NATURA JURNAL ILMU ALAM DAN SOSIAL
Vol.2, No.1 (August– 2026)
E-ISSN: 3110-1402
pp.16-24

Diversity of Soil Insects in Suranadi Nature Tourism Park, Narmada, West Lombok, Indonesia

Nurmalasari, Baiq Muli Harisanti*, Safnowandi
Biology Education Study Program, Faculty of Science, Engineering, and Applied Technology, Universitas Pendidikan Mandalika
*Corresponding Author: baiqmuliharisanti@undikma.ac.id

Abstract: Soil insects inhabit the soil layer and litter surface and play important ecological roles as decomposers, contributors to nutrient cycling and soil fertility, and indicators of environmental conditions. Their diversity and distribution are influenced by abiotic and habitat-related factors, including temperature, humidity, soil pH, vegetation cover, and litter availability. This study aimed to assess soil-insect diversity across three habitat zones in Suranadi Nature Tourism Park, Narmada, West Lombok, Indonesia, and to provide an empirical basis for developing a field-based Animal Ecology practicum guide. A descriptive-exploratory design was employed, with specimens collected using pitfall traps at three sampling stations representing a footpath area, an area near a water source, and an open area. A total of 46 individuals were recorded, representing 10 species, 8 families, and 4 orders. The Shannon–Wiener diversity index was 1.653 at Station I, 1.242 at Station II, and 1.063 at Station III, indicating moderate diversity at all stations. Station I showed the highest diversity, suggesting that variation in local habitat and microenvironmental conditions may be associated with differences in the distribution and composition of soil-insect communities.

Article History
Received: July, 2026
Reviewed: July 2026
Published: August, 2026

Key Words
soil insects, species diversity, community structure, species richness, tropical forest ecosystem.

How to Cite: Nurmalasari, N.., Harisanti, B.M., & Safnowandi, S. (2026). Diversity of Soil Insects in Suranadi Nature Tourism Park, Narmada, West Lombok, Indonesia. *NATURA: Jurnal Ilmu Alam dan Sosial*, *2*(1), 16-24.

INTRODUCTION

Indonesia's biodiversity is an important ecological asset for maintaining ecosystem stability and sustaining life (Noor, 2023). Soil is one of the most biologically diverse habitats on Earth; globally, most groups of organisms include species that spend all or part of their life cycle in soil, including approximately 30% of arthropod species (Anthony et al., 2023). Soil arthropods are also extremely abundant and are dominated by microarthropods, particularly mites and Collembola, making them essential components of terrestrial food webs (Rosenberg et al., 2023). Within ecosystems, soil insects function as decomposers, predators, herbivores, and food resources for other organisms, while also contributing to the return of nutrients to the soil (Hasyimuddin et al., 2017).

Soil insects include fauna that are active within the soil layer and on the litter surface, either as mesofauna or macrofauna. Their activities contribute to litter fragmentation, organic-matter decomposition, nutrient cycling, pore formation, and the maintenance of soil structure. Experiments in tropical rainforests have shown that changes in litter quantity can alter the abundance, biomass, and composition of soil-arthropod communities (Ashford et al., 2013). Regional conditions and land-use intensity can also affect trophic structure and the potential contribution of soil arthropods to ecosystem services (Birkhofer et al., 2016). Because these organisms respond relatively rapidly to environmental change, their presence and diversity are widely used as bioindicators of soil quality and ecosystem stability (Panwar et al., 2022).

The structure of soil-insect communities is influenced by biotic and abiotic conditions, including vegetation cover, litter depth, organic-matter availability, temperature, humidity, soil pH, and the intensity of human disturbance. Anthropogenic disturbance can reduce microhabitat availability and decrease the population size and reproductive success of several insect groups, including ants (Walter et al., 2018). Changes in forest cover can also create warmer microclimates and shift the composition and activity of ant communities according to their thermal tolerances (Boyle et al., 2021). Conversely, greater habitat complexity, including increased canopy cover and vegetation diversity, tends to support higher invertebrate abundance and species richness (Campera et al., 2024). Therefore, differences among habitat characteristics within a conservation area should be considered when investigating soil-insect diversity.

Suranadi Nature Tourism Park, located in Suranadi Village, Narmada District, West Lombok Regency, West Nusa Tenggara, is a lowland-forest conservation area covering approximately 52 ha. The area contains varied vegetation cover, litter conditions, open spaces, visitor trails, and water sources, which create distinct microhabitats for soil fauna. A previous study in Suranadi Nature Tourism Park documented soil-arthropod diversity that could be used as a science-learning resource (Ilhamdi & Syazali, 2021). Rosinta et al. (2021) also reported that soil-insect communities in Kerandangan Nature Tourism Park were influenced by local habitat conditions. However, the coastal and secondary-forest characteristics of Kerandangan differ from the lowland-forest ecosystem of Suranadi; consequently, data from one conservation area cannot fully represent the soil-insect community of another.

Investigating soil-insect diversity in Suranadi Nature Tourism Park is important not only for strengthening biodiversity records and supporting ecosystem-health monitoring, but also for providing a contextual learning resource for Animal Ecology courses. Field-research experiences enable students to formulate questions, conduct sampling, identify organisms, analyze data, and communicate scientific findings (Ernst et al., 2015). Field-based entomology can also improve understanding of insect functions and awareness of forest-ecosystem conservation (Lamarre et al., 2018), while direct biodiversity inventories can strengthen students' observation, species-identification, and environmental-awareness skills (Gass et al., 2021). Based on this research gap, the present study aimed to identify soil-insect diversity across three habitat zones in Suranadi Nature Tourism Park and to use the findings as a basis for preparing an Animal Ecology practicum guide.

RESEARCH METHOD

This study employed a descriptive-exploratory design to characterize soil-insect diversity in Suranadi Nature Tourism Park and to provide research-based material for an Animal Ecology practicum guide. The investigation focused on species composition, abundance, and diversity across the selected sampling stations.

The study was conducted in March 2025 in Suranadi Nature Tourism Park, West Lombok. The location was selected because its tropical ecosystem supports diverse soil-insect communities. The study population comprised all soil-insect species occurring within the park, while the samples consisted of insects captured using pitfall traps. Sampling was conducted at three stations representing different habitat conditions: Station I, a footpath area; Station II, an area near a water source; and Station III, an open area. Three pitfall traps were installed at each station, with a distance of 5 m between traps.

The equipment and materials used for field sampling, specimen observation, and data collection are listed in Table 1.

Table 1. Equipment and Materials Used in the Study

No.	Equipment/Material	Function
1	Pitfall trap	To capture soil insects
2	Binocular microscope	To examine insect morphology in greater detail
3	Label paper	To label the collected specimens
4	Camera	To document the study site and research activities
5	70% alcohol	To preserve insect specimens
6	Detergent	To prevent captured insects from escaping
7	Soil meter	To measure soil temperature and pH
8	Hygrometer	To measure humidity
9	Stationery	To record field and laboratory data
10	Identification guide	To identify the collected specimens
11	Crowbar/knife	To excavate holes for installing the trap cups
12	Measuring tape	To measure the distance between pitfall traps

The research data were analyzed quantitatively using three ecological indices to describe the structure of the soil-insect community at each sampling station. The Shannon–Wiener diversity index was used to measure species diversity, the Simpson dominance index was used to determine whether particular species numerically dominated the community, and the evenness index was used to assess the distribution of individuals among the recorded species. Each index was calculated separately for the three sampling stations to facilitate comparisons of soil-insect community characteristics across the different habitat zones.

Shannon-Wiener Diversity Index

Species diversity at each station was calculated using the Shannon-Wiener diversity index (Ilhamdi & Syazali, 2021), as follows:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where:
1) H' = Shannon-Wiener diversity index
2) $pi = ni/N$
3) ni = number of individuals belonging to species i
4) N = total number of individuals of all species
5) S = total number of species
6) i = species i

The diversity index was interpreted using the following criteria:
1) $H' < 1$: low diversity
2) $1 \leq H' \leq 3$: moderate diversity
3) $H' > 3$: high diversity

Dominance Index

The dominance index was used to determine whether one or more species were numerically dominant at each station or across the study area (Rosinta et al., 2021). The index was calculated using the following formula:

$$C = \sum_{i=1}^{S} \left(\frac{n_i}{N}\right)^2$$

Where:

1) C= dominance index
2) n_i= number of individuals belonging to species i
3) N= total number of insect individuals
4) S= total number of species
5) i= species sequence

The dominance index was interpreted as follows:

1) $C < 0.5$: no species strongly dominates the community
2) $C > 0.5$: one or more species dominate the community

Values approaching 0 indicate low dominance and a more evenly structured community, whereas values approaching 1 indicate strong dominance by one or a few species.

Evenness Index

According to Odum (1988, as cited in Pertiwi & Afandhi, 2022), the evenness index describes the degree to which individuals are distributed among species. Evenness analysis was used to evaluate the distribution of soil insects collected at each pitfall-trap station. The index was calculated using the following formula:

$$E = \frac{H'}{\ln S}$$

Where:

1) E= evenness index
2) H'= Shannon–Wiener diversity index
3) $\ln S$= natural logarithm of the total number of species
4) S= total number of species

The evenness index was interpreted using the following criteria:

1) $E < 0.3$: low evenness
2) $0.3 \leq E \leq 0.6$: moderate evenness
3) $E > 0.6$: high evenness

Theoretically, the value of (E) ranges from 0 to 1. A value approaching 1 indicates that individuals are distributed relatively evenly among species, whereas a value approaching 0 indicates an uneven distribution of individuals.

RESULT AND DISCUSSION

A total of 46 soil-insect individuals were recorded in Suranadi Nature Tourism Park, representing 10 species, 8 families, and 4 orders. Hymenoptera was the most abundant order, with 33 individuals from three species, followed by Collembola with seven individuals from two species. Orthoptera and Coleoptera were each represented by three individuals; Orthoptera comprised two species, whereas Coleoptera comprised three species.

Sample identification showed that several soil-insect species occurred across multiple sampling locations, whereas others were restricted to particular stations. Thus, some species had relatively broad distributions, while others had limited distributions. These differences may be associated with habitat characteristics that influence the abundance and composition of soil insects. Habel et al. (2021) reported that insect communities vary among forest types according to vegetation structure and abiotic conditions. The identified species and their abundance are presented in Table 2.

Table 2. Soil-Insect Species Recorded in Suranadi Nature Tourism Park

No	Order	Family	Species	Number of Individuals		
				Station I	Station II	Station III
1	Collembola	Anisolabididae	*Euborellia annulipes*	4	0	0
		Tomoceridae	*Tomocerus sp*	2	1	0
2	Coleoptera	Chrysomelidae	*Argopistes sp*	1	0	0
		Curculionidae	*Brassicogethes sp*	0	1	0
		Nitidulidae	*Stegonium paniceum*	0	0	1
3	Hymenoptera	Formicidae	*Camponotus modoc*	8	0	3
			Paratrechina longicornis	3	3	12
			Myrmica sp	0	0	4
4	Orthoptera	Balttodea	*Blattela germania*	1	1	0
		Gryllidae	*Acheta domesticus*	1	0	0
Total					46	

The Shannon–Wiener diversity index (H′) varied among the three sampling stations, with values of 1.653 at Station I, 1.242 at Station II, and 1.063 at Station III. Based on the classification criteria proposed by Ilhamdi & Syazali (2021), H′ values ranging from 1 to 3 indicate a moderate level of species diversity. Therefore, all three stations were categorized as having moderate soil-insect diversity. This category suggests that each station supported a relatively diverse soil-insect community, although the distribution and abundance of species were not equally high across all locations.

Station I showed the highest diversity index, indicating that this station supported a more heterogeneous soil-insect community than Stations II and III. The higher value at Station I may be associated with more favorable microhabitat conditions, such as greater litter availability, suitable soil moisture, moderate temperature, vegetation cover, and a wider range of food and shelter resources. Station II had a lower diversity value than Station I, while Station III recorded the lowest value. These differences suggest that local habitat characteristics and environmental conditions may influence the composition, abundance, and distribution of soil insects. However, because the study was descriptive, the observed variation should be interpreted as an ecological pattern rather than as evidence of a direct causal relationship between environmental factors and soil-insect diversity.

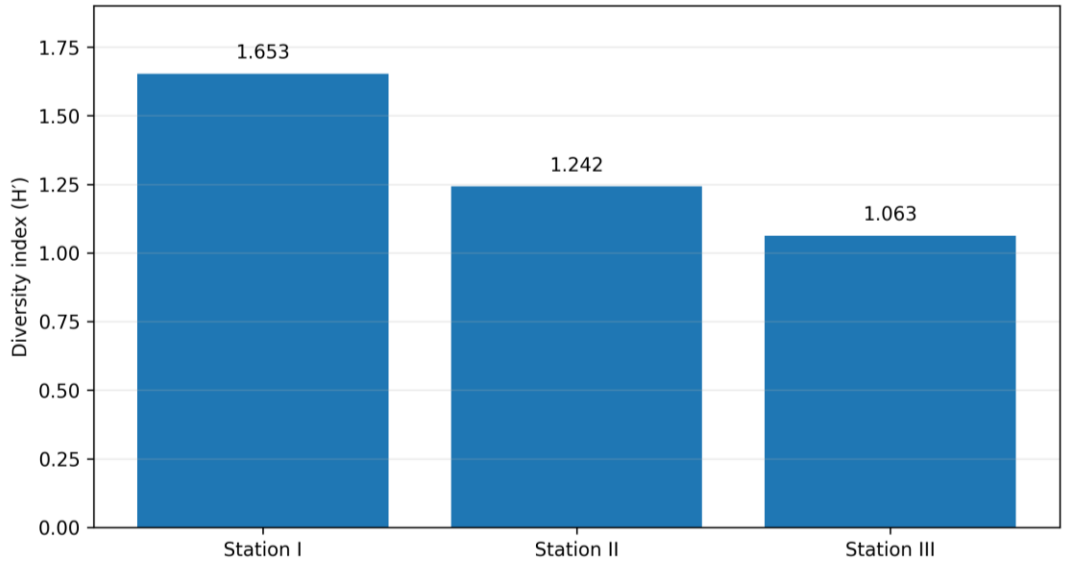

Figure 1. Shannon-Wiener Diversity Index at the Three Sampling Stations

Variation in H′ among sampling locations can be influenced by both biotic and abiotic factors. Although all stations were classified as having moderate diversity, Station I, located along the footpath, had a higher H′ value than Station II near the water source and Station III in the open area. This difference may be related to variations in the physical and chemical environment and to human activities that create distinct microhabitats for soil insects. Habel et al. (2021) explained that changes in vegetation cover and disturbance of a particular intensity can increase habitat heterogeneity and influence insect-community diversity. At Station I, the soil temperature was 26°C and humidity was 75%, conditions that may support the activity of soil insects, particularly Formicidae, which can adapt successfully to semi-open environments. This observation is consistent with Kinasih et al. (2017), who found that Formicidae can dominate surface-insect communities in habitats with particular environmental characteristics.

Overall, the most abundant soil insects belonged to the order Hymenoptera, particularly the family Formicidae. Kinasih et al. (2017) reported that Formicidae can dominate ground-surface insect communities because of their high species richness, large colonies, and broad ecological tolerance. Hymenoptera is also one of the largest insect orders and has a wide distribution across different habitat types (Borror, 1996, as cited in Kartikasari et al., 2015).

Physical and chemical environmental factors also play important roles in shaping soil-insect diversity, dominance, and evenness. The measurements recorded at the three sampling stations are presented in Table 3 and Figure 2.

Table 3. Physical and Chemical Conditions at the Sampling Stations

Parameter	Station I	Station II	Station III
Soil pH	7	7	7
Temperature	26°C	27°C	25°C
Humidity	75%	68%	70%

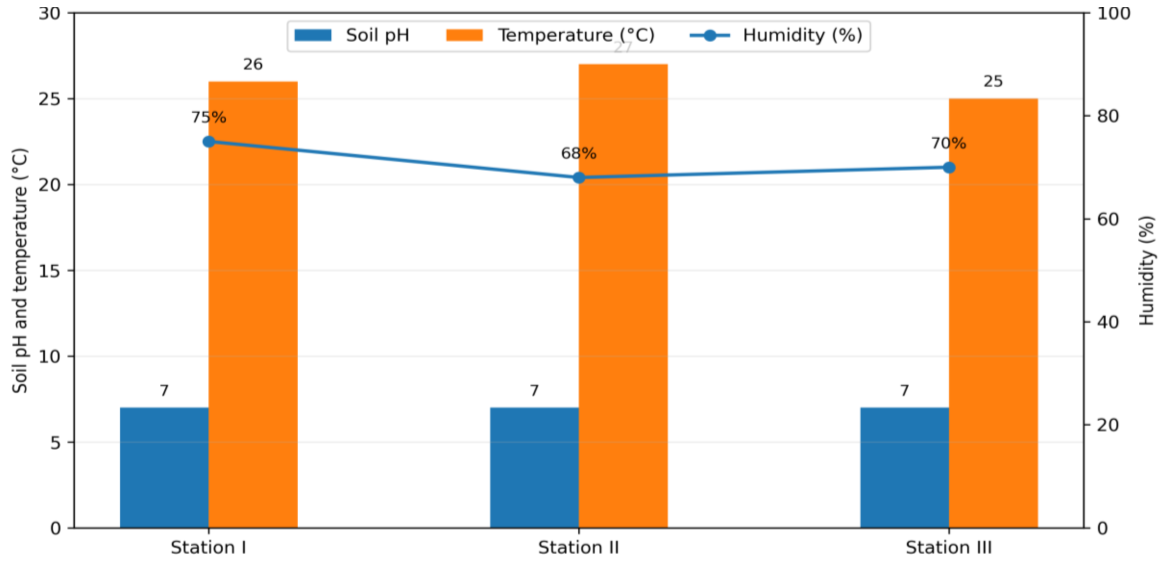

Figure 2. Physical and Chemical Measurements at the Three Sampling Stations

Environmental measurements showed that all three stations had neutral soil conditions (pH 7). The highest temperature was recorded at Station II (27°C), followed by Station I (26°C) and Station III (25°C); these temperatures remain within a range that supports the activity of tropical insects. Humidity was highest at Station I (75%), followed by Station III (70%) and Station II (68%). Although the differences were relatively small, variation in temperature and humidity may have influenced the distribution and activity of soil insects across the sampling stations.

CONCLUSION

The study recorded 46 soil-insect individuals in Suranadi Nature Tourism Park, representing 10 species, 8 families, and 4 orders: Hymenoptera, Coleoptera, Orthoptera, and Collembola. The Shannon-Wiener diversity index was 1.653 at Station I, 1.242 at Station II, and 1.063 at Station III. All stations were classified as having moderate diversity, with Station I showing the highest value. These findings demonstrate that soil-insect community composition and diversity differed among habitat zones and may be associated with local microhabitat conditions.

RECOMMENDATIONS

Further studies should include more sampling points, additional pitfall traps, repeated observations across seasons, and measurements of environmental factors such as litter depth, canopy cover, soil organic matter, and human disturbance. The findings should also be used to support biodiversity monitoring and the development of a field-based Animal Ecology practicum guide for Suranadi Nature Tourism Park.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the 2021 cohort of Biology Education students at Universitas Pendidikan Mandalika for their assistance with field data collection. The authors also thank the management of Suranadi Nature Tourism Park for granting permission and providing support during the study.

REFERENCES

Anthony, M. A., Bender, S. F., & van der Heijden, M. G. A. (2023). Enumerating soil biodiversity. *Proceedings of the National Academy of Sciences of the United States of America, 120*(33), e2304663120. https://doi.org/10.1073/pnas.2304663120

Ashford, O. S., Foster, W. A., Turner, B. L., Sayer, E. J., Sutcliffe, L., & Tanner, E. V. J. (2013). Litter manipulation and the soil arthropod community in a lowland tropical rainforest. *Soil Biology and Biochemistry, 62*, 5–12. https://doi.org/10.1016/j.soilbio.2013.03.001

Birkhofer, K., Dietrich, C., John, K., Schorpp, Q., Zaitsev, A. S., & Wolters, V. (2016). Regional conditions and land-use alter the potential contribution of soil arthropods to ecosystem services in grasslands. *Frontiers in Ecology and Evolution, 3*, 150. https://doi.org/10.3389/fevo.2015.00150

Boyle, M. J. W., Bishop, T. R., Luke, S. H., van Breugel, M., Evans, T. A., Pfeifer, M., Fayle, T. M., Hardwick, S. R., Lane-Shaw, R. I., Yusah, K. M., Ashford, I. C. R., Ashford, O. S., Garnett, E., Turner, E. C., Wilkinson, C. L., Chung, A. Y. C., & Ewers, R. M. (2021). Localised climate change defines ant communities in human-modified tropical landscapes. *Functional Ecology, 35*(5), 1094–1108. https://doi.org/10.1111/1365-2435.13737

Campera, M., Chavez, J., Humber, C., Jain, V., Cioci, H., Aulia, F., Alua, K. A., Prawerti, D. A. D., Ali, S. R. R., Swastika, I. W., Dusak, P. G. B. J., Priatama, I. P. A., Jones, A. K., Bulbert, M. W., Putra, N. G. M., Kuntayuni, Sukmadewi, D. K. T., Nijman, V., Setiawan, I. M., & Manson, S. (2024). Impact of cropland management on invertebrate richness and abundance in agroforestry systems in Bali, Indonesia. *Land, 13*(4), 493. https://doi.org/10.3390/land13040493

Ernst, C. M., Buddle, C. M., & Soluk, L. (2015). The value of introducing natural history field research into undergraduate curricula: A case study. *Bioscience Education*. https://doi.org/10.11120/beej.2014.00023

Gass, S., Mui, A., Manning, P., Cray, H., & Gibson, L. (2021). Exploring the value of a BioBlitz as a biodiversity education tool in a post-secondary environment. *Environmental Education Research, 27*(10), 1538–1556. https://doi.org/10.1080/13504622.2021.1960953

Habel, J. C., Koc, E., Gerstmeier, R., Gruppe, A., Seibold, S., & Ulrich, W. (2021). Insect Diversity Across An Afro-Tropical Forest Biodiversity Hotspot. *Journal Of Insect Conservation*, *25*, 221-228.

Hasyimuddin, H., Bulan, S., & Usman, A. A. (2017). Peran Ekologis Serangga Tanah Di Perkebunan Patallassang Kecamatan Patallassang Kabupaten Gowa Sulawesi Selatan. In *Prosiding Seminar Nasional Biologi* (Vol. 3, No. 1).

Ilhamdi, M. L., & Syazali, M. (2021). Diversity Of Soil Arthropods In Suranadi Nature Park, Lombok, And Its Role On Science Lesson In Elementary And Secondary School. *Jurnal Biologi Tropis*, *21*(3), 926-937.

Kartikasari, H., Heddy, Y. B. S., & Wicaksono, K. P. (2015). Analisis biodiversitas serangga di Hutan Kota Malabar sebagai urban ecosystem services Kota Malang pada musim pancaroba. Jurnal Produksi Tanaman, 3(8), 623–631

Kinasih, I., Cahyanto, T., & Ardian, Z. R. (2017). Perbedaan Keanekaragaman Dan Komposisi Dari Serangga Permukaan Tanah Pada Beberapa Zonasi Di Hutan Gunung Geulis Sumedang. *Jurnal Istek*, *10*(2).

Lamarre, G. P. A., Juin, Y., Lapied, E., Le Gall, P., & Nakamura, A. (2018). Using field-based entomological research to promote awareness about forest ecosystem conservation. *Nature Conservation, 29*, 39–56. https://doi.org/10.3897/natureconservation.29.26876

Noor, I. A. (2023). Peran Keanekaragaman Hayati Di Indonesia Dalam Mengatasi Perubahan Iklim Global. In *Prosiding Seminar Nasional Biologi* (Vol. 3, No. 2, Pp. 243-265).

Panwar, M., Sharma, M. P., Dhyani, S. K., & Sundarapandian, S. M. (2022). A review on effective soil health bio-indicators for ecosystem restoration and sustainability. *Ecological Indicators, 136*, 108661.

Pertiwi, K. M., & Afandhi, A. (2022). Keanekaragaman jenis jamur patogen serangga asal tanah pada sistem agroforestri pinus-kopi di Hutan Pendidikan Universitas Brawijaya. *Jurnal Hama Dan Penyakit Tumbuhan*, *10*(1), 1-11.

Rosinta, M., Artayasa, I. P., & Ilhamdi, M. L. (2021). Diversity Of Soil Insect In Kerandangan Ecotourism Nature Park Area West Lombok Island. *Jurnal Biologi Tropis*, *21*(3), 870-877.

Rosenberg, Y., Bar-On, Y. M., Fromm, A., Ostikar, M., Shoshany, A., Giz, O., & Milo, R. (2023). The global biomass and number of terrestrial arthropods. *Science Advances, 9*(5), eabq4049. https://doi.org/10.1126/sciadv.abq4049

Sarie, F., Untarti, A., Amrullah, M. N. K., Syah, R. F., Amruddin, M. P., Ir Wati Asriningsih Pranoto, M. T., ... & Saksono, H. (2023). *Mengenal Ekologi Sosial*. Cendikia Mulia Mandiri.

Walter, B., Graclik, A., Tryjanowski, P., & Wasielewski, O. (2018). Ants response to human-induced disturbance in a rain tropical forest. *Neotropical Entomology, 47*, 757–762. https://doi.org/10.1007/s13744-018-0624-5