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# Short Communication: Leopard cat (*Prionailurus bengalensis*) distribution in the Cisokan Hydropower Plant, West Java, Indonesia

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**Abstract.** *Husodo T, Megantara EN, Mutaqin AZ, Kendarto DR, Wulandari I, Shanida SS. 2022. Short Communication: Leopard cat (*Prionailurus bengalensis*) distribution in the Cisokan Hydropower Plant, West Java, Indonesia. Biodiversitas 23: 6247-6253.* Globally, leopard cats (*Prionailurus bengalensis*) can be found in various land cover types. Information about leopard cats is still low in Indonesia, especially in Java. Java Island has high human activities that impact leopard cats, such as the UCPS hydropower development area, a non-conservation area. The UCPS hydropower plant is in the upper catchment area of the Cisokan River as a tributary of the Citarum River. Although leopard cats can adapt to various land cover types, monitoring their existence is necessary. This study aims to reveal the distribution of leopard cats in the UCPS hydropower development area, Cianjur Regency and West Bandung Regency, West Java, Indonesia. Sign survey and literature were applied in this study. Fifty-eight leopard cat findings were found in the UCPS hydropower area. Leopard cats were found in 16 of the 47 grids from 2012-2022. After 5-10 years, leopard cats still use the same area in certain areas to meet their needs. In eight of 16 grids, 50% of the grids used by leopard cats were habitats used repeatedly. They were most commonly found in shrubs (39%), riparian (20%), and pine plantations (15%). Leopard cats were located at 445-895 masl and are most commonly found at 400-800 masl. Leopard cats are found in the UCPS development area and Perhutani Land. After 5-10 years, leopard cats still use the UCPS development area, so the habitat still fulfills their daily needs. Further monitoring is needed to determine the ecological status of the leopard cat population during the construction and post-construction process.

**Keywords:** Camera trap, non-conservation area, sign survey

## INTRODUCTION

Leopard cat (*Prionailurus bengalensis*) is a carnivore species generally found in Asia, such as Afghanistan, Pakistan, India, Laos, Myanmar, Thailand, Malaysia, Vietnam, Taiwan, Indonesia, Borneo, Nepal, Korea, and Cambodia (Srivathsa et al. 2015). In Indonesia, leopard cats are found in Java, which is in Java, with the densest human population in Indonesia. Most of the wildlife is associated with or dependent on the forest in Java (Meijaard and Ferguson 2014). However, Java Island experiences high deforestation rates, significantly threatening wildlife (Meijaard and Ferguson 2014). Leopard cats are adversely affected by habitat loss, fragmentation, and poaching (Seto et al. 2012; Coudrat et al. 2014). The main deforestation drivers are industrial-scale agriculture (Hansen et al. 2013; Stibig et al. 2014), pulp, and logging (Abood et al. 2015). The high deforestation is due to the increased human expansion to reach the natural habitat of wildlife. Agriculture and logging result in modified landscapes that affect biodiversity (Chua et al. 2016; Partasasmita et al. 2016). Human expansion has a direct impact on biodiversity, affecting various ecosystems in the world (Hooper et al. 2012).

An example of human expansion is the Upper Cisokan Pumped Storage (UCPS) hydropower development area, Cianjur Regency, and West Bandung Regency, West Java. The construction process of the UCPS hydropower development impacts the loss or decline in the quality of wildlife habitats, one of which is the leopard cat which has Rare, Endangered, Endemic, and Protected Species (REEPS) status (Husodo et al. 2019b). Therefore, it is necessary to monitor leopard cats in the UCPS hydropower development area.

Various responses of leopard cats to environmental changes have been proven through studies. According to Mohamed et al. (2013), leopard cats can adapt to multiple land cover types. Leopard cats are more tolerant to habitat disturbances and can be found in primary and secondary forests, plantations, and orchards (Mohamed et al. 2016). The density of the leopard cat increases in disturbed forests (Mohamed et al. 2013). With the wide distribution of the leopard cat in multiple conditions, its abundant population

(Wilting et al. 2016), and its ability to survive in disturbed habitats, the leopard cat is classified as Least Concern (LC) by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Ross et al. 2015). Besides, the leopard cat is registered by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) with Appendix II status (UNEP-WCMC 2022) and is protected by Regulation No. P. 20 of 2018 regarding Protected Plant and Animal Species, which the Ministry of Environment and Forestry issues.

Studies on the ecology of leopard cats have been carried out, specifically on Java. The studies of leopard cats have been studied in the UCPS hydropower development area by Husodo et al. (2019a), Husodo et al. (2019b), Megantara et al. (2019), The Indonesian Institute of Sciences (2012), Meijaard and Ferguson (2014), PPSDAL (2014), PPSDAL (2017), and Shanida et al. (2018). Leopard cats were also found in the Ciletuh Geopark, Kamojang, Mount Salak, and Darajat (Megantara et al. 2019; Husodo et al. 2019c).

Certain predators, leopard cats, are keystone species because they can control the prey population in the ecosystem (Fernandez et al. 2018). The apex predators can be ideal indicator species, representing changing food webs (Ramirez et al. 2014). If predator species disappear from the ecosystem, the prey will experience overpopulation, which will take up a lot of natural resources in the ecosystem. Cats need a large area to provide the food, water, shelter, and space they need. If the leopard cat population is categorized as healthy, other species in the ecosystem will also have healthy populations. If we are protecting feral cats, such as leopard cats, at the same time protecting most other species (Povey and Spaulding 2006). Based on the above introduction, this study aimed to determine the distribution of leopard cats in the UCPS hydropower development area, West Java.

## MATERIALS AND METHODS

### Study area

The study was conducted in August-September 2022 in the Cisokan Watershed, the UCPS hydropower development area, West Java, Indonesia (Figure 1). Administratively, the UCPS hydropower plant development area and its infrastructure cover an area of 775.64 ha, located in two regencies, namely West Bandung Regency (two sub-districts) and Cianjur Regency (three sub-districts). The UCPS hydropower plant is in the upper catchment area of the Cisokan River, as a tributary of the Citarum River, which flows from south to north, leading to the Java Sea. The UCPS hydropower plant construction consists of two dams and a reservoir, transmission line, power station, access road, quarry, and other facilities, which are estimated to require an area of ±723.15 ha. This area consists of a community area of ±337.89 ha and a forest area of ±385.25 ha in West Bandung and Cianjur Regencies. The outside area of the UCPS is Perhutani land. The UCPS development area consists of various types of vegetation: natural forests, riparians, shrubs, production forests, mixed gardens, monoculture gardens, paddy fields, and swidden cultivations (PPSDAL 2014).

The UCPS hydropower area is the study area shown on a 1 km x 1 km grid (Figure 1). There are 47 grids in the study area, covering a total of 47 km$^2$. The grids were determined based on the environmental document-Biodiversity Management Plan 2020 (PPSDAL 2020). The grid size can be applied to this study because the average leopard cat's home range is 3-14 km$^2$ (Rajaratnam et al. 2007).

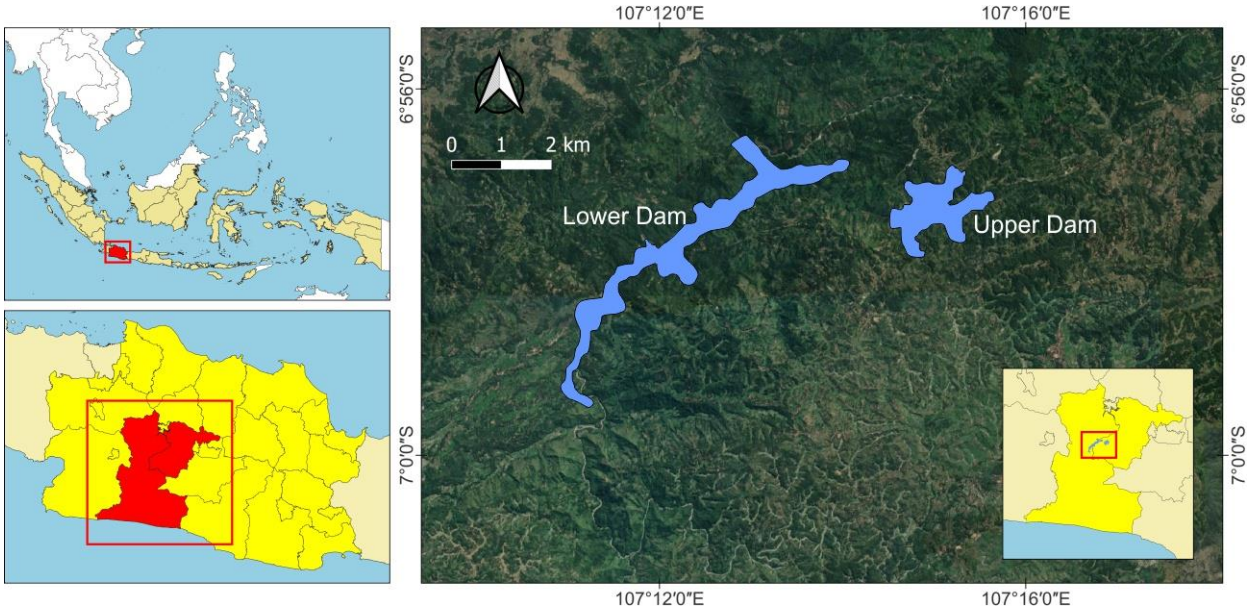


**Figure 1.** Hydropower plant development area, Cianjur Regency and West Bandung Regency, West Java, Indonesia

**Procedures**

*Sign survey*

The sign survey was conducted from 06.00 a.m. - 04.00 p.m. (10 hours), looking for footprints and feces left behind. We used seven observers and four local guides during one month of observation. Searches were carried out on trails, paddy fields, river banks, dry rivers, large rocks, and shrub edges. Indirect evidence is advantageous when observing rare, elusive creatures like carnivores, found in low densities and challenging to capture. Therefore, observing indirect evidence, the presence of medium and big animals was also precisely shown (Campos et al. 2013; Borges et al. 2014; Dereje et al. 2015). Locations were recorded using a GPS (Garmin 62s).

*Literature review*

The literature used as secondary data collection is 1) final report: A study on flora and fauna in the project area of HEPP "Upper Cisokan Pumped Storage" West Java by The Indonesian Institute of Sciences (2012); 2) short communication: Javan leopard cat (*Prionailurus bengalensis javanensis*) in the Cisokan non-conservation forest areas, Cianjur, West Java, Indonesia by Shanida et al. (2018). Any findings, signs and camera traps found through those previous studies were tabulated.

**Data analysis**

Data were analyzed using simple statistics (percentage) via Microsoft Excel and described qualitatively. Data were collected according to land cover types and study periods. Coordinates of the leopard cat presence were mapped using Google Earth to illustrate the leopard cats' distribution.

## RESULTS AND DISCUSSION

Fifty-eight leopard cat findings, both through signs and camera traps, were found in the UCPS hydropower development area. In 2012, two signs were found in the upper dam. In 2017, there were 38 findings in the upper and lower dam areas. In 2022, there were 17 findings in the upper and lower dam areas (Table 1) (Figure 3). The difference in the results was influenced by the survey area, observation time, number of surveyors, and methods used.

The evidence shows that feces were found the most compared to other findings, resulting in 69% of the three studies. Leopard cat feces were on the edges of rice fields and river banks. Leopard cats also were found on the edges of access roads (paved roads) and artificial walking trails. Leopard cats frequently use roads and artificial walking trails in Malaysian Borneo (Sollmann et al. 2013) and Iriomote Island, Japan (Diaz-Sacco and Izawa 2013). Leopard cats were captured in forest areas near the edges of mixed brushland habitats (Fernandez et al. 2018). Usually, feces were found on sandy soil and rocks. Footprints are more difficult to find than feces because they are not found on covered ground plants and dry soil. The footprints will be easily left on moist, wet, and sandy soil.

Based on their distribution in the grid, leopard cats were found in 16 of the 47 grids from 2012-2022 (Figure 2). In 2012, leopard cats were found on two grids, F2 (Palisiran and Pasir Nangka) and I3 (Cibima), which are the upper dam area. In 2017, leopard cats were in the upper and lower dams in 13 grids. In 2022, leopard cats were located on 11 grids, both upper and lower dams. If accumulated, the leopard cats are scattered on grids, namely C4 (Cilieur), C5 (Ciawitali, Cinomer, Mount Masigit, and Panenggang), D3 (Cigintung), D4 (Ciawitali), D5 (Ciawitali and Cibungbulang), E1 (Sarongge), E3 (Cigintung), F1 (Sarongge), F2 (Curug Kunti-Access Road, Bantar, Palisiran, Pasir Nangka, and Batununggul), F3 (Batununggul), G3 (Walet Waterfall and Cilengkong), H2 (Cilengkong), H3 (Cirumamis River, Japarana, Datar Domba, and Batu Bedil), I2 (Cimarel), I3 (Japarana and Cibima), and K2 (Cipateungteung - Access Road).

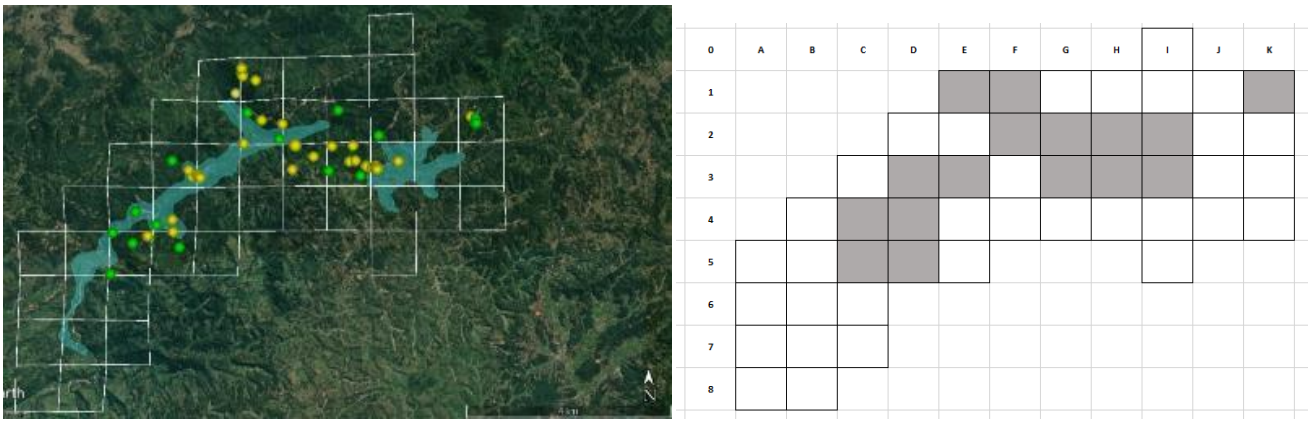


**Figure 2.** Leopard cat distribution in the Hydropower Plant Development Area. Sources: The Indonesian Institute of Sciences (2012), PPSDAL (2017), and Primary Data (2022); Notes: (🟢): Primary Data; (🟡): Secondary Data

**Table 1.** Distribution of leopard cat

| Findings | Locations | Land cover types | | | | | | | | Studies | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nf | Al | Ga | Sh | Ri | Rf | Pl | Se | 2012 | 2017 | 2022 |
| Feces | Cilieur | | | | | ✓ | | | | | | ✓ |
| Feces | Ciawitali | | | | | ✓ | | | | | ✓ | |
| Feces | Ciawitali | | | | | ✓ | | | | | ✓ | |
| Footprints | Cinomer | | | | | ✓ | | | | | | ✓ |
| Feces | Panenggang | | | | ✓ | | | | | | | ✓ |
| Feces | Gunung Masigit | | | | | | | ✓ | | | | ✓ |
| Feces | Cigintung | | | | | ✓ | | | | | ✓ | |
| Feces | Cigintung | | ✓ | | | | | | | | ✓ | |
| Footprints | Cigintung | | | | | | ✓ | | | | | ✓ |
| Feces | Ciawitali | | | | | ✓ | | | | | ✓ | |
| Feces | Ciawitali | | | | ✓ | | | | | | | ✓ |
| Feces | Ciawitali | | | | | ✓ | | | | | ✓ | |
| Feces | Ciawitali | | | | | ✓ | | | | | ✓ | |
| Feces | Cibungbulang | | | | | | ✓ | | | | | ✓ |
| CT | Sarongge | ✓ | | | | | | | | | ✓ | |
| Feces | Cigintung | | | | | ✓ | | | | | ✓ | |
| Feces | Cigintung | | | | | ✓ | | | | | ✓ | |
| Feces | Cigintung | | | | | ✓ | | | | | ✓ | |
| Feces | Cigintung | | | | | ✓ | | | | | ✓ | |
| Feces | Sarongge | ✓ | | | | | | | | | ✓ | |
| Footprints | Sarongge | | | | ✓ | | | | | | ✓ | |
| Feces | Sarongge | ✓ | | | | | | | | | ✓ | |
| Feces | Sarongge | ✓ | | | | | | | | | ✓ | |
| Feces | Sarongge | ✓ | | | | | | | | | ✓ | |
| CT | Sarongge | ✓ | | | | | | | | | ✓ | |
| Feces | Sarongge | | | | ✓ | | | | | | | ✓ |
| Feces | Access Road (Curug Kunti) | | | | ✓ | | | | | | | ✓ |
| Feces | Access Road (Curug Kunti) | | | | ✓ | | | | | | | ✓ |
| Footprint | Bantar | | | | | ✓ | | | | | | ✓ |
| CT | Palisiran | | ✓ | | | | | | | ✓ | | |
| CT | Pasir Nangka | | | | ✓ | | | | | ✓ | | |
| Footprint | Batununggul | | | | ✓ | | | | | | ✓ | |
| Feces | Batununggul | | | | ✓ | | | | | | ✓ | |
| CT | Batununggul | | | | ✓ | | | | | | ✓ | |
| Feces | Walet Waterfall | | | | ✓ | | | | | | ✓ | |
| Footprint | Cilengkong | | | | ✓ | | | | | | ✓ | |
| CT | Cilengkong | | | | ✓ | | | | | | ✓ | |
| Feces | Cilengkong | | | | ✓ | ✓ | | | | | | ✓ |
| Feces | Cirumamis River | | | | ✓ | ✓ | ✓ | | | | | ✓ |
| Feces | Japarana | | | | ✓ | | | ✓ | | | ✓ | |
| CT | Japarana | ✓ | | | | | | | | | ✓ | |
| Feces | Datar Domba | | | | ✓ | | | | | | ✓ | |
| Footprint | Batu Bedil | | | | ✓ | | | | | | ✓ | |
| Feces | Japarana | | | | ✓ | | | ✓ | | | ✓ | |
| Feces | Japarana | | | | ✓ | | | ✓ | | | ✓ | |
| Feces | Japarana | | | | ✓ | | | ✓ | | | ✓ | |
| Feces | Cimarel | | | | ✓ | | | | | | | ✓ |
| Footprint | Japarana | | | | ✓ | | | | | | ✓ | |
| Feces | Japarana | | | | ✓ | | | ✓ | | | ✓ | |
| Feces | Japarana | | | | ✓ | | | ✓ | | | ✓ | |
| Feces | Cibima | | | | ✓ | | | | | ✓ | | |
| Footprint | Japarana | | | | ✓ | | | | | | ✓ | |
| CT | Japarana | | | | ✓ | | | | | | ✓ | |
| Feces | Japarana | | | | ✓ | | | ✓ | | | ✓ | |
| Feces | Access Road (Cipateungteung) | | | ✓ | | | ✓ | ✓ | ✓ | | | ✓ |
| Feces | Access Road (Cipateungteung) | | | ✓ | | | ✓ | ✓ | ✓ | | | ✓ |
| Feces | Access Road (Cipateungteung) | | | | | | | ✓ | | | | ✓ |
| Direct Encounter | Access Road (Cipateungteung) | | | | | | ✓ | | | | ✓ | |

Sources: The Indonesian Institute of Sciences (2012); PPSDAL (2017); Primary Data (2022). Notes: Nf: Natural forest; Al: Agroforestry land; Ga: Garden; Sh: Shrub; Ri: Riparian; Rf: Rice field; Pl: Plantation (Pines); Se: Settlement; (✓): Presence; CT: Camera trap

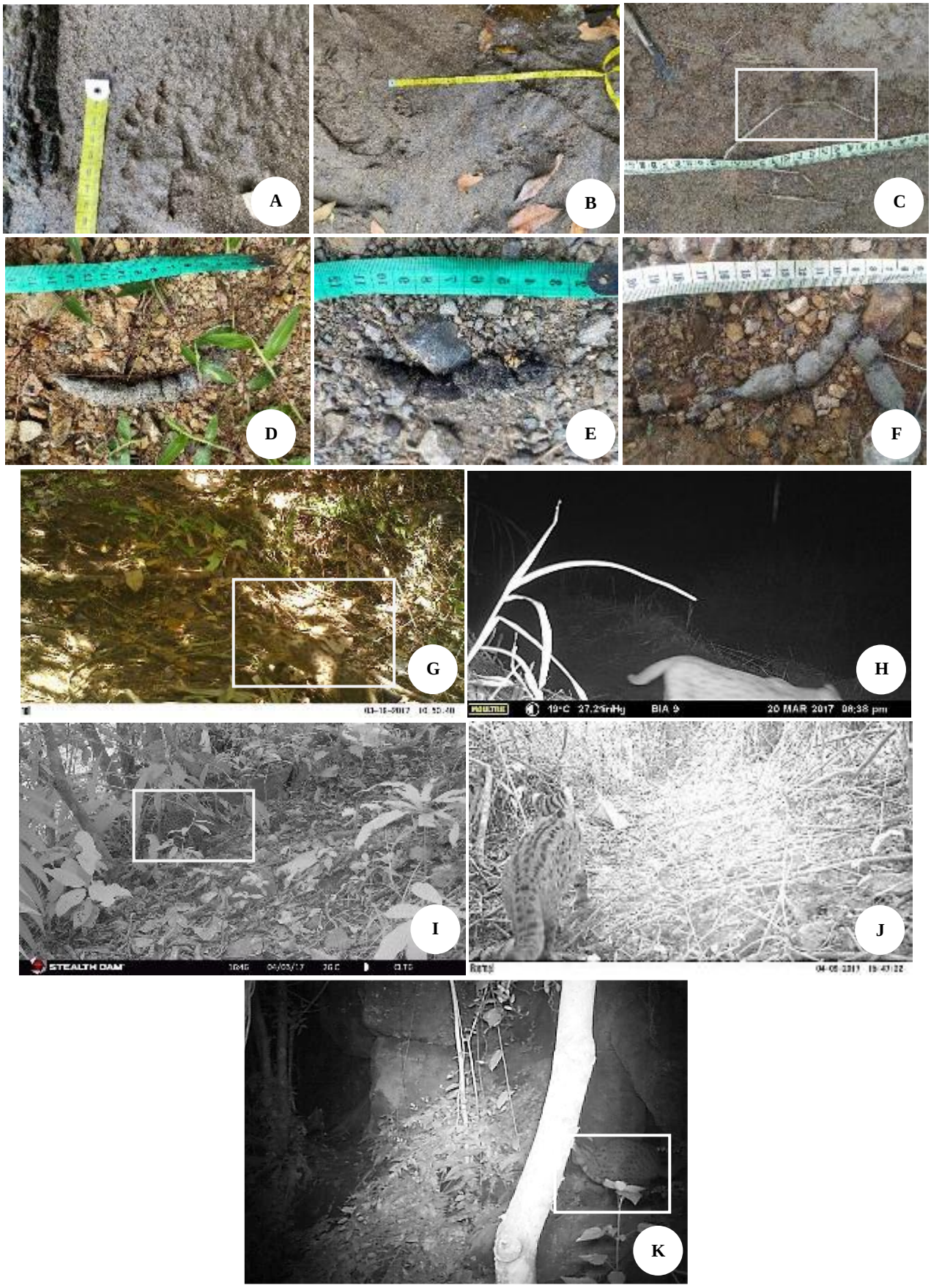


**Figure 3.** ABC. Footprints (2017 and 2022); DEF. Feces (2017 and 2022); GHIJ. Leopard cat (2017); K. Leopard cat (The Indonesian Institute of Sciences 2012)

The grids are known as the latest information on the existence of leopard cats in 2022, including C4, H2, and I2. Leopard cats were found again on the same grid in 2012 and 2017 but not in 2022, on grids F2 and I3. The rediscovered leopard cats in 2017 and 2022, including C5, D3, D4, D5, F1, F2, H3, and K2. The leopard cat rediscovered in 2012, 2017, and 2022 is grid F2. This result shows that after 5-10 years, leopard cats are still using the same area in a grid to meet their needs. In eight of 16 grids, 50% of the grids used by leopard cats were habitats used repeatedly. The rediscovery after years assumed that the habitat has adequate prey availability and the habitat meets their daily needs.

Based on their habitat, leopard cats are found in various land cover types. They were most commonly found in shrubs (39%), followed by riparian (20%), pine plantations (15%), natural forests (9%), and rice fields (8%). They were found the least in agroforestry lands, gardens, and settlements, with 3% of each. Compared to the previous study by Xiong et al. (2016), leopard cat is found in human-modified landscapes, such as farmlands and human residences. The prey's presence influences leopard cats' distribution. Fernandez et al. (2018) more small mammals were captured in mixed brushlands due to the higher food sources in the area. Silmi et al. (2013) said that leopard cats are known to visit plantations to feed on rodents frequently. Pimsai et al. (2014) reported that rodents are often elevated in degraded habitats due to increased resource availability.

Based on the altitude, the leopard cat was found at 445-895 masl in the UCPS hydropower development area. Leopard cats are most commonly found at 400-800 masl, with 41 findings. Others are located at>800 masl with 17 findings. According to Lee et al. (2015), leopard cats were found more in high elevations (340-1950 masl) than in lower elevations <340 masl), which may provide a safe habitat from competition, including from humans.

Figure 2 shows that the existence of leopard cats overlaps with the construction of the UCPS hydropower plant. Nineteen of 58 presences were found in the upper and lower dams construction plan area. This plan will affect the distribution of leopard cats. The leopard cat population may survive or move in search of a new habitat. In the search for new habitats, there is potential habitat competition for other individuals. According to Lorica and Heaney (2013), the Visayan leopard cats (*Prionailurus bengalensis rabori*) survived the massive conversion of forests into sugarcane plantations.

In conclusion, leopard cats are found in the UCPS development area and Perhutani Land. After 5-10 years, leopard cats still use the UCPS development area, so the habitat still fulfills their daily needs. Further monitoring is needed to determine the ecological status of the leopard cat population during the construction and post-construction process. According to Mohamed et al. (2016), the combined impacts of various factors influence the habitat distributions of wild animals. Environmental factors include topographic characteristics, forest properties, and distance from essential factors to support life, such as water. Further research is also needed to reveal the habitat preference of leopard cats. Ground elevation, slope aspect, slope gradient, timber age, timber type, land cover type, and distance from water, road, and forest were selected as factors influencing the habitat distributions of the leopard cats (Lee et al. 2017).

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