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# CONTRIBUTON THE KNOWLEDGE OF COLEOPTERAN FAUNA OF SOME ECOSYSTEMS FROM THE NORTHERN ZONE OF THE REPUBLIC OF MOLDOVA

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**ABSTRACT**

The paper represents a study regarding the structure of coleopteran coenoses from three types of ecosystems (forest, apple orchard and wheat crop) from the northern zone of the Republic of Moldova (Branzeni village, Edinet district). As result of collection with soil barber traps, in vegetation period of 2008 in studied ecosystems 58 species of coleopterans from 31 genera and 5 families were registered. In oak and hornbeam forest 628 individuals from 23 species and 16 genera have been collected; in apple orchard – 112 specimens from 29 species and 19 genera and in the wheat crop – 301 specimens from 38 species and 21genera. 9 species from 7 genera and 4 families were common for all three studied ecosystems. The species *Geotrupes stercorosus* and *Nicrophorus vespilloides* are characteristic ($W_5$, $W_4$) for forest ecosystem, while in agricultural ecosystems by soil traps only accidental and accessorial species were identified.

**Key words**: Coleopterans, diversity, ecological indexes, forest, apple orchard, wheat crop.

## Introduction

At present, in Republic of Moldova, as well as in many European countries the focus is on achieving organic products that don't pollute the environment and don't affect the consumer's health.

where chemical treatments was not use, an apple orchard, which has not been chemically treated for several years and a wheat crop. In forest ecosystem any soil processing activities does not apply, in apple culture is practiced plowing through the rows, and in the wheat crop, the soil is mechanically processed several times a year, thus influencing the soil fauna.

Forest ecosystems play an important role in purifying the atmosphere, retain water in the soil, prevent soil erosion, maintain soil fertility, protect biodiversity, provide raw material for construction, wood industry, produce herbs, fruits, can be used for tourism and entertainment.

Wheat is one of the most important crops grown worldwide, used in alimentary purposes for human population as well as in livestock nutrition. It is used in the production of bread and pastry products, feeding over 40% of world population, at the same time the wheat is used for animal feed.

Agricultural practice without synthetic chemicals allowed the restoring of agricultural ecosystems and first of all of invertebrate fauna. To know the structure of coleopteran coenoses of agricultural ecosystems a comparative study in three types of ecosystems was performed. A forest ecosystem,

Worldwide, the area cultivated with wheat is over than 240 million hectares. The largest areas of wheat are cultivated in Russia, China, USA, India and Australia. The total land area cultivated with cereals and legumes in R. Moldova in 2015 constituted 949.6 thousand ha.

For the Republic of Moldova, the apples are one of the most consumed fruits that have the longest storage period. They have a very important role in healthy nutrition, contain many antioxidants and vitamins benefic for the organism. The area cultivated with fruit crops (apples, pears, quince etc.) in R. Moldova in 2015 constituted 65 300 ha [7].

Along with the economic importance and the need to increase production it is also essential the knowledge of the environmental status of anthropized ecosystems. The studies of coleopteran fauna in agricultural ecosystems permit to know the status of the ecosystem and to identify possible outbreaks of pests and potential agents for biological control.

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## Material and methods

The studies were performed during vegetation period of 2008 in three types of ecosystems from the northern zone of the Republic of Moldova, Branzeni village, Edinet district. The material collections were made in forest of oak (*Quercus robur*) mixed with hornbeam (*Carpinus betulus*), in apple orchard (*Malus domestica*) and in the wheat crop (*Triticum estivum*).

The entomological material was collected by 10 soil traps of Barber type in each ecosystem, during the whole vegetation period. In total 70 Barber traps were installed in each ecosystem of oak forest and apple orchard and 50 traps in autumn wheat crop, because in September the cultivated land was technically processed. As fixator-preserving liquid was used the concentrated solution of salt NaCl, in vessels with the volume of 700 ml and diameter of 75 mm.

The identification of coleopterans was realized based on the works of Kryjanovskij (1965), Panin (1955), Medvedev (1961), Freude et al. (1976).

In the ecological analysis the following indexes were used: abundance, dominance, constancy and index of ecological significance (Simionescu (1983); Stan (1994).

## Results and discussions

As result of performed investigations new data on species compositions, abundance and dominance of coleopterans from the mentioned ecosystems were obtained. In total from the three studied ecosystems there were collected 1041 specimens of coleopterans from 58 species, 31 genera and 5 families (Carabidae, Tenebrionidae, Scarabaeidae, Geotrupidae, Silphidae).

In oak and hornbeam forest 628 specimens from 23 species and 16 genera were registered. In apple orchard 112 specimens from 29 species and 19 genera were collected. In wheat crop 301 specimens from 38 species and 21 genera were collected.

For all three studied biotopes 9 species were common. The species *Nicrophorus vespilloides* had the highest number of specimens – 259, being attracted by the smell of decompositions of small vertebrate fallen in the traps. The species *Carabus cancellatus* with 76 specimens and *Opatrum sabulosum* with 51 specimens follow. Other species registed a lower number of individuals (*Silpha carinata* – 22 ind., *Harpalus rufipes* – 21 ind., *Nicrophorus fossor* – 13 ind., *Caccobius schreberi* – 11 ind., *Badister bipustulatus* – 5 ind. and *Silpha obscura* with 3 ind). For the oak and hornbeam forest and apple orchard 11 species were common. For the oak and hornbeam forest and wheat crop 11 species were common. For apple orchard and wheat crop 20 species were common.

**Table 1 -** Structure of coleopteran coenoses in forest ecosystem, apple orchard and wheat crop

| Species | Oak and hornbeam forest | | | | Apple orchard | | | | Wheat crop | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | D | C | W | A | D | C | W | A | D | C | W |
| *Abax parallelopipedus* (Piller, Mitterpacher,1783 | 10 | 1,6 | 11,4 | 0,2 | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Abax parallelus* (Duftschmid, 1812) | 23 | 3,7 | 20,0 | 0,7 | 1 | 0,89 | 1,4 | 0,01 | | | | |
| *Amara eurynota* (Panzer, 1797) | | | | | 1 | 0,89 | 1,4 | 0,01 | | | | |
| *Amara familiaris* (Duftschmid, 1812) | | | | | 1 | 0,89 | 1,4 | 0,01 | 1 | 0,3 | 2,0 | 0,01 |
| *Amara similata* (Gyllenhal, 1810) | | | | | | | | | 2 | 0,7 | 2,0 | 0,01 |
| *Anchomenus dorsale* (Pontoppidan, 1763) | | | | | | | | | 3 | 1,0 | 6,0 | 0,06 |
| *Anisodactylus signatus* (Panzer, 1797) | | | | | | | | | 2 | 0,7 | 4,0 | 0,03 |
| *Aphodius rufipes* (Linnaeus, 1758) | | | | | 2 | 1,79 | 2,9 | 0,05 | | | | |
| *Aptinus bombarda* (Illiger, 1800) | 61 | 9,7 | 32,9 | 3,2 | | | | | | | | |
| *Badister bullatus* (Schrank, 1798) | 2 | 0,3 | 2,9 | <0,1 | 1 | 0,89 | 1,4 | 0,01 | 2 | 0,7 | 4,0 | 0,03 |
| *Blaps halophila* FischerWaldheim,1832 | | | | | 1 | 0,89 | 1,4 | 0,01 | | | | |
| *Caccobius schreberi* (Linnaeus, 1761) | 2 | 0,3 | 1,4 | <0,1 | 4 | 3,57 | 2,9 | 0,10 | 5 | 1,7 | 4,0 | 0,07 |
| *Calathus halensis* (Schaller, 1783) | | | | | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Callistus lunatus* (Fabricius, 1775) | | | | | 1 | 0,89 | 1,4 | 0,01 | | | | |
| *Carabus cancellatus* Illiger, 1798 | 70 | 11,1 | 41,4 | 4,6 | 2 | 1,79 | 2,9 | 0,05 | 4 | 1,3 | 8,0 | 0,11 |
| *Carabus coriaceus* Kraatz, 1877 | 8 | 1,3 | 7,1 | 0,1 | | | | | | | | |
| *Carabus excellens* Kraatz, 1887 | 10 | 1,6 | 10,0 | 0,2 | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Carabus ullrichi* Germar, 1824 | 7 | 1,1 | 10,0 | 0,1 | | | | | | | | |
| *Cetonia aurata* (Linnaeus, 1758) | | | | | 1 | 0,89 | 1,4 | 0,01 | 1 | 0,3 | 2,0 | 0,01 |
| *Chlaenius vestitus* (Paykull, 1790) | | | | | 1 | 0,89 | 1,4 | 0,01 | 7 | 2,3 | 8,0 | 0,19 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Geotrupes stercorosus* Scriba, 179 | 193 | 30,7 | 67,1 | 20,6 | | | | | | | | |
| *Harpalus affinis* (Schrank, 1781) | | | | | | | | | 4 | 1,3 | 6,0 | 0,08 |
| *Harpalus atratus* Latreille, 1804 | | | | | 3 | 2,68 | 4,3 | 0,11 | 1 | 0,3 | 2,0 | 0,01 |
| *Harpalus distinguendus* (Duftschmid, 1812) | | | | | | | | | 36 | 12,0 | 26,0 | 3,11 |
| *Harpalus oblitus* Dejean, 1829 | | | | | | | | | 3 | 1,0 | 4,0 | 0,04 |
| *Harpalus picipennis* (Duftschmid, 1812) | | | | | 1 | 0,89 | 1,4 | 0,01 | 13 | 4,3 | 10,0 | 0,43 |
| *Harpalus rubripes* (Duftschmid, 1812) | | | | | 3 | 2,68 | 4,3 | 0,11 | 9 | 3,0 | 12,0 | 0,36 |
| *Harpalus rufipes* (De Geer, 1774) | 11 | 1,8 | 12,9 | 0,2 | 2 | 1,79 | 2,9 | 0,05 | 8 | 2,7 | 12,0 | 0,32 |
| *Harpalus signaticornis* (Duftschmid, 1812) | | | | | 1 | 0,89 | 1,4 | 0,01 | | | | |
| *Harpalus smaragdinus* (Duft., 1812) | | | | | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Harpalus tardus* (Panzer, 1797) | | | | | 1 | 0,89 | 1,4 | 0,01 | 9 | 3,0 | 10,0 | 0,30 |
| *Melolontha melolontha* Linnaeus, 1758 | 1 | 0,2 | 1,4 | <0,1 | | | | | | | | |
| *Molops piceus* (Panzer, 1793) | 8 | 1,3 | 10,0 | 0,1 | | | | | | | | |
| *Nebria brevicollis* (Fabricius, 1792) | | | | | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Nicrophorus fossor* Erichson, 1837 | 5 | 0,8 | 5,7 | <0,1 | 1 | 0,89 | 1,4 | 0,01 | 7 | 2,3 | 8,0 | 0,19 |
| *Nicrophorus vespillo* (Linnaeus, 1758) | 2 | 0,3 | 1,4 | <0,1 | | | | | | | | |
| *Nicrophorus vespilloides* Herbst, 1784 | 175 | 27,9 | 20,0 | 5,6 | 42 | 37,5 | 10,0 | 3,75 | 42 | 14,0 | 22,0 | 3,07 |
| *Oiceoptoma thoracicum* (Linnaeus, 1758) | 11 | 1,8 | 8,6 | 0,2 | | | | | | | | |
| *Onthophagus coenobita* (Herbst, 1783) | 1 | 0,2 | 1,4 | <0,1 | 1 | 0,89 | 1,4 | 0,01 | | | | |
| *Onthophagus ovatus* (Linnaeus, 1758) | | | | | | | | | | | | |
| *Onthophagus taurus* Schreber, 1759 | | | | | | | | | 3 | 1,0 | 2,0 | 0,02 |
| *Onthophagus verticicornis* Leicharting, 1781 | | | | | 13 | 11,6 | 5,7 | 0,66 | 26 | 8,6 | 18,0 | 1,55 |
| *Opatrum sabulosum* (Linnaeus, 1761) | 4 | 0,6 | 5,7 | <0,1 | 12 | 10,7 | 15,7 | 1,68 | 35 | 11,6 | 28,0 | 3,26 |
| *Ophonus azureus* (Fabricius, 1775) | | | | | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Ophonus diffinis* (Dejean, 1829) | | | | | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Ophonus gammeli* (Schauberger, 1932) | | | | | 1 | 0,89 | 1,4 | 0,01 | 4 | 1,3 | 4,0 | 0,05 |
| *Ophonus rufibarbis* (Fabricius, 1792) | | | | | | | | | 17 | 5,6 | 14,0 | 0,79 |
| *Panagaeus bipustulatus* (Fabricius, 1775) | 4 | 0,6 | 4,3 | <0,1 | | | | | | | | |
| *Poecilus cupreus* (Linnaeus, 1758) | | | | | | | | | 6 | 2,0 | 8,0 | 0,16 |
| *Poecilus sericeus* Fischer-Waldheim, 1824 | | | | | | | | | 3 | 1,0 | 4,0 | 0,04 |
| *Polystichus connexus* (Fourcroy, 1785) | | | | | | | | | 1 | 0,3 | 2,0 | 0,01 |
| *Pterostichus melanarius* (Illiger, 1798) | 1 | 0,2 | 1,4 | <0,1 | | | | | | | | |
| *Pterostichus ovoideus* (Sturm, 1824) | | | | | 1 | 0,89 | 1,4 | 0,01 | | | | |
| *Pterostichus strenuus* (Panzer, 1797) | | | | | 3 | 2,68 | 4,3 | 0,11 | 1 | 0,3 | 2,0 | 0,01 |
| *Silpha carinata* Herbst, 1783 | 18 | 2,9 | 12,9 | 0,4 | 1 | 0,89 | 1,4 | 0,01 | 3 | 1,0 | 6,0 | 0,06 |
| *Silpha obscura* Linnaeus, 1758 | 1 | 0,2 | 1,4 | <0,1 | 1 | 0,89 | 1,4 | 0,01 | 1 | 0,3 | 2,0 | 0,01 |
| *Tanatophilus rugosus* (Linnaeus, 1758) | | | | | 8 | 7,14 | 2,9 | 0,20 | 34 | 11,3 | 10,0 | 1,13 |
| *Zabrus tenebrioides* Fischer-Waldheim, 181 | | | | | 1 | 0,89 | 1,4 | 0,01 | | | | |
| **Total** | 628 | | | | 112 | | | | 301 | | | |

**Oak and hornbeam forest.** According to analyzed ecological parameters of coleopterans collected from forest ecosystem, it was revealed that the species *Geotrupes stercorosus* with 193 individuals (30,73%), *Nicrophorus vespilloides* – 175 (27,87%) and *Carabus cancellatus* – 70 (11,15%) are eudominat species ($D_5$); *Aptinus bombarda* - 61 (9,71) dominant species ($D_4$); 2 species were subdominant ($D_3$); 7 species – recedent ($D_2$) and 10 species – subrecedent ($D_1$).

The constancy registered the highest values in species *Geotrupes stercorosus* - 67,14 % ($C_4$); the species *Carabus cancellatus* and *Aptinus bombarda* proved to be accessorial ($C_2$), with a frequency of 41,43% and 32,86; other 20 species were accidental ($C_1$).

The species characteristic for forest ecosystem that have registered the highest valued of ecological significance index are: *Geotrupes stercorosus* - 20,63% ($W_5$) and *Nicrophorus vespilloides* - 5,57% ($W_4$), 10 species were accessorial ($W_2$-$W_3$) and 11 species – accidental ($W_1$) (tab.1).

**Apple orchard.** In the orchard 3 species were eudominant (D5) - *Nicrophorus vespilloides* with 42 individuals (37,50%), *Onthophagus verticicornis* with 13 ind. (11,610%) abnd *Opatrum sabulosum* with 12 ind. (10,71%); the species *Tanatophilus rugosus* with 8 individuals and 7,14% was registered as dominant ($D_4$); 4 species subdominant ($D_3$); 3 species recedent ($D_2$); 18 species subrecedent ($D_1$).

According to constancy index only accidental species were registered ($C_1$).

The index of ecological significance emphasized 8 accessorial species ($W_2$-$W_3$), the other 21 being accidental ($W_1$) (tab.1)

**Wheat crop.** The most abundant and dominant species in autumn wheat crop are: *Nicrophorus vespilloides* with 42 individuals (14,0%), *Harpalus distinguendus* with 36 individuals (12,0%), *Opatrum sabulosum* with 35 individuals (11,6) and *Tanatophilus rugosus* with 34 individuals (11,3%) – being eudominant species ($D_5$); *Onthophagus verticicornis* with 26 individuals (8,6%) and *Ophonus rufibarbis* with 17 individuals (5,6%) – dominant ($D_4$); 6 species were subdominant ($D_3$); 5 species – recedent ($D_2$) and 21 species – subrecedent ($D_1$). 2 species were accessorial ($C_2$) the other were accidental ($C_1$).

The index of ecological significance registered 14 accessorial species ($W_2$-$W_3$), the other 24 species were accidental ($W_1$) (tab.1).

According to trophic preferences the fauna of coleopterans from the studied ecosystems (forest, apple orchard and wheat crop) from the northern zone of the republic is composed of 5 trophic groups: phytophagous, zoophagous, necrophagous, coprophagous and mixophagous. The group of phytophagous constitute 40% (23 species) from all identifies species, followed by zoophagous one with 33% (19 species). A similar number of species – 7 have been registered in the groups of: necrophagous (12%) and coprophagous (12%), the mixophagous (3%) were represented by 2 species (Fig. 1.).

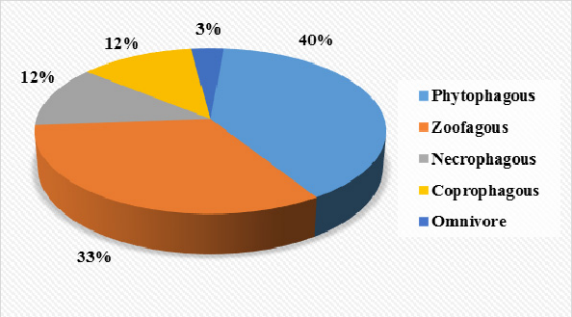


**Fig. 1 -** Trophic spectrum of coleopterans collected in studied ecosystems

Coleopteran species collected from the northern zone of the republic, according to the distribution area belong to 9 zoogeographic elements with the dominance of the Trans-Palearctic ones (18 species), followed by European (15 species) and Euro-Caucasian (7 species), which constitute more than 50% of all collected species. With a lower species number were recorded the elements from West-Palearctic (5 species), Euro-Siberian (4), Holarctic (3), Pontic (3), Palearctic (2) and Mediterranean (1) (Fig. 2.).

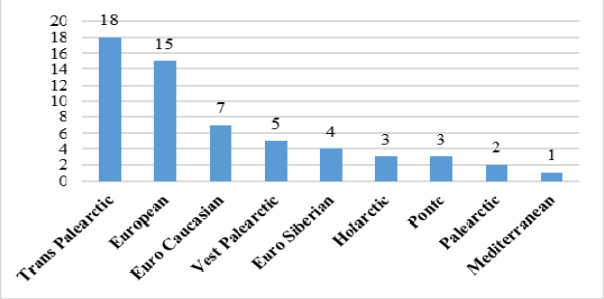


**Fig. 2 -** Geographic spreading of coleopterans from the studied ecosystems

## Conclusions

1. Fauna of identified coleopterans in the three studied 3 ecosystems was represented by 58 species from 31 genera and 5 families.
2. The highest species diversity was registered in wheat crop - 38 species from 21 genera, followed by apple orchard – 29 species from 19 genera and the lowest species number was recorded in oak and hornbeam forest, where 23 species from 16 genera have been identified.
3. For all 3 ecosystems 9 species were common. For the oak and hornbeam forest and apple orchard 11 species were common. For the oak and hornbeam forest and wheat crop 11 species were common. For apple orchard and wheat crop 20 species were common.
4. As result of ecological parameter analysis of coleopterans from the forest it was revealed the presence of two characteristic species, 10 accessorial species and 11 accidental species.
5. In wheat crop and apple orchard characteristic species were not registered, although the number of species was considerably higher than the oak forest mixed with hornbeam, which shows that the number of species was quite small.
6. According to trophic preferences the group of phytophagous was the most numerous with 40% (23 species) from all identifies species, followed by zoophagous one with 33% (19 species). A similar number of species – 7 have been registered in the groups of necrophagous (12%) and coprophagous (12%), the mixophagous (3%) were represented by 2 species
7. According to the distribution area the Trans-Palearctic (18) and European (15) species dominate.
8. In general, the fauna of coleopterans is well represented in wheat crop and in apple orchard, which prove the lack of chemical treatments and the restoring of ecosystems.

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