DATA CONCERNING THE DIVERSITY OF SCARABEOID LARVAE (COLEOPTERA: SCARABEOIDEA: MELOLONTHIDAE, RUTELIDAE AND CETONIIDAE) IN FOREST NURSERIES FROM COVASNA COUNTY, ROMANIA

ARINTON Mihaela, CIORNEI Constantin, PAP Mihaly

Abstract. The researches regarding the diversity of scarabeoid larvae in the forest nurseries from Covasna County were made in October, 2013. The material (477 larvae) was collected from the soil (121 samples of 1 m x 1 m x 0.5 m); systematically, it belongs to three families: Melolonthidae, Rutelidae and Cetoniidae; three subfamilies: Melolonthinae, Rutelinae and Cetoniinae, 6 genera and 6 species. The dominant species was *Protaetia (Netocia) cuprea* (Fabricius 1775) – 312 individuals (in 52 samples) identified for three forest nurseries: Dârnău, Iancău and Păpăuţi. It was followed by: *Melolontha melolontha* (Linnaeus 1758) with 52 individuals collected from 10 forest nurseries (106 samples); *Rhizotrogus aestivus* (Olivier 1789) with 40 individuals (in 2 forest nurseries – 17 samples); *Amphimallon solstitiale* (Linnaeus 1758) – 35 individuals from 3 forest nurseries (22 samples). The authors analysed the densities of the species in correlation with the types of forest, types of soil, types of stations, altitude. Regarding the infestation level, very high infestations were identified for Oituz, Turia and Comandău forest nurseries. Low infestations were registered for Dârnău and Păpăuţi.

Keywords: scarabeoids, larvae, forest nurseries, infestation, Covasna County, Romania.

Rezumat. Date privind diversitatea larvelor de scarabeoidee (Coleoptera: Scarabeoidea: Melolonthidae, Rutelidae şi Cetoniidae) în pepiniere din judeţul Covasna, România. Cercetările privind diversitatea larvelor de scarabeoidee în pepiniere din judeţul Covasna au fost realizate în octombrie, 2013. Materialul biologic (477 de larve) a fost colectat din sol (121 de sondaje de sol: 1 m x 1 m x 0,5 m); din punct de vedere sistematic, acesta aparţine la trei familii: Melolonthidae, Rutelidae şi Cetoniidae; trei subfamilii: Melolonthinae, Rutelinae şi Cetoniinae, 6 genuri şi 6 specii. Specia dominantă a fost *Protaetia (Netocia) cuprea* (Fabricius 1775) – 312 indivizi (în 52 de sondaje) identificaţi în trei pepiniere: Dârnău, Iancău şi Păpăuţi. Această specie a fost urmată de: *Melolontha melolontha* (Linnaeus 1758) cu 52 de indivizi colectaţi din zece pepiniere (106 sondaje); *Rhizotrogus aestivus* (Olivier 1789) cu 40 de indivizi (în două pepiniere – 17 sondaje; *Amphimallon solstitiale* (Linnaeus 1758) – 35 de indivizi în trei pepiniere (22 de sondaje). De asemenea, au fost analizate densităţile speciilor în corelaţie cu tipurile de pădure, tipurile de sol, tipurile de staţiune, altitudine. Referitor la gradul de infestare, s-a constatat faptul că infestări foarte puternice s-au înregistrat pentru pepinierele: Oituz, Turia şi Comandău. Infestări slabe au prezentat pepinierele Dârnău şi Păpăuţi.

Cuvinte cheie: scarabeoidee, larve, pepiniere, infestare, judeţul Covasna.

INTRODUCTION

Nowadays, in Romania, in the forest nurseries and plantations, the root feeders represent the main disturbing biotic agents. Among them, the scarabeoids (Melolonthidae and Rutelidae Families) cause important losses in forest cultures (CIORNEI et al., 2011). Therefore, it is very important to investigate the presence of the root feeders in the soil (soil samples). All the material found in the samples was identified, analysed and then the specialists evaluated the infestation level. The aim of this paper is to present some contributions to the knowledge of the diversity of scarabeoids, by analysing the populations of larvae present in the soil, in different forest nurseries from Covasna County.

MATERIAL AND METHODS

The material analysed in this paper was collected in October 2013. Twelve forest nurseries were investigated: Breţcu, Oituz, Ojdula, Turia (Breţcu Forest District), Comandău, Dârnău, Iancău, Păpăuţi (Comandău Forest District), Ghelinţa (Covasna Forest District), Ozunca Băi, Szalkas and Vârghiş (Tălişoara Forest District). All of them belong to the Romanian National Forest Administration, Covasna Forest Direction (geographically – Covasna County – Fig. 1).

The characteristics of the twelve forest nurseries are presented in Table 1.

For this study, the scarabeoid larvae were collected from the soil – samples of 1 m x 1 m x 0.5 m. All the larvae were preserved in alcohol. The material was identified using the keys by PANIN (1955, 1957) and KLAUSNITZER (1978).

The number of samples was established for each forest nurseries according to their surface (1 sample / ha). Thus, for analysing the data, it was necessary to establish the density of the larvae (no. larvae / m^2).

Also, for establishing the level of infestation, for all the species that were identified, it was necessary to calculate the average number of *Melolontha melolontha* (Linnaeus 1758) in the third larval instar, using the critical number of larvae / m^2 established for each species (SIMIONESCU et al., 2000 – Table 2).

The taxonomy and nomenclature used in this paper is in accordance with Fauna Europaea (http://www.faunaeur.org).

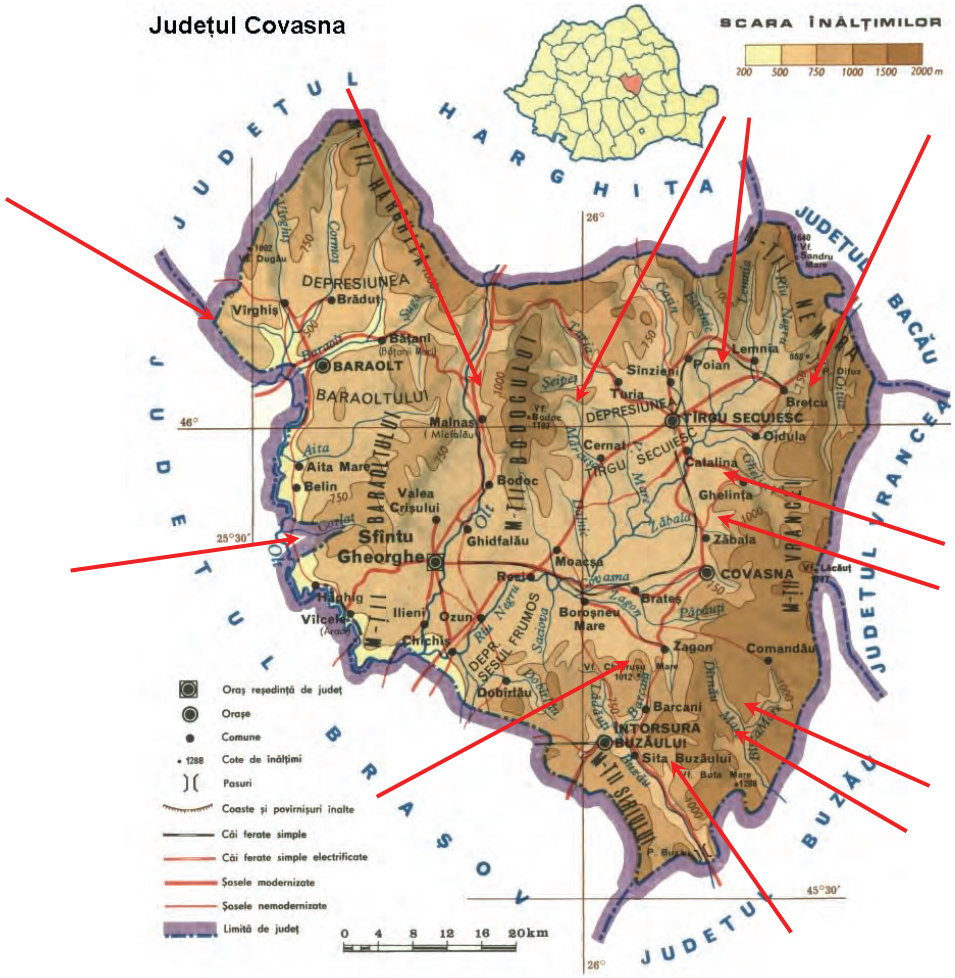

Figure 1. Map of Covana County, Romania (the studied forest nurseries) (http://www.pe-harta.ro/covasna/).

Table 2. The critical number of larvae for the scarabeoid species identified for the forest nurseries from Covasna County – October 2013 (SIMIONESCU et al., 2000).

	The species					
	Melolontha melolontha (Linnaeus 1758)			*Amphimallon solstitiale* (Linnaeus 1758) *Rhizotrogus aestivus* (Olivier 1789) *Anomala* sp. *Phyllopertha horticola* (Linnaeus 1758)		
The larval instar	L_1	L_2	L_3	L_1	L_2	L_3
The critical number of larvae / m^2	5	3	1	10	6	3
The formula for calculating the average number of *Melolontha melolontha* (Linnaeus 1758) in the third larval instar	$L_1 \times 1/5 + L_2 \times 1/3 + L_3$			$L_1 \times 1/10 + L_2 \times 1/6 + L_3 \times 1/3$		

RESULTS AND DISCUSSIONS

For studying the diversity of scarabeoids by analysing the populations of larvae present in the soil, 121 samples (1 m x 1 m x 0.5 m) from different forest nurseries were analysed. The biological material (477 larvae) was studied for identifying the species and the larval instar. Systematically, the 477 larvae belonged to three families: Melolonthidae, Rutelidae and Cetoniidae; three subfamilies: Melolonthinae, Rutelinae and Cetoniinae, 6 genera and 6 species (Table 3).

According to the results presented in table 3, the dominant species was *Protaetia (Netocia) cuprea* (Fabricius 1775) – 312 individuals (in 52 samples) identified for 3 forest nurseries (Dârnău – in 12 samples, Iancău – 5 samples and Păpăuți – 35 samples). It is necessary to mention that this species does not attack the roots of the plant (it is not a disturbing biotic agent). It was followed by: *Melolontha melolontha* (Linnaeus 1758) with 52 individuals collected from the 10 forest nurseries (106 samples): Brețcu (14 samples), Oituz (7 samples), Ojdula (12 samples), Turia (5 samples), Comandău (5 samples), Dârnău (12 samples), Păpăuți (35 samples), Ozunca Băi (2 samples), Szalkas (2 samples) and Vârghiș (12 samples); *Rhizotrogus aestivus* (Olivier 1789) with 40 individuals (in 2 forest

nurseries – 17 samples: Ojdula – 12 samples and Turia – 5 samples); *Amphimallon solstitiale* (Linnaeus 1758) – 35 individuals from 4 forest nurseries (36 samples): Ojdula (12 samples), Turia (5 samples) and Comandău (5 samples).

The largest number of individuals was collected from Păpăuţi forest nursery (244 individuals in 35 samples). The material was also well represented in: Dârnău (53 individuals in 12 samples), Ojdula (49 individuals in 12 samples) and Turia (35 individuals in 5 samples).

Also, the largest number of species was registered for Turia forest nursery (4 species). For three forest nurseries (Oituz, Ojdula and Comandău), there were identified three species. From other three forest nurseries (Breţcu, Dârnău and Păpăuţi) there have been collected 2 species. Only one species was identified for four forest nurseries: Iancău, Ozunca Băi, Szalkas and Vârghiş.

In one single forest nursery (Ghelniţa) 10 samples have been investigated, but no larva was found.

For comparing the data, it was necessary to calculate the density (no. larvae / m^2) (Table 4). According to the data presented in Table 3, the distribution of the 6 scarabeoid species in the twelve investigated forest nurseries from Covasna County is presented in Figure 2. Comparing the densities of species, the results indicate that the largest densities were registered for *P. (N.) cuprea*: 6.69 larvae / m^2 for Păpăuţi, 5.8 larvae / m^2 for Iancău, 4.08 larvae / m^2 for Dârnău; for *A. solstitiale*: 3.4 larvae / m^2 in Turia forest nursery, for *R. aestivus*: 2.83 larvae / m^2 in Ojdula forest nursery and for *M. melolontha*: 2.5 larvae / m^2 in Ozunga-Băi forest nursery.

The authors also analysed the data regarding the density of larvae in different types of forests (deciduous forests, coniferous forests, mixed forests) – table 4. Thus, the largest densities of *M. melolontha*, *A. solstitiale* and *R. aestivus* were registered for mixed forests area; *Anomala* sp., *Phyllopertha horticola* (Linnaeus 1758) and *P. (N.) cuprea* – for coniferous forests area (Fig. 3).

Table 4. Survey of species, number of individuals and density of scarabeoid larvae identified for different types of forest from Covasna County (October 2013).

Species	Deciduous forests			Coniferous forests			Mixed forests			Total		
	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2
M. melolontha	4	14	0.29	28	66	0.42	20	41	0.49	**52**	**121**	**0.43**
A. solstitiale	1	14	0.07	17	66	0.26	17	41	0.41	**35**	**121**	**0.29**
R. aestivus				6	66	0.09	34	41	0.83	**40**	**121**	**0.33**
Anomala sp.				9	66	0.14				**9**	**121**	**0.07**
P. horticola				19	66	0.29	10	41	0.24	**29**	**121**	**0.24**
P. (N.) cuprea				263	66	3.98	49	41	1.20	**312**	**121**	**2.58**
Total	**5**	**14**	**0.36**	**342**	**66**	**5.18**	**130**	**41**	**3.17**	**477**	**121**	**3.94**

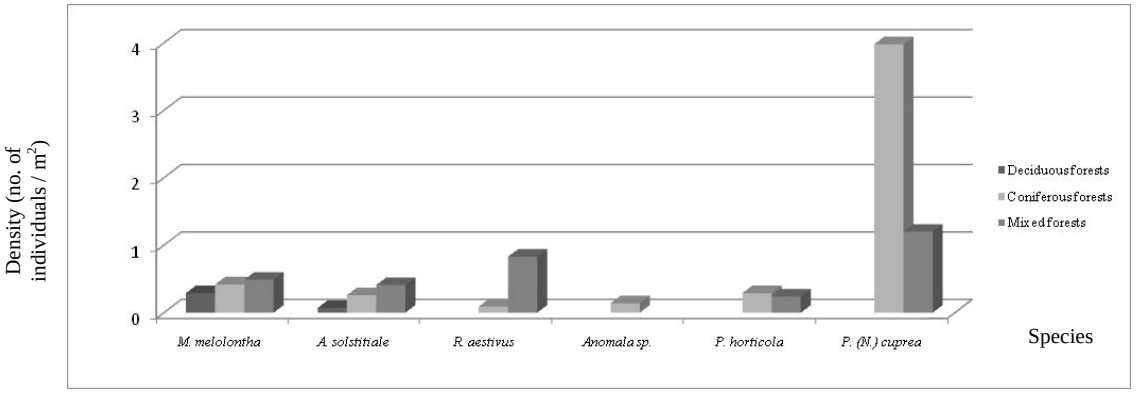

Figure 3. Survey of species, the density of scarabeoid larvae identified for different types of forest from Covasna County (October 2013).

Studying the density of scarabeoid larvae in different types of soil (Table 5), the results indicate that the typical eutricambosoil presented the largest number of species (all six), the largest number of individuals (302) and the largest density of larvae (6.43 larvae / m^2). Also, it can be noticed that typical luvosol registered a large density of *M. melolontha*; typical alosol – a large density of *A. solstitiale*; typical preluvisoil – a large density of *R. aestivus*; typical eutricambosoil – large densities of *Anomala* sp. and *P. horticola*; alluvial soil – a large density of *P. (N.) cuprea* (Fig. 4).

Table 5. Survey of species, number of individuals and density of scarabeoid larvae identified for different types of soil from Covasna County (October 2013).

Species	1			2			3			4			5			6			7		
	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2
M. m	7	26	0.27	12	47	0.26	10	15	0.67	4	12	0.34				7	4	1.75	12	12	1
A. s	13	26	0.5	5	47	0.11	17	15	1.13												
R. a	34	26	1.31	6	47	0.13															
A. sp.				9	47	0.19															
P. h				27	47	0.57	2	15	0.13												
P. c				243	47	5.17				49	12	4.08	29	5	5.8						
Total	**54**	**26**	**2.08**	**302**	**47**	**6.43**	**19**	**15**	**1.93**	**53**	**12**	**4.42**	**29**	**5**	**5.8**	**7**	**4**	**1.75**	**12**	**12**	**1**

Legend: 1 = typical preluvisoil; 2 = typical eutricambosoil; 3 = typical alosol; 4 = mollic, lithic soil; 5 = alluvial soil; 6 = typical luvosol; 7 = antrisol. *M. m = M. melolontha*; *A. s = A. solstitiale*; *R. a = R. aestivus*; *A.sp. = Anomala* sp.; *P. h = P. horticola*; *P. c = P. (N.) cuprea.*

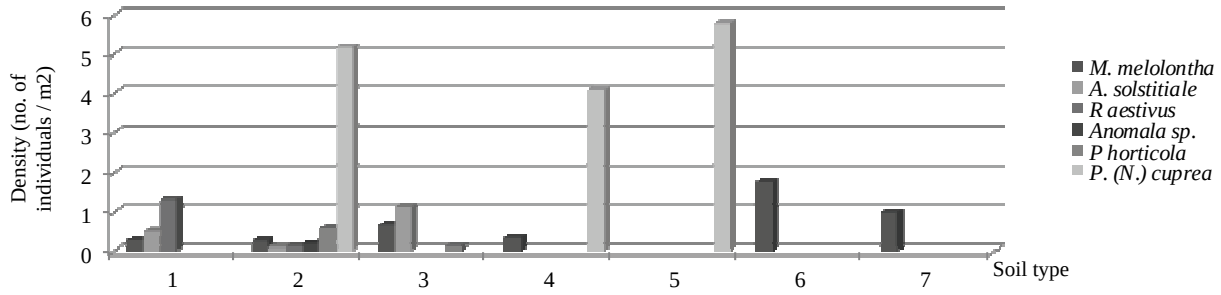

Figure 4. Survey of species, the density of scarabeoid larvae identified for different types of soil from Covasna County (October 2013): 1-7 – according to table 5.

Regarding the types of station (Table 6), it can be noticed that *M. melolontha* presented a high density in hilly regions, beech forests with high and medium productivity; *A. solstitiale*, *R. aestivus* and *P. horticola* were found in hilly regions, with sessile oak and beech forests and also in mountain regions, with mixed forests and medium productivity; *Anomala* sp. was identified in mountain regions, with mixed forests and medium productivity; *P. (N.) cuprea* registered high densities in mountain regions, with mixed forests (medium productivity and semi-swampy) (Fig. 5).

Table 6. Survey of species, number of individuals and density of scarabeoid larvae identified for different types of stations from Covasna County (October 2013).

Species	5152			3332			3630			5243			5232		
	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2
M. melolontha	14	19	0.74	15	69	0.22	4	17	0.23	17	14	1.21	2	2	1
A. solstitiale	18	19	0.95	17	69	0.25		17			14			2	
R. aestivus	6	19	0.31	34	69	0.49		17			14			2	
Anomala sp.		19		9	69	0.13		17			14			2	
P. horticola	2	19	0.11	27	69	0.39		17			14			2	
P. (N.) cuprea		19		234	69	3.39	78	17	4.59		14			2	
Total	**40**	**19**	**2.11**	**336**	69	**4.87**	**82**	17	**4.82**	**17**	**14**	**1.21**	2	2	1

Legend: 3332 – mountain, mixed forests, medium productivity, brown medium edaphic, with *Asperula – Dentaria*; 3630 - mountain, mixed forests, semi-swampy; 5152 – hilly, sessile oak and beech forests with inferior (medium) productivity, alluvial, low humiferous, in flood plain; 5232 – hilly, beech forests, medium productivity, podzolic, medium edaphic, with *Festuca*; 5243 - hilly, beech forests, high productivity, brown, large edaphic, with *Asperula – Asarum.*

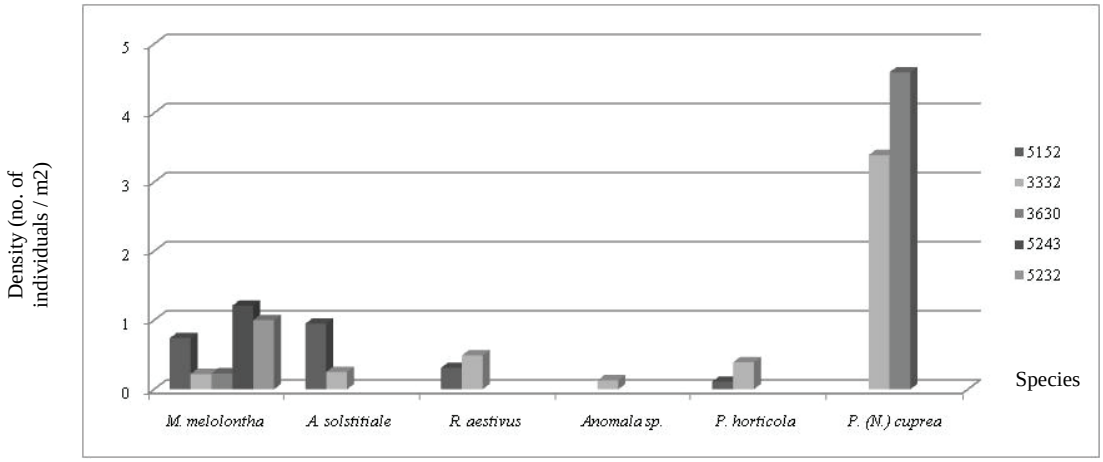

Figure 5. Survey of species, the density of scarabeoid larvae identified for different types of station from Covasna County (October 2013): 3332, 3630, 5152, 5232, 5243 – according to table 6.

The twelve forest nurseries are situated at different altitudes: 400-500 m: Vârghiş (470 m); 500-600 m: Păpăuţi (550 m); 600-700 m: Szalkas (620 m), Breţcu (630 m), Ojdula (635 m), Oituz (640 m), Ozunca Băi (650 m), Ghelinţa (670 m); 700-800 m: Turia (700 m); 800-900 m -; 900-1000 m: Dârnău (948 m), Iancău (973 m); 1000-1100 m: Comandău (1017 m). According to the results, the largest numbers of species were registered for different altitudes: five species for 600-700 m, four species for 700-800 m; three species for 1000-1100 m; and two species for 500-600 and 900-1000 m (Table 7). *M. melolontha* was found in almost all the altitudes: 400-800 m and 1000-1100 m (the largest density was at 700-800 m – 2 larvae / ha); *A. solstitiale* at 600-800 m and 1000-1100 m (the largest density – 3.4 larvae / ha – at 700-800 m); *R. aestivus* at 600-800 m (the largest density – 1.2 larvae / ha – at 700-800 m); *Anomala* sp. only at 600-700 m (0.19 larvae / ha); *P. horticola* at 600-800 m and 1000-1100 m (the largest density – 2 larvae / ha – at 1000-1100 m); *P. (N.) cuprea* at 500-600 m and 900-1000 m (the largest density – 6.69 larvae / ha – at 500-600 m) (Fig. 6).

Table 7. Survey of species, number of individuals and density of scarabeoid larvae identified for different altitudes from Covasna County (October 2013).

Species	Altitude (metres)																				
	400-500			500-600			600-700			700-800			800-900			900-1000			1000-1100		
	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2	No. of individuals	No. of samples	No. of indiv. / m^2
M.melolontha	12	12	1	10	35	0.29	15	47	0.32	10	5	2	-	-	-	4	17	0.23	1	5	0.2
A. solstitiale	-	12	-	-	35	-	13	47	0.28	17	5	3.4	-	-	-	-	17	-	5	5	1
R. aestivus	-	12	-	-	35	-	34	47	0.72	6	5	1.2	-	-	-	-	17	-	-	5	-
Anomala sp.	-	12	-	-	35	-	9	47	0.19	-	5	-	-	-	-	-	17	-	-	5	-
P. horticola	-	12	-	-	35	-	17	47	0.36	2	5	0.4	-	-	-	-	17	-	10	5	2
P. (N.) cuprea	-	12	-	234	35	6.69	-	47	-	-	5	-	-	-	-	78	17	4.59	-	5	-
Total	**12**	**12**	**1**	**244**	**35**	**6.98**	**88**	**47**	**1.87**	**35**	**5**	**7**	**-**	**-**	**-**	**82**	**17**	**4.82**	**16**	**5**	**3.2**

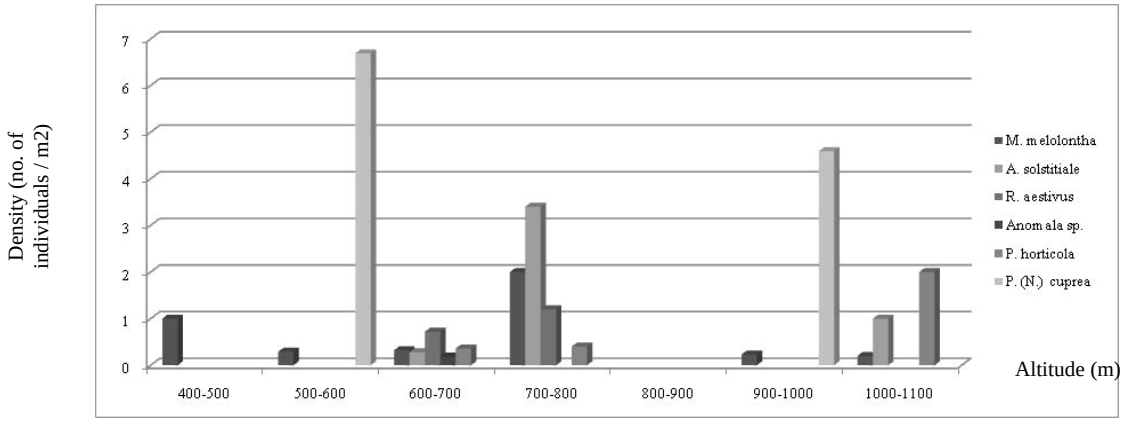

Figure 6. Survey of species, the density of scarabeoid larvae identified for different altitudes Covasna County (October 2013).

In order to establish the level of infestation, for all the species that were identified, it was necessary to calculate the average number of *M. melolontha* transformed in the third larval instar (Table 8).

Table 8. The level of infestation with scarabeoid larvae in the studied forest nurseries from Covasna County (October 2013).

Forest Department	Forest nursery	Species	Density (the average number of individuals / m^2)	Infestation (the average number of *Melolontha melolontha* transformed in the third larval instar - L_3 / m^2)	Level of infestation	
					Per species	Total
Breţcu	Breţcu	*M. melolontha*	0.29 L_3	0.32	M	M
		A. solstitiale	0.07 L_3		L	
	Oituz	*M. melolontha*	0.14 A	1.87	L	VH
		Anomala sp.	1.29 L_3		H	
		P. horticola	2.43 L_3		VH	
	Ojdula	*M. melolontha*	0.25 L_2	0.80	L	H
		A. solstitiale	0.5 L_1 + 0.1 L2 + 0.4 L_3		M	
		R. aestivus	0,33 L1 + 2.5 L_2		H	
	Turia	*M. melolontha*	0.4 L2 + 1.4 L_3 + 0.2 A	2,42	VH	VH
		A. solstitiale	0.8 L1 + 2.6 L_2		H	
		R. aestivus	0.4 L_1 + 0.8 L_2		L	
		P. horticola	0.4 L_3		L	
Comandău	Comandău	*M. melolontha*	0.2 L_3	1.63	L	VH
		A. solstitiale	0.2 L2 + 0.8 L_3		L	
		P. horticola	2.0 L_3		H	
	Dârnău	*M. melolontha*	0.33 L_2	0.11	L	L
		P. (N.) cuprea	4.08 L_3		0	
	Iancău	*P. (N.) cuprea*	5.8 L_3	0	0	0
	Păpăuţi	*M. melolontha*	0.03 L1 + 0.03 L2 + 0.23 L_3	0.25	L	L
		P. (N.) cuprea	6.69 L_3		0	
Covasna	Ghelinţa	-	0	0	0	0
Tălişoara	Ozunca Băi	*M. melolontha*	1 L_1 + 1.5 L_2	0.7	H	H
	Szálkás	*M. melolontha*	1.0 L_2	0.33	M	M
	Vârghiş	*M. melolontha*	0.1 L_1 + 0.9 L_2	0.32	M	M

Observation: *Protaetia cuprea* does not attack the roots of the plant (it is not a disturbing biotic agents);
Legend: Level of infestation: L – low infestation; M – medium infestation; H – high infestation; VH – very high infestation

Thus, very high infestations were registered for the following species: *P. horticola* – Oituz forest nursery; *M. melolontha* – Turia forest nursery. Data indicate that low infestations were registered for: *A. solstitiale* – Breţcu, Turia and Comandău forest nurseries; *M. melolontha* – Oituz, Ojdula, Comandău, Dârnău and Păpăuţi forest nurseries; *R. aestivus* – Turia forest nursery; *P. horticola* – Turia forest nursery.

Regarding the forest nurseries, the results indicate that very high infestations were identified for Oituz, Turia and Comandău. Low infestations were registered for Dârnău and Păpăuţi forest nurseries.

CONCLUSIONS

1. For studying the diversity of scarabeoid larvae in the forest nurseries from Covasna County, 121 soil samples (1 m x 1 m x 0.5 m) from twelve forest nurseries were analysed: Breţcu, Oituz, Ojdula, Turia, Comandău, Dârnău, Incău, Păpăuţi, Ghelinţa, Ozunca Băi, Szalkas and Vârghiş (Covasna County). The material was collected in October 2013.

2. The biological material (477 larvae) was studied for identifying the species and the larval instar. Systematically, the 477 larvae belonged to three families: Melolonthidae, Rutelidae and Cetoniidae; three subfamilies: Melolonthinae, Rutelinae and Cetoniinae, 6 genera and 6 species.

3. The dominant species was *P. (N.) cuprea* – 312 individuals (in 52 samples) identified for three forest nurseries: Dârnău, Iancău and Păpăuţi. It was followed by: *M. melolontha* with 52 individuals collected from 10 forest nurseries (106 samples); *R. aestivus* with 40 individuals (in 2 forest nurseries – 17 samples; *A. solstitiale* – 35 individuals from 3 forest nurseries (22 samples).

4. The largest densities were registered for *P. (N.) cuprea*: 6.69 larvae / m^2 for Păpăuţi, 5.8 larvae / m^2 for Iancău, 4.08 larvae / m^2 for Dârnău; for *A. solstitiale*: 3.4 larvae / m^2 in Turia forest nursery, for *R. aestivus*: 2.83 larvae / m^2 in Ojdula forest nursery and for *M melolontha*: 2.5 larvae / m^2 in Ozunga-Băi forest nursery.

5. Regarding the density of larvae in different types of forests, the largest densities were registered for *P. (N.) cuprea* in coniferous forests (3.98 larvae / m^2) and mixed forests (1.20 larvae / m^2).

6. The typical eutricambosoil presented the largest number of species (all six), individuals (302) and the largest density of larvae (6.43 larvae / m^2).

7. Regarding the types of station, *M. melolontha* presented a high density in hilly regions, beech forests with high and medium productivity; *A. solstitiale*, *R. aestivus* and *P. horticola* were found in hilly regions, with sessile oak and beech forests and also in mountain regions, with mixed forests and medium productivity; *Anomala* sp. was identified in mountain regions, with mixed forests and medium productivity; *P. (N.) cuprea* registered high densities in mountain regions, with mixed forests (medium productivity and semi-swampy).

8. The largest numbers of species were registered for different altitudes: five species for 600-700 m (*M melolontha*, *A. solstitiale*, *R. aestivus*, *P. horticola* and *Anomala* sp.), four species for 700-800 m (*M. melolontha*, *A. solstitiale*, *R. aestivus* and *P. horticola*); three species for 1000-1100 m (*M. melolontha*, *A. solstitiale* and *P. horticola*); and two species for 500-600 and 900-1000 m (*M. melolontha* and *P. cuprea*).

9. Very high infestations were registered for the following species: *P. horticola* – Oituz forest nursery; *M. melolontha* – Turia forest nursery. Data indicate that low infestations were registered for: *A. solstitiale* – Turia and Comandău forest nurseries; *M. melolontha* – Oituz, Ojdula, Comandău, Dârnău and Păpăuţi forest nurseries; *R. aestivus* and *P. horticola* – Turia forest nursery.

REFERENCES

CIORNEI C., ANDREI ANA-MARIA, ARINTON MIHAELA, LUPAŞTEAN DANIELA, APOSTOL B., POPA N., CARDAŞ G., ROTARIU C., CUCOŞ V. 2011. Use of fungal insecticides, with Beauveria brongniartii (Sacc) Petch., for biological control of may cockchafer (*Melolontha melolontha* L.) in forest nurseries in Romania. *Biotic Risks and Climate Change in Forests.* Helf 89. Freiburg: 148-151.

KLAUSNITZER B. 1978. Ordnung Coleoptera (Larven*). Bestimmungs Bücher zur Bodenfauna Europas.* Lieferung 10. Akademie-Verlag. Berlin: 11, 15, 103-113.

PANIN S. 1955. Coleoptera. Familia Scarabaeidae*. Fauna R.P.R.* ***10****(3).* Edit. Academiei R.P.R. Bucureşti: 35-50, 56-98. Planşe: VI, VII, XIII.

PANIN S. 1957. Coleoptera. Familia Scarabaeida. *Fauna R.P.R.* ***10****(4).* Edit. Academiei R.P.R. Bucureşti: 273-301. Planşe: 21, 23, 24, 26, 27, 31.

SIMIONESCU A., MIHALACHE GH., MIHALCIUC V., CIORNEI C-TIN., CHIRA D., OLENICI N., LUPU D., NEŢOIU C-TIN., VLĂDULEASA A., ILIESCU MARIA, VIŞOIU D., CHIRA FLORENTINA, RANG C., TĂUT I., MIHAI D. 2000. Protecţia pădurilor. Regia Naţională a Pădurilor. Edit. Muşatinii. Suceava: 30-50.

***. Fauna Europaea. version 2.6.2, http://www.faunaeur.org. (Accessed: February 8, 2014).

***. http://www.pe-harta.ro/covasna/. (Accessed: April 4, 2014).

Mihaela Arinton
"Ion Borcea" Natural Science Museum Complex of Bacău
Aleea Parcului, nr. 9, O.P. 1, C.P. 102, Bacău, Romania.
E-mail: mihaela_arinton@yahoo.com

Constantin Ciornei
Forest Research and Management Institute Bacău
Str. Ştefan cel Mare, nr. 28, Bacău, Romania.
E-mail: ciorneitinel@yahoo.com

Mihaly Pap
Covasna Forest Direction
Str.Kos Karoly nr.5A, Sfântu Gheorghe, Covasna, Romania.
E-mail: papmihaly@yahoo.com

Received: March 30, 2014
Accepted: May 9, 2014

Table 1. The characteristics of the twelve forest nurseries (Romanian National Forest Administration, Covasna Direction), studied in October 2013.

Forest District	Forest nursery	Surface (ha)	No. of samples	Type of culture	Geographical coordinates			type of station	Type of the soil	Exposure	Treatments (nematorin) in the last three years
					Altitude - m -	Latitude N	Longitude E				
Brețcu	Brețcu	1.40	14	De	630	46º02’58”	26º18’57,71”	5152	typical preluvisoil	SE	50 kg / ha (2011, 2012) 30 kg / ha (2013)
	Oituz	0.70	7	Co	640	46º04’29,60”	26º23’37,32”	3332	typical eutricambosoil	SE	30 kg / ha (2011, 2012, 2013)
	Ojdula	1.20	12	Co, De	635	45º58’15”	26º16’41,20”	3332	typical preluvisoil	S	50 kg / ha (2011) 30 kg / ha (2012, 2013)
	Turia	0.55	5	Co	700	46 º03’ 59”	25º57’19,39”	5152	typical alosol	NE	50 kg / ha (2011, 2012) 30 kg / ha (2013)
Comandău	Comandău	0.67	5	Co, De	1017	45º45’ 48,74”	26º16’28,36”	3332	typical eutricambosoil	-	30 kg / ha (2012, 2013)
	Dârnău	1.3	12	Co, De	948	45º40’39,80”	26º15’04,69”	3630	mollic, lithic	-	50 kg / ha (2011, 2012, 2013)
	Iancău	0.80	5	Co	973	45º42’14,94”	26º17’0536”	3630	alluvial	-	50 kg / ha (2011, 2012, 2013)
	Păpăuți	3.10	35	Co	550	45º47’ 41,78”	26º07’30,55”	3332	typical eutricambosoil	-	30 kg / ha (2013)
Covasna	Ghelința	1.80	10	Co	670	45º55’17”	26º16’49”	3332	typical alosol	NW	-
Tălișoara	Ozunca Băi	0.20	2	Co	650	46º04’42”	25º46’36”	5243	typical luvosol	N	-
	Szalkas	0.50	2	Co	620	45º56’56”	25º38’46”	5232	typical luvosol	N	-
	Vârghiș	2.0	12	Co, De	470	46º06’03”	25º33’55”	5243	antrisol	S	30 kg / ha (2011, 2013) 50 kg / ha (2012)

Legend type of culture: Co – coniferous; De - deciduous

Legend type of station:- 3332 – mountain, mixed forests, medium productivity, brown medium edaphic, with *Asperula – Dentaria*;
- 3630 -- mountain, mixed forests, semi-swampy;
- 5152 – hilly, sessile oak and beech forests with inferior (medium) productivity, alluvial, low humiferous, in flood plain;
- 5232 – hilly, beech forests, medium productivity, podzolic, medium edaphic, with *Festuca*;
- 5243 – illy, beech forests, high productivity, brown, large edaphic, with *Asperula – Asarum*..

Table 3. Survey of species, number of individuals in samples and density of scarabeoid larvae identified for the forest nurseries from Covasna County (October 2013).

Species		Breţcu				Comandău				Covasna	Tălişoara			Total
		Breţcu	Oituz	Ojdula	Turia	Comandău	Dârnău	Iancău	Păpăuţi	Ghelinţa	Ozunca Băi	Szalkas	Vârghiş	
Melolonthidae / Melolonthinae														
M. melolontha	The larval instar	4 L_3	1A	3 L_3	2 L_2 + 7 L_3 + 1 A	1 L_3	4 L_2		1 L_1 + 1 L_2 + 8 L_3		2 L_1 + 3 L_2	2 L_2	1 L_1 + 11 L_2	4 L_1 + 23 L_2 + 23 L_3 2 A
	Total individuals	4	1	3	10	1	4		10		5	2	12	52
	Density (no. larvae / m^2)	0.29	0.14	0.25	2	0.2	0.33		0.29		2.5	1	1	
A.solstitiale	The larval instar	1 L_3		5 L_1 + 1 L_2 + 6 L_3	4 L_1 + 13 L_2	1 L_2 + 4 L_3								9 L_1 + 15 L_2 + 11 L_3
	Total individuals	1		12	17	5								35
	Density (no. larvae / m^2)	0.07		1	3.4	1								
R.aestivus	The larval instar			4 L_1 + 30 L_2	2 L_1 + 4 L_2									6 L_1 + 34 L_2
	Total individuals			34	6									40
	Density (no. larvae / m^2)			2.83	1.2									
Rutelidae / Rutelinae														
Anomala sp.	The larval instar		9 L_3											9 L_3
	Total individuals		9											9
	Density (no. larvae / m^2)		1.29											
P. horticola	The larval instar		17 L_3		2 L_3	10 L_3								29 L_3
	Total individuals		17		2	10								29
	Density (no. larvae / m^2)		2.43		0.4	2								
Cetoniidae / Cetoniinae														
P. (N.) cuprea	The larval instar						49 L_3	29 L_3	234 L_3					312 L_3
	Total individuals						49	29	234					312
	Density (no. larvae / m^2)						4.08	5.8	6.69					
No. samples		14	7	12	5	5	12	5	35	10	2	2	12	121
No. species		2	3	3	4	3	2	1	2	0	1	1	1	6
No. individuals		5	27	49	35	16	53	29	244	0	5	2	12	477
Density / m^2		0.36	3.86	4.08	7	3.2	4.41	5.8	6.98	0	2.5	1	1	3.94

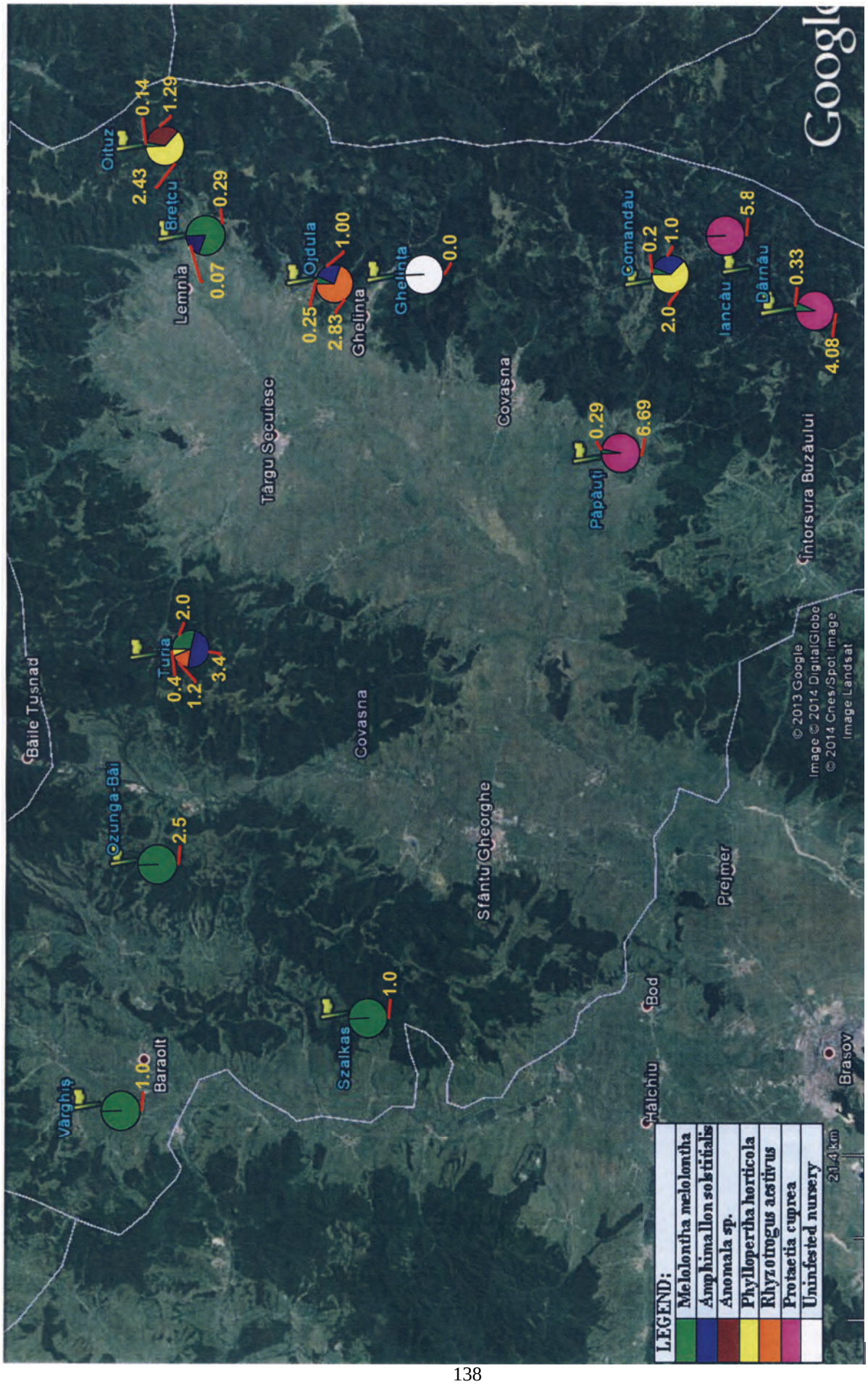

Figure 2. The distribution of scarabeoid species in the twelve forest nurseries from Covasna County.