Selcuk Journal of Agriculture and Food Sciences

https://dergipark.org.tr/tr/pub/selcukjafsci

Research Article

(2025) 39(1), 240-248 DOI:10.15316/SJAFS.2025.020 e-ISSN: 2458-8377 Selcuk J Agr Food Sci

Lepidoptera Species in Selçuk University Alaeddin Keykubat Campus Area

Duha Hatem Hussein Albaraj[1], Ekrem Ögür[1,*]

[1] Selçuk University, Faculty of Agriculture, Department of Plant Protection, Konya, Türkiye

HIGHLIGHTS

- 37 species belonging to 11 families in the order Lepidoptera were identified in the Selçuk University.
- In Rhopalocera, butterflies, 16 genera and 18 species belonging to 5 families were identified.
- In Heterocera, moths, 17 genera and 19 species belonging to 6 families were identified.
- Nymphalidae (7 species) and Noctuidae (8 species) were the families with the highest number of species detected.

Abstract

This study was conducted in April-September 2023 to determine the Lepidoptera species in the Selçuk University Alaeddin Keykubat campus area. Four different methods were used to collect butterfly specimens. The first of these methods is the sweep net method, which allows catching Rhopalocera adults in April-September when they fly actively in nature, or on plants. Robinson-type light traps powered by a 125 W mercury vapor bulb were used as the second method for catching Heterocera species. In the third method, the specimens were captured in production areas such as vegetable fields, vine and apple orchards with species-specific delta-type sexual attractant pheromone traps in order to determine the presence of lepidopteran species specific to these areas. The last method is the butterfly walk method, which is based on the collection of eggs, larvae and pupae of pre-adult butterflies during field observation. The collected specimens were prepared for diagnosis in the laboratory and species identifications were made. As a result of the study, 37 species belonging to 11 families in the order Lepidoptera were identified in the Selçuk University Alaeddin Keykubat campus area. In Rhopalocera, butterflies, 16 genera and 18 species belonging to 5 families were identified. Among these families, the family Nymphalidae with 7 species was the family having the most species detected. In Heterocera, moths, 17 genera and 19 species belonging to 6 families were identified. Among these families, Noctuidae, with 8 species, was the family having the most species detected.

Keywords: Alaeddin Keykubat Campus; Butterfly; Konya; Lepidoptera; Selçuk University

1. Introduction

Insects have a very important place in human life due to their diversity, ecological role, agriculture and impact on human health (Rosenberg et al. 1986). In a popular sense, "insect" usually refers to familiar pests or disease carriers such as bedbugs, houseflies, clothes moths, aphids, mosquitoes, fleas, horseflies, etc. There are

Citation: Albaraj DHH, Ögür E (2025). Lepidoptera species in Selçuk University Alaeddin Keykubat campus area. *Selcuk Journal of Agriculture and Food Sciences*, 39(1), 240-248. https://doi.org/10.15316/SJAFS.2025.020
Corresponding Author E-mail: ekremogur@selcuk.edu.tr
Received date: 01/01/2025
Accepted date: 19/03/2025

also many beneficial insects such as honeybees, silkworms and ladybirds (Gillott 2005). Insects belong to the class Insecta of the Arthropoda phylum of the animal kingdom. There are 26 orders of insects in the subclass Pterygota and the orders with the most species are Coleoptera, Lepidoptera, Hymenoptera and Diptera (Kansu 2000; Ülger 2022).

The order Lepidoptera, which includes butterflies and moths in the class Insecta, is second only to Coleoptera in terms of species richness. Lepidoptera is an insect order with more than 250,000 species and accounts for about a quarter of all known insect species (Grimaldi and Engel 2005). The order Lepidoptera is also known as the "Scalewings". The Lepidoptera is divided into two suborders: "butterflies (Rhopalocera)" and "moths (Heterocera)" (Kansu 2000; Gullan and Cranston 2014). Butterflies (Rhopalocera) are usually brightly colored, mostly diurnal, wings closed at rest, antennae with knobs, body slender and smooth, pupa in chrysalis structure, hard and silky, without frenulum, the structure that connects the forewing to the hindwing. Moths (Heterocera) are usually dull in appearance and nocturnal, their wings are open at rest, their antennae are hairy or thread-like, their bodies are more densely hairy, their pupae have a silky structure called cocoon, and they have a frenulum (Kansu 2000; Gullan and Cranston 2014).

Lepidoptera are an indicator of a healthy environment and ecosystem, and are a part of life on Earth and an important component of its rich biodiversity. They are also an important component of the food chain and are prey for birds, bats and other insectivores. These insects are widely used by ecologists as model organisms to study the impact of habitat loss, fragmentation and climate change (Ghazanfar et al. 2016; Ögür and Çetin 2018).

Lepidoptera have always attracted the attention of human beings due to both their elegance and visual appeal. For this reason, they are used in weddings, birthdays, education, academic studies, fashion and design (Isbill 2003; Rogers 2013; Padilla et al. 2021). In addition, there are species that cause significant economic losses in cultivated plants. For example, the larvae of *Cydia pomonella* (L., 1758) (Lepidoptera: Tortricidae) directly damage the fruit (Birgücü and Erol 2021). Another pest, *Lobesia botrana* (Denis & Schiffermüller 1775) (Lepidoptera: Tortricidae) is one of the main pests of grapevines (Venette et al. 2003). *Spodoptera littoralis* (Boisd., 1833) (Lepidoptera: Noctuidae) larvae feed on the leaves, flowers, and fruits of vegetables, causing quality and yield loss (Karlsson Green 2021). Another important pest, *Helicoverpa zea* (Boddie, 1850) (Lepidoptera: Noctuidae) causes great damage to more than 100 crop plants such as corn, sorghum, cotton, eggplant, pepper and tomato (Jackson et al. 2008).

Selçuk University Alaeddin Keykubat (SUAK) campus, where the study was carried out, is one of the leading campuses of our country with an area of 10,000 da. More than half of this area is vegetative landscape, with a total of 6,270 da designated as green space. This means that 62.7% of the campus consists of green areas. Selçuk University Faculty of Agriculture has a production area of approximately 120 da in which various vegetables (*Phaseolus vulgaris* L., *Solanum lycopersicum* L., *Daucus carota* L. and *Cucumis sativus* L.), field crops (*Zea mays* L., *Triticum aestivum* L., *Helianthus annuus* L. and medicinal aromatic plants) and various orchards (*Malus communis* L., *Pyrus communis* L., *Fragaria ananassa* Duch. and *Vitis vinifera* L.) are grown. In addition, various vegetables and fruits are grown in hobby gardens of 30 da within the campus.

In this study, it was aimed to determine the Lepidoptera species in the campus area of SUAK. Determination of Lepidoptera species in the research area is important for the conservation of butterfly species identified in this area and to determine the increase or decrease in species in future studies. In addition, it is important to determine the species that may cause damage to the landscape plants in the campus area and the cultivated plants in the production areas of the Faculty of Agriculture and to take necessary measures against the pests to be identified. The fact that no previous study has been conducted on the determination of Lepidoptera species in SUAK campus area reveals that this study is unique.

This study was carried out between April and October 2023. Field trips were organized in the campus area of SUAK, and light and pheromone traps were set, where diurnal and nocturnal lepidopteran specimens were collected. The species found were identified with the help of literature and artificial intelligence applications (Seek, Picture Insect, and Google Lens).

2. Materials and Methods

2.1. Capturing of Lepidoptera species

Adults were generally caught during the 6-7 month period from April to October, when lepidoptera began to fly actively, in the landscape areas of SUAK campus and in the production areas of Selçuk University Faculty of Agriculture, which were determined as study areas for capturing Lepidoptera species (Figure 1). There are approximately 250 types of ornamental plants in the campus landscape areas. The most common ones are; *Lavandula angustifolia* Mill., *Rosa* spp., *Platanus orientalis* L., *Anthemis nobilis* L. and *Picea pungens* Engelm. There are also a wide variety of vegetables (*Phaseolus vulgaris* L., *Solanum lycopersicum* L., *Daucus carota* L. and *Cucumis sativus* L.), field crops (*Zea mays* L., *Triticum aestivum* L., *Helianthus annuus* L. and medicinal aromatic plants), and various fruit gardens (*Malus domestica* L., *Pyrus communis* L., *Fragaria* spp. and *Vitis vinifera* L.) in the production areas of Selçuk University Faculty of Agriculture.

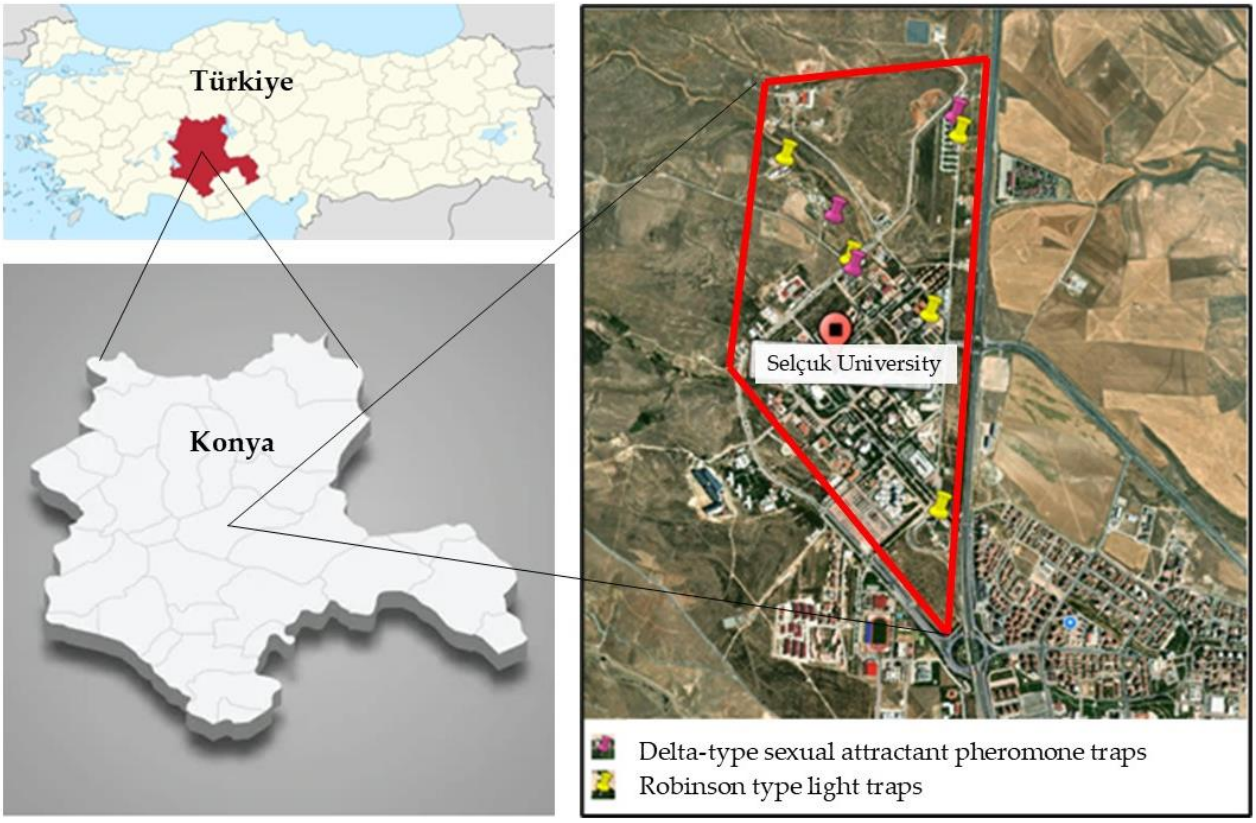

Figure 1. Map of the research area. Locations where the Robinson-type light traps and the delta-type sexual attractant pheromone traps were set up are pointed.

2.1.1. Butterfly walk method

The larvae collected during field observations were cultured on the plant they were found on and adults were obtained. The adults obtained were used for identification purposes. Some Archips larvae were collected by hand from cherry and maple trees and cultured in the laboratory to obtain adults.

2.1.2. Trapping with sweep net

A sweep net was used to collect diurnal butterflies. Trapping with a sweep net was done every day during the daylight hours from the end of April, when diurnal butterflies were actively flying in nature, until the end of September, 2023. The captured specimens were immediately placed in a killing bottle containing cyanide and taken to the laboratory on the same day for stretching and pinning (Perveen and Fazal 2013; Gibb 2014).

2.1.3. Trapping with light traps

Robinson-type light traps working with 125 W mercury vapor bulbs were used to catch the moths. Moths were collected with light traps in five different locations in the SUAK campus area from May to the end of September, 2023 and for two weeks in each location. Boxes containing DDVP impregnated sawdust were placed in the chamber section of the light trap to ensure that the butterflies that came to the trap died. In some cases, rehydration was performed to prevent the samples that were too dry from breaking during the stretching process (Perveen and Fazal 2013; Gibb 2014). The coordinates and dates of the light traps set up in the SUAK campus area are shown in Table 1.

Table 1. Coordinates and installation dates of Robinson-type light traps established in Selçuk University Alaeddin Keykubat campus area.

Trap name	Trap coordinates	Dates of trap installation
Trap 1 - Greenhouse	38°01'49"N 32°30'31"E	23.05.2023
Trap 2 - Farm	38°02'05"N 32°30'20"E	23.06.2023
Trap 3 - Landscape area	38°01'42"N 32°30'52"E	21.07.2023
Trap 4 - Tram	38°01'09"N 32°30'53"E	4.08.2023
Trap 5 – Hobby garden	38°02'12"N 32°30'52"E	18.08.2023

2.1.4. Trapping with pheromone traps

In order to determine the presence of pest species specific in production areas such as vine greenhouse and apple orchard, moth trapping was carried out with species-specific pheromone traps. For this purpose, delta-type sexual attractant pheromone traps were used against grapevine moth (*Lobesia botrana*) in vine greenhouses, tomato moth (*Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae)) in hobby gardens, and codling moth (*Cydia pomonella*) in the apple orchard. These traps were established in production areas starting from the end of April and the first week of May, 2023 in accordance with the biology of the species. Observations were made weekly until adults were caught in the traps (Table 2). If necessary, pheromone capsules were replaced with new ones after 4-6 weeks.

Table 2. Coordinates and installation dates of delta-type sexual attractant pheromone traps established in Selçuk University Alaeddin Keykubat Campus Area.

Trap name	Trap coordinates	Dates of trap installation
Trap 1 - Apple orchard	38°01'57"N 32°30'33"E	28.04.2023
Trap 2 - Vine greenhouse	38°01'47"N 32°30'32"E	12.05.2023
Trap 3 - Hobby garden	38°02'12"N 32°30'52"E	26.05.2023

In addition to all these collection methods, lepidopter larvae found on plants were collected, reared in the laboratory, and adults were obtained.

2.2. Evaluation of Lepidoptera Species

After killing the captured lepidopterans, they were brought to the laboratory without drying and immediately stretched on stretching boards. The insect was positioned in a natural standing position on the stretching board, the samples were fixed in a horizontal position with the wings, legs, and antennae at body level and were left to dry at room temperature for at least 15 days and then removed from the stretching boards and labeled. The samples removed from the stretching boards were labeled with a label indicating the place of collection, date of collection and host plant information and were examined for identification. The collected samples were placed in storage boxes containing naphthalene to protect them from ants and museum insects (Gibb 2014).

2.3. Identification of Lepidoptera Species

Specimens collected in the study were identified according to their external morphological characters. All collected specimens were identified using the literature (Şengün and Güneyi 1968; Horak and Komai 2006; Bıçak 2007; Zobar and Genç 2008; Ioriatti et al. 2012; Koçak and Kemal 2012; Serik 2015; Parlak 2017; Mediouni Ben Jemâa et al. 2023) and verified by Prof. Dr. Levent ÜNLÜ. In addition, applications such as Seek, Picture Insect and Google Lens were also used for species identification.

3. Results

As a result of the study carried out to determine the Lepidoptera species in the SUAK campus area, a total of 37 species belonging to 33 genera from 11 families of the order Lepidoptera were identified. In the study, 1,871 individuals from 5 families, 16 genera and 18 species of diurnal butterflies were collected in SUAK campus area. Among these, the Nymphalidae with 7 species was the family having the most species detected within the Rhopalocera suborder. This was followed by Pieridae (4), Lycaenidae (4), Papilionidae (2) and Hesperiidae (1) families (Table 3). *Pieris brassicae* (L., 1758) (Lepidoptera: Pieridae) was found to be the most abundant species among the diurnal butterflies. It is thought that this species is polyphagous and its host plants are widespread in the campus area. The least abundant species was *Iphiclides podalirius* (L., 1758) (Lepidoptera: Papilionidae). Due to the fact that the study area was open to the prevailing winds, sometimes there were difficulties in capturing butterflies with the sweep net. This is one of the reasons for the low number of butterflies caught especially in the Papillionidae family.

Among the nocturnal butterflies, 2,971 individuals were collected from 17 genera and 19 species belonging to 6 families. Among these, the Noctuidae with 8 species was the family having the most species detected within the Heterocera suborder. This was followed by Sphingidae (4), Tortricidae (3), Erebidae (2), Gelechiidae (1) and Lasiocampidae (1) families (Table 3). It was determined that *Agrotis crassa* (Hübner, 1803) (Lepidoptera: Noctuidae) was the most abundant nocturnal butterfly species and *Leucania loreyi* (Duponchel, 1827) (Lepidoptera: Noctuidae) was the least abundant species. In order for the Robinson-type light traps used to catch nocturnal butterflies to be more effective, areas with high plant diversity and dark areas were preferred in the campus area. However, the scarcity of dark areas in the campus area, the difficulty in reaching the electricity source in the dark areas and the disturbing behaviors of some animals (dogs, etc.) while going to check the traps caused difficulties in sampling.

4. Discussion

This study is unique as it is the first study to determine the Lepidoptera species in SUAK campus area. In such faunistic studies, unless the study area is the same, comparison with the results of previous studies on the subject is not very accurate. However, the results obtained from this study are similar to those of some previous studies. This study revealed that the Nymphalidae with 7 species was the family having the most species detected within the Rhopalocera suborder and followed by Pieridae, Lycaenidae, Papilionidae and Hesperiidae families. Among the diurnal butterflies, *Pieris brassicae* was the most abundant species. Similar results were obtained in the study conducted by Zobar and Genç (2008) to determine the species belonging to the order Lepidoptera in Terzioglu Campus of Çanakkale Onsekiz Mart University. As a result of the study, Nymphalidae family was determined as the family with the highest number of species in Rhopalocera suborder. This was followed by Pieridae, Hesperiidae, Papillionidae and Lycaenidae. As determined in our study, *Pieris brassicae* was the most frequently observed species in the campus area. In some other studies (Hüseyinoğlu and Atay 2017; Arslangündoğdu et al. 2018; Atay et al. 2019) conducted to determine Lepidoptera species in different parts of our country, it was determined that Nymphalidae was the family with the highest number of species in the Rhopalocera suborder. Not only in our country, but also in studies conducted on university campuses abroad, similar results have been found. Sebua and Nuñeza (2023) conducted a study to determine the species diversity of Lepidoptera in Western Mindanao State University (Philippines) and found that the family Nymphalidae was dominant, most abundant, and had the highest

Table 3. Suborder, family, species names, date of capture and capture method of individuals belonging to the order Lepidoptera detected in Selçuk University Alaeddin Keykubat Campus area

Suborder	Family	Species	Type of capture	Date of capture
Rhopalocera	Hesperiidae	*Thymelicus sylvestris* (Poda, 1761)	Sweep net	28.07.2023
	Pieridae	*Pieris brassicae* (Linnaeus, 1758)	Sweep net	28.07.2023
		Pieris rapae (Linnaeus, 1758)	Sweep net	28.07.2023
		Colias crocea (Fourcroy, 1785)	Sweep net	15.07.2023
		Pontia edusa (Fabricius, 1777)	Sweep net	16.07.2023
	Lycaenidae	*Aricia agestis* (Denis & Schiffermüller, 1775)	Sweep net	16.07.2023
		Eumedonia eumedon (Esper, 1780)	Sweep net	29.07.2023
		Lycaena alciphron (Rottemburg, 1775)	Sweep net	29.07.2023
		Polyommatus icarus (Rottemburg, 1775)	Sweep net	02.08.2023
	Nymphalidae	*Brintesia circe* (Fabricius, 1775)	Sweep net	02.08.2023
		Chazara briseis (Linnaeus, 1764)	Sweep net	15.08.2023
		Hyponephele lupina (Costa, 1836)	Sweep net	15.08.2023
		Hyponephele lycaon (Rottemburg, 1775)	Sweep net	15.08.2023
		Melanargia larissa (Geyer, 1828)	Sweep net	02.08.2023
		Melitaea trivia (Lederer, 1861)	Sweep net	01.07.2023
		Vanessa cardui (Linnaeus, 1758)	Sweep net	01.07.2023
	Papilionidae	*Iphiclides podalirius* (Linnaeus, 1758)	Sweep net	01.07.2023
		Papilio machaon (Linnaeus, 1758)	Sweep net	01.07.2023
Heterocera	Noctuidae	*Agrotis crassa* (Hübner, 1803)	Light trap	14.07.2023
		Agrotis segetum (Denis & Schiffermüller, 1775)	Light trap	24.07.2023
		Acontia lucida (Hufnagel, 1766)	Sweep net	23.07.2023
		Leucania loreyi (Duponchel, 1827)	Light trap	03.08.2023
		Mythimna unipuncta (Haworth, 1809)	Light trap	06.08.2023
		Noctua pronuba (Linnaeus, 1758)	Light trap	03.08.2023
		Spodoptera exigua (Hübner, 1803)	Light trap	10.08.2023
		Tyta luctuosa (Denis & Schiffermüller, 1775)	Light trap	03.08.2023
	Erebidae	*Grammodes stolida* (Fabricius, 1775)	Light trap	10.08.2023
		Psalis pennatula (Fabricius, 1793)	Light trap	10.08.2023
	Gelechiidae	*Tuta absoluta* (Meyrick, 1917)	Pheromone trap	12.08.2023
	Lasiocampidae	*Malacosoma neustria* (Linnaeus, 1758)	Light trap	17.08.2023
	Sphingidae	*Hyles euphorbiae* (Linnaeus, 1758)	Light trap	21.08.2023
		Hyles nicaea (de Prunner, 1798)	Light trap	18.08.2023
		Agrius convolvuli (Linnaeus,1757)	Light trap	18.08.2023
		Macroglossum stellatarum (Linnaeus, 1758)	Light trap	12.08.2023
	Tortricidae	*Archips rosana* (Linnaeus,1758)	Larvae culture	28.07.2023
		Cydia pomonella (Linnaeus,1758)	Pheromone trap	01.05.2023
		Lobesia botrana (Denis & Schiffermüller, 1775)	Pheromone trap	22.05.2023

species richness. The results of some other studies (Khan et al. 2007; Ilhamdi et al. 2023; Ruales et al. 2023) also showed that the most abundant family was Nymphalidae. These results should not be surprising because, with approximately 7,080 known species worldwide, the Nymphalidae are the largest butterfly family (Heppner 2008). On the other hand, Perveen and Fazal (2013) studied butterflies of Hazara University, Garden Campus, Mansehra, Pakistan and found that Pieridae was the dominant family and followed by Nymphalidae and Papilionidae.

Noctuidae is one of the largest families of Lepidoptera order (Ribas-Marques et al. 2022). In our study the Noctuidae with 8 species was the family having the most species detected within the Heterocera suborder and followed by Sphingidae, Tortricidae, Erebidae, Gelechiidae and Lasiocampidae families. Hüseyinoğlu and Atay (2017) carried out a study to determine the Lepidoptera fauna in Darboğaz, Bolkar Mountains (Niğde) and detected that the highest number of genera in moths, belonged to Noctuidae, followed by Geometridae, Crambidae and Pyralidae. Seven and Çakır (2019) studied the Heterocera fauna of eastern Türkiye and determined that most of the identified species belonged to the family Noctuidae. By contrast, Sebua and Nuñeza (2023) did not find any Noctuidae in Western Mindanao State University.

Türkiye is one of the few countries in the world with continental characteristics in terms of biological richness (Can 2010). While there are 482 lepidopter species in the European continent, there are 400 species only in Türkiye and 45 of them are endemic. However, these species, which are an important part of biodiversity today, are rapidly decreasing and this decrease may occur as a result of natural effects as well as human effects (Çelik and Topsakal 2017). Lepidoptera have been recognized by experts as indicators of biodiversity (Ghazanfar et al. 2016). Their fragile and sensitive structure causes them to be unable to respond quickly to changes in their environment. Therefore, their struggle for survival is a serious warning about our environment (Ögür and Çetin 2018).

5. Conclusions

Abnormal weather events caused by climate change, which have become more pronounced in recent years, excessive chemical spraying in agricultural areas, soil, water and air polluted as a result of human activities rapidly affect lepidopter species, which are very sensitive to changes in their environment. For this reason, it is necessary to protect and increase natural environments as much as possible by avoiding all kinds of interventions that may harm the ecosystem. Although there are some species (*T. absoluta*, *C. pomonella*, *L. botrana*, etc.) that can be defined as pests among the species we detected, it should not be forgotten that they have a very important place in the ecosystem due to some other functions. All these species are very valuable for the biodiversity of the fauna of Türkiye and necessary measures should be taken for their conservation.

Selçuk University Alaeddin Keykubat campus area is one of the green campuses of our country and more than half of this area (62.7%) consists of landscape areas. Approximately 250 plant species in herbaceous, shrub and tree form are used in landscape areas. Diversity and richness in plant species affect the diversity and richness in insect species. It is thought that the diversity of plant species has an effect on the high number of species obtained as a result of the study. The determination of Lepidoptera species in SUAK is important for the conservation of the species to be identified in this area and to determine the increase or decrease in species in future studies. This study provided a basis for future studies on the species identification of Lepidoptera in Konya province. However, such studies should be continued in detail in order to determine the entire fauna of the region and contribute to the determination of the fauna of Türkiye.

Author Contributions: Conceptualization, E.Ö. and D.H.H.A.; methodology, D.H.H.A. and E.Ö.; validation, E.Ö. and D.H.H.A.; investigation, D.H.H.A.; resources, E.Ö. and D.H.H.A.; data curation, E.Ö. and D.H.H.A.; writing—original draft preparation, E.Ö. and D.H.H.A.; writing—review and editing, E.Ö.; visualization, E.Ö.; supervision, E.Ö. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: This study was summarized from Duha Hatem Hussein Albaraj's Master's Thesis entitled "The Determination of Lepidoptera Species in Selçuk University Alaeddin Keykubat Campus Area".

Conflicts of Interest: The authors declare no conflict of interest.

References

Arslangündoğdu Z, Bacak E, İhsanoğlu MA (2018). İstanbul-rumelikavağı'nın gündüz kelebekleri. *Turkish Journal of Bioscience and Collections*, *2*(1): 1-11.

Atay E, Yıldırım H, Tatlı M (2019). Bursa ili Rhopalocera (*Lepidoptera)* faunası ve yeni kayıtlar. *Journal of Anatolian Environmental and Animal Sciences*, *4*(2): 70-75. https://doi.org/10.35229/jaes.539213

Bıçak G (2007). Istanbul Belgrad ormanı Lepidoptera faunası. Master Thesis, Istanbul University (Unpublished), Türkiye.

Birgücü AK, Erol AB (2021). Isparta ili elma bahçelerinde *Cydia pomonella* (L.) (Lepidoptera: Tortricidae)'nın larva popülasyonun ve vuruklu meyve oranının belirlenmesi. *Türk Tarım ve Doğa Bilimleri Dergisi*, *8*(2): 453-462.

Can F (2010). Evaluation of morphological characters and male genitalia features of emerald moths (Lepidoptera: Geometridae, Geometrinae) from Turkey. *African Journal of Agricultural Research*, *5*(9): 867-873.

Çelik P, Topsakal Y (2017). Butterfly watching in Turkey within the scope of alternative tourism. Innovation and Global Issues in Social Science, 27 - 29 Nisan 2017,Antalya, Türkiye, pp. 100-105.

Ghazanfar M, Malik MF, Hussain M, Iqbal R, Younas M (2016). Butterflies and their contribution in ecosystem: A review. *Journal of Entomology and Zoology Studies*, *4*(2): 115-118.

Gibb TJ (2014). Contemporary insect diagnostics: the art and science of practical entomology. Academic Press, Oxford- England, p. 1-336.

Gillott C (2005). Entomology. Springer Science & Business Media. Springer Dordrecht. p. 1-832 https://doi.org/10.1007/1-4020-3183-1

Grimaldi D, Engel MS (2005). Evolution of the Insects. Cambridge University Press, USA. p. 1-755.

Gullan PJ, Cranston PS (2014). The insects: an outline of entomology. Wiley-Blackwell, USA. p. 1-624.

Heppner JB (2008). Butterflies (Lepidoptera: Rhopalocera). In: Capinera, J.L. (eds) Encyclopedia of Entomology. Springer, Dordrecht. pp. 623-626 https://doi.org/10.1007/978-1-4020-6359-6_497

Horak M, Komai F (2006). Olethreutine Moths of Australia:(Lepidoptera: Tortricidae). Csiro Publishing, Australian. p. 1-521.

Hüseyinoğlu Y, Atay E (2017). A faunistic study of diurnal and nocturnal Lepidoptera in Darboğaz, Bolkar Mountains (Niğde, Turkey). *Journal of the Kansas Entomological Society*, *90*(1): 44-53.

Ilhamdi ML, Al Idrus A, Santoso D, Hadiprayitno G, Syazali M, Hariyadi I (2023). Abundance and diversity of butterfly in the Lombok Forest Park, Indonesia. *Biodiversitas Journal of Biological Diversity*, *24*(2). https://doi.org/10.13057/biodiv/d240205

Ioriatti C, Lucchi A, Varela LG (2012). Grape berry moths in western European vineyards and their recent movement into the New World. *Arthropod management in vineyards: pests, approaches, and future directions*, 339-359. https://doi.org/10.1007/978-94-007-4032-7_14

Isbill J A (2003). The continuing influence of René Lalique in jewelry design. California State University, Dominguez Hills, California, USA. p. 1-13.

Jackson RE, Bradley JR, Van Duyn J, Leonard BR, Allen KC, Luttrell R, Head G (2008). Regional assessment of *Helicoverpa zea* populations on cotton and non-cotton crop hosts. *Entomologia Experimentalis et Applicata*, *126*(2), 89-106. https://doi.org/10.1111/j.1570-7458.2007.00653.x

Kansu IA (2000). Genel entomoloji (Dokuzuncu Baskı). Birlik Matbaacılık-Yayıncılık, Ankara, Türkiye. p. 1-425.

Karlsson Green, K (2021). The effects of host plant species and larval density on immune function in the polyphagous moth *Spodoptera littoralis*. *Ecology and Evolution*, *11*(15), 10090-10097. https://doi.org/10.1002/ece3.7802

Khan MR, Rafi MA, Munir M (2007). Biodiversity of butterflies from districts Kotli, Mipur and Azad Kashmir. *Pakistan Journal of Zoology*, 39, 27–34.

Koçak A, Kemal M (2012). Iğdır Kelebekleri, Centre for Entomological Studies, Ankara, Türkiye, p. 253

Mediouni Ben Jemâa J, Soltani A, Djebbi T, Mejri I, Kanyesigye D, Otim MH (2023). The maize caterpillar *Mythimna* (= Leucania) *loreyi* (Duponchel, 1827)(Lepidoptera: Noctuidae): Identification, distribution, population density and damage in Tunisia. *Insects*, *14*(10): 786. https://doi.org/10.3390/insects14100786

Ögür E, Çetin H (2018). Kentsel alanların biyoindikatörleri böcekler. Uluslararası Yeşil Başkentler Kongresi, 8-11 Mayıs 2018, Konya, Türkiye, pp. 884-896.

Padilla JJ, Collado JL, García CGG, Collado CJL (2021). Spatial and economic assessment of butterfly-based handicrafts as a tourism service provided by rural populations. *Cuadernos de desarrollo rural= International journal of rural development*, *18*(1): 6. https://doi.org/10.11144/Javeriana.cdr18.seab

Parlak NN (2017). Istanbul-Büyükada'nın Lepidoptera türleri. Yüksek Lisans, Istanbul Üniversitesi, Türkiye.

Perveen F, Fazal F (2013). Biology and distribution of butterfly fauna of Hazara university, garden campus, Mansehra, Pakistan. *Open Journal of Animal Sciences*, 3(2): 28-36. https://doi.org/10.4236/ojas.2013.32A004

Rosenberg DM, Danks HV, Lehmkuhl DM (1986). Importance of insects in environmental impact assessment. *Environmental management*, 10: 773-783. https://doi.org/10.1007/BF01867730

Ribas-Marques E, Díaz-Calafat J, Boi M (2022). The role of adult noctuid moths (Lepidoptera: Noctuidae) and their food plants in a nocturnal pollen-transport network on a Mediterranean island. *Journal of Insect Conservation*, 26(2): 243-255. https://doi.org/10.1007/s10841-022-00382-7

Rogers L (2013). All about professional butterfly farming. https://www.butterflyboutique.net/ebooks/11aapbf84612/en/All_About_Professional_Butterfly_Farming.pdf (access date: 4 February 2024).

Ruales JJJ, Demetillo MT, Along AA, Mohagan AB, Jumawan JH (2023). Diversity and status of true butterflies (Lepidoptera: Papilionoidea) in two ecological parks of Butuan City, Agusan del Norte, Philippines with new locality record. *Species*, 24: 1-12. https://doi.org/10.54905/disssi/v24i73/e46s1539

Sebua CMD, Nuñeza OM (2020). Species diversity of Lepidoptera in Western Mindanao State University–experimental forest area, Zamboanga City, Philippines. *Entomology and Applied Science Letters*, *7*(1): 33-43.

Serik T (2015). Moldova'nın gündüz kelebekleri (Lepidoptera, Rhopalocera) faunası. PhD Thesis, Istanbul University (Unpublished), Turkey Türkiye.

Seven E, Çakır A (2019). A Contribution to the moth fauna (lepidoptera, heterocera) of Elazığ Province, Turkey. *Bitlis Eren University Journal of Science and Technology*, *9*(1): 18-21.

Şengün A, Güneyi N (1968). İstanbul gündüz kelebekleri, Fen Fakültesi Basımevi, İstanbul, Türkiye, p.103.

Ülger G (2022). Kahramanmaraş ili ve çevresinde yer alan Pterygota (*Arthropoda Insecta*) taksonları üzerine ekolojik ve faunistik araştırma. PhD Thesis, Nevşehir Hacı Bektaş Veli University (Unpublished), Türkiye.

Venette RC, Davis EE, DaCosta M, Heisler H, Larson M (2003). Mini risk assessment grape berry moth, *Lobesia botrana* (Denis & Schiffermuller)[Lepidoptera: Tortricidae]. *USDA CAPS PRA, Department of Entomology, University of Minnesota, St. Paul, Minnesota, USA*. p.129.

Zobar D, Genç H (2008). Çanakkale Onsekiz Mart Üniversitesi Terzioğlu yerleşkesi gündüz kelebekleri (Lepidoptera: Rhopalocera). *Tekirdağ Ziraat Fakültesi Dergisi*, *5*(3): 309-321.