Türkiye Tarımsal Araştırmalar Dergisi
dergipark.org.tr/tutad

Research Article

Turk J Agric Res
2025, 12(1): 44-51
© TÜTAD
ISSN: 2148-2306
e-ISSN: 2528-858X
doi: 10.19159/tutad.1628124

Diversity and Distribution of Coccinellidae Species in the Karacadağ Region of Türkiye*

Zeynep KAÇAR[1], Halil DİLMEN[2]**

[1]*Siirt University, Graduate School of Natural and Applied Sciences, Department of Plant Protection, Siirt, TÜRKİYE*

[2]*Siirt University, Faculty of Agriculture, Department of Plant Protection, Siirt, TÜRKİYE*

Received: 27.01.2025 **Accepted:** 14.03.2025

ORCID ID (By author order)
orcid.org/0009-0004-8420-1578 orcid.org/0000-0002-3802-9947
**Corresponding Author: halildilmen@siirt.edu.tr

Abstract: This study was conducted to determine and examine species of the Coccinellidae family in the Karacadağ region (Diyarbakır-Şanlıurfa), Türkiye. The research took place between April-October 2023 and April-June 2024. Sampling was carried out at randomly selected points in various habitats including agricultural areas, forests, meadows, and non-agricultural lands such as rocky areas and fields with weeds. The sampling of Coccinellid species was conducted using hand nets, hand collection, and beating sheets (Japanese umbrellas). Collected specimens were preserved under suitable conditions and transported to the Entomology Laboratory of the Department of Plant Protection at Siirt University for morphological examination. Species identification was conducted using stereo microscopes, and photographs were taken. A total of 281 samples were collected, representing 12 species belonging to 10 genera: *Coccinella septempunctata* (Linnaeus), *Oenopia conglobata* (Linnaeus), *Hippodamia variegata* (Goeze), *Adalia decempunctata* (Linnaeus), *Adalia bipunctata* (Linnaeus), *Propylea quatuordecimpunctata* (Linnaeus), *Pharoscymnus pharoides* (Marseul), *Stethorus punctillum* (Weise), *Nephus nigricans* (Weise), *Hyperaspis quadrimaculata* (Redtenbacher), *Hyperaspis* spp., *Exochomus nigromaculatus* (Goeze). The most commonly found species were *C. septempunctata* (113 individuals), *H. variegata* (80 individuals), and *A. decempunctata* (31 individuals). This research contributes to understanding the richness and distribution of Coccinellidae species in the region, serving as a crucial starting point for future ecological and plant protection studies.

Keywords: Insects, biological control, Coccinellidae, Karacadağ, *Coccinella septempunctata*

1. Introduction

The global use of pesticides in agricultural production was approximately 1.795.502,6 tons in 1990, rising to 3.531.959,08 tons by 2021 (Anonymous, 2024). Pesticide usage in Türkiye increased from around 10.000 tons in 1990 to approximately 18.200 tons by 2021 (Anonymous, 2024). These figures indicate a significant increase in pesticide usage globally and within Türkiye over the 1990 to 2021 period.

The excessive and prolonged use of chemical pesticides has led insects to adapt and develop resistance to these products (Kole et al., 2019). The uncontrolled increase in pesticide dosages not only leaves residues in plants, soil, water, and the atmosphere, but also poses significant threats to human health and the environment. This situation can disrupt ecosystem balance and decrease biodiversity (Lin et al., 2024). Residues in agricultural products create challenges for producers in marketing their goods (Bajwa and Sandhu, 2014). Additionally, chemical pesticides negatively impact beneficial insect species such as parasitoids, predators, and pollinators (Erdoğan, 2024).

Due to the environmental effects and potential harm to human health associated with chemical pesticides, there is widespread concern and debate worldwide regarding their use in pest management. Consequently, recent years have seen a surge in research on alternative methods to replace chemical pesticides. Biological control methods, in particular, stand out as effective strategies, utilizing

*: This study is derived from a part of the Master's Thesis entitled "Research on the Coccinellidae (Coleoptera) Family Around Karacadağ (Diyarbakır-Şanlıurfa) (In Turkish)" by the first author accepted by the Graduate School of Natural and Applied Sciences at Siirt University.

natural enemies of agricultural pests to regulate pest populations. These methods are seen as critical components within Integrated Pest Management (IPM), offering sustainable solutions that could replace chemical pesticides in agriculture (Tiwari, 2024).

Biological control is a pest management method that utilizes natural enemies present in the environment to keep pest populations below the economic damage threshold (Ehi-Eromosele et al., 2013). The Coccinellidae family plays a crucial role in biological control due to the large number of beneficial species it contains. The first successful application of biological control occurred in 1889, when entomologists introduced the coccinellid *Rodalia cardinalis* and the parasitoid *Cryptochaetum iceryae*, which effectively managed the invasive *Icerya purchasi*, thereby protecting the California citrus industry from potential financial disaster (Messing and Brodeur, 2018). Numerous biological control studies have since evaluated the biocontrol potential of Coccinellidae species in Türkiye and globally.

Globally, over 4.200 Coccinellidae species, distributed across approximately 490 genera, have been identified, with about 400 species in North America and around 110 species in Europe. In Türkiye, about 105 species have been documented (Oğuzoğlu et al., 2017). Significant studies on the ecology, taxonomy, population dynamics, biology, and efficacy of Coccinellidae species in biological control have been conducted worldwide and in Türkiye. Research on Coccinellidae fauna across different regions has revealed a broad range of species. Studies conducted in Türkiye and various regions of the world underscore the biodiversity and role of Coccinellidae species in biological control (Raimundo and van Harten, 2000; Öztürk and Muştu, 2018; Romanowski et al., 2019, 2023; Johari et al., 2020; Sünter, 2022).These studies highlight the importance of the Coccinellidae family in biological control and serve as essential resources for understanding species distribution and ecological roles.

Karacadağ, located in Southeastern Anatolia, Türkiye, is an extinct volcano known for its rich diversity of plants and insects (Ertekin, 2002). This region hosts a wide variety of insect species, which play vital roles in maintaining ecological balance. This study aims to identify species belonging to the Coccinellidae family in and around the Karacadağ region and to assess their populations, contributing to an understanding of the region's ecological balance.

2. Materials and Methods

This study was conducted during 2023 and 2024 in the Karacadağ region, which spans the provinces of Diyarbakır, Mardin, and Şanlıurfa (Figure 1). It focused on collecting various life stages (egg, larva, prepupa, pupa, and adult) of species belonging to the Coccinellidae family from the vegetation in both agricultural and non-agricultural areas.

Sampling of Coccinellidae species was conducted in the Karacadağ region and its surroundings during April-October 2023 and April-June 2024. Field visits were made at least once a month in accordance with the vegetation period of plants, with more frequent visits during peak population times based on the climate and field conditions of the surrounding districts. Samples were collected from various habitats, especially untreated areas.

For herbaceous plants, sampling involved visual inspections and sweep netting, while for woody plants, visual inspections and the beat method with a Steiner funnel were used. A 35 cm diameter standard net was used on annual plants, swept in a figure-eight pattern. After every 8-10 steps, insects trapped in the net were collected using a brush, aspirator, or by hand. For the beat method, branches were struck twice from each of the four sides of a tree, causing any insects to fall into a Steiner funnel, from which they were collected.

In the visual inspection method, herbaceous plants were checked from root to tip, while woody plants were inspected from all four sides. Specimens from each collection point were placed into pre-labeled collection jars with ethyl acetate to euthanize adults. Specimens were then cleaned of plant debris and stored in Petri dishes (9 cm in diameter) for preservation.

Non-adult specimens were collected along with their host plant material and placed in collection jars or transparent bags. These were cultured in 9 cm in diameter Petri dishes under controlled laboratory conditions (25±5 °C, 16 hours light/8 hours dark) until they reached the adult stage.

All collected specimens were brought to the Entomology Laboratory at the Department of Plant Protection, Faculty of Agriculture, Siirt University. Measurements and photographs were taken using an Olympus SC61 stereo microscope connected to an Olympus SC50 camera head and the Entry CellSens Olympus SC50 software. Each specimen was labeled with details of the collection plant, date, altitude, coordinates, and specimen count.

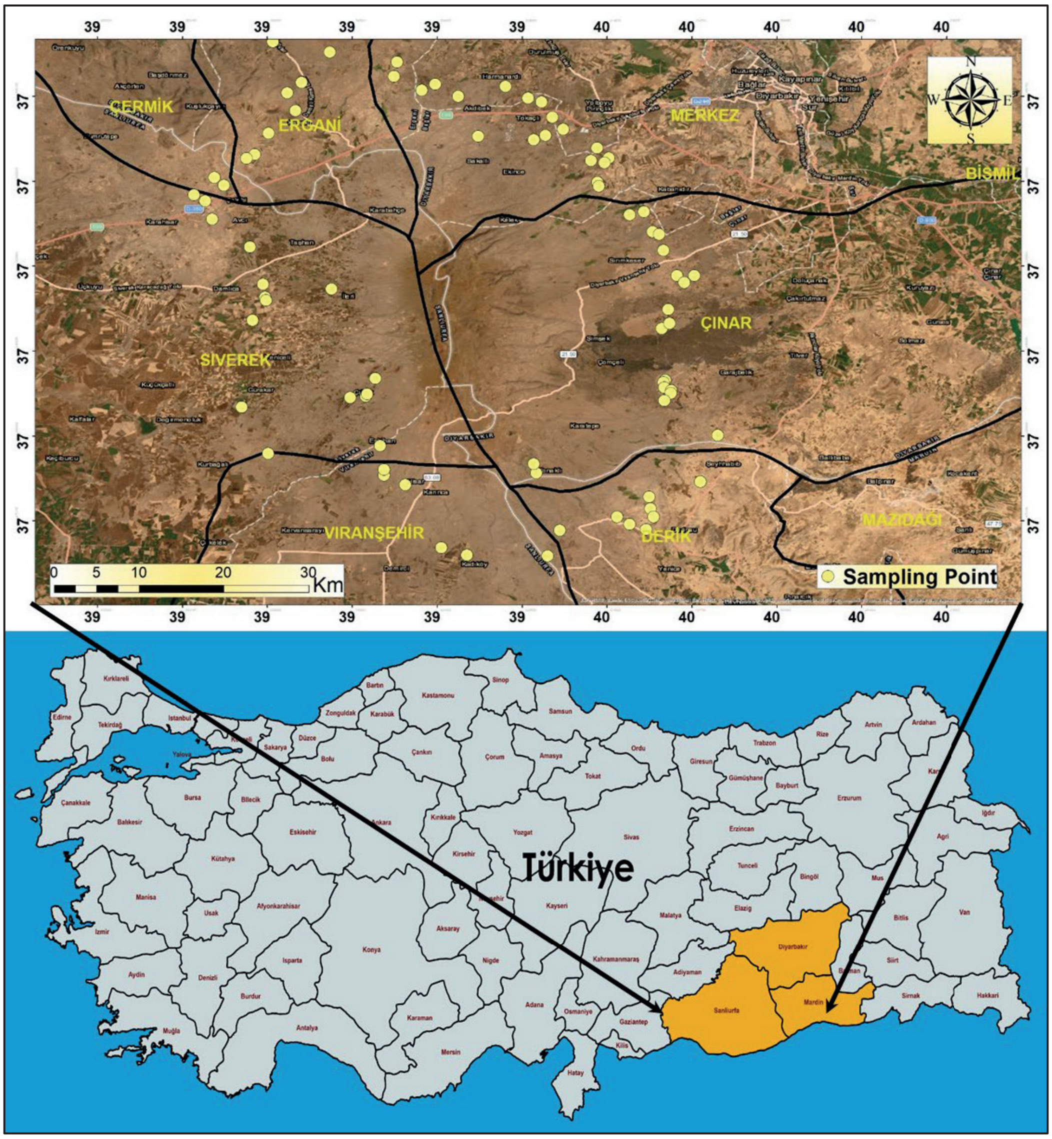

Figure 1. Map displaying the sampling locations in Karacadağ and surrounding areas where the study was conducted

Specimens with similar morphology were grouped, and remaining specimens were transferred to Eppendorf tubes with 96% ethanol for identification. All Coccinellidae species were identified by Dr. Derya ŞENAL, a retired expert in the field of entomology.

3. Results and Discussion

Sampling efforts in the Karacadağ region (Diyarbakır-Şanlıurfa) identified 12 species belonging to the Coccinellidae family. These species included *Coccinella septempunctata* (Linnaeus), *Oenopia conglobata* (Linnaeus), *Hippodamia variegata* (Goeze), *Adalia decempunctata* (Linnaeus), *Adalia bipunctata* (Linnaeus), *Propylea quatuordecimpunctata* (Linnaeus), *Pharoscymnus pharoides* Marseul, *Stethorus punctillum* (Weise), *Nephus nigricans* (Weise), *Hyperaspis quadrimaculata* (Redtenbacher), *Exochomus nigromaculatus* (Goeze), and *Hyperaspis* spp. (Table 1).

Fieldwork was conducted at 80 locations across agricultural and non-agricultural areas in the Karacadağ foothills, yielding a total of 281 individual specimens from the Coccinellidae family. The most common and abundant species were *C. septempunctata* (113 individuals), *H. variegata* (80 individuals), and *A. decempunctata* (31 individuals) (Table 1). Their presence in various plant species and habitats reflects their ecological flexibility and adaptability. In contrast, species with fewer individuals may depend more on specific habitats or host plants. For example, *E. nigromaculatus* (2 individuals),

Table 1. Genera and species of the Coccinellidae family identified in the Karacadağ region in 2023-2024, along with their host plants and individual counts

Genus	Species	Host plant	Individual count
Adalia Mulsant	*Adalia bipunctata* (Linnaeus, 1758)	Wheat, chickpea, weeds, rangeland, stony areas, pine tree	6
	Adalia decempunctata (Linnaeus, 1758)	Wheat, chickpea, plum tree, cherry tree, walnut tree, meadow area, stony areas, rangeland, weeds	31
Coccinella L.	*Coccinella septempunctata* (Linnaeus,1758)	Wheat, lentil, corn, rice, tomato, melon, pepper, cucumber, eggplant, meadow area, stony area, rangeland, weeds, oak tree	113
Exochomus Redtenbacher	*Exochomus nigromaculatus* (Linnaeus, 1758)	Rangeland, weeds	2
Hippodamia Mulsant	*Hippodamia variegata* (Goeze, 1777)	Mulberry tree	80
Hyperaspis Redtenbacher	*Hyperaspis quadrimaculata* (Redtenbacher, 1843)	Almond tree	14
	Hyperaspis spp.	Lentil, barley, cherry tree, pistachio tree, grassland, stony area, pasture, weed	1
Nephus Mulsant	*Nephus nigricans* (Weise, 1897)	Cherry tree, apricot tree, pistachio tree	2
Oenopia Ganglbauer	*Oenopia conglobata* (Linnaeus, 1758)	Mulberry tree	10
Stethorus Weise	*Stethorus punctillum* (Weise, 1891)	Lentil	17
Pharoscymnus Bedel	*Pharoscymnus pharoides* (Marsuel, 1868)	Rangeland, weeds	1
Propylae Mulsant	*Propylea quatuordecimpunctata* (Linnaeus, 1758)	Mulberry tree	4

N. nigricans (2 individuals), and *P. pharoides* (1 individual), as shown in Table 1, exhibited a more limited host plant range.

In this study, the seasonal population density of the Coccinellidae species showed variations in the population density of each species during the spring, summer, and autumn months.

As shown in Figure 2, *Adalia decempunctata* (L.) had a notably high population in spring (29 individuals), while its population density significantly decreased in summer and autumn (1 individual). *Coccinella septempunctata* (L.) exhibited high population densities in all three seasons, with 27 individuals in spring, 38 in summer, and 48 in autumn, indicating that this species maintained a stable and high population throughout the year (Figure 2).

Hippodamia variegata (Goeze) had the highest population in summer (50 individuals), with recorded densities of 20 individuals in spring and 10 in autumn. *Hyperaspis quadrimaculata* (Redtenbacher) had a noticeable population of 13 individuals in spring, but its population density dropped to 1 individual in autumn, and it was not observed during summer. *Stethorus punctillum* (Weise) had a significant population density of 17 individuals in spring, but it was not recorded in summer or autumn (Figure 2).

The other species detected in the study (*Exochomus nigromaculatus*, *Nephus nigricans*, *Oenopia conglobata*, *Pharoscymnus pharoides*, *Propylea quatuordecimpunctata*, *Hyperaspis* spp.) generally exhibited low population densities or were not found in certain seasons (Figure 2). According to the study findings, the population density of Coccinellidae species is generally sensitive to seasonal changes. For example, some species, such as *H. variegata*, reached the highest population densities in summer, while their populations significantly decreased in other seasons. Additionally, some species (*C. septempunctata*) maintained high and stable populations throughout the year, while the population densities of other species showed considerable seasonal variation (Figure 2). These seasonal population changes can be attributed to predator-prey relationships, climatic conditions, and other environmental factors within the ecosystem.

When examining Figure 3, which shows the population densities of Coccinellidae species in different habitats, it can be observed that *Propylea quatuordecimpunctata* exhibits the highest

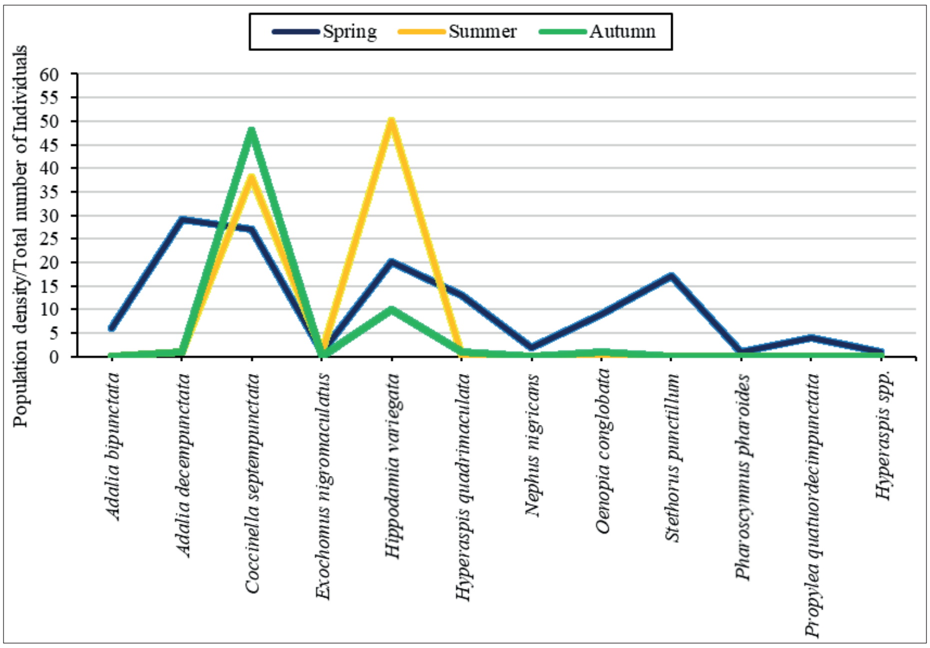

Figure 2. Seasonal population density of Coccinellidae species in the Karacadağ region

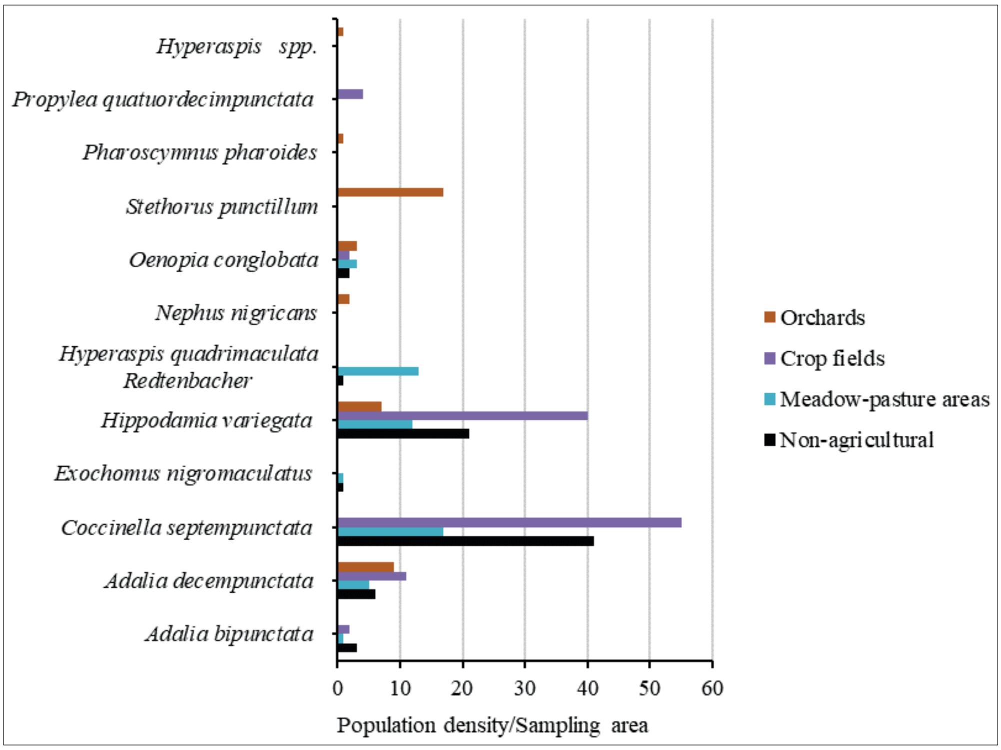

Figure 3. Density of Coccinellidae species according to habitats in the Karacadağ region

population density in crop fields. Although *Pharoscymnus pharoides* is found in orchards and non-agricultural areas, its population density is very low. *Stethorus punctillum* and *Nephus nigricans* are found exclusively in orchards, with *S. punctillum* exhibiting significant population density. *Oenopia conglobata* has low population density and has been observed in all habitat types. *Hyperaspis quadrimaculata* was recorded in meadow-pasture and non-agricultural areas but displayed low population density. *Hippodamia variegata* showed the highest population density in crop fields and was also detected in all other areas. *Exochomus nigromaculatus* was identified with a distinct population density in non-agricultural areas. *Coccinella septempunctata* was found in all habitats except orchards, with particularly high population densities in crop fields and non-agricultural areas. *Adalia decempunctata* was encountered in all habitats, with significant population density recorded in crop fields. *Adalia bipunctata* also showed high population density in crop fields and non-agricultural areas. Overall, *C. septempunctata* and *A. bipunctata* are seen to be the most common and densely populated species among the Coccinellids in different habitats, while *S. punctillum* has shown significant presence in orchards. Other species have been recorded with distinct population densities in more specific habitats (Figure 3).

In the assessment of Coccinellid species distribution across various habitats, field crops emerge as the most densely populated area for Coccinellids, accounting for 46%. Following closely, agricultural non-crop areas, grassland-pasture, and weeds represent the second-highest density at 26%. Grassland-pasture zones also contribute significantly to the Coccinellid population, comprising 18%. Conversely, fruit orchards have been identified as the habitat with the lowest density of Coccinellids, at just 10%. This reduced density may be linked to the negative impact of pesticides applied in these orchards (Figure 4).

Upon reviewing previous studies on Coccinellidae species in the provinces of Diyarbakır and Şanlıurfa. In this context, Efil et al. (2010) reported the identification of 14 Coccinellidae species in alfalfa fields situated in Akçakale, Şanlıurfa, with *H. variegata* being the most abundant species, followed by *Coccinella undecimpunctata*, *C. septempunctata*, and *Scymnus levaillanti*. They noted that these species maintained high populations throughout the year. Similarly, Şimşek and Bolu (2016) conducted research in pistachio cultivation fields in Diyarbakır to identify predatory species, reporting the presence of ten species associated with the Coccinellidae fauna. Altun and Çıkman (2019) documented the occurrence *of C. septempunctata*, *O. conglobata*, *S. punctillum*, and *C. undecimpunctata* in tomato-producing fields in Şanlıurfa. Furthermore, Duman et al. (2013), identified species such *as C. septempunctata, Scymnus levaillanti, Scymnus bivulneris, Scymnus pallipediformis, Scymnus flagellisiphanatus,* and *Nephus nigricans* in their study conducted in the rice fields of Karacadağ, Diyarbakır. However, in our study conducted in 2023 and 2024, no *Scymnus* species were observed. The absence of *Scymnus* species may be attributed to natural fluctuations in their populations, differences in sampling methods, or changes in the ecosystem.

When comparing the findings of this study with existing literature, several important ecological and agricultural points emerge. The prevalence of *C. septempunctata*, *H. variegata*, and *A. decempunctata* indicates that these species are the most commonly found and abundant in the region. The consistently high population density of *C. septempunctata* throughout the year aligns with its broad ecological tolerance and adaptability. Previous studies have yielded similar results to our findings, confirming the prevalence of

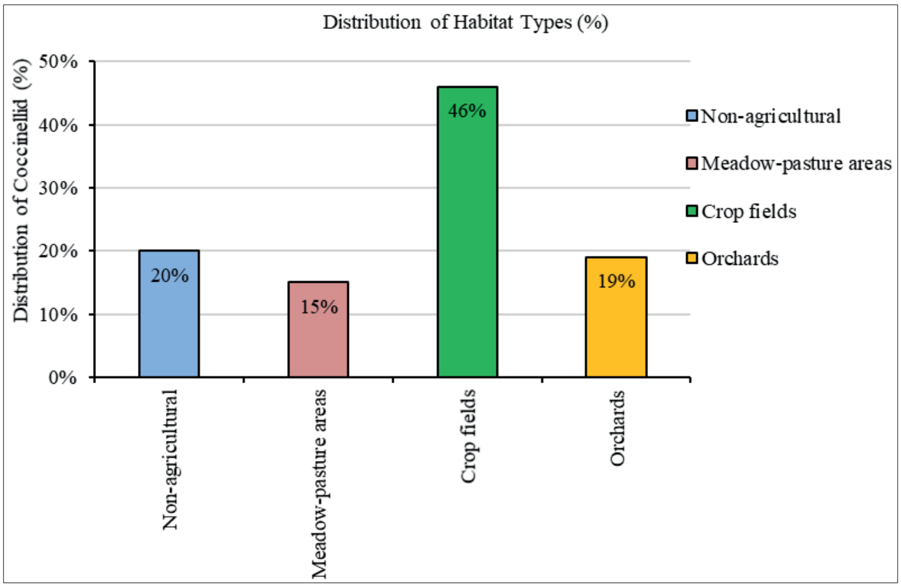

Figure 4. Percentage distribution of coccinellid species in different habitats

C. septempunctata and *H. variegata* as the most common species (Başar and Yaşar, 2011; Baştuğ and Kasap, 2015; Buğday et al., 2015). The presence of various Coccinellidae species across different plant types and habitats illustrates their ecological flexibility and adaptive capabilities. Species like *C. septempunctata* and *H. variegata* demonstrate wide habitat preferences and high population densities, reinforcing their adaptability to diverse environmental conditions. These findings are consistent with earlier research, where (Hodek, 1996) highlighted *C. septempunctata*'s wide habitat preferences. Furthermore, the dependency of certain species on specific host plants narrows their ecological niches. For example, the relationships of *P. pharoides* and *E. nigromaculatus* with limited host plants suggest they occupy narrow niches within the ecosystem.

The population dynamics of Coccinellidae species in the Karacadağ region provide crucial insights for integrated pest management strategies. Additionally, the conservation and support of less common species are vital for maintaining ecosystem balance. Implementing biological control strategies is essential for supporting the ecosystem services provided by Coccinellidae species and managing pest insect populations. In conclusion, this study presents findings on the population dynamics and ecological distributions of Coccinellidae species in the Karacadağ region, consistent with existing literature. Understanding the roles of these species within the ecosystem provides valuable information for developing biological control strategies and preserving biodiversity in the region. Future research could further elaborate on these findings, contributing to the enhancement of ecosystem services.

4. Conclusions

This study offers valuable insights into the Coccinellidae (Coleoptera) family within the Karacadağ region, enhancing our understanding of their role in biodiversity and ecological balance. The findings underscore the potential of these species as natural predators, highlighting the importance of promoting biological control methods in agriculture to diminish reliance on chemical pesticides and maintain ecological integrity. Additionally, future research could focus on the impact of environmental factors on the population dynamics of Coccinellidae species. Further studies may also explore the interactions between these beetles and other pest control agents to develop more effective integrated pest management strategies.

Ethical Statement

The authors declare that ethical approval is not required for this research.

Funding

This research received no external funding.

Declaration of Author Contributions

Conceptualization, Material, Methodology, Investigation, Data Curation, Formal Analysis, Visualization, Writing-Original Draft Preparation, *Z. KAÇAR*; Material, Methodology, Investigation, Data Curation, Formal Analysis, Visualization, Supervision, Writing-Review & Editing, *H. DİLMEN*. All authors declare that they have seen/read and approved the final version of the article ready for publication.

Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

Acknowledgments

Authors thank retired Dr. Derya ŞENAL for her assistance in the identification of Coccinellidae.

References

Altun, A.A., Çıkman, E., 2019. Determination of natural enemies of tomato moth [*Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae)] in natural production areas of Sanlıurfa Province. *Journal of ADYUTAYAM*, 7(2): 1-6. (In Turkish).

Anonymous, 2024. Pesticides Use and Trade, 1990-2022. FAOSTAT Statistical Database, Food and Agriculture Organization of the United Nations, (https://doi.org/10.4060/cd1486en), (Accessed: 05.10.2024).

Bajwa, U., Sandhu, K.S., 2014. Effect of handling and processing on pesticide residues in food-A review. *Journal of Food Science and Technology*, 51: 201-220.

Başar, M.K., Yaşar, B., 2011. Determination of ladybird species (Coleoptera: Coccinellidae) on fruit trees in Isparta, Turkey. *Turkish Journal of Entomology*, 35(3): 519-534. (In Turkish).

Baştuğ, G., Kasap, İ., 2015. Faunistic studies on Coccinellidae (Coleoptera) family in the province of Çanakkale. *Türkiye Biyolojik Mücadele Dergisi*, 6(1): 41-50. (In Turkish).

Buğday, H., Şenal, D., Atlıhan, R., 2015. Coccinellidae (Coleoptera) species and their distribution in different habitats of Yalova Province in Turkey. *Türkiye Biyolojik Mücadele Dergisi*, 6(2): 129-140. (In Turkish).

Duman, M., Mutlu, Ç., Büyük, M., Karaca, V., 2013. Beneficial insects, spider and polinater species determined in the Karacadağ paddy growing areas. *Türkiye Biyolojik Mücadele Dergisi*, 4(1): 53-64. (In Turkish).

Efil, L., Bayram, A., Ayaz, T., Şenal, D., 2010. Coccinellidae species and their population changes in alfalfa field of Akçakale country of Şanlıurfa province and a new record, *Exochomus pubescens* Küster for Turkey. *Plant Protection Bulletin*, 50(3): 101-109. (In Turkish).

Ehi-Eromosele, C.O., Nwinyi, O.C., Ajani, O.O., 2013. Integrated Pest Management. In Weed and Pest Control-Conventional and New Challenges, IntechOpen, London, UK.

Erdoğan, C., 2024. Risk assessment and selection of plant protection products to be used in integrated pest management programmes. *Journal of Tekirdag Agricultural Faculty*, 21(1): 277-284. (In Turkish).

Ertekin, S., 2002. Karacadağ Plant Diversity. Sürdürülebilir Kırsal ve Kentsel Derneği Yayınları, Diyarbakır, Türkiye. (In Turkish).

Hodek, I., 1996. Food relationships. In: I. Hodek and A. Honěk (Eds.), *Ecology of Coccinellidae*, Series Entomologica, Springer, Dordrecht, pp. 143-238.

Johari, A., Oktafiani, D.W., Dewi, R.S., 2020. The presence of ladybug beetle (Coleoptera: Coccinellidae) as a predator on agriculture in Jambi region. *Journal of Entomological Research*, 44(1): 45-50.

Kole, R.K., Roy, K., Panja, B.N., Sankarganesh, E., Mandal, T., Worede, R.E., 2019. Use of pesticides in agriculture and emergence of resistant pests. *Indian Journal of Animal Health*, 58(2): 53-70.

Lin, D.-J., Zhou, J., Ali, A., Fu, H., Gao, S., Jin, L., Fang, Y., 2024. Biocontrol efficiency and characterization of insecticidal protein from sugarcane endophytic *Serratia marcescens* (SM) against oriental armyworm *Mythimna separata* (Walker). *International Journal of Biological Macromolecules*, 262: 129978.

Messing, R., Brodeur, J., 2018. Current challenges to the implementation of classical biological control. *BioControl*, 63(1): 1-9.

Oğuzoğlu, Ş., Avcı, M., Şenal, D., Karaca, İ., 2017. First record of *Anatis ocellata* (Linnaeus, 1758) (Coleoptera: Coccinellidae) in Turkey. *Türkiye Entomoloji Bülteni*, 7(2): 197-202. (In Turkish).

Öztürk, D.Ö., Muştu, M., 2018. Parasitoids and predaceous coccinellids of aphids (Hemiptera: Aphididae) on ornamental plants in central districts of Kayseri Province. *Türkiye Biyolojik Mücadele Dergisi*, 9(1): 48-65. (In Turkish).

Raimundo, A.A., van Harten, A., 2000. An annotated checklist of the Coccinellidae (Insecta: Coleoptera) of Yemen. *Fauna of Arabia*, 18: 211-244.

Romanowski, J., Ceryngier, P., Větrovec, J., Szawaryn, K., 2019. The Coccinellidae (Coleoptera) from Fuerteventura, Canary Islands. *Zootaxa*, 4646(1): 101-123.

Romanowski, J., Ceryngier, P., Větrovec, J., Szawaryn, K., 2023. The ladybird beetles (Coleoptera: Coccinellidae) of La Palma. *Insects*, 14(7): 655.

Sünter, T., 2022. Investigations on coccinellidae (Coleoptera) fauna in agricultural and non-agricultural areas of Tekirdağ province. Master Thesis, Tekirdağ Namık Kemal University, Graduate School of Natural and Applied Sciences, Tekirdağ, Türkiye. (In Turkish).

Şimşek, A., Bolu, H., 2016. Determination of the beneficial insect fauna in pistachio (*Pistacia vera* L.) areas in Diyarbakır province. *Plant Protection Bulletin*, 56(3): 267-282. (In Turkish).

Tiwari, A.K., 2024. Insect pests in agriculture identifying and vercoming challenges through IPM. *Archives of Current Research International*, 24(3): 124-130.

CITATION: Kaçar, Z., Dilmen, H., 2025. Diversity and Distribution of Coccinellidae Species in the Karacadağ Region of Türkiye. *Turkish Journal of Agricultural Research*, 12(1): 44-51.