Estimation of demographic parameters, spatial distribution of activity and its habitat types used of Javan Surili (*Presbytis comata*) in Sigedong Forest Block, Ciremai Mount National Park

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Abstract. As one of the priority species for conservation in Indonesia, Javan surili is listed as an endangered species (IUCN red list) and the population trend tends to decrease year by year. A conservation step need to be done and relevant data is needed to guide the management strategy and support its conservation. However the data and information about the population of Javan surili is still limited. The research objectives are to estimate the population of Java surili and identify their activity distribution related to the habitat types used in Sigedong Forest Block, Ciremai Mount National Park. Concentration count methods and camera trap were used to obtain the demographic parameters. Activities trace obtained by direct observation methods, by making line transects (±1km) and vegetation analysis. Chi-square method is used to determine the connectivity between the type of activity and the habitat types used. The result shows that there are nine group of Javan surili with a total 42 individuals. The value of sex ratio is 1:1.31, the birth rate is 0.238, and the mortality rate on teen-adult age class is 0.769. Activities of Javan surili that found during the observation are allelomimetic, ingestive, resting, and shelter seeking. Those activities scattered in lowland forest, sub mountains forest, and mountains forest. The distribution activities divided into four types of vegetation horticultural plantations, fields, forest and undergrowth. Furthermore, the result shows that there is a correlation between Javan surili activity distribution and its vegetation type, seen from the land cover types that used by this species, wherein the fields and undergrowth vegetation no individual was found.

1. Introduction

Javan surili (*Presbytis comata*) is one of the endemic species in West Java, Indonesia [1], [2], [3], [4]. This species also internationally listed as an endangered species by IUCN red list and listed as one of the protected primates in Indonesia, based on Indonesian law, Act Number 5/1990 and Decree of Ministry of Forestry Number 301/Kpts-II/1992 [2]. Known one of its natural habitat distribution is in Ciremai National Park [5]. This National Park placed Javan surili as one of the species priority, along with javan eagle (*Spizaetus bartelsi*) and javan leopard (*Panthera pardus*) [6]. Ciremai National Park is grouped in several blocks of forest, one of the block is Sigedong Forest Block, and since this block has data deficient of Javan surili, so that a study is needed in this area.

At the present the existence of Javan surili in the nature become harder to find. The preservation of Javan surili as a species priority is important due to its existence, whether its population or its habitat in the nature are being threatened time by time, and estimated to continuously decrease. The loss of this
species can cause an alteration to other species population or the ecosystem [7]. We need to put a concern on the Javan surili habitat protection to preserve and keep maintain the population, equal with the need of its relevant data and information. Those including the population size and the relevancy between spatial distribution of Javan surili’s activities and its habitat type used. The estimation on population size is a major component to maintain wildlife population. In addition as a quantitative indicator source, it can be used to guide the management strategy and support its conservation.

The study of Javan surili spatial distribution activity was done to identify and analyse the relation between land cover types used with its activity types, to find out the habitat types that Javan surili preferred. Therefore a study about demographic parameters, spatial distribution of activity and its habitat types used of Javan surili in sigedong forest block was conducted. It is also important for the National Park consideration in managing Javan surili in their area, seeing that it is one of the species priority.

2. Method

2.1. Time and study site

This research is located in Sigedong Forest Block, Region 1 of Ciremai National Park, Kuningan, West Java. The field data was collected within March 2017 until April 2017. The species monitoring was conducted in the morning within 06.00-10.00 and in the evening 15.00-18.00. As for the zone map can be seen in Figure 1.

![Figure 1 Ciremai National Park and Sigedong Forest Block Map](image)

2.2. Data collection

2.2.1. Demographic parameters

Data collection was taken with concentration count and camera trap method. In concentration count method we stay and invent the animal in the observation point area that has been determined. However a preliminary study must be done to acknowledge the spot area where Javan surili gathered. Determination of the concentration area in this research was made based on National Park’s monitoring data and some preliminary studies in this national park [8], [3], [4], and after that, we did validation right on the field before the first monitoring for this research was held. Data collection on Javan surili population size was carried out at seven observation points. Data taken includes identification of Javan
surili groups, gender, estimation of age structure, and activities. The installation of camera traps is placed in the concentration point area by observing the surrounding of the placement location with the path or road, the height, land cover, former feces, and water sources (rivers, springs). In addition, the determination of the installation of camera traps was done by presume which tree is used as its place to rest and sleep. The number of camera traps used in this study were four. The camera trap was installed from March 2017 until April 2017, within the study time, and the installation can be moved in accordance to the need, with intention to increase the encounter of the observed object. Sex ratio calculation is obtained through analysis based on the results of direct observation data and camera trap photos, by counting the number of identified male and female individuals, then comparing them. Sex ratio observation can only be applied on young-adult and adult age class, because it is difficult to identify the sex of juvenile. In this research the age classification is divided in three class, juvenile (0-4 years old), young-adult (4-7 years old), and adult (7-20 years old) [9].

2.2.2 Distribution of Javan surili activity

The types and distribution activities is carried out by direct observation and vegetation analysis. This observation is carried out simultaneously with concentration count of population observation. The number of sample plot in the study was carried out as much as one plot at each first meeting with Javan surili in different locations (the total of vegetation analysis was taken 13 times), so that the plot distribution was approximately the same as the distribution of Javan surili (map in figure 1).

Figure 2 Illustration of single plot method

Figure 2 shows the illustration of how the single plot made, with a size of 20x20m to measure trees, 10x10m for poles, 5x5m for saplings, and 2x2m for undergrowth.

2.3. Data analysis

Population size analysis

Data analysis were done toward demographic parameters and correlation between spatial distribution of Javan surili’s activities, with characteristic of land cover that used. The formulation used are:

1. Population size
The estimation of population size counted with formula below:

\[ N = \Sigma Xi \]

Average group size estimation (x):

\[ X = \Sigma Xi/n \]

Average group size estimation in each location is taken with dividing individual number of each group (\( \Sigma Xi \)) with the number of group (n).

2. Sex ratio

\[ S = \frac{Y}{X} \]
Sex ratio number (S) gained with counting the number of male (Y) and female (X) individual and compared both number.

3. Age structure
Javan surili age structure is obtained by counting and grouping the number of adults, young-adult, and juveniles that divided into three age structure categories. The annual age structure of the surili group in one year is obtained by dividing the number of frequencies of the recent age classes (juvenile, young-adult, adult) by the age class interval.

4. Crude birth rate
\[ b = \frac{B}{N} \]
Crude birth rate is obtained by dividing the number of individual juveniles (B) per total number of productive female individuals (N).

Analysis of habitat biotic characteristics
The data taken in vegetation analysis is density value in each class of plant, tree, pole, and sapling. The formula to count the density value [10] is by dividing

1. Density
Density is the number of individuals per unit area. Density is obtained with calculation as follows:
\[ D = \frac{\text{individual number of a species}}{\text{total sample area}} \]
Therefore, relative density is the percentage density of a species to total density.
\[ RD = \frac{\text{density of a species}}{\text{total density of all species}} \times 100\% \]

Analysis of estimating parameter correlation
Estimator parameters were analyzed using the chi-square test (X2). The parameter tested between spatial distribution of activities and vegetation cover type with the initial hypothesis as follows:
H0: There is no correlation between distribution activities with the land cover or vegetation type
H1: There is correlation between distribution activities with the land cover or vegetation type

Hypothesis testing uses the chi-square (X2) formula which is notated as follows:
\[ X^2\text{count} = \left[ \Sigma (f_o - f_e)^2 / f_e \right] \]
Explanation:
\[ X^2\text{count} \] : Chi-square value
\[ f_o \] : Observed Frequency
\[ f_e \] : Expected Frequency
\[ X^2\text{table} = X^2 (\alpha ; Db) \]
Explanation: Alpha level : \( \alpha = 5\% = 0.05 \) Degrees of freedom : \( Db = 2 \)

Test criteria:
- If \( X^2\text{count} \leq X^2\text{table} \), then accept H0
- If \( X^2\text{count} > X^2\text{table} \), then refuse H0

3. Results and discussion
3.1 The estimation of demographic parameters
There are 7 observation sites which are divided into 4 areas, namely the JICA cottage area and the research station (upper ridge, lower ridge, Sigedong spring, and Sipariuk River), Pangwalangan, Batu
Arca and Kubang areas. The total number of Javan surili groups that were found in 7 observation locations were 9 groups with a total of 42 individuals. Based on observations obtained, the size of a group consist of 2-7 individuals. Data on group size and age structure can be seen in Tables 1 and 2.

Table 1 Composition of the size of Javan surili groups in Sigedong Forest Block

| Number of group | Location        | Individual Number |
|-----------------|-----------------|-------------------|
|                 |                 | Juvenile Male     | Juvenile Female  | Young-Adult Male | Young-Adult Female | Adult Male | Adult Female | Total |
| 1               | Upper ridge     | 0                 | 0                 | 1               | 1                | 2          |             |       |
| 2               | Lower ridge     | 0                 | 1                 | 2               | 0                | 0          | 3           |       |
| 3               | Sigedong spring | 1                 | 1                 | 2               | 1                | 1          | 6           |       |
| 4               | Pangwalangan    | 0                 | 1                 | 2               | 0                | 0          | 3           |       |
| 5               | Sipariuk river  | 0                 | 2                 | 1               | 1                | 1          | 5           |       |
| 6               | Batu arca       | 2                 | 1                 | 1               | 1                | 2          | 7           |       |
| 7               |                 | 1                 | 1                 | 2               | 1                | 1          | 5           |       |
| 8               |                 | 1                 | 1                 | 1               | 1                | 1          | 4           |       |
| 9               | Kubang          | 0                 | 2                 | 2               | 0                | 0          | 4           |       |
| Total           |                 | 5                 | 10                | 13              | 6                | 8          | 42          |       |

Table 1 shows that the group that has the highest group size is Batu Arca and Sipariuk sites with a group size of 7 individuals per groups. The lowest Javan surili group size is in the upper ridge location with a group size of 2 individuals per groups. Other related research Tobing [11] in the Mount Halimun National Park with the condition of undisturbed forest areas found that there are 2-8 individuals in a group, and disturbed forest areas of 2-6 individuals. Furthermore, according to reference [1] in the Situ Patenggang Nature Reserve area, he found that the size of Javan surili groups in the area was 3-8 individuals per group. Reference [6] results showed that there was one group in each block in the Pasir Ipis Block and there were 7 individuals per group, 8 individuals per group in Lembah Cilengkrang Block, 4 individuals per group in Cibunian Block, and 9 individuals per group Kalawija Block. Meanwhile, the location of Batu Arca is also seen as the location of the group with the highest number of individuals with a total of 12 individuals. Surili has a home range of 35-40 Ha [12]. The home range depends on the group size and sometimes overlaps with the range of other groups.

The observation results can only find out the gender of Javan surili in the young-adult and adult classes, because it is difficult to differ the sex of the juveniles. Sex ratio data for each group is presented in Table 2.

Table 2 Javan surili sex ratio in Sigedong Forest Block

| No. | Lokasi     | Sex ratio umur produktif | Sex ratio total |
|-----|------------|--------------------------|-----------------|
|     |            | Male  Female             | Male  Female    |
| 1   | Upper ridge| 1                1        | 1                1        |
| 2   | Lower ridge| 1                2        | 1                2        |
| 3   | Sigedong spring | 2          3        | 1                1.5     |
| 4   | Pangwalangan| 4                4        | 1                1        |
| 5   | Sipariuk river| 2          3        | 1                1.5     |
| 6   | Batu arca  | 4                6        | 1                1.5     |
| 7   | Kubang     | 2                2        | 1                1        |
| Total |           | 16               21       | 1                1.31    |
From the table above, it can be seen that the sex ratio is dominated by productive females with a ratio of the number of males and females of 1: 1.31. This value is almost the same as the total sex ratio value of Javan surili in the Salak Mountain UGI area, with a comparison value of 1: 1.27 [13]. Reference [3] research results at TNGC also showed that the number of the female was higher than male. Javan surili is a primate group consisting of only one male as group leader and several females [2].

**Age structure**

The age structure is a comparison of the total number of individuals in an age class of the population so that the average annual Javan surili is known. Age classifications are very important to evaluate the development of a population size. Table 7 shows the composition of the age structure based on qualitative characteristics, while the annual age structure were obtained with the population number in each class data in Table 3 divided by the number of the age interval.

| Age Classification | Age (yo) | Age Interval | Population Number | Annual Average |
|--------------------|---------|--------------|--------------------|----------------|
| Juveniles          | 0-4     | 4            | 5                  | 1.25           |
| Young-Adults       | 4-7     | 3            | 23                 | 7.67           |
| Dewasa             | 7-20    | 13           | 14                 | 1.08           |

The annual age structure of Javan surili in the Sigedong Forest Block based on the results of data processing shows a high age structure pattern in the young-adults age class compared to juveniles and adults. Based on the patterns of population change, the structure shows that the population has a slow growth rate, due to the small number of the juvenile, but high in young-adult class.

**Natality rate**

Surili birth rates in the Sigedong Forest Block TNGC are relatively low. There are a number of research sites where there are no juveniles in the group. The birth rate calculated in this study is a crude birth rate because the specific birth rate cannot be known with certainty so the grouping of each individual is based on a qualitative scale. There were no juvenile in the upper ridge, lower ridge, pangwalangan and kubangan at the time of observation. The birth rate results from 9 Javan surili groups is 0.238. This value is different from the result of reference [3] research, where it is estimated that the value of Javan surili in TNGC was 0.125. It is also different from the value predicted by reference [13] who received a birth value of 1.23. There are few studies related to Javan surili especially about the demographic parameters so it is difficult to compare.

3.2 **Activity type and distribution of Javan surili**

The data of Javan surili activity types was observed directly in the field, both with direct and indirect observation through the traces and feed marks. A description of primate specific behavior according to reference [14], are eating (ingestive), grouping (allelomimetic), sexual behavior, looking for shelter (shelter seeking), epimeletic or grooming, removing dirt (eliminative), playing (playing) and resting (resting). Meanwhile, the types of activities found during the observation are group (allelomimetic), eating (ingestive), resting (resting), and seeking shelter (shelter seeking). Sigedong Forest Block TNGC has four types of land cover, including plantations, fields, forest and shrubs. The type of surili activity based on the type of vegetation cover in Sigedong Forest Block is presented in Table 4.
Table 4 Activity type of Javan surili based on land cover type in Sigedong Forest Block

| No. | Activities       | Land cover type |
|-----|------------------|-----------------|
|     |                  | Forest | Plantation | Agricultural Field | Shrubs | Total |
| 1   | Allelomimetic   | 2      | 2          | 0                  | 0      | 4     |
| 2   | Ingestive       | 3      | 1          | 0                  | 0      | 4     |
| 3   | Resting         | 2      | 6          | 0                  | 0      | 8     |
| 4   | Shelter seeking | 0      | 3          | 0                  | 0      | 3     |

The total encounter shows that resting activities are the most frequently performed surili activity. Resting behavior is usually carried out by the surili after eating, standing still at the end of branches or branches by occasionally turning to the right and left to be alert while occasionally scratching the body and drying the body. This is in accordance with the research of reference [2], daily surili time is used to carry out eating activities by 30%, movement by 5% and rest by 60%. Some surili activity is shown in Figure 3.

![Figure 3](image1.png)

Figure 3 Javan surili activities: a) resting, b) allelomimetic, c) shelter seeking, and d) ingestive

Figure 4 presents a map of surili distribution based on the type of vegetation cover in the Sigedong Forest Block. Reference [15] states that aspects of spatial use patterns describe interactions between animals and their habitats. The type of vegetation cover in the Sigedong Forest Block is still classified as natural and has very little interference from humans.

![Figure 4](image2.png)

Figure 4 Javan surili distribution map based on vegetation type
The results show that there is a correlation between surili distribution activity and vegetation type. Obtained from the results of the meeting point with the surili, where in shrubs and fields cover type, not a single individual was found. Most surili activities are carried out in plantation and forest land cover. That is because surili is an arboreal primate that uses forest vegetation as a protector and as a food source. Arboreal animals are animals that most of their lives are spent in trees with dense canopy. Members of the surili group sleep close to each other at night and are about 20 meters above ground level. The results of this study are in accordance with reference [3] study, which states that surili in Ciremai National Park mostly utilize strata B (20-30m) and C (4-20 m) for various activities. The completeness of the function of forest vegetation is more meaningful as a habitat function when added to water sources [16]. Javan surili also has a lot of activities on plantations due to the large number of feed plants that are available and favored by this species.

Classification of habitat types based on altitude are divided into lowland forest (<1000 masl), sub-mountain forest (1000-1500 masl), mountain forest (1500-2400 masl) and sub alpine forest (> 2400 masl) [17]. The nine Javan surili groups were found in several topographies in the Sigedong Forest Block, Ciremai National Park, including lowland forest, sub-mountain forest and mountain forest. Sigedong Forest Block only reaches an altitude of 2400 masl so that the topography used is only lowland forest, sub-mountain forest and mountain forest. This species lie in primary forests, secondary forests, mangroves, from the coast to an altitude of 250-2,500 masl and often found in forests edge, next to plantations [12]. A map of the distribution of surili in the Sigedong Forest Block is presented in Figure 5.

Figure 5 Javan surili distribution map based on topography

Javan surili is a folivora with the composition of young leaves by 62%, old leaves by 6%, 9% in the form of branches and fungi [18]. Other types of feed surili consumed are flowers (7%) and fruit (15%). Based on the results of vegetation analysis that has been carried out there are 26 species of Javan surili feed plants that found in the entire location of the observation described in Table 5.
Table 5 Plant diet type of Javan surili in Sigedong Forest Block

| No. | Local Name | Scientific Name          | Family          | Part of the plant used |
|-----|------------|--------------------------|-----------------|------------------------|
| 1   | Mara       | *Macaranga tanarius*     | Euphorbiaceae   | Seed rind              |
| 2   | Huru minyak| *Litsea resinosa*        | Lauraceae       | Seed, shoots           |
| 3   | Kipare     | *Glochidion lutencens*   | Euphorbiaceae   | Seed, shoots           |
| 4   | Kondang    | *Ficus variegata*        | Moraceae        | Fruit, shoots          |
| 5   | Bubuay     | *Pinanga kuhlii*         | Arecaceae       | Seed                   |
| 6   | Bingbin    | *Pinanga coronata*       | Arecaceae       | Seed                   |
| 7   | Ruyung     | *Pinanga sp*             | Arecaceae       | Seed                   |
| 8   | Benunging  | *Ficus fistulosa*        | Moraceae        | Fruit, shoots          |
| 9   | Pinus      | *Pinus merkusii*         | Pinaceae        | Strobilus              |
| 10  | Salam      | *Syzygium polyantum*     | Myrtaceae       | Fruit, shoots          |
| 11  | Puspa      | *Schima wallichii*       | Theaceae        | Shoots                 |
| 12  | Saninren   | *Castanopsis argentea*   | Fagaceae        | Seed, fruit, shoots    |
| 13  | Kayu afrika| *Maesopsis eminii*       | Rhamnaceae      | Seed, fruit, shoots    |
| 14  | Pasang     | *Lithocarpus pallidus*   | Fagaceae        | Fruit, shoots          |
| 15  | Hantap     | *Sterculia oblongata*    | Sterculiaceae   | Fruit                  |
| 16  | Nangsi     | *villebrunea rubescens*  | Urticaceae      | Shoots                 |
| 17  | Huru       | *Croton argyratus*       | Euphorbiaceae   | Fruit                  |
| 18  | Ki Sawo    | *Manilkara kauki*        | Sapotaceae      | Seed, fruit, shoots    |
| 19  | Nangka     | *Artocarpus integra*     | Moraceae        | Seed, fruit, shoots    |
| 20  | Huru batu  | *Litsea sp*              | Lauraceae       | Fruit                  |
| 21  | Huru madam | *Belischmeidia madang*   | Lauraceae       | Fruit                  |
| 22  | Ki tumbila | *Prunus javanica*        | Rosaceae        | Fruit                  |
| 23  | Kaliadra   | *Calliandra callothyrsus*| Fabaceae        | Fruit, shoots          |
| 24  | Dolog      | *Pinanga sp*             | Arecaceae       | Fruit                  |
| 25  | Ki meong   | *Mallotus philippensis*  | Euphorbiaceae   | Fruit                  |
| 26  | Bayur      | *Pterospermum javanicum* | Malyaceae       | Fruit, shoots          |

The results showed 26 of 46 plant species were Javan surili diet, obtained from direct observations and vegetation analysis at the entire observation site. The amount of diet availability in a habitat can influence the presence of the species. The more types of diet available, the more Javan surili lie in that location. Observations showed that this species ate more type of diets from the poles and trees growth rates. This species also eat sapling-type feed, so the diversity of saplings can also guarantee its feed, which means an adequate amount of feed will guarantee the size of the next Javan surili group.

4. Conclusion
The population size of the Javan surili from the nine groups in the Sigedong Forest Block is categorized as normal, with total of 42 individuals and number of individual per groups are 2-7 individual, the sex ratio of 1: 1.31, and the birth rate of 0.238 shows a low birth rate.

There is correlation between Javan surili activity type with the land cover and vegetation type, where all the activities, only found in forest and plantation cover.

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