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DIVERSITY OF ORTHOPTERA (INSECTA) IN GRASSLANDS FROM COMANA NATURAL PARK (ROMANIA)

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Abstract. In this paper we present some aspects regarding the diversity of the Orthoptera communities in a comparative way, from three grasslands from Comana forest, the main component of Comana Natural Park. We analyze the data collected systematically in May, July and September during a two years period using synecological and diversity indices. A total of 38 Orthoptera species were collected in the three sites. The lowest values of Margalef and Shannon-Wiener diversity indices for the Orthoptera communities were observed in the site with degraded vegetation. In the other two sites, with a higher degree of naturalness, higher values of biodiversity indices were observed for Orthoptera communities.

Résumé. Dans ce travail on présente, d'une manière comparative, quelques aspects concernant la diversité des communautés d'orthoptères dans trois pâturages qui se trouvent dans la forêt de Comana, principal component du Parc Naturel Comana. On y analyse, à l'aide des indices synécologiques et de diversité, les données collectées systématiquement au cours de deux années, pendant les mois de mai, juillet et septembre. Un nombre total de 38 espèces d'orthoptères ont été capturées dans ces trois sites. Le pâturage avec la végétation la plus dégradée présente aussi les plus petites valeurs des indices de diversité Margalef et Shannon-Wiener. Les deux autres pâturages ont des valeurs de biodiversité plus grandes.

Key words: Orthoptera, diversity, grassland, Comana forest, Romanian Plane.

INTRODUCTION

Comana forestry complex is situated in the southern part of Romania, in the Burnaz Plane district of the Romanian Plane, at approximately 30 km from București. The most part of the Comana forestry complex is included in Comana Natural Park. The characteristic landscape is that of flat plane with small depressions formed by the Neajlov, Argeș, Câlniștea and Gurban rivers. Although the landscape is not spectacular, the biological diversity is very high (Tarnavski et al., 1973). It is considered that Comana Natural Park is the third important wetland area in Romania, after the "Danube Delta" Biosphere Reservation and the "Balta Mică a Brăilei" Natural Park (Comana Natural Park Managemet Plan, 1997).

The area is situated at the border between the Gavanu-Burdea steppic Plane and the Romanian Plane sylvosteppe ecoregions which confers its special phytocenological traits and a great floristic biodiversity. In a relatively small area there are many vegetation types like sylvostepic forests, oak forest formations, alluvial forest formations, steppic grasslands, pastures, halophilic vegetation, wetlands, marshes etc. (Paucă-Comănescu et al., 2001).

Some data on the Orthoptera from Comana forest are given by Frey-Gessner (1897), Burr (1899), Zottu (1903, 1909), Ramme (1942) and Kis (1968), 62 orthoptera species being reported from this area.

Orthoptera have a significant importance in the economy of grassland ecosystems, being important primary herbivores (especially grasshoppers) and contributing to the diet of many other animals (birds, spiders, reptiles, etc) (Gandar,

1982; Ryszkowski et al., 1993; Gangwere et al., 1997). Orthoptera were successfully used in monitoring effects of changes in the land management regimes (Gardiner et al., 2002; O'Neill et al., 2003) and in identifying the grasslands state of conservation (Baldi & Kisbenedek, 1997; Andersen et al., 2001).

The aim of the study was to identify the ecological structure of the Orthoptera communities from several grasslands with different degrees of naturalness from the Comana Natural Park.

MATERIAL AND METHODS

Studied sites

The study was carried out in three sites with grassland vegetation from Comana forest (Fig. 1). The mean annual temperature is 10.8-11.2°C and the mean annual rainfall is 560 mm.

The first site (I) is a clearing in the Comana forest situated in the eastern part of Gurbanu Valley. The vegetation is composed of tall grass and *Prunus spinosa* and *Crataegus monogyna* shrubs with *Rubus caesius*. The herbaceous layer is composed of *Vicia tenuifolia*, *Festuca valesiaca*, *Poa angustifolia* etc.

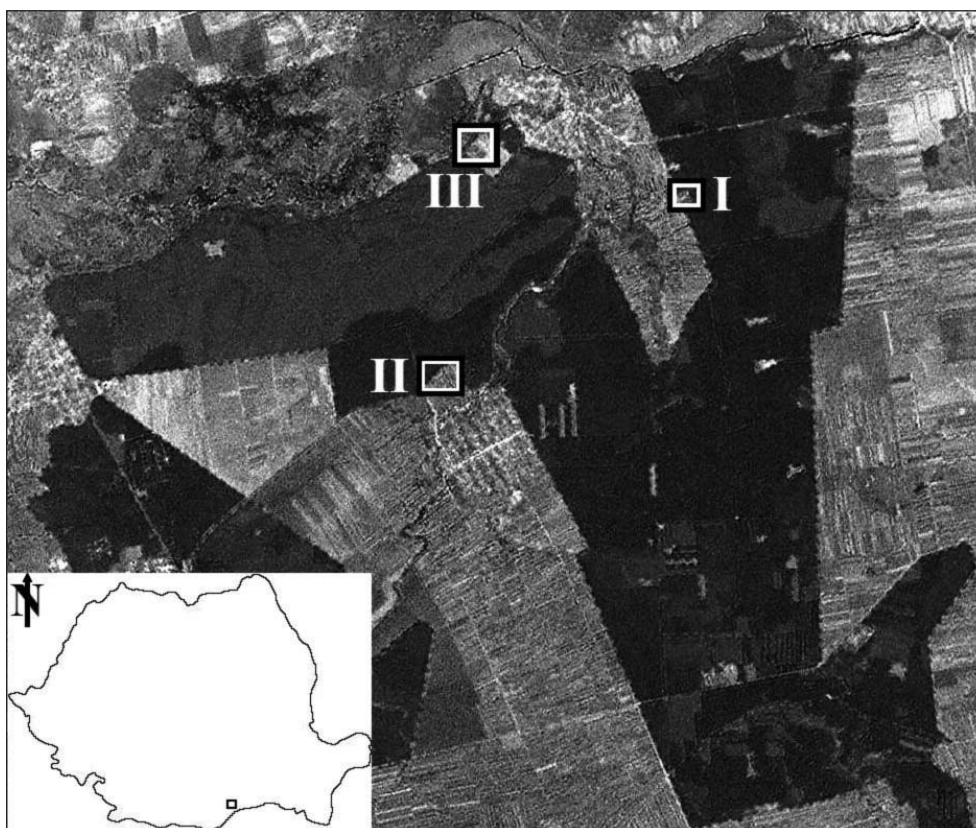


Fig. 1 - Map of Comana forest and the location of the sampling sites: I, II, III.

The second site (II) is characterized by a steppic like habitat, located near the forest, with shrubs of *Crataegus monogyna*, *Cornus sanguinea*, *Rosa canina* and *Ligustrum vulgare*. The herbaceous layer is composed mainly of *Festuca valesiaca*, *Poa angustifolia*, *Vicia tenuifolia*, *Bromus inermis*, *Origanum vulgare* etc.

The third site (III) is an abandoned agricultural field with degraded vegetation, characterized by the presence of *Sisymbrium loeselii*, *Descurania sophia*, *Agropyron repens*, *Artemisia annua*, *Capsella bursa-pastoris*, *Malva sylvestris*, *Ballota nigra*, *Geum urbanum*, *Cirsium lanceolatum*. In this site, near the forest there is an ecoton area with shrubs of *Cornus* ssp., *Prunus spinosa* and *Rosa canina*.

The first two sites are secondary grasslands common in the forest steppe region, being habitats resulted from deforestation of different types of oak and mixt forests. The degree of naturalness is higher in the first two sites than in the third site, which has been cultivated in the past and therefore has a higher degree of anthropisation.

Orthoptera sampling and analysis

Sampling was performed in three months, late May, July and September during 2007 and 2008 in order to catch most of the species from the area in an adult state. The Orthoptera were sampled using the sweep-net method along a 250 m transect, 1 m wide, with constant speed. The number of sweeps was 116/50 m. The sampling was carried out around 10:00 AM in sunny days without wind and precipitation.

A total of 2251 individuals were collected in the studied areas. All the collected Orthoptera were identified as far as it was possible, but for the biodiversity analysis only the adults were taken into account. The identification was made using Kis (1976, 1978).

The evaluation of Orthoptera diversity was performed using synecological indices such as abundance (A), constancy (C) and the ecological significance index (W) and diversity indices such Margalef index (D - evaluates the richness of species and of individuals) and Shanon–Wiener index (H - evaluates the heterogeneity of species).

RESULTS AND DISCUSSIONS

Thirty eight species were identified in the studied areas (32 in site I, 29 in site II and 25 in site III). In the Ensifera suborder 17 species of bushcrickets (Tettigoniidae) were identified, belonging to five subfamilies, respectively Phaneropterinae, Conocephalinae, Tettigoniinae, Decticinae and Bradyporinae.

We also captured three species of crickets (Gryllidae, Gryllinae and Oecanthine). The Caelifera suborder was represented by three species of groundhoppers (Tetrigidae) and 15 species of true grasshoppers (Acrididae), belonging to five subfamilies (Cantatopinae, Calliptaminae, Acridinae, Oedipodinae and Gomphocerinae) (Tab.1).

In site I the eudominant species are *Poecilimon fussi* and *Chorthippus brunneus* and dominant species are *Pachytrachis gracilis*, *Chorthippus loratus* and *C. parallelus*. Subdominant species are: *Phaneroptera nana*, *Conocephalus fuscus*, *Platycleis veyseli*, *Pholidoptera griseoaptera*, *Pholidoptera litoralis*, *Ephippiger ephippiger*, *Tetrix subulata*, *Pezotettix giornae*, *Chorthippus mollis*, *C. oschei*, *Euchorthippus declivus* (Fig. 2). Rare species are: *Leptophyes discoidalis*, *Melanogryllus desertus*, *Tetrix tenuicornis* and *T. bolivari*.

Table 1

Orthoptera species captured in three grassland sampling sites from the Comana forest.

Orthoptera species	2007									2008									
	May			July			September			May			July			September			
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
Subord. Ensifera																			
Fam. Tettigoniidae																			
1 <i>Phaneroptera nana</i> Fieber, 1853	0	0	0	2	5	2	13	24	5	0	0	0	4	7	3	6	16	8	0
2 <i>Leptophyes albivittata</i> (Kollar, 1833)	0	0	0	5	3	0	0	0	0	1	0	0	4	1	0	0	0	0	0
3 <i>Leptophyes discoidalis</i> (Furwaldsky, 1867)	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
4 <i>Isophya recitipennis</i> Brunner von Wattenwyl, 1878	0	3	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
5 <i>Poecilimon fuscii</i> Brunner von Wattenwyl, 1878	2	0	0	25	0	0	0	0	0	1	0	0	45	0	0	1	0	0	0
6 <i>Conocephalus fuscus</i> (Fabricius, 1793)	0	0	0	2	4	2	4	4	5	0	0	0	3	4	7	5	5	8	0
7 <i>Ruspolia nitidula</i> (Scopoli, 1786)	0	0	0	3	4	0	1	1	0	0	0	0	2	5	0	2	1	0	0
8 <i>Tettigonia caudata</i> (Charpentier, 1845)	0	0	0	0	0	5	0	0	2	0	0	2	0	0	3	0	0	0	0
9 <i>Tettigonia viridissima</i> (Linnaeus, 1758)	0	0	0	4	3	6	3	2	4	0	0	0	3	4	7	2	2	3	0
10 <i>Platycleis intermedia</i> (Serville, 1838)	0	0	0	0	0	5	0	0	1	0	0	0	0	0	3	0	0	1	0
11 <i>Platycleis albopunctata grisea</i> (Fabricius, 1781)	0	0	0	5	9	12	1	2	5	0	0	0	3	6	11	2	3	5	0
12 <i>Platycleis veyselei</i> (Kocak, 1984)	0	0	0	3	5	7	6	5	8	0	0	0	3	4	7	3	2	5	0
13 <i>Pholidoptera griseoptera</i> (De Geer, 1773)	0	0	0	13	16	2	5	8	1	0	0	0	9	11	1	5	9	0	0
14 <i>Pholidoptera litoralis</i> (Brunner von Wattenwyl, 1861)	0	0	0	7	0	0	2	0	0	0	0	0	6	0	0	2	0	0	0
15 <i>Pachytrachis gracilis</i> (Brunner von Wattenwyl, 1861)	0	0	0	15	17	0	7	9	0	0	0	0	9	17	0	6	8	0	0
16 <i>Rhacocleis germanica</i> (Herrich-Schäffer, 1840)	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	2	0	0
17 <i>Ephippiger ephippiger</i> (Fiebig, 1784)	0	0	0	1	2	0	13	15	3	0	0	0	2	3	0	11	15	1	0

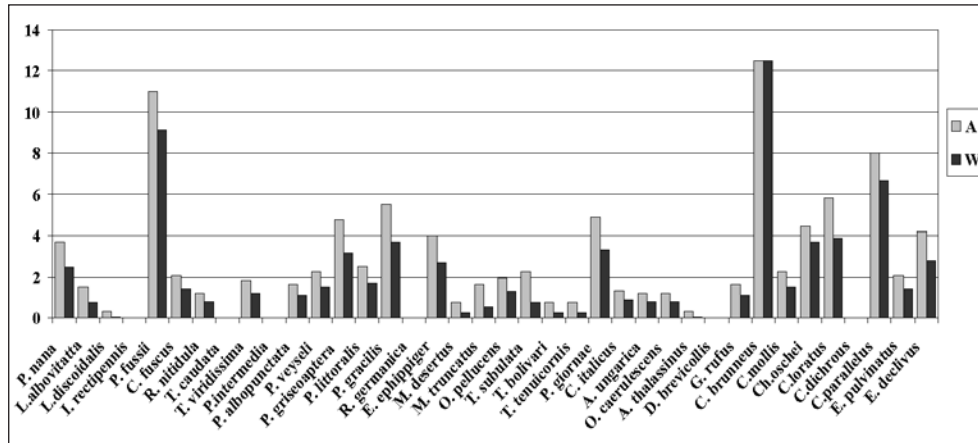


Fig. 2 - Relative abundance (A) and cenotypic affinity index (W) of Orthoptera species in site I.

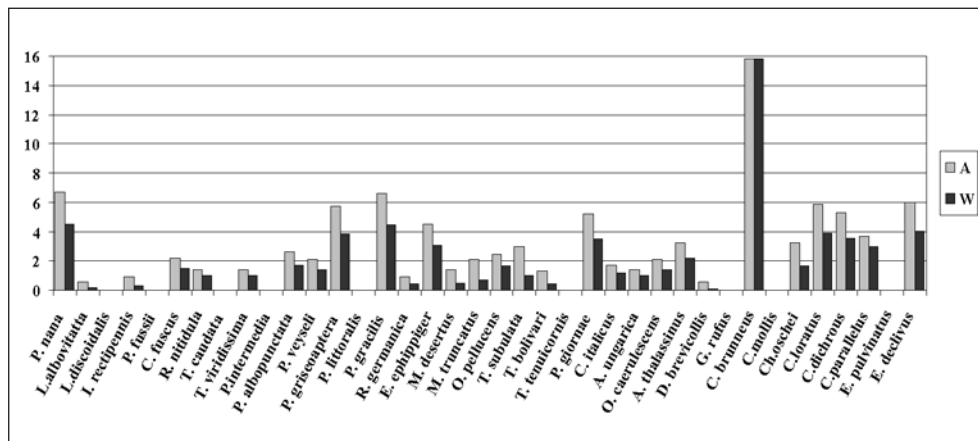


Fig. 3 - Relative abundance (A) and cenotypic affinity index (W) of Orthoptera species in site II.

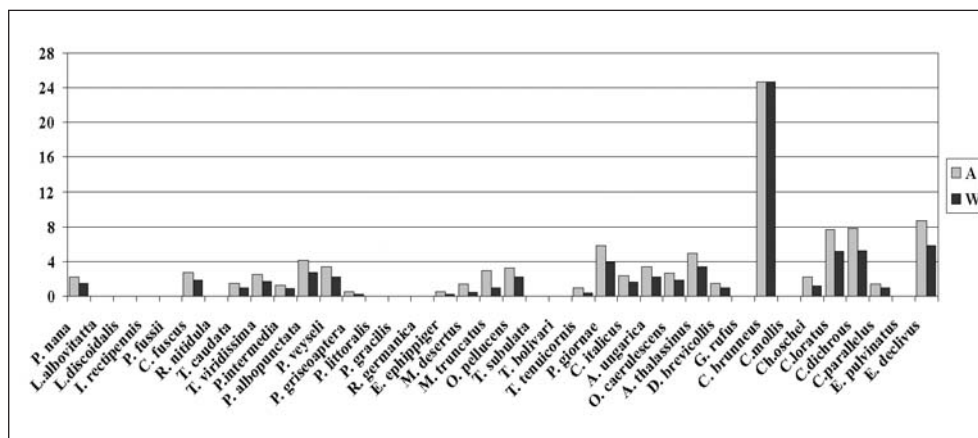


Fig. 4 - Relative abundance (A) and cenotypic affinity index (W) of Orthoptera species in site III.

In site II the eudominant species is *Chorthippus brunneus*, dominant species are: *Phaneroptera nana*, *Pholidoptera griseoptera*, *Pachytrachis gracilis*, *Pezotettix giornae*, *Chorthippus loratus*, *C. dichrous* and *Euchorthippus declivus* and subdominant species are: *Chorthippus parallelus*, *C. oschei*, *Aiolopus thalassinus*, *Oedipoda caerulescens*, *T. subulata*, *Oecanthus pellucens*, *Modicogryllus truncatus*, *Ephippiger ephippiger*, *Platycleis grisea*, *P. veyseli* and *Conocephalus fuscus* (Fig. 3). The rare species are: *Leptophyes albovitatta*, *Isophya rectipennis*, *Rhacocleis germanica* and *Dociostaurus brevicollis*.

In site III the eudominant species is also *Chorthippus brunneus* and dominant species are: *Euchorthippus declivus*, *Chorthippus loratus*, *C. dichrous* and *Pezotettix giornae*. Subdominant species are: *Chorthippus oschei*, *Calliptamus italicus*, *Acrida ungarica*, *Oedipoda caerulescens*, *Aiolopus thalassinus*, *Platycleis veyseli*, *P. grisea*, *Tettigonia viridissima*, *Oecanthus pellucens*, *Modicogryllus truncatus*, *Conocephalus fuscus* and *Phaneroptera nana* (Fig. 4). The rare species are: *Tetrix tenuicornis*, *Ephippiger ephippiger* and *Pholidoptera griseoptera*.

The highest number of species was found in site I (32 species, fig. 5), meadow species like *Chorthippus brunneus*, *C. parallelus* and other *Chorthippus* species being the most numerous ones. Species associated with bushes and species associated with tall grass are both present, such as *Poecilimon fussi*, *Pholidoptera litoralis*, *Phaneroptera nana*, *Conocephalus fuscus* and *Leptophyes discoidalis*. The species *Leptophyes discoidalis*, *Poecilimon fussi*, *Pholidoptera litoralis*, *Gomphocerippus rufus* and *Chorthippus mollis* were found only here.

In site II 29 species were found (Fig. 5). Here, the Orthoptera community is a mixture between forest species like *Pholidoptera griseoptera* and *Pachytrachis gracilis* and meadow species like *Chorthippus brunneus*, *C. dichrous* and *Aiolopus thalassinus*. The species, *Isophya rectipennis* and *Rhacocleis germanica* were found only in this site. In site III only 25 species were found, the majority of them being meadow species like *Chorthippus brunneus*, *Euchorthippus declivus*, *Chorthippus loratus*, *C. dichrous* and *Pezotettix giornae*. The species *Chorthippus brunneus*, *Euchorthippus declivus*, *C. loratus* and *Pezotettix giornae* are very common in the southern part of Romania being found in high numbers in the ruderal vegetation near roads and urban ecosystems.

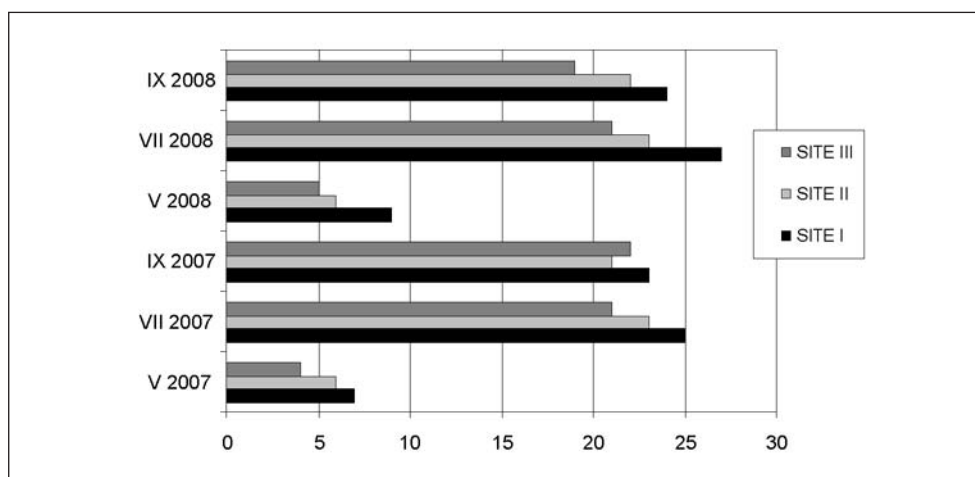


Fig. 5 - The number of species collected in three surveyed sites from Comana forest during 2007-2008.

Table 2

Diversity indices of Orthoptera communities from three analyzed sites.

Sites	2007			2008			TOTAL		
	I	II	III	I	II	III	I	II	III
No. species	30	28	25	32	29	25	32	29	25
Individuals	355	413	437	318	357	371	673	770	808
Shannon_W	3.098	3.019	2.74	3.109	3.095	2.763	3.125	3.07	2.777
Margalef	4.939	4.482	3.947	5.38	4.764	4.057	4.761	4.213	3.585

Margalef index of diversity (D) showed that the highest diversity is found in site I (4.761), followed by site II (4.213) and site III with the lowest D value (3.585) (Tab. 2). The Shannon-Wiener index (H) value is highest also in site I (3.125), followed by site II (3.07). Site III has also the lowest H value (2.777) (Tab. 2). In 2007 and 2008, Margalef index values are higher than the value calculated for the total data in the three sites. The Shannon-Wiener index values are also higher in 2008 than in 2007 for all three sites. The D and H values for site III are lower than for sites I and II both in 2007 and in 2008.

In order to see if the differences observed between Margalef and Shannon-Wiener values for the three sites are significant we performed an one-way ANOVA test. The results showed us that there is not a significant difference for H and D values between site I and II ($p_H = 0.3495$; $p_D = 0.1769$) but the test showed that there are significant differences between H values for sites I and III and between sites II and III respectively ($p < 0.05$). The differences between D values for sites I and II are significant ($p < 0.05$) while the differences between D values in sites II and III are not (Tab. 3).

Table 3

Values obtained after application of one way ANOVA test considering the sites I, II, III in 2007 and 2008 (N = number of samples, Mean, SE = standard deviation).

	N	Mean	SE	F	P	
Shannon-Wiener Index	Site I	2	3.1035	6.05E-05	1.4667	0.3495
	Site II	2	3.057	0.002888		
	Site I	2	3.1035	6.05E-05	762.4862	<u>0.0013</u>
	Site III	2	2.7515	0.000264		
	Site II	2	3.057	0.002888	59.2103	<u>0.0165</u>
	Site III	2	2.7515	0.000264		
Margalef Index	Site I	2	5.1595	0.097241	4.2019	0.1769
	Site II	2	4.623	0.039762		
	Site I	2	4.002	0.00605	25.9425	<u>0.0365</u>
	Site III	2	5.1595	0.097241		
	Site II	2	4.623	0.0398	16.8358	0.0546
	Site III	2	4.002	0.0060		

Site III which has the highest state of anthropisation also has the lowest number of species and the lowest values of biodiversity. The eudominant species *Chorthippus brunneus* and dominant species *Euchorthippus declivus*, *Chorthippus loratus*, *C. dichrous* and *Pezotettix giornae* are meso-xerophilous species associated with vegetation from agro-ecosystems and ruderal vegetation in general.

In conclusion, the indices we used to evaluate the Orthoptera communities from the three studied grasslands showed significant differences in biodiversity between the sites with a higher degree of naturalness and the site with degraded vegetation.

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DIVERSITATEA ORTOPTERELOR (INSECTA) ÎN PAJIȘTILE DIN PARCUL NATURAL COMANA (ROMÂNIA)

REZUMAT

În această lucrare sunt prezentate în mod comparativ, câteva aspecte privind diversitatea comunităților de ortoptere din trei pajiști din cadrul Pădurii Comana, componentă principală a Parcului Natural Comana. Astfel, sunt analizate datele colectate în mod sistematic pe parcursul a doi ani în lunile mai, iulie și septembrie cu ajutorul indicilor sinecologici și de diversitate. În total 38 de specii de ortoptere au fost capturate în cele trei situri. Cele mai mici valori ale indicilor de diversitate Margalef și Shannon-Wiener calculați pentru comunitățile de ortoptere au fost observate în pajiștea cu vegetație degradată. În celelalte două pajiști, cu grade de naturalitate ridicate, se observă valori ale indicilor de biodiversitate mai mari pentru comunitățile de ortoptere.

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