

Noisy neighbors: Slow loris response to anthropogenic noise disturbance in West Java, Indonesia

KATHERINE J. KLING,¹ Francis Cabana² and K.A.I. Nekaris^{3,4}



¹Stony Brook University, Stony Brook, NY, USA; ²Oxford Brookes University, Oxford, Oxfordshire, UK; ³Nocturnal Primate Research Group, Oxford Brookes University, Oxford, Oxfordshire, UK; ⁴Little Fireface Project, Cisarupan, Garut, Jawa Barat

Fig 4. Researchers are permitted to observe at no closer than 3 meters to loris (K. Kling)



Fig. 3. Javan slow loris (*Nycticebus javanicus*) exhibit eyeshine which aids in determining alert behavior (K. Kling)

Introduction

- Anthropogenic disturbance measures are increasingly incorporated into studies of animal behavior, especially among primates [1, 2]. However, anthropogenic noise, which can often be the first indication of human influence on an environment [3], is seldom considered [4].
- Noise pollution masks sounds relevant to animal species [5]. The risk disturbance hypothesis also predicts that anthropogenic noise will result in increased antipredator activities (e.g. vigilance) and decreased foraging [6].
- Intermittent or unpredictable noises are more often perceived as a threat than more continual sounds [4].
- Anthropogenic noise elicits varied responses from animal species, including increased vigilance [6] and glucocorticoid levels [7] and area avoidance [8].
- Lorises are nocturnal and arboreal [9]. They exhibit a larger audible frequency range than humans [10] and utilize distinct vocalizations among individuals [11]. Recent studies in the USA show that typical anthropogenic noise levels exceed natural ambient sounds even in remote areas [5]: this trend may be expected in many loris ranges in Java due to its rapidly expanding human population [12].

Study Objectives

1. Test noise collection as a means of assessing anthropogenic disturbance alongside behavioral data collection.
2. Test the influence of anthropogenic noise disturbance on Javan slow loris (*Nycticebus javanicus*).
3. Determine whether other noise factors, such as duration, intensity or co-occurrence influence loris response.

Methods

- Noise instances were recorded alongside behavioral data collection of Javan slow loris (n = 13) in Cipaganti, West Java, Indonesia for a total of 100.5 hours (Shift 1: 64.75 hours; Shift 2: 35.75 hours) from September to October 2014: 936 instances were recorded.
- Noise type (e.g. dog, owl, human conversation) were recorded for each instance as well as noise duration (1-3), intensity (1-3), and co-occurrence.
 - **Duration**—a score of “1” was given to exclamatory noises; “2” for intermittent sounds and; “3” for continual.
 - **Exclamatory**—noise occurs in isolation (<5 seconds long)
 - **Intermittent**—same noise type occurs with 15-60 second breaks; noise must be identifiable from same location
 - **Continual**—noise type continues with <15 second breaks
 - **Intensity**—scores “1,” “2,” and “3” indicate relative volume levels.
 - **Co-Occurrence**—presence of any other noises (excluding ambient noise—e.g. wind, insects) was recorded as a binary (0 or 1)
- Loris behavior (from standard behavioral ethogram used at site) was recorded upon instigation of each noise instance (e.g. feeding, resting, alert).
 - Distinction was made between loris general alert behavior and alert behavior *in the direction of the noise instance*. Only latter were used to indicate loris response to noise.
- Relationships between noise categories and loris response were tested with a Fisher’s exact test.
 - α value of 0.05 was used for the planned anthropogenic noise comparisons.
 - α value of 0.0071 (using Bonferroni correction) was applied to all post hoc analyses.

Results

- On average, 9.3 noise instances occurred per hour of observation, 43.0% were Volume “3” and 18.0% were exclamatory.

Anthropogenic Noise Types

- Anthropogenic noise accounted for 87.9% of all noise instances (Table 1).
 - Most common noise types were motorcycles (37.7%) and dogs (16.3%).
 - Researcher noise accounted for 5.9% of all noise instances.

Noise timing

- Percentage of noise instances per shift for a given 15 minutes showed strong variation (total average: 4.3% +/- 1.9%) but did not follow an obvious pattern (Figure 1, Figure 2).
 - Shift 1: The highest average percentage of noise instances per 15 minutes for a given hour occurred between 18:00-20:00 (Figure 1).
 - Shift 2: The highest average percentage of noise instances per 15 minutes for a given hour occurred between 0:00-1:00 (Figure 2).

Table 1. Noise type and percent of given noise type instances per total noise instances. Non-anthropogenic noise indicated by (*).

Noise Type	% of total noise instances	Noise Type	% of total noise instances
Motorcycle	37.7%	Owls*	5.2%
Dogs	16.3%	Stereo music	4.1%
Leaf litter (movement)	13.4%	Human communication (non-researcher)	2.9%
Native Birds*	7.0%	Water sprinkler	0.97%
Domestic animals (non-dog)	6.0%	Fireworks	0.32%
Researcher noise	5.9%	Tin scarecrow	0.11%

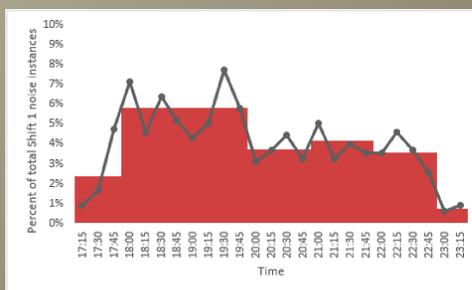


Figure 1. Shift 1 times (17:15-23:30) and percent of total Shift 1 noise instances as delineated by 15-minute increments. Line graph indicates % noise instances for a given 15 minutes. Bar graph indicates average % noise instances for a given hour (e.g. 17:00-18:00)

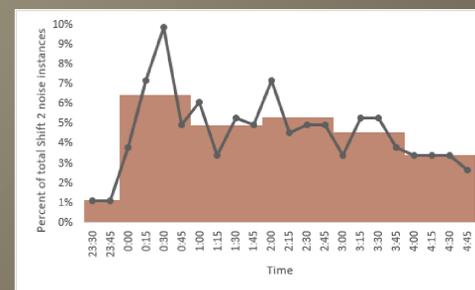


Figure 2. Shift 2 times (23:30-5:00) and percent of total Shift 2 noise instances as delineated by 15-minute increments. Line graph indicates % noise instances for a given 15 minutes. Bar graph indicates average % noise instances for a given hour (e.g. 0:00-1:00)

Anthropogenic Noise Response (Table 2)

- Lorises were found to respond significantly more to anthropogenic noise than non-anthropogenic noise ($p = 0.047$).
- This result was not significant when noises generated by the researchers were removed from analysis ($p = 0.56$).

Intensity of Noise Response (Table 2)

- Lorises were found to respond significantly more to Volume “3” noises than all others ($p = 0.0002$) and to respond significantly less to Volume “1” noises than all others ($p = 0.0044$).

Duration and Co-Occurrence Noise Response (Table 2)

- Lorises were not found to respond significantly more to noises of any duration category or to co-occurring noises.

Table 2. Relationship between loris response and anthropogenic, duration, intensity and co-occurrence noise categories. All p-values found using Fisher’s Exact. Note different α values for planned comparison v. post hoc analyses (See Methods). All significant p-values are bolded.

	Test Question	p-value (α value)
Anthropogenic Tests	Do lorises respond more to anthropogenic noises than non-anthropogenic noises?	0.047 (0.05)
	Do lorises respond more to anthropogenic noises than non-anthropogenic noises when researcher noises are removed?	0.56 (0.05)
Duration Tests	Do lorises respond more to exclamatory noises than all other durations?	0.19 (0.0071)
	Do lorises respond more to intermittent noises than all other durations?	0.073 (0.0071)
	Do lorises respond more to persistent noises than all other durations?	1.0 (0.0071)
Intensity Tests	Do lorises respond less to Volume “1” noises than all other intensities?	0.0044 (0.0071)
	Do lorises respond more to Volume “2” noises than all other intensities?	0.21 (0.0071)
	Do lorises respond more to Volume “3” noises than all other intensities?	0.0002 (0.0071)
Co-Occurrence Test	Do lorises respond to co-occurring noises more than isolated noises?	0.036 (0.0071)

Conclusions

- **Anthropogenic noise:** anthropogenic noises were found to have a significant ‘alert response’ from lorises: this could have a negative impact on forging efficiency.
- **Researcher influence:** Due to its effect on loris response to anthropogenic noise, strong consideration should be paid to researcher influence on focal animal behavior [13, 14].
- **Noise intensity:** Noise volume was shown to strongly influence loris response. Further exploration would yield stronger, more objective techniques.
- **Noise habituation:** Animal habituation to anthropogenic noise may explain overall lack of significance across varying duration types and co-occurrences [15]. Further research would elucidate whether habituation to noise correlates with species-tolerance toward human disturbance.
- **Future Directions:** Further research is needed to determine whether any concurrent variables beyond noise may be influencing results [5] and to provide a spatial element [16] to anthropogenic noise’s reach.
- This study suggests the value of noise collection alongside behavioral data collection as a cost-efficient strategy for both 1) assessing and indexing the extent and means of human disturbance within a conservation context and 2) providing an extrasensory perspective on animal environments that extends beyond a visual outlook.

Figure 5 (left). A busy street in Surabaya, Indonesia: anthropogenic noise originating from cities and villages can include input from large human populations and busy traffic. (K. Kling); Figure 6 (right). A motorcycle < 1 km from loris habitat, Cipaganti, Indonesia: anthropogenic noise is not restricted to cities and may occur very near animal habitats (K. Kling).



Works Cited

1. Benichou, M., & Peres, C. (2013). Anthropogenic modulators of species-area relationships in Neotropical primates: a continental-scale analysis of fragmented forest landscapes. *Diver & Dist* 19, 1339-1352.
2. Bubblitz, D., Wright, P., Rasambainarivo, F., Arrigo-Nelson, S., Boadager, J., & Gillespie, T. (2015). Pathogenic Enterobacteria in Lemurs Associated with Anthropogenic Disturbance. *Am J Primatol* 77, 330-337.
3. Laio, P. (2010). The emerging significance of bioacoustics in animal species conservation. *Bio Con* 143, 1635-1645.
4. Francis, C., & Barber, J. (2013). A framework for understanding noise impacts on wildlife: an urgent conservation priority. *Front Ecol & Environ* 11, 305-313.
5. Barber, J., Crooks, K., & Fristrup, K. (2010). The costs of chronic noise exposure for terrestrial organisms. *Trends Ecol & Evol* 25, 180-189.
6. Shannon, G., Angeloni, L., Witemyer, G., Fristrup, K., & Crooks, K. (2014). Road traffic noise modifies behaviour of a keystone species. *Animal Behav* 94, 135-141.
7. Bickley, J., & Paivcelli, G. (2012). Potential acoustic masking of Greater Sage-Grouse (*Centrocercus urophasianus*) display components by chronic industrial noise. *Ornith Mono* 74, 23-35.
8. McClure, C., Ware, H., Carlisle, J., Kallenecker, G., & JR, B. (2013). An experimental investigation into the effects of traffic noise on distributions of birds: avoiding the phantom road. *Proc Royal Soc B* 280, 20132290.
9. Nekaris, K., & Starr, C. (2015). Conservation and ecology of the neglected slow loris: priorities and prospects. *En Spec Res* 28, 87-95.
10. Hefner, H., & Masterson, B. (1970). Hearing in primitive primates: slow loris (*Nycticebus coucang*) and potto (*Perodicticus potto*). *J Comp & Phys Psych* 71, 175-182.
11. Diechbach, N., Schein, M., & Haines, D. (1981). Vocalizations of the Slow Loris (*Nycticebus coucang*) (Primates, Lorisidae). *Int J Primatol* 2, 71-80.
12. The World Bank. World Development Indicators. (2015, October 3). *Population, Population growth (annual %) of Indonesia* [Data Set]. Retrieved from <http://databank.worldbank.org/data/>
13. Jack, K., Lenz, B., Healan, E., Rudman, S., School, V., & Fedigan, L. (2008). The Effects of Observer Presence on the Behavior of *Cebus capucinus* in Costa Rica. *Am J Primatol* 70, 490-494.
14. Blom, A., Cioletta, C., Brunsting, A., & Prins, H. (2004). Behavioral responses of gorillas to habituation in the Dzanga-Ndoki National Park, Central African Republic. *Int J Primatol* 25, 179-196.
15. Kight, C., & Swaddle, J. (2011). How and why environmental noise impacts animals: an integrative, mechanistic review. *Ecol Lett* 14, 1052-1061.
16. Gill, S., Job, J., Myers, K., Naghshineh, K., & Vonhof, M. (2015). Toward a broader characterization of anthropogenic noise and its effects on wildlife. *Behav Ecol* 26, 328-333.