ALLUVIAL *SALIX PURPUREA* AND *HIPPOPHAË RHAMNOIDES* COLLINAR SHRUBLANDS IN PRAHOVA AND DOFTANA ZONE

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The biological diversity of shrublands dominated by *Hippophaë rhamnoides* and *Salix purpurea* along the collinar floodplain of rivers Prahova and Doftana is presented in this paper. *Hippophaë rhamnoides* shrubland is included in the 3240th European Habitats. The diversity of plant species is high at the level of shrubs (15-17 species) and of herbs as well (55-80 species). There are differences between sites concerning both shrub biomass (67 t/ha, respective 35 t/ha) and herbaceous biomass (360 kg/ha, respectively 1 123 kg/ha). The identified invertebrates' communities are represented by detritophagous, predator and phytophagous populations in endogeous-epigeous gradient. The highest degree of specific diversity is noticed mainly in Cornu shrubland as well as the highest numerical densities. The degree of similarity between the three communities of invertebrates is generally low, varying between 0.28 and 0.66 in the soil communities and between 0.16 and 0.5 in epigeous communities. The common characteristic of the three invertebrate communities is the model of seasonal dynamics: the humidity, organic matter and predators' presence influencing the endogenous groups and the vegetation characteristics influencing directly the epigeous phytophagous and indirectly the predators.

Key words: shrubland, *Hippophaë rhamnoides*, *Salix purpurea*, plant biomass, soil fauna.

INTRODUCTION

Shrublands are a pioneering coenotic formation, installed on vegetationless lands, with grassy vegetation or, they have developed secondary to wood clearing (Paucă 2008). The alluvial shrublands grow naturally on gravels, being dominated in the field area by *Tamarix ramosissima*, accompanied by the whole spectrum of plants and animals specific to the small rivers (Paucă *et al.*, 2002) or somehow similar to the Danube banks and the Danube Delta (Paucă *et al.*, 1996). In the Romania Plain, the gravels are already more soilified, the shrublands being represented by Pruno-Crataegetum with mesophyllic trend (Paucă *et al.*, 2004).

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In the collinar zone, the Tamarix shrubs do no longer form compact associations properly represented quantitatively and coenotically, leaving place to the purple willow (*Salix purpurea*) and sea buckthorn (*Hippophaë rhamnoides*), as shown by some phytocoenology papers (Parascan and Danciu. 1975; Ştefan, 1993).

Quantitative studies, using the main ecological indices, including the wood biomass, or indices referring to the soil invertebrate fauna, to the *epigaion* fauna, or to the canopy fauna were missing up to this paper.

According to the Manual of European Habitats Interpretation (Gafta and Mountford, 2008) the *Hippophaë rhamnoides* shrublands have a status of European protection under the code name 3240 – Eur 2007, but their specificity in Romania is still very little known, even controversial, which is why their characterisation is partially distorted in relation to this habitat (3240 "Alpine rivers and their ligneous vegetation with *Salix elaeagnos*"). The mentioned manual sets a correspondence between habitat 3240 and the ass. *Hippophaë – Salicetum elaeagni* Br. Bl. et Volk 1940 and also with *Salicetum elaeagni-purpureae* Sillinger 1933.

MATERIAL AND METHOD

The ecological investigations were conducted in an "itinerant" regime between Comarnic and the confluence of Prahova and Doftana, between 600 and 450 m altitude, and they showed the predominant spreading of *Salix purpurea* shrubs (as. *Saponario-Salicetum purpureae* Br.Bl.1930 Tscho 1946; Romanian habitat R4418 – purple willow scrubs) and the lower spreading of the *Hippophaë rhamnoides* shrubs (as. *Hippophaë – Salicetum elaeagni* Br.Bl. et Volk 1940; Romanian habitat R4417 – Danubian sea buckthorn and white willow shrubs), much better represented in another structure and therefore in another habitat, on the rocky slopes, higher than the water level.

Quantitative surveys in "stationary" regime have been conducted between 2005-2007 at the following three sites:

- Nistoreşti, Prahova Valley (km 98 on DN1) – *Hippophaë rhamnoides* shrub altitude 558m; 45°10`3,8″N; 25°41`23,6″E;
- Cornu, Prahova Valley (km 94 on DN1) – *Salix purpurea* shrub; altitude 488 m; 45°08`24″N; 25°42`37,6″E;
- Lunca Mare, Doftana Valley, *Salix purpurea* shrub; altitude 437 m; 45°12`13,5″N; 25°44`48,7″E.

The substrate was alluvial soil at all three sites, with a lot of coarse material, frequently flooded at Lunca Mare – located below the level of minor water bed, and less frequently flooded at Cornu and Nistoreşti, on the first terrace, 3 m higher than the previous site.

The determinations were done on areas of one hectare (strips of 20×50 m) along each river, for an inventory of the flora and fauna, from spring till autumn.

The various ecological indices, including the aboveground biomass of the herbaceous and shrubs layer, were calculated using samples collected on areas of 0.25 m^2 for the herbs and 9 m^2 for the shrubs in the minimal numbers allowed for the statistical significance of each indicator. The biomass determinations were done using the direct weighing method as follows: for shrubs they were done on location with a scale with 1g accuracy; for the herbs they were done using an analytical scale, after sorting and drying plant material in a stove at 84 °C. The invertebrate fauna was collected seasonally, using methods specific to each surveyed group: the MacFayden probe for the soil fauna (enchytreids, nematods, springtails, oribatid mites and gamasids) in the upper 10 cm, divided on three levels and 20×20 cm squares dug 40 cm deep, for the earthworms, the method of the litter squares (25×25cm) for the chilopods, sampling with the entomological net for the herbaceous layer and canopy fauna (thryps, chrysomelids, weevils); the trap method (with 4% formaldehyde and ethylene glycol), for the epigaion invertebrate (coleopteran-ground beetles). The biomass was determined by weighing in the ground beetles and from the tables (Petersen and Luxton, 1982) for the rest of the invertebrates.

RESULTS AND DISCUSSION

Shrubs. The ecosystems edified by the shrubs have their spatial area determined by the composing shrubs, particularly by those with a dominant quantitative role. As Table 1 shows, the *Salix purpurea* shrubs are higher (8.5-9 m) than the shrubs edified by *Hippophaë rhamnoides* in the Prahova Valley floodplain (4.52 m). Even the average height of the shrubs is higher in the purple willow shrubs from Prahova floodplain.

The current structure of the biocoenosis is displayed on two layers, the shrub layer, which includes the specimens of growing trees, still during their early stages, and the herbaceous layer, continuous, but with unequal development, in an inversely proportional ratio with shrub density. The coverage of the biocoenosis is 100%, but the shrub layer, although very well developed in all three sites, has coverage of about 70-85%; there are areas with only grass vegetation, maybe with some young shoots no taller than the grasses.

The age of the shrubs, evaluated by the age of the oldest specimens of shoots, is of 25-30 years, and it was determined using the system of counting the years by the number of growth rings in cut sections, like in the forest trees. Since the oldest shoot of the shrub is also the thickest, we consider it can be a reference for the entire shrub and for the entire shrubland.

The spatial distribution of these shrublands is not homogeneous: groups of dense and loose shrublands alternate with areas of herbaceous vegetation. The most homogeneous shrubland in terms of ligneous bioforms is the Lunca Mare shrubland, on the Doftana Valley, but this homogeneity does not appear at the level of the microrelief too, which is why the herbaceous layer has different characteristics of diversity than the shrub layer.

On the average, the highest shrub density was recorded at the *Salix purpurea* shrubland from Cornu (Table 2), if we speak only of the shoots with a diameter higher than 1 cm, since at this dimension we consider that the vitality and, particularly, the survival capacity is closer to reality. It is known that a "cohort" of young specimens appears in large numbers through seeds or vegetative (clonal) shoots, but they are rapidly smothered by the other members of the community. Under this aspect, we note that the cohort shoots are in the largest numbers (2330) at Cornu too, followed by the ones from Lunca Mare (1499) and by the least numerous shoots from the *Hippophaë* shrub at Nistoreşti (801). The large number of new, thin shoots, determines at Lunca Mare the low dimension of the average shrub diameter, although the largest shrub diameter was recorded here (Table 1). The abundant presence of the water in soil, almost throughout the entire vegetation period, promotes the development of large numbers of shoots, but it is not enough to ensure the survival of the competing shoots.

The supraterranean biomass accumulated in these shrublands is quite large (Table 2), ranging between 34.8-67.3 t/hectare. If we compare these values with the accumulation from the beech forests in the area, whose biomass reaches 260 t/hectare (Lespezi, Posada) at maturity, at over 100 years, we may evaluate the productivity of the phytocoenosis as being high, under the conditions of an emerging soil and of occasional wood cutting (the thickest shoots) by the riparian inhabitants.

At present the highest amount of biomass is recorded at Cornu, where the size of the shrubs is higher, and the number of specimens is also the highest.

The values of the variation coefficient are high, showing an increased local variability. This is why a higher number of replicated would have been useful.

As general aspect, the *Salix purpurea* shrubland from Lunca Mare is the tallest, with a moderate density of the stabilized shrubs, while at Cornu, the shrubland displays large clusters of shoots, with median dimensions, alternating with patches lacking woody specimens. At Nistoreşti, *Hippophaë rhamnoides* dominates together with the *Salix purpurea* population the entire shrubland, but it has lower dimensions, the character of "thicket" being achieved particularly by the thorns and rich branching of the first species.

The shrub layer consists of numerous species, 27 in all (Table 3); a single shrubland contains 15 to 17 species, about 7 of them being common; their proportion differs the most, both as number and as biomass, in each surveyed shrubland (Table 3). This makes the alluvial shrublands from the plain very different, where the *Tamarix* shrublands are monodominant, with the sporadic participation of 3-4 other species. In the collinar area there are present the tree species of the riverside coppice (Alno-Padion), but species which migrated from cultures have also developed here. In the wider floodplain from Cornu we noticed the frequent presence of *Hippophaë* species along the collinar course of the Prahova River, along with numerous shrub species typical to the forest associations or to the vegetation of the neighboring slopes, species which are not met in the other alluvial shrublands; their amount in the biocoenosis is very large, both as numbers and as biomass (*Frangula alnus, Viburnum opulus, V. lantana*).

Considering only the presence of the shrub species, the shrublands of Lunca Mare and Nistoreşti are closer coenotically than those from Nistoreşti and Cornu, although they are on the same valley (28.0) or from those from Cornu and Lunca Mare, belonging to the same type of habitat and association. In terms of quantity, *Salix purpurea* is dominant or co-dominant in all three sites both as numbers and particularly as biomass. *Ligustrum vulgare* and *Cornus sanguinea* are remarked for a noticeable numerical participation.

It is difficult to explain the absence of the species *Salix elaeagnos* characteristic for the association *Hippophaë – Salicetum elaeagni* in the phytocoenological classification from Nistoreşti (Table 3) although it is present in the other two shrublands, as well as the absence of the herbaceous species *Saponaria officinalis* from the association in which it is characteristic next to *Salix purpurea*. *Saponaria officinalis* has not been identified by previous botanical survey either (Parascan and Danciu 1975).

The lower layer of the biocoenosis was analyzed globally as a layer located between the soil surface and the height of 50-70 cm, although it is very diverse. It is various both as coverage and height, and as composition. It covers the area 100% and has a composition similar to that of a meadow in the patches still not occupied by shrubs, but it has a low density, covering between 5% and 50% of the area among the absence and the very dense shrubs. In the shadow of the shrubs, the herbs grow up to 70 cm tall; they also grow in the sunny areas where, according to the genetic characteristics, tall species, up to 1 m (*Festuca arundinacea*) can be noticed. At the soil surface, the moss grows almost permanently, being more spread in the spring and less numerous in the summer, sharing the microlayer with the short species of the phytocoenosis. Also in the layer grow the shoots regenerating the whole year around from the perennial plants, or the plantlets emerging from seeds, or the woody species, shrubs or trees, which populate in the first year, sometimes even longer, this structural level. The contribution to the biomass of the coenosis ranges between 37 kg DM/ha and 112 kg DM/ha if we only consider the herbs and between 47-268 kg DM/ha if we include all the mentioned components (Table 4).

Table 1

Salix and *Hippophaë* shrubs' size according to edifying species

Ecosystem type (Habitat)	Height of edifying species				Diameter of edifying species			
	Average m	Average deviation Sx	Variation coefficient S%	Maximum m	Average cm	Average deviation Sx	Variation coefficient S%	Maximum cm
Salix purpurea shrubs Lunca Mare	3.48	0.72	27.90	5.79	3.04	0.60	28.73	9.00
Salix purpurea shrubs Cornu	2.70	0.33	15.96	4.53	3.66	0.43	15.44	8.50
Hippophaë rhamnoides shrubs Nistoreşti	1.85	0.38	20.54	3.56	1.94	0.72	20.54	4.52

Table 2

Structural indices for *Salix* and *Hippophaë* shrubs' layer

Ecosystem type (Habitat)	Biomass of shrub layer			Density of viable shrub's youngsters		
	Average kg/100m^2	Average deviation Sx	Variation coefficient S%	Individual no.>1 cm thickness/100 m^2	Average deviation Sx	Variation coefficient S%
Salix purpurea shrubs Lunca Mare	599	210	49	276	94	54
Salix purpurea shrubs Cornu	673	150	45	891	363	34
Hippophaë rhamnoides shrubs Nistoreşti	348	103	46	320	22	9

Table 3

Biocoenotic importance of wood species for shrubs' layer organization

3.1. *Salix purpurea* shrubs, Lunca Mare			
Wood species into shrub's layer	Frequency (%)	Relative abundance (%)	
		numerical	biomass
Salix purpurea	100	15.65	52.01
Cornus sanguinea	100	20.10	12.30
Hippophaë rhamnoides	100	1.80	6.35
Salix elaeagnos	100	1.80	5.18
Ligustrum vulgare	100	11.18	1.00
Crataegus monogyna	100	1.56	0.005
Rubus caesius	100	17.68	0.42
Populus alba	30	0.46	6.35
Salix alba	30	0.23	11.37
Other species having relative abundance below 1%: *Cytisus nigricans, Alnus incana, Fraxinus excelsior, Ulmus minor, Cornus mas, Cerasus avium, Robinia pseudoacacia*			
3.2. *Salix purpurea* shrubs, Cornu			
Wood species into shrub's layer	Frequency (%)	Relative abundance (%)	
		numerical	biomass
Salix purpurea	100	2.60	27.00
Frangula alnus	100	4.13	9.22
Viburnum opulus	100	4.26	4.56
Viburnum lantana	100	3.96	4.37
Berberis vulgaris	100	4.26	4.08
Cornus sanguinea	100	32.00	17.01
Ligustrum vulgare	100	34.68	20.22
Crataegus monogyna	100	5.38	6.65
Rhamnus saxatile	100	0.85	1.46
Evonymus europaeus	60	2.26	1.52
Rubus caesius	60	4.13	0.04
Salix elaeagnos	30	0.12	0.57
Other species having relative abundance below 1%: *Cornus mas, Rhamnus cathartica, Rosa canina, Juglans regia, Ulmus minor*			
3.3. *Hippophaë rhamnoides* shrubs, Nistorești			
Wood species into shrub's layer	Frequency (%)	Relative abundance (%)	
		numerical	biomass
Hippophaë rhamnoides	100	25.96	50.96

Salix purpurea	100	19.97	31.46
Cytisus nigricans	100	3.74	4.06
Cornus sanguinea	100	25.96	3.10
Ligustrum vulgare	100	13.73	3.32
Populus alba	60	4.11	3.19
Betula pendula	60	1.37	3.19
Salix alba	60	0.87	0.58
Other species having relative abundance below 1%: *Berberis vulgaris, Crataegus monogyna, Rosa canina, Rubus caesius, Clematis vitalba, Fraxinus excelsior*			

Table 4

Seasonal accumulation of herbaceous layer's biomass from shrublands (gDM/m^2)

Ecosystem type (Habitat)	**Organic matter type**	**Dry organic mass (g/m^2)**	
		spring (May)	summer (July/August)
Salix purpurea shrubs Lunca Mare	Herbaceous	36.32	112.46
	Diverse seedlings	0.21	0.34
	Shrubs and trees' saplings	3.44	15.93
	Mosses	7.09	0.78
	Total biomass	47.05	127.93
	Necromass	228.98	131.68
	Total organic mass	276.03	259.62
Salix purpurea shrubs Cornu	Herbaceous	64.25	123.26
	Diverse seedlings	0.67	1.32
	Shrubs and trees' saplings	3.07	8.87
	Mosses	118.48	8.09
	Total biomass	186.48	141.54
	Necromass	286.00	126.56
	Total organic mass	472.48	268.10
Hippophaë rhamnoides shrubs Nistoreşti	Herbaceous	55.51	87.97
	Diverse seedlings	0.05	0.39
	Shrubs and trees' saplings	3.93	11.56
	Mosses	65.76	17.83
	Total biomass	125.25	117.75
	Necromass	247.93	153.23
	Total organic mass	373.18	270.98

Also in this layer we may include the dead biomass – the necromass – which in the gramineous species and in the young shrub shoots which did not survive remains a long time in vertical position next to the living part; adding to this is all the dead and undecayed material remaining at the soil surface, sometimes several centimetres thick.

The annual dynamics of the layer is quite active and specific to these biocoenoses, the highest amounts being recorded in summer. The explanation is the almost complete absence of the short life-cycle species – the vernal species – so spread in other phytocoenosis in the area (Table 4). The quantitative role of the moss, maybe their strongly inhomogeneous spatial distribution changed more at Cornu and less at Nistoreşti the total value of the biomass, by the higher amount during the spring and by dramatic depression during the summer, falling from 118 g DM/m^2 in spring to barely 8.09 m^2 in summer. A constant growth in spring towards summer was noticed in the herbs, in the saplings and in the young shrubs which increase their numbers and particularly the individual biomass. The contribution of the herbaceous species to the layer biomass (Table 4) is dominant in all phytocoenoses, ranging in the summer from 75% at Nistoreşti to 87-88% of the *Salix purpurea* shrubland biomass at Cornu and Lunca Mare. However, during the spring, the moss in the Prahova Valley shrublands from Cornu and Nistoreşti reaches 55-52% of the total amount of the herbaceous layer – the lower biocoenosis layer. The values used as reference for the biomass were those related to the dry matter, so as to maintain a constant standard of the comparison under the conditions in which, particularly in the spring, the herbaceous biomass contains over 70% water, while in the moss and saplings, the water percentage falls below 50%. The total amount of necromass decreases constantly in all sites, from spring to summer, due to the decomposition achieved by the microorganisms and the invertebrate micro consumers, to be analysed subsequently.

The organic mass resulting from the activity of the primary producers is the highest on the Prahova Valley, particularly in the *Salix* shrubland from Cornu (4.72 t/ha) and in the *Hippophaë* shrubland from Nistoreşti (3.73 t/ha), while at Lunca Mare, on the Doftana river, the amount is lower (2.76 t/ha), either due to the higher consumption by other consumers (for instance, in late summer and autumn, the sheep and goats herds of the local people), or due to their partial washout, in early spring when the floods on the Doftana Valley are more frequent and cover larger areas. If the total organic mass of the lower layer is quite similar among all the biocoenoses in the summer months (2.59; 2.68; 2.71 t/ha), in late spring (in May), on the Doftana Valley, the organic mass is just 60% of the value for the Prahova Valley *Salix* shrubland but, as mentioned, here the bank is less affected by floods.

The composition of the herbaceous layer (Table 5) is rich. All the shrublands generally have over 60 species; the shrublands edified by *Salix purpurea* have over 80 species in the Doftana Valley and about 70 on the Prahova Valley. Among them are shrubs species, but in a lower proportion, next to species of saplings existing in the area forests. It is interesting that the tree species are not the dominant ones and they have not even been found in the shrub layer (*Acer campestre*, *Acer pseudoplatanus*), therefore they cannot cope with the competition.

The presence of the shrub and tree species with representative values both in the herbaceous layer and in the shrub layer shows their good capacity of regeneration and a strong capacity for spatial expansion, therefore a better ability of competition as shown by the evolution of the biocoenosis towards shrublands formations, towards alluvial forests and not towards meadow. *Salix elaeagnos* appears as young shoots in both shrublands of *Salix purpurea*, but not in the *Hippophaë rhamnoides* shrubland where it should be, if not co-dominant, at least present. Reanalysing the similarity of the three shrublands, this time in terms of all array of present species, we notice that the *Jaccard index* of similarity is higher (29.35) in the two shrublands from the Prahova Valley, although with a different dominance of shrubs, followed by the index of similarity between Cornu and Lunca Mare (21.02) both sites dominated by *Salix purpurea* and, on the last position, the Nistoreşti shrubland compared to the Lunca Mare shrubland. The richness of the herbaceous species, noticed at Lunca Mare, is due to the very varied microrelief; small brooks spread throughout the shrubland are keeping the soil humid until late summer. At its border towards the river, it neighbours with an area of reeds and rush which explains the penetration of paludous species even within the shrublands. On the opposite side, the sudden ending of the slope brings a multitude of species with mesophillic or even dry character and some species which migrated from the local orchards.

The quantitative contribution of the herbaceous populations to the composition of the layer biomass is different in the three shrublands, but the gramineous and cyperaceae species are the representative ones. Between 6 and 9 species have a participation higher than 1%, but only three species form the main mass of the layer, of about 50% (Table 5): *Carex ornithopoda, Clinopodium vulgare* and *Agrostis stolonifera* at Lunca Mare; *Carex flacca, Carex ornithopoda* and *Carex montana* at Cornu; *Carex digitata*, *Festuca rubra* and *Brachypodium sylvaticum* at Nistoreşti

THE INVERTEBRATE FAUNA of the shrublands depends on the mechanical carrier, the existing plants, as well as on the food source of the phytophagous fauna, and on the general substrate, respectively the emerging soil.

In the soil, most invertebrate groups are detritophagous (nematods, enchytreids, earthworms, collembola, oribatide mites) and, partially, predators (mesostigmate mites).

The variations from site to site of the numeric abundance of the populations of soil invertebrates have in common the fact that in the Cornu shrublands they were detected in the highest numbers, except for the collembola (Fig. 1, Table 7).

As season of peak density, the differences from site to site, at the level of each invertebrate group were larger; in most cases the numerical peak was recorded in the spring or autumn, associated to the presence of a new supply of dead vegetal mass (necromass).

In the litter we noticed the presence of the predator myriapods (chilopods). They were best represented as numerical density at Lunca Mare, the total numerical densities being equal or lower in the other two locations than in Lunca Mare. As seasonal dynamics, the peak densities were reached in summer at Cornu and Lunca Mare decreasing thereafter below the spring values (6.4 specimens/m^2 in October compared to 12.8 specimens/m^2 in May at Cornu and 3.2 specimens/m^2 in October compared to 9.6 specimens/m^2 in May at Lunca Mare), and at Nistoreşti – in spring (25.6 specimens/m^2), the population being predominated by the specimens of *Geophilomorpha* genus (62% of the collected specimens) (Figs. 1-3).

In the epigeous, the ground beetles fauna (Ord. *Coleoptera*, Fam. *Carabidae*) is represented by populations with variable relative abundances, numerical densities and frequencies variable both spatially (from site to site) and temporally (seasonally). The highest numerical densities were recorded at Lunca Mare and the lowest at Nistoreşti (Figs. 1-3). As seasonal variation, at Nistoreşti and Cornu, the peak numeric densities were recorded in autumn, while at Lunca Mare, the peak numeric abundance was recorded in spring (Figs. 1-3). We also noticed that at Nistoreşti and Lunca Mare, the eurytopic forest species *Abax parallelipipedus* displayed the highest values of the relative abundances of the local ground beetles populations, its status within the structure of these populations being that of constant species at Lunca Mare and accessory species at Nistoreşti. Also in these two sites, the species of *Carabus* genus, important both for the trophic structure and as specific biomass are at the best accessory within the populations and displayed low values of the relative abundance (8.1-13.51% at Lunca Mare and 7.14-10.71% at Nistoreşti). At Cornu, the forest hygrophilous *Agonum sexpunctatum* species is the only constant species of the population, the other species being accidental within the local structure (except for *Pterostichus oblongopunctatus,* accessory species) (Table 6).

In the shrub canopy and in the herbaceous layer, of the total thrips species observed in the three locations, in the herbaceous layer they were present in a proportion of 40% and 65%, respectively. At Cornu and at Nistoreşti thrips density was higher when sweeping than when shaking, compared to the values observed at Lunca Mare (Table 7). In the canopy, the average values of the numerical abundance were much lower than in the herbaceous layer. The identification in these shrublands of the same genera (*Chirothrips* and *Haplothrips*) also identified on other areas (shrublands on the Neajlov Valley, with *Pruno spinosae – Crataegetum* Soó 1927 (31) from Chirculeşti, where the xerophilous species are dominant, and in Chirculeşti site II, *Rubi-Salicetum cinereae* Somsak 63 where the mesophilous species are dominant, 7 species being common, of the total 18 species) but with different species from the mentioned ones, is explained by the large plasticity of these insects, phenomenon generated, among others, by a certain similitude of the site vegetation. The appearance of other species belonging to the same genera is due to the dependence of these species on the vegetation characterized by *Hyppophaë rhamnoides* and *Salix purpurea*. The fact that the species observed on these areas are largely accidental may also be due to the similar specific structure of the neighboring vegetation, creating thus a large trophic basis for these insects.

The weevil fauna consisted of polyphagous species in majority. Most weevil species are accidental, with a different participation in the structure of the communities from the surveyed areas (Table 6). The weevil populations from Nistoreşti and Cornu have a status of accessory species at the best, in each of these populations existing two eudominant species. Similarly to the other phytophagous, the weevils have often modified their ecological niche in what concerns the consumption of different parts of the plant or of the entire host plant (Marvaldi, 2002). Therefore, the presence or absence of certain weevil species on these areas depends directly on the presence or absence of the host plant.

In terms of the trophic spectrum, the chrysomelids are exclusively phytophagous species (mono- or oligophagous), strictly specialized on certain plant species, genera or families. In the case of the species from the *Chrysomelinae* subfamily, the most frequently consumed are the species from the *Salicaceae*, *Betulaceae* and *Fabaceae* families. The fact that species *Chrysomela saliceti* and *Phratora tibialis* were noticed in all three surveyed sites is accounted by the fact that the vegetal structure of these shrublands includes large amounts of *Salix* species. Also, the plants required for the existence of species *Plagiodera versicolora* – observed in the shrublands from Nistoreşti – are Salix and Populus plant species. In general, the species of Plagiodera and *Chrysomela* attack the young shoots. The chrysomelids fauna of these shrublands lacks species *Pachybrachis sinuatus* (*Cryptocephalinae*) known for its trophic preference for *Hippophaë rhamnoides* L.

Analysing the structural parameters of the groups of endogenous invertebrates (abundance, average density, s, cv%) (Table 7) we can say that the populations of nematodes and enchytreids are homogeneous, displaying the highest level of aggregation (enchytreids) and dispersion (nematodes) at Cornu.

The mites – mesostigmate, as well as the oribatid mites, have heterogeneous populations (cv%>30%) on all three sites and a variable level of dispersion, the highest one being recorded at Lunca Mare for the oribatid mites and at Nistoreşti for the mesostigmate, while the latter species displayed the highest level of aggregation at Cornu (*e.g.* the enchytreids).

The ground beetles and the chilopods, the latter consisting exclusively of predator species, have a grouped distribution in all three shrublands and heterogeneous populations. The ground beetles had a lower level of dispersion, but high values of the variability coefficient, at least at Nistoreşti and Lunca Mare (Table 7), which supports the existence of heterogeneous populations on these areas. At Cornu, the ground beetles and the chilopods have populations with the highest level of aggregation and very heterogeneous, even highly heterogeneous in the chilopods.

The thrips, in terms of the actual distribution of the numeric stock in space, displayed clear differences between the populations from the herbaceous layer and those from the canopy. Thus, in the canopy, all three sites had extremely aggregate and heterogeneous populations (cv% = 100%), while in the herbaceous layer, although little dispersed, the populations are almost homogeneous (cv% = 16.16%-19.4%) (Table 7). These aspects show that the particularities of the vegetal carpet in the surveyed shrublands account for the homogeneity or heterogeneity of the local thrips populations; this is also due to the structure and trophic relations established between the invertebrates of this level.

In the groups of endogeous invertebrates, the structure of dominance is variable seasonally and from site to site. Thus, in terms of time representation and dominant community structures, in the soil, from the existing earthworms species, *Octolasion lacteum* is eudominant at Nistoreşti and Lunca Mare, while at Cornu, this statute went to *Aporrectodea rosea rosea* (Tables 6-7). The earthworms species identified on these areas have also been noticed in forestry ecosystems, but in much higher densities. The differences in quality and quantity of the forest and shrublands earthworms populations are due first to the structural differences of the soil vegetation (Donita *et al*., 2005).

In the enchytreids populations, the constant species were noticed only at Cornu, where they also had the status of dominant species. In the other 2 sites, the eudominant and dominant species only had the status of accessory species within the local populations (Table 7). Also due to the bioedaphic conditions the springtails species identified on these areas had lower values compared to the forest populations, given the particularities of the predator springtail groups such as oribatid mites, spiders, centipedes, etc. (Ferguson, 2001). In 2005 Derraik also shows that the specific wealth and the relative abundance of the shrubland springtails is two time lower compared to the meadow ecosystems. In 2003 Derraik and collaborators showed that the specific diversity of the shrublands springtails varies significantly due to the microclimatic factors. Among the three surveyed shrublands, the highest density of springtail populations was observed at Lunca Mare, emphasizing their important action within the local litter decaying processes. There were few dominant species within the springtail communities in the surveyed areas, and among them were *Isotomiella minor* and *Parisotoma notabilis*, species with wide ecological properties, which also populate other types of ecosystems, the natural ones particularly. The analysis of the material revealed the presence at Nistoreşti of *Proisotoma minima*, a new species for the fauna of Romania.

Table 5

Herbaceous layer's plant species and their importance for layer's biomass

5.1. ***Salix purpurea*** **shrubs, Lunca Mare**		
Species	**Frequency %**	**Biomass (DM)relative abundance %**
Carex ornithopoda	40	10.18
Clinopodium vulgare	10	9.36
Agrostis stolonifera	20	9.25
Carex tomentosa	40	6.33
Carex flacca	30	5.59
Brachypodium sylvaticum	20	5.31
Calamagrostis epigeios	50	4.98
Cirsium arvense	10	4.98
Cirsium oleraceum	10	4.32
Other species having quantity below 1%: *Achillea millefolium, Aegopodium podagraria, Angelica sylvestris, Asperula cynanchica, Astragalus cicer, Astragalus onobrychis, Betula pendula/pl, Briza media, Calamintha sylvatica, Carlina vulgaris, Chrysanthemum leucanthemum, Cornus sanguinea/pl, Crataegus monogyna/sed, Cichorium intybus, Dactylis glomerata, Dactylorhiza maculata, Equisetum palustre, Erigeron annuus, Fragaria vesca, Fraxinus angustifolium/sed, Fraxinus excelsior/sed, Glyceria notata(plicata), Glechoma hederacea, Gypsophila muralis, Helianthemum nummularia, Hippophaë rhamnoides, Holcus lanatus, Inula britanica, Juncus bufonius, Leontodon hispidus, Ligustrum vulgare, Listera ovata, Lycopus europaeus, Lycopus exaltatus, Lysimachia vulgaris, Melampyrum nemorosum, Myricaria germanica/sed, Onobrychis viciifolia, Ononis arvensis, Peucedanum oreoselinum, Phragmites australis, Poa angustifolia, Poa compressa,Poa pratensis, Potentilla reptans, Prunella vulgaris ,Ranunculus acer, Ranunculus ficaria, Ranunculus repens, Rhinanthus angustifolius, Rubus caesius, Salix alba/sed, Salix elaeagnos/sed, Salix purpurea/sed, Salix triandra/sed, Salvia glutinosa, Sambucus nigra/sed, Sanguisorba minor, Solidago virgaurea, Stachys sylvatica, Taraxacum officinale, Trifolium pratense, Tussilago farfara, Typha latifolia, Typha laxmanii, Typha minima, Veronica beccabunga, Veronica chamaedrys, Veronica verna,Vicia cracca, Viola hirta, Viola reichenbachiana*		
5.2. ***Salix purpurea*** **shrubs, Cornu**		
Species	Frequency %	Biomass (DM) relative abundance %
Carex flacca	40	22.89
Carex ornithopoda	100	19.00
Carex montana	60	16.67
Calamagrostis epigeios	50	6.55
Cornus sanguinea	70	5.88
Dactylis glomerata	60	3.14

Other species having quantity below 1%: *Acer platanoides/sed, Agrimonia eupatoria,Agrostis gigantea, Agrostis stolonifera, Ajuga reptans, Asperula cynanchica, Berberis vulgaris/sed, Brachypodium pinnatum, Brachypodium sylvaticum, Bromus hordeaceus, Campanula rapunculoides, Carex depressa, Carex tomentosa, Crysanthemum leucanthemum, Cirsium arvense, Clinopodium vulgare, Cornus mas/sed, Crataegus monogyna/sed, Cruciata glabra, Cruciata laevipes, Dactylis glomerata, Daucus carota, Erigeron annuus, Euphorbia cyparissias, Evonymus europaeus, Festuca arundinacea, Festuca rubra, Fragaria vesca, Frangula alnus/sed, Galium verum, Geum rivale, Glechoma hirsuta, Helianthemum nummularia, Lamium galeobdolon, Ligustrum vulgare, Lysimachia nummularia, Origanum vulgare, Plantago lanceolata, Plantago media, Poa angustifolia, Poa compressa, Pulmonaria officinalis, Ranunculus acris, Ranunculus repens, Rhamnus saxatile/sed, Rubus caesius, Saginia procumbens, Salix elaeagnos/sed, Salix purpurea/sed, Senecio sylvaticus, Scabiosa lucida, Teucrium chamaedrys, Thlaspi perfoliatum, Thymus pulegioides, Valeriana officinalis, Veronica chamaedrys, Viburnum lantana/sed, Viburnum opulus/sed, Vicia cracca, Viola canina, Viola hirta, Viola reichenbachiana*		
5.3. *Hippophaë rhamnoides* shrubs, Nistoreşti		
Species	Frequency %	Biomass Relative abundance %
Carex digitata	60	19.63
Festuca rubra	60	9.22
Brachypodium sylvaticum	70	8.10
Fragaria vesca	20	5.49
Carex tomentosa	10	5.00
Plantago lanceolata	50	2.81
Euphorbia cyparissias	40	2.72
Other species having quantity below 1%: *Acer campestre, Asperula cynanchica, Calamagrostis epigeios, Carex flacca, Carex ornithopoda, Chamaecytisus hirsutus, Crysanthemum leucanthemum, Cornus sanguinea, Cornus setosa, Cytisus (Lembotropis) nigricans, Dactylis glomerata, Erigeron annuus, Euphorbia cyparissias, Euphorbia stricta, Galium mollugo, Galium verum, Geum rivale, Glechoma hirsuta, Hippophaë rhamnoides, Leonurus cardiaca, Ligustrum vulgare, Linaria vulgaris, Leontodon autumnalis, Lotus corniculatus, Medicago falcata, Medicago lupulina, Melampyrum nemorosum, Pimpinella saxifraga, Poa angustifolia, Poa compressa, Populus alba, Prunus cerasifera, Pulmonaria officinalis, Rosa canina, Rubus caesius, Salix purpurea, Salvia nemorosa, Sanguisorba minor, Scabiosa ochroleuca, Teucrium chamaedrys, Teucrium montanum, Valeriana officinalis, Veronica chamaedrys, Viburnum opulus, Vicia angustifolia, Viola canina, Viola elatior, Viola hirta, Viola reichenbachiana*		

/sed = seedlings or saplings

Table 6

The constancy classes and relative abundances (%) of invertebrate species in soil, epigaion, herbaceous layer and canopy in the three shrublands

INVERTEBRATE GROUP	**Lunca Mare**	**Cornu**	**Nistoreşti**
Constant species			
Enchytraeidae	-	*Fridericia bulbosa* e 27%; *Achaeta eiseni* – 27%,	-

Acari-Oribatida	*Berninniella bicarinata* – 3.54%; *Ceratozetella thienemani* – 0.25%; *Hypochthonius rufulus* – 5.34%; *Lauroppia falcata* – 2.03%; *Lauroppia neerlandica* – 0.76%; *Lauroppia obsoleta* – 3.8%; *Minunthozetes semirufus* – 0.51%; *Mycobates carly* – 1.52%; *Protoribates badensis* – 1.27%; *Protoribates lophotrichus* – 4.05%; *Protoribates monodactylus* – 2.53%; *Punctoribates punctum* – 1.52%; *Scheloribates laevigatus* – 0.76%; *Steganacarus magnus* – 1.01%; *Steganacarus serratus* – 2.03%; *Tectocepheus sarekensis* – 0.76%; *Tectocepheus velatus* – 3.8%; *Zygoribatulla exilis* – 0.21%	*Berninniella bicarinata* – 0.43%; *Ceratozetella thienemani* – 1.72%; *Carabodes femoralis* – 0.43%; *Hypochthonius rufulus* – 1.29%; *Lauroppia falcata* – 2.15%; *Lauroppia neerlandica* – 6.44%; *Lauroppia obsoleta* – 1.29%; *Minunthozetes semirufus* – 1.72%; *Protoribates badensis* – 1.29%; *Protoribates lophotrichus* – 2.15%; *Protoribates monodactylus* – 39.91%; *Punctoribates punctum* – 5.15%; *Scheloribates laevigatus* – 3%; *Steganacarus magnus* – 0.86%; *Steganacarus serratus* – 3%; *Tectocepheus sarekensis* – 0.43%; *Tectocepheus velatus* – 3.86%; *Zygoribatulla exilis* – 1.29%	*Berninniella bicarinata* – 1.12%; *Ceratozetella thienemani* – 0.28%; *Hypochthonius rufulus* – 10.89%; *Lauroppia falcata* – 0.84%; *Lauroppia neerlandica* – 12.92%; *Lauroppia obsoleta* – 2.53%; *Metabellba pulverulenta* – 0.56%; *Minunthozetes semirufus* – 0.56%; *Mycobates carly* – 1.68%; *Protoribates badensis* – 0.28%; *Protoribates lophotrichus* – 0.28%; *Protoribates monodactylus* – 4.21%; *Punctoribates punctum* – 5.7%; *Ramusella insculptum* – 3.93%; *Scheloribates laevigatus* – 0.56%; *Steganacarus magnus* – 0.84%; *Steganacarus serratus* – 6.74%; *Tectocepheus sarekensis* – 0.28%; *Tectocepheus velatus* – 7.3%;
Acari-Gamasidae		*Asca aphidoides* – 10.14%;	*Veigaia nemorensis* – 26.94%;
Coleoptera-Carabidae	*Abax parallelipipedus* – 37.84%;	*Agonum sexpunctatum* – 24%;	-
Thysanoptera sweeps	-	-	-
shakes	-	-	-
Coleoptera-Curculionidae	-	-	-
Accessory species			
Enchytraeidae	*Fridericia ratzeli* – August 29%; *Enchytraeus buchholzi* – August 14%; *Lumbricillus pagenstecheri* – August 14%	*Fridericia ratzeli* – April 15%; *Fridericia callosa* April 15%; *Fridericia ratzeli* – October 15%; *Fridericia bulbosa* – October 35%;	-
Acari-Oribatida	*Damaeollus ornatissimus* – 0.76%; *Euphthiracarus monodactylus* – 1.27%;	*Chamobates spinosus* – 0.43%; *Damaeollus ornatissimus* – 0.86%;	*Chamobates spinosus* – 1.12%; *Dissorhina ornata* – 1.12%;

	Hypochthonius luteus – 3.8%; *Nothrus biciliatus* – 0.51%; *Oppia laniseta* – 2.03%; *Phthiracarus anonnimum* – 1.01%; *Ramusella insculptum* – 0.76%; *Suctobelbella seratirostris* – 1.01%; *Trichoribates trimaculatus* – 2.78%;	*Dissorhina ornata* – 0.43%; *Oppia laniseta* – 1.72%; *Ramusella insculptum* – 2.15%; *Scheloribates fimbriatus* – 0.86%;	*Euphthiracarus monodactylus* – 0.28%; *Hypochthonius luteus* – 2.26%; *Nothrus biciliatus* – 1.12%; *Oppia laniseta* – 0.56%; *Phthiracarus anonnimum* – 1.4%; *Suctobelbella seratirostris* – 0.28%; *Trichoribates trimaculatus* – 0.28%;
Acari-Gamasidae	*Veigaia nemorensis* – 14.29%; *Veigaia exigua* – 8.92%; *Hypoaspis milles* – 3.57%; *Hypoaspis aculeifer* – 6.92; *Geholaspis mandibularis* – 17.86%; *Macrocheles carinatus* – 8.92%; *Trachytes aegrota* – 13.45%;	*Veigaia nemorensis* – 13.04%; *Rhodacarellus silesiacus* – 5.79%; *Prozercon traegardhi* – 5.79%; *Uropoda sp.* – 8.69%;	*Lysigamasus lapponicus* – 5.79%; *Veigaia exigua* – 2.89%; *Asca bicornis* – 2.89%; *Hypoaspis milles* – 1.45%; *Geholaspis mandibularis* – 8.25%; *Pachyseius humeralis* – 1.45%; *Trachytes aegrota* – 16.84%;
Coleoptera-Carabidae	*Pterostihcus nigrita* – 16.21%; *Nebria brevicollis* – 18.92%; *Pterostichus burmeisteri* – 5.4%	*Carabus violaceus* – 12%; *Pterostichus oblongopunctatus* – 20%	*Abax parallelipipedus* – 25%; *Carabus violaceus* - 10.71%; *Nebria brevicollis* – 14.28%; *Pterostichus oblongopunctatus* – 17.86%
Thysanoptera sweeps	*Haplothrips minutus* – 50%	-	-
shakes	-	-	-
Coleoptera-Curculionidae sweeps		*Phyllobius pyri* – 40.91%;	
shakes	-	-	*Acalyptus carpini* – 20%; *Anthonomus sorbi* – 80%
Accidental species			
Enchytraeidae	*Enchytraeus albidus* – April 100%; *Fridericia bulbosa* – August 43%; *Lumbricillus pagenstecheri* – October 100%;	*Enchytraeus buchholzi* – April 15%; *Achaeta eiseni* – October 20%; *Lumbricillus pagenstecheri* – October 10%; *Mesenchytraeus beumeri* – October 20%	*Fridericia bulbosa* – April 100%; *Achaeta eiseni* – August 100%; *Fridericia ratzeli* – October 33%; *Achaeta eiseni* – October 67%;

Acari-Oribatida	*Atropacarus striculus* – 0.25%; *Camisia segnis* – 1.52%; *Epilohmannia cylindrica* – 0.76%; *Eremaeus hepaticus* – 0.25%; *Euphthiracarus cybrarius* – 0.25%; *Galumna longiplumus* – 1.27%; *Galumna obvia* – 1.01%; *Heminothrus peltifer* – 0.51%; *Hermannia gibba* – 0.51%; *Oppiella nova* – 1.52%; *Oribella paolly* – 0.76%; *Oribotritia serrata* – 0.51%; *Perlohmannia disimilis* – 0.51%; *Phthiracarus dubinini* – 1.52%; *Phthiracarus globosus* – 1.01%; *Suctobelbella acutidens* – 2.78%; *Suctobelbella subcornigera* – 1.77%; *Tropacarus pulcherimus* – 0.51%;	*Achypteria coleoptrata* – 1.29%; *Achypteria nitens* – 0.86%; *Achypteria sp.* – 0.43%; *Chamobates cuspidatus* – 2.58%; *Ctenobellba pectinigera* – 0.43%; *Cultroribulla bicultrata* – 1.29%; *Damaeollus laciniatus* – 0.86%; *Euphthiracarus cybrarius* – 0.43%; *Galumna longiplumus* – 0.43%; *Gustavia microcephala* – 1.29%; *Heminothrus peltifer* – 0.43%; *Oribotritia serrata* – 0.43%;	*Achypteria coleoptrata* – 0.28%; *Achypteria nitens* – 0.28%; *Atropacarus striculus* – 0.28%; *Bellba laniseta* – 1.12%; *Eulohmannia ribagay* – 0.28%; *Galumna obvia* – 0.28%; *Haplozetes vindobonensis* – 0.28%; *Hermannia gibba* – 0.28%; *Oppia ruschenensis* – 0.28%; *Oppiella nova* – 1.12%; *Oribatulla panonica* – 0.28%; *Oribella Paolly* – 0.28%; *Peloptulus phaenotus* – 0.28%; *Perlohmannia disimilis* – 0.56%; *Phthiracarus dubinini* – 1.12%; *Phthiracarus globosus* – 0.28%; *Phthiracarus lentulus* – 0.28%; *Pylogalumna altera* – 0.28%; *Rhisotritia ardua* – 0.28%; *Scheloribates confundatus* – 0.28%; *Scutovertex minutus* – 0.28%; *Suctobelba trigona* – 0.28%; *Suctobelbella aliena* – 0.28%; *Suctobelbella vera* – 0.28%; *Tropacarus carrinatus* – 0.28%; *Zetorchestes micronychus* – 0.28%;
Acari-Gamasidae	*Lysigamasus sp.* – 1.78%; *Lysigamasus lapponicus* – 4.35%; *Leptogamasus sp.* – 3.57%; *Pachylaelaps furcifer* – 1.78%; *Eviphis ostrinus* – 1.66%; *Uropoda sp.* – 7.92%;	*Lysigamasus lapponicus* – 2.89%; *Lysigamasus neoruncatellus* – 5.79%; *Eugamasus magnus* – 4.34%; *Hypoaspis aculeifer* – 26.2%; *Macrocheles decoloratus* – 2.89%; *Macrocheles montanus* – 1.44%; *Pachylaelaps furcifer* – 4.34%; *Prozercon sellnicki* – 1.44%; *Trachytes aegrota* – 2.89%; *Dynichus sp.* – 1.44%.	*Leptogamasus parvulus* – 7.83%; *Veigaia transisalae* – 2.89%; *Macrocheles decoloratus* – 1.45%; *Macrocheles montanus* – 5.34%; *Macrocheles insignitus* – 1.45%; *Olopachys suecicus* – 5.79%; *Pachylaelaps furcifer* – 2.89%; *Eviphis ostrinus* – 2.89%; *Zercon peltatus* – 1.45%; *Uropoda sp.* – 1.45%;

Coleoptera-Carabidae	*Carabus auronitens* – 8.1%;	*Nebria brevicollis* – 12%; *Pterostichus diligens* – 1%; *Trechus micros* – 28%;	*Carabus nemoralis* – 7.14%; *Pterostichus burmeisteri* – 7.14%; *Pterostichus diligens* – 10.71%; *Trechus secalis* – 7.14%
Thysanoptera sweeps	*Haplothrips aculeatus* – 33.3%; *Thrips atratus* – 16.67%; *Thrips physapus* – 33.3%	*Anaphothrips atroapterus* – 16.67%; *Thrips fuscipennis* – 33.33%; *Chirothrips manicatus* – 3.5%; ***Chirothrips pallidicorni*s* – 10.5%;** *Frankliniella intonsa* – 3.5%; *Haplothrips setiger* – 3.5%; *Thrips physapus* – 7%; *Sericothrips bicornis* – 7%; *Thrips tabaci* – 14.5%	*Aptinothrips elegans* – 20%; *Frankliniella intonsa* – 40%; *Haplothrips niger* – 20%; *Thrips atratus* – 20%
shakes	*Dendrothrips ornatus* – 1.67%; *Thrips fulvipes* – 6.67%; *Haplothrips acanthoscelis* – 1.67%; *Haplothrips phyllophilus* – 5%; *Liothrips setinodis* – 1.67%	-	*Frankliniella intonsa* – 50%; *Haplothrips acanthoscelis* – 50%
Coleoptera-Curculionidae sweeps	*Phyllobius pyri* – 100%	*Sciaphilus asperatus* – 4.55%; *Tapinotus sellatus* – 4.55%; *Sitona humeralis* – 50%	*Phyllobius pyri* – 50%; *Sitona suturalis* – 50%
shakes	-	*Acalyptus carpini* – 33.3%; *Dorytomus occalescens* – 66.67%	-

* New records for Romanian fauna.

Table 7

The annual values of the main structural parameters of the invertebrate groups in the three shrublands

INVERTEBRATE GROUP	**LUNCA MARE**				**CORNU**				**NISTOREŞTI**			
	$\overline{X}$	s	Cv%	$\overline{X}/m^2$	$\overline{X}$	s	Cv%	$\overline{X}/m^2$	$\overline{X}$	s	Cv%	$\overline{X}/m^2$
Thysanoptera - canopy	0.67	1.03	30		0.033	0.1	3.33		0.1	0.3	6.67	
Thysanoptera - grasses	0.33	0.1	3.33	3.3	5.67	1.1	40	56.7	1.67	0.27	13.33	16.7
Carabidae	5	4.32	86.41	16	3.67	1.25	34.02	11.73	3.67	3.09	84.31	11.73

Chilopoda	5	4.32	86.4		3.67	1.25	34.06		3.67	3.09	84.19	
Acari - Mesostigmata	0.64	4.12	6.44	6.4	0.79	3.61	4.57	7.9	7.8	12	1.54	7.8
Acari - Oribatida	38.5	105	2.73	38.5	19.1	52.3	2.74	38.2	28.8	78.9	2.74	28.9
Enchytraeidae	26.67	0.628	26.67		153.33	1.51	93.33		16.67	0.54	13.33	
Nematoda	243.6×10^3	43.17	0.17		390.53×10^3	85.24	0.02		127.6×10^3	39.52	0.03	

Table 8

The specific diversity (Shannon Wiener index) and the degree of similarity (Jaccard index) of the invertebrates in the three shrublands

INVERTEBRATE GROUP	**DIVERSITY**			**SIMILARITY**		
	Lunca Mare	**Cornu**	**Nistoreşti**	**Nistoreşti vs Cornu**	**Nistoreşti vs Lunca Mare**	**Cornu vs Lunca Mare**
Lumbricidae	0.663	0.7	0.811	0.5	0.66	0.66
Enchytraeidae	1.00	1.405	0.929	0.428	0.33	0.5
Acari-Mesostigmata	2.21	2.15	2.41	0.28	0.41	0.286
Acari-Oribatida	2.005	1.801	5.601	0.33	0.55	0.396
Carabidae	1.6	1.4	1.59	0.4	0.4	0.2
Thysanoptera canopy	1.398	0	0.69	0	0	0
grasses	1.32	1.784	1.33	0.5	0.33	0.167
Chrysomelidae	-	-	-	0.5	0.5	0.5
Curculionidae canopy	0	0.633	0.498	0.33	0	0
grasses	0	0.988	0.69	0.5	0.5	0.25

The detritophagous species, represented by oribatid mites and partially by mesostigmate mites, dominates the edaphic fauna. The taxonomic structure identified on these areas includes species also identified in other types of surveyed ecosystems (forest, grassland, agricultural, ecotonal, etc.) The detritophagous oribatid mites had an almost equal number of constant species within the populations of the three shrublands, but among them, in all three sites, only one or two are dominant species in terms of relative abundance, most being sporadic (Table 6). As specific diversity Nistoreşti had a clearly higher value of the index of diversity compared to the other two sites, although the highest level of similarity was noticed between the oribatid mites populations from Nistoreşti and Lunca Mare (Table 8). The presence of some species on one area and their lack on other areas is conditioned by the seasonal differences induced by the environmental factors. The oribatid mites species specific to these ecosystems may be considered the eudominant and dominant species, with the highest densities. In these shrublands, the values of the seasonal and annual densities are very low compared to the values recorded in the forestry ecosystems. The fact that at Lunca Mare these values were higher is also due to the soil humidity (Paucă *et al.*, 2000, Doniță *et al.*, 2005).

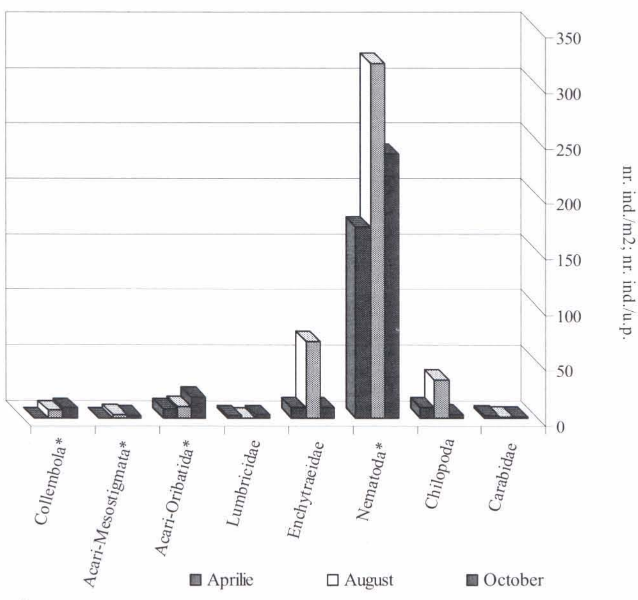
The species of predator mesostigmata mites which live free in the soil depend largely on the soil structure, on the level of detritus, humus and water in the soil. According to their trophic preferences they are divided into several trophic categories: omnivorous, phytophagous, parasitic, nematophagous and predator. In the conducted surveys, the seasonal presence of an almost equal share of eudominant and dominant species throughout the survey shows that these predators hold control of the other invertebrate populations by a small number of specimens. The fact that these predators have a specific diversity very close in all shrublands supports the fact that invertebrate groups which they feed on are present and even more, in satisfactory densities, considering the high density of the predator mesostigmata mites.

At the epigeous level, the ground beetle fauna accounts for an important proportion of the coenotic structure, both as size of the population and as composition and position of the species within the local trophic networks.

In terms of time presence and position of the species within the structure of dominance, only the ground beetle fauna from Cornu had a constant species (*Agonum sexpunctatum*) which is also eudominant, while at Lunca Mare there is an euconstant species – *Abax parallelipipedus*, also eudominant. At Nistoreşti, the present species have at the best a status of accessory species (Table 6). As specific diversity, the population from Nistoreşti is the best one represented in time, while in terms of similarity, quite low overall, the population from Nistoreşti and from the other two sites resemble the most. The ground beetle populations from Cornu and Lunca Mare also resemble as ecological traits of the composing species (particularly the percentage of existing eurytopic forest and riparian species, of the macroptera species, etc.). The similitude between these two populations relies on the resembling abiotic and biotic elements: the similar microclimatic characteristics, the amount and quality of existing food and the presence and dimension of the potential competitors (chilopods).

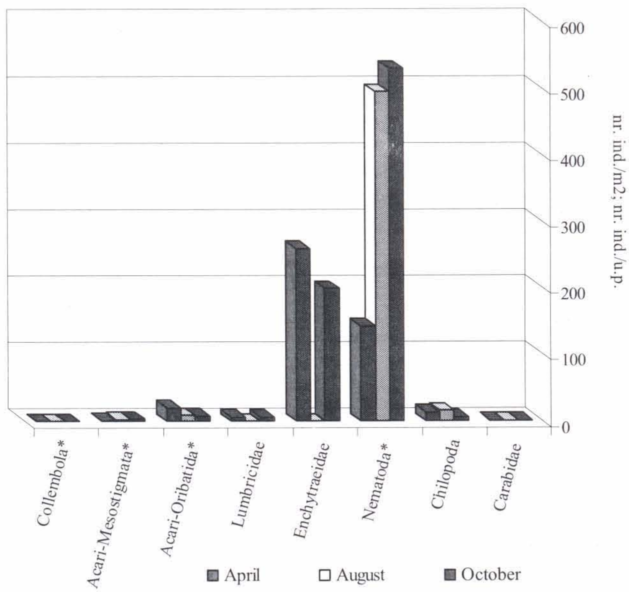
The study in vertical gradient of the invertebrate diversity showed at the soil level a fauna composed of 4 species of earthworms, 8 species of enchytreids, 29 species of predator mites and 75 species of detritophagous mites. In the litter, the chilopods are represented by 4 species and the fauna of epigeous ground beetles consists of 12 species, most of them predator. In the canopy and herbaceous layer of the surveyed shrublands were determined 20 thrips species, 5 chrysomelids species, 8 weevil species.

In the soil layers, the specific richness within each group of surveyed invertebrates varied from one site to the other according to the abiotic and biotic factors of the habitats and according to the ecological characteristics of the present species. Thus, the site with the largest specific richness of the endogeous populations is Nistoreşti (except the enchytreids, which displayed the highest density at Cornu), although in terms of dimension of the population, at Cornu, the endogenous groups were in higher numbers. The same peculiarity was also noticed for the epigeous ground beetles – a higher index of diversity at Nistoreşti while the highest numeric stock was noticed at Lunca Mare (Figs. 1-3).



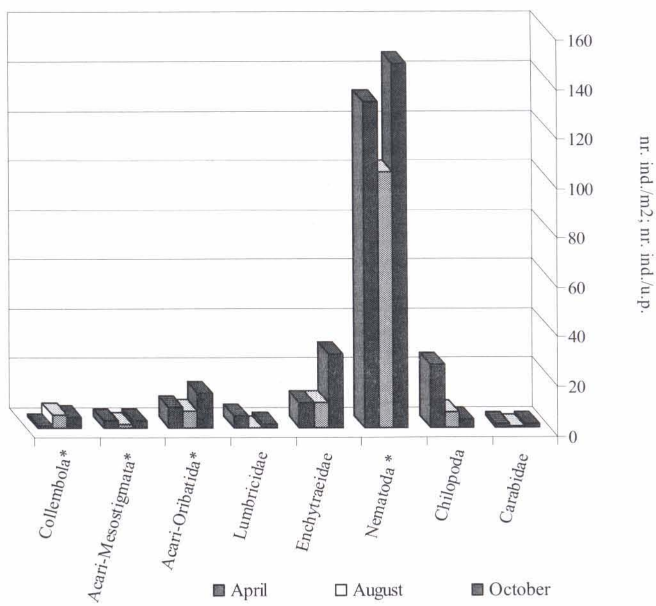
(*the real values are 1000 times higher than the graphical ones)

Fig. 1. The seasonal variation of the numerical densities of the endogeous and epigeuos invertebrates in Lunca Mare shrubland.



(*the real values are 1000 times higher than the graphical ones)

Fig. 2. The seasonal variation of the numerical densities of the endogeous and epigeous invertebrates in Cornu shrubland.



(*the real values are 1000 times higher than the graphical ones)

Fig. 3. The seasonal variation of the numerical densities of the endogeous and epigeuos invertebrates in Nistoreşti shrubland.

At the litter level, the chilopods, characterised generally by a low resistance to dehydration, traits which in 1955 was attributed to the lack of an efficient mechanism of spiracular closure, were present in very low numbers on the surveyed areas (Nistoreşti, Cornu), just because of this factor which gave the litter a xerophilous character. The river banks and shrublands chilopods were very little studied during 1966 when it was reported that on the river banks there were few species, most of them getting there probably accidentally (*Lithobius forficatus, Geophilus longicornis*). Although Matic says that *Lamyctes fluvicornis* is a species growing only on the water banks, in other works the species has been identified on meadows, cultivated plots, forests and coastal localities. The average densities of the chilopods recorded in the surveyed shrublands were close to those from the arable lands and meadows, mentioned in the literature, but much lower than those of the forests.

A particular situation is noticed for the fauna of the herbaceous layer and from the canopy, where the three groups of invertebrates living there had the highest index of diversity at Cornu.

In terms of similarity between the invertebrate populations from the three surveyed shrublands, we may say that in most cases, in the groups of endogenous invertebrates, the highest level of similarity exists between the populations from Lunca Mare and the other two sites, while for the epigaion, herbaceous layer and canopy invertebrates, the highest level of similarity was noticed generally between the populations from Nistoreşti and Cornu (Table 8).

The weevil fauna consisted of 8 species, most of them polyphagous. *Phyllobius pyri* species is common to the three areas, while *Acalyptus carpini* appears only at Nistoreşti and Cornu. Species *Anthonomus sorbi* and *Sitona suturalis* have been identified only at Nistoreşti, while species *Tapinotus sellatus*, *Dorytomus occalescens* and *Sitona humeralis* have been identified only at Cornu.

CONCLUSIONS

The alluvial shrublands from the floodplain of the two rivers are properly delimited from other formations of vegetation from the area, but the differentiation of the two types of habitats (ecosystems) is determined better by the build-up of biomass, and particularly by the quantitative representation (density, biomass) of the two dominant species, than by the presence or absence of some characteristic species. As shown before, *Salix elaeagnos* lacks from Hippophaëtum and *Saponaria officinalis* lacks completely from the surveyed areas, although each of them is characteristic to the particular associations. Furthermore, in one of the *Salix purpurea* shrublands from Cornu, where *Hippophaë rhamnoides* lacks even in the genetic reserve (composition) of the herbaceous layer, we observed in exchange the species *Salix elaeagnos*. The richness of species is large both in the shrub layer (15-17 species) and especially in the herbaceous layer (59-82 species).

In terms of quantity, *Salix purpurea* shrublands have a higher biomass than *Hippophaë rhamnoides* shrublands; the higher is the participation of *Hippophaë*, the lower is the biomass and height in the shrubland, due to its genetic characteristics, which are not compensated by the large number of specimens, as it happens in other biocoenoses.

The collinar alluvial shrublands display a very high variability (S% > 45), which requires further, in depth, studies to explain the much more diverse situations.

The structure and dynamics of the zoocoenoses present in the 3 shrublands reflects the abiotic characteristics of the limiting factors on the invertebrate groups in endogeous-epigeous gradient.

The seasonal variations of the numerical densities in the surveyed groups of invertebrates are determined by the limiting micro-soil-climatic factors and by the trophic structure of the zoocoenoses (the presence of the competitors/food source).

The spatial distribution of the invertebrate populations is determined by the food source.

The size of the populations, the specific diversity and the position of the species within the structure of the dominance reflects their answer to the ecological characteristics of the shrublands (higher or lower variations of the abiotic and biotic parameters) and to the sequential character of the shrublands.

The invertebrate species which have been constantly detected in the samples show, by their ecological traits, that the shrublands are ecological structures which – at least at this stage – provide optimal conditions for the species with a wider ecological amplitude.

The values of the studied parameters (numerical densities, biomass, specific composition, diversity index) emphasize, at least by the structure and dynamics of the invertebrate groups, the differentiation of the shrublands from other types of ecosystems.

The rather low level of similarity between the populations of the three shrublands shows the heterogeneity of this type of ecological structure.

The common element of the invertebrate coenoses from the collinar shrublands and from the field shrublands is that the fauna groups generally have the same pattern of seasonal variation according to the limiting factors: for the soil groups – soil humidity, pH and the amount of humus/supply of litter; and for the phytophagous groups – the characteristics of the herbaceous layer and of the canopy.

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