Estimated Abundance and Distribution of Common Palm Civet (*Paradoxurus hermaphroditus*, Pallas 1777) in the Rural Landscape of Sukaresmi, West Bandung Regency

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Abstract. Common palm civet (*Paradoxurus hermaphroditus*, Pallas 1777) is one species of mammal that has high ecological and economical functions. The ecological function of common palm civet is as an agent of forest rejuvenation by dispersing seeds of forest plants. A study to estimate the abundance and distribution of common palm civet was carried out in Sukaresmi village, West Bandung Regency. The study proposed to collect the data of common palm civet abundance and distribution that can be used as a reference for common palm civet protection and conservation measures. Three methods were used: direct survey on common palm civet encounter, direct survey on common palm civet signs, and semi-structured interviews with local informants. The result showed that common palm civet abundance in the study site was estimated between 12 and 66 individuals. The dominant habitat type was *kebun campuran* (annual-perennial rotation garden) and shrubs. The potential threats to the population of common palm civet was the presence of coucang, bats, squirrels, and frugivorous birds as rivals, dholes as predators, and human as illegal poachers. The effort to protect common palm civet is not yet carried out by the local people as the population is still regarded as abundant and it is not yet of protection concern. Nevertheless, local knowledge about the important roles of common palm civet in the environment can lead to an awareness aimed to reduce illegal poaching.

Keywords : abundance, common palm civet, distribution, threats

1. Introduction
Small mammals have an important role in the preservation of forest ecosystems, among others, as soil fertilizers, pollinators, seed dispersers, and biological pest controllers [1]. One of the small mammals in Indonesia that has an important role in the natural as well as in human-dominated landscapes is common palm civet (*Paradoxurus hermaphroditus* Pallas, 1777). Common palm civets are known as nocturnal, arboreal, and mostly solitary animals, but they can live in groups with a group size of 5-8 individuals [2]. The common palm civet is small carnivorous mammal that spreads from the South to Southeast Asian region and is able
to adapt well to the human environment [3]. Despite its small size, common palm civet has high ability to roam across a landscape where the presence of human is high. Formerly, common palm civet was considered as pest in the area of fruit and coffee plantations and they prey poultry belonging to local people. However, over time, the negative view of society towards common palm civet as pest began to diminish because this small mammal is known to have high ecological and economic values. The economic value of common palm civets is that it is the most expensive producer of perfume and coffee in the world [4], and its ecological value is derived from its role as an agent of forest regeneration, namely as seeds dispersers of forest plants.

Common palm civet is well known for its ability to choose the best fruit based on its maturity level and to leave other fruits behind for supply [5]. In addition to fruits, common palm civets are very fond of the sap of sugar palm trees (Arenga pinnata) found throughout their habitat. In some places, the sap has been used by native inhabitants of the region to make sweet drinks by fermenting the sugar sap called “toddy”, thus common palm civet is often referred to as "toddy cats". Common palm civets drink the nectar of kapok trees (Ceiba pentandra) and Apocynaceae tree trunk. Common palm civets are included in carnivores that eat, among others, chicken, rats, and lizards [5]. The existence of food affects whether common palm civets have overlapping areas or not. If food is available throughout the region, the common palm civet region does not overlap; however, when common palm civets need to find food, usually they travel to other regions [6]. Therefore, common palm civets are said to be high matrix resistance.

Common palm civets have the characteristic of being able to live in a variety of habitat types to an altitude of 2,400 masl. This mammal species lives in forests, plantations, dense vegetation areas, grasslands, agricultural land, open land, vacant land, and residential areas [7]. Therefore, they are categorized as multiple landscape users. Sukaresmi village is used as the study site because this area consists of various types of ecosystems which are the habitats of common palm civets, including primary forests, secondary forests, production forests, agroforestry called kebun campuran, plantations, shrubs, dry land agriculture, mixed dry land agriculture, rice fields, residential areas, and open/empty land [8]. Additionally, common palm civet in this village has high economic value not only from the selling price of the civet itself but because of its role as palm seeds (Arenga pinnata) disperser. The palm is the main commodity of the people in study site.

Although common palm civet is known to be quite useful in the fields of agriculture, economics, and ecology, very limited studies have been conducted about this animal, especially in Indonesia. Reports about common palm civet population are still scanty; the recent report was concerning five common civets in Sebangau National Park in Central Kalimantan. Even report related to the common palm civet population in Sumatra and Java is not available [9]. The limited information related to the availability of common palm civet population dynamics illustrates why this species is currently listed as the least concern species by the IUCN Redlist [10]. Therefore, to enrich the information about common palm civet in Indonesia, this study aims to determine the estimated population and distribution of common palm civet in various habitat types in Sukaresmi village, West Bandung Regency. The results of this study are expected to be useful in the management, protection and preservation of common palm civet population in various habitat types in one of the sites where this species is still commonly encountered in West Java.
2. Materials and Methods
This research is an exploratory study using three methods, namely direct observation, sign surveys, and semi-structured interviews. Direct observations were carried out by exploring through scanning techniques to calculate the number of common palm civet individuals directly encountered. Sign surveys were carried out by exploring signs of the presence of common palm civets in the form of footprints, droppings, food waste, and nests. The estimation of the number of common palm civets found through direct encounter was calculated from the distance between individuals and the encounter time, while estimate on sign findings was generally judged by the size, sign conditions, and time and location found. The population estimation of common palm civet was calculated based on the data of the direct encounter and sign survey.

Estimation through the droppings was seen from the condition and composition of these droppings, with the assumption that droppings found in close vicinity and having the same conditions and composition were considered to originate from one individual. In this case when a number of droppings were found, then the minimum number of the common palm civet was one, and the maximum number is the same as the number of the droppings found within those close proximity. The nest estimation was determined by assuming that at least one common palm civet occupied the active nest up to six individuals (one of the parent and two to five kits) [17]. The overall results of the analysis were then summed up to obtain the population estimation.

The interviews were carried out to gather information about the location, signs of existence, distribution of common palm civets, and data regarding disturbances and protection of common palm civet populations.

Distribution data were presented based on the projected coordinates of the sign of existence and encounter of common palm civets, which then interpreted into maps. An description of the disturbances includes habitat damage, predators, and hunting, while on the other hand protection measure was described as the alternative effort to conserve common palm civet carried out by local communities as part of conservation management.

3. Results and Discussion

3.1. Existence of common palm civet
Based on the information gathered from local people, common palm civets were usually found in forested areas, vegetation where palm trees and/or bamboos were present, and around human settlements. They were usually found at night around 18.00-23.00 when they were actively looking for foods. During the day common palm civets were difficult to find because they spent most of their activities by resting on tall trees. The number of civets found in one encounter was usually around one to two individuals, but sometimes it could be up to four in their nest during the mating season.

According to the local people, common palm civets had footprints similar to those of a cat’s, and they were quite hard to find in the dry season because of the hardened soil structure. Foods commonly eaten by common palm civets mainly fruits like palm sugar, bananas, jackfruits, and yams. The presence of common palm civets could also be identified from the released smell – the smell of pandanus leaf – so that the common palm civets were often dubbed as ‘musang pandan’ because of the body odor they produce. The presence of common palm civets could also be detected from their sound that was similar to that of the sound of a crying baby.
If the position of common palm civets sighting was not too far or too high, their body could sometimes be clearly observed. However, if the position was too close to the observers, there was a bigger chance that common palm civets would leave immediately. The location and the number of common palm civets individuals found in this study can be seen in Table 1. Twenty-eight individuals of common palm civets were found spread out in 15 different locations. Most of the common palm civets found were solitary individuals, with distances between individuals in adjacent locations ranging from 0.16-3.33 km. The distance between individuals can be seen in Figure 1 (the Distribution of common palm civet). The range of distances between adjacent individuals mostly shows that they were still within the same range because common palm civets were known to have a range of 17 ha for males and 1.6 ha for females [11]. This shows that there were several encounter locations that had overlapping roaming areas based on their habitat use.

| No. | Observation Block | Location Found | Time Found | Habitat Type | Activity when Found | Number of individuals (tail) |
|-----|-------------------|----------------|------------|--------------|---------------------|-----------------------------|
| 1.  | Datar Benda       | 05:45          | Human settlement | Looking for chickens around the residential areas | 1 |
| 2.  |                   | 00.54          | Kebun Talun | Eating palm fruit in the tree | 1 |
| 3.  |                   | 01.13          | Kebun Talun | Staying on the palm tree | 1 |
| 4.  | Cipateungteung   | 22.15          | Human settlement | Staying on the puspa tree | 1 |
| 5.  |                   | 22.35          | Shrub      | Eating palm fruit in the tree | 1 |
| 6.  | Dusun I (Cimarel) | 21.50          | Human settlement | Walking around the residential area | 1 |
| 7.  | Campaka           | 00.42          | Field      | Eating palm fruit in the tree | 2 |
| 8.  |                   | 10.25          | Kebun Talun | Staying in a tree hole | 5 |
| 9.  |                   | 22.13          | Kebun Talun | Staying in the tree | 1 |
| 10. | Cibima            | 22.52          | Kebun Talun | Walking on a cliff | 1 |
| 11. |                   | 00.45          | Kebun Talun | Eating palm fruit in the tree | 1 |
| 12. |                   | 23.11          | Shrub      | Walking in the bush | 1 |
Common palm civets were commonly found in kebun talun and shrubs. Thus, it can be concluded that kebun talun and shrubs were the most suitable habitat types for common palm civets. This can be seen from the amount of food available for common palm civets found in both types of habitat. In some locations where there were palm trees (*Arenga pinnata*), the existence of common palm civets living in that location could be guaranteed. This was because common palm civets were very fond of palm fruit [12]. It is not surprising to infrequently encounter palm civets in human settlement because this animal is usually frightened by humans, so they tended to stay away when they met humans or when approached by one. But the signs of common palm civets' presence helped to facilitate the discovery of these animals.}

During the direct encounter, the main activity carried out by common palm civets was roaming around human settlement and in shrubby vegetation, possibly foraging for foods. Arboreal common palm civet can adapt and forage on the surface of the ground [13] and they are also known to be more active on the ground (terrestrial) compared to root civets [11]. Additionally, being nocturnal, these animals are more active at night spending most of their time looking for foods. Common palm civets develop nocturnal behaviour as a way to avoid predators that are active during the day [14].

Based on field observations, it was revealed that the number of encounters with common palm civets was influenced by weather conditions and moonlight. Common palm civets are known to be more active at moonless nights and cloudy weather conditions. However, during rainy weather or when there is moonlight, it is more difficult to encounter common palm civets.
Based on the results of the sign survey, 196 traces were found consisting of footprints, droppings, leftover food, and nests as shown in Table 2. Traces in the form of droppings were the most common compared to other signs because common palm civet faeces could be easily recognized [15]. This depends on what type of food that was available in the vicinity and how open the field was. Meanwhile, other traces, footprints, and active nests were more difficult to find because they were difficult to identify and the footprints were easily lost or rubbed out by the rain or by other animals. As for traces of leftover food, it was difficult to find because most of them were located on tall trees, making it difficult for observers to see.

Table 2. Traces of Common Palm Civet Found Through Sign Surveys

| No. | Trace Type     | Total |
|-----|----------------|-------|
| 1.  | Footprints     | 1     |
| 2.  | Droppings      | 153   |
| 3.  | Leftover Food  | 7     |
| 4.  | Nest           | 35    |
|     | **Total**      | **196** |

Source: Primary Data (2018)

Common palm civets choose the tallest and largest trees with thick leaves and dense floor vegetation like ferns cover. Such vegetation and tree characteristics are selected by the common palm civets to hide their entire body to avoid disturbances. They also prefer to rest on trees covered with thick vines than on trees without vines or holes. Common palm civets also often use the same tree repeatedly to rest, even in logged forests [16].

Based on nest identification, 35 nest trees were found, with nine active nest trees and 26 inactive. Active nests are nests that are still, or recently, used by common palm civets and some of them could be found performing their activities in these nests. Active nests could be identified through the traces of the common palm civets’ presence, such as droppings, scratch marks, leftover foods, and footprints. Meanwhile, inactive nests are nests that show signs of being used in the past but are now abandoned because there are no signs of common palm civets’ presence around these nests.

The nests were found in bamboo trees (Bambusa sp.), sugar palm trees (Arenga pinnata), kapuk randu (Ceiba petandra), African wood (Maesopsis eminii), rasamala (Eltingia excelsa), passion fruit trees (Passiflora ligularis), puspa (Schima wallichi), and jackfruit trees (Artocarpus heterophyllus). The kinds of trees used as nests were mostly food plants of the common palm civets, and these plants are fruit trees.

3.2. The Estimation of Common Palm Civet Population

Based on the field observations, 28 common palm civets were found from direct encounter and 196 from sign findings, which were then analyzed to obtain the estimates of the number of individuals (Table 3).

The total results of the estimated number of common palm civets in the four blocks of observation are presented in Table 3.

As shown in Table 3, the number of common palm civets in the study site was estimated between 12 and 66 individuals. Common palm civets had a foraging range of 2-17 ha [11], with a population density of 0.144 individuals / ha [18]. When compared to its range, the number of common palm civets is fairly stable for their population group. Within the total
research area of 556 ha, there were at least 33 common palm civets. This figure suggests that the population density of the common palm civets in the study area was not high although no comparison with study in other site can be carried out. Some possible factors like expansion of human settlement, poaching, agricultural activities might affect the increment of palm civet population in the study site.

| No. | Observation Block | Location       | Data Type | Number of individuals |
|-----|-------------------|----------------|-----------|----------------------|
| 1.  | Datar Benda       | 3 - 1- 26      | TK K SA   | 8-26                 |
| 2.  | Cipateungteung    | 2 - 1 - -      |           |                      |
| 3.  | Cimarel           | 1 - 1-5 -      |           |                      |
| 4.  | Campaka           | 8 - 1-8 2-12   |           |                      |
| 5.  | Dusun I (Cimarel) |                 | M TK K SA | 8-26                 |
| 6.  | Cimanggu          | 2 - 1-3 -      |           |                      |
| 7.  | Cipangkalan       | 1 - 1-7 -      |           |                      |
| 8.  | Tapos             | 1 - - -        |           |                      |
| 9.  | Cilengkong        | - - 1-25 -     |           |                      |
| 10. | Lembur Sawah      | 1 - - -        |           |                      |
| 11. | Dusun II (Hanjawar)| 1 - 1-19 1-6 | TK K SA   | 1-19                 |
| 12. | Cijambu           | 1 - 1-17 -     |           |                      |
| 13. | Dusun III (Cibaros)| 1 - 1-9 -     |           | 1-9                  |
| 14. | Datarmala         | 1 - 1-5 -      |           |                      |
| 15. | Dusun IV (Sukawargi)| 1 - 1-6 -   |           | 1-6                  |
| 16. | Pasir Gagak       | 1 - 1-8 2-12   |           | 2-12                 |

Total 12-66

Source: Primary Data (2018)

Description: M = Common palm civet Found; TK = Footprint; K = Dirt; SA = Active Nest

3.3. Distribution of the Common Palm Civet

The distribution of common palm civets based on their habitat types can be seen in Table 4 and Figure 1. The data of the common palm civet distribution was obtained from the projected coordinates of the direct encounters and sign findings.

Table 4 shows that common palm civets were found in all observed blocks: Datar Benda, Cipateungteung, Cimarel, Campaka, Cibima, Cimanggu, Cipangkalan, Tapos, Lembur Sawah, Palasari, Cijambu, Sanginten, Datarmala, Pasir Gagak, and Babakan. The habitat types where they were mostly found were kebun campuran and shrubs. The area of the plantation covered with shrubs is a habitat type suitable for small mammals such as common palm civets, because it is often used as their shelter. Common palm civets use shrubs to hide their bodies so they are not seen by predators when foraging, especially during the day [19].
Table 4. Distribution of Common Palm Civets

| No. | Observation Block | Location Found | Coordinate Latitude | Coordinate Longitude | Habitat Type          |
|-----|-------------------|----------------|---------------------|----------------------|-----------------------|
| 1.  | Dusun I (Cimarel) | Datar Benda    | 6° 56'15.87" S     | 107° 14'49.40 "E    | Human settlement      |
| 2.  |                   |                | 6° 56'55.47" S     | 107° 14'10.74 "E    | Kebun Talun          |
| 3.  |                   |                | 6° 56'28.24" S     | 107° 14'18.85 "E    | Kebun Talun          |
| 4.  |                   | Cipateungteung | 6° 57'16.27" S     | 107° 15'25.14 "E    | Human settlement      |
| 5.  |                   |                | 6° 57'5.48 "S      | 107° 15'27.90 "E    | Shrubs                |
| 6.  |                   | Cimarel        | 6° 56'19.82" S     | 107° 14'53.47 "E    | Human settlement      |
| 7.  |                   |                | 6° 56'11.67" S     | 107° 14'58.17 "E    | Field                |
| 8.  |                   | Campaka        | 6° 56'16.41" S     | 107° 14'59.90 "E    | Kebun Talun          |
| 9.  |                   |                | 6° 56'25.27" S     | 107° 15'23.77 "E    | Kebun Talun          |
| 10. |                   |                | 6° 56'47.87" S     | 107° 14'54.15 "E    | Kebun Talun          |
| 11. |                   | Cibima         | 6° 56'54.71" S     | 107° 14'48.71 "E    | Kebun Talun          |
| 12. |                   |                | 6° 57'8.04" S      | 107° 14'44.91 "E    | Shrubs                |
| 13. |                   | Cimanggu       | 6° 56'43.96" S     | 107° 14'43.28 "E    | Shrubs                |
| 14. |                   |                | 6° 56'32.90" S     | 107° 14'43.69 "E    | Shrubs                |
| 15. |                   | Cipangkalan    | 6° 56'36.65" S     | 107° 15'12.75 "E    | Shrubs                |
| 16. |                   | Tapos          | 6° 56'50.89" S     | 107° 15'12.68 "E    | Human settlement      |
| 17. |                   | Lembur Sawah   | 6° 56'43.02" S     | 107° 15'42.03 "E    | Forest               |
| 18. | Dusun II (Hanjawar)| Palasari      | 6° 56'42.72" S     | 107° 16'33.30 "E    | Shrubs                |
| 19. |                   | Cijambu        | 6° 56'41.52" S     | 107° 16'46.61 "E    | Kebun Talun          |
| 20. | Dusun III (Cibaros)| Sanginten    | 6° 56'7.62" S      | 107° 17'27.55 "E    | Shrubs                |
| 21. |                   | Datarmala      | 6° 56'25.61" S     | 107° 15'40.86 "E    | Forest               |
| 22. | Dusun IV (Sukawargi)| Pasir Gagak | 6° 56'49.00" S     | 107° 17'24.25 "E    | Human settlement      |
| 23. |                   | Babakan        | 6° 57'49.70" S     | 107° 17'40.92 "E    | Field                |

Source: Primary Data (2018)

From Figure 1, it can be seen that the common palm civets were randomly distributed with irregular distances. The irregular distribution pattern might be due to the irregularity of landscape structure. This means that the distribution of the common palm civets follows the configuration of suitable land use types preferred by this animal.

3.4. Disturbance and Protection of Common Palm Civet

Interviews with local informants suggested that disruption to the existence of common palm civet might be due to habitat fragmentation, rivalries, predators, and from human threats like poaching. The disturbance in the form of habitat fragmentation is related to the presence of dam construction project for Hydroelectric Power Plant, which had an effect on landscape structure through the changes of land cover from denser vegetation to open land uses like agricultural lands, thereby reducing the number of the common palm civet habitats.

Common palm civet’s rival in the study site was the slow loris (Nycticebus coucang), which was found in several locations close to the locations where the common palm civets were encountered. In addition, slow lorises are also known to consume similar foods as common
palm civets: fruits, insects and small vertebrates, tree sap, and nectar [20]. Despite slow lorises have a high possibility as common palm civets competitor, further study is necessary to confirm rivalry between the two species in the study site. Such study is important to establish a strategy for conservation management of small mammals in human-dominated landscape.

Figure 1. Distribution Map of Common Palm Civet and Sign Findings

Common palm civet poaching occurred in the study site was mostly carried out not by the local people, but by outsiders with the purpose of hunting or capturing common palm civets. This was carried out to fulfil personal interests, without regard to its preservation in nature. Information gathered from local people revealed that the population of common palm civets in the study site experienced a decrease compared to the last few years, as seen from the more difficulties to encounter common palm civets. In recent years in Indonesia there has been a significant increase of poaching of common palm civets because they are hugely needed for the production of the very well known ‘kopi lueak (civet coffee)’ [21]. Therefore, although common palm civets are not protected by national law, it is likely that conservation efforts need to be carried out through the protection of this mammal species so that their presence and its ecological role in the environment can be maintained.
The protection of common palm civets in place where human already dominates the landscape has been becoming necessary. This is because the local people living in rural landscape often consider the population of common palm civet in the area is still abundant and far from extinction, therefore, it does not require special concern. In addition, the absence of institutions handling the protection and preservation of common palm civets in the area where big construction like the development of dam for hydroelectric like that in the present study site hampers the local community to take part in conservation measure.

Efforts to maintain the ecological integrity of Sukaresmi landscape as non-conservation area with a high level of biodiversity need to be taken, especially in the conservation of mammals. The existence of mammals in a landscape where human domination is taking place nature requires sustainable management actions because there are many factors that can threaten their existence in nature. One of the disturbances that may threaten the presence of mammals in nature is a dynamic change in the ecological balance [22].

One of the efforts that can be undertaken to protect wildlife in general is by protecting their habitats. Habitat protection can be prioritized to: 1) prevent the escalation of poaching on the small habitat, 2) maintain sustainable wildlife population size (viable population), and 3) guarantee the connectivity of a population/group of animals with other habitats [23]. Some of these efforts can be carried out in the present study site for the preservation of the common palm civets in particular and wildlife in general. This ultimately may lead to the maintenance of landscape integrity and productivity in the midst of continuing human expansion.

4. Conclusion
The estimation of the abundance of common palm civets found in various habitat types based on direct encounters and sign surveys ranges between 12 and 66 individuals. Common palm civets were found to be distributed in five habitat types: kebun campuran, shrubs, agricultural fields, human settlement, and remnant secondary forests. The potential for disruption to the existence of common palm civets comes from its competitors, predators, and human beings. Efforts to protect common palm civets have not been carried out by the local community because the palm civet population is still perceived to be abundant, thus it does not require special concern. However, the promotion of the ecological and economic importances of the common palm civets in nature may increase public awareness, especially in minimizing poaching and habitat degradation.

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