AGARICUS: Advances Agriculture Science & Farming
Vol. 5 No. 1 June 2025, Page. 84-90
E-ISSN: 2797-0884

Study of Arthropod Diversity in the Location of Pine Forests and Orange Groves in the Bedengan Campground Area, Malang Regency

Abu Na'im[1*], Rosalina Edy Swandayani[2], Titanio Auditya Pribadi[3]
[1*]Agricultural and Biosystems Engineering, KH.A. Wahab Hasbullah University
[2]Department of Biology, Al-Azhar Islamic University
[3]Center for Tourism Studies, Directorate of Research and Community Service, Brawijaya University,
*Email: abunaim@unwaha.ac.id

ABSTRACT
The Bedengan campground is a location with natural conditions that are still natural which is dominated by pine forests. Around the forest, there are orange plantations managed by the local community. To determine the comparison of Arthropod diversity in the two locations, the Pitfall trap, Net, and Barrel turgin methods were used with data analysis using Shannon-Wiener and QBS index. Based on the results of the research that has been carried out, it can be seen that there are 11 orders, 29 families and 487 species, while in the orange plantation area there are 7 orders, 10 families and 335 species. In addition, based on the calculation of the Diversity Index (H') and the QBS Index in both areas, there is a significant difference. Pine areas have a higher diversity index value compared to orange plantation areas. High Important Value Index (INP) includes the family Myrmicidae, family Entomobridae, and Cicadelidae, the three arthropod families are types of arthropods that have behaviors that are easily adapted to the environment. Environmental quality has a significant difference in the relatively stable and low pine area, while in the orange plantation area it has a quality that tends to be dry. According to the QBS analysis on the citrus plantation area, the quality of arthropods and environmental biotics is influenced by the use of peptideicides that have an impact on soil diversity and mesofauna

***Keywords**: Bedengan campground, Arthropods, index Shannon-Wiener dan index QBS*

INTRODUCTION
Studies and research in the fields of ecology and environment reveal a lot about the diversity of a community. This is because diversity shows indicators of stability. Where this stability shows that a community will be relatively stable despite many disturbances to the community.

According to Dharmawan et al. (2005), species diversity is a community character that is important to be discussed in depth both conceptually and in terms of its application in the field. Odum (1998) and Fachrul (2008) said that diversity is synonymous with the stability of an ecosystem, that is, if the diversity of an ecosystem is high, then the condition of the ecosystem tends to be stable.

In a forest area, the difference between the main plant and other plants will affect the type of arthropod that lives in that habitat. This is because the difference in vegetation will affect the existing organic material, the intensity of light that reaches the soil, and soil moisture. According to Dindal (1990), different plant species will produce different soil chemical conditions and organic matter. Similarly, the older the plant age, the more litter that accumulates in the soil which indirectly determines the thickness of the humus, which then affects the availability of food for soil fauna, especially ground surface Arthropods.

According to Meglithsch (1972), Arthtropods are the largest phylum in the kingdom Animalia and the largest group in that phylum are Insects. There are an estimated 713,500 types of Arthropods, which is estimated to be 80% of the known animal species. Arthropods play an important role in forest ecosystems, among other things, as an exchange of energy, water, and nutrients between the atmosphere and the forest floor. Defoliation by herbivorous insects can increase rainfall, affect increased sunlight penetration in forests, increased evaporation, and wind speed (Asquith et al., 1990 in Winchester, 1997; Schowalter and Lowman, 1999). Fauna diversity plays an important role in maintaining ecosystem

stability, this is influenced by environmental factors, biotic factors include (plants and animals), abiotic factors (including water, soil, air, light, and soil acidity) (Kramadibrata, 1995).

This research was carried out in two locations, namely in the pine forest area and orange plantations around the Bebed campground with the aim of finding out and comparing Arthropods found in these locations. Through this research, it is hoped that it can provide information and data about the diversity of Arthropods in the region.

METHOD

Sampling was carried out on May 1-4, 2014 in two locations, namely in the pine forest area and orange plantations around the Bedengan campground, Selorejo Village, Dau District, Malang Regency. Bebed Campground is a location with natural conditions that are still natural dominated by pine forests located at 07°56'15.6"S, 112°31'53.8"E with an altitude ranging from 900-1200 mdpl.

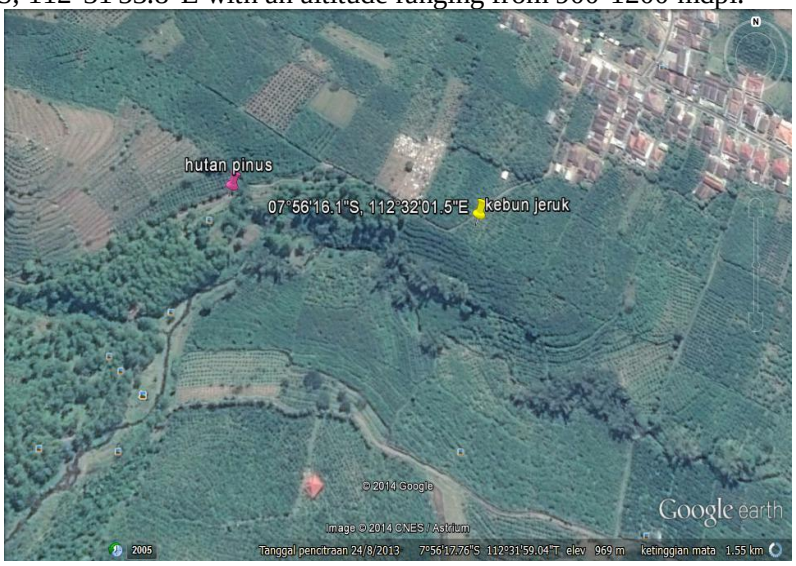

Figure 1. Area Studies used in research. The yellow color indicates the orange orchard area and the purple color indicates the pine forest area.

Method sample

a. Pitfall traps

Pitfall traps are carried out to take samples of terrestrial arthropods by installing traps composed of plastic cups with a diameter of 10 cm. The plastic cup serves as a container to trap Arthropods. The container is buried in the ground with the lip of the container located on the surface of the ground. Above the trap is covered to avoid evaporation and rainwater ingress. Traps are placed on 9 plots with a distance of 5 meters at both locations. Traps are carried out for 12 hours in the morning (06.00-16.00) and hours (16.00-07.00) in the afternoon. In the trap, a third of it is filled with water, then detergent water is added. After 12 hours of trapping each, the arthropods were collected from each trap and stored in 70% ethyl alcohol. The collected arthropods were then analyzed. The selected arthropods were then identified at the level of their taxonomy. The number of arthropods in each taxa is calculated from each trap. The abundance of data from each habitat illustrates the composition of terrestrial arthropod communities (Gardner et al., 2009).

b. Jaring

The netting method is used to catch insects that are above the ground surface. The sampling was carried out at three points in each 10-meter area by combing the surface of the ground using a net. (Schauff, without year). The number of arthropods in each taxa is calculated from each trap. From this data, it was further analyzed.

c. Barlis Turgin

Identify the type of soil arthopod by making a 25cm x 25cm plot on each plot and then excavated. The soil was taken to the laboratory to identify the type of arthropod by the Barlis turgin method. The principle of this method is that the soil weighing 300 g each of the plots is weighed. Furthermore, extraction is carried out by irradiating the soil continuously for five days so that the arthropods in the soil fall into the alcohol below (Herlinda, 2008).

Analysis Data

In this study, the Shannon-Wiener Diversity Index was used to analyze the diversity of Arthropods in

two locations using the following formula (Henderson, 2003):

$$H' = -\sum_{i=1} Pi\ 2.\ Log\ Pi \quad \text{dengan} \quad Pi = ni/N$$

Information:
H' = Shannon-Wiener Diversity Index
Pi = proportion of the first species to the total number
S = total number of species within the community
ni = Number of individuals in the first species
N = Total number of individuals

In addition, the Relative Abundance (KR) value of a species is also calculated with the following formula:

$$KR_i = \frac{K_i}{\sum_{i=1}^{s} K} \times 100\%$$

Information:
KRi = Relative abundance of the ith species
Ki = Abundance of the first species
S = total number of species found at the research site

QBS Index

To determine the morphological type that can adapt well in the soil, the QBS method is used. This type is used as an adaptation level, which is based on an eco-morphological score (EMI). As a general rule, eu-edapik (habitat in the soil) will get an EMI = 20, while hemi-edapik (habitat in the soil intermediate) gets an idex based on its degree of specialization, and epi-edapik (soil surface habitat) gets an EMI score of = 1 (Parisi, et al., 2005).

RESULT AND DISCUSSION

Composition of the Arthropod community

Based on the results of identification during the study, in the pine forest area there were 11 orders in 29 families, while in the orange plantation area there were 7 orders in 10 families.

Table 1. Types of Insects and Number of Insects

Sample	Method	P	O
Types of Insects (S) (Family)	Pit fall trap	12	5
	Barlis Turgin	9	4
	Jaring	15	6
	amount		

Note: P : Pine Area, O: Orange Area

The results of the study using the pitfall trap method in pine forest areas found 9 types of families, with 7 types of arthropods acting as predators and 2 types of arthropods acting as parasitoids. Meanwhile, in the orange plantation area, 11 types of families were found, with 8 types of arthropods that act as predators, 1 type of parasitoid arthropod, 1 type of pest arthropod, and 1 type of pollinator arthropod.

The dominant arthropods in both citrus and pine forest areas are from the family Formicidae, with the number of INPs in pine forest areas of % and citrus plantations %. The abundance of predators of the family formicidae according to Maftuah et al. (2002) is related to total nitrogen (N) and soil moisture. The presence of dried leaf litter and the ingestion of organic fertilizers is directly correlated with the abundance of ants (formicidae) in the agroecosystem. The results of measuring humidity and the number of leaf litter in the restored and unrestored areas are high enough that it is possible to trigger the abundance of formicidae.

The difference in the findings in table 1 illustrates that pine forest areas have representative environmental conditions for the survival of arthopods compared to orange plantation areas. The reduction in the number of arthropods in orange plantations indicates the excessive application of pesticides.

Price (1997) states that increasing the number of food chains in an ecosystem will have an impact on increasing the stability of that ecosystem. Dindal (1977) added that the stability of an ecosystem can be

formed by a stable condition of the organism and is indicated by its balance against disturbances from external factors.

Table 3. Abiotic Factors

Plot	Temperature (^{O}C)	Humidity (Wet Temperature/Dry Temperature)	Light Intensity (Lux)
P1	22,4	24,1/22,4	512,8x100
P2	21,4	21,3/19,7	170,2x 10
J1	22,5	22.5/19,1	405,1x10
J2	20,6	24,7/21,2	633x10

Note: P1: Morning Pine Forest, P2: Afternoon Pine Forest, J1: Morning Orange Grove, J2: Afternoon Orange Grove

Indeks Diversitas Shannon-Wiener

The results of the calculation of the Diversity Index (H') in both areas show a significant difference. Pine areas have a higher diversity index value compared to orange plantation areas (Fig. 2).

Table 2. Diversity and Simpson Index

Indexs	Pine forest	Orange Plantation
Diversity Index (H')	2.5323	1.4756
Simpson Index (S)	0.8913	0.9723

Based on the results of the INP calculation, it is known that cumulatively the dominance of Arthopod species in Pine plantations is relatively small compared to the orange plantation area. Oka (1995) and Price (1997) stated that the more species found in a planted area, the greater or higher the level of community diversity. In a highly diverse community, a species cannot be dominant, on the contrary, in a low-diversity community, one or two species can be dominant

The results of the calculation of the Diversity Index (H') in both areas show a significant difference. Pine areas have a higher diversity index value compared to orange plantation areas. (Fig. 2). Odum (1993) said that diversity will tend to be low in physically controlled ecosystems (subjected to strong physical and chemical limiting factors) and high in biologically regulated ecosystems.

The high diversity causes the formed food webs to be more complex, so stability increases. This is in accordance with the statement of Price (1997), who stated that diversity can produce stability.

The application of pesticides that aim to maintain the quality and quantity of cultivated crops directly and indirectly has an impact on changes in agroecosystems. Pesticides directly affect the fauna that lives in the soil (Brown, 1987) and indirectly affect the use of pesticides through the food chain (Croft, 1990).

Pielou (1975) stated that high environmental stability is preceded by high diversity. The more complex a community, the higher the stability of the community system, so high diversity will lead to high community stability.

The role of soil fauna is very large in maintaining the balance of the ecosystem, especially the scavenger which acts as a decomposer so that the material in living creatures can return to nature. The identification results showed that in pine forests there were more types of soil arthropods that acted as scavengers than orange plantations, namely 3 types from the collembolan group and 1 type from the Chilopod group.

The material that has returned to nature will be used by plants to synthesize products with the help of energy from the sun. The energy stored in plants will move to other organisms through the food chain. Herbivores that are directly related to plants can utilize plant tissues through long evolutionary mechanisms.

Levins and Wilson (1980) stated that the insect response to plants is caused by the first due to the presence of chemical signals released by plants, such as depressants, stimulators, attractants and repellants and secondly due to changes in the host plant due to the influence of plant content, such as nitrogen, amino acids, phytohormones and antifedanes.

Predators and parasitoids play a very important role in agroecosystems, as they can naturally control the presence of herbivores. In this study, the parasitoids and predators found were mostly a group of hymenoptera (Formicidae and Sphecidae). Croft (1990) stated that predators and parasitoids are present in large numbers in fauna communities in most agroecosystems. So the side effects of pesticide use directly or indirectly cause significant changes in the amount of energy and nutrient flow in the ecosystem.

Odum (1993) said that diversity will tend to be low in physically controlled ecosystems (subjected to strong physical and chemical limiting factors) and high in biologically regulated ecosystems. The high

diversity causes the formed food webs to be more complex, so stability increases. This is in accordance with the statement of Price (1997), who stated that diversity can produce stability. The application of pesticides that aim to maintain the quality and quantity of cultivated crops directly and indirectly has an impact on changes in agroecosystems. Pesticides directly affect the fauna that lives in the soil (Brown, 1987) and indirectly affect the use of pesticides through the food chain (Croft, 1990).

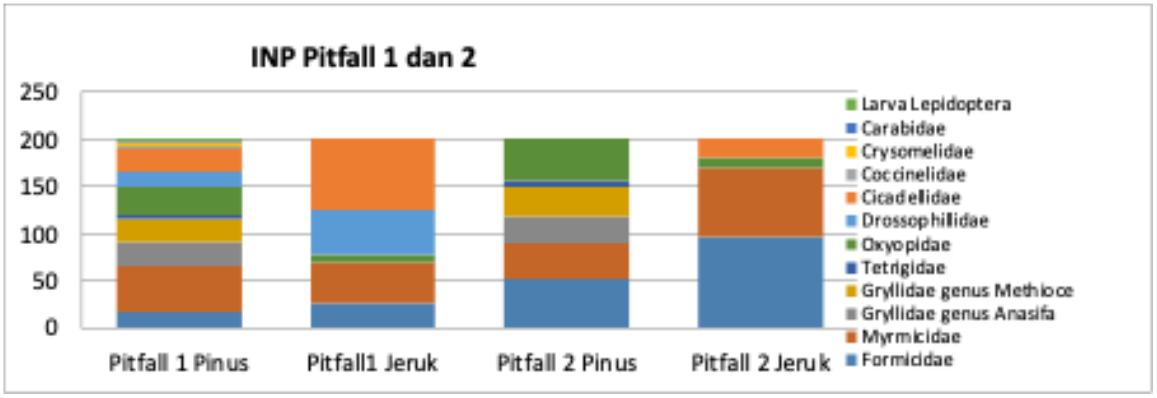

Figure 2. Index of Important Values of Insects Pitfall method

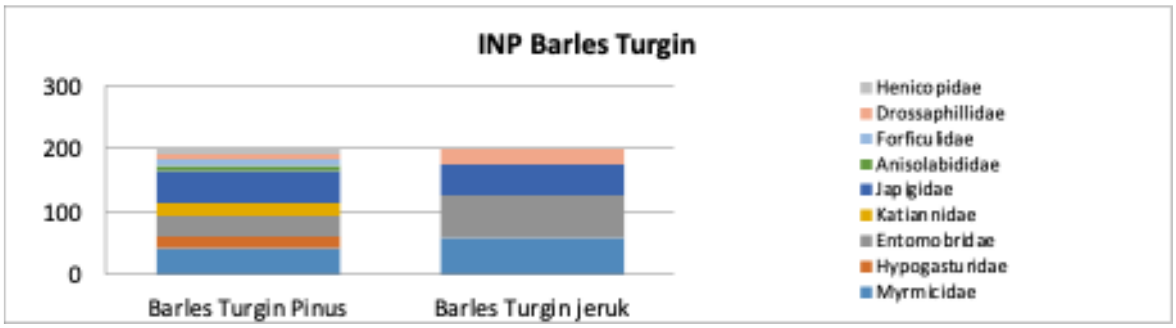

Figure 3. Index of Important Values of Insects method Barles turgin

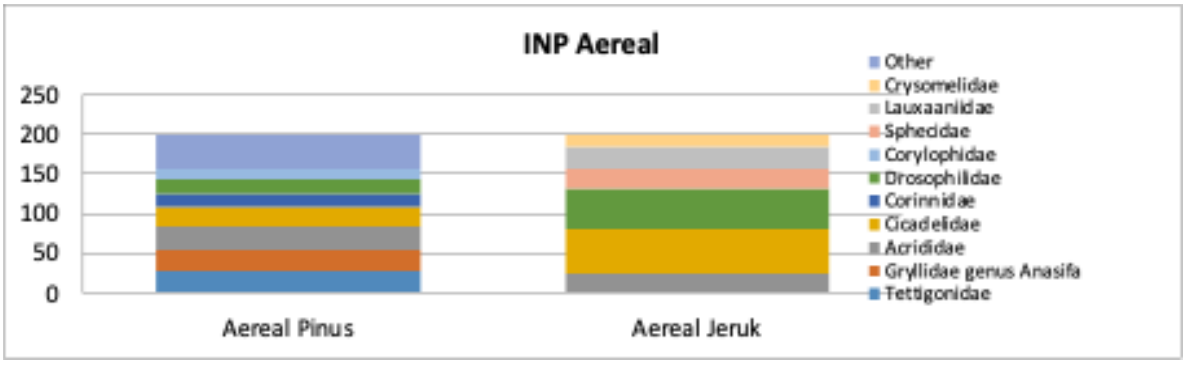

Figure 4. Insect Important Value Index method

QBS Index

QBS is one of the quick ways to find out the character of the edaphic population from the sampling site. The results of the QBS calculation based on the Eco-Morphologic indices (EMI) calculation score obtained that the Pine forest area has a higher QBS index score (from each trap) than the QBS index score in the orange plantation area.

The QBS index above shows that in pine forest areas, microarthropod species that are sensitive to environmental changes are found more than in orange plantation areas. This causes the IME score in pine forests to be higher.

QBS is applied to soil microarthropods, separated according to the biological form approach with the aim of evaluating the degree of adaptation of microarthropods to the life of the soil environment (Parisi, 1974) and overcoming the well-known difficulties of taxonomic analysis for species levels for edhapic mesofauna (mesofauna whose habitat is in soil). Focusing on the presence of these characters, and not requiring complex taxonomic identification for the species level, means that non-specialists can use QBS analysis as well. The use of excessive doses of pesticides applied by citrus farmers causes environmental damage and causes damage to the soil with reduced preference and abundance of edhapic mesofauna.

Table 3. QBS Index of Pine Forest and Orange Plantation regions

Ordo	Pitfall Trap		Barlis Turgin		Aereal	
	Pine	Orange	Pine	Orange	Pine	Orange
Diplura	-	-	20	20	-	-
Collembola	-	-	10	10	-	-
Hemiptera	1	1	-	-	1	1
Dermeptera	-	-	1	-	-	-
Coleoptera adult	1	-	-	-	1	1
Hymenoptera	5	5	1	1	5	1
Diptera adults	1	1	1	1	1	1
Diptera larvae	-	-	-	-	-	-
Araneae	1	1	-	-	1	-
Chilopoda	-	-	10	-	-	-
Orthoptera	20	-	-	-	20	1
QBS	29	8	43	32	29	5

CONCLUSIONS

The quality of arthropods around the Bedan Tourism area, namely pine forests and orange plantations, was found to be 39 families, in the pine forest area according to the results of the study found 29 families and 10 families in the orange plantation area. The diversity of arthropod quality in pine forest areas and orange plantations has differences, in pine forest areas there is an average of H' (2.5) with relatively high quality, while orange plantations have H' (1.4) quality with relatively low quality. Based on the analysis of arthropod species that have a high Important Value Index (INP), including the Myrmicidae, Entomobridae, and Cicadelidae families, the three arthropod families are arthropod types that have behaviors that are easily adaptable to the environment. Environmental quality has a significant difference in the relatively stable and low pine area, while in the orange plantation area it has a quality that tends to be dry. According to the QBS analysis on the citrus plantation area, the quality of arthropods and environmental biotics is influenced by the use of peptideicides that have an impact on soil diversity and mesofauna.

REFERENCES

Brown, A.W.A. (1978). Ecology of Pesticides. John Wiley & Sons, Inc., New York.

Croft, B.A. (1990) Arthropod Biological Control Agents and Pesticides. John Wiley & Sons, Inc., New York. 69(4):521-536

Dharmawan, A. Dkk. (2005). Ekologi Hewan. UM-Press. Malang.

Dindal, D.L. (1990). Soil Biology Guide. John Wiley & Sons, New York.

Fachrul, N.F. (2007). Metode Sampling Bioekologi. Bumi Aksara. Jakarta.

Gardner, E. T., V. J. Anderson, R. L. Johnson, P. A. Handerson. (2003). Practical Methods in Ecology. R. L. (2009). Arthropod and Plant Communities as Indicator of Land Rehabilitation Effectiveness in a Semiarid Shrubsteppe. *Western North American Naturalist*. 69(4): 521-536

Herlinda.S, Waluyo, S. P. Estuningsih, C. Irsan. (2008). Perbandingan Keanekaragaman Spesies dan Kelimpahan Arthropoda Predator Penghuni Tanah di Sawah Lebak yang Diaplikasi dan Tanpa Aplikasi Insektisida. *Jurnal Etmol Indonesia*. 5(2): 96-107.

Kramadibrata, I. (1995). Entomologi Hewan. Bandung. ITB

Meglitsch, Paul. A. (1972). Invertebrate Zoology. Second Edition. Oxford University, London.

Odum, E. (1993). Dasaar-Dasar Ekologi. Yogyakarta: UGM Press.

Price, P.W. (1997) Insect Ecology. Third Edition. John Wiley & Sons, Inc., New York.

Parisi, V., C. Menta, C. Gardi. (2005). Microarthropod communities as a tool to assess soil quality and biodiversity: a new approach ini Italy. *Agriculture Ecosystems & Environment*. 105: 323-333.

Schauff, M. E. (2001). Cllecting & Preserving Insects and Mites. Systematic Entomology Laboratory. Washington DC.

Schowalter, T. D., L. M. Ganio. (1998). Vertical and Seasonal Variation in Canopy Arthropod

Communities in An Old Growth Conifer Forest in Southwestern Washington. USA. *Bulletin of Entomological Research*. 88: 633–640.