# BOOK OF ABSTRACTS

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## 4) ASSESSMENT OF BEES *(HYMENTOPTERA: APIDAE)* DIVERSITY IN AGROECOSYSTEMS OF CENTRAL FOREST-STEPPE ZONE OF UKRAINE

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**Abstract**
The objective of the study was the assessment of bees (domestic, wild, bumblebees) diversity in different types of ecotopes in agroecosystems of Central Forest-Steppe zone of Ukraine. Bee communities were investigated in agrocenosis, semi-natural habitats and ecotones between on territories of 6 farms. In total were sampled 1131 individuals of bees that were presented by 60 species. Species composition, density and richness of bees were investigated. Indexes of Shannon, Simpson and Sorensen were used for biodiversity analysis. The results indicated that the species richness of bees grows by gradient: agrocenosis – semi-natural habitat – ecotone. The most common and spread species were *Apis mellifera* L., *Bombus lapidarius* L., *B. terrestris* L., *Halictus simplex* Blüthgen, *Systropha curvicornis* Scopoli, *Lasioglossum leucozonium* Schrank. Density of *Apidae* increases in agrocenosis and falls in semi-natural habitats. Forming of bees fauna in agrocenosis depends from fauna of semi-natural habitats. Availability of ecotones promotes increasing of bee diversity in agroecosystems because it performs preservation function for biota and improves the spreading of bees and other species.

**Introduction**
Bees provide crucial ecological service in the agricultural landscape in most geographical regions because they are considered to be predominant and most economically important group of pollinators. A decline in bee diversity will affect the pollination of many insect-pollinated crops and wild plant species. Although the honeybee (*Apis mellifera* L.) is generally regarded as the most important bee pollinator, wild bees are also relevant. There has been growing concern about suspected declines in wild bee populations and the implications for agricultural and natural ecosystems. There is also a greater likelihood of toxicological effects of insecticides in agriculturally dominated landscapes.

The objective of the study is the assessment of bees (domestic, wild, bumblebees) diversity in different types of ecotopes in agroecosystems of Central Forest-Steppe zone of Ukraine.

**Materials and Methods**
The study comprises farms in six villages (Yablunivka, Bloschintsi, Terezine, Matyushi, Bugayivka, Karapishi) of Kiev region located on the territory of Dniester-Dnipro province of Central Forest-Step of Podilska and Pridneprovska hills.

The habitat mapping method is based on generic system of habitat definitions 'General Habitat Categories' (Dennis et al., 2012). We applied QGIS tool (GNU General Public License, http://qgis.org) for creating digital maps of surveyed habitats. Data validation was carried out in a field conditions.

At each farm, studied habitats were divided into 3 groups: agrocenoses – fields of winter wheat, soybeans, corn, barley, buckwheat; ecotones – ecotone between agrocenosis and single-row wind-protection trees, ecotone between agrocenosis and forest band, a grass band on a field road between agrocenoses; semi-natural territories – grasslands.

The management was rather similar on all farms. Agro-chemicals are not applied on the grasslands, stocking rates are very low (0.15–1.75 LU/ha grassland). Zero or low inputs of fertilizers (15–50 t/4 year solid

cattle manure or 20–30 kg N/ha/year inorganic fertilizer) and one or two pesticide applications are usual on the arable fields.

At each farm bee samples were taken and identified during the bee season. Bees were captured with an insect net. The aerial net method along transect ('belt') walks has been used for years in ecological studies (Banaczak, 1980).

Species composition, density and richness of bees were investigated. Indexes of Shannon, Simpson and Sorensen were used for biodiversity analysis (Szujecki, 1980).

**Results and discussion**

Bee communities were investigated in agrocenosis, semi-natural habitats and ecotones between. In total were sampled 1131 individuals of bees that were presented by 60 species.

The species richness of bees grows by gradient: agrocenosis – semi-natural habitat – ecotone. Increasing of species' richness was established in grass stripes on an agrocenosis edge close to forest bands, one-row wind-protection trees and meadows. In total 40 species were sampled in ecotones. The lowest number of bee species was found in agrocenosis (18 species), and medium species number – in semi-natural habitats (28).

The dominant species in agrocenosis, semi-natural habitats and ecotones was *Apis mellifera* L. with the highest density in agrocenosis (7.9 samples per 100 $m^2$) during blooming period. Other species were rare in fields. Some of them could be observed on specific plant species only. *Andrena pilipes, Megachile centuncularis* were found in soya cenosis only, likewise *Evylaeus leucopus, Lasioglossum sexnotatum*, *L. xanthopus* – could be seen in barley, and *Osmia cerinthidis, Sphecodes* sp. – in cenosis of buckwheat and alfalfa. At the same time *Osmia cerinthidis* is typical for South regions, it is not often found in north regions of Ukraine.

Ecotones on the edge of agrocenosis close to forest bands and meadows were presented by 40 species of bees. The most spread and common species were *Apis mellifera* (4.5 samples/100 $m^2$), *Bombus lapidarius* (0.8 samples/100 $m^2$), *B. terrestris* (0.8 samples/100 $m^2$), *Halictus simplex* (0.7 samples/100 $m^2$). We have found *Bombus argillaceus* (0.03 samples/100 $m^2$) from the Red List of Ukraine in grass stripes between agrocenosis and wind-protection trees.

Ecotones between agrocenosis were not rich for bee species and were presented by 5 species only. The most spread were *Systropha curvicornis* (0.5 samples/100 $m^2$), *Lasioglossum leucozonium* (0.3 samples/100 $m^2$). The same species were common for other types of ecotones.

Density of *Apidae* increases in agrocenosis and decreases in semi-natural habitats. The average density of *Apidae* was 1.0±0.21 samples/100 $m^2$ in agrosenosis, 0.9±0.20 – in ecotones and 2.4±0.38 – in semi-natural habitats.

As a result of a number of studies, several features associated with agriculture management make farm poor habitat for bees and other pollinators. Intensification of agriculture has led to a more homogenous landscape, characterized by large crop fields and fewer non cultivated habitats. Loss of complex landscape elements between farmland and adjacent ecosystems, as well as the increased use of agrochemicals, has been linked to the reducing in richness of bee species in agroecosystems.

The comparative analysis showed the strong correlation between abundance of bees species and habitat affiliation to semi-natural territories (biotopes) (r = 0.59). We have found the highest average numbers of bee species diversity in meadows and pastures (0.8 species per 100 $m^2$) that could be explained by the diversity of flowering plants (Fig. 1).

The lower level of average bee species diversity (0.2 species/100 $m^2$) and density (1.0 individual/100 $m^2$) were noticed in agrocenosis that linked to monoculture and agromanagement treats (mineral fertilizing, pesticides applying etc.). At the same time, we have found the strong correlation between numbers of bee species and sizes of agrocenosis plots.

The average numbers of bee species diversity and density were about 0.5 species/100 $m^2$ and 0.9 individuals/100 $m^2$ in ecotones. Giving this, availability of ecotones promote increasing of bee diversity in agroecosystems because it performs preservation function for biota and improves the spreading of bees and other species.

In total 28 species of *Apidae* were found in semi-natural biotopes (habitats). The dominant species were *Apis mellifera* L. (12.1 individuals/100 $m^2$), *Bombus terrestris* Linnaeus (2.1 individuals/100 $m^2$), *Systropha curvicornis* Scopoli (1.3 individuals/100 $m^2$), *Halictus quadricinctus* Fabricius (0.9 individuals/100 $m^2$), *H.*

*simplex* Blüthgen (0.8 individuals/100 $m^2$). Most of them we have also found in ecotones on the edge of fields close to forest bands, meadows and in gross stripes between fields.

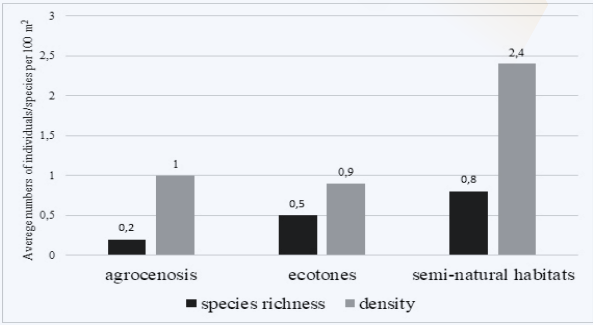


**Fig.1.** Species diversity and density of bees in different types of habitats

The highest numbers of Shannon index for bees diversity were established in grass stripes between agrocenosis and forest bands, meadows (H=2.12). The species evenness in ecotones was J=0.76. Lower level of species diversity and higher level of evenness were found in agrocenosis (H=1.73, J=0.97). The lowest numbers of species diversity and evenness were noticed in semi-natural habitats (H=1.45, J=0.75).

The highest similarity of bees species were found in both agrocenosis and semi-natural habitats (Sorensen similarity index – 0.50). That points toward dependents of bees fauna forming in agrocenosis from fauna of semi-natural habitats. The decreasing of Sorensen index was established for semi-natural habitats and ecotones between them and agrocenosis (down to 0.3). The lowest similarities were observed in ecotones and agrocenosis.

The results obtained make it possible to assume that bees respond to changes in their environment and in particular to increased intensiveness of agriculture management. That makes them a reliable indicator and allows their use in biomonitoring of the environment.

## Conclusions and Outlook

The species richness of bees grows by gradient: agrocenosis – semi-natural habitat – ecotone and presented by 60 species in the observed farm territory of Kiev region (Dniester-Dnipro province of Central Forest-Step of Podilska and Pridneprovska hills). The most common and spread species are *Apis mellifera* L., *Bombus lapidarius* L., *B. terrestris* L., *Halictus simplex* Blüthgen, *Systropha curvicornis* Scopoli, *Lasioglossum leucozonium* Schrank.

Density of *Apidae* increases in agrocenosis and falls in semi-natural habitats. Forming of bees' fauna in agrocenosis depends from fauna of semi-natural habitats. Availability of ecotones promotes increasing of bee diversity in agroecosystems because it performs preservation function for biota and improves the spreading of bees and other species.

The presented results could be used to predict changes in the formation of bee entomocomplexes in order to preserve their biodiversity.

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