

RESEARCH ARTICLE



Camera Trap Records of Sumatran Striped Rabbits (*Nesolagus netscheri*) in Batutegi Protection Forest, Lampung, Indonesia

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Abstract

The Sumatran striped rabbit (*Nesolagus netscheri*) is a little-known lagomorph endemic to southwest Sumatra. Despite its taxonomic significance, limited sightings and a paucity of ecological data have hindered population assessments and conservation efforts. This study presents findings from camera trap surveys conducted in Batutegi Protection Forest (BPF), Lampung Province, Indonesia. The BPF, covering approximately 58,000 hectares, hosts diverse flora and fauna but faces threats from habitat loss and degradation due to agricultural encroachment. The study was carried out in Way Sekampung and Rindingan Forests within BPF. Camera trapping between 2017 and 2023 yielded 42 independent photographs of solitary individuals. The majority of sightings were at elevations above 600m, but two occurred at 366 and 454 m. The rabbits exhibited nocturnal behavior, with peak activity observed between 19:00 and 21:00 and 02:00 and 03:00. Our sightings from BPF, which is situated at some distance from the Bukit Barisan Selatan National Park, provide new records of small but isolated populations of Sumatran striped rabbits in fragmented pockets of remnant forest. Conservation efforts by the Forest Management Unit (KPH) are underway in BPF, but further measures are necessary to preserve the forests rich biodiversity. This study emphasizes the need for continued monitoring and conservation efforts to protect the Sumatran striped rabbit and its habitat. Further research is warranted to assess population densities and ecological requirements, underscoring the importance of implementing effective and collaborative conservation measures in the region.

Keywords: Batutegi Protection Forest, Camera Trap, Leporidae, *Nesolagus netscheri*, Sumatra, Sumatran striped rabbit

1. Introduction

Endemic to southwest Sumatra, the Sumatran striped rabbit (*Nesolagus netscheri*) is arguably the least known of all lagomorphs, the taxonomic order comprising rabbits, hares, and pikas [1,2]. The only other extant species of the genus *Nesolagus* is the Annamite striped rabbit found in the Annamite Mountain range of Laos and Vietnam [3]. First described in 1880 based on a specimen obtained in the Padang Highlands of West Sumatra collected by E. Netscher, the Sumatran striped rabbit was not officially documented in the wild until 1972 by M. Borner in Gunung Leuser National Park [4]. A further 20 years passed before the first verified photograph of a wild individual was taken on a camera trap in Kerinci Seblat National Park by Fauna & Flora International in 1997 [5].

Subsequent records of this species have been extremely scarce. Despite an exhaustive survey of this species carried out by McCarthy et al in 2012, insufficient data were obtained to provide any meaningful base estimates of population size or density [5]. Once thought to encompass the entire Barisan Mountain range, its range is now suspected to be more confined. As most sightings in recent years occurred within two national parks, Bukit Barisan Selatan and Kerinci Seblat, for a while it was assumed that these protected areas represented the sole refugia for this species [6,7]. More recently, four separate reports have revealed the presence of this species outside of the Bukit Barisan Selatan and Kerinci Seblat National Parks indicating that there may still be other remnant and isolated populations yet to be discovered [2,8-10].

The species is thought to be heavily reliant on densely forested montane and submontane habitats occurring at elevations from 600 m to 1600 m [1,6]. Largely nocturnal and solitary, Sumatran striped rabbits are thought to avoid open areas, foraging only under the cover of dense forest. Very little is known of its diet, but *Cyrtandra* spp, a fairly common genus of understory plant, is suspected to be among the species of plants consumed [7].

Owing to the paucity of ecological information available on this highly cryptic species, the status of the Sumatran striped rabbit was changed from Vulnerable to Data Deficient in 2019. Here we present the findings from camera trap surveys in Batutegei Protection Forest in the Province of Lampung between 2017 and 2023.

2. Methods

2.1. Study Site

Batutegei Protection Forest (BPF) is a lower montane tropical forest located in the Tanggamus District of Lampung Province that occupies an area of 58,000 ha. Once connected to Sumatra's Bukit Barisan National Park, extensive habitat loss across Sumatra in recent decades has resulted in the fragmentation and gradual depletion of BPF [11-14]. Today, BPF's remaining natural forest is confined to two protected core zones (*Blok Inti*): Way Sekampung and Rindingan that cover an area of around 13,000 ha. The former is the larger of the two areas with around 11,000 ha, whereas the more mountainous Rindingan is approximately 2000 ha. These two protected core zones are surrounded by a utilization zone (*Zona Pemanfaatan*) where local community farmers are allowed to manage and utilize the forest under the government's Social Forestry Scheme [12,15-17].

Situated within the watershed of the Way Sekampung, Way Seputih and Way Rilau Rivers and lying between elevations of 200 and 1,740 meters above sea level (masl) , BPF represents the main catchment area for the Batutegei Reservoir that provides a source of freshwater, irrigation and hydropower to Lampung Province [18,19]. Topographically, BPF is predominantly a hilly area with just under 50% categorized as steep slope [15,20]. Despite its relatively small size, BPF's remaining forests boast high levels of biodiversity and are home to at least 58 types of mammals, eight species of primates, 245 species of bird, 54 types of reptiles and amphibians and 346 species of flora, many of which are rare and protected [12,21,22].

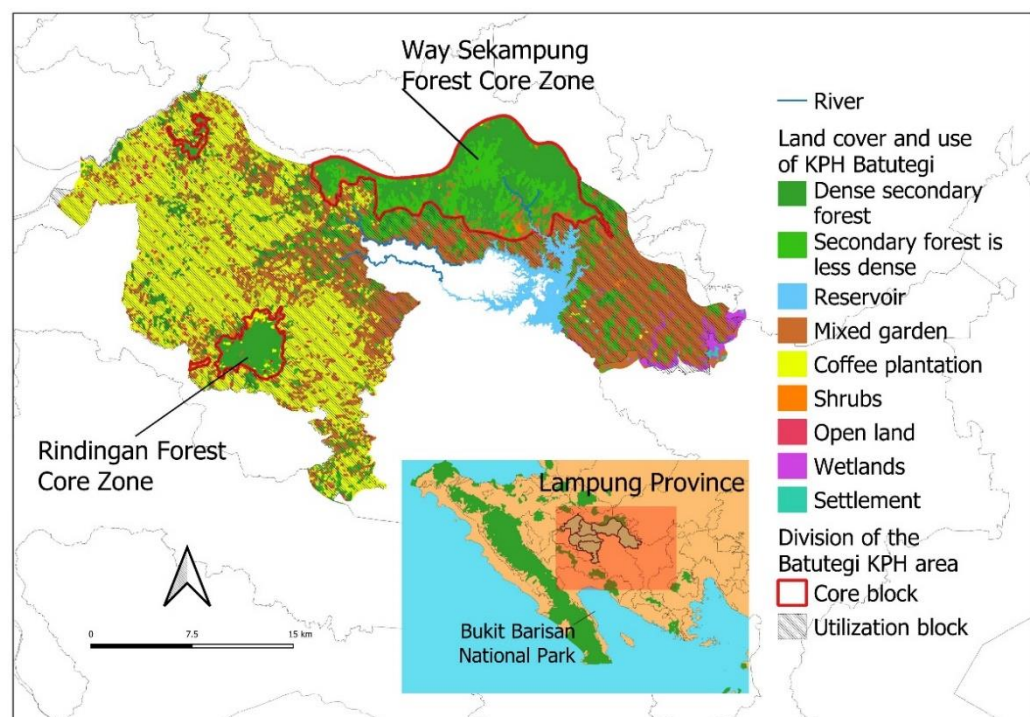


Figure 1. Map of Study Site at the Batutegei Protection Forest (BPF), Lampung Province

2.2. Survey Methods

Between 2017 and 2018, in collaboration with Batuteği’s Forest Management Unit (KPH Batuteği), we carried out a camera trapping survey of the fauna in Batuteği’s Way Sekampung Forest. We set a total of 33 camera traps (Bushnell Trophy Cam Model 119678C) in varied habitat types using a systematic random sampling method with a 2 × 2 km grid. We strapped cameras to trees and the infrared beam was set to a height of 50 cm. Cameras were set to be operational 24 hours a day and with a five second delay between triggers. Trigger events were considered independent when more than 60 minutes apart. We changed batteries and memory cards every three months. This survey design is typically used for larger mammals, primarily the Sumatran tiger. Subsequently, from 2022 to 2023, 41 camera traps (Browning Recon Force Advantage 20 MP and Bushnell Trophy Cam) were set again in the Way Sekampung Forest following the previous survey design, but this time covering a larger area. In addition, six camera traps were set in the Rindingan Forest.

3. Results

Between 2017 and 2018, 24 independent Sumatran striped rabbit photographs (from a total of 25) were obtained from four different camera trap stations in Batuteği’s Way Sekampung Forest (Figure 2). Elevations of camera locations ranged from 366 to 915 masl. From 2022 and 2023, additional camera trapping in Way Sekampung and the Rindingan Forests yielded a further 18 independent Sumatran striped rabbit photographs from a total of 68 photographs (Figure 3). In Way Sekampung, two independent photographs (from six in total) were obtained from one camera station at an elevation of 454 m. In Rindingan, 16 independent photographs were obtained from 52 taken at five different camera stations ranging from 1438 to 1600 masl. All photographs of Sumatran striped rabbits obtained across the two study periods and at the two different locations were of single solitary individuals (Figure 5 (a)).

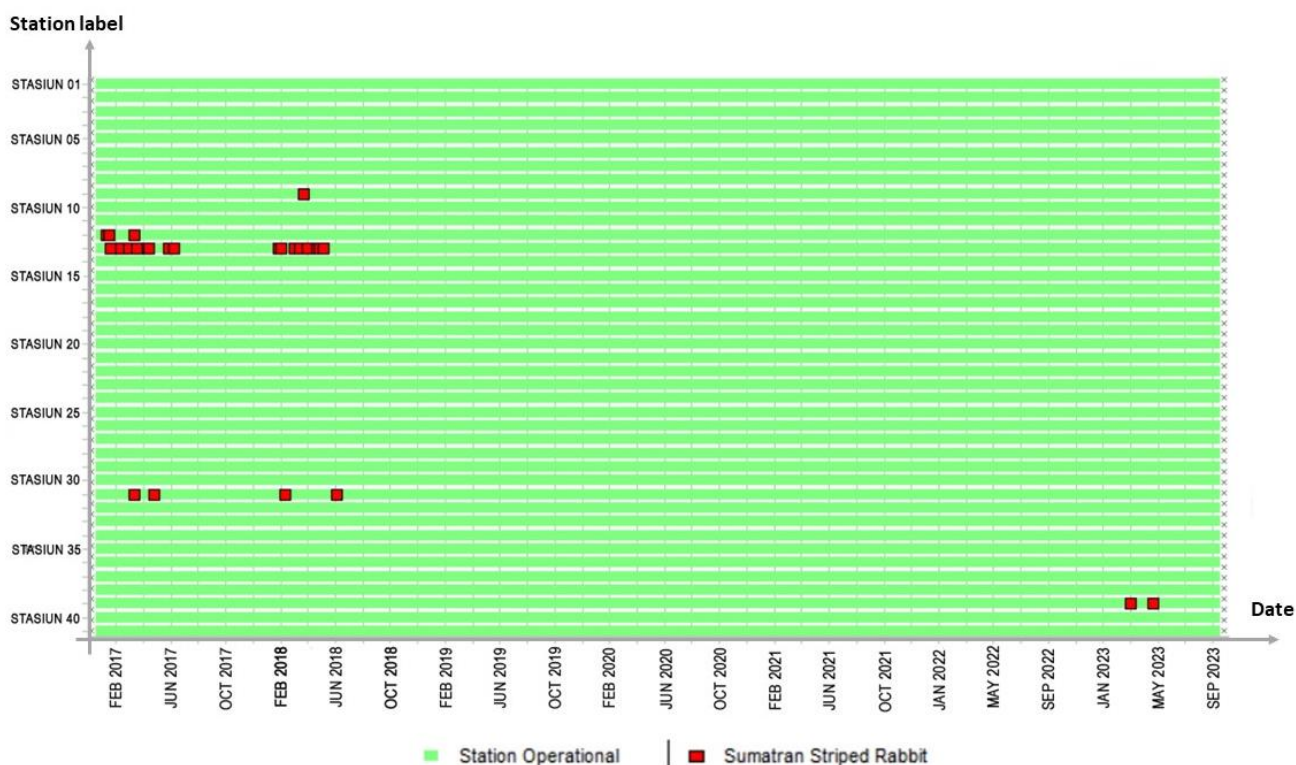


Figure 2. Distribution and frequency of Sumatran striped rabbits captured on camera traps in the Way Sekampung Forest, BPF between 2017 and 2018, and 2022 and 2023.

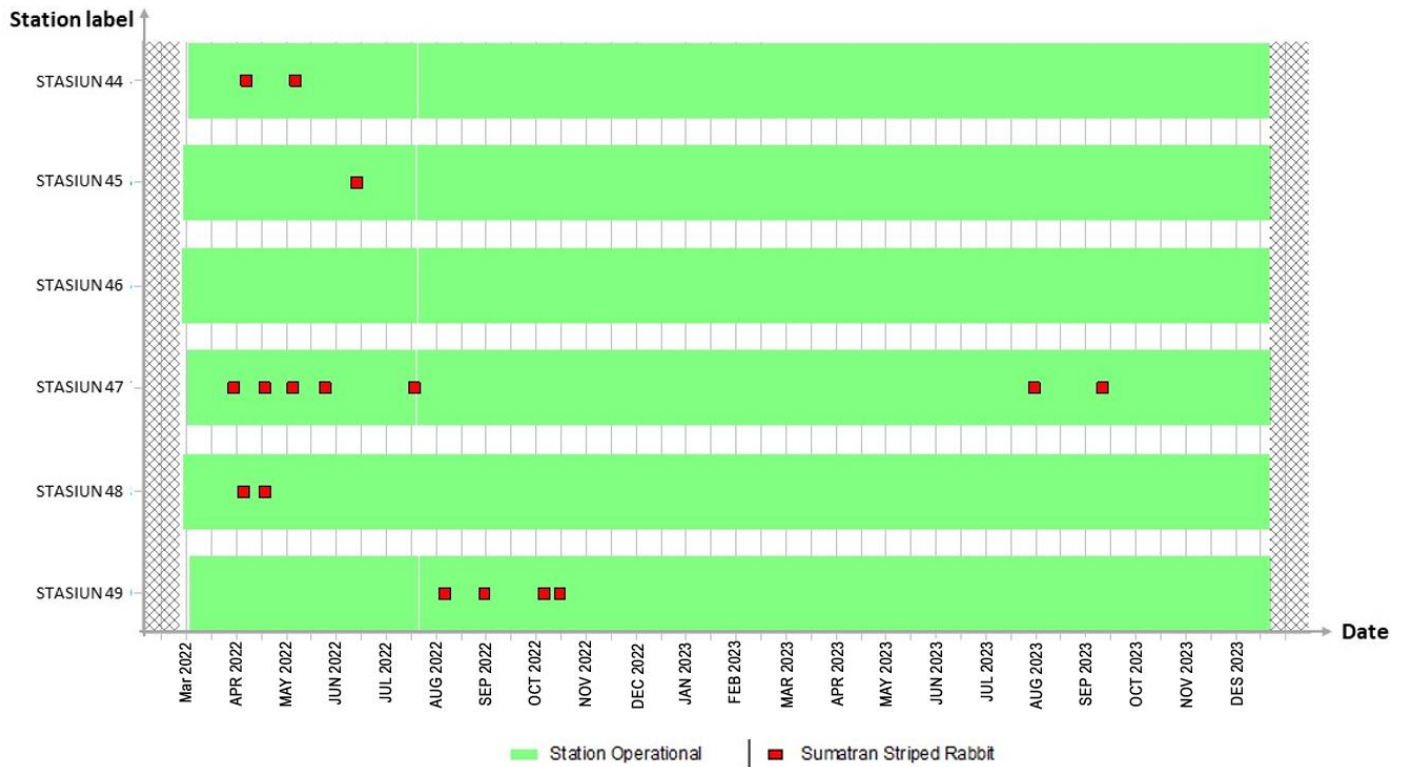


Figure 3. Distribution and frequency of Sumatran striped rabbits captured on camera traps in the Rindingan Forest, BPF between 2022 and 2023.

Environmental conditions at the different observation stations in the two forests were varied. In Way Sekampung almost all camera stations were characterized by having fairly open canopy cover, a dense understory of shrubs including of rattan and ferns, interspersed with tree saplings and thick leaf litter (Figure 5 (b)). In Rindingan, the canopy was moderately closed by comparison, but with similarly dense understory vegetation and leaf litter. The forest surrounding the camera trap stations, however, was considerably denser with more closed canopy cover. The presence of *Cyrtandra* spp. was documented at numerous camera locations, particularly in Rindingan. Based on the times of the photographs, Sumatran striped rabbits were found to be active between 18:00 and 06:00, but were more frequently observed between 19:00 and 21:00 and between 02:00 and 03:00 (Figure 4).

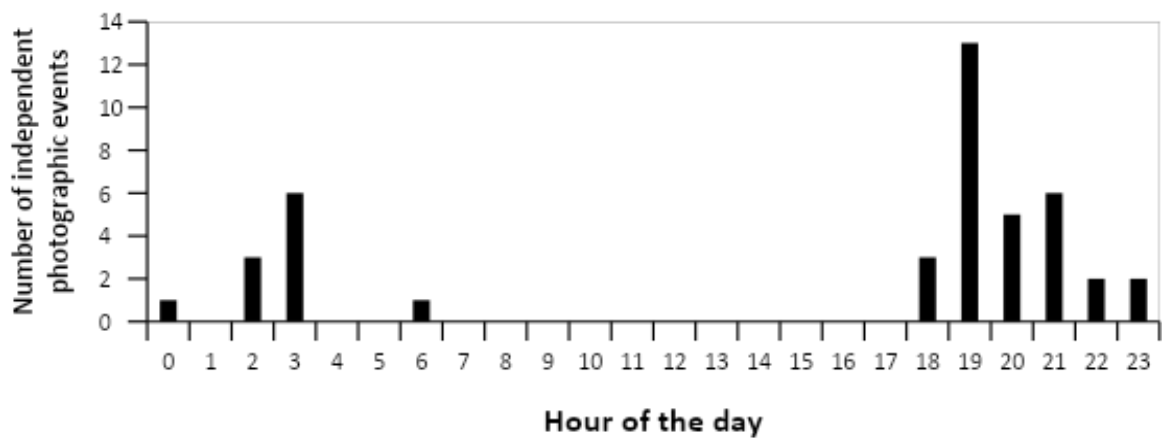


Figure 4. Sumatran striped rabbit activity patterns at Batutegi Protection Forest based on number of camera-trap captures.



Figure 5. Camera trap photograph of a Sumatran striped rabbit in Batutege Protection Forest (a) and Diurnal photograph of the same location showing the habitat (b).

4. Discussion

Here we present new information on the presence of the Sumatran striped rabbits in BPF, Lampung Province, recorded on camera traps from 2017 to 2018 and 2022 to 2023. Despite the camera traps in this survey being set at a height more suitable for detecting Sumatran tigers, we obtained a total of 44 independent photographs of the Sumatran striped rabbit from a total of 99. Most cameras were strategically placed along existing or suspected wildlife trails that were typically slightly more open areas of forest, and this could be a contributing factor to the relatively high capture rates.

It was previously assumed that the range of the Sumatran striped rabbit was confined to within the Bukit Barisan Selatan and Kerinci Seblat National Parks [5]. However, there are now at least four reports of the species occurring at locations outside these national parks, in the Isau-Isau and Gunung Raya Wildlife Reserves in South Sumatra, and at Curup Selatan in Bengkulu Province [2,8-10]. Our sightings from BPF, similar to those from the Isau-Isau Wildlife Reserve which is also located at some distance from the central spine of the Bukit Barisan Mountain Range, provide new records of small but isolated populations of Sumatran striped rabbits in fragmented pockets of remnant forest. Now completely separated from the Bukit Barisan Selatan National Park by an extensive patchwork of agricultural land and residential areas, Way Sekampung and Rindingan Forests in BPF represent refuge habitats for the Sumatran striped rabbit and numerous other threatened and endemic fauna [12]. Surrounded by a mosaic of smallholder coffee fields, rice paddies and vegetable gardens, these isolated forest patches face continuing threats from agricultural encroachment, habitat degradation and clearance for plantations, which is contributing to a gradual erosion of the ecosystem and biodiversity [12,23]. Moreover, being highly forest-dependent and preferring higher elevations; it seems unlikely that any gene flow is occurring between the two isolated populations in BPF.

In this study, a substantial proportion (38%) of Sumatran striped rabbit sightings were from the smaller Rindingan Forest, which covers an area of around 2000 ha. From the six camera traps set in this forest, they were captured at all but one of the locations indicating their presence across almost the entirety of this forest. Although most commonly found in habitats above 600 m, the Sumatran striped rabbit has occasionally been recorded at slightly lower elevations such as at 544 m [7]. Rindingan Forest ranges between 750-1750 masl and therefore falls within the preferred elevation range of this species [5]. Sumatran striped rabbits were also recorded at five locations in Way Sekampung Forest, which is the larger of the two areas (11,000 ha) and covers a slightly lower altitudinal range, i.e., 200-1150 masl. In Way Sekampung two sightings were recorded below 600 masl, at 366 and 454 masl.

Many Sumatran striped rabbit sightings in BPF were in relatively open areas of forest with broken canopy, where the sunlight (and moonlight) could penetrate through the trees reaching the understory. The understory layer in these locations, however, was dense with rattan and ferns and may provide the rabbit with shelter and protection from both aerial and terrestrial predators. All capture times of the photographs were between 18:00 and 06:00 indicating strict nocturnality, but with the most active period between 19:00 and 21:00. Consistent with sightings from other studies [7], all photographs of Sumatran striped rabbits captured in BPF were of single animals, indicating solitary behaviour. The presence of *Cyrtandra* spp. at locations in both Way Sekampung and Rindingan is consistent with previous reports that at least some species of this common understory plant may be consumed by the rabbits [4,8].

Although seasonal hunting of Sumatran striped rabbits has been reported, for meat in Gunung Raya, and for the pet trade in Gunung Dempo [2,8], in general, hunting does not appear to constitute a significant threat to this species [5]. This is possibly due to its cryptic nature and rarity making it difficult to catch. No indication was evident of any systematic or opportunistic hunting in BPF throughout the duration of the study.

Despite its high biodiversity value, the Batutegi Forest is a 'Protection Forest' and not a designated conservation area. State forests in Indonesia are classified into three functional categories: 'Production Forest' for providing forest products; 'Protection Forest' for ecosystem protection, such as watershed and soil conservation; and 'Conservation Forest' for protecting biodiversity and ecosystem conservation [24]. Protection forests essentially act as buffer zones to regulate hydrology, control floods, prevent erosion and maintain soil fertility [25]. In BPF, the Forest Management Unit (KPH) serves a critical role in protecting the watershed, which consists of three main river systems [15,26]. Conversely, fewer resources and less time are afforded to the management and preservation of its biodiversity.

5. Conclusions

These new records of Sumatran striped rabbit populations in Way Sekampung and Rindingan Forests further emphasize the need for long-term biodiversity monitoring and conservation efforts in BPF. More targeted research should be carried out on Sumatran striped rabbits in BPF to determine population densities and shed light on the species' ecological needs. While KPH Batutegi's main role in BPF is to protect the watershed, following the rediscovery of Sumatran tigers in BPF in 2010 a long-term strategy for the conservation of the forest's biodiversity was developed. Over the last decade, KPH, supported by YIARI, has carried out regular patrols and other conservation initiatives to reduce illegal activities that threaten the core forest zones. Increased knowledge sharing and technical support from Indonesia's main conservation authority, the Ministry of Environment and Forestry (MoEF), would help bolster KPH's current conservation efforts and help to ensure BPF's biodiversity is preserved. The establishment of BPF as an Essential Ecosystem Area (*Kawasan Ekosistem Esensial*, or KEE) could bring additional support from the central government in its long-term management and regulation of protected species in the landscape [27].

Author Contributions

RH: Conceptualization, Methodology, Software, Writing – Review & Editing; **AS:** Conceptualization, Data collection, Software, Writing – Review & Editing; **KLS:** Conceptualization, Writing - Review & Editing; **RSM:** Conceptualization, Writing - Review & Editing; **DA:** Writing - Review & Editing

Conflicts of interest

There are no conflicts of interest to declare.

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