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On the occurrence and distribution of *Presbytis comata* (Desmarest, 1822) (Mammalia: Primates: Cercopithecidae) in Java, Indonesia

Vincent Nijman

Institute for Systematics and Population Biology (Zoological Museum), University of Amsterdam,
P.O. Box 94766, 1090 GT Amsterdam, The Netherlands

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Abstract

The colobine monkey *Presbytis comata* is confined to the rain forests of West and Central Java, Indonesia. In order to determine its distribution, a review of the literature, evidence from the study of museum specimens, and the results of recent surveys are presented. Recent surveys in the central parts of the island indicate that *P. comata* is still present on four volcanic mountain complexes, viz. Mt. Sawal, Mt. Slamet, Mts. Dieng, and Mt. Lawu. The present paper gives the results of the surveys combined with a review of its distribution. Altitudinal and habitat preferences, and the conservation status of the species are discussed.

Zusammenfassung

Die Verbreitung des Slankaffen *Presbytis comata* ist beschränkt auf die Urwälder West- und Zentraljavas, Indonesien. Um seine Verbreitung festzustellen werden eine Literaturübersicht, eine Untersuchung von Museumsexemplaren und die Resultate neuer Feldstudien wiedergegeben. Demnach kommt *P. comata* noch immer auf vier verschiedenen Vulkangruppen vor: Sawal, Slamet, Dieng und Lawu. Dieser Artikel kombiniert die Ergebnisse der Feldstudien mit einer Übersicht aller bekannten Verbreitungsvorkommen und diskutiert Höhe- und Habitatpräferenzen sowie die jetzt notwendigen Schutzmassnahmen.

Introduction

Indonesia supports a relatively high number of colobine monkeys belonging to the genus *Presbytis* sensu stricto and, due to the partial isolation of Asia and the intermittent connection between islands, the country includes numerous endemic taxa. One of these is the Grizzled leaf monkey

Presbytis comata (Desmarest, 1822) [formerly *P. aygula*, see Weitzel & Groves, 1985], endemic to the island of Java, viz., the West and Central Javan provinces. Animals of this species live in single male groups containing three to over thirteen individuals. During the day the troops frequently visit the middle and lower layer of the forest, whilst resting at night in the upper layer (Ruhayat, 1983). The species is strictly arboreal and is restricted to rain forest areas with a continuous forest canopy. *Presbytis comata* plays an important ecological role as one of the principal arboreal shoot- and leaf-eating mammals of the Javan rain forest, although fruit may also be eaten when available (Sujatnika, 1992; Ruhayat, 1983; 1991). Little is known about the ecology of the species, and particularly knowledge about its distribution at the individual and population level is limited (Supriatna et al., 1994).

Java is Indonesia's most cultivated large island and has a long history of forest conversion and degradation. Nowadays less than 10% of the original forest remains in Java and especially West and Central Java have suffered from deforestation. In these two provinces 48% of the montane forest, 14% of the hill forest and less than 2% of the lowland forest remains (MacKinnon et al., 1982). For the latest update on land use and ecological issues concerning the island of Java (and Bali), see Whitten et al. (1996).

Because of its small, fragmented populations and its severely reduced habitat *Presbytis comata* is considered to be among the most endangered primate species in the world (Eudey, 1987).

P. comata –together with another Javan endemic, the Javan gibbon *Hylobates moloch* (Audebert, 1799)– have suffered more than any other Malaysian primate from deforestation (MacKinnon, 1987). Population size estimates have been theoretically calculated and range from 8040 (MacKinnon, 1987) to 2285 (Supriatna et al., 1994).

Sody (1930) described the subspecies *P. c. fredericae* based on specimens collected on the southern slopes of Mt. Slamet, Central Java. This subspecies differs from the grizzled nominate from West Java in having a dark collar on the upper side of the chest and a dark belly region, and by the occurrence of melanistic individuals. A more elaborate discussion on geographical variation in pelage characteristics in *P. comata* is discussed elsewhere (Nijman, in press). Otherwise very little has been written about the occurrence of *P. comata* in Central Java. If mentioned at all, the species was most frequently reported to occur on or to the east of Mt. Slamet (Chasen, 1940; Hooijer, 1962; Medway, 1970; MacKinnon, 1987; Weitzel et al., 1988; Ruhayat, 1991; Corbet & Hill, 1992). Apart from Kappeler (1984), who conducted a gibbon survey in 1978 and visited some sites in Central Java, and M. Linsley (pers. comm, 1994), few people have extended or concentrated their (biological) surveys into Central Java (see e.g. Appendices II and III in Whitten et al., 1996). Eudey (1987) states that *P. c. fredericae* is known with certainty only from Mt. Slamet. However, Bartels (1937) reported the occurrence of the species on the north-western slopes of the Dieng mountains, and moreover some specimens have been collected on the Dieng mountains and Mt. Lawu, on the border between Central and East Java (National Museum of Natural History (hereafter RMNH), Leiden, coll. Bartels, no. 14612, 14613, and 14614).

The only other record from the eastern half of the island comes from Eugène Dubois who collected a fragment of the right palate with P3-M2 in situ of a *Presbytis* sensu stricto from a Middle Pleistocene deposit in Sumber Kephuh (112°5' E, 7°30' S), East Java (RMNH, coll. Dubois, no. 3780). The sediments in which the fossils were found are of volcanic origin and Dubois inferred that the animals in the deposits died due to a

volcanic eruption. Based on the structure of the sediments he concluded that most likely this had been an eruption of Mt. Wilis (cf. Theunissen, 1985).

The aim of the present paper is to synthesize the main results from studies published in various journals and unpublished reports, not all of which are easily accessible, and to integrate this with new data on the distribution and conservation status of central Javan populations of *P. comata*, collected during two field surveys in 1994 and 1995. An overview of the historic and present distribution of *P. comata* is given, after which new data on the species gathered in the central parts of Java are presented. Finally, altitudinal and habitat preferences are discussed, and some recommendations for conservation are given.

Methods

1. Study sites

In order to assess the current distribution of *P. comata* in the central parts of Java, data were gathered over an eight months (March-Sept.) period during 1994, with an additional two months (June-July) survey in 1995. Surveys were conducted in almost all forest areas larger than 5000 ha, between east of Mt. Papandayan and Mts. Wilis-Liman. The forest areas visited included Mt. Sawal, Mt. Segara, Mt. Slamet, Mts. Dieng, Mt. Sundoro, Mt. Sumbing, Mt. Merapi, Mt. Muria, Mt. Lawu, and Mts. Wilis-Liman (see Table I). Together the forests on these mountains comprise more than 90% of the remaining natural forest in the central part of the island.

In the same period additional data on the distribution of the species were collected on Mt. Pancar and Mt. Gede-Pangrango, both in West Java.

2. Survey methods

The area was surveyed by scanning the forest area from vantage points over the canopy and by surveys inside the forest along available trails. Data were collected on habitat type and order of disturbance, and when the species was detected, notes on group size, age-class composition, habitat utilization, altitude, and behaviour were taken. Additional data on the presence or absence of *P. comata* were gathered by semi-structured interviews with local people living in the vicinity of the forests and with officers of nature conservation and forestry departments.

Comprehensive information on the distribution of the species was obtained from the study of specimens in the Museum

Table 1. Study sites on the island of Java, Indonesia.

Locality	Status ¹	Coordinates E-S	Forest type ²	Alt. range ³
Mt. Pancar	unp.	106°54'–6°35'	wet hill	700–1000
Mt. Gede-Pangrango	NP	107°00'–6°45'	wet hill-montane	800–3019
Mt. Sawal	wr	108°16'–7°12'	wet hill-montane	700–1764
Mt. Segara	[nr]/unp.	108°48'–7°07'	wet lowland-submontane	300–1812
Mt. Slamet	[nr]	109°15'–7°15'	wet hill-montane	700–3000
Mts. Dieng	[wr]/unp.	109°37'–7°05'	wet lowland-montane	250–2565
Mt. Sundoro	pf	110°00'–7°17'	wet montane	2000–3135
Mt. Sumbing	[nr]	110°04'–7°22'	wet lowland-montane	500–3371
Mt. Merapi	[rf]	110°26'–7°32'	wet montane	900–2911
Mt. Muria	[nr]	110°52'–6°37'	moist hill-submontane	600–1620
Mt. Lawu	[nr]	111°11'–7°40'	wet submontane-montane	1000–3000
Mt. Wilis-Liman	[wr]	111°46'–7°48'	moist-wet hill-montane	600–2563

¹NP = national park (Taman Nasional), nr = nature reserve (cagar alam), pf = protection forest (hutan lindung), rf = recreation forest (hutan wisata), unp. = unprotected, wr = wildlife reserve (suaka margasatwa), [] = proposed. ²After MacKinnon et al., 1982. ³Numbers in italic represent approximate lower and upper limits of forest; *before the eruption on 22-11-1994: present state of forest unknown but lower limit has gone up considerably and only the eastern slopes are left covered with natural forest (Rudiyanto, pers. comm., 1996).

Zoologi (Bogor, MZB), the British Museum of Natural History (London, BMNH) and the National Museum of Natural History (Leiden, RMNH), from the literature, and from unpublished data obtained by correspondents.

Results

1. Geographic distribution

Map 1 and Table II show the localities where *P. comata* has been recorded, both in historic and recent times. The species' distribution encompasses the area from the westernmost tip of the island at Ujung Kulon to Mt. Lawu on the border between Central and East Java. It has been recorded in 33 forest patches, most of which are located in the West Javan province and a few records originate from the Central Javan province. The only records from East Java are those from Mt. Lawu and the Middle Pleistocene fossil excavated at Sumber Kephuh.

2. Distribution in the central parts of Java

In this section, information gathered in the central parts of the island are discussed in a west to east sequence.

Mt. Sawal: The characteristic vocalizations of *P. comata* were recorded in a secondary forest patch, on the southern slopes at 1025 m. The dense cover prevented sightings of the animals although the group was very close at hand. Three other individuals and a juvenile were seen later resting in an emergent tree in the primary forest at an altitude of 935 m.

According to local villagers and staff from the forestry department, *P. comata* is also present in the higher parts on the northern slopes, although the species was not recorded there.

Mt. Slamet: Both in 1994 and 1995, groups of *P. comata* were recorded on several occasions on the southern slopes near the hotwater springs near 'Pancuran tujuh', north of the village of Baturaden. Group sizes ranged from 4–5 to 10 individuals and records were established at altitudes between 700 and 910 m.

On 30 June 1995, the vocalizations of *P. comata* were heard coming from the edge of the forest at 1985 m, on the eastern slopes of Mt. Slamet. The same day two other groups were observed. The first group consisted of more than three individuals and was seen descending to a lower part of the mountain from an altitude of 2150 m. A few moments later a group of Ebony leaf monkeys, *Trachypithecus auratus* (E. Geof-

Table II. Localities with records, and altitude (in m above sea level) when available, of *Presbytis comata*, forest type with its approximate present altitudinal range, and climate type.

No.*	Locality	Coordinates E-S	Forest type**	Alt. range forest†	Climate type††	Alt. record (reference)†††
1.	Ujung Kulon	105°20'–6°45'	L	0–623	2–3	0–200 (1–2)
2.	Cerita	105°50'–6°10'	L	<i>100</i>	2	(3)
3.	Ranca Danau	106°00'–6°10'	L	90–744	3	(3–4)
4.	Haurbentes-Jasinga	106°27'–6°31'	P	200–470	3	200–470 (5)
5.	Cikepuh/Cibanteng	106°25'–7°12'	L	0–235	2	(6)
6.	Halimun	106°30'–6°40'	H/SM/M	500–1929	3	(4), 700–1075 (7), 900–1200 (6)
7.	Pelabuhan Ratu	106°32'–6°59'	L	<i>100</i>	2	30 (8)
8.	Mt. Salak	106°45'–6°45'	SM/M	1700–2211	3	600 (a)
9.	Jampang	106°47'–7°15'	–	–	2–3	(b)
10.	Mt. Pancar	106°54'–6°35'	H	700–1000	3	785–850 (9)
11.	Mt. Gede-Pangrango	107°00'–6°45'	H/SM/M	800–3019	3	900–1400 (9), 1000–2600 (5)
12.	Ciwangi	107°02'–7°04'	–	–	3	1200 (8)
13.	Sanggabuana	107°15'–6°35'	L/H	150–1219	2	(6)
14.	Mt. Magesi	107°20'–7°05'	SM/M	1000–2078	3	(10)
15.	Kamojang	107°22'–7°10'	M	1400–2250	3	1390–1625 (11)
16.	Mt. Simpang	107°25'–7°15'	H/SM	600–1600	3	(10)
17.	Mt. Tilu	107°30'–7°09'	SM/M	1200–2177	3	(4–10–11)
18.	Burangrang	107°33'–6°46'	SM/M	1000–2000	2–3	(6)
19.	Cibeureum	107°33'–7°10'	–	–	3	(c)
20.	Mt. Kencana	107°35'–7°18'	H/SM/M	600–2182	3	(10)
21.	Mt. Papandayan	107°45'–7°20'	SM/M	1000–2622	3	(11)
22.	Patenggang	107°46'–7°08'	M	1600–1775	3	1600–1775 (11)
23.	Cikajang	107°47'–7°22'	–	–	3	900 (d)
24.	Mt. Limbung	107°50'–7°25'	L/H/SM	300–1815	3	(10)
25.	Magesit Kareumbi	107°54'–6°54'	H/SM	–	2–3	(6)
26.	Mt. Sawal	108°16'–7°12'	H/SM	700–1764	3	915–1025 (9)
27.	Mt. Ciremay	108°25'–7°00'	SM/M	1000–3078	3	(12)
28.	Ciringin	108°30'–7°27'	–	–	3	(e)
29.	Mt. Slamet	109°15'–7°15'	H/SM/M	700–3000	3	1000 (f), 1400 (g), 1500 (13), 700–2350 (9)
30.	Mt. Cupu/Simembut	109°26'–7°14'	L/H	350–1000	3	350–1000 (14)
31.	Mt. Lumping	109°38'–7°07'	L/H/SM	250–1327	3	300–1300 (9)
32.	Mt. Prah	109°55'–7°10'	M	1600–2565	3	1300–1400 (15), 2500–2565 (9)
33.	Mt. Lawu	111°11'–7°40'	SM/M	1000–3000	2	1500–1600 (h), 1880 (9) 1900 (3)
34.	Sumber Kepuh	112°05'–7°30'	–	–	1 (Mt. Wilis 2–3)	(i)

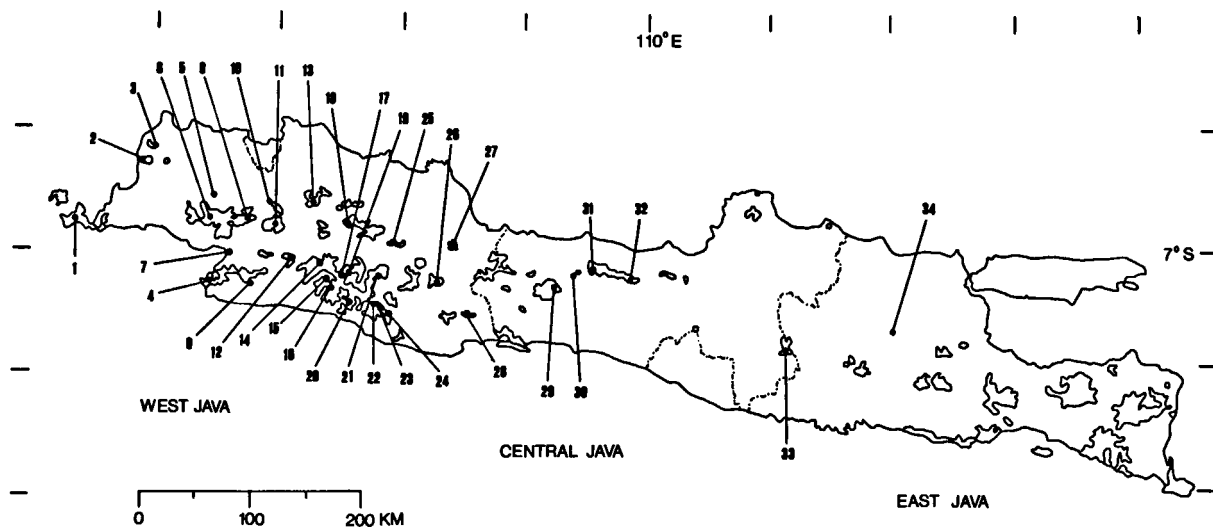
* Cf. Map 1.

** L = lowland forest (0–500 m); H = hill forest (500–1000 m); SM = submontane forest (1000–1500 m); M = montane forest (1500 m and above); P = forest plantation.

† Italic numbers represent approximate altitudes in m above sea level (after MacKinnon et al., 1982; Kappeler, 1984; pers. observation).

†† Climate types based on the number of rainy days during the four driest consecutive months of the year (abbreviated as RDFDCM): 1 = areas with 0–10 RDFDCM; 2 = areas with 10–30 RDFDCM; 3 = areas with more than 30 RDFDCM (after Van Steenis, 1965).

††† Key: (1) Hoogerwerf, 1970; (2) Gurmaya et al., 1992; (3) S. van Balen, pers. comm., 1995; (4) Van der Zon, 1979; (5) Sujatnika, 1992; (6) Supriatna et al., 1994; (7) Kool, 1992; (8) Napier, 1985; (9) present study; (10) MacKinnon et al., 1982; (11) Ruhayat, 1991; (12) Weitzel et al., 1988; (13) Seitre & Seitre, 1990; (14) Linsley & Nawimar, 1994, in Brandon-Jones, 1995; (15) Bartels, 1937; (a) RMNH 34302/34336/34337/34338; (b) MZB 3817; (c) RMNH 26822; (d) MZB 6646; (e) RMNH 34296; (f) RMNH 34318; (g) MZB 167; (h) RMNH 14614; (i) Middle Pleistocene fossil, coll. Dubois no. 3780, RMNH.



Map 1. Geographical distribution of *Presbytis comata* in Java, Indonesia. The map shows areas covered with natural forests, excluding mangrove and swamp forest (after RePPPProT, 1990), and the localities where *P. comata* has been recorded. Numbers correspond with those listed in Table II.

froy, 1812), were seen heading in the same direction. It is not clear whether the two species formed one group or were divided into two separate groups. A mixed group of both species was observed later that day: a group of 9 leaf monkeys – 3 to 4 of which *P. comata* – were seen moving in the upper layer of the canopy, in oak-laurel forest at an altitude of 2350 m.

Mts. Dieng: *P. comata* was found in different parts of this c. 255 km² large forest block, ranging from lowland to upper-montane. The species was first seen on 5 June 1994, near the summit (2565 m) of Mt. Prahu in the easternmost part. Two individuals were moving through the upper strata of the forest, and one could be observed for up to half an hour (Nijman & Sözer, 1995). Near this observation point, in June 1995, a group of leaf monkeys was observed but it was not clear whether or not *P. comata* was involved.

In the lower parts near the village of Linggo, seven times a group was seen ranging from 3 to 13 individuals and two groups were detected by means of their vocalizations only. Records were established at altitudes of 1300 m on Mt. Lumpung to 650 m near Linggo, but the species was also reported to occur at the lower parts to c. 300 m.

Mt. Lawu: The species was recorded once during five days of surveying, in the montane forests (1880 m) between Cemoro Sewu and the waterfall of Mojosemi near Sarangan, East Java. On 12 July 1995, the characteristic diagnostic vocalizations of *P. comata* were heard and a few minutes later a group of at least seven leaf monkeys was observed. Although the light conditions were far from optimal due to the incoming darkness, the shape of the monkeys and the clear presence of a pale belly and underside of tail left no doubt that *P. comata* was involved. Groups of Ebony leaf monkeys were also observed in the area.

According to local informants, two types of *budeng* (East Javan name for Ebony leaf monkey) were present. I have not spoken with anybody who was familiar with the name (*lutung*) *rekra-kan* (Javanese name for *P. comata*), nor have I heard of anyone who had a local word to describe the species other than *budeng* or *lutung* (the latter name is used in West and Central Java and Bali to indicate Ebony leaf monkeys).

On 8 October 1988, S. van Balen (pers. comm., 1995) recorded a group of *P. comata* consisting of 10–15 individuals, at c. 1900 m in the forests above Cemoro Sewu.

Mt. Wilis: Nowadays only the southeastern

slopes of Mt. Wilis are left covered with rain forests and might provide a suitable habitat for *P. comata*. The remainder of this mountain complex consists of disturbed secondary forest, bushland and some patches of primary forest. The species was not recorded to be present.

In May 1994, Linsley & Nawimar (in Brandon-Jones, 1995) observed *P. comata* on Mt. Cupu-Mt. Simembut in a fragment of natural forest apparently totally surrounded by pine plantations or open ground. In none of the other forest areas of Central Java has *P. comata* been recorded, nor did we receive information that could indicate its presence.

Discussion

1. Geographic distribution

The present study shows that the distribution of *P. comata* shows a very scattered pattern with records originating from 33 forest areas. In some of these areas the species is only known with certainty from historic observations and whether or not the species is still present in these localities remains to be solved. *P. comata* is a strictly arboreal species and even relatively small areas without forest will not be crossed. The populations in most of the forest areas are thus isolated from one another. Furthermore, within the forested areas the forest proper is often not continuous, resulting in the fragmentation into sub-populations of *P. comata* with a limited or unknown possibility of migration. Surveys in the central parts of Java revealed that *P. comata* is still present in all three localities where it has been reported formerly. The independent observations of *P. comata* on Mt. Lawu by two observers might be significant, as Brandon-Jones (1995) questions the validity of Mt. Lawu as the site of collection for the skin collected by Bartels (RMNH 14614). Fact is that Bartels did collect on Mt. Lawu (see e.g. photographs in Becking, 1989), and whether or not this skin was indeed collected on Mt. Lawu or on the Mts. Dieng, as suggested by Brandon-Jones (1995), might be of historic interest only.

At present it is unlikely that, apart from the

Mts. Pembarisan-Mt. Segara and perhaps some small isolated forest patches, the species will be present at any other locality. Mts. Pembarisan is an area of lowland and hill forest probably over 200 km² of which c. 130 km² are proposed as conservation forest (MacKinnon, 1987) where both Javan gibbon and Ebony leaf monkey were observed (Nijman & Sözer, 1995). Most of the forests in Central Java are severely diminished, and almost all remaining forest areas were visited for several days.

In some areas, for instance Mt. Sundoro and Mt. Sumbing, the absence of *P. comata* may simply be explained by the total lack of suitable habitat, i.e., the total absence of closed canopy forest. In other areas the absence is more difficult to explain. Some areas seemed, at least from the human observer's eye, to contain suitable habitat. Most of the forests on the central Javan mountains are rather disturbed, either as a result of human influences and/or of natural causes. Those areas that seem suitable at present may consist of regrowth, while isolation did not allow them to be colonized.

It was not until 1990, when Seitre & Seitre (1990) observed *P. comata* on Mt. Slamet, that there was any certainty about the continued existence of the species in Central Java. *P. comata* was also reported to occur on Mt. Slamet by M. Linsley (pers. comm., 1994). The present study shows that the scant information we have on the eastern half of the species' distribution is equally likely due to the limited amount of focussed research done in the area as well as to the rarity of the species. However, it must be stressed that the species is present at few localities only and the nature of the species evades easy observation. Furthermore, for unexperienced observers melanistic individuals are easily confused with the more common Ebony leaf monkey.

With the observations of *P. comata* at Mt. Sawal, the (historic) presence on Mt. Ciremay and at Cisaga, and the present observations at Mt. Slamet, Mts. Dieng, and Mt. Lawu, it becomes clear that the species shows a more or less continuous, though very scattered, distribution from Ujung Kulon in the west to Mt. Lawu in the east.

2. Altitudinal distribution

Some confusion exists in literature about the altitudinal distribution of *P. comata*. Older researchers (e.g. Hoogerwerf, 1970; Medway, 1970) consider the species to be restricted to the lowlands and not to high mountainous regions, and also MacKinnon (1987) restricts the species to the lowland and hill forest up to 1500 m altitude. According to Whitten et al. (1996) the species' altitudinal limit is probably about 1250 m, although it is sometimes found higher than this, particularly where lowland forests have diminished in area. The given altitudes at which museum specimens were collected range from sea level to 1600 m.

Recent workers (e.g. Ruhiyat, 1983, 1991; Supriatna et al., 1994) however, consider the species to be confined to higher elevations between 1200 and 1800 m, and according to Supriatna et al. (1994), individuals have rarely been noted below 1200 m.

In Table II the approximate present-day altitudinal range of the forest on the different localities is given, as well as altitudes at which individuals have been reported, in present or historic times. From these data it becomes clear that the species covers the whole range between lowland and mountains from sea level up to above 2500 m. As in West and Central Java more than twice as much forest remains above the 1000 m line than below (MacKinnon et al., 1982), it is possible that the species nowadays is more easily observed in montane areas than in lowland and hill forests.

In some forest areas densities may be very low and the lack of sightings prevents any density estimates from being made (e.g., Ujung Kulon: Hoogerwerf, 1970; Gurmaya et al., 1992; Halimun: Kool, 1992). Calculated densities range from 28 individuals per km² at altitudes between 650–850 m on Mts. Dieng (Nijman & Van Balen, unpublished data), 4–5 per km² between 900–1200 m in Halimun (Maitar in Supriatna et al., 1994), 25 per km² at 1300–1500 m on Mt. Gede (Sujatnika, 1992; Sujatnika, pers. comm., 1995), and 11 per km² at 1400–1600 m at Kamojang to 35 per km² at elevations between 1600–1800 m in

Patenggang (Ruhiyat, 1983). As the primary production of the forest decreases with increasing altitude, and the forest composition changes as well, densities at higher altitudes may be lower when compared with lower altitudes. The only two dietary studies on the species (Ruhiyat, 1983; Sujatnika, 1992) have been conducted in montane forests above 1300 m. Only 8% (Sujatnika, 1992) and 14% (Ruhiyat, 1983) of its diet consisted of fruit and seeds, while 45–65% is more typical for other species of the genus. However, all of these other species have been studied in lowland forests (reviewed by Bennett & Davies, 1994). Whether these findings are indicative for living in a sub-optimal habitat and whether or not the species is 'forced' to live in mountain forests, due to the ongoing deforestation and disturbance in the lowlands, remains to be solved.

3. Habitat preferences

Recently *P. comata* has been recorded in both primary and secondary forest, as well as in some plantations (Seitre & Seitre, 1990; Sujatnika, 1992). According to Supriatna et al. (1994) the species might prefer younger rather than mature forest stands, though the present study indicates that the species is present in both primary and secondary forest habitats. Most likely the optimal habitat for the species will be rather undisturbed primary forest; the incidental observations of *P. comata* in degraded forests or even plantations may not lead to the conclusion that the species can survive in these habitats for a long period of time. The plantation where Seitre & Seitre (1990) observed the species was situated adjacent to relatively undisturbed natural forest (pers. observation), while the population in Haurbentes-Jasinga studied by Sujatnika (1992) most likely has been 'trapped' inside the plantation forest, unable to move out as there is no adjacent forest left (Sujatnika, pers. comm., 1995).

The original forest cover in Java consisted of two types: rain forest in the west and monsoon forest in the east (Van Steenis, 1965), Central Java forming the transition zone between the two. The wettest forest types, viz. the mixed lowland

and hill rain forest and the montane everwet forest occur only in those areas with at least 30 rainy days during the four driest consecutive months of the year (Van Steenis, 1972). On the southern and southwestern slopes of some of the higher mountains in the otherwise seasonally dry East Java, some patches of everwet rain forest exist. Condensation at higher altitudes causes rain to be given off by the otherwise dry south-east trade winds, resulting in 'wet islands' (Van Steenis, 1972). The distribution pattern of mixed lowland and hill rain forest and the montane everwet forest corresponds roughly with the distribution of *P. comata*, with the vast majority of records originating from the wettest areas (see Table II). The forests on Mt. Lawu lie far inside the drought area and the population of *P. comata* on this mountain is postulated to be a relic of a formerly larger distribution.

4. Conservation status

Although the range of *P. comata* appears to be more extensive than formerly suggested, the species should still be considered as among the world's most endangered primate species. As discussed above, the species distribution is severely fragmented and it is likely that many populations in the smaller areas contain too few animals to be viable. In the western part of its range at least some of the larger populations occur in relatively safe nature reserves or national parks, most notably Ujung Kulon, Halimun, and Gede-Pangrango. Although populations in these areas are not totally safeguarded from loss of habitat, or occasional poaching or killing, at least there is a chance that these populations may survive in the long term.

This is in contrast with the larger populations in the eastern part of the species' range, all of which are found in unprotected forest, protected forest in water catchment areas, or production forest. None of the forest areas on Mt. Slamet, Mts. Dieng, and Mt. Lawu are protected as conservation forests, although all three areas have

been recommended as such (MacKinnon et al., 1982; RePPPProT, 1990).

Although more data on the status of *P. comata* are needed, especially for those populations in the central part of the island, some recommendations for its preservation can be given.

In order to get a better insight in the population status of *P. comata* it is suggested to perform a comprehensive survey on the distribution of the species. As little is known about the ecology of the species (cf. Supriatna et al., 1994), more detailed studies could be focussed on the species' habitat preferences and its ability to adapt to various degrees of disturbance over the widest possible range of habitats, in different stadia of re- and degeneration. A dietary study in a lowland forest area, e.g. Mts. Dieng, can explain whether the difference between the reported diets of *P. comata* and other members of the genus are intraspecific or due to the fact that *P. comata* has been studied in mountain areas and the others in lowland forests.

As conversion of natural forest, forest fragmentation and encroachment are an ongoing process, raising the status of one or preferably more of the above-mentioned Central Javan forest areas to a higher conservation status, e.g. wildlife reserve, nature reserve, or even national park, seems of prime importance for the survival of the eastern populations of *P. comata*. On the basis of the extent of forest and the number of endemic (bird) species present, the two most important forest areas for conservation are considered to be those on Mt. Slamet and Mts. Dieng (Nijman & Sözer, 1996). As Java is one of the world's most active volcanic areas and Mt. Slamet is an active volcano, for the long-term preservation of *P. comata* protection of the population on Mts. Dieng seems most feasible. By following the recommendations of MacKinnon et al. (1982), with the extension into the lowland zone as proposed by Nijman & Sözer (1996), not only *P. comata* would benefit from such an action but also several equally unique and endangered wildlife species, most notably the Javan gibbon and the Javan hawk-eagle *Spizaetus bartelsi* Stresemann, 1924.

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