The effect of anthropogenic noise on Sumatran Elephant’s anti-predator behavior in the Elephant Conservation Center

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Abstract. The increase of human activity around forest area causes noise anthropogenic effect to animals. This long-term effect can lead to decrease behavior and impact on species composition and inter-species interactions. Sumatran Elephants are classified as endangered animal. This study aims to determine the effect of noise on the Sumatran elephant’s anti-predator behavior and the difference in behavioral response based on the difference noise exposure time. The observation was conducted to Sumatran Elephants in Elephant Conservation Center Saree, Aceh Besar District. Observation method was animal focal sampling technique. The data was analyzed using the chi square test with a significant level of 5%. Based on the results of the chi-square test, the value of sig is 0.00 or smaller than 0.05, indicate that there is an effect of noise toward anti-predator behavior. The observed Sumatran elephants also look more responsive to the noise that is sounded in the morning. Noise can interfere with prey perceptions of predators and correlate with increased energy use.

1. Introduction
The increase of human activity around forest area and exploration activities cause noise anthropogenic effects to animals in forest [1]. Noise comes from industrial, construction, traffic, and logging activities. These activities are assumed to disrupt the safety and comfort of animals because they produce high-intensity sounds in using of heavy equipment [2]. Continuous noise for long term effect will significantly change habitat conditions and also trigger biological responses, physiological stresses and changes in animal behavior [3]. Decreasing behavior due to noise is predicted to occur in behaviors that utilize natural signals such as finding partners, as well as routine behavior including species interactions, foraging, and anti-predator behavior.

Anti-predator behavior is an important survival response in predator-prey conditions. Increased noise levels can affect the perception of threats to prey. Conversely, prey can increase awareness where this behavior increases energy use. Noise can act as a stressor and can cause changes in activity and movement patterns. So far research that focuses on the relationship of noise to behavior change is still rare [4].

Sumatran elephants are critically endangered species in the red list of endangered species issued by the World Conservation Institute (IUCN). In Indonesia, this wild animal is protected under the government regulation. Elephants are very sensitive to sounds. Elephants can hear sounds in the frequency range of 1-20.000 Hz with a distance of 10 km of hearing. Absolutely, increasing of human
activity around elephant habitat causes noise effects that result in a decrease of quality and quantity of elephant habitat that can be impacted to population decline [5].

Several studies have been conducted to see the effect of noise on animal behavior and physiology, but so far research on the effect of noise on animals in conservation areas or animals that have been domesticated is lack. This study aims to determine the effect of noise on the Sumatran Elephant's anti-predatory behavior and differences in behavior response based on differences in noise exposure time.

2. Methods

2.1 Study Site
This research was conducted at the Elephant Saree Conservation Center in Sukamulia Village, Mukim Saree, Lembah Seulawah District, Aceh Besar District. The study was conducted in May-June 2018.

2.2 Noise Measurement
This study used three types of sound as noise; (1) ax for cutting wood, (2) motorcycle, and (3) chainsaw. The three sounds recorded using voice recorder then edited using Audacity program and measured the intensity using sound level meter. Sound recordings are converted into graphs (Figure 1). The recordings are played back using portable loudspeakers.

![Figure 1. Noise intensity](image)

2.3 Behavior Observation and Data Analysis
The Observation of Elephant behavior uses focal animal sampling techniques. The object of this research was two female Sumatran Elephants. Each noise was played for 5 minutes, the distance between the noise and the elephant was 15 meters, intervals of noise were 10 minutes [6]. Observations were carried out for 5 minutes toward four behavioral criteria; alert, fear, stress and aggression. ‘Alert’ was characterized as gaze fixedly at tourists, or adopt a guarding position. ‘Fear’ was defined as run away from the tourists. ‘Stress’ was when elephants flap ears fast, toss soil, repetitively sway the head and shoulders, even the whole body from side to side while standing in one place or circling. ‘Aggression’ was defined as run towards the tourist vehicle/s, attack tourists or tourist vehicles.

Observations were carried out for 5 days intermittently with 3 repetitions in each day (morning, noon, afternoon). Data were analyzed by the Chi Square statistical test using the SPSS version 17.0, while the data of differences in noise exposure time was explained descriptively.
3. Result and Discussion

The noise, from axes, motorbikes and chainsaws, has effect on the anti-predatory behavior of Sumatran Elephants. It can be inferred from the results of chi square test with a significant value of 0.000 or smaller than 0.05. In a previous study [6] which examined the effects of anthropogenic noise in the presence of humans and motorized vehicles on elephant behavior also showed correlation between anthropogenic noise and anti-predatory behavior.

The results of the observations for noise at different times are shown in Figure 2 (morning), Figure 3 (daytime) and Figure 4 (evening). Alert and fear were showed in all three periods of noise exposure.

| Table 1. Chi Square Test         | Value   | df | Asymp. Sig. (2-sided) |
|---------------------------------|---------|----|-----------------------|
| Pearson Chi-Square              | 30.844a | 6  | .000                  |
| Likelihood Ratio                | 33.379  | 6  | .000                  |
| Linear-by-Linear Association    | 14.939  | 1  | .000                  |
| N of Valid Cases                | 90      |    |                       |

**Figure 2.** Anti-predator response to noise in the morning
Figure 3. Anti-predator response to noise in the noon

Figure 4. Anti-predator response to noise in the evening

Alert is the initial response to disturbances, animals will show different alertness responses among species. In general, the alertness behavior is indicated if animal focus on the source of the disturbance. Based on the observation, the two elephants stopped doing their activities and turned to the noise source once they heard. This condition was observed at the first and second day. In the next observation, elephants did not stop their activities but still showed alert behavior by directing the ear towards the noise. Correlated to Alger's, 1984 in [7] study that examined the effect of noise on calf behavior where after hearing noise, the direction of calf standing began to be oriented towards the noise. Furthermore, [8] state that in the area of conservation or captivity, the behavior of adult animals
is strongly influenced by noise. Noise increases with increasing visitors, and this correlates with increased alertness behavior.

Elephants also showed fear behavior afterward alertness, the alert behavior starts from the noise being sounded until 1 minute later, after that the elephant started to walk away from the noise source. The elephants will choose a closed area, for instance; between bushes and trees. [7] mentions that mammals will react to sudden high-intensity noise, with responses including escape from noises sources. Elephants which have been in a safe position will continue their activities while still directing their ears towards the noise. However the percentage of stress behavior was only shown by individuals 1 (4.16%) due to motorbikes noise. Certainly, alertness and fear behavior can trigger to a stressor for animals if continuously experienced [8] state that noise is one of the causes of stress experienced by animals in captivity.

The Sumatran elephants did not show aggressive behavior. Based on the interview to mahout (elephant handler). Generally, aggressive behavior on elephants in Saroo Conservation Center will arise when meeting new people. For instance visitors who stand with a distance of 1-2 meters from an elephant without any mahout escort, elephants will usually show aggressive behavior by attacking visitor. Response to noise by both Sumatran elephants specifically has differences, correlated to [7] which states that the reaction rate of animals to noise is different from animal species, age and individuals. Individuals 1 have a response to noise faster and more reactive to motorcycle noise than individuals 2. This can be caused by differences in the history of sound exposure between the two individuals. [8] states that the level of disruption of noise in individuals depends on psychology and history of noise exposure. Noise with the same intensity can trigger a rapid response in one individual while in another individual can last longer.

“Fear” behavior has the highest percentage in the morning. According to previous research [6] states that elephants will show a high response to disturbance in the morning than the other time. Animals are also reported to tend to be more active in the morning period than in the afternoon period, this is related to the increase in the general noise level in the morning [9].

In relation to anti-predator behavior in nature, the emergence of noise can affect the predator's orientation towards prey. On the other hand, prey will consume a lot of energy and experience a decrease in daily activity due to an increased sense of alertness. Basically the emergence of disturbance will certainly affect the daily activities of the animal. [10] states that antrophogenic activities which also produce noise cause animals to be confuse between avoiding the risk of perceived threats or continuing their daily activities such as eating and reproduction. So that noise at certain times can cause a different response depending on the animal's daily activity.

4. Conclusion
Increasing of antrophogenic activity by humans produce high level of noise. Noise can cause changes in animal behavior. In Indonesia, the impact of noise on the survival of a species has not been a major focus in conservation strategies, because the effects arising from noise are long-term effects, differ from other threats such as poaching, conflicts between animals and humans, and habitat degradation can directly reduce the number of animal populations drastically in a shorter period. However, the effects of noise cannot be ignored because it will be impacted to the success of conservation.

In the animal conversation area, noise must be considered carefully. The presence of visitor, motorized vehicles, and other voices from around area contributed significant noise which had an impact on the welfare of animals in captivity. Basically, animals in captivity will habituate to new environments, but the length and the success of the habituation process cannot be predicted correctly. In conclusion, providing conservation areas is better conditioned as close as possible to the natural habitat conditions.
5. References

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