THE SYNECOLOGICAL ANALYSIS OF SOME POPULATIONS OF SCARABEOID DUNG BEETLES (INSECTA: COLEOPTERA: SCARABAEOIDEA) FROM THE FLOODPLAIN OF THE SIRET RIVER AREA (HOLT VILLAGE, LETEA VECHE COMMUNE)

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Abstract. *Holt Village (Letea Veche Commune) is situated within the floodplain of the Siret River (Bacau County). The climate of this region is influenced by the Azoric anticyclone, Siberian anticyclone, Iceland cyclone and Mediterranean cyclones. The vegetation of this area is determined by the relief and climate. The diversity of scarabeoid dung beetles from the floodplain of the Siret River area were studied between 2004 and 2006. The material collected during these three years was represented by 11,588 specimens, which systematically belong to two families: Geotrupidae and Scarabaeidae, eighteen genera and twenty-eight species. Twenty-two species were collected in each year of study (they are euconstant species). Onthophagus taurus (SCHREBER, 1759), Euoniticellus fulvus (GOEZE, 1777), Aphodius fimetarius (LINNAEUS, 1758) and Caccobius schreberi (LINNAEUS, 1767) are eudominant species. Euoniticellus fulvus GOEZE, Aphodius fimetarius L., Caccobius schreberi L., Colobopterus erraticus (LINNAEUS, 1758), Onthophagus taurus SCHR., O. illyricus (SCOPOLI, 1763), O. ruficapillus (BRULLÉ, 1832) and Acanthobodilus immundus (CREUTZER, 1799) were identified as the characteristic species for the floodplain of the Siret River area. The highest coenotic affinity is between two species: Onthophagus nuchicornis (LINNAEUS, 1758) and O. ovatus (LINNAEUS, 1767) - 90.8%. Another group of species is represented by Aphodius fimetarius L. and Caccobius schreberi L. (90.7%).*

Keywords: *dung beetles, synecological analyse, coenotic affinities.*

Rezumat. Analiza sinecologică a unor populaţii de scarabeoidee coprofage (Insecta: Coleoptera: Scarabaeoidea) din zona de luncă a Siretului (Satul Holt, comuna Letea Veche). *Satul Holt (comuna Letea Veche) este situat în zona de luncă a Siretului. Clima acestei zone este influenţată de anticiclonul Azoric, anticiclonul siberian, ciclonul islandez şi ciclonul mediteranean. Vegetaţia este determinată de relief şi de climă. Diversitatea scarabeoideelor coprofage din zona de luncă a Siretului a fost studiată în perioada 2004-2006. Materialul colectat în cei trei ani de studiu a fost reprezentat prin 11.588 de indivizi, care din punct de vedere sistematic aparţin la două familii (Geotrupidae şi Scarabaeidae), 18 genuri şi 28 de specii. 22 de specii au fost colectate în fiecare an (aceste specii sunt euconstante). Onthophagus taurus (SCHREBER, 1759), Euoniticellus fulvus (GOEZE, 1777), Aphodius fimetarius (LINNAEUS, 1758) şi Caccobius schreberi (LINNAEUS, 1767), sunt specii eudominante. Speciile: Onthophagus taurus SCHR., Euoniticellus fulvus GOEZE, Aphodius fimetarius L., Caccobius schreberi L., Colobopterus erraticus (LINNAEUS, 1758), Onthophagus illyricus (SCOPOLI, 1763), O. ruficapillus (BRULLÉ, 1832) şi Acanthobodilus immundus (CREUTZER, 1799) au fost identificate ca fiind caracteristice pentru zona de luncă a râului Siret. Cea mai mare afinitate cenotică există între speciile: Onthophagus nuchicornis (LINNAEUS, 1758) şi O. ovatus (LINNAEUS, 1767) - 90,8%. O altă grupă de specii este reprezentată de Aphodius fimetarius L. şi Caccobius schreberi L. (90,7%).*

Cuvinte cheie: *coprofage, analiza sinecologică, afinităţi cenotice.*

INTRODUCTION

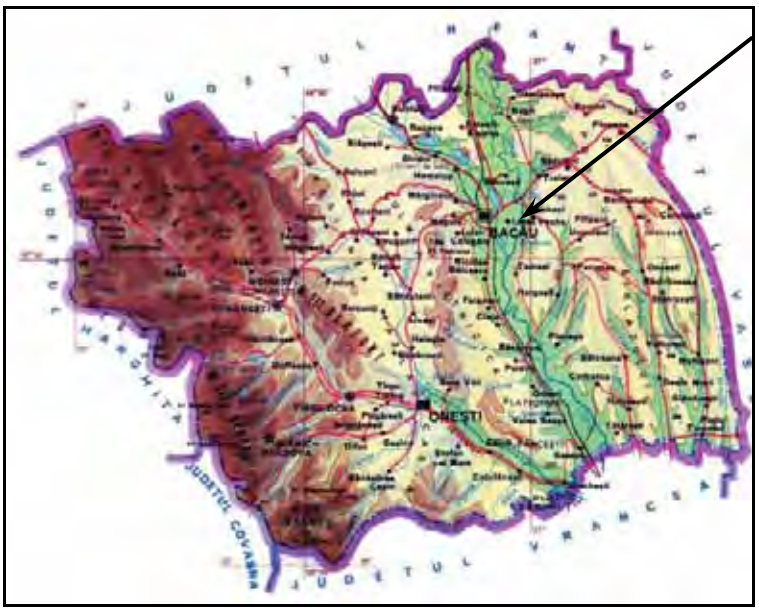

Figure 1. The physical-geographical map of Bacau County (FILIP et. al., 1996).
Figura 1. Harta fizico-geografică a judeţului Bacău (FILIP et. al., 1996).

Holt Village (Letea Veche Commune) is situated in Bacău County, within the floodplain of the Siret River (Fig. 1).

The climate of this region (the climate of the floodplain of the Siret River) is influenced by the Azoric anticyclone, Siberian anticyclone, Iceland cyclone and Mediterranean cyclones, all of them with a semi-permanent character. Thus, the temperature here reaches +20.3^{o} C in July and -3.5^{o} C in January. The main characteristic of the precipitation is their variation in time – the annual average rainfall is 554 mm.

The vegetation of this area is determined by the relief and climate. Hereby, the vegetation is represented by different types of vegetal associations, such as: *Phragmitetum vulgaris* (SOÓ, 1927), *Typhaetum latifoliae* (LANG, 1973), *Glycerietum maximae* (HUECK, 1931), *Scirpetum sylvatici* (RALSKI, 1931), *Caricetum acutiformis* (EGGLER, 1933), *Trifolio-Lolietum perennis* (KRIPPELOVA, 1967), *Salci-Populetum* (MEIJER-DREES, 1936), *Stellario nemorum-Alnetum glutinosae* (LOHMEYER, 1957), *Hippophaëo-Berberidetum* (MOOR, 1958), *Pruno spinosae-Crataegetum* (HUECK, 1931) (MARĂ et al., 2004).

MATERIAL AND METHODS

The diversity of scarabeoid dung beetles from the floodplain of the Siret River area was studied between 2004 and 2006. During each year, the material was collected weekly, from May to September. Hereby, there were 16 samples for each year of study. Each sample was represented by ten dung pads (proximate sizes) – the quantity of the faeces was approximately the same. There have been studied only faeces populated by insects (dung with crust). In the field, the author also dug for the insects burrowed in the soil, under the faeces. The scarabeoid beetles were collected by investigating the dung on a transparent plastic foil.

The coprophagous beetles collected from the dung have been preserved in alcohol. The material was identified using the specialty literature (DELLACASA, 1983, IENIŞTEA, 1975, 1982, MEDVEDEV, 1965). The taxonomy and nomenclature used in this paper is in accordance with Fauna Europaea.

In order to make a synecological analysis, some ecological indexes were calculated: abundance, frequency, constancy, dominance, the ecological significance index (W) and the similarity index (VARVARA et al., 2001).

RESULTS AND DISCUSSIONS

During the forty-eight weeks of study (2004-2006), 11,588 specimens of scarabeoid dung beetles were collected from the floodplain of the Siret River area: 3,652 insects in 2004, 4,893 in 2005 and 3,043 in 2006. Systematically, these coleopterans are included into two families: Geotrupidae (one subfamily – Geotrupinae) and Scarabaeidae (with two subfamilies – Aphodiinae and Scarabaeinae), eighteen genera and twenty-eight species.

In Table 1 it is presented the synecological analysis for the twenty-eight species collected from the Siret River area (Holt Village, Letea Veche Commune) during 2004-2006.

Table 1. The synecological analysis for the Scarabaeoidea species, collected from the floodplain of the Siret River area (2004-2006).
Tabel 1. Analiza sinecologică pentru speciile de Scarabaeoidea, colectate din zona de luncă a râului Siret (2004-2006).

No.	Specie	2004	2005	2006	A	C		D		W	
1.	*Onthophagus taurus* SCHR.	590	926	567	2083	100	C4	17.97	D5	17.97	W5
2.	*Euoniticellus fulvus* GOEZE	787	472	379	1638	100	C4	14.13	D5	14.13	W5
3.	*Aphodius fimetarius* L.	300	609	455	1364	100	C4	11.77	D5	11.77	W5
4.	*Caccobius schreberi* L.	348	578	294	1220	100	C4	10.53	D5	10.53	W5
5.	*Colobopterus erraticus* L.	191	551	270	1012	100	C4	8.73	D4	8.73	W4
6.	*Onthophagus illyricus* SCOP.	214	320	291	825	100	C4	7.12	D4	7.12	W4
7.	*Onthophagus ruficapillus* BRULLÉ	148	367	144	659	100	C4	5.69	D4	5.69	W4
8.	*Acanthobodilus immundus* CREUTZ.	326	141	134	601	100	C4	5.18	D4	5.18	W4
9.	*Onthophagus furcatus* FABR.	119	182	75	376	100	C4	3.24	D3	3.24	W3
10.	*Eupleurus subterraneus* L.	131	119	65	315	100	C4	2.72	D3	2.72	W3
11.	*Onthophagus ovatus* L.	69	164	71	304	100	C4	2.62	D3	2.62	W3
12.	*Onthophagus nuchicornis* L.	53	150	50	253	100	C4	2.18	D3	2.18	W3
13.	*Bodilus lugens* CREUTZER	104	80	65	249	100	C4	2.15	D3	2.15	W3
14.	*Copris lunaris* L.	74	42	63	179	100	C4	1.55	D2	1.55	W3
15.	*Otophorus haemorrhoidalis* L.	106	43	17	166	100	C4	1.43	D2	1.43	W3
16.	*Onthophagus vacca* L.	21	62	29	112	100	C4	0.97	D1	0.97	W2
17.	*Aphodius foetens* FABR.	38	15	28	81	100	C4	0.7	D1	0.7	W2
18.	*Coprimorphus scrutator* HERBST	19	22	22	63	100	C4	0.54	D1	0.54	W2
19.	*Geotrupes puncticollis* MALIN.	3	15	8	26	100	C4	0.23	D1	0.23	W2
20.	*Teuchestes fossor* L.	2	11	11	24	100	C4	0.21	D1	0.21	W2
21.	*Anoplotrupes stercorosus* SCRIBA	4	2	2	8	100	C4	0.07	D1	0.07	W1
22.	*Onthophagus vitulus* FABR.	1	1	2	4	100	C4	0.04	D1	0.04	W1

No.	Specie	2004	2005	2006	A	C		D		W	
23.	*Onthophagus fracticornis* PREYSS.	1	1		2	66.66	C3	0.02	D1	0.01	W1
24.	*Oxyomus sylvestris* SCOP.		11		11	33.33	C2	0.09	D1	0.03	W1
25.	*Calamosternus granarius* L.		9		9	33.33	C2	0.08	D1	0.02	W1
26.	*Agrilinus rufus* MOLLER	2			2	33.33	C2	0.02	D1	0.006	W1
27.	*Trichonotulus scrofa* FABR.			1	1	33.33	C2	0.01	D1	0.003	W1
28.	*Bodilus ictericus* LAICH.	1			1	33.33	C2	0.01	D1	0.003	W1
		3652	4893	3043	11588	-	-	100	-	-	-

The synecological analysis shows that *Onthophagus taurus* (SCHREBER, 1759) (Fig. 2a), *Euoniticellus fulvus* (GOEZE, 1777) (Fig. 2b), *Aphodius fimetarius* (LINNAEUS, 1758) (Fig. 2c) and *Caccobius schreberi* (LINNAEUS, 1767) (Fig. 2d) are eudominant species. Other four specie – *Colobopterus erraticus* (LINNAEUS, 1758), *Onthophagus illyricus* (SCOPOLI, 1763), *O. ruficapillus* (BRULLÉ, 1832) and *Acanthobodilus immundus* (CREUTZER, 1799) – are included in the dominant class. According to the same index, *Eupleurus subterraneus* (LINNAEUS, 1758), *Onthophagus furcatus* (FABRICIUS, 1781), *O. ovatus* (LINNAEUS, 1767), *O. nuchicornis* (LINNAEUS, 1758) and *Bodilus lugens* (CREUTZER, 1799) are subdominant species. Only two species are recedent – *Copris lunaris* (LINNAEUS, 1758) and *Otophorus haemorrhoidalis* (LINNAEUS, 1758); the last thirteen species are subrecedent.

The values of the ecological significance index (W) indicate that the twenty-eight species of dung beetles belong to three groups. Thus, for the floodplain of the Siret River area there were identified eight characteristic species: *Euoniticellus fulvus* GOEZE, *Aphodius fimetarius* L., *Caccobius schreberi* L., *Colobopterus erraticus* L., *Onthophagus taurus* SCHR., *O. illyricus* SCOP., *O. ruficapillus* BRULLÉ and *Acanthobodilus immundus* CREUTZ.; twelve species are accessory and other eight species are accidental.

Figure 2. The eudominant coprophagous species identified for the floodplain of the Siret River area (2004-2006).
Figura 2. Speciile coprofage eudominante identificate pentru zona de luncă a Siretului (2004-2006).
a) *Onthophagus taurus* SCHR.; b) *Euoniticellus fulvus* GOEZE; c) *Aphodius fimetarius* L.; d) *Caccobius schreberi* L.

For revealing the coenotic affinities between the twenty-eight coprophagous species, it was necessary to calculate the similarity index (Table 2). Based on the values of this index it was easy to represent graphically the coenotic relationships between the species of Scarabaeoidaea collected from the floodplain of the Siret River area during 2004-2006. The dendrogram is presented in Fig. 3.

Analyzing the dendrogram (Fig. 3) it is easy to notice that the highest coenotic affinity is between two species: *Onthophagus nuchicornis* L. and *O. ovatus* L.-90.8% (in every year of study, their abundance had close values). *Aphodius fimetarius* L. and *Caccobius schreberi* L. were also well represented in all three years of study; the coenotic affinity between these two species is 90.7%. *Calamosternus granarius* (LINNAEUS, 1767) and *Oxyomus sylvestris* (SCOPOLI, 1763) were collected only in 2005, but they were represented by a different number of individuals (nine, respectively eleven insects). The affinity between these two species is 90%.

The dendrogram also indicates other groups of species: *Bodilus lugens* CREUTZER and *Eupleurus subterraneus* L.-88.3%; *Teuchestes fossor* (LINNAEUS, 1758) and *Geotrupes puncticollis* (MALINOWSKY, 1811)-84%; *Coprimorphus scrutator* (HERBST, 1789) and *Aphodius foetens* (FABRICIUS, 1787)-77.8%. The species included in these groups were collected each year, but their abundance index had different values. Another group is constituted by *Agrilinus rufus* (MOLLER, 1782), *Bodilus ictericus* (LAICHARTING, 1781) *Onthophagus fracticornis* (PREYSSLLER, 1790), *O. vitulus* (FABRICIUS, 1776) and *Anoplotrupes stercorosus* (SCRIBA, 1791). The coenotic affinity between these five species is 66.6%.

Table 2. The values of the similarity index calculated for the coprophagous species collected from the floodplain of the Siret River area (2004-2006).
Tabel 2. Valorile indicelui de similaritate calculat pentru speciile coprofage colectate în zona de luncă a Siretului (2004-2006).
1- *Onthophagus taurus* SCHR., 2 - *Euoniticellus fulvus* GOEZE, 3 - *Aphodius fimetarius* L., 4 - *Caccobius schreberi* L., 5 - *Colobopterus erraticus* L., 6 - *Onthophagus illyricus* SCOP., 7 - *Onthophagus ruficapillus* BRULLÉ, 8 - *Acanthobodilus immundus* CREUTZ., 9 - *Onthophagus furcatus* FABR., 10 - *Eupleurus subterraneus* L., 11- *Onthophagus ovatus* L., 12 - *Onthophagus nuchicornis* L., 13 - *Bodilus lugens* CREUTZER, 14 - *Copris lunaris* L., 15 - *Otophorus haemorrhoidalis* L., 16 - *Onthophagus vacca* L., 17 - *Aphodius foetens* FABR., 18 - *Coprimorphus scrutator* HERBST, 19 - *Geotrupes puncticollis* MALIN., 20 - *Teuchestes fossor* L., 21 - *Anoplotrupes stercorosus* SCRIBA, 22 - *Onthophagus vitulus* FABR., 23 - *Onthophagus fracticornis* PREYSS., 24 - *Oxyomus sylvestris* SCOP., 25 - *Calamosternus granarius* L., 26 - *Agrilinus rufus* MOLLER, 27 - *Trichonotulus scrofa* FABR., 28 - *Bodilus ictericus* LAICH.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1																											
2	77.4																										
3	79.1	76.7																									
4	73.9	77.9	90.7																								
5	65.4	70.4	85.2	90.7																							
6	56.7	67.0	75.4	80.7	85.0																						
7	48.0	57.4	65.1	70.1	78.9	82.5																					
8	44.8	53.7	58.5	66.0	57.8	68.6	67.1																				
9	30.6	37.3	43.2	47.1	54.2	62.6	72.6	68.6																			
10	26.3	32.2	37.5	41.0	47.5	55.2	64.7	68.8	87.7																		
11	25.5	31.3	36.4	39.9	46.2	53.8	63.1	62.1	89.4	81.7																	
12	21.6	26.5	31.3	34.3	40.0	46.9	55.5	57.1	80.4	78.1	90.8																
13	21.3	26.4	30.9	33.9	39.5	46.3	54.8	58.6	79.7	88.3	77.4	72.9															
14	15.8	19.7	23.2	25.6	30.0	35.6	42.7	45.9	64.5	72.4	72.0	67.1	83.6														
15	14.7	18.4	21.7	23.9	28.2	33.5	40.2	43.3	61.2	69.0	54.9	53.9	79.0	77.1													
16	10.2	12.8	15.2	16.8	19.9	23.9	29.0	31.4	45.9	52.4	53.8	61.3	62.0	63.2	58.3												
17	7.5	9.4	11.2	12.4	14.8	17.9	21.9	23.7	35.4	40.9	42.0	48.5	49.1	62.3	56.7	66.3											
18	5.9	7.4	8.8	9.8	11.7	14.2	17.4	19.0	28.7	33.3	34.3	39.9	40.4	52.0	50.6	72.0	77.8										
19	2.4	3.1	3.7	4.2	5.0	6.1	7.5	8.3	12.9	15.2	15.7	18.6	18.9	25.3	27.1	37.7	48.6	58.4									
20	2.3	2.9	3.4	3.8	4.6	5.6	7.0	7.7	12.0	14.1	14.6	17.3	17.6	23.6	25.2	35.3	45.7	55.2	84.0								
21	0.7	1.0	1.1	1.3	1.6	1.9	2.4	2.6	4.1	4.9	5.1	6.1	6.2	8.5	9.2	13.3	18.0	22.5	41.8	37.5							
22	0.4	0.5	0.6	0.6	0.8	0.9	1.2	1.3	2.1	2.5	2.6	3.1	3.1	4.4	4.7	6.9	9.4	11.9	26.6	28.6	66.6						
23	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.6	1.0	1.2	1.3	1.6	1.6	2.2	2.4	3.5	4.8	6.1	14.3	15.4	40.0	66.6					
24	1.0	1.3	1.6	1.8	2.1	2.6	3.3	3.6	5.7	6.7	7.0	8.3	8.4	11.6	12.4	17.9	23.9	29.7	59.4	62.8	21.0	13.3	15.4				
25	0.8	1.1	1.3	1.4	1.7	2.1	2.7	2.9	4.7	5.5	5.7	6.9	7.0	9.6	10.3	14.9	20.0	25.0	51.4	54.5	23.5	15.4	18.2	90.0			
26	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.6	1.0	1.2	1.3	1.6	1.6	2.2	2.4	3.5	4.8	6.1	14.3	15.4	40.0	33.3	50.0	0.0	0.0		
27	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.6	0.6	0.8	0.8	1.1	1.2	1.8	2.4	3.1	7.4	8.0	22.2	40.0	0.0	0.0	0.0	0.0	
28	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.6	0.6	0.8	0.8	1.1	1.2	1.8	2.4	3.1	7.4	8.0	22.2	40.0	66.6	0.0	0.0	66.6	0.0

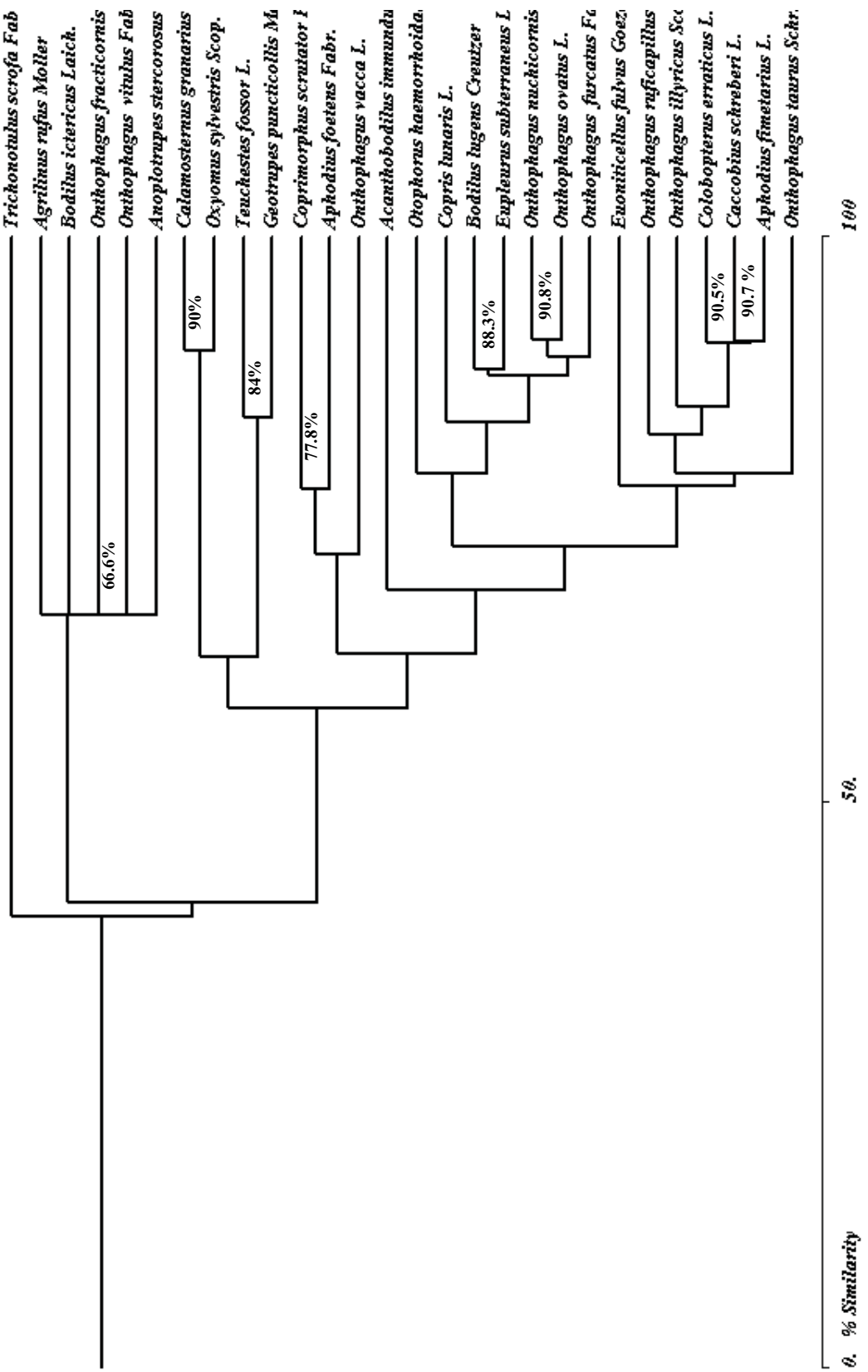

Figure 3. The coenotic affinities between the coprophagous species collected from the floodplain of the Siret River area (2004-2006).
Figura 3. Afinităţile cenotice dintre speciile de coprofage colectate în zona de luncă a Siretului (2004-2006).

CONCLUSIONS

1. The research concerning the diversity of scarabeoid dung beetles from the floodplain of the Siret River area were made between 2004 and 2006. Systematically, the 11,588 individuals collected in this area belong to two families (Geotrupidae and Scarabaeidae), three subfamilies (Geotrupinae, Aphodiinae and Scarabaeinae), eighteen genera and twenty-eight species.

2. Twenty-two species were collected during each year of study (they are euconstant species). *Onthophagus fracticornis* PREYSSLLER is the only constant specie. *Oxyomus sylvestris* SCOP., *Calamosternus granarius* L., *Agrilinus rufus* MOLLER, *Trichonotulus scropha* FABR., *Bodilus ictericus* LAICH. are accessory species.

3. According to the synecological analysis, *Onthophagus taurus* SCHR., *Euoniticellus fulvus* GOEZE, *Aphodius fimetarius* L. and *Caccobius schreberi* L. are eudominant species. *Colobopterus erraticus* L., *Onthophagus illyricus* SCOP., *O. ruficapillus* BRULLÉ and *Acanthobodilus immundus* CREUTZ. – are included in the dominant class.

4. The characteristic coprophagous species for the floodplain of the Siret River area are: *Euoniticellus fulvus* GOEZE, *Aphodius fimetarius* L., *Caccobius schreberi* L., *Colobopterus erraticus* L., *Onthophagus taurus* SCHR.,*O. illyricus* SCOP., *O. ruficapillus* BRULLÉ and *Acanthobodilus immundus* CREUTZ.; twelve species are accessory and other eight species are accidental.

5. The highest coenotic affinity is between two species: *Onthophagus nuchicornis* L. and *O. ovatus* L.-90.8% (every year of study, their abundance had proximate values). *Aphodius fimetarius* L. and *Caccobius schreberi* L. were also well represented in each number; the coenotic affinity between these two species is 90.7%.

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