The influence of intensive farming practices on biodiversity of selected species of invertebrates

JANA PODHORNA, MARIE BORKOVCOVA
Department of Zoology, Fisheries, Hydrobiology and Apiculture
Faculty of Agronomy
Mendel University in Brno
Zemedelska 1, 613 00 Brno
CZECH REPUBLIC

jana.podhorna@mendelu.cz

Abstract: Biodiversity of selected species of invertebrates focused on necrophagous species was monitored in the South Moravia region (Czech Republic) using pitfall traps. Traps were placed in total in 6 locations divided into 2 types A and B. Three localities marked as A are wine regions with almost no disturbance of the landscape, while the other three sites marked as B are in the intensive agricultural farming area. Monitoring was conducted from May to August 2014. In total were laid 216 traps and for the processing were used 110 traps. Each trap was evaluated for the species spectrum of trapped animals, and counted the total number of individuals of each species. The results were processed using biodiversity indexes. In the localities A were captured in total 31 species and 3024 specimens. In the localities B were 18 species and 3708 individuals. Index of species diversity in the localities A was 1.8, in the localities B 0.9. Simpson's Diversity Index evaluation in the localities A was 0.63 and 0.46 in the B localities. Dominance indexes evaluation shows undisturbed character in habitats marked A, with typical occurrence of subordinate species, on the contrary, in areas B was significantly higher occurrence of eudominant species. These observations are consistent with the results of the other authors that intensive anthropogenic activity - intensive agriculture farming - can also affect species diversity at necrophagous species.

Key-Words: necrophagous insect, carabids, vineyard, intensive agricultural farming, South Moravia region

Introduction

Arable (agricultural) landscapes, grassland farming systems, as well as forests, uplands and freshwater habitats are often the point of many research studies not only in Central and Northern Europe, whilst there are minority of those have been carried out in agro-systems, such as vineyards, despite their economic importance for farmers [1]. Vineyards must however be prevented to avoid future biotic losses and these measures should be supported by all stakeholders while at the same time conserving the natural complement of biodiversity [2].

The global decline in biodiversity needs to identify the drivers responsible for conflicts between human activities and the conservation of European biodiversity. There is an effort to promote the management of these conflicts [3]. In grassland strips, and only marginally in vineyards, we found that the positive effect of organic farming was more pronounced for perennial than annual species [1].

As North 2007 states we represent habitat quality as a continuously varying surface over the two-dimensional landscape and the quality affects either fecundity or probability of propagule production. Control of the properties of the landscape is conducted by two parameters, which we call the patch size (the characteristic length scale in quality variation), and the level of heterogeneity (the characteristic quality difference between poor quality and high quality areas) [4].

Generally heterogeneity has positive effect on population density, and hence it is beneficial to improve best quality habitat at the expense of worst quality habitat. Large-scale disturbance events simultaneously affect contiguous blocks of sites. Increasing spatial autocorrelation in the disturbances has a harmful effect to population density so its decreasing equilibrium [5]. The presence of spatially structured fixed habitat heterogeneity, increasing local spatial autocorrelation in habitat generally has a beneficial effect on such populations which increase the equilibrium of population density [5]. The overall suitability of an environment is characterized by the principal eigenvalue of the corresponding linearized equation on the spatial arrangement of regions [6].

Favourable and unfavourable habitat on boundary conditions is analysed.

Material and Methods

Characterization of localities

The experiments were carried out in six localities (Fig. 1) in the South Moravian region in about 40 km range southward from Brno as following Brno-Venkov, Znojmo and Breclav districts with different farming practices. Locations were divided into 2 types A and B. Localities A are characteristic for the almost no disturbance of the landscape. B localities are placed in the intensive agricultural farming area. Three localities marked as A constitute vineyards and orchards. These regions have typical hilly landscape features and on the sunny hillside are grown grapevine, apricots and peaches. Forest steppe and steppe associations are present. Experimental localities were placed nearby Moravsky Krumlov, Nosislav and Kobyli.

Moravsky Krumlov is situated 225 MASL. The average annual rainfall is 500-550 mm. The average annual temperature is 9° C. Abiotic conditions, their number and variations (humidity, local chemistry of the soil, orientation, slope) in this area has developed a number of association of different nature. The whole territory is very rich of extraordinary species. Area has a warm, dry climate with shorter sun shines and mild winters.

An average altitude of Nosislav village is 192 m. The average annual temperature is 9° C. The average rainfall amount is 551 mm per year. Slopes location, warm climate and mild winters support traditional crops growing as grapevine, apricots and peaches.

Kobyli is situated 205 MASL. The average annual rainfall is 515 mm. The average annual temperature is 9° C. Favourable climatic conditions allow the existence of protected steppe association. Fields, orchards and vineyards are predominant extensive agricultural crops. In recent decades there was also a lot of terracing slopes.

The next three localities marked as B are cultivated in an intensive crop farming way focused on maize, sunflower, cereals and vegetables production. Agriculture management greatly affects the appearance of the landscape. Due to the warm climate harvest takes place twice a year. Localities were as follows: Lodenice, Nesvacilka and Zajeci.

Sample collecting

The study was focused preferably to necrophagous species with the use of pitfall traps. Pitfall traps were formed from the one litre size bottle. On the bottom was poured layer of soil up to height of about 3 cm. On this layer was placed bait – raw fish meat weighing 70 g. This amount was empirically verified before the beginning of the experiment. Bottles with bait were always buried in three in a row, on every site were made 3 rows at a distance of 1 km. Traps were covered with stone or brick, thus invertebrates could fly in but not to get out of the bottle. After 7 days, the traps were removed and processed at the Institute of Zoology Fisheries, Hydrobiology and Apiculture.

Fig. 1 Observed localities in the South Moravian region

Results and Discussion

Monitoring was conducted from May to August 2014. In total were laid 216 traps and for the processing were used 110 traps. Each trap was evaluated for the species spectrum of trapped animals, and counted the total number of individuals of each species. The results were processed using biodiversity indexes. In the localities A were captured in total 31 species and 3024 specimens. In the localities B were 18 species and 3708 individuals (tab. 1). Index of species diversity in the localities A was 1.8, in the localities B 0.9. Simpson's Diversity Index evaluation in the localities A was 0.63 and 0.46 in the B localities. Dominance indexes evaluation shows undisturbed

character in habitat marked A, with typical occurrence of subordinate species, on the contrary, in areas B was significantly higher occurrence of eudominant species. These observations are consistent with the results of the other authors that intensive anthropogenic activity can also affect species diversity at necrophagous species [7].

Table 1 Number of species in both localities

A localities	taxonomy	species	specimens in total	B localities	taxonomy	species	specimens in total
necrophagous		10	162	necrophagous		7	216
carabids	Carabidae	8	378	carabids	Carabidae	4	486
rove beetles	Staphylinidae	4	162	rove beetles	Staphylinidae	3	189
true flies	Diptera	4	2268	true flies	Diptera	2	2754
others		5	54	others		2	63
in total		31	3024	in total		18	3708

Conclusion

In 6 localities in southern Moravia region were collected samples of insect from pitfall traps. In the areas A were 3024 individuals captured in total 31 species. In the localities B were 18 species and 3708 individuals gathered. Simpson's Diversity Index evaluation in the localities A was 0.63 and 0.46 in the B localities. Dominance indexes evaluation shows undisturbed character in habitats marked A, with typical occurrence of subordinate species (Carabidae), on the contrary, in areas B was significantly higher occurrence of eudominant species as genus *Calliphora* and *Lucillia* from the order Diptera. Location A index of species dominance evaluate as less anthropogenically influenced. The differences in between locality A were not in very large range in comparison with the location B.

Acknowledgement

This research was financially supported by the Internal Grant Agency of Mendel University in Brno (IGA TP7/2014) namely, under the aegis of Ing. Vladimir Hula, Ph.D.

References

[1] Nascimbene J, Marini L, Paoletti MG, Organic farming benefits local plant diversity in vineyard farms located in intensive agricultural landscapes. *Enviromental management*, Vol. 49, No. 5, 2012, pp. 1054–60

[2] Kehinde T, Samways MJ, Effects of vineyard management on biotic homogenization of insect-flower interaction networks in the Cape Floristic Region biodiversity hotspot, *Journal of Insect Conservation*, Vol. 18, No. 3, 2014, pp 469–477

[3] Young J, Watt A, Nowicki P, Alard D, Clitherow J, Henle K, Johnson R, Laczko E, McCracken D, Matouch S, Niemela J, Richards C, Towards sustainable land use: identifying and managing the conflicts between human activities and biodiversity conservation in Europe, *Biodiversity & Conservation*, 2005, Vol. 14, No. 7, 2005, pp 1641–1661

[4] North A, Ovaskainen O, Interactions between dispersal, competition, and landscape heterogeneity, *Oikos*, Vol. 116, No. 7, 2007, pp. 1106–1119

[5] Hiebeler DE, Morin BR, The effect of static and dynamic spatially structured disturbances on a locally dispersing population, *Journal of Theoretical Biology*, Vol. 246, No. 1, 2006, pp 136–144

[6] Cantrell RS, Cosner C, The effects of spatial heterogeneity in population dynamics, *Journal of Mathematical Biology*, Vol. 29, No. 4, 1991, pp 315–338

[7] Horenstein M. B., Rosso B., Dolores García M. D., Seasonal structure and dynamics of sarcosaprophagous fauna on pig carrion in a rural area of Cordoba (Argentina): Their importance in forensic science, *Forensic Science International,* Vol. 1, No. 3, 2012, pp. 146–156