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STUDY ON USEFUL AND HARMFUL BEETLE SPECIES IN THE GUȘTERIȚA AGROECOSYSTEM, SIBIU COUNTY, ROMANIA

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Abstract

Research in the "Priestess's Garden" of Gustrita began in 2014. The agro-ecosystem combines traditional gardening with the current ecological precepts of biodiversity. As method, there were used Barber traps with the help of which 383 Coleoptera beetles were caught. After sorting the entomological material in the systematic laboratory, a number of 61 species, 38 genera, 14 families of Coleoptera were identified. The ratio of useful species (51 species) to harmful species (10 species) is clearly in favor of the first category, which proved to be highly effective in depressing and controlling phytophages.

Key words**:** *entomofauna, coleoptera, ecological garden, Gusterița, Sibiu county*

INTRODUCTION

Famous is the "Gușteriței Hill" with its belvedere tower, from the height of which, in the harsh but clear mornings of spring, you can look out over the Hârtibaciului Valley, Secașelor Plateau, the Depression of Sibiu, to the distant heights of the Făgăraș Mountains.
The hill in the center of Gusterita (today a district of Sibiu) is a real acropolis on which the medieval buildings of the community were built: the church, the parish house and the parish school.
The church is one of the 600 fortified churches in Transylvania and one of the 150 churches that still exist. It was built at the beginning of the XIII-century as a Roman basilica and received its final Gothic aspect in the XVI century, as a fortress - church.
Towards the south-eastern side of the hillock, the slope descends slowly till the wall of the precincts that bounds a large area, which formerly was used as a refuge for villagers and their goods, during distressing times.
In the long run, this space was turned into a vegetable garden, and it was nicknamed "the Priestess Garden".
Here an extensive agricultural-educational exercise has been developed that combines traditional gardening with current ecological precepts of biodiversity.
The scientific studies undertaken so far [1], [2] have elevated it to a successful "biological experiment" with a definite tinge of originality.
The studies concerning in-vertebrata fauna that divide the species of the agro-ecosystem in two parts (useful and pest) are interesting and prove the important role of the entomofauna. This is man's great and unseen allied army that ensures the circuitry of organic matter in nature. The subtle interplay of the entomofauna of the agroecosystem must be understood and interventions must be judicious and ensure the optimal balance between useful and harmful entomofauna so that the circuits that prepare plant food function, ensuring sustainable fertility. As an entomological regulating factor for wildlife, the "entomological guesthouse" was established. This cultivates fauna with a role in regulating the balance between the two components, inhibiting, or keeping harmful fauna below the damage threshold.

MATERIALS AND METHODS

The experiment took place between May and October 2015, in the "Priestess' Garden" in the Gușterița district, Sibiu.

In the experimental plot, the cultivation technology applied was in line with the concept of organic farming. Thus, the following are used: appropriate tools with a role in protecting the soil and its fauna, green manure, compost, soil mulching technique, natural bioactive preparations, untreated seeds, crop rotation, allelopathy, cultivation of plants in concentric strips, stagnant water for watering, cultural hygiene [1], [2].

The analyzed biological material includes 383 coleopteran specimens (adults, larvae), collected using Barber traps. This is the classical method for the continuous collection of beetles from the ground, both day and night. A trap consists of a 400-450 ml container. The traps were buried in the ground so that there was no difference in level between the top lid of the trap and the ground level, and a gap of 3 cm between the trap and the trap lid. The formaldehyde was used as an attractant.

The biological material, captured in every trap, was moved into another plastic container in 70 % alcohol, that constituted a sample collected during a period of 48 hours. There were 10 pcs. Barber's traps with a 10 m distance between them. During this experiment, 80 samples were collected. They were selected by families, genera and species, in the systematic laboratory.

The laboratory phase includes sample unpacking, labelling, numbering, determination. For this last operation, a large number of determinators were used [5], [9], [12], [13], [17].

RESULTS AND DISCUSSIONS

We studied the Order Coleoptera because it includes species from different trophic categories (zoophagous, coprophagous, detritivores, necrophagous, phytophagous), components of most food chains in terrestrial ecosystems [20]. Many species of *Coleoptera* are important bio-indicators that bring useful information about the health of the ecosystem; they offer data concerning about the quality and the durability of life.

Ecological agriculture has an important objective, that is the knowledge and the protection of the useful species that are responsible with the maintaining the pest populations under the damage limit.

In this research work, there were identified 61 species of *Coleoptera* that belong to a number of 14 families (*Carabidae*, *Silphidae*, *Nitidulidae*, *Staphylinidae*, *Cantharidae*, *Elateridae*, *Histeridae*, *Chrysomelidae*, *Curculionidae*, *Anthicidae*, *Monotomidae*, *Scarabaeidae*, *Lathridiidae*, *Coccinelidae*) and 38 genera (*Poecilus*, *Amara*, *Pterostichus*, *Harpalus*, *Bembidion*, *Acupalpus*, *Silpha*, *Nitidula*, *Carpophilus*, *Staphylinus*, *Actobius*, *Atheta*, *Bolitobius*, *Calodera*, *Ocalea*, *Omalium*, *Oxytelus*, *Oxypoda*, *Quedius*, *Aleochara*, *Heterothops*, *Philonthus*, *Tachyporus*, *Tachinus*, *Microglossa*, *Lathrobium*, *Scopaeus*, *Cantharis*, *Drasterius*, *Hister*, *Longitarsus*, *Chaetocnema*, *Sitona*, *Anthicus*, *Monotoma*, *Aphodius*, *Corticarina*, *Tytthaspis* (Table 1).

Table 1. The faunistical spectrum of the coleoptera in the ecological garden in Gusterita (Sibiu county)

Taxa	Numerical abundance	Relative abundance (%)
Carabidae		
**Poecilus cupreus* L.	26	6.78
+Amara ovata Dej.	1	0.26
+Amara aenea Dej.	6	1.56
+Amara concinna Zimm.	9	2.34
**Pterostichus niger* Schall.	1	0.26
+Harpalus distinguendus Duft. L.	14	3.65
+Harpalus griseus Panz.	2	0.52
+Harpalus pubescens Müll. L.	1	0.26
**Bembidion splendidum* Strm.	20	5.22
**Bembidion properans* Steph.	3	0.78
**Bembidion* sp. (lv.)	2	0.52
**Acupalpus meridianus* L.	1	0.26
Silphidae		
**Silpha carinata* Herbst.	9	2.34
**Silpha carinata* Herbst. (lv.)	3	0.78
Nitidulidae		
**Nitidula carnaria* Schall.	22	5.74
**Carpophilus bipustulatus* Er.	95	24.80
Staphylinidae		
**Staphylinus similis* F.	8	2.08
**Actobius cinerascens* Grav.	1	0.26
**Atheta sordidula* Er.	7	1.82
**Atheta tabida* Kiesw.	3	0.78
**Bolitobius pygmaeus* Er.	1	0.26
**Calodera nigrita* Mnnh.	1	0.26
**Calodera uliginosa* Er.	1	0.26
**Ocalea picata* Steph.	16	4.17
**Ocalea badia* Er.	6	1.56

**Omalium oxyacanthae* Grav.	1	0.26
**Oxytelus insecatus* Grav.	53	13.83
**Oxytelus opacus* Er.	2	0.52
**Oxytelus sculptus* Grav.	1	0.26
**Oxytelus sculpturatus* Grav.	1	0.26
**Oxytelus piceus* L.	1	0.26
**Oxypoda elongatula* Aubé.	2	0.52
**Oxypoda vittata* Märkel	7	1.82
**Oxypoda spectabilis* Märkel	1	0.26
**Quedius ventralis* Arag.	3	0.78
**Aleochara laevigata* Gyll.	1	0.26
**Aleochara clavicornis* Redtb.	13	3.39
**Aleochara moerens* Gyll.	8	2.08
**Aleochara intricata* Mnnh.	1	0.26
**Aleochara lata* Grav.	1	0.26
**Aleochara crassicornis* Lac.	1	0.26
**Heterothops binotata* Grav.	1	0.26
**Philonthus aerosus* Kiesw.	1	0.26
**Tachyporus nitidulus* F.	2	0.52
**Tachinus collaris* Grav.	1	0.26
**Microglossa pulla* Gyll.	1	0.26
**Lathrobium sodale* Kr.	1	0.26
**Lathrobium quadratum* Payk.	2	0.52
**Lathrobium spadiceum* Er.	2	0.52
Scopaeus cognatus Rey.	2	0.52
Cantharidae		
**Cantharis violacea* Payk.♀	1	0.26
**Cantharis fusca* L.	4	1.04
**Cantharis* sp. (lv.)	6	1.56
Elateridae		
+Drasterius bimaculatus Rossi	9	2.34
Histeridae		
**Hister sepulchralis* Er.	1	0.26
Chrysomelidae		
+Longitarsus anchusae Payk.	1	0.26
+Chaetocnema tibialis Illig.	2	0.52
Curculionidae		
+Sitona crinitus Herbst.	2	0.52
Anthicidae		
**Anthicus floralis* L.	1	0.26
Monotomidae		
**Monotoma spinicollis* Aubé	2	0.52
Scarabaeidae		
**Aphodius granarius* L.	3	0.78
**Aphodius varians* Duft.	1	
Lathridiidae		
+Corticarina gibbosa Herbst.	1	0.26
Coccinellidae		
**Tytthaspis* (*Micraspis*) *sedecimpunctata* L.a.12-*punctata* L.	1	0.26
Total	**383**	**100%**
* useful species + pest species		

Source: Own experiment and calculation.

The best represented family of *Coleoptera* is the *Staphylinidae* family (35 species) followed by *Carabidae* (12 species). In opposition to them, the *Nitidulidae*, *Cantharidae*, *Chrysomelidae*, *Scarabaeidae* families have only two species each. The *Silphidae*, *Elateridae*, *Histeridae*, *Curculionidae*, *Anthicidae*, *Monotomidae*, *Lathridiidae*, *Coccinelidae* families have only one species each.

In Table 2, the taxonomical and also the identified quantitative structure of the *Coleoptera* resulting from the research field in the Gusterița agro-ecosystem are presented.

Table 2. The taxonomical and quantitative structure of the fauna of *Coleoptera*, collected by means of the Barber's traps in the Gusterita agro-ecosystem

Taxa	Numerical abundance	Relative abundance
Carabidae	86	22.45
Silphidae	12	3.13
Nitidulidae	117	30.52
Staphylinidae	133	34.72
Cantharidae	11	2.87
Elateridae	9	2.34
Histeridae	1	0.27
Chrysomelidae	3	0.78
Curculionidae	2	0.54
Anthicidae	1	0.26
Monotomidae	2	0.54
Scarabaeidae	4	1.04
Lathridiidae	1	0.27
Coccinellidae	1	0.27
Total	383	100.00

Source: Own calculation.

The family with the highest quantitative abundance is represented by *Staphylinidae* - 133 samples (34.72%), followed by *Nitidulidae* family - 117 samples (30.52%) and *Carabidae* - 86 samples (22.45%). Among the families with a small numerical abundance are: *Silphidae* - 12 samples (3.13%), *Cantharidae* - 11 samples (2.87%), *Elateridae* - 9 samples (2.34%), *Scarabaeidae* - 4 samples (1.04%), *Chrysomelidae* - 3 samples (0.78%), *Curculionidae* - 2 samples (0.54%) and *Monotomidae* - 2 samples (0.54%), *Histeridae*, *Anthicidae*, *Lathridiidae*, *Coccinelidae*, each of them - 1 sample (0.27%).

In the mobile fauna on the surface of the soil, the *Staphylinidae*, *Nitidulidae*, and *Carabidae* families were dominant.

The pest coleoptera in the agro-ecosystem Gusterița are represented by 10 phytophagous species that belong to 5 families. They totalized a small number of individuals: 39 (10.18%). The useful coleoptera are represented by 51 species that belong to 10 families. They totalized 344 individuals that represent 89.82% from the total samples collected by making use of the Barber's traps. In the useful component they were identified zoophagous, detritophagous and coprophagous species.

(1) In the first category of the phytophagous species we remarked the following:

Amara ovata Dej., *A. aenea* Dej., *A.concinna* Zimm., species of *Carabidae*, produce a lot of damages to the cultivated plants, attacking them when they are young. *Amara ovata* Dej. attacks with predilection the species of the *Brassicaceae* family [15], [17].

Harpalus distinguendus Duft.L., *H. griseus* Panz., *H. pubescens* Mull. L. attack the germinated seeds, strawberries and young plants and *Bembidion properans* Steph., attacks the young plants [8].

Drasterius bimaculatus Rossi (*Elateridae*) attacks the plants on the surfaces with herbs [6].

All the species of the *Chrysomelidae* family are phytophagous. *Longitarsus anchusae* Payk. produce damages on herbs and it could be also due to the pest for the species of the *Plantaginaceae*, *Asteraceae*, *Scrophulariaceae*, *Boraginaceae* and *Convolvulaceae* [19]; The *Chaetocnema tibialis* Illig. species attack the beet and the spinach.

The *Sitona crinitus* Herbst. (*Curculionidae*) attack species of the Fabaceae. The adult feeds on the foliar apparatus of the seedlings, the plant suffers because the photosynthesis process is drastically reduced, the larvae feed on the root systems and their nodes, thus decreasing the plant's ability to fix atmospheric nitrogen [10], [14].

(2) From the category of useful species we highlight the presence of zoophagous species. They are extremely important in the agroecosystem, being biotic factors in the natural control of pest populations and 'key' links in the trophic structure of the biocenosis. They are found in several families of *Coleoptera*:

From family *Carabidae*: *Poecilus cupreus* L. which attacks the eggs of the Colorado beetle, larva of *Tentredinidae* and *Aphidae* [21]; *Pterostichus niger* Schall., which feeds with eggs and larvas of the mole cricket; *Bembidion splendidum* Strm., which feeds with larva of *Curculionidae* and *Heteroptera*. About *Bembidion properans* Steph., the researches certified that it has a role in the reduction of the larva of *Elateridae* [3], *Acupalpus meridianus* L., is considered by some scientific investigators, to be omnivorous. It is known the fact that, from the trophic point of view, there is not a definite limit between the predatory and the omnivorous insects.

The *Staphylinidae* family includes useful species, most of them being predatory species, among them we could find: the larva of *Staphylinus similis* F. that burrow galleries in soil and chase caterpillars, worms and small insects; the two species *Ocalea picata* Steph. and *Ocalea badia* Er. [4]; *Bolitobius pygmaeus* Er.; *Oxytelus insecatus* Grav. that attacks the pupa of *Delia brassicae* Bouche or it is considered as detritophagous; Oxypoda *vittate* Märk., *Tachyporus nitidulus* F. that could attack the pupa of *Delia brassicae* Bouche; *Philonthus aerosus* Kiesw. and also *Atheta sordidula* Er. and *Atheta tabida* Kiesw. [18].

Cantharis violacea Payk and *Cantharis fusca* L., (*Cantharidae*) play an important role in the biological control of the aphid *Myzus cerasi* F. and of the other small insects.

The *Histeridae* family is represented by only one species: *Hister sepulchralis* Er. The larva of this coleoptera are predators, the adults are necrophagous or coprophagous.

The representants of the *Coccinellidae* family are in their majority zoophagous. *Tytthaspis (Micraspis) sedecimpunctata* L. a.*12-punctata* L., attacks aphids, acariennes and tripsh. Some specialists affirm that this species is mycetophagous [16].

The detritophagous coleoptera are also useful. They feed with fragments of organic material resulted from the crumb and the partial decomposition of the dead plants and animals.

In the majority, the *Silphidae* family includes species found on dead bodies, rotten fungus, and on the other vegetal and animal matters in decomposition [11]. In the studied ecosystem it was identified the *Silpha carinata* Herbst. species

The *Nitidulidae* family registered the highest number of the collected insects. They feed on decaying vegetal matter. Such a trophic system have also the *Nitidula carnaria* Schall. and *Carpophilus bipustulatus* Er. species.

In the *Staphylinidae* family there are species that belong to the *Atheta, Omalium, Oxytelus, Tachyporus, Lathrobium* and *Aleochara* genera; they were found on the decaying vegetal matters, compost and on the tree moss [11].

In the *Anthicidae* family there are phytophagous species, but the *Anthicus* genus includes species that feed on decaying vegetal matters, as *Anthicus floralis* L. [7], [17].

The *Monotomidae* family is represented by *Monotoma spinicollis* Aube that appears often in decaying vegetal matter, inclusive in the artificial habitats like the heaps of compost.

The *Lathridiidae* family is represented in agro-ecosystem by *Corticarina gibbosa* Herbst. that is considered to be mycetophagous and not to produce damages [22].

They were identified also the coprophagous species that belong to the *Scarabaeidae* family: *Aphodius granarius* L., *A. varians* Duft that consume the catabolic produces of different animals mainly vertebrata, produces that are to be found in the manure of the stable.

Detritus- and coprophagous insects are considered "crop sanitarians" and provide bacteria and fungi with the resources needed for the mineralisation process. Their actions successfully place them in the category of useful insects.

CONCLUSIONS

The list of beetles in the Gusterita Ecological Garden includes a total of 14 families, 38 genera and 61 species.

Surveys revealed the spectrum of beetles: 10 harmful species belonging to five families and 51 useful species belonging to 10 families.

The family with the highest numerical abundance is represented by *Staphylinidae* - 133 samples (34.72%), followed by *Nitidulidae* - 117 samples (30.52%), and *Carabidae* - 86 samples (22.45%).

The group of the useful species is characterized by dominance of the detritivorous species *Carpophilus bipustulatus* Er. (24.80%) and *Nitidula carnaria* Schall (5,74%) and the zoophagous species *Oxytelus insecatus* Grav. (8.61%) and *Poecilus cupreus* L. (6.78%).

The dominance of the useful coleoptera (89.82%) in comparison with the pest species (10.18%) emphasizes that at the level of the Gușterița agro-ecosystem, cultivated in the ecological manner, the useful species are efficient in inhibiting and keeping under control both the number of the pest coleoptera and also of other in-vertebrata in the agro-ecosystem.

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