OBSERVATIONS ON THE STRUCTURE AND DYNAMICS OF ARTHROPOD SPECIES COLLECTED FROM PEA CROPS

OBSERVAȚII PRIVIND STRUCTURA ȘI DINAMICA SPECIILOR DE ARTROPODE COLECTATE DIN CULTURILE DE MAZĂRE

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Abstract.
The present study aimed to evaluate the community structure of arthropods in a pea crop (Pisum sativum) located in Răducăneni commune, Iași County, over two consecutive growing seasons (2023 and 2024). Biological material was collected using Barber pitfall traps, a passive and efficient technique for monitoring ground-dwelling fauna. Samples were collected at regular intervals of 12–16 days, and the captured material was subsequently preserved in 40% ethanol and taxonomically identified based on specialized literature and online resources. To characterize community diversity, the Shannon, Simpson, and Pielou's Evenness indices were calculated. The results revealed significant differences between the two years, reflecting the influence of climatic conditions on faunal dynamics. In 2023, the community was dominated by Coleoptera (1,048 individuals), followed by Hymenoptera and Orthoptera, indicating a diversified and relatively stable structure. In 2024, the total abundance of Coleoptera decreased significantly (702 individuals), while Diptera showed a marked increase (425 individuals), becoming the second most abundant group. This shift reflects the differential response of taxonomic groups to the warmer and drier conditions observed in 2024, which favored water-tolerant and generalist species. Analysis of diversity indices indicated a reduction in both diversity and evenness in 2024, associated with a more uneven distribution of abundances. The study highlights the sensitivity of ground-dwelling arthropod communities to interannual climatic variability and underscores the importance of continuous monitoring for understanding ecological dynamics in agroecosystems
Key words: pea crop, dwelling fauna, biodiversity indices.

Rezumat.
În lucrarea de față am avut ca scop evaluarea structurii comunității de artropode dintr-o cultură de mazăre (Pisum sativum) situată în comuna

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Răducăneni, județul Iași, pe parcursul a două sezoane consecutive de creștere (2023 și 2024). Materialul biologic a fost colectat folosind capcane Barber, o tehnică pasivă și eficientă pentru monitorizarea faunei terestre. Probele au fost colectate la intervale regulate de 12-16 zile, iar materialul capturat a fost ulterior conservat în etanol 40% și identificat taxonomic pe baza literaturii de specialitate și a resurselor online. Pentru a caracteriza diversitatea comunității, au fost calculați indicii de uniformitate Shannon, Simpson și Pielou. Rezultatele au relevat diferențe semnificative între cei doi ani, reflectând influența condițiilor climatice asupra dinamicii faunistice. În 2023, comunitatea a fost dominată de Coleoptera (1.048 de indivizi), urmate de Hymenoptera și Orthoptera, indicând o structură diversificată și relativ stabilă. În 2024, abundența totală de Coleoptera a scăzut semnificativ (702 indivizi), în timp ce Diptera a înregistrat o creștere marcantă (425 indivizi), devenind al doilea grup ca abundență. Această schimbare reflectă răspunsul diferențial al grupurilor taxonomice la condițiile mai calde și mai uscate observate în 2024, care au favorizat speciile tolerante la apă și generaliste. Analiza indicilor de diversitate a indicat o reducere atât a diversității, cât și a uniformității în 2024, asociată cu o distribuție mai inegală a abundențelor. Studiul evidențiază sensibilitatea comunităților de artropode terestre la variabilitatea climatică interanuală și subliniază importanța monitorizării continue pentru înțelegerea dinamicii ecologice în agroecosisteme.

Cuvinte cheie: cultura de mazăre, indici de biodiversitate, fauna terestră.

INTRODUCTION

Arthropods represent one of the most important and diverse groups of organisms in agroecosystems, being essential for maintaining biological balance and ensuring the optimal functioning of agricultural systems. In legume crops, such as pea (*Pisum sativum*), these communities include both entomophagous species — natural predators of pests or pollinators — and phytophagous species capable of causing significant yield losses. Therefore, the analysis of arthropod population structure and dynamics constitutes a fundamental tool for understanding ecological interactions in agroecosystems and for implementing integrated pest management strategies [Southwood and Henderson, 2000; Magurran, 2004].

Pea cultivation holds major agronomic importance in Romania, being used both for human consumption and as a fodder source. Due to its biological nitrogen-fixing capacity, pea contributes to the development of favorable soil structure and creates a suitable habitat for various arthropod groups associated with the soil and vegetation. *Coleoptera, Hemiptera, Diptera, Hymenoptera*, and other present orders provide valuable insights into the state of the agroecosystem and its resilience to climatic pressures [McGeoch, 1998].

Climate change, manifested through increased frequency of drought events, alternation of extreme temperature periods, and changes in precipitation patterns,

profoundly affects the dynamics and distribution of arthropods in agricultural environments. Hygrophilous or mesophilous species may experience population declines during dry years, while thermophilous or opportunistic species tend to expand their activity and abundance [Wagner, 2000; Begon *et al*., 2006]. In this context, monitoring arthropod communities becomes crucial for assessing the adaptive capacity of agroecosystems.

The present study aims to analyze the diversity and abundance of arthropods in a pea crop located in Răducăneni commune (Iași) during the 2023 and 2024 growing seasons, characterized by contrasting climatic conditions. The use of Barber pitfall traps, an internationally recognized method for efficiently sampling ground-dwelling fauna [Greenslade, 1964; Andersen, 1995], allows the evaluation of population fluctuations and their interpretation in relation to temperature and humidity variations specific to each year. The obtained results contribute to a deeper understanding of the response of entomological communities to abiotic stress and provide a valuable data basis for the sustainable management of agricultural ecosystems.

MATERIAL AND METHOD

The study on the diversity of arthropods associated with pea (*Pisum sativum*) crops was conducted during the 2023–2024 period in Răducăneni commune, Iași County, which is characterized by a temperate-continental climate with significant annual variations in temperature and precipitation. These climatic fluctuations directly influence the phenology and population dynamics of arthropods, as widely documented in the literature [Krebs, 1999; Begon *et al*., 2006].

Arthropods were collected using Barber pitfall traps, a standardized method extensively used in ecological studies of ground-dwelling arthropods [Greenslade, 1964; Thiele, 1977]. These traps operate by passively intercepting walking individuals and are particularly effective for Carabidae, Staphylinidae, and other epigeic groups [Gâdei and Popescu, 2012].

The traps were constructed from cylindrical plastic containers (7–9 cm in diameter, 12 cm in depth) filled with a 2.5% sodium chloride (NaCl) solution used as a killing agent. This solution preserves the morphological integrity of the exoskeleton, allowing safe handling of specimens without structural damage [Gâdei and Dragomir, 2025].

Traps were arranged in uniform transects within the pea crop, spaced 10–15 meters apart to ensure adequate representation of microhabitats. Throughout the growing season, traps were continuously active and checked at 12–16 day intervals, according to standard population ecology protocols [Southwood and Henderson, 2000].

The date of each collection and the corresponding trap number were meticulously recorded to allow correlation of faunal data with climatic variables.

Collected specimens were transferred to labeled containers and preserved in 40% ethanol, a method suitable for maintaining morphological integrity and preventing degradation under variable temperature conditions [Gâdei and Dragomir, 2025].

The arthropods were identified in the laboratory using a stereomicroscope and recognized taxonomic keys for Romanian fauna, complemented by updated digital resources [Triplehorn and Johnson, 2005; Magurran, 2004]. Identification was

performed to the species level whenever possible; in cases where specimen integrity was compromised, identification was limited to the genus level.

Data Processing — Ecological Indices

To assess the diversity of arthropod communities, three major ecological indices widely used in biodiversity studies were calculated [Magurran, 2004]: Shannon–Wiener index (H'), Simpson index (1–D), and Pielou's Evenness (J').

Shannon–Wiener Index (H'):

$$H' = -\sum_{i=1}^{S} p_i \log_2 p_i$$

This index quantifies overall diversity, combining species richness and evenness.

Simpson Index (1–D):

$$D = \frac{\sum n\ (n\ -1)}{N(N-1)}$$

D- represents the probability that two randomly selected individuals belong to different species.

Evenness (J'): $J' = \ln(S)H'$ - assesses the degree of uniformity in the distribution of abundances among species.

The calculation methodology follows standard recommendations in ecological literature [Krebs, 1999; Magurran, 2004].

RESULTS AND DISCUSSIONS

Comparison of arthropod species abundance collected in 2023 and 2024 reveals significant changes in the community structure of the pea crop, closely associated with notable climatic variations during this period [Table 1]. The year 2024 was characterized nationwide by record high temperatures and pronounced soil drought, directly affecting the availability of microhabitats and the dynamics of trophic resources. These climatic conditions led, in particular, to a marked reduction in species sensitive to dehydration and high temperatures, as reflected

by sharp declines in their abundance.

A significant number of species present in 2023 recorded zero captures in 2024. Among these were: *Hippodamia variegata, Hippodamia variegeta, Opatrum sabulosum, Anthicus floralis, Anthicus humeralis, Anisodactylus binotatus, Aphthona euphorbiae*, and *Coccinella 11-punctata*. All these species are affected by changes in soil moisture and extreme temperatures, either through impacts on larval stages or by reducing the availability of food. Their temporary disappearance suggests a high sensitivity to abiotic stress, indicating that 2024 exerted strong pressure on these populations.

In addition to these disappearances, other groups exhibited moderate but significant declines. Species such as *Coccinella septempunctata*, *Dermestes*

laniarius, ants, *Heteroptera, and Hymenoptera* showed lower abundances in 2024 compared to 2023. Although these are generalist species more resilient to temperature fluctuations, their reduction suggests a cumulative ecological pressure generated by prolonged drought and limited trophic resources. For coccinellids, the decline in aphid populations during periods of extreme heat may have been an important factor, while for *Hymenoptera* and ants, the degradation of soil microhabitats could have reduced colony efficiency.

Interestingly, certain groups showed significant increases in 2024, indicating a high tolerance to extreme climatic conditions. These included *Diptera* (52 → 425), *Crypticus quisquilius* (1 → 23), *Orthoptera* (111 → 136), as well as species such as *Chromatoiulus unilineatus, Pedinus femoralis, Podonta nigrita, Tipula sp., Syrphidae,* and *Otiorhynchus sulcatus*, which appeared in substantial numbers only in 2024. These increases can be explained by the ecological advantage of opportunistic species that benefit from dry microhabitats, reduced competition, and accelerated developmental cycles under high temperatures. Dipterans, for example, develop rapidly in environments with decomposing organic matter, and arid conditions may favor the accumulation of such resources.

Overall, the data indicate a clear reorganization of the arthropod community between the two study years. While mesophilous species experienced drastic declines and some disappeared entirely from the samples, thermophilous or opportunistic species showed significant increases, reflecting a differential response to climatic changes. These results suggest that drought and elevated temperatures in 2024 were the main factors shaping the arthropod community structure in the pea crop, leading both to losses among sensitive species and proliferation of those tolerant to abiotic stress.

Table 1

Structure, dynamics, and abundance of arthropod species collected in the pea (Pisum sativum) crop (Răducăneni, Iași, 2023–2024)

No.	Name of species/taxon	2023	2024	Total
1.	Acarieni	3	5	8
2.	*Acupalpus elegans*	1	1	2
3.	*Adalia bipunctata*	0	3	3
4.	Afide	0	2	2
5.	*Aleochara laevigata*	0	1	1
6.	*Aleochara moereus*	0	1	1
7.	*Amara aenea*	2	2	4
8.	*Amara apricaria*	2	0	2
9.	*Amara crenata*	1	0	1
10.	*Amara familiaris*	1	0	1
11.	*Anisodactylus binotatus*	6	0	6
12.	*Anisodactylus signatus*	2	0	2
13.	*Anthicus floralis*	19	0	19
14.	*Anthicus humeralis*	10	0	10
15.	*Aphodius granarius*	1	0	1

16.	*Aphthona euphorbiae*	7	0	7
17.	*Baris artemisiae*	1	0	1
18.	*Bothynoderes punctiventris*	14	3	17
19.	*Brachynus crepitans*	3	0	3
20.	*Bruchus pisorum*	2	1	3
21.	*Cantharis fusca*	1	0	1
22.	*Cantharis nigricans*	1	0	1
23.	*Carabus coriaceus*	1	0	1
24.	*Ceutorhynchus macula alba*	2	0	2
25.	*Chromatoiulus unilineatus*	0	7	7
26.	*Chrysomela menthastri*	0	1	1
27.	Cicade	0	1	1
28.	*Coccidula scutellata*	0	1	1
29.	*Coccinella 11-punctata*	12	0	12
30.	*Coccinella septempunctata*	225	201	426
31.	*Corymbites affinis*	0	2	2
32.	*Crypticus quisquilius*	1	23	24
33.	*Dermestes laniarius*	263	137	400
34.	Diptere	52	425	477
35.	*Elater elongatulus*	0	1	1
36.	*Elater nigerrimus*	3	0	3
37.	Furnici	260	131	391
38.	*Harpalus calceatus*	5	1	6
39.	*Harpalus distinguendus*	19	7	26
40.	*Harpalus tardus*	9	4	13
41.	Heteroptere	70	46	116
42.	Himenoptere	86	40	126
43.	*Hippodamia variegata*	68	0	68
44.	*Hippodamia variegeta*	20	0	20
45.	Lepidoptere	68	4	72
46.	*Lixus cardui*	1	0	1
47.	*Longitarsus anchusae*	2	0	2
48.	*Longitarsus suturalis*	1	0	1
49.	*Malachius bipustulatus*	1	0	1
50.	*Mecinus janthinus*	0	1	1
51.	*Meligethes aeneus*	1	0	1
52.	*Metabletus foveatus*	0	1	1
53.	*Metabletus truncatellus*	2	0	2
54.	Neuroptere	1	0	1
55.	*Notaris maerkeli*	1	0	1
56.	*Opatrum sabulosum*	57	0	57
57.	*Ophonus azureus*	3	0	3
58.	*Ophonus rupicola*	1	0	1
59.	Ortoptere	111	136	247
60.	*Otiorhynchus ovatus*	1	0	1
61.	*Otiorhynchus pinastri*	1	0	1

62.	*Otiorhynchus raucus*	5	0	5
63.	*Otiorhynchus sulcatus*	0	5	5
64.	*Oxythyrea funesta*	10	0	10
65.	*Pedinus femoralis*	0	26	26
66.	*Pentodon idiota*	0	3	3
67.	*Phyllobius piri*	5	0	5
68.	*Phyllobius pyri*	1	0	1
69.	*Pleurophorus caesus*	1	0	1
70.	*Podagrica malvae*	8	13	21
71.	*Podonta nigrita*	0	14	14
72.	*Polydrusus confluens*	0	1	1
73.	*Pterostichus vernalis*	1	0	1
74.	*Rhinomias forticornis*	1	0	1
75.	*Rhizophagus picipes*	1	0	1
76.	*Sitona lineatus*	19	25	44
77.	*Soronia punctatissima*	0	1	1
78.	*Tanymecus dilaticolis*	0	1	1
79.	*Valgus hemipterus*	1	0	1
80.	*Myzus persicae*	0	2	2
81.	*Tetranychus urticae*	0	2	2
82.	Syrphidae	0	8	8
83.	Liriomyza sp.	0	1	1
84.	*Tipula* sp.	0	5	5
	Total	1478	1296	2774

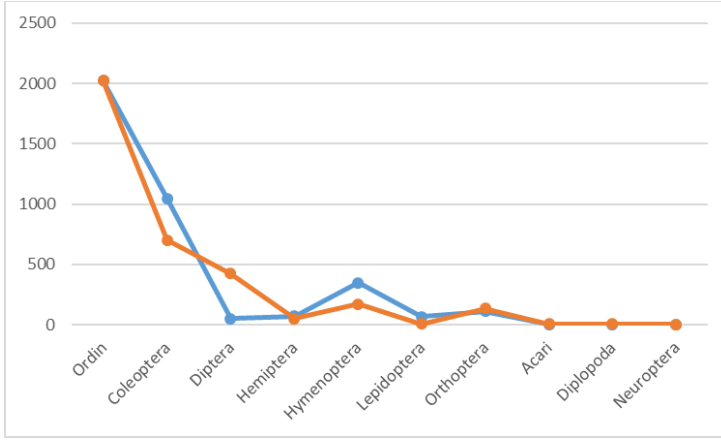

Fig. 1. Comparative abundance of arthropod orders in the pea (*Pisum sativum*) crop in 2023 (blue) and 2024 (orange), Răducăneni, Iași

The arthropod community structure showed marked differences [Fig. 1] between the two sampling seasons. In 2023, *Coleoptera* dominated the community (1,048 individuals), followed by Hymenoptera and *Orthoptera,* reflecting a complex structure and a relatively stable ecosystem. In 2024, Coleoptera abundance

decreased substantially (702 individuals), while *Diptera* exhibited a sharp increase (425 individuals), becoming the second most abundant group in the total captures. This partial reversal of taxonomic dominance suggests a direct ecological response to the warmer and drier conditions in 2024, which favored generalist and water-tolerant groups (*Diptera*) at the expense of ground-dwelling *Coleoptera* sensitive to desiccation.

The analysis of species diversity, quantified using the Shannon, Simpson, and Evenness indices, reveals significant differences between the arthropod communities collected in 2023 and 2024. In 2023, the Shannon index (H' = 2.38) indicates a relatively diverse community, characterized by a more balanced distribution of abundance among species. This is further supported by the Simpson index (1–D = 0.87), reflecting a low probability that two randomly selected individuals belong to the same species, suggesting a complex community structure well-represented across different ecological niches. Additionally, the Evenness value (J' = 0.61) confirms a moderately uniform distribution of individuals among identified species, with a relatively low dominance of highly abundant species.

In contrast, 2024 exhibits a noticeable decline in diversity, with all three ecological indices decreasing. The Shannon index (H' = 2.11) and Simpson index (1–D = 0.82) indicate a reduction in both active species richness and abundance uniformity, suggesting a more unbalanced community dominated by a limited number of generalist species. Evenness (J' = 0.56) also reflects increased imbalance in community structure, with larger differences between dominant and rare species.

These interannual variations can be associated with the distinct climatic conditions of the two years. The year 2023 was characterized by favorable conditions for soil fauna and predatory insects, with well-distributed precipitation and moderate temperatures, supporting the maintenance of high diversity. In contrast, 2024 experienced high temperatures and prolonged periods of water deficit, leading to a decrease in abundance for several sensitive groups (e.g., *Carabidae, Staphylinidae*), while other tolerant–generalist groups (e.g., *Diptera*, *Coccinellidae*) became more dominant.

Overall, the decrease in diversity and evenness indices in 2024 reflects a simplification of the arthropod community and a clear ecological response to climatic stress, confirming the sensitivity of ground-dwelling fauna to temperature and moisture variations in agroecosystems.

CONCLUSIONS

The study of arthropod communities associated with pea (*Pisum sativum*) crops in Răducăneni (Iași), conducted over two agricultural years with contrasting climatic conditions (2023 and 2024), highlights significant structural changes in the composition and abundance of ground-dwelling fauna.

First, the comparison between the two seasons shows that 2023 was characterized by higher overall abundance, with warmer and drier conditions

favoring species adapted to arid, pedestral environments and elevated temperatures, such *as Coleoptera* from the families *Dermestidae, Tenebrionidae, Carabidae,* and *Coccinellidae.* Species such as *Dermestes laniarius, Opatrum sabulosum, Coccinella septempunctata,* and *Hippodamia variegata* recorded notably higher abundances in 2023, confirming the general trend of thermophilous species developing more intensively under water-deficit conditions.

In contrast, 2024, characterized by more frequent precipitation and higher soil moisture, favored the increased abundance of groups dependent on moist microclimates, including *Diptera, Myriapoda, Opiliones*, and certain species of *Curculionidae* and *Staphylinidae.* Notable differences, such as the dramatic increase of Diptera from 52 individuals in 2023 to 425 in 2024, and the appearance of groups such as *Chromatoiulus unilineatus and Otiorhynchus sulcatus*, are consistent with literature reporting the direct relationship between soil moisture and the activity of detritivorous or saprophagous fauna.

At the community level, diversity (Shannon), dominance (Simpson), and evenness (Pielou's Evenness) indices indicate that community structure was strongly influenced by climatic dynamics. In 2023, a few abundant species dominated, whereas in 2024, although total abundance was lower, there was a more balanced distribution of individuals among taxonomic groups. This pattern reflects how abiotic stress (soil drought) can favor the proliferation of opportunistic species, thereby reducing community diversity and evenness.

The ecological roles of the identified arthropods are also relevant to agroecosystem functioning. Natural predators (*Coccinellidae, Carabidae*), detritivores (*Dermestidae,* saprophagous *Diptera*), pollinators, and phytophagous species can influence both the resilience of the pea crop and the overall stability of the soil. The simultaneous presence of these functional groups indicates a functioning agroecosystem that is nonetheless sensitive to climatic fluctuations.

In conclusion, the comparative analysis of the two years demonstrates that climatic factors are key determinants of arthropod community dynamics, influencing both abundance and taxonomic composition. These results emphasize the importance of continuous monitoring of fauna associated with agricultural crops, particularly under climate change, and can contribute to optimizing integrated pest management strategies adapted to local climatic conditions.

REFERENCES

1. Andersen A., 1995 – *Sampling ground-active arthropods: Pitfall traps*. Australian Journal of Ecology, 20(1), 15–21.

2. Begon M., Townsend C.R., Harper J.L., **2006** – *Ecology: From Individuals to Ecosystems*. Blackwell Publishing.

3. Gâdei P., Popescu D., 2012 – *Cercetări privind coleopterele epigee colectate cu capcane Barber în ecosisteme agricole din Moldova*. Analele Științifice ale Universității "Al. I. Cuza" Iași.

4. Gâdei P., Dragomir A., **2025** – *Coleoptera din România – Morfologie, ecologie și metode de studiu.* Editura Universității Alexandru Ioan Cuza.

5. Greenslade P.J.M., **1964** – *Pitfall trapping as a method for studying populations of Carabidae (Coleoptera).* Journal of Animal Ecology, 33, 301–310.
6. Krebs C.J., 1999 – *Ecological Methodology* (2nd ed.). Addison-Wesley.
7. Magurran A.E., 2004 – *Measuring Biological Diversity*. Blackwell Publishing.
8. McGeoch M.A., 1998 – *The selection, testing and application of terrestrial insects as bioindicators.* Biological Reviews, 73(2), 181–201.
9. Southwood T.R.E., Henderson P.A., 2000 – *Ecological Methods* (3rd ed.). Blackwell Science.
10. Thiele H.-U., 1977 – *Carabid Beetles in Their Environments*. Springer-Verlag.
11. Triplehorn C., Johnson N., 2005 – *Borror and DeLong's Introduction to the Study of Insects.* Thomson Brooks/Cole.
12. Wagner T., 2000 – *Influence of Rainfall on Arthropod Abundance Collected by Pitfall Traps in Tropical Forests*. Journal of Tropical Ecology, 16, 241–254.