



# Assessing Anuran Diversity Using Leaf Litter Plot in a Tourism Object in Sumatera Barat, Indonesia

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**Abstract.** The wildlife monitoring survey is urgently conducted because they are currently facing many factors that may drive to extinction. The effective way in monitoring survey method is limitedly studied for tropical sumatran amphibian. The goal of the study is to examine the efficacy of plot technique in documenting the amphibian diversity in the forest leaf litter floor. We used 45 plots of  $4 \times 4$  m covering 720 m<sup>2</sup> of forest floor. The study site is a tourism object located in Sumatera Barat province, Indonesia. We found 11 species of frogs with the total of 20 individuals representing five families. The richest family was Microhylidae with five species while the highest number of individuals belong to *Bijurana nicobariensis* with five individuals. The leaf litter frogs' density was 2.8 and the diversity index was medium ( $H' = 2.2$ ). Each plot can be completed by two persons within 5–8 minutes. The species accumulation curve showed that no additional new species after 20 plots. For population studies or obtaining small litter frogs, we recommend smaller plot (16 m<sup>2</sup>) to be applied in the study area but preliminary study is pivotal step to ensure how many plot replications are needed.

**Keywords:** Diversity · Population · Anura · Quadrat

## 1 Introduction

Sumatra has a variety of habitats ranging from lowlands that have swamps and peatlands to highlands such as tropical rain forests, so that the organisms in it are also diverse. However, the actual level of biodiversity is highly underestimated. This is due to the weakness and lack of comprehensive field survey efforts [1]. One of the groups of animals that have received less attention are the amphibians (frogs and caecilians) and reptiles (snakes, lizards, turtles, crocodiles) [2]. For comparison, the number of frog species in Sumatra is 114 species while Borneo has 180 species, or only slightly different from West Malaysia (non-Borneo) (111 species) which is much smaller (4 times that of Sumatra Island) [3].

Surveys of amphibians and reptiles (herpetofauna) have been carried out on the island of Sumatra starting around 50–60 years ago, but the surveys were not extensive, inconsistent or only done sporadically [1]. At least the last 2 decades, more frequent and more extensive expeditions have been and are being carried out by many research groups in the world resulting in many discoveries of new species [4–19]. This number will continue to grow as an integrated taxonomic approach using various kinds of evidence is growing [20].

Especially in Sumatera Barat Province, herpetofauna has become the attention of many researchers. Inventories in this group have been carried out by Inger and Iskandar, 2005; Teynie et al, 2010; Nugraha et al., 2020 [21] and Nugraha et al. 2021 [22]. However, the vastness of the area and the diversity of existing habitats make exploration for inventory neither easy nor short. Iskandar and Inger, 2005 explored three areas: Payakumbuh, Padang and Limau Manis; Teynie et al, 2010 did so in the area around Lake Maninjau; Sumarmin et al., 2019 [23] conducted an inventory in the Timber Plantation area; Nugraha et al, 2020 did so in the Gunung Sago Natural Tourism Park area; and Nugraha et al, 2021 did so in the tourist area of the Lembah Anai Resort.

The exploration they carried out used the visual encounter survey (VES) method in which the researcher walked along an existing path. Although VES allowing researchers to cover a large area of survey, the limitation of the method is that the density data cannot be analyzed. This is because there is no exact size of survey area that is explored by the researcher while density analysis needs the exact size. In addition, the weakness of this method is that repeated surveys cannot be carried out consistently. If a researcher wants to survey the same area several years after the first survey, then there is absolutely no way to get comparable data. This is due to the absence of clear survey area boundaries or measured areas [24], so that monitoring of the population/community as a conservation effort cannot be carried out.

In this study we used area-based survey, plot, that was laid on the forest litter floor. We aim to analyze the diversity index, to know the maximum effort in which there is no additional new species to the list and to analyze the density. The comparison is mainly referred to the works from tropical African country and South America.

## 2 Materials and Methods

### 2.1 Survey Site and Data Collection

The study site was located in the province of Sumatera Barat, Indonesia. The location is a tourism object that has been maintaining the forest (latitude 0° 25' 41.7" N, 100° 18' 56.124" E, elevation 612 meter above sea level - masl). The ambient temperature ranging from 23–21°C and the humidity of 90%. The survey was conducted during two consecutive nights in October 2021 starting from 08.00 pm until the end of the defined plots.

We installed 45 plots of 4m x 4m for each plot on the forest floor and the plots were separated five meters each other. The plot was set about 20 m away from the nearest stream. The floor contained leaf litter and grass. We used plastic string to mark the plot boundaries. Each plot was searched by 2 persons spending about 5–8 minutes to complete the careful searching. Due to disturbance on the habitat resulted from the searching, we

surveyed each plot without repetition. Once the individuals were seen, we capture it and get it into the transparent plastic bag to avoid counting the same individuals. Photograph was taken in the following morning and the frogs were released back to their natural habitat after documentation.

## 2.2 Data Analysis

We recorded species and individual number in each plot. The species identification was based on published articles e.g. Atmaja et al. (2019), Garg et al. (2019) [25], Zug (2015) [26]. The species accumulation curve was constructed using Microsoft Excel by calculating number of species in each plot and defining the accumulative species.

## 3 Results and Discussion

### 3.1 Results

The total area surveyed was 720 m<sup>2</sup>. We recorded 11 species representing five families (Table 1) and the total number of individuals were 20. The highest individual number was made up by *Bijurana nicobariensis* (n = 5) followed by *Microhyla superciliaris* (n = 3). The richest family was Microhylidae containing 5 species. The number of anuran species and individual number per plot ranged from 0 to 2. Twenty seven plots has not contained the frog representing 60% of the total. The total anuran density estimated was 2.8 per 100 m<sup>2</sup>. The Shannon-Wiener diversity index was 2.2.

Each plot was completed by two persons for approximately 5-8 minutes. The species accumulation curve showed that in the first 19 plots the number of species increased markedly. In the following effort, the curve hovered at 11 cumulative species (Fig. 1).

### 3.2 Discussion

Visual encounter survey (VES) is an effective way to make a rapid list of amphibian species and to survey many habitat types in one study [24]. However, small leaf litter frogs on the forest floor are often missed when surveyed using VES. Our field survey in the previous year using the VES method [22] only found three species that are usually found in forest litter floor (*Kalophrynus*, *Megophrys* and *Leptobrachium*) while in this study we found 11 species. There were 4 species from this study which were also found by the VES method on the forest floor, while the remaining species were only found in this study. The same species are *L. borbonica*, *K. pleurostigma*, *S. cf. malayana* and *M. nasuta*. Generally, species found only by this plot method are species with small body size such as *Microhyla*, *Kalophrynus*, *L. microdiscus*. This result is also in line with [27] who proved that a survey using a small plot of 2 m x 1 m found a group of frogs with a smaller size than using a larger plot of 64 m<sup>2</sup>.

The use of litter plots has been examined by several researchers. If compared with [27] in Brazil, this study found more number of species even though this study was conducted in a tourist area (11 species vs 9 species using 64 m<sup>2</sup> quadrat and vs 8 species using 2 m<sup>2</sup>). Meanwhile, when compared with the research of [28] in eastern Africa,

**Table 1.** The list of the species found in all plots and the value of the density

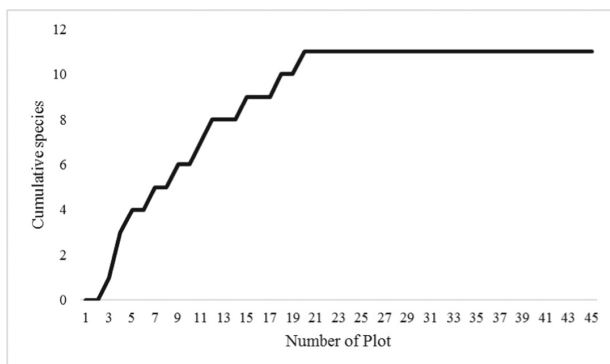
Species	Individual number	Density/100 m <sup>2</sup>
<b>Bufonidae</b>		
<i>Leptophryne borbonica</i>	1	0,1
<b>Dicroglossidae</b>		
<i>Limnonectes microdisucs</i>	1	0,1
<i>Occidozyga lima</i>	1	0,1
<b>Megophryidae</b>		
<i>Megophrys nasuta</i>	2	0,3
<b>Microhylidae</b>		
<i>Kalophrynus minusculus</i>	1	0,1
<i>Kalophrynus pleurostigma</i>	2	0,3
<i>Kalophrynus</i> sp.	1	0,1
<i>Microhyla gadjahnadai</i>	2	0,3
<i>Microhyla superciliaris</i>	3	0,4
<b>Ranidae</b>		
<i>Bijurana nicobariensis</i>	5	0,7
<i>Sylvirana</i> cf. <i>malayana</i>	1	0,1
<b>Total individuals</b>	20	2,8

this study also found a higher number of species (11 vs 10 species using 25 m<sup>2</sup>). The research of Siquiera et al. (2007) in the Atlantic rainforest using 25 plots of 25 m<sup>2</sup> (total area = 625 m<sup>2</sup>) found seven species of frog and research by [29] used 28 plots of 25 m<sup>2</sup> obtained 8 species. The comparison clearly indicated that small plot was powerfull to detect leaf litter frog in Sumatera Barat and most likely could be applied throughout Sumatera island.

Anuran species diversity index at the study site is classified as medium, higher than the results of [28] study in three habitat types and in two seasons in each habitat; and [27] using either large or small plots. Regarding the density, our results showed significantly lower than [27] (vs 40.6/ 100 m<sup>2</sup> using small plots and 5.8/100 m<sup>2</sup> using bigger plots) but slightly higher than [28] (vs 1.6/100 m<sup>2</sup>).

Based on our accumulation curve, we recommend to apply 20–30 plots to survey the leaf litter frog populations. Our study showed that after 20 plots, no additional new species included in the list. However, we believe that the preliminary study is crucial to every studies to match with the geographical or habitat condition in the study area and once it is completed the number plot replication needed can be determined.

Based on our study and previous studies [27, 28], we recommend smaller plot (16 m<sup>2</sup>) than the bigger than that. Smaller plots can be installed and surveyed by two persons and can be completed within 5–8 min. If the research would be conducted, the researchers can allocate 2 hours per night by two persons to complete 15 plots in an area of study. Our



**Fig. 1.** Cumulative species

recommendation is provided for those who keen on studying the fluctuation of leaf litter frog populations or to obtained more number of smaller litter frogs such as *Microhyla* or *Kalophrynus*. We also recommend to implement plot for a minimum of 19 times to document the species composition in the study area.

## 4 Conclusion

A total 11 species of frogs from five families was collected. The richest family was Microhylidae with five species while the highest number of individuals belong to *Bijurana nicobariensis* with five individuals. The leaf litter frogs' density was 2.8 and the diversity index was medium ( $H' = 2.2$ ). Anuran species diversity index at the study site is classified as medium.

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