis*), vervet monkeys (*Chlorocebus aethiops*), and blue monkeys (*Cercopithecus mitis stuhlmanni*) at Budongo Forest Reserve Western Uganda [30].

Our result showed that the food trees has aggregated dispersal pattern. Group size grows parallelly with Variant Coefficient (VC) of food tree's basal area and larger CV means food tree disperse more aggregated [31]. Aggregated food tree allows primates to have a large group size. On area with aggregated food trees, grizzled leaf monkey group travels far to one food tree to another and facing many risks. The larger group size, the ability to detect threats is better [32]. Thus, grizzled leaf monkey needs a large group size to raise awareness and lower the risk of predation while gathering food.

We recorded three groups of grizzled leaf monkey on mixed farm, two groups were live in the farm and others were not. We suspect the third group entered the mixed farm on dry season, due to food scarcity on their main habitat. Yamada and Muroyama [3] reported on their study at Kameyama and Nabari Japan that a group of macaques (*Macaca fuscata*) entered farm area to steal food due to similar reason. Thus, we conclude that the presence of trees along highway and river is important for grizzled leaf monkey movement. We also conclude that mixed farm contributes as food reserve when food on monkey's main habitat is scarce.

Groups of langur had already occupied the mixed farm before grizzled leaf monkey. Langurs and grizzled leaf monkeys consume leaves as their main food [33]; [34]. Two species will compete if they share similar diet resources but the availability is limited. [9] found both langur and grizzled leaf monkey consume teureup (*Artocarpus elastica*), peusar (*Artocarpus rigida*), purut (*Parartocarpus venenosa*) and duku (*Lansium domesticum*). However, there was no sufficient information about food tree species both primates consume and whether they compete. Long tail monkeys had also occupied the mixed farm even longer than langurs and grizzled leaf monkeys. Long tail monkey has already been considered as pest due to their disturbing activities to cultivation such as nut, cassava, corn, and ripen paddy. Long tail monkey will consume leaves when its food source has become rare [35]. Thus, this will lead to competition with grizzled leaf monkey. We propose further study about langur, long tail monkey and grizzled leaf monkey competition on food source. The information would be needed for habitat management and preservation of those species.

Mixed farms were also on eagles range. [36] reported two eagle species *Accipiter henstii* and *Polyboroides radiatus* preyed some primates such as *Microcebus rufus*, *Cheirogaleus major*, and *Avahi laniger*. Other predator species that was seen on research site was a large phyton. We suggest further research is needed to examine predator threats of grizzled leaf monkey on mixed farm.

Although potentially disturb grizzled leaf monkey, loggings were not conducted on many spots at the same time. Selective loggings were also applied. Therefore, grizzled leaf monkey were able to move to surrounding places when its previous tree was cut down. Grizzled leaf monkey was not subject of hunting because locals can tolerate their presence and their feeding activities has not been considered as harm.

5. Conclusion

Tree density, stratum, diameter class distribution, tree food availability and potential predator are the influencing factors for grizzled leaf monkey to live at a mixed farm. Further study is needed to examine the competition of food source between grizzled leaf monkey, langur and long tailed monkey. Further research about predators threats of grizzled leaf monkey by eagles and snakes is also needed. Overall, mixed farm is feasible to be used as an alternative habitat for grizzled leaf monkey population conservation outside protection area.

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MIXED FARM AS HABITAT FOR GRIZZLED LEAF MONKEY (*Presbytis comata*) POPULATION

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Mixed Farm as Habitat For Grizzled Leaf Monkey (*Presbytis comata*) Population

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Abstract

There is limited evidence of mixed farm area as a habitat of grizzled leaf monkey. In this study we found an important finding of small grizzled group in a mixed farm area. This study also examines the vegetation characteristic, presence of other animals and disturbances that influence presence of the monkey. Vegetation data was collected on 57 sample plots. Information about disturbances and other animals were obtained by interviewing the locals. Data were analyzed using standard descriptive analysis. Number of trees and food tree species were 42 and 28 with density of 305.79 and 113.58 tree ha^{-1} respectively. Stratum C trees with 4-20 m height and 10-20 cm in diameter were dominating this farm. Other animals found were *Macaca fascicularis, Trachypitecus auratus*, eagles, and phytons. We suggest that the vegetation and relatively secure environment have enable occupancy of mixed farm as a habitat of grizzled leaf monkey.

***Keywords*:** food tree; primate; density; stratum; *Presbytis comate*.

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* Corresponding author.

1. Introduction

Conservation of wildlife in mixed farm are rare due to current conservation efforts are limited to protection areas including national parks and wildlife reserves. Mixed farms mostly dominated by multipurpose trees, which mainly harvested of woods and fruits [1] and located in private land. We propose that the land ownership status was one of factors reasons why the areas are yet to be included on conservation activities. Whereas, some farms have shown an important role on wildlife conservation, for example orangutan in Sumatera [2] and Japanese macaques at [3].

Grizzled leaf monkey has been listed as endangered species with a limited area of distribution, shy [4] and sensitive to human presence [5]. The monkey population was estimated approximately 2285 individuals [6] and continued to decrease [7]. Indonesian Government has included grizzled leaf monkey as one of priorities in species conservation. The natural habitat of grizzled leaf monkey is lowland forest ecosystem [8]. However, the decreasing of lowland forest due to land conversions affecting grizzled leaf monkey population to be more common at hill and mountain forests. Therefore, many conservation programs were done in the mountain forest, which mainly designated also as conservation area.

Although grizzled leaf monkeys occupied hill and mountain forests, in some places they could be found in artificial ecosystems. Reference [9] found group of surili consuming fruit of a tree in a farm area. Other study recorded surili entering a tea farm and consuming the leaves [4]. However, the existence of grizzled leaf monkey on mixed farm received less attention from researchers. Researchers tend to focus the population studies in conservations areas [10,11,5]. The information about grizzled leaf monkey population on mixed farm is still limited while it may provide opportunity for the population conservation.

No study has been conducted to examine grizzled leaf monkey occupied a mixed farm in Kuningan District. Thus, we analyzed variables of a mixed farm that can explain the existence of the monkey. According to previous studies the presence of a species in an area influenced by several factors, such as distance to settlements, size of area[12], tree density[13], tree diameter, the presence of pioneer and non-pioneer trees, basal area of food tree [14] and domination of food tree [15]. This study examines the explanatory factors of grizzled leaf monkey occupancy in a mixed farms according with particular focus on vegetation characteristics, the presence of other species and existing disturbances.

2. Methods

2.1. Research Location

This study was conducted at forest area of Ciberung Village, Selajambe Sub-District, Kuningan District. Research site consisted of two blocks including Pasir Argasari in the south and Pasir Tanggulun in the north. Both blocks surrounded by paddy fields and bordering with settlement at some points. The areas between block were divided with road. However, the crown cover of both areas were almost connected and fully covered by vegetation. The northern part of Pasir Tanggulun block was less dense and connected to a wider forest area (Bukit Pembarisan block). The research site was mixed farm owned by local community mainly planted with

trees producing timber and fruit. The species which commonly planted on mixed farms at Kuningan District were sengon (*Paraserianthes falcataria*), mahogany (*Swietenia mahagoni*), kihiyang, jeungjing, coconut (*Cocos nucifera*), melinjo (*Gnetum gnemon*), rambutan (*Nephelium mutabile*), and bamboo[1].

2.2. Data Collecting

2.2.1. Vegetation

The vegetation parameters observed in this study were number of tree and food tree species, total tree density, total food tree density,food tree distribution, dominating tree species and tree height. We collected vegetation data using transect method [16]. Sample plots of 20 x 20 were established every 100 meters [17]. We recorded species name, diameter at breast height for all tree with diameter ≥ 10 cm[18], and tree height. Trees with diameter ≥ 10 cm considered strong and capable of supporting primate activities in particular feeding activities [19]. We did not record trees with diameter less than 10 cm due to the arboreal characterist of grizzled leaf monkey[4,20]. Food tree species of grizzled leaf monkeys could be identified using three approachments: studies of previous research [4,9,21], interview with local local community and direct observations.

2.2.2. Grizzled Leaf Monkey Group and Other Animals

The measured parametersof grizzled leaf monkey group ware the number of individuals and their activities. Data were obtained by interviewing local community and followed by a field survey using a transect method. We visited places in mixed farms where community observe the monkey. During this observation we also collected data of other animals.

2.2.3. Disturbance to Grizzled Leaf Monkey

We recorded the disturbances of the research site including hunting and logging. We interviewed the local community to collect hunting data. Logging data were identified from the number of stumps on sample plots collected during vegetation survey.

2.3. Data Analysis

We calculated the frequency, relative frequency, tree density, relative density, tree dominance, relative dominance and importance value index. Each variable was using the following formula :

Frequency of each species = number of sample plot of each species/ total sample plots

Relative frequency of each species (%) = frequency of each species/ total frequency x 100%

Density of each species (ind/ha) = number of each species from entire plots/ total area of sample plots

Relative density of each species (100%) = density of each species/ total density x 100%

Dominance of each species (m^2/ha) = basal area of each species/ total area of sample plots

Relative dominance of each species (m^2/ha) = domination of each species/ total domination entire species x 100%

Importance Value Index (%) = relative frequency + relative domination + relative density

Food tree distribution pattern was estimated using theformula [22]:

$\lambda^2 = (\Sigma(x_i - \bar{x})^2)/\bar{x}$, then $d = \sqrt{2\lambda^2} - \sqrt{2(n-1)-1}$

where n is the number of sample plots. If |d| < 1.96, random distribution pattern. If d < -1.96, uniform distribution pattern. If d > 1.96, aggregated distribution pattern. Other data was analyzed descriptively.

3. Result

3.1. Tree Species and Density

We recorded 679 trees originated from 42 tree species. Total tree density was 305.70 ind ha^{-1} and basal area approximately 18.68 m^2ha^{-1}. The most dominant and dense species were mahagony (*Swietenia macrophylla*), teak (*Tectona grandis*) and sengon (*Paraserianthes falcataria*) (Table 1). Other plant were also recorded including coconut (5.26 tree ha^{-1}), sugar plum (2.19 tree ha^{-1}), bamboo (8.33 cluster ha^{-1}), and banana (67.11 cluster ha^{-1}).

Table 1: Frequency, basal area, and density of ten trees with the highest Importance Value Index in the mixed farm

Name	Family	F	BA (m^2ha^{-1})	D ($indha^{-1}$)	IVI (%)
Swietenia macrophylla	Meliaceae	45	5.32	93.42	75.35
Tectona grandis	Verbenaceae	45	3.82	70.61	59.85
*Paraserianthes falcataria**	Fabaceae	34	1.98	39.47	35.82
*Michelia velutina**	Magnoliaceae	11	1.33	10.53	14.55
*Albizia procera**	Fabaceae	15	0.71	9.21	12.25
*Artocarpus heterophyllus**	Moraceae	14	0.38	6.58	9.25
*Cassia siamea**	Fabaceae	10	0.62	7.02	9.24
Gmelina arborea	Verbenaceae	8	0.43	10.09	8.50
Casearia vellutina	Salicaceae	8	0.59	5.26	7.76
*Mangifera foetida**	Anacardiaceae	10	0.45	5.26	7.75

Note: *tree food ; F = frequency; BA = basal area; D = density; IVI = Importance Value Index

3.2. Stand Structure

Most of tree species were 10 to 20 cm in diameter while those with 40 cm diameter were the less one (Figure 1). Mixed farms were occupied by many trees of stratum C (302 indha^{-1}), followed by stratum D (1.75 indha^{-1}) and B (1.32 indha^{-1}). We found no A and E in our research site.

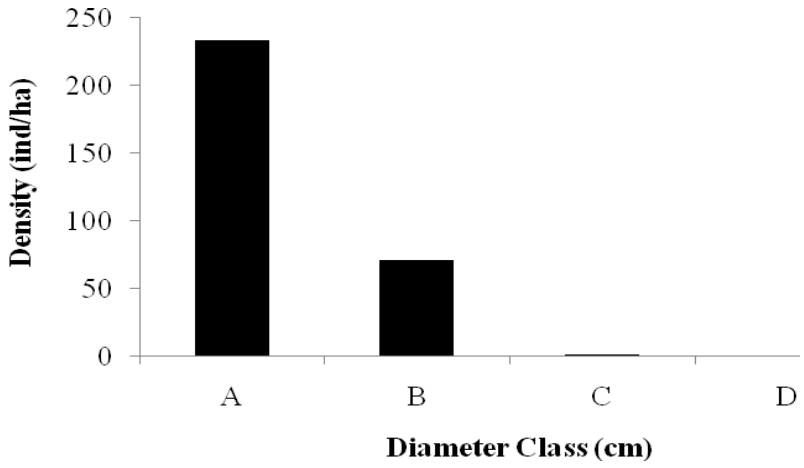

Figure 1: Tree density distribution at four diameter classes. A = 10 - <20 cm; B = 20 - < 40 m; C = 40 - < 50 cm; and D = > 50 cm

3.3. Food Tree

This research found 28 potential food trees with a total of 258 individuals. Total density of food trees was 113.58 ind ha^{-1}and the density of ten most dominance species was 90.71 ind ha^{-1}. Total basal area was 7.62 m^2 ha^{-1} and basal area of ten most dominance species was 6.43 m^{2}ha^{-1}. The food trees showed an aggregated pattern of distribution (d = 12.06).

3.4. Group Size, History of Existence and Activity

Through field observation we recorded a group of grizzled leaf monkey consisted of 3 individuals at Pasir Argasari block on January 2014. Local community also observed a group of grizzled leaf monkey around March 2014. Grizzled leaf monkey has never been observed in the location since 1960's. On mid 2015 the community also reported a different group of grizzled leaf monkey consisted of 7 individuals entered the research site during dry season. This group left the site to a larger forest area (Bukit Pembarisan forest block). Another group consisted of 6-8 individuals reported seen at Pasir Tanggulun block but left the area before our field observation. There were no information when grizzled leaf monkey first seen at Pasir Tanggulun block.

We conducted a direct observation and found grizzled leaf monkey group on *Parkia speciosa* trees consuming its fruits. The local people reported that the group was also eat white lead tree fruits and *Paraserianthes* shoots.

3.5. Disturbance

Grizzled leaf monkey was not subject to hunting of the local community. The activity that could potentially cause disturbance was tree logging. Stump density was found in 10 out of 57 sample plots with a total of 81 stumps and density 35.52 stumps ha^{-1}. Mixed farms were also crossed by a road. Therefore, all mixed farms along the road have potential disturbance from vehicles.

3.6. Other Species and Their Presence History

Other primates found on the site were long tail monkey and langur. By the time we collected vegetation data, we found a group consisted of 38 individuals of long tail monkey at Pasir Argasari block. The local community informed that there were three groups of long tail monkey on research site. The first group of long tail monkey seen on the site was on 1997, consisted of 4-5 individuals.

We found a group of langur consisted of 10 individuals at Pasir Argasari block. Local community informed that there were three groups of langur with 10-17 individuals. First observation of langur at research site was on 1997, when one community member was biten by two individuals while sawing wood. In the period of 1960-1996, there were no long tail monkey nor langur observed at Pasir Argasari block. It is unclear when both species started occupying Pasir Tanggulun block. According to information, potential predators especially for infant of grizzled leaf monkey were phytons and eagles.

4. Discussion

Grizzled leaf monkey has arboreal characteristic [4] and used trees and canopies for movement. Thus, tree and canopy densities were important vegetation parameter. Our study found tree density on research site was close to tree density of grizzled leaf monkey habitat on Situ Patenggang Conservancy Area which was 380 ind ha^{-1}[23]. As a comparison, tree density of *Presbytis fredericae* in rubber plantation at Pekalongan District was 1361.22 ind ha^{-1}[24] and in Gunung Salak National Park was 630 ind ha^{-1}[11]. Tree lower density in mixed farm was due to logging activities. In the contrary, logging was forbidden on both conservancy areas. Tree logging was also low at rubber plantation. We could calculated a denser land coverage by including data of bamboo, sugar plum, coconut and banana on tree density measurement. However, we avoid the calculation since the plans are not categorized as timber species.

Our result showed that tree density on mixed farm was dominated by trees with diameter 10-19 cm followed by trees with diameter 20-39 cm. Larger trees were very rare. We found 3 species with diameter >40 cm which are kedondong (*Spondias dulcis)* around 46 cm, sengon (*Paraserianthes falcataria)* around 51 cm, and manglid (*Michelia velutina)* around 107 cm. Reference [23] reported grizzled leaf monkey natural habitat at Situ Patenggang Conservation Area composed by trees with diameter above 12 cm. According to diameter class density, we concluded that mixed farms were feasible as habitat for grizzled leaf monkey. Reference [14] also reported that trees with large diameter were influencing the presence of howler monkey (*Alouatta palliata mexicana*) on fragmented habitats. For this reason, we propose to preserve trees with large diameter on mixed farms.

Mixed farms commonly dominated by timber trees, but we also recorded some fruit-bearing trees. Five out of ten most dominating tree with highest density were mahagony (*Swietenia macrophylla*), teak (*Tectona grandis*), and sengon (*Paraserianthes falcataria*), followed by fruit-bearing species jackfruit (*Artocarpus heterophyllus*) and pakel (*Mangifera foetida*). A study by [24]on rekrekan habitat (rubber plantation and other purposes) found the most dominating tree on sapling stage were pine (*Pinus merkusii*), mbagan (*Syzygium attenuatum*), pucung (*Pangium edule*) and durian (*Durio zibethinus*); as for tree stage were pine, rubber (*Hevea brasiliensis*), and kondang (*Ficus variegata*). Another habitat of grizzled leaf monkey was Gunung Salak National Park, where the most dominating species on sapling stage were huru (*Litsea* sp.), mara (*Macaranga triloba*), and jirak (*Symplocos fasciculata*) while on tree stage were pasang (*Quercus sundaicus*), huru, and kisireum (*Syzygium teneicuspis*) [11]. According to these results, we concluded that grizzled leaf monkeys were not only occupy natural forest but also able to live and adapt to production forests with high human activities.

Pozo-Montuy et al. [25] reported that canopy height has important role for primates. Our research showed that mixed farms were dominated by trees with stratum C (4-20 m) while stratum C and D were rarely found. Stratum A was not found and stratum E was not recorded. The density of trees at Situ Patenggang Conservancy Area with a height 5-15m was around 40,13%, height>15m around 49,34% while those with a height less than 5m was around 10,53% [23]. Previous study showed that grizzled leaf monkey activities mainly occur on these stratums [4]. Reference [5] also reported that grizzled leaf monkey mainly observed on a 5-20 meters height in Gunung Halimun National Park, where 62,06% of them found on undisturbed forest and 68,42% found on disturbed forest. Trees of stratum C at Situ Patenggang Conservancy Area were used for feeding activities [23]. Although stratum A and B were rare or non-exist, previous studies showed that canopy height at mixed farm was sufficient to support movement and activities of grizzled leaf monkey.

Grizzled leaf monkey mainly consumes leaves [4]. Our study recorded 28 species of food trees both producing leaves and fruit. Thus, we compared this study with previous studies conducted in other places. However, our result was lower than that in Resort Bedogol at Gunung Gede Pangrango National Park which was 58 species [26]. On the site of Situ Patenggang Conservation Area, [23] reported there were 25 food trees and [4] found 34 food trees, both excluding lianas and bushes. Reference [24] recorded 45 species originated from 29 families at rubber plantation which can be used as potential food source for rekrekan. We suspected primary and secondary natural forests and concervation area shave the feasibility to support more tree species.

Food were abundant on mixed farm since 6 out of 10 species found were food trees, including *Paraserianthes falcataria*, *Michelia velutina*, and *Artocarpus heterophyllus.* According to a study by [24], rekrekan's feeding time on *Paraserianthes falcataria* was 1,63% and 0,28% on *Michelia velutina* but one of the most consumed was *Nephelium lappaceum.* In the contrary, we found *N. lappaceum* was not dominant on mixed farm. In natural habitat, dominant trees which can be used as a potential food souce were pasang, huru, and puspa (*Schima walichii*) [11]. Reference [23] also reported that at Situ Patenggang Conservation Area the species which their leaves and fruits commonly eaten were cerem (*Macropanax dispermum*), kikopi (*Canthium glabrum*), pasang (*Lithocarpus* sp.) and kijambe (*Memecylon costatum*). Total density of food trees of our result was lower than on research of [27] at lowland forest ecosystem of Gunung Ciremai National Park (225 ind ha^{-1}).

Grizzled leaf monkey can use timber, fruit including unripen bananas as the source of food. [9] reported similar findings at Rawa Danau Conservancy Area and Tukung Gede Mountain. According to previous studies on different locations, other species found consuming cultivated plants were red tail monkey (*Cercopithecus ascanius*), chimpanzee (*Pan troglodytes*), black and white monkey (*Colobus guereza*) at Kibale Uganda National Park area (Naughton-Treves 1998), bale monkey (*Chlorocebus djamdjamensis*) at fragmented forests of South Ethiopia [29], olive baboons (*Papio anubis*), vervet monkeys (*Chlorocebus aethiops*), and blue monkeys (*Cercopithecus mitis stuhlmanni*) at Budongo Forest Reserve Western Uganda [30].

Our result showed that the food trees has aggregated dispersal pattern. Group size grows parallelly with Variant Coefficient (VC) of food tree's basal area and larger CV means food tree disperse more aggregated [31]. Aggregated food tree allows primates to have a large group size. On area with aggregated food trees, grizzled leaf monkey group travels far to one food tree to another and facing many risks. The larger group size, the ability to detect threats is better [32]. Thus, grizzled leaf monkey needs a large group size to raise awareness and lower the risk of predation while gathering food.

We recorded three groups of grizzled leaf monkey on mixed farm, two groups were live in the farm and others were not. We suspect the third group entered the mixed farm on dry season, due to food scarcity on their main habitat. Reference [3] reported on their study at Kameyama and Nabari Japan that a group of macaques (*Macaca fuscata*) entered farm area to steal food due to similar reason. Thus, we conclude that the presence of trees along highway and river is important for grizzled leaf monkey movement. We also conclude that mixed farm contributes as food reserve when food on monkey's main habitat is scarce.

Groups of langur had already occupied the mixed farm before grizzled leaf monkey. Langurs and grizzled leaf monkeys consume leaves as their main food [33,34]. Two species will compete if they share similar diet resources but the availability is limited. Reference [9] found both langur and grizzled leaf monkey consume teureup (*Artocarpus elastica*), peusar (*Artocarpus rigida*), purut (*Parartocarpus venenosa*) and duku (*Lansium domesticum*). However, there was no sufficient information about food tree species both primates consume and whether they compete. Long tail monkeys had also occupied the mixed farm even longer than langurs and grizzled leaf monkeys. Long tail monkey has already been considered as pest due to their disturbing activities to cultivation such as nut, cassava, corn, and ripen paddy. Long tail monkey will consume leaves when its food source has become rare [35]. Thus, this will lead to competition with grizzled leaf monkey. We propose further study about langur, long tail monkey and grizzled leaf monkey competition on food source. The information would be needed for habitat management and preservation of those species.

Mixed farms were also on eagles range. [36] reported two eagle species *Accipiter henstii* and *Polyboroides radiatus* preyed some primates such as *Microcebus rufus*, *Cheirogaleus major*, and *Avahi laniger*. Other predator species that was seen on research site was a large phyton. We suggest further research is needed to examine predator threats of grizzled leaf monkey on mixed farm. Although potentially disturb grizzled leaf monkey, loggings were not conducted on many spots at the same time. Selective loggings were also applied. Therefore, grizzled leaf monkey were able to move to surrounding places when its previous tree was cut down. Grizzled leaf monkey was not subject of hunting because locals can tolerate their presence and their feeding

activities have not been considered as harm.

5. Conclusion

Tree density, stratum, diameter class distribution, tree food availability and potential predator are the influencing factors for grizzled leaf monkey to live at a mixed farm. Further study is needed to examine the competition of food source between grizzled leaf monkey, langur and long tailed monkey. Further research about predators threats of grizzled leaf monkey by eagles and snakes is also needed. Overall, mixed farm is feasible to be used as an alternative habitat for grizzled leaf monkey population conservation outside protection area.

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