FAUNISTIC DATA ON ORTHOPTERA INSECTS FROM THE SCIENTIFIC RESERVE "PLAIUL FAGULUI" (REPUBLIC OF MOLDOVA)

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Abstract. The study presents the results of the research studies on the Orthoptera fauna of Scientific Reserve "Plaiul Fagului" from the Republic of Moldova, carried out between June and September 2008. The paper shows a list of 53 species from this reserve grouped in 13 Orthoptera subfamilies with ecological and zoogeographical data.

Keywords: Orthoptera, Scientific Reserve "Plaiul Fagului".

Rezumat. Date faunistice privind insectele ortoptere din Rezervaţia Ştiinţifică „Plaiul Fagului" (Republica Moldova). Lucrarea dată prezintă rezultatele cercetărilor a faunei insectelor din ordinul Orthoptera din Rezervaţia Ştiinţifică „Plaiul Fagului" din Republica Moldova, efectuate în iunie-septembrie 2008. Lucrarea include o listă de 53 specii de ortoptere din această rezervaţie, grupate în 13 subfamilii cu date privind ecologia şi zoogeografia.

Cuvinte cheie: Orthoptera, Rezervaţia Ştiinţifică „Plaiul Fagului".

INTRODUCTION

In the Republic of Moldova, there are known 113 species of insects from Orthoptera order (STAHI & DERJANSCHI, 2009). For the first time in the Scientific Reserve "Plaiul Fagului" there were cited 12 species (OSTAFICIUC et al., 2005), followed by 8 (DERJANSCHI et al., 2006). In other paper, at those 21 known Orthoptera species, there were added other 4 (STAHI, 2007). Thus, 53 species were identified within this reserve. The recorded species represent 46.9% of the whole fauna of Orthoptera insects of our republic, 31 belonging to Caelifera suborder and 22 to Ensifera.

MATERIAL AND METHODS

Description of the studied area. The Scientific Reserve "Plaiul Fagului" has been protected by the state since 1975. In 1976, the landscape – nature, including forestland, went into the forest reserve and synergetic category. On March 12, 1992 it was set up the Scientific Reserve "Plaiul Fagului" for the conservation, regeneration, organic recovery, and study of one of the most picturesque and representative ecosystems of the Central Codrii in an area of 5,642 ha (96.4% of the surface is covered by forests).

The reserve is situated in the North-Western part of Central Codrii Plateau. Central Codrii is the name of the forests that grow in the hilly part of the Republic of Moldova. The current reserve was created to protect unique and precious beech forests and other species of trees (Fig. 1).

The territorial-administrative structure includes 5,387 acres of natural trees including European Beech formations (*Fagus sylvatica*) – 272 ha, Ash (*Fraxinus excelsior*) – 1,163 ha, Oak (*Quercus robur*), Sessile Oak (*Q. petraea*) – 1,039 ha, lime (*Tilia* sp.) – 169 ha and other species – 169 ha.

The territory of the reserve is highly fragmented; the relief displays a mountainous character in certain areas and steep slopes prevail here; these are affected by old landslides and linear erosion, forming deep ravines with groundwater sources. The Bik River and several rivulets spring within this area. The altitudes vary between 140 and 410 meters. The vegetation of the reserve includes about 680 species of vascular plants, 150 fungi, 48 lichens and 65 mosses (POPUŞOI, 2008).

Plant formations are represented by forests of Central European kind, which have been preserved in their natural origin (beech, oak, lime, hornbeam, oak are the dominant species). Beech formations reach more than 150 years and a height of up to 40 meters with a stem diameter of over 100 cm. Beech grows mixed with hornbeam and oak. These forests grow at more than 200 m altitude (POPUŞOI, 2008). In the neighbouring zones, there are crops, vineyards and orchards, which are favourable for various species of vertebrates and invertebrates.

At present, within the reserve, there are recorded: 42 species of mammals, about 140 species of birds, 7 reptiles and 8 of amphibians. Recently the wildlife of reserve has been enriched with Noble Deer, Deer-in-spots and Roe Deer. The number of vertebrates is exceeded by the insects. As for the bird variety, only during the spring-winter passage and nesting period there were observed birds from 14 orders (POPUŞOI, 2008).

Method of sampling and evaluation of Orthoptera species. Orthoptera specimens were obtained by sweep-sampling and by hand directly on the grasses. The insects were collected from different locations like meadows, wet meadows also, the vegetation from paths in the woods, alfalfa fields from the reserve.

For collecting of the Orthoptera individuals we used the sweep net. The samples were collected during calm, warm and sunny weather conditions, in June and August 2008. During each visit we performed 50 sweeps by 6 times in every studded habitat. At each step a sweep was made by traversing a horizontal arc of 180^0 with a standard canvas net,

which had 38 cm in diameter. Sample collection took place from 10 am to 6 pm with repose between 11.30 am till 15 pm (GARDINER et al., 2005). The individuals were identified immediately in the field or in the laboratory using identification keys (HARZ, 1969, 1975; HELLER, 1998; IORGU & IORGU, 2008; KNECHTEL & POPOVICI-BÂZNOŞEANU, 1959; BEY-BIENKO, 1964). Both system and nomenclature follow the work of EADES & OTTE (Orthoptera Species File. Version 2.0/4.0), and Grasshoppers, crickets and katydids Orthoptera (http://www.biolib.cz).

The zoogeographic elements were established according to the work of BEY-BIENKO (1950, 1952) and IORGU & IORGU (2008). At processing of mathematical and statistical analysis of the entomological material we have applied the works of ANDREEV (2002).

The classification of the life forms of long-horned and short-horned grasshoppers were based on the works of BEY-BIENKO (1950, 1952) and PRAVDIN (1978).

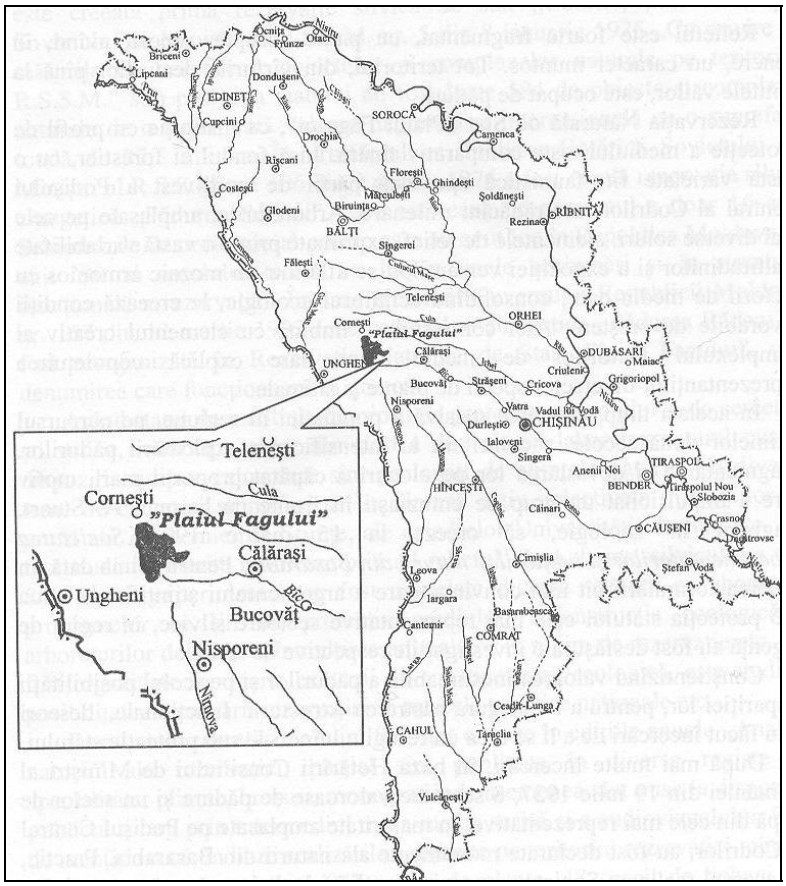

Figure 1. Localisation of the Scientific Reserve "Plaiul Fagului" in the Republic of Moldova.
Figura 1. Localizarea Rezervației Științifice „Plaiul Fagului" în Republica Moldova.

RESULTS AND DISCUSSIONS

During our researches, on the Scientific Reservation "Plaiul Fagului" from the Republic of Moldova, we collected 2,525 individuals of insects from Orthoptera order from 53 species which belong to 33 genera, 11 subfamilies: Bradyporinae - 1 species, Conocephalinae - 2, Meconematinae - 1, Phaneropterinae - 5, Tettigoniinae - 9, Gryllinae - 2, Oecanthinae - 1, Gryllotalpinae - 1, Tridactylinae - 1, Tetriginae - 4, Acridinae - 1, Calliptaminae - 1, Gomphocerinae – 19, and Oedipodinae respectively 5 species, 6 families and 5 superfamilies. Acridoidea superfamily registered the most numerous number of species, twenty-six, while Tridactyloidae and Tetrigoidea had just one and respectively four species (Table 1).

The analyses of the synecological indices according to the degree of dominance of species revealed that 30 are subrecedent and represent 11.95% – 302 individuals from the total collected (2,525).

The species *Conocephalus fuscus*, *Decticus albifrons*, *Metrioptera bicolor*, *M. roeselii*, *Chrysochraon dispar*, *Chorthippus loratus*, *Stauroderus scalaris*, *Mecostethus alliaceus* and *Paracinema tricolor bisignata* are recedent and constitute 12.83% – 324 individuals of the collected specimens.

The species *Oecanthus pellucens*, *Chorthippus mollis*, *Ch. parallelus*, *Ch. vagans*, *Omocestus haemorhoidalis*, *O. rufipes*, *O. viridulus*, *Stenobothrus lineatus* and *Aiolopus thalassinus* are subdominants and represent 27.60% – 697 individuals of the collected specimens.

The species *Leptophyes punctatissima*, *Pholidoptera griseoaptera* and *Chorthippus albomarginatus* are dominant; more individuals of the first two species were collected from the bushes and trees and vegetation from the pads. The value of the index of these three species was 20.56% – 519 individuals of the 2,525 collected specimens.

The species *Chorthippus biguttulus* and *Ch. brunneus* (Fig. 6) were eudominant and constituted 27.05% – 683 individuals of the collected specimens. The majority of individuals of these species were collected from the meadows and alfalfa fields, which are located in the vicinity of pools in the middle of the reservation.

The variety of ecological preferences of Orthoptera species in this reservation is so high, because collections were carried along selvedge and meadows, alfalfa fields which are nearby woods, also in the wet meadows where vegetation is represented by typical hygro-mesophilous plants. So, in this reserve, mesophilous, hygrophilous and hygro-mesophilous species are prevalent.

Analysing the species composition and the distribution of some Orthoptera species we notice that *Conocephalus fuscus*, *Ruspolia nitidula*, *Decticus verrucivorus*, *Metrioptera bicolor*, *M. roeselii*, *Pholidoptera griseoaptera*, *Platycleis veyseli*, *Pterolepis germanica*, *Tettigonia viridissima*, *Chrysochraon dispar*, *Euthystira bracyptera*, *Gryllotalpa gryllotalpa*, *Xya variegata*, *Depressotetrix depresa*, *Tetrix bipunctata*, *T. subulata*, *T. tenuicornis*, *Chorthippus albomarginatus*, *Ch. parallelus*, *Omocestus viridulus*, *Aiolopus thalassinus*, *Mecostethus alliaceus*, *Paracinema tricolor bisignata* and *Stethophyma grossus* inhabit vegetation near streams and lakes, meadows and wet meadows of the reserve (Fig. 4).

In the fields of alfalfa, there were collected *Tettigonia viridissima*, *Chorthippus albomarginatus*, *Ch. biguttulus*, *Ch. brunneus*, *Omocestus haemorhoidalis*, *O. rufipes*, *O. viridulus*, *Stenobothrus lineatus* and those from genera *Chorthippus*, *Omocestus* and *Stenobothrus*. Also, in spring and early summer we collected individuals of Field Crikets (*Gryllus campestris*) and Steppe Cricket (*Melanogryllus desertus*).

According to the ecological forms 16 species are mesophilous, 12 – hygrophilous and meso-xerophilous, 11 are xerophilous and the last two species are hygro-mesophilous (Fig. 2).

Concerning Orthoptera species, on the investigated territory, the dominant species in terms of number are chortobionts and thamnobionts (Table 1).

The index of diversity of Orthoptera insects from Scientific Reserve "Plaiul Fagului" had a value of 28.949 with an error of 0.056%; the Simpson index was 0.035%, the Shannon index – 1.284 with an error of 0.0098% and the Equitability – 0.4 (Table 1).

Table 1. Sinecologycal analyse of Orthoptera fauna from Scientific Reserve "Plaiul Fagului".
Tabel 1. Analiza sinecologică a faunei ortopterelor din Rezervaţia Ştiinţifică „Plaiul Fagului".

No.	Species	N ♀/♂	Domination		Feeding group	Habit		Zoo-geography
			%	Class		Eco-form	Life form	
Family TETTIGONIIDAE KRAUSS, 1902								
1.	***Ephippiger ephippiger*** (FIEBIG, 1784)	1/2	0.12	D_1	Ph.	3	B	CSE
2.	***Conocephalus fuscus*** (FABRICIUS, 1793)	44/35	1.94	D_2	Ph-cr.	1	A	HP
3.	***Ruspolia nitidula*** (SCOPOLI, 1786)	3/1	0.16	D_1	Ph-cr.	1	A	MA
4.	***Meconema thalassinum*** (DE GEER, 1773)	1/0	0.04	D_1	Ph-cr.	3	C	HE
5.	***Isophya zubowskii*** BEI-BIENKO, 1954	0/1	0.04	D_1	Ph.	3	B	PC
6.	***Leptophyes albovittata*** (KOLLAR, 1833)	12/9	0.83	D_1	Ph.	4	D	CAM
7.	***Leptophyes boscii*** FIEBER, 1853	7/5	0.48	D_1	Ph.	4	D	SEE
8.	***Leptophyes punctatissima*** (BOSC, 1792)	106/72	7.05	D_4	Ph.	4	D	NE
9.	***Phaneroptera falcata*** (PODA, 1761)	15/10	0.99	D_1	Ph.	3	C	ES
10.	***Decticus albifrons*** (FABRICIUS, 1775)	11/19	1.19	D_2	Ph-cr.	5	F	CM
11.	***Decticus verrucivorus*** (LINNAEUS, 1758)	1/0	0.04	D_1	Ph-cr.	4	F	ES
12.	***Metrioptera bicolor*** (PHILIPPI, 1830)	15/13	1.11	D_2	Ph-cr.	4	A	ES
13.	***Metrioptera roeselii*** (HAGENBACH, 1822)	14/21	1.39	D_2	Ph-cr.	3	A	ES
14.	***Pholidoptera fallax*** (FABRICIUS, 1793)	1/3	0.16	D_1	Ph-cr.	3	B	CAM
15.	***Pholidoptera griseoaptera*** (DE GEER, 1773)	52/115	6.61	D_4	Ph-cr.	2	C	HE
16.	***Platycleis veyseli*** (KOÇAK, 1984)	0/1	0.04	D_1	Ph-cr.	5	A	CAP
17.	***Pterolepis germanica*** (HERRICH-SCHÄFFER, 1840)	2/4	0.24	D_1	Ph-cr.	4	E	PM
18.	***Tettigonia viridissima*** LINNAEUS, 1758	5/2	0.28	D_1	Ph-cr.	3	C	HP
Family GRYLLIDAE LAICHARTING, 1781								
19.	***Gryllus campestris*** LINNAEUS, 1758	7/8	0.59	D_1	Ph-cr.	3	F	HP
20.	***Melanogryllus desertus*** (PALLAS, 1771)	13/10	0.91	D_1	Ph-cr.	3	F	CAM
21.	***Oecanthus pellucens*** (SCOPOLI, 1763)	31/47	3.09	D_3	Ph-cr.	5	B	CAM
Family GRYLLOTALPIDAE LEACH, 1815								
22.	***Gryllotalpa gryllotalpa*** (LINNAEUS, 1758)	2/0	0.08	D_1	Ph-cr.	3	F	HP
Family TRIDACTYLIDAE BRULLÉ, 1835								
23.	***Xya variegata*** (LATREILLE, 1809)	11/9	0.79	D_1	Ph-cr.	1	F	CAM
Family TETRIGIDAE SERVILLE, 1838								
24.	***Depressotetrix depressa*** (BRISOUT DE BARNEVILLE, 1848)	2/1	0.12	D_1	Ph.	1	F	CM
25.	***Tetrix bipunctata*** (LINNAEUS, 1758)	10/10	0.79	D_1	Ph.	1	F	ES
26.	***Tetrix subulata*** (LINNAEUS, 1758)	16/12	1.11	D_1	Ph.	2	G	HR
27.	***Tetrix tenuicornis*** (SAHLBERG, 1891)	6/4	0.40	D_1	Ph.	1	F	HP
Family ACRIDIDAE MACLEAY, 1821								
28.	***Acrida ungarica*** (HERBST, 1786)	6/11	0.67	D_1	Ph.	5	A	MA

29.	***Calliptamus italicus*** (LINNAEUS, 1758)	2/6	0.32	D_1	Ph.	5	E	HP
30.	***Chrysochraon dispar*** (GERMAR, 1834)	12/26	1.50	D_2	Ph.	1	A	ES
31.	***Euthystira brachyptera*** (OCSKAY, 1826)	8/5	0.51	D_1	Ph.	1	A	CAP
32.	***Chorthippus albomarginatus*** (DE GEER, 1773)	124/50	6.89	D_4	Ph.	3	A	CNE
33.	***Chorthippus apricarius*** (LINNAEUS, 1758)	1/2	0.12	D_1	Ph.	3	A	ES
34.	***Chorthippus biguttulus*** (LINNAEUS, 1758)	130/168	11.80	D_5	Ph.	4	G	CAM
35.	***Chorthippus brunneus*** (THUNBERG, 1815)	226/159	15.25	D_5	Ph.	4	G	HP
36.	***Chorthippus dichrous*** (EVERSMANN, 1859)	6/3	0.36	D_1	Ph.	5	A	CAP
37.	***Chorthippus dorsatus*** (ZETTERSTEDT, 1821)	1/3	0.16	D_1	Ph.	3	A	ES
38.	***Chorthippus loratus*** (FISCHER VON WALDHEIM, 1846)	17/16	1.31	D_2	Ph.	5	A	PM
39.	***Chorthippus mollis*** (CHARPENTIER, 1825)	49/51	3.96	D_3	Ph.	4	A	EP
40.	***Chorthippus parallelus*** (ZETTERSTEDT, 1821)	54/57	4.40	D_3	Ph.	4	A	EP
41.	***Chorthippus pullus*** (PHILIPPI, 1830)	3/6	0.36	D_1	Ph.	3	A	CE
42.	***Chorthippus vagans*** (EVERSMANN, 1848)	31/45	3.01	D_3	Ph.	4	A	P
43.	***Omocestus haemorrhoidalis*** (CHARPENTIER, 1825)	34/19	2.10	D_3	Ph.	4	E	EP
44.	***Omocestus minutus*** (BRULLÉ, 1832)	3/4	0.28	D_1	Ph.	4	A	P
45.	***Omocestus rufipes*** (ZETTERSTEDT, 1821)	33/31	2.53	D_3	Ph.	5	A	HP
46.	***Omocestus viridulus*** (LINNAEUS, 1758)	45/45	3.56	D_3	Ph.	3	A	ES
47.	***Staurodesus scalaris*** FISCHER VON WALDHEIM, 1846	26/12	1.50	D_2	Ph.	3		ES
48.	***Stenobothrus lineatus*** (PANZER, 1796)	29/33	2.46	D_3	Ph.	4	A	ES
49.	***Aiolopus thalassinus*** (FABRICIUS, 1781)	30/33	2.50	D_3	Ph.	1	A	HP
50.	***Mecostethus alliaceus*** (GERMAR, 1817)	21/22	1.70	D_2	Ph.	1	A	ES
51.	***Oedipoda caerulescens*** (LINNAEUS, 1758)	14/8	0.87	D_1	Ph.	5	F	PM
52.	***Paracinema tricolor bisignata*** (CHARPENTIER, 1825)	15/15	1.19	D_2	Ph.	1	A	CM
53.	***Stethophyma grossum*** (LINNAEUS, 1758)	2/1	0.12	D_1	Ph.	1	A	ES
TOTAL INDIVIDUALS		2,525						
The index of diversity		**28.949 error – 0.056**						
The Simpson index		**0.035 error – 0**						
The Shannon index		**1.284 error – 0.098**						
The Equitability		**0.4**						

Legend: Feeding groups: Ph. – phytophagous, Cr. – carnivorous, Ph-cr. – omnivorous;

Eco-forms: 1 – hygrophilous, 2 – hygro-mesophilous, 3 – mesophilous, 4 – meso-xerophilous, 5 – xerophilous;

Life forms: **A** – chortobiont, **B** – gramineous chortobiont, **C** – sedge-chortobionts, **D** – facultative chortobionts, **E** – herbivore chortobiont, **F** – thamnobiont; **G** – openly-living geophilous; **H** – under-cover geophilous, **I** – fissure-living biont **J** – herpetobionts, **K** – geobiont.

Zoogeographical groups: **PAL** – Palaearctic: ES – Eurosiberian, HP – Holopalaearctic, EP – Euro-Asiatic-Palaearctic, HR – Holarctic; **MED** – Mediterranean: CM – Circum-Mediterranean, MA – Mediterranean-African, PM – Ponto-Mediterranean, P – Pontic; **C-A –** Central Asian: CAM – Central Asian-Mediterranean, CAP – Central Asian-Pontic; **EUR –** European: HE – Holoeuropean, CE – Central European, CNE – Central-North-European, CSE – Central-South- European, NE – North-European, SEE – South-East-European.

The rarest species have been *Ephippiger ephippiger* (Fig. 7) and *Meconema thalassinum* because thamnobiont species are difficult to find out and collect.

In the oak forests from the Scientific Reserve "Plaiul Fagului" we collected the next species: *Leptophyes albovittata*, *L. bosci*, *L. punctatissima*, *Phaneroptera falcata*, *Meconema thalassinum* and *Oecanthus pellucens*. On the vegetation from the paths within the woods, we collected just *Pholidoptera griseoaptera* species (Fig. 5).

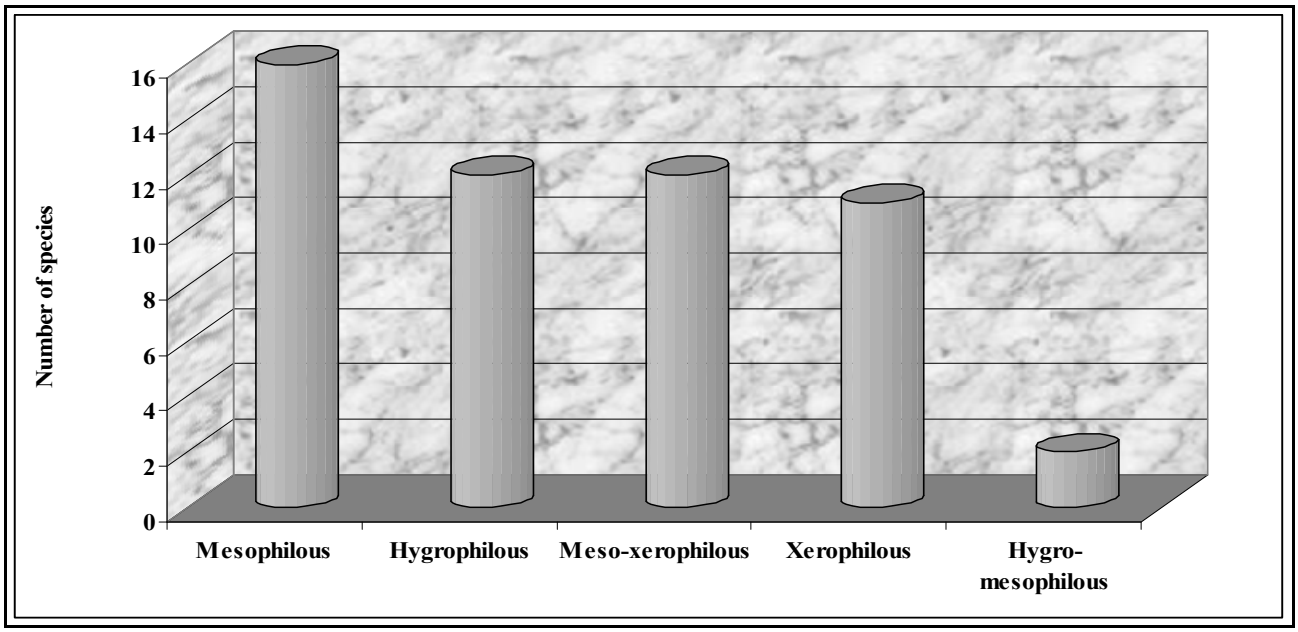

Figure 2. The distribution to the eco-form of Orthoptera species from the Scientific Reserve "Plaiul Fagului".
Figura 2. Distribuția ortopterelor din Rezervația Științifică „Plaiul Fagului" conform eco-formelor.

CONCLUSIONS

During of our regarding the fauna of insects from the order Orthoptera in the Scientific Reserve "Plaiul Fagului", there were collected 53 species which belong to 33 genera and 11 subfamilies.

Of the 2,525 collected individuals just two species are dominants – *Chorthippus biguttulus* and *C. brunneus*.

Zoogeographically, 24 have a Palaearctic distribution, 10 Mediterranean and Central-Asian and the last 7 – European.

Concerning Orthoptera species, on the investigated territory, the dominant species in terms of number are chortobionts and thamnobionts.

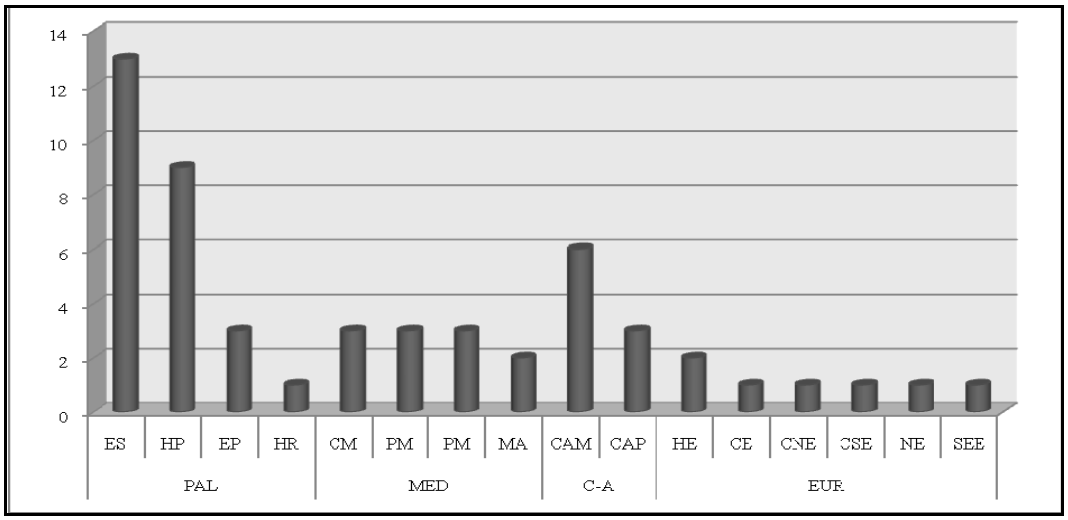

Figure 3. The zoogeographical distribution of Orthoptera species from the Scientific Reserve "Plaiul Fagului".
Figura 3. Distribuţia zoogeografică a ortopterelor din Rezervaţia Ştiinţifică „Plaiul Fagului".

Zoogeographically, 26 species have a Palaearctic distribution, 11 – Mediterranean, 9 – Central-Asian and the last – European (Fig. 2). Most of the Palaearctic group has Eurosiberian distribution (12 species) and the fewest (1 species) – Holopalaearctic; most of the Mediterranean group has Circummediterranean (7) and the fewest (1) – Pontic zoogeographical distribution. In case of Central Asian group 8 species have Central Asian-Mediterranean and 2 – Central Asian-Pontic distribution. The last 2 species are European elements (Central-North-European and North-European) (Fig. 3).

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Figure 4. Wet meadow from the Scientific Reserve "Plaiul Fagului". / Figura 4. Luncă umedă din cadrul Rezervaţiei Ştiinţifice „Plaiul Fagului". (original).

Figure 5. Male of *Pholidoptera griseoaptera* the Scientific Reserve "Plaiul Fagului" July 9, 2008 / Figura 5. Mascul de *Pholidoptera griseoaptera* „Plaiul Fagului" 09.07.2008. (original).

Figure 6. Male of *Chorthippus brunneus* the Scientific Reserve "Plaiul Fagului" July 8, 2008. / Figura 6. Mascul de *Chorthippus brunneus* „Plaiul Fagului" 08.07.2008. (original).

Figure 7. Female of *Ephippiger ephippiger* the Scientific Reserve "Plaiul Fagului" July 19, 2008 / Figura 7. Mascul de *Ephippiger ephippiger* „Plaiul Fagului" 19.08.2008. (original).

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