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Controlling Factors of Grizzled Leaf Monkey (*Presbytis comata*) Population Density in a Production Forest in Kuningan District, West Java, Indonesia

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Abstract: Land use change and deforestation continues in Indonesia at an alarming rate, resulting in widespread loss of habitat for wildlife. In this study, we propose that a production forest can serve as a refuge for otherwise afflicted animal populations. Information on population densities and an understanding of the influencing factors are important to evaluate the efficacy of protected areas and production forest. Very little is known in this regard, however, for the species in question here, the Endangered grizzled leaf monkey, *Presbytis comata*. Here we report on a study to estimate the population density of this langur (and other primates) in a production forest and to identify the controlling factors. We conducted population surveys in 19 forest patches and recorded the numbers and density of tree species that figure in the diet of the langur. We also counted tree stumps, an indication of the intensity of logging. We measured the distance of each of the 19 forest patches to the nearest road, the nearest settlement, and to other forest patches. Descriptive statistics and multiple linear regression were used in data analysis. We recorded population densities of 36.97 to 54.12 individuals/km² (mean = 44.71 ind./km²). Densities were positively correlated with the number of food tree species, but negatively related to the density of tree stumps, an indicator of habitat disturbance due to timber extraction. Our results indicate that the diversity of food tree species and logging activities should be taken into consideration in formulating conservation strategies of grizzled leaf monkey population in production forests.

Keywords: grizzled leaf monkey, *Presbytis comata*, population density, food trees, conservation, production forest

Introduction

Tropical forests continue to decline, and their loss, fragmentation and degradation is one of the major issues in biodiversity conservation. Production forests, generally in the form of mixed plantations, can, however, be important in the conservation of wildlife communities (Brockerhoff *et al*. 2008; Lindenmayer *et al*. 2009; Rayadin and Saitoh 2009; Salek *et al*. 2010; Van Halder *et al.* 2011; Fashing *et al.* 2012). Appropriately managed protected areas of this sort can increase options for wildlife and landscape conservation, reducing as such the dependency on strictly protected areas. In Indonesia, many production forests have become refuges for dispersing and displaced wildlife populations (Marsden *et al*. 2001; Luckett *et al.* 2004; Pawson *et al.* 2008; Lindenmayer *et al*. 2009; Van Halder *et al.* 2011), including those of nationally protected and threatened species (for example, *Hylobates agilis*, *H. lar*, and *M. nemestrina*: Nasi *et al*. 2008; orangutan: Rayadin and Spehar 2015). Some species are quite able to persist in these forests once they provide food, sleeping sites and sufficient area, counting on corridors to allow for genetic exchange (Ganzhorn 1987; Rayadin and Saitoh 2009; Yamada and Muroyama 2010; Henzi *et al*. 2011; Campbell-Smith *et al.* 2012).

The Javan grizzled langur, *Presbytis comata*, has a restricted range in West Java, east to Mt. Lawu on the border with East Java (Nijman 2013, 2017). It is Endangered (Nijman and Richardson 2008), and nationally protected (Regulation No. P.20/Menlhk/Setjen/Kum. 1/6/2018) and has been identified as a conservation priority by the Indonesian government (Regulation No.P.57/Menhut-II/2008). The principal habitat for this species was forest in the lowlands and hills (Hoogerworf 1970; Nijman 1997), but its range is today largely restricted to montane forest (Nijman 1997). Due to a long history of land conversion (Whitten *et al*. 1996), only 16.39% of Java's original forest cover remains, of this, 9.51% comprises production forests and 6.88% combined protection and conservation forests (KLHK 2018). Nijman (2013) indicated that forest fragments, and especially montane areas, total about 10% of the island. Grizzled langurs can still be found in some lowland forests (Nijman and van Balen 1998; Nijman 2017), but priorities for the conservation of this species have focused on montane areas (Supriatna *et al.* 1994). Nijman (2017) listed all the large remaining populations of *P. comata* by altitude.

Population density estimates for the grizzled langurs have mostly been conducted in strictly protected areas (Ruhiyat 1983; Melisch and Dirgayusa 1996; Tobing 1999; Heriyanto and Iskandar 2004; Kartono *et al*. 2009; Nijman 2017), few in production forests. Information about the factors that determine population density is particularly important in developing effective conservation strategies (Chapman *et al.* 2004; Mbora and Meikle 2004; Agetsuma *et al*. 2015). There have been numerous studies on such factors for primate populations (for example, Ross and Srivastava 1994; Wich *et al.* 2004; Ray *et al.* 2015) but few for the Javan grizzled langurs. Kartono *et al.* (2009) looked at the effect of the density of some tree species on the numbers of grizzled langurs in the forest of Gunung Ciremai National Park. A study conducted by Nijman (2017) examined the relationship between group size and altitude and other environmental variables.

Many factors affect population density of primates. In this study we examined the availability of food sources (Mammides *et al.* 2008; Pozo-Montuy *et al.* 2011; Kankam and Sicote 2013), spatial attributes (Estrada and Coates-Estrada 1996; Arroyo-Rodríguez *et al.* 2008), and habitat disturbance (Chapman *et al.* 2007). This study aimed at (1) estimating the population density of grizzled langurs, (2) identifying the factors that determine the population density of this monkey in production forests, and (3) discussing the conservation implications. We proposed that the number of tree species and food trees, and food density would have a positive effect on the population of grizzled langurs, while the density of other primates occupying the same habitat would have a negative effect. We also predicted that population density would decrease with a) increasing distance of the survey sites to more extensive, remote areas, and b) decreasing distance from research site to the nearest road. Greater forest disturbance indicated by higher tree stump density was also expected to negatively affect population density. This information on the factors that influence the population density could help to promote more favorable conditions for grizzled langur conservation in production forests.

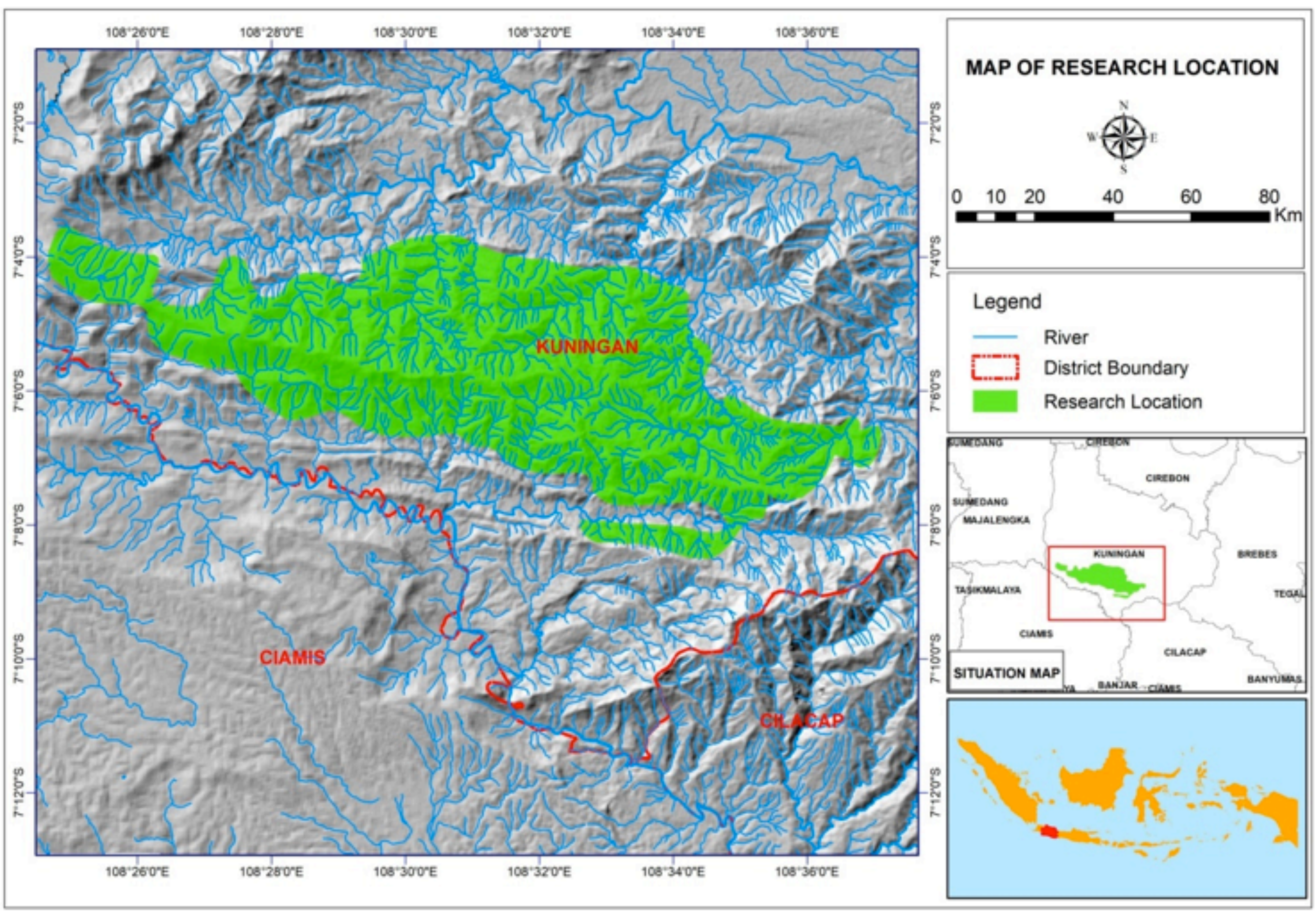

Figure 1. Map of the study site the for grizzled langur surveys in the Kuningan District, West Java Province.

Methodology

Study area

We conducted this research in 19 forest patches in the Bukit Pembarisan forest in Kuningan District (108°23'–108°47'E and 6°47'–7°12'S) (Fig. 1), West Java Province, Indonesia. Annual rainfall in this district is 1,000-4,000 mm (Bappeda Kuningan District 2015). Our research site was a production forest with a total area of 52.57 km². Land use there was a combination of mixed farms, plantations and natural forest remnants (Prasetyo *et al.* 2012). Mixed farms are managed by communities on private land, planted with commercial tree species and fruit-crops, such as sengon (*Paraserianthes falcataria*), mahogany (*Swietenia mahagoni*), jabon (*Anthocepalus cadamba*), teak (*Tectona grandis*), mango (*Mangifera indica*), bitter bean (*Parkia speciosa*), coconut (*Cocos nucifera*), jackfruit (*Artocarpus heterophyllus*), and melinjo (*Gnetum gnemon*) (Prasetyo *et al.* 2012). Planted production forests on state land were managed by PT Perhutani under Kuningan Forest Management Units (FMU). They were generally teak or pine monocultures. Forest remnants were also part of the production forest, scattered randomly and allocated as local protected areas due to steep or very steep topography. The remnant natural forests in lowland and hilly areas were disturbed in the past, and are mostly bordered, or surrounded, by mixed farms and plantations.

Besides *P. comata*, we observed long-tailed macaques (*Macaca fascicularis*), ebony langurs (*Trachypithecus auratus*), and the Javan slow loris (*Nycticebus javanicus*). We never saw Javan gibbons (*Hylobates moloch*). Data were collected on *M. fascicularis* and *T. auratus* considering that their numbers may be influencing the size of the grizzled langur population. *Trachypithecus auratus* is folivorous (Kool 1993) and *M. fascicularis* includes leaves in its diet when other food sources are scarce.

Surveys

We carried out line-transect surveys in the forest patches indicated by the villagers, following Martins (2005) and Greenwood and Robinson (2006). This method has been widely used to estimate primate population densities (Brugiere and Fleury 2000; Hoing *et al.* 2013). The location of the survey transects was not chosen randomly or systematically (we followed the villager's advice as to where the langurs (Figure 2) could be found), so it is not possible to deduce an overall population density for the production forest.

Surveys were carried out in the morning, from around 06:00 until around 12:00 h. We used already existing trails or paths that we cut prior to the survey, taking into account the distance between the trails to avoid double counting (Estrada and Coates-Estrada 1996). We walked slowly but the time spent on each trail varied due to the topography and the density of the vegetation. The direction of the transect had to be deflected when confronting obstacles such as ravines or cliffs, but the overall direction was maintained.

Figure 2. Javan Grizzled langur (*Presbytis comata*) found in the study sites, in Kuningan District, West Java Province.

Table 1. Number and length of line transects in 19 study sites in Kuningan District, West Java, Indonesia.

No.	Sites	Number of line transects	Length of line transects (km)
1	Bagawat	3	5.0
2	Gunung Aci	5	5.1
3	Kutawaringin	4	5.1
4	Subang	4	5.1
5	Jalatrang	3	5.1
6	Jamberama	3	5.5
7	Padahurip	3	5.0
8	Cilebak	3	5.0
9	Cikondang	4	5.0
10	Tundagan	3	5.4
11	Pasir Agung	4	5.1
12	Citapen	4	5.0
13	Cipedes	5	6.1
14	Pinara	5	5.3
15	Gunung Manik	5	5.5
16	Cijemit	4	5.8
17	Pamulihan	4	5.0
18	Karangkancana	4	6.0
19	Patala	2	5.3
	Total	72	100.3

The length of the line transects at each site varied from 5.0 to 6.1 km (Table 1). The lengths were measured using a hipchain, and each transect was walked once. The transect widths used for estimating the density of the three species encountered was the effective width and was obtained after all data for each species had been entered into Distance 5.0. They were: 2×36.16 m for *P. comata*, 2×33.96 m for *T. auratus*, and 2×51.20 m for *M. fascicularis*. We recorded the size and, when possible, the composition of each group, the distance from the observer to the first individual seen (using a Nikon Forestry Rangefinder), the activities of the group, the species of tree in which the first individual was seen and its coordinates (using a Garmin GPSmap 60Csx), the angle (θ) of the group to the position of the observer, and the direction they were moving (Eisenberg *et al.* 1981). Observation time varied and was terminated when each individual in the group had been identified accurately or observers agreed to an estimated group size (Anderson *et al*. 2007; Pozo-Montuy *et al.* 2011). Data collection was assisted by two trained field assistants.

Habitat attributes

We recorded habitat attributes in sample plots of 20 m × 20 m placed every 100 m along each trail (Kusmana and Istomo 1995; Soerianegara and Indrawan 2005). Habitat characteristics considered included the number of tree species (Ross and Srivastava 1994; Kankam and Sicote 2013), the number of food tree species (Pozo-Montuy *et al.* 2011), tree density (Ross and Srivastava 1994; Wieczkowski 2004), and food tree density (Anderson *et al.* 2007). For each tree in the plot, we recorded the species and the diameter at breast height for those with diameters ≥10 cm, large enough to be of use to the langurs (Ruhiyat 1983; Gunawan *et al.* 2008; Onderdonk and Chapman 2000; Worman and Chapman 2006). We took botanical samples of those trees that we were unable to recognize, and they were subsequently classified by botanists at the Bogoriense Herbarium of the Indonesian Institute of Sciences. We observed grizzled langurs eating the leaves and fruits of some of the species. Villagers, who knew the monkeys and their feeding habits well, also provided valuable information on which species they feed from, and we also consulted Ruhiyat (1983), Farida and Harun (2000) (two studies in montane forest) and Melisch and Dirgayusa (1996), who listed species included in their diet elsewhere.

Spatial attributes

The study also included some spatial attributes that we predicted might influence the population density. The variables were the distance from each of the 19 sites to the nearest undisturbed forest (Estrada and Coates-Estrada 1996; Pozo-Montuy *et al*. 2011) and the distance from the transects to the nearest settlement and road (Arroyo-Rodríguez *et al.* 2008). The distance of each transect to a larger undisturbed forest edge was obtained by measuring the average distance from coordinates of the initial point of the line transect and projecting the distance using Google Earth Map. A similar method was used to obtain the distance from each location to the nearest road and settlement.

Habitat disturbance

A surrogate for habitat disturbance and a measure of the intensity of past logging was tree stump density (Wood and Gillman 1998). Logging was expected to negatively affect the density of primates (Chapman *et al.* 2007). Data were collected in parallel with vegetation data in the sample plots. Only stumps without signs of decay were recorded.

Data Analysis

We estimated the total population density and the density at each site to identify the controlling factors of the population density. To estimate the group density of the entire area surveyed we used the following equation (Martins 2005): D = number of groups seen /2(ESW)L, where D = grizzled langur group density (group/km²), ESW = effective strip width (m), and L = total line transect (km). The ESW value was obtained using Distance 5.0. The population density was obtained by multiplying the group density by the average group size (Martins 2005; Fashing *et al.* 2012). Estimates of population density in each transect were also calculated using the same formula with the number of groups in each transect, transect length, and the average size of groups in each location. We rarely found more than one group along any one transect, thus we used one ESW value for transects. The same technique was used to estimate the population densities of ebony langurs and long-tailed macaques.

Table 2. Descriptive statistic and Kolmogorov-Smirnov test of habitat and other factors influencing grizzled leaf monkey in production forest of Kuningan District (all based on 19 forest divisions).

Variable	**Mean**	**SD**	**Kolmogorov-Smirnov test**	
			Z	**P**
Ebony langur population density (individuals/km^2)	144.16	103.51	0.517	0.952
Long tailed macaque density (individuals/km^2)	40.47	74.67	1.281	0.075
Number of food tree species (species/ha)	22.21	4.25	0.717	0.683
Food tree density (individuals/ha)	158.24	43.88	0.798	0.548
Stump density (individuals/ha)	2.10	3.19	1.126	0.159
Research site distance to the nearest road (km)	0.59	0.38	0.699	0.713
Research site distance to the nearest forest area (km)	12.57	6.42	0.549	0.924

Habitat characteristics were analyzed and compared by means and standard deviations. Variables that predicted grizzled langur population densities were identified in three stages. We first analyzed the data distribution using the Kolmogorov-Smirnov test. Data is normally distributed if $p>0.05$. We then ran a Pearson Correlation test among all independent variables at $p \leq 0.05$ (Anzures-Dadda and Manson 2007; Arroyo-Rodríguez *et al*. 2008). In the multiple regression, the number of tree species was excluded from the analysis due to a significant correlation with the number of food tree species ($r = 0.90$; $p<0.001$). Total tree density was excluded due to its correlation with food tree density ($r = 0.58$; $p = 0.009$) and tree stump density ($r = 0.46$; $p = 0.050$). The distance of the site to the nearest settlement was also excluded because of the strong correlation with distance to the nearest road and forest area ($r = 0.94$; $p <0.001$, $r = 0.46$; $p = 0.048$, respectively). Stepwise multiple linear regression in SPSS 21 was used to identify the components of the habitat that significantly influenced population density (Mbora and Meikle 2004). The significance level used was (α) ≤ 0.05. The contribution of combined variables to population density was calculated as an R2 value.

Results

Population density

We conducted this study in 19 forest divisions with a total line transect length of 100.3 km (Table 1). The total population of grizzled langurs from both the line transects and nearby areas was 486 in 65 groups. The relative abundance was calculated based on 41 groups located on the line transects—0.41 groups/km of transect. We used Distance ver.5.0 to estimate a group density of 5.66 groups/km² (min = 4.68 groups/km²; max = 6.85 groups/km²). We estimated the population density to be 44.71 individuals/km² (min = 36.97 individuals/km²; max = 54.12 individuals km²), calculated by multiplying the mean group size by group density. The mean group size used was 7.9 (Nijman 2017).

Habitat characteristics

Data on habitat characteristics was collected from 19 forest divisions, comprising 1003 plots. Data of all measured variables were normally distributed. Descriptive statistics and Kolmogorov-Smirnov test of the seven variables estimated to control population density are presented in Table 2.

Factors controlling population density

Our study revealed that two out of seven variables were significantly related to grizzled leaf monkey density in this production forest—the number of food tree species and stump density. The effects of each variable were contradictory (Table 3). The number of food tree species showed a significant positive relationship with the monkey population while increasing stump density was significantly associated with a decrease in the monkey population. Increasing stump number indicates increasing forest disturbance. Both variables explain 40% variability of the monkey population density ($R2 = 0.40$; $F = 5.33$; $p = 0.017$). There was, however, no significant relationship ($p>0.05$) between population density and other measured variables, including food tree density, langur population density, and the distance of the transects to the nearest road and forest. Thus, we suggest that number

Table 3. Variables significantly related to *Presbytis comata* population density.

Model	Constant (SE)	T	P
Constant	-60.92 (43.28)	-1.408	0.178
Number of food tree species (species/ha)	5.32 (1.94)	2.739	0.015
Stump density (individuals/ha)	-5.79 (2.59)	-2.237	0.040

of food tree species and stump density are good predictors in estimating the population density of *P. comata*.

Discussion

Previous population studies have been conducted mainly in conservation areas and, in adding data on a production forest, we suggest that our results will be helpful in obtaining better estimates of the grizzled langur population on Java. We recorded 486 animals and suggest that this will increase our current estimate of the total population. A recent estimate for the grizzled langur population on Java, based on 11 areas surveyed, was 1,760–2,360 groups, which, with an average group size of just over seven, translates to between 13,000 and 17,000 individuals (Nijman 2017). Our results also provide information on factors affecting the monkey population. The population was influenced by food availability and habitat disturbance from human activities. Forests with a high diversity of food tree species have higher densities, and lower population densities are associated with higher levels of logging or timber harvesting.

It is difficult to compare this study with others as so few have been done, and none previously in a production forest. We can only compare our results with surveys in conservation forests. We found similar population densities to those of grizzled langurs in Situ Patenggang Nature Reserve (Ruhiyat 1983). However, our results were eleven and six times higher than the densities of this species in Ujung Kulon National Park and Gunung Ciremai National Park, respectively (Heriyanto and Iskandar 2004; Kartono *et al.* 2009). Group densities of this species in the Dieng Mountains have been found to range from 1.2 to 4.4 groups/km² (Nijman and Nekaris 2013). Combining the results of previous studies, group density ranges from 0.4 to 0.6 groups/km² in lowland forest and 0.5 to 2.4 groups/km² in hill forest (Nijman 2017). Our estimate is higher and, while we lack sufficient information to say why, it is possible that different methods and habitat quality could be involved. Nevertheless, this study provides the first evidence of the significant contribution of a production forest in supporting this population of grizzled langurs that have been ranked as Endangered on the IUCN Red List since 1988 (Nijman and Richardson 2008). The identification of further potential habitats and populations such as at this site, will be imperative for the conservation of this species.

Lowland forests have been identified as the grizzled langur's principal habitat (Hoogerwerf 1970), most likely due to the diversity of food tree species available. Variation in tree species density results in variation in food availability and habitat quality (Li 2004; Arroyo-Rodríguez and Mandujano 2006). A positive correlation between the number of species of food trees and the *P. comata* population in our study showed the importance of food source variability in the survival of this species. In Gunung Merbabu National Park, grizzled langurs were found mostly in forests with a high plant species diversity providing for a more diverse diet (Handayani and Latifiana 2019). There, Kusumanegara *et al.* (2017) frequently recorded grizzled langurs in areas close to the forest edge, but they did not associate this with possible differences in food tree diversity between the edge and the interior of the forest. In Kartono *et al.*'s (2009) study in Gunung Ciremai National Park, the population density was found to be affected by the density of nine tree species, namely: *Podocarpus neriifolius*, *Saprosma arborea*, *Glochidion arborescens*, *Palaquium impressinervium*, *Ficus* sp., *Psychotria* sp., *Litsea sanguinolenta*, *Lithocarpus ewyckii*, and *Lithocarpus sundaicus.* Previous studies, including, for example, *Presbytis kirkii* in Zanzibar (Siex and Struhsaker 1999) and *P. rubicunda* in the di Sepilok Nature Reserve, Malaysia (Davies *et al*. 1988) are in agreement with our findings. Cristobal-Azkarate and Arroyo-Rodríguez (2007) reported that howler monkey (*Alouatta palliata*) population densities depend on a number species of food tree. In Cabeza del Toro and the Santuario Nacional Cordillera de Colan, Peru, the occupancy probability of the Peruvian night monkey *Aotus miconax* is positively correlated with the diversity of the vegetation (Campbell *et al.* 2019). Based on our and other previous studies, it is evident that enriching the tree species diversity in production forests would be a valuable conservation tool for these primates.

Ultimately, population density is likely determined by the nutritional benefits of a diverse diet provided by high tree species diversity (Cristobal-Azkarate *et al.* 2005; Chapman *et al.* 2012). The main source for the colobines is leaves (Ruhiyat 1983; Kirkpatrick 1999; Wasserman and Chapman 2003), and the leaves of each tree species differ in their nutritional and energetic value (Farida and Harun 2000; Nelson *et al*. 2000; Wasserman and Chapman 2003; Hockings *et al.* 2009). *Albizia falcataria*, for example, has higher protein (26.34%) and energy (5.17 kcal/gram) compared to *Ficus padana* with a protein content of 14.64% and energy value of 4.69 kcal/gram. *Albizia falcataria* leaves have a lower fat content (0.96%) than those of *F. padana* (2.93%) (Farida and Harun 2000). Grizzled langurs also eat fruit (Ruhiyat 1983), available at different times of the year depending on the species (Koenig *et al.* 1997; Hockings *et al.* 2009) and likewise variable in their nutrient content (Milton 2003; Wasserman and Chapman 2003). Primates require diverse diets to support reproduction, growth and development (Koenig *et al.* 1997; Felton *et al.* 2009; Chaves *et al*. 2011, Chapman *et al.* 2012).

Populations were lower in sites with a high tree stump density reflecting the extent of logging. Other studies have also found this correlation: *Galago demidovii*, *G. inustus*, and *Perodicticus potto* in Kibale forest (Weisenseel *et al.* 1993), chimpanzees, *Pan troglodytes verus*, in western Equatorial Africa (Morgan and Sanz 2007), and *Procolobus pennantii* and *Colobus guereza* in western Uganda (Chapman *et al.* 2007). Logging has been responsible for the decline of *Lophocebus albigena* group density in Kibale National Park in Uganda (Chapman *et al.* 2000). Negative effects of logging are observed for gorilla populations in Congo resulting from facilitated access for poachers (Haurez *et al*. 2013). Logging, of course, is the objective of production forests, and it is important to further examine the effect of logging intensity in order to ensure the sustainability of the primate populations there.

Grizzled langurs are shy (Ruhiyat 1983) and avoid interactions with humans (Tobing 1999; Nijman and Nekaris 2013). The disturbance created by logging and the sound of chainsaws inevitably result in the monkeys moving to other locations, and Tobing (1999) has shown that in Gunung Halimun National Park the populations density is lower in disturbed forests. Li (2004) reported decreasing population densities of snub-nosed monkey (*Rhinopithecus roxellana*) as a result of human disturbance in Shennongjia Nature Reserve in China.

Our hypothesis was that food tree density will positively correlate to the grizzled langur population in accordance with the findings of studies on *Procolobus rufomitratus*, *Pan troglodytes*, and *Alouatta pigra* (Balcomb *et al.* 2000; Mbora and Meikle 2004; Pozo-Montuy *et al.* 2011). Our preliminary hypothesis was that east Javan langur, *Trachypithecus auratus*, and long-tailed macaque, *Macaca fascicularis* densities would negatively influence those of the grizzled langur due to overlap in their diets (Kool 1992; Kool 1993; Yeager 1996). Our results did not reveal this, however. No response of food tree density on the monkey population implied that food availability was not the limiting factor (Yeager and Kirkpatrick 1998). We suspect that the grizzled langur is distinct in its use of different food sources, as has been shown, for example, for Peter's Angolan colobus, *Colobus angolensis palliatus* (v. Anderson *et al*. 2007).

Asian colobines can consume young and old leaves (Yeager and Kirkpatrick 1998). Leaves are a relatively stable and abundant food (Chapman 1990), and grizzled langur populations are probably well below the environmental carrying capacity (Yeager and Kirkpatrick 1998). No direct competition was observed between grizzled langurs and *T. auratus* and *M. fascicularis*.

We also examined the relationship of population density and the distance of the transects to the nearest road, assuming that this represents the proximity of the nearest community settlement. Arroyo-Rodríguez *et al.* (2008) reported that the proximity of settlements and the occupation of forest patches by Mexican howler monkeys, *Alouatta palliata mexicana*, were positively correlated; the further away the settlement, the more likely the forest was occupied by howlers. Our results, however, indicate a different response, perhaps due to less intense human activity. A lack of correlation of grizzled langur population density to the nearest road indicated that this variable has yet to be a threat—the monkeys, it seems, tolerate road traffic and human activities.

This study was carried out in one forest landscape in one district, and similar surveys are needed in other parts of the species' range to establish a more robust estimate of population density and the controlling factors. Our results only explained less than 50% of population variability. Further research should consider a larger study site, and linear transects rather than using available paths in the site, and increasing the measurement of environmental variables including such as lianas as food sources (Ruhiyat 1983) and nutritional content, protein and fiber, of their foods.

Conservation approaches can be tested at government-owned plantations (PT Perhutani), mixing commercial species with food tree species, including pulai (*Alstonia scholaris*), saninten (*Castanopsis argentea*), kondang (*Ficus glomerata*), walen (*Ficus ribes*), beunying (*Ficus* sp.), kareumbi (*Omalanthus populneus*), pasang (*Quercus* sp.), and peutag (*Syzygium lineatum*) (Ruhiyat 1983). In such agroecosystems, in addition to planting food tree species, it would be possible to increase the proportion and number of multipurpose trees, including those providing non-timber forest products, along with cloves, coconut, mango, mangosteen, melinjo, rambutan, nutmeg, and guava. This enrichment of forests low in food tree species could expand the habitats suitable for the grizzled langurs because the species can only survive in forests of >50 km² (Nijman 2013). Nonetheless, population management of grizzled monkey populations in production forests, including mixed farms, requires more in-depth studies that involve relevant stakeholders to sustain both conservation and economic benefits.

Variability of food tree species and the level of forest disturbance due to logging were the controlling factors of grizzled leaf monkey population. Conservation efforts for grizzled langurs should consider these environmental variables. Balancing the proportion of commercial tree species with sufficient food tree species will contribute to supporting populations of the grizzled langur, while also ensuring the economic health of the timber companies. With further research, we suggest that this approach can be replicated in other production forests.

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Literature Cited

Agetsuma, N., R. Koda, R. Tsujino and Y. Agetsuma-Yanagihara. 2015. Effective spatial scales for evaluating environmental determinants of population density in Yakushima macaques. *Am. J. Primatol.* 77: 152–161.

Anderson, J., G. Cowlishaw and J. M. Rowcliffe. 2007. Effects of forest fragmentation on the abundance of *Colobus angolensis palliatus* in Kenya's Coastal Forest. *Int. J. Primatol.* 28: 637–655.

Anzures-Dadda, A. and R. H. Manson. 2007. Patch- and landscape-scale effects on howler monkey distribution and abundance in rain forest fragments. *Anim. Conserv.* 10:69–76.

Arroyo-Rodríguez, V. and S. Mandujano. 2006. Forest fragmentation modifies habitat quality for *Alouatta palliata. Int. J. Primatol.* 27: 1079–1096.

Arroyo-Rodríguez, V., S. Mandujano and J. Benitez-Malvido. 2008. Landscape attributes affecting patch occupancy by howler monkey (*Alouatta palliata mexicana*) at Los Tuxtlas, Mexico. *Am. J. Primatol.* 70: 69–77.

Balcomb, S. R., C. A. Chapman and R. W. Wrangham. 2000. Relationship between chimpanzee (*Pan troglodytes*) density and large, fleshy-fruit tree density: conservation implications. *Am. J. Primatol.* 51: 197–203.

Badan Perencanaan Daerah Kab. Kuningan. 2015. Program kegiatan prioritas Kabupaten Kuningan. URL:<www. bappeda.jabarprov.go.id>. Downloaded 8 January 2015.

Brockerhoff, E. G., H. Jactel, J. A. Parrotta, C. P. Quine and J. Sayer. 2008. Plantation forests and biodiversity: oxymoron or opportunity? *Biodiv. Conserv.* 17: 925–951.

Brugière, D. and M. C. Fleury. 2000. Estimating primate densities using home range and line transect methods: a comparative test with the black colobus monkey *Colobus satanas. Primates* 41: 373–382.

Campbell, N., K. A. I. Nekaris, T. S. Pereira, N. Allgas and S. Shanee. 2019. Occupancy modeling for the conservation assessment of the Peruvian night monkey (*Aotus miconax*). *Primate Conserv.* (33): 13–20.

Campbell-Smith, G., R. Sembiring and M. Linkie. 2012. Evaluating the effectiveness of human-orangutan conflict mitigation strategies in Sumatra. *J. Appl. Ecol.* 49:3 67–375.

Chapman, C. A. 1990. Ecological constraints on group size in three species of Neotropical primates. *Folia Primatol.* 55: 1–9.

Chapman, C. A., S. R. Balcomb, T. R. Gillespie, J. P. Skorupa and T. T. Struhsaker. 2000. Long-term effect of logging on African primate communities: a 28-year comparison from Kibale National Park, Uganda. *Conserv. Biol.* 14: 207–217.

Chapman, C. A., L. J. Chapman, L. Naughton-Treves, M. J. Lawes and L. R. Mcdowell. 2004. Predicting folivorous primate abundance: validation of a nutritional model. *Am. J. Primatol.* 62: 55–69.

Chapman, C. A., L. Naughton-Treves, M. J. Lawes, M. D. Wasserman and T. R. Gillespie. 2007. Population declines of colobus in western Uganda and conservation value of forest fragments. *Int. J. Primatol.* 28: 513–528.

Chapman, C. A., J. M. Rothman and J. E. Lambert. 2012. Food as a selective force in primates. In: *The Evolution of Primate Societies*, J. C. Mitani, J. Call, P. M. Kappeler, R. A. Palombit and J. B. Silk (eds.), pp.149–168. University of Chicago Press, Chicago.

Chaves, O. M., K. E. Stoner and V. Arroyo-Rodríguez. 2011. Differences in diet between spider monkey groups living in forest fragments and continuous forest in Mexico. *Biotropica* 44(1): 105-113.

Cristobal-Azkarate, J. and V. Arroyo-Rodríguez. 2007. Diet and activity pattern of howler monkeys (*Alouatta palliata*) in Los Tuxtlas, Mexico: effects of habitat fragmentation and implication for conservation. *Am. J. Primatol*. 69: 1013–1029.

Cristobal-Azkarate, J., J. J. Vea, N. Asensio and E. Rodríguez-Luna. 2005. Biogeographical and floristic predictors of the presence and abundance of mantled howlers (*Alouatta palliata mexicana*) in rainforest fragments at Los Tuxtlas, Mexico. *Am. J. Primatol.* 67: 209–222.

Davies, A. G., E. L. Bennett and P. G. Waterman. 1988. Food selection by two South-east Asian colobine monkeys (*Presbytis rubicunda* and *Presbytis melalophos*) in relation to plant chemistry. *Biol. J. Linn. Soc*. 34: 33–56.

Eisenberg, J. F., W. P. J. Dittus, T. H. Fleming, K. Green, T. T. Struhsaker and R. W. Thorington Jr. 1981. *Techniques for the Study of Primate Population Ecology*. National Academy Press, Washington, DC.

Estrada, A. and R. Coates-Estrada. 1996. Tropical rain forest fragmentation and wild population of primates at Los Tuxtlas, Mexico. *Int. J. Primatol.* 17: 759–783.

Farida, W. R. and Harun. 2000. The diversity of plants as feed resources for the Java gibbon (*Hylobates moloch*), grizzled langur (*Presbytis comata*), and silver langur (*Trachypithecus auratus*) in Gunung Halimun National Park. *J. Primatol. Indonesia* 3: 55–61.

Fashing, P. J., N. Nguyen, P. Luteshi, W. Opondo, J. F. Cash and M. Cords. 2012. Evaluating the suitability of planted forests for African forest monkey: a case study from Kakamega Forest, Kenya. *Am. J. Primatol.* 74: 77–90.

Felton, A. M., A. Felton, D. B. Lindenmayer and W. J. Foley. 2009. Nutritional goal of wild primates. *Funct. Ecol.* 23: 70–78

Ganzhorn, J. U. 1987. A possible role of plantations for primate conservation in Madagascar. *Am. J. Primatol.* 12: 205–215.

Greenwood, J. J. D. and R. A. Robinson. 2006. General census methods. In: *Ecological Census Techniques*, W. J. Sutherland (ed.), pp.87–185. Cambridge University Press, New York.

Gunawan, A P. Kartono and I. Maryanto. 2008. Keanekaragaman mamalia besar berdasarkan ketinggian tempat di Taman Nasional Gunung Ciremai. *J. Biol. Indonesia* 4: 321–324.

Handayani, K. P. and K. Latifiana. 2019. Distribusi spasial lutung surili (*Presbytis comata*) di Taman Nasional Merbabu. In: *Prosiding Seminar Nasional Konservasi dan Pemanfaatan Tumbuhan dan Satwa Liar*, D. Dwibadra, D. C. Murniati, R. Rachmatika, I. P. G. P. Damayanto, N. Inayah, J. G. Sukmawati, A. Elang, N. Herlambang, S. H. Dalimunthe, A. D. Fefirenta, R. S. Rahayu and A. D. Prawestri (eds.), pp.118–125. Lembaga Ilmu Pengetahuan Indonesia, Jakarta.

Haurez, B., C. A. Petre and J. L. Doucet. 2013. Impacts of logging and hunting on western lowland gorilla (*Gorilla gorilla gorilla*) populations and consequences for forest regeneration. A review. *Biotechnol. Agron. Soc. Environ.* 17: 364–372.

Henzi, S. P., L. R. Brown, L. Barrett and A. J. Marais. 2011. Troop size, habitat use, and diet of chacma baboons (*Papio hamadryas ursinus*) in commercial pine plantations: implications for management. *Int. J. Primatol.* 32: 1020–1032.

Heriyanto, N. M. and S. Iskandar. 2004. The population status and habitat of grizzled leaf monkey (*Presbytis comata* Desmarest) in Kalajeten-Karangranjang forest complex, Ujung Kulon National Park. *Jurnal Penelitian Hutan dan Konservasi Alam* 1: 89–98.

Hockings, K. J., J. R. Anderson and T. Matsuzawa. 2009. Use of wild and cultivated foods by chimpanzees at Bossou, Republic of Guinea: feeding dynamics in a human-influenced environment. *Am. J. Primatol.* 71: 636–646.

Hoing, A., M. C. Quinten, Y. M. Indrawati, S. M. Cheyne and M. Waltert. 2013. Line transect and triangulation surveys provide reliable estimates of the density of Kloss' gibbon (*Hylobates klossii*) on Siberut Island, Indonesia. *Int. J. Primatol.* 34: 148–156.

Hoogerworf, A. A. 1970. *Udjung Kulon: The Land of the Last Javan Rhinoceros*. Brill, Netherlands.

Kankam, B. O. and P. Sicotte. 2013. The effect of forest fragment characteristics on abundance of *Colobus vellerosus* in the forest-savanna transition zone of Ghana. *Folia Primatol.* 84: 74–86.

Kartono, A. P., Gunawan, I. Maryanto and Suharjono. 2009. Hubungan mamalia dengan jenis vegetasi di Taman Nasional Gunung Ciremai. *J. Biol. Indonesia* 5: 279–294.

KLHK. 2018. Data dan Informasi Pemetaan Tematik Kehutanan Indonesia: penutupan lahan Indonesia, deforestasi Indonesia, moratorium hutan alam primer dan lahan gambut. Kementrian Kehutanan dan Lingkungan Hidup Republik, Jakarta, Indonesia.

Kirkpatrick, R. C. 1999. Colobine diet and social organization. In: *The Nonhuman Primates*, P. Dolhinow and A. Fuentes (eds.), pp.93–105. Mayfield Publishing, Toronto.

Koenig, A., C. Borries, M. K. Chalise and P. Winkler. 1997. Ecology, nutrition, and timing of reproductive events in an Asian primate, the hanuman langur (*Presbytis entellus*). *J. Zool., Lond.* 243: 215–235.

Kool, K. M. 1993. The diet and feeding behavior of the silver leaf monkey (*Trachypithecus auratus sondaicus*) in Indonesia. *Int. J. Primatol.* 14:667–700.

Kool, K. M. 1992. Food selection by the silver leaf monkey, *Trachypithecus auratus sondaicus*, in relation to plant chemistry. *Oecologia* 90: 527–533.

Kusumanegara A., A. P. Kartono, L. B. Prasetyo. 2017. Preferensi habitat surili di Taman Nasional Gunung Ciremai. Media Konservasi 22: 26–34.

Li, Y. 2004. The effect of forest clear-cutting on habitat use in Sichuan snub-nosed monkey (*Rhinopithecus roxellana*) in Shennongjia Nature Reserve, China. *Primates* 45: 69–72.

Lindenmayer, D. B., J. T. Wood, R. B. Cunningham, M. Crane, C. MacGregor, D. Michael and R. Montague-Drake. 2009. Experimental evidence of the effects of a changed matrix on conserving biodiversity within patches of native forest in an industrial plantation landscape. *Landscape Ecol.* 24: 1091–1103.

Luckett, J., E. Danforth, K. Linsenbardt and K. Pruetz. 2004. Planted trees as corridors for primates at El Zota Biological Field Station, Costa Rica. *Neotrop. Primates* 12: 143–146.

Mammides, C., M. Cords and M. K. Peters. 2008. Effects of habitat disturbance and food supply on population densities of three primate species in the Kakamega Forest, Kenya. *Afr. J. Ecol.* 47: 87–96.

Marsden, S. J., M. Whiffin and M. Galetti. 2001. Bird diversity and abundance in forest fragments and Eucalyptus plantations around an Atlantic Forest reserve, Brazil. *Biodiv. Conserv.* 10: 737–751.

Martins, M. M. 2005. Density of primates in four semi-deciduous forest fragments of São Paulo, Brazil. *Biodiv. Conserv.* 14: 2321–2329.

Mbora, D. N. M., B. Douglas and Meikle. 2004. Forest fragmentation and the distribution, abundance and conservation of the Tana River red colobus (*Procolobus rufomitratus*).*Biol. Conserv.* 118:67–77.

Melisch, R. and I. W. A. Dirgayusa. 1996. Notes on the grizzled leaf monkey (*Presbytis comata*) from two nature reserves in the West Java, Indonesia. *Asian Primates* 6:5–11.

Milton, K. 2003. Micronutrient intakes of wild primates: are humans different? *Comp. Biochem. Physiol. Part. A*. 136: 47–59.

Morgan, D. and C. Sanz. 2007. *Best Practice Guidelines for Reducing the Impact of Commercial Logging on Great Apes in Western Equatorial Africa*. IUCN SSC Primate Specialist Group (PSG), Gland, Switzerland. URL: <http://www.primate-sg.org/BP.logging.pdf>.

Nasi, R., P. Koponen, J. G. Poulsen, M. Buitenzorgy and W. Rusmantoro. 2008. Impact of landscape and corridor design on primates in a large-scale industrial tropical plantation landscape. *Biodiv. Conserv.* 17: 1105–1126.

Nelson, S. L., M. A. Miller, E. J. Heske and G. C. Fahey Jr. 2000. Nutritional quality of leaves and unripe fruit consumed as famine foods by the flying foxes of Samoa. *Pac. Sci.* 54: 301–311.

Nijman, V. 1997. On the occurrence and distribution of *Presbytis comata* (Desmarest, 1822) (Mammalia: Primates: Cercopithecidae) in Java, Indonesia. *Contrib. Zool*. 66: 247–256.

Nijman, V. 2013. One hundred years of solitude: effects of long-term forest fragmentation on the primate community of Java, Indonesia. In: *Primates in Fragments: Complexity and Resilience*, L. K. Marsh and C. A. Chapman (eds.), pp.33–45. Springer, New York.

Nijman, V. 2017. Group composition and monandry in grizzled langurs, *Presbytis comata*, on Java. *Folia Primatol*. 88: 237–254.

Nijman, V. and K. A. I. Nekaris. 2012. Loud calls, startle behaviour, social organisation and predator avoidance in arboreal langurs (Cercopithecidae: *Presbytis*). *Folia Primatol.* 83: 274–287.

Nijman, V. and M. Richardson. 2008. *Presbytis comata*. The IUCN Red List of Threatened Species 2008. Downloaded 11 January 2020.

Nijman, V. and S. B. Van Balen. 1998. A faunal survey of the Dieng Mountains, Central Java, Indonesia: distribution and conservation of endemic primate taxa. *Oryx* 32: 145−156.

Onderdonk, D. A. and C. A. Chapman. 2000. Coping with forest fragment: the primates of Kibale National Park, Uganda. *Int. J. Primatol.* 21: 587–611.

Pawson, S. M., E. G. Brockerhoff, E. D. Meenken and R. K. Didham. 2008. Non-native plantation forests as alternative habitat for native forest beetles in a heavily modified landscape. *Biodiv. Conserv.* 17: 1127–1148.

PeraturanMenteri Kehutanan Nomor P.57/Menhut-II/2008 tentang arahan strategis konservasi spesies nasional 2008–2018. Kementrian Kehutanan Republik Indonesia, Jakarta.

Pozo-Montuy, G., J. C. Serio-Silva and Y. M. Bonilla-Sanchez. 2011. Influence of the lanscape matrix on the abundance of arboreal primates in fragmented landscapes. *Primates* 52: 139–147.

Prasetyo, L. B., E. K. Damayanti and M. Masuda. 2012. Land cover changes before and after implementation of the PHBM program in Kuningan District, West Java, Indonesia. *Tropics* 21: 47–57.

Ray, P.C., A. Kumar, A. Devi, M. C. Krishna, M. L. Khan and W. Y. Brockelman. 2015. Habitat characteristics and their effects on the density of groups of Western hoolock gibbon (*Hoolock hoolock*) in Namdapha National Park, Arunachal Pradesh, India. *Int. J. Primatol.* 36: 445–459.

Rayadin, Y. and T. Saitoh. 2009. Individual variation in nest size and nest site features of the Bornean orangutan (*Pongo pygmaeus*). *Am. J. Primatol.* 71: 393–399.

Rayadin, Y. and S. N. Spehar. 2015. Body mass of wild Bornean orangutans living in human-diminated landscapes: implication for understanding their ecology and conservation. *Am. J. Phys. Anthropol.* 157: 339–346.

Ross, C. and A. Srivastava. 1994. Factors influencing the population density of the Hanuman langur (*Presbytis entellus*) in Sariska Tiger Reserve. *Primates* 35: 361–367.

Ruhiyat, Y. 1983. Socio-ecological study of *Presbytis aygula* in West Java. *Primates* 24: 344–359.

Salek, M., J. Svobodova and P. Zasadil. 2010. Edge effect of low-traffic forest roads on bird communities in secondary production forests in central Europe. *Landscape Ecol.* 25: 1113–1124.

Siex, K.S. and T. T. Struhsaker. 1999. Ecology of the Zanzibar red colobus monkey: demographic variability and habitat stability. *Int. J. Primatol.* 20: 163–192.

Soerianegara, I. and A. Indrawan. 2005. *Ekologi Hutan Indonesia.* Institut Pertanian Bogor, Bogor.

Supriatna, J., J. R. Tilson, K. J. Gurmaya, J. Manangsang, W. Wardojo, A. Sriyanto, A. Teare, K. Castle and U. Seal. 1994. *Javan Gibbon and Langur Population and Habitat Viability Analysis*. Taman Safari Indonesia, Bogor.

Tobing, I. S. L. 1999. Pengaruh perbedaan kualitas habitat terhadap perilaku dan populasi primata di Kawasan Cikaniki, Taman Nasional Gunung Halimun, Jawa Barat. Thesis, Institut Pertanian Bogor, Bogor.

Van Halder, I., I. Barbaro and H. Jactel. 2011. Conserving butterflies in fragmented plantation forests: are edge and interior habitats equally important? *J. Insect. Conserv*. 15: 591–601.

Wasserman, M. D. and C. A. Chapman. 2003. Determinants of colobine monkey abundance: the importance of food energy, protein and fibre content. *J. Anim. Ecol.* 72: 650–659.

Whitten, A.J., R. E. Soeriaatmadjaand S. A. Afiff. 1996. *The Ecology of Java and Bali. The Ecology of Indonesia. Volume II*. Periplus Editions, Singapore.

Weisenseel, K., C. A. Chapman and L. J. Chapman. 1993. Nocturnal primates of Kibale Forest: effects of selective logging on prosimian densities. *Primates* 34: 445–450.

Wich, S., R. Buij and C. van Schaik. 2004. Determinants of orangutan density in the dryland forests of the Leuser ecosystem. *Primates* 45: 177–182.

Wieczkowski, J. 2004. Ecological correlates of abundance in the Tana Mangabey (*Cercocebus galeritus*). *Am. J. Primatol.* 63: 125–138.

Wood, B. and M. P. Gillman. 1998. The effects of disturbance on forest butterflies using two methods of sampling in Trinidad. *Biodiv. Conserv.* 7: 597–616.

Worman, C. O. and C. A. Chapman. 2006. Densities of two frugivorous primates with respect to forest and fragment tree species composition and fruit availability. *Int. J. Primatol.* 27: 203–225.

Yamada, A. and Y. Muroyama. 2010. Effects of vegetation type on habitat use by crop-raiding Japanese macaques during a food-scarce season. *Primates* 51: 159–166.

Yeager, C. P. 1996. Feeding ecology of the long-tailed macaque (*Macaca fascicularis*) in Kalimantan Tengah, Indonesia. *Int. J. Primatol.* 17:51–62.

Yeager, C. P. and R. C. Kirkpatrick. 1998. Asian colobine social structure: ecological and evolutionary constraints. *Primates* 39: 147–155.

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Appendix

List of food tree species for *Presbytis comata* in 19 sites in Kuningan District, West Java, Indonesia.

No.	Scientific name	Family
1	*Aglaia argentea* Blume	Meliaceae
2	*Aglaia odorata* Lour.	Meliaceae
3	*Aglaia* sp.1	Meliaceae
4	A*langium rotundifolium* (Hassk.) Bloemb.	Cornaceae
5	*Albizia falcataria* (L.) Fosberg	Leguminosae
6	*Albizia procera* (Roxb.) Benth	Leguminosae
7	*Aleurites moluccana* (L.) Willd.	Euphorbiaceae
8	*Alseodaphne umbelliflora* Hook.f.	Lauraceae
9	*Alstonia scholaris* R. Br.	Apocynaceae
10	*Antidesma bunius* (L.) Spreng	Phyllanthaceae
11	*Antidesma montanum* Blume	Phyllanthaceae
12	*Archidendron pauciflorum* (Benth.) Nielsen	Leguminosae
13	*Arthrophyllum diversifolium* Blume	Araliaceae
14	*Artocarpus elastica* Reinw.	Moraceae
15	*Artocarpus heterophyllus* Lam.	Moraceae
16	*Baccaurea javanica* Muell. Arg.	Phyllanthaceae
17	*Bischofia javanica* Blume	Phyllanthaceae
18	*Blumeodendron tokbrai* (Blume) Kurz	Euphorbiaceae
19	*Bridelia monoica* Merr.	Phyllanthaceae
20	*Calliandra calothyrsus* Meisn.	Leguminosae
21	*Cananga odorata* (Lamk.) Hook.	Annonaceae
22	*Canthium glabrum* Blume	Rubiaceae
23	*Cassia siamea* Lamk	Leguminosae
24	*Castanopsis argentea* A. DC.	Fagaceae
25	*Castanopsis tungurrut* A. DC.	Fagaceae

26	*Ceiba pentandra* L. Gaertn.	Bombacaceae
27	*Cinnamomum burmannii* (Nees & T.Nees) Blume	Lauraceae
28	*Cinnamomum iners* Reinw. ex Blume	Lauraceae
29	*Coffea* sp.	Rubiaceae
30	*Croton argyratus* Blume	Euphorbiaceae
31	*Cryptocarya ferrea* Blume	Lauraceae
32	*Dalbergia latifolia* Roxb.	Leguminosae
33	*Dillenia indica* L.	Dilleniaceae
34	*Diospyros macrophylla* Blume	Ebenaceae
35	*Dracontomelum dao* Merr. & Rolfe	Anacardiaceae
36	*Dysoxylum macrocarpum* Blume	Meliaceae
37	*Elaeocarpus glaber* Blume	Elaeocarpaceae
38	*Erythrina lithosperma* Miq.	Leguminosae
39	*Eurya acuminata* DC.	Pentaphyllaceae
40	*Ficus ampelas* Burm.f.	Moraceae
41	*Ficus fistulosa* Reinw. ex Blume	Moraceae
42	*Ficus magnoliaefolia* Blume	Moraceae
43	*Ficus padana* Burm.f.	Moraceae
44	*Ficus ribes* Reinw	Moraceae
45	*Ficus septica* Burm. F.	Moraceae
46	*Ficus sumatrana* Miq.	Moraceae
47	*Ficus variegata* Blume	Moraceae
48	*Flacourtia rukam* Zoll.& Mor.	Salixaceae
49	*Garcinia parvifolia* (Miq.) Miq.	Clusiaceae
50	*Geunsia pentandra* Merrill	Lamiaceae
51	*Gironniera cuspidata* (Blume) Kurz	Canabaceae
52	*Gliricidia sepium* H.B.K.	Leguminosae
53	*Glochidion arborescens* Blume	Phyllanthaceae
54	*Glochidion philippicum* (Cav.) C.B. Rob.	Phyllanthaceae
55	*Gnetum gnemon* L.	Gnetaceae
56	*Grewia laevigata* Vahl	Malvaceae
57	*Hibiscus macrophyllus* Roxb. ex Hornem	Malvaceae
58	*Homalanthus populneus* (Giesel.) Pax	Euphorbiaceae
59	*Knema cinerea* Warb.	Myristicaceae
60	*Lansium domesticum* Corr	Meliaceae
61	*Leucaena leucocephala* (Lam.) de Wit	Leguminosae
62	*Macaranga tanarius* (L.) M.A.	Euphorbiaceae
63	*Macaranga triloba* (Reinw.ex Blume) Muell. Arg.	Euphorbiaceae
64	*Macropanax dispermus* (Blume) O.K.	Araliaceae
65	*Maesopsis eminii* Engl.	Rhamnaceae.
66	*Mallotus* sp.1	Euphorbiaceae

67	*Mangifera foetida* Lour	Anacardiaceae
68	*Mangifera longipes* Griff.	Anacardiaceae
69	*Melia azedarach* L.	Meliaceae
70	*Melicope lunu-akenda* (Gaertn.) T.G. Hartley	Rutaceae
71	*Meliosma ferruginea* Blume	Sabiaceae
72	*Melochia umbellata* (Houtt.) Stapf.	Malvaceae
73	*Michelia velutina* DC	Magnoliaceae
74	*Nauclea orientalis* L.	Rubiaceae
75	*Neonauclea obtusa* (Blume) Merr.	Rubiaceae
76	*Nephelium lappaceum* L.	Sapindaceae
77	*Oreocnide rubescens* (Blume) Miq.	Urticaceae
78	*Ostodes paniculata* Blume	Euphorbiaceae
79	*Pangium edule* Reinw.	Achariaceae
80	*Paraserianthes falcataria* (L.) Nielsen	Leguminosae
81	*Paratocarpus venenosa* (Z.& M.) Becc.	Moraceae
82	*Parkia javanica (Lam.)* Merr.	Leguminosae
83	*Parkia speciosa* Hassk.	Leguminosae
84	*Persea americana* P. Mill.	Lauraceae
85	*Persea rimosa Zoll.* ex Meisn.	Lauraceae
86	*Piper aduncum* L.	Piperaceae
87	*Pittosporum ramiflorum* Zoll. ex Miq.	Pittosporaceae
88	*Planchonia valida* Blume	Lecythidaceae
89	*Platea excelsa* Blume	Icacinaceae
90	*Radermachera gigantea (Blume) Miq.*	Bignoniaceae
91	*Samanea saman* (Jacq.) Merr.	Leguminosae
92	*Saurauia bracteosa* DC.	Actinidiaceae
93	*Saurauia reinwardtiana* Blume	Actinidiaceae
94	*Schima wallichii (DC.)* Korth.	Theaceae
95	*Schleichera oleosa* Merrill	Sapindaceae
96	*Sterculia oblongata* R. Br.	Malvaceae
97	*Symplocos fasciculata* Zoll.	Symplocaceae
98	*Syzygium lineatum (DC.)* Merr. & Perry	Myrtaceae
99	*Syzygium polyanthum* Wigh Walp.	Myrtaceae
100	*Tabernaemontana sphaerocarpa* Blume	Apocynaceae
101	*Terminalia belirica* (Gaertn.) Roxb.	Combretaceae
102	*Toona sureni* (Blume) Merr.	Meliaceae
103	*Turpinia sphaerocarpa* Hassk.	Staphyleaceae
104	*Vernonia arborea* Buch. - Ham.	Compositae
105	*Vitex pinnata* L.	Lamiaceae
106	*Xanthophyllum excelsum* (Blume) Miq.	Polygalaceae

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