Effect Of Asilidae On Decreasing Locust Population As A Pest In Agricultural Ecosystems

Shalmita Sakinah1[[1]](#footnote-2)\*,Zulyusri2, Tomi Apra Santosa3

1Department of Biology, Universitas Negeri Padang, Indonesia

2Department of Biology, Universitas Negeri Padang, Indonesia

Abstract

Pathogenic insects such as Asilidae or robber flies can eat other insects, causing a decrease in the number of insect populations, namely grasshoppers. Decreasing the locust population will have a positive impact on the agricultural ecosystem. Research to determine the effect of Asilidae on decreasing grasshopper populations in agricultural ecosystems. The research method was carried out in a meta-analysis using references from theories relevant to the research. Meta analysis is a quantitative analysis using certain data to obtain information from 5 accredited articles. The results of the study showed that flies are small to very large (body length: 4–65 mm; wing length: 4–40 mm), are predatory, eat other insects on their wings. The results of the research that has been done show that there is an influence of Asilidae insects on the decline in locust populations in agricultural ecosystems.

**Keywords**: : asilidae, locust, decomposer, ecosystem

Introduction

Grasshoppers are a class of insects that belong to the order Orthoptera with a total of 20,000 species (Prakoso, 2017). Some are herbivores, but some play a role as decomposers, and eat other insects. Grasshoppers are plant-eating animals or known as herbivores, in cereals and vegetables they can become pests. (Adnan, 2009) states that locusts in Indonesia are pests that have an impact on damage to corn crops

In agricultural areas various types of insects are often found, (More & Nikam, 2016) stated that millions of locusts damage crops by congregating in large numbers at an agricultural locus. Locusts have the potential to be an indicator of the quality of a field because of the diversity of locusts that are spread over the land in large quantities. (Rowell, 1987) states that locusts are found in every area, but some types of locusts inhabit forest ecosystems. Research from (Probe & Scalpel, 1980) says that grasshoppers eat some wild and cultivated plants.

Forest is one of the areas where living things exist. (Hartley, 2002) states that forests will be modified in the long term which changes the climate in the forest and obtains components from undergrowth that are different from natural forests. The modified forest is filled and planted with industrial plants aimed at industrial needs, especially for raw materials, this area is also called plantation forest. (Altieri, 1999) states that there is an agro-ecosystem, namely the simplification of various biodiversity to be converted into plants in the form of monocultures so that they need constant treatment by being given chemical or organic fertilizers or pesticides.

Control of pests that cause disease in plants with chemical pesticides is not the right solution now, because seen from the negative impacts that have arisen, namely the occurrence of environmental pollution on soil and water caused by chemical residues and their residues are in food crops at harvest, which gives immunity on pathogenic pests on the chemical content in pesticides so that it inhibits and destroys parasitoid insects and predators.

Research conducted by (Moningka et al., 2012) states that the excessive use of pesticides and any development in the forest will not be able to protect natural enemies but will cause environmental damage and eradicate these natural enemies. One of the solutions to control pests naturally is by exploiting the potential of the enemy itself. In essence natural enemies can naturally control pests if the surrounding environment has the possibility in which they thrive. In Indonesia, agricultural ecosystems actually have various enemies that can reduce the presence of natural pathogenic pests.

At this time in the agricultural ecosystem has developed a lot of integrated pest control (IPM), to limit farmers in the use of chemical pesticides. The component of integrated biological control is to use biological control techniques. Biological control is controlling pests by using predators, pathogens and parasitoids. There are many insects that can destroy ecosystems, one of which is the agricultural ecosystem. Biological control is a way to control natural enemies by exploiting the potential of predators, pathogens and parasitoids. Although some types of insects provide benefits, for example predators and parasitoids that can pollinate flowers and destroy remaining organic matter, insects as pests can damage ecosystems such as agriculture which causes huge losses to agricultural land resulting in crop failure.

Pest control using parasitoids is an alternative strategy for controlling pests currently being developed to reduce the use of pesticides (Kojong et al., 2015). Parasitoids are natural enemies capable of controlling pest populations in nature. Parasitoids play a role as an effort to control pests biologically which has been successfully applied. Parasitoid insects reproduce in their host's body. Insect parasitoids can eat eggs, larvae and imago or adult insects. One of the parasitoids plays a role in controlling pests, namely asilidae.

Robber flies or Asilidae are one of the largest families in the Diptera order. Consists of 7,500 species (Dikow et al., 2017). Robber flies range in size from 5 to 60 mm. Robber flies have a distinct body shape and are usually with an elongated cylindrical abdomen and various sclerite colourations, often covered with thick hairs. Representative members come from various habitats. The greatest species diversity is typical of arid, semi-arid and tropical forests.

Diptera, Coleoptera, Hymenoptera and Hemiptera are some of the largest animal orders in the world. Even for regional fauna. Over the past few years, many species have become endangered and listed species of several families (Ruchin et al., 2019).

Members of the Diptera family are an unexplored group. There is little information on the Mordovian fauna of the Tipulidae and Limoniidae (Pilipenko et al., 2020), (Budaeva & Ruchin, 2016). Being active predators, adult flies and their larvae play an important role in the ecosystem (Astakhov, 2015), (More & Nikam, 2016). Robber flies can inhabit a wide variety of terrestrial ecosystems.

Insects tend to have different things about the abundance in a place and related to their ability to reproduce and adapt to suitable habitats. (Untung, 2006) said that the stability of agricultural ecosystems can be seen from the ecological pyramids and the relationships of components in the community such as pests/herbivores, predators and parasites/carnivores. Therefore it is necessary to know how the role of asilidae in reducing locust populations in agricultural ecosystems.

ResearchMethods

The research was carried out by means of meta-analysis using references from theories relevant to the research. Meta-analysis is a method of using a method by summarizing the results of two or several studies that aim to obtain results from combining, reviewing and summarizing existing research. According to Palmam, (2015) babythe results of the same research were reviewed for meta-analysis purposes.

This study uses national and international articles related to the effect of asilidae on decreasing locust populations as pests in agricultural ecosystems. The aim of the study was to determine the effect of asilidae on the decline in locust populations as pests in agricultural ecosystems. This research was traced from several articles as research samples.

From several accredited articles, Grasshopper species were taken for observation in a research laboratory, determining their role and identifying specimens (Borror et al., 1996). According to research (Catling et al., 2020) and several other studies. The role of grasshoppers in the ecosystem can be determined by observing images taken of plants using the camera in the same plot position and then measuring temperature, humidity, altitude and wind speed.

Research Results and Discussion

Based on the search results for national and international articles in scientific publications published in 2017-2022 that meet the stipulated conditions, it can be found in Table 1. Insects in an ecosystem totaling 3,097 Orthoptera individuals belong to the Acrididae, Pyrgomorphidae and Tetrigidae families, which have 7 genera, namely Oxya, Gesunola, Criotettix, Atractomorpha, Valanga, Miramella, and 7 other species. In the agricultural ecosystem area there are 3 species while in the plantation forest ecosystem there are 5 species.

**Table 1  
*Findings of locust species in agricultural ecosystems and plantation forests***

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Fly species** | **Article Title** | **Total** |
| 1 | *M. domestica M. conducens, C. megacephala dan C. rufifacies* | Kelimpahan Nisbi, Frekuensi Dan Dominansi Jenis Lalat Di Beberapa Pasar Tradisional Di Kecamatan Martapura | 823. |
| 2 | *Atractomorpha crenulata, Criotettix cf. robustus (Hancock), Gesonula mundata (Walker), Hesperotettix viridis pratensis, Miramella alpine, Oxya hyla intricata (Stal) , Valanga nigricornis (Burmeister)* | Biodiversitas Belalang (Acrididae: ordo Orthoptera) pada Agroekosistem (zea mays l.) dan Ekosistem Hutan Tanaman di Kebun Raya Baturaden, Banyumas | 1030. |

In Table 1 it can be observed that in several studies, there were 823 species of M. domestica, M. conducens, C. megacephala, and C. rufifacies. In addition, research on other articles on agricultural ecosystems (Zea mays L.) contained species of Valanga nigricornis (Burmeister). , Gesonula mundata (Walker), and Oxya hyla intricata (Stal). In the plantation forest ecosystem the species found include: Oxya hyla intricata (Stal), Atractomorpha crenulata, Criotettix robustus (Hancock), Hesperotettix viridis pratensis, Miramella alpina (Kollar). The agricultural ecosystem has 1030 individuals covering 1 family and 3 species. While the plantation forest has 2067 individuals covering 3 families and 5 species. This illustrates that there are fewer species in agricultural ecosystems than plantation forest ecosystems.

Obtained a number of different types of insects in agricultural ecosystems and plantation forest ecosystems. Insect species are more abundant in plantation forest ecosystems than agricultural ecosystems. This happens because the existence of various types of flora in plantation forest ecosystems is higher than agricultural ecosystems. Species diversity of grasshoppers is influenced by the vegetation structure in both ecosystems. Insects need nests and food sources which are obtained from the abundance of various types of vegetation in natural forests (Lachat et al., 2006).

Several factors affect the diversity of grasshoppers in both ecosystems, one of which is environmental factors. From research results traced from several articles accredited by SINTA, it was found that in agricultural areas the average temperature is 32.16 ºC with an estimate of 28ºC-39 ºC. Then in the plantation forest ecosystem area has an average temperature of 23 ºC, a minimum temperature of 21ºC and a maximum of 26 ºC.

The results of research by (Pudjiharta, 2010) at the Baturaden Botanical Garden in dammar forest had a temperature of 19.5ºC-21.4ºC. In the agricultural ecosystem, (Fajarwati et al., 2009) conducted a study on tomatoes, which had a temperature of 14ºC-26ºC, indicating that the temperature in the agricultural ecosystem increased by 10 ºC compared to the temperature in the plantation forest ecosystem, which only increased 2 ºC.

The results of research on agricultural ecosystems obtained an average humidity of 60% with a range of 46-81%. Plantation forests have an average humidity of 77.6% with a range of 69-98%. Research conducted by (Pudjiharta, 2010) states that dammar forest has humidity ranging from 87.5-93.2% and in agricultural ecosystems according to research by (Fajarwati et al., 2009) tomatoes in agricultural ecosystems have humidity of 81.4%. It can be concluded that the greater the decline that occurred in agricultural ecosystems, namely as much as 10% compared to plantation forest ecosystems, as much as 5%.

(Mock, 1973) stated that a temperature change of approximately 1°C had an effect on 2 to 3% evapotranspiration, and 5% humidity had an effect on 9% evapotranspiration. According to (Haneda et al., 2013) increasing temperature changes affect geographical distribution, insect activity, reproduction, and evaporation of fluids in the insect's body.

Several factors that influence insect diversity include: temperature and humidity, this can be observed if samples are taken for a long time in different seasons. Research by (Noor, 2008) in (Tofani, 2008) stated that, during the dry season, many Formicidae and Nitidulidae families will be found on the soil surface, while during the rainy season there will be more Formicidae and Tenebrionidae families.

The diversity of grasshoppers is not only influenced by vegetation and environmental structures, biological factors can also affect diversity such as parasitoids, predators and entomopathogens. Research by (Susniahti et al., 2005) when the biological factors in the form of the three components are higher, the grasshopper population decreases, this explains that the three components are very influential in the number of grasshopper populations.

(Fajarwati et al., 2009) stated that in each ecosystem the diversity of insects varies. This happens because of the nature of insects which include eating, way of life and reproduction, climate, type of food, geographical conditions, altitude, temperature differences and other environmental factors including geology and ecology, (Tofani, 2008) states that this ability spreads, light, weather , habitat selection, and an abundant supply of food and plants.

In India in 1997 found the Orthoptera order of 50 species in the paddy field ecosystem which included the family Tettiigonidae with 8 long antennae, the families Acrididae and Pyrgomorphidae with 28 species with short antennae, 3 crickets and 1 tree cricket and 10 families Tetrigidae (Chitra et al., 2000). According to (Erawati & Kahono, 2010) a total of 414 individual locusts were found, consisting of 5 families and 25 species in Mount Kendeng and Mount Botol.

Similarities can be seen in (Akthar et al, 2012) in paddy field ecosystems, and research in India in Uttar Pradesh City from 2010 to 2011 by Rabi and Kharif. Similar results were obtained that there was an abundance of diversity in Acrididae and Pyrgomorphidae. This is due to the ease of obtaining grass as a food source for the Acrididae Oxyinae and Truxalinae subfamilies (Das & Ray, 2013).

*Gesonula mundata* or Walker is the most abundant species in the agricultural ecosystem, totaling 807 individuals. Meanwhile, *Hesperotettix viridis* pratensis is the most abundant species in the plantation forest ecosystem with a total of 1,199 individuals. In both ecosystems, the species Oxya hyla intricata (Stal) was also found, in the agricultural ecosystem there were 9 individuals while in the plantation forest ecosystem there were 456 individuals.

In the agricultural ecosystem there are 213 individuals of V. nigricornis. (Sofyan, 2010) said that the wood locust or V. nigricornis has characteristics in the antennae, body, wings and legs, the antennae are short, the body length is 6.2 cm, it has straight front wings that are slightly hard and the rear wings are in the form of membranes, and the front legs are thicker. short forelegs. Nymphs and adults of the wood locust are approximately 44-72 mm long and have a light yellowish green color (Kalshoven, 1981).

In the article cited V. nigricornis eats various plants or is phytopagus. (Sofyan, 2010) said that V. nigricornis can damage plants if the population is not controlled and has the potential to become a pest for plants. V. nigricornis can be a pest on new crops and seedlings but V. nigricornis is not a major pest on crops in Malaysia (Lee, 2014).

In another article according to (Leatemia & Rumthe, 2011) in the village of Jakarta Baru and the location of the corn planting at UPT-Y found V. nigricormis. In addition, in Bula District, the damage to V. nigricornis corn plants was categorized as mild, namely 10.65%. As a result of the attack from V. nigricornis, it gets bite marks around the edges to the middle of the leaves which causes the leaves to become hollow.

Agricultural ecosystems and plantation forests have an indicator of the similarity of 0.25 or 25% of the species found in both ecosystems. (Das & Ray, 2013) said that O. hyla is a species that exists in both ecosystems. O. hyla belongs to the Poaceae family which prefers grasses, therefore O. hyla is more prevalent in plantation forest ecosystems than agricultural ecosystems.

According to the results of research on locusts causing a lot of losses to agricultural products so that the presence of parasitoids can reduce the locust population in agricultural areas and can prevent damage to agricultural products, gardens and other areas, because locusts can eat plants in the form of leaves which cause leaves in garden areas to have holes. hole.

**Table 2.**

***Recapitulation of the results of the influence of Asilidae insects***

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Article Title** | **Writer** | **Year** |
| 1. | To robber flies fauna (Diptera: Asilidae) of Mordovia, Russia | Dmitry M. Astakhov, ,Alexander B. Ruchin, Olga D. Romadina, Ivan M. Pristrem | 2019 |
| 2. | Serangga Predator pada Ekosistem Padi Sawah di Kecamatan Tombatu, Kabupaten Minahasa Tenggara | Herianto I. Kojong, Moulwy F., Noni N. Wanta | 2014 |
| 3. | Identifikasi Predator Tanaman Padi (*Oryza sativa*) Pada Lahan Yang Diaplikasikan Dengan Pestisida Sintetik | Fitriani | 2018 |
| 4. | Keanekaragaman Serangga Parasitoid untuk Pengendalian Hama pada Tanaman Kehutanan | Yeni Nuraeni, Illa Anggraeni dan Wida Darwiati | 2017 |
| 5. | Robber Flies, Asilidae (Insecta: Diptera: Asilidae) | E. M. Finn | 1969 |
| 6. | Keanekaragaman Jenis Belalang (Ordo Orthoptera) Di Pertanian Kacang Hijau (Vigna radiata L.) Desa Manusak Kabupaten Kupang | Chatarina Gradict Semiun , Yulita Iryani Mamulak | 2019 |

Species of the Orthoptera order in agricultural ecosystems and plantation forests have a role as plant eaters. The plant-eating families Orthoptera in agriculture and plantation forests include Acrididae, Pyrgomorphidae, and Tetrigidae. From the observations made, it was found that locusts were found in Ageratina riparia (Regel) R.M.King & H.Rob, Ageratum sp, Impatiens platypetala (Lindl), Kyllinga sp, Polytrias sp, Thelypteris sp and others in plantation forest ecosystems while in agricultural ecosystems it was observed from Damage to corn leaves caused by locusts. This research is supported by (Ullah, 2012) stating that grasshoppers belong to the order Orthoptera: Acrididae are plant eaters that are needed in the prairies of the western United States.

In the agricultural ecosystem, the insects found come from Acrididae. This is the same as plantation forests which were later discovered from the families Tetrigidae and Pyrgomorphidae. Generally plant-eating grasshoppers from the Acrididae family. Even though it is found in agriculture and plantation forests, it has a different KR. In the agricultural ecosystem there are no species from the families Tetrigidae and Pyrgomorphidae.

Parasitoids are insects that play an important role in biological control, this occurs because of a phase when parasitoid insects live in their host's body during the life process. Parasitoids can eat eggs, larvae to adult/ imago insects. The presence of parasitoids can reduce the presence of locust species in agricultural areas.

B

A

Conclusion

Based on the results of the meta analysis, it was concluded that many various families, species and individuals of grasshoppers belong to the Orthoptera Order: Acrididae found in many plantation forest ecosystems including: 2096 individuals consisting of 5 species and 3 families, not comparable to agricultural ecosystems including: 1029 individuals, consisting of 3 species and only 1 family. The research continued by comparing habitat types and heights in natural forest areas, plantation forests and agricultural ecosystems in order to obtain data regarding the potential of grasshoppers belonging to the Orthoptera Order: Acrididae to become pests that are detrimental to humans. A meta-analysis of the articles carried out resulted in the conclusion that there is an influence of asilidae on the decline in the grasshopper population as a pest in the agricultural ecosystem. The research was carried out to find out whether there was an influence of parasitoids, namely asilidae, on the grasshopper population and its impact on the agricultural ecosystem.

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1. \*Corresponding Author: First Author, Second Author, Third Autor, full affiliation address.

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