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Population and habitat analysis of Javan gibbon (*Hylobates moloch*) in fragmented forests of West Java, Indonesia

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Abstract. *Atsaury ZIA, Husodo T, Megantara EN, Lastini T, Hernawan E, Wulandari I, Shanida SS. 2025. Population and habitat analysis of Javan gibbon (*Hylobates moloch*) in fragmented forests of West Java, Indonesia. Biodiversitas 26: 2857-2872.* Javan gibbons (*Hylobates moloch*) face various anthropogenic disturbances that are intensive enough to damage and even eliminate their habitat. Additionally, previous studies have primarily focused on protected areas. However, there is limited information on the Javan gibbon in non-conserved areas, such as Ciletuh Geopark, Cisokan, Cijedil, and Kanaan, West Java, Indonesia. The study objective was to determine the distribution and habitat of Javan gibbon in non-conservation areas in West Java. Line transect distance sampling and quarter methods were used in this study. Despite the high level of anthropogenic disturbance, Cisokan exhibited the highest density of Javan gibbon individuals and groups, with 19.48 individuals per square kilometer and 7.79 groups per square kilometer. Generally, the habitat of Javan gibbons is dominated by food plants, such as *kondang* (*Ficus variegata*), *puspa* (*Schima wallichii*), and *beunying* (*Ficus fistulosa*). Hence, 97 plant species were identified as food plants of Javan gibbons, while 84 were eaten by their fruits, 25 by their leaves, and 12 by both. Javan gibbons tend to live in forests with closed and interconnected canopies, as well as on slopes and hilltops with a slope greater than 40% at altitudes ranging from 115 to 1,564 meters above sea level (m asl). Establishing ecological corridors to enhance habitat connectivity in degraded vegetation is crucial for conserving Javan gibbon populations.

Keywords: Density, minimum convex polygon, territory

INTRODUCTION

The degradation and fragmentation of natural forests have become the primary drivers of the decline in Javan gibbon populations, in addition to poaching (Smith et al. 2018). This frugivorous and strictly arboreal primate exclusively depends on a rainforest providing diverse fruit trees and the continuous canopy structure as its habitat (Kim et al. 2011). The Javan gibbon's (*Hylobates moloch* Audebert, 1798) carrying capacity may be directly lowered by the loss of forest brought on by conversion to other land uses (Smith et al. 2018). In several cases in Java, Indonesia, Javan gibbons in Cisokan, West Bandung, and Cianjur Districts have been directly affected by Upper Cisokan Pumped Storage (UCPS) hydropower development activities, which can damage and even eliminate their habitat due to land clearing (Husodo et al. 2019b, 2024). In another case, the Javan gibbon in Ciletuh Geopark, Sukabumi District, was also directly affected by land clearing used for tourist development to improve the local community's economy (Megantara et al. 2019). Additionally, both areas are designated as non-conservation areas (Husodo et al. 2019b). Like Cisokan and Ciletuh Geopark, Cijedil and Kanaan are non-conservation areas (Lukman et al. 2021; Khairina et al. 2022).

In Java, forests without national park or nature reserve status are managed by Perum Perhutani. By law, this state-owned company may allow the forests under its management to be used for non-conservation purposes, which could negatively affect the Javan gibbons in those forests (Kheng et al. 2018). The Javan gibbon is also listed as an Endangered (EN) species (Nijman 2020). Gibbons may even find it difficult to cross a 510-meter linear gap in canopy cover to reach the other side (Asensio et al. 2021). Human-made structures often disconnect and fragment the habitats of wildlife animals, negatively impacting their survival and potentially leading to local extirpation of species (Warner et al. 2021).

Javan gibbons are strictly arboreal, diurnal, and highly territorial primates that live primarily in socially monogamous groups comprising an adult female and adult male pair and their offspring (Ham et al. 2017; Yi et al. 2020b, c). Gibbons preferentially use high canopy layers for various activities, including travel, feeding, resting, and singing (Cheyne et al. 2016; Jang et al. 2021). Because Javan gibbons, like all small apes, primarily travel through brachiation (arm-swinging locomotion that can only be performed across a relatively intact forest canopy), they require high canopy connectivity to travel efficiently and are particularly susceptible to habitat disturbance. High forest connectivity may also indicate high tree density or the presence of large trees, which are related to the increased availability of plant foods (Zhang et al. 2022).

Previous studies tend to be conducted in protected areas, such as Gunung Halimun Salak National Park (Oktaviani et al. 2018; Yi et al. 2020a, 2022; Jang et al. 2021), Ujung Kulon National Park (Smith et al. 2018), Gunung Simpang Nature Reserve, Gunung Papandayan Protection Forest, Leuweung Sancang Nature Reserve, Gunung Slamet Protection Forest, and Gunung Gede Pangrango National Park (Iskandar et al. 2018), and other areas in the Dieng Mountains (Widyastuti et al. 2023), Cisokan and Ciletuh (Husodo et al. 2019a, b; Megantara et al. 2019). Around Gunung Gede Pangrango, Javan gibbons are also found, such as in the Cijedil Forest Stakeholder Resort/*Resor Pemangku Hutan* (RPH) and another area, Kanaan, where Javan gibbons were released by the Aspinall Foundation (communication with local people and The Aspinall Foundation).

A survey of the Javan gibbon in non-conservation areas is crucial for identifying its population status and determining how it can survive in these areas. Understanding the distribution of animals in space and the ecological factors that predict their abundance is crucial for designing effective conservation plans (Sarma et al. 2015). Therefore, we can determine necessary conservation actions, such as establishing corridors between unprotected areas and the closest conservation area and assigning protected status to unprotected areas (Iskandar et al. 2018). According to the explanation, this study aims to reveal the population status, including the distribution and habitat of Javan gibbons, in the Cisokan (UCPS area), Ciletuh Geopark, Cijedil, and Kanaan areas of West Java, Indonesia.

MATERIALS AND METHODS

Study area

This research was conducted in Ciletuh (2018), Cijedil (2018), Cisokan (2019), and Kanaan (2019), West Java, Indonesia (Figure 1). The respective study areas are as follows: Ciletuh (793.02 ha), Cisokan (189 ha), Cijedil (250 ha), and Kanaan (412 ha). Sample sites were chosen based on their presence in the non-conservation areas (Husodo et al. 2019b, 2024; Megantara et al. 2019; Lukman et al. 2021; Khairina et al. 2022). Time constraints limited the scope of the study to the 2018-2019 period. Despite these limitations, this study provides baseline data on the Javan gibbon population and habitat in these non-conservation areas, which are understudied. Baseline data is essential for future research and monitoring efforts, allowing for assessing changes over time. While more recent data would be ideal, the absence of prior research in these specific locations highlights the importance of this work.

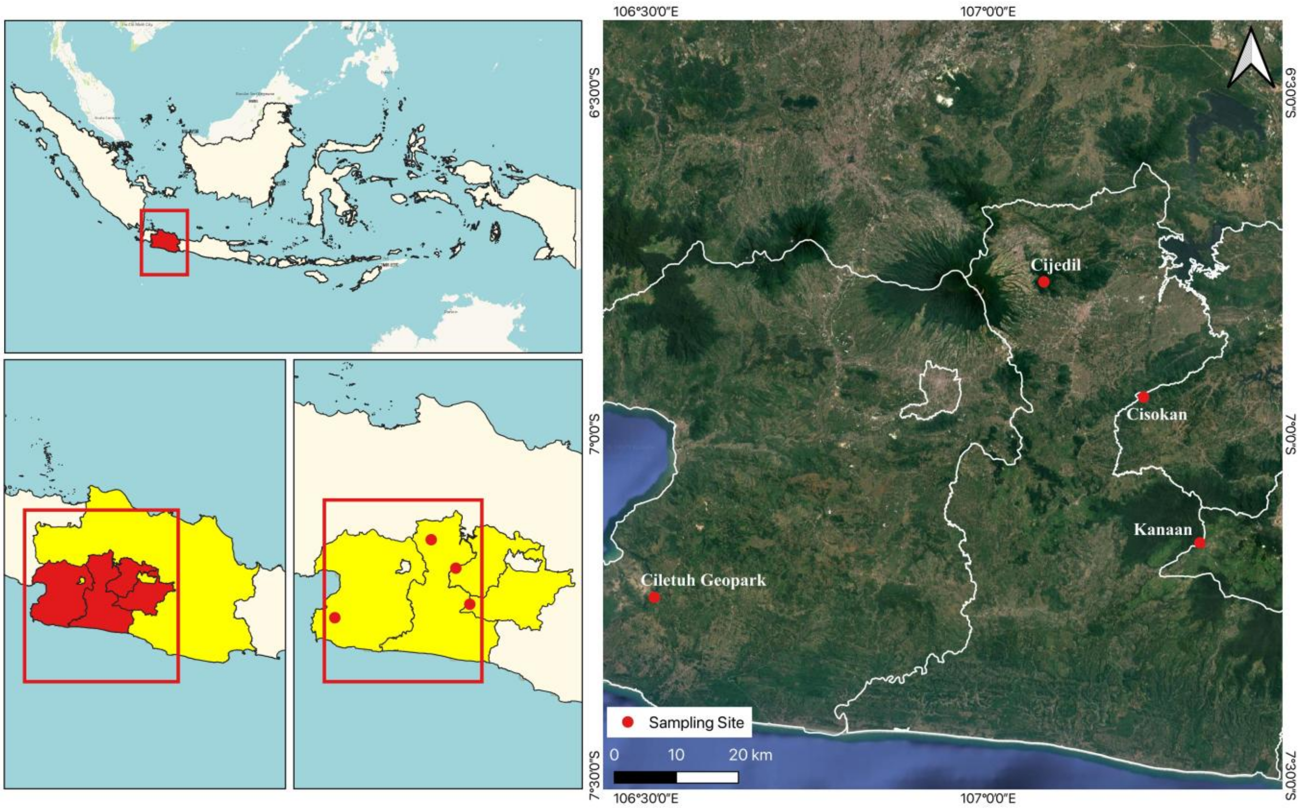

Figure 1. Study areas of Javan gibbons in West Java, Indonesia: Cisokan (6°56'43.90"S 107°13'37.89"E); Ciletuh Geopark (7°14'19.75"S 106°30'43.38"E); Cijedil (6°46'36.11"S 107° 4'53.48"E), and Kanaan (7°9'32.41"S 107°18'34.24"E)

Ciletuh Geopark is a 790 ha coastal area of Ciemas Sub-district, Sukabumi District, which is part of the Ciletuh-Palabuhanratu Global Geopark with an elevation between 0-500 m asl. Geographically, Ciletuh forms a cliff Amphitheater where Pelabuhanratu Beach borders the southern part, and Cibanteng Reserve and Cikepuh Wildlife Sanctuary border the eastern part. Land cover comprises natural forests, shrubs, riparian areas, settlements, fields, and rice paddies. The slope level is >40%.

Cisokan is a 189 ha Upper Cisokan Pumped Storage (UCPS) hydropower development plan area. This area is located in the Rongga Sub-district of West Bandung District and Cibeber Sub-district of Cianjur District, with an elevation ranging from 450 to 100 m asl. The UCPS hydropower plant is situated in the upper catchment area of the Cisokan River, a tributary of the Citarum River, which flows from south to north toward the Java Sea. The construction of the UCPS hydropower plant includes two dams for water storage and power generation, a reservoir to store water, transmission lines to carry electricity, a power station to convert water energy into electricity, access roads for construction and maintenance, quarries for sourcing construction materials, and various other facilities. This area encompasses around 337.89 hectares of community land and approximately 385.25 hectares of forested land in the West Bandung and Cianjur Districts (Husodo et al. 2024). Based on the land cover, the area is dominated by production forests (managed by Perum Perhutani III, Forest Stakeholder Area/*Kawasan Pemangku Hutan* (KPH) South Bandung and Cianjur), natural forests, shrubs, dry and wet paddy fields, and settlements. The slope level ranges from 35-55%.

Forest Stakeholder Resort of Cijedil is a forest area managed by the Forest Stakeholder Unit Section/*Bagian Kesatuan Pemangku Hutan* (BKPH) Cianjur, Perhutani Company III, which is still in the same landscape as Gunung Gede Pangrango National Park (7 km away). Administratively, this area is located in Cugenang District, Cianjur District, with a forest area of 250 ha. The study area is situated in the southern part of Mount Geulis, where a transition zone between lowland and lower montane forests is found. The land cover consists of natural forest and production forest. The slope level in Cijedil ranges from 20% to 40%, with elevations between 800 and 1,300 m asl.

Kanaan Protected Forest is a forest area managed by BKPH East Tambakruyung, KPH South Bandung, Perhutani Company III. Administratively, Kanaan is located in Rancabali District, Bandung District, bordering Cianjur District. The area covers 412 hectares, with elevations ranging from 1,300 to 2,000 m asl and slopes varying from 21% to 40%. The study area is surrounded by tea plantations managed by Kabepe Chakra Company. In addition to tea plantations, the area is covered by natural forests, production forests, such as *pinus* (*Pinus merkusii*), *rasamala* (*Altingia excelsa*), weeping paperback (*Melaleuca leucadendra*), coffee (*Coffea* sp.), mixed gardens, and shrubs. Several rivers flow in the study area, including Ciparay, Cibunut, and Ciherang rivers. This area was designated as a release site for Javan gibbons by the Aspinall Foundation in 2019 (communication with Aspinall Foundation Staff). The Republic of Indonesia's Environment and Forestry Minister No. P.57 of 2016 concerning the strategy and conservation action plan for Javan gibbon (*H. moloch*) 2016-2026, the Gunung Masigit protected forest area, including the Kanaan, is one of the priority areas for Javan gibbon conservation in the South Bandung landscape.

Procedures

Javan gibbons' presence

Javan gibbon presence data were collected using the Line Transect Distance Sampling Method (LTDS) with a perpendicular distance technique, specifically a triangle count. The length of each line varies between 500 and 1,000 m, depending on the size of the forest area at each site. The transects at each study site were designed to cover a representative proportion of the forest area. By maintaining several observers and walking speed across all transects, we ensured equivalent sampling effort between sites, despite variations in transect length to match each site's topographic characteristics and forest extent.

After approaching the source of the Javan gibbon's call, two to three observers walked slowly (±1 km/hour) and quietly along the transect, frequently stopping to observe the area and listen for gibbons. When a group/individual was encountered (visually), the following information was recorded: time of sighting, location along the transect (via GPS coordinates), perpendicular distance from the transect to the first animal observed, and number of animals observed (and age/sex class when possible) (National Research Council 1981). Groups or individuals encountered were observed for a maximum of 10 minutes to allow us to adequately observe group characteristics to identify them individually and avoid repeatedly counting the same group. Only data involving visual sightings of Javan gibbons were used for analysis, thus allowing for highly conservative estimates of group and individual density. Visual sightings of single animals were rare but were noted when observed (National Research Council 1981). Indirect signs, such as fruit leftovers on the forest floor, can be supporting data that help identify areas of possible gibbon habitat.

We established clear criteria for identifying distinct Javan gibbon groups to reduce double-counting risk. These criteria included differences in age (infant, juvenile, or adult) or sex (male or female) composition and spatial separation between groups. Groups observed nearby within a short time frame were considered the same group unless there was clear evidence to suggest otherwise.

Javan gibbons' habitat

Habitat data collection is carried out using the quarter method. The quarter or point-centered quarter method is a plotless sampling method that can be performed efficiently, as its application does not require a long time and is relatively easy to implement. This method does not use squares, lines, or points; only the distance between a randomly placed point and the nearest plant or from a tree to another is measured (Kusmana 1977).

Sampling was conducted by two surveyors on predetermined transects located in representative habitat types at each site, which included areas with tree plantations and provided food sources (Iskandar et al. 2018). Transects were sampled daily in a single direction during the early morning (beginning at 06:00 a.m.) for two weeks at each site. Sampling was postponed during periods of rain (Iskandar et al. 2018). Then, sampling points were set that followed the direction of the transect. The distance between the two sample points was 20 meters. The number of transects was determined based on the area under study. The minimum number of points was 20. Then, the area around the sampling points was divided into four quadrants. The Diameter at Breast Height (DBH) of the closest trees in each quadrant was measured, and the distance from each tree to the sample point was recorded (Dombois-Mueller and Ellenberg 1974). Other supporting parameters collected included elevation and slope.

Data analysis

Javan gibbons' presence

The presence, number of individuals, and sex of Javan gibbons were tabulated per group and location in Microsoft Excel. The number of individuals per study area was analyzed using the following formula to determine population density.

$$Density = \frac{Number\ of\ individuals\ or\ groups\ found}{Area\ of\ study\ (km^2/Ha)}$$

The coordinates of the Javan gibbon group presence were analyzed using a Minimum Convex Polygon (MCP) (Jang et al. 2021) to describe the home range area per group. This method was also used to determine the core and territory areas. The polygon was created per the Javan gibbon group using ArcGIS (Jang et al. 2021). Estimates of the Javan gibbon habitat area were obtained from map delineation using ArcGIS in areas with dense canopy forest, minimal land clearing, and habitat and home range support.

Home range mapping was carried out by uploading all coordinate data of the position of each group into the database files and then analyzing them using the Hawth's Tools v. 3.6 extension, which is operated through ArcGIS 9.3. The home range area was determined using the MCP and Fixed Kernel (FK) methods (Priatna 2012). This method connects the outermost coordinate points where Javan gibbons move. Home range estimation using FK yields better results than MCP (Priatna 2012). Home range estimation in this study was calculated based on the 95% FK confidence interval.

After that, the area of the range was estimated by analyzing the three-dimensional volume (cut and fill) using Global Mapper v.11 software. The analysis was carried out by cut and fill analysis of all polygons from the analysis results based on the MCP method and FK 95%, which overlapped with the DEM of the Landsat image of each location and then searched for the polygon area so that the estimation of the Javan gibbon's home range adjusts to the contours.

In each home range, color fill modifications are made from blue and yellow to red. This is carried out to know the Javan gibbon's most distant and safe home range heat zone from the edge effect of each home range outer boundary, which can be indirectly said to be the core territory of each group. The redder it appears, the safer and more resistant a Javan gibbon group is to external edge effects, both from anthropogenic disturbances and disturbances from other Javan gibbon groups, if they are located next to each other. Conversely, the bluer it reflects, the edge effects are very risky to the Javan gibbon.

In addition, on the Javan gibbon home range polygon, a yellow-striped layer was also created to show the buffer zone required for each Javan gibbon home range as a safe distance limit (which must be sterile) from outside anthropogenic activities. Establishing these buffer zones is necessary to avoid conflicts between humans and Javan gibbons when they are too close to each other.

Javan gibbons' habitat

Data obtained through the quarter method was tabulated using Microsoft Excel. Species diversity was analyzed using the Relative Frequency (RF), Relative Density (RD), Relative Dominance (RC), Important Value Index (IVI), and Shannon-Wiener's diversity index (H') (Dharma et al. 2021). The data obtained through the profile diagram were analyzed descriptively and qualitatively.

$$Frequency\ (F) = \frac{The\ number\ of\ plot\ which\ is\ found\ a\ species}{The\ total\ number\ of\ plots}$$

$$Relative\ Frequency\ (FR) = \frac{Frequency\ of\ species}{The\ total\ frequency\ of\ all\ species}\ x\ 100\%$$

$$Density\ (D) = \frac{All\ number\ of\ individual\ species}{The\ total\ width\ of\ plots}$$

$$Relative\ Density\ (RD) = \frac{Density\ of\ a\ species}{The\ total\ number\ of\ all\ species\ density}\ x\ 100\%$$

$$Dominance = \frac{The\ total\ of\ basal\ area\ of\ a\ species}{The\ total\ width\ of\ plots}$$

$$Relative\ Dominance\ (RC) = \frac{Dominance\ of\ a\ species}{The\ total\ dominance\ of\ all\ species}\ x\ 100\%$$

$$IVI = RF + RD + RC$$

$$H' = -\Sigma(pi)\ln(pi)$$

IVI is the sum of RF, RD, and RC, with a value range of 0-300. pi is the number of individuals of species i, identified as ni/N, where ni is the number of individuals recorded at the observation point. At the same time, the N is the total number of individuals encountered. ln is a natural logarithmic value, and Σ is the sum of calculations (Gatti and Chitakira 2020). The amount of species variety is categorized as high (H'>3), moderate (1≤H' ≤3), or low (H' < 1) (Susilowati et al. 2021).

RESULTS AND DISCUSSION

Javan gibbons were found in 3-4 groups per area and no more than four individuals/group (Table 1 and Table 2). Javan gibbons can be found in groups of 3-5 individuals, consisting of adult males and females, as well as 1-3 juveniles or infants. Some still lived in solitary, such as in Tonjong, Ciletuh, Puncak Katomas, and Kanaan.

Javan gibbons were found in Cijedil in greater numbers than in any other area, with 11 individuals divided into four groups. Javan gibbons inhabit habitats with diverse dominant plant compositions, as illustrated in Table 3. Some dominant plants are also food plants for the Javan gibbon and other species (Table 4). When viewed based on density, the highest group density was observed in Cisokan, at 7.79 groups per km², and the individual density was 19.48 individuals per km². With a slight difference, the next highest density is Cijedil, with a group density of 5.87 groups per square kilometer and an individual density of 19.09 individuals per square kilometer (Table 2). The density of groups and individuals indicates the environment's carrying capacity. The greater the capacity, the narrower the movement area, and the greater the density of individuals and groups. The high density in the Cisokan and Cisokan may be related to a smaller home range size than in other areas.

Ciletuh geopark

Ciletuh has coastal forest and lowland forest vegetation types. Javan gibbon habitat is fragmented from one another in Ciletuh. Puncak Manik and Selagedang are still connected to the natural forest in the amphitheater. Still, not all of them can be used by the Javan gibbon due to the unsustainable canopy structure and small tree size. Meanwhile, the habitat in Tonjong is known to be isolated from other habitats. The fragmented forest is far from the nearest forest (Selagedang), surrounded by shrubs, plantations, and settlements (Figure 2). Some natural forests on flat topography tend to be easier to clear, while natural forests on amphitheaters are difficult to convert into human land.

Puncak Manik has a sloping topography of around 40%. Some areas are characterized by cliffs difficult for humans to reach, with a dense and continuous canopy cover of approximately 70%. This sublocation features the Puncak Manik waterfall as a tourist attraction. At the bottom of Puncak Manik, there have been land clearings for dry paddy fields. The habitat is dominated by *benda* (*Artocarpus elastica*), *nangsi* (*Oreocnide rubescens*), and *balung injuk* (*Diospyros pilosanthera*) (Table 3), which are also food plants for the Javan gibbon (Table 4).

Table 1. Population composition of Javan gibbons in West Java, Indonesia

Study areas/ groups	Altitude (m asl)	Population					Total
		Adult		Juvenile		Infant	
		M	F	M	F		
Ciletuh (790 ha)							
Tonjong	332		1				1
Puncak Manik	115		1		1		2
Selagedang	228	1	1				2
Cisokan (189 ha)							
Lembur Sawah	583	1	1	1		1	4
Walet Waterfall	597	1	1				2
Sarangsang Bentang	640	1	1				2
Cibungbulang	739	1	1				2
Cijedil (250 ha)							
Geger Tengah	966	1	1				2
Cipicung	966	1	1				2
Sarongge	964	1	1		1	1	4
Legok Saritmi	1007	1	1	1			3
Kanaan (412 ha)							
Baruyuda	1425	1	1				2
Puncak Katomas	1506		1				1
Sungai Cibunut	1331	1	1				2
Pasir Ciparay	1564	1	1				2

Source: Primary Data (Ciletuh (2018), Cijedil (2018), Cisokan (2019), and Kanaan (2019)); M: Male; F: Female

Table 2. The density of the Javan gibbon's population

Locations	Total of the group	Total of individuals	Average of individuals per group	Area (ha)	Study area (ha)	Estimated area as habitat	Group density (group/km^2)	Individual density (individual/km^2)
Ciletuh	3	5	1.67	37,280.87	790	95.4	3.14	5.24
Cisokan	4	10	2.5	775.64	189	51.34	7.79	19.48
Cijedil	4	11	3.25	850	250	68.1	5.87	19.09
Kanaan	4	7	1.75	10,059.86	412	412	0.97	1.70

Source: Primary Data (2018-2019)

Table 3. Tree diversity index in the Javan gibbon's habitat

Location	Family	Scientific name	Common name	RF	RD	RC	IVI	H'
Ciletuh	**Puncak Manik**							
	Moraceae	*Artocarpus elastica*	*Benda*	6.122	7.692	9.294	23.108	0.197
	Urticaceae	*Oreocnide rubescens*	*Nangsi*	2.041	1.538	1.549	5.128	0.064
	Ebenaceae	*Diospyros pilosanthera*	*Balung injuk*	6.122	7.692	7.125	20.94	0.197
	Selagedang							
	Moraceae	*Artocarpus elastica*	*Benda*	9.091	11.905	13.023	34.019	0.253
	Meliaceae	*Dysoxylum caulostachium*	*Pisitan monyet*	6.061	7.143	7.535	20.738	0.189
	Moraceae	*Ficus ampelas*	*Ki hampelas*	6.061	4.762	4.465	15.288	0.145
	Tonjong							
	Euphorbiaceae	*Macaranga gigantea*	*Mara*	5.357	6.557	5.641	17.556	0.179
	Combrettaceae	*Terminalia catappa*	*Ketapang*	5.357	6.557	6.716	18.63	0.179
	Moraceae	*Artocarpus elastica*	*Benda*	5.357	4.918	5.641	15.917	0.148
Cisokan	**Lembursawah**							
	Euphorbiaceae	*Macaranga tanarius*	*Mara*	7.547	9.211	9.328	26.086	0.22
	Fabaceae	*Albizia lebbeck*	*Albasiah*	7.547	7.895	7.676	23.118	0.2
	Moraceae	*Artocarpus elastica*	*Benda*	5.66	7.895	6.716	20.272	0.2
	Walet Waterfall							
	Euphorbiaceae	*Macaranga tanarius*	*Mara*	10.526	10.714	9.603	30.844	0.239
	Moraceae	*Ficus ampelas*	*Ki Hampelas*	5.263	7.143	5.846	18.252	0.189
	Meliaceae	*Toona sureni*	*Suren*	7.895	7.143	6.402	21.44	0.189
	Sarangsang Bentang							
	Moraceae	*Artocarpus elastica*	*Benda*	5.357	5.634	5.192	16.183	0.162
	Euphorbiaceae	*Macaranga tanarius*	*Mara*	7.143	5.634	5.192	17.969	0.162
	Meliaceae	*Swietenia macrophylla*	*Mahoni daun besar*	5.357	5.634	5.869	16.86	0.162
	Cibungbulang							
	Pinaceae	*Pinus merkusii*	*Pinus*	8.511	11.268	11.865	31.644	0.246
	Fabaceae	*Albizia lebbeck*	*Jengjen*	8.511	9.859	9.584	27.953	0.228
	Arecaceae	*Arenga pinnata*	*Kawung*	8.511	8.451	6.845	23.807	0.209
Cijedil	**Cipicung**							
	Altingiaceae	*Altingia excelsa*	*Rasamala*	2.105	3.571	3.563	9.24	0.119
	Phyllanthaceae	*Bridelia insulana*	*Kanyere*	2.105	3.571	3.054	8.731	0.119
	Cannabaceae	*Celtis timorensis*	*Huru hiris*	2.105	3.571	3.436	9.113	0.119
	Geger Tengah							
	Altingiaceae	*Altingia excelsa*	*Rasamala*	3.093	5.096	6.518	14.706	0.152
	Meliaceae	*Toona sinensis*	*Suren biru*	2.062	4.459	4.047	10.568	0.139
	Moraceae	*Artocarpus elastica*	*Benda*	3.093	3.822	3.627	10.541	0.125
	Legok Saritmi							
	Fagaceae	*Castanopsis javanica*	*Riung anak*	3.125	3.937	3.578	10.64	0.127
	Moraceae	*Ficus ribes*	*Walen*	4.167	3.937	3.407	11.511	0.127
	Moraceae	*Ficus fistulosa*	*Beunying*	3.125	3.15	2.862	9.137	0.109
	Sarongge							
	Fagaceae	*Castanopsis javanica*	*Riung anak*	3.297	4.93	4.382	12.608	0.148
	Theaceae	*Schima wallichii*	*Puspa*	4.396	4.93	6.259	15.584	0.148
	Moraceae	*Artocarpus elastica*	*Benda*	4.396	4.225	4.471	13.092	0.134
Kanaan	**Baruyuda**							
	Theaceae	*Schima wallichii*	*Puspa*	5.941	6.061	8.69	20.692	0.17
	Araliaceae	*Macropanax dispermus*	*Cerem*	3.96	5.303	4.225	13.488	0.156
	Moraceae	*Ficus sinuata*	*Peer*	2.97	4.545	4.707	12.223	0.141
	Puncak Katomas							
	Altingiaceae	*Altingia excelsa*	*Rasamala*	6.329	8.036	10.377	24.742	0.203
	Fagaceae	*Castanopsis acuminatissima*	*Riung anak*	5.063	7.143	9.224	21.43	0.189
	Theaceae	*Schima wallichii*	*Puspa*	3.797	6.25	7.635	17.682	0.173
	Sungai Cibunut							
	Fagaceae	*Castanopsis argentea*	*Saninten*	6.098	5.376	5.236	16.71	0.157
	Moraceae	*Ficus fistulosa*	*Beunying*	4.878	5.376	4.998	15.252	0.157
	Moraceae	*Ficus ribes*	*Walen*	6.098	5.376	4.76	16.234	0.157
	Pasir Ciparay							
	Theaceae	*Schima wallichii*	*Puspa*	5.882	8.434	12.025	26.341	0.209
	Fagaceae	*Castanopsis acuminatissima*	*Riung anak*	7.353	8.434	8.861	24.647	0.209
	Altingiaceae	*Altingia excelsa*	*Rasamala*	4.412	6.024	8.137	18.573	0.169

Source: Primary Data (2018-2019); RF: Relative Frequency; RD: Relative Density; RC: Relative Dominance; IVI: Important Value Index; H': Shannon-Wiener's Diversity Index

Table 4. Javan gibbon food plants in West Java, Indonesia

Family	Common name	Scientific name	Locations															FP	
			Ciletuh			Cisokan				Cijedil				Kanaan					
			PM	Se	T	LSa	WW	SB	Ci	GT	Cp	Sa	LSi	PK	PC	B	CR	F	L
Actinidiaceae	*Kileho leutik*	*Saurauia cauliflora*									+	+	+					+	+
Actinidiaceae	*Kileho*	*Saurauaia bracteosa*													+		+	+	+
Altingiaceae	*Rasamala*	*Altingia excelsa*								+	+	+	+	+	+		+	+	+
Anacardiaceae	*Dahu*	*Dracontomelon puberulum*	+															+	
Anacardiaceae	*Kedondong*	*Spondias dulcis*	+	+	+													+	
Annonaceae	*Ki saeuhan*	*Orophea hexandra*	+								+							+	
Araliaceae	*Cerem*	*Macropanax dispermus*					+		+			+		+	+	+	+		+
Cannabaceae	*Kuray*	*Trema orientalis*				+		+	+	+				+				+	
Cannabaceae	*Kitamiang*	*Celtis timorensis*												+		+			+
Daphniphyllaceae	*Kihurang*	*Daphniphyllum glaucescens*								+			+					+	
Ebenaceae	*Balung injuk*	*Diospyros pilosanthera*	+		+													+	
Ebenaceae	*Kicalung*	*Diospyros macrophylla*								+								+	
Elaeocarpaceae	*Ganitri*	*Elaeocarpus ganitrus*				+	+	+										+	
Elaeocarpaceae	*Ganitri*	*Elaeocarpus angustifolius*														+		+	
Elaeocarpaceae	*Beleketebe*	*Sloanea sigun*												+		+	+	+	
Escalloniaceae	*Kicabe*	*Polyosma integrifolia*								+			+					+	
Euphorbiaceae	*Mara*	*Macaranga gigantea*	+	+	+													+	
Euphorbiaceae	*Ki Pare*	*Glochidion glaucum*						+						+	+			+	
Euphorbiaceae	*Mara leuweung*	*Macaranga rhizinoides*								+	+	+						+	
Euphorbiaceae	*Muncang cina*	*Ostodes paniculata*								+	+	+	+						+
Fagaceae	*Pasang*	*Lithocarpus* sp.						+										+	
Fagaceae	*Riung anak*	*Castanopsis javanica*						+				+	+	+	+	+		+	
Fagaceae	*Tunggurut*	*Castanopsis tungurrut*										+	+	+	+			+	
Fagaceae	*Pasang kayang*	*Lithocarpus pallidus*								+	+	+	+					+	
Fagaceae	*Pasang batu*	*Quercus* sp.										+						+	
Fagaceae	*Saninten*	*Castanopsis argentea*												+	+	+	+	+	
Fagaceae	*Pasang batarua*	*Lithocarpus indutus*												+	+			+	
Fagaceae	*Pasang beureum*	*Quercus lineata*														+		+	
Icacinaceae	*Kikadanca*	*Platea latifolia*								+								+	+
Juglandaceae	*Kihujan*	*Engelhardia serrata*								+		+	+					+	
Juglandaceae	*Kihujan*	*Engelhardia spicata*														+	+	+	
Lauraceae	*Huru manggu*	*Litsea* sp.						+										+	
Lauraceae	*Huru Tangkalak*	*Litsea glutinosa*					+											+	
Lauraceae	*Kibodas*	*Neolitsea cassiaefolia*						+		+		+						+	
Lauraceae	*Huru kacang*	*Phoebe exelsa*						+										+	
Lauraceae	*Huru alpukat*	*Actinodaphne glabra*								+			+						+
Lauraceae	*Kiteja*	*Cinnamomum iners*								+		+	+	+	+	+	+		+
Lauraceae	*Huru mentek*	*Cryptocarya ferrea*									+	+							+
Lauraceae	*Huru buweuk*	*Litsea mappacea*										+	+					+	
Lauraceae	*Huru perak*	*Phoebe grandis*								+		+	+				+	+	

Lauraceae	*Huru hiris*	*Litsea diversifolia*														+	+	+	
Lauraceae	*Huru minyak*	*Litsea resinosa*													+			+	
Lauraceae	*Huru leueur*	*Persea rimosa*												+	+	+		+	
Magnoliaceae	*Manglid*	*Magnolia blumei*				+			+		+	+						+	
Magnoliaceae	*Cempaka*	*Magnolia montana*															+	+	
Meliaceae	*Kokosan monyet*	*Dysoxylum alliaceum*	+		+			+			+	+	+					+	
Meliaceae	*Pisitan monyet*	*Dysoxylum caulostachium*		+														+	
Meliaceae	*Suren leuweung*	*Toona sinensis*	+		+													+	
Meliaceae	*Pisitan monyet*	*Dysoxylum parasiticum*				+		+										+	
Meliaceae	*Pingku*	*Dysoxylum excelsum*								+								+	
Meliaceae	*Suren hutan*	*Toona sureni*				+	+			+					+			+	
Meliaceae	*Kedoya*	*Dysoxylum gaudichaudinum*													+	+		+	
Moraceae	*Benda*	*Artocarpus elastica*	+	+	+		+		+	+	+	+							+
Moraceae	*Ki hampelas*	*Ficus ampelas*	+	+	+		+		+	+								+	
Moraceae	*Beunying*	*Ficus fistulosa*	+		+					+	+		+	+	+	+	+	+	
Moraceae	*Bisoro*	*Ficus lepicarpa*	+		+					+			+					+	
Moraceae	*Kondang*	*Ficus variegata*	+	+	+					+	+	+		+	+	+	+	+	
Moraceae	*Sukun*	*Artocarpus altilis*	+															+	
Moraceae	*Darangdan*	*Ficus melinocarpa*						+										+	
Moraceae	*Bunut*	*Ficus microstoma*						+	+									+	
Moraceae	*Leles*	*Ficus retusa*				+		+										+	
Moraceae	*Kiara*	*Ficus* sp.				+	+											+	
Moraceae	*Kiara beas*	*Ficus sumatrana*						+	+									+	
Moraceae	-	*Ficus cuspidata*								+	+	+						+	
Moraceae	*Walen*	*Ficus ribes*								+	+	+	+	+			+	+	
Moraceae	*Hampelas*	*Ficus sinuata*								+		+	+			+		+	
Moraceae	*Hamerang*	*Ficus padana*				+		+							+		+	+	+
Myrtaceae	*Jambu leuweung*	*Syzygium jambos*	+		+													+	
Myrtaceae	*Kitambaga*	*Eugenia cuprea*						+										+	+
Myrtaceae	*Kopo*	*Eugenia subglauca*						+										+	
Passifloraceae	*Cermot*	*Passiflora foetida*					+		+									+	
Phyllantaceae	*Kiseueur*	*Antidesma tetrandrum*						+								+	+	+	
Phyllanthaceae	*Kiseueur*	*Antidesma cf. stipulare*										+						+	
Phyllanthaceae	*Gambiran*	*Glochidion rubrum*										+						+	
Podocarpaceae	*Kiputri*	*Podocarpus neriifolius*												+				+	
Rhamnaceae	*Afrika*	*Maesopsis eminii*				+					+		+					+	
Rosaceae	*Kawoyang*	*Prunus arborea*												+		+			+
Rubiaceae	-	*Lasianthus rigidus*								+								+	
Rubiaceae	*Cangcaratan*	*Neonauclea lanceolata*														+	+	+	+
Rubiaceae	*Angrit*	*Metadina trichotoma*												+					+
Rubiaceae	*Kicengkeh*	*Urophyllum arboreum*												+					+
Rubiaceae	*Kokopian*	*Lasianthus stercorarius*												+			+	+	
Rutaceae	*Kijeruk*	*Acronychia pedunculata*	+		+									+			+	+	
Rutaceae	*Sarogol*	*Evodia* sp.						+										+	
Rutaceae	*Jejerukan*	*Acronychia* sp.										+						+	

Sapindaceae	*Lengsar*	*Pometia pinnata*						+										+	+
Sapindaceae	*Kiregas*	*Acer laurinum*										+	+		+				+
Staphyleaceae	*Kikeuyeup*	*Turpinia montana*								+								+	
Staphyleaceae	*Kibangkong*	*Turpinia sphaerocarpa*						+		+			+					+	
Sterculiaceae	*Kepuh*	*Sterculia foetida*	+	+	+													+	
Symplocaceae	*Sariawan*	*Symplocos odoratissima*						+										+	+
Symplocaceae	*Jirak*	*Symplocos fasciculata*						+		+	+	+	+					+	+
Symplocaceae	*Jirak*	*Symplocos ramosissima*												+				+	+
Theaceae	*Ki nteh*	*Gordonia excelsa*									+		+					+	
Theaceae	*Puspa*	*Schima wallichii*					+		+	+	+	+	+	+	+	+			+
Urticaceae	*Nangsi*	*Oreocnide rubescens*	+	+	+														+
Urticaceae	*Nangsi beureum*	*Villebrunea scabra*									+	+						+	+

Source: Primary Data (2018-2019); Note: PM: Puncak Manik; Se: Selagedang; T: Tonjong; LSa: Lembur Sawah; WW: Walet Waterfall; SB: Sarangsang Bentang; Ci: Cibungbulang; GT: Geger Tengah; Cp: Cipicung; Sa: Sarongge; LSi: Legok Sartimi; PK: Puncak Katomas; PC: Pasir Ciparay; B: Baruyuda; CR: Cibunut River; FP: Foodplants; F: Fruits; L: Leaves

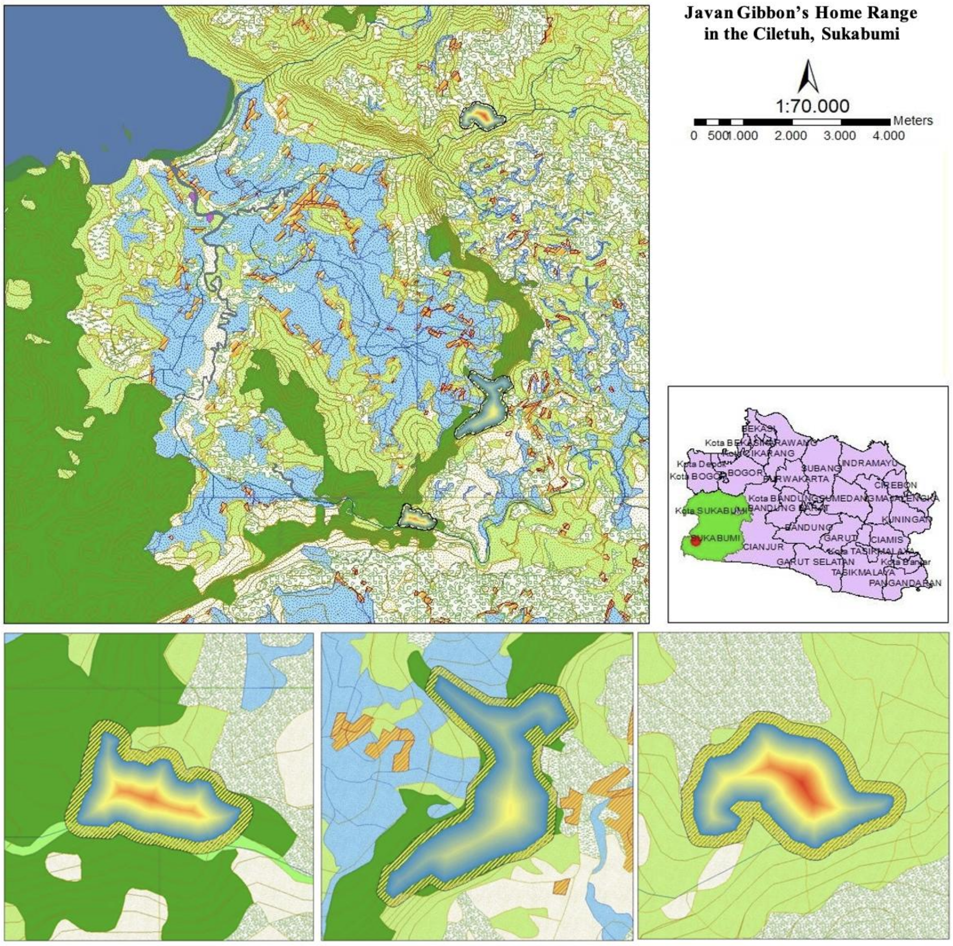

Figure 2. Javan gibbons' home ranges in the Ciletuh Geopark, Sukabumi District, West Java, Indonesia. : Home range; : Buffer zone

Selagedang topography is around 40%. The canopy is quite dense and continuous, around 70%. Vegetation is dominated by *benda* (*A. elastica*), pisitan monkey (*Dysoxylum caulostachium*), and *ki hampelas* (*Ficus ampelas*) (Table 3), which are also food plants for the Javan gibbon (Table 4).

Tonjong has a 46% topography near the Cikanteh River. The canopy tends to be closed around 80%, which is continuous. People who want to farm in dry paddy fields still often cross this area. Vegetation is dominated by *mara* (*Macaranga gigantea*), *ketapang* (*Terminalia catappa*), and *benda* (*A. elastica*) (Table 3). *Mara* (*M. gigantea*) and *benda* (*A. elastica*) are food plants for the Javan gibbon (Table 4).

Cisokan

Similar to Ciletuh, Cisokan is characterized by a fragmented forest. Pine forests and other agricultural lands, such as dry paddy fields, separate the habitats. Hence, the natural forest forms a patched forest that is generally still used by Javan gibbons. Some habitats, such as Walet Waterfall and Lembur Sawah, are threatened with loss due to land clearing (Figure 3).

Lembur Sawah has topography varies from flat to sloping, with approximately 55% of the area sloping, a canopy cover of 60%, and a continuous canopy. This forest is adjacent to the Cilengkong River. Some dominant species in this habitat include *mara* (*Macaranga tanarius*), *albasiah* (*Albizia lebbeck*), and *benda* (*A. elastica*) (Table 3).

The natural forest in Walet Waterfall is located on a steep topography of around 40%, surrounded by *huma* (dryland agricultural) and shrub areas. This natural forest, located near the waterfall, has a canopy cover of 65%. The forest is divided into two areas, separated by the Cirumamis River. Some dominant species in this area include *mara* (*M. tanarius*), *ki hampelas* (*F. ampelas*), and *suren* (*Toona sureni*) (Table 3).

Cibungbulang is located in the southern part of the UCPS hydropower development plan area. Cibungbulang has contours varying from flat to sloping, with slopes ranging from 40% and hilly topography. Rice fields, gardens, and mixed agricultural areas surround the Cibungbulang forest. Cibungbulang forest has a canopy cover of 65%. The Ciawitali River is downstream from the forest. This habitat is dominated by *pinus* (*P. merkusii*), *albasiah* (*A. lebbeck*), and *kawung* (*Arenga pinnata*) (Table

3). During observations, Javan gibbons were occasionally observed using pinus trees for moving, as they were still in continuity with trees of other species.

Cijedil

Javan gibbon habitats tend to have minimal anthropogenic disturbance, as the contours are steep and difficult for humans to access, resulting in no human-modified land within these habitats. Unlike other locations, the four groups in Cijedil have home ranges close to each other. This allows for encounters, group competition, and easy access to breeding mates (Figure 4).

Cipicung Forest is directly adjacent to rice fields, separated by a small river. This forest is situated on a slope with an angle of approximately 30% and a canopy cover of around 70%. This habitat is dominated by *rasamala* (*A. excelsa*), *kanyere* (*Bridelia insulana*), and *huru hiris* (*Celtis timorensis*), where rasamala is a Javan gibbon food plant (Table 3).

Geger Tengah is a forest located between Cipicung and Sarongge. This forest features a valley contour with a 20% slope, where several tributaries flow beneath it. The canopy cover in this forest is 80%. The forest is dominated by *rasamala* (*A. excelsa*), blue *suren* (*Toona sinensis*), and *benda* (*A. elastica*) (Table 3), where *rasamala* (*A. excelsa*) and benda (*A. elastica*) are Javan gibbon food plants (Table 4). Geger Tengah is where Javan gibbon sounds are most clearly audible, as the surrounding area is characterized by valleys that are generally lower than the surrounding terrain.

Legok Sartimi is located near the summit of Mount Geulis, which remains part of the Cijedil forest. The forest is situated on a cliff with an 80% slope and features small waterfalls and streams. The forest floor is composed of rocky soil that is prone to landslides. The forest is dominated by *riung anak* (*Castanopsis javanica*), *walen* (*Ficus ribes*), and *beunying* (*Ficus fistulosa*) (Table 3), which are Javan gibbon food plants (Table 4).

Sarongge forest is bordered by *rasamala* (*A. excelsa*) and actively managed bamboo plantations, which are maintained by local communities. Bamboo is one of the forest products planted homogeneously in certain areas and separated from natural forests so that production activities do not disturb the Javan gibbon significantly. Sarongge Forest has a canopy cover of 80% with a slope of 32%. The forest is dominated by *riung anak* (*C. javanica*), *puspa* (*Schima wallichii*), and *benda* (*A. elastica*) (Table 3), which are Javan gibbon food plants (Table 4).

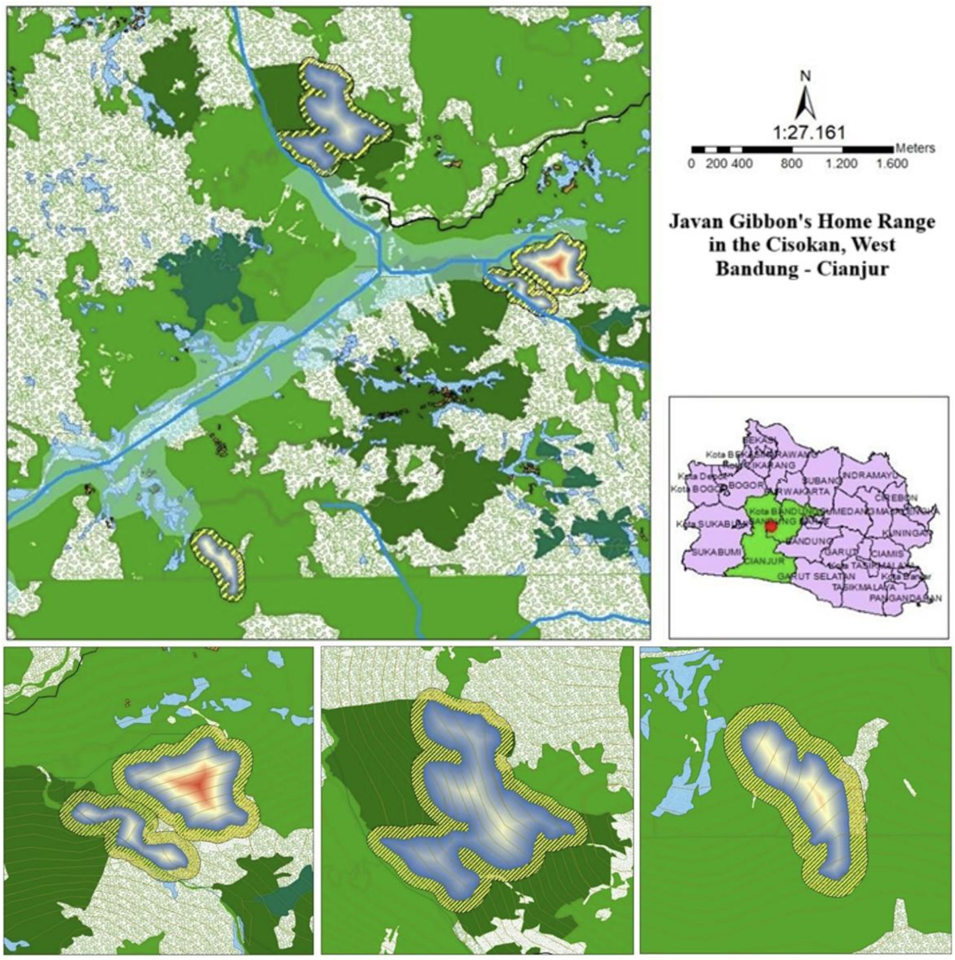

Figure 3. Javan gibbons' home ranges in the Cisokan, Bandung Barat-Cianjur Districts, West Java, Indonesia. ▬: Home range; ▨: Buffer zone

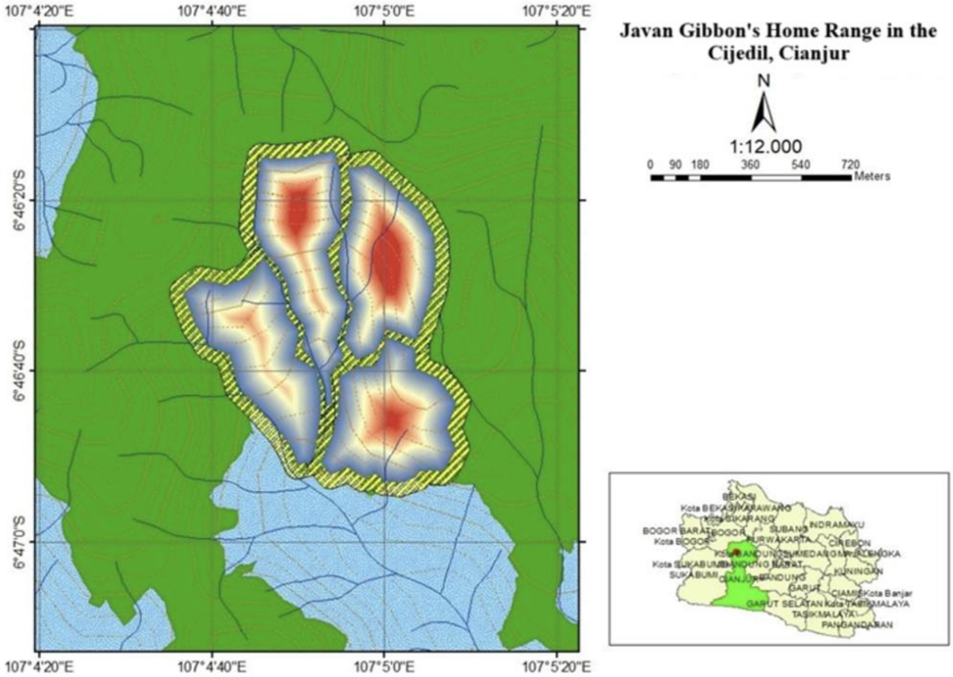

Figure 4. Javan gibbons' home ranges in the Cijedil, Cianjur District, West Java, Indonesia. : Home range; : Buffer zone

Kanaan

Just like Cijedil, Kanaan still has forests relatively far from anthropogenic disturbances. Javan gibbons can still use other forest areas, as the canopy is continuous and closed. The distance between the two groups is not great, as steep topography only separates them. The sounds are still heard intermingling when the Javan gibbon group vocalizes (e.g., morning call). Breeding is still possible between groups because the vegetation cover around the home range remains continuous, although it is dominated by non-food plants (Figure 5).

This forest has three rivers, including the Ciparay River, the Cibunut River, and the Ciherang River. In this location, the Javan gibbon has undergone an individual introduction process (release) by The Aspinall Foundation in collaboration with the Center for Natural Resources Conservation/*Balai Konservasi Sumber Daya Alam* (BKSDA) and Perhutani (the Indonesian state forest company), involving three individuals in early 2019, conducted in two stages. The first stage involved releasing a male, who now joins the female in Baruyuda, and the second stage involved releasing a male and a female, who now occupy the Cibunut River. Kanaan was chosen as the release site because it is considered a relatively natural forest, but previously had a low density of Javan gibbons.

Baruyuda is directly adjacent to a tea plantation, which has operated since 1960 (communication with the tea farmer). Consequently, tea farmers often encounter Javan gibbons in this area. The canopy cover of this forest is 70%, with a slope of 40%. The forest is dominated by *puspa* (*S. wallichii*), *cerem* (*Macropanax dispermus*), and peer (*Ficus sinuata*) (Table 3), all of which are Javan gibbon food plants (Table 4). As in Gunung Halimun Salak National Park, Javan gibbons are found near tea plantations and rice paddies (Yi et al. 2020a).

Puncak Katomas is the highest site among others, with a canopy cover of 60%. Some parts of the site were formerly dry paddy fields now open within the forest. This forest is situated on a 30% slope. The forest is dominated by *rasamala* (*A. excelsa*), *riung anak* (*C. javanica*), and *puspa* (*S. wallichii*) (Table 3), which are Javan gibbon food plants (Table 4).

The forest area in Cibunut River has a valley topography with a canopy cover of 80% and a slope of 20%. The forest is dominated by *saninten* (*Castanopsis argentea*), *beunying* (*F. fistulosa*), and *walen* (*F. ribes*) (Table 3), which are also food plants for the Javan gibbon (Table 4).

Pasir Ciparay is on a 21% slope with 75% canopy closure. The forest is dominated by *puspa* (*S. wallichii*), *riung anak* (*C. javanica*), and *rasamala* (*A. excelsa*) (Table 3), which are Javan gibbon food plants (Table 4).

Cisokan and Cijedil showed the highest density of groups and individuals compared to the other two locations (Table 2). The density of groups and individuals indicates the environment's carrying capacity; the greater the carrying capacity, the narrower the movement area, and the greater the density of individuals and groups. From the four sites, 97 species were recorded as Javan gibbons' food plants, such as *kondang* (*Ficus variegata*), *puspa* (*S. wallichii*), *beunying* (*F. fistulosa*), *benda* (*A. elastica*), *kiteja* (*Cinnamomum iners*), *cerem* (*M. dispermus*), and *rasamala* (*A. excelsa*) (Table 4). Of the 97 species, 84 were eaten by the fruit, 25 by the leaves, and 12 by both (Table 4).

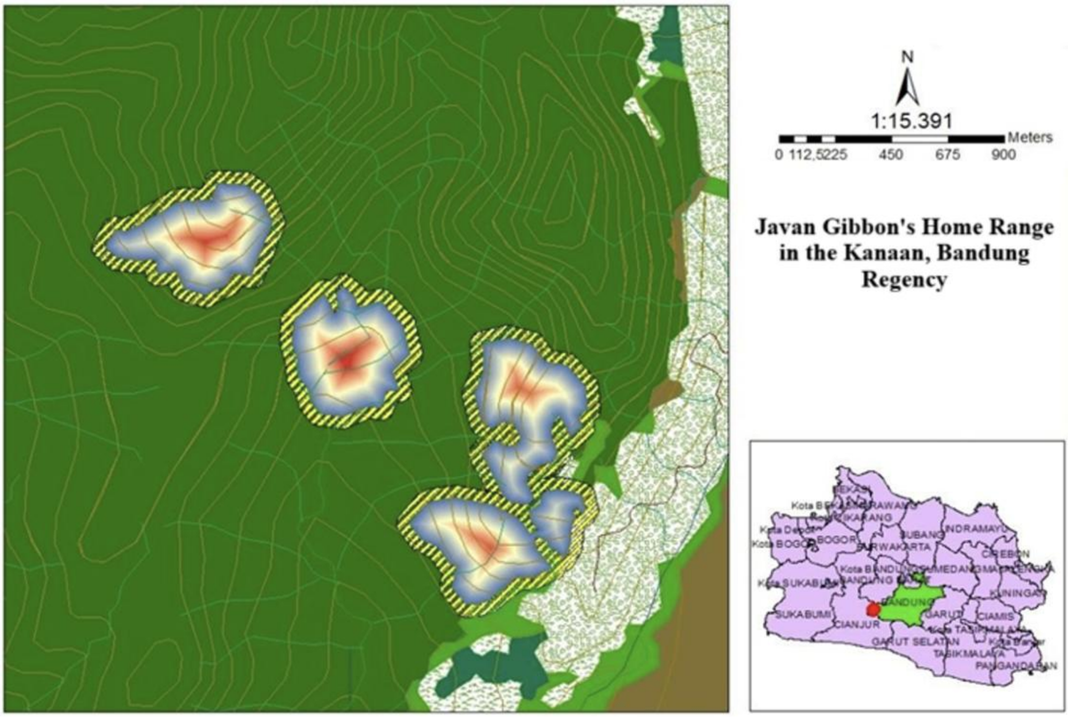

Figure 5. Javan gibbons' home ranges in the Kanaan, Bandung District, West Java, Indonesia: Home range; : Buffer zone

Oktaviani et al. (2018) stated that ripe fruits were the most important component of the diet, accounting for over half of feeding time (76.9%), followed by young leaves (16.4%). Besides ripe fruit and young leaves, unripe fruits (6%) and flowers (4.7%) were also crucial in the diet of Javan gibbons. Javan gibbons in the Gunung Halimun Salak National Park rely heavily on figs (Yi et al. 2020c). Figs occupy over 30% of their daily feeding time throughout the year, and gibbons spent more time feeding on figs even when overall fruit availability in the forest was high, suggesting that figs were not fallback foods but actively selected foods of Javan gibbons (Yi et al. 2020c).

Of all Javan gibbon groups, the presence of infants in Lembur Sawah (Cisokan) and Sarongge (Cijedil) indicates that the area can support their breeding. In Lembur Sawah and Sarongge, nine and 29 species of food plants were found, respectively, including *cerem* (*M. dispermus*), *rasamala* (*A. excelsa*), *kuray* (*Trema orientalis*), *kihujan* (*Engelhardia serrata*), and *hamerang* (*Ficus padana*) (Table 4). Land clearing in Cisokan will impact food availability for these groups, particularly for infant growth and development. Preserving infants from anthropogenic disturbances can support the sustainability of the Javan gibbon population in Cisokan.

The other subareas, Sarangsang Bentang and Cibungbulang, are outside the development plan area but have the potential to be pressured by the need for agricultural land, which is also being pressured by hydropower development. Cijedil is situated near the settlement center of Cianjur, which is just 7 km away, making it vulnerable to development into a built-up area in the next few years.

The Javan gibbon is usually found at heights between 115 and 1,564 meters above sea level, on hillsides and summits with 40% or more slopes (Figure 6). It is frequently found in unproductive production forests, particularly on steep slopes. Unfortunately, various human activities, such as producing forests, settlements, wet paddy fields, dry paddy fields, and gardens, frequently encircle and disrupt their habitat.

As population growth continues, land needs increase, squeezing the Javan gibbon's living space. This condition puts the Javan gibbon in a vulnerable position, facing threats such as forest conversion, decreased habitat carrying capacity, and easy human accessibility to its habitat.

In another case, Ciletuh Geopark, the development of tourist villages encourages the construction of tourist facilities, such as permanent roads, inns, restaurants, and others, thereby expanding land clearing to enhance tourism opportunities and tourist attractions. Cisokan is used to construct the UCPS hydropower plant where the Javan gibbon overlaps with the development plan area, such as in Lembur Sawah and Walet Waterfall. Many permanent roads in the Ciletuh Geopark and Cisokan areas cut through forest areas, creating habitat gaps. The road is a significant anthropogenic feature that triggers habitat fragmentation (Mehdipour et al. 2019) and can affect the movement dynamics of primate species (Ramsay et al. 2019; Asensio et al. 2021). The dissecting road may have an impact on gibbons' behavior. Even though there is a gap over the road (approximately 5 m), gibbons are unlikely to cross the gap if traffic is heavy, such as on Linggoasri's main road (Widyastuti et al. 2023).

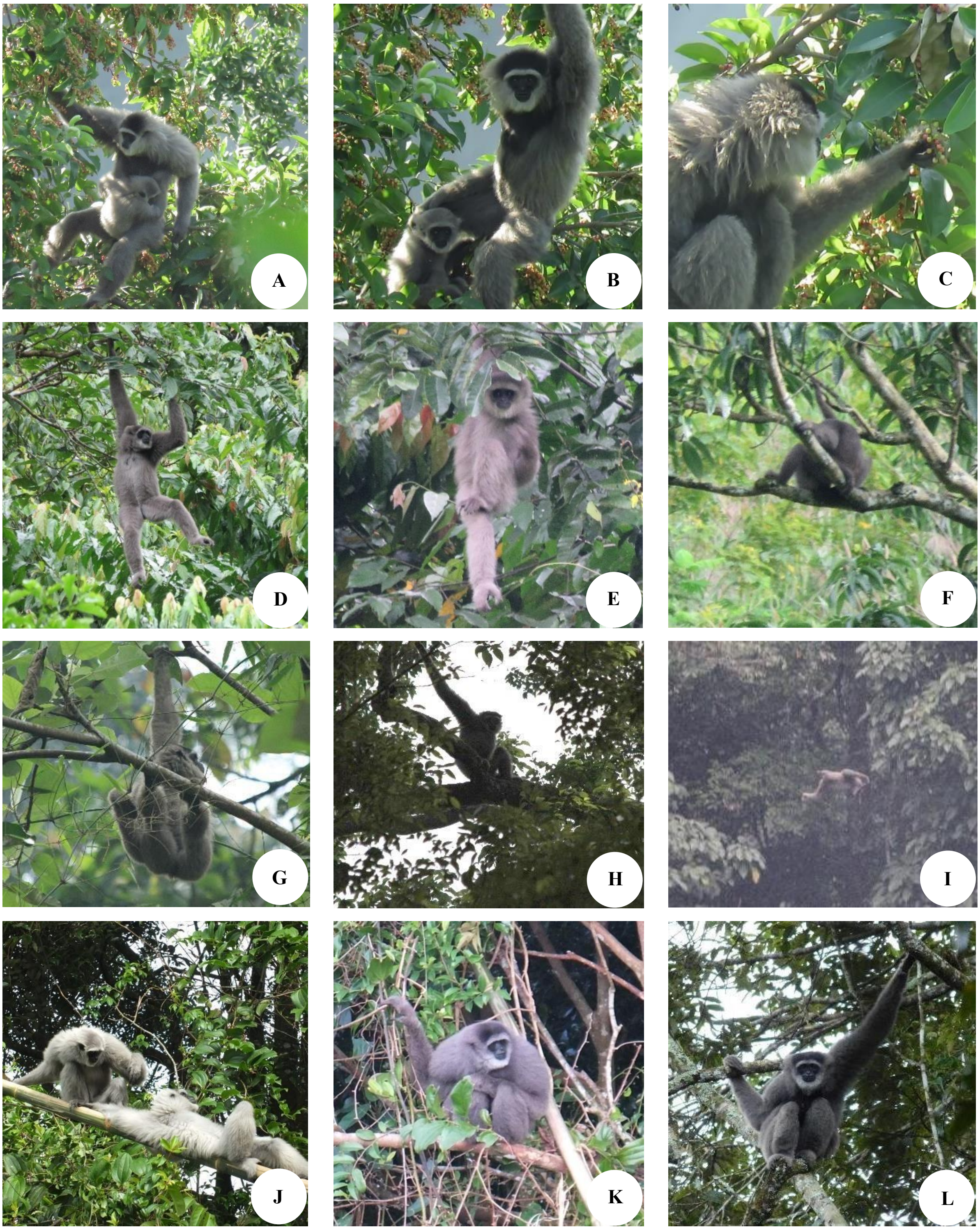

Figure 6. Javan gibbon in the (A-C) Ciletuh; (D-F) Cisokan; (G-I) Cijedil; (J-L) Kanaan, West Java, Indonesia

Two gibbons were observed to cross a gap less than 5 m above the road but did not cross a gap of more than 5 m in the Khao Yai National Park canopy. The road partially delineated the gibbons' home range (Asensio et al. 2021). Alternatively, installing an artificial canopy bridge is also helpful for crossing spots with broken canopies, as with other gibbon habitats (Chan et al. 2020; Chetry et al. 2022). However, further study is needed to identify the prioritized areas where artificial canopy bridges are required to reconnect forest blocks (Widyastuti et al. 2023).

These threats impact the loss of Javan gibbon habitat. Javan gibbons tend to choose specific habitats, such as canopies between trees that are connected or close together and closed, tree crowns with horizontal branches, and food sources. As an arboreal animal, the Javan gibbon rarely uses the ground and spends its time in the upper tree canopy, so its survival depends on trees.

Given its threat level and natural population status, conservation efforts must be made to maintain its population amid anthropogenic disturbances. The UCPS hydropower development project employs a Biodiversity Management Plan (BMP) to protect important species, including the Javan gibbon, thereby maintaining Javan gibbon populations throughout development (Husodo et al. 2019b). BMP is an example of a wildlife management model that integrates various stakeholders to optimize environmental utilization and minimize anthropogenic disturbances.

Regular monitoring of the Javan gibbon population status is also one of the conservation efforts to monitor their population status. Information on their presence can be used to determine species protection policies. Another conservation effort is the implementation of agroforestry systems (Yuwati et al. 2023). Having canopies and deep-rooting systems can help reduce soil erosion, a main cause of landslides. Trees along the border can be planted for agricultural species that are not shade-tolerant (Yuwati et al. 2023).

In conclusion, Cisokan exhibited the highest density of Javan gibbon individuals and groups, at 19.48 individuals per square kilometer and 7.79 groups per square kilometer, respectively. Cijedil also showed a slight difference, with the highest average number of individuals per group, resulting in individual and group densities of 19.09 individuals/km² and 5.87 groups/km². In general, Javan gibbon habitats are typically characterized by the presence of food plants. Hence, 97 plant species were identified as food plants for Javan gibbons, including Moraceae, Euphorbiaceae, and Fabaceae, among others. In contrast, 84 species were eaten by their fruits, 25 species were eaten by their leaves, and 12 species were eaten by both leaves and fruits. Javan gibbons tend to inhabit forests with closed and interconnected canopies, as well as on hillsides and hilltops with a slope of greater than 40% at elevations ranging from 115 to 1,564 m asl.

Javan gibbons have been directly disturbed by projects such as the construction of UCPS hydropower in Cisokan and the development of tourist villages in Ciletuh Geopark. Cijedil still has little anthropogenic disturbance but has the potential to be disturbed in the next few years due to its proximity to urban areas, while tea plantations and settlements limit the Kanaan habitat. Based on this study, emphasis should be placed on conservation strategies in non-conservation areas. Establishing ecological corridors to enhance habitat connectivity in damaged vegetation is crucial for maintaining Javan gibbon populations. Regular population monitoring, especially in areas that are actively disturbed, is needed to monitor the population status. The results of this study are expected to provide basic information for determining Javan gibbon conservation policies in West Java.

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