Birds activities at urban greenways in Bogor

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Abstract. Greenway is one of available habitats for birds in Bogor. Birds that occupied greenways are more susceptible to traffic noise disturbance because birds use acoustic signals to communicate. This research aims to identify noise levels and bird activities in four Bogor greenways with different traffic frequencies. Four greenways observed in this research were Jalan Ahmad Yani, Jalan Paledang, Jalan Semeru and Jalan Tentara Pelajar. Methods used in this research were measuring noise with sound level meter, and O’Donnell and Dilk’s five-one minute observation on birds. The result showed that Jalan Semeru had the highest noise value. Foraging activities, singing, and perching had lower frequencies in the noisiest greenway, while breeding activities was never recorded.

Keywords: birds, greenways, noise levels

1. Introduction
Cities have potentials as habitat for birds in urban areas. Vegetation in urban green open spaces provides food, resting and nesting sites for birds. Greenways are among the types of urban green spaces suitable for bird habitats [5], however this type of habitat is not free from disturbance. Urban greenways are located adjacent to road; therefore noise from traffic is a major disturbance for birds. Noise in urban areas can be generated by industrial activities, traffic, markets, schools, and others. Some studies suggest that noise generated by traffic is higher than those generated by other factors such as schools [20] and settlement [12].

Birds that utilize greenway habitats might be disturbed by noise that comes from the traffic because birds use acoustic signals to communicate. Lower number of bird species in greenways compared to those in city parks due to higher level of noise had been reported, and it was suggested that birds may avoid the dangers that exist on the habitat adjacent to the road [5]. Bogor has a variation of greenways that are occupied by birds. Some of the greenways were located along arterial roads that are passed by vehicles more frequently than other road types; therefore the levels of noise pollution in those greenways might be higher. This study examined noise levels at different types of greenways and their effect on the activities of birds. This study is important because research related to noise and its impact to bird, especially in Indonesia, is still lacking.

2. Methods

2.1. Study area
A preliminary survey at 8 greenways of Bogor City was done to select study sites (Table 1). The criteria used to determine study site include traffic condition (heavy and light traffic), vegetation...
(composition, structure and density), and road characteristics. Heavy and light traffic conditions were determined by the numbers of motor bikes in each lane per 30 minutes. The motor bikes were chosen as reference because they pass more continuously compared to cars. Information on the number of passing vehicles at each location was obtained by counting vehicles manually. The calculation was carried out to obtain the average number of vehicles on the congested lanes traversed by >1000 units per 30 minutes, while the deserted lanes traversed by <1000 units per 30 minutes.

Greenway vegetation characteristics chosen were those with relatively similar structure and density, and the species composition of vegetation were diverse. Road characteristics include length (>1 km), no median, and roads whose noise comes mainly from traffic. Based on the survey greenways selected were Jalan Semeru, Jalan Paledang, Jalan Ahmad Yani and Jalan Tentara Pelajar. Jalan Semeru and Jalan Paledang were traversed by >1000 units of motor bike per 30 minutes while Jalan Ahmad Yani and Jalan Tentara Pelajar were the opposite.

### Table 1. Road length and number of passing vehicles at study sites

| Location/Street | Length (m)* | Vegetation | Number of Vehicles/30 minutes | 2-wheel (unit) | ≥4-wheel (unit) |
|-----------------|-------------|------------|-------------------------------|---------------|-----------------|
| Semeru          | 2075        | Dense      |                               | 1808          | 764             |
| Paledang        | 1041        | Dense      |                               | 1452          | 540             |
| Ciremai Ujung   | 1650        | Dense      |                               | 98            | 54              |
| Lawang Gintung  | 1004        | Dense      |                               | 880           | 596             |
| Batu Tulis      | 1761        | Sparse     |                               | 1272          | 672             |
| RE Martadinata  | 1060        | Sparse     |                               | 1560          | 548             |
| Tentara Pelajar | 1392        | Dense      |                               | 780           | 332             |
| Ahmad Yani      | 2111        | Dense      |                               | 794           | 426             |

*Source: Bogor Public Work Office 2017

2.2. Equipment

Equipment used in this study was sound level meter LT Lutron SL-4012 for noise measuring, binoculars Nikon Aculon A211 16x50, camera Nikon CoolPix L840, and bird observation field guidebook [10].

2.3. Sites and observation times

This research was conducted at Jalan Ahmad Yani, Jalan Tentara Pelajar, Jalan Semeru and Jalan Paledang, Kota Bogor. The data collected in April 2017. The observations were conducted in the morning at 6:00 to 09:00 am and afternoon from 3:00 to 18:00 pm, based on the time of peak activities. Observations were made on weekdays and only during clear weather.

2.4. Noise measurements

Noise measurements were carried out in accordance to the Decree of the State Minister for The Environment No.Kep-48/MENLH/11/1996. The measurement was done for 10 minutes in each measurement, taken in the morning and afternoon. The noise level was measured at three points in the observation path that was at the point 0 km, 0.5 km and 1 km.

Measurement of noise is done at two altitudes at each point i.e at an altitude of 0.5 m (below) and 3-5 m (above). The height of 0.5 m is chosen because it is adjusted to the height of the vehicle, while the height of 3-5 m represents the mean of free height of tree branches in all locations. The resulting noise value was the result of morning and afternoon measurements at 3 points on each road, where each point has 2 altitude locations, so that 12 noise measurements per day is done. Two Sound Level Meters were used in order to measure the noise value at two different heights at the same time.
2.5. Bird activities
Bird observation was conducted using the five-one minute observation method [13]. The observer walked slowly along the 1 km transects while recording bird activity seen, and follow it for one minute. If the bird could be followed, four further observations were made for one minute, giving a maximum of five observations per bird. The parameters recorded were bird species, number of individuals, activities (Table 2), time used to perform the activity, and substrate. Individual bird was recorded when birds use the trees within the greenway. Any bird that just flew over the greenway was not recorded. Species belonging to Apodidae family was not considered in the analysis because they always fly above the trees and never perched.

| Activities         | Description                                                                 |
|--------------------|-----------------------------------------------------------------------------|
| Calling and Singing| Chirp a note or a full song                                                  |
| Breeding           | Calls to attract a partner, mating, courtship; bring materials to the nest or when inside the nest |
| Interaction        | Interspecific and intraspecific interaction                                |
| Perching           | Steady, looking around                                                      |
| Locomotion         | Move from one substrate to another substrate                               |
| Resting            | Bath, drinking, excretion, browse                                           |
| Feeding (on vegetation) | Searching and taking food from the substrate of vegetation            |
| Feeding (on the ground) | Searching for food from the ground                                         |

2.6. Data analysis

2.6.1. Bird activities
Data on observation of birds in the morning and afternoon were analyzed separately to examine whether there is any effect of time. Frequency of activities is described as a histogram. Analysis was only conducted for individuals that were recorded more than three times during the overall observations. The frequency of bird activity was calculated using the following formula:

\[
\text{Frequency of activity (\%) = \frac{\text{Number of each activity at one period in each location}}{\text{Sum of all activities at all locations}}}
\]

2.6.2. Statistical analysis
Mann-Whitney test was used to examine the difference between the average noise value of each location with heavy and light traffic. To examine whether there is any difference in bird activities among different noise level the Chi-Square test was used.

3. Results and Discussion

3.1. Noise level
Noise value at Jalan Semeru was the highest of all locations, while the lowest was at Jalan Paledang (Figure 1). ; but the value of heavy and light traffic noise has no significant difference (U test = 0.88; \(p> 0.05\)). This can be caused by the small number of samples.
3.2. Bird activities

Species that were recorded more than three times during the observation, thus were analyzed for its activities, were Spotted-dove (*Streptopelia chinensis*), Sooty-headed Bulbul (*Pycnonotus aurigaster*), Yellow-vented Bulbul (*Pycnonotus goiavier*), Olive-backed Tailorbird (*Orthotomus sepium*), Scarlet-headed Flowerpecker (*Dicaeum trochileum*), Oriental White-eye (*Zosterops palpebrosus*), Javan Munia (*Lonchura leu gastroides*), and Eurasian Tree Sparrow (*Passer montanus*).

3.2.1. *Spotted-dove* (*Streptopelia chinensis*)

Spotted-dove often used trees within the greenway for locomotion (figure 2). Its activities were more performed in the morning. Spotted-dove was most prevalent in Jalan Ahmad Yani and Jalan Semeru. The species was usually seen inside a lush canopy, and never seen on the ground, while usually the Spotted-dove often seen on the ground, looking for food [10]. Spotted-dove in this study seemed to avoid roadways due to traffic or human disturbances. Spotted dove using higher strata in urban area to avoid human disturbances was also reported in Lampung [15].

3.2.2. *Sooty-headed Bulbul* (*Pycnonotus aurigaster*)

Sooty-headed Bulbul was a dominant species at Jalan Ahmad Yani, Jalan Paleledang and Jalan Semeru. Its activities were more performed in the morning. This species was observed doing all daily activities...
except for feeding on the ground. Feeding activities were mostly performed at Jalan Paledang which
the noise level was the lowest (figure 3). Perching was the most common activities performed by this
species, with the least were recorded at Jalan Semeru. It can be caused by this species’ intolerance to
exposing to noise for a long period. However, the presence of Sooty-headed Bulbul in Jalan Semeru
was less frequent compared to those in the three other locations.

Figure 3. Frequency of activities of Sooty-headed Bulbul; (M: morning; A: afternoon)

3.2.3. Yellow-vented Bulbul (*Pycnonotus goiavier*)
The most frequent activities of Yellow-vented Bulbul was feeding on vegetation and perching (Figure 4).
Its activities were more performed in the morning. Variety of its activities was higher at Jalan Paledang.
The frequency of activities was lower in Jalan Semeru which had the highest noise level. In
addition, factors such as illegal hunting suspected to be the cause of the low occurrence of Yellow-
vented Bulbul in Jalan Semeru. Yellow-vented Bulbul was one of the most widely sold birds in Jakarta
after Oriental White-eye [2].

Figure 4. Frequency of activities of Yellow-vented Bulbul; (M: morning; A: afternoon)
3.2.4. Olive-backed Tailorbird (*Orthotomus sepium*)
This species rarely recorded at Jalan Semeru, but it was quite often observed with various activities in the three other sites. Its activities were more performed in the morning. This species was recorded foraging only at Jalan Ahmad Yani and Jalan Tentara Pelajar (Figure 5). Frequent activities were calling and singing. These birds were more often found in pairs, although no breeding activity was ever recorded. Some species of birds were found in the greenway only to perform foraging activity but do not breed [5]. It can be influenced by the needs of the area to breed which should be wider than the greenway. Singing was less frequent at Jalan Semeru. Birds used song to attract a partner, limiting the territory from competitors, communication between individuals in a group, calls from chicks to the parents, and warning of the dangers of predators that lurk [3].

![Figure 5. Frequency of activities of Olive-backed Tailorbird; (M: morning; A: afternoon)](image)

3.2.5. Scarlet-headed Flowerpecker (*Dicaeum trochileum*)
The presence of this species was on Jalan Ahmad Yani and Jalan Paledang at most (figure 6). Its activities were more performed in the morning. Scarlet-headed Flowerpecker was frequently feeding at Jalan Ahmad Yani and Jalan Paledang. This bird was never seen feeding and breeding in Jalan Semeru. Noisy condition at Jalan Semeru allegedly impacted on the feeding activity of Scarlet-headed Flowerpecker. It also happened to *Turdus merula* that was seeking for food in a shorter time to raise awareness of human-derived disturbance (noise and pedestrians) [6]. It was also observed in *Charadius melodus* which hunt for a shorter meal because of the noise coming from ships [1]. Birds increased vigilance due to noise in order to avoid predators whose arrival may be difficult to detect due to masking effects [5].
3.2.6. **Oriental White-eye (Zosterops palpebrosus)**

Smaller species with louder and higher song frequency were not susceptible to noise [17,18]. In this study, this small sized bird was never seen in Jalan Semeru. Oriental White-eye was most visible at Jalan Paledang and had diverse activities (Figure 7). Its activities were more performed in the morning. Other factors than noise that affect the species at the study site were food availability. Oriental White-eye was often found in Jalan Paledang and Jalan Ahmad Yani because there were plants *Tabebuia crysantha* and *Bauhinia purpurea* which was a source of food such as nectar [4]. The presence of Oriental White-eye at the study site was thought to be influenced by noise levels and food availability. The presence of Oriental White-eye was not distributed evenly along the road at the study site. Each encounter with Oriental White-eye when observation was no more than 3 individuals, whereas Oriental White-eye supposed to form large groups [10], and have high relative abundance in Bogor [14]. Another factor that was suspected to affect the least of Oriental White-eye encounter was the illegal hunting due to high market demand for the species. Oriental White-eye were one of the most vulnerable bird species which hunted in their natural habitat [11] and were the most sold birds in Jakarta [2].

![Figure 6. Frequency of activities of Scarlet-headed Flowerpecker; (M: morning; A: afternoon)](image)

![Figure 7. Frequency of activities of Oriental white-eye; (M: morning; A: afternoon)](image)
3.2.7. *Javan Munia (Lonchuraleug astroides)*  
The most varied activity of Javan Munia was performed at Jalan Tentara Pelajar. Its activities were more performed in the morning. Perching was the most frequent activity performed by Javan Munia. Making nest as breeding activity was only recorded at Jalan Tentara Pelajar (figure 8). Javan Munia prefers habitat such as agricultural land and open grassland due to its primarily feeding on rice and grass seeds [19]. This was related with the conditions around Jalan Tentara Pelajar which was a moor-shaped area and open land belongs to the Department of Agriculture. The area around the Jalan Tentara Pelajar which formed as agricultural land was thought to be the reason why Javan Munia presented more, although the species was capable to present in the area with a high noise level like Jalan Semeru. This was supported by the presence of Javan Munia on the pavement within Jalan Semeru at the height of 1 meter.

![Figure 8. Frequency of activities of Javan Munia; (M: morning; A: afternoon)](image)

3.2.8. *Eurasian Tree Sparrow (Passer montanus)*  
Most recorded activities by Eurasian Tree Sparrow were perching and feeding on the ground. Its activities were more performed in the morning (figure 9). This species was often seen as group to search for food. Perching was more often performed on a building. This species were rarely seen at Jalan Ahmad Yani. The noise level was not expected to affect the Eurasian Tree Sparrow because this species was often observed on the pavement along the roadway. Foraging behavior of Eurasian Tree Sparrow causing these birds was often at the pavement. Some species were not affected by the presence of the highway because of its differences in sensitivity to noise [17]. This bird was rarely seen taking advantage of the trees on the greenway and more frequent to use the building wall. Eurasian Tree Sparrow frequently used roofs for nesting, seeds on the roadside and gardens as food [11]; therefore, this bird was never recorded feeding at Jalan Ahmad Yani because the site was dominated by trees with large seeds like canary.
3.3. Relationship between noise and birds activity
Perching, feeding, calling and singing, and breeding activities were influenced by noise levels at the study sites, although the Chi-Square test showed that there was no correlation between noise and bird activities in this research (Chi-Square test: 0.33; \( p > 0.05 \)). Some species were not found in noisy location. Seven observed species can occur in all locations with different noise levels, but certain activities were not performed, or the frequency of the activity was decreased. Noise affected birds in the greenways because the highest noise levels occur when the birds do their activities [8]. This caused an overlap between bird’s song frequency and traffic noise [18]. There was a pattern of bird activities in all research sites: the activity of most bird species were more varied at Jalan Ahmad Yani and Jalan Paledang, except for Javan Munia which activities were more varied in Jalan Tentara Pelajar. This may be due to several factors such as the suitability of the location of the bird habitat and the level of disturbance for birds [7]. Jalan Ahmad Yani and Jalan Semeru were dominated by similar vegetation types, but bird activity was more varied on Jalan Ahmad Yani. The noise on Jalan Semeru was suspected to be a prime disturbance that caused the birds to avoid this site.

4. Conclusions and Recommendations

4.1. Conclusions
Noise in this research sites were at the values of 71.9 to 83.3 dB (A). Traffic noise measured in heavy and light traffic lanes did not have significant differences. Although the Chi-Square test showed that there was no correlation between noise and bird activities in this research due to small sample of locations, birds occupied in the greenway with highest noise level did not perform certain activities such as breeding activities. Feeding, calling and singing and perching performed less than in the quieter sites. Certain activity which less performed on noisier site showed that a high noise level impacted the lives of birds at urban greenways in Bogor.

4.2. Recommendations
Developing the greenway on many roads in Bogor by increasing the structure of vegetation should be done. Planting more vegetation such as shrubs and herbs will add the composition of the vegetation structure of the greenway. The vegetation which composed of the ground to the upper canopy would
reduce more value of traffic noise. Attention to the wildlife in the greenway should be increased because its population can still be maintained. More green open space is also needed thus urban wildlife corridor can be increased inside the city.

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