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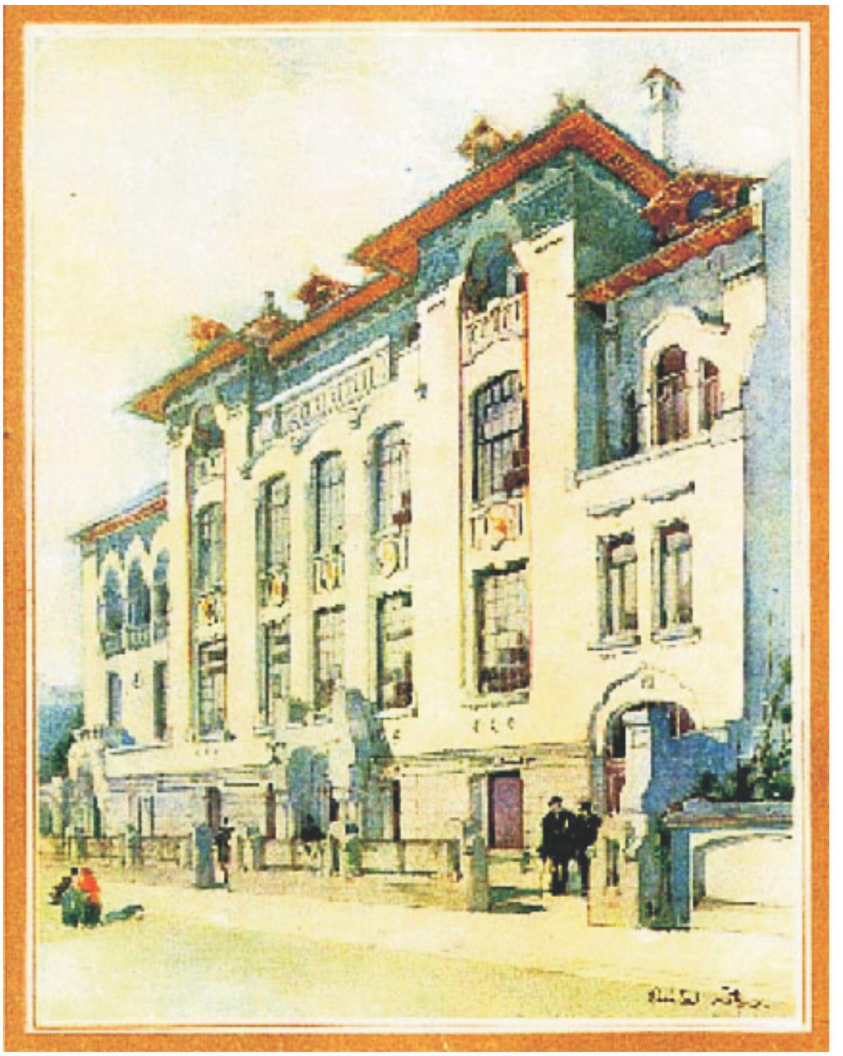

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CLAY MINERALS IDENTIFIED IN RED QUATERNARY DEPOSITS, FROM CORLĂŢEL AREA (MEHEDINŢI COUNTY, ROMANIA), USING XRD AND IR

NEGREANU Ştefan, SOARE Barbara

Abstract. The area from which samples were collected is placed in Mehedinţi County, about 25 km west of the Danube, locality Porțile de Fier 2. The Quaternary loess like red deposits from Oltenia are described in the specialized literature as "red clays" or "red loams". This paper renders data on the type and proportion of the clay minerals identified by X-ray diffraction of the clay fraction separated from both red loess like deposits and older deposits either ruditic with red matrix, mainly silty-sandy or sandy red levels.

Keywords: Quaternary, loess like deposits, clayish minerals, X-ray diffraction.

Rezumat. Minerale argiloase identificate din depozite roşii cuaternare, zona Corlăţel (judeţul Mehedinţi), folosind XRD şi IR. Zona din care au fost culese probele pentru analize se găseşte în apropierea limitei judeţului Mehedinţi, la aproximativ 25 km vest de Dunăre, localitatea Portile de Fier 2. Depozitele loessoide cuaternare de culoare roşie din Oltenia sunt descrise în literatură ca „argile roşii" sau „luturi roşii". Lucrarea de faţă redă date referitoare la tipul şi proporţia mineralelor argiloase identificate prin difracţia de raze X din fracţia argiloasă, separată atât din depozitele loessoide roşii, cât şi din depozite mai vechi, fie ruditice cu matrice roşie, preponderent silto-nisipoasă, fie nivele nisipoase roşii.

Cuvinte cheie: Cuaternar, depozite loessoide, minerale argiloase, difracţie de raze X.

INTRODUCTION

On the western side of Bungetu Almajel hill, in Corlăţel settlement, it can be observed a 3.5 - 4 m outcrop of loess-like red deposits (Fig. 1). On the left side of the country road linking Corlăţel to Ştircovița, alongside Valea lui Radu, approximately 600 m after leaving Corlăţel, there is another outcrop of sands, gravels and loess-like deposits (Fig. 2). The opening is about 7 m high and 15 - 20 m long. The coordinates of this open pit are 44° 23.9' N and 22° 56' E.

In the upper part, beneath the A soil horizon, there appear three layers rich in carbonaceous concretions separated by red loess-like deposits. Beginning-with the depth of 4 m, for 0.5 m, a level of mainly fine and very fine pebbles with a red matrix made of silt and sand is present. For the next 2 m, there appears an alternation of gray medium sands and medium gravels. In the lower part of the outcrop, there can be observed very coarse pebbles and boulders with gray sandy matrix. The analysed samples were collected from the loess-like deposits of the first aforementioned outcrop and from the loess-like deposits of Valea lui Radu outcrop. From the last mentioned location, there were collected also fine gravel and matrix samples from the level c, represented in Fig. 2. On the hydrogeological map 1:100 000, sheet 40b Drobeta Turnu Severin, this type of deposit is considered to have been formed in the Upper Pliocene - Lower Pleistocene.

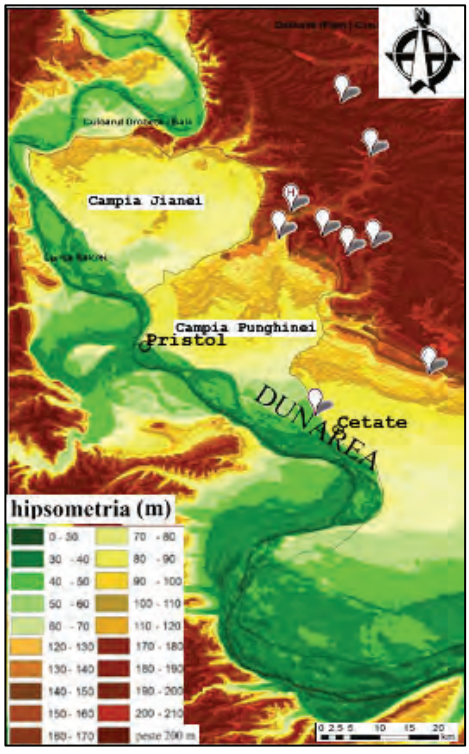

Figure 1. The hypsometric map of the area surrounding the sampling site; H-sampling site. (original)

MATERIALS AND METHODS

After drying, the samples of gravel, sand and red clay were sieved using a 2 mm mesh sieve. The pelitic fraction needed for XRD analysis was obtained by centrifugation and for IR by applying the pipette method.

To prevent the flocculation of clay minerals that can cause the formation of agglomerates larger than 1mm in the natural environment (HILL, 1998), which is strongly influenced by the existence of organic matter, it was carried out its removal by using the method proposed by KUNZE & DIXON (1986), which requires the treatment with 10% hydrogen peroxide.

In order to remove the carbonates from the analysed samples, we applied the method presented by RABENHORST & WILDING (1984) using diluted weak acids.

The deflocculation process was done by adding a dispersant, a very commonly used one being sodium hexametaphosphate or polyphosphate, known under the commercial name of Calgon (JIPA, 1987).

5 ml of the <2 μm fraction, separated by centrifugation were used for the saturation with $MgCl_2$ and 5 ml for the saturation with KCl.

For cation saturation, there were used potassium chloride (KCl) and magnesium chloride ($MgCl_2$), the samples being covered by the solution of a chloride and then centrifuged 3 times. To prevent the flocculation of the clay minerals, after this treatment, washing with distilled water was performed 3 times, to remove the chlorides.

The ethylene glycol treatment was done by adding 100-200 ml of ethylene glycol in a desiccator, the sample slides being placed on a ceramic plate. The desiccator was left in the oven at 60°C for at least 8 hours.

For the heat treatment, the slides with samples were placed in an oven and heated at 330°C and 500°C for one hour. After this period of time, they were analysed right after taking them out of the oven, to prevent the rehydration of the sample.

Diffractograms were obtained from a range of 2θ, 2-40° using a Philips XPert MPD diffractometer, with Cu (40 mA, 40 kV) anticathode, Ni filter, with Kα radiation with a wavelength of 1.5406 Å, scanning step 0.01, step time 1s/step. X'Pert Quantify and X'Pert High Score programs were used to analyse and process diffraction data. Information about the amount of clay minerals identified based on X-ray diffractograms, was obtained using the calculation method of MOORE & REYNOLDS (1997).

The pipette method was performed according to the recommendations made by Krumbein in 1933 and presented by JIPA (1987); mixing about 500-750 grams of fraction smaller than 2 mm, with about 8-10 litres of heated distilled water. The suspension was collected from the sedimentation cylinders according to the data rendered by JIPA (1988) and JACKSON & BARAK (2005). No chemical treatment for the removal of organic matter or carbonates was applied.

For the IR method, the samples were analysed in the form of disks obtained by pressing a mixture of KBr and clay fraction. The mixture used to obtain the disks contained 2 mg sample and 200 mg KBr (MADEJOVA & KOMADEL, 2001).

The infrared spectra were obtained with Bruker Optics FTIR spectrophotometer, which, for the range 374-400 cm^{-1}, obtained 2,531 frequency-intensity of absorption couples.

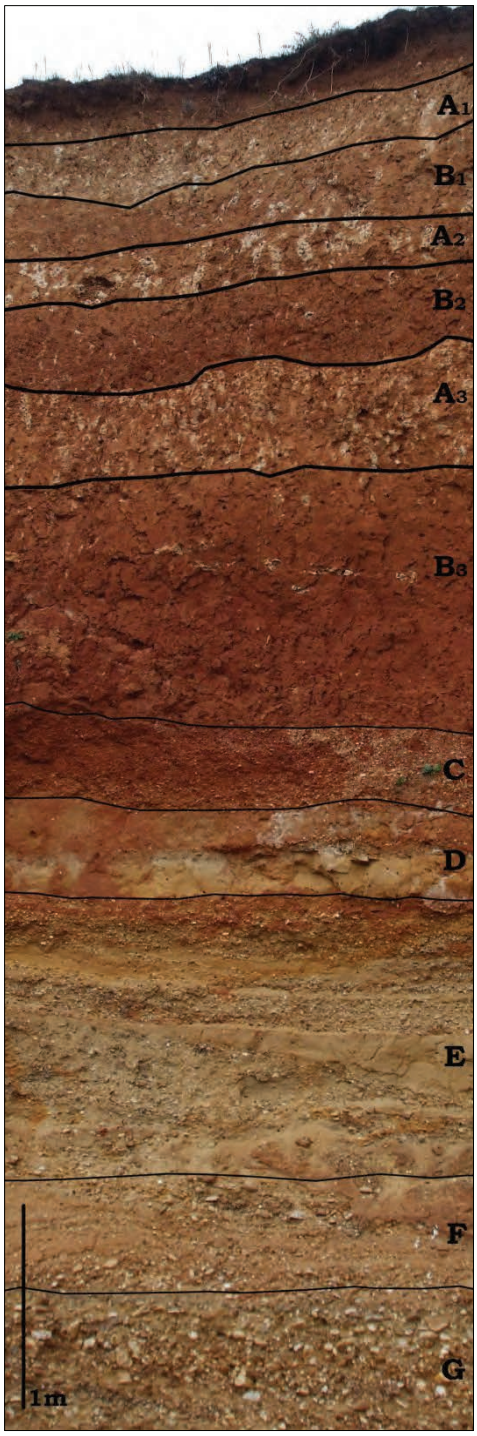

Figure 2. Lithological succession in Corlăţel area. A-loess-like level with calcareous concretions; B-loess-like material; C-mostly fine and very fine gravels; D-medium sand; E-medium gravels with medium sand pellicles; F-medium gravels; G - coarse gravels and boulders. (original)

RESULTS AND DISSCUSIONS

XRD analysis

On the diffractograms of the samples saturated with K^+, rendered in Fig. 3, we can observe the presence of certain peaks corresponding to the interplanar distances with values of 14.01 Å, 9.95 Å, 7.14 Å, 4.97 Å, 3.56 Å and 3.31 Å.

The diffractogram of the sample saturated with Mg^{2+} presents the same characteristics as the previously mentioned sample. A more defined reflex is observed at 14.09 Å due to the absorption of magnesium ions.

Due to the treatment with ethylene glycol, it can be observed an increase of the interplanar distance from 14.01 Å to 17.36 Å, without any significant changes in the other peaks.

After heating the sample to 330°C, it can be observed the complete lack of any reflexes in 14 Å region due to the reduction of the basal distance to the value of 10 Å (Fig. 4). At 500°C, 7.17 Å and 3.56 Å reflexes disappear too.

Based on the information, the clay minerals identified in both the gravel matrix and in the loess-like deposits are kaolinite, smectite and illite.

Illite was identified according to the characteristic reflexes for the interplanar distances of 10.1 Å, 4.98 - 5.01 Å, 3.33 Å and 2.89 - 2.92 Å. Other characteristics of illite are the lack of expansion and retention of the reflex plane (001) after the treatment with ethylene glycol and heating to 500°C.

The reflexes according to which kaolinite can be identified are those corresponding to the basal distance d (001) ranging from 7.15 to 7.20 Å and, when they are well crystallized, based on the doublets from 4.17 - 4.12 Å and 3.144 - 3097 Å (MATEI, 1986).

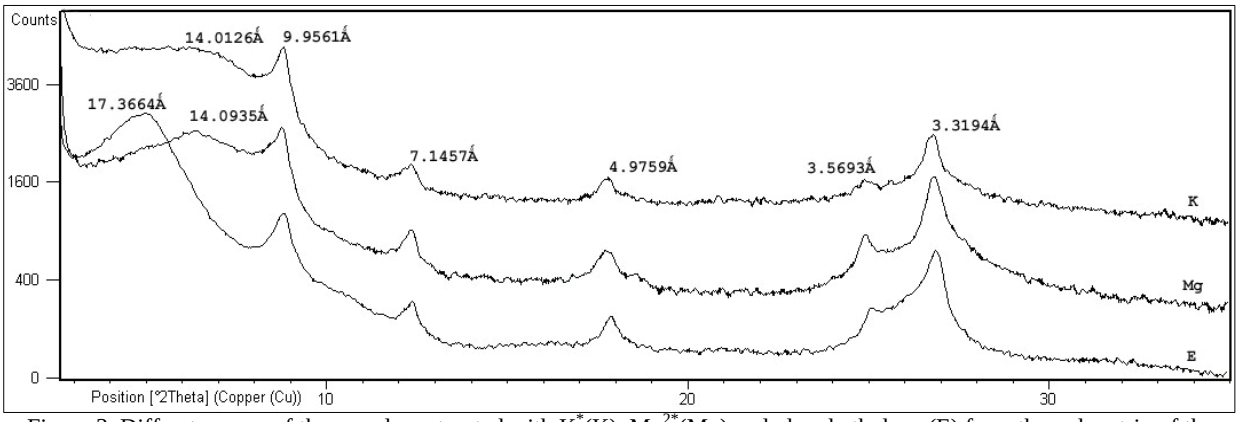

Figure 3. Diffractograms of the samples saturated with K^{*}(K), Mg^{2*}(Mg) and glycol ethylene (E) from the red matrix of the gravel from Corlăţel area.

The lack of swelling, as well as in case of illite, when it is treated with ethylene glycol and also, structural collapse by heating to 500°C, which determine the total disappearance of kaolinite reflexes, are other features of the kaolinite.

The term of smectite used in this paper refers to a clay phase with a structure of the type 2:1, dioctaedric and expandable. This was identified considering the basal distance of smectite as14-15 Å. Another feature used for the identification was swelling induced by the treatment with organic molecules, resulting in the corresponding reflexes d (001) with values of 17 - 17.7 Å.

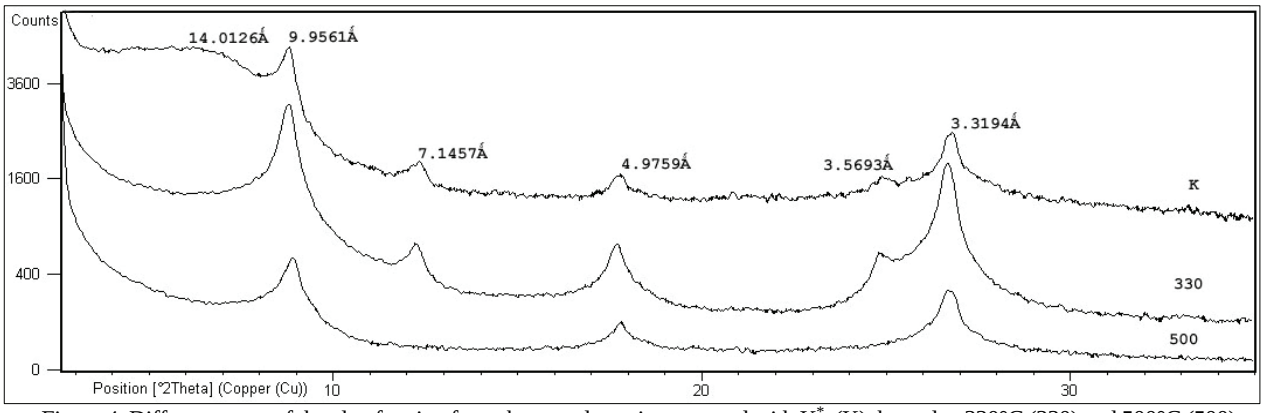

Figure 4. Diffractograms of the clay fraction from the gravel matrix, saturated with K^{*}, (K), heated at 330°C (330) and 500°C (500).

The value of 14 Å can also indicate the presence of chlorite or vermiculite minerals, but in their case, the swelling is not observed after the treatment with ethylene glycol. In addition, chlorite keeps the same basal distance after the 300 and 500°C heat treatments.

In case of typical smectites, after heating at 500°C, the basal distance decreases to 9.4-10 Å (the same as in case of illite), depending on the nature of the interfoliar cations.

In Fig. 4, it can be seen how the reflex from 14 Å of the saturated sample disappears after heating to 330ºC, due to the reduction of the basal distance to the value of 10 Å.

The percentages of the clay minerals in the pelitic fraction separated from the red loess-like deposits from Corlăţel are 3% kaolinite, 29% smectite, 68% illite. In the matrix of the red gravels, there are present the same minerals but with a different quantitative share: 1% kaolinite, 56% smectite, 43% illite. The other samples show percentages close to the aforementioned values, the average being 55% illite, 42% smectite, 2% kaolinite.

IR analysis

The IR spectra performed on the samples taken from the two outcrops indicates the presence of the same absorption bands, minor differences being identified only in terms of their intensity (Fig. 5).

The frequencies of 430 cm^{-1} and 470 cm^{-1}, corresponding to the Si-O-Si bond, with high and medium absorption intensity, were identified in all the analysed samples. The first frequency is absorbed by both montmorillonit and illite, but the intensity is significant only in case of kaolinite. Consequently, this band was attributed to the presence of kaolinite.

The second frequency mentioned above, cannot provide clear information on the mineral responsible for its appearance, because both kaolinite and montmorillonit show strong absorption rates in this area. However, the values, which always maintained above 470 cm^{-1}, may indicate kaolinite, as montmorillonit displays slightly lower values.

The frequencies of 535 cm^{-1} correspond to the bonds of the type Al-O-Si (STUBICAN & ROY, 1961) from the network of several clay minerals and, in this case, they cannot provide clear information on a specific mineral.

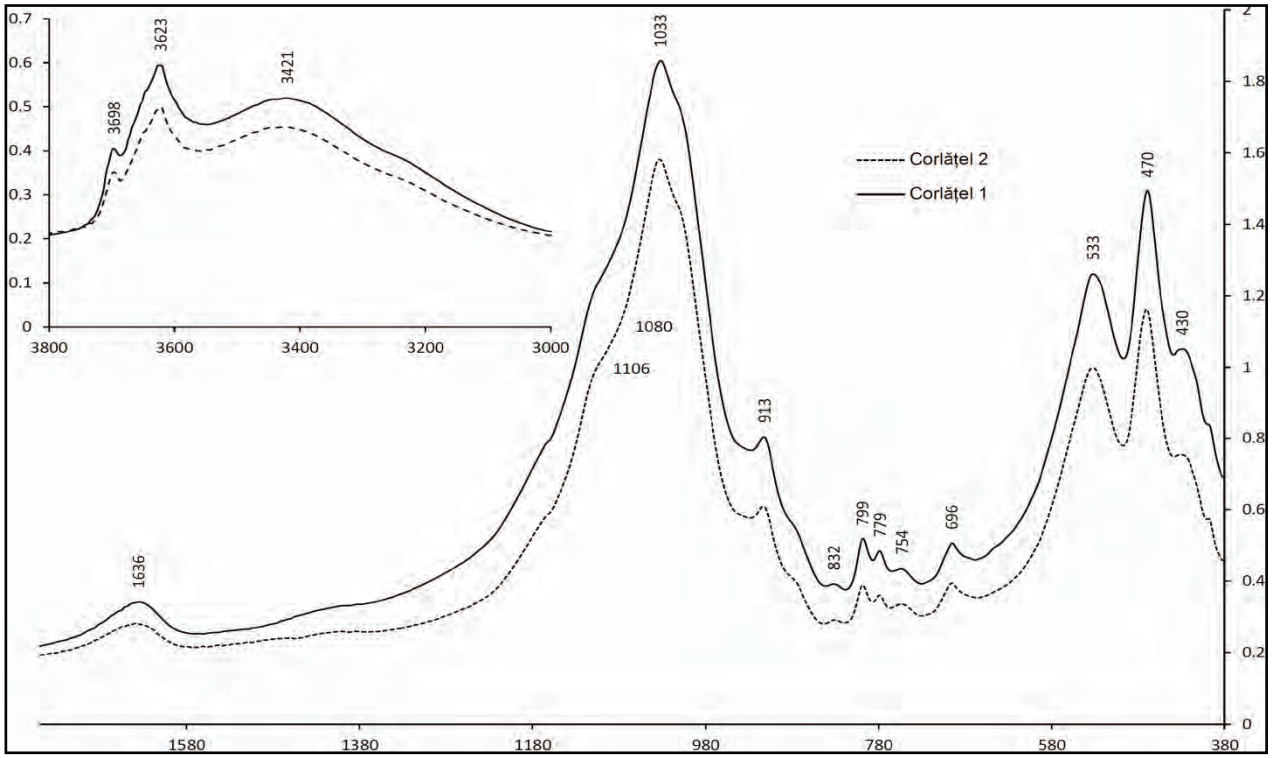

Figure 5. IR absorption spectra for the samples taken from the gravel matrix (Corlăţel 1) and the loess-like deposit (Corlăţel 2); on the horizontal axis, there are rendered the wavenumbers in cm^{-1}.

Another non-specific bond is found at 696 cm^{-1}, indicating the presence of the bond Si-O-Si.

The diagnostic absorption doublet from 779 cm^{-1} and 799 cm^{-1} indicates quartz. In the samples taken from Corlăţel, the absorption intensity is among the lowest compared to the other absorption intensities identified. This indicates a reduced presence of quartz.

The weak and very weak absorption at 755 cm^{-1} was present in all the samples, but it cannot be used to identify the minerals that generated it. 832 cm^{-1} frequency indicates the presence of anion $(CO_3)^{2-}$ (FROST et al., 2004).

The slight shoulder between frequencies 832 cm^{-1} and 915 cm^{-1} corresponds to the deformation vibrations, out of the plane, of $(CO_3)^{2-}$, located at of 875 cm^{-1} (MADEJOVA & KOMADEL, 2001). In the range 1,382-1,440 cm^{-1}, it can be observed a very fine rise, which also indicates carbon-oxygen bonds: 1,430 cm^{-1} stretching vibration $(CO3)^{2-}$ of calcite, MADEJOVA & KOMADEL (2001); 1,410-1,490 cm^{-1} frequencies that indicate $(CO3)^{2-}$ COATES (2000); 6.90 to 6.97 μm (1,449-1,435 cm^{-1}), bands considered to belong to the group $(CO3)^{2-}$, HUANG & KERR (1960); 1,384 cm^{-1} stretching vibration of the bond C = O of the inorganic carbonyl group, JACKSON (1998); 1,365 cm^{-1}, the stretching vibration in the bicarbonate ion COO^{-}, YRUELA et al. (1998).

The frequencies of 913-915 cm^{-1} are absorbed by Al-Al-OH vibrations characteristic to the networks of montmorillonit, kaolinite and illite, showing strong absorption (40-80%) in kaolinite and average absorption (20-40%) in montmorillonit and illite, MATEI (1988). In all the analysed samples, the intensity was average, which would suggest the presence of montmorillonit and illite.

The inflection present at approximately 1,010 cm^{-1}, occurs in case of illite and montmorillonit. Considering the conclusions drawn by HUNT et al. (1950), the maximum intensity of absorption registered at 1,030-1,034 cm^{-1} was attributed to illite distinguished from montmorillonit, which is indicated by the vibration absorption of 1,041.66 cm^{-1} according to the same author.

The "ramp" present in all samples in the interval 1,080-1,106 cm^{-1} may indicate montmorillonit and / or illite, MATEI (1988). At values above 3,000 cm^{-1}, only two frequencies can be used, one at 3,620 cm^{-1}, absorbed by all the three aforementioned clay minerals and 3,696-3,699 cm^{-1}, which is a diagnostic band for the mineral kaolinite (FARMER, 1964). The 1,640 cm^{-1} and 3,620 cm^{-1} bands are assigned to the deformation vibrations, respectively the stretching vibrations of OH groups, belonging to the molecules of water (FARMER, 1974).

CONCLUSIONS

The clay minerals identified in the study area are illite, smectite and kaolinite.

The participation of the three minerals in the clay fraction is approximately uniform, illite having a share of over 40%, smectite of 30 - 60% and kaolinite around 2%.

At Corlăţel, it is observed the increase in the smectite content of the fraction <2 μm in lower, ruditic deposits compared with the higher loess-like deposits. The illite content varies inversely as compared with that of smectite, decreasing in the lower horizons. This quantitative difference it was found in all the analysed cases and might amount over 25%. The abundance of smectite in the ruditic layers can be explained by the petrographic diversity of the clasts, which can provide the cations necessary to the formation of the network of these minerals, or by the size of the smectite crystals, which are smaller than those of illite, and, thus can be easily moved to lower levels.

Based on IR spectra, we can say that the analysed samples contain very small amounts of quartz and even smaller quantities of carbonates, probably calcite. Kaolinite is the clay mineral that is identified very clear using this method by the presence of 3698 cm^{-1} absorption band. The reduced intensities for this frequency correlate well with the small amounts of this mineral, indicated by XRD data. Illite and montmorillonit, showing similar bands of absorption, cannot be separated, as clearly as kaolinite.

The presence of the bands characteristic to the vibration of the bond Al-Al-OH shows that the identified clay minerals are dioctaedric, such positions being occupied mostly by Al^{3+}.

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LITHOLOGICAL AND STRATIGRAPHICAL FEATURES OF PATOS - MARINËZ - KOLONJË MONOCLINE IN ALBANIA (ADRIATIC DEPRESSION)

PRIFTI Irakli, DORRE Piro

Abstract. The Patos - Marinez - Kolonje region has been studied with geological and geophysical methods as well as by well drillings. These studies were carried out in the context of searches for oil and gas. In this region, there have been discovered pay beds in carbonate deposits of the Ionian Zone as well as in the Miocene terrigenous sediments of the Adriatic Depression. This last tectonic unit lies in a stratigraphic position over the Ionian tectonic zone. At the base of the transgressive Miocene sequence the bituminous pay sands are met. Geological and geophysical studies have identified two tectonic units: Hekal - Patos - Verbas anticline belt (the Ionian Zone) and Patos - Marinez - Kolonje monocline (the Adriatic Depression). The Ionian tectonic zone is represented by Patos - Verbas brachyanticline. This brachyanticline is eroded by the Miocene transgression. Hydrocarbons formed in the carbonate section (T_3-Cr_2) of the Ionian Zone have migrated into the Miocene terrigenous deposits right through the transgression base. Patos - Marinez - Kolonje (PMK) monocline is a unit of the Adriatic Depression. This unit is represented by Tortonian up to Pliocene deposits. The lowermost horizon belongs to the *G. menardii* sl biozone. In the Tortonian - Messinian section of PMK monocline there are distinguished seven lithostratigraphic formations, which are: Bubullima and Guret e Zeze (Black Stones), Marinez, Driza, Goran, Kuçova and Polovina. The respective descriptions will be given following the separation of the above mentioned formations. Within each of these formations, different pay beds are found. PMK monocline represents a complex oilfield. The Pliocene deposits lie by discordance over the Messinian deposits. They are divided into Helmes Formation, mainly argillaceous with conglomerates at the base and upwards the mainly conglomeratic Rrogozhina Formation follows.

Keywords: monocline, Adriatic Depression, biozone, seismic section.

Rezumat. Caracteristici litologice şi stratigrafice ale monoclinului Patos - Marinëz - Kolonjë din Albania (Depresiunea Adriatică). Regiunea Patos - Marinez - Kolonje a fost studiată cu metode geologice şi geofizice, dar şi cu ajutorul forajelor. Aceste studii au avut loc ca urmare a prospecţiunilor pentru identificarea zăcămintelor de petrol şi gaze. În această regiune, au fost descoperite zone productive în depozitele carbonatice ale Zonei Ionice, precum şi în sedimentele terigene miocene ale Depresiunii Adriatice. Această ultimă unitate tectonică, stratigrafic, este suprapusă zonei tectonice ionice. La baza secvenţei transgresive miocene se găsesc nisipuri bituminoase rentabile. Studiile geologice şi geofizice au dus la identificarea a două unităţi tectonice: anticlinalul (Zona Ionică) şi monoclinul Patos - Marinez - Kolonje (Depresiunea Adriatică). Zona tectonică ionică este reprezentată de brahianticlinalul Patos - Verbas. Această cutare este erodată de transgresiunea miocenă. Hidrocarburile formate în secţiunea carbonatică (T_3-Cr_2) a Zonei Ionice au migrat în depozitele terigene miocene exact prin baza de transgresiune. Monoclinul Patos - Marinez - Kolonje (PMK) este o unitate a Depresiunii Adriatice. Această unitate este reprezentată de depozite formate din Tortonian până în Pliocen. Orizontul inferior aparţine biozonei *G. menardii* sl. În secţiunea tortonian - mesiniană a monoclinului PMK se disting şapte formaţiuni litostratigrafice şi anume: Bubullima şi Guret e Zeze (Black Stones), Marinez, Driza, Goran, Kuçova şi Polovina. Descrierile respective vor fi făcute urmând separarea formaţiunilor menţionate anterior. În cadrul fiecăreia dintre aceste formaţiuni se regăsesc strate productive. Monoclinul PMK reprezintă un câmp petrolifer complex. Depozitele pliocene sunt dispuse discordant peste depozitele mesiniene. Acestea sunt împărţite în formaţiunea Helmes Formation, alcătuită predominant din materiale argiloase cu conglomerate la bază, şi Formaţiunea Rrogozhina, predominant conglomeratică, deasupra.

Cuvinte cheie: monoclin, Depresiunea Adriatică, biozonă, secţiune seismică.

INTRODUCTION

The oilfield complex of Patos - Marinez - Kolonje is one of the largest in Europe. In the period 1925-1930 "Anglo-Persian Oil Company" (APOC) pierced 10 wells in Patos area. The oil in Driza Formation was discovered during 1929. In 1957, oil was discovered in Marinez area (542 well). 1974 year marks the highest value of oil production of 2.25 million tons. Presently, the production is 1.5 million tons (PRIFTI, 2011). The main contribution in the oil production is the oilfield complex of Patos - Marinez - Kolonje (GJOKA et al., 2002).

This paper deals briefly with the geological and tectonic properties of Patos - Marinez - Kolonje (PMK).

This unit is located in the western part of Albania and is geologically represented by the uppermost part deposits of the Adriatic Depression, which is included in the central Mediterranean Basins group (Fig. 1). The Adriatic Depression is stratigraphically represented by the terrigenous deposits of the Serravalian-Pleistocene age. These deposits are folded in the western part forming some anticlinal and synclinal structures placed linearly, while to the east, it is represented by some monoclines, one of them being PMK monocline, represented by deposits of Messinian and Pliocene age. These deposits are divided into formations; seven formations in the Messinian section and two in the Pliocene section (MYFTARI et al., 2002). The northwestern boundary of the monocline is the backthrust of ‑Ardenica anticline, while the south-eastern border is the transgression base of the Adriatic Depression (Fig. 6), while in southwest, the border with Kreshpan - Cakran monocline, is represented by a tectonic fault (NAÇO et al., 2012). In PMK region 2,300 vertical wells and 550 horizontal wells are drilled, so it is impossible to render the wells in the presented figures.

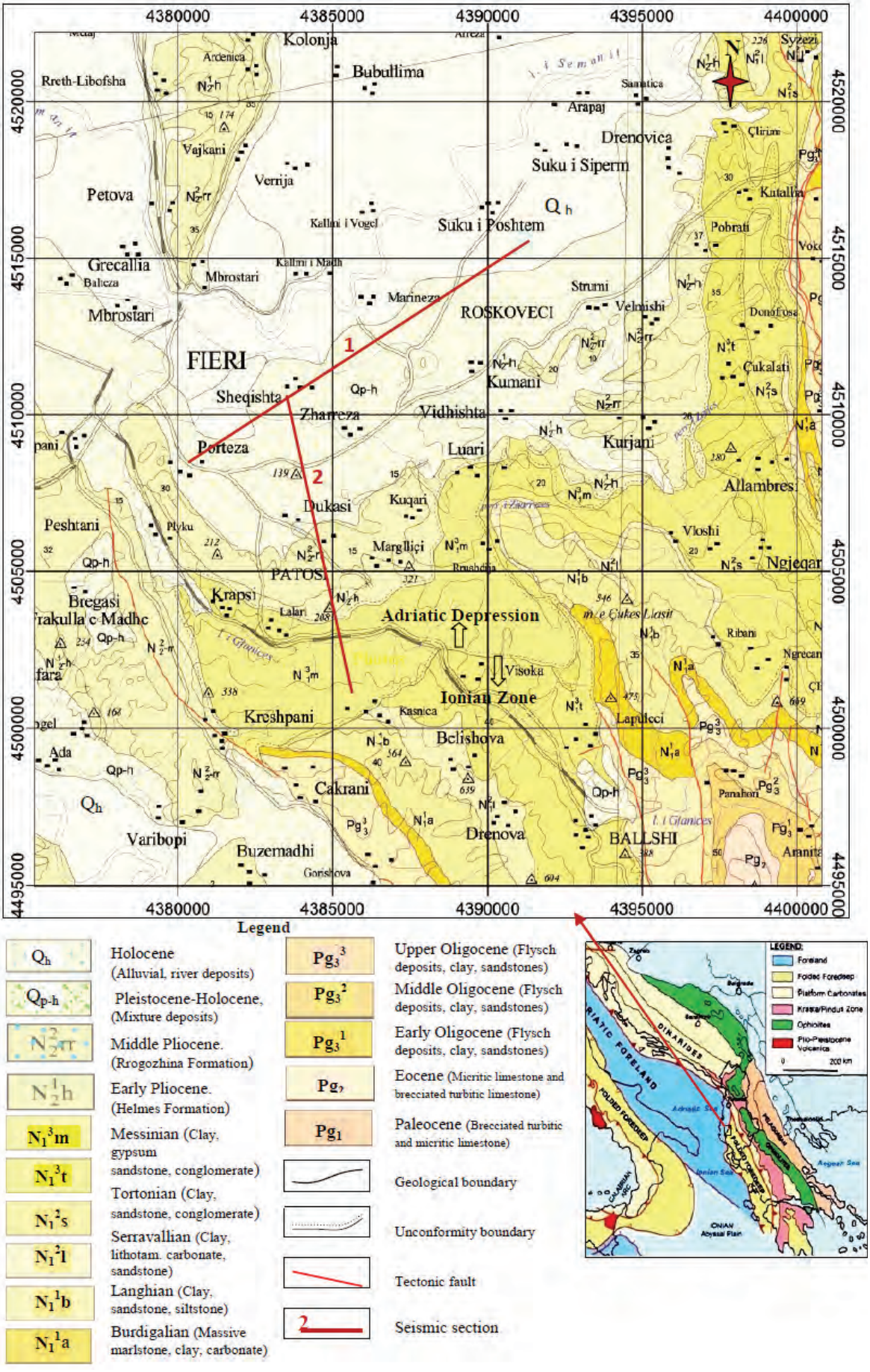

Figure 1. Geological map of PMK region, 1:200 000 (VRANAJ et al., 2002).

The thickness increases from the lateral parts of the basin towards its centre. The deposits are lithologically represented by clay, evaporate (gypsum), siltstone, sandstone and conglomerate. Based on the drilled wells, passing from the lateral parts towards the depression centre, data indicate that the facies change from coarse-grain to fine-grain ones i.e. from shallow facies to deep ones. Vertically, from the bottom to the top of this section, it is noticed a facies change from fine-grain facies to coarse-grain ones, which indicates the shallow direction of the depression.

MATERIAL AND METHODS

In the early stages of exploration for oil and gas detailed geological surveying to scale 1:10 000 are carried out.

The geological model of PMK region has been determined by geological and geophysical methods and by drilling wells. Age dating of the terrigenous section is performed with the method of palaeontology and micropaleontology, on the base of which the Tortonian and Messinian biozones are defined. In this regard, planktonic and benthic foraminifera have been used. So, in the western part of the region, biostratigraphic deciphering was realized using plankton foraminifera while in the east, where the section is represented mostly by sandstones, benthic foraminifera have been used (PRILLO et al., 2001; MYFTARI et al., 2002).

Geophysical studies were conducted following two directions: seismic surveys and well logs. This region represents a complex oil and gas bearing area, where many wells have been drilled, which have detailed the geological structure of the region.

The complex of the studies conducted in PMK region are accompanied with detailed paleontological, petrographic, geochemical and petrophysical studies.

Based on these studies, the geological structure of PMK region that represents the southern extremity of the Adriatic Depression has been evidenced.

RESULTS AND DISCUSSIONS

Based on geological and geophysical studies and drilled wells, we have interpreted the geological structure of PMK region. PMK region is characterized by two structural units that represent two different tectonic zones: the Adriatic Depression and the Ionian Zone (Fig. 2). In order to present the geological structure, we will bring out both the stratigraphy and tectonic features.

1. Stratigraphy

PMK region is formed by Upper Miocene (Fig. 3) and Pliocene deposits (PRILLO et al., 2001; MYFTARI et al., 2002; DORRE & MALO, 2008).

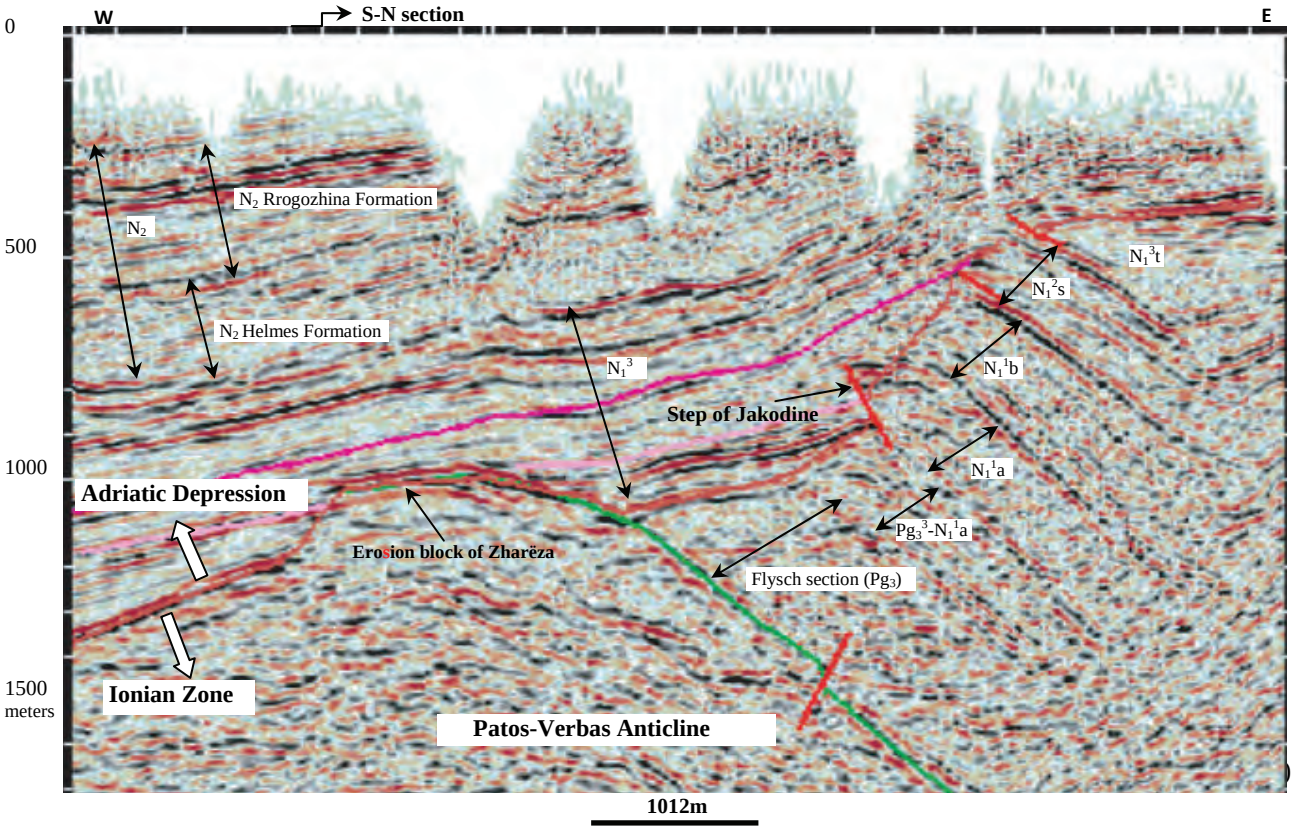

Figure 2. Seismic cross section 1-1 (migrated).

Tortonian deposits. Tortonian deposits crop out in the eastern part of the region, followed upward in the section by Messinian transgressive deposits. In PMK monocline, they are not exposed on the surface, but were met by drilled wells and studied by seismic exploration.

Tortonian deposits are represented by two lithofacies; sandy-clayey lithofacies that is propagated in the southern part of PMK region (southern extremity of the Adriatic Depression and the southern Adriatic area). The second lithofacies is characterized by an alternation of clays and sands and is met in the western Adriatic Depression.

Sandy-clayey lithofacies is characterized by sands and clays that alternate – with lithothamnic limestones. The sandstones are grey to yellow, while in fresh fracture they are of dark beige colour. They are compact, large to medium grained. The thickness of the layers varies from 0.5 - 1.5 m up to 5 - 6 m (GJOKA et al., 2002).

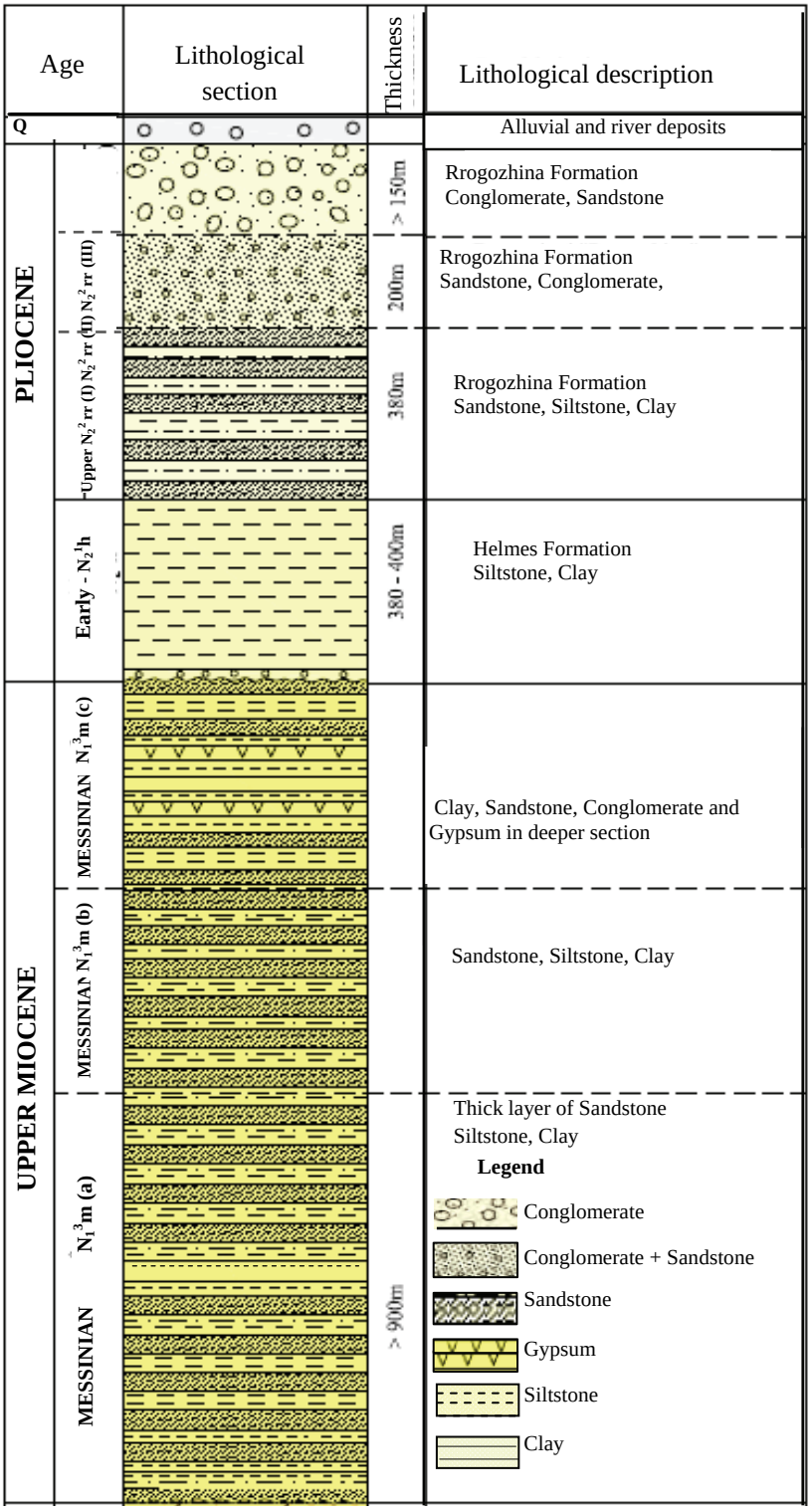

Figure 3. Lithological column of Messinian-Pliocene section.

Clays appear gray to blue with shell-like fracture and 2-3 m up to 15-20 m thick. Within them, resistant multicoloured layers rich in macrofauna, of 1-2 m thick, are often met. In some areas, within such horizons, there are met small crystals of gypsum.

This lithofacies is characterized by a shallow environment of sedimentation, mainly shelf deposits while clay sandy lithofacies denotes a deep environment. The latter - appears in the dipped sectors.

Messinian deposits

From the lithologic point of view, there also are separated two lithofacies, reflecting more or less the same history of sedimentation as during the Tortonian (sandy-clayey lithofacies, clayey-sandy lithofacies).

In the northwest of PMK region, *Globorotalia conomiozea* biozone deposits are met. The section is represented by Bubullima and Guret e Zeze (Black stones) formations. Bubullima Formation is propagated on the east while the Black stones formation on the west.

An important contribution in the lithologic deciphering is given by well logs. By the respective logs we have interpreted both the apparent resistance and spontaneous polarity.

Bubullima Formation lies by transgression on older deposits (Fig. 5). This formation is represented by bedded lithothamnic limestones. In Kallm - Kolonje sector, there have been distinguished 20 layers which, towards the west and northwest pass to clay deposits; the thickness of this formation varies from 20 to 200 m.

Guret e Zeze (Black Stones) Formation is represented by massive silty clays alternated with siltstones. Its thickness increases from south-east to north-west and to the west and varies in the range from 0-700 to 1100m. The Uppermost Messinian deposits belong to *Ammonia beccarii acme* zone.

Here are included Patos - Marinez - Kolonje (PMK) monocline deposits, where upward the lithological formations are separated between Marinez up to Polovina.

They are characterized by the presence of *Ammonia beccarii*, *A. beccarii beccarii*, *A. beccarii bradyi*, *A. latiseptata*, etc. Usually, in the lower part of this assemblage, *Elphidium decipiens, E. crispum* etc., are met (GJOKA et al., 2002).

Marinez Formation. In the framework of PMK monocline this formation takes part in the building of Patos and Marinez bays; in the western part, it lies in normal position on Bubullima Formation, while in the east and south, it lies discordantly on the buried erosion surface (Figs. 4; 5).

The lithofacies is represented by massive beds of loose sandstones containing carbonate sandstone concretions.

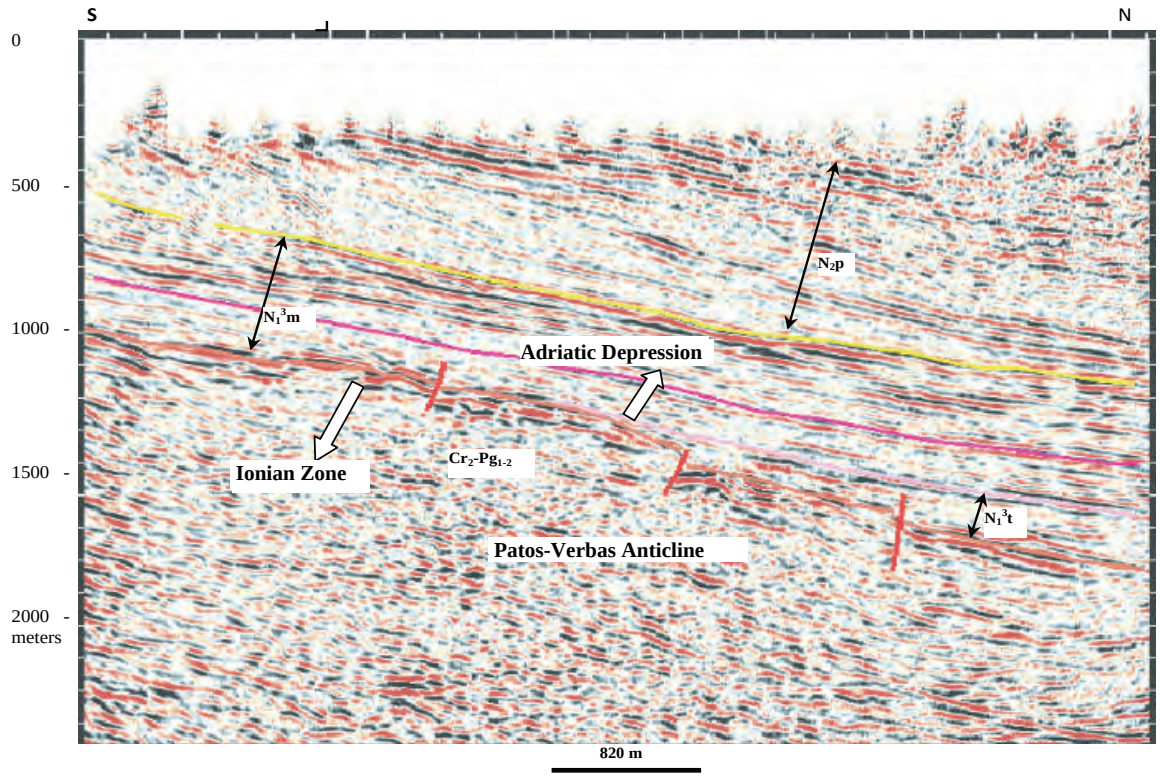

Figure 4. Seismic section 2-2 (migrated).

The sandstones alternate with clays containing carbonate concretions. From south to north, their thickness varies from 30 to 180m.

Driza Formation. It has a vast distribution in PMK monocline (Fig. 5). Horizontally, it presents accentuated lithologic changes. In Kasnic, it is mainly argillaceous alternating with sandstones and ostreidic banks, while in Marinez and Kolonje, the section is mainly argillaceous alternating with sandstones.

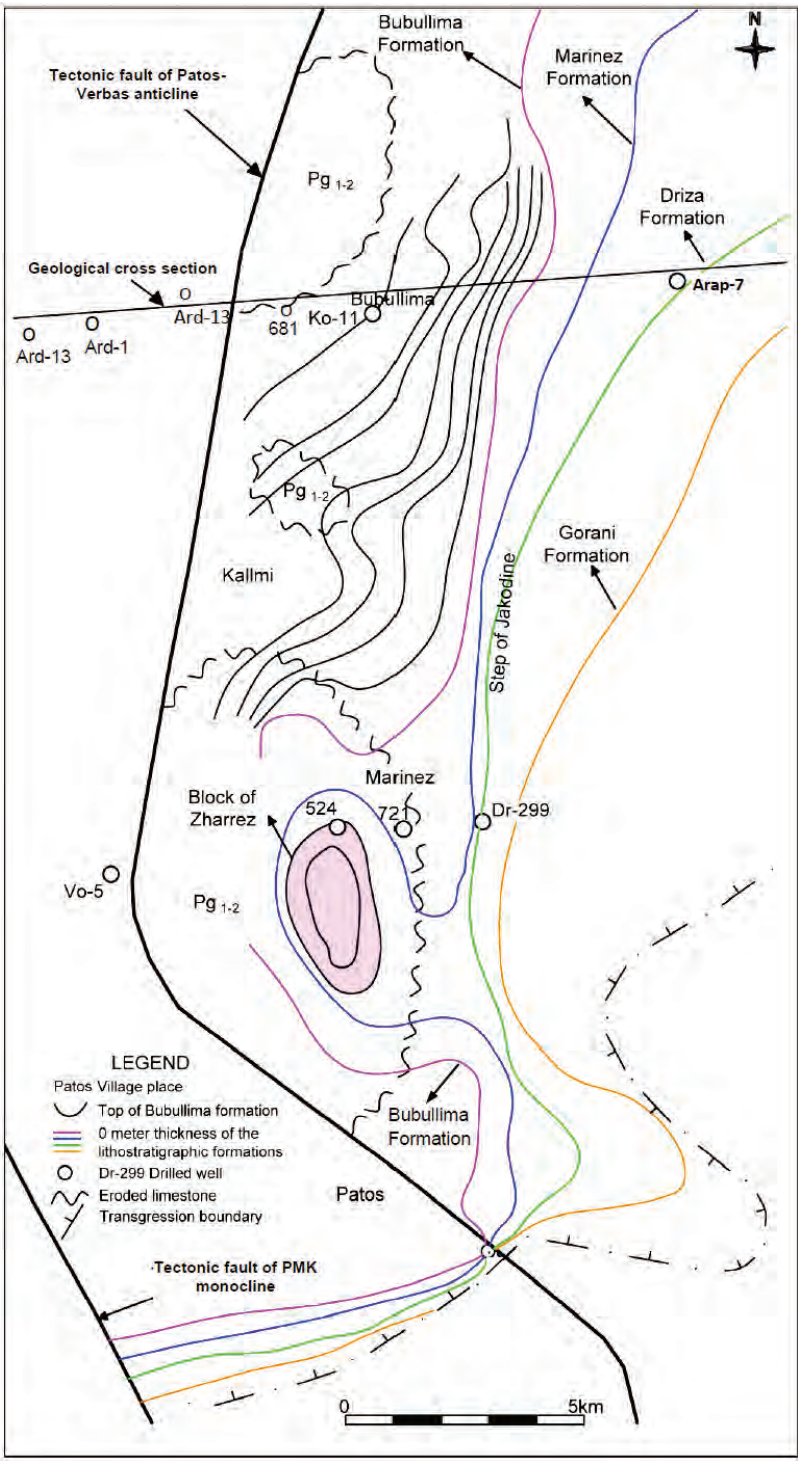

Figure 5. Scheme of the PMK lithostratigraphic formations.

Gorani Formation lies normally on Driza Formation (Fig. 5), but it lies through a stratigraphic break on the buried carbonate erosion of Zhareza. In Patos - Marinez sector, it is represented by an alternation of loose sandstones up to gravel with clays and carbonate aleurites. Its thickness varies from 100m in the south to 160 m in the north.

Kuçova Formation is propagated all over the region and lies normally on Gorani Formation. It is represented by an alternation between clays and loose sandstones. The thickness varies from 160 to 330 m.

Polovina Formation, with its vast propagation, lies normally on Kuçova Formation; in the eastern part of the Marinez sector it is eroded. It is characterized by the alternation between clays and loose sandstones, while in the western part (out of the region) in addition, gypsums alternated with clays. The respective thickness increases from Patos northwards from 200 to 300 m, while westwards, it increases even more.

As a conclusion, *Globorotalia menardii* s.l., *G. extremus* and *G. conomiozea* zones, from the west to the east come crashing to the eroded surface reducing their thickness.

As it concerns *G. conomiozea* zone, through a not well defined zone in Patos - Marinez - Kolonje sector (equivalent to both Bubullima and Black stones formations), eastwards, it is replaced by *Amonia* gr. *beccarii acme* zone. Generally speaking, the potential thickness of this zone reduces from east to west and from north to south.

Pliocene deposits. They include two lithological formations: Helmes and Rrogozhina.

Helmes Formation lies by transgression on the Messinian deposits, represented by clays and aleuritic clays with sandstones and aleurites intercalations. From down upward, it is represented by *Sphaeroidinellopsis* spp., *Globorotalia margaritae*, *G. punticulata* and *G. amiliana*.

Rrogozhina Formation; its lithofacies is represented by sandstones, conglomerates and gravels, alternated with clays and aleurites. In this formation, there can be separated three sub formations, in the base of dominant faction.

Pleistocene-Holocene depositions; in many cases they lie with a break on the older depositions. Their thickness varies from 40 to 140 m. The age is dated by benthos forms like *Ammonia papillosa*, *A. tepida* and *Hyalinea* sp.

2. Tectonics

The transgression of the Tortonian-Messinian basin was conditioned by the change of the structural plane of the Ionian zone and gradually it overlaps the Patos - Marinez - Kolonje region. The respective deposits increase their thickness from south to-north and from east to west. Whereas in the west, where it occurred a successive sedimentation, the biozones are well distinguished, in the east, where the deposits lie by transgression, on the contrary, the stratigraphic deciphering becomes difficult because of the high percentage of the sandstone lithofacies; in such conditions, the different planktonic zones characteristic in the west -are replaced by the one and - unique zone, the acme zone of Ammonia beccarii.

In the considered region, two tectonic units (Fig. 6) are separated (NAÇO et al., 2012):

1. Ionian zone (represented by Hekal - Ballsh - Patos - Verbas anticline belt);
2. Adriatic Depression (here represented by Patos - Marinez - Kolonje monocline).

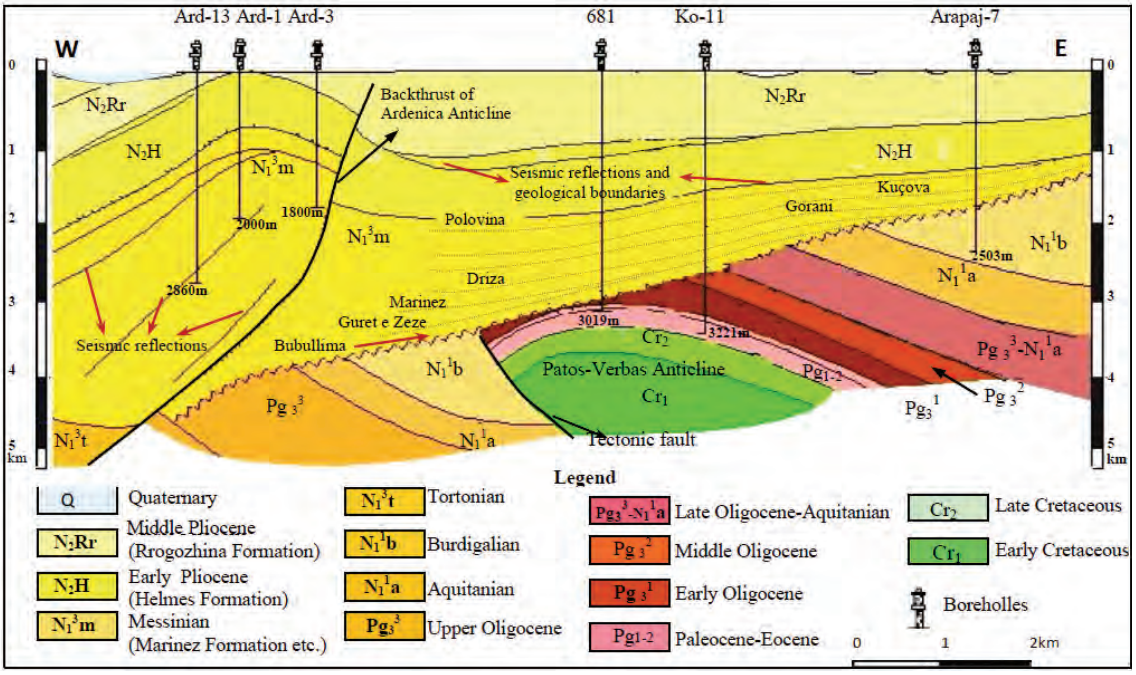

Figure 6. Geological cross-section in northern part of PMK monocline.

Patos - Verbas - Hekal - Ballsh anticline belt

This anticline belt is characterized by a step-like arrangement of the structural units in relation to one another. Its structures is related the hydrocarbon accumulations beginning with the tectonic block of Karbunara (PRIFTI & MUSKA, 2013) as well as Hekal fold. Ballsh anticline is in the north of that of Hekal and has the form of a cupola. The tectonic disjunction that complicates the western flank is the continuation of the flank of Hekal anticline and has an amplitude of 1500 to 2000 m. It conserves its southern orientation. Northwards, its orientation becomes northwest-southeast. Between the two structures, there is a pass below 1400 m absolute.

The main structure of this belt is Patos - Verbas brachyanticline with a southern prolonged pericline closing in Visoka. Actually, we have a buried structure with its apex eroded down to nearly Upper Cretaceous deposits.

Patos - Marinez - Kolonje monocline (PMK)

The monocline sinks north-westward and its deposits are constituted by different formations that lie transgressively, through an angular and azimuthal discordance on carbonate, flysch and flyschoide deposits of the eroded Patos - Verbas structure. The respective deposits pinch out over the erosion elevation of Zharëza and on the Kuman - Jagodina step. One part of them passes the erosion elevation and lies transgressively on Roskovec syncline deposits (in the east of the monocline).

Pliocene deposits lie through a transgressive break over different levels of the Messinian sediments; their thickness increases north-westwards. The Pliocene erosion on the Messinian deposits was considerable in the east of the monocline, concretely down to Gorani and Driza formations, while in the west it arrives only to Polovina and Kuçova Formations. The most powerful erosion is in Zharëza sector.

CONCLUSIONS

The geologic structure of Patos - Marinez - Kolonje region is characterized by the presence of two tectonic stages. In the central part and in the east, there lie the carbonate structures of the Ionian zone. Westwards, there exists a transgressive position of beds, while seaward the region is included in the Adriatic Depression.

Beginning with the change of the tectonic plane of Patos - Verbas structure, the Tortonian-Messinian transgression covers the region. The thickness of the respective deposits increases westwards and northwards. On the west, a successive position of the beds is observed, a good definition of plankton zones is realized (the oldest biozone is *Globorotalia miozea*), while in the east, where a transgressive position is observed, the lack of planktonic foraminifera makes the stratigraphic deciphering difficult. The younger deposits of the section are met in the east (*Ammonia beccarii* zone). The Messinian deposits are delimited by two erosion surfaces: the first is before the Tortonian-Messinian and the second before the Pliocene, the erosion surface thus denoting transgressive contacts.

The Miocene deposits of Patos - Marinez - Kolonje monocline increase their thickness north-westwards.

The Messinian deposits constitute seven lithostratigraphic formations: Bubullima, Guret e Zeze (Black Stones), Marinez, Gorani, Driza, Kuçova and Polovina. In these formations, there are met pay beds that constitute the oilfield complex of Patos-Marinez with estimated geological reserves of 258 394 000 tons. Part of these formations crop out thus forming the bituminous sands with reserves estimated to 540 000 000 tons.

ACKNOWLEDGEMENTS

The authors wish to thank the geophysicist colleagues for their cooperation in the interpretation of the seismic section. We also thank to the specialists of “Albpetrol” company for making available some data of Patos - Marinez oilfield complex.

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MONTE CARLO SIMULATION FOR ESTIMATING GEOLOGIC OIL RESERVES. A CASE STUDY FROM KUÇOVA OILFIELD IN ALBANIA

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Abstract. Reserve Estimates of oil and gas is one of the most important and difficult tasks to accomplish in oil industry because of uncertainties and errors during all the process of Estimating Reserves. During all the processes, there will be errors and uncertainties that will impact in the result of reserves estimation. We may say that the Reserves Estimation is a function of time and data, which, at the end of the production, will be properly and finally defined. Reserves Estimation methods are classified as analogy, volumetric and of performance types. Volumetric and performance methods are the most used techniques; they differ from each other due to the type of used data. The choice of method depends on the phase of oilfield development and production maturity, degree of reservoir heterogeneity, quality and amount of data. The two established volumetric methods for Oil Reserves are deterministic and stochastic ones (DERMINEM, 2005). In case of deterministic method, mathematical formulas are used to estimate oil volumes in a reservoir. The stochastic method considers the fact that each parameter is not presented with a single value, but it is included in an interval of values and fits a probability distribution. The results from stochastic calculations are summarized generally by a descending (reverse) cumulative probability function commonly known as expectation curve (WADSLEY, 2011). We will use both methods in estimating reserves in case of Kuçova (KA-1 sector) Oilfield.

Keywords: Reserve, probability, oilfield, estimation, Monte Carlo.

Rezumat. Simularea Monte Carlo pentru estimarea reservelor geologice de petrol. Studiu de caz câmpul petrolifer Kuçova din Albania. Estimarea rezervelor de petrol şi gaz reprezintă unul dintre cele mai importante obiective pe care industria petrolieră trebuie să le îndeplinească datorită incertitudinilor şi erorilor care se produc pe parcursul procesului de estimare a rezervelor. Pe parcursul tuturor proceselor se vor înregistra erori şi incertitudini care vor avea impact asupra rezultatului estimărilor rezervelor. Putem spune că estimarea rezervelor este o funcţie a timpului şi datelor, care, la finalul producţiei, va fi probabil definită. Metodele de estimare a rezervelor sunt de mai multe tipuri: analogice, volumetrice şi de randament. Metodele volumetrice şi de randament sunt cele mai utilizate; acestea sunt diferite una de cealaltă prin datele utilizate. Alegerea metodei depinde de faza de dezvoltare a câmpului petrolifer şi de maturitatea producţiei, gradul de heterogenitate a bazinului, calitatea şi cantitatea datelor. Cele două metode volumetrice stabilite pentru estimarea rezervelor de petrol sunt deterministice şi stocastice (DERMINEM, 2005). În cazul metodei deterministe, sunt utilizate formule matematice pentru estimarea volumului rezervelor de petrol. Metoda stocastică pleacă de la premiza că fiecare parametru are mai multe valori şi, astfel, este inclus într-un interval de valori şi prezintă o probabilitate de distribuţie. Rezultatele calculelor stocastice sunt în general rezumate de o funcţie de probabilitate cumulativă descendentă (inversă) cunoscută drept curbă de aşteptare (WADSLEY, 2011). Vom utiliza metoda stocastică pentru estimarea rezervelor în cazul câmpului petrolier Kuçova (sectorul KA-1).

Cuvinte chele: rezerve, probabilitate, câmp petrolier, estimare, Monte Carlo.

INTRODUCTION

The oil and gas reserves estimation methods can be grouped into the following categories (www.petrobject.com):

1. Analogy
2. Volumetric
3. Decline analysis
4. Material balance calculations for oil reservoirs
5. Material balance calculations for gas reservoirs
6. Reservoir simulation

The analogy method is applied by comparing factors for the *analogous* and *current* fields or wells. A *close-to-abandonment* analogous field is considered as an approximate to the field we are interested in. During the process, as production and pressure data from the field become more available, decline analysis and material balance calculations become the main methods of estimating reserves.

For the decline analysis, the most common decline curve relationship is the constant percentage decline exponential. With lower productivity of oil wells, some fit decline curve will be hyperbolic and harmonic. Material balance is mostly used for estimating gas reserves. By considering a reservoir as a closed system, the pressure in the reservoir will decline proportionately to the amount of gas produced. In any method of Reserves Estimation, two ways of calculation are used: deterministic or probabilistic. The deterministic procedure uses a single value for each parameter to input into an appropriate formula and, as result it produces a single value for the Reserves. The probabilistic method uses a fit distribution curve for each parameter and, through the use of Monte Carlo Simulation; a distribution curve for the result (Reserves) can be developed. Reserves can be calculated both ways and results are compared. If the two values agree, then we are more confident about the Reserves Estimation. If the two values are away different, we need to rerun the full procedure again (SMITH & BUCKEE, 1985). The magnitude of uncertainty, however, decreases with time (Fig.1).

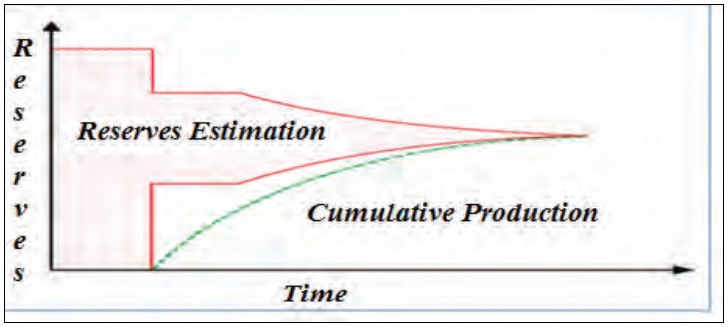

Figure 1.Magnitude of Reserves Estimation over time.

MATERIALS AND METHODS: CLASSIFICATION OF RESERVES: (SPE 2007, www.spe.org)

Resources are the total quantities of oil and gas and other related substances that are estimated, at a particular time, to be contained in, or that have been produced from known accumulations, plus those estimated quantities in accumulations are yet to be discovered.

Contingent Resources are those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from known accumulations, but which are not currently considered to be commercially recoverable.

Prospective Resources are those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from undiscovered accumulations.

Proven Reserves are those reserves claimed to have a reasonable certainty (at least 90% confidence) of being recoverable under existing economic and political conditions, with the present existing technology and state regulations. Oil industry specialists refer to this as P90 or 1P.

Proved plus Probable Reserves are those reserves claimed to have a reasonable certainty (at least 50% confidence) of being recoverable under existing economic and political conditions, with the present existing technology and state regulations. Oil industry specialists refer to this as P50 or 2P.

Proved plus Probable plus Possible Reserves are those reserves claimed to have a reasonable certainty (at least 10% confidence) of being recoverable under existing economic and political conditions, with present existing technology and state regulations. Oil industry specialists refer to this as P10 or 3P (Fig. 2).

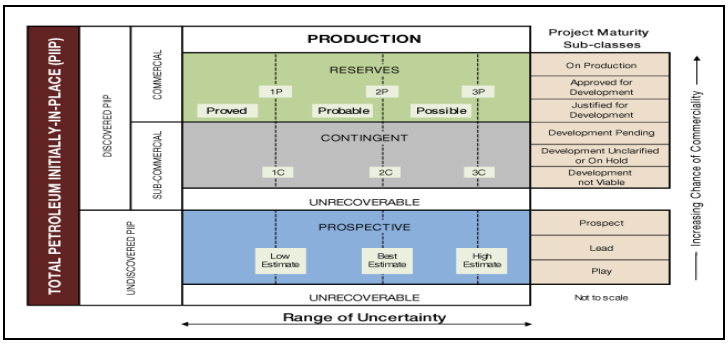

Figure 2. Reserves Classification.

ALBANIDES AND KUÇOVA OILFIELD: GEOLOGICAL SETTINGS

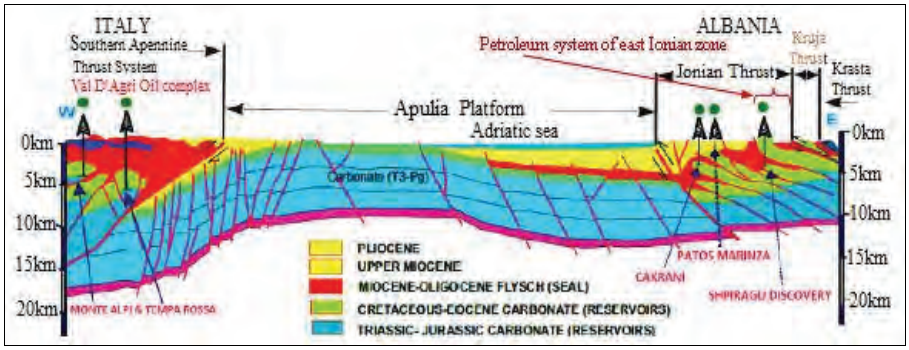

Figure 3. Southern Apennine & Ionian/ Kruja thrust systems (www.petromanas.com, modified by PRIFTI).

The Albanides represents the assemblage of the geological structures in the territory of Albania. Oil and gas fields are located in the area of the Ionian zone and Adriatic depression (Fig. 3). Oilfields are discovered in Kurveleshi belt, Berati belt and molasses section of Miocene extending over the eroded limestone (PRIFTI et al., 2014).

The north part of Berati anticline belt is constructed by three units: diaper of Dumre, the Tectonic blocks of Anticline belt of Berat and the Syncline of Ballagati. Berati anticline belt consists of two tectonic blocks called "thrust sheet Berat" and "thrust sheet Sqepuri". In the western and southern periphery of the diaper, there are located Kuçova oilfield and Rase- Pekisht oilfield (Fig. 4).

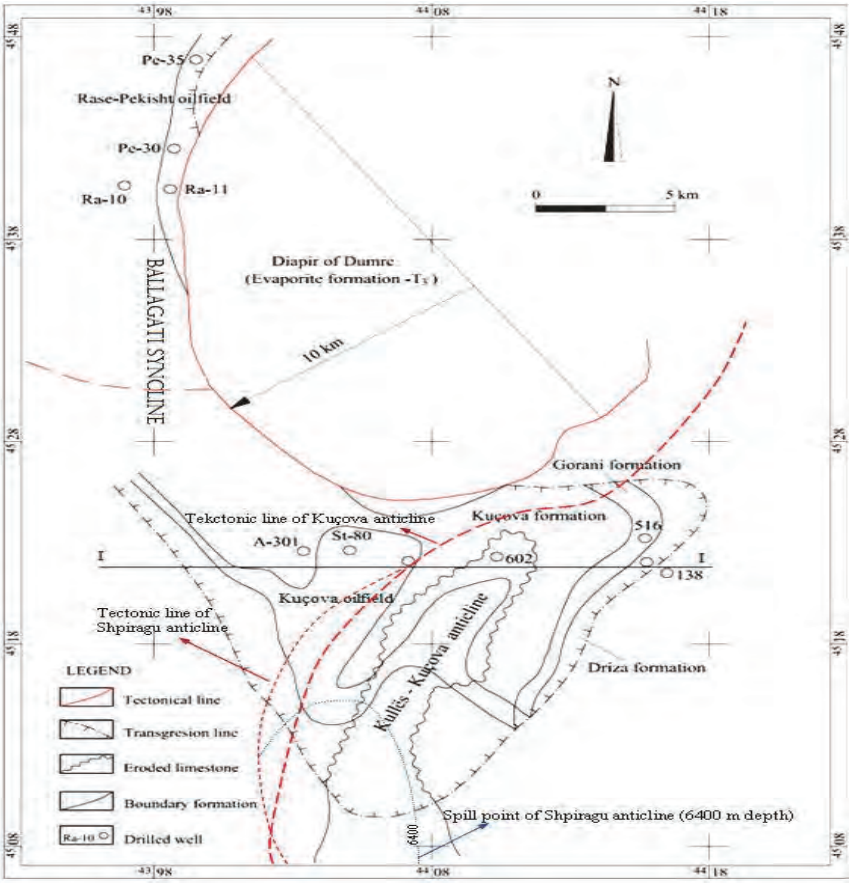

Figure 4. Kuçova, Rase - Pekisht and Dumre diaper (GJOKA et al., 2002, modified by Prifti).

KUÇOVA OILFIELD (KA-1 SECTOR)

Kuçova oilfield is located in the South Central region of Albania, approximately 40 km north east of Patos- Marinza oilfield. Kuçova oilfield was discovered in 1928 and was developed with the drilling of 1,722 wells in 5 major pools (Kozare, Gege, Ferme, Arreza and Kuçova- Sector 1), (www.bankers.com). Engineering evaluation of the oilfield indicates it is severely pressure depleted with an estimated recovery factor of 8.1% to date and an ultimate recovery forecast of 9.1% on primary recovery. Crude oil of Kuçova oilfield are aromatic- asphalt type (GJOKA et al., 2002), with 14 to 22 API range.

VOLUMETRIC METHOD: INPUT PARAMETERS

The volumetric method uses rock parameters values, the physical size of the reservoir, the pore volume within the rock matrix, the fluid content within the void space, the average depth of reservoir, etc. This provides an estimate of the hydrocarbons-in-place, from which ultimate recovery can be estimated by using an appropriate recovery factor (RF). For Oil Reserves, we have this formula:

$$OOIP = Qprov = S * h\,m * m * Sn * Yn * 1 / bn \quad (1)$$

$$UR = OOIP * RF \quad (2)$$

OOIP = Oil Originated in Place (Geological Reserves)
UR = Ultimate Recovery (Primary Recoverable Reserves)
Q = Oil Reserves (tons)

S = Oilfield area (m^2).
hm= Average depth of reservoir (m)
m = Porosity ratio (%); it is the ratio of the volume of space to the total volume of a rock
Sn = Oil saturation (%); the relative amount of oil and gas in the pores of a rock, usually as a percentage of volume

Yn = Density of oil ($\frac{kg}{m^3}$); mass per unit of oil volume

bn = Formation Volume Factor; oil and dissolved gas volume at reservoir conditions divided by oil volume at standard conditions. Oil formation volume factor is almost always greater than 1
RF= Recovery Factor. For primary recovery (i.e., natural depletion of reservoir pressure), the RF does not exceed 20% in most cases. For secondary recovery, the incremental RF ranges from 15 to 25%.

THE DATA (RESERVOIR PARAMETERS): DETERMINISTIC METHOD

The simplest way to produce a number for Reserves is to use the average or mode of each reservoir parameter (Table 1). The number, produced by formula, is an approximate value of Reserves that may correspondent to the average Reserves or P50. Besides the average value of Reserves, we may calculate the minimum and maximum values of Reserves or worst estimate and high estimate values. The values, giving some "probabilistic form" in our case, are: Q_{min} = Qw = 1.3M tons, Q_{av}= Q_{best} = 4.4 M tons and Q_{max}= Q_{high} = 17 M tons.

PROBABILISTIC METHOD AND MONTE CARLO SIMULATION

Monte Carlo technique consists in building a continuous probability density function (PDF) for each parameter and, after the formula, to generate a PDF for Reserves. The input PDFs (triangular, normal etc.) are combined either analytically (CAPEN, 1992) or by random sampling (Monte Carlo simulation).

By central-limit theorem, the resultant (Reserves) distribution approaches lognormal, regardless of the type of input variables. The area and the thickness of the reservoir are usually assigned the triangular distribution, the porosity is usually assigned a log normal distribution (CRONQUIST, 2001) following (ARPS & ROBERTS, 1958) and (KAUFMAN, 1963); in a given geologic setting, a log normal distribution is a reasonable fit to the frequency distribution of field size and other parameters like porosity, water saturation and net pay thickness.

In our case, following other similar cases and the distributions of data, it is used the triangular distribution (Table 1).

Table1. Partial Data of KA- 1 Sector, Kuçova Oilfield, parameters and their distributions.

Kuçova Oilfield Ka-1 sector data	**Reservoir area m^2**	**Thickness M**	**Porosity %**	**Oil % saturation**	**Oil density**	**b_n**
Average	2, 500,000	15	22	75	0.85	
Intervals	1,5- 3,5 mil	8- 30	5-35	50-88	0.5-0.95	1.18- 1.22
Distributions	triangular	triangular	triangular	triangular	triangular	Uniform
Low	1,500,000	8	5	50	.5	1.18
Best	2,500,000	15	22	75	.85	1.2
High	3,500,000	30	35	88	.95	1.22
Distr. Values	(1.5; 2,5; 3,5)	(8; 15;30)	(.05; .22;.35)	(.5; .75;.88)	(.5; .85; .95)	1.188; 1.22

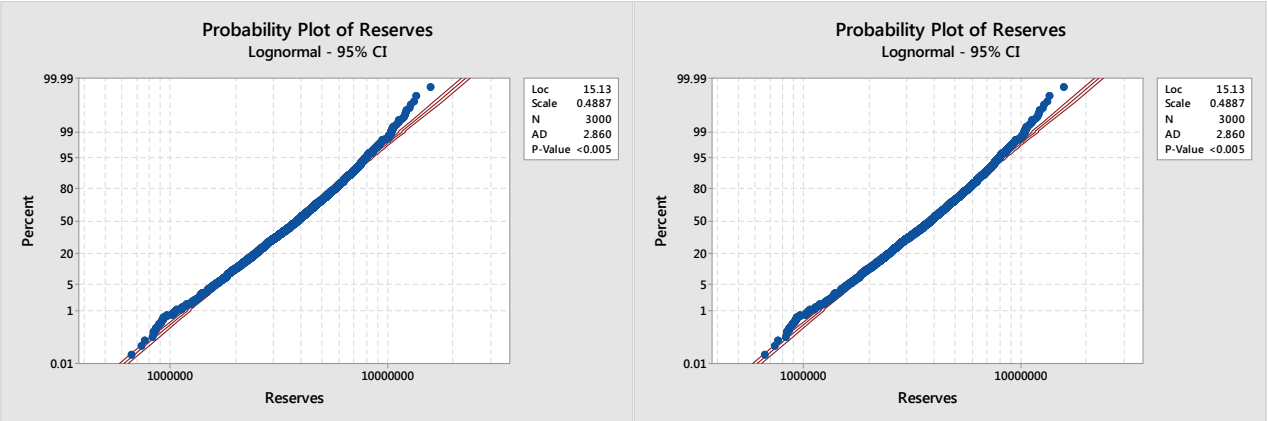

Figure 6. Reserves Lognormal Distribution.

The Monte Carlo simulation was run by using Minitab 17 software. With the reservoir parameters and their distributions, there are generated values for each of them (3,000 iterations) and, as result, the distributions for the Reserves was produced. As it is proved and tested, the Reserves fit the lognormal distribution (Fig. 6).

RESULTS

Cumulative Reserves gives us the Estimation for Proven Reserves (P10), Possible Reserves (P50) and Probable Reserves (P90), (Fig. 7).

Proven Reserve (P90) = 2 M tons. Reserves are equal or more than 2.0 M tons, with confidence 90%.

Proven and Possible Reserves (P50) = 3.7 M tons. Reserves are at least 3.7 M tons, with confidence 50%.

Proven, Possible and Probable Reserves (P10) = 7 M tons. Reserves are at least 7.0 M tons, with confidence 10%.

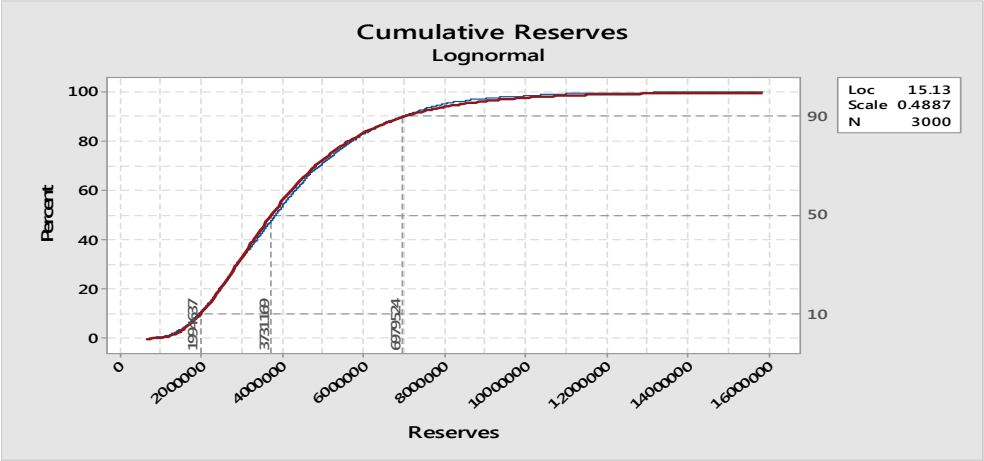

Figure 7. Cumulative Reserves and P10, P50, P90.

CONCLUSIONS

In this study, we re-evaluate oil Reserves of Kuçova oilfield; sector KA-1, by using the probabilistic method of Reserves Estimation.

Monte Carlo Simulation was successfully applied to the real oilfield to build the distribution of basic reservoir characteristics (net thickness of rock, porosity, oil saturation, etc).

For the purpose to have a fit distribution, there are some useful software like Cristal Ball, Cum Freq, Minitab, Stat Assist, Minitab, etc., which can find fit distribution, simulate random numbers, fill the missing data, etc.

When estimating low value or minimum value, it is not wise to produce all the minimum values of parameters, because this is not the case in real values. The minimum value of Reserves is bigger than produced; the maximum value is less than produced.

For a more "conservative" estimation, Reserves Distribution may have to be truncated to 10% or more. This is to avoid outliers that are produced by extreme values of parameters. As a result, we will have a more accurate estimation.

With more data, the accuracy and the fit distribution and, at the end, Reserves Estimation will be more precise, considering the level of confidence.

It is up to the company, after all the estimation process is done, to make the decision about projects, considering them and continuing or asking for other result from other methods.

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SOME MAASTRICHTIAN VERTEBRATES FROM FLUVIAL CHANNEL FILL DEPOSITS AT PUI (HAȚEG BASIN)

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Abstract. Latest Cretaceous deposits are cropping out in various localities of the Hațeg basin (Romania). Among these localities Pui is of peculiar interest, being the southeastern most one where Maastrichtian fluvial deposits are exposed. These terrestrial deposits are represented mainly by red beds, which yielded since the end of the 19th century, rich vertebrate assemblages. From a channel fill block discovered *ex situ*, a diverse fossil vertebrate assemblage was recovered (turtles, crocodilians, pterosaurs, and various herbivore and carnivore dinosaurs). This study is focused on the fossil taxa collected from this block and their fossilization processes.

Keywords: latest Cretaceous, fluvial deposits, vertebrates, Hațeg basin, Romania.

Rezumat. Câteva vertebrate maastrichtiene din depozite de canal fluvial de la Pui (Bazinul Hațeg). Depozite cretacic terminale aflorează în varii localități din Bazinul Hațeg (România). Dintre acestea, Pui este localizată în extremitatea sud-estică a bazinului, unde apar la zi depozite fluviale maastrichtiene. Aceste depozite sunt dominate de *red beds*, din care au fost colectate, încă de la finele secolului XIX, bogate asociații de vertebrate fosile. Dintr-un bloc cu umplutură de canal descoperit *ex situ* a fost extrasă o asociație diversă de vertebrate fosile (țestoase, crocodili, pterosauri și variați dinozauri erbivori și carnivori). Asociația de fosile din acest bloc și procesele de fosilizare evidențiate sunt descrise în acest studiu.

Cuvinte cheie: Cretacic terminal, depozite fluviale, vertebrate, Bazinul Hațeg, România.

INTRODUCTION

In latest Cretaceous, an emerged land occurred in the actual Transylvania named the "Hațeg Island". It was part of a larger Tethyan archipelago, in southern Europe (DERCOURT et al., 2000; CSONTOS & VÖRÖS, 2004). Geological evidence of this paleogeography can be noticed in Transylvania: besides the already notorious Hațeg basin, other data related on the Maastrichtian terrestrial deposits are found in the Transylvanian and Rusca Montană basins (NOPCSA, 1905; CODREA & DICA, 2005; CODREA & GODEFROIT, 2008; CODREA et al., 2010; 2012). It is estimated that the whole island had almost 80,000 km^2 (BENTON et al., 2010, and references therein). The island is known all over the world due its vertebrate fauna, which evolved in endemic (?insular) environment (NOPCSA, 1914; CODREA et al., 2014).

Within the "Hațeg Island", the Hațeg basin (Figs. 1A; 1B) is the most studied, due to the peculiar sedimentary Maastrichtian deposits (NOPCSA, 1905; GRIGORESCU et al., 1985; GRIGORESCU & ANASTASIU, 1990; GRIGORESCU, 1992; THERRIEN, 2005, 2006; VAN ITTERBEECK et al., 2005; THERRIEN et al, 2009; PANAIOTU & PANAIOTU, 2010) bearing rich fossil assemblages - mainly vertebrates - and among these ones, peculiar endemic dwarf dinosaurs, reported both by baron Francisc Nopcsa and Gyula Halaváts since the end of the 19th (NOPCSA, 1897; HALAVÁTS, 1897; GRIGORESCU, 2010). Apart their systematic, biodiversity and ecology, very important data refer to their taphonomy and fossilization processes (CSIKI et al., 2010a).

The majority of the Maastrichtian terrestrial deposits concerns *red beds*. The most illustrative ones are exposed in the southeastern side of the basin at Pui (Figs. 1B; 1C), a commune located 20 km from Hațeg town, on the road connecting Hațeg to Petroșani. The locality is crossed by the Bărbat River (Fig. 1C). The red beds can be best observed when the river water plane is low, in dry seasons.

GEOLOGICAL SETTING

In Hațeg basin two Maastrichtian terrestrial formations were coined (GRIGORESCU & ANASTASIU, 1990): Densuș-Ciula Formation, exposed in the northern sectors of the basin (ANASTASIU & CSOBUKA, 1989; GRIGORESCU et al., 1990; BOJAR et al., 2005), and Sânpetru Formation in the southern basin areas, as the Sibișel or the Râul Mare rivers (CODREA et al., 2002; SMITH et al., 2002; VAN ITTERBEECK et al., 2004, 2005; BOJAR et al., 2005; THERRIEN, 2005, 2006; THERRIEN et al., 2009). Both formations are of same fluvial origin (GRIGORESCU & ANASTASIU, 1990; GRIGORESCU, 1992; THERRIEN, 2005, 2006; VAN ITTERBEECK et al., 2004, 2005; THERRIEN et al., 2009; PANAIOTU & PANAIOTU, 2010). VAN ITTERBEECK et al. (2004, 2005) and THERRIEN (2005, 2006) considered that these sediments accumulated in well drained floodplain environments.

The deposits from Pui were related to Sânpetru Formation (NOPCSA, 1905; GRIGORESCU et al., 1985, 1999; GRIGORESCU, 1992; etc.). However, THERRIEN's work (2005) points out the differences between the Sibișel type-section and the one exposed at Pui, underlining even the major dominance in colour of the rocks: while in Sânpetru the fluvial deposits are gray-yellow-greenish, in Pui the red mudstones are in prevalence. For this reason he called the deposits from Pui "Pui beds", suggesting even a possible distinct formation, "Bărbat Formation".

As in the others fluvial Maastrichtian deposits from the Hațeg basin, in Pui ones, one can outline sequences of fines marking overbank sediments *vs.* channel filling rocks - conglomerates, microconglomerates and mainly sandstones (VAN ITTERBEECK et al., 2004, 2005; THERRIEN, 2005, 2006; THERRIEN et al., 2009).

Another kind of deposits can be also noticed, interpreted as oxbow ponds. Such deposits are in sharp contrast with the red beds, dominated by dark colour mudstones with white mica flakes and pyrite noodles (CODREA & SOLOMON, 2012; VASILE & PANAITESCU, 2012; CODREA et al., 2013; SILYE et al., 2014). CODREA & SOLOMON (2012) reported three stratigraphic successive levels of this kind, calling them Pui Gater, Pui Depozit and Pui Islaz, but possibly some others could be also present into the Maastrichtian succession from the Bărbat River. The fossil assemblages of the oxbows are also different from the ones of the red beds, the fossilization being peculiar too (dark coloured bones and teeth).

Inside the red beds, the channel filling rocks were a specific fossilization environment. The channel deposits are common mainly in the basal part of the Bărbat River section. To the top they are not absent, but the vertebrate fossils are rather rare, compared to the basal ones. They are filled by coarse conglomerates and sandstones. The main clasts are represented by quartzite and other metamorphic rocks, but intra-formation reworked mudstones can be noticed too.

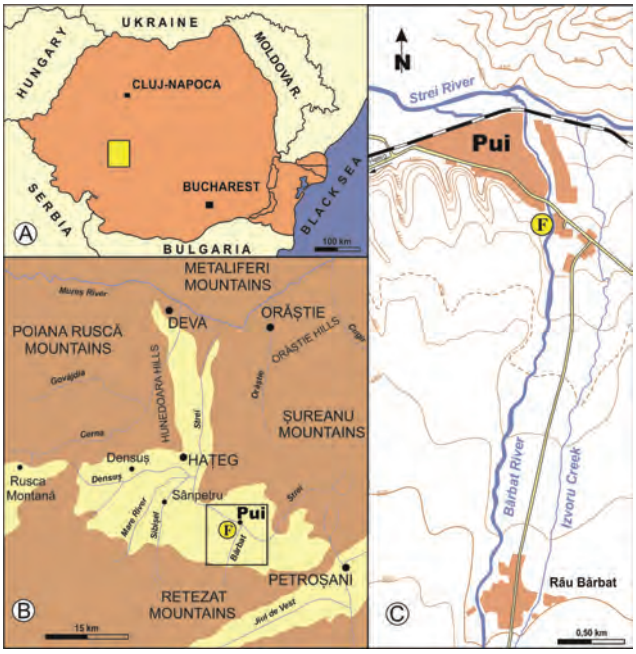

Figure 1. A. The yellow rectangle indicates the position of Hațeg basin on the map of Romania;
B. Location of Pui locality - marked by rectangle - in the Hațeg basin; "F" indicates the place where the block originated from;
C. Map of Pui locality; "F" indicates the place where the block was found *ex situ*.

MATERIAL AND METHODS

This work is focused on the vertebrate fossils recovered from a channel fill block collected at Pui, on the Bărbat River. The block was found *ex situ* in the river alluvia, at Pui Gater (Fig. 2A). According to the natives' statements, this block was extracted several years ago from its original bed, when a concrete bank was erected in order to protect the mill saw. It worth mentioning that several decades ago, probably in the first half of the 20th, two similar blocks bearing large bones (probably dinosaur bones) had been brought in the geological collection of Babeș-Bolyai University of Cluj-Napoca by an anonymous donor (inventory numbers: V508, V509).

The rock has a gray-faint greenish colour. The full rock block (Fig. 2C), estimated at 250-300 kg was extracted from the alluvia (Fig. 2A), than carried in the Laboratory of Vertebrate Paleontology of Cluj-Napoca university (Figs. 2B; 2C). The block was turned into small pieces using classical tools as chisels and hammers, but also electric bore hammer (Borehammer Z1C-Dl05-26; Fig. 2D) and microengraver (Dremel engreaver 290). The vertebrate fossils from the smaller pieces of rocks were extracted from their matrix by classical methods, using chisels, hammer and microengraver. Professional polymers such as paraloid and mowillite consolidated the bones, when necessary. The cleaned bones were measured with professional calipers, than photographed with Nikon Coolpix P520 (18.1 megapixels). The photos were processed in Adobe Photoshop CS2.

The material is hosted at the Laboratory of Vertebrate Paleontology at "Babeș-Bolyai" University of Cluj-Napoca. The material was labelled as PB1-X, where PB is the abbreviation for "Pui Block", "1" represents the fact that this is the first block of this type that was discovered, and "X" represents the number of each fossil extracted from the block.

RESULTS

Inside the block matrix several bones - most broken - and teeth belonging to various reptiles were recovered. The majority of these remains belongs to crocodilians, especially to *Allodaposuchus precedens* Nopcsa 1928 (NOPCSA, 1928). Other remains by far less numerous, are documenting the crocodilian *Acynodon*. Various dinosaur remains are present in this block too. This study is focused on the description of the faunal material recovered from the block, and on some taphonomic processes, which took place before the final burial of the vertebrate remains.

Figure 2. A. The place where the block was found *ex situ*; B. Preparing the transport of the block to the Laboratory of Vertebrate Paleontology at Babeș-Bolyai University of Cluj-Napoca; C. The block in the laboratory; D. One of us (Al.S.) working on the block.

SYSTEMATIC PALAEONTOLOGY

Reptilia Laurenti 1768
Chelonii Brogniard (Latreille) 1800
Testudines Linnaeus 1758
Chelonia indet. (Plate I, Figs. 2a; 2b; 3)

Turtle carapace fragments were extracted from the block (e.g. PB1-38, PB-1-39). These remains are poorly preserved and a lot of cracks are crossing their surfaces. Due to the water stream transport and subsequent taphonomic processes, the ornamentation of external surfaces is almost lost.

In the "Hațeg Island" turtles were several times reported (NOPCSA, 1923; GAFFNEY & MEYLAN, 1992; DE LAPPARENT et al., 2009; VREMIR & CODREA, 2009; RABI & VREMIR, 2011; CODREA & SOLOMON, 2012; etc.), referring both to pleurodira and cryptodira. The poor state of preservation of the fragments does not allow assigning these remains to one or another of these groups.

Remains of turtles are widespread in the "Hațeg Island", being common elements in the Maastrichtian continental biota. The most common turtle in the "Hațeg Island" is *Kallokibotion bajazidi* Nopcsa 1923 (NOPCSA, 1923), but as we underlined above, Dortokidae representatives were also present.

Crocodylomorpha Walker 1970 (*sensu* Benton & Clark 1988)
Eusuchia Huxley 1875 (*sensu* Benton & Clark 1988)
Alligatoroidea Gray 1844 (*sensu* Norell et al. 1994)
Allodaposuchus Nopcsa 1928
Allodaposuchus precedens Nopcsa 1928 (Plate II, Figs. 1a; 1b; 1c; 2; 3)

This species is documented by numerous isolated teeth of various sizes, ranging from 11.34 to 25.30 mm in height and from 8.40 to 14.20 mm in wide. Following BUSCALIONI et al. (1986), these teeth tentatively can be separated into morphotypes. The first morphotype (morphotype B, in BUSCALIONI et al., 1986) is represented by a conical, slender, and pointed tooth crown, medially twisted, with well-developed mesial and distal keels, both continuous from the base to the top of the crown. The keels are devoid of serrations. The cross section of these teeth is sub-rounded. Some teeth preserve parts of

their roots, the missing parts being removed by the water stream transport before their definitive burial in the sediment. On the medial side, fine vertical enamel ridges can be noticed. The largest tooth from the available sample (PB1-1) is longitudinally broken: in this manner the crown of the new replacing tooth, can be observed inside the older crown. This type of tooth was already noticed by DELFINO et al. (2008a) in the *A. precedens* skull collected from the Maastrichtian deposits at Oarda de Jos (Alba District), considering it to be placed on premaxilla. The second morphotype (morphotype C, in BUSCALIONI et al., 1986) is less frequent in the sample. The crown is robust, less elongated and slender compared to the previous morphotype, and the apex of the crown is less pointed. The cross section of the crown is sub-rounded. The mesial and distal keels are present, and fine enamel ridges can be also noticed on both sides, starker on the medial one. This morphotype is also reported on the *A. precedens* skull, assigned to maxillary teeth (DELFINO et al., 2008a).

Acynodon Buscalioni, Ortega & Vasse 1997
Acynodon sp. (Plate II, Figs. 4a; 4b; 5a; 5b; 6a; 6b)

This crocodilian is documented by several isolated teeth. BUSCALIONI et al. (1997, 1999), and DELFINO et al. (2008b) coined two types of teeth for this genus. The anterior teeth are spatula-like, while the posterior ones are molariform. In our sample, four anterior (PB1-15, 16, 17, 19) and a single posterior one (PB1-18) are present. The size of the anterior teeth varies from 4.10 mm to 6.50 mm in height, and 3.47 mm to 6.95 in wide. The crown is bulbous and the apex is rounded. Fine enamel wrinkles are present on both the labial and lingual sides of the crown. As in our sample there are exclusively isolated teeth, we are devoid of enough arguments to separate the upper from the lower ones. The rear molariform tooth has wider than higher crown, with oval outline in crown view, apically worn. The crown is ornamented by numerous fine pustules, as in *A. adriaticus* Delfino, Martin & Buffetaut 2008.

Crocodylia indet.

Mandible - a surangular articulation fragment (PB1-24) and an indeterminate mandible fragment (PB1-25) were recovered.The preserved portion of the surangular articulation is elongated, the total preserved length being 81.96 mm. In outer view, the lateral surface is completely sculptured by pits and grooves (Plate II, Fig. 7a), while in inner view the bone is less ornamented (Plate II, Fig. 7b). The dorsal surface is almost smooth. The dorsal edge is caudally ascendant. Due to its size, it may belong to the eusuchian *A. precedens*. The other mandible fragment (PB1-24) presents the same sculptured surface in outer view, while in inner view the surface is almost smooth.

Vertebrae - two caudal vertebrae are available. One of them is much damaged (PB1-23), preserving only the centrum, in a very poor condition. Therefore, only the other vertebra worth a detailed description (PB1-22; Plate II, Figs. 8a; 8b; 8c; 8d). It is a caudal vertebra, probably coming from the proximal half of the tail. It is procoelous, with an elongated centrum. The total length of the centrum is 47.48 mm. The centrum is strongly transversally compressed. The neural arch is much higher than the centrum, a feature already observed in the caudal vertebra described by CODREA et al. (2012) from Rusca Montană Basin. The prezygapophyses and postzygapophyses are well developed. The neural spine is broken, as well as the left postzygapophysis, which is partially broken too. One of the transverse processes is almost complete, while the other one is partially broken. The transverse processes are dorsally trended. In lateral view a groove can be noticed under the transverse processes. The condyle is damaged, while the cotyle is better preserved. The neural canal is round-shaped, still filled by sediment. The prezygapophyses are larger than the postzygapophyses, all of them having the articular surface oval-elongated.

Tibia - one fragmentary young crocodilian tibia (PB1-26; Plate II, Fig. 9) was recovered from the block. Unfortunately, the proximal epiphysis is damaged, lacking the medial and lateral condyles. The distal epiphysis is damaged too. In dorsal view, the proximal extremity has a subtriangular outline, as in *Allodaposuchus palustris* Blanco, Puértolas-Pascual, Marmi, Vila & Sellés 2014. The shaft has an elliptic outline, being similar to *A. palustris* (BLANCO et al., 2014). The proximal and distal epiphysis of the bone is expanded, while the shaft is slender.

Osteoderms - a rich sample of osteoderms, complete or fragmentary, was extracted from the block (Plate II, Figs. 10; 11; 12; 13; 14). Two morphotypes were recognized: oval-shaped and subrectangular. The majority of the osteoderms exposes a keel on the surface, but there are some devoid of keel (ie. PB1-46; Plate II, Fig. 11). None of the osteoderms has such a high keel as in the Spanish eusuchian presented by BUSCALIONI et al. (1986). The whole dorsal surface of the osteoderms is ornamented by circular or sub-circular pits, while the ventral surface is smooth, with nutritional foramens.

Pterosauria Kaup 1834
Pterodactyloidea Plieninger 1901
Pterosauria indet. (Plate I, Figs. 4a; 4b; 5a; 5b)

Two pterosaur bone fragments were recovered from the block (PB1-27, PB1-28). Pterosaurs are rather rare in the Romanian Maastrichtian deposits (NOPCSA, 1899; BUFFETAUT et al., 2002; VREMIR et al., 2013; GRELLET-TINNER & CODREA, 2014). The cortex of the bone is thin, and due to this fact, in both bones the cortex was broken and the filling sediment can be observed (Plate I, Figs. 4a; 5a; 5b). These fragments could originate from the wings, based on their shapes and bone structure. Based on this scarce sample and the fragmentary state of the bones, we cannot assign these remains to any of the known pterosaurs from the “Hațeg Island”.

Dinosauria Owen 1842
Saurischia Seeley 1888
Theropoda Marsh 1881
Theropoda indet. (Plate I, Figs. 6a; 6b; 6c; 7a; 7b)

Two fragmentary theropod phalanges (PB1-33, PB1-34) were recovered from the block. The maximum length of PB1-33 is 26.11 mm, while in PB1-34 is 31.57 mm. The fragmentary state of the preservation is due to the fact that the theropod bones are very fragile and could be easily broken by water transport. The non-ungual phalanges have extensor pits, a typical feature for theropods. In both phalanges, the distal condyles are damaged; the extensor groove between the condyles is shallow. The distal condyles are better preserved in PB1-33, and its distal articular surface has a typical theropod outline (Plate I, Fig. 6b). The proximal articular surface is broken in both cases, but the general outline is typical for theropods. These phalanges could originate from a paravian theropod.

Two theropod species are documented by postcranial bones in the "Haţeg Island": *Elopteryx nopcsai* Andrews 1913, and *Balaur bondoc* Csiki, Vremir, Brusatte & Norell 2010 (CSIKI et al. 2010b; BRUSATTE et al., 2013). Various isolated teeth (e.g. GRIGORESCU et al., 1985; CSIKI & GRIGORESCU, 1998; CODREA et al., 2002; SMITH et al., 2002; CSIKI et al., 2008; VASILE, 2008; CODREA & SOLOMON, 2012) are indicative for a high diversity of theropods in this Maastrichtian biota. Besides crocodilians, the theropods were top predators in "Haţeg Island".

Sauropoda Marsh 1878
Titanosauriformes Salgado, Coria & Calvo 1997
Titanosauria Bonaparte & Coria 1993
Titanosauria indet. (Plate I, Figs. 10; 10b; 11a; 11b; 11c)

Sauropod remains recovered from the block are represented by an ungual phalanx (PB1-36) and a femur mid-shaft fragment (PB1-30). The ungual phalanx is gracile and asymmetrical in dorsal view. Its length is around 49 mm. It is crescent-shaped, with a convex dorsal surface and a relatively flat ventral side. The medial side is convex, while the lateral side is almost flat. A groove is visible on the medial side, near the proximal part of the phalanx. The articular proximal surface (Plate I, Fig. 11c) is concave, and a central ridge divides this surface in two distinct lateral parts. In proximal view, the ungual phalanx has a round-triangle shape. The lateral side is damaged in its distal part; the apex is pointed and ventrally trended. Other ungual sauropod phalanges from the Haţeg basin were reported by NOPCSA (1915) and CSIKI et al. (2010c). By comparison with an ungual phalanx (UBB NVM1-11) of *Paludititan nalatziensis* Csiki, Codrea, Jipa-Murzea & Godefroit 2010 (CSIKI et al., 2010c), which is a left ungual phalanx, the one from the block it is a right ungual phalanx, probably the third one.

The femur mid-shaft fragment is broken and a lot of cracks are visible on its surface, probably due to the water transport.

Until now, the sauropods from the "Haţeg Island" were assigned to two genera, *Magyarosaurus* von Heune 1932 (VON HUENE, 1932) and *Paludititan*, but recent unpublished discoveries could evidence a higher sauropod diversity in the Maastrichtian of Transylvania.

Ornithischia Seeley 1887
Hadrosauridae Cope 1869
Telmatosaurus Nopcsa 1903
Telmatosaurus transsylvanicus Nopcsa 1900 (Plate I, Fig. 9)

The presence of duck-bill dinosaurs (hadrosaurs) in this channel fill deposit is documented only by a tooth fragment (PB1-21). The tooth is highly damaged, but the preserved part of the crown is completely covered by enamel. A strong medial carina is present on the crown, but the secondary ridges are absent. Relatively large denticles are disposed along the preserved margin, but without the marginal ridges reaching them. The apex is broken. The general morphology of the tooth is concordant with the teeth of *Telmatosaurus transsylvanicus* Nopcsa 1900 (NOPCSA, 1900) described by WEISHAMPEL et al. (1993).

Ornithopoda Marsh 1881
Euornithopoda (*sensu* Weishampel 1990)
Iguanodontia Sereno 1986
Rhabdodontidae Weishampel, Jianu, Csiki & Norman 2003
*Zalmoxes*Weishampel, Jianu, Csiki & Norman 2003
Zalmoxes sp. (Plate I, Figs. 8a; 8b)

The euornithopod *Zalmoxes* Weishampel, Jianu, Csiki & Norman 2003 (WEISHAMPEL et al., 2003), is documented by a single isolated and highly damaged tooth. The crown is slightly taller than wide. The enamel is distributed on both sides of the crown, but it is much damaged. The root is higher than the crown and labially curved, as in the *Zalmoxes* specimen from Nălaţ-Vad described by GODEFROIT et al. (2009). Despite the fact that the tooth is

heavily damaged, in buccal view (Plate I, Fig. 8a) slightly divergent vertical ridges can still be noticed on the crown. The remains of *Zalmoxes* are the most abundant in the Maastrichtian of the "Haţeg Island". Two species were coined, *Z. shquiperorum* Weishampel, Jianu, Csiki & Norman 2003 (WEISHAMPEL et al., 2003), and *Z. robustus* Nopcsa 1902 (NOPCSA, 1902). As CODREA & SOLOMON (2012) pointed out, isolated teeth are not indicative for one or another of these species.

Reptilia indet. (Plate II, Figs. 12; 13)

Apart the reptiles described above, a lot of indeterminate fragments belonging to various reptiles were extracted from theblock. The majority bear roll marks (e.g. Plate II, Fig. 12), or are broken (e.g. Plate II, Fig. 13) due to taphonomic processes.

TAPHONOMY

The remains are isolated, broken and some of them rounded, indicating a pre-burial transport. Usually, the vertebrate fossils found at Pui in the red beds, are white coloured. The ones from this channel fill block are dark coloured, resembling the teeth and bones reported (CODREA & SOLOMON, 2012; CODREA et al., 2013) from the dark mudstone deposits. Dark-coloured bones and teeth are indicative for fossilization processes that took place in poor oxygen content environments, where the bones were soon buried into the sediment. No microvertebrate remains were found in the block because the channel fill consists of coarse clasts which do not represent a proper environment for the fossilization of micro remains.

Following CSIKI et al. (2010a), the sedimentary facies of the block is in concordance with "massive, structureless conglomerates and coarse conglomeratic sandstones, cross-bedded coarse and medium grained sandstones", a near-channel facies, coded "CH", and interpreted as a channel fill. Also following their hierarchical classification of the taphonomic modes, in the block are present two groups of fossils: complete isolated bones, coded"A1" (e.g. teeth and one of the vertebrae), and incomplete isolated bones, coded "A2" (in dominance). The remains from the block bear marking features for these two taphonomic modes, such as: for A1 - low degrees of weathering, abrasion, breakage; for A2 - advanced weathering, breakage, rarely identifiable taxonomically. However, a difference between the fossil assemblages from this block and the above mentioned taphonomic modes consist in the mix of taxa in the block, while in the coined modes there is only a mono-taxon.

CONCLUSIONS

The block extracted near the location called "Pui Gater" (CODREA & SOLOMON, 2012) contained at least eight reptiles taxa, documented either by teeth, or cranial and postcranial bones. The majority of the remains belongs to crocodilians, an unusual aspect at Pui where the presence of crocodilians is usually, poor. At least two crocodiles, *A. precedens* and *Acynodon* sp. are documented in the fossil assemblage from the block. The vertebrate remains include also turtles, pterosaurs and various dinosaurs. No small vertebrates were found inside the block. Therefore, this channel fill may be interpreted as a high-energy deposit (storm deposit). It is possible that a flood took place bringing together teeth and bones originating from several skeletons. Obviously, no anatomical connection could be observed. The teeth and bones were carried by the water stream on various distances, but we cannot think to a very long lasting transport, as far as some bones were extremely fragile (i.e. pterosaurs). This taphonomic context could have been possible due the fact that the climate in "Haţeg Island" was subtropical, characterized by alternation of dry and rainy seasons (VAN ITTERBEECK et al., 2004; THERRIEN, 2005).

CSIKI et al. (2010a) even suggested that the genesis of some fossil assemblages from the Haţeg basin could be related to flooding events, and that these events preferentially concentrated the bones.

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Plate I: Maastrichtian terrestrial reptiles from Pui

Figure 1. A block fragment illustrating the high concentration of fossils;
Figure 2. a - Chelonia indet., carapace fragment, internal view (PB1-38); b - carapace fragment, external view (PB1-38);
Figure 3. Chelonia indet., carapace fragment external view (PB1-39);
Figures 4a, b. Pterosauria indet., bone fragment (PB1-27);
Figures 5a, 5b. Pterosauria indet., bone fragment (PB1-28);
Figure 6. Theropoda indet., fragmentary phalanx (PB1-33): a. lateral view, b. distal view, c. proximal view;
Figure 7. Theropoda indet., fragmentary phalanx (PB1-34): a. lateral view, b. proximal view;
Figure 8. *Zalmoxes* sp., isolated tooth (PB1-20): a. buccal view, b. lingual view;
Figure 9. *Telmatosaurus transsylvanicus*, isolated tooth fragment, buccal view (PB1-21);
Figure 10. Titanosauria indet., mid-shaft fragment (PB1-30): a. caudal view, b. cranial view;
Figure 11. Titanosauria indet., ungual phalanx (PB1-36): a. lateral view, b. medial view, c. proximal view;
Figure 12. Reptilia indet., bone fragment (PB1-40);
Figure 13. Reptilia indet., bone fragment (PB1-41).

Plate II: Maastrichtian crocodiles from Pui

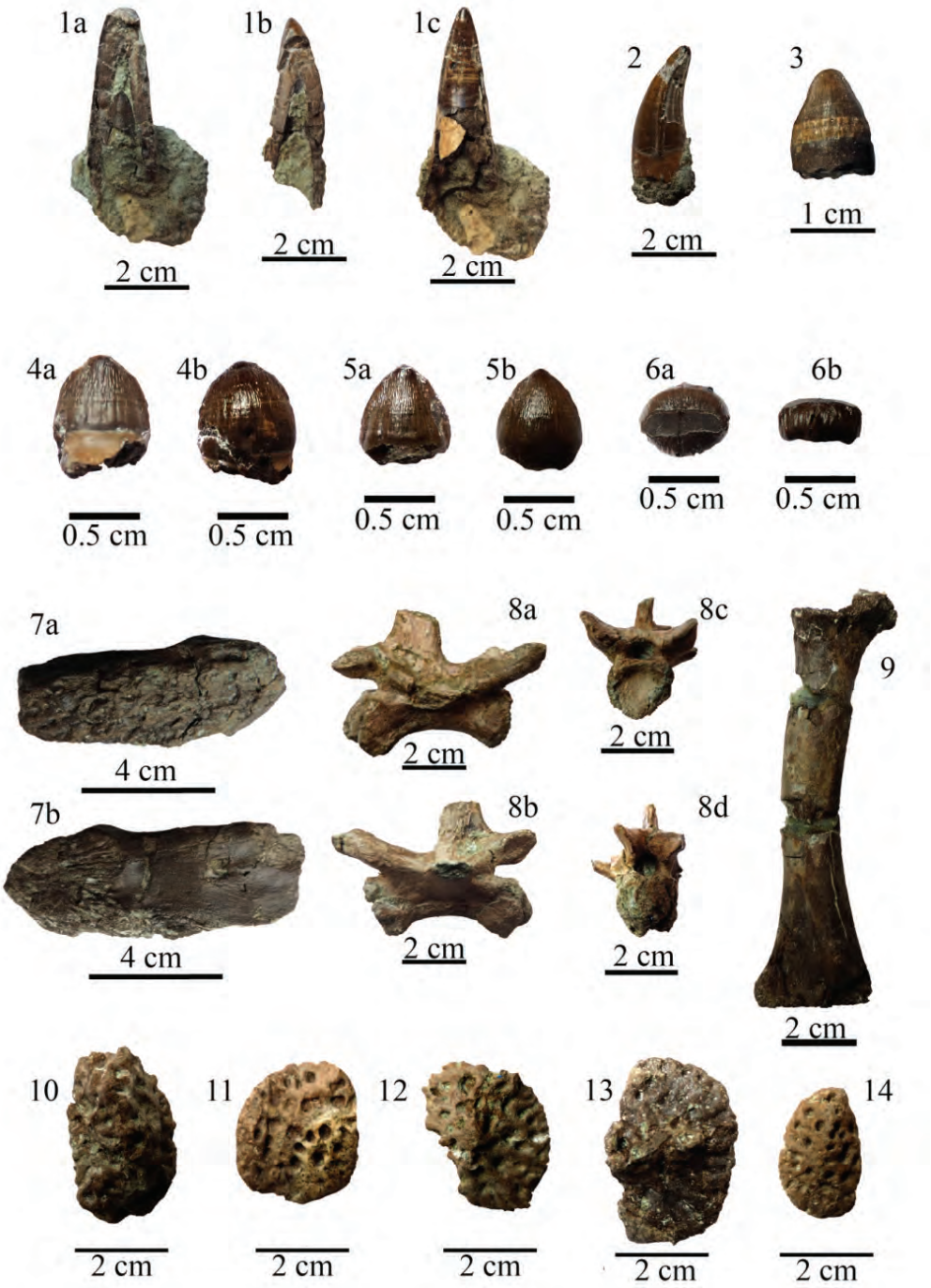

Figure 1. *Allodaposuchus precedens*, isolated tooth (Pb1-1): a, b. the broken tooth with the replacing tooth inside; c. lingual view;
Figure 2. *A. precedens*, isolated tooth, mesial view (Pb1-2);
Figure 3. *A. precedens*, isolated tooth, labial view (Pb1-7);
Figure 4. *Acynodon* sp., isolated tooth (Pb1-15): a. lingual view, b. labial view;
Figure 5. *Acynodon* sp, isolated tooth (Pb1-16): a. lingual view, b. labial view;
Figure 6. *Acynodon* sp, isolated tooth (Pb1-18): a. dorsal view, b. lateral view;
Figure 7. Crocodylia indet., surangular articular fragment (PB1-28): a. outer view, b. inner view;
Figure 8. Crocodylia indet., caudal vertebra (PP1-22): a, b. lateral views , c. anterior view, d. posterior view;
Figure 9. Crocodylia indet., tibia in caudal view (PB1-26);
Figure 10. Crocodylia indet., osteoderm in dorsal view (PB1-45);
Figure 11. Crocodylia indet., osteoderm in dorsal view (PB1-46);
Figure 12. Crocodylia indet., osteoderm in dorsal view (PB1-47);
Figure 13. Crocodyli aindet., osteoderm in dorsal view (PB1-49);
Figure 14. Crocodylia indet., osteoderm in dorsal view (PB1-52).

LICHEN RECORDS FROM TWO MILITARY BASES IN THE ASIAN SIDE OF ISTANBUL

ÇOBANOĞLU ÖZYİĞİTOĞLU Gülşah, YAVUZ Mustafa

Abstract. A list of 65 lichenized fungi taxa and a lichenicolous fungus is reported from two military bases: Infantry Academy and Naval Academy in Tuzla district, Istanbul province. 15 lichen species and a lichenicolous fungus are new records for the province. This paper is a first among equals (primus inter pares) since it mentions lichen records for the first time from military bases in Turkey.

Keywords: lichenized fungi, lichenicolous fungus, biodiversity, military bases, Turkey.

Rezumat. Semnalări de licheni din două baze militare din partea asiatică a oraşului Istanbul. Este prezentată o listă cu 65 ciuperci lichenizate şi o ciupercă lichenicolă din două baze militare: Academia de Infanterie şi Academia Navală din districtul Tuzla a Provinciei Istanbul. Dintre aceştia, 15 specii de licheni şi o ciupercă lichenicolă sunt semnalări noi pentru provincie. Lucrarea este prima care semnalează licheni pentru baze militare din Turcia.

Cuvinte cheie: ciuperci lichenizate, ciuperci lichenicole, biodiversitate, baze militare, Turcia.

INTRODUCTION

Studies on lichen mycota of several provinces in Turkey have become more numerous in the last decades. Although there is still a high number of deficient records for lichen species throughout the country, many papers with various impacts mark records or new records in course of time. In the literature, there is not any paper dealing with lichen records from military bases or areas. The present study aims at a contribution to the first lichen records in two military bases in Tuzla district of Istanbul, Turkey. Tuzla district is located in the eastern region of the Asian Part of Istanbul (Figure 1). Turkish Armed Forces have two major military security zones in the vicinity of Tuzla, Istanbul. Infantry Academy covers 1,700 ha surface area and Naval Academy 78 ha while the total surface area of Tuzla district is 12,363 ha (IBB, 2015).

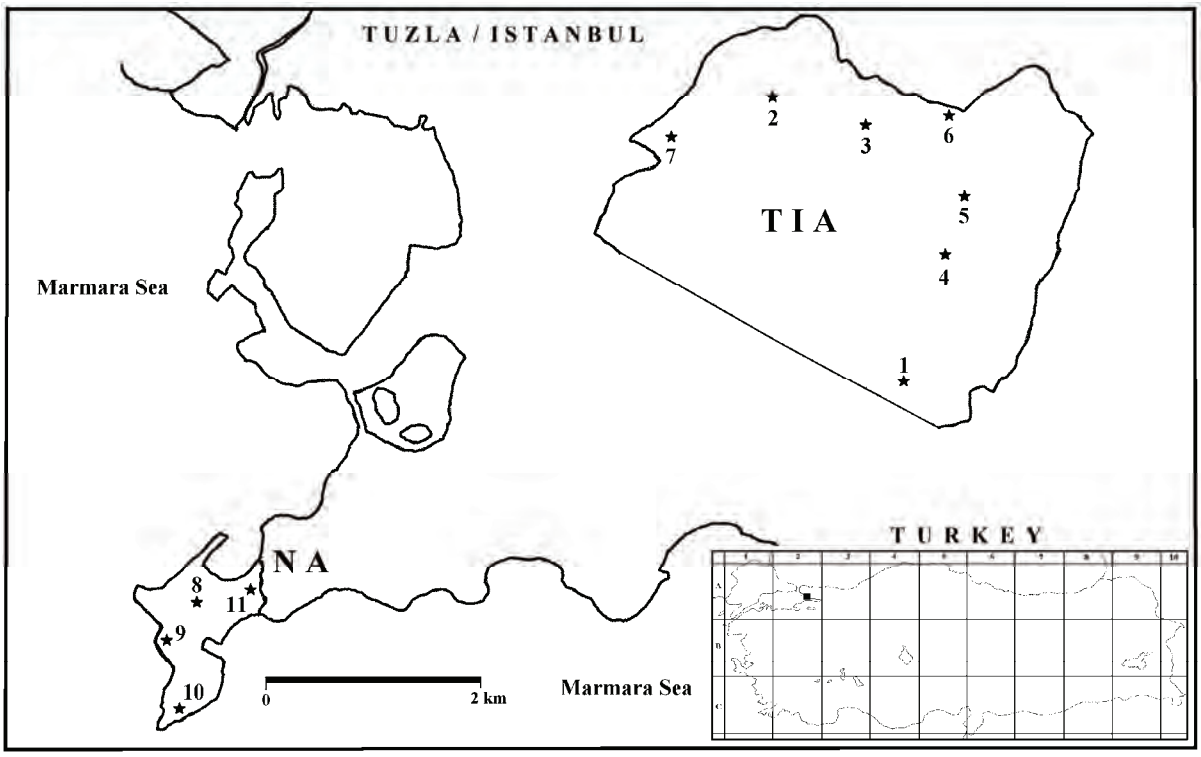

Figure 1. The Collecting Sites in the two military zones in Tuzla District of Istanbul.
TIA: Tuzla Infantry Academy, NA: Naval Academy.

According to the literature investigated, the first lichen samples from Istanbul were collected by J. Nemetz, between 1894 and 1897. These samples were determined by Dr. Karl Fritsch, a professor of systematic botany at the University of Vienna, and were published by STEINER (1899). The rest of the papers dealing with lichens from

Istanbul are as follows: SZATALA (1927); YALTIRIK (1966); ÇOBANOĞLU (1996); ÇOBANOĞLU & AKDEMIR (1997); ÖZDEMIR TÜRK & GÜNER (1998); ÇOBANOĞLU (2005); ÇOBANOĞLU (2007); GÖKMEN et al. (2007); GÖKMEN et al. (2008); ÇOBANOĞLU et al. (2008); YAZICI et al. (2010); ORAN & ÖZTÜRK (2011) and ORAN (2011). A total of 223 taxa from Istanbul have been recorded so far.

Table 1. Istanbul / Asian Side Long Term Climate Data.

Months	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Yearly**
Mean Temperature	5.7	5.7	7.2	11.7	16.4	21.1	23.5	23.5	19.8	15.6	11.5	7.9	**14.1**
Mean Precipitation	88.1	74.5	62.0	44.7	30.8	24.5	22.4	25.6	44.4	70.5	86.3	103.9	**677.7**

The general climatic features of Tuzla (Istanbul) are presented in (Table 1) and according to this table the ombrothermic diagram is created as in Figure 2. According to the data from Göztepe Meteorological Station, the climate is generally Temperate Mediterranean with a shift to Oceanic in the north. The average annual mean temperature is 14.1 C° and the annual precipitation is about 677.7 mm (MGM, 2015).

As it regards to the ombrothermic diagram given in Figure 2, the area scanned by the first and second junctions of mean temperature and mean precipitation curves is the dry session which includes April – October term for Istanbul.

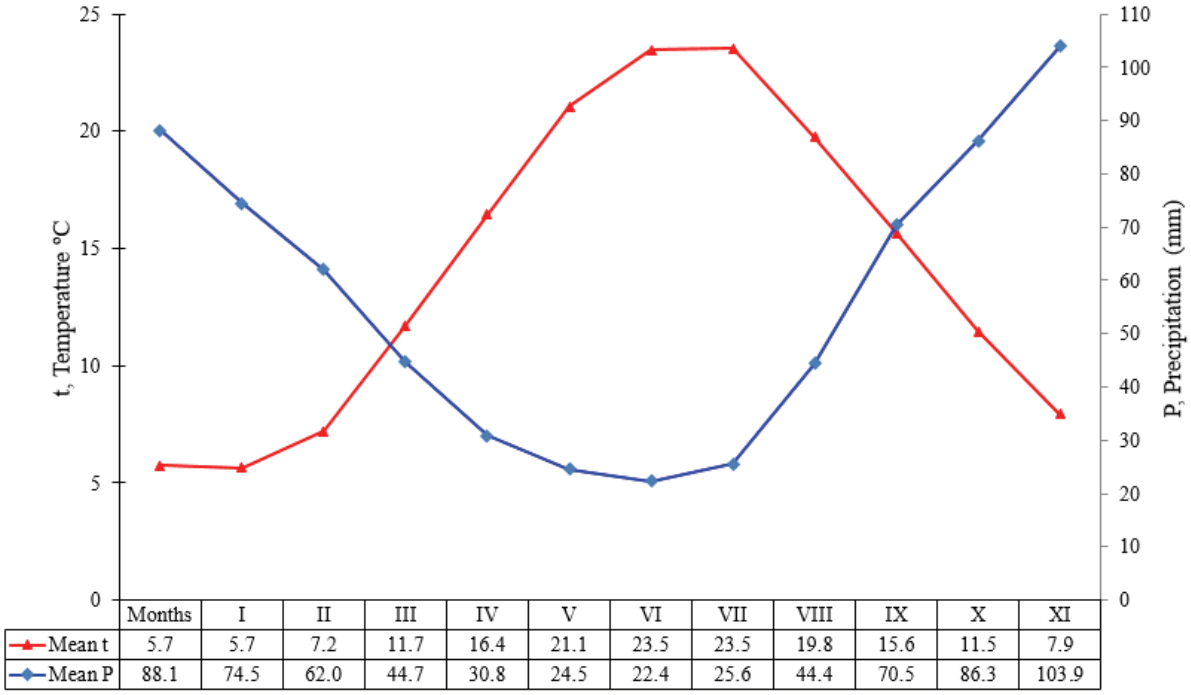

Figure 2. Ombrothermic Diagram of Tuzla, İstanbul.

MATERIALS AND METHODS

A special decree of authorisation and permission is given to the authors by the Ministry of National Defence (Turkey) with the date 17th May 2005 and number 2943-8456 in order to enter in and collect lichen materials from military bases in Tuzla, Istanbul. The lichen material was collected from seven sites in Tuzla Infantry Academy and four sites in Naval Academy between 2005 and 2006. The geographic coordinates and elevations were recorded by a *Garmin e-trex Summit*, GPS navigation instrument and the necessary data such as the substrate and habitat types were noted during the collection works. The lichen samples were placed in paper bags and after a visual observation taken out of the military zones. The taxa were identified with the aid of flora books and identification keys (CLAUZADE & ROUX, 1985; PURVIS et al., 1992; WIRTH, 1995). The lichen specimens are preserved in the Herbarium of the Faculty of Science and Arts, Marmara University, Istanbul (MUFE) with numbers given by Gülşah Çobanoğlu, (G.Ç. 2495-2646). A list of the collecting sites; locality, habitat and substrate properties are presented below under the following title.

Collection Sites and Localities

1. Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, on *Cupressus sempervirens*, on *Pinus nigra*, on Siliceous Rocks and on Soil, 40°49’52.20” N, - 29°20’28.50” E, May 25, 2005.
2. Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, on Siliceous Rocks and on Soil, 40°51’09.20” N, - 29°19’39.30” E, May 25, 2005.

3. Tuzla Infantry Academy, Northern Hill, 167 m, on Bark, on Siliceous Rocks and on Soil, 40°51'12.00" N, - 29° 20'15.60" E, May 25, 2005.
4. Tuzla Infantry Academy, Umur Creek, on Siliceous Rocks and on Soil, 63 m, 40°50'32.00" N, - 29°20'47.90" E, June 20, 2005.
5. Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40° 50' 50.60" N, - 29° 20' 53.20" E, June 20, 2005.
6. Tuzla Infantry Academy, Karakol Hill, 178 m, on Bark, on *Cupressus sempervirens* and on Siliceous Rocks, 40° 51' 03.90" N, - 29° 20' 37.40" E, June 20, 2005.
7. Tuzla Infantry Academy, Komando, 70 m, on *Pinus nigra*, 40° 51' 09.60" N, - 29° 18' 58.20" E, June 20, 2005.
8. Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40°48'47.98"N - 29°15'44.56"E, June 6, 2006.
9. Naval Academy, Near Sport Facilities, 3m, on *Populus* sp., on Wall and on *Washingtonia filifera*, 40°48'38.00"N - 29°15'28.50"E, June 6, 2006.
10. Naval Academy, Near Headquarters, 9 m, on *Cupressus sempervirens* and on *Populus* sp., 40°48'16.20"N - 29°15'38.00"E, June 6, 2006.
11. Naval Academy, Picnic Area, 4 m, on *Phoenix* sp. 40°48'53.00"N - 29°16'3.20"E, June 6, 2006.

RESULTS

65 lichen taxa and a lichenicolous fungus from the two military bases from Tuzla, Istanbul are listed alphabetically. 15 lichen species and a lichenicolous fungus are new records for Istanbul and are indicated with an asterisk (*) in the list. The names of authors are abbreviated according to BRUMMITT & POWELL (1992). The nomenclature follows the recent literature (BLANCO et al., 2004 a, b; SANTESSON et al., 2004). Geographic information about the localities and substrate preferences of the taxa are comparatively given below.

List of Taxa

Acarospora fuscata (Nyl.) Th. Fr.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40°49'52.20"N - 29°20'28.50"E, May 25, 2005, G.Ç. 2495; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40°51'09.20" N - 29°19' 39.30"E, May 25, 2005, G.Ç. 2496.

Alyxoria varia (Pers.) Ertz & Tehler

Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40°48'47.98"N - 29°15'44.56"E June 6, 2006, G.Ç. 2497; Naval Academy, Near Sport Facilities, 3 m, on *Washingtonia filifera*, 40°48'38.00"N - 29°15'28.50"E, June 6, 2006, G.Ç. 2498.

Amandinea punctata (Hoffm.) Coppins & Scheid.

Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40°48'47.98"N - 29°15'44.56"E, June 6, 2006, G.Ç. 2499; Naval Academy, Near Sport Facilities, 3 m, on *Washingtonia filifera*, 40°48'38.00"N - 29°15'28.50"E, June 6, 2006, G. Ç. 2500; Naval Academy, Picnic Area, 4 m, on *Phoenix* sp. 40°48'53.00"N - 29°16'3.20"E, June 6, 2006, G.Ç. 2501.

Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold

Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40°50'50.60"N - 29°20'53.20" E, June 20, 2005, G.Ç. 2502.

Aspicilia cinerea (L.) Körb.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40°49'52.20"N - 29°20'28.50"E, May 25, 2005, G. Ç. 2503; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40°51'09.20"N - 29°19' 39.30" E, May 25, 2005, G.Ç. 2504; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40°51'12.00"N - 29°20'15.60"E, May 25, 2005, G.Ç. 2505; Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40°50'50.60" N - 29°20'53.20" E, June 20, 2005, G. Ç. 2506; Tuzla Infantry Academy, Karakol Hill, 178 m, on Siliceous Rocks, 40°51' 03.90"N - 29°20'37.40"E, June 20, 2005, G. Ç. 2507.

Aspicilia contorta (Hoffm.) Körb.

Tuzla Infantry Academy, Umur Creek, on Siliceous Rocks, 63 m, 40° 50' 32.00" N - 29° 20' 47.90" E, June 20, 2005, G.Ç. 2508.

Aspicilia recedens (Taylor) Arnold

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2509; Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40° 50' 50.60" N, - 29° 20' 53.20" E, June 20, 2005, G.Ç. 2510.

**Bacidia arceutina* (Ach.) Rehm & Arnold

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on *Pinus nigra*, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2511.

Caloplaca arenaria (Pers.) Müll. Arg.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2512.

Caloplaca carphinea (Fr.) Jatta

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2513.

Caloplaca ceracea J. R. Laundon

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2514; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2515.

Caloplaca cerina (Hedw.) Th. Fr.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on *Pinus nigra*, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2516; Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens* 40° 51’ 03.90” N, - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2517.

Caloplaca saxicola (Hoffm.) Nordin

Naval Academy, Near Sport Facilities, 3 m, on Wall, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2518.

**Candelariella coralliza* (Nyl.) H. Magn.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2519; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2520.

Candelariella vitellina f. *flavovirella* (Nyl.) A. Hend.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2521; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2522; Tuzla Infantry Academy, Karakol Hill, 178 m, on Siliceous Rocks, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2523; Naval Academy, Near Sport Facilities, 3 m, on Wall, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2524.

Candelariella xanthostigma (Pers. ex Ach.) Lettau

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on *Pinus nigra*, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2525; Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2526; Naval Academy, Near Sport Facilities, 3 m, on *Populus sp.*, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2527.

Cetraria aculeata (Schreb.) Fr.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Soil, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2528.

**Cladonia caespiticia* (Pers.) Flörke

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Soil, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2529.

Cladonia convoluta (Lam.) Anders

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Soil, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2530; Tuzla Infantry Academy, Northern Hill, 167 m, on Soil, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2531.

Cladonia foliacea (Huds.) Willd.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Soil, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2532; Tuzla Infantry Academy, Umur Creek, on Soil, 63 m, 40° 50’ 32.00” N - 29° 20’ 47.90” E, June 20, 2005, G.Ç. 2533.

Cladonia furcata ssp. *rangiformis* (L.Scriba ex Sandst.) Pišút

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Soil, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2534; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Soil, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2535.

Cladonia pyxidata (L.) Hoffm.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Soil, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2536; Tuzla Infantry Academy, Northern Hill, 167 m, on Soil, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2537; Tuzla Infantry Academy, Umur Creek, on Soil, 63 m, 40° 50’ 32.00” N, - 29° 20’ 47.90” E, June 20, 2005, G.Ç. 2538.

Cladonia rangiformis Hoffm.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Soil, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2539; Tuzla Infantry Academy, Umur Creek, on Soil, 63 m, 40° 50’ 32.00” N - 29° 20’ 47.90” E, June 20, 2005, G.Ç. 2540.

Cladonia symphycarpia (Flörke) Fr.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Soil, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2541.

**Diploschistes caesioplumbeus* (Nyl.) Vain.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, on Siliceous Rocks 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2542; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks 40° 51' 12.00" N - 29° 20' 15.60" E, May 25, 2005, G.Ç. 2543.

Diplotomma alboatrum (Hoffm.) Flot.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, on Siliceous Rocks 40° 49' 52.20" N, - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2544.

Diplotomma epipolium (Ach.) Arnold

Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51' 03.90" N - 29° 20' 37.40" E, June 20, 2005, G.Ç. 2545.

**Gloniopsis praelonga* (Schwein.) Underw. & Earle

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, 40° 51' 09.20" N - 29° 19' 39.30" E, May 25, 2005, G.Ç. 2546.

Lecanora argentata (Ach.) Malme

Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51' 03.90" N - 29° 20' 37.40" E, June 20, 2005, G.Ç. 2547.

Lecanora carpinea (L.) Vain.

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, 40° 51' 09.20" N - 29° 19' 39.30" E, May 25, 2005, G.Ç. 2546; Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51' 03.90" N - 29° 20' 37.40" E, June 20, 2005, G.Ç. 2549.

Lecanora chlarotera Nyl.

Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51' 03.90" N - 29° 20' 37.40" E, June 20, 2005, G.Ç. 2550.

Lecanora dispersa (Pers.) Röhl.

Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48' 47.98" N - 29° 15' 44.56" E, June 6, 2006, G.Ç. 2551; Naval Academy, Near Sport Facilities, 3 m, on *Populus sp.*, and on *Washingtonia filifera*, 40° 48' 38.00" N - 29° 15' 28.50" E, June 6, 2006, G.Ç. 2552.

Lecanora hagenii (Ach.) Ach.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2553.

Lecanora muralis (Schreb.) Rabenh.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49' 52.20" N, - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2554.

Lecanora saligna (Schrad.) Zahlbr.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on *Cupressus sempervirens*, on *Pinus nigra*, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2555; Tuzla Infantry Academy, Komando, 70 m, on *Pinus nigra*, 40° 51' 09.60" N - 29° 18' 58.20" E, June 20, 2005, G.Ç. 2556.

**Lecanora swartzii* (Ach.) Ach.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2557.

**Lecanora symmicta* (Ach.) Ach.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2558.

Lecidea fuscoatra (L.) Ach.

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51' 09.20" N - 29° 19' 39.30" E, May 25, 2005, G.Ç. 2559.

**Lecidella anomaloides* (A. Massal.) Hertel & H.Kilias

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51' 09.20" N - 29° 19' 39.30" E, May 25, 2005, G.Ç. 2560; Tuzla Infantry Academy, Gölet, 104 m, on Siliceous Rocks, 40° 50' 50.60" N - 29° 20' 53.20" E, 20.VI.2005, G.Ç. 2561.

Lecidella carpathica Körb.

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51' 09.20" N - 29° 19' 39.30" E, May 25, 2005, G.Ç. 2562; Tuzla Infantry Academy, Umur Creek, on Siliceous Rocks, 63 m, 40° 50' 32.00" N - 29° 20' 47.90" E, June 20, 2005, G.Ç. 2563; Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40° 50' 50.60" N - 29° 20' 53.20" E, June 20, 2005, G.Ç. 2564.

Lecidella elaeochroma (Ach.) M. Choisy

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on *Pinus nigra*, 40° 49' 52.20" N, - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2565; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, 40° 51' 09.20" N - 29° 19' 39.30" E, May 25, 2005, G.Ç. 2566; Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51' 03.90" N - 29° 20' 37.40" E, June 20, 2005, G.Ç. 2567.

Melanohalea exasperatula (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw & Lumbsch

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2568; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2569.

Parmelia sulcata Taylor

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2570; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2571; Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48’ 47.98” N - 29° 15’ 44.56” E, June 6, 2006, G.Ç. 2572; Naval Academy, Near Sport Facilities, 3 m, on *Washingtonia filifera*, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2573.

Parmelina tiliacea (Hoffm.) Hale

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, on *Cupressus sempervirens*, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2574.

Phaeophyscia orbicularis (Neck.) Moberg

Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48’ 47.98” N - 29° 15’ 44.56” E, June 6, 2006, G.Ç. 2575; Naval Academy, Near Sport Facilities, 3 m, *Washingtonia filifera*, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2576.

Physcia adscendens (Fr.) H. Olivier

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, on *Cupressus sempervirens*, on *Pinus nigra*, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2577; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2578; Tuzla Infantry Academy, Northern Hill, 167 m, on Bark, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2579; Tuzla Infantry Academy, Karakol Hill, 178 m, on Bark, on *Cupressus sempervirens*, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2580; Tuzla Infantry Academy, Komando, 70 m, on *Pinus nigra*, 40° 51’ 09.60” N - 29° 18’ 58.20” E, June 20, 2005, G.Ç. 2581; Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48’ 47.98” N - 29° 15’ 44.56” E, June 6, 2006, G.Ç. 2582; Naval Academy, Near Sport Facilities, 3 m, on *Populus sp.*, on *Washingtonia filifera*, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2583; Naval Academy, Near Headquarters, 9 m, on *Cupressus sempervirens* and on *Populus sp.*, 40° 48’ 16.20” N - 29° 15’ 38.00” E, June 6, 2006, G.Ç. 2584; Naval Academy, Picnic Area, 4 m, on *Phoenix sp.* 40° 48’ 53.00” N - 29° 16’ 3.20” E, June 6, 2006, G.Ç. 2585.

Physcia tenella (Scop.) DC.

Tuzla Infantry Academy, Karakol Hill, 178 m, on Bark, on *Cupressus sempervirens*, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2586; Tuzla Infantry Academy, Komando, 70 m, on *Pinus nigra*, 40° 51’ 09.60” N - 29° 18’ 58.20” E, June 20, 2005, G.Ç. 2587; Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48’ 47.98” N - 29° 15’ 44.56” E, June 6, 2006, G.Ç. 2588; Naval Academy, Near Sport Facilities, 3 m, on *Washingtonia filifera*, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2589; Naval Academy, Near Headquarters, 9 m, on *Cupressus sempervirens* and on *Populus sp.*, 40° 48’ 16.20” N - 29° 15’ 38.00” E, June 6, 2006, G.Ç. 2590; Naval Academy, Picnic Area, 4 m, on *Phoenix sp.* 40° 48’ 53.00”N - 29° 16’ 3.20” E, June 6, 2006, G.Ç. 2591.

Physconia grisea (Lam.) Poelt

Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2592; Tuzla Infantry Academy, Komando, 70 m, on *Pinus nigra*, 40° 51’ 09.60” N - 29° 18’ 58.20” E, June 20, 2005, G.Ç. 2593; Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48’ 47.98” N - 29° 15’ 44.56” E, June 6, 2006, G.Ç. 2594; Naval Academy, Near Sport Facilities, 3m, on *Washingtonia filifera*, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2595; Naval Academy, Near Headquarters, 9 m, on *Cupressus sempervirens* and on *Populus sp.*, 40° 48’ 16.20” N - 29° 15’ 38.00” E, June 6, 2006, G.Ç. 2596; Naval Academy, Picnic Area, 4 m, on *Phoenix sp.* 40° 48’ 53.00” N - 29° 16’ 3.20” E, June 6, 2006, G.Ç. 2597.

**Pleurosticta acetabulum* (Neck.) Elix & Lumbsch

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Bark, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2598.

**Polychidium muscicola* (Sw.) Gray

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Soil, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2599; Tuzla Infantry Academy, Umur Creek, on Soil, 63 m, 40° 50’ 32.00” N - 29° 20’ 47.90” E, June 20, 2005, G.Ç. 2600.

Polysporina simplex (Taylor) Vězda

Tuzla Infantry Academy, Umur Creek, on Siliceous Rocks, 63 m, 40° 50’ 32.00” N - 29° 20’ 47.90” E, June 20, 2005, G.Ç. 2601; Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40° 50’ 50.60” N - 29° 20’ 53.20” E, June 20, 2005, G.Ç. 2602.

Protoparmelia montagnei (Fr.) Sancho & A.Crespo

Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2603.

**Ramalina canariensis* J. Steiner

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2604; Tuzla Infantry Academy, Northern Hill, 167 m, on Bark, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2605.

**Ramalina pollinaria* (Westr.) Ach.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2606; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2607; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2608; Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48’ 47.98” N - 29° 15’ 44.56” E, June 6, 2006, G.Ç. 2609; Naval Academy, Near Sport Facilities, 3 m, on *Washingtonia filifera*, 40° 48’ 38.00” N - 29° 15’ 28.50” E, June 6, 2006, G.Ç. 2610.

**Rhizocarpon geminatum* Körb.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2611; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2612; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2613.

Rhizocarpon geographicum (L.) DC.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2614; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2615; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2616; Tuzla Infantry Academy, Umur Creek, on Siliceous Rocks, 63 m, 40° 50’ 32.00” N - 29° 20’ 47.90” E, 20.VI.2005, G.Ç. 2617.

**Rhizocarpon lecanorinum* Anders

Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2618.

**Rhizocarpon postumum* (Nyl.) Arnold

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2619; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2619; Tuzla Infantry Academy, Umur Creek, on Siliceous Rocks, 63 m, 40° 50’ 32.00” N - 29° 20’ 47.90” E, June 20, 2005, G.Ç. 2620; Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40° 50’ 50.60” N - 29° 20’ 53.20” E, June 20, 2005, G.Ç. 2621.

Rinodina exigua (Ach.) Gray

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on *Pinus nigra*, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2623; Tuzla Infantry Academy, Karakol Hill, 178 m, on *Cupressus sempervirens*, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2624.

**Romjularia lurida* (Ach.) Timdal

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2625.

Xanthoparmelia conspersa (Ehrh. ex Ach.) Hale

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2626.

Xanthoparmelia mougeotii (Schaer.) Hale

Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2627; Tuzla Infantry Academy, Karakol Hill, 178 m, on Siliceous Rocks, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2628.

Xanthoparmelia pulla (Ach.) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2629; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Siliceous Rocks, 40° 51’ 09.20” N - 29° 19’ 39.30” E, May 25, 2005, G.Ç. 2630; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2631.

Xanthoparmelia tinctina (Maheu & A.Gillet) Hale

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2632; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2633; Tuzla Infantry Academy, Pond, 104 m, on Siliceous Rocks, 40° 50’ 50.60” N - 29° 20’ 53.20” E, June 20, 2005, G.Ç. 2634; Tuzla Infantry Academy, Karakol Hill, 178 m, on Siliceous Rocks, 40° 51’ 03.90” N - 29° 20’ 37.40” E, June 20, 2005, G.Ç. 2635.

Xanthoparmelia verruculifera (Nyl.) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on Siliceous Rocks, 40° 49’ 52.20” N - 29° 20’ 28.50” E, May 25, 2005, G.Ç. 2636; Tuzla Infantry Academy, Northern Hill, 167 m, on Siliceous Rocks, 40° 51’ 12.00” N - 29° 20’ 15.60” E, May 25, 2005, G.Ç. 2637.

Xanthoria parietina (L.) Th. Fr.

Tuzla Infantry Academy, Tavşantepe Hill, 108 m, on *Cupressus sempervirens*, on *Pinus nigra*, on Siliceous Rocks, 40° 49' 52.20" N - 29° 20' 28.50" E, May 25, 2005, G.Ç. 2638; Tuzla Infantry Academy, Bayraktepe Hill, 202 m, on Bark, on Siliceous Rocks, 40° 51' 09.20" N - 29° 19' 39.30" E, May 25, 2005, G.Ç. 2639; Tuzla Infantry Academy, Northern Hill, 167 m, on Bark, 40° 51' 12.00" N - 29° 20' 15.60" E, May 25, 2005, G.Ç. 2640; Tuzla Infantry Academy, Karakol Hill, 178 m, on Bark, on *Cupressus sempervirens*, 40° 51' 03.90" N - 29° 20' 37.40" E, June 20, 2005, G.Ç. 2641; Tuzla Infantry Academy, Komando, 70 m, on *Pinus nigra*, 40° 51' 09.60" N - 29° 18' 58.20" E, June 20, 2005, G.Ç. 2642; Naval Academy, Main Avenue, 4 m, on *Acer negundo*, 40° 48' 47.98" N - 29° 15' 44.56" E, June 6, 2006, G.Ç. 2643; Naval Academy, Near Sport Facilities, 3 m, on *Populus* sp., on *Washingtonia filifera*, 40° 48' 38.00" N - 29° 15' 28.50" E, June 6, 2006, G.Ç. 2644; Naval Academy, Near Headquarters, 9 m, on *Populus sp.*, 40° 48' 16.20" N - 29° 15' 38.00" E, June 6, 2006, G.Ç. 2645; Naval Academy, Picnic Area, 4 m, on *Phoenix sp.* 40° 48' 53.00" N - 29° 16' 3.20" E, June 6, 2006, G.Ç. 2646.

CONCLUSIONS

The present study reports a total of 65 lichenized fungi taxa and 1 lichenicolous fungus from the two military bases in Tuzla. The study results contribute to the Turkish lichen mycota as well as to the lichen diversity of Istanbul with a good ratio of 15/65 taxa. Fifteen lichen species, *Bacidia arceutina* (Ach.) Rehm & Arnold, *Candelariella coralliza* (Nyl.) H. Magn., *Cladonia caespiticia* (Pers.) Flörke, *Diploschistes caesioplumbeus* (Nyl.) Vain., *Lecanora swartzii* (Ach.) Ach., *Lecanora symmicta* (Ach.) Ach., *Lecidella anomaloides* (A. Massal.) Hertel & H. Kilias, *Pleurosticta acetabulum* (Neck.) Elix & Lumbsch, *Polychidium muscicola* (Sw.) Gray, *Ramalina canariensis* J.Steiner, *Ramalina pollinaria* (Westr.) Ach., *Rhizocarpon geminatum* Körb., *Rhizocarpon lecanorinum* Anders, *Rhizocarpon postumum* (Nyl.) Arnold, *Romjularia lurida* (Ach.) Timdal, and one lichenicolous fungus species, *Gloniopsis praelonga* (Schwein.) Underw. & Earle are new records for the province. Earlier records in the literature show that 223 lichen taxa have been recorded from Istanbul. Since the military fields are protected and special permission is required to enter and make a botanical study, lichens of these areas have remained intact. Therefore the data is valuable in terms of lichen diversity of both the province and the country.

The list given in this study includes 31 genera and the most frequent genera within the study area are *Lecanora* (represented by 9 species), *Cladonia* (represented by 7 species), *Caloplaca* (represented by 5 species) and *Xanthoparmelia* (represented by 5 species).

Table 2. Distribution of taxa within the study area according to the substrate types.

	Terricolous Taxa	Saxicolous Taxa		Epiphytic Taxa							Total
Substrate	Soil	Wall	Siliceous Rocks	Bark	*A. negundo*	*C. sempervirens*	*W. filifera*	*P. nigra*	*Populus sp.*	*Phoenix sp.*	
Number	9	2	32	12	10	14	10	10	6	5	110
	9	34		67							110
Percentage	**8.18 %**	**30.91 %**		**60.91 %**							100 %

From a total of 110 collected lichen samples from the study area, Table 2 depicts the distribution of taxa according to substrate types. As a result of the Mediterranean climate, maquis vegetation is present in the region. Thus, the epiphytic taxa are rather abundant and higher in number with a sum of 60.91% in the collection sites, scattered on *Cupressus sempervirens* L. (substrate for 14 taxa), on bark (substrate for 12 taxa) and on *Washingtonia filifera* (J.Linden ex Andre) H.Wendl and *Pinus nigra* J.F.Arnold (both substrates for 10 taxa). Saxicolous taxa that follow the epiphytes with 30.91 % of the whole have been collected majorly on siliceous rocks (32 taxa). The only two taxa collected from cement-wall are *Caloplaca saxicola* (Hoffm.) Nordin and *Candelariella vitellina* f. *flavovirella* (Nyl.) A.Hend. Terricolous taxa hold only 8.18 % of the total samples and are represented by 9 taxa.

According to the data recorded in the field, *Xanthoria parietina* (L.) Th. Fr. prefers 8 of 10 different substrate types while both *Physcia adscendens* (Fr.) H. Olivier and *P. tenella* (Scop.) DC. prefer 7, *Physconia grisea* (Lam.) Poelt prefers 6. These species have an ability to adapt on a diversity of substrata. The relation between substrate types and the taxa correspond with the literature.

Xanthoria parietina (L.) Th. Fr. and *Physcia adscendens* (Fr.) H. Olivier have been collected from 9, *Physcia tenella* (Scop.) DC. and *Physconia grisea* (Lam.) Poelt have been collected from 6, and *Ramalina pollinaria* (Westr.) Ach. has been collected from 5 different localities of total 11 collecting sites. These species show a frequency of abundance in the study area.

This paper is a primus inter pares since it mentions lichen records for the first time from military bases in Turkey. The distribution of taxa according to localities is 13.8 on average. The first locality is represented by 40 taxa while the second by 27, the sixth by 16 and the third by 15 taxa. These localities indicate most protected areas by means of habitats and substrates in Tuzla Infantry Academy field. The localities in the Naval Academy have lower number of taxa (below the average) due to the artificial terrain. Human intervention on the natural environment such as man-made

landscapes, have resulted in lichen-deserts in the Naval Academy Field. It is obvious that, due to the number, frequency and distribution of lichen taxa, variety of substrate and habitat types, Tuzla Infantry Academy field is better protected than that of the Naval Academy. It is still unclear if there is a prominent distinction in the understanding and use of nature between Land Forces and Naval Forces in the army.

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INFLUENCE OF THE MATERNAL FACTOR IN THE CONTROL OF SOME BIOLOGICAL CHARACTERS AND PRODUCTIVITY OF TOMATOES

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Abstract. The phenotype character is determined not only by genotype, but also by maternal effects, namely by the direct contribution of the maternal phenotype on the phenotype of the descendants. By researching the influence of maternal factor in the control of some biological characters and productivity in tomato, there were registered 64 % cases of maternal effects. It was found that one and the same maternal form, in different combinations may manifest different influence on the phenotypic spectrum in segregating populations, what reveals the importance of the interactions of the two genomes - maternal and paternal in the formation of the character.

Keywords: maternal effect, tomato, reciprocal hybrids.

Rezumat. Influenţa factorului maternal în controlul unor caractere biologice şi de productivitate la tomate. Fenotipul caracterului este determinat nu doar de genotip, ci şi de efectele materne (maternale), adică de contribuţia directă a fenotipului matern asupra fenotipului urmaşilor. Prin cercetarea influenţei factorului matern în controlul unor caractere biologice şi de productivitate la tomate, au fost înregistrate 64 % cazuri de efecte materne. S-a constatat că una şi aceeaşi formă maternă, în diferite combinaţii poate manifesta influenţă diferită asupra spectrului fenotipic în populaţiile segregante, ceea ce relevă importanţa interacţiunilor celor 2 genomuri - matern şi patern în formarea caracterului.

Cuvinte cheie: efect matern, tomate, hibrizi reciproci.

INTRODUCTION

Optimization and efficiency programmes of amelioration of tomato is inconceivable in the absence of knowledge of the genetic basis of characters for which it is performed research and technology development genotypes with the desired qualities (AGONG et al., 2000). The extension of the tomato cultures into new geographic areas, developing technologies, diversification of production destination, all these make necessary the creation of varieties with special adaptations (BOTNARI & CEBOTARI, 2003). In recent years, the research focused on the adaption of the vegetable material to the environmental conditions, in particular at the stressful factors that play a limitative role. On the other hand, the consumers' requirements regarding the quality of the fruit are increasingly diversified, with regard to both appearance and consistency of the fruit, organoleptic and nutritional attributes, but also to the opportunities of industrial capitalization of tomatoes. The productivity of tomatoes, as as well as of other vegetable species, is a very complex trait that depends on the productivity elements – features set up on the basis of hereditary varieties and their interaction with environmental conditions (http://ru.scribd.com).

In relatively recent studies, it is mentioned about the involvement of maternal factor in the heritance of quantitative and qualitative characters (BALASHOVA et al., 2012). Even the response to selection can be affected by this effect (ETTERSON & GALLOWAY, 2002). Maternal and paternal effects can lead to different evolutions of the one for which selection is oriented. Parents influence children indirectly (genetically) and directly (through the resources they supply the seed) (HOLESKI, 2007). However, selection based on direct genetic effect, without taking into consideration the cytoplasm maternal form may not be adequate, and lead to the exclusion of an important source of genetic variance (WOLF et al., 2002). The **goal of the research** was to determine the influence of maternal factor in control of some biological characters and productivity of tomatoes.

MATERIAL AND METHODS

Three combinations of reciprocal hybrids belonging to to F_1, F_2 and F_3 generations, derivatives from 4 varieties of tomatoes - Gloria, Jubiliar, Atlasnâi, Zastava were used as research material as they present many characters. There were analysed the following biological indices: the number of seeds per fruit, fruit mass (g), fruit length and diameter (mm), pericarp and mesocarp thickness (mm), number of seminal lodges, plant height (cm); the productivity: mass (g) and number of fruit per plant.

The influence of the maternal factor was determined by reciprocity effect (r_e) according to the formula proposed by the author (REINHOLD, 2002).

The statistical processing of the data was performed in STATISTICA 7 software package.

RESULTS AND DISCUSSION

The study of the influence of parental factor, in control of some biological characters and productivity in tomato, during two years has demonstrated the differentiated contribution of maternal factor depending on the character and combination. Thus, the overall maternal effects were confirmed in 64 % of cases. The most affected indices by the

maternal influence characters were: plant height, fruit length, pericarp thickness and number of fruit per plant, while less influenced were mass, fruit diameter, number of seeds per fruit, number of seminal lodges (Table 1).

Table 1. Maternal and paternal effects in the reciprocal hybrids F_1 of tomato for some quantitative characters.

Combination	**Gloria x Jubiliar/ Jubiliar x Gloria**		**Gloria x Atlasnâi/ Atlasnîi x Gloria**		**Gloria x Zastava/ Zastava x Gloria**		**Total maternal effects:**	
Character	2012	2013	2012	2013	2012	2013	2012	2013
Plant height (mass flowering)	-0.01	-1.73	+0.09	-1.03	-0.71	+2.45	*2*	*2*
Plant height (mass fructification)	+0.21	-2.29	-0.47	-71.00	-0.08	-452.00	*2*	*3*
Plant height (mass ripening)	+0.14	-1.31	-0.48	-1.00	-0.24	-1.21	*2*	*3*
Fruit mass	+0.02	-0.11	+0.12	+0.58	-0.65	+1.64	*1*	*1*
Fruit length	-0.25	-0.46	-1.77	-7.75	-0.46	-0.24	*3*	*3*
Fruit diameter	-0.83	+0.69	+0.49	-0.41	+1.08	+4.79	*1*	*1*
Pericarp thickness	-0.31	-0.72	+0.27	+2.48	-0.10	-1.24	*2*	*2*
Mesocarp thickness	-0.07	-1.14	-0.07	+0.26	-0.14	+2.11	*3*	*1*
Number of seminal lodges	-0.43	-0.43	+0.11	+0.25	-2.40	+0.83	*2*	*1*
Number of seeds per fruit	+0.08	-0.42	+1.11	+0.70	-0.20	+0.42	*1*	*1*
Number of fruit per plant	-0.13	-0.63	+1.06	-0.15	-0.80	-0.49	*2*	*3*
Total maternal effects:	*7*	*10*	*4*	*6*	*10*	*5*	*21*	*21*

Although in all the 3 reciprocal combinations Gloria variety was involved, the biggest impact as maternal form it had in combination with Jubiliar and less with Atlasnâi, which reveals the important role of intra-allelic interactions in the manifestation of the maternal effect. As it is known, the weight (mass) of fruit and number of fruits per plant are the basic elements of plant productivity – mass of fruit per plant. By analysis the elements of the productivity of tomatoes, there were registered quite different values in case of both parental forms and the reciprocal hybrids.

Mass of fruit per plant. The value of this index varied between 1.6 and 2.9 kg at parents and between 1.8 and 2.7 kg – at hybrids. The true differences between reciprocal hybrids were found to the combinations: F_3 Gloria x Atlasnâi (II)/F_3 Atlasnâi x Gloria (II), F_3 Gloria x Zastava (II)/F_3 Zastava x Gloria (II).

Number of fruit per plant. It varied in interval 19.1 … 46.0 at parents and 18.7 … 41.2 – at hybrids. Significant differences between reciprocal combinations were found to the hybrids: F_3 Gloria x Jubiliar (II)/F_3 Jubiliar x Gloria (II), F_3 Gloria x Atlasnâi (I)/F_3 Atlasnâi x Gloria (I), F_3 Gloria x Atlasnâi (II)/F_3 Atlasnâi x Gloria (II), F_3 Gloria x Zastava (I)/F_3 Zastava x Gloria (I) şi F_3 Gloria x Zastava (I)/ F_3 Zastava x Gloria (I) (Fig. 1).

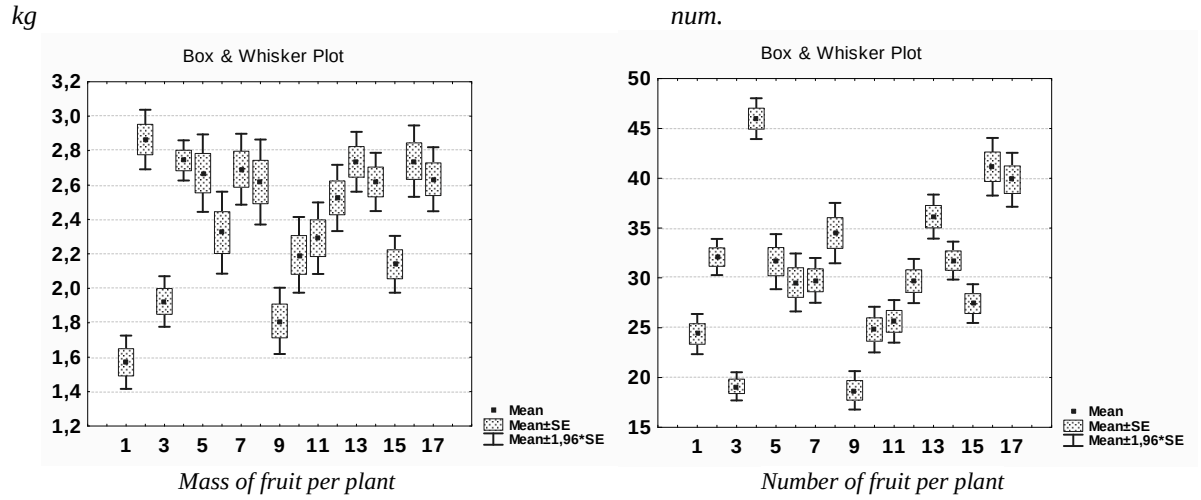
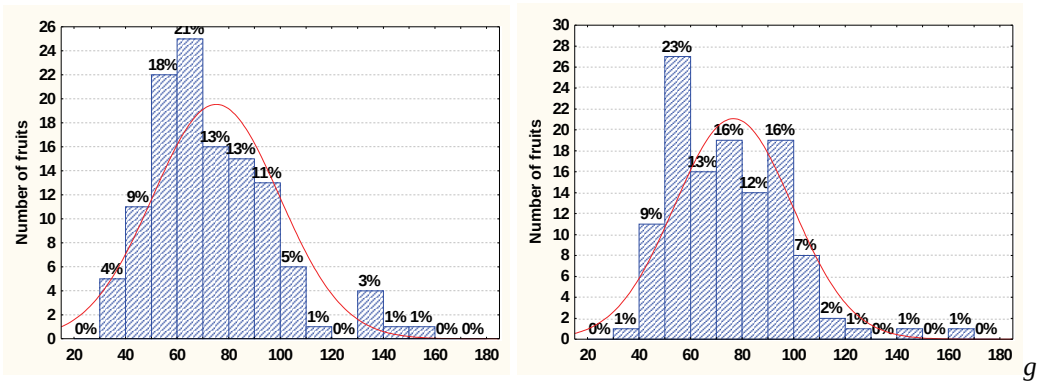


Figure 1. Comparative notes of the productivity elements of tomatoes.

Legend: 1. Gloria; 2. Jubiliar; 3. Atlasnâi; 4. Zastava; 5. F_3 Gloria x Jubiliar (I); 6. F_3 Gloria x Jubiliar (II); 7. F_3 Jubiliar x Gloria (I); 8. F_3 Jubiliar x Gloria (II); 9. F_3 Jubiliar x Gloria (I); 10. F_3 Gloria x Atlasnâi (I); 11. F_3 Gloria x Atlasnâi (II); 12. F_3 Atlasnâi x Gloria (I); 13. F_3 Atlasnâi x Gloria (II); 14. F_3 Gloria x Zastava (I); 15. F_3 Gloria x Zastava (II); 16. F_3 Zastava x Gloria (I); 17. F_3 Zastava x Gloria (II).

The research histograms demonstrated that, in case of the reciprocal hybrids F_2 and F_3, the plant distribution in phenotypic classes was different for all the analysed characters.

For example, for the *weight (mass) of the fruit*, the analysis of the histograms of the distribution of fruits in reciprocal populations, demonstrated that in F_2 Gloria x Zastava, the maximum frequency of distribution was registered for the phenotypic class 60-70 g (21 %), while the maximum weight class, 150-160 g, registered the lowest percentage, namely 1%. In case of F_2 Zastava x Gloria, the maximum frequency was certified for the class 50-60 g (23 %) and the class with maximum weight – 160-170 g registered the lowest frequency (1 %) (Fig. 2).

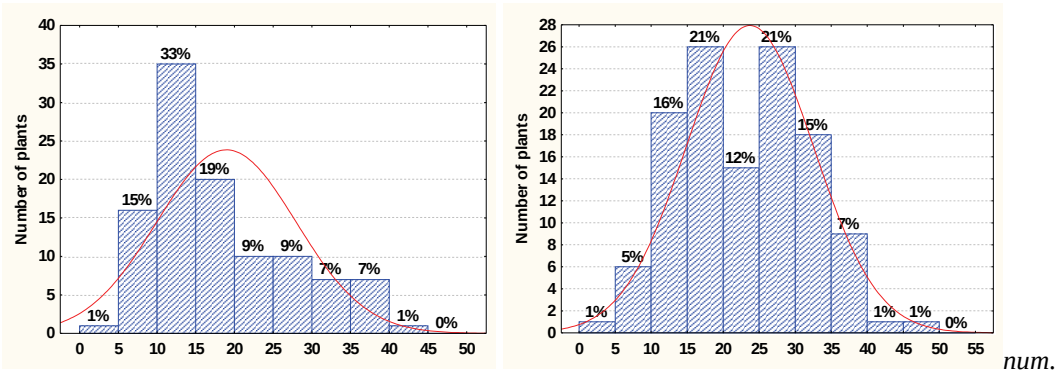


g

F_2 Gloria x Zastava *F_2 Zastava x Gloria*

Figure 2. The histograms of distribution of the tomato plants on the basis of *fruit size* in F_2 reciprocal segregating populations.

There were found important differences for the *number of fruits per plant*. In case of F_2 Gloria x Jubiliar the maximum frequency of distribution was for the class 10-15 (33 %), and maximum class: 40-45 (15 %), while for F_2 Jubiliar x Gloria, it was observed the tendency of dividing the population in two subpopulations with their own maximum of distribution; the maximum class was 45-50 (1 %) (Fig. 3).

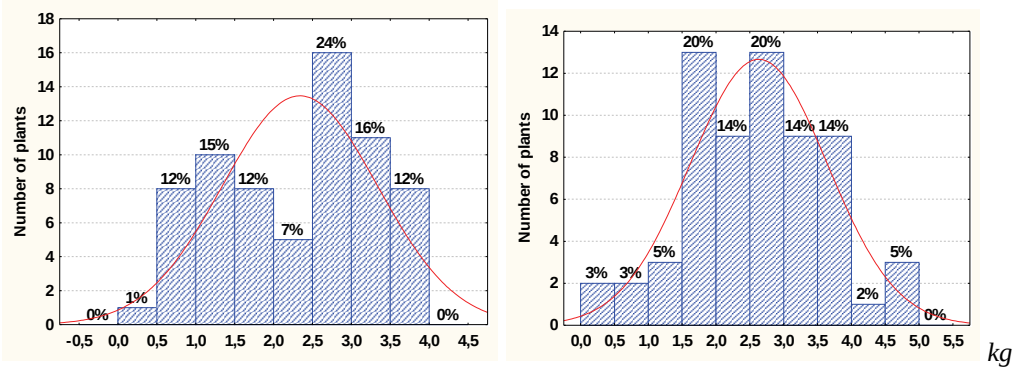


num.

F_2 Gloria x Jubiliar *F_2 Jubiliar x Gloria*

Figure 3. The histograms of distribution of the tomato plants on the basis of *number of fruit per plant* in F_2 reciprocal segregating populations.

The differences in the distribution histograms were also certified in reciprocal populations F_3. For *mass of fruit per plant*, the combination F_3 Gloria x Jubiliar, the phenotypic class 2.5-3.0 kg registered the maximum frequency of distribution (24 %) and the class with maximum values – 3.5-4.0 kg (12.0 %); in case of F_3 Jubiliar x Gloria, the maximum frequency was certified for the class 1.5-2.0 kg and 2.5-3.0 kg (20 %) and the class with maximum values – 4.5-5.0 kg (5 %) (Fig. 4).

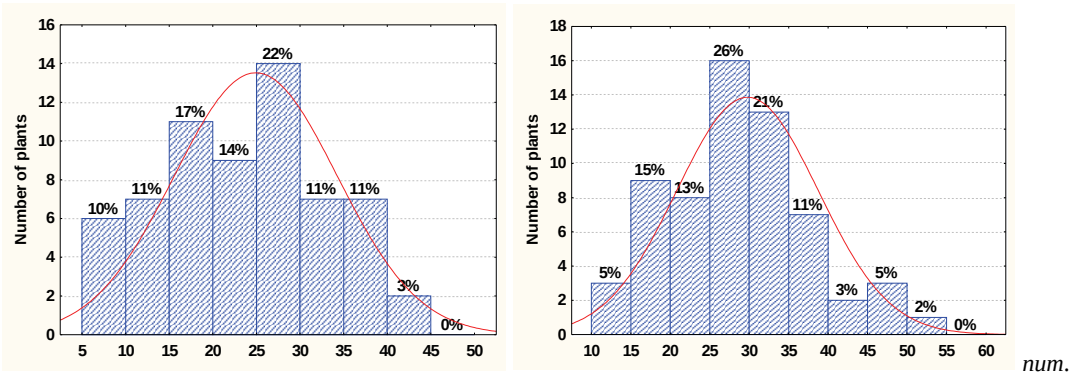


kg

F_3 Gloria x Jubiliar *F_3 Jubiliar x Gloria*

Figure 4. The histograms of distribution of the tomato plants on the basis of *mass of fruit per plant* in reciprocal populations F_3.

There were found important differences and for the *number of fruits per plant*. For F_3 Gloria x Atlasnâi, the maximum frequency of distribution was for the class 25-30 (22 %) and maximum class: 40-45 (1 %), while for F_3 Atlasnâi x Gloria the maximum frequency of distribution was for the class 25-30 (29 %) and maximum class – 50-55 (2 %) (Fig. 5).



F_3 Gloria x Atlasnâi *F_3 Atlasnâi x Gloria*

Figure 5. The histograms of distribution of the tomato plants on the basis of *number of fruit per plant* in reciprocal populations F_3.

We underline that the same maternal form – genotype Gloria, in combination with Jubiliar, Atlasnâi and Zastava, manifested different influence on the phenotypic spectrum in segregating populations, what reveals the importance of the interactions of the two genomes - maternal and paternal in the formation of the character and the degree of efficiency of the maternal factor.

CONCLUSIONS

1. By researching the influence of parental factor in the control of some biological characters and productivity in tomato, there were found 64 % cases of maternal effects.
2. There were registered quite different values of the productivity elements, both for the parental forms as well as the reciprocal hybrids of F_3 generation; these differences denote–the importance of the maternal form in the formation of the quantitative characters.
3. It was found that the same maternal form in combination with different conditions manifested different influence on the phenotypic spectrum in segregating populations of tomato; this reveals the importance of the interactions of the two genomes - maternal and paternal in the formation of the character and factor interaction *maternal form x abiotic conditions.*

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IN VITRO CONSERVATION OF THE CRITICALLY ENDANGERED TAXON *Convolvulus persicus* L. AND REGENERANTS EVALUATION

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Abstract. We had the aim to test *in vitro* reactivity of *Convolvulus persicus* for conservative purpose. Fragments of roots, hypocotyls, stem and leaves were used as explants. Modified Chu formula (1978) was used as a base medium owing to the lower content of salts comparing to MS formula. Two main directions of *in vitro* development were taken into consideration in our experiment: callus induction on auxins added media and shoots development on media supplemented with higher level of cytokinins and lower level of auxins. *In vitro* developmental processes varied from the induction of a non-regenerative callus or a friable proembryogenic callus, to indirect and direct morphogenesis process, depending on the type of explants and medium variant used. The best regeneration rates were registered in the case of medium Chu supplemented with kinetin (kin) and indole acetic acid (IAA) and active charcoal and medium Chu added with benzyl-amino-purine (BAP), dichlorophenoxyacetic acid (2,4-D) and active charcoal. Several clones were regenerated having the origin in different seeds. The uniformity of the individuals belonging to two different regenerated clones was evaluated using isoenzymes markers as peroxidase, malate-dehydrogenase and isoesterase. Among the analysed biochemical markers, peroxidase showed a relevant spectrum of bands, the regenerants being identical concerning this marker.

Keywords: *Convolvulus persicus, in vitro* conservation, morphogenesis, isoenzymes spectrum.

Rezumat. Conservarea în vitro a taxonului critic periclitat *Convolvulus persicus* L. şi evaluarea regeneranţilor. A fost studiată reactivitatea *in vitro* a speciei *Convolvulus persicus* în vederea conservării. In acest scop s-au utilizat diferite tipuri de explante: rădăcini, hipocotil, fragmente de tulpină şi frunze. Explantele s-au cultivat pe mediul Chu (1978) care prezintă o concentraţie de săruri scăzută în comparaţie cu mediul Murashige-Skoog. In cadrul experimentelor s-au urmărit două direcţii de dezvoltare in vitro: inducerea calusării pe medii adiţionate cu auxină şi regenerarea lăstarilor pe medii suplimentate cu concentraţii ridicate de citokinine şi concentraţii scăzute de auxine. Procesele de dezvoltare au variat în funcţie de tipul de explant şi varianta de mediu utilizată de la calus neregenerativ, la calus friabil proembriogen, la morfogeneza directă şi indirectă. Cele mai bune rate de regenerare au fost înregistrate în cazul variantei constând în mediul Chu adiţionat cu kinetină, acid indolil acetic (IAA) şi cărbune activ şi a celei bazate pe aceeaşi formulă şi suplimentată cu benzil amino purina (BAP), acid diclorophenoxiacetic (2,4 D) şi cărbune activ. Mai multe clone au fost regenerate cu originea din seminţe diferite. Uniformitatea indivizilor aparţinând a două clone diferite a fost evaluată fololosind ca markeri enzimatici peroxidazele, malat dehidrogenazele şi izoesterazele. Între markerii biochimici analizaţi, peroxidazele au evidenţiat un spectru de benzi relevante, regeneranţii fiind identici.

Cuvinte cheie: *Convolvulus persicus,* conservare *in vitro*, morfogeneza, spectrul izoenzimatic.

INTRODUCTION

Conservation of biodiversity is important for the future of humanity and the Planet Earth, so it "is integral to the biological inheritance of many people and the critical components of healthy ecosystems that are used to support economic and social developments (KASSO & BALAKRISHNAN, 2013).

Global diversity is affected by numerous, varied and interacting factors, mainly as consequence of human activities as habitats loss, fragmentation, degradation, harvesting and exploitation (YOUNG et al., 2007) and also due to natural factors as climatic changes, invasive species, and pests.

Biological factors as problems with sexual reproduction and genetic drift conducted to small, fragmented and isolated remnant populations (LACY et al., 2000).

Owing to these anthropogenic or natural factors, many plant species became threatened, and for this reason, different measures at international and national levels were imposed.

Two main directions of conservation, which are complementary, were developed*: in situ* and *ex situ* strategies; the last one was outlined in the Article 9 of the Convention on Biological Diversity (GLOWKA et al., 1994) and in Target 8 of the Global Strategy of Plant Conservation (2012),

Owing to the heavy loss or decline of species, populations and ecosystem composition, leading to biodiversity reduction due to habitat destruction, *in situ* methods alone are insufficient for saving endangered species needing complementary approaches (CRUZ-CRUZ et al., 2013).

Progresses made in plant biotechnology can provide tools for collection, multiplication and conservation of plant species during different time intervals using *in vitro* cultures, which complement the other *ex situ* conservation methods (field collections, botanical gardens, seeds banks).

In vitro collecting methods are less invasive because they do not affect the viability of the whole plant, relying on the fragments detached from vegetative or reproductive organs or seeds, allowing an efficient sampling (PENCE, 2005).

In the case of reduced population or when seeds are not available or plant has low seeds viability, the vegetative multiplication and even variability, if it is necessary, can be ensured by *in vitro* methods, which are convenient for *ex situ* conservation purpose (BENSON, 1999; REED et al., 2011).

Plant biotechnology have already proved an important role for *ex situ* preservation of plant diversity around the world (TANDON & KUMARIA, 2005; HOLOBIUC, 2005; SARASAN et al., 2006; BUNN et al. 2007; PILLATTI et al., 2011; ENGELMANN, 2011; REED et al., 2011; ASHMORE et al., 2011; GONZÁLEZ-BENITO & MARTÍN, 2011; KASSO & BALAKRISHNAN, 2013).

As *ex situ* conservation strategy, *in vitro* methods can provide the conservation on short-term based on tissue culture induction, medium-term preservation relied on slow-growth procedures (HOLOBIUC & BLINDU, 2006; HOLOBIUC et al., 2009; 2010) or long–term using cryopreservation techniques (REED et al., 2000; SARASAN et al., 2006; CRUZ-CRUZ et al., 2013), the initiation of *in vitro* cultures and multiplication being the first step in this *ex situ* approach.

Convolvulus persicus L. taxon has the conservation status as critically endangered for Romanian Flora (DIHORU & NEGREAN, 2009).

The general distribution of *C. persicus* is Asia and Asia Minor, Caucasus and the Black Sea coast in Romania and Bulgaria (FĂGĂRAS, 2012; TZONEV et al., 2005). This taxon is a Ponto-Caspian element, growing in Romania on sandy areas from Mamaia, Agigea, Eforie, Movila (CT), Sf. Gheorghe, Mila 15, Rosetti, Letea, Caraorman, Sulina, Cardon, Rosetti, Portita, Perisor (TL).

This species has generally a limited distribution and small size of the populations; tourism can affect the populations in the coastal areas.

This species may have a decorative value and was used in traditional medicine for insomnia and respiratory diseases treatment, being surnamed 'fisherman tea', containing calming and emollient principles.

C. persicus is a perennial plant with a short woody rhizome, with stems of 15–40 cm high, with elliptic-ovoid leaves and white pubescent flowers consisting in white corolla, with 5 pubescent stripes on the outer side. Fruit are ovoid with 1–2 black seeds.

Conservation measures which already were taken: the species is protected and included in the Critical List of Vascular Plants from Romania (OPREA, 2005), in the Red Book of Vascular Plants from Romania (DIHORU & NEGREAN, 2009), and in Bulgaria in the Red List of Bulgarian Vascular Plants (2009).

Conservation measures recommended for this taxon are: elaboration of an action plan for *in situ* conservation; the *ex situ* preservation, the multiplication and reintroduction in the natural habitats from Romania and Bulgaria could also significantly help the conservation of this species.

Our aim was to introduce *in vitro* for conservative purpose, to micropropagate and to evaluate the regenerants using biochemical markers as isoenzymes electrophoretic spectrum.

MATERIAL AND METHODS

Seeds collected from plants growing in Sulina were pre-sterilized in 70^0 ethylic alcohol for 1 minute and then in 0.1% $HgCl_2$ for 15 min, followed by three washing in sterile distilled water.

Sterilized seeds were cultured on 1/2 MS medium (MURASHIGE & SKOOG, 1962) and germinated in 3 weeks after incubation at 16/8 photoperiod of illumination and 25 ^{0}C temperature regime.

After 2 weeks, from germinated seedlings, different organs (roots, hypocotyls, stem and leaf fragments) were used as explants and cultured on different media variants based on modified Chu formula (CHU, 1978) added with B5 Gamborg vitamins (GAMBORG, 1968), 30 g/l sucrose and active charcoal at 0.5 g/l (Table 1).

The culture media were adjusted at pH 5.9 and sterilized at autoclave at 121^0C and 1.2 atm.

Because this species usually grows on sandy and salty substrate, we tested the addition of NaCl in one medium variant to check if its presence had a beneficial *in vitro* effect;

Five explants/ 6 cm Petri dish in 3 repetitions were cultured for every variant. The fragments of roots, hypocotyls, petioles and leaves were placed horizontally, while stem fragments were cultured vertically. The subcultures were made after 2 months. The regenerated shoots were cultured in glass jars of 7 cm diameter and 10 cm height.

The cultures were maintained at 2,000 lux illumination and 16/8 photoperiod and 25^0C temperature regime using cool white fluorescent lamps.

In vitro response was scored after 60 days of culture concerning the mean number of regenerants/explants in ten media variants. Data were statistically analysed using Daniel's XL Toolbox version 6.52 program (http://xltoolbox.sourceforge.net) and for comparison of variants Posthoc test Bonferroni-Holm was applied.

Shoots were grown on MS medium without growth factors and supplemented with 20 g/l sucrose and also on M11 variant based on modified Chu formula added with active charcoal, 20 g/l sucrose and low level of auxin NAA.

Several clones were regenerated having the origin in different seeds.

The stability of individuals belonging to two different clones (A and B) regenerated on variant M10 was analysed concerning isoenzymes markers using entire shoots for processing the protein extracts.

Preparation of total protein extract and isozymes electrophoresis

The enzymes extraction was carried out in 50mM phosphate buffer, pH=7, EDTA 2mM, 4% PVP. The tissues samples were ground with quartz sand and the homogenate was centrifuged at 15,000 rpm, for 20 min; the supernatant was used for electrophoresis to detect several enzymes: peroxidases (POX), esterases (EST), catalases (CAT), alkaline phosphatases (AKP) and malate dehydrogenase (MDH).

The polyacrylamide gel electrophoresis was prepared using a 10% (7% in case of catalases) running gel and the running buffer was 0.025M Tris-Gly, pH 8.3.

Gel electrophoresis staining bands

For peroxidase detection, it was used H_2O_2 as substrate in acetate buffer and benzidine (WANG & WANG, 1989).

In the case of ***catalases***, we used as substrate 0.003% H_2O_2 prepared in 0.01 M phosphate buffer, at pH=7, added with $K_3(Fe(CN)_6)$ and $FeCl_3$ (IORDACHESCU & DUMITRU, 1988).

For ***esterases*** detection, it was used as substrate a solution of α naphthyl acetate and Fast Blue RR prepared in 0.1 M phosphate buffer, at pH=6.5 (BACH, 1989 modified.) The bands are stained in red-violet.

For ***alkaline phosphatases*** assay, the substrate was Na α naphthyl phosphate prepared in Tris –citrate, at pH=8.3. The bands are stained in brown.

For ***malate dehydrogenase*** *(*MDH), the reaction mixture consisted from 2M malic acid in Tris-HCl buffer, pH=8, 2mM EDTA, 0.5M $MgCl_2$, 1% NAD, than 1% NBT, 1% PMS, 1% MTT. The bands are coloured in violet.

Table 1. Media tested for *in vitro* cultures of *Convolvulus persicus.*

Components		**Variants**										
		1	2	3	4	5	6	7	8	9	10	11
Macroelements		Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu
Microelements		Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu	Chu
B Complex Vitamins		B 5	B5	B5	B5	B5	B5	B5	B5	B 5	B 5	-
Sucrose (g/l)		30	30	30	30	30	30	30	30	30	30	20
Growth factors (µM/l)	**BAP**	-	-	-	-	4.4	4.4	22	-	-	-	-
	Kin	-	-	-	0.84	-	-	-	-	-	9.2	-
(µM/l)	**2-IP**	-	-	-	-	-	-	-	-	9.8	-	
	Ads	-	-	-	-	-	207.2	-	207.2	-	-	
	NAA	-	-	-	-	0.54	0.54	-	0.54	1.08	-	0.054
	IAA	-	-	-	-	-	-	-	-	-	1.14	-
	IBA	-	-	-	2	-	-	-	-	-	-	-
	24- D	9.04	-	-	4.52	-	-	9.04	-	-	-	-
	2,4.5-T	-	7.8	7.8	-	-	-	-	-	-	-	-
Other compounds (g/l)	**NaCl**	-	-	2.5	-	-	-	-	-	-	-	-
compounds (g/l)	**AC**	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Legend: BAP-benzyl amino purine, Kin-kinetin, 2-IP- isopentenyl adenine, Ads, adenine sulphate, NAA, α-naphthyl acetic acid, IAA-β indole acetic acid; IBA- indole butyric acid, 2,4-D-acid 2,4- dichlorophenoxyacetic acetic acid, 2,4,5-T- 2,4,5-trichlorphenoxyacetic acid, NaCl- sodium chloride, AC- active charcoal.

RESULTS AND DISCUSSIONS

Referring to *Convolvulus persicus*, no works concerning *in vitro* culture for conservative purpose have been reported so far.

To test *in vitro* reactivity, we used several types of explants as roots, hypocotyls, stem and leave fragments.

Chu formula was chosen as a base medium owing to the lower content of salts comparing to MS formula.

Two main directions of *in vitro* development were taken into consideration in our experiment: callus induction on auxins added media and shoots development on media supplemented with higher level of cytokinins and lower level of auxins.

In vitro developmental processes varied from the induction of non-regenerative callus or a friable proembryogenic callus, to indirect and direct morphogenesis, depending on the type of explants and medium used (Table 2).

In the case of auxin-supplemented media (M1-M4), only roots underwent morphogenesis (Fig. 3), while leaf and stem fragments generated only callus (Fig. 2). Root fragments cultured on auxin –added media M1-M3, generated shoots (2-3/ explant), but hypocotyl fragments generated only friable green callus.

The regeneration frequency (the number of regenerative explants/total of inoculated explant x100) was lower, about 35% for M4 variant in the case of roots, in the other variants as M1-M3 using roots as explants the rate of regeneration varied between 50 and 70 % and in M5-M10 using stem fragments, the regenerative rate was about 90-100 %.

The culture of leaf and petiole fragments on M1-M4 variants conducted only to callus development. The same explants generated proembryogenic callus on M1 variant, which did not develop further, and also a friable green –white callus on M2 and M4 variants. This friable callus can be further evaluated and tested for secondary metabolites production. Using stem fragments, also a green compact non-regenerative callus was induced at the end of the explants on media M1-M4. Concerning regenerative response, the shoots formation was evaluated on M1-M10 variants (Fig. 1) using roots fragments as initial explants cultured on M1-M4 and stem fragments cultured on M5-M10.

The root and stem fragments had a positive *in vitro* response, while leaves and petioles were less reactive and not appropriate as a source for micropropagation of plants.

The culture in the presence of different combinations of growth factors with the cytokinin dominance (M5-M10) conducted to indirect (Fig. 4) or direct morphogenesis (Figs. 3, 5) with a mean number of shoots/explants varying between 2 and 4 (Fig. 1). This developmental way occurred in *C. persicus* slower, the number of regenerants per initial explant being scored just after 2 months.

The presence of NaCl at 0.25 % in the culture medium M3 did not influence the in vitro response.

The culture on M7 variant determined the formation of callus at the end of the stem fragments, which also generated shoots from lateral meristems. Their culture on regeneration media M5-M10 conducted to morphogenesis process; the best regeneration (significantly different) were registered in the case of M10 variant supplemented with kinetin and IAA (Fig. 5), and M7 added with BAP and 2.4-D.

An improved regeneration rate in *C. persicus* was obtained on M10 variant, with a maximum of 5 shoots/explant registered after two months.

The regenerants were further cultured both on MS medium, added with 20 g/l sucrose and also on MS medium based on Chu formula, added with AC and NAA, the last one which stimulated both rooting process (long and well-developed roots) and lateral shoots formation on already regenerated shoots. The frequency of shoots rooting was 100% on M11 variant, while on MS medium the frequency was lower – about 30% and number reduced at 1-2 poorly developed roots.

In the related species *Convolvulus scindicus*, ABBAS et al., (2012), it was evaluated the *in vitro* response also using germinated seeds as initial plant material. Nodal segments were used as explants and cultured on MS media added with various combination of BAP and NAA and BAP, kin and NAA.

The regeneration frequency was quite limited and the maximum number of shoots /explant was close to our record – 4.7. Further, using a combination of BAP (2.5 mg/l), kin (0.5 mg/l) and NAA (0.5 mg/l), they succeeded to regenerate a mean of 8.2 shoots/explants. The rooting occurs with the best frequency (67%) at 2 mg/l IAA supplemented medium, but with weak root formation.

Shoots culture on variant M11 consisting in modified Chu medium supplemented with 20 g/l sucrose, active charcoal 0.5 mg/l and low level of NAA conducted to improved rooting rate(100%), well developed roots and stimulation of lateral branching, which can ensure material for secondary multiplication (Fig. 6).

In *C. persicus*, regenerated shoots grew well on MS added with 20 g/l sucrose without growth factors, but rooted poorly on this variant (Fig. 7).

Table 2. *In vitro* behaviour of *C. persicus* using different explants after 60 days of culture.

Variants	Roots fragments and hypocotyls	Stem fragments	Fragments of petioles and leaves
1	direct morphogenesis from roots and callus from hypocotyls	green callus at the ends of explant	green yellow friable proembryogenic callus
2	direct morphogenesis from roots and callus from hypocotyls	green callus at the ends of explant	green non-regenerative callus
3	direct morphogenesis from roots and callus from hypocotyls	callus at the end of explants	green non-regenerative callus
4	poor shooting and callus formation	non-regenerative green callus	green non-regenerative callus
5	-	buds development	green callus, indirect morphogenesis
6	-	indirect morphogenesis	green callus without regeneration
7	-	direct morphogenesis	yellow friable callus
8	-	direct morphogenesis	Indirect morphogenesis wit lower rate
9	-	indirect morphogenesis with friable callus, without root formation	indirect morphogenesis
10	-	direct morphogenesis	indirect low morphogenesis

The newly formed lateral shoots can be also used as source of explants for further culture cycles contributing to improve the regeneration rate.

Concerning rooting process, RATHORE et al., 2004, considered that the plant growth factors and conditions necessary for rooting varied among species, some studies reported strong effect of IBA in some recalcitrant species (HOLOBIUC et al., 2004; HUSAIN et al., 2008), or the positive effect of IAA comparing to IBA (ABBAS et al., 2012).

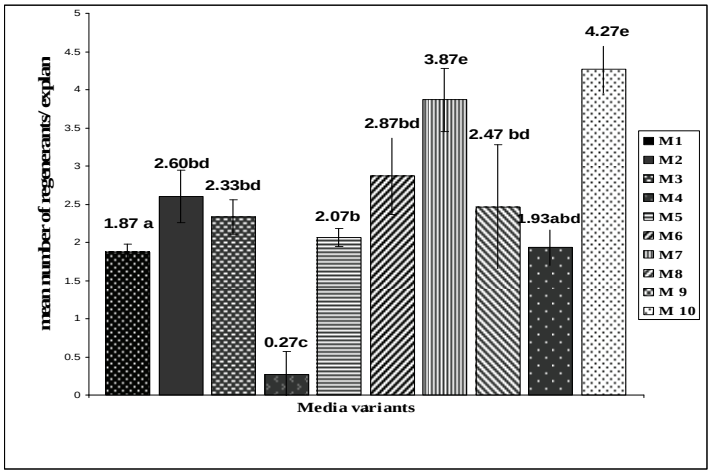

Figure 1. The evaluation of *in vitro* regeneration of *C. persicus* after 60 days of culture.
Mean values with the same letter do not differ significantly at P <0.05.

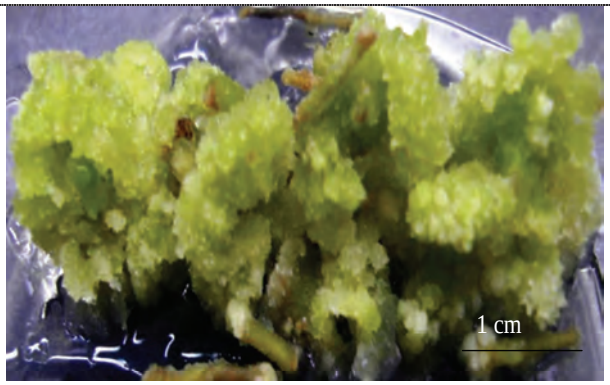

Figure 2. Proembryogenic friable callus induced from hypocotyls on M1 medium after 1 month (original).

Figure 3. The initiation of direct morphogenesis induced on root explants on M1 medium after 3 weeks (original).

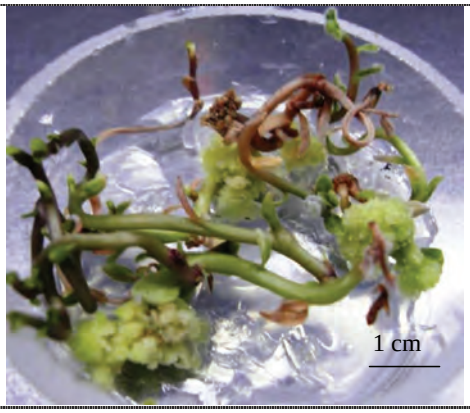

Figure 4. Indirect morphogenesis induced on M6 variant after 1 month (original).

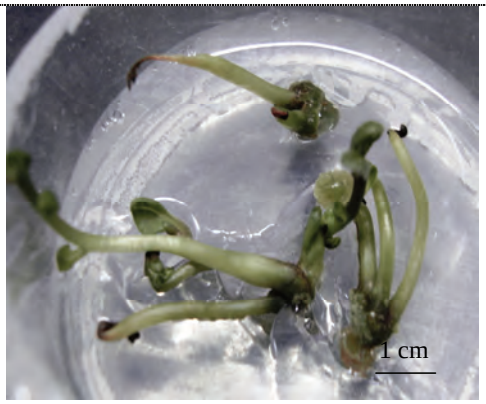

Figure 5. Direct morphogenesis on stem fragments induced after 30 days on M10 medium (original).

Figure 6. Rooted plants of *C. persicus* developed on M11 variant after 1 month (original).

Figure 7. *C. persicus* plants cultured on MS medium without growth factors with weak rooting (original).

Biochemical evaluation of the regenerants

The stability of individuals belonging to two different clones obtained through direct morphogenesis was evaluated using isoenzymes markers.

The use of biochemical markers to evaluate the identity of regenerants is more affordable and easily to perform comparing to molecular methods, but it is important to find the relevant biochemical markers for a certain plant species. Concerning the biochemical evaluation of the regenerants obtained through direct morphogenesis, in the case of regenerated clones (A and B), the isoenzymes spectra was expressed differently comparing to mature plants, probably due to *in vitro* conditions and age of plants.

The isoperoxidase spectrum (POX) analysed in individuals belonging to the same clone with the origin in one seed, shown the same number of bands, but with some differences in intensity (Fig. 8a).

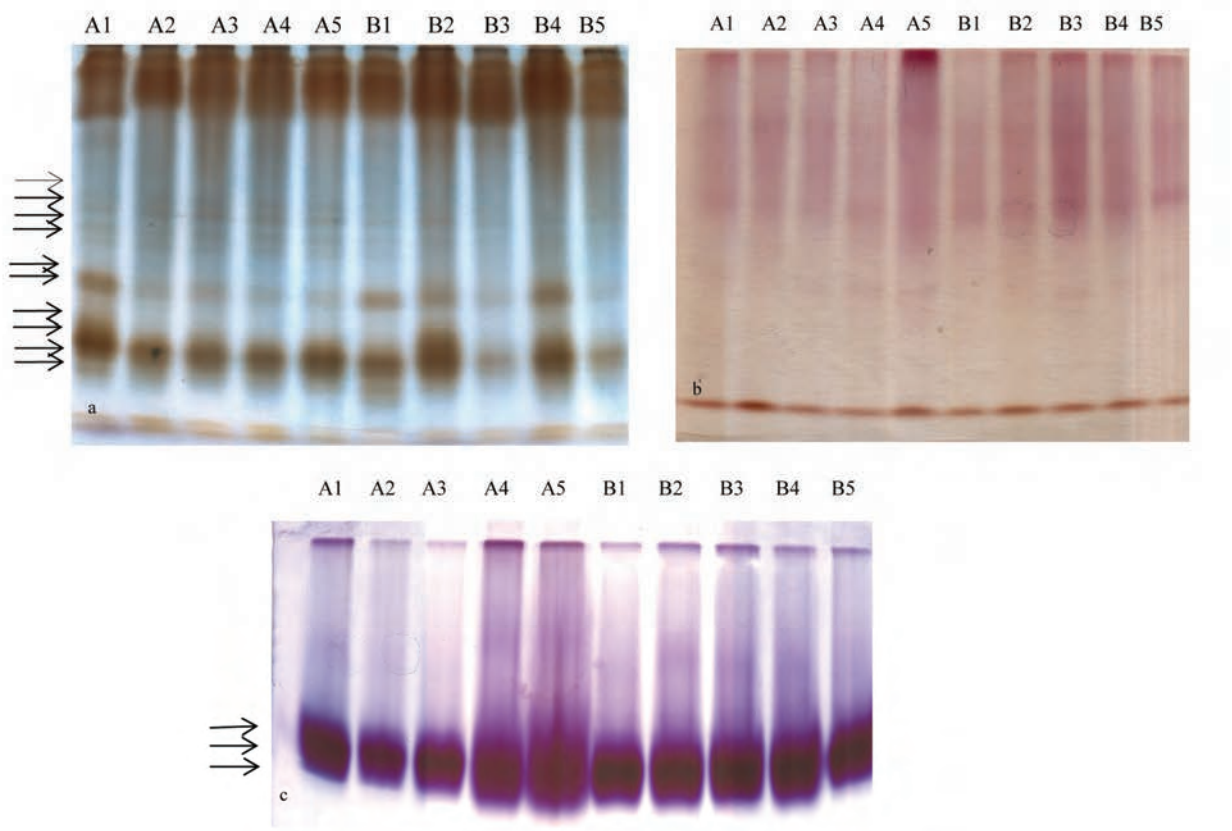

Figure 8. Electrophoresis spectra of isozymes from 2 clones (A, B) each of them consisting in ten individuals (A1-A5; B1-B5): peroxidases (a), esterases (b) and malate dehydrogenase (c).

In the case of clone A, A1 individual had more intense bands and for clone B, individuals B1, B2, B4 had also higher expression correlated with plants development. It is possible that the two in vitro regenerated clones have a certain level of genetic similarity concerning this marker.

In the case of catalase detection (CAT), in the analysed regenerants, there were not evidenced bands.

Its expression may be correlated with a certain developmental stage (it is expressed in mature lignified plants) and was not expressed *in vitro*. In the natural population, CAT expression was detected with a certain level of polymorphism (VOICHIȚĂ et al., 2013). A similar result was observed in the case of alkaline phosphatases (AKP); the bands were not evidenced in the regenerants.

Isoesterase spectrum (EST) did not show any differences among the individuals and even different clones (Fig. 8b). The expression of this enzyme probably was influenced by the culture condition and developmental stage of the regenerants, being not suitable as biochemical marker to check the regenerants identity in this taxon.

Malate dehydrogenase spectrum (MDH) was further analysed in the regenerants developed from direct morphogenesis and showed the same pattern of bands in the case of individuals from the same clone (Fig. 8c).

Several papers reported the characterization of intra-populational diversity in different taxa using biochemical markers. MÜLLER-STARCK et al.,(1993) characterized the intra- and inter-populational genetic variation in *Quercus robur* and *Q. petraea* using more enzymatic systems to identify the genetic polymorphism as leucyl aminopeptidases, phosphoglucomutase, menadione reductase.

There were reported some relevant studies in which enzyme spectra was successfully used in the case of endangered or endemic plant species, mainly to characterize intra-populational variability (KRZAKOVA, 1996; ZHELEV et al., 2002; BORBA et al., 2007; KENNEDY et al., 2007; KULL & OJA, 2010).

KRZAKOVA (1996) based on isoperoxidase spectrum, found variation among individuals and populations in *Phragmites australis*.

BUTIUC-KEUL (2006) also described that the isoperoxidases pattern in *Puccinella poissoni* characterized small intrapopulational diversity, while the isoesterase had a relevant pattern concerning variability. By the other hand, the electrophoretic spectra of POX and EST analysed by the same author were found to be identically in all plants analysed from *Jurinea molis*.

In Romania, genetic polymorphism in the endemic species *Astragalus peterfi*, was also described using others biochemical markers as: alcohol-dehydrogenase, superoxide dismutase, and malate dehydrogenase (BORZA et al., 1996).

The genes, which are responsible for these enzymes, depend on the species, being necessary to carry out analyses to find the suitable marker. The enzyme detection, if they are appropriate for variability characterization could be more affordable.

In a previous study concerning to use of isoenzymes spectrum to detect variation among the individuals of *C. persicus*, just POX and CAT proved to be suitable for the evaluation of intra-populational diversity, while esterases and phosphatases were not optimal for this purpose (VOICHIȚĂ et al., 2013).

By the other hand, in the case of *in vitro* regenerants, only peroxidase spectrum showed some differences, while the pattern of malate dehydrogenase and isoesterase were not relevant. It is possible that owing to *in vitro* culture conditions and developmental stage (young plantlets), the expression of the genes involved in this enzymes pattern to not be the same as in the natural population consisting in mature, flowering and lignified plants. Concerning *in vitro* culture, there were some reports based on the use of isoenzymes patters to evaluate regenerants in different species mainly obtained through indirect morphogenesis (SAMANTARAY et al., 1999; PETROVA et. al., 2006).

PETROVA et al. (2006) described in the case of regenerated plants of *Gentiana lutea*, significant differences in the expression of EST, ACPH and ADH, these results being rather correlated with the growth factors content, especially the cytokinin added on different culture media used to regenerate plants. This modified expression was considered as a result of a change of the expression of genes codifying loci responsible of these enzymes under the influence of growth regulators nature and their level used in vitro cultures.

In comparison, in our case, all regenerants analysed were obtained on M10 variant, further rooted on M11 medium, being influenced by the same combination of growth factors and culture conditions.

CONCLUSIONS

- *In vitro* developmental processes varied from the induction of non-regenerative callus and friable proembryogenic callus, to indirect and direct morphogenesis, depending on explants and media used.
- The variants of media with cytokinin dominance were optimal for shoots development starting from stem fragments, allowing a maximum of 5 shoots/explants. In the case of root fragments, morphogenesis can also occur, but with lower number of regenerants.
- Concerning rooting, Chu medium supplemented with active charcoal and low level of NAA sustained both a good rhizogenesis and stimulated the development of lateral shoots.
- The stability of individuals belonging to two different clones was evaluated using isoenzymes markers as peroxidase, malate-dehydrogenase and isoesterase, but only peroxidase showed a relevant spectrum of bands, the two analysed clones being related.

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Rosmarinus officinalis L. (ROSEMARY), A LEGENDARY HERB WITH MANY BENEFICIAL EFFECTS ON THE HUMAN BODY

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Abstract. *Rosmarinus officinalis* Linnaeus 1753 comes from the countries of the Mediterranean region, but it has adapted to different climate and soil variations, and modifying its dimensions according to the aforementioned conditions; however, the flowers remain the same. The study of the activity of this plant on the human body (antibacterial activity, antifungal, relaxing effect on the smooth muscles of trachea and intestines, hepatoprotective and antitumorogenic activity) preoccupied and still is a current study for many specialists. In this study, we revealed the importance of this plant against Gram negative bacteria isolated from nosocomial infections. Identifying the compounds of essential oil and ethanol extracts of rosemary leaves was made by GC-MS (Gas chromatography coupled with mass spectrometer impact ionization). The most important compounds identified were rosmanol, eucalyptol, luteolin, caffeic acid and bornyl acetate. The antibacterial activity of ethanol and oil extracts of rosemary was reported against all supported strains, MIC ranging, depending on the species or on its virulence factors strain, between 15.625 and 125 µl / ml. The antibacterial activity of ethanolic extract and oil essential of rosemary was due to the synergistic action of all the compounds resulting from the secondary metabolism of the plant by inhibition of efflux pump, having a direct effect on the bacterial membrane. As a general conclusion, the essential oil and ethanolic extracts of rosemary can be used with success in the prevention and in the treatment of infections caused by Gram negative bacteria.

Keywords: *Rosmarinus officinalis*, antibacterial activity, Gram negative bacteria.

Rezumat. *Rosmarinus officinalis* L. (rozmarinul), o plantă legendară cu multiple efecte benefice asupra organismului uman. *Rosmarinus officinalis* Linnaeus 1753, provine din țările din regiunea mediteraneană, dar s-a adaptat la diferite variații de climă și sol, modificându-și în funcție de acestea dimensiunile, florile rămânând însă aceleași. Studiul activității acestei plante asupra organismului uman (activitatea antibacteriană, antifungică, hepatoprotectoare, relaxare a mușchilor netezi ai traheei și intestinului și antitumorogenetică), a preocupat și încă reprezintă un studiu de actualitate pentru mulți specialiști în domeniu. În acest studiu am relevat importanța acestei plante împotriva unor bacterii Gram negative izolate din infecții nosocomiale. Identificarea compușilor din extractele etanolice și ulei din frunze de rozmarin a fost efectuată prin metoda GC-MS (cromatografia de gaz cuplată cu spectrometru de masă cu ionizare prinimpact). Cei mai importanți compuși identificate au fost rosmanol, eucaliptol, luteolina, acidul cafeic și acetat de bornil. Activitatea antibacteriană a extractelor etanolice și de ulei esențial din rozmarin a fost raportată împotriva tuturor tulpinilor studiate, CMI variind funcție de specia tulpinii sau factorii de virulență ai acesteia, fiind cuprins între 15.625 și 125 µl/ml. Activitatea antibacteriană a extractelor etanolice și uleiului de rozmarin s-a datorat actiunii sinergice a tuturor compușilor rezultați din metabolismul secundar al plantei, prin inhibiția pompelor de eflux, având acțiune directă asupra membranei bacteriene. Ca o concluzie generală, extractele etanolice și uleiul esențial din rozmarin pot fi utilizate cu succes atât în prevenirea cât și în tratamentul infecțiilor cauzate de bacterii Gram negative.

Cuvinte cheie: *Rosmarinus officinalis*, activitate antibacterială, bacterii Gram negative.

INTRODUCTION

Rosmarinus officinalis Linnaeus, commonly known as rosemary, is a woody, perennial herb with fragrant, evergreen, needle-like leaves and white, pink, purple, or blue flowers, belonging to the family Lamiaceae (Room, 1988). The name rosemary derives by combining two words, Rose and Mary referring to the flower as a symbol of the Virgin Mary, first recorded in the eighteenth century. It is found in continental Europe as rosemary and Rosa Maria. After mid-nineteenth century, when flower names became common, it may also refer to the herb rosemary, Latin *ros marinus* "dew of the sea". In our popular tradition, rosemary is considered a flower of protection, purification, worn at important events, such as wedding or Christmas carolling. In addition to its properties as a spice, its antibacterial, anti-inflammatory activity, the role of modulator of the nervous system, and hyperglycaemia, gives it well-deserved appreciation. The main compounds obtained from the essential oil of rosemary, identified by GC-MS reported by TSCHIGGERL & BUCARAM, 2010, were: 1,8-cineole, camphor, α-pinene, camphene, borneol, bornyl acetate, myrcene, limonene, α- terpineol and caryophyllene. HUSSAIN et al., 2010, demonstrated in vitro antiproliferative activity of cancer cells, antioxidant and antibacterial activity of the essential oil of rosemary, reporting a total of six major compounds identified by GC: 1,8-cineole (38.5%), camphor (17.1%), α-pinene (12.3%), limonene (6.23%), camphene (6.00%) and linalool (5.70%). By vacuum liquid chromatography (VLC) on silica gel, OLUWATUYI et al., 1994, isolated five compounds from the extract ethanolic of *R. officinalis*: carnosic acid, carnosol, 12-methoxy-trans-carnosic acid, 12-methoxy-trans-carnosic acid and 12-methoxy-cis-carnosic acid to test the antibacterial activity against MDR bacterial with efflux pump. Most of the studies have shown synergistic activityof several compounds resulting from the secondary metabolism of the plant as having activity against MDR bacteria. Gram negative bacteria are responsible for most of antibiotic resistant infectious diseases due to the impermeability of external membrane (PAGÈS et al., 2008; DAVIES & DAVIES, 2010). Penicillin G was the first antibiotic introduced in the clinical therapy but its use is limited because the side chain does not allow passage through the external membrane of enteric Gram negative bacteria (*Escherichia coli*). Similarly, macrolides does not penetrate the outer membrane, although the *E. coli* cell-free

systems, as effective erythromycin inhibit protein synthesis in cell-free systems as a Gram positive bacteria. Permeability of the external membrane is the cause for which vancomycin (inhibitory glycopeptide antibiotic of the formation of peptidoglycan transversal links after binding to the peptides of D-Ala-D-Ala) cannot inhibit the growth of Gram negative bacteria, but is inhibitory against Gram positive bacteria (CHIFIRIUC et al., 2011). The inaccessibility of the target may be due to the impermeability of the external membrane by an activation of efflux pumps (porins), which removes the drug from the interior of the cell, against the concentration gradient (PAGES et al, 2008). Adaptive resistance, a variant of intrinsic resistance signifies temporary increase in bacterial cell capacity to survive in the presence of inhibitors or toxic chemical agents by altering the activity of gene expression. Adaptive resistance may be mediated by efflux. Their activity varies with the concentration of NaCl. Physiological NaCl concentration is associated with the increased level of resistance due to the increased expression of efflux pumps. Adaptive resistance is induced by subinhibitory concentrations of antibiotics during therapy: cells do not die, but become more resilient. Also, biocides used excessive induce the adaptive resistance of bacteria. High resistance to bacteria grown in biofilm is on the one hand due to the increased activity of the efflux pumps, but with increasing thickness of the biofilm antibiotic diffusion rate decreases and the cells adapt to subinhibitory concentrations. Natural production of antibiotics is insignificant, and the trade is practically the only source of antibiotics biosphere. Under pressure from the presence of antibiotics, selection of resistant strains is much faster because it is geared towards survival in a hostile environment, and not to adapt to the environment, characteristic of populations that evolve slowly. Therapeutic exposure to high antibiotic concentrations of pathogenic bacteria creates conditions of severe selection pressure and induces high-level resistance. Antibiotic resistance cannot be removed. The chemical modification of aminoglycosides, macrolides and other classes of antibiotics has led to the semisynthesis of the chemical derivatives resistant to the inactivation mechanisms of bacteria. But chemical modification is limited to no influence of the antimicrobial activity. New semisynthetic compounds had the effect of extending the use of antibiotic classes (meticylin β-lactam), azithromycin (macrolide), amikacin (aminoglycoside), etc. and the resistance genes evolved in response to the new chemical compounds and clinical efficiency diminished progressive (DAVIS, 2010). Recycling antibiotics is a short-term measure, because resistant strains do not disappear, and when reintroduced into the antibiotic therapy resistance genes will be selected soon (CHIFIRIUC et al., 2011). In this context, the effectiveness of antibiotics against bacteria is no longer valid and finding new compounds, such as those obtained in the synthesis of herbs known for their antibacterial properties, represents the only solution.

MATERIALS AND METHODS

1. Analysis of phenotypic resistance to antibiotics of Gram negative strains

Gram-negative strains, which were the subject of this article, were isolated from urogenital infections from the patients hospitalized at Theodor Burghele Hospital, Bucharest. Strains were identified in the unit, automatic identification method VITEK®2 compact. For determining spectrum antibiotic sensitivity of bacterial strains from the collection, it was used the disc-diffusion method. Gram-negative strains were seeded in the cloth using a sterile swab Müller-Hinton medium, a bacterial suspension with a turbidity corresponding to McFarland standard 0.5. On seeded plates, there were applied the disks impregnated with the antibiotic, applied to β-lactam antibiotic discs specific family of bacterial strains tested according to the CLSI 2009. The plates were incubated 16-18 hours at 37° C with the cover down. The reading of the results was conducted by measuring the diameters of the zones of inhibition generated by different antibiotics, using a graduated ruler. The interpretation of results was performed according to standard CLSI 2009.

2. Preparation of the extract and analysis of the compounds

The ethanolic extract was prepared by macerating leaves of *R. officinalis* powder in 95% ethyl alcohol for 24 hours (1: 4 w / v), after which it was introduced into a rotary evaporator for 10-15 minutes and then the supernatant was purified by Watthmann filter paper no. 41. The extract thus obtained was stored in an amber glasscontainer at 4° C. The volatile oil of the leaves of *R. officinalis* was obtained by hydrodistillation in a Clevenger- Neo for 4 h. The volatile oil was dried with Na_2SO_4 and stored in a dark glass bottle at 4°C. Oil samples were diluted in dichloromethane (1/200) for the analysis of chemical compounds. To identify the compounds of the *R. officinalis* oil extract we used a GC-MS (Shimadzu GC-2010 Plus gas chromatograph). A multi-dimensional GC/GCMS system performed separations using two columns that had different chromatographic selectivity. When the components of interest are insufficiently separated on the first column, they can be selectively introduced ("heart-cut") to a second chromatographic column with different selectivity. The first used capillary column was MEGA SE-52 0.25 x 25 m df=0.25 μm. The operating conditions were: split splitless injector (injection mode - split flow dividing ratio 1/100 at 250° C). Oven temperature is up from 50°C - 280°C (3°C/min). Monitoring FID (Flame Ionization Detector) was at 290° C (H_2: 50 mL/min, Air: 400 mL/min, Make-up: 0 mL/min). Switching for the second column was 8 times. Second capillary column was: MEGA DetTBuSililBeta 0.25 x 25 m df=0.25 μm (oven temp: 45 °C (12.00 min) - 180 °C (2 °C/min). The relative concentration of the compounds was calculated using the values of the chromatographic peak areas under the curves, without applying correction factors.

3. Determination of antimicrobial activity of rosemary extract

The quantitative determination of the antimicrobial activity and establishing of the minimum inhibitory concentration (MIC) was made by the method of serial microdilution in a liquid medium BHI (Hearth Infusion Broth) in 96 well plates / Ependorf tubes of 1.5ml (CHIFIRIUC et al., 2011). MIC was established macroscopically as being

the last concentration where no growth of the microbial medium was observed, respectively, the beginning of turbidity medium appearance. Also, for higher precision, a spectrophotometric absorbance read at 620 nm was made. Antimicrobial activity was determined by disc diffusion method adapted to standardized control antimicrobial activity of antibiotics, CLSI, 2009 (Kirby-Bauer). The microbial inoculum represented by a suspension obtained from a culture grown on a solid medium 16-18h adjusted to 0.5 McFarland nephelometric standard cloth seeded on one Mueller-Hinton agar plate. Mueller-Hinton medium plates after inoculation were allowed to dry before applying the plant extract of the stock solution at 10 mL. The plates are incubated for 16-18 hours at 35 ± 2 ° C, with the lid down. Reading the results was done by measuring the diameters of the zones of inhibition comparatively. The influence on the ability adhesion to the inert substrate was quantified after the protocol quantitative analysis of the effect of antimicrobial, evaluating the biomass, after fixation with methanol and staining with crystal violet. The optical density was determined spectrophotometrically and the biological material resuspended at 490 nm (NORUZI et al., 2010).

RESULTS AND DISCUSSION MCI was established macroscopically as being the last concentration

The results of the antibiotic resistance by disk diffusion method are listed in the following table:

Table 1. Antibiotic resistance of Gram-negative strains.

Strain	STX	MPM	ERT	AMC	AMP	CTX	CAZ	CIP	ATM	GM	CXM	NOR	FEP	CL	FOT	IMP	TZP	LEV
E. coli	21	3	1	18	17	0	20	16	3	12	6	7	18	1	2	3	8	6
Klebsiella pn.	15	5	7	17	8	2	21	10	1	13	2	3	17	0	0	2	18	7
JProteus m.	3	0	0	3	0	0	1	1	0	3	0	0	3	0	0	0	1	2
Ps. aeruginosa	0	2	0	3	0	0	3	3	3	2	0	0	2	0	0	2	3	0
Acinetobacter b.	3	1	0	3	0	0	2	2	1	3	0	0	2	0	0	2	2	0
Alcaligenes f.	1	0	0	2	0	0	2	0	2	2	0	0	2	1	0	2	2	2
Total strins	35	67	70	35	53	76	28	46	68	43	70	68	35	76	76	67	44	61

Of the total of 40 strains of *E. coli*, 22 (44%) showed resistance to SXT (Trimethoprim / Sulfamethoxazole), 25 (50%) strains to AMC (ampicillin/clavulanic CAID), 20 (0.40%) to CAZ (ceftazidime), 18 (36%) to FEP (cefepime). A greater resistance to STX had a *Klebsiella pneumoniae* strains- out of 26 strains, 15 (0.57%) showed resistance. Resistance of *K. pneumoniae* strains to CAZ was 58% and to EFP and AMC was 0.47%. Phenotypic analysis spectrum antibiotic resistance as penicillins, cephalosporins and carbapenems, showed the existence of ESBL. β-lactamases are the main factor of resistance of β-lactam antibiotics Gram-negative bacteria. These hydrolyses the β-lactam bond (C - N) of this class of antibiotics. This chemical linkage is essential for β-lactam antibiotic activity, as it has the role of analog peptide bond linking the terminal D-Ala peptide of peptidoglycan monomer. β-lactamases are highly effective enzymes: a single molecule can hydrolyse over 100,000 β-lactam molecules. They constitute a large family of enzymes with unitary structure; the β-lactam ring cleaves and inactivates the antibiotic, but differs in amino acid sequence (MIHĂESCU et. al. 2007). *P. aeruginosa* and *Acinetobacter baumannii* strains had MPM high resistance to carbapenems (meropenem) and IMP (imipenem) by developing additional mechanisms of resistance, biofilm formation, porins with a role in drug efflux. All Gram negative strains, particularly *K. pneumoniae* showed high resistance to CAZ (ceftazidime- generation cephalosporin III). The high resistance to FEP (cephalosporin- antibiotics cefepime generation IV) is due to the phenomenon of adaptation of strains to the antibiotic by developing new resistance mechanisms, efflux pumps whose activity increases due to cellular stress. A high resistance to ERT (ertopenem, a carbapenem with a structure very similar to meropenem but a somewhat less broad spectrum of activity) was registered in case of the strains of *K. pneumoniae* (0.26%).

In vitro action of fosfomycin against ESBL strains had higher efficiency compared to lactam antibiotics. FOT may be a suitable, effective and cheap alternative in the treatment of ESBL strains. FOT is a phosphonic acid, a bactericidal agent with in vitro activity against most pathogens: *Proteus mirabilis, K. pneumoniae, P. aeruginosa, A. baumanni, Alcaligenes faecalis, E. coli*. Fosfomycin tromethamine is well tolerated, with a low incidence of adverse events. Fosfomycin tromethamine achieves high clinical and bacteriological cure rates in patients with acute uncomplicated lower urinary tract infection and is well tolerated (PATELL et. al., 1997). A lower resistance to antibacterial treatment is observed when using CL (colistin). In the last two decades, the paucity of novel antibiotics to treat drug-resistant infections, especially those caused by Gram-negative pathogens, has led to the reconsideration an old antibiotic (fosfomycin and colistin) as a therapeutic option. The polymyxin group of polypeptide antibiotics, discovered in the 1940s, was among the first antibiotics with significant activity against Gram negative bacteria. Colistin is polymyxin E, used clinically. Colistin has no activity against Gram positive bacteria, all cocci, and anaerobes. The rates of colistin resistance have been relatively low, probably because of its infrequent use. The emergence of colistin-resistant *K. pneumoniae* has been described following widespread use of colistin. The most common mechanism of colistin resistance is the modification of LPS and efflux pump/potassium system. Empirical treatment with colistimethate sodium should be considered for patients at high risk for infection by carbapenem-resistant bacteria with severe sepsis (YAHAV et al., 2011).

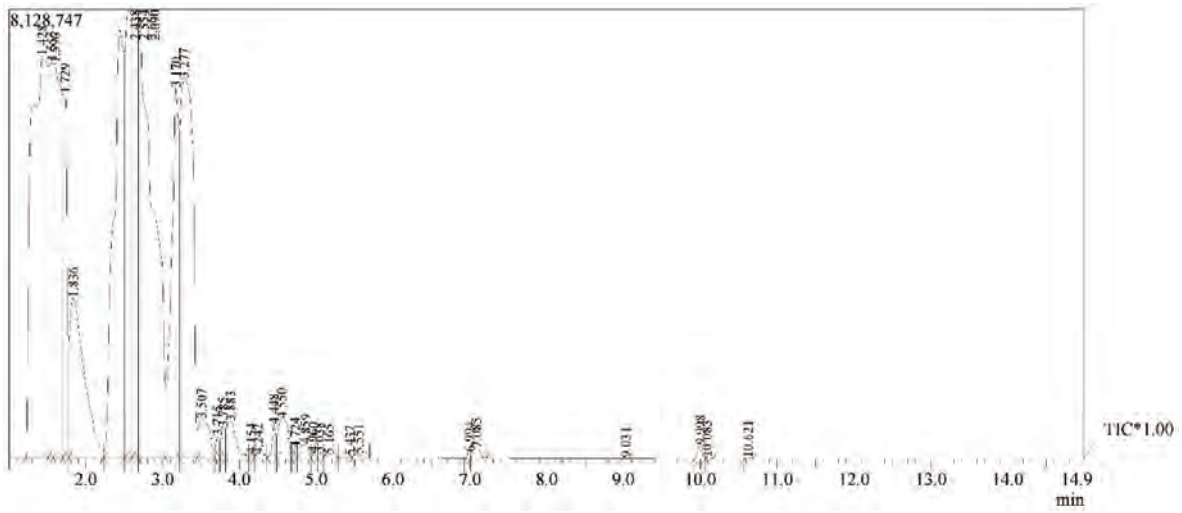
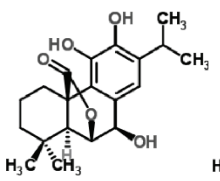


Diagram 1. Chromatogram of the extract of *R. officinalis.* In abscise it is passed retention time and in ordinate, abundance. The peaks represent the concentration of the compound.

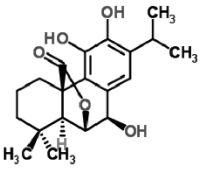
Table 2. The most representative compounds of *R. officinalis* identified by GC-MS depending on the retention time of the eluent.

Peak	Compound	R.T.	Area%	Height
1	Rosmanol	1.428	15.81	7255947
2	Camosic acid	1.555	4.29	7155358
3	Camosol	1.596	7.72	7125622
4	α–Amyrin	1.729	3.33	6572308
5	β–Amyrin	1.836	5.73	37967088
6	Luteolin	2.438	11.01	7739074
7	α–pinene	2.554	7.17	8095066
8	β–pinene	2.656	6.08	8094181
9	Eucalyptol	2.696	15.67	8068706
10	Camphor	3.170	6.90	6687047
11	Bornyl acetate	3.277	11.45	6855123
12	Caffeic acid	3.507	1,05	704751
13	Chlorogenic acid	3.715	0.19	395057
14	Labiatic acid	3.785	0.33	547778

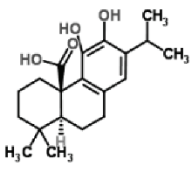
Rosmanol is a terpenoid glycoside and has the molecular formula $C_{20}H_{26}O_5$. ZHANG et al., 2014 refers to a further 5 terpenoid glycoside in addition to the existing, (1S,4S,5S)-5-exo-hydrocamphor 5-O-β-d-glucopyranoside, isorosmanol, rosmanol, 7-methoxyrosmanol, epirosmanol, ursolic acid, micromeric acid, oleanolic acid, niga-ichigoside, glucosyl tormentate and asteryunnanoside B, were obtained from the aerial parts of *R. officinalis* L. The principal antioxidative components of *R. officinalis* leaf extract are the phenolic diterpenes carnosol and carnosic acid. Highly oxidized diterpenes increase in rosemary plants exposed to drought and high light stress (FIUME, 2013). Carnosic acid reached the maximum concentrations in December, decreasing by 50% during the summer months, while rosmarinic acid showed a constant concentration during the year (LUIS & JOHNSON, 2005). The essential oil of rosemary is reported to have antimicrobial activities (FIUME, 2013). Rosmarinic acid and carnosic showed strong activity against DPPH (1,1-diphenyl-2-picrylhydrazyl) absorption radical *in vitro*. Rosmarinic acid scavenging activity was always much higher than other tested compounds such as vanillin acid, naringin and even ascorbic acid, the "classic" antioxidants. These results highlight the importance of a catechol group moiety for hydrogen-donating activity, which is present in rosmarinic, caffeic, and carnosic acid all three showing a similar DPPH scavenging capacity (LUIS & JOHNSON, 2005; AL-SEREITIA et al., 1999). Carnosol and carnosic acid are powerful inhibitors of lipid peroxidation in microsomal and liposomal systems. Carnosic acid reacted with HOCl in such a way as to protect the protein alpha 1-antiproteinase against inactivation (ARUOMA, 1992). Carnosol has a bridging epoxide group straddling the 1,4 positions on one of the cyclohexane rings. The main isolated triterpenes have been α–amyrin and β– amyrin. Amyrin has the chemical formula C30H50O. OLIVERIA et al., 2005 reported the hepatoprotective potential of alpha- and beta-amyrin against toxic liver injury and suggest that the diminution in oxidative stress and toxic metabolite formation as likely mechanisms involved in its hepatoprotection. Epidemiological evidence suggests that flavonoids may play an important role in the decreased risk of chronic diseases associated with a diet rich in plant-derived foods. Flavonoids are also common constituents of plants used in traditional medicine to treat a wide range of diseases (LOPÉZ-LÁZARO, 2009). Luteolin (3′,4′,5,7-tetrahydroxyflavone) is a yellow flavonoid used as a dye. It is found mostly in the leaves of plants, but it is also present in the edible parts of celery, dandelion, thyme oregano citricus and carrot. It is one of the most common flavones and plays a role in the human body as an anti-oxidant, scavenging dangerously reactive free-radicals. It is also an anti-inflammatory, a promoter of carbohydrate metabolism, and a moderator of the immune system. The anti-inflammatory activity may be linked to its anticancer property. Luteolin anticancer property is associated with the induction of apoptosis, and the inhibition of cell proliferation, metastasis and angiogenesis (LIN et al., 2009; LOPÉZ-LÁZARO, 2009).



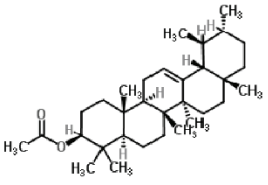
Rosmanol



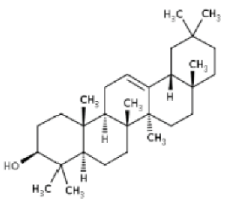
Carnosic acid



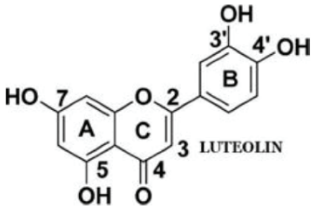
Carnosol



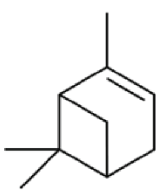
α– amyrin



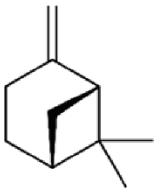
β- amyrin.



3-H =Luteolin, 3-OH=Quercitin

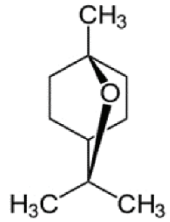


α–pinen



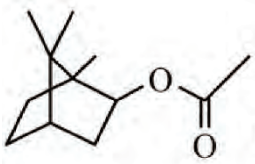
β-pinen

Eucalyptol

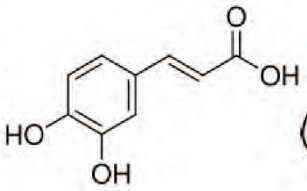


Camphor

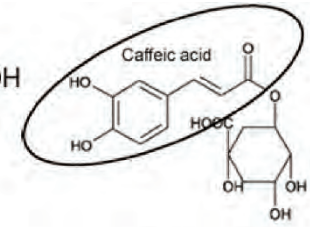
Pinene (C10H16) is a bicyclic monoterpene chemical compound. Pinene has been recognized for centuries for its antifungal activity, insecticidal and aromatic property. Several biological activities are associated with pinenes, including the use as a natural insecticide. The antimicrobial activities of the isomers and enantiomers of pinene were evaluated against bacterial and fungal cells. The agar diffusion test showed that only the positive enantiomers of the a- and β-isomers of pinene were active (RIVAS DA SILVA et al., 2014). α-pinene was chosen as a surrogate for the endocyclic structured monoterpenes. Its carbon double bond is located inside a C6-ring structure. Therefore, the oxidation reactions, especially by ozone, cause primarily ring-opened structured products, such as pinonaldehyde, possessing different saturation vapour pressures, than found for the exocyclic monoterpene reactions with predominantly ring-retaining products, such as nopinone in the case of β-pinene (BONN & MOORTGAT, 2002).



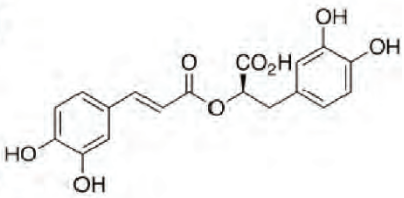
Bornyl acetate



Caffeic acid



Chlorogenic acid



Labiatic acid

Eucalyptol (1,3,3-Trimethyl-2-oxabicyclo[2.2.2]octane); the molecular formula $C_{10}H_{18}O$ is a bicyclic monoterpene with a distinctive aroma. Eucalyptol and camphor ($C_{10}H_{16}O$) are found in the majority of aromatic herbs. Camphor and eucalyptol showed the strongest antimicrobial activity (HASOUNA et al., 2013). ASGHAR et al., 2012, reported the antibacterial activity of the essential oil obtained from the aerial parts of *Artemisia aucheri*. The CG-MS analysis identified among major compounds with antimicrobial activity, bornyl acetate and borneol in a concentration of 2.7% and 7.8% respectively. Caffeic acid ((2E)-3-(3,4-dihydroxyphenyl)prop-2-enoic acid, 3-(3,4-dihydroxyphenyl)acrylic acid) and molecular formula ($C_9H_8O_4$) is an antioxidant with *in vitro* and *in vivo* activity (OTHOF, 2001). Antibacterial activity of the caffeic acid was reported by ALMEIDA et al., 2006, in a study against virulent strains, *Serratia marcescens* and *Enterobacter cloacae*, using disk diffusion. Phenolics are the most widespread dietary antioxidants, and among these, chlorogenic acid (CGA) accumulates to high levels in some crop plants. Chlorogenic acids (3-(3,4-Dihydroxycinnamoyl) quinic acid) are cinnamic acid derivatives and they are an important intermediate in lignin biosynthesis. Green coffee is a major source of CGA. Antibacterial activity of CGA has been reported by several authors. Chlorogenic acids, trigonelline and caffeine are the compounds with the greatest action against the strains of *Streptococcus mutans* (ANTONIA et al., 2010). *Hyptis atrorubens* Poit (Lamiaceae) is a plant species used as an antimicrobial agent in Guadeloupe. The hydromethanolic extract of the stems showed the best antibacterial activity against bacteria, mostly Gram-positive ones. The bactericidal power of rosmarinic acid was much faster in the time kill study (ABEDINI et al., 2013). Rosmarinic acid (R)-O-(3,4-Dihydroxycinnamoyl)-3-(3,4-dihydroxyphenyl) has the molecular formula $C_{18}H_{16}O_8$.

Qualitative and quantitative evaluation of the antimicrobial activity R. officinalis extract

The qualitative testing by disc diffusion method Kirby-Bauer, adapter (CHIFIRIUC et al., 2011) emphasized that hydroalcoholic extracts and essential oil of *R. officinalis* shoots had antimicrobial activity for all bacterial strains from the collection achieved, quantified by the appearance of a zone of growth inhibition around the spot stock solution deposited on the seeded agar medium (Figure 1).

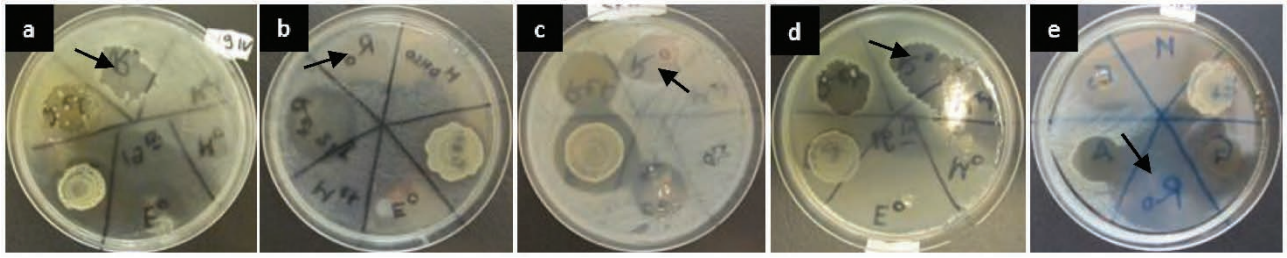


Figure 1. Qualitative Testing of susceptibility to volatile oil and ethanol extract of *R. officinalis* strains studied, (from left to right): *Ps aeruginosa*$_{9IV}$ (a), *E. coli*$_{28II}$ (b), *P. mirabilis* (c), *K. pneumonia* (d), *A. baumannii* (e) (original).

Qualitative evaluation is an estimate, because it is not known the extent of absorption of the compound by the medium. Quantitative determination of antimicrobial activity was performed by the technique of successive binary microdilution in a liquid medium which is a method of determining the minimum inhibitory concentration (MIC). The assay was performed according to the method described by CHIFIRIUC et al., 2011. Out of stock solutions of the compounds to be analysed there are performed micro binary successive dilutions in liquid BHI medium, distributed in 96-well plates. No dilutions were made in the wells treated for positive control (culture medium) and negative control (the control microbial culture). MIC values are between 15.6 and 125 µl / ml for ethanolic extracts and essential oils of *R. officinalis*. The antimicrobial activity of extracts from *R officinalis* could be attributed to compounds resulting from the secudar metabolism of the plant having protective against phytopathogens, most of which are Gram negative bacteria.

Table 3. The minimal inhibitory concentrations (MICs) for the essential oil and ethanolic extracts of *R. officinalis* against Gram negative bacteria.

	MICs ethanolic extract (µl/ml)		MICs essential oil (µl/ml)	
Strain	MIC_{50}	MIC_{90}	MIC_{50}	MIC_{90}
Escherichia coli	31.25	62,5	31.25	62.5
Klebsiella pneumoniae	62,5	125	31.25	125
Proteus mirabilis	31,25	62,5	15.625	31.25
Alcaligenes faecalis	31,25	62,5	15,625	31,25
Acinetobacter baumannii	15,625	125	15.625	62.5
Pseudomonas aeruginosa	31,25	62,5	31.25	62.5

The antimicrobial activity of essential oils and plant extracts, evaluated qualitatively and quantitatively, is often first demonstrated for these pharmacological properties, but the specificity and complexity of interactions at the molecular level between cell components and components of plant extracts are not yet understood fully.

It was demonstrated that ethanolic extracts and essential oil of *R. officinalis*, reported by different authors, have antimicrobial effects that are highly differentiated according to the chemical structures of the components present in the extract, the specific mechanisms of the synergistic influence / antagonism between the components or environmental factors or specific microorganisms. Ethanolic extract and essential oil of *R. officinalis* contain a variety of compounds, most with intrinsic antimicrobial activity, others without antimicrobial activity. After determining the MIC, there can be applied a variety of methods to elucidate the mode of action of the compounds resulting from the secondary metabolism of a plant against microbial cells. The establishment of a mechanism of action should emphasized the importance of knowing the molecular interactions between the studied substance and specific targets of the host cell.

CONCLUSIONS

Antimicrobial resistance is not new but the number of resistant organisms are unprecedented. Diseases and pathogens that were once thought to be controlled by antibiotics are returning in new forms of resistance. Antibiotic-resistant strains have first appeared in hospitals, where the use of antibiotics is varied. Resistance to multiple drugs was first detected among enteric bacteria (*E. coli*, 1950s to early 1960s). To several antibiotic resistance bacteria increased especially in developing countries where antimicrobials were readily available without prescription. The severity of and difficulty in treating MDR strains necessitates the use of several, sometimes six to seven different, drugs. Among the Gram negative bacteria, hospital infections caused by *P. aeruginosa* and *A. baumanii* are sometimes resistant to all, or all but one, which seriously challenges the treatment of immunocompromised individuals and can result in death. ESBL (Extended Spectrum β-lactamases), carried among Enterobacteriaceae destroy even the latest generations of penicillin and cephalosporins. Metallo-β-lactamases that inactivate carbapenems are often the 'last resort' in serious infections of Gram negative bacteria (LEVI & MARSHALL, 2004).

In this context, the pharmaceutical industry seems to be no longer effective and the return to medicinal plants seems to be the only opportunity in the fight against MDR bacteria. The use of plants is as old as mankind. Rosemary is a spice with multiple uses in both food and seasoning in many diseases: cancer, diabetes, digestive diseases, respiratory and bacterial

infections. The most important compounds of rosemary are caffeic acid and its derivatives such as rosmarinic acid (labiatic acid) and chlorogenic acid. These compounds have antioxidant effect and activity against Gram negative bacteria. The phenolic compound, rosmarinic acid, obtains one of its phenolic rings from phenylalanine via caffeic acid and the other from tyrosine via dihydroxyphenyl-lactic acid. Relatively large-scale production of rosmarinic acid can be obtained from the cell culture of Coleus blumei Benth when supplied exogenously with phenylalanine and tyrosine (AL-SEREITI et al., 1999). Eucalyptol was also found in high concentration, being one of the major monoterpene constituents. Camphor and eucalyptol showed the strongest antimicrobial activity (HSOUNA et al., 2013). Carnosol and carnosic acid have been for over 90% of the antioxidant properties of rosemary extract. Ethanolic extracts and essential oil of *R. officinalis* have been shown to have a strong antibacterial activity. The studied strains showed antibacterial resistance both intrinsic and acquired to antibiotics. Gram negative infections are the most common for both people and plants. The antibacterial activity of ethanolic extracts and oil of *R. officinalis* proved effective due to the synergistic action of compounds resulting from the plant secondary metabolism. Literature revealed that most of the identified compounds by GC-MS showed antioxidant and antibacterial activity individually. As a general conclusion, the essential oil ethanolic extracts of *R. officinalis* can be used in the treatment of infections caused by Gram negative bacteria, or may be used as a preventive treatment. The mode of action of the metabolism compounds, with multiple targets of action, prevents the development of new virulence factors for bacteria. Compared to synthetic drugs, plant action on the human body does not create side effects such as drug dependence or damage to other organs. In the future, the results justify the need for continuing studies at the molecular level in order to clarify the mechanisms of action of essential oils and their fractions of microbial cells and their specific targets for action.

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FOREST HABITATS FROM VALEA VÂLSANULUI RESERVE

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Abstract. The paper presents four forest habitats from Valea Vâlsanului Reserve: R4109 Southeast Carpathian beech forests (*Fagus sylvatica*) with *Symphytum cordatum*; R 4206 Southeast Carpathians spruce forests (*Picea* abies) and fir (*Abies alba*) with *Hieracium rotundatum*; R 4401 Southeast Carpathians white alder forests (*Alnus incana*) with *Telekia speciosa*; R 4402 Geto – Dacian forests of hilly meadows of alder (*Alnus glutinosa*) with *Stellaria nemorum.* These habitats were characterized by the following elements: distribution in territory, structure, floristic composition, conservation status, potential threats.

Keywords: forest habitats, floristic composition, conservation status, Valea Vâlsanului Reserve.

Rezumat. Habitate forestiere din Rezervaţia Valea Vâlsanului. Lucrarea prezintă patru habitate forestiere din Rezervaţia Valea Vâlsanului. Acestea sunt: R4109 Păduri sud est carpatice de fag (*Fagus sylvatica*) cu *Symphytum cordatum*; R 4206 Păduri sud est carpatice de molid (*Picea* abies) şi brad (*Abies alba*) cu *Hieracium rotundatum*; R 4401 Păduri sud est carpatice de anin alb (*Alnus incana*) cu *Telekia speciosa*; R 4402 Păduri daco-Getice de lunci colinare de anin negru (*Alnus glutinosa*) cu *Stellaria nemorum.* Habitatele au fost caracterizate din punct de vedere al distribuţiei în teritoriu, structură, compoziţie floristică, statutul de conservare, potenţiale ameninţări.

Cuvinte cheie: habitate forestiere, compoziţie floristică, statutul de conservare, Rezervaţia Valea Vâlsanului.

INTRODUCTION

The protected natural area of a Community importance "Valea Vâlsanului" has a wide geographic exposure on the north - south in Argeş county, including areas in the Southern Carpathians (Făgăraş), Getic Plateau and Getic Subcarpathians. The reserve includes the Vâlsan River basin upstream of the village Brădet, point Bariera, and the lower riverbed of the Vâlsan River down to its confluence with the Argeş River. Site details: Latitude N 45º15'4"; Longitude E: 24º45'33"; Site area (ha): 9.602; Altitude (m): Min. 300, Max. 2310, Med. 1350; Biogeographical region: alpine and continental.

The importance of the protected area is due to the presence of a tertiary endemite, the Romanian darter (*Romanichthys valsanicola*), within its territory.

Beside this species of fish, in the protected natural area Vâlsan Valley, there are also present other rare and protected species of plants and animals and outstanding natural areas and special landscapes. All these underscore the need for an effective protection of the biodiversity of this region, demonstrating the great scientific importance of the protected area “Valea Vâlsanului” (SANDA et al., 1995).

The research of flora and vegetation are relatively reduced in this protected area.

Habitats are diverse, the most representative being: heaths and scrubs temperate, subalpine and alpine meadows, wet meadows and tall herb communities, temperate deciduous forests, temperate coniferous forests, scrub forests and meadows, bogs, springs and streams (COMBROUX & SCHWOERER, 2007).

This paper presents a description of the most important forest habitats in the studied area.

MATERIAL AND METHOD

In the summer of 2014, there were conducted phytosociological surveys for each forest habitat, corresponding to the classification systems used in Europe, consisting of indications of names and codes for each type of habitats from the classifications which were taken into consideration (NATURA 2000, EMERALD, CORINE, PALEARCTIC HABITATS, EUNIS) from the Romanian classification system (CRISTEA V. et al., 2004).

RESULTS AND DISCUSSION

After the research there were identified 4 forest habitats: R4109 Southeast Carpathian beech forests (*Fagus sylvatica*) with *Symphytum cordatum*; R 4206 Southeast Carpathian spruce forests (*Picea abies*) and fir (*Picea abies*) with *Hieracium rotundatum*; R 4401 Southeast Carpathian forests of grey alder (*Alnus incana*) with *Telekia speciosa*; R 4402 Geto-Dacian forests of hilly meadows of black alder (*Alnus glutinosa*) with *Stellaria nemorum* (COLDEA, 1991) (Fig. 1).

R 4109 Southeast Carpathian beech forests (*Fagus sylvatica*) with *Symphytum cordatum*

Correspondent:
NATURA 2000: 91V0 Dacian beech forests (*Symphyto-Fagion*)
EMERALD: 41.1 Beech forests
CORINE: –

PAL. HAB: 41.1D211 Dacian *Dentaria glandulosa* beech forest
EUNIS: G1.6D21 Dacian *Symphytum* beech forest
Plant associations: *Symphyto - Fagetum* Vida 1959

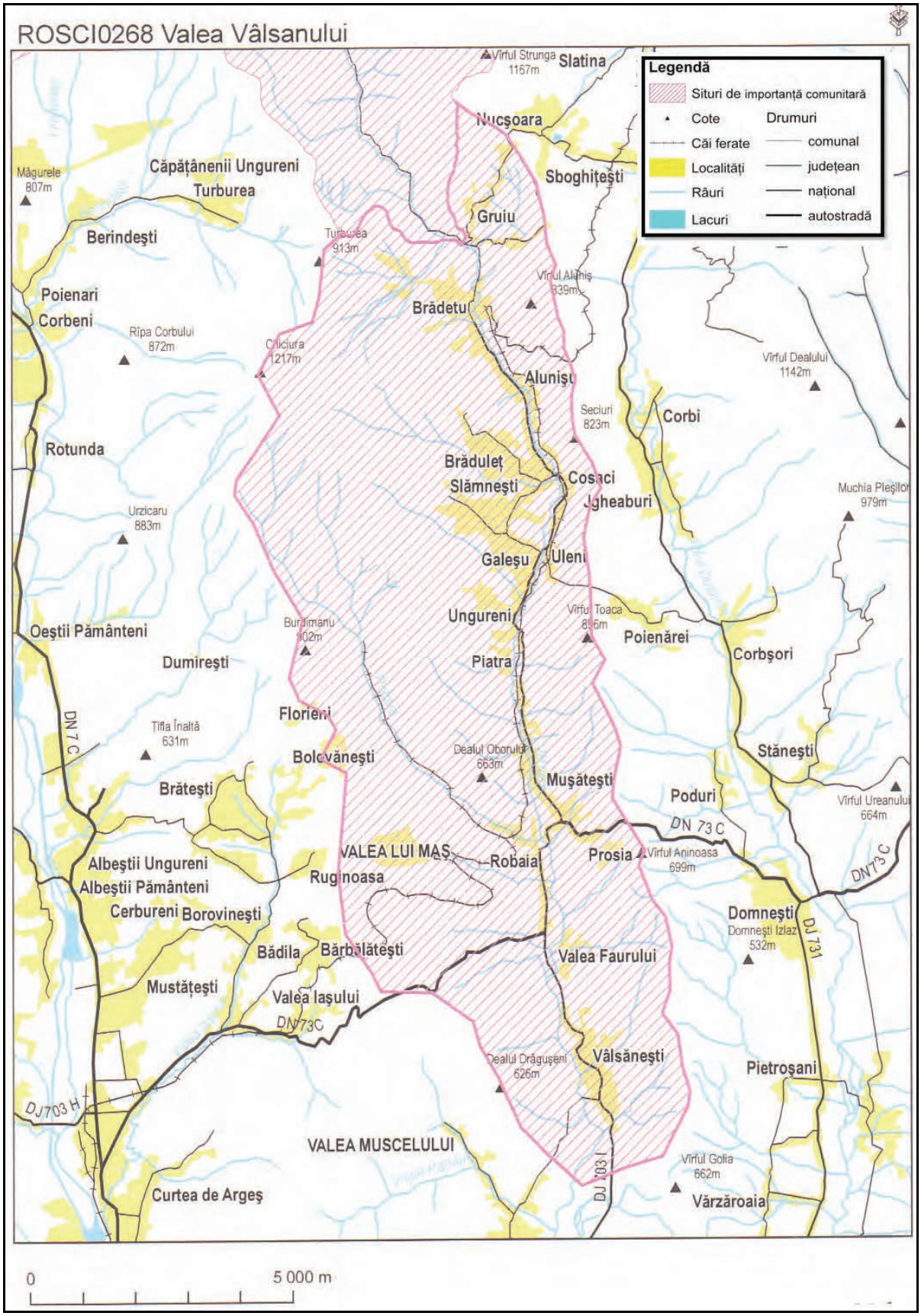

Figure 1. Location and delimitation of SCI VALEA VÂLSANULUI.

Distribution within the territory: this habitat was identified along the Vâlsan River, upstream of Brădet, fits in the lower mountain level. Downstream Vâlsan Lake, beech becomes dominant. The phytocoenosis of this association develops on the flat or slightly inclined slopes of the Valsan Valley, preferring brown, wet forest soils (DONIȚĂ et al., 1992).

Structure: trees layer consists of beech 90%. The remaining 10% consists in elm (*Ulmus glabra*), sycamore (*Acer pseudoplatanus*), ash (*Fraxinus exceşsior*) and rarely spruce (*Picea abies*) and fir (*Abies alba*). Shrub layer is encountered in rare specimens of *Sambucus nigra, Corylus avellana, Lonicera xylosteum.* Herbs and under shrubs layer has the following characteristic species: *Symphytum cordatum, Pulmonaria rubra, Dentaria glandulosa, Mercurialis perennis, Epilobium montanum, Oxalis acetosella, Carex sylvatica.*

Floristic composition: edifying species: *Fagus sylvatica* ssp. *sylvatica.* Characteristic species: *Symphytum cordatum, Pulmonaria rubra, Dentaria glandulosa.* Other important species: *Epilobium montanum, Dryopteris filix-mas, Galium odoratum, Lamium galeobdolon, Geranium robertianum, Mercurialis perennis, Mycelis muralis, Oxalis acetosella, Dentaria bulbifera, Euphorbia amygdaloides, Anemone nemorosa.*

Potential threats are related to property regime, the lack of understanding of the legislation of nature protection, misapplication by the state of the compensation for the limitation or suppression of protective measures in the protected areas. Cutting, extraction of alive or dead wood from private forest is a dangerous issue for the present and also for the future. Arboretum composition from the high altitudes will change, even if exploitation will be made according to ecological shares. It will be necessary to introduce softwood seedlings.

Figure 2. Beech forest in Valea Vâlsanului Reserve (original).

This habitat has a great conservative value.

R 4206 Southeastern Carpathians Spruce forests (*Picea* abies) and fir (*Abies alba*) with *Hieracium rotundatum.*

Correspondent:
NATURA 2000: 9410 acidophilous *Picea* forests of the montane to alpine levels (*Vaccinio – Piceetea*)
EMERALD: -
CORINE: -
PAL. HAB: 42.21621 Carpathian high montane *Hieracium* spruce forest
EUNIS: G3.1B1 Bilbery spruce forest
Plant associations: *Hieracio rotundato – Piceetum* Pawl et Br.- Bl. 1939

Distribution within the territory: this habitat is present in Valea Vâlsanului Reserve at the superior limit of the forest. It has a medium extension and is found in all the mountains of the reserve. Coenoses are developed on podzolic soils and slopes with 25-30° inclination (DONIȚĂ et al., 2005) (Fig. 2).

Structure: tree layer is composed exclusively of spruce (*Picea abies*), which is the dominant species. At lower altitudes, there are also met some fir specimens (*Abies alba*). In the herbaceous layer, besides the characteristic species *Hieracium transsilvanicum*, there are found many acidophilous species such as *Luzula sylvatica, Luzula luzuloides, Calamagrostis villosa, Calamagrostis arundinacea, Campanula patula* ssp. *abietina, Athyrium filix-femina, Fragaria*

vesca, Homogyne alpina, Lycopodium annotinum, Oxalis acetosella, Stellaria nemorum, Vaccinium myrthillus. In the muscinal layer, there are found species as: *Hylocomium splendens, Dicranum scoparium, Politrichum* sp.

Floristic composition: edifying species: *Picea abies* şi *Abies alba.* Characteristic species: *Hieracium rotundatum.* Other important species: *Senecio nemorensis, Campanula abietina, Calamagrostis villosa, Luzula luzuloides, Luzula sylvatica, Oxalis acetosella, Stellaria nemorum, Lycopodium annotinum, Gentiana asclepiadea, Huperzia sellago, Dryopteris filix-mas, Fragaria vesca, Polygonatum verticillatum.*

Figure 3. Spruce forest in Valea Vâlsanului reserve (original).

This habitat has a moderate conservative value.

R 4401 Southeaster Carpathians white alder forests *Alnus incana* with *Telekia speciosa*

Correspondent:

NATURA 2000: 91E0* Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)

EMERALD: -

CORINE: -

PAL: HAB: 44.214 Eastern Carpathian grey alder galleries

Plant associations: *Telekio speciosae – Alnetum incanae* Coldea (1986) 1991

Distribution within the territory: this habitat is developed and is well represented along the Vâlsan River, 600 – 850 m altitude. White alder has strong regeneration, dominating Vâlsan warbler (Vâlsan riverside coppice), having the tendency to spread toward the riverbed. In the upper mountain zone, alder trees are rare, but their role is partially substituted by juniper and spruce (Fig. 3). Because of the tourists' bad behaviour, in Poienile Vâlsanului, the alders are rather rare. The original forest was cut and in its place secondary grasslands were installed.

Structure: the tree layer is dominated by *Alnus incana* (Fig. 4), slightly mixed with beech (*Fagus sylvatica*), *Picea abies*, and at a lower altitude *Alnus glutinosa.* The coverage of arborescent layer is 80-90%. Shrub layer misses or is underrepresented by *Corylus avellana, Prunus padus, Salix triandra.* The herbaceous layer is well developed, dominated by *Telekia speciosa* and *Petasites albus* accompanied by other species such as: *Impatiens noli-tangere, Tussilago farfara, Stellaria nemorum, Equisetum arvense, Aegopodium podagraria.*

Floristic composition: edifying species: *Alnus incana.* Characteristic species: *Telekia speciosa.* Other important species: *Geranium phaeum, Cirsium oleraceum, Impatiens noli-tangere, Myosotis sylavatica, Oxalis acetosella,*

Angelica sylvestris, Athyrium felix-femina, Petasites hybridus, Stellaria nemorum, Tussilago farfara, Dryopteris filix-mas, Festuca gigantea, Carex remota, Petasites kablikianus, Glechoma hederacea (GAFTA & MOUNTFORD, 2008) .

The high humidity of these habitats has allowed the growth of elements typical to *Molinio-Arrhenatheretea* class such as: *Equisetum arvense, Dactylis glomerata, Caltha palustris, Leucanthemum vulgare, Prunella vulgaris, Trifolium repens, Agrostis stolonifera.*

The ruderal species are widely spreading along the Vâlsan River: *Angelica sylvestris* ssp. *montana, Petasites kablikianus, P. hybridus, Lamium maculatum, Heracleum sphondylium, Glechoma hederacea, Urtica dioica.*

The potential threats in the future could be: illegal tree cutting, touristic actions (camping & the consequent waste, bush cutting, car washing in the river), sheep or cows grazing inside the forest.

Figure 4. Alluvial forest with *Alnus incana* and *Telekia speciosa* along the Vâlsan River (original).

This habitat has a very high conservative value.

R 4402 Hilly meadows Geto – Dacian alder (*Alnus glutinosa*) with *Stellaria nemorum.*

Correspondent:
NATURA 2000: 91E0* Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)
EMERALD: -
CORINE: -
PAL. HAB: 44.323 Pre – Carpathian stream ash – alder woods
EUNIS: G1. 2123 Pre – Carpathian stream ash – alder woods
Plant associations: *Stellario nemori – Alnetum glutinosae* (Kästner 1938) Lohm. 1957

Distribution within the territory: this habitat develops along the Vâlsan River, 300 – 600 m altitude.

Structure: the tree layer is dominated by *Alnus glutinosa* with a few specimens of *Fraxinus angustifolia, Acer campestre, Salix alba, S. fragilis.* Shrub layer is composed by *Sambucus nigra, Corylus avellana, Crataegus monogyna.*

Floristic structure: edifying species: *Alnus glutinosa.* Characteristic species: *Stellaria nemorum, Ficaria verna.* Other important species: *Geranium robertianum, Impatiens noli-tangere, Galium aparine, Lamium galeobdolon, Mentha longifolia, Petasites albus, Ranunculus repens, Salvia glutinosa, Sambucus ebulus, Solanum dulcamara, Tussilago farfara, Myosotis palustris, Brachypodium sylvaticum.*

This habitat has a very high conservative value.

CONCLUSIONS

The phytosociological research performed in the summer of 2014 in Valea Vâlsanului Reserve showed a good conservation status of the forest habitats in the studied area. There are important coenotic structures from the phytogeographical point of view, where we meet Endemic, Carpathian and Balkan-Carpathian elements such as:

Campanula patula ssp. *abietina, Pulmonaria rubra, carduus kerneri, Petasites kablikianus, Hieracium transsilvanicum, Leucanthemum waldsteinii.*

Because of the frequent human intervention, these habitats should be regularly monitored, recording both floristic composition and structure stability of ecosystems. Human interventions are, for example, changes in the extent and types of agricultural and forest land, modifications of water courses from dams, the fragmentation of the habitats and natural areas as a consequence of the transport system, or direct extermination. Such types of changes where they have detrimental effects on habitats or species of Community interest are in contradiction with the aims of the directive to maintain a favourable conservation status or restore habitats and species of Community interest.

But, there are also natural reasons, which include changing climatic conditions, the successions of habitats or the exploitation of a new food resource by animal species. Some of these reasons may be considered as natural responses to environmental conditions or natural variation in the characteristics of species, over which we have no influence.

It is necessary to realize and respect the management plan for preserving the area of the habitats in its current form.

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DIVERSITY OF MITES (ARACHNIDA: ACARIFORMES ET PARASITIFORMES) ON THE LEAVES OF WILD TREES AND SHRUBS FROM THE FORESTS OF THE REPUBLIC OF MOLDOVA

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Abstract. Mite fauna of trees and shrubs (during 2000 – 2012 years) is represented by one hundred ninety species registered on fifty one species of trees and shrubs in the forests of the Republic of Moldova. The registered mites are strictly confined to fifty three species or can inhabit on several plant species. It was determined that the formation of specific groups of mites is determined by interspecific competition. During the studies it was established that rare species of mites are found only on specific plants.

Keywords: mites, fauna, trees, schrubs, Republic of Moldova.

Rezumat. **Diversitatea acarienilor (Arachnida: Acariformes, Parasitiformes) de pe frunzele arborilor şi arbuştilor din pădurile Republicii Moldova.** Au fost indentificate o sută nouăzeci de specii de acarieni pe frunzele a cincizeci şi trei specii (in intervalul de timp 2000 - 2012) de arbori şi arbuşti în pădurile din Republica Moldova. Acarienii înregistraţi sunt cu predilecţie strictă pe o specie sau mai multe specii de arbori sau arbuşti. S-a stabilit că formarea unor grupuri specifice de acarieni este rezultatul concurenţei interspecifice. Observatiile au demonstrat că speciile rare de acarieni se găsesc doar pe o anumită specie de arbore sau arbuşti.

Cuvinte cheie: acarieni, faună, arbori, arbuşti, Republica Moldova.

INTRODUCTION

The area of distribution of mites coincides with the area of trees and shrubs species, which represent their source of food, their habitat and have preference to a certain structure of the soil, temperature and humidity and light regime. For a more complete elucidation of the specificity of the relationships between mites and a particular type of trees and shrubs it is necessary to know the features of their distribution among all the species of plants that grow in the forests of various natural areas of the Republic of Moldova.

MATERIAL AND METODS

The studies were conducted in the forests of the Republic of Moldova during 2000-2012 years. The surveys were conducted on the demarcated sectors of 50x100, 100x100, 200x100, 500x100 meters from the edge of the forest.

Fifty three species of trees and shrubs were examined: *Acer tataricum, A. campestre, A. platanoides, A. negundo, Alnus incata, Carpinus betulus, C. orientalis, Cerasus mahaleb, C. avium, C. fruticosa, Cornus mas, Cotinus coggygria, Corylus avellana, Crataegus sanguinea, C. curvisepala, Euonymus europaea, E. verrucosa, Fagus sylvatica, Frangula alnus, Fraxinus excelsior, F. ornus, F. europaea, Ligustrum vulgare, Lonicera xylosteum, Malus sylvestris, Quercus robur, Q. borealis, Q. petraea, Q. pubescens, Tilia cordata, T. europaea, T. platyphyllos, T. tomentosa, Padus avium, P. serotina, Prunus insitilia, P. spinosa, Pyrus pyraster, Rhamnus cathartica, Robinia pseudacacia, Sambucus nigra, Salix cinerea, S. caprea, Staphylea pinnata, Sorbus torminalis, Swida alba, S. australis, S. sanguinea, Ulmus glabra, U. carpinifolia, U. europaea, U. laevis, Viburnum lantana*.

A number of 20 leaves from each species of trees and shrubs represented the plant samples. As basis for this served the mite collection of the Institute of Zoology of the Academy of Sciences of Moldova (over 7000 individuals), while studying the diversity and the importance of insects and artropods in Moldova biocenoses (Figs. 1, 2, 3, 4, 5, 6). Mite individuals were counted under the microscope MBS-10. Species of mites were determined under the binocular microscope Leica CME.

Figure 1. Species *Panonychus ulmi* (Family Tetranychidae).

Figure 2. Species *Amblyseius andersoni* (Family Phytoseiidae).

Figure 3. Species *Tydeus caudatus* (Family Tydeidae).

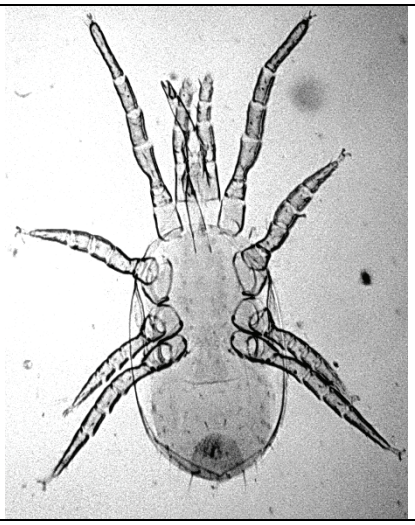

Figure 4. Species *Typhlodromus cotoneastri* (Family Phytoseiidae.)

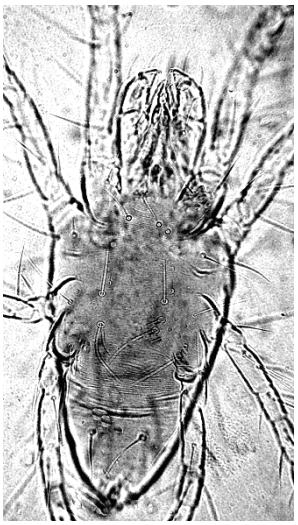

Figure 5. Species *Schizotetranychus fraxini* (Family Tetranychidae).

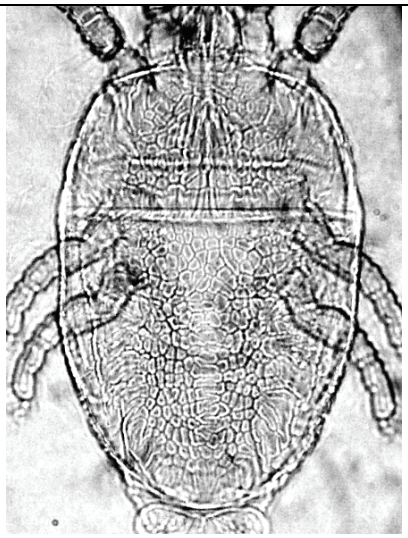

Figure 6. Species *Cenopalpus pulcher* (Family Tenuipalpidae).

RESULTS AND DISCUSSIONS

The mite fauna on the leaves of trees and shrubs of the forests of the Republic of Moldova is represented by one hundred ninety species: *Tarsonemus angulatus, T. bifurcatus, T. bilobatus, T. ellipticus, T. lobosus, T. nodosus, T. confusus, T. crassus, T. floricolus, T. hermes, T. talpae, T. trapezoides, T. pauperoseatus, T. virgineus, Phytonemus pallidus, Xenotarsonemus belemnitoides, Schaarschmidtia naegelei, Steneotarsonemus erlangensis, Tydeus argutus, T. diversus, T. caudatus, T. californicus, T. heterosetus, T. kochi, T. inclutus, Lasiotydeus volaticus, Lorryia elinguis, L. electra, L. devexa, L. dumosa, L. ferula, L. formosa, L. mali, L. matura, L. mirabilis, L. minuta, L. lena, L. obligua, L. obstinata, L. obnoxia, L. opifera, L. ocellata, L. placita, L. praefata, L. reticulata, L.* sp. 1, *L. pinnigera, L. scopa, L. visenda, L. volgini, L. woolleyi, L. wainsteini, Metalorryia armaghensis, M. insignita, M. delicata, Pseudolorryia spineus, Paralorryia chapultepecensis, Pronematus testatus, P. sextoni, P. bonatii, Neopronematus rapidus, Homeopronematus anconai, Triophtydeus flatus, T. immanis, T. fragarius, T. ineditus, Eustigmaeus chilensis, E. segnis, Storchia robustus, Cunaxa setirostris, Cunaxoides parvus, C. biscutum, C. fidus, Zetzellia mali, Imparipes boldi, Spinibdella cronini, Siteroptes primitivus, Cheletocarus raptor, Cheletomorpha lepidopterorum, Mediolata similans, Bdella muscorum, B. iconica, Cyta coerulipes, Cheyletus eruditus, C. malaccensis, Anystis baccarum, Cheletogenes ornatus, Cenopalpus pennatisetus, C. pulcher, C.* sp. 3, *C. piger, C. platani, C. populi, C. ruber, Brevipalpus thelicraniae, B.* sp. 1, *Eotetranychus fraxini, E. orientalis, E. latifrons, E. rajae, E. ulmicola, E. uncatus exiguus, E. uchidai, E. pomeranzevi, E. populi, E. prunicola, E. tiliarium, Allonychus braziliensis, Schizotetranychus spireafolia avetjanae, Bryobia angustisetis, B. borealis, B. lonicerae, B. graminum, B. obihsaphedi, B. confusa, B. ulmophila, Tetranychus pamiricus, T. polygoni, T. przhevalskii, T. armeniaca, T. lonicerae, T. urticae, Oligonychus buschi, O. kobachidzei, Neotetranychus rubi, Amphitetranychus viennensis, Tetranycopsis horridus, Panonychus ulmi, P. citri, Acotyledon agilis, A. rhizoglyphoides, A. redikorzevi, A. michaeli, A. krameri, Tyrophagus humerosus, Amblyseius andersoni, A. nemorivagus, A. rademacheri, A. neobernhardi, A. obtusus, Transeius herbarius, Neoseiulus astutus, N. reductus, N. marginatus, N. umbraticus, N. cucumeris, Anthoseius inopinatus, A. involutus, A. clavatus, A. caudiglans, A. pirianykae, A. recki, A. rhenanus, A. verrucosus, Typhloctonus squamiger, Galendromus pilosus, Typhlodromus graminisilis, T. georgicus, T. invectus, T. halinae, T. kazachstanicus, T. cerasicolus, T. cotoneastri, T. rapidus, T. phialatus, T. pyri, T. tubifer, T. tiliae, Paraseiulus soleiger, P. incognitus, Kampimodromus aberrans, K. langei, Eharius marzhaniani, Dubininellus juvenis, D. echinus, D. macropilis, Phytoseius salicis, P. severus, Euseius finlandicus, Proprioseiopsis dacus, P. okanagensis, Typhlodromips bicaudus, T. rubini, T. tauricus, T. maior, T. similis, T. lutezhicus, Seulus simplex.* In the study of the mite species composition of trees and shrubs forests there were identified the differences between the groups of mites on a particular plant species. The registered mites are strictly confined to one species or can inhabit several plant species. It was determined that the formation of specific groups of mites is determined by interspecific competition (KULIKOVA, 2005, 2007, 2007a, 2008, 2009). During the studies it was established that rare species of mites are marked in the text with "*" and the species of mites found only on specific plant species are marked in the text with "**". The number of mite species found on the leaves of trees and schrubs are mentioned in round brackets at each species of trees or schrubs:

1. ***Acer tataricum*** **(53 species of mites)** - *Schaarschmidtia naegelei, Tarsonemus nodosus, *T. virgineus, *Tydeus argutus, T. caudatus, T. californicus, *T. heterosetus, T. kochi, *Lorryia elinguis, L. obstinata, L. wainsteini, L. lena, **L. opifera, L. ferula, L. mali, L. formosa, L. placita, L. devexa, Triophtydeus flatus, T. immanis, Pronematus sextoni, Homeopronematus anconai, *Cunaxa setirostris, **Cunaxoides biscutum, *C. fidus, Zetzellia mali, Bryobia lonicerae, Cenopalpus pennatisetus, C. pulcher, Eotetranychus fraxini, E. orientalis, *E. rajae, *E. uncatus exiguus, E. pomeranzevi, E. prunicola, Tetranychus lonicerae, *T. pamiricus, Acotyledon agilis, Amblyseius andersoni, A. nemorivagus, *Transeius herbarius, Neoseiulus reductus, Anthoseius caudiglans, Typhloctonus squamiger, Typhlodromus pyri, *T. georgicus, **T. halinae, Paraseiulus soleiger, *P. incognitus, Kampimodromus aberrans, Dubininellus juvenis, D. echinus, Euseius finlandicus;*

2. ***Acer campestre*** **(61 species of mites)** - *Schaarschmidtia naegelei, Tarsonemus lobosus, T. talpae, *T. bilobatus, T. angulatus, T. hermes, T. virgineus, Phytonemus pallidus, Triophtydeus immanis, T. flatus, Tydeus caudatus, *T. inclutus, T. kochi, Lorryia wainsteini, *L. dumosa, *L. obstinata, L. obnoxia, L. praefata, L. devexa, L. reticulata, L. ferula, L. formosa, L. lena, L. mali, Pronematus sextoni, Homeopronematus anconai, Zetzellia mali, Eotetranychus prunicola, E. pomeranzevi, *E. rajae, E. orientalis, *E. uchidai, E. fraxini, *Oligonychus buschi, Acotyledon rhizoglyphoides, A. michaeli, A. krameri, Euseius finlandicus, *Proprioseiopsis okanagensis, Amblyseius andersoni, A. nemorivagus, Neoseiulus umbraticus, *N. marginatus, N. astutus, Anthoseius caudiglans, A. inopinatus, A. involutus, A. pirianykae, A. rhenanus, Kampimodromus aberrans, K. langei, Dubininellus juvenis, D. echinus, **Typhlodromips rubini, Typhloctonus squamiger, Typhlodromus cotoneastri, **T. rapidus, *T. phialatus, T. pyri, *T. tubifer, Paraseiulus soleiger;*

3. ***Acer platanoides*** **(59 species of mites)** - *Tarsonemus angulatus, **T. confusus, **T. bifurcatus, T. nodosus, T. talpae, *T. virgineus, *Xenotarsonemus belemnitoides, Tydeus californicus, *T. heterosetus, *T. inclutus, T. kochi, *Lorryia volgini, L. praefata, L. obnoxia, L. wainsteini, L. ferula, L. formosa, L. placita, L. devexa, *L. ocellata, L. lena, **L.* sp. 1, *L. mali, *L. electra, *L. dumosa, Triophtydeus immanis, T. flatus, Pronematus sextoni, Homeopronematus anconai, **Metalorryia armaghensis, **Imparipes boldi, Euseius finlandicus, Neoseiulus reductus, Amblyseius nemorivagus, *Transeius herbarius, Typhlodromus phialatus, T. cotoneastri, *T. tiliae, *T. tubifer,*

*Anthoseius pirianykae, A. inopinatus, A. rhenanus, A. caudiglans, Kampimodromus aberrans, K. langei, Eharius marzhaniani, Eotetranychus prunicola, E. fraxini, *E. populi, Tetranychus lonicerae, Cenopalpus pennatisetus, **C.* sp. 3*, C. pulcher, Acotyledon agilis, A. redikorzevi, Typhloctonus sguamiger, *Seulus simplex, Zetzellia mali, *Paraseiulus incognitus;*

4. ***Acer negundo*** **(48 species of mites)** - **Tydeus argutus, *T. heterosetus, T. californicus, T. caudatus, Lorryia obstinata, L. praefata, L. wainsteini, L. ferula, L. lena, *L. ocellata, *L. woolleyi, L. formosa, L. mali, Triophtydeus immanis, **T. fragarius, *T. ineditus, T. flatus, Pronematus sextoni, Acotyledon rhizoglyphoides, A. redikorzevi, Typhloctonus sguamiger, Typhlodromus pyri, T. cotoneastri, *T. tiliae, **T. invectus, Euseius finlandicus, Amblyseius andersoni, A. rademacheri, Neoseiulus umbraticus, Anthoseius inopinatus, A. caudiglans, A. recki, A. rhenanus, Dubininellus juvenis, D. echinus, *D. macropilis, *Phytoseius salicis, Kampimodromus aberrans, Eharius marzhaniani, Eotetranychus prunicola, E. pomeranzevi, Amphitetranychus viennensis, *Tetranycopsis horridus, Tetranychus lonicerae, Tarsonemus lobosus, T. talpae, Zetzellia mali, *Cunaxoides fidus;*

5. ***Alnus incata*** **(8 species of mites)** - *Euseius finlandicus, Kampimodromus aberrans, Lorryia mali, L. devexa, Dubininellus echinus, Eotetranychus fraxini, Panonychus ulmi, Acotyledon redikorzevi;*

6. ***Carpinus betulus*** **(38 species of mites)** - *Euseius finlandicus, Amblyseius andersoni, *Typhlodromus graminisilis, *Transeius herbarius, Typhloctonus sguamiger, Typhlodromus pyri, *T. phialatus, T. cotoneastri, Neoseiulus umbraticus, N. astutus, Kampimodromus aberrans, Eharius marzhaniani, *Seiulus simplex, Lorryia ferula, L. devexa, L. formosa, L. mali, L. lena, L. wainsteini, L. praefata, *Tydeus heterosetus, T. californicus, T. caudatus, T. kochi, Triophtydeus flatus, *T. ineditus, Eotetranychus prunicola, *E. rajae, E. pomeranzevi, E. orientalis, E. fraxini, Acotyledon krameri, *Cunaxa setirostris, Schaarschmidtia naegelei, Tarsonemus lobosus, *T. ellipticus, Cenopalpus piger, *C. platani;*

7. ***Carpinus orientalis*** **(10 species of mites)** - *Euseius finlandicus, Neoseiulus umbraticus, N. reductus, N. astutus, Anthoseius involutus, A. rhenanus, Lorryia ferula, L. formosa, *Tydeus heterosetus, Eotetranychus fraxini;*

8. ***Cerasus mahaleb*** **(10 species of mites)** - *Euseius finlandicus, Tydeus californicus, T. caudatus, Lorryia lena, L. praefata, L. wainsteini, Zetzellia mali, Triophtydeus flatus, Cenopalpus piger, Kampimodromus aberrans;*

9. ***Cerasus avium*** **(40 species of mites)** - *Neoseiulus astutus, Amblyseius andersoni, A. rademacheri, Euseius finlandicus, Anthoseius caudiglans, Typhlodromus cotoneastri, T. pyri, Dubininellus juvenis, D. echinus, *Seiulus simplex, Paraseiulus soleiger, *P. incognitus, **Spinibdella cronini, Tydeus caudatus, T. californicus, T. kochi, *T. inclutus, Lorryia ferula, *L. elinguis, L. lena, L. wainsteini, L. praefata, L. mali, Triophtydeus flatus, Homeopronematus anconai, Pronematus sextoni, Schaarschmidtia naegelei, **Siteroptes primitivus, Eotetranychus fraxini, E. pomeranzevi, Zetzellia mali, Cenopalpus piger, C. pulcher, *C. populi, *C. platani, C. ruber, C. pennatisetus, Bryobia lonicerae, *B. confusa, Acotyledon rhizoglyphoides;*

10. ***Cerasus fruticosa*** **(26 species of mites)** - *Amblyseius andersoni, Neoseiulus reductus, Euseius finlandicus, Typhlodromus cotoneastri, Kampimodromus aberrans, K. langei, *Anthoseius involutus, A. pirianykae, *Paraseiulus incognitus, Lorryia wainsteini, L. placita, Tydeus californicus, T. kochi, *Triophtydeus ineditus, Pronematus sextoni, Homeopronematus anconai, Schaarschmidtia naegelei, *Oligonychus kobachidzei, Panonychus citri, Bryobia lonicerae, Eotetranychus rajae, E. orientalis, E. fraxini, E. prunicola, Zetzellia mali, *Anystis baccarum;*

11. ***Cornus mas*** **(48 species of mites)** - *Tarsonemus talpae, T. nodosus, *T. virgineus, **T. trapezoides, Schaarschmidtia naegelei, Tydeus caudatus, T. californicus, *T. argutus, *T. inclutus, **Lorryia obligua, L. ferula, L. formosa, L. obstinata, L. lena, L. mali, L. devexa, *L. minuta, *L. elinguis, Triophtydeus flatus, Homeopronematus anconai, Pronematus sextoni, *Cunaxoides parvus, **Cheletocarus raptor, Acotyledon rhizoglyphoides, Eotetranychus fraxini, **Neotetranychus rubi, **Bryobia borealis, B. lonicerae, Cenopalpus piger, C. pennatisetus, C. pulcher, C. ruber, Zetzellia mali, Typhlodromus cotoneastri, T. pyri, *T. phialatus, Euseius finlandicus, Amblyseius andersoni, A. nemorivagus, Neoseiulus astutus, *Transeius herbarius, *Typhlodromips tauricus, *Proprioseiopsis okanagensis, Anthoseius inopinatus, *A. verrucosus, Kampimodromus aberrans, Dubininellus juvenis, *D. macropilis;*

12. ***Corylus avellana*** **(38 species of mites)** - *Schaarschmidtia naegelei, Tarsonemus talpae, T. lobosus, **Steneotarsonemus erlangensis, Tydeus californicus, T. caudatus, T. kochi, *Metalorryia insignita, *Lorryia electra, L. praefata, **L. elinguis, L. wainsteini, L. ferula, L. devexa, L. lena, L. mali, Triophtydeus flatus, *Tetranycopsis horridus, *Tyrophagus humerosus, Eotetranychus fraxini, Euseius finlandicus, Amblyseius andersoni, A. nemorivagus, Neoseiulus reductus, N. umbraticus, Anthoseius rhenanus, A. involutus, Kampimodromus aberrans, Eharius marzhaniani, Typhlodromus pyri, *T. phialatus, T. cotoneastri, Dubininellus juvenis, D. echinus, *D. macropilis, *Phytoseius severus, *Typhlodromips tauricus, Zetzellia mali;*

13. ***Cotinus coggygria*** **(24 species of mites)** - *Kampimodromus aberrans, *Lorryia electra, *L. dumosa, L. praefata, *L. elinguis, L. wainsteini, L. ferula, L. lena, *Metalorryia insignita, Tydeus californicus, T. caudatus, Homeopronematus anconai, **Pronematus testatus, P. sextoni, Euseius finlandicus, Amblyseius andersoni, Dubininellus juvenis, D. echinus, *Phytoseius severus, Typhlodromus cotoneastri, T. pyri, Triophtydeus immanis, T. flatus, Zetzellia mali;*

14. ***Crataegus sanguinea*** **(18 species of mites)** - *Lorryia ferula, L. lena, L. mali, L. wainsteini, Triophtydeus flatus, **Pseudolorryia spineus, Tarsonemus angulatus, Phytonemus pallidus, *Tyrophagus humerosus, Eotetranychus fraxini, *E. uchidai, Cenopalpus pennatisetus, C. pulcher, C. piger, Paraseiulus soleiger, Typhlodromus pyri, Euseius finlandicus, Kampimodromus aberrans;*

15. ***Crataegus curvisepala*** **(2 species of mites)** - *Euseius finlandicus, Triophtydeus flatus;*

16. ***Euonymus europaea*** **(18 species of mites)** - *Tarsonemus talpae, Tydeus caudatus, T. californicus, *T. heterosetus, Lorryia ferula, L. devexa, L. mali, **L. mirabilis, Triophtydeus immanis, T. flatus, Amblyseius andersoni, Euseius finlandicus, Amphitetranychus viennensis, Eotetranychus fraxini, E. prunicola, Typhloctonus sguamiger, Typhlodromus cotoneastri, *T. tubifer;*

17. ***Euonymus verrucosa*** **(24 species of mites)** - *Paraseiulus soleiger, *Anthoseius clavatus, Kampimodromus aberrans, Typhlodromus pyri, T. georgicus, Typhloctonus sguamiger, Amblyseius andersoni, Euseius finlandicus, *Cheletomorpha lepidopterorum, Zetzellia mali, Cenopalpus pennatisetus, C. ruber, *Schizotetranychus spireafolia avetjanae, Eotetranychus fraxini, Amphitetranychus viennensis, Tydeus caudatus, T. californicus, Lorryia wainsteini, L. ferula, L. lena, L. mali, Triophtydeus immanis, T. flatus, *Pronematus bonatii;*

18. ***Fagus sylvatica*** **(26 species of mites)** - *Typhloctonus sguamiger, Tydeus caudatus, T. californicus, Typhlodromus cotoneastri, **Galendromus pilosus, Euseius finlandicus, **Proprioseiopsis dacus, Amblyseius andersoni, *Transeius herbarius, Eotetranychus fraxini, E. pomeranzevi, E. orientalis, Tarsonemus hermes, *T. virgineus, *T. bilobatus, T. talpae, Lorryia praefata, L. lena, L. mali, L. ferula, **Neopronematus rapidus, Triophtydeus immanis, T. flatus, Paraseiulus soleiger, *Phytoseius severus, Dubininellus juvenis;*

19. ***Frangula alnus*** **(8 species of mites)** - *Euseius finlandicus, Amblyseius andersoni, A. nemorivagus, Neoseiulus reductus, *Typhlodromips bicaudus, *Tetranycopsis horridus, Panonychus ulmi, Eotetranychus fraxini;*

20. ***Fraxinus excelsior*** **(42 species of mites)** - *Zetzellia mali, Euseius finlandicus, Amblyseius andersoni, A. rademacheri, *A. neobernhardi, Anthoseius caudiglans, A. inopinatus, A. rhenanus, Typhloctonus sguamiger, Typhlodromus cotoneastri, T. pyri, Dubininellus juvenis, D. echinus, *Phytoseius salicis, *Paraseiulus incognitus, Kampimodromus aberrans, Eharius marzhaniani, Tydeus caudatus, *T. heterosetus, T. californicus, T. kochi, Lorryia wainsteini, L. lena, L. mali, L. obstinata, L. ferula,*L. visenda, L. placita, Pronematus sextoni, Homeopronematus anconai, Triophtydeus immanis, T. flatus, Tarsonemus lobosus, *T. floricolus, T. talpae, Panonychus ulmi, *Tetranychus polygoni, Eotetranychus fraxini, *E. tiliarium, E. pomeranzevi, Acotyledon rhizoglyphoides, A. agilis;*

21. ***Fraxinus ornus*** **(42 species of mites)** - *Zetzellia mali, Euseius finlandicus, Amblyseius andersoni, A. rademacheri, *A. neobernhardi, Anthoseius caudiglans, A. inopinatus, A. rhenanus, Typhloctonus sguamiger, Typhlodromus cotoneastri, T. pyri, Dubininellus juvenis, D. echinus, *Phytoseius salicis, *Paraseiulus incognitus, Kampimodromus aberrans, Eharius marzhaniani, Tydeus caudatus, *T. heterosetus, T. californicus, T. kochi, Lorryia wainsteini, L. lena, L. mali, L. obstinata, L. placita, L. ferula, *L. visenda, Pronematus sextoni, Homeopronematus anconai, Triophtydeus immanis, T. flatus, *Tarsonemus floricolus, T. talpae, T. lobosus, Panonychus ulmi, *Tetranychus polygoni, Eotetranychus fraxini, *E. tiliarium, E. pomeranzevi, Acotyledon rhizoglyphoides, A. agilis;*

22. ***Fraxinus europaea*** **(7 species of mites)** - *Euseius finlandicus, Tydeus caudatus, Lorryia wainsteini, **Anthoseius rechi, Triophtydeus flatus, *Cunaxa setirostris, Typhloctonus sguamiger;*

23. ***Ligustrum vulgare*** **(10 species of mites)** - *Amblyseius andersoni, Euseius finlandicus, Anthoseius caudiglans, A. rhenanus, Typhlodromus cotoneastri, *T. phialatus, T. pyri, Triophtydeus flatus, Lorryia ferula, *Tydeus inclutus;*

24. ***Lonicera xylosteum*** - *Tydeus caudatus;*

25. ***Malus sylvestris*** **(60 species of mites)** - *Amblyseius andersoni, A. nemorivagus, *Typhlodromips maior, *Neoseiulus marginatus, *Typhlodromips tauricus, *Proprioseiopsis okanagensis, Euseius finlandicus, Typhloctonus sguamiger, Anthoseius caudiglans, A. inopinatus, A. pirianykae, Kampimodromus aberrans, K. langei, Dubininellus juvenis, D. echinus, *Phytoseius salicis, Tydeus caudatus, T. californicus, Lorryia wainsteini, L. devexa, L. placita, *L. volgini, L. lena, *L. electra, L. mali, L. obstinata, L. ferula, L. formosa, Triophtydeus immanis, T. flatus, *T. ineditus, Pronematus sextoni, Homeopronematus anconai, **Lasiotydeus volaticus, Tarsonemus bilobatus, T. hermes, T. lobosus, Schaarschmidtia naegelei, Eotetranychus prunicola, E. fraxini, E. pomeranzevi, *E. populi, Tetranychus urticae, *Bryobia confusa, B. lonicerae, **B. angustisetis, *B. ulmophila, **B. obihsaphedi, **Eustigmaeus chilensi, **E. segnis, Zetzellia mali, **Storchia robustus, *Bdella muscorum, *Cunaxa setirostris, Cenopalpus pulcher, C. piger, C. pennatisetus, **Brevipalpus* sp. 1, *Acotyledon rhizoglyphoides, A. redikorzevi;*

26. ***Quercus robur*** **(48 species of mites)** - *Eotetranychus fraxini, E. prunicola, *E. uncatus exignuus, *E. tiliarium, E. orientalis, *E. latifrons, E. pomeranzevi, *E. rajae, Lorryia lena, L. mali, L. ferula, L. wainsteini, L. praefata, L. obstinata, L. formosa, *Allonychus braziliensis, Kampimodromus aberrans, Eharius marzhaniani, Typhlodromus cotoneastri, Anthoseius inopinatus, A. caudiglans, Euseius finlandicus, Amblyseius andersoni, A. rademacheri, A. nemorivagus, Paraseiulus soleiger, Neoseiulus reductus, N. astutus, Dubininellus juvenis, *D. macropilis, *Phytoseius salicis, *Seiulus simplex, Zetzellia mali, **Tydeus diversus, T. caudatus, T. kochi, Triophtydeus flatus, T. immanis, Homeopronematus anconai, Schaarschmidtia naegelei, Tarsonemus talpae, T. lobosus, Cenopalpus pulcher, Amphitetranychus viennensis, Panonychus ulmi, Tetranychus lonicerae, **Cheletomorpha lepidopterorum, Zetzellia mali;*

27. ***Quercus borealis*** **(7 species of mites)** - *Tydeus californicus, Pronematus sextoni, Zetzellia mali, Euseius finlandicus, *Typhlodromips tauricus, Typhlodromus cotoneastri, Paraseiulus soleiger;*

28. ***Quercus petraea*** **(5 species of mites)** - *Euseius finlandicus, Triophtydeus flatus, Lorryia lena, *L. elinguis, L. ferula;*

29. ***Quercus pubescens*** **(14 species of mites)** - *Lorryia lena, L. ferula, **L. matura, L. wainsteini, Euseius finlandicus, **Amblyseius obtusus, Eharius marzhaniani, Typhlodromus pyri, **T. kazachstanicus, Zetzellia mali, Triophtydeus flatus, Acotyledon agilis, A. michaeli, Eotetranychus pomeranzevi;*

30. ***Tilia cordata*** **(46 species of mites)** - *Tydeus californicus, T. caudatus, *Lorryia minuta, *L. elinguis, T. placita, L. obstinata, L. obnoxia, L. wainsteini, *L. dumosa, L. lena, L. ferula, L. mali, *L. woolleyi, L. formosa, Homeopronematus anconai, Schaarschmidtia naegelei, **Tarsonemus crassus, T. talpae, *T. virgineus, Triophtydeus immanis, T. flatus, *Metalorryia insignita, Euseius finlandicus, Amblyseius andersoni, A. nemorivagus, Neoseiulus umbraticus, Anthoseius rhenanus, A. caudiglans, *Proprioseiopsis okanagensis, Typhlodromus pyri, Kampimodromus aberrans, K. langei, Dubininellus juvenis, *D. macropilis, *Seiulus simplex, Paraseiulus soleiger, Cenopalpus pulcher, C. piger, C. pennatisetus, Acotyledon rhizoglyphoides, Eotetranychus pomeranzevi, E. orientalis, *E. uchidai, E. prunicola, Zetzellia mali, *Cunaxoides parvus;*

31. ***Tilia europaea*** - *Euseius finlandicus;*

32. ***Tilia platyphyllos*** **(2 species of mites)** - *Euseius finlandicus, Tydeus californicus;*

33. ***Tilia tomentosa*** **(34 species of mites)** - *Schaarschmidtia naegelei, *Tarsonemus bifurcatus, T. hermes, Phytonemus pallidus, Lorryia obstinata, L. praefata, L. wainsteini, L. ferula, L. formosa, L. lena, L. mali, Triophtydeus immanis, T. flatus, Eotetranychus fraxini, E. prunicola, E. pomeranzevi, *E. uncatus exignuus, Tetranychus lonicerae, *T. pamiricus, Acotyledon michaeli, A. agilis, Euseius finlandicus, Kampimodromus aberrans, Anthoseius inopinatus, A. caudiglans, A. rhenanus, Typhloctonus sguamiger, Typhlodromus cotoneastri, T. pyri, *T. tubifer, *T. phialatus, Paraseiulus soleiger, Cenopalpus pulcher, Zetzellia mali;*

34. ***Padus avium*** **(5 species of mites)** - *Euseius finlandicus, Amblyseius andersoni, Anthoseius rhenanus, Triophtydeus flatus, Lorryia ferula;*

35. ***Padus serotina*** - *Euseius finlandicus;*

36. ***Prunus insitilia*** **(25 species of mites)** - *Triophtydeus flatus, *Lorryia elinguis, L. lena, L. wainsteini, Amphitetranychus viennensis, **Tetranychus armeniaca, *Bryobia confusa, *Oligonychus buschi, Eotetranychus fraxini, Euseius finlandicus, Amblyseius andersoni, Neoseiulus reductus, *Typhlodromus graminisilis, Anthoseius caudiglans, Kampimodromus langei, Dubininellus juvenis, D. echinus, Typhloctonus sguamiger, Paraseiulus soleiger, Zetzellia mali, Tarsonemus talpae, T. nodosus, T. bilobatus, Homeopronematus anconai, Pronematus sextoni;*

37. ***Prunus spinosa*** **(24 species of mites)** - *Homeopronematus anconai, Pronematus sextoni, Cenopalpus pulcher, Eotetranychus fraxini, E. pomeranzevi, Amphitetranychus viennensis, Panonychus ulmi, *Oligonychus kobachidzei, *Bryobia confusa, Tydeus caudatus, Kampimodromus aberrans, Typhlodromus phialatus, T. pyri, Dubininellus juvenis, D. echinus, Triophtydeus flatus, T. ineditus, Lorryia praefata, *L. elinguis, L. mali, Zetzellia mali, **Cheyletus eruditus, Amblyseius andersoni, Euseius finlandicus;*

38. ***Pyrus pyraster*** **(16 species of mites)** - *Euseius finlandicus, Typhlodromus cotoneastri, *Phytoseius salicis, Dubininellus echinus, Tydeus californicus, Triophtydeus flatus, Homeopronematus anconai, Lorryia lena, *L. dumosa, *Metalorryia delicata, Eotetranychus prunicola, E. fraxini, **Mediolata similans, *Bdella muscorum, **B. iconica, **Cyta coerulipes;*

39. ***Rhamnus cathartica*** **(4 species of mites)** - *Lorryia formosa, Euseius finlandicus, Bryobia lonicerae, Tydeus kochi;*

40. ***Robinia pseudacacia*** **(2 species of mites)** - *Lorryia wainsteini, Euseius finlandicus;*

41. ***Sambucus nigra*** **(11 species of mites)** - *Tarsonemus virgineus, *Tydeus heterosetus, Homeopronematus anconai, Lorryia ferula, L. lena, Tetranychus lonicerae, Eotetranychus fraxini, Euseius finlandicus, Amblyseius andersoni, **Neoseiulus cucumeris, Kampimodromus aberrans;*

42. ***Salix cinerea*** **(2 species of mites)** - *Zetzellia mali, Cenopalpus piger;*

43. ***Salix caprea*** **(2 species of mites)** - *Triophtydeus flatus, Cenopalpus pulcher;*

44. ***Staphylea pinnata*** **(15 species of mites)** - *Euseius finlandicus, Amblyseius andersoni, Typhlodromus pyri, Paraseiulus soleiger, *Tarsonemus virgineus, *Tydeus inclutus, Lorryia wainsteini, L. ferula, L. lena, L. mali, Homeopronematus anconai, **Brevipalpus thelicraniae, Tetranychus lonicerae, *Eotetranychus latifrons, E. orientalis;*

45. ***Sorbus torminalis*** **(20 species of mites)** - *Amblyseius andersoni, Euseius finlandicus, Typhlodromus pyri, Anthoseius caudiglans, *Seiulus simplex, *Paraseiulus incognitus, Eotetranychus fraxini, E. populi, E. prunicola, Zetzellia mali, Cenopalpus piger, C. pulcher, C. pennatisetus, Lorryia wainsteini, L. ferula, L. lena, L. formosa, Tydeus inclutus, Schaarschmidtia naegelei, Triophtydeus flatus;*

46. ***Swida alba*** **(13 species of mites)** - *Typhlodromus cotoneastri, T. pyri, Amblyseius andersoni, Euseius finlandicus, Cenopalpus pennatisetus, *Allonychus braziliensis, Eotetranychus pomeranzevi, Pronematus sextoni, Triophtydeus immanis, T. flatus, Lorryia wainsteini, L. devexa, Tydeus caudatus;*

47. ***Swida australis*** **(8 species of mites)** - *Euseius finlandicus, Amblyseius nemorivagus, Paraseiulus soleiger, Dubininellus echinus, Tydeus californicus, Triophtydeus flatus, Tarsonemus talpae, T. hermes;*

48. ***Swida sanguinea*** **(9 species of mites)** - *Lorryia ferula, Triophtydeus flatus, Pronematus sextoni, Cenopalpus pennatisetus, C. pulcher, Paraseiulus soleiger, Kampimodromus aberrans, Acotyledon redikorzevi, Euseius finlandicus;*

49. ***Ulmus glabra*** **(34 species of mites)** - *Tarsonemus hermes, **T. pauperoseatus, Tydeus californicus, T. kochi, Lorryia praefata, L. ferula, L. devexa, L. lena, L. obstinata, **L. pinnigera, L. mali, Pronematus sextoni,*

*Homeopronematus anconai, *Bryobia graminum, Typhloctonus sguamiger, Triophtydeus flatus, Zetzellia mali, Eotetranychus fraxini, *E. rajae, *E. ulmicola, *Tetranychus pamiricus, Kampimodromus aberrans, K. langei, Amblyseius andersoni, A. nemorivagus, **Typhlodromips similis, Euseius finlandicus, *Anthoseius verrucosus, Dubininellus echinus, *D. macropilis, Typhlodromus pyri, T. cotoneastri, Acotyledon redikorzevi, A. rhizoglyphoides;*

50. ***Ulmus carpinifolia*** **(25 species of mites)** - *Amblyseius andersoni, A. nemorivagus, Euseius finlandicus, Triophtydeus flatus, Kampimodromus aberrans, Typhloctonus sguamiger, Dubininellus echinus, Tarsonemus hermes, T. angulatus, *T. bifurcatus, Lorryia ferula, L. devexa, L. lena, *L. woolleyi, L. mali, *L. mirabilis, Pronematus sextoni, Homeopronematus anconai, *Tydeus inclutus, T. californicus, *T. heterosetus, *Paraseiulus incognitus, *Cunaxoides biscutum, Amphitetranychus viennensis, Eotetranychus fraxini;*

51. ***Ulmus europaea*** **(23 species of mites)** - *Amblyseius andersoni, A. rademacheri, *Typhlodromips tauricus, **T. lutezhicus, Euseius finlandicus, Typhlodromus pyri, T. cotoneastri, Typhloctonus sguamiger, Kampimodromus aberrans, **Cheyletus malaccensis, Lorryia ferula, L. lena, L. mali, *L. electra, L. placita, Tydeus californicus, T. caudatus, Triophtydeus flatus, T. immanis, Pronematus sextoni, Paraseiulus soleiger, Eotetranychus uchidai, **Tetranychus przhevalskii;*

52. ***Ulmus laevis*** **(44 species of mites)** - *Neoseiulus astutus, N. umbraticus, N. reductus, Amblyseius andersoni, A. nemorivagus, *Typhlodromips tauricus, *Proprioseiopsis okanagensis, Euseius finlandicus, Anthoseius verrucosus, A. rhenanus, A. pirianykae, A. clavatus, A. caudiglans, Typhloctonus sguamiger, Typhlodromus cotoneastri, Kampimodromus aberrans, K. langei, Dubininellus echinus, Homeopronematus anconai, Pronematus sextoni, Lorryia ferula, *L. elinguis, L. lena, L. praefata, L. wainsteini, *L. electra, **L. scopa, *Metalorryia delicata, *M. insignita, Tydeus kochi, T. caudatus, Triophtydeus immanis, *Tarsonemus confusus, T. hermes, Phytonemus pallidus, Amphitetranychus viennensis, Eotetranychus fraxini, E. prunicola, E. pomeranzevi, E. orientalis, Bryobia redicorzevi, *B. graminum, *Anystis baccarum, Zetzellia mali;*

53. ***Viburnum lantana*** **(40 species of mites)** - *Zetzellia mali, Cenopalpus pulcher, Eotetranychus fraxini, Tydeus californicus, *Typhlodromus tiliae, T. pyri, T. cotoneastri, Amblyseius andersoni, A. nemorivagus, Neoseiulus reductus, N. astutus, Euseius finlandicus, Typhloctonus sguamiger, Kampimodromus aberrans, Eharius marzhaniani, Triophtydeus immanis, T. flatus, Anthoseius rhenanus, A. inopinatus, A. pirianykae, *A. clavatus, **A. recki, *A. verricosus, **Typhlodromus cerasicolus, Dubininellus juvenis, D. echinus, Tarsonemus angulatus, T. bilobatus, T. hermes, *T. confusus, Lorryia ferula, L. devexa, L. lena, L. mali, *L. minuta, **Paralorryia chapultepecensis, Acotyledon michaeli, **Cheletogenes ornatus, *Anystis baccarum, Pronematus sextoni.*

The comparison of mite species composition in investigated tree and shrub species showed: 1. The presence of specific complexes of mites; 2. The highest diversity of mites was registered on: *Acer platanoides* - 59, *A. campestre* - 61, *A. tataricum* - 53, *Quercus robur - 48, Tilia cordata* - 46, *Ulmus glabra* - 34, *U. laevis* - 44. These plants are edificators of forests stands.

There were identified 53 species of mites that are found only on a particular species of wild trees and shrubs: *Tarsonemus bifurcatus, T. confusus, T. crassus, T. trapezoides, T. pauperoseatus, Steneotarsonemus erlangensis, Tydeus diversus, Lasiotydeus volaticus, Lorryia matura, L. obligua, L. opifera, L. sp.* 1, *L. pinnigera, L. scopa, Metalorryia armaghensis, Pseudolorryia spineus, Paralorryia chapultepecensis, Pronematus testatus, Neopronematus rapidus, Triophtydeus fragarius, Eustigmaeus chilensis, E. segnis, Storchia robustus, Cunaxoides biscutum, Imparipes boldi, Spinibdella cronini, Siteroptes primitivus, Cheletocarus raptor, Mediolata similans, Bdella iconica, Cyta coerulipes, Cheyletus eruditus, C. malaccensis, Cheletogenes ornatus, Cenopalpus sp.* 3, *Brevipalpus thelicraniae, B. sp.* 1, *Bryobia angustisetis, B. borealis, B. obihsaphedi, Tetranychus przhevalskii, T. armeniaca, Neotetranychus rubi, Amblyseius obtusus, Neoseiulus cucumeris, Anthoseius recki, Galendromus pilosus, Typhlodromus invectus, T. halinae, T. rapidus, Proprioseiopsis dacus, Typhlodromips rubini, T. similis.*

CONCLUSIONS

In the forests of the Republic of Moldova, mite fauna present on the leaves of trees and shrubs is represented by one hundred ninety species registered on fifty three species of trees and shrubs.

There were registered 65 rare species of mites on wild plants and 53 species were recorded only on specific plant species in the forest stands of the Republic of Moldova.

The highest diversity of mites was registered on the following plants - edificators of the forest stands: *Acer platanoides* - 59, *A. campestre* - 61, *A. tataricum* - 53, *Quercus robur - 48, Tilia cordata* - 46, *Ulmus glabra* - 34, *U. laevis* - 44.

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THE PREFERENCE OF THE THRIPS COENOSES FOR DIFFERENT ROSE VARIETIES IN THE TOWN OF PITEŞTI (ARGEŞ COUNTY)

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Abstract. The collectings carried out in June-September 2011 regarding the Thysanoptera fauna on red and white varieties of roses from the parks of the town of Piteşti, show a specific diversity of 17 species. White varieties show much greater attractiveness both in terms of number of species and their populations. The floricultural polyphagous *Frankliniella intonsa* has constantly participated in providing the Thysanoptera coenosis, with the highest values of structural indicators and values of relative abundance ranging between 60.97 and 100%. Such studies reveal the importance of ornamental plants, in ensuring and preserving the biodiversity of thrips în parks, as veritable urban oases.

Keywords: Thysanoptera, taxonomic structure, rose varieties, specific diversity, ecological indicators, Piteşti

Abstract. Preferinţa cenozelor de tripşi pentru diferite soiuri de trandafiri din oraşul Piteşti. Cercetări efectuate în perioada iunie-septembrie 2011 privind fauna de tisanoptere de pe trandafiri din două parcuri din oraşul Piteşti, relevă o diversitate specifică de 16 specii. Soiurile albe prezintă o atractivitate mult mai mare atât din punct de vedere al numărului de specii, cât şi al populaţiilor acestora. Polifagul floricol *Frankliniella intonsa* a participat constant la edificarea cenozei de Thysanoptera, având cele mai ridicate valori ale indicatorilor structurali şi valori ale abundenţei relative care variază între 60.97 şi 100%. Astfel de studii relevă importanţa plantelor ornamentale în asigurarea şi conservarea biodiversităţii tripşilor în parcuri, adevărate oaze urbane.

Cuvinte cheie: Thysanoptera, structura taxonomică, soiuri de trandafiri, diversitate specifică, indicatori ecologici, oraşul Piteşti.

INTRODUCTION

The rose has always been considered the queen of flowers, being most frequently cultivated in parks and gardens as a decorative plant. In turn, this species of Rosaceae is the trophic support for a large number of insects, including the delicate Thysanoptera. Many species of thrips have a role in pollination, the small number of pollen grains carried being compensated by the large number of individuals present in flowers (LEWIS, 1973). The commercial importance of the rose determined in the course of time numerous studies on the species of thrips hosted, the harmful potential and developing strategies for the proper control of their populations (BERGH & LE BLANC, 1997; BOLL et al., 2007; GAUM et al., 1994; PIZZOL et al., 2010). In this regard, a baseline study is the one conducted by DAVIDSON & ANDREWARTHA (1948) who have tracked the dynamics of the populations of *Thrips imagines* Bagnall, 1926 of rose flowers for 14 years.

No studies have been done in Romania about the thrips fauna on roses. KNECHTEL (1951) finds the species *Thrips major* Uzel 1895 on *Rosa* sp., and VASILIU-OROMULU (2002) mentions four species on *Rosa canina*: *Frankliniella intonsa* (Trybom 1895), *Thrips fuscipennis* Haliday 1836, *Thrips major* Uzel 1895, *Taeniothrips inconsequens* (Uzel 1895).

The present study completes the list of Thysanoptera species that inhabit the roses from urban parks. It also constitutes a pleading on the importance of cultivating roses in parks, not only for aesthetic reasons, but also to ensure and preserve the biodiversity of Thysanoptera species.

MATERIAL AND METHODS

The observations were carried out during June-September 2011 on roses cultivated in two parks of the town of Piteşti (Argeş County). The following varieties were investigated: Kent and White Morsdag, as white varieties, Crimson Glory and Red Berlin, as red varieties. There are differences between the two parks in terms of diversity of plant species and maintenance works.

Expo Park, located in the center of Piteşti on an area of approx 11.000 sq m is in private management; coordinates: 44.86274 N; 24.87079 E. Herbaceous vegetation is dominated by Poaceae, so the trophic alternative for the thrips species is poorer. Moreover, there is woody vegetation consisting of trees and decorative bushes. It was posible a treatment with insecticides in August.

The varieties of roses observed are: White Morsdag and Red Berlin.

The ADP Park belongs to the local Administration of the city and it benefits from a much diversified vegetation, grassy and woody, being located on the outskirts of the city, near a lot of waste ground with ruderal vegetation, local administration greenhouses and another park, with many woody species (coordinates: 44.85476 N; 24.88421 E). The treatments carried out in greenhouses also concern the decorative species in the park, so that in the months of June-July the roses monitored in this study were treated with Actellic 0.3% (June 14) and Actara 25 WG 0.05% (July 8). The ADP Park has an area of approx 15.000 sq m. Observed varieties: Kent and Crimson Glory.

In both parks, the small number of white rose cuttings as compared to the red ones and, respectively, of flowers, allowed the collecting of samples from the white varieties only in June.

The areas with roses from which the samples were collected have close areas, of approx 200 sq m.

Collectings were made during the flowering of roses. There were collected every two weeks ten (10) samples each, except for June, when adverse weather conditions allowed the collecting of samples only in the first decade. A sample consisted of 10 flowers. The thrips species were identified with the following keys of determination: KNECHTEL (1951); ZUR STRASSEN (2003).

RESULTS AND DISCUSSIONS

The data obtained from the current study reveal aspects related to the specific diversity, comparative aspects of the structure of populations from the two parks, on white and red varieties.

a. Specific diversity

According to our observations, the flowers of roses from parks represent a trophic niche for species from *Aeolothrips, Frankliniella, Thrips,* and *Haplothrips* kinds.

The numerical abundance reveals a total of 4,300 adults and 147 larvae - 2,088 adults and 49 larvae în ADP Park, and 2,212 adults and 98 larvae in Expo Park, which belong to 17 species (Table 1). *Frankliniella intonsa, Frankliniella occidentalis, Thrips fuscipennis, Thrips tabaci* are mentioned by RASPUDIC et al. (2009) on *Rosa* sp. The trophic behavior results in the distribution of species into the two modules, primary and secondary consumers, only two species, *Aeolothrips fasciatus* and *A. intermedius*, being zoophagous.

Polyphagous, as a strategy to ensure the trophic resource in living conditions more or less optimal, is found in all identified species. From the ecological point of view, typical floricolous elements are dominant; exceptions are the species *Thrips fuscipennis* and *Thrips tabaci*, both floricolous and folicolous, as well as the arboricolous species *Haplothrips minutus*. Conditions in June, with increased rainfall regime, favor mesophilous species, while in July and August, the xerophilous *Frankliniella intonsa* will generally be the only component of thrips populations on roses (Table 2). Otherwise, it is known the attachment of this species to plant inflorescences, behavior which is also reflected in the name of the species – the thrips of inflorescences.

The same diversity is also noticed in terms of geographical distribution; we find Holarctic, Palaearctic, and West-Palaearctic, Euro-Siberian, European, Cosmopolite and Ponto-Mediterranean. Euro-Siberian elements are dominant, followed by ther Palaearctic and West-Palaearctic ones.

Sex-ratio of thrips species is an expression of female dominance, situation typical to Thysanoptera. The most abundant species of this study, *Frankliniella intonsa*, presents a percentage of females of 93.8% and sex ratio of 0.071.

The stability and dynamics of thrips populations on this host plant is expressed by the presence of larvae of *Terebrantia and Tubulifera.* Corresponding to the higher number of adults, Terebrantia larvae are much more numerous than the Tubulifera ones (Table 1).

Table 1. Specific diversity of the Thysanoptera Order on roses in the two parks.

Suborders	Families	Species	ADP Park	Expo Park
			No. of individuals	No. of individuals
Terebrantia	Aeolo-thripidae	*Aelothrips fasciatus* (Linneaeus 1758)	-	**1**♂
		Aeolothrips intermedius Bagnall 1934	2♀♀	2♀♀; 3♂♂
	Thripidae	*Frankliniella intonsa* (Trybom 1895)	1,905♀♀; 113♂♂	1,924♀♀; 160 ♂♂
		Frankliniella occidentalis (Pergande 1895)	2♀♀	-
		Frankliniella pallida (Uzel 1895)	2♀♀	1♀
		Thrips atratus Haliday 1836	1♀	-
		Thrips fuscipennis Haliday 1836	1 ♀	1 ♀
		Thrips major Uzel 1895	2♀♀	14♀♀
		Thrips physapus Linneaeus 1758	1♀	-
		Thrips pillichi Priesner 1924	2♀♀	2♀♀
		Thrips tabaci (Lindeman 1888)	35♀♀	10♀♀
		Thrips validus Uzel 1985	1♀	-
		Terebrantia larvae	46	90
Tubulifera	Phlaeo-thripidae	*Haplothrips angusticornis* Priesner 1921	-	12♀♀; 9♂♂
		H. leucanthemi (Schrank 1781)	5 ♀♀	8♀♀
		H. reuteri Karny 1907	9♀♀; 5♂♂	26♀♀; 15♂♂
		H. setiger (Priesner 1921)	1♀	1♀
		H. minutus (Uzel 1895)	1♀	20♀♀; 3♂♂
		Tubulifera larvae	3	8

b. Comparative aspects of the structure of thrips populations in the two parks

The analysis of data on thrips populations in the two parks highlights a series of qualitative and quantitative aspects.

Regarding the number of species, the roses of the ADP Park are inhabited by 15 species, while in Expo Park there are present 14 species of thrips; 11 species are common. This situation is determined by the location and neighborhoods of the two parks.

In the case of the ADP Park, the surrounding diverse vegetation offers trophic support to many species of Thysanoptera, thus some will be temporarily attracted by roses. ADP greenhouses with decorative plants in the immediate vicinity explain the presence of the two females of the invasive species *F. occidentalis*. Moreover, previous studies highlight the *F. occidentalis* species in those greenhouses (BĂRBUCEANU & VASILIU-OROMULU, 2012).

In Expo Park, the location in the very urban center leads to a less diversified vegetation, so that roses represent one of the few options that thrips have, which during collectings in July registered a record density of 1,001 individuals/sample, of which 99.8% belong to the *Frankliniella intonsa* species. To this there are added the maintenance works, periodically carried out, which largely eliminate the inflorescences of spontaneous species. However, the specific diversity is close to the one of the ADP Park. The low trophic offer leads to an aggregation of thrips on the roses, both in terms of the number of species and numerical density.

In both parks, the floricolous polyphagous *F. intonsa* proves attachment for this host plant, having the greatest numerical density of the samples among the collected species, representing 95.4% of thrips populations (Fig. 1, Table 1). The other accidental species reach the rose coming from the surrounding plants.

Nevertheless, the temporal dynamics of *F. intonsa* populations on the red variety registers a different evolution in the two parks, so that it does not provide conclusive data on the biology of this species on roses in those conditions. In the ADP Park, the treatment in June and July maintain the population at a low level, but in the second half of August the numerical abundance doubles, reaching the highest value of the whole monitored period: 518 individuals/sample. In Expo Park, the absence of treatments highlights the highest numerical density, i.e. of 999 individuals/sample in the first decade of July. Subsequently, a sharp decline in the dynamics of individuals is noticed, following a descending line until the end of collections, probably due to the treatments applied in August (Fig. 1).

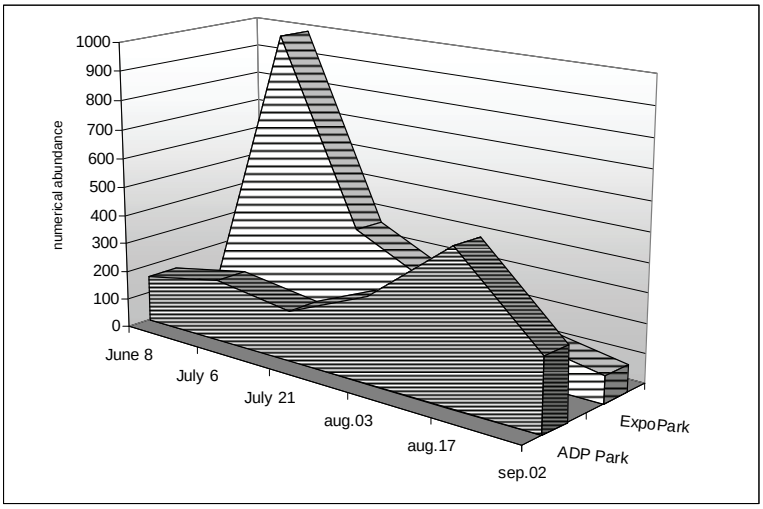


Figure 1. Dynamics of *Frankliniella intonsa* populations on red roses.

c. Comparative aspects of the structure of thrips populations on rose varieties

In the course of time, there have been concerns regarding the preference of thrips for species with a certain color of flowers, aiming at effective control of thrips populations from different cultures. Many of the studies have been focused on *Frankliniella occidentalis*, species present in greenhouses all over the world. Initially, studies on the response to color on different host plants found that white color was more attractive than the yellow one, blue or other colors. According to other studies on roses and carnations, yellow and blue were more attractive than white (LES SHIPP, 1995), while CHYZIK et al. (1995) find the preference of individuals of *Frankliniella occidentalis* on the flowers of gladiolus for lilac color and violet and the least attractiveness for red color. In terms of trap color, MATEUS & MEXIA (1995) notice greater attractiveness of yellow traps for *F. occidentalis* individuals from a culture of roses, compared to the blue or white ones, while other ornamental plants have a different response. Thrips chromatic response is influenced by a series of factors: color, smell and structure of the host plant, characteristics of solar radiation, temperature and humidity (GAUM et al., 1994; MATEUS & MEXIA, 1995).

In the present study, the observations were carried out on white and red varieties of roses. Comparative analysis of data from the first decade of June reveals greater specific diversity and abundance of thrips on white variety, in both parks (Fig. 2, Table 2).

Thus, in the ADP Park, 10 thrips species manifest attractiveness for the white variety, with a numerical density of 478 individuals/sample. *Frankliniella intonsa* species expresses the highest attachment to the flowers of rose, with 423 individuals/sample and dominates the other species in a ratio of 88.49%.

The Thysanoptera association on the red variety consists of 8 species whose populations present a numerical density of 168 individuals/sample. In this case, the *F. intonsa* species also dominates with a relative abundance of 93.5%. Only three species are common to both varieties.

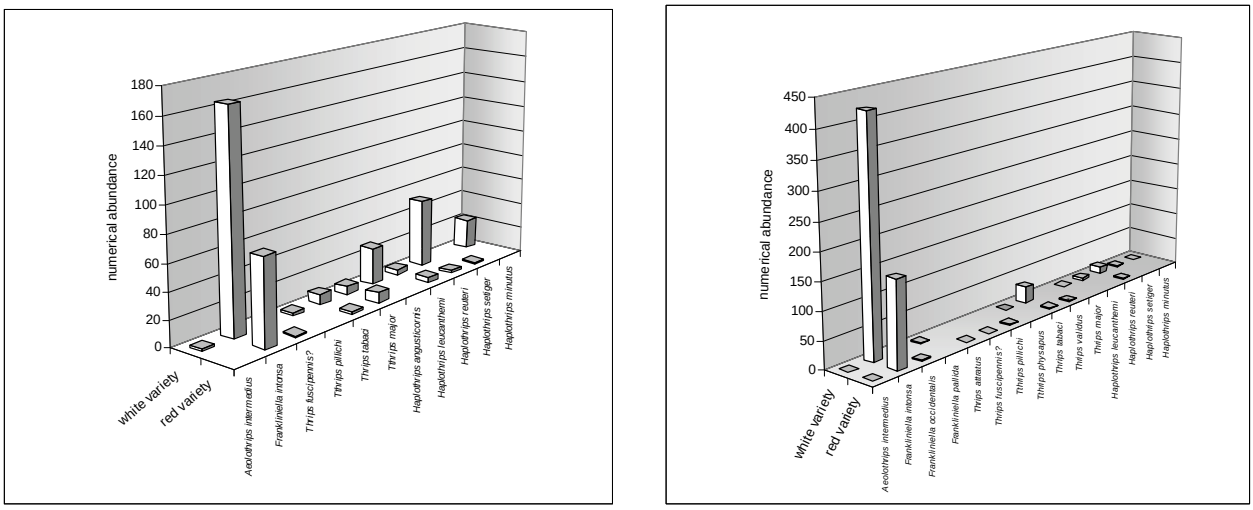
Table 2. The structural indicators of the thrips populations in two parks and on varieties of roses in the town of Pitești.

ADP Park Crimson Glory (red variety), 08.06.2011	**No.ind./ sample**	**x**	**s^2**	**STDEV**	**s'**	**mg.dry matter/m^2**	**A%**	**C%**
Frankliniella intonsa	157	15.7	81.8	9.0	0.90	15.70	93.5	100
Frankliniella occidentalis	2	0.2	0.2	0.4	0.04	0.20	1.2	20
Thrips atratus	1	0.1	0.1	0.3	0.03	0.10	0.6	10
Thrips fuscipennis	1	0.1	0.1	0.3	0.03	0.10	0.6	10
Thrips pillichi	2	0.2	0.4	0.6	0.06	0.20	1.2	10
Thrips tabaci	2	0.2	0.4	0.6	0.06	0.20	1.2	10
Thrips validus	1	0.1	0.1	0.3	0.03	0.10	0.6	10
Haplothrips reuteri	2	0.2	0.2	0.4	0.04	0.20	1.2	20
Σ	**168**	17	82.4	9.1	0.91	**16.80**	100.0	
Kent (white variety), 8.06.2011								
Aeolothrips intermedius	1	0.1	0.1	0.3	0.03	0.10	0.21	10
Frankliniella intonsa	423	42.3	602.2	24.5	2.45	42.30	88.49	100
Frankliniella pallida	***2***	0.2	0.4	0.6	0.06	0.20	0.42	10
Thrips physapus	1	0.1	0.1	0.3	0.03	0.10	0.21	10
Thrips tabaci	30	3.0	12.9	3.6	0.36	3.00	6.28	50
Thrips major	2	0.2	0.2	0.4	0.04	0.20	0.42	20
Haplothrips leucanthemi	5	0.5	1.6	1.3	0.13	0.50	1.05	20
Haplothrips reuteri	12	1.2	1.3	1.1	0.11	1.20	2.51	60
Haplothrips setiger	***1***	0.1	0.1	0.3	0.03	0.10	0.21	10
Haplothrips minutus	1	0.1	0.1	0.3	0.03	0.10	0.21	10
Σ	478	48	690.6	26.3	2.63	**47.80**	100.00	
Expo Park Red Berlin (red variety), 8.06.2011								
Frankliniella intonsa	66	6.6	153.6	12.4	1.24	6.60	78.6	100
Thrips fuscipennis	1	0.1	0.1	0.3	0.03	0.10	1.2	10
Thrips tabaci	2	0.2	0.2	0.4	0.04	0.20	2.4	20
Thrips major	8	0.8	1.1	1.0	0.10	0.80	9.5	50
Haplothrips leucanthemi	4	0.4	1.6	1.3	0.13	0.40	4.8	10
Haplothrips reuteri	2	0.2	0.2	0.4	0.04	0.20	2.4	20
Haplothrips setiger	1	0.1	0.1	0.3	0.03	0.10	1.2	10
Σ	**84**	8.4	171.5	13.1	1.31	**8.40**	100.0	
White Morsdag (white variety), 08.06.2011								
Aeolothrips intermedius	2	0.2	0.2	0.4	0.04	0.20	0.74	10
Frankliniella intonsa	164	16.4	13.6	3.7	0.37	16.40	60.97	80
Tthrips pillichi	2	0.2	0.2	0.4	0.04	0.20	0.74	10
Thrips tabaci	8	0.8	0.6	0.8	0.08	0.80	2.97	40
Thrips major	6	0.6	0.7	0.8	0.08	0.60	2.23	20
Haplothrips angusticornis	21	2.1	6.1	2.5	0.25	2.10	7.81	50
Haplothrips leucanthemi	4	0.4	0.3	0.5	0.05	0.40	1.49	40
Haplothrips reuteri	***39***	3.9	21.7	4.7	0.47	3.90	14.50	50
Haplothrips minutus	23	2.3	5.6	2.4	0.24	2.30	8.55	60
Σ	269	27	105.4	10.3	1.03	**26.90**	100.00	

In the Expo Park, the flowers of the white variety are inhabited by 9 species of thrips which reach densities of 261 individuals / sample, *Frankliniella intonsa* dominating the other species by 60.97%. The red variety is preferred by 7 species, having a numerical density of 84 individuals/sample, of which 66 individuals/sample belong to the *F. intonsa* species; five species are common.

The size of the biomass with which thrips participate in the biocoenosis biomass and implicitly the size of their value within the trophic modules thereof vary, depending on variety and the collecting place between 8.40 and 47.80 mg. dry matter/m^2.

Although the observations concern the data from a single collecting, thrips preference for white varieties of rose versus red ones is obvious. It is also noted the preference of Tubulifera species for the flowers of the white variety (Table 2). Observations performed by ELIMEM & CHERMITI (2012) on greenhouse roses note a greater attractiveness of *F. occidentalis* individuals to white-cream as compared to the red one.



a b

Figure 2. Numerical abundance of thrips populations, June 2011
(a- Expo Park; b - ADP Park)

CONCLUSIONS

The component populations of the Thysanoptera association on roses consist of 4,100 individuals and belong to 17 species, which proves a rich diversity of the coenosis.

The study revealed a greater specific diversity and abundance of thrips populations on white varieties, in both parks.

The species constantly participating in the coenosis structure is *Frankliniella intonsa* with the highest values of ecological indicators and a relative abundance varying between 60.97 and 100%.

Cultivation of roses on limited areas in parks does not allow the thrips attached to this trophic substrate to develop potentially major pest populations, respectively to cause damage to inflorescences and transmission of viruses to these plants.

Our research completes the list of species of Thysanoptera which inhabit the flowers of roses; study case, roses from Pitesti parks.

Such studies reveal the importance of flowering plants – as trophic niche in ensuring and preserving the biodiversity of species of this order of insects, even in small parks located in urban centers.

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PRELIMINARY DATA REGARDING BEETLE PARASITE SPECIES COLLECTED FROM DIFFERENT ECOSYSTEMS MET IN DOLJ COUNTY IN 2014-2015

LILA Gima

Abstract. The research on the diversity of parasite and parasitoid beetles from Dolj County exposed in this paper were made between 2009 and 2013. The beetle biological material (193 specimens, 3 of which displaying various parasite forms) was collected from terrestrial ecosystems (Urzicuţa and Breasta). The hosts, from the systematic viewpoint, belong to the order Coleoptera and 2 families: Scarabaeidae and Melolonthidae. The species on which parasites were found are *Orictes nasicornis* (Linnaeus 1758) and *Melasoma populi* (Linnaeus 1758). The identified parasite and predator species from the systematic viewpoint, are *Zicrona caerulea* (Linnaeus,1758) (Hemiptera: Pentatomidae: *Zicrona*) and *Metarhizium anisopliae* (Metchnikoff) Sorokin (Ascomycota: Sordariomycetes: Hypocreales: Clavicipitaceae: *Metarhizium*). In this paper we expose the results of research conducted in two species of parasites, the other will be set out in a forth coming paper.

Keywords: parasites, predator, beetles, *Zicrona caerulea, Metarhizium anisopliae.*

Rezumat. Date preliminare privind specii de paraziţi la coleoptere din diferite ecosisteme din judeţul Dolj colectate în perioada 2014-2015. Cercetările privind diversitatea paraziţilor şi parazitoizilor la coleoptere din judeţul Dolj expuse în lucrarea de faţă au fost realizate între anii 2014 – 2015. Materialul biologic de coleoptere (193 exemplare din care 2 exemplare au parazit, respectiv prădător) a fost colectat din ecosisteme terestre (Urzicuţa, Breasta). Gazdele, din punct de vedere sistematic, aparţin ordinului Coleoptera încadrandu-se în 2 familii: Scarabaeidae şi Melolonthidae. Speciile pe care s-au găsit paraziţi, respectiv prădător, sunt: *Orictes nasicornis* (Linnaeus 1758) şi *Melasoma populi* (Linnaeus 1758). Parazitul si prădătorul identificati în urma cercetărilor de specialitate, din punct de vedere sistematic sunt *Zicrona caerulea* (Linnaeus, 1758) (Hemiptera: Pentatomidae: *Zicrona*) şi *Metarhizium anisopliae* (Metchnikoff) Sorokin (Ascomycota: Sordariomycetes: Hypocreales: Clavicipitaceae: *Metarhizium*). În lucrarea de faţă sunt expuse rezultatele cercetărilor efectuate la două specii de coleoptere, celelalte rezultate ale cercetărilor efectuate pe teren şi în laborator, urmând a fi expuse într-o lucrare viitoare.

Cuvinte cheie: paraziţi, prădător, coleoptere, *Zicrona caerulea, Metarhizium anisopliae.*

INTRODUCTION

The purpose of this paper is to present some contributions to the knowledge of the diversity of parasites and predator, analyzing beetle species present in different types of ecosystems in Dolj County. This paper renders the results of the researches conducted between the 2011 and 2013.

All the material found on land has been identified, analysed and then assessed the level of infestation.

The beetle biological material (193 specimens, were various parasitic forms) was collected from the terrestrial ecosystems Urzicuţa and Breasta. The hosts, from the systematic viewpoint, belong to the order Coleoptera and 2 families: Scarabaeidae and Melolonthidae and the identified parasites and predator, from the systematic view point, belong to the two orders: Pentatomidae (genre *Zicrona*) and Clavicipitaceae (genre *Metarhizium*).

MATERIALS AND METHODS

The material used in this paper consists in identifying, analyzing and researching a total of 193 specimens found in the field, on which, there were identified two species of parasites and predators.

The taxonomy and nomenclature of the identified species, is made according to the database Fauna Europea. The species of beetles are presented in systematic order according to the year they were collected and there are mentioned the species of parasite and parasitoids identified for each of them. The material was collected from Urzicuţa and Breasta settlements in 2014-2015. Collections were made at different times each year from April to June and continued. Collection date is mentioned for each species. Moreover, for every locality there are rendered the geographic coordinates, flora and fauna information.

Collection methods were different according to the analysed species.

Collection methods for *Oryctes nasicornis* and *Melasoma populi*: the insect was sampled from the ground with a pair of tweezers and put ajar containing filter paper soaked with alcohol. I took photos and transported the material to the Faculty of Biology, biology laboratory, where the specialists took samples from the surface of the insect body. To analyze the fungi, it was used the solid media culture method (the method of exhaustion and flooding method).

Collection method for *Metarhizium anisopliae*

The method by exhaustion:

- the product is discharged by means of platinum loop in a first sector on suitable solid growth medium;
- poured into petri dish;
- sterilize loop;
- disseminating product previously seeded as parallel grooves;

- sterilize the loop, continue the procedure until the entire surface is covered environment, finishing with a zigzag dissemination;

- is the most used to obtain isolated colonies (that will grow in the last sector).

Collection method for *Zicrona caerulea*

With forceps, after we took photographs and filmed, I got along with the predator of larvae to *C. populi*, and I deposited in the entomological jar. It was then given to Mr. V. Derjanski for determination.

RESULTS AND DISCUTIONS

Host: *Oryctes nasicornis* Linnaeus 1758 (rhinoceros beetle)
Parasites: *Metarhizium anisopliae*
Collection site: Urzicuţa (Fig. 1)
Collection date: March 6, 2015
According to IUCN Status: Threaten species, low risk.

Coordinates: 44°01′00″N 23°33′00″E

Urzicuţa village is located west of the Desnăţui valley, within Oltenia plain, with a plain relief represented by the Danube terraces with relative altitudes between 25 and 40 m; it is crossed by the Desnăţui river in the east and Baboia creek in the south. At the base of the terraces there emerged some springs that formed a chain of pools. In the southern part of the village, there is a lake whose waters were mineralized gradually gaining therapeutic properties in the treatment of rheumatic diseases, known as "Ionele Baths". The climate is temperate continental with a minimum between 5 and -20°C and maximum values between 28 and 38°C. The average amount of precipitation is about 520 mm / year.

Figure 1. Urzicuta and Breasta locality in Dolj county on the map (surse google maps).

Oryctes nasicornis

The species is found in the forest, forest steppe and steppe-like territories.

Adults are active during the period from April to August and survive only one year. The species was reported flying around light sources (PANIN 1957).

Measures of protection and preservation. Protecting old trees of deciduous forests; prohibiting the collection of the species by amateur collectors.

Species included in the Annexes of the Bern Convention as a threatened and rare species.

The insect was sampled from soil with a pair of tweezers and put in a entomologic jar. I took photos and transported the material to the Faculty of Biology, biology laboratory, where the specialists took samples from the surface of the insect body. After laboratory analysis was found muscardini green fungus *M. anisopliae* (Figs. 2, 3).

Figure 2. *Metarhizium anisopliae* to *Orictes nasicornis* female (original).

Metarhizium anisopliae (Metchnikoff) Sorokin

Muscardini green fungus was isolated from *Anisoplia austrian* beetle by Metchnikoff in 1879. He suggested that it can be used as antimicrobial agent against insect pests. Cultures of *M. anisopliae* produce destruxins A, B, C, D, and E and desmethyldestruxin B, toxic to insects. The production of destruxins quickly kills the larvae. *M. anisopliae* produced also toxic proteolytic enzymes (MARK et al., 1989).

Infections of arthropods by *Metarhizium* species are easily recognized a few days after death, when the fungus grows out of the arthropod integument and forms reproductive structures. Initially, one only sees fungal hyphae that appear white, but, as conidia form and mature they often take on a characteristic olive green color. However, depending on the species and strain of *Metarhizium*, spores can range in color from white to yellow to brown and green (TANADA & KAYA, 1993) in TODD UGINE 2014.

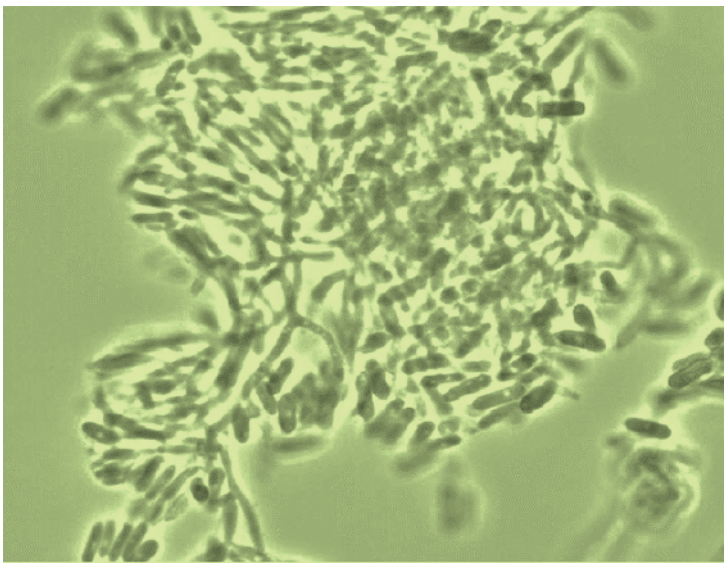

Figure 3. Hyphae at *Metarhizium anisopliae* (original).

On the larvae, *M. anisopliae* also form an opaque white, which turns green at the formation of conidia. Conidiophores are branched, a chain of conidia is formed on each of the conidiophores. The mass of the spore chains becomes dense and in cohorts with other spores produces prismatic masses of columns from the spore chains.

The infection takes place generally through the skin. However, the exact stage of infection depends on the stage of insect, environmental conditions and opportunity. The cuticle is penetrated by enzymes secreted by the penetrating tip of the hyphae. A penetrating hypha gives birth to the hyphal body before the host death. A hyphal body distributed throughout the body cavity gives rise to secondary hyphae.

In humid, warm environments, hypha occurs some days after the death of the insect, usually by weakening the tegument. This fungus also produces more toxic components that can kill the host.

Geographic distribution and hosts – *Metarhizium anisolpliae* is reported to be able to infect more than 100 different species of insects belonging to a wide variety of insect orders.

Host: *Melasoma populi* (Stephens, 1834)
Predator: *Zicrona caerulea* (Linnaeus, 1758)
Collection site: Breasta commune, village Obedin (Fig. 1)
Collection date: July 22, 2014
In this area we have not done research. Therefore the situation is first detected (Figs. 4a, 4b).

The territory of Breasta (coordinates: 44°10′N 23°42′E) settlement is situated in the southern part of the Getic Plateau, within Bălăciţa hilly plain, located west of the Jiu. The relief is represented by wide and long fields separated by the tributaries of the Jiu, NW-SE and W-E directed.The NE part of the territory is crossed by the Rasnic stream, a tributary of the Jiu and in the central part, by Breasta creek, a tributary of the Rasnic. Their beds are generally broad and high, providing favourable conditions for the development of the surrounding settlements. Along the wider sectors of the valleys, there develop floodplains and lower terraces formed from alluvial gravels and sand deposits. Generally, the relief of a hilly plain is one of lacustrine accumulation composed of gravels, sands and thick layers of clays.

Zicrona caerulea can reach an adult size of about 5–8 millimetres (0.20–0.31 in). The body is uniformly metallic blue-green (latin name *caerulea*, is blue). In the immature stage, the abdomen is red with black markings. These bugs are useful predators of leaf beetles in the genus *Altica* (BUG GUIDE), of larvae of various beetles and caterpillars of moths, but it also feeds on plants. Eggs are laid in spring. New adults of this univoltine species can be found from July onwards. This bug overwinters as an adult.

Figure 4a . Early instar nymph (the 4th stage of development) of *Zicrona caerulea* preying a larva of *M. populi* (original).

Figure 4b. Early instar nymph (the 4th stage of development) of *Zicrona caerulea* preying a larva of *M. populi* (original).

Melasoma (Crysomela) populi (Stephens, 1834) (Fig. 5)

This chrysomelid as well as the majority of about 50 Central-European dendrophagous species lives on species of the family Salicaceae and also often as a larva on some of them. Similarly as in many other insect pests its activity is mainly affected by moderate winters and dry and warm springs. Frequent climatic anomalies at the end of the last century and at the beginning of this century markedly affected the water balance of trees and their resistance to insect defoliators. Increased food quality (particularly the higher proportion of sugars) and favourable living conditions manifested themselves in the general increase of the population density of Chrysomelidae (including *C. populi*). The species was identified in localities Bucovăț Forest- 4 specs., July 5, 2005;; Ciuperceni - 1 spec. May 22, 2004; Craiova (the Botanical Garden) - 1 spec., June 20, 2005; Negoi - 7 specs., May 3, 2005; 3 specs., May 2, 2008; Secui - 1 spec., May 26, 2007 (MAICAN & CHIMIȘLIU, 2013) and in Varvoru de Jos (ILIE, 2007).

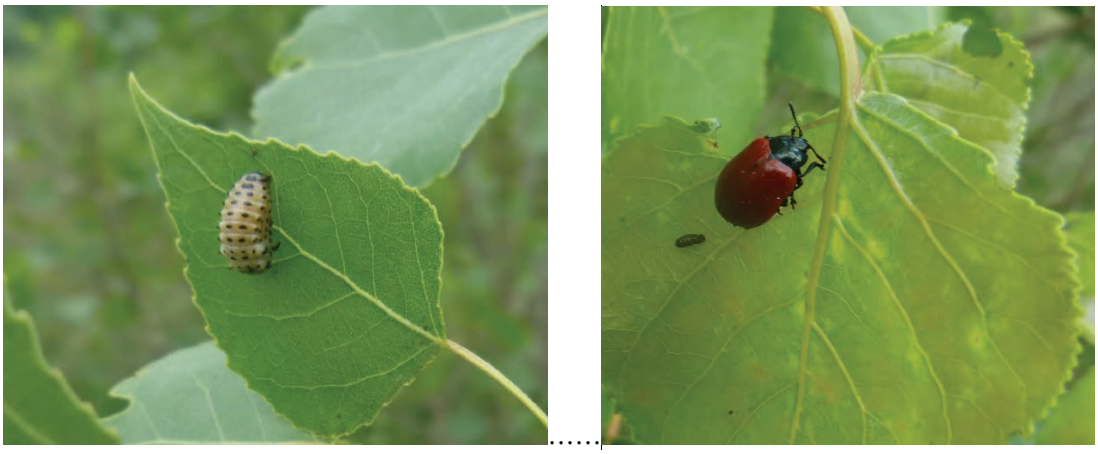

Figure 5. Larva and adult to *Melasoma (Crysomela) populi* (original).

Records from the patrimony of the museum: Baia de Fier (BOBÎRNAC et al., 1999); Coțofenii din Față, Craiova, Desa (ILIE & CHIMIȘLIU, 1999); Craiova (the Botanical Garden), Zvorsca (CHIMIȘLIU & MOGOȘEANU, 2009) in MAICAN & CHIMISLIU, 2013, but there were no reported parasites, parasitoids or predators.

Natural enemies of *C. populi* are discussed recently, e.g. by TEODORESCU (1980) in Romania and ZEKI &TOROS (1990) in Turkey. Findings on Central-European parasitoids of Chrysomelidae (including *C. populi*) from the family Tachinidae were summarized by TSCHORSNIG & HERTING (1994). For example, *Hexamermis albicans* (v. Sieb.) (Mermithidae) (POINAR 1988) and *Linobia coccinellae* (Sc.) TARASI et al., 2001) rank among parasitoids of *C. populi. Schizonotus sieboldi* (Ratz.) (Pteromalidae) as a widely distributed and important parasitoid of pupae is recently mentioned, e.g. by PETTERSEN (1976) from Norway, DŽANOKMEN (1978) from the European part of the former USSR and LOTFALIZADEH & AHMADI (1998) from Iran. DELLEDONNE et al. (2001) found that transgenic *P. alba* was resistant to larvae of *C. populi.*

They explain the resistance by the enzymatic activity of papain in tissues of this genetically modified poplar inhibiting the digestive proteinases of larvae. The inhibitor could be used in clone programmes for the selection of new poplar genotypes resistant to main insect pests (in URBAN 2006).

CONCLUSIONS

The degree some phyllophagous species of Chrysomelidae feed on leaves leading to the defoliation of trees was used for the study of their occurrence, bionomics and harmfulness. In recent years, attention was also paid to *C. populi*. Generally, with respect to appearance abundance of the pest and its wide area of distribution and considering size and varied colouring, *C. populi* is rather well known. It is dealt with by numerous special entomological and entomological/forest protection papers.

M. anisopliae is well known for its ability to control pest insects. It has been developed into commercial products for use in several countries. A few examples include: Bio-Green and Bio-Cane granules for control of soil grubs of pasture and sugar cane in Australia, Green Muscle for control of locusts in Africa, Ago Biocontrol for control of various pests of ornamental crops in South America, and BioPath for control of cockroaches in the United States. In general, different strains of *M. anisopliae* are species specific, meaning that *M. anisopliae* found to infect one insect species will not necessarily infect other insect species. While this limits its use as a general pest control, it makes the fungus safer by limiting its effects on non-target organisms.

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DIVERSITY OF SOIL MITE FAUNA (ACARI: MESOSTIGMATA) FROM SOME CLIFF ECOSYSTEMS - ROMANIA

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Abstract. The paper presents the diversity of soil mite fauna from some cliff ecosystems from mountain and hilly areas, from Romania. 39 species were identified, with 272 individuals. The Shanon index of diversity demonstrated that the cliffs from mountain areas are the most favourable habitats for these arthropods. The dominant species in all the studied cliff ecosystems, neighbouring forests, were: *Leptogamasus parvulus* (Berlese 1903), *Pergamasus crassipes* (Linne 1758), *Veigaia nemorensis* (C.L. Koch 1839), *Hypoaspis aculeifer* (G. Canestrini, 1884), *Prozercon traegardhi* (Halbert, 1923), *Zercon berlesei* Sellnicki, 1958 and *Trachytes aegrota* (C. L. Koch 1841). Only, two species were characteristic only for the cliffs situated in proximity of a meadow: *Hypoaspis praesternalis* Willmann 1949 and *Asca bicornis* (Canestrini & Fanzago 1887). The evenness index revealed that some mites from mountain cliff areas are numerically dominant, as: *Leptogamasus parvulus, Zercon berlesei* and *Trachytes aegrota.* In the cliffs from hilly areas, this index showed us that the numerical abundances of identified species had an equitable distribution. The Bray-Curtis similarity index between the soil mite populations from the investigated cliffs revealed an affinity between invertebrates from ecosystems, closed to the forests.

Keywords: cliff, diversity, evenness, mite, similarity.

Rezumat. **Diversitatea faunei de acarieni edafici (Acari: Mesostigmata) din câteva ecosisteme de stâncărie din România.** Lucrarea prezintă diversitatea faunei de acarieni de sol din cîteva ecosisteme de stâncărie din zone montane şi de deal din România. Au fost identificate 39 de specii, cu 272 indivizi. Indicele de diversitate Shannon a demosntrat faptul că ecosistemele de stâncărie din zonele montane oferă cele mai bune condiţii de dezvoltare pentru aceste arthropode. Speciile de acarieni dominante pentru stâncăriile învecinate cu ecosisteme forestiere, au fost: *Leptogamasus parvulus* (Berlese 1903), *Pergamasus crassipes* (Linne 1758), *Veigaia nemorensis* (C. L. Koch 1839), *Hypoaspis aculeifer* (G. Canestrini, 1884.), *Prozercon traegardhi* (Halbert, 1923), *Zercon berlesei* Sellnicki, 1958 şi *Trachytes aegrota* (C.L. Koch 1841). Numai două specii sunt caracteristice pentru stâncaria învecinată cu un ecosistem praticol: *Hypoaspis praesternalis* Willmann 1949 and *Asca bicornis* (Canestrini & Fanzago 1887). Indicele de echitabilitate a evidenţiat că ecosistemele de stâncărie din zonele montane sunt caracterizate de câteva specii dominante numeric: *Leptogamasus parvulus, Zercon berlesei* şi *Trachytes aegrota*. În zonele de deal, conform valorilor acestui indice, populaţiile de acarieni au fost distribuite în mod echitabil. Indicele de similaritate Bray-Curtis a arătat o afinitate semnificativă între acarienii din ecosistemele de stîncărie, învecinate cu păduri.

Cuvinte cheie: stâncă, acarieni, diversitate, echitabilitate, similaritate.

INTRODUCTION

It is known that soil mites (mesostigmatids) inhabit diverse ecosystems as forests, shrubs, meadows, urban areas, agroecosystems, anthropogenic ecosystems (industrial areas), being found in different microhabitats (soil, bark, litter, humus, moss, detritus, plants, in anthill, molehill, on fungus, mushrooms) (WALTER & PROCTOR, 1999; KRANTZ & WALTER, 2009; SALMANE & BRUMELIS, 2010; MADEJ et al., 2011). There are many studies concerning the species diversity and distribution in these ecosystems, all over Europe, as well as in Romania (KOEHLER, 2000; BEAULIEU et al., 2006; CĂLUGĂR, 2006; GULVIK, 2007; KACZMAREK et al., 2009; RUF & BEDANO, 2010; MARCHENKO, 2011; WISSUWA et al., 2012; MANU, 2013; KAMCZYC et al., 2014). But which is the diversity of mites in an untypical ecosystem as cliff? If we take into consideration the acarofauna, this type of ecosystems are not studied in Europe. In Romania, some researches were made only in one area (Brebu gorges - Prahova County), revealing characteristic structure and dynamics of the plant and soil invertebrates communities, in correlation with environmental factors (MANU, 2010; 2012; ONETE et al., 2011; FIERA, 2013; FIERA et al., 2013). Even, the adjacent area to cliff ecosystems was investigated, demonstrating that the soil mites are not stable communities (MANU, 2014). But this research is singular. I considered that these studies must be extended on many cliff ecosystems from Romania, from mountain and hilly areas. In this context, the main objectives of this study were to establish the diversity of soil mites from four cliff ecosystems from a temperate area.

MATERIAL AND METHODS

The present research was made in 2011-2012, in four cliff ecosystem from mountain and hilly areas: Buila-Cheile Cheii (BuC), Peleş Valley (PC) from the first category and Tohani cliff (TC) and Brebu gorges (BrC) from the second category. Three of the investigated ecosystems are located in Prahova County (PC, TC, BrC) and only one is located in Vâlcea County (BuC) (Fig. 1). Some of the investigated cliff ecosystems are included in Natura 2000 protected areas (Fig. 1, Table 1). The geographical characterization of the investigated cliff ecosystems is presented beneath (Table 1).

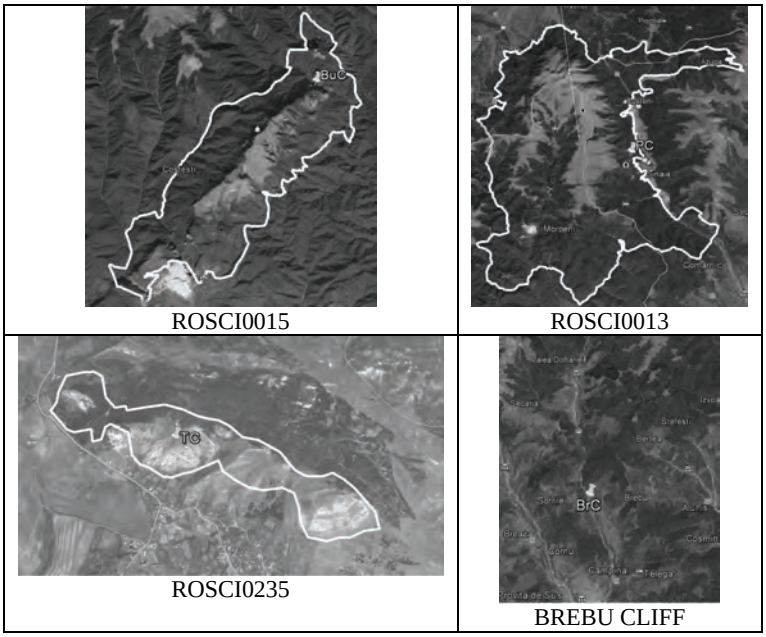

Figure 1. Geographical position of the investigated cliff ecosystems (www. earth.google.com).

In total, 112 soil samples, with 39 species and 272 individuals were analysed. Twenty eight samples per ecosystem were collected with a metal frame (20 x 20 cm), on 3 cm deep. The samples were taken in July, August, October and November, 2011-2012. Often, the sample contained moss or sandy substrate from the cliff area. The extraction was performed with a modified Berlese-Tullgren extractor, in ethylic alcohol and the mites samples were clarified in lactic acid. The identification of the mites from the Mesostigmata order was made up to the species level, using the most actual keys for determination (GHILIAROV & BREGETOVA, 1977; KARG, 1993; MASAN, 2003; MASAN & FENDA, 2004; GWIAZDOWICZ, 2007; MASAN, 2007; MASAN & HALLIDAY, 2010, 2014).

Mite diversity (Shannon index), dominance (Simpson's index), and evenness (E index) were calculated using the PAST software (HAMMER et al., 2001). The similarity of mite presence and composition was assessed using Bray-Curtis (q_{BC}) dendrogram.

Table 1. Description of the investigated cliff ecosystems.

Cliff ecosystem	**Tohani cliff**	**Brebu gorges**	**Buila- Cheile Cheii**	**Peleş Valley**
GIS coordinates	N: $45^0$04'19,34" E: $26^0$25'35,21"	N: $45^0$12'31,10" E: $25^0$44'23,50"	N: $45^0$16'04,52" E: $24^0$07'34,91"	N: $45^0$21'50,75" E: $25^0$31'29,76"
Altitude	388 meters	537 meters	966 meters	1110 meters
Adjacent ecosystems	Meadow	Deciduous Forest Shrub Grassland	Mixed forest	Mixed forest
Affiliation to Natura 2000 Protected Areas	ROSCI0235 Stânca Tohani	-	ROSCI0015 Buila National Park	ROSCI0013 Bucegi National Park

RESULTS AND DISCUSSIONS

After taxonomical identification of the soil mite communities, in the whole period of study 39 species were found, with 272 individuals (Table 3). The species are included in the following families: *Parasitidae* (28.20%), *Zerconidae* (20.51%), *Ascidae* (10.25%), *Macrochelidae* (10.25%), *Pachylaelapidae* (10.25%), *Veigaiidae* (10.25%), *Laelapidae* (7.69%), *Digamasellidae* (2.56%), *Eviphididae* (2.56%) and *Trachytidae* (2.56%).

The dominant species are mobile predators, finding their prey by chemical or tactile stimuli. Species belonging to the families: *Ascidae*, *Parasitidae* or *Veigaiidae* feed with small arthropods, especially springtails. Others, as those from *Macrochelidae* family feed on eggs of insects and their first instar larvae. In general, even if the body size on Mesostigmata is big, their trophic position was not related with this feature. Their hunting success may depend on the availability i.e., on the density of prey in the investigated microhabitat. The species from *Ascidae*, *Veigaiidae*, *Macrochelidae* and *Pachylaelapidae* families are hemiedaphic surface dwellers, found not in greater soil depths (KOEHLER, 1999; GULVIK, 2007; WISSUWA et al., 2012; KLARNER et al., 2013).

Pursuing the species diversity, as well as the highest abundance of the mite fauna, in the analysed ecosystems, it has been pointed out that the best conditions for their development are in mountain cliffs (Peleş Valley, Buila- Cheile Cheii), as well as one in the hilly area (Brebu gorges).

Shannon index of diversity, as well as the alpha diversity had recorded the highest values in these ecosystems (Table 2, Fig. 2A). The proximity of the forest ecosystem to the cliff areas and the characteristic environment could be the main explanation of the most abundant mite fauna in mountain cliff ecosystems. Many researches revealed that in the soil of the forest ecosystems the humidity is more increased, the temperature is lower, the acidity is higher and the organic layer is more developed, in comparison with the sandy soils from grassy areas, as those from Tohani (PONGE, 2003; LAL & BRONICK, 2005).

If we make a comparison with other types of ecosystems from Romania, adjacent to cliff area, the recorded number of species from Buila - Cheile Cheii and Peleş Valley is low, compared with the mountain forest (97 species) and mountain grassland (46 species). If we take into consideration the hilly cliff ecosystem, the species diversity is comparable with that obtained in the deciduous forest (12-22 species) and in shrub ecosystems (12-15 species) (Table 3) (MANU, 2012; 2013).

The species evenness calculated for the four investigated areas had recorded similar values in Tohani cliff – Brebu gorges and in Buila - Cheile Cheii – Peleş Valley. The numerical abundances of identified species from the Tohani cliff and Brebu gorges had an equitable distribution. In Buila- Cheile Cheii and Peleş Valley, identified species are characterized by different (more increased) numerical abundances, revealing that the cliffs from mountain area are more favourable habitats for some dominant mesostigmatids, as: *Leptogamasus parvulus* (Berlese 1903), *Zercon berlesei* Sellnicki 1958 and *Trachytes aegrota* (C. L. Koch 1841). The probability that two individuals randomly selected from a sample will belong to the same species, measured through Simpson index, is higher in Buila- Cheile Cheii, Peleş Valley and Brebu gorges, being strongly related with numerical abundances (Table 2).

Table 2. Diversity of soil mites in investigated cliff ecosystems.

Index	BuC	TC	BrC	PC
Total number of species	17	3	19	18
Total number of individuals	134	5	67	66
Simpson (D)	0.81	0.56	0.92	0.84
Shannon index of diversity (H)	2.12	0.95	2.74	2.35
Evenness index (E)	0.49	0.6	0.81	0.58

The dominant species in all studied cliff ecosystems were: *Leptogamasus parvulus*, *Pergamasus crassipes* (Linne 1758), *Veigaia nemorensis*, *Hypoaspis aculeifer*, *Prozercon traegardhi*, *Zercon berlesei* and *Trachytes aegrota*. All the species are indicator of natural ecosystems, having a wide ecological plasticity. *Zercon berlesei* and *Prozercon traegardhi* are well adapted to the xerothermophilous phytocoenosis, as those from cliffs (MASAN & FENDA, 2004). With the exception of *Trachytes aegrota*, *Veigaia nemorensis* and *Prozercon traegardhi*, all signalled species are common for Buila- Cheile Cheii, Brebu gorges and Peleş Valley. In Tohani cliff, two species are characteristic for this area: *Hypoaspis praesternalis* and *Asca bicornis* These species are most abundant in sod from grassland or meadows ecosystems, as the Tohani cliff adjacent ecosystems (CĂLUGĂR, 2006; GWIAZDOWICZ, 2007).

Table 3. Soil mite species (Acari: Mesostigmata) from investigated cliff ecosystems.

No.	Species	BuC	TC	BrC	PC	Total
1	*Asca aphidoides* (Linnaeus 1758)	2	0	0	0	2
2	*Asca bicornis* (Canestrini & Fanzago)	0	1	0	0	1
3	*Cheroseius bryophilus* Karg, 1969	0	0	1	0	1
4	Digamasellus sp.	2	0	0	0	2
5	*Eviphis ostrinus* (C. L. Koch, 1836)	0	0	2	1	3
6	*Gamasolaelaps excisus* (C. L. Koch, 1879)	0	0	0	1	1
7	*Geholaspis mandibularis* (Berlese, 1904)	0	0	2	0	2
8	*Holoparasitus calcaratus* (C.L. Koch, 1839)	0	0	0	3	3
9	*Hypoaspis aculeifer* (G. Canestrini, 1884)	9	0	1	1	11
10	*Hypospis claviger* (Berlese, 1883)	0	0	5	0	5
11	*Hypospis praesternalis* Willmann, 1949	0	3	0	0	3
12	*Leptogamasus parvulus* (Berlese, 1903)	20	0	9	5	34
13	Leptogamasus sp.	0	0	0	4	4
14	*Leptogamasus variabilis* Juvara-Bals, 1981	1	0	0	0	1
15	*Lysigamasus lapponicus* (Tragardh, 1910)	0	0	4	1	5
16	Lysigamasus sp.	7	0	0	0	7
17	*Lysigamasus neoruncatellus* (Schweizer, 1961)	0	0	5	0	5
18	*Macrocheles montanus* (Willmann, 1951)	0	0	2	0	2
19	*Macrocheles recki* Bregetova & Koroleva, 1960	0	0	4	0	4
20	*Olopachys suecicus* Sellnick, 1950	0	0	1	0	1
21	*Olopachys vysotskajae* Koroleva, 1976	0	0	2	0	2
22	*Pachylaelaps furcifer* Oudemans, 1903	3	0	0	0	3
23	*Pachylaelaps pectinifer* (G. & R. Canestrini, 1881)	0	0	2	0	2
24	*Paragamasus alpestris* (Berlese, 1904)	0	0	0	2	2
25	*Paragamasus similis* (Willmann, 1953)	0	0	0	2	2
26	*Pergamasus crassipes* (Linne, 1758)	7	0	4	2	13
27	*Pergamasus barbarus* (Berlese, 1904)	2	0	0	2	4

28	*Prozercon karsticus* Halaskova, 1963	0	0	2	0	2
29	*Prozercon sellnicki* Halaskova, 1963	1	0	0	0	1
30	*Prozercon traegardhi* (Halbert, 1923)	5	0	5	0	10
31	*Trachytes aegrota* (C. L. Koch, 1841)	12	0	0	0	12
32	*Veigaia kochi* (Tragardh, 1901)	0	0	0	2	2
33	*Veigaia nemorensis* (C. L. Koch, 1839)	9	0	3	9	21
34	*Veigaia planicola* (Berlese, 1892)	0	1	3	1	5
35	*Zercon berlesei* Sellnicki, 1958	51	0	10	23	84
36	*Zercon fageticola* Halaskova, 1969	1	0	0	2	3
37	*Zercon peltatus peltatus* C. L. Koch, 1836	1	0	0	0	1
38	Zercon sp.	1	0	0	3	4
39	*Zercon triangularis* C. L. Koch, 1836	0	0	0	2	2
	Total	134	5	67	66	272

Analysing the Bray-Curtis similarity between mesostigmatids, we observed that numerical abundances recorded have closed values in the species from Peleş Valley and Buila- Cheile Cheii areas ($q_{PC\text{-}BuC}$ = 45.71) and in those from Brebu gorges and Peleş Valley ecosystems ($q_{PC\text{-}BrC}$ = 43.24). On the opposite, there are species from Tohani cliff and Peleş Valley ecosystems, where the Bray-Curtis index recorded the lowest value ($q_{PC\text{-}TC}$ = 9.52) (Fig. 2B).

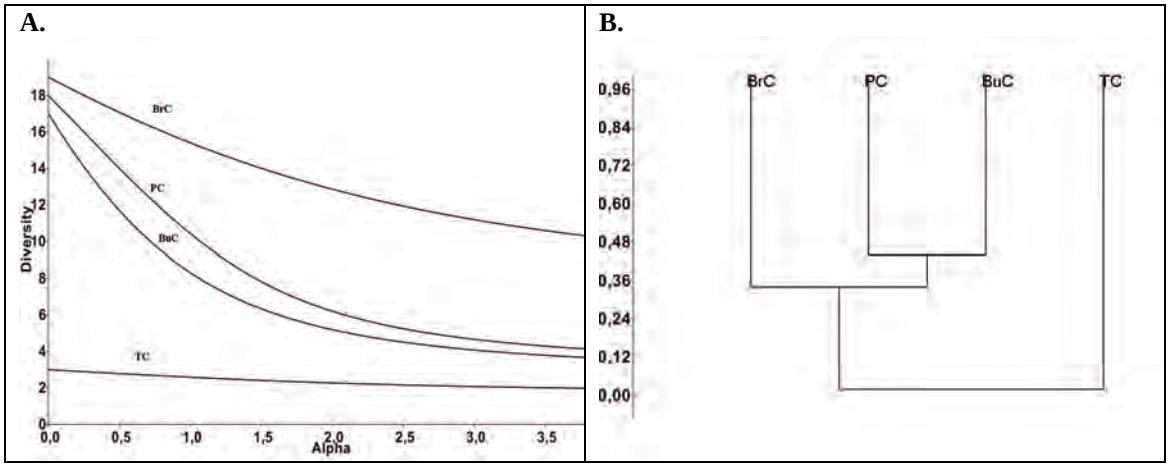

Figure 2. Population parameters of mites from investigated cliff ecosystems (A= Alpha diversity; B = Bray-Curtis Similarity dendrogram).

These differences between cliff areas are possible due to the influence of the adjacent ecosystems and to their geographical position. The cliffs from mountain areas recorded closed population structure and numerical abundances. In the same time, even if the cliff is not in mountain area, the forest ecosystems situated near it, influence the species composition (as is in Brebu gorges ecosystem). In the cliff from the hilly area, Tohani cliff, due to the specific structure of mites, the differences between it and the other three ecosystems are very high. Due to their closed vicinity with a meadow, the species composition is different, a phenomena that is highlighted by the similarity dendrogram (Fig. 2B).

CONCLUSIONS

Taxonomic structure of the mite communities from some cliff ecosystems from Romania revealed the presence of a total of 39 species, with 272 individuals, grouped into 10 families. The best conditions for their development are provided by the mountain cliffs ecosystems (Peles Valley, Buila - Cheile Cheii), as well as one from the hilly area (Brebu gorges), where there was recorded the highest species diversity. On the opposite, it is the ecosystem Tohani cliff, with the lowest species diversity. The dominant species in all studied cliff ecosystems, neighbouring forests, were: *Leptogamasus parvulus, Pergamasus crassipes, Veigaia nemorensis, Hypoaspis aculeifer, Prozercon traegardhi, Zercon berlesei* and *Trachytes aegrota*. They are mobile predators, with a high ecological plasticity. Two species were characteristic only for the Tohani cliff area: *Hypoaspis praesternalis* and *Asca bicornis*, species that are often identified in grassland or meadows ecosystems.

On one hand, the evenness index calculated for soil mites from four ecosystems revealed that the cliffs from the mountain area, Buila - Cheile Cheii and Peles Valley are more favourable habitats for some numerically dominant mesostigmatids, as *Leptogamasus parvulus, Zercon berlesei* and *Trachytes aegrota*. On the other hand, this index showed that the numerical abundances of the identified species from the Tohani cliff and Brebu gorges from the hilly areas had an equitable distribution. The similarities between the soil mite populations from the investigated cliffs revealed an affinity between invertebrates from ecosystems, closed to the forests.

In order to evaluate all biological processes from this unique type of ecosystems (as cliff), the research must be extended, on all soil fauna groups in correlations with environmental factors.

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THE COLLECTION OF LEPIDOPTERA PRESERVED AT THE "LUCIAN BLAGA" UNIVERSITY - SIBIU (NOTE 1)

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Abstract. This paper represents an important contribution to the knowledge of the Romanian butterfly heritage, thereby completing the literature faunal data of great interest for the values of the natural heritage. In the Lepidoptera collection of "Lucian Blaga" University-Sibiu, there are 1,017 samples, 660♂♂ and 357♀♀, belonging to 19 families, 334 genera, 572 species. The collection was acquired in 1998 from Lepidopterolog Levente Szekely from Braşov. The list of the 572 species renders the collecting data of each specimen, the altitude, the name of the collecting sites and the classification in geographical regions of Romania, as well as the degree of endangerment, which are of great documentary value. The systematic classification is updated according to *Verzeichnis der Schmetterlinge Romäniens* (RÁKOSY et al., 2003).

Keywords: Lepidoptera, collection, species.

Rezumat. Lepidoptere din colecția Universității „Lucian Blaga” din Sibiu (nota 1). Prezenta lucrare reprezintă o contribuție importantă la cunoașterea patrimoniului lepidopterelor din România, completând astfel literatura de specialitate cu datele faunistice de mare actualitate pentru valoarea patrimoniului natural. În colecția de lepidoptere a Universității „Lucian Blaga” din Sibiu, sunt 1017 exemplare dintre care 660♂♂ și 357♀♀, aparținând la 19 familii, 334 genuri, 572 specii. Colecția a fost achiziționată în anul 1998 de la lepidopterologul Levente Szekely din Brașov. Lista celor 572 de specii prezintă indicația locului de colectare a fiecărui exemplar, altitudinea și denumirile zonei și încadrarea în regiunile geografice ale României, precum și gradul de periclitare sunt de o mare valoare documentară. Încadrarea sistematică este actualizată conform *Catalogului lepidopetrelor României* (RÁKOSY et al., 2003).

Cuvinte cheie: lepidoptere, colecție, specii.

INTRODUCTION

The value of a collection of insects has been proven throughout history, zoology, but now it gains in importance as the number of insect species decreases rapidly at regional, national and global level due to pollution and destruction of habitats, natural and anthropogenic intervention in ecosystems. Such scientific materials stored in collections (POPESCU-GORJ, 1964; NEMEȘ & VOICU, 1973; KÖNIG, 1975; CIOCHIA & BARBU, 1980; CIOCHIA & STANCĂ, 2000; MARCU & RÁKOSY, 2002; SZÉKEL & CERNEA, 2007) become the only evidence of the unrecoverable past of the biosphere, which is increasingly jeopardized. The publication of this paper on the species of butterflies collected in Romania can be useful to the specialists but it also has a great cultural and scientific values.

MATERIALS AND METHOD

The material that is the subject of this study was collected by the lepidopterologist Levente Szekely between 1972 and 2000 from Romania (SZÉKELY, 1995, 1996, 1999a, b, 2003a, b, 2007, 2008, 2010, 2011). The oldest existing species in the collection are: 1♀, *Acherontia atropos* Linnaeus, 1758, collected from Brasov on September 30, 1975, 1♂ of *Peridroma saucia* Hübner, 1788 in Săcele-Brașov collected on March 26, 1979, 1♂ *Eulihtis pyraliata* Denis & Schiffermüller, 1775 collected from Roșu Lake, 1♂ *Agrotis ipsilon* Hufnagel, 1766, on August 2, 1979 collected from Roșu Lake-Cupaș, August 1, 1975. The collection was gathered using the entomological net for diurnal Lepidoptera and light source for noctuid species. The data of collection are noticed (day, month, year, sex, place of collection, geographical area and altitude). The material in the entomological boxes is arranged systematically and represents the Lepidoptera collection from "Lucian Blaga" University of Sibiu. In this study, there are listed only 212 species from the total of 527 species, the rest of species will be presented in future papers.

RESULTS AND DISCUSSIONS

In the Lepidoptera collection of "Lucian Blaga" University-Sibiu, there are 1,017 samples, 660♂♂ and 357♀♀, belonging to 19 families, 334 genera, 572 species. The collection was acquired in 1998 from the lepidopterologist Levente Szekely from Brasov. The entomological material is stored at "Lucian Blaga" University of Sibiu, Faculty of Agricultural Sciences, Food Industry and Environmental Protection. The collection is very important as didactic material at the courses like: *Entomology* and *Pest population control*. The Lepidoptera Collection of "Lucian Blaga" University contains many scientific and interesting data. The material comes from all parts of Romania (NICULESCU & KÖNIG, 1970). Thus, the samples were gathered starting from Omu Peak, (Bucegi Mountains), at an altitude of 2400 m, 2♂♂ species *Glacies coracina dioszeghyi* Schmidt, 1930, August 1, 1993, Piatra Arsă (Bucegi), July 31, 1993, 2100 m alt. to the Danube Delta, Canaraua Fetii, 6 m altitude (RÁKOSY & SZEKELY, 1996). The samples of Lepidoptera collection represent a real testimony of the

biodiversity of these areas. The faunistic and biogeographical value of the collection lies in the presence of rare species: 1♂, *Apatura ilia ilia* Denis & Schiffermüller, 1775, Lăureni Forest (Târgu Mureş), on June 13, 1972, 1♂ of *Syntomis phegea orientalis* Daniel, 1951, Herculane- Cerna Valley collected on July 19, 1978, and local species collected in Switzerland as: *Clossiana titania transsylvania* Tiltscher, 1913 in West Les Dialerets, collected on July 9, 1997, 1♂ *Argynis ino ino* Rottenburg, 1775 in West Les Dialerets on July 10, 1997 and 1♀ West Gruyere, on July 4, 1997 (WEIDEMANN & KÖHLER, 1996). The bio-historic value of the collection is revealed the presence of rare species like the 1♀, *Parasemia plantaginis carpathica* Daniel, 1939, collected from Roşu Lake-Cupaş, on July 27, 1978 (RÁKOSY & SZÉKELY, 1993).

The identified species present a label with the sex of each individual (NICULESCU, 1961, 1963, 1965; STANĚK, 1977; KOCH, 1991; KARLSHOLT & RAZOWSKI, 1996; RÁKOSY, 1996; STICHMANN et. al., 1999; FRĄCKIEL, 1999; WINIARSKA, 2003; DZIEKANSKA & SIELEZNIEW, 2008); they are arranged in accordance with the taxonomic system proposed by RÁKOSY et al., 2003. The following abbreviations were used: **CR** - Critically endangered, it is estimated that the survival of these species in the next 10-20 years is unlikely if the factors that have caused this situation are not eliminated; after the analysis of the quantitative cost it was determined a decay rate of the population with at least 50% in the last 10 years. **EN** - Endangered, endangered taxa when there is a critical stage of threat, but shows high risk or the extinction threat is critical in the immediate future; it is estimated a probability of about 20% extinction in the next 20 years, **VU** - Vulnerable, a taxon is vulnerable when it is not in the critical threat or endangered, but have a high risk of extinction or critical threat in the near future, **NT** - Near threatened, includes taxa not included in CR, EN or VU, but in case the degree of threat increases, it may be included in one or other of the three categories (RÁKOSY, 2002; 2003; 2005).

IUCN RED LIST OF LEPIDOPTERA (INSECTA: LEPIDOPTERA), COLLECTION OF "LUCIAN BLAGA" UNIVERSITY

No.	No Ro*	No. K.&*R.***	Taxon	Place and date of collection	Area of România	Degree of endangerment
FAMILY LASIOCAMPIDAE (3306 Ro, K. & R.6722)						
1	3309 Ro	K. & R. 6728	*Poecilocampa populi* Linnaeus, 1758	2♂♂, Timişul de Jos (Bv), November 10-20, 1997, 700 m alt. 1♀, Timişul de Jos (Bv), November 1-10, 1997, 700 m alt.	BT,CR,TR, MM/SM,OT, MT, MD, DB, LR	
2	3318 Ro	K. & R.6743	*Malacosoma neustria* Linnaeus, 1758	1♂, Băneasa (DB), June 13, 1998, 90 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
3	3319 Ro	K. & R. 6744	*Malacosoma castrensis castrensis* Linnaeus, 1758sin. *M. castrensis shardaghi* Daniel, Foster & Osthelder, 1951	1♂, Canaraua Fetii (DB), June 13, 1997, 150 m alt.	TR, MM, OT	CR
4	3323 Ro	K. & R. 6752	*Lasiocampa quercus quercus* Linnaeus, 1758	1♂, Buda Forest (Ilfov), August 4, 1980	BT, CR, TR, MM, OT, MT, MD; DR	
5	3325 Ro	K. & R. 6755	*Macrothylacia rubi* Linnaeus, 1758	1♂, Rediu-Botoşani, June 8, 1987 1♀, Canaraua Fetii (DB), May 19, 1994, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
6	3327 Ro	K. & R. 6763	*Dendrolimus pini montana* Staudinger, 1871	3♂♂, Timişul de Sus (Bv), June 10, 1997, 750 m alt., Muntele Roşu, July 20, 1993, 1300 m alt., Lepşa (Vrancea), July 1-2, 1997 1♀, Timişul de Jos (Bv.), June 10-20, 1999	BT, TR, MM, MT, MD; DB	
7	3331 Ro	K. & R. 6769	*Cosmotriche lunigera* Esper, 1784 (sin. *C. lobulina* Denis & Schiffermüller, 1775)	2♂♂, Muntele Roşu (Ciucaş Massif), July 20, 1983, 1300 m alt., Bicazului Gorges, August 4, 1996	BT, TR, MM, OT, MT, MD	
8	3334 Ro	K. & R. 6773	*Phyllodesma tremulifolia* Hübner, 1810	1♂, Racoş (Bv.), April 26, 1992	BT, CR, TR, OT, MT, MD; DB	NT
9	3336 Ro	K. & R. 6777	*Gastropacha quercifolia* Linnaeus, 1758	3♂♂, Timişul de Sus (Bv), July 10, 1997, 750 m alt., Hagieni Forest (DB), August 19, 1993, 17- August 18, 2000 1♀, Hagieni Forest (DB), August 19, 1993	BT, CR, TR, MM, OT, MT, MD; DB	NT
10	3339 Ro	K. & R. 6780	*Odonestis pruni pruni* Linnaeus, 1758	2♂♂, Frumuşica (Botoşani), June 23, 1983, Racoş (Bv.), June 20, 1997	BT, CR, TR, MM, OT, MT, MD; DB	NT
FAMILY SATURNIIDAE (3344 RO, K. & R. 6785)						
11	3347 Ro	K. & R. 6788	*Aglia tau* Linnaeus, 1758	1♀, Timişul de Jos (Bv), November 10-20, 1992, 700 m alt.	BT, TR, MM, OT, MT, MD	
12	3350 Ro	K. & R. 6793	*Saturnia pyri pyri* Denis & Schiffermüller, 1775	1♂, Hagieni (DB), May 29, 1987	BT, CR, TR, MM, OT, MT, MD; DB	VU

13	3351 Ro	K. & R. 6794	*Saturnia pavonia* Linnaeus, 1758	1♂, 1♀, Canaraua Fetii (DB), February 20, 1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	VU
FAMILY LEMONIIDAE (3356 RO, K. & R. 6803)						
14	3360 Ro	K. & R. 6808	*Lemonia balcanica* Herrich-Schäffer, 1847	1♂ Canaraua Fetii (DB), September 30 – October 2, 1995, 150 m alt.	BT, DB	
FAMILY SPHINGIDAE (3361 RO, K. & R. 6812						
15	3364 Ro	K. & R. 6817	*Marumba quercus* Denis & Schiffermüller, 1775	3♂♂, Comana Forest (Buc.), July 12, 1997, Periprava (D.D.), July 6, 1994, 6 m alt., Mihai Bravu (Buc.), July 12, 1997	BT, CR, TR, OT, MT, MD; DB	NT
16	3368 Ro	K. & R. 6822	*Smerinthus ocellata* Linnaeus, 1758	1♂, Maliuc (D.D.), July 18, 1997, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
17	3370 Ro	K. & R. 6824	*Laothoe populi* Linnaeus, 1758	1♂, Brăneşti (Buc.), July 31, 1998 1♀, Periprava (D.D.), July 6, 1994, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
18	3373 Ro	K. & R. 6828	*Agrius convolvuli* Linnaeus, 1758	2♂♂, Periprava (D.D.), July 30, 1997, September 1, 1997, 6 m alt. 1♀, Hagieni (DB), August 19, 1983	BT, CR, TR, MM, OT, MT, MD; DB	
19	3375 Ro	K. & R. 6830	*Acherontia atropos* Linnaeus, 1758	1♀, Braşov, September 30, 1975	BT, CR, TR, MM, OT, MT, MD; DB	VU
20	3377 Ro	K. & R. 6832	*Sphinx ligustri* Linnaeus, 1758	1♂, Canaraua Fetii (DB), July 9, 1994, 150 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
21	3379 Ro	K. & R. 6834	*Hyloicus pinastri pinastri* Linnaeus, 1758	2♂♂, Lepşa (Vrancea Mountains), July 1-2, 1997, July 1-8, 1997, 800 m alt. 1♀, Săcele (Bv.), August 3, 1996, 650 m alt.	BT, CR, TR, MM, MT, MD	
22	3388 Ro	K. & R. 6843	*Macroglossum stellatarum* Linnaeus,1758	1♂, Vâlcele (Covasna), June 17, 1996, 650 m alt. 1♀, Canaraua Fetii (DB), May 1, 1993, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
23	3392 Ro	K. & R. 6849	*Proserpinus proserpina* Pallas, 1772	1♂, Săcele (Bv.), July 2, 1993, 650 m alt.	BT, TR, MM, MD; DB	VU
24	3394 Ro	K. & R. 6853	*Hyles euphorbiae* Linnaeus, 1758	1♂, Canaraua Fetii (DB), June 14, 1998, 150 m alt. 1♀, Canaraua Fetii (DB), August 7, 1980, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
25	3395 Ro	K. & R. 6855	*Hyles gallii* Rottemburg, 1775	1♂, Frumușica (Botoșani), August 9, 1989	BT, CR, TR, MM, MT, MD; DB	VU
26	3398 Ro	K. & R. 6860	*Hyles lineata livornica* Esper, 1779	1♂, Periprava-Chilia Branch (D.D), July 30, 1997, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	VU
27	3400 Ro	K. & R. 6862	*Deilephila elpenor* Linnaeus, 1758	1♂, Timişul de Sus (Bv), July 17, 1992, 750 m alt. 1♀, Zizin (Bv.), July 9, 1981	BT, CR, TR, MM, OT, MT, MD; DB	NT
28	3401 Ro	K. & R. 6863	*Deilephila porcellus* Linnaeus, 1758	3♂♂, Canaraua Fetii (DB), May 25, 1997; May 2, 1998,150 m alt.; Târlungeni, May 17, 2000, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
FAMILY THYATIRINAE (3721 RO, K. & R. 7479)						
29	3723 Ro	K. & R. 7481	*Thyatira batis* Linnaeus, 1758	1♂, Brăneşti (Buc.), August 2, 1997 1♀, Tişiţei Gorges -Lepşa (Vrancea Mountains), July 4, 1996	BT, CR, TR, MM, OT, MT, MD; DB	
30	3725 Ro	K. & R. 7483	*Habrosyne pyritoides* Hufnagel, 1766 (sin. *H. derasa* Linnaeus, 1787)	1♂, Lepşa (Vrancea Mountains), July 1-2, 1997, 800 m alt. 1♀, Canaraua Fetii (DB), May 3-4, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
31	3727 Ro	K. & R. 7485	*Tethea ocularis* Linnaeus, 1767, (sin. *Cymatophora octogesima* Hübner, 1796)	1♂, Canaraua Fetii (DB), 3-May 4, 1998, 150 m alt. 1♀, Canaraua Fetii (DB), May 1-2, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
32	3728 Ro	K. & R. 7486	*Tethea or* Denis & Schiffermüller, 1775	1♂, Tişiţei Gorges - Lepşa (Vrancea Mountains), July 3, 1998, 800 m alt. 1♀, Tişiţei Gorges -Lepşa (Vrancea Mountains), 4.VII.1998, 800 m alt.	BT, TR, MM, MT, MD	
33	3734 Ro	K. & R.7492	*Cymatophorima diluta* Denis & Schiffermüller, 1775	1♂, Rediu (Botoşani), June 8, 1987 1♀, Timişul de Sus (Bv.), July 7, 1992, 750 m alt.	BT, CR, TR, MM, MD; DB	

34	3739 Ro	K. & R. 7488	*Tetheella fluctuosa* Hübner, 1803	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1997, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
FAMILY DREPANIDAE (3720 RO, K. & R. 7478)						
35	3742 Ro	3743, K. & R. 7501	*Falcaria lacertinaria* Linnaeus, 1758	1♂, Tişiţei Gorges (Munţii Vrancei), June 29-30, 1997, 900 m alt.	BT, TR, MM, MD	NT
36	3745 Ro	K. & R. 7503	*Watsonalla binaria* Hufnagel, 1767	1♀, Canaraua Fetii (DB), May 17, 1996, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
37	3746 Ro	K. & R. 7505	*Watsonalla cultraria* Fabricius, 1775(*W. hanula* Deni & Schiffermüller, 1775, *W. unguicula* Hübner, 1803)(,)	1♂, Teliu (Bv.), June 22, 1991	BT, TR, MM, OT, MT, MD; DB	
38	3749 Ro	K. & R. 7508	*Drepana falcataria* Linnaeus, 1758 (sin. *D. sicula* Denis & Schiffermüller, 1775, *D. falcula* Denis & Schiffermüller, 1775)	1♂, Racoş (Bv.), June 22, 1991	BT, CR, TR, MM, OT, MT, MD	NT
39	3751 Ro	K. & R. 7510	*Sabra harpagula* Esper, 1786	1♀, Lepşa (Vrancea), June 26-27, 1997	BT, CR, TR, MM, MT, MD; DB	NT
40	3753Ro	K. & R. 7512	*Cilix glaucata* Scopoli, 1763*(* sin. *C. spinula* Denis & Schiffermüller, 1775)	1♂, Frumuşica (Botoşani), April 9, 1989 1♀, Canaraua Fetii (DB), May 2, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
FAMILY GEOMETRIDAE (3755 RO, K. & R.7514)						
41	3760 Ro	K. & R. 7519	*Archiearis puella* Esper, 1787	1♂, Satu Mare March 2, 1997	BT, CR, TR, MM, MT, MD	VU
42	3763 Ro	K. & R. 7522	*Abraxas grossulariata* Linnaeus, 1758	1♂, Leorda (Botoşani), July 10, 1998	BT, CR, TR, MM, OT, MT, MD; DB	NT
43	3765 Ro	K. & R. 7524	*Calospilos sylvata* Scopoli, 1763	1♂, Tişiţei Gorges (Vrancea Mountains), August 3, 1998, 900 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), August 4, 1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD	VU
44	3767 Ro	K. & R. 7527	*Lomaspilis marginata* Linnaeus, 1758	1♂, Canaraua Fetii (DB), June 13, 1998, 150 m alt. 1♀, Lepşa (Vrancea Mountains), June 24, 1997, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
45	3769 Ro	K. & R 7530	*Ligdia adustata* Denis & Schiffermüller, 1775	2♂♂, Pasărea Forest (Buc.), June 22-23, 1997, July 7, 1998 2♀♀, Pasărea Forest (Buc.), May 30, 1997, Şercaia (Vad Forest, Bv.), July 27, 2000	BT, CR, TR, MM, OT, MT, MD; DB	
46	3772 Ro	K. & R. 7534	*Lomographa dilectaria* Hübner, 1790	1♂, Canaraua Fetii (DB), June 8, 1997, 150 m alt.	BT, CR, TR, MM, OT, MD; DB	NT
47	3774 Ro	K. & R. 7537	*Heliomata glarearia* Denis & Schiffermüller, 1775	1♂, Băneasa (DB), June 12, 1998 2♀♀, Canaraua Fetii (DB), June 1-2, 1998, 150 m alt., Băneasa (DB), June 13, 1998	BT, CR, TR, OT, MT, MD; DB	
48	3776 Ro	K. & R. 7539	*Macaria notata* Linnaeus, 1758	1♂, Pasărea Forest (Buc.), July 25, 1998 1♀, Pasărea Forest (Buc.), June 20, 1993	BT, CR, TR, MM, OT, MD; DB	
49	3777 Ro	K. & R. 7540	*Macaria alternaria* Hübner, 1805	2♂♂, Sângiorgiu (Mureş), June 3, 1982, Brăneşti (Buc.), July 24, 1998 1♀, Canaraua Fetii (DB), May 1, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
50	3779 Ro	K. & R. 7542	*Macaria liturta* Clerck, 1759	1♂, Lepşa (Vrancea Mountains), July 1-2, 1997, 800 m alt. 1♀, Muntele Roşu, July 20, 1993, 1300 m alt.	BT, TR, MM, MT, MD; DB	
51	3784 Ro	K. & R. 7547	*Chiasmia clathrata* Linnaeus, 1758	1♂, Canaraua Fetii (DB), May 13, 1998, 150 m alt. 1♀, Canaraua Fetii (DB), May 12, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
52	3796 Ro	K. & R. 7569	*Tephrina murinaria* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), May 1, 1998, 150 m alt.	BT, CR, TR, MT, MD; DB	NT
53	3798 Ro	K. & R. 7571	*Tephrina arenacearia* Denis & Schiffermüller, 1775	2♂♂, Maliuc (D.D.), July 18, 1997, Periprava (D.D.), August 30, 1997, 6 m alt. 3♀♀, Brăneşti (Buc.), August 8, 1998, Canaraua Fetii (DB), June 12,	BT, CR, TR, MM, OT, MT, MD; DB	NT

				1998, 150 m alt., Băneasa (DB), June 13, 1998, 90 m alt.		
54	3800 Ro	K. & R. 7581	*Neognopharmia stevenaria* Boisduval, 1840	1♂, Hagieni (DB), August 11, 1980	BT, OT, MT, MD; DB	NT
55	3806 Ro	K. & R. 7606	*Plagodis pulveraria* Linnaeus, 1758	1♂, Brăneşti (Buc.), July 25, 1998 2♀♀, Brăneşti (Buc.), July 24, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
56	3807 Ro	K. & R. 7607	*Plagodis dolabraria* Linnaeus, 1767	1♂, Săcele (Bv.), May 17, 1997, 650 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
	3809 Ro	K. & R. 7613	*Opisthograptis luteolata* Linnaeus, 1767	2♂♂, Canaraua Fetii (DB), May 9, 1998, 150 m alt., Frumuşica (Botoşani), May 17, 1989	BT, CR, TR, MM, OT, MT, MD; DB	NT
57	3811 Ro	K. & R. 7615	*Epione repandaria* Hufnagel, 1767	1♂, Uila livadă, Mureş, September 29, 1981	BT, CR, TR, MM, MT, MD; DB	NT
58	3814 Ro	K. & R. 7618	*Therapis flavicaria* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), June 14, 1992, 150 m alt., Brăneşti (Buc.), July 24, 1998	BT, CR, TR, MM, OT, MT, MD; DB	NT
59	3816 Ro	K. & R. 7620	*Pseudopanthera macularia* Linnaeus, 1758 (sin. *P. maculata* Scopoli, 1763)	2♂♂, Canaraua Fetii (DB), May 2, 1998, 150 m alt., Târlungeni (Bv.), August 1, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
60	3818 Ro	K. & R. 7622	*Eilicrinia cordiaria* Hübner, 1790	2♀♀, Maliuc (D.D.), July 18, 1997, 6 m alt., Pasărea Forest (Buc.), August 1, 1997	BT, CR, OT, MT, MD; DB	NT
61	3819 Ro	K. & R. 7624	*Eilicrinia trinotata* Metzner, 1845	2♂♂, Canaraua Fetii (DB), May 24, 1997; May 26, 1997, 150 m alt.,	BT, CR, OT, MT, MD; DB	NT
62	3821 Ro	K. & R. 7628	*Hypoxystis pluviaria* Fabricius, 1787	2♂♂, Săcele (Bv.), May 14, 1992, Racoş (Bv.), May 1, 1991	BT, CR, TR, MM, MD	NT
63	3823 Ro	K. & R. 7630	*Apeira syringaria* Linnaeus, 1758	2♂♂, Brăneşti (Buc.), July 25, 1998, Pasărea Forest (Buc.), July 24, 1998	BT, CR, TR, MM, MT, MD; DB	NT
64	3825 Ro	K. & R. 7632	*Ennomos autumnaria* Werneburg, 1859	1♂, Botoşani, November 7, 1987 1♀, Frumuşica (Botoşani), August 28, 1989	BT, CR, TR, MM, MT, MD; DB	
65	3829 Ro	K. & R. 7636	*Ennomos erosaria* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), June 27, 1993, 150 m alt., Rediu (Botoşani), July 13, 1987	BT, CR, TR, MM, OT, MT, MD; DB	NT
66	3832 Ro	K. & R. 7641	*Selenia dentaria* Fabricius, 1775	2♂♂, Zizin (Bv.), July 13, 1990, 750 m alt., Tişiţei Gorges (Vrancea Mountains), July 10, 1999, 800 m alt. 2♀♀, Timişul de Jos (Bv), April 20-25, 1994, 750 m alt., Timişul de Jos (Bv), May 5-12, 1996, 700 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
67	3833 Ro	K. & R. 7642	*Selenia lunularia*, Hübner, 1788	2♂♂, Frumuşica (Botoşani), July 7, 1989, Pasărea Forest-Brăneşti (Buc.), July 28, 2000, ♂, Timişul de Jos (Bv), June 10-15, 1996, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
68	3836 Ro	K. & R. 7645	*Artiora evonymaria* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), October 7, 1990, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	VU
69	3838 Ro	K. & R. 7647	*Odontopera bidentata bidentata* Clerck, 1759	1♂, Lepşa (Vrancea), July 1-2, 1997, 800 m alt.	BT, TR, MM, OT, MT, MD	NT
70	3842 Ro	K. & R. 7652	*Crocallis trusciaria* Borkhausen, 1793	1♀, Hagieni (DB), October 5, 1985	BT, CR, TR, OT, MT, MD; DB	NT
71	3843 Ro	K. & R. 7654	*Crocallis eliguaria* Linnaeus, 1758	1♂, Roşu Lake -Cupaş, August 2, 1979 1♀, Canaraua Fetii (DB), September 17, 1997, 100 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
72	3844 Ro	K. & R. 7659	*Ourapteryx sambucaria* Linnaeus, 1758	2♂♂, Timişul de Jos (Bv), July 25, 1994, 750 m alt., Săcele (Bv.), July 5, 1999, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	CR
73	3849 Ro	K. & R. 7663	*Colotois pennaria* Linnaeus, 1761	1♂, Timişul de Jos (Bv), October 30, 1996, 600 m alt.	BT, CR, TR, MM, MT, MD; DB	
74	3851 Ro	K. & R. 7665	*Angerona prunaria* Linnaeus, 1758	3♂♂, Tişiţei Gorges (Vrancea Mountains), July 1-2, 1997, 850-900 m alt., Timişul de Jos (Bv), July 8, 1991, 750 m alt. 3♀♀, Tişiţei Gorges (Vrancea Mountains), July 1-2, 1997, 850-900 m alt., Vâlcele (Covasna), June 12, 1999, 600 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT

75	3853 Ro	K. & R. 7671	*Apocheima pilosaria* Denis & Schiffermüller, 1775	2♂♂, Săcele (Bv.), February 24, 1998; March 15, 1979, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
76	3856 Ro	K. & R. 7674	*Lycia hirtaria hirtaria* Clerck, 1759	3♂♂, Săcele (Bv.), April 4,6, 1998; August 28, 1999, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
77	3861 Ro	K. & R. 7686	*Biston betularia* Linnaeus, 1758	3♂♂, Timişul de Jos (Bv), May 14, 1992; June 10, 1997; June 10-20, 1997, 700 m alt. 1♀, Şercaia- Vad Forest, July 27, 2000	BT, CR, TR, MM, OT, MT, MD; DB	
78	3864 Ro	K. & R. 7694	*Agriopis bajaria bajaria* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), October 19, 1996; November 10-20, 1996, 150 m alt.	BT, CR, TR, MM, OT, MD; DB	NT
79	3865 Ro	K. & R. 7695	*Agriopis aurantiaria* Hübner, 1799	1♂, Săcele (Bv.), October 19, 1996, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
80	3866 Ro	K. & R. 7696	*Agriopis marginaria* Fabricius, 1777	1♂, Frumuşica (Botoşani), March 5, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
81	3867 Ro	K. & R. 7699	*Erannis defoliaria* Clerck, 1759	2♂♂, Canaraua Fetii (DB), November 10-20, 1996, 150 m alt., Săcele (Bv.), April 7, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
82	3881 Ro	K. & R. 7733	*Synopsia sociaria* Hübner, 1799	2♂♂, Canaraua Fetii (DB), May 31, 1991; June 24, 1998, 150 m alt.	BT, CR, TR, MM, MT, MD; DB	
83	3885 Ro	K. & R. 7754	*Peribatodes rhomboidaria* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), May 31, 1991, 150 m alt. 1♀, Canaraua Fetii (DB), May 13, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
84	3887 Ro	K. & R. 7762	*Peribatodes secundaria secundaria* Denis & Schiffermüller, 1775	1♂, Hagieni (DB), October 4, 1981	BT, CR, TR, MM, OT, MT, MD; DB	
85	3893 Ro	K. & R. 7773	*Cleora cinctaria* Denis & Schiffermüller, 1775	1♀, Rediu (Botoşani), May 13, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
86	3895 Ro	K. & R. 7775	*Dileptenia ribeata* Clerck, 1759	1♂, Tişiţei Gorges (Vrancea Mountains), July 10, 1999, 800 m alt.	BT, TR, MM, MT, MD	
87	3897 Ro	K. & R. 7777	*Alcis repandata* Linnaeus, 1758	2♂♂, Tişiţei Gorges (Vrancea Mountains), August 2, 1997, 900 m alt., Vad Forest, June 9, 2000 3♀♀, Săcele (Bv.), July 21, 1998; August 1, 1998, Şercaia (Bv.), July 31, 2000	BT, TR, MM, OT, MT, MD; DB	
88	3898 Ro	K. & R. 7778	*Alcis bastelbergeri* Hirschke, 1908	1♀, Malnaş Băi, August 23, 1980	BT, TR, MM, MT, MD; DB	
89	3903 Ro	K. & R. 7783	*Boarmia roboraria* Denis & Schiffermüller, 1775 (*Hypomecis* Hübner, 1821)	1♂, Pasărea Forest (Buc.), July 21, 1997 2♀♀, Tişiţei Gorges (Vrancea Mountains), July 3, 1997, 800 m alt., Brăneşti (Buc.), July 2, 1997	BT, CR, TR, MM, MT, MD; DB	
90	3910 Ro	K. & R. 7794	*Ascotis selenaria selenaria* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), May 4, 1998, 150 m alt. 2♀♀, Canaraua Fetii (DB), May 2,12, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
91	3911 Ro	K. & R. 7796	*Ectropis bistornata* Goeze, 1781	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1998, 900 m alt. 1♀, Săcele (Bv.), April 6, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
92	3914 Ro	K. & R. 7798	*Paradarisa consonaria* Hübner, 1799	1♀, Timişul de Jos (Bv.), 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
93	3916 Ro	K. & R. 7800	*Parectropis extensaria* Hübner, 1799	1♀, Racoş (Bv.), June 20, 1997, 500 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
94	3920 Ro	K. & R. 7804	*Ematurga atomaria atomaria* Linnaeus, 1758	2♂♂, Canaraua Fetii (DB), June 13, 1998, 150 m alt., Şercaia (Pădurea Vad, Bv.), July 27, 2000 1♀, Canaraua Fetii (DB), June 13, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
95	3926 Ro	K. & R. 7822	*Bupalus pinaria pinaria* Linnaeus, 1758	1♂, Săcele (Bv.), July 3, 1992	BT, TR, MM, MD	NT
96	3929 Ro	K. & R. 7824	*Cabera pusaria* Linnaeus, 1758	2♂♂, Târlungeni (Bv.), June 27, 1998, Săcele (Bv.), July 31, 2000 1♀, Lepşa (Vrancea), June 1-2, 1997, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
97	3930 Ro	K. & R. 7826	*Cabera exanthemata* Scopoli, 1763	1 ♂, Tişiţei Gorges (Vrancea Mountains), July 4, 1998, 900 m alt. 1♀, Canaraua Fetii (DB), May 2,	BT, CR, TR, MM, OT, MT, MD; DB	NT

				1998, 150 m alt.		
98	3932 Ro	K. & R. 7828	*Lomographa bimaculata* Fabricius, 1775	3♂♂, Timişul de Jos (Bv), May 14, 1997, 700 m alt., Săcele (Bv.), June 8, 1997, Rediu (Botoşani), June 8, 1987	BT, CR, TR, MM, OT, MT, MD; DB	
99	3933 Ro	K. & R. 7829	*Lomographa temerata* Denis & Schiffermüller, 1775	1♂, Săcele (Bv.), June 26, 1992, June 25, 1997, 650 m alt. 1♀, Săcele (Bv.), June 21, 1996	BT, CR, TR, MM, OT, MD; DB	NT
100	3937 Ro	K. & R. 7836	*Campaea margaritata* Linnaeus, 1767 (*C. margaritaria* Denis & Schiffermüller, 1775, *C. autumnata* Alexinschi & Peiu, 1960)	2♂♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1998, 900 m alt., Săcele (Bv.), July 5, 1999 2♀♀, Tişiţei Gorges (Vrancea Mountains), April 20-25, 1994; July 3, 1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
101	3939 Ro	K. & R. 7839	*Hylaea fasciaria fasciaria* Linnaeus, 1758	3♂♂, Timişul de Sus (Bv), 10-June 20, 1997, 750 m alt.,	BT, TR, MM, OT, MT, MD	
102	3957Ro	K. & R. 7870	*Costignophos pullata* Denis & Schiffermüller, 1775	2♂♂, Tişiţei Gorges (Vrancea Mountains), July 3, 4, 1998, 900 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), July 4, 1998	BT, TR, MT, MD	
103	3977 Ro	K. & R. 7910	*Glacies coracina dioszeghyi* Schmidt, 1930	2♂♂, Omu Peak (Bucegi Mountains), August 1, 1993, 2400 m alt., Piatra Arsă (Bucegi Mountains), July 31, 1993, 2100 m alt.	TR, MM, OT, MT	VU
104	3980 Ro	K. & R. 7916	*Siona lineata* Scopoli, 1763	1♂, Lepşa-Vrancea, July 1-2, 1997, 800 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), July 3, 1997, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
105	3997 Ro	K. & R. 7953	*Alsophila aescularia* Denis & Schiffermüller, 1775	2♂♂, Săcele (Bv.), March 3, 1978, April 3, 1998, 650 m alt. 2♀♀, Canaraua Fetii (DB), May 26, 1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
106	3998 Ro	K. & R. 7954	*Alsophila quadripunctaria* Esper, 1801 (sin. *Anisopteryx aceraria* Denis & Schiffermüller, 1775)	1♂, Timişul de Jos (Bv), November 20-28, 1992, 700 m alt., Tişiţei Gorges (Vrancea Mountains), July 9, 1999, 800 m alt. 1♀, Săcele (Bv.), July 6, 1999, 650 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
107	4008 Ro	K. & R. 7969	*Geometra papilionaria* Linnaeus, 1758	2♂♂, Bicazului Gorges (Harghita), August 2, 1996, 1100 m alt., Roşu Lake-Cupaş, July 7, 1985	BT, CR, TR, MM, OT, MT, MD; DB	NT
108	4009 Ro	4010, K. & R.	*Comibaena pustulata* Hufnagel, 1767 (sin. *C. bajularia* Denis & Schiffermüller, 1775)	2♂♂, Pasărea Forest (Buc.), Băneasa (Buc.), May 31, 1998	BT, CR, TR, MM, OT, MT, MD; DB	NT
109	4013 Ro	K. & R. 7975	*Thetidia smaragdaria* Fabricius, 1787	1♂, Pasărea Forest (DB), June 12, 1998, alt. 90 m 1♀, Pasărea Forest (Buc.), July 24, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
110	4015 Ro	K. & R. 7980	*Hemithea aestivaria* Hübner, 1789 (sin. *H. strigata* Müller, 1764)	1♂, Târgu Mureş, June 15, 1988 1♀, Frumuşica (Botoşani), May 24, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
111	4017 Ro	K. & R. 7982	*Chlorissa viridata* Linnaeus, 1758	2♂♂, Sîngiorgiu-Mureş, June 3, 1982, Canaraua Fetii (DB), May 2, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
112	4018 Ro	K. & R. 7983	*Chlorissa cloraria* Hübner, [1813] (sin. *C. porrinata* Zeller, 1848)	1♂, Canaraua Fetii (DB), May 3-4, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
113	4020 Ro	K. & R. 7984	*Phaiogramma pulmentaria* Guenée, 1858 (sin. *P. etruscaria* Zeller, 1849)	1♀, Canaraua Fetii (DB), May 23, 1997, 150 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
114	4026 Ro	K. & R. 8000	*Hemistola chrysoprasaria* Esper, 1795 (sin. *H. imaculata* auct.)	1♂, Pasărea Forest (DB), June 12, 1998, alt. 90 m 1♀, Canaraua Fetii (DB), July 3, 1994, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
115	4034 Ro.	K. & R. 8014	*Cyclophora annulata* Schulze, 1775 (sin. *C. annularia* Fabricus, 1775, *C. omicronaria* Denis & Schiffermüller, 1775)	2♂♂, Băneasa Forest (Buc.), May 31, 1998; July 24, 1998 alt. 90 m 1♀, Băneasa Forest (Buc.), July 7, 1998 alt. 90 m	BT, CR, TR, MM, OT, MT, MD; DB	NT
116	4037 Ro	K. & R. 8018	*Cyclophora ruficiliaria* Herrich & Schäffer, 1855	1♂, Timişul de Jos (Bv), August 17, 1998, 700 m alt. 1♀, Racoş (Bv.), June 22, 1991	BT, CR, TR, MM, MT, MD; DB	VU
117	4040 Ro	K. & R. 8022	*Cyclophora punctaria* Linnaeus, 1758	1♀, Frumuşica (Botoşani), May 5, 1989	BT, CR, TR, MM, OT, MT, MD; DB	NT

118	4042 Ro	K. & R. 8024	*Cyclophora linearia* Hübner, 1799 (sin. *C. trilinearia* Borkhausen, 1794, nec. Hübner, 1787)	1♂, Teliu (Bv.), May 25, 1995, 650 m alt. 1♀, Tișiței Gorges -Lepșa (Vrancea Mountains), July 3, 1998, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
119	4044 Ro	K. & R. 8028	*Timandra griseata* W. Petersen, 1902 (sin. *T. comae* A. Schmidt, 1931, *Calothysanis amata* auct.)	1♂, Pasărea Forest (Buc.), May 30, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
120	4046 Ro	K. & R. 8036	*Scopula immorata* Linnaeus, 1758	2♂♂, Săcele (Bv.), July 29, 1996, 650 m alt., Șercaia-Pădrea Vadului (Bv.), July 27, 2000 2♀♀, Rediu (Botoșani), June 3, 1987, Șercaia-Pădrea Vadului (Bv.), July 27, 2000	BT, CR, TR, MM, OT, MT, MD; DB	
121	4047 Ro	K. & R. 8037	*Scopula tessellaria* Boisduval, 1840	2♂♂, Canaraua Fetii (DB), June 13-14, 1997; June 13, 1998, 150 m alt. 2♀♀, Canaraua Fetii (DB), June 14, 1998 150 m alt., Hagieni Forest, August 17-18, 2000 40 m alt.	BT, TR, MT, MD; DB	VU
122	4052 Ro	K. & R. 8042	*Scopula nigropunctata* Hufnagel, 1767 (sin. *S. strigilaria* auct., *S. prataria* Boisduval, 1840)	1♂, Pasărea Forest (Buc.), August 1, 1998 1♀, Brănești (Buc.), June 31, 1998	BT, CR, TR, MM, OT, MT, MD; DB	NT
123	4053 Ro	K. & R. 8043	*Scopula virgulata* Denis & Schiffermüller, 1775	1♂, Racoș (Bv.), June 22, 1991	BT, CR, TR, MM, OT, MT, MD; DB	
124	4054 Ro	K. & R. 8045	*Scopula ornata* Scopoli, 1763	2♂♂, Canaraua Fetii (DB), September 21, 1991; September 18, 1993, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
125	4056 Ro	K. & R. 8051	*Scopula decorata decorata* Denis & Schiffermüller, 1775 (sin. *Acidalia violata* Thunberg, 1784*)*	1♂, Canaraua Fetii (DB), August 8, 1994, 150 m alt.	BT, CR, TR, OT, MT, MD; DB	NT
126	4057 Ro	K. & R. 8054	*Scopula rubiginata* Hufnagel, 1767	1♂, Pasărea Forest (Buc.), July 25, .1998 1♀, Canaraua Fetii (DB), September 21, 1991, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
127	4059 Ro	K. & R. 8059	*Scopula marginepunctata* Goeze,1781	♂♂, Canaraua Fetii (DB), May 23, 1997; May 13-14, 1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
128	4080 Ro	K. & R. 8104	*Idaea muricata* Hufnagel, 1767	2♂♂, Pasărea Forest (Buc.), August 7, 1998; July 24, 1998 1♀, Canaraua Fetii (DB), June 13, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
129	4081 Ro	K. & R. 8107	*Idaea vulpinaria* Herrich-Schäffer, 1847	3♂♂, Hagieni (DB), July 21, 1981, C.A. Rosetti (DB), July 13, 1991, Canaraua Fetii (DB), July 7, 1994, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
130	4082 Ro	K. & R. 8110	*Idaea filicata* Hübner, 1787	4♂♂, Canaraua Fetii (DB), May 18, 1996; May 15, 23, 24, 1997, 150 m alt. 2♀♀, Canaraua Fetii (DB), May 24, 26, 1997, 150 m alt.	BT, TR, OT, MT, DB	NT
131	4083 Ro	K. & R. 8111	*Idaea laevigata* Scopoli, 1763	2♂♂, Săcele (Bv.), July 21, 1998, 650 m alt., Târlungeni (Bv.), June 19-21, 1999, 700 m alt.	BT, CR, TR, OT, MD; DB	NT
132	4089 Ro	K. & R. 8132	*Idaea biselata* Hübner, 1767	2♂♂, Periprava (D.D.), August 3, 1997, 30 m alt, Tișiței Gorges (Vrancea Mountains), July 10, 1999	BT, CR, TR, MM, OT, MT, MD; DB	
133	4092 Ro	K. & R. 8137	*Idaea fuscovenosa fuscovenosa* Goeze,1781	2♂♂, Tișiței Gorges (Vrancea Mountains), 3.VII.1998, 900 m alt., Pasărea Forest (Buc.), 10.VIII.1999	BT, CR, TR, MM, OT, MD; DB	NT
134	4095 Ro	K. & R 8155	*Idaea seriata* Schrank, 1802	1♂, Săcele (Bv.), July 14, 1998, 650 m alt. 1♀, Jepilor Valley (Bucegi Mountains), July 25, 1991	BT, CR, TR, MM, OT, MT, MD; DB	NT
135	4096 Ro	K. & R 8161	*Idaea dimidiata* Hübner, 1767	1♂, Canaraua Fetii (DB),June 13, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
136	4098 Ro	K. & R. 8167	*Idaea subsericeata* Haworth, 1809	1♂, Canaraua Fetii (DB), May 23, 1997, 150 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
137	4104 Ro	K. & R. 8183	*Idaea emarginata* Linnaeus, 1758	1♂, Canaraua Fetii (DB), June 12, 1998, 150 m alt.	BT, CR, TR, MM, OT, MD; DB	

138	4105 Ro	K. & R. 8184	*Idaea aversata aversata* Linnaeus, 1758 (sin. *I. remulata* Linnaeus, 1758)	2♂♂, Canaraua Fetii (DB), June 13-14, 1997, 150 m alt. 1♀, Săcele (Bv.), July 8, 1998, 650 m alt., Bicazului Gorges, August 5, 1996, 1100 m alt. 1♀, Băneasa (DB), June 12, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
139	4107 Ro	K. & R. 8186	*Idaea degeneraria* Hübner, 1767	2♂♂, Canaraua Fetii (DB), 12-June 13, 1997, 150 m alt. 1♀, Canaraua Fetii (DB), June 14, 1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
140	4109 Ro	K. & R. 8188	*Idaea deversaria* Denis & Schiffermüller, 1775	3♂♂, Canaraua Fetii (DB), June 13-14, 1997, 150 m alt., Săcele (Bv.), July 8, 1998, 650 m alt.	BT, CR, TR, MT, MD; DB	NT
141	4111 Ro	K. & R. 8205	*Rhodostrophia vibricaria* Clerck, 1759	1♂, Canaraua Fetii (DB), May 26. 1997, 150 m alt. 1♀, Canaraua Fetii (DB), June 14, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
142	4113 Ro	K. & R. 8209	*Rhodostrophia tabidaria* Zeller, 1847	1♂, Băneasa (DB), June 13, 1998, 90 m alt. 1♀, Hagieni (DB), June 15, 1997	BT, OT, DB	DD
143	4118 Ro	K. & R. 8221	*Lythria purpuraria* Linnaeus, 1758 (sin. *L. cruentata* Hufnagel, 1767, nec. Scopoli, 1763)	2 ♂♂, Pasărea Forest (Buc.), August 24, 1998; August 10, 1999 2♀♀, Frumuşica (Botoşani), July 24, 1989, Pasărea Forest (Buc.), August 11, 1999	BT, CR, TR, MM, OT, MT, MD; DB	NT
144	4119 Ro	K. & R. 8222	*Lythria purpurata* Linnaeus, 1761	2 ♂♂, Periprava (D.D.), July 8, 1996, 6 m alt, Canaraua Fetii (DB), May 27, 1990, 150 m alt.	BT, CR, TR, MM, OT, MD; DB	NT
145	4129 Ro	K. & R. 8239	*Scotopteryx chaenopodiata* Linnaeus, 1758	1♂, Târlungeni (Bv.), June 23, 1996, 650 m alt. 2♀♀, Frumuşica (Botoşani), July 27, 1989, Roşu Lake, August 10, 1982	BT, CR, TR, MM, OT, MT, MD; DB	
146	4132 Ro	K. & R. 8241	*Scotopteryx luridata* Hufnagel, 1767 (sin. *S. plumbaria* Denis & Schiffermüller, 1775)	1♂, Racoş (Bv.), June 4, 1993	BT, TR, MM, MT, MD; DB	NT
147	4137 Ro	K. & R. 8248	*Xanthorhoe biriviata* Borkhausen, 1794	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1994, 900 m alt. 2♀♀, Săcele (Bv.), June 7, 1997, 650 m alt., Târlungeni (Bv.), June 14, 1997, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
148	4141 Ro	K. & R. 8253	*Xanthorhoe ferrugata* Clerck, 1759 (sin. *X. unidentaria* Haworth, 1809, *X. ferrugaria* Denis & Schiffermüller, 1775)	2♂♂, Frumuşica (Botoşani), May 5, 1989, Canaraua Fetii (DB), May 2, 1989, 150 m alt. 1♀, Săcele (Bv.), July 25, 1998, 650 m	BT, CR, TR, MM, OT, MT, MD; DB	
149	4142 Ro	K. & R. 8254	*Xanthorhoe quadrifasciata* Clerck, 1759	1 ♂, Săcele (Bv.), July 11, 1997, 650 m	BT, CR, TR, MM, OT, MT, MD; DB	
150	4143 Ro	K. & R. 8255	*Xanthorhoe montanata* Denis & Schiffermüller, 1775	1♂, 1♀, Tişiţei Gorges (Vrancea Mountains), July 4, 1997, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
151	4144 Ro	K. & R. 8256	*Xanthorhoe fluctuata* Linnaeus, 1758	1♂, Târlungeni (Bv.), August 17, 1997, 700 m alt. 1♀, Lepşa (Vrancea Mountains), June 26-27, 1997, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
152	4150 Ro	K. & R. 8268	*Catarhoe rubidata* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), June 2, 1998, 150 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
153	4155 Ro	K. & R. 8275	*Epirrhoe alternata* Müller, 1764	2 ♂♂, Pasărea Forest (Buc.), May 30, 1998; Tişiţei Gorges (Vrancea Mountains), July 9, 1999, 900 m alt. 2♀♀, Săcele (Bv.), June 4, 1998, 650 m, Frumuşica (Botoşani), May 13, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
154	4162 Ro	K. & R. 8289	*Camptogramma bilineata* Linnaeus, 1758	2 ♂♂, Canaraua Fetii (DB), May 26, 1997, 150 m alt., Şercaia, Vad Forest (Bv.), June 10, 2000 2♀♀, Pasărea Forest (Buc.), August 24, 1998; August 8, 1998, Canaraua Fetii (DB), June 1, 1992, 150 m	BT, CR, TR, MM, OT, MT, MD; DB	
155	4165 Ro	K. & R. 8297	*Entephria cyanata* Hübner, 1809	1♂, Tişiţei Gorges (Vrancea Mountains), June 3, 1995, 900 m alt.	BT, TR, MM, OT, MT, MD	NT
156	4168 Ro	K. & R. 8302	*Entephria caesiata* Denis & Schiffermüller, 1775	1♂, Bâlea (Făgăraş Mountains), July 25, 1994, 2200 m alt.	BT, CR, TR, MM, OT, MT, MD	

157	4177 Ro	K. & R. 8314	*Pelurga comitata* Linnaeus, 1758 (sin. *P. moldavinata* Caradja, 1896)	2♂, September 8, 9, 2000, Periprava (D.D) 1♀, Periprava (D.D), September 9, 1996, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
158	4179 Ro	K. & R. 8316	*Lampropteryx suffumata* Denis & Schiffermüller, 1775	1♂, 1♀, Teliu (Bv.), June 18, 1998, 700 m alt.	TR, MT,MD	NT
159	4182 Ro	K. & R. 8319	*Cosmorhoe ocellata* Linnaeus, 1758	1♂, Canaraua Fetii (DB), May 12, 1998, 150 m 1♀, Frumușica (Botoșani), May 7, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
160	4184 Ro	K. & R. 8321	*Nebula salicata* Denis & Schiffermüller, 1775	1♂, Caraiman (Bucegi Maountains), July 4, 1994, 2500 m alt.	BT, CR, TR, MT, MD; DB	
161	4190 Ro	K. & R. 8330	*Eulihtis prunata* Linnaeus, 1758	1♂, Roșu Lake-Cupaș, August 12, 1985	BT, TR, MT, MD	NT
162	4194 Ro	K. & R. 8335	*Eulihtis pyraliata* Denis & Schiffermüller, 1775	1♂, Roșu Lake, August 2, 1979	BT, CR, TR, MM, OT, MT, MD; DB	
163	4196 Ro	K. & R. 8338	*Ecliptopera silaceata* Denis & Schiffermüller, 1775	2♂♂, Tișiței Gorges (Vrancea Mountains), July 3, 4, 1998, 900 m	BT, CR, TR, MM, OT, MT, MD; DB	
164	4197 Ro	K. & R. 8339	*Ecliptopera capitata* Herrich & Schäffer, 1839	2♂♂, Tișiței Gorges (Vrancea Mountains), July 2, 1997; July 10, 1999, 800 m	CR, TR, MM, OT, MT, MD; DB	NT
165	4199 Ro	K. & R. 8341	*Chloroclysta siterata* Hufnagel, 1767	1♂, Timișul de Jos (Bv), September 28, 1998, 700 m alt. 1♀, Timișul de Jos (Bv), September 1-10, 1998, 700 m alt.	BT, CR, TR, MM, OT, MT, MD	
166	4201 Ro	K. & R. 8343	*Chloroclysta citrata* Linnaeus, 1761	1♂, Bicazului Gotges-Harita, August 2, 1996, 1100 m alt. 1♀, Săcele (Bv.), October 6, 1997, 650 m	BT, CR, TR, MM, MT, MD; DB	NT
167	4202 Ro	K. & R. 8348	*Chloroclysta trucata* Hufnagel, 1767	2♂♂, Tișiței Gorges (Vrancea Mountains), July 3, 1998, 900 m, Timișul de Jos (Bv), August 1-17, 1998, 700 m alt.	BT, CR, TR, MM, OT, MT, MD	
168	4204 Ro	K. & R. 8350	*Cidaria fulvata* Forster, 1771	1♂, Roșu Lake-Cupaș, August 8, 1985 1♀, Tișiței Gorges (Vrancea Mountains), July 2, 1997; July 3, 1998, 900 m alt.	BT, CR, TR, MM, MT, MD; DB	
169	4206 Ro	K. & R. 8352	*Plemyria rubiginata* Denis & Schiffermüller, 1775	1♀, Tișiței Gorges (Lepșa-Vrancea Mountains), July 3, 1997, 900 m alt.	BT, CR, TR, OT, MT, MD; DB	NT
170	4210 Ro	K. & R. 8356	*Thera obeliscata* Hübner, 1787	1♂, Săcele (Bv.), July 12, 1992, 650 m alt	BT, TR, MM, OT, MT, MD	NT
171	4211 Ro	K. & R. 8357	*Thera variata* Denis & Schiffermüller, 1775	2♂♂, Săcele (Bv.), October 8, 1996, 650 m alt., Timișul de Jos (Bv), September 28, 1998, 700 m alt. 1♀, Săcele (Bv.), April 4, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD	
172	4213 Ro	K. & R. 8360	*Thera strangulata* Hübner, 1809	1♂, Zizin (Bv.), September 25, 1990	TR, MM, OT, MT, MD	DD
173	4217 Ro	K. & R. 8366	*Eustroma reticulata* Denis & Schiffermüller, 1775	1♂, Tișiței Gorges (Vrancea Mountains), July 4, 1998, 900 m alt.	BT, TR, MM, OT, MT, MD	NT
174	4219 Ro	K. & R. 8368	*Electrophaes corylata* Thunberg, 1792	2♂♂, Săcele (Bv.), June 22, 1996; June 21, 1999, 650 m alt. 2♀♀, Timișul de Jos (Bv), July 5-12, 1996; May 13, 2000, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
175	4226 Ro	K. & R. 8385	*Colostygia pectinataria* Knoch, 1781	1♂, Bicazului Gorges-Harghita, August 4, 1996, 1100 m alt. 1♀♀, Timișul de Jos (Bv), July 10-15, 1992, 700 m alt.	BT, CR, TR, MM, OT, MT, MD	
176	4228 Ro	K. & R. 8391	*Hydriomena furcata* Thunberg, 1784	1♂, Bicazului Gorges-Harghita, August 5, 1996, 1100 m alt. 1♀, Săcele (Bv.), July 21, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD	
177	4229 Ro	K. & R. 8392	*Hydriomena impluviata impluviata* Denis & Schiffermüller, 1775	1♀, Timișul de Jos (Bv), June 19, 1992, 700 m alt.	TR, MM, OT, MT, MD	NT
178	4234 Ro	K. & R. 8400	*Horisme vitalbata* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), May 3-4, 1998, 150 m, Hagieni Forest (DB), August 17-18, 2000, 40 m alt. 2♀♀, Canaraua Fetii (DB), June 14, 1998; June 1-2, 1998, 150 m alt.	BT, CR, TR, OT, MT, MD; DB	

179	4235 Ro	K. & R. 8401	*Horisme corticata* Treitschke, 1835	2♂♂, Canaraua Fetii (DB), May 26, 1997; June 14, 1998, 150 m alt.	BT, CR, TR, OT, MD; DB	NT
180	4236 Ro	K. & R. 8402	*Horisme tersata* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), May 1, 1998, 150 m, Pasărea Forest (Buc.), 30.V.1998 2♀♀, Canaraua Fetii (DB), 3-June 4, 1998, 150 m alt., Pasărea Forest (Buc.), May 31, 1998	BT, CR, TR, MM, OT, MT, MD; DB	NT
181	4238 Ro	K. & R. 8407	*Horisme aemulata* Hübner, 1813	2♂♂, Hagieni (DB), June 22, 1988, Năvodari (DB), August 18-22, 2000 2♀♀, Canaraua Fetii (DB), May 23, 1997, 150 m alt., Năvodari (DB), August 17-18, 2000, 40 m alt.	BT, TR, MM,MT, MD; DB	NT
182	4242 Ro	K. & R. 8411	*Melanthia procellata* Denis & Schiffermüller, 1775	1♂, Săcele (Bv.), August 14, 1996, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
183	4257 Ro	K. & R. 8432	*Philereme vetulata* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), June 3, 1995, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
184	4265 Ro	K. & R. 8442	*Epirrita dilutata* Denis & Schiffermüller, 1775	1♂, Timişul de Jos (Bv), September 10-20, 1997, 700 m alt.	BT, CR, TR, MM, MT, MD; DB	
185	4269 Ro	K. & R. 8447	*Operophtera brumata* Linnaeus, 1758	1♂, Timişul de Jos (Bv), September 10-20, 1997, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
186	4274 Ro	K. & R. 8456	*Perizoma alchemillata* Linnaeus, 1758 (*P. rivulata* Deni & Schiffermüller, 1775)	2♂♂, Săcele (Bv.), July 26, 28, 1998, 650 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), July 4, 1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD	
187	4275 Ro	K. & R. 8457	*Perizoma hydrata* Treitschke, 1829	1♂, Racoş (Bv.), May 12, 1992	TR, MM, MT, MD	NT
188	4276 Ro	K. & R. 8458	*Perizoma lugdunaria* Herrich & Schäffer, 1855	1♂, Letea Forest (D.D.), August 14, 1991, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
189	4280 Ro	K. & R. 8463	*Perizoma albulata* Deni & Schiffermüller, 1775	4♂♂, Săcele (Bv.), June 5, 22, 1996; July 4, 2000, 650 m alt., Şercaia (Vad Forest, Bv.), June 11, 2000	BT, CR, TR, MM, OT, MT, MD; DB	
190	4286 Ro	K. & R. 8470	*Perizoma verberata* Scopoli, 1763	2♂♂, Săcele (Bv.), June 22, 1996, 650 m alt., Jepilor Valley (Bucegi Mountains), August 14, 2000, 1700 m alt. 2♀♀, Jepilor Valley (Bucegi Mountains), August 2, 1998; August 14, 2000, 1700 m alt.	TR, MM, OT, MT, MD	
191	4298 Ro	K. & R. 8483	*Eupithecia linaria* Denis & Schiffermüller, 1775	1♂, Pasărea Forest (Buc.), July 24, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
192	4317 Ro	K. & R. 8509	*Eupithecia centaureata* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), 1-June 2, 1998; May 4, 1998, 150 m alt. 1♀, Canaraua Fetii (DB), June 1-2, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
193	4333 Ro	K. & R. 8534	*Eupithecia vulgata* Haworth,1809	2♂♂, Timişul de Jos (Bv), June 5,12, 1994, 650 m alt.	CR, TR, MM, OT, MT, MD; DB	
194	4336 Ro	K. & R. 8537	*Eupithecia castigata* Hübner, 1813	2♂♂, Timişul de Jos (Bv), May 12, 1997, 700 m alt., Greşu (Vrancea), July 3, 1997, 800 m alt.	BT, CR, TR, MT, MD; DB	
195	4337 Ro	K. & R. 8538	*Eupithecia icterata icterata* Villers, 1789	1♂, Muntele Roşu, July 21, 1993, 1300 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
196	4345 Ro	K. & R. 8551	*Eupithecia milefoliata* Rössler, 1866	1♂, Canaraua Fetii (DB), September 17, 1993, 100 m alt.	BT, CR, TR, OT, MT, MD; DB	
197	4367 Ro	K. & R. 8596	*Eupithecia tantillaria* Boisduval, 1840	2♂♂, Săcele (Bv.), May 21, 1992; June 4, 1992, 650 m alt.,	BT, TR, MM, MT, MD	
198	4372 Ro	K. & R. 8601	*Chloroclystis v-ata* Hübner, 1809	1♂, Pasărea Forest (Buc.), August 1, 1997 1♀, Târlungeni (Bv.), May 18, 1997, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
199	4374 Ro	K. & R. 8603	*Rhinoprora rectangulata* Linnaeus, 1758	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1998, 900 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), June 7, 1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
200	4375 Ro	K. & R. 8604	*Rhinoprora chloerata* Mabille, 1870	2♂♂, Piatra Mare Massif, June 10, 1990, 1000 m alt., Săcele (Bv.), June	BT, CR, TR, MM, MT,	

				5, 1998, 650 m alt.	MD; DB	
201	4388 Ro	K. & R. 8624	*Aplocera praeformata* Hübner, 1826	1♀, Tişiţei Gorges (Vrancea Mountains), 3.VII.1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
202	4389 Ro	K. & R. 8625	*Aplocera simpliciata* Treitschke, 1835	1♂, Bâlea Lake (Făgăraş Mountains), July 27, 1994, 2100 m alt. 2♀♀, Jepilor Valley (Bucegi Massif), August 6, 1993, 1800 m alt., Caraiman (Bucegi Massif), July 5, 2000, 2100 m alt.	BT, TR, OT, MT	NT
203	4392 Ro	K. & R. 8631	*Odezia atrata* Linnaeus, 1758 (sin. *O. chaerophyllaria* Boisduval, 1840)	1♂, Tişiţei Gorges (Vrancea Mountains), July 2, 1997, 900 m alt.	TR, MM, MT, MD	NT
204	4397 Ro	K. & R. 8638	*Lithostege griseata* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), 1-May 3,4, 1998, 150 m alt. 1♀, Canaraua Fetii (DB), May 1, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
205	4398 Ro	K. & R. 8639	*Lithostege farinata* Hufnagel, 1767 (sin. *L. illibata* Denis & Schiffermüller, 1775, *L. nivearia* Hübner, 1799)	1♂, Canaraua Fetii (DB), May 25, 1997, 150 m alt. 1♀, Canaraua Fetii (DB), June 13, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
206	4401 Ro	K. & R. 8650	*Discoloxia blomeri* Curtis, 1832	1♂, Tişiţei Gorges (Vrancea Mountains), July 1, 1997, 900 m alt.	BT, TR, MM, OT, MD	NT
207	4405 Ro	K. & R. 8654	*Euchoeca nebulata* Scopoli, 1763	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1997, 900 m alt.	BT, CR, TR, OT, MT, MD	
208	4407 Ro	K. & R. 8656	*Asthena albulata* Hufnagel, 1767	1♂, Canaraua Fetii (DB), May 1, 1998, 150 m alt. 1♀, Canaraua Fetii (DB), June 14, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
209	4410 Ro	K. & R.	*Hydrelia flammeolaria* Denis & Schiffermüller, 1775	1♂, Tişiţei Gorges (Vrancea Mountains), July 2, 1997, 900 m alt. 1♀, Rediu (Botoşani), August 5, 1986	BT, CR, TR, MM, OT, MT, MD	
210	4411 Ro	K. & R. 8661	*Hydrelia sylvata* Denis & Schiffermüller, 1775	1♂, Tişiţei Gorges (Vrancea Mountains), July 2, 1997, 900 m alt.	TR, MM, MT, MD	NT
211	4415 Ro	K. & R. 8665	*Lobophora halterata* Hufnagel, 1767	1♂, Frumuşica (Botoşani), April 23, 1989	BT, CR, TR, MM, MT, MD; DB	
212	4418 Ro	K. & R.	*Trichopteryx carpinata* Borkhausen, 1794	1♂, Timişul de Jos (Bv), May 20, 1997, 700 m alt.	BT, TR, MM, OT, MT, MD;	

CONCLUSIONS

This paper contributes to the study of Lepidoptera fauna of Romania collected during 1972-2000, found in the Lepidoptera collection at "Lucian Blaga" University of Sibiu. From the 572 existing species in this collection, there are described only 212 species belonging to 7 families (Lasiocampidae, Saturniidae, Lemoniidae, Sphingidae, Thyatirinae, Drepanidae, Geometridae). The species list is updated after *Verzeichnis der Schmetterlinge Romäniens*, (RÁKOSY et al., 2003). There are presented the geographical areas where these species were collected from and the most valuable aspect is the IUCN classification of the degree of endangerment of each species. The documentary and scientific value of the Lepidoptera collection of "Lucian Blaga" University is available to those interested in a valuable documentary material that can be used for systematic, faunistic and zoogeographical studies.

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I thank to Mr. Levente Szekely from Brasov for this small part (572 species) of his own rich collection (40,000 samples, with 2,600 species) that he sold to our institution, "Lucian Blaga" University-Sibiu. I want to present homage to Prof. univ. dr. biol. Victor Ciochia who was the initiator of the acquisition of this collection and with whom I have worked to organised it.

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THE COLLECTION OF LEPIDOPTERA PRESERVED AT THE "LUCIAN BLAGA"UNIVERSITY- SIBIU (NOTE 2)

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Abstract. The present paper is a continuation of the systematic list of Lepidoptera species preserved in the Collection of "Lucian Blaga" University of Sibiu. In the year 2000, it was published the Catalogue of this collection but only with partial data. After a new acquisition, the value of the collection increased. The present paper presents the updated systematic list of Suprafamily Noctuoidea - with Subfamily Pygaerinae (36 species), Herminiinae (11 species), Acontiinae (10 species), Psaphidininae (5 species), Stiriinae (44 species), Hadeninae (58 species), Noctuinae (37 species)**,** and Family Lymantriidae (9 species). The total number of 211 species and 471 samples are presented with the data and place of collection, the number of samples and their sex. Their name was updated and the endangered degree is mentioned at all species according to *"Verzeichnis der Schmetterlinge Romäniens"* (RÁKOSY et al., 2003).

Keywords: Lepidoptera, collection, species.

Rezumat. Lepidoptere din colecția Universității „Lucian Blaga" din Sibiu (nota 2). Prezenta lucrare este o continuare a listei sistematice a speciilor de lepidoptere existente în colecția Universității „Lucian Blaga" din Sibiu. În anul 2000, a fost publicat catalogul acestei colectii, cu date parțiale. După achiziția ulterioară a altor specii și introducerea lor în colecție a crescut valoarea prin completarea sa. Lucrarea de față prezintă lista sistematică actualizată a Suprafam. Noctuoidea (cu Subfam. Pygaerinae (36 de specii), Herminiinae (11 specii), Acontiinae (10 specii), Psaphidininae (5 specii), Stiriinae (44 de specii), Hadeninae (58 de specii), Noctuinae (37 de specii), și Fam. Lymantriidae (9 specii) reprezentând în total un număr de 211 specii și 471 exemplare. Pe lângă datele și locul de colectare, sunt menționate numărul de indivizi și sexul acestora, cu actualizarea denumirilor, indicarea zonelor unde au fost semnalate în România și a gradului de periclitare conform *Catalogului lepidopterelor României* (RÁKOSY et al., 2003).

Cuvinte cheie: lepidoptere, colecție, specii.

INTRODUCTION

Following the International Convention held in Rio de Janeiro, Brazil in 1992, where Romania joined, biodiversity conservation, plant and animal species, became a priority. Since 1999, the research has covered fauna inventory of Romania, subject to aggression or other anthropogenic factors, and the measures that must be taken to preserve them (DAVIDESCU, 2002).

Lepidoptera collection of "Lucian Blaga" University has a special documentary and scientific value. Publishing papers offer a data base for specialists for further research. The species available in the collection come mostly from Romania being collected from lower altitudes of 6 m in Dobrogea (Canaraua Fetii) (RAKOSY & SZEKELY, 1996), the Danube Delta (Periprava, Maliuc) up to 2100 m in the mountains (Vrancea Mountains, Retezat Mountains, Bucegi and Fagaras Mountains). The collection was gathered between 1979 and 2000. This is important as a starting point for further study of the previous situation and evolution in time of Lepidoptera fauna. There is one exception, a species collected from another country, Germany, Daining: 1♀ *Papestra biren* Goeze, 1781, July 17, 1981.

MATERIALS AND METHOD

The material that is the subject of this study was collected by lepidopterologist Levente Szekely between 1972-2000 from Romania (SZÉKELY, 1994, 1995, 1996, 1999a, b, 2003a, b, 2006, 2007, 2008, 2010, 2011).

In this paper, the oldest data of collection is 1979 1♀ de *Cerapteryx graminis* Linnaeus, 1758, a specimen collected from Roșu Lake (August 2, 1979), 1300 m alt.

The material was collected by means of entomological net for diurnal species and with a light source Noctuidae. On the labels, there are noted (day-month-year-sex-of the collected specimens, the geographical zone and altitude). The material was arranged in entomological boxes in systematic order in the Lepidoptera Collection of "Lucian Blaga" University of Sibiu.

In the present study, there are enumerated 211 species from the total 572 species of the collection and the other part of 146 species will presented in a future paper.

RESULTS AND DISCUSSIONS

In the present paper, there were inventoried 211 species of the Lepidoptera Collection of "Lucian Blaga" University of Sibiu. From Noctuidae Superfamily (with Subfamily Pygaerinae (36 species), Herminiinae (11 species), Acontiinae (10 species), Psaphidininae (5 species), Stiriinae (44 species), Hadeninae (58 species), Noctuinae (37 species)), there are listed in total 202, while 9 species belong to the Family Lymantriidae.

In terms of the degree of endangerment, of the 211 species presented in the paper, 59 species fall into different categories: 44 species NT (Near threatened), 10 species VU (Vulnerable), 3 species EN (Endangered) and 2 species DD (Data Deficient) and the difference of 152 species are not in danger.

The following abbreviations were used: **CR** - Critically endangered, it is estimated that the survival of these species in the next 10-20 years is unlikely if the factors that have caused this situation are not eliminated; after the analysis of the quantitative cost it was determined a decay rate of the population with at least 50% in the last 10 years. **EN** - Endangered, endangered taxa when there is a critical stage of threat, but shows high risk or the extinction threat is critical in the immediate future; it is estimated a probability of about 20% extinction in the next 20 years, **VU**- Vulnerable, a taxon is vulnerable when it is not in the critical threat or endangered, but have a high risk of extinction or critical threat in the near future, **NT**- Near threatened, includes taxa not included in CR, EN or VU, **DD** - Data deficient, but in case the degree of threat increases, it may be included in one or other of the three categories. This category largely replaces RL variant category IUCN 2000, (RÁKOSY, 2002, 2003, 2005).

LEPIDOPTERA (INSECTA: LEPIDOPTERA), IN THE COLLECTION OF "LUCIAN BLAGA" UNIVERSITY OF SIBIU

No.	No Ro*	No. K.&R.**	Taxon	Place and date of collection	Area of Romania	Degree of endangerment
FAMILY NOTODONTIDAE (4429 RO, K. & R. 8686)						
Subfam. PYGAERINAE (4435 RO, K. & R. 8694)						
213	4437 Ro	K. & R. 8698	*Clostera curtula* Linnaeus,1758	2♂♂, Zizin (Bv.), May 10, 1990, Canaraua Fetii (DB), May 26, 1997, 150 m alt.		
214	4438 Ro	K. & R. 8699	*Clostera pigra* Linnaeus,1758	1♂, Frumușica (Botoșani), June 24, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
215	4439 Ro	K. & R. 8700	*Clostera anachoreta* Denis & Schiffermüller, 1775	1♂, Săcele (Bv.), May 10, 1992, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
216	4440 Ro	K. & R. 8701	*Clostera anastomosis* Linnaeus,1758	2♂♂, Maliuc (D.D.), July 18, 1997; August 2, 1997, 6 m alt. 1♀, Brănești (Buc.), August 2, 1997	BT, CR, TR, MM, OT, MD; DB	
217	4444 Ro	K. & R. 8706	*Cerura erminea* Esper, 1783	1♂, Frumușica (Botoșani), June 24, 1989	BT, CR, TR, MM, OT, MT, MD; DB	NT
218	4445 Ro	K. & R. 8708	*Furcula furcula forficula* Fischer v. Waldheim, 1820	2♂♂, Maliuc (D.D.), July 18, 1997, 6 m alt., Periprava (D.D.), September 1, 1997 1♀, Săcele (Bv.), June 26, 1992	BT, CR, TR, MM, OT, MT, MD; DB	
219	4448 Ro	K. & R. 8710	*Furcula bifida bifida* (Brahm, 1787)	1♀, Zizin (Bv.), June 9, 1981	BT, CR, TR, MM, OT, MT, MD; DB	
220	4450 Ro	K. & R. 8714	*Dicranura ulmi* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), May 3-4, 1998, 150 m alt. 2♀♀, Rediu (Botoșani), May 5, 1998	BT, CR, TR, OT, MT, MD; DB	NT
221	4452 Ro	K. & R. 8716	*Notodonta dromedarius* Linnaeus,1758	2♂♂, Timișul de Jos (Bv.), July 5-15, 1998, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
222	4454 Ro	K. & R. 8718	*Notodonta tritophus tritophul* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), July 28, 1990, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
223	4455 Ro	K. & R. 8719	*Notodonta ziczac* Linnaeus, 1758	3♂♂, Roșu Lake, July 4, 1981; C.A.Rosetti (D.D.), July 12, 1991 and Periprava (D.D.), September 1, 1997, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
224	4457 Ro	K. & R. 8721	*Drymonia dodonea* Denis & Schiffermüller, 1775	2♂♂, Zizin (Bv.), June 7, 1990, Lepșa (Vrancea), July 1-2, 1997, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
225	4459 Ro	K. & R. 8723	*Drymonia melongana* Borkhausen, 1790	1♂, Sângiorgiu (Mureș), July 11, 1985	BT, CR, TR, MM, OT, MT, MD	
226	4460 Ro	K. & R. 8724	*Drymonia querna querna* Denis & Schiffermüller, 1775	1♂, Sângiorgiu (Mureș), July 11, 1985	BT, CR, TR, OT, MT, MD; DB	
227	4463 Ro	K. & R. 8727	*Pheosia tremula* Clerck, 1759	1♂, Canaraua Fetii (DB), 3-May 4, 1998, 150 m alt. 1♀, Periprava (D.D.), September 21, 1996	BT, CR, TR, MM, OT, MT, MD; DB	

228	4466 Ro	K. & R. 8730	*Paradrymonia vittata* Staudinger, 1892	2♂♂, Canaraua Fetii (DB), June 17, 1998; July 15, 1998, 150 m alt.,	DB	VU
229	4467 Ro	K. & R. 8732	*Pterostoma palpina* Clerck, 1759	2♂♂, Canaraua Fetii (DB), May 1-2, 1998, 150 m alt. , Băneasa (DB), June 13, 1998, 30 m alt. 1♀, C.A. Rosetti (D.D.), July 19, 1987	BT, CR, TR, MM, OT, MT, MD; DB	
230	4470 Ro	K. & R. 8734	*Ptilophora plumigera* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), October 10-30, 1994, 150 m alt., Timişul de Jos (Bv.), November 22, 1991, 700 m alt. 1♀, Canaraua Fetii (DB), October 24-28, 1995, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
231	4473 Ro	K. & R. 8738	*Ptilodon capucina* Linnaeus,1758	1♂, Timişul de Jos (Bv.), June 10-20, 1997, 700 m alt. 1♀, Muntele Roşu, August 1, 1995, 1300 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
232	4475 Ro	K. & R. 8739	*Ptilodon cucullina* Denis & Schiffermüller, 1775	1♂, Frumuşica (Botoşani), July 7, 1989	BT, CR, TR, MM, MT, MD; DB	
233	4479 Ro	K. & R. 8747	*Gluphisia crenata* Esper, 1785	2♂♂, Săcele (Bv.), July 3, 1996, Tişiţei Gorges (Vrancea Mountains), July 2, 1997, 900 m alt.		
234	4481 Ro	K. & R. 8749	*Phalera bucephala* Linnaeus,1758	2♂♂, Tişiţei Gorges (Vrancea Mountains), July 4, 1998, 900 m alt.; Canaraua Fetii (DB), August 9, 1992, 150 m alt. 1♀, Pasărea Forest (Buc.), August 1, 1997	BT, CR, TR, MM, OT, MT, MD; DB	
235	4483 Ro	K. & R. 8752	*Phalera bucephaloides* Ochsenheimer, 1810	2♂♂, Canaraua Fetii (DB), July 7, 1992, 150 m alt., Pădurea Mihai Bravu (Buc.), July 12, 1997	BT, CR, TR, OT, MT, MD; DB	NT
236	4485 Ro	K. & R. 8754	*Peridea anceps* Goeze, 1781	2♂♂, Canaraua Fetii (DB), June 18, 1996, 150 m alt., Frumuşica (Botoşani), July 7, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
237	4489 Ro	K. & R. 8758	*Stauropus fagi* Linnaeus, 1758	2♂♂, Canaraua Fetii (DB), May 2, 1998, 150 m alt., Brăneşti (Buc.), July 9, 1997	BT, CR, TR, MM, OT, MT, MD; DB	
238	4493 Ro	K. & R. 8762	*Spatalia argentina* (Denis & Schiffermüller, 1775)	2♂♂, Lepşa (Vrancea), 1-June 2, 1997, 800 m alt., Frumuşica (Botoşani), May 3, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
239	4499 Ro	K. & R. 8772	*Moma alpium alpium* (Osbeck, 1778) (sin. *orion* Esper, 1787)	1♂, Lepşa-Vrancea, June 27-29, 1997, 800 m alt. 1♀, Racoş (Bv.), June 22, 1997	BT, CR, TR, MM, OT, MT, MD	
240	4501 Ro	K. & R. 8774	*Acronicta alni* Denis & Schiffermüller, 1775	1♂, Tişiţei Gorges (Vrancea), August 3, 1998, 900 m alt. 1♀, Săcele (Bv.), June 20, 1979, 650 m alt.	BT, CR, TR, MM, OT, MT, MD	
241	4503 Ro	K. & R. 8776	*Acronicta tridens tridens* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), May 4, 1998, 150 m alt. 1♀, Canaraua Fetii (DB), May 13, 1996, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
242	4504 Ro	K. & R. 8777	*Acronicta psi psi* Linnaeus, 1758	1♀, Săcele (Bv.), August 17, 1991, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
243	4505 Ro	K. & R. 8778	*Acronicta aceris aceris* Linnaeus, 1758	1♂, Racoş (Bv.), June 12, 1992	BT, CR, TR, MM, OT, MT, MD; DB	
244	4508 Ro	K. & R. 8781	*Acronicta strigosa* Denis & Schiffermüller, 1775	1♂, Săcele (Bv.), June 7, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
245	4507 Ro	K. & R. 8780	*Acronicta megacephala* Denis & Schiffermüller, 1775	2♂♂, Maliuc (D.D.), July 18, 1997, Săcele (Bv.), May 8, 1990, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
246	4514 Ro	K. & R. 8787	*Acronicta rumicis* Linnaeus, 1758 (sin. salicis Curtis, 1826)	8♂♂, Hagieni (DB), September 14, 1984; Rediu (Botoşani), July 5, 1986, Periprava (D.D.), August 28 and September 1, 1997, 6 m alt., Canaraua Fetii (DB), June 14, 1998, 150 m alt., Hagieni August 21, 1983, Periprava (D.D.), August 31, 1997, Maliuc (D.D.), July 19, 1997	BT, CR, TR, MM, OT, MT, MD; DB	

				5♀♀, Sângiorgiu-Mureş, June 1, 1982 (2 specimens), Canaraua Fetii, May 1-2, 1992, May 2, 1998, 150 m alt., Periprava (D.D.), September 1, 1997, 6 m alt.,		
247	4516 Ro	K. & R. 8789	*Craniophora ligustri ligustri* Denis & Schiffermüller, 1775	3♂♂, Tișiței Gorges (Vrancea Mountains), July 3, 1998, 900 m alt., July 10, 1999. 800 m alt., Pasărea Forest (Buc.), August 1, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
248	4520 Ro	K. & R. 8793	*Simyra albovenosa* (Goeze, 1781)	1♂, C.A. Rosetti (D.D.), July 20, 1987 1♀, Periprava (D.D.), August 30, 1997, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
	4526 Ro	K. & R. 8801	*Cryphia algae* Fabricius, 1775 (sin. *degener* Denis & Schiffermüller, 1775, *calligrapha* Borkhausen, 1792 *mendacula* Hübner, 1813	1♀, Hagieni (DB), September 1, 1984	BT, CR, TR, MM, OT, MT, MD; DB	
249	4532 Ro	K. & R. 8810	*Cryphia raptricula* Denis & Schiffermüller, 1775 (sin. *divisa* Esper, 1791)	1♂, Săcele (Bv.), July 21, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
SUBFAMILY HERMINIINAE (4536 Ro, K. & R. 8829)						
250	4573 Ro	K. & R. 8874	*Catocala nupta nupta* Linnaeus, 1767	2♂♂, Canaraua Fetii (DB), 1-September 15, 1996, 150 m alt., Pasărea Forest (Buc.), August 7, 1998 1♀, Săcele (Bv.), August 28, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
251	4574 Ro	K. & R. 8877	*Catocala elocata* Esper, 1788	1♂, Periprava (D.D.), September 1, 1997, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
252	4576 Ro	K. & R.8882	*Catocala promissa promissa* Denis & Schiffermüller, 1775	1♂ și 2♀♀, Comana Forest (Buc.), July 12, 1997	BT, CR, TR, MM, OT, MT, MD; DB	NT
253	4579 Ro	K. & R. 8888	*Catocala nymphagoga* Esper, 1787	2♂♂, Comana Forest (Buc.), August 12, 1997, Pasărea Forest (Buc.), August 1, 1998 1♀, Comana Forest (Buc.), August 12, 1997	BT, CR, TR, OT, MT, DB	NT
254	4580 Ro	K. & R. 8889	*Catocala hymenaea* (Denis & Schiffermüller, 1775)	1♂, Periprava (D.D.), July 7, 1996, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
255	4581 Ro	K. & R. 8890	*Catocala fulminea fulminea* Scopoli, 1763 (sin. *paranympha* Linnaeus, 1767)	1♂, Frumușica (Botoșani), June 29, 1989 1♀, Săcele (Bv.), July 28, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD	NT
256	4585 Ro	K. & R. 8879	*Minucia lunaris lunaris* Denis & Schiffermüller, 1775	1♀, Frumușica (Botoșani), May 11, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
257	4591 Ro	K. & R. 8904	*Dysgonia algira algira* Linnaeus, 1767 (sin. *europea* Schawerda, 1912)	1♂, Canaraua Fetii (DB), August 7, 1992, 150 m alt.	BT, CR, MM, OT, MT, MD; DB	NT
258	4593 Ro	K. & R. 8909	*Prodotis stolida* Fabricius, 1775	1♂, Slavă Forest (DB), May 1, 1993 1♀, Periprava (D.D.), September 1, 1997, 6 m alt.	BT, TR, MM, OT, MT, MD; DB	
259	4615 Ro	K. & R. 8967	*Callistege mi mi* Clerck, 1759 (sin. *mi elzei* De Freina, 1976)	1♂, Racoș (Bv.), May 10, 1998	BT, CR, MM, OT, MT, MD; DB	
260	4617 Ro	K. & R.8969	*Euclidia glyphica* Linnaeus, 1758	1♂, Băneasa (DB), May 12, 1998 1♀, Pasărea Forest (Buc.), July 31, 1998, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
SUBFAMILY ACONTIINAE (4694 Ro, K. & R. 9095)						
261	4736 Ro	K. & R. 9181	*Cucullia fraudatrix* Eversmann, 1837	1♀, Săcele (Bv.), July 19, 1998, 650 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
262	4737 Ro	K. & R. 9174	*Cucullia absinthii* Linnaeus, 1761	1♂, Canaraua Fetii (DB), August 8, 1992, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
263	4745 Ro	K. & R. 9199	*Cucullia umbratica* Linnaeus, 1758	2♂♂, Sângiorz, July 1, 1985, Rediu (Botoșani), August 15, 1988 1♀, Canaraua Fetii (DB), May 31, 1993, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	

264	4752 Ro	K. & R. 9217	*Cucullia tanaceti* Denis & Schiffermüller, 1775	1♂, Periprava Brațul Chilia (D.D.), July 30, 1997, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
265	4757 Ro	K. & R. 9228	*Shargacucullia gozmanyi* G. & L. Ronkay, 1992	1♂, Hagieni (DB), May 3, 1986	BT, TR, DB	VU
266	4767 Ro	K. & R. 9240	*Calophasia lunula* Hufnagel, 1766	1♂, Pasărea Forest (Buc.), July 31, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
267	4769 Ro	K. & R. 9245	*Calophasia casta* Borkhausen, 1793, nec. Pallas, 1767	1♂, Canaraua Fetii (DB), June 14, 1998, 150 m alt.	BT, CR, MD; DB	VU
268	4770 Ro	K. & R. 9250	*Omphalophana antirrhinii* Hübner, 1808	1♂, Canaraua Fetii (DB), June 14, 1998, 150 m alt.	BT, CR, TR, OT, MD; DB	
269	4772 Ro	K. & R. 9056	*Autographa gamma* Linnaeus, 1758	6♂♂, Hagieni (DB), August 19, 1983, Timiş (Bv.), May 14, 1992, June 27, 1994, Caraiman (Bucegi Mountains), June 28, 1994, 2100 m alt., Săcele (Bv.), , May 21, 1997, Târlungeni (Bv.), June 14, 1997, 700 m alt. 2♀♀, Pasărea Forest (Buc.), August 8, 1997, Canaraua Fetii (DB), June 13, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
270	4775 Ro	K. & R. 9266	*Callierges ramosa* Esper, 1786	1♂, Săcele (Bv.), July 2, 1996, 650 m alt.	BT, TR, MM, MT, MD	NT
SUBFAMILY PSAPHIDININAE (4784 Ro)						
271	4788 Ro	K. & R. 9320	*Asterscopus sphinx* Hufnagel, 1766	1♂, Canaraua Fetii (DB), October 20, 1996, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
272	4798 Ro	K. & R. 9682	*Allophyes oxyacanthae* Linnaeus, 1758	1♂, Racoș (Bv.), September 28, 1991 1♀, Racoș (Bv.), October 24, 1992	BT, CR, TR, MM, OT, MT, MD; DB	
273	4803 Ro	K. & R. 9307	*Amphipyra pyramidea* Linnaeus, 1758	1♂, Săcele (Bv.), September 3, 1996, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
274	4805 Ro	K. & R. 9309	*Amphipyra perflua* Fabricius, 1787	1♂, Bicazului Gorges, August 2, 1996, 1100 m alt.	BT, TR, MM, MD	NT
275	4807 Ro	K. & R. 9311	*Amphipyra tragopoginis* Clerck, 1759	1♀, Zizin (Bv.), September 25, 1990	BT, CR, TR, MM, OT, MT, MD; DB	
SUBFAMILY STIRIINAE (4814 Ro, K. & R. 9336)						
276	4819 Ro	K. & R. 9343	*Aegle kaekeritziana* Hübner, 1799	1♂, Canaraua Fetii (DB), June 13, 1998, 150 m alt.	BT, CR, TR, OT, MT, MD; DB	NT
277	4830 Ro	K. & R. 9364	*Heliothis viriplaca viriplaca* Hufnagel, 1766 (sin. *dipsacea* Linnaeus, 1758)	1♂, Canaraua Fetii (DB), May 2, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
278	4831 Ro	K. & R. 9365	*Heliothis maritima* Graslin, 1855	1♂, Săcele (Bv.), July 21, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
279	4850 Ro	K. & R. 9396	*Elaphria venustula* Hübner, 1790	3♂♂, Canaraua Fetii (DB), 1-June 4, 1998; May 4, 1998, June 14, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
280	4856 Ro	K. & R. 9417	*Caradrina morpheus* Hufnagel, 1766	1♂, Canaraua Fetii (DB), May 4, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
281	4862 Ro	K. & R. 9424	*Platyperigea kadenii* Freyer, 1836	1♂, Canaraua Fetii (DB), September 18, 1993, 150 m alt.	BT, CR, TR, MM, MT, MD; DB	NT
282	4865 Ro	K. & R. 9433	*Paradrina clavipalpis* Scopoli, 1763 (sin. *quadripunctata* Fabricius, 1775, *cubicularis* Denis & Schiffermüller, 1775)	4♂♂, Canaraua Fetii (DB), June 12, 13, 14, 1998, 150 m alt., Hagieni (DB), August 18, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
283	4870 Ro	K. & R. 9449	*Hoplodrina alsines* Brahm, 1791 (sin. *octogenaria* Goeze, 1781)	1♂, Tișiței Gorges (Vrancea Mountains), July 3, 1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
284	4871 Ro	K. & R. 9450	*Hoplodrina blanda* Denis & Schiffermüller, 1775 (sin. *taraxaci*, Hübner, 1813)	3♂♂, Maliuc (D.D.), June 18, 1997, Pasărea Forest (Buc.), August 1, 1997, Șercaia (Vad Forest) Bv., July 27, 2000	BT, CR, TR, MM, OT, MT, MD; DB	
285	4873 Ro	K. & R. 9453	*Hoplodrina respersa* Deni & Schiffermüller, 1775	1♂, Tișiței Gorges (Vrancea Mountains), August 3, 1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	

286	4874 Ro	K. & R. 9454	*Hoplodrina ambigua* Denis & Schiffermüller, 1775	2♂♂, Băneasa (DB), June 13, 1998, 90 m alt.; Brănești (Buc.), June 20, 1997	BT, CR, TR, MM, OT, MT, MD; DB	
287	4876 Ro	K. & R. 9456	*Charanyca trigrammica* Hufnagel, 1766 (sin.*trilinea* Denis & Schiffermüller, 1775, bilinea Hübner, 1803)	1♂, Brănești (Buc.),31.V.1998 1♀, Canaraua Fetii (DB), 24.V.1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
288	4884 Ro	K. & R. 9474	*Athetis gluteosa* Treitschke, 1835	3♂♂, Pasărea Forest (Buc.), July 22-30, 1997, Pădurea Hagieni (DB), August 17, 18, 2000	BT, CR, TR, MM, OT, MT, MD; DB	NT
289	4888 Ro	K. & R. 9479	*Proxenus lepigone* Möschler, 1860	2♂♂, Periprava (D.D.), July 9, 1996, 6 m alt. (2 ex.)	BT, TR, MM, MD; DB	NT
290	4890 Ro	K. & R. 9481	*Amphipyra scabriuscula* Linnaeus, 1758 (sin. pinastri Linnaeus, 1761)	1♂, Canaraua Fetii (DB), June 14, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
291	4905 Ro	K. & R. 9501	*Trachea atriplicis* Linnaeus, 1758	2♂♂, Pasărea Forest (Buc.), 30.V.1998, Brănești (Buc.), August 7, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
292	4907 Ro	K. & R. 9503	*Euplexia lucipara* Linnaeus, 1758	1♂, Săcele (Bv.), May 27, 1996, 650 m alt. 1♀, Săcele (Bv.), June 27, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
293	4909 Ro	K. & R. 9505	*Phlogophora meticulosa* Linnaeus, 1758	1♂, Timișul de Jos, November 10,1997, 700 m alt. 1♀, Timișul de Jos, 10-November 20, 1997, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
294	4916 Ro	K. & R. 9515	*Actinotia polyodon* Clerck, 1759 (sin. *perspicillaris*, Linnaeus, 1761	2♂♂, Canaraua Fetii (DB), May 1, 1998, 150 m alt.; Brănești (Buc.), May 31, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
295	4919 Ro	K. & R. 9518	*Chloantha* Boisduval, Rambur & Graslin, 1836	1♂, Canaraua Fetii (DB), May 23, 1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
296	4926 Ro	K. & R. 9525	*Eucarta virgo* Treitschke, 1835	1♂, Băneasa (DB), June 12, 1998, 90 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
297	4928 Ro	K. & R. 9525	*Ipimorpha retusa* Linnaeus, 1758	1♂, Canaraua Fetii (DB), June 14, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
298	4929 Ro	K. & R. 9528	*Ipimorpha subtusa* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), June 13, 14, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
299	4935 Ro	K. & R. 9537	*Parastichtis ypsillon* Denis & Schiffermüller, 1775 (sin. *fissipuncta* Hawotth, 1840)	1♂, Băneasa (DB), June 13, 1998, 90 m alt. 1♀, Săcele (Bv.), June 4, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
300	4940 Ro	K. & R. 9544	*Dicycla oo* Linnaeus, 1758 (sin. *ferruginago* Hübner, 1803, *renago* Haworth, 1909)	1♂, Horia (DB), June 19, 1979	BT, CR, TR, OT, MT, MD; DB	NT
301	4942 Ro	K. & R. 9546	*Cosmia diffinis* Linnaeus, 1767	1♂, Comana Forest (Buc.), July 12, 1997	BT, CR, TR, MM, OT, MT, MD; DB	NT
302	4944 Ro	K. & R. 9548	*Cosmia affinis* Linnaeus, 1767	1♂, Brănești (Buc.), May 31, 1998	BT, CR, TR, MM, OT, MT, MD; DB	NT
303	4945 Ro	K. & R. 9549	*Cosmia pyralina* Denis & Schiffermüller, 1775	1♀, Săcele (Bv.), July 19, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
304	4946 Ro	K. & R. 9550	*Cosmia trapezina* Linnaeus, 1767	1♂, Tișiței Gorges (Vrancea Mountains), July 4, 1998, 900 m alt. 1♀, Canaraua Fetii (DB), June 27, 1993, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
305	4948 Ro	K. & R. 9748	*Apamea monoglypha* Hufnagel, 1766 (sin. *polyodon* Linnaeus, 1761, nec. Clerck, 1759)	1♂, Săcele (Bv.), November 2, 1993, 650 m alt. 1♀, Jepilor Valley (Bucegi Mountains), June 25, 1994, 1400 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
306	4950 Ro	K. & R. 9752	*Apamea lithoxylaea* Denis & Schiffermüller, 1775 (sin. *muscialis* Esper, 1790)	1♂, Zizin (Bv.), July 9, 1981	BT, CR, TR, MM, OT, MT, MD; DB	NT
307	4952 Ro	K. & R. 9755	*Apamea crenata* Hufnagel, 1766 (sin. *rurea* Fabricius, 1775, *alopecurus* Esper, 1790)	1♂, Lepșa-Vrancea, June 1-2, 1997, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
308	4961 Ro	K. & R. 9765	*Apamea oblonga* Haworth, 1890 (sin. *lunulina* Haworth,	1♂, Săcele (Bv.), September 13, 1991, 650 m alt.	CR, TR, MT, MD	VU

			1809, *abjecta* Hübner, 1813, *fribulus* Boisduval, 1832)	1♀, Timişul de Jos (Bv.), July 8, 1991, 700 m alt.		
309	4965 Ro	K. & R. 9770	*Apamea anceps* Denis & Schiffermüller, 1775 (sin. *sordida* Borkhausen, 1792, *infesta* Ochsenheimer, 1816, *renardi* Boisduval, 1829)	1♂, Canaraua Fetii (DB), May 4, 1998, 150 m alt. 1♀, Timişul de Sus (Bv.), May 20, 1997, 750 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
310	4966 Ro	K. & R. 9771	*Apamea sordens* Hufnagel, 1766 (sin. *basilinea* Denis & Schiffermüller, 1775, *nebulosa* Vieweg, 1790)	1♂, Pasărea Forest (Buc.), May 30, 1998 1♀, Canaraua Fetii (DB), July 2, 1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
311	4967 Ro	K. & R. 9774	*Apamea scolopacina* Esper, 1788 (sin. *abbreviata* Haworth, 1809)	1♂, Băneasa (Buc.), June 13, 1998, 90 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
312	4968 Ro	K. & R. 9775	*Apamea ophiogramma Esper, 1794* (sin. *biloba* Haworth, 1809)	1♂, Târlungeni (Bv.), July 29, 1996, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
313	4972 Ro	K. & R. 9780	*Oligia strigilis* Linnaeus, 1758	1♂, Canaraua Fetii (DB), May 25, 1997, 150 m alt. 1♀, Săcele (Bv.), June 23, 1997, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
314	4973 Ro	K. & R. 9781	*Oligia versicolor* Borkhausen, 1792 (sin. *nerminae* Koçak, 1983)	2♂♂, Canaraua Fetii (DB), June 25, 1993, June 14, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
315	4974 Ro	K. & R. 9782	*Oligia latruncula* Denis & Schiffermüller, 1775 (sin. *aerata* Esper, 1790, *meretricula* Borkhausen, 1792)	2♂♂, Săcele (Bv.), June 4, 6, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
316	4983 Ro	K. & R. 9794	*Photedes captiuncula* Treitschke, 1825 (sin. *expolita* Doubleday, 1855, *unica* Freyer, 1858)	2♂♂, Jepilor Valley (Bucegi Mountains), August 1, 1993, 1700 m alt., M-ţii Ciucaş, July 21, 1993, 1500 m alt.	BT, R, MM, OT, MT, MD	NT
317	4984 Ro	K. & R. 9795	*Photedes minima* Haworth, 1809 (sin. *arcuosa* Haworth, 1809)	2♂♂, Săcele (Bv.), June 2, 1994, July 6, 1996, 650 m alt.	BT, CR, TR, MM, OT, MT, MD	NT
318	4989 Ro	K. & R. 9809	*Luperina rubella* Duponchel, 1826	1♂, Hagieni (DB), September 1, 1984	BT, DB	EN
319	5001 Ro	K. & R. 9829	*Amphipoea fucosa* Freyer, 1830	1♂, Canaraua Fetii (DB), August 7, 1992, 150 m alt.	BT, CR, TR, MM, MD; DB	NT
SUBFAMILY HADENINAE (5039 RO, K. & R. 9389)						
320	5043 Ro	K. & R. 9895	*Hadula trifolii* Hufnagel, 1766	7♂♂, Hagieni (DB), May 3, 1986; Rediu (Botoşani), May 5, 1988; Verona (Botoşani), July 6, 1988, Canaraua Fetii (DB), June 26, 1993, 150 m alt.; Periprava (D.D.), August 31, 1997; September 8, 9, 2000; Pasărea Forest, July 31, 1999 8♀♀, Hagieni (DB), July 3, 1992; Canaraua Fetii (DB), October 18, 1993, May 23, 1997, May 1-2, 1998, 150 m alt.; Săcele (Bv.), June 8, 1995, 650 m alt.; Periprava (D.D.), September 1, 1997, Băneasa (DB), June 12, 1998, 150 m alt; Timişul de Jos (Bv.), August 4, 1992, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
321	5051 Ro	K. & R. 9992	*Polia hepatica* Clerck, 1759	1♀, Tişiţei Gorges (Vrancea Mountains), July 3, 1998, 900 m alt.	BT, CR, TR, MM, MT, MD; DB	
322	5052 Ro	K. & R. 9993	*Polia nebulosa* Hufnagel, 1766 (sin. *P. grandis* Donovan, 1801)	1♂, Tişiţei Gorges (Vrancea Mountains), July 4, 1998, 900 m alt. 2♀♀, Tişiţei Gorges (Vrancea Mountains), 3- July 4, 1998; July 10, 1999, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
323	5060 Ro	K. & R. 9918	*Dianobia thalassina* Hufnagel, 1766	1♀, Rediu (Botoşani), June 8, 1987	BT, CR, TR, MM, OT, MT, MD; DB	
324	5061 Ro	K. & R. 9919	*Dianobia contigua* Denis & Schiffermüller, 1775	1♂, Săcele (Bv.), July 22, 1997, 650 m alt 1♀, Canaraua Fetii (DB), July 12, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
325	5062 Ro	K. & R. 9920	*Dianobia suassa* Denis & Schiffermüller, 1775	7♂♂, Hagieni (DB), July 3, 1982; Frumuşica (Botoşani), May 11,	BT, CR, TR, MM, OT, MT,	

				1989; Canaraua Fetii (DB), May 17, 1996, May 1, 5, 1998; Săcele (Bv.), July 30, 1996, 650 m alt.; Periprava (D.D.), July 7, 1996; Rediu (Botoşani), May 13, 1998 (2 specimens) 5♀♀, Uila Livadă, September 24, 1981; Rediu (Botoşani), May 5, 13, 1998 (2 specimens); Săcele (Bv.), August 23, 1985, 650 m alt.; Hagieni Forest, August 17-18, 2000, 40 m alt.	MD; DB	
326	5070 Ro	K. & R. 9919	*Malanchra persicariae* Linnaeus, 1761	1♂, Lepşa-Vrancea, 1- July 2, 1997, 800 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), July 9, 1999, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
327	5072 Ro	K. & R. 9985	*Ceramica pisi* Linnaeus,1758	1♀, Zizin (Bv.), June 20, 1990	BT, CR, TR, MM, OT, MT, MD; DB	
328	5074 Ro	K. & R. 9989	*Papestra biren* Goeze, 1781	1♂, Daining (Germania), July 17, 1981	TR, MM, OT, MT, MD	
329	5076 Ro	K. & R. 9925	*Hada nana* Hufnagel, 1766	1♂, Turda-Tureni, May 9, 1981 1♀, Timişul de Jos (Bv.), July 1, 1993, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
330	5080 Ro	K. & R. 9987	*Mamestra brassicae* Linnaeus, 1758	5♂♂, Săcele (Bv.), September 7, 1984, August 12, 1986, September 7, 1998, 650 m alt.; Pasărea Forest (Buc.), August 7, 1998, Brănești (Buc.), August 8, 1989 5♀♀, Frumuşica (Botoşani), May 20, 1989; Canaraua Fetii (DB), May 3-4, 1998, 150 m alt.; Botoşani, May 24, 1998; Săcele (Bv.), August 27, 1998, June 28, 1990, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
331	5088 Ro	K. & R. 9972	*Heliophobus reticulata* Goeze, 1781	2♂♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1998; July 10, 1999, 900 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), July 10, 1999; Racoş (Bv.), June 22, 1991	BT, CR, TR, MM, OT, MT, MD; DB	
332	5100 Ro	K. & R. 9935	*Luteohadena luteago luteago*, Denis & Schiffermüller, 1775	1♂, Săcele (Bv.), June 20, 1999, 650 m alt	BT, CR, TR, MM, OT, MT, MD; DB	
333	5102 Ro	K. & R. 9928	*Hacatera bicolocata* Hufnagel, 1766	1♂, C.A.Rosetti (D.D.), July 20, 1987	BT, CR, TR, MM, OT, MT, MD; DB	
334	5103 Ro	K. & R. 9927	*Hacatera dysodea* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), June 13, 1997, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
335	5112 Ro	K. & R. 9928	*Hadena confusa* Denis & Schiffermüller, 1775	2♂♂, Canaraua Fetii (DB), May 18, 1996, (2 ex.), 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
336	5125 Ro	K. & R. 10062	*Cerapteryx graminis* Linnaeus,1758	1♂, Târlungeni (Bv.), June 26, 2000, 700 m alt. 1♀, Roşu Lake, August 2, 1979, 1300 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
337	5127 Ro	K. & R. 10064	*Tholera cespitis* Denis & Schiffermüller, 1775	1♂, Zizin (Bv.), September 5, 1980	BT, CR, TR, MM, OT, MT, MD; DB	
338	5128 Ro	K. & R. 10065	*Tholera decimalis* Poda, 1761	2♂♂, Săcele (Bv.), September 12, 1996, 650 m alt.; Şercaia (Vad Forest), September 2, 2000 1♀, Săcele (Bv.), September 12, 1996, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
339	5131 Ro	K. & R. 9999	*Mythimna turca* Linnaeus,1761	1♂, Pasărea Forest (Buc.)., May 30, 1998 1♀, Canaraua Fetii (DB), June 4, 1995, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
340	5133 Ro	K. & R. 10000	*Mythimna conigera* Denis & Schiffermüller, 1775 (sin. *M. floccida* Esper, 1788)	1♂, Timişul de Sus (Bv.), August 23, 1992, 700 m alt.	BT, CR, TR, MM, OT, MT, MD	

341	5134 Ro	K. & R. 10007	*Mythimna pallens* Linnaeus,1758	3♂♂, Frumușica (Botoșani), June 7, 1981; Săcele (Bv.), June 4, 1997, May 11, 2000 1♀, Târgu Mureș, May 27, 1982	BT, CR, TR, MM, OT, MT, MD; DB	
342	5136 Ro	K. & R. 10005	*Mythimna straminea* Treitschke, 1825	1♂, Șercaia (Vad Forest), June 10, 2000	BT, TR, OT, MT, MD; DB	NT
343	5137 Ro	K. & R. 10003	*Mythimna vitellina* Hübner, 1808	3♂♂, Canaraua Fetii (DB), 26.V.1997, 150 m alt.; Periprava (D.D.), August 30, 1997, September 1, 1997 1♀, Periprava (D.D.), May 25, 1997	BT, CR, TR, MM, OT, MT, MD; DB	
344	5144 Ro	K. & R. 10002	*Mythimna albipuncta* Denis & Schiffermüller, 1775 (sin. *Hyphilare flecki* Cradja, 1896)	2♂♂, Timişul de Jos (Bv.), September 28, 1998, 700 m alt. 3♀♀, Pasărea Forest (Buc.), May 31, 1998; Hagieni (Bv.), August 17-18, 2000, Șercaia (Vad Forest), August 27, 2000	BT, CR, TR, MM, OT, MT, MD; DB	
345	5147 Ro	K. & R. 10022	*Hyphilare l-album* Linnaeus,1767	3♂♂, Sângiorz-Mureș, June 10, 1985; Periprava (D.D.), August 6, 1996; Hagieni (DB), October 6, 1985 2♀♀, Canaraua Fetii (DB), June 13, 1998, 150 m alt.; Lepşa-Vrancea, July 1-2, 1997, 800 m alt., Hagieni (DB), October 4, 1981	BT, CR, TR, MM, OT, MT, MD; DB	
346	5150 Ro	K. & R. 10011	*Leucania comma* Linnaeus,1761	2♂♂, Canaraua Fetii (DB), June 13, 14, 1998, 150 m alt	BT, CR, TR, MM, OT, MT, MD; DB	
347	5151 Ro	K. & R. 10010	*Leucania obsoleta* Hübner, 1803	1♂, Canaraua Fetii (DB), May 25, 1997, 150 m alt. 1♀, Canaraua Fetii (DB), May 4, 1998, 150 m alt.	BT, CR, TR, MM, MT, MD; DB	
348	5155 Ro	K. & R. 10034	*Acantholeucania loreyi* Duponchel, 1827	1♂, Canaraua Fetii (DB), September 17, 1993, 150 m alt.	TR, MD,DB	VU
349	5159 Ro	K. & R. 10052	*Panolis flammea* Denis & Schiffermüller, 1775	3♂♂, Teliu (Bv.), April 18, 1998, 700 m alt.; Săcele (Bv.), April 20, 1991, 650 m alt.	BT, CR, TR, MM, OT, MD; DB	VU
350	5167 Ro	K. & R. 10044	*Monima miniosa* Denis & Schiffermüller,1775	1♂, 2♂♂, Teliu (Bv.), April 18, 1998, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
351	5171 Ro	K. & R. 10048	*Orthosia gracilis* Denis & Schiffermüller,1775 (sin. *Cororthosia gracilis* Berio, 1980)	2♂♂şi 2♀♀, Teliu (Bv.), April 18, 1998, 700 m alt.	BT, CR, TR, MM, MT, MD	
352	5176 Ro	K. & R.10050	*Anorthoa munda* Denis & Schiffermüller,1775 (sin. *Anorthoa munda* Berio, 1980)	2♂♂, Teliu (Bv.), April 18, 1998, 700 m alt.; Săcele-Babarunca (Bv.), June 27, 1990, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
353	5168 Ro	K. & R. 10039	*Orthosia cruda* Denis & Schiffermüller,1775 (sin. *Monima pulverulenta* Esper, 1786)	1♂, Sângiorgiu Mureș, March 30, 1992 1♀, Săcele-Babarunca (Bv.), June 27, 1990, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
354	5171 Ro	K. & R. 10048	*Cororthosia gracilis* Denis & Schiffermüller, 1775	1♂, Racoș, April 26, 1992	BT, CR, TR, MM, MT, MD;	
355	5181 Ro	K. & R. 10054	*Egira conspicillaris* Linnaeus,1758	1♂, Teliu (Bv.), April 18, 1998, 700 m alt. 1♀, Canaraua Fetii (DB), May 4, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
356	5188 Ro	K. & R. 9557	*Tiliacea aurago* Denis&Schiffermüller, 1775, (sin. *rutilago* Fabricius, 1775, fuscata Esper, 1788, nec. Hufnagel, 1766)	1♂, Timişul de Jos, October 28, 1998, 700 m alt.	BT, CR, TR, MM, MT, MD; DB	
357	5194 Ro	K. & R. 9559	*Xanthia icteria* Hufnagel, 1766 (sin. *fulvago* auct.)	2♂♂, Canaraua Fetii (DB), October 6, 7, 1990, 150 m alt. 1♀, Uila-Livadă (Mureș); September 24, 1981	BT, CR, TR, MM, MT, MD; DB	
358	5195 Ro	K. & R. 9560	*Cirrhia gilvago* Denis & Schiffermüller, 1775 (sin. *palleago* Hübner, 1803	1♂, Canaraua Fetii (DB), October 7, 1990, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
359	5196 Ro	K. & R. 9561	*Cirrhia ocellaris* (Borkhausen, 1972) sin. lineago Guenée, 1852	1♂, Rediu (Botoșani), October 17, 1988 1♀, Canaraua Fetii (DB), October 7, 1990, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT

360	5198 Ro	K. & R. 9565	*Agrochola lychnidis* (Denis & Schiffermüller, 1775) (sin. *pistacina* Denis & Schiffermüller, 1775, sin. *rubetra* Esper, 1791)	1♂, Canaraua Fetii (DB), October 1, 1994, 150 m alt. 2♀♀, Canaraua Fetii (DB), 1-September 15, 1996, October 19, 1996, 150 m alt.	BT, CR, TR, OT, MT, MD; DB	
361	5201 Ro	K. & R. 9573	*Agrochola nitida* Deni & Schiffermüller,1775	1♂, Canaraua Fetii (DB), October 6, 1990, 150 m alt.	BT, CR, TR, OT, MT, MD; DB	
362	5203 Ro	K. & R. 9686	*Agrochola litura* Linnaeus,1761	1♂, Canaraua Fetii (DB), October 8, 1990, 150 m alt. 1♀, Hagieni (DB). October 5, 1985	BT, CR, TR, MM, OT, MT, MD; DB	
363	5207 Ro	K. & R. 9571	*Leptologia macilenta* Hübner, 1809	2♂♂, Timişul de Jos, October 30, 1996, November 1-10, 1997, 700 m alt. 1♀, Săcele (Bv.), September 27, 1996, 650 m alt.	BT, CR, TR, MM, MT, MD; DB	
364	5209 Ro	K. & R. 9566	*Sunira circellaris* Hufnagel, 1766(sin.ferruginea Denis & Schiffermüller,1775)	2♂♂, Rediu (Botoşani), October 14, 1994, October 17, 1998 1♀, Teliu, September 17, 1994, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
365	5216 Ro	K. & R. 9600	*Conistra (C.) vaccinii* Linnaeus, 1761 (sin. *C. spadicea* Denis & Schiffermüller,1775, *C. polita* Denis & Schiffermüller,1775)	2♂♂, Racoş (Bv.), May 1, 1993 ; Timişul de Jos, May 2, 1997, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
366	5228 Ro	K. & R. 9642	*Brachylomia viminalis* Fabricius, 1777	1♂, Tişiţei Gorges (Vrancea Mountains), July 4, 1998, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
367	5233 Ro	K. & R. 9660	*Lithophane ornitopus* Hufnagel, 1766 (*L. rizolitha* Denis & Schiffermüller,1775)	2♂♂, Canaraua Fetii (DB), April 15, 1993, 150 m alt.; Racoş (Bv.), September 29, 1993	BT, CR, TR, MM, OT, MT, MD; DB	
368	5235 Ro	K. & R. 9663	*Lithophane consocia* Borkhausen, 1792	1♀, Timişul de Jos (Bv.), June 1, 1997, 750 m alt.	BT, TR, MD; DB	VU
369	5242 Ro	K. & R. 9670	*Xylena vetusta* Hübner, 1808	3♀♀, Babarunca (Bv.), March 27, 1990, September 12, 1991,650 m alt.; Timişul de Sus, May 20, 1997, 700 m alt.	BT, CR, TR, MM, OT, MT, MD	NT
370	52147 Ro	K. & R. 9596	*Eupsilia transversa* Hufnagel, 1766 (sin. *E. satellitia* Linnaeus, 1767)	1♂, Săcele (Bv.), September 6, 1998, 650 m alt. 1♀, Pasărea Forest (Buc.), June 3, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
371	5257 Ro	K. & R. 9694	*Griposia aprilina* Linnaeus,1758	1♂, Călimăneşti-Vâlcea, October 21, 1994	BT, CR, TR, MM, OT, MT, MD; DB	
372	5260 Ro	K. & R. 9694	*Dryobotes eremita* Fabricius, 1775 (s*in. D. protea* Denis & Schiffermüller,1775)	1♀, Canaraua Fetii (DB), October 6, 1990, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
373	5267 Ro	K. & R. 9710	*Ammoconia caecimacula* Denis & Schiffermüller, 1775	1♂, Zizin (Bv.), September 22, 1979 1♀, Canaraua Fetii (DB), April 15, 1993, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
374	5272 Ro	K. & R. 9649	*Phylapora lutulenta* Denis & Schiffermüller, 1775	1♂, Hagieni (DB), October 3, 1981	BT, CR, TR, MM, OT, MT, MD; DB	NT
375	5282 Ro	K. & R. 9726	*Myxinia rufocincta rufocincta* Geyer, 1828	1♂, Canaraua Fetii (DB), September 15, 1996, 150 m alt.	BT, TR, DB	NT
376	5288 Ro	K. & R. 9738	*Mniotype satura* Denis & Schiffermüller,1775	1♂, Săcele (Bv.), October 8, 1996, 650 m alt.	BT, CR, TR, MM, OT, MT, MD	
377	5297 Ro	K. & R. 9636	*Ulochlaena hirta* Hübner, 1813	2♂♂, Canaraua Fetii (DB), November 15, December 10, 1991, December 1-10, 1993, 150 m alt.	BT, MT, MD; DB	VU
SUBFAMILY NOCTUINAE (5298 Ro, K. & R. 10080)						
378	5300 Ro	K. & R. 10082	*Axylia putris* Linnaeus,1758	2♂♂, Racoş (Bv.), June 20, 1997, 500 m alt.; Brăneşti (Buc.), May 31, 1998 1♀, Canaraua Fetii (DB), 3- May 4, 1998, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
379	5302 Ro	K. & R. 10084	*Ochropleura flammatra flammatra* Denis &	1♂, Caraiman (M-ţii Bucegi), September 26, 1994	BT, CR, TR, MM, MT, MD;	

			Schiffermüller, 1775	1♀, Hagieni (DB), September 14, 1984	DB	
380	5304 Ro	K. & R. 10086	*Ochropleura plecta* Linnaeus,1761	2♂♂, Brăneşti (Buc.), May 31, 1998; Săcele (Bv.), June 6, 1998, 650 m alt. 1♀, Săcele (Bv.), June 6, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
381	5307 Ro	K. & R. 10089	*Diarsia mendica mendica* Fabricius, 1775	1♂, Roşu Lake -Cupaş, July 17, 1993, 1300 m alt.	BT, CR, TR, MM, OT, MT, MD	
382	5309 Ro	K. & R. 10092	*Diarsia brunnea brunnea* Denis & Schiffermüller, 1775	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1998, 900 m alt. 2♀♀, Tişiţei Gorges (Vrancea Mountains), July 4, 1998, 900 m alt., Săcele (Bv.), July 12, 1984, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
383	5313 Ro	K. & R. 10096	*Noctua pronuba* Linnaeus, 1758 (*N. innuba* Treitschke, 1825)	1♂, Canaraua Fetii (DB), May 23, 1997, 150 m alt. 2♀♀, Săcele (Bv.), August 27, 1996, 650 m alt., Periprava (D.D.), August 31, 1997, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
384	5314 Ro	K. & R. 10097	*Noctua orbona* Hufnagel, 1766	2♂♂, C.A.Rosetti (D.D), July 12, 1991, Pasărea Forest (Buc.), August 25, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
385	5317 Ro	K. & R. 10100	*Noctua fimbriata* Schreber, 1759	1♂, Canaraua Fetii (DB), June 12, 1998, 150 m alt. 1♀, Rediu (Botoşani), July 1, 1988	BT, CR, TR, MM, OT, MT, MD; DB	
386	5318 Ro	K. & R. 10102	*Noctua janthina* Denis & Schiffermüller, 1775	1♂, Periprava (D.D.), June 9, 1996, 6 m alt.		
387	5336 Ro	K. & R. 10139	*Rhyacia simulans*, Hufnagel, 1766	1♀, Maliuc (D.D.), July 18, 1997	BT, CR, TR, MM, OT, MT, MD; DB	
388	5361 Ro	K. & R. 10199	*Xestia c-nigrum* Linnaeus,1758	7♂♂, Frumuşica (Botoşani), August 6, 1989; Săcele (Bv.), 16, August 19, 1979, June 1.VI, 1989 September 21, 1996, 650 m alt.; Periprava (D.D.), September 6, 1996, August 30, 1997, 6 m alt. 5♀♀, Săcele (Bv.), May 16, 25, 1995, May 16, 1997, May 10, 12, 1998, August 20, 1998, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
389	5362 Ro	K. & R. 10200	*Xestia ditrapeziun* Denis & Schiffermüller, 1775	1♀, Valea Rece, June 30, 1985	BT, CR, TR, MM, OT, MT, MD	
390	5363 Ro	K. & R. 10201	*Xestia triangulum* Hufnagel, 1766	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1998, 900 m alt. 1♀, Timişul de Jos (Bv.), July 12, 1992, 700 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
391	5364 Ro	K. & R. 10203	*Xestia ashworthii* Doubleday, 1855	1♀, Tişiţei Gorges (Vrancea Mountains), July 2, 1997, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
392	5366 Ro	K. & R. 10206	*Xestia rhomboidea* auct., nec (Esper, 1790)	1♀, Tişiţei Gorges (Vrancea Mountains), August 22, 1981, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
393	5369 Ro	K. & R. 10209	*Xestia ochreago* Hübner, 1790	1♂, Jepii Valley (Bucegi Mountains), August 11, 1994, 1600 m alt.	TR,MT	EN
394	5371 Ro	K. & R. 10212	*Xestia xantographa* Denis & Schiffermüller, 1775	1♂, Canaraua Fetii (DB), September 10, 1994, 150 m alt. 1♀, Canaraua Fetii (DB), September 18, 1993, 150 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
395	5374 Ro	K. & R. 10218	*Eugraphe sigma* Denis & Schiffermüller, 1775	1♂, Tişiţei Gorges (Vrancea Mountains), July 3, 1998, 900 m alt. 1♀, Tişiţei Gorges (Vrancea Mountains), August 1, 1997, 900 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
396	5376 Ro	K. & R. 10224	*Cerastis rubricosa* Denis & Schiffermüller, 1775	2♂♂, Săcele (Bv.), April 29, 1991, 650 m alt. 1♀, Sângeorz-Mureş, April 1, 1985	BT, CR, TR, MM, OT, MT, MD; DB	
397	5377 Ro	K. & R. 10225	*Cerastis leucographa* Denis & Schiffermüller, 1775	1♀, Babarunca-Săcele (Bv.), March 27, 1990, 650 m alt.	BT, CR, TR, MM, OT, MD; DB	NT

398	5381 Ro	K. & R. 10232	*Anaplectoides prasina* Denis & Schiffermüller, 1775	1♀, Roşu Lake -Cupaş, July 28, 1978, 1300 m alt.	BT, CR, TR, MM, OT, MT, MD	
399	5385 Ro	K. & R. 10238	*Peridroma saucia* Hübner, 1808	1♂, Săcele (Bv.), August 26, 1979, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
400	5396 Ro	K. & R. 10266	*Euxoa aquilina* (Denis & Schiffermüller, 1775)	3♂♂, Frumuşica (Botoşani), July 7, 1989, Periprava (D.D.), July 8, 1996, Mihai Bravu Forest (Buc.), July 12, 1997 1♀, Frumuşica (Botoşani), August 1, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
401	5399 Ro	K. & R. 10273	*Euxoa temera* Hübner, 1808	1♂, Hagieni (DB), September 24, 1983 1♀, Hagieni (DB), September 24, 1983	BT, CR, TR, OT, MT, MD; DB	
402	5400 Ro	K. & R. 10275	*Euxoa nigricans* Linnaeus,1761	1♂, Maliuc (D.D.), July 19, 1997	BT, TR, MT, MD; DB	NT
403	5401 Ro	K. & R. 10278	*Euxoa segnilis* Duponchel, 1836	1♂, Periprava (D.D.), August 31, 1997, September 1, 1997, 6 m alt. 1♀, Periprava (D.D.), August 29, 1997	MD,DB	DD
404	5403 Ro	K. & R. 10279	*Euxoa crypta Dadd, 1927*	1♂, Periprava (D.D.), July 8, 1996 1♀, Perriprava (D.D.), July 7, 1996, 6 m alt.	TR, DB	DD
405	5404 Ro	K. & R. 10280	*Euxoa tritici* Linnaeus,1761, n.inv.	3♂♂, Periprava (D.D.), July 9, 1996, September 1, 1997, 6 m alt.; Maliuc (D.D.), July 19, 1997 1♀, Perriprava (D.D.), July 7, 1996, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
406	5405 Ro	K. & R. 10282	*Euxoa obelisca* (Denis & Schiffermüller, 1775)	1♂, Hagieni, September 15, 1984	BT, CR, TR, OT, MT, MD; DB	
407	5419 Ro	K. & R. 10334	*Agrotis obesa* Boisduval, 1829	1♂, Hagieni (DB), October 4, 1981	OT, DB	EN
408	5420 Ro	K. & R. 10336	*Agrotis crassa* Hübner, 1803	3♂♂, Frumuşica (Botoşani), July 18, 1989; August 1, 14, 1989 1♀, Perriprava (D.D.), August 29, 1997, 6 m alt.	BT, CR, TR, OT, MT, MD; DB	VU
409	5423 Ro	K. & R. 10346	*Agrotis ipsilon* Hufnagel, 1766	4♂♂, Uila Livadă, September 24, 1981; Hagieni (DB), October 4, 1981; Teliu (Bv.), November 11, 1994; Roşu Lake -Cupaş, August 1, 1975 3♀♀, Botoşani, October 20, 1987; Timişul de Jos (Bv), June 21, 1996; Săcele (Bv.), July 2, 1996, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
410	5425 Ro	K. & R. 10348	*Agrotis exclamationis* Linnaeus,1758	4♂♂, Canaraua Fetii (DB), May 23, 24, 25, 1997, 150 m alt.; Timişul de Jos (Bv), October 5, 1997, 700 m alt. 6♀♀, Săcele (Bv.), June 6, 1996, Timişul de Jos (Bv), August 17, 1997, June 7, 1998 (2 ex.) ; Lepşa (Vrancei Mountains), July 3, 1998, 500 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
411	5426 Ro	K. & R. 10350	*Agrotis clavis* Hufnagel, 1766	1♂, Lepşa (Vrancea), 1- July 2, 1997, 800 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
412	5427 Ro	K. & R. 10351	*Agrotis segetum* Denis & Schiffermüller, 1775	5♂♂,Hagieni (DB), September 25, 1983, September 24, 1993; Timişul de Jos (Bv), September 16, 1987, 700 m alt.; Brăneşti (Buc.), August 9, 1997, Pasărea Forest (Buc.), August 7, 1998 5♀♀, Hagieni (DB), July 22, 1981; Timişul de Jos (Bv), August 12, 1996, 700 m alt., Pasărea Forest (Buc.), August 1, 1997; Brăneşti (Buc.), August 9, 1997; July 7, 1998	BT, CR, TR, MM, OT, MT, MD; DB	
413	5429 Ro	K. & R. 10356	*Arotis vestigialis* Hufnagel, 1766	2♂♂, Periprava (D.D.), August 30, 1997, September 1, 1997, 6 m	BT, CR, TR, MM, OT, MD;	NT

				alt 1♀, Perriprava (D.D.), August 31, 1997, 6 m alt.	DB	
414	5430 Ro	K. & R. 10360	*Agrotis cinerea* Denis & Schiffermüller, 1775)	1♂, Timişul de Sus (Bv), May 10, 1997, 750 m alt.	BT, CR, TR, OT, MT, MD; DB	
FAMILY LYMANTRIIDAE (5438 RO, K. & R. 10373)						
415	5441 Ro	K. & R. 10375	*Limantria monacha* Linnaeus,1758	1♂, Zizin (Bv.), June 13-14, 1997 1♀, Bicazului Gorges (Harghita), August 2, 1996, 1100 m alt.	BT, CR, TR, MM, OT, MT, MD	
416	5448 Ro	K. & R. 10387	*Calliteara pudibunda* Linnaeus,1758	1♂, Zizin (Bv.), June 20, 1990	BT, CR, TR, MM, OT, MT, MD; DB	
417	5456 Ro	K. & R. 10397	*Orgyia antiqua* Linnaeus,1758	1♂, Pasărea Forest (Buc.), August 25, 1998 1♀, Frumuşica (Botoşani), May 17, 1989	BT, CR, TR, MM, OT, MT, MD; DB	
418	5459 Ro	K. & R. 10405	*Euproctis chrysorrhoea* Linnaeus,1758	8 ♂♂, Hagieni (DB), 20, July 21, 1981; Rediu (Botoşani), July 13, 1987; Timişul de Jos (Bv.), 5-June 12, 1998, 700 m alt.; Periprava (D.D.), June 9, 1997, 6 m alt.; Săcele (Bv.), July 2, 1996, 650 m alt. 4♀♀, Hagieni (Botoşani), July 8, 1983; Frumuşica (Botoşani), July 7, 1989; Periprava (D.D.), July 7, 1996, 6 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
419	5460 Ro	K. & R. 10406	*Euproctis similis* Fuessly, 1775	1♂, C.A.Rosetti (D.D), June 19, 1996	BT, CR, TR, MM, OT, MT, MD; DB	
420	5462 Ro	K. & R. 10408	*Pentophera morio* Linnaeus,1758	2♂♂, Tişiţei Gorges (Vrancea Mountains), July 4, 1998, 900 m alt., Bogăţii Forest (Perşani Mountains), June 11, 1995, 550 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	
421	5464 Ro	K. & R. 10410	*Laelia coenosa* (Hübner, 1808)	1♂, Periprava (D.D.), August 30, 1997, 6 m alt. 2♀♀, Periprava (D.D.), July 29, 1997; September 1, 1997, 6 m alt.	BT, TR, OT, MD; DB	VU
422	5465 Ro	K. & R. 10414	*Leucoma salicis* Linnaeus,1758	1♂, Săcele (Bv.), June 23, 1997, 650 m alt. 2♀♀, Săcele (Bv.), June 23, 1997, 650 m alt.	BT, CR, TR, MM, OT, MT, MD; DB	NT
423	5468 Ro	K. & R. 10416	*Arctornis l-nigrum* Müller, 1764	2♂♂, Brănești (Buc.), July 8, 31, 1998	BT, CR, TR, MM, OT, MT, MD; DB	NT

CONCLUSIONS

This paper contributes to the study of Lepidoptera fauna of Romania. The material was collected during 1979-2000 and could be found in the Lepidoptera collection of "Lucian Blaga" University of Sibiu. From the 572 existing species in this collection, there are presented only 211 species and 471 samples belonging to the Suprafamily Noctuoidea with six Subfamilies - Pygaerinae (36 species), Herminiinae (11 species), Acontiinae (10 species), Psaphidininae (5 species), Stiriinae (44 species), Hadeninae (58 species), Noctuinae (37 species) and the Family Lymantriidae. The list of species is updated after *Verzeichnis der Schmetterlinge Romäniens* (RÁKOSY et al., 2003). There are presented the geographical areas where these species were collected from; the most important aspect is the IUCN classification of the degree of endangerment of each species. The documentary and scientific value of the Lepidoptera collection of "Lucian Blaga" University offers to those interested a valuable documentary material that can be used for systematic, faunistic and zoogeographical studies.

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BIOLOGICAL PROTECTION OF STORED GRAIN PRODUCTS AGAINST THE MOTHS COMPLEX

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Abstract. Before depositing in the warehouse, there were determined the biological indexes of *Trichogramma pintoi*. The determined indexes were: prolificacy of females of 31.9 eggs / female hatching of the individuals 91.6%, female share 60.4%, static criterion of the quality 17.4. In order to determine the number of *Sitotroga cerealella* eggs parasitized by *T. pintoi* in the grain warehouse from Chişinău, an artificial fond was created to have a more precise evidence, by fixing 120 cards on the walls of the warehouse, windows, equipments with an amount of 12,000 eggs of *Sitotroga cerealella* preliminarily irradiated with gamma rays. In this warehouse *T. pintoi* was launched in capsules, with a rate of 1:1 (host: parasite), meaning 12.000 moth eggs to 12.000 *Trichogramma* females. The cards were then gathered and analysed, in order to emphasize the share of parasitized and exposed eggs. The the percent of parasitized eggs of *T. pintoi* varied between 61.8 to 80.24%.

Keywords: biological indices, prolificacy, effectiveness, *Trichogramma*, biological efficacy.

Rezumat. Protecţia biologică a produselor cerealiere depozitate în combaterea complexului de molii. Înainte de lansare în depozit s-au determinat indicii biologici a speciei *Trichogramma pintoi*. Aceşti indici sunt: prolificitatea femelelor de 3,.9-ouă/femelă, ecloziunea indivizilor de 91,6%, cota femelelor 60,4%, criteriul static al calităţii 17,4. În scopul determinării numărului de ouă de *Sitotroga cerealella* parazitate de *T. pintoi* în depozitul de cereale din Chişinău, a fost creat un fond artificial, pentru a face o evidenţă mai exactă. Pe pereţi, ferestre, utilajul din depozit, s-au fixat 120 de cartonaşe cu 12.000 de ouă de *Sitotroga cerealella* iradiate cu raze gama şi încleiate pe aceste cartonaşe. În acest depozit s-a lansat *T. pintoi* în capsule, cu raportul de 1:1 (gazdă: parazit), adică la 12.000 de ouă de *S. cerealella* s-au lansat 12.000 de femele incluse în capsule. Cartonaşele au fost scoase (culese) şi efectuată evidenţa procentului de ouă parazitate şi expuse în depozit. Procentul de ouă parazitate de *T. pintoi* a variat între 61,8-80,24%.

Cuvinte cheie: indici biologici, prolificitate, eficacitate, *Trichogramma*, eficacitate biologică.

INTRODUCTION

The damage caused by the insects to the agricultural products has a great economic importance. There have been undertaken numerous and various investigations, related to this issue; therefore, a series of synthesis papers of general and systematic nature concerning this group of insects were realized. Studies on the biology and ecology of the insect pests of the stored cereal products have been published by EVANS, 1987.

A major concern in the protection of the stored agricultural products is the biological control of pests. Scientific papers have been elaborated by many authors on the use of the parasitic hymenoptera in the biological control of the insect pests of the stored agricultural products.

To control the complex of flour pests there were performed experiments with three species of *Trichogramma* - *T. deion, T. ostriniae, T. pretiosum* in the laboratory conditions for control of *Plodia interpunctella* (MATTHEEW, 2008). The researches on the application of the biological protection of stored pests control with the different species of entomophages - *Trichogramma pretiosum* and *Bracon hebedor* have been realized by (BROWE, 1988; BROWER & PRESS, 1990). The works of these authors demonstrated the real possibility of application of the entomophages *Trichogramma* and *Bracon*) in the control of the moth product pests as one of the main elements of the integrated protection of the stored food products. The approach to the integrated protection strategy of the stored food products is well reflected in the work of the authors (TODIRAŞ et al., 2009). There is a large complex of pests in the warehouses: *Calandra granaria* L., *Sitophilus granarius* L., *Acarus siro* L., *Sitotroga cerealella* Ol., *Tinea granella* L., *Plodia interpunctella* Hubn., *Ephestia elutella* Hubn., *Ephestia кuhniella* Zell., etc. Against these pests different control methods are used: biological, chemical controls, fumigation, the use of pheromones, acoustic methods, thermal methods, application of plant products, gamma radiation, animal pests, etc.

The objective of the studies: Evaluation of the application technology of *Trichogramma pintoi* V. and other elements of biological protection in the control of moths in stored products.

MATERIAL AND METHODS

The objectives of the research during 2009-2010 were the entomophage *Trichogramma pintoi* and the hosts *S. cerealella* Ol., *P. interpunctella* L. and *E. kuehniella Zell*. The researches were conducted in the laboratory conditions of the Institute of Genetics, Physiology and Plant Protection and in the grain warehouse from Chisinau. The biological indices of the entomophagous *Trichogramma pintoi* were determined with the goal of using the entomophagous insects against a complex of moths present in the warehouse.

The collecting, determination, maintaining and accumulation of the species of *Trichogramma* sp. were performed according to the author methods (DYURICH, 2008), which are to be recommended.

Rearing the laboratory host grain moth (*Sitotroga cerealella* Ol.), determining biological indices of *T. pintoi*, determination of the biological efficacy of *Trichogramma* were performed according to the traditional methods of the authors (ABASCHIN et al., 1979). Breeding of grain moth and *Trichogramma*, the evaluation of biological effectiveness of the entomophages *by pest and mathematical data processing were conducted according to the relevant procedures and guidelines for mass breeding and use of Trichogramma* (ABASCHIN et al., 1979*;* MENCER & ZIMERMAN, 1986; EVANS, 1987). The biological efficacy of *T. pintoi* after each launching was determined by taking into consideration the number of moth larvae from the samples of wheat flour. The biological efficacy of *T. pintoi* was determined by the formula: E = 100 – B/A x 100, where: E - biological efficacy expressed in % compared with the control; A – the average number of pest in control; B – the average number of pest in experiments („Îndrumări metodice pentru testarea produselor chimice si biologice, 2002).

RESULTS AND DISCUSSIONS

1. **Evaluation of the percentage of infestation and biological effectiveness of *T. pintoi* as a result of different tests conducted at different substrates of cereal products in the warehouse.**

Experiments were held in the thermostat at the temperature of 25±1ºC and relative humidity of the air of 80-85 %, with a repetitiveness of 5 times. Experiments were mounted in a glass desiccator with a cereal product substrate of a thickness of 5-6 cm, in an amount of 1 kg of each substrate of wheat, barley, maize, beforehand infested with grain moth (for each kg of cereal substrate a gram of moth eggs was used). The period of development of a grain moth generation lasted 32-34 days; then, the butterflies started flying and precisely 5 days after the interval when the butterflies laid their eggs) *T. pintoi* was launched with a report of parasite: host of 1:10 (100 females to 1,000 eggs) to control the grain moth. Five days after the launching of *Trichogramma*, the biological effectiveness was determined for *T. pintoi* (number of eggs parasitized) on each substrate of cereal product. In Control, the experiments were carried out without substrates (Table 1, Fig. 1).

Table 1. The biological efficacy of *T. pintoi* at different layers of cereal products in the warehouse.

No. of variants	Layer-types	% of infested grains	% of *S. cerealella* parasitized eggs on layers
1	barley	90.8±3.9	78.2±3.0
2	wheat	82.4±3.5	72.5±2.6
3	corn	78.4±3.0	70.0±2.0
5	Control (no layers)	0	86.7±3.7

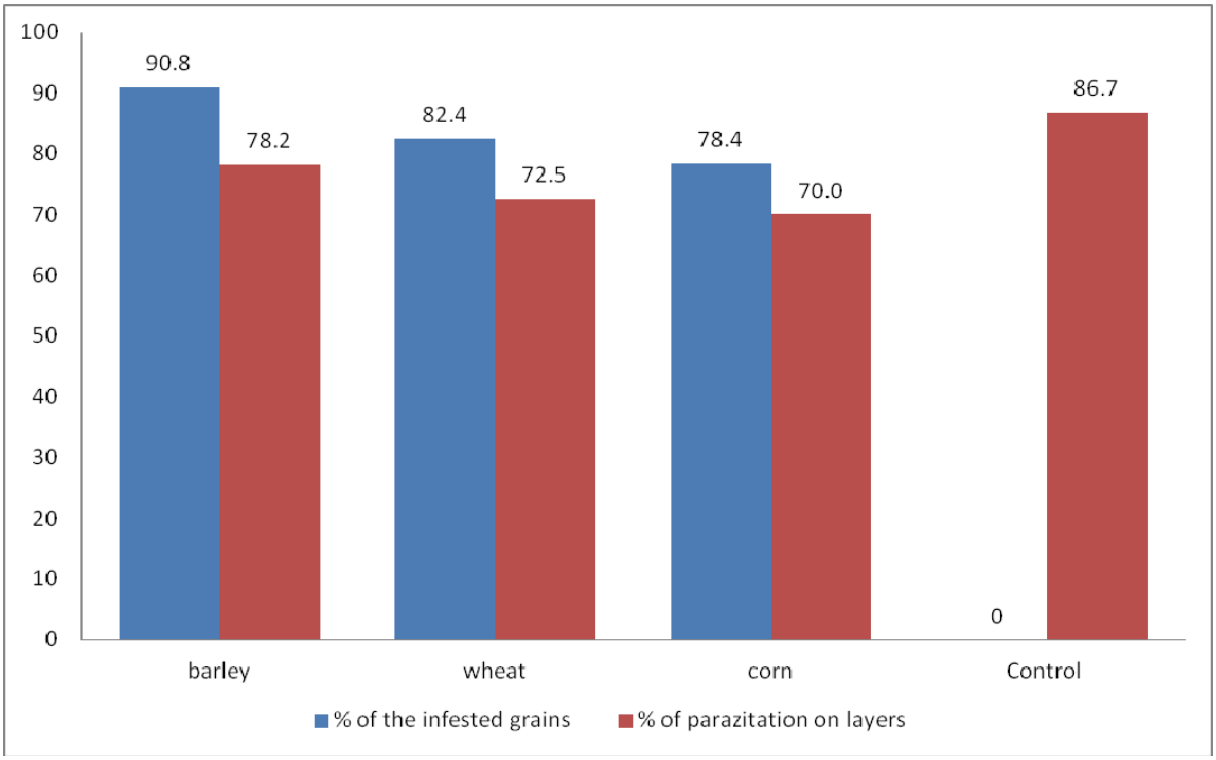


Figure 1. Percentage of the grains infested by the grain moth *S. cerealella* and the brown moth *T. pintoi.*

Analyzing the number of infested grains on variants, it was revealed that the substrate of barley grains was infested up to 90.8%. The number of eggs parasitized by the *T. pintoi* on the barley substrate was of 78.2%. The infestation on the wheat substrate reached 82.4% and on corn the infestation percentage was of 78.4%. Parasitizing

percentage on the wheat layer reached 72.5%, on corn though it was of 70%. In Control experiment, the researches were conducted without substrates and the number of parasitized eggs registered a percentage of 86.7% i

2a. **The estimation of biological effectiveness of *T. pinto*i with varying amounts of flour on the surface of the eggs of *S. cerealella* and *E. kuehniella*.**

The experiments were carried out in the thermostat at a temperature of 25 ± 1°C and relative humidity 80-85%, in 5 replicates. The amount of 2,000 eggs were placed in the Petri dish, in one single layer, then the eggs were covered with various amounts of flour on substrates (1, 2, 3, 4, 5, 6, 7, 8 grams), after which *T. pintoi* was launched with a norm of 40 females at 2.000 eggs of *S. cerealella* (ratio 1:50). The launch was carried out in semi capsules placed in the centre of the Petri dish. In the Control experiment, non-covered eggs were used (no flour). Five days after the launching, we recorded the number of parasitized eggs by *T. pintoi* in controlling *S. cerealella* and *E. kuehniella* on variants (Table 2; Figs. 2, 3).

Table 2. Evaluation of the percentage of parasitation of *T. pintoi* with varying amounts of flour on the surface of the grain moth eggs.

No. of variants	**The amount of flour on the surface of the moth eggs (g) and thickness of the flour layer (mm).**								**Control**
	1/0.5	2/1	3/1.5	4/2	5/2.5	6/3	7/3.5	8/4	0
Number of *S. cerealella* Ol. eggs parasitized with *T.pintoi*, %	88.3 ±3.5	80.9 ±3.1	72.5 ±2.8	59.6 ±2.4	40. ±2.1	20. ±1.9	9.0 ±1.0	2 ±0.3	92.5±3.9
Number of *E. kuehniella* Zell. eggs parasitized with *T. pintoi*, %	90.0 ±3.9	84.0 ±3.6	76.5 ±3.4	60.0 ±2.7	42.4 ±2.3	22. ±2.0	10.0 ±1.2	2.5 ±0.3	95.0±4.2

As a result of the carried out experiments, it was noticed that the eggs of *S. cerealella* and *E. kuhniella* placed in the Petri dish and covered with flour up to a 0.5 mm (one gram of flour) were parasitized by *T. pintoi* up to 88.3% and 90% respectively; for a higher amount of flour (two grams) and the thickness of 1 mm, the indices are as it follows: 80.9% and 84% respectively, for 1.5 mm (three grams of flour) the results are: 72.54% and 76.5% respectively. The indices of parasitation for 2 mm layer of flour (4 grams) are 59.57% and 60%, for 2.5 mm layer of flour (5 grams) the percentage is 40.5% for *S. cerealella* and 42.4% for *E. kuhniella*, for the layer of 3.0 mm (six grams) of flour the indices are 22.2-20.5% and for a layer of 3.5 mm (seven gram) of flour: 9.0% and 10.0%, for the layer of 4 mm of flower (eight grams) the indices are 2.0% and 2.5% respectively.

In control, there were used uncovered eggs. The number of eggs parasitized by *T. pintoi* amounted 92.5% at *S. cerealella* and 95.0% at *E. kuhniella*. The entomophagous *Trichogramma* can penetrate through the layers of flour from 0.5 mm to 4 mm and parasitize the eggs of *S. cerealella* from 88.3% to 2.0%, *E. kuehniella* 90.0 to 2.5%.

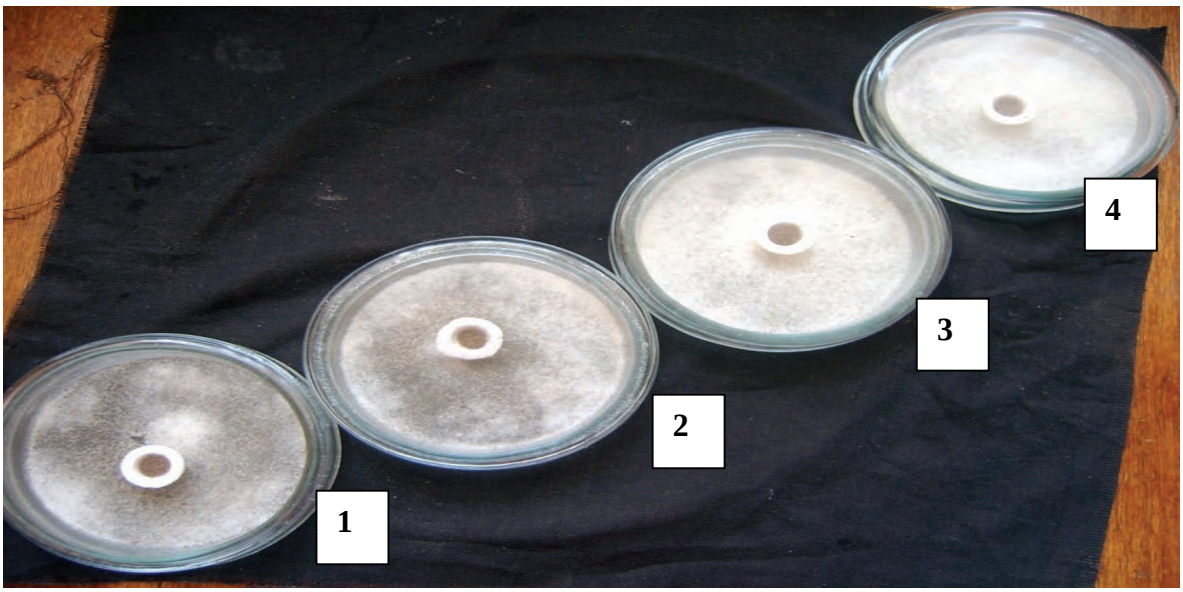
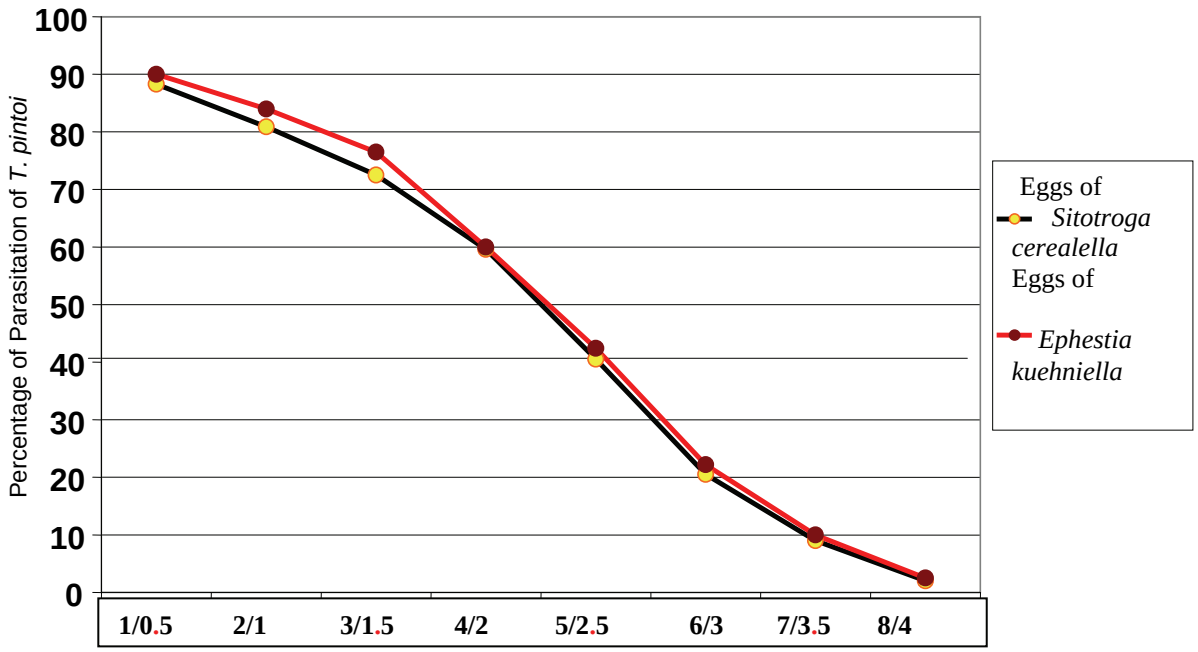


Figure 2. Percentage of parasitation by *T. pintoi* of *S. cerealella* eggs covered with different quantities of flower: 1 gram; 2 grams; 3 grams; 4 grams.



Quantity of flour on the surface of *S. cerealella* eggs in (gr.) and *E. kuhniella* and the thickness of the flour layer (mm)

Figure 3. Percentage of parasitation *of S. cerealella* and *E. kuhniella* eggs covered by flour by *T. pintoi.*

2b. **Determination of the biological efficiency of *Trichogramma pintoi* in the ecological space room and within the warehouse.**

In order to elaborate the technology based on *T. pintoi*, for the integrated protection of the cereal products and control of the moth complex in the warehouses, artificial conditions were created, but similar to the ones in warehouses, where preliminary results were estimated for later *Trichogramma* control technology implementation and examination.

Laboratory experiments were carried out in the ecological room at the temperature of 25±1ºC and relative humidity of 80-85%, in 50 repetitions (50 cards). Thermostat volume is 2m x 2m x 2m = 8 m^3, where eggs of *S. cerealella* and *E. kuhniella* were placed on small sized cards. In the given space, *T. pintoi* was launched in 10 capsules with the launching norm of 1,000 females at 20,000 eggs of *S. cerealella and E. kuhniella* with the rate of parasite: host of 1:20. After 7 days, we conducted the tracking of the number of host eggs parasitized (blackened) on cards by the entomophagous *T. pintoi*, where the biological efficacy in controlling hosts by *T. pintoi* varied from 60.4 to 80%.

Under the same laboratory conditions of the ecological room, experiments with the same hosts were carried out with the optimal rate of 1:1 (parasite: host). The number of parasitized eggs of *S. cerealella* and *E. kuhniella* in the area of 8m^3 varied from 62.5 to 88.6%. The entomophages searched for the moth eggs in the given area and parasitized them. In a warehouse, which is much bigger, the eggs of the hosts can be searched and parasitized by *Trichogramma*, but with a smaller rate parasite: host.

3**. Determination of the percentage of parasitized eggs by *T. pintoi* in the grain warehouse from Chişinău.**

Before launching, in the warehouse *T. pintoi* biological indexes were determined. The determined indexes were: prolificacy of females of 31.9 eggs /female hatching of the individuals 91.6%, female share 60.4%, static criterion of the quality 17.4. In order to determine the number of eggs parasitized by *T. pintoi* in the grain warehouse from Chisinau, an artificial fond was created to have a more precise evidence, by fixing 120 cards on the walls of the warehouse, windows, equipments with an amount of 12,000 eggs of *Sitotroga cerealella* preliminarily irradiated with gamma rays. In this warehouse *T. pintoi* was launched in capsules, with a rate of 1:1 (host: parasite), meaning 12,000 moth eggs to 12,000 *Trichogramma* females. The cards were then gathered and analysed, in order to emphasize the share of parasitized and exposed eggs. The percent of parasitized eggs of *T. pintoi* varied between 61.8 to 80.24%. It can be affirmed that in the grain warehouses the entomophagous *Trichogramma* can be used as one of the main elements in integrated protection.

During the years 2009-2010 the experiments were carried out in the grain warehouse from Chisinau. The evidence of the pests in warehouse was carried out on the entire surface of the investigated territory by means of application of the main techniques for monitoring inspections: inspections, sampling, temperature monitoring, and usage of pheromone traps. In order to determine the presence and numerical density of various species of moths in the grain store, there were mounted pheromone traps for: *E. kuhniella* Zell., *P. interpunctella Hubn.* and *E. elutella Hubn.* The monitoring of the moths by pheromone traps (Fig. 4) during the storage of cereal products was carried out from the 18th of May till the 20th of May 2010. The analysis of the moths captured in traps revealed the presence of the following species in the warehouse: *E. kuhniella*, which varied between 8.0 and 80.0 individuals and *P. interpunctella* between 1.0 and 5.0 individuals in a pheromone trap at the Mill No. 1. At the mill No. 2, *E. kuhniella* between 7.0 and 86.0

individuals were caught in a trap; *P. interpunctella* varied between 1.2 and 3.0 individuals. In the elevator (grain store), 2 to 10 individuals of *E. κuhniella* were caught in a trap in average, while *P. interpunctella* varied between 5.0 and 79.0 individuals. In the flour storage, there were caught in a trap from 17.7 to 109.0 *E. κuhniella* individuals, but *P. interpunctella* varied between 3.0 and 7.0 individuals. In elevator No. 2 - wheat warehouse, which served as a control – 3 to 9 *E. κuhniella* individuals were caught in a trap from, *P. interpunctella* varied between 19.0 and 139.0 individuals. The difference of the average is essential. *E. elutella* was not captured in the pheromone traps. In the flour mills, it predominates *E. κuhniella*, but in the elevator – *P. interpunctella*. The average temperature from the 18th of May till the 20th of August 2010, varied from 18.5ºC to 28°C.

4. Determination of the numerical density of moths in cereal products warehouse.

To identify the strategies that would ensure the protection of the stored cereals stocks, the first requirement is the knowledge of the diversity of pests present in warehouses. To realize this program of moths control with *T. pintoi*, it was necessary to determine the species and numerical density of the moth complex from the grain warehouse from Chişinău.

To determine the density of the moth complex (number of larvae) within the grain warehouse and the wheat elevators, there were collected 9 samples from different places in each store for every record. The determination of the numerical density of moths in the grain mill was made according to (TODIRAŞ et al., 2009).

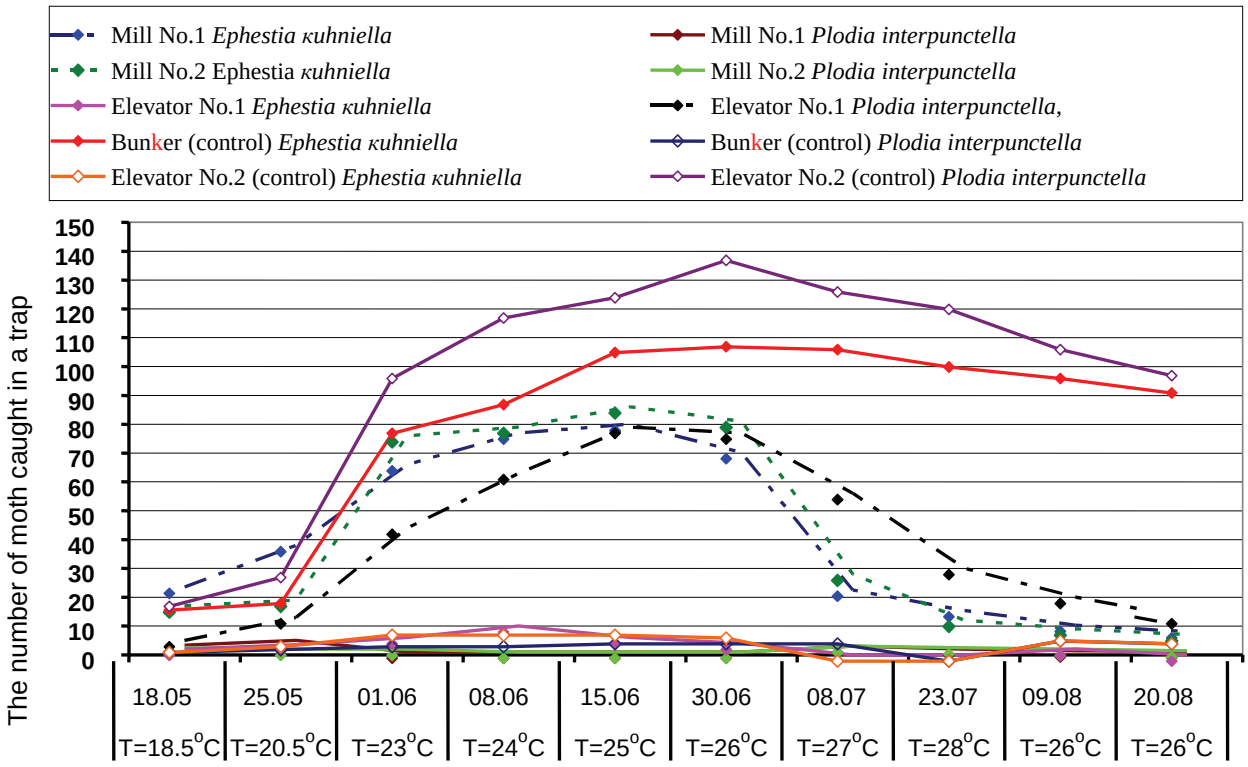


Figure 4. The dynamics of moths caught in the traps and the temperature.

After determining of the pest density it was determined the biological efficacy of *T. pintoi* in the control of the moths *E. κuhniella* and *P.interpunctella* in warehouses. The entomophagous *T. pintoi* was used as one of the important elements in the integrated protection of cereal products. The entomophagous *T. pintoi* was launched in capsules. The records of the bags of cereal products, walls, windows, equipment in the warehouse were realized, and then *T. pintoi* launched. During the experiments, *T. pintoi* was launched six times and there were realized seven records before and after the launching of the moths *Ephestia κuhniella* and *Plodia interpunctella*.

The biological efficacy after six launches of *T. pintoi* varied from 16.67% to 71.4% within the Mill No. 1. The biological efficacy of *T. pintoi* varied from 20.0% to 68.5% within the, Mill No. 2. Within the elevator No. 1 (grain warehouse), the biological efficacy of *T. pintoi* varied from 27.50% to 73.3%. In the control (flour mill and elevator No. 2), where the entomophagous insect has not been launched, the efficacy was not reported. The biological efficacy of *T. pintoi* increased after each start until the end of the experiments.

When comparing the efficacies of *T. pintoi* at the mills No. 1, No. 2, Elevator No. 1 and control (where the entomophagous insect was not launched), the difference of the average was significant: (T_d = 2.88-10.40)> ($T_{0.05}$ = 2.12) after sixth launches. Our results demonstrate that the release of *T. pintoi* into commodity storages can play an important role in the elimination of moth populations from warehouses, especially as part of an integrated control program.

CONCLUSIONS

As a result of the evaluation of the percentage of infestation of *Sitotroga cerealella* and *Ephestia kuhniella* Z, in laboratory conditions in different sublevels of barley, wheat, corn warehouses, the values of infestation varied from 70% to 90.8%.

As a result of estimating the biological efficacy of *T. pintoi* with different amounts of dust on the surface of *S. cerealella* and *E. κuhniella* eggs in the Petri dish and covered with flour, *T. pintoi* can parasitize the moth eggs under the layers the thickness of which varies from 0.5 mm (one gram) to 4 mm (eight grams), with 2.0% to 90.0% indices. In the control, number of eggs parasitized by *T. pintoi* was 92.5% in *S. cerealella* and 95.0% in *E. kuhniella.*

The density of larvae in the warehouse varied from 2 to 3. 4 individuals at mill No. 1 and mill Nr. 2. In the control (warehouse) the density of larvae varied from 3 to 7.5 individuals. In the elevator No. 1 (wheat storage), the larvae density varied from 2.7 individuals to 4.4 individuals. In the control at elevator No. 2 the number of larvae varied from 4 to 10.2 individuals. There is a very big difference compared to the control. The most encountered pests at the cereal warehouses from Chişinău were *E. κuhniella* and *P. interpunctella*; against these pests, *T. pintoi* has been launched six times.

The number of eggs of *S. cerealella* and *E. κuhniella* parasitized by *T. pintoi* in the area of 8 m^3 where the optimal ratio (P:H) is 1:1 ranged from 60.4 to 88.6%. The percentage of eggs parasitized by *T. pintoi* in the deposit was 61.8%-80.24%.

As a result of the launching the *T. pintoi* in the ecological room and storage spaces on cards, it was determined – the biological efficacy of *T. pintoi*. Analyzing range parasite: host relationships, it was found that the optimum ratio (P:H) is 1:1, where the maximum efficacy in controlling the moth complex in the ecological room is 88.66% and 80.24% in deposits.

In the control option from the bunker, which was held in elevator No. 1 (flour warehouse), No. 2 (wheat warehouse) and where the entomophagous insect was not launched, the efficacy has not been reported. The mean differences is critical, (DEM), (Td = 2.88 to 10.40> 2.12 = T 0.05), after the second – the sixth release.

The density of larvae in the storage ranged from 2.0 to 3.4 individuals, mill No. 1, No. 2 flour storage, the control – bunker (flour storage), the density of larvae ranged from 3 to 7.5 individuals. In case of elevator No. 1 (wheat storage), larval density ranged from 2.7 to 4.4 individuals, in the control - (Elevator No. 2 - wheat warehouse the density of larvae ranged from 4.0 to 10.2 individuals. This difference is essential compared to the control.

The results obtained in the 2009-2010 were used for the elaboration of the technology used for *T. pintoi*, for integrated protection of the cereal products used against the moth complex in warehouses.

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THE SCIENTIFIC VALORISATION OF THE ENTOMOLOGICAL PATRIMONY PRESERVED AT THE MUSEUM OF OLTENIA CRAIOVA

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Abstract. In this article we analyzed and synthesized the results of scientific processing and publication of data held by the museum pieces preserved in the entomological heritage of Craiova Oltenia Museum. The material underpinning the development of the 56 papers published during the years 1982 to 2015, was registered in the museum heritage during 1951-2014. It comes from acquisitions, donations and collections done by the specialists of the Natural Sciences Department. Of the total of 53,870 registered insects, were published data for a total of 24,189 insects. The processed material belongs to the following orders: Coleoptera, Dictyoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Orthoptera. There were identified six new species for Romania, six species reported for the second time in the Romanian fauna, 137 species and subspecies reported for the first time in Oltenia fauna, numerous rare and very rare species in the fauna of Romania and also protected species of national and community level. This material may be a reference paper for the specialists interested in knowing the insect fauna of Oltenia, and for the specialist who will address this area in the museum in the future, will constitute a database on the state of valorization and knowledge of the entomological heritage.

Keywords: entomological collections, scientific importance, Natural Sciences Department, diversity, insect fauna, Oltenia.

Rezumat. Valorificarea ştiinţifică a patrimoniului entomologic conservat la Muzeul Olteniei Craiova. În prezentul articol au fost analizate şi sitetizate rezultatele obţinute în urma prelucrării ştiinţifice şi publicării datelor deţinute de piesele muzeale conservate în patrimoniul entomologic al Muzeului Olteniei Craiova. Materialul care a stat la baza elaborării celor 56 de lucrări publicate în perioada anilor 1982-2015, a fost înregistrat în patrimoniul muzeului în perioada anilor 1951-2014. El provine din achiziţii, donaţii şi colectări efectuate de către specialiştii Secţiei de Ştiinţele Naturii. Din totalul de 53.870 insecte înregistrate, au fost publicate datele deţinute de 24.189 insecte. Materialul prelucrat aparţine ordinelor: Coleoptera, Dictyoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Orthoptera. Au fost identificate şase specii noi pentru fauna României, şase specii semnalate pentru a doua oară în fauna României, 137 specii şi subspecii semnalate pentru prima dată în fauna Olteniei, numeroase specii rare şi foarte rare în fauna României, precum şi specii protejate de interes naţional şi comunitar. Prezentul material poate constitui o lucrare de referinţă pentru specialiştii interesaţi în cunoaşterea faunei de insecte a Olteniei, iar pentru specialiştii care vor aborda acest domeniu în cadrul muzeului în viitor, va constitui o bază de date asupra stadiului de valorificare şi cunoaştere a patrimoniului entomologic.

Cuvinte cheie: colecţii entomologice, importanţă ştiinţifică, Secţia de Ştiinţele Naturii, diversitate, fauna de insecte, Oltenia.

INTRODUCTION

The entomological heritage preserved at the Natural Sciences Department of Craiova Oltenia Museum totalizes 53,870 specimens and has the largest share in the department heritage, representing almost 50%. The preserved specimens came from: acquisitions (11,241 specimens), donations (7,539 specimens) and collections (35,090 specimens).

The constitution of the insect heritage was made in two distinct stages.

The first stage was between 1951-1978. At the end of this stage, the collection totalized 13,870 specimens coming from:

I. Acquisitions (2,700 specimens): "Mihai Peiu" Collection of autochthonous Lepidoptera – 1,500 specimens and the "Claudia Stănoiu" Collection of exotic Lepidoptera – 1,200 specimens;

II. Collection carried out by specialists at the Department during the scientific researches carried out in the natural and anthropic ecosystems of Oltenia (especially) – 11,170 specimens.

In this period, the collection was scientific and cultural-educational valorized by PhD. Ion Firu.

The second stage began in 1979 and continues today (2015). During this period, entomological heritage was enriched with 40,000 specimens; it was and is still scientific and cultural-educational harnessed by PhD. Cornelia Chimişliu. The pieces registered in this period come from:

I. Acquisitions (8,541 specimens): "N. A. Săvulescu" Collection of beetles – 650 specimens; "Aurelia Ursu" Collection of Diptera – 497 specimens; "Vl. Brădescu" Collection of Diptera – 523 specimens; "I. Firu" Entomological Collection – 6,871 specimens.

II. Donations (7,539 specimens): "I. Stănoiu" donation of autochthonous Lepidoptera – 7,447 specimens; "Aurelia Ursu" donation of dipteran – 92 specimens.

III. Collections – 23,920 specimens.

The biggest share is held by beetles, followed by lepidopterans.

Given the great diversity of insects, the difficulty of their identification and the poor knowledge of the diversity of the Oltenia entomofauna, during the 36 years of activity in the department, the undersigned has developed and published 56 scientific papers alone, or in collaboration with other specialists in the field. These works were developed based on the data held by insects preserved in the entomological heritage of the department.

This paper aims to analyze, synthesize, and centralize data held by the entomological museum pieces from the museum's heritage, scientifically processed and published during 1979-2015 in order to know the status of scientifical valorization of the entomological heritage.

MATERIAL AND METHOD

The material used for the preparation of this work consists in the papers published during 1982-2015, in which the analyzed data came from insects preserved in the entomological heritage of the Department of Natural Sciences constituted during the years 1951-2014.

The presentation of the published works was made grouped in; purchased collections, donated collections and collections made from insects gathered by the museum's specialists in the period 1951-2014. In the three categories of collections, the works are presented in alphabetical order of the analyzed orders, superfamilies, families and subfamilies.

The analyzed order, superfamily, family and subfamilies, the examined number of copies, the number of species, subspecies and genera identified in the examined material, the new species reported for Oltenia and/or Romania, the protected species of national or Community level and the rare or very rare species in Romanian fauna were mentioned for every published paper. At the end of this data we mentioned the bibliographical references.

The taxonomic classification of the taxa is consistent with the taxonomic system used during the period in which the papers were published.

I. THE ACQUIRED COLLECTIONS
COLEOPTERA order

1. "N. A. Săvulescu" Collection of beetles

Processed material: 650 specimens belonging to 163 species and subspecies included in 85 genera and 18 families: Cicindelidae, Carabidae, Silphidae, Staphylinidae, Dermestidae, Dytiscidae, Hydrophilidae, Cleridae, Histeridae, Chrysomelidae, Cantaridae, Coccinelidae, Tenebrionidae, Buprestidae, Scarabaeidae, Lampiridae, Curculionidae, Cerambycidae.

Rare and very rare species: the collection preserves 64 rare and very rare species in the fauna of Romania.

Note: Collection preserves and three specimens of *Carabus alutensis* Săvulescu 1972 identified and described as a new species for science by N. Săvulescu. (CHIMIŞLIU, 1990-1993).

2. The Scarabeidae family from the "I. Firu" Entomological Collection

Processed material: 458 specimens belonging to 50 species and subspecies included in 25 genera and ten subfamilies: Coprinae, Geotrupinae, Aphodiinae, Hybosorinae, Sericinae, Melolonthinae, Rutelinae, Dynastinae, Valginae, Cetoniinae.

Rare and protected species: *Anisoplia (Ammanisoplia) desserticola* Fischer von Waldheim 1824, *Hybosorus illigeri* (Reiche 1853), *Protaetia (Netocia) ungarica* Herbst 1790.

Protected species: *Onthophagus vacca* (Linnaeus 1767) (=*Scarabaeus affinis* Brullé 1832). (CHIMIŞLIU, 2000c).

ORDER DIPTERA

3. "Vl. Brădescu"Collection of Diptera

Processed material: the Syrphidae family – 523 specimens belonging to 181 species and subspecies included in 54 genera and two subfamilies: Milesiinae şi Syrphinae.

Note: 45 rare species and 28 rare species. The collection preserves also four specimens of *Merodon strobli* Bradescu 1986, species, identified and described as a new species for science by Vl. Brădescu. (CHIMIŞLIU & LILA, 2007).

4. "Aurelia Ursu" Collection of Diptera

Processed material: 497 specimens belonging to 149 species and subspecies included in 91 genera and 11 families – Asilidae, Pipunculidae (Doriloidae), Conopidae, Sepsidae, Piophilidae, Sphaeroceridae, Micropezidae, Uliidae, Lauxaniidae, Ephydridae, Calliphoridae.

Note: 25 species are very rare, 63 are rare. (LILA & CHIMIŞLIU, 2003).

5. Diptera (part) - "I. Firu" Entomological Collection

Processed material: 459 specimens belonging to 66 species and subspecies included in 47 genera, 13 families – Asilidae, Bombyliidae, Calliphoridae, Conopidae, Nemestrinidae, Scatophagidae, Sciomyzidae, Stratiomyidae, Syrphidae, Thereviidae, Ulidiidae, Xylomyidae, Xylophagidae.

Rare species: 25 species are very rare, 63 rare, 22 relatively rare. *Nemestrinus caucasicus* (Fischer 1806) – relict tertiary, species very rare in nature and museum collections. (CHIMIŞLIU, 2013).

LEPIDOPTERA order

6. "Mihai Peiu"Collection of Lepidoptera

Processed material: 1,500 specimens belonging to 245 species and subspecies, included in 196 genera, 23 families – Tineidae, Yponomeutidae, Ethmiidae, Oecophoridae, Gelechiidae, Pyralidae, Lasiocampidae, Saturniidae, Drepanidae, Thyatiridae, Geometridae, Sphingidae, Notodontidae, Lymantriidae, Arctiidae, Ctenuchidae, Noctuidae, Hesperiidae, Papilionidae, Pieridae, Nymphalidae, Satyridae, Lycaenidae.

Rare species: *Arctia caja* (Linnaeus 1758), *Ammobiota festiva* Hufnagel 1766, *Diacrisia sannio* (Linnaeus 1758), *Maculinea arion* Linnaeus 1758, etc.

Protected species: *Parnassius apollo* Schwetzer 1911-1912, *P. mnemosyne distinctus* Bryk-Eisner 1934. (CHIMIŞLIU, 1989).

7. Microlepidoptera from the "I. Firu" Entomological Collection

Processed material: 189 specimens belonging to 45 species and subspecies included in 42 genera, ten families – Hepialidae, Cossidae, Psychidae, Yponomeutidae, Sesiidae, Tortricidae, Cochylidae, Zygaenidae, Pyralidae. (CHIMIŞLIU, 1996).

8. Macrolepidoptera from the "I. Firu" Entomological Collection

Processed material: 1,172 specimens belonging to 243 species and subspecies, included in 182 genera, 57 subfamilies and 15 families – Saturniidae (Saturniinae), Sphingidae (Macroglossinae, Sphinginae, Smerinthinae), Drepanidae (Drepaninae, Thyatirinae), Geometridae (Ennominae, Geometrinae, Larentiinae, Sterrhinae), Hesperiidae (Hesperiinae, Pyrginae), Lasiocampidae (Lasiocampinae, Malacosominae, Pinarinae, Poecilocampinae), Arctiidae (Arctiinae, Syntominae, Lithosiinae), Lymantriidae (Arctorninae, Calliterinae, Lymantriinae, Nygmininae, Orgyinae), Noctuidae (Acontiinae, Acronictinae, Aedeiinae, Amphipyrinae, Bryophilinae, Calpinae, Catocalinae, Cuculliinae, Eustrotiinae, Hadeninae, Heliothinae, Noctuinae, Plusiinae, Rivulinae, Tytinae), Nolidae (Eariadinae, Chloephorinae), Notodontidae (Notodontinae, Phalerinae, Ptilodoninae, Pygaerinae, Stauropinae), Lycaenidae (Lycaeninae), Nymphalidae (Apaturinae, Heliconiinae, Melitaeinae, Nymphalinae, Satyrinae), Papilionidae (Papilioninae, Parnassiinae), Pieridae (Coliadinae, Dismorphiinae, Pierinae).

Protected species: *Lycaena dispar* (Haworth 1802), *Parnassius apollo jarensis* Kertesz 1922.

Rare species: *Nymphalis polychloros* (Linnaeus 1758), *Papilio machaon* Linnaeus 1758, *Saturnia (Saturnia) pyri* (Denis & Schiffermüller 1775), *Hyles livornica* (Esper 1780), *Acherontia atropos* (Linnaeus 1758), *Carcharodus floccifera* (Zeller 1847), *Gastropacha* (*Stenophylloides*) *populifolia* (Denis & Schiffermüller 1775, *Apatura ilia* (Denis & Schiffermüller 1775), *Argynnis* (*Pandoriana*) *pandora* (Denis & Schiffermüller 1775, *Hipparchia* (*Neohipparchia*) *statilinus* (Hufnagel 1766), *Iphiclides podalirius* (Linnaeus 1758) (CHIMIŞLIU, 2006).

ORTHOPTERA order

9. Orthoptera from the "I. Firu" Entomological Collection

Processed material: 775 specimens belonging to 39 species and subspecies included in 26 genera, eight families – Acrididae Tetrigidae, Tridactylidae, Gryllidae, Gryllotalpidae, Conocephalidae, Phaneropteridae, Tettigoniidae.

Rare and protected species: *Tetrix tuerki* Krauss 1876 and *Pholidoptera transsylvanica* (Fischer, 1853) (CHIMIŞLIU, 2014).

II. DONATED COLLECTIONS
LEPIDOPTERA order

10. Macrolepidoptera from the "I. Stănoiu" donation indigenous lepidoptera

Processed material: 935 specimens belonging to 335 species and subspecies, included in 231 genera, 48 subfamilies, 16 families – Lasiocampidae (Lasiocampinae), Endromiidae, Saturniidae (Agliinae, Saturniinae), Sphingidae (Smerinthinae, Sphinginae), Hesperiidae (Hesperiinae, Pyrginae, Heteropterinae), Papilionidae (Papilioninae, Parnassiinae), Pieridae (Coliadinae, Dismorphiinae, Pierinae), Lycaenidae (Riodininae, Lycaeninae), Nymphalidae (Libytheinae, Heliconiinae, Nymphalinae, Limenitinae, Apaturinae, Satyrinae), Drepanidae (Drepaninae, Thyatirinae), Geometridae (Archiearinae, Ennominae, Geometrinae, Sterrhinae, Larentiinae), Notodontidae (Pygaerinae, Notodontinae, Phalerinae), Noctuidae (Acronictinae, Bryophilinae, Herminiinae, Catocalinae, Calpinae, Hypeninae, Plusiinae, Acontiinae, Eustrotiinae, Cuculliinae, Amphipyrinae, Stiriinae, Heliothinae, Hadeninae, Noctuinae), Lymantriidae, Nolidae, Arctiidae (Arctiinae, Syntominae, Lithosiinae).

Rare and protected species: *Pyrgus sidae sidae* (Esper 1784), *Zerynthia polyxena* (Denis & Schiffermüller 1775), *Parnassius apollo jaraensis* (Kertész 1922), *P. mnemosyne* (Linnaeus 1758), *Leptidea morsei-major* (Grund 1907), *Euchloe ausonia taurica* Röber [1907], *Colias myrmidone myrmidone* (Esper 1780), *C. chrysotheme chrysotheme* (Esper 1781), *Lycaena helle* (Denis & Schiffermüller 1775), *L. dispar* (Haworth 1802), *Maculinea arion* (Linnaeus 1758), *Euphydryas aurinia aurinia* (Rottenburg 1775), *Krinia roxelana* (Cramer 1777). (CHIMIŞLIU & GOGA, 2005).

III. COLLECTIONS

From the collected insects there were scientifically processed species of orders: Coleoptera, Diptera, Dictyoptera, Hemiptera, Hymenoptera, Lepidoptera, Orthoptera.

ORDER COLEOPTERA
Superfamily Chrysomeloidea
Family Cerambycidae

11. Processed material: 1,077 specimens belonging to 94 species and subspecies included in 61 genera, five subfamilies – Prioninae, Lepturinae, Spondylinae, Cerambycinae, Lamiinae.

Rare and protected species: *Stromatium unicolor* (Olivier 1795), *Gracilia minuta* (Fabricius 1781), *Cerambyx* (*Cerambyx*) *miles* Bonelli 1823, *C.* (*C.*) *welensii* Küster 1846, *C.* (*C.*) *cerdo* Linnaeus 1758 and *Rosalia alpina* (Linnaeus 1758).

Note: *Oplosia cinerea* (Mulsant 1839) newly mentioned in the fauna of Oltenia. (SERAFIM et al., 2004).

12. Processed material: 370 specimens belonging to 58 species and subspecies included in 45 genera, five subfamilies – *Cerambycinae, Lamiinae, Lepturinae, Prioninae, Spondylinae.*

Note: *Exocentrus punctipennis* Mulsant & Builebeu 1856 is newly reported in Oltenia. Twelve species are new to the collection: *Clytus arietis* (Linnaeus 1758), *C. lama* Mulsant 1847, *Trichoferus fasciculatus* (Faldermann 1837) (Cerambycinae), *Exocentrus punctipennis* Mulsant & Builebeu 1856, *Agapanthia cardui* (Linnaeus 1767), *Mesosa curculionoides* (Linnaeus 1761), *Stenostola ferrea* (Schrank 1776) (Lamiinae), *Leptura aurulenta* Fabricius 1792, *Paracorymbia maculicornis* (De Geer 1775), *Stictoleptura cordigera* (Fuessly 1775) (Lepturinae), *Tetropium castaneum* (Linnaeus 1758) and *Saphanus piceus* (Laicharting 1784) (Spondylidinae). (SERAFIM & CHIMIŞLIU, 2009).

Family Chrysomelidae

13. Material processed: 1,590 specimens belonging to 71 species and subspecies included in 28 genera, eight subfamilies – Criocerinae, Clytrinae, Cryptocephalinae, Eumolpinae, Chrysomelinae, Galerucinae, Halticinae, Cassidinae.

Note: five new species reported in the Oltenia fauna – *Timarcha metallica* (Laicharting 1781) *Chrysocus asclepiadeus* (Pallas 1776), *Galeruca interrupta* Illiger 1802, *Galerucella lineola* (Fabricius 1781), *Pyrrhalta viburni* (Paykull 1799). (ILIE & CHIMIŞLIU, 1999).

14. Processed material: 247 specimens belonging to 35 species and subspecies included in 15 genera, six subfamilies: Alticinae, Chrysomelinae, Clytrinae, Criocerinae, Cryptocephalinae, Galerucinae.

Note: 12 species are new to the collection: *Podagrica menetriesi* (Faldermann 1837), *Chrysolina* (*Anopachys*) *aurichalcea bohemica* (Müller G. 1948), *C.* (*Ovostoma*) *olivieri* (Bedel 1892), *C.* (*Colaphosoma*) *sturmi* (*Westhoff* 1882), *Clytra* (*Clytra*) *quadripunctata appendicina* Lacordaire 1848, *Smaragdina* (*Smaragdina*) *affinis* (Illiger 1794), *S.* (*Smaragdina*) *salicina* (Scopoli 1763), *Lilioceris merdigera* (Linnaeus 1758), *Coptocephala* (*Coptocephala*) *unifasciata* (Scopoli 1763), *C.* (*Heterichnus*) *coryli* (Linnaeus 1758), *Cryptocephalus* (*Cryptocephalus*) *hypochaeridis* (Linnaeus 1758), *C.* (*C.*) *virens* (Suffrian 1847). (CHIMIŞLIU & MOGOŞEANU, 2009).

15. Processed material: 531 specimens belonging to 53 species and subspecies included in 23 genera, six subfamilies – Criocerinae, Cassidinae, Chrysomelinae, Galerucinae, Cryptocephalinae, Eumolpinae.

Rare species: *Tituboea macropus* (Illiger 1800), *Smaragdina limbata* (Stéven 1806) and *Eupales ulema* (Germar 1813).

Note: 18 species are new to the collection – *Oulema gallaeciana* (Heyden 1870), *Pilemostoma fastuosum* (Schaller 1783), *Chrysomela saliceti* Suffrian 1849, *Linaeidea aenea* (Linnaeus 1758), *Neophaedon pyritosus* (Rossi 1792), *Chrysolina* (*Sphaeromela*) *varians* (Schaller 1783), *Chrysolina* (*Stichoptera*) *rossia* (Illiger 1802), *Labidostomis* (*Labidostomis*) *pallidipennis* (Gebler 1830), *Smaragdina limbata* (Steven 1806), *Tituboea macropus* (Illiger 1800), *Cryptocephalus* (*Asionus*) *apicalis* Gebler 1830, *C.* (*Cryptocephalus*) *androgyne* Marseul 1875, *C.* (*Burlinius*) *connexus* Olivier 1808, *C.* (*Cryptocephalus*) *flavipes* Fabricius 1781, *C.* (*Cryptocephalus*) *nitidus* (Linnaeus 1758), *C.* (*Cryptocephalus*) *sexpunctatus* (Linnaeus 1758), *Pachybrachis* (*Pachybrachis*) *sinuatus* (Mulsant & Rey 1859) and *Floricola ulema* (Germar 1813). (MAICAN & CHIMIŞLIU, 2013).

Superfamily Cucujoidea
Family Coccinellidae

16. Processed material: 821 specimens belonging to 24 species and subspecies, included in 17 genera, four subfamilies – Epilachninae, Scymninae, Chilocorinae, Coccinellinae.

Note: Five newly reported species for wildlife Oltenia – *Scymnus quadrimacullatus* (Herbst 1783), *Coccinella divaricata* (Olivier 1808), *Calvia quinquedecimguttata* (Fabricius 1777), *Sospita vigintiguttata* (Linnaeus 1758) and *Anatis ocellata* (Linnaeus 1758).

Rare species: *Sospita vigintiguttata* (Linnaeus 1758) (var. *tigrina), Coccinella divaricata* (Olivier 1808), *Exochomus flavipes* (Thunberg 1781) and *Anatis ocellata* (Linnaeus, 1758). (ANDRIEV & CHIMIŞLIU 2003).

17. Processed material: 567 specimens belonging to 17 species and subspecies included in 15 genera, three subfamilies – Chilocorinae, Coccinellinae, Epilachninae.

Note: Four species are new to the collection – *Brumus quadripustulatus* (Linnaeus 1758), *Adalia decempunctata* (Linnaeus 1758), *Harmonia quadripunctata* (Pontoppidan 1763), *Henosepilachna argus* (Geoffroy 1785). (SERAFIM & CHIMIŞLIU 2005).

Superfamily Elateroidea
Family Elateridae

18. Processed material: 459 specimens belonging to 49 species and subspecies, included in 20 genera, ten subfamilies – Agrypninae, Conoderinae, Ampedinae, Hypnoidinae, Cardiophorinae, Melanotinae, Athoinae, Ctenicerinae, Agriotinae, Adrastinae.

Note: All species and subspecies are mentioned for the first time in the entomological collections of the Museum. (ZAHARIA (CIUCĂ) & CHIMIŞLIU, 2004).

Superfamily Scarabaeoidea
Subfamily Cetoniinae

19. Processed material: 1,705 specimens belonging to 12 species and subspecies included in 6 genera from the Cetoniinae subfamily.

Rare species: *Liocola lugubris* (Herbst 1786), *Protaetia* (s. str.) *fieberi* (Kraatz 1880), *P.* (*Netocia*) *ungarica* (Herbst 1790), *P.* (*Netocia*) *vidua* (Gory & Percheron 1833) and *Tropinota* (s. str.) *squalida* (Scopoli 1883).

Note: Two species (*Liocola lugubris* and *Protaetia fieberi*) are reported for the first time in the fauna of Oltenia. (CHIMIŞLIU, 1999).

20. Processed material: 1,029 specimens belonging to 17 species and subspecies included in eight genera, three subfamilies – Cetoniinae, Trichiinae, Valginae.

Note: *Protaetia* (*Netocia*) *cuprea metallica* (Herbst 1782) subspecies newly reported in Oltenia. The existence of the *Oxythyrea cinctella* (Schaum 1841) species was reconfirmed in the wildlife of Oltenia. (CHIMIŞLIU & MOGOŞEANU, 2011).

Family Copridae

21. Processed material: 18 specimens belonging to two species, included in a genus, Coprinae subfamily.

Note: *Onthophagus vacca* (= *Scarabaeus affinis*), the protected species of national level has been identified and referred for the second time in the fauna of Oltenia, 95 years after the first mention (FLECK, 1904; RUICĂNESCU & CHIMIŞLIU, 1999).

Subfamilies Coprinae and Geotrupinae

22. Processed material: 929 specimens: 778 specimens belonging to 20 species and subspecies, included in seven genera, subfamily Coprinae, and 151 specimens belonging to seven species and subspecies included in seven genera, subfamily Geotupinae.

Rare and protected species: *Onthophagus vacca* (Linnaeus 1767) (=*Scrabaeus affinis* Brűllé 1832), *Gymnopleurus sturmi* Mac-Leay 1821, *Geotrupes* (*Trypocopris*) *vernalis* Linnaeus1758, *Lethrus apterus* Laxmann 1770.

Note: *Oniticellus pallipes* Fabricius 1781, the species is reported for the first time in the fauna of Oltenia. (CHIMIŞLIU, 2000).

Families: Copridae, Geotrupidae, Aphodiidae, Ochodaeidae, Melolonthidae, Hoplinae

23. Processed material: 37 specimens belonging to nine species and subspecies included in nine genera, seven subfamilies, six families – Copridae (Coprinae), Bolboceridae (Bolbocerinae, Lethrinae), Aphodiidae (Aphodiinae), Ochodaenidae (Ochodaeninae), Melolonthidae (Sericinae), Hoplidae (Hoplinae).

Rare species: *Euoniticellus pallipes* (Fabricius 1798), *Odontaeus armiger* (Scopoli 1772), *Ochodaeus chyrsomeloides* (Schrak 1881), *Lethrus apterus* (Laxmann 1770), *Maladera holosericea* (Scopoli 1772).

Note: The four species are new for the fauna of beetles of Oltenia: *Alocoderus hydrochaeris* (Fabricius 1798), *Melinopterus pubescens* (Sturm 1800), *Heptaulacus sus* (Herbst 1783), *Hoplia gramminicola* (Fabricius 1792). (CHIMIŞLIU, 2001b).

24. Processed material: 72 specimens, included in 40 species, 25 genera, 9 subfamilies – Coprinae, Geotrupinae, Sericinae, Melolontinae, Rutelinae, Dynastinae, Valginae, Trichiinae, Cetoniinae.

Note: Five species were identified and reported for the first time in the Oltenia fauna – *Odontaeus armiger* (Scopoli 1772), *Aphodius* (*Acrossus*) *rufipes* (Linnaeus 1758), *A.* (*Bodilus*) *ictericus* Laicharting 1781, *A.* (*Amidorus*) *porcus* (Fabricius 1792), *Omaloplia* (*O.*) *erythroptera* Frivaldsky 1835. (BOBÎRNAC et al, 1999; CHIMIŞLIU, 2014).

Family Dynastidae

25. Processed material: 359 specimens belonging to four species and subspecies included in two genera, Dynastinae subfamily.

Note: Two rare subspecies for the country fauna – *Pentodon bidens bidens* (Pallas 1771) and *Pentodon bidens sulcifrons* Küster 1789, previously reported only in Dobrogea are again reported in Oltenia. (CHIMIŞLIU, 2005).

26. Processed material: 111 specimens belonging to two species included in two genera, Dynastinae subfamily. (CHIMIŞLIU & MOGOŞEANU, 2009a).

Families: Glaresidae, Trogidae, Scarabaeidae

27. Processed material: 91 specimens, belonging to 10 species and subspecies, included in six genera, four subfamilies, three families – Glaresidae, Trogidae, Scarabaeidae (Aphodiinae, Scarabaeinae, Melolonthinae and Orphninae).

Note: ten species, newly reported in Oltenia fauna – *Glaresis rufa* Erichson 1848, *Trox hispidus* Pontoppidan 1763, *Trox scaber* (Linnaeus 1767), *Trox sabulosum* Linnaeus 1758, *Aphodius* (*Esimus*) *merdarius* (Fabricius 1775), *Onthophagus* (*O.*) *gibbulus* (Pallas 1781), *O.* (*O.*) *grossepunctatus* Reitter 1905, *O.* (*O.*) *marginalis* Gebler 1871, *Triodonta flavimana* Burmeister 1855, *Chaetonyx robustus* Schaum 1862. The genus *Triodonta* Mulsant 1842 and the species *Triodonta flavimana* are first reported in the Romanian fauna. (CHIMIŞLIU, 2003).

Family Lucanidae

28. Processed material: 285 specimens belonging to three species and subspecies included in three genera, three subfamilies – Lucaninae, Aesalinae, Syndesinae.

Rare and protected species: *Lucanus cervus* (Linnaeus 1758) – protected species of Community interest. (CHIMIŞLIU, 2007).

Subfamily Melolonthinae

29. Processed material: 207 specimens belonging to 16 species and subspecies included in six genera.

Rare species: *Monotropus nordmanni* Blanchard 1850, *Amphimallon* (s. str.) *assimilis* Herbst 1790, *Melolontha* (s. str.) *hippocastan*i Fabricius 1801, *Rhizotrogus* (s. str.) *aestivus* (Olivier 1789), *Rh.* (*Miltotrogus*) *pilicollis* Gyllenhal 1817, *Amphimallon* (s. str.) *caucasicus* Gyllenhal 1817. The last three species were reported for the first time in the fauna of beetles of Oltenia. (CHIMIŞLIU, 2000a).

Subfamily Rutelinae

30. Processed material: 930 specimens belonging to 14 species and subspecies included in five genera.

Rare species: *Anisoplia* (s. str.) *tempestiva* Erichson 1847, is a newly mentioned species for Oltenia. (CHIMIŞLIU, 2000b).

Family Scarabaeidae
SubfamilyAphodiinae

31. Processed material: 473 specimens belonging to 17 species and subspecies included in nine genera.

Rare species: 12 identified species are rare in the country's fauna – *Aphodius* (*Amidorus*) *obscurus* Fabricius 1792, *Aph.* (*Agolius*) *mixtus* Villa 1833, *Aph.* (*Agrilinus*) *putridus* Herbst 1789, *Aph.* (*Agrilinus*) *convexus* (Erichson 1848), *Aph.* (*Bodilus*) *nitidulus* Fabricius, 1792, *Aph.* (*Nialus*) *kraatzi* Harold 1868, *Aph.* (*Nialus*) *plagiatus* (Linnaeus 1767), *Aph.* (*Phalacronotus*) *paracoenosus* (Balthasar & Hrubant 1960) *Heptaulacus carinatus* (Germar 1824), *Psammobius laevipennis* Costa 1844, *Oxyomus silvestris* Scopoli 1763. (CHIMIŞLIU, 2001).

32. Processed material: 458 specimens belonging to ten species and subspecies included in *Aphodius* genus.

Note: All ten species were reported for the first time in the fauna of beetles of Oltenia – *Aphodius* (*Biralus*) *satellitus* (Herbst 1789), *Aph.* (*Volinus*) *sticticus* Panzer 1798, *Aph.* (*Volinus*) *melanostictus* Schmidt 1840, *Aph.* (*Melinopterus*) *prodromus* Brahm 1790, *Aph.* (*Melinopterus*) *sphacelatus* Panzer 1798, *Aph.* (*Orodalus*) *pusillus* Herbst 1789, *Aph.* (*Orodalus*) *tristis* Zenker 1801, *Aph.* (s. str.) *aestivalis* Stephens 1839**,** *Aph.* (*Bodilus*) *lugens* Creutzer. 1799,

Aph. (*Bodilus*) *rufus*, *Aph.* (*Nialus*) *lividus* Olivier 1789 and and two new subgenera: *Biralus* Mulsant 1870 and *Orodalus* Mulsant 1870. (CHIMIŞLIU, 2001a).

33. Processed material: 38 specimens, belonging to five species and sub-species included in the *Aphodius* genus.

Note: six species have been reported for the first time in Oltenia fauna – *Aphodius* (*Colobopterus*) *scrutator* Herbst 1789, *Aph.* (*Volinus*) *pictus* Sturm 1805, *Aph.* (*Nobius*) s*erotinus* Panzer 1799, *Aph.* (*Trichonotulus*) *scropha* Fabricius 1787, *Aph.* (*Bodilus*) *sordidus* Fabricius 1775, as well as the subgenera *Nobius* Mulsant 1870 and *Trichonotulus* Bedel 1911. (CHIMIŞLIU, 2001-2002).

Subfamily Trichiinae

34. Processed material: 30 specimens, belonging to five species and subspecies included in three genera.

Rare and protected species: *Gnorimus octopunctatum* (Fabricius 1775) and *Osmoderma eremita* Scopoli 1863.

Note: *Trichius sexualis* Bedel 1906, a rare species in Romanian fauna was identified and mentioned for the first time in the fauna of Oltenia. (CHIMIŞLIU, 2002).

Superfamily Staphylionoidea
Family Staphylinidae

35. Processed material: 160 specimens, belonging to 55 species and subspecies included in 26 genera, eight subfamilies –Omaliinae, Oxytelinae, Oxyporinae, Steninae, Paederinae, Staphylininae, Tachyporinae, Aleocharinae.

Note: *Aleochara breiti* Ganglbauer 1897 is a new species in Romanian fauna. (STAN & CHIMIŞLIU, 2005).

ORDER DIPTERA

36. Processed material: 88 specimens belonging to 14 species included in 12 genera, one family – Asilidae.

Note: The two species reported for the second time in the fauna of Romania (*Eutolmus mediocris* Becker 1923 and *Antipalus bilobus* Ionescu & Weinberg 1960. Two species are very rare in Romania fauna: *Lasiopogon montanus* Schiner 1862, *Cyrtopogon maculipennis* (Macquart 1834), and nine species are newly mentioned in the fauna of Oltenia: *Stenopogon sabaudus* (Fabricius 1794), *Lasiopogon montanus* Schiner 1862, *Cyrtopogon maculipennis* (Macquart 1834), *Dioctria linearis* (Fabricius 1787), *Dioctria rufipes* (De Geer 1776), *Machimus gonatistes* (Zeller 1840), *Nemochterus hungaricus* Engel 1927. (WEINBERG & CHIMIŞLIU, 1990-1993b).

37. Processed material: 117 specimens belonging to 21 species included in 14 genera, one family – Asilidae.

Note: *Antyphrison trifarius* (Loew 1849) is new species in the Romanian fauna. *Choerades fulva* (Meigen 1804) species has been reported for the second time in the Romanian fauna. Twelve new species for collection. (WEINBERG & CHIMIŞLIU, 1996b).

38. Processed material: 294 specimens belonging to 23 species included in 14 genera, one family – Asilidae.

Note: *Epitriptuis cowini* Hobby 1946 species as mentioned for the second time in the Romanian fauna. Eight species are new for the Oltenia fauna: *Lasiopogon cinctus* (Fabricius 1781), *Dioctria atricapilla* Meigen 1804, *D. longicornis* Meigen 1820, *Paritamus geniculatus* (Meigen 1820), *Pamponerus germanicus* (Linnaeus 1758), *Epitriptus cowini* (Hobby 1946), *Dysmachus praemorsus* (Loew 1854) and *Neomochterus palipes* Meigen 1830. (CHIMIŞLIU, 2003-2004).

39. Processed material: 230 specimens belonging to 24 species included in 13 genera, three families – Bombyliidae, Conopidae, Platystomatidae.

Note: 17 new species for collection. *Anthrax varia* Fabricius 1794 species was reported for the second time in Romanian fauna. (WEINBERG & CHIMIŞLIU, 1995).

40. Processed material: 11 specimens belonging to four species included in four genres, one family – Micropezidae.

Note: *Comsobata* (*Trylophyrobata*) *nigricornis* (Zetterstedt 1838) species was reported for the second time in the Romanian fauna. (WEINBERG & CHIMIŞLIU, 1996).

41. Processed material: 71 specimens belonging to three species included in the three genera, one family – Therevidae.

Note: Three species are new to the collection. (WEINBERG & CHIMIŞLIU 1990-1993a).

42. Processed material: 156 specimens belonging to 34 species and subspecies included in 26 genera, nine families – Solvidae, Stratiomydae, Nemestrinidae, Asilidae, Therevidae, Bombyliidae, Conopidae, Platystomatidae and Sciomyzidae.

Note: 20 species are newly reported in Oltenia fauna – *Solva marginata* (Meigen 1820), *Chloromya formosa* (Scopoli 1763), *Stratiomys chamaeleon* (Linnaeus 1758), *Stichopogon scaliger* Loew 1847, *S. aemula* (Meigen 1820), *Machimus annulipes* (Brullé 1832), *M. atricapillus* (Fallen 1814), *M. cingulatus* (Fabricius 1781), *Nemochtherus flavicorne* (Ruthe 1831), *Thereva annulata* (Fabricius 1805), *Th. nigripes* Loew 1846, *Bombylius ater* (Scopoli 1763, *B. discolor* Mikan 1796, *B. major* Linnaeus 1758, *Systoechus ctenopterus* (Mikan 1787), *Hemipenthes morio* (Linnaeus 1758), *Villa circumdata* (Meigen 1820), *Thecophora pusilla* (Meigen 1824), *Platystoma seminationis* (Fabricius 1775). (WEINBERG & CHIMIŞLIU, 1982).

43. Processed material: 130 specimens belonging to 26 species and subspecies included in 13 genera, four families – Tabanidae, Dolichopodidae, Chloropidae and Hippoboscidae.

Note: three new species for Romanian fauna – *Dolichopus sabinus* Haliday 1838, *Synthormon rufipes* (Meigen 1824) and *Sciapus contristans* (Wiedemann, 1817). The Hypoboscidae family is reported for the first time in Oltenia. Eleven species are newly reported in Oltenia fauna: two species are very rare in Romania fauna – *Tabanus spectabilis* Loew 1858, *Haplegis diadema* (Meigen 1830). (PÂRVU & CHIMIŞLIU 1982).

ORDER HETEROPTERA

44. Processed material: 146 specimens belonging to 11 species and subspecies included in nine genera, six families and seven subfamilies – Nepidae (Nepinae, Ranatrinae), Corixidae (Corixinae), Naucoridae (Naucorinae), Notonectidae (Notonectidae), Gerridae (Gerrinae), Veliidae (Veliinae).

Note: eight species and subspecies are reported for the first time in Oltenia fauna – *Nepa cinerea* Linnaeus 1758, *Ranatra* (*R.*) *linearis* (Linnaeus 1758), *Corixa punctata* (Illiger 1807), *Sigara* (*Pseudovermicorixa*) *nigrolineata nigrolineata* (Fieber 1848), *Ilyocoris cimicoides cimicoides* (Linnaeus 1758), *Aquarius paludum paludum* (Fabricius 1794), *Gerris* (*G.*) *thoracicus* Schummel 1832, *Velia* (*Plesiovelia*) *saulii* Tamanini 1947. The species *Notonecta* (*N.*) *meridionalis* Poisson 1926 is rare in Romanian fauna. (BERCHI & CHIMIŞLIU, 2015)

ORDER HYMENOPTERA

45. Processed material: 165 specimens belonging to 47 species and subspecies, included in 15 genera, seven families, three superfamilies – Apoidea (Colletidae, Andrenidae, Halictidae, Megachilidae, Apidae), Formicoidea (Formicindae), Vespoidea (Vespidae).

Note: 16 new species for Oltenia family Halictidae – *Halictus lativentris* Schenck 1853, *H. morbillosus* Kriechbaumer 1873, *H. morio* (Fabricius 1793), *H. nitidulus* Pérez 1903, *H. podolicus* Noskiewicz 1925, *H. politus* Schenck 1853, *H. subauratus* Rossi 1792, *H. sexcinctus* Fabricius 1775, *H. tumulorum* Linnaeus 1758, *Lasioglossum quadrinotatum* (Kirby 1802) (= *Halictus 4-notatus*), *Sphecodes albilabris* (Fabricius 1793), *Sph. gibbus* Linnaeus 1758, *Sph. pellucidus* Smith 1845, *Nomioides minutissima* Rossi 1790, *N. variegata* Olivier 1789, *Rophitoides canus* Eversmann 1852. (GOAGĂ et al., 1999)

ORDER LEPIDOPTERA

Family Lycaenidae

46. Processed material: 193 specimens belonging to 25 species and subspecies included in 16 genera, three subfamilies – Lycaeninae, Polyommatinae, Theclinae**.**

Note: three species are newly mentioned in the fauna of Oltenia: *Cupido (Everes) alcetas* (Hoffmannsegg 1804), *Cupido* (*Everes*) *decolorata* (Staudinger 1886), *Leptotes pirithous* (Linnaeus 1767). (CHIMIŞLIU 2015).

Family Nymphalidae

47. Processed material: 392 specimens belonging to 39 species and subspecies included in 15 genera, five subfamilies – Apaturinae, Heliconiinae, Libytheinae, Limenitidinae, Melitaeinae.

Note: two new species reported for the first time in Oltenia – *Argynnis (Argyronome) laodice* (Pallas 1771) and *Nymphalis xanthomelas* (Esper 1781).

Rare and protected species: *Apatura metis* Freyer 1829, *Limenitis reducta* Staudinger 1901, *Neptis sappho* (Pallas 1771), *Euphydryas aurinia* (Rottemburg 1775), *Melitaea britomartis* Assmann 1847 and *Nymphalis xanthomelas* (Esper 1781). (CHIMIŞLIU, 2011a).

48. Processed material: 442 specimens belonging to 31 species and subspecies, included in 14 genera, four subfamilies – Apaturinae, Heliconiinae, Limenitidinae, Melitaeinae.

Rare and protected species: *Apatura metis*, *Limenitis reducta*, *Euphydryas aurinia aurinia*, *Melitaea britomartis*. (CHIMIŞLIU, 2011b).

49. Processed material: 379 specimens included in 32 species and subspecies, 18 genera, Satyrinae subfamily.
Note: *Melitaea galathea* (Linnaeus 1758) (f. *leucomelas*) is newly reported in the Oltenia fauna. (CHIMIŞLIU, 2011c).

Family Papilionidae

50. Processed material: 118 specimens belonging to five species and subspecies included in four genera, two subfamilies – Papilioninae, Parnasiinae.
Rare and protected species: *Zerynthia* (*Z.*) *polyxena* (Denis & Schiffermüller 1775), *Parnassius apollo jaraensis* (Kertész 1922), *P. mnemosyne* (Linnaeus 1758) (CHIMIŞLIU, 2008).

Family Pieridae

51. Processed material: 382 specimens belonging to 13 species and subspecies included in seven genera, three families – Coliadinae, Dismorphiinae, Pierinae.
Rare and protected species: *Colias myrmidone* (Esper 1781), *Leptidea morsei* (Fenton 1882), *Colias chrysotheme* (Esper 1781). (CHIMIŞLIU, 2009).

Family Sphingidae

52. Processed material: 82 specimens belonging to 16 species and subspecies included in 13 genera, three subfamilies – Smerinthinae, Sphinginae, Macroglossinae.
Note: three species are now listed for the first time in Oltenia fauna – *Sphinx pinastri* Linnaeus 1758, *Hyles gallii* (Rottemburg 1775), *Hippotion celerio* (Linnaeus 1758). (CHIMIŞLIU, 2010).

ORDER ORTHOPTERA

53. Processed material: 173 specimens belonging to 54 species and subspecies included in 31 genera, seven families – Acrididae, Gryllidae, Gryllotalpidae, Pamphigidae, Tettigoniidae, Tetrigidae, Tridactylidae.
Note: *Asiotmethis limbatus* (Charpentier, 1842) a very rare Balkan species for the country fauna, known so far only in Dobrogea; an endemic species – *Pholidoptera transsylvanica* (Fischer 1853), Carpathian element, rare at lower heights and four less widespread species, occurring localy – *Pteronemobius heydenii*, (Fischer 1853), *Tetrix tuerki tuerki* (Krauss 1876), *Celes variabilis variabilis* (Pallas 1771), *Chrysochraon dispar dispar* (Germar 1834). (TOGĂNEL & CHIMIŞLIU, 2005).

Protected insects of community interest

54. Processed material: 48 specimens belonging to 12 species included in 12 genera, three orders – Orthoptera (1 species, 1 genus), Coleoptera (5 species, 5 genera) and the Lepidoptera order (6 species, 5 genera).
Protected species: *Pholidoptera transsylvanica* (Fischer 1853) – Orthoptera order, *Cerambyx cerdo* Linnaeus 1758, *Rosalia alpina* (Linnaeus 1758), *Morimus funereus* Mulsant 1863, *Lucanus cervus* Linnaeus 1758, *Osmoderma eremita* (Scopoli 1763) – Coleoptera order, *Parnassius mnemosyne* (Linnaeus 1758), *Colias myrmidone* (Esper 1780), *Lycaena dispar* (Haworth 1802), *Maculinea nausithous* (Bergsträsser, 1779), *Euplagia quadripunctaria* (Poda 1761) – Lepidoptera order. (CHIMIŞLIU, 2006a).

Invasive insect species preserved in the museum heritage

55. Processed material: 166 specimens belonging to nine species included in nine genera, four orders – Coleoptera, Dictyoptera, Hemiptera, Orthoptera. (CHIMIŞLIU, 2011c).

56. Processed material: 654 specimens belonging to 12 species and 11 genera, four orders – Coleoptera, Dictyoptera, Hemiptera, Orthoptera. (CHIMIŞLIU, 2011d).

RESULTS

We analyzed 56 published works. Of these, nine works were compiled from data of the insects preserved in the purchased collections, one paper was based on the data of the insects preserved in the donated collections and 46 papers were based on the collected insects data.

Data of 6,223 specimens of the 11,241 **purchased** insects were published. A number of 5,018 insects preserved in «Ion Firu» Entomological Collection have not been processed and published.

Of the 7,539 specimens from **donations**, only 935 macrolepidopterans from „Ioan Stănoiu" donation were published. The 6,604 donated pieces are unpublished (6,512 microlepidopterans from „Ioan Stănoiu" donation and 92 specimens of the „Aurelia Ursu" donation).

As for the 35,090 collected specimens, the data of 17,031 specimens were published. Data held by 18,059 collected insects are still unprocessed.

Entomological heritage processing situation is shown in Table 1.

Table 1. Status of scientific capitalization of entomological heritage.
Tabel 1. Stadiul valorificării ştiinţifice al patrimoniului entomologic.

	Number of pieces purchased collections 11,241		**Nr. donations pieces 7,539**		**Nr. collected pieces 35,090**		**Total pieces 53,870**	
	published	unpublished	published	unpublished	published	unpublished	published	unpublished
No. piese	6223	5018	935	6604	17,031	18,059	24,189	29,681
%	55.36%	44.64%	12.40%	87.60%	48.54%	51.46%	44.90%	55.10%

In the processed and published heritage have been identified:

- Six new species for the Romanian fauna: four species of Diptera – *Dolichopus sabinus*, *Synthormon rufipes*, *Sciapus contristans* (PÂRVU & CHIMIŞLIU, 1982), *Anthyphrison trifarius* (WEINBERG & CHIMIŞLIU, 1996) and two species of beetles – *Triodonta flavimana* (CHIMIŞLIU, 2003) and *Aleochara breiti* (STAN & CHIMIŞLIU, 2005);
- a new genre (*Triodonta*) for the Romanian fauna;
- six species reported for the second time in Romanian fauna: *Eutolmus mediocris*, *Antipalus bilobus* (WEINBERG & CHIMIŞLIU, 1990-1993b), *Anthrax varia* (WEINBERG & CHIMIŞLIU, 1995), *Comsobata (Trylophyrobata) nigricornis* (WEINBERG & CHIMIŞLIU, 1996a), *Choerades fulva* (WEINBERG & CHIMIŞLIU, 1996b) *Epitriptuis cowini* (CHIMIŞLIU, 2003-2004);
- 137 species and subspecies reported for the first time in the fauna of Oltenia.
- 15 genera and subgenera newly reported in Oltenia: *Alocoderus* Schmidt 1913, *Biralus* Mulsant 1870, *Esymus* Mulsant & Rey 1870, *Nobius* Mulsant & Rey 1870, *Trichonotulus* Bedel 1911, *Chaetonyx* Schaum 1862, *Glaresis* Erichson 1848, *Trox* Fabricius 1775, *Odontaeus* Klug 1843, *Triodonta*, *Dolichopus* Latreille 1796, *Syntormon* Loew 1857, *Sciapus* Zeller 1842, *Anthiphrisson* Loew 1849 and *Aleochara* Gravenhorst, 1802.

DISCUSSIONS

The collection preserves both common species in nature, which remain testimony to the existence of species in nature at a time, but also rare and very rare wildlife not only in Romanian, but also in the fauna of Europe. The existence of protected species of community and national level in the museum heritage attests the scientific, national and international value of the preserved entomological collections.

The identification of new taxa for the fauna of Romanian, the reconfirmation mentions of the species presence in Romanian fauna and the identification of protected species of Community and national level such as *Osmoderma eremita*, *Rosalia alpina*, *Euplagia quadripunctaria*, *Cerambyx cerdo*, *Morimus funereus*, *Pilemia tigrina*, *Lucanus cervus*, *Parnassius apollo*, *Parnassius mnemosyne*, *Zerynthia polyxena*, *Lycaena dispar*, *Pholydoptera transsylvanica* certify the diversity and the scientific importance of the insect fauna of Romania.

The specimens of *Scarabaeus affinis* preserved in the heritage provides data on the presence of this protected species of national interest, very rare in Romanian fauna.

In those 56 papers there were published data from the orders: Coleoptera, Dictyoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Orthoptera I mention that there are still some families of these orderes whose data was not yet processed. There are still many insects that have not yet been determined and which certainly hold important scientific data that someday will be processed and published. Given that the remained unpublished insect groups are less known and studied, the results of processing these insects may be more spectacular than those achieved so far.

The determination and publication of these groups of insects offered scientific pleasant surprises every time by identifying new species for the country's fauna species, by reconfirming some species that were reported tens of years before in Oltenia fauna and implicitly in Romanian fauna.

CONCLUSIONS

The entomological heritage of the Oltenia Museum Craiova was scientifically valorized by processing and publishing the data held by 24,189 insects preserved in the entomological collections (44.90%).

The purchased collections were processed and published in proportion of 55.36%, the donations in proportion of 12.40% , and those collected in proportion of 48.54%.

The published data from the museum heritage, have contributed to a better understanding of the diversity and the habitat of the insects from the Oltenia fauna which is little known compared to other areas of the country.

The results show the importance of the museum collections in the knowledge of diversity of the insect fauna. Because of the small number of the specialists from museums and because of the museum activity diversity, many data remain unknown years, maybe tens of years until the insects are determined and published.

This material may be a reference work for the specialists interested in knowing the insect fauna of Oltenia, and for experts who will address this area in the museum in the future. It will constitute a database on the state of valorization and knowledge of the entomological heritage.

The museum collections are the natural treasure of Romania, storing much information about the flora and fauna and it would be ideally that all the data held by museum pieces would be researched and published.

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ASPECTS OF THE DIVERSITY OF BIRD FAUNA FROM RACOVA VALLEY (VASLUI COUNTY, ROMANIA)

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Abstract. Our study is the first one focused on the diversity and present status of bird fauna from the territory of Racova Valley (Vaslui County). Our monitoring activity began during the spring of 2010 year around Puşcaşi reservoir, next years, being extended to other reservoirs forest ecosystems and open lands from this region. We identified 157 bird species, the highest diversity being recorded in the forest ecosystems. The breeding bird fauna include 106 species, 97 being regular breeding. The aquatic and semi-aquatic bird species present a low diversity, while the most important effectives for these groups were recorded during the migration time. We present estimated effectives for the migration period, breeding season and wintering time, but also the phenology status of the bird species that need special conservation measures, being included in the Annexe 1 of the Birds Directive.

Keywords: bird fauna, diversity, effectives, habitats, Racova Valley.

Rezumat. Aspecte ale diversității avifaunei de pe Valea Racovei (județul Vaslui, România). Studiul nostru este primul ce urmărește diversitatea și starea actuală a avifaunei de pe teritoriul Văii Racovei (județul Vaslui). Activitatea de monitorizare a fost inițiată în primăvara anului 2010 în perimetrul acumulării Pușcași, ulterior, fiind extinsă la celelalte acumulări acvatice, suprafețele forestiere și teritoriile deschise din regiune. Au fost identificate 157 de specii de păsări, cea mai mare diversitate fiind întâlnită în ecosistemul forestier. Avifauna clocitoare este reprezentată de 106 specii, dintre care 97 sunt cert clocitoare. Speciile acvatice și semi-acvatice prezintă o diversitate redusă, iar efectivele cele mai importante se înregistrează în timpul migrației. Prezentăm estimări ale efectivelor unor specii pe durata migrației, în sezonul de reproducere și în perioada de iernat, precum și statutul fenologic al speciilor de păsări care fac obiectul unor măsuri speciale de management și conservare, fiind incluse în Anexa 1 a Directivei Păsări.

Cuvinte cheie: avifaună, diversitate, efective, habitate, Valea Racovei.

INTRODUCTION

The importance of knowledge regarding the diversity of the bird fauna and its population size in one territory is given by the status of bio-indicators for this group of vertebrates, recognized through their presence in the annexes of different international conventions (Bonn, Berne, Washington) but also through the Birds Directive that represents one basis of long-term conservation of biodiversity on the territory of the European Union.

There is just one old and general study regarding the diversity of the bird fauna on the territory of Vaslui County (PAPADOPOL, 1975), some data on the breeding bird species from this area being presented in CIOCHIA (1992), respectively, MUNTEANU et al. (2002). Starting from middle '90s, there were done different studies on birds presence and seasonal dynamics from the Prut River basin, but just during the last ten years, the ornithologists began to pay their attention on the bird fauna from forests and other habitats perimeters from this part of Romania related to some projects of wind farms development (GACHE & MULLER, 2010a, 2010b, 2011; GACHE & CHACHULA, 2013).

The territory of Racova Valley is a mosaic of habitats, dominants being the open lands (cultivated lands – rape, sunflower, maize, wheat, rye, barley and alfalfa, dry and humid meadows) and the forest areas (in the vicinity of villages Pușcași, Poiana lui Alexa, Poienești-Deal, Pungești, Gârceni, Dragomirești and Poienești), but also some wetlands and three small reservoirs (Pușcași, Pungești and Trohan) with reed beds, some clumps of willows and humid meadows in their tail areas. During our study period, the reservoirs Pușcași and Trohan were drained temporarily (August 2010 - May 2011, respectively, 2013 - 2014) for hydrotechnical arrangements.

The climate is temperate-continental, with very cold winters, respectively, hot and dry summers.

PERIOD OF STUDY AND METHODS

Our first fieldworks in the area of Racova Valley began during the spring of 2010 year and were focused on the perimeter of Pușcași reservoir and its vicinities - the humid meadow and meadow forest along the Racova River and the reservoir southern side that is hilly, covered by dry meadows with bushes and shrubs, small orchards and vineyards. Beginning with the winter of 2012 year, we started to visit also the forest areas, looking for the raptor birds (Accipitriformes, Falconiformes and Strigiformes) and the presence of the Common Raven (*Corvus corax* Linnaeus 1758).

Starting from June 2013, we established a large principal transect and some secondary transects inside the forest areas (with lengths of about 1 – 1.5 kilometres) for our bird fauna monitoring, in order to obtain a general image of this group presence on the whole Racova Valley, including the other two small reservoirs in our study (Pungești and Trohan). The main transect followed the national road DN 2F, some county roads (DJ 207, DJ 245 and DJ 245A) and local forest roads passing through the villages Laza, Pușcași, Poiana lui Alexa, Fântâna Blănarului, Poienești-Deal, Dragomirești Monastery (Bleșca), Ivănești and Poienești (Fig. 1). We must mention that all transects were shorter during winter period because most of the local and county roads become near impassable due to the rainfalls and snowfalls in the area.

We identified the bird species and we estimated their effectives using the direct observation through the binoculars and telescope (BRUUN et al., 1990), through the visual recording and through the males' sounds, too. We followed to identify and estimate the wintering birds population, but also the diversity and the effectives present during the migration time and breeding period. The forest birds were counted along transects and from fixed observation points, too. For the aquatic birds recorded on the surface of the reservoirs, we counted each bird for the small groups and used the quantitative evaluation in band for the larger groups or flocks than 200 individuals.

During the period May - June, we made nocturnal monitoring too, visiting each site twice in May and June, in order to identify the presence and the effectives of the corncrake (*Crex crex* Linnaeus 1758), protected species in the whole distribution range. We made also a census of the breeding population of white stork (*Ciconia ciconia* Linnaeus, 1758) in the area (May - July).

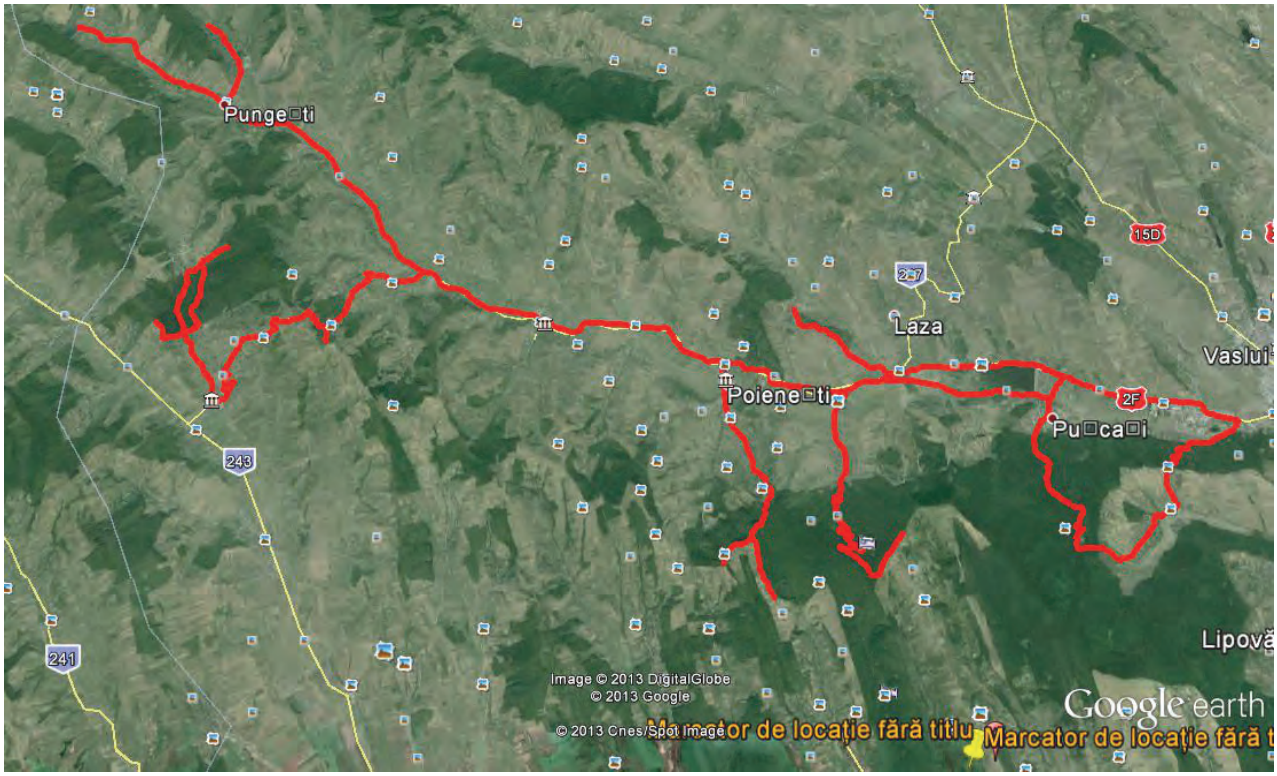

Fig. 1. Transects for bird fauna monitoring on Racova Valley (2013 - 2014), modified from maps.google.

During the migration time, in order to identify the bird species and to evaluate their effectives, we used the transect and fixed point counting methods, the second one being very useful for the monitoring of soaring birds (raptor birds - Accipitridae, Pandionidae and Falconidae, respectively, storks - Ciconiidae). These methods permit, also, to identify the existence of the flyways inside or nearest the site perimeter and to establish the limits of the hunting or feeding territories used by the birds in the visited area.

During the winter period, taking benefits from the better visibility due to the absence of the leaves, we tried to identify the number and the position of the large nests that could be occupied by the raptor birds or by the common raven (*Corvus corax*) in the forest areas along our observation transects and their vicinity. These birds present a calling activity starting from December till February – March, when they occupy the breeding territories and form their pairs.

RESULTS AND DISCUSSIONS

The diversity, the estimated effectives, the phenology and conservation status of the recorded bird fauna from Racova Valley are presented in Table 1, using Sibley & Ahlquist taxonomic system (1995) with subsequent additions and modifications (http://avibase.bsc-eoc.org/). For migration and wintering time, we give the minimum and maximum effective recorded for every species in one day of fieldwork, during the whole period of study. For the conservation status of birds we used like references the Annexes 1 and 2 of the Birds Directive (last revised form, 2009) and the Red Book of Vertebrates from Romania (BOTNARIUC & TATOLE, 2005).

Table 1. Bird fauna recorded from Racova Valley: presence, phenology and conservation status.

No.	Species	Presence on Racova Valley			Phenology In Romania	Birds Directive	Red Book of Vertebrates in Romania
		Breeding (pairs)	Migration (individuals)	Wintering (individuals)			
1.	*Coturnix coturnix*	18 – 27p	x	-	SV	A2	-
2.	*Perdix perdix*	16 – 24p	x	12 - 25	S	A2	-
3.	*Phasianus colchicus*	7 – 11p	x	x	S	A2	-
4.	*Cygnus olor*	+	1 - 25	5 – 11	PM	A2	-
5.	*Cygnus cygnus*	-	0 - 3	0 – 5	WV	A1	-
6.	*Anas platyrhynchos*	1 - 5p	41 - 830	56 – 148	PM, WV	A2	-
7.	*Anas strepera*	1 – 2p?	8 - 32	-	SV	A2	-
8.	*Anas acuta*	-	0 - 3	-	P, WV	A2	-
9.	*Anas penelope*	-	6 - 480	-	P, WV	A2	-
10.	*Anas crecca*	-	12 – 820	14 – 134	P, WV, SV	A2	-
11.	*Anas querquedula*	+	17 - 740	-	SV	A2	-
12.	*Anas clypeata*	-	6 - 32	-	P, SV	A2	-
13.	*Netta rufina*	-	0 - 2	-	SV, WR	A2	T
14.	*Tardona tadorna*	-	0 - 1	-	SV	-	V
15.	*Aythya fuligula*	-	2 – 20	8 - 23	P, WV, SV?	A2	-
16.	*Aythya marila*	-	0 - 4	-	P	A2	-
17.	*Aythya ferina*	+	6 - 55	-	PM	A2	-
18.	*Aythya nyroca*	-	2 - 18	-	SV, WR	A1	V
19.	*Bucephala clangula*	-	2 - 11	2 - 8	WV	A2	V
20.	*Mergus merganser*	-	0 - 1	0 – 1	WV	A2	-
21.	*Gavia arctica*	-	-	0 - 1	WV	A1	-
22.	*Phalacrocorax carbo*	-	1 - 24	-	SV	-	-
23.	*Ardeola ralloides*	1 – 2p?	1 – 3	-	SV	A1	V
24.	*Nycticorax nycticorax*	2 - 5p?	4 – 20	-	SV	A1	V
25.	*Egretta garzetta*	1 – 2p?	2 – 36	-	SV	A1	T
26.	*Ardea alba*	+	3 – 5	-	SV, WR	A1	T
27.	*Ardea cinerea*	+	6 - 44	-	SV,WR	-	-
28.	*Ciconia ciconia*	9p	18 - 156	-	SV	A1	V
29.	*Ciconia nigra*	-	0 - 3	-	SV	A1	V
30.	*Clanga pomarina*	1p?	x	-	SV	A1	V
31.	*Hieraaetus pennatus*	-	x	-	SV	A1	En
32.	*Buteo buteo*	3 – 5p	x	5 – 10	PM	-	-
33.	*Buteo lagopus*	-	x	1 – 4	WV	-	-
34.	*Pernis apivorus*	1p	x	-	SV	A1	V
35.	*Accipiter gentilis*	2 – 3p	x	1 – 5	S	-	-
36.	*Accipiter nisus*	-	x	2 – 5	S, WV	-	-
37.	*Circus aeruginosus*	-	x	-	SV	A1	-
38.	*Circus pygargus*	-	x	-	SV	A1	T
39.	*Circus cyaneus*	-	x	-	WV	A1	-
40.	*Falco peregrinus*	-	-	1 – 3	S. WV	A1	T
41.	*Falco columbarius*	-	-	5 – 7	WV	A1	-
42.	*Falco tinnunculus*	5 – 11p	x	-	PM	-	-
43.	*Falco subbuteo*	3 – 5p	x	-	SV	-	-
44.	*Crex crex*	28 – 40p	x	-	SV	A1	V
45.	*Gallinula chloropus*	4 – 6p	12 - 35	-	SV	A2	-
46.	*Fulica atra*	5 – 42p	12 - 277	12 - 38	PM	A2	-
47.	*Gallinago gallinago*	-	1 – 40	-	P	A2	-
48.	*Lymnocryptes minimus*	-	0 – 8	-	P	A2	-
49.	*Numenius arquata*	-	0 – 32	-	SV	A2	-
50.	*Limosa limosa*	-	3 - 48	-	P, SV	-	-
51.	*Actitis hypoleucos*	-	1 – 11	-	P	-	-
52.	*Tringa ochropus*	-	2 – 18	-	P	-	-
53.	*Tringa glareola*	-	4 – 32	-	P	A1	-
54.	*Tringa nebularia*	-	3 – 12	-	P	A2	-
55.	*Tringa totanus*	-	17 - 29	-	P	A2	-
56.	*Tringa erythropus*	-	18 – 46	-	P	A2	-
57.	*Philomachus pugnax*	-	12 – 88	-	P	A1	-
58.	*Himantopus himantopus*	1p?	0 – 5	-	SV	A1	T
59.	*Vanellus vanellus*	7 – 18p	12 – 78	-	SV	A2	-
60.	*Charadrius dubius*	1 – 2p	2 - 6	-	SV	-	-
61.	*Larus cachinnans*	1 – 2p	12 - 124	4 – 12	S	A2	-
62.	*Larus minutus*	-	1 – 11	-	SV	A1	-
63.	*Chroicocephalus ridibundus*	1 – 5p	23 - 533	5 - 36	PM	A2	-
64.	*Sterna hirundo*	2 – 5p	7 – 21	-	SV	A1	-
65.	*Chlidonias hybrida*	17 – 67p	12 – 32	-	SV	A1	-
66.	*Chlidonias niger*	+	0 – 11	-	SV	A1	-
67.	*Podiceps cristatus*	4 – 25p	5 – 45	-	SV	-	-

68.	*Podiceps grisegena*	-	1 – 5	-	SV	-	-
69.	*Podiceps nigricollis*	1 - 3p	3 – 8	-	SV	-	-
70.	*Tachybaptus ruficollis*	1 – 2p	4 - 13	-	SV	-	-
71.	*Columba palumbus*	+/C	x	-	SV, WR	A2	-
72.	*Streptopelia turtur*	+/C	x	-	SV	A2	V
73.	*Streptopelia decaocto*	+/C	x	x	S	A2	-
74.	*Cuculus canorus*	+/C	x	-	SV	-	-
75.	*Caprimulgus europaeus*	+/C	x	-	SV	A1	-
76.	*Athene noctua*	+/C	x	x	S	-	-
77.	*Asio otus*	+/C	x	x	S	-	-
78.	*Strix aluco*	+/C	x	x	S	-	-
79.	*Upupa epops*	+/C	x	-	SV	-	V
80.	*Merops apiaster*	+/C	x	-	SV	-	-
81.	*Picus canus*	+/C	x	x	S	A1	-
82.	*Picus viridis*	+/C	x	x	S	-	-
83.	*Dendrocopos major*	+/C	x	x	S	-	-
84.	*Dendrocopos syriacus*	+/C	x	x	S	A1	-
85.	*Dendrocopos medius*	+/C	x	x	S	A1	-
86.	*Jynx torquilla*	+/C	x	-	SV	A1	T
87.	*Oriolus oriolus*	+/C	x	-	SV	-	-
88.	*Lanius collurio*	+/C	x	-	SV	A1	-
89.	*Lanius minor*	+/C	x	-	SV	A1	-
90.	*Lanius excubitor*	-	x	x	SV	-	-
91.	*Pica pica*	+/C	x	x	S	A2	-
92.	*Garrulus glandarius*	+/C	x	x	S	A2	-
93.	*Corvus monedula*	+/C	x	x	S	A2	-
94.	*Corvus frugilegus*	+/C	x	x	S	A2	-
95.	*Corvus cornix*	+/C	x	x	S	-	-
96.	*Corvus corax*	+/C	x	x	S	-	T
97.	*Alauda arvensis*	+/C	x	-	PM	A2	-
98.	*Galerida cristata*	+/C	x	x	S	-	-
99.	*Hirundo rustica*	+/C	x	-	SV	-	-
100.	*Delichon urbicum*	+/C	x	-	SV	-	-
101.	*Riparia riparia*	+/C	x	-	SV	-	-
102.	*Phylloscopus collybita*	+/C	x	-	SV	-	-
103.	*Phylloscopus sibilatrix*	+/C	x	-	SV	-	-
104.	*Locustella fluviatilis*	+/C?	x	-	SV	-	-
105.	*Locustella luscinioides*	+/C	x	-	SV	-	-
106.	*Acrocephalus arundinaceus*	+/C	x	-	SV	-	-
107.	*Acrocephalus scirpaceus*	+/C	x	-	SV	-	-
108.	*Acrocephalus schoenobaenus*	+/C	x	-	SV	-	-
109.	*Hippolais icterina*	+/C	x	-	SV	-	-
110.	*Sylvia communis*	+/C	x	-	SV	-	-
111.	*Sylvia curruca*	+/C	x	-	SV	-	-
112.	*Sylvia borin*	+/C	x	-	SV	-	-
113.	*Sylvia atricapilla*	+/C	x	-	SV	-	-
114.	*Panurus biarmicus*	+/C	x	-	PM	-	-
115.	*Ficedula albicollis*	+/C	x	-	SV	A1	-
116.	*Ficedula parva*	+/C?	x	-	SV	A1	-
117.	*Muscicapa striata*	+/C	x	-	SV	-	-
118.	*Oenanthe oenanthe*	+/C	x	-	SV	-	-
119.	*Saxicola rubetra*	+/C	x	-	SV	-	-
120.	*Saxicola torquata*	+/C	x	-	SV	-	-
121.	*Phoenicurus phoenicurus*	+/C	x	-	SV	-	-
122.	*Phoenicurus ochruros*	+/C	x	-	SV	-	-
123.	*Erithacus rubecula*	+/C	x	-	SV	-	-
124.	*Luscinia luscinia*	+/C	x	-	SV	-	-
125.	*Luscinia megarhynchos*	+/C	x	-	SV	-	-
126.	*Turdus merula*	+/C	x	x	SV	A2	-
127.	*Turdus philomelos*	+/C	x	-	SV	A2	-
128.	*Turdus iliacus*	-	x	-	P	A2	-
129.	*Turdus viscivorus*	-	x	-	P	A2	-
130.	*Turdus pilaris*	-	-	x	PM, WV	A2	-
131.	*Sturnus vulgaris*	+/C	x	-	PM	A2	-
132.	*Sitta europaea*	+/C	x	x	S	-	-
133.	*Certhia familiaris*	+/C	x	x	S	-	-
134.	*Troglodytes troglodytes*	+/C	x	x	S	-	-
135.	*Poecile palustris*	-	x	-	P	-	-
136.	*Poecile lugubris*	+/C	x	x	S	-	-
137.	*Parus major*	+/C	x	x	S	-	-
138.	*Cyanistes coeruleus*	+/C	x	x	S	-	-
139.	*Passer domesticus*	+/C	x	x	S	-	-

140.	*Passer montanus*	+/C	x	x	S	-	-
141.	*Anthus campestris*	+/C	x	-	SV	A1	-
142.	*Anthus trivialis*	+/C	x	-	SV	-	-
143.	*Anthus pratensis*	+/C	x	-	SV	-	-
144.	*Motacilla alba*	+/C	x	-	PM	-	-
145.	*Motacilla flava*	+/C	x	-	SV	-	-
146.	*Fringilla coelebs*	+/C	x	x	PM	-	-
147.	*Fringilla montifringilla*	-	-	x	WV	-	-
148.	*Pyrrhula pyrrhula*	-	-	x	S	-	-
149.	*Coccothraustes coccothraustes*	+/C	x	x	S	-	-
150.	*Carduelis spinus*	-	x	x	PM	-	-
151.	*Carduelis chloris*	+/C	x	-	SV	-	-
152.	*Carduelis carduelis*	+/C	x	x	S	-	-
153.	*Carduelis cannabina*	+/C	x	-	PM	-	-
154.	*Emberiza calandra*	+/C	x	-	PM	-	-
155.	*Emberiza hortulana*	+/C	x	-	SV	A1	-
156.	*Emberiza citrinella*	+/C	x	x	S	-	-
157.	*Emberiza schoeniclus*	+/C	x	-	PM	-	-

Legend:
Presence on Racova Valley: Breeding: + - summer present but not breeding species; +/C – breeding species, not recorded effectives; +/C? – probably breeding species, not recorded effectives; 1 – 2p? – probably breeding species; Migration & Wintering: x – present species, not recorded effectives.
Phenology: S – sedentary species; SV – summer visitor species; PM – partial migratory species; WV – wintering visitor species; WR – wintering rare species; P – passage species.
Birds Directive: A1 – species from Annexe 1; A2 – species from Annexe 2.
Red Book of Vertebrates in Romania: V – vulnerable species; T – threatened species; En – endangered species.

The elements that define the vegetation of one territory are essentially for bird populations. As we mentioned above, on the Racova Valley territory, the habitats of forest and open lands are dominant, so, the passerines and other bird species that are breeding and feeding inside these habitats are dominant, being represented by 105 species in the bird fauna list of the area. Despite the small sizes of reservoirs and wetlands on this territory (including the largest one, Pușcași reservoir, if we compare it with other reservoirs from Vaslui County), the bird fauna list includes 55 aquatic or semi-aquatic bird species and some passerines species that use these habitats to feed or breed.

Looking for the birds phenology on Racova Valley, we notice some deviations from their status in Romania, explained especially through the absence or small surfaces of suitable habitats for the breeding season. For example, the recorded aquatic birds in the area need large reed beds in order to build their nests, so, their summer presence is done by immature individuals that are not breeding, using these territories in order to avoid the feeding competition with the adult birds (*Cygnus olor* Linnaeus 1758, *Anas querquedula* Linnaeus 1758, *Larus cachinnans* Pallas 1811, *Chroicocephalus ridibundus* Linnaeus 1766, etc.).

The highest bird fauna diversity was recorded during spring, in March – April, when we met 133 bird species, while during winter time, the bird fauna list includes just 52 bird species, most of them being passerines and woodpecker sedentary species.

The raptor birds group presents a high diversity during winter time, but their effectives were unexpectedly low for one territory with large forest areas. *Buteo buteo* Linnaeus 1758 was the dominant species through the effectives and number of presence in recording points, being followed by *Buteo lagopus* Pontoppidan 1763, *Accipiter nisus* Linnaeus 1758, *Falco peregrinus* Tunstall 1771 and *Falco columbarius* Linnaeus 1758. After the middle February, we recorded an obvious diminution of these species effectives in the investigated area, while in March, we recorded just *Buteo buteo* and *B. lagopus* from the raptor birds winter visitors, respectively, the passage species (*Clanga pomarina* Brehm 1831, *Hieraaetus pennatus* Gmelin 1778, *Circus cyaneus* Linnaeus 1766 or *C. pygargus* Linnaeus 1758) and the arrival of the summer visitor species (*Buteo buteo*, *Pernis apivorus* Linnaeus 1758, *Falco tinnunculus* Linnaeus 1758 and *F. subbuteo* Linnaeus 1758).

In the last decade of February, the nocturnal raptor birds (*Asio otus* Linnaeus 1758 and *Strix aluco* Linnaeus 1758), but also the Common Raven (*Corvus corax*) were identified by their calling activity, but also were observed with mating display behaviour or in matting flying sequences.

On Pușcași reservoir, we recorded 11 aquatic bird species in the wintering period, but we must emphasis the idea that, usually, all the aquatic surfaces are frozen starting from middle December till middle February, sometimes, March beginning, so, these bird species (*Cygnus olor*, *C. cygnus* Linnaeus 1758, *Anas platyrhynchos* Linnaeus 1758, *A. crecca* Linnaeus 1758, *Aythya fuligula* Linnaeus 1758, *Bucephala clangula* Linnaeus 1758, *Mergus merganser* Linnaeus 1758, *Gavia arctica* Linnaeus 1758) are present just during the mild winters, with small effectives.

We cannot exclude completely the possibility of existence of some flyways for soaring birds in this region but we did not meet very large flocks of diurnal raptor birds or storks during the spring or autumn migration period. The largest flocks were recorded for the white stork (C*iconia ciconia*), formed by 18 – 156 individuals, during the last decade of March or first days of April.

During the summer time, 112 bird species are present on the territory of Racova Valley, but we assess that 97 are regular breeding species and another 9 bird species are probable or irregular breeding species (we recorded adult birds presence, with parental behaviour but also juvenile birds presence in the last part of the breeding season in the area).

If we look for the ecological groups related to the suitable habitats for nest building, the breeding bird fauna on Racova Valley comprises especially forests and open lands typically birds, the passerines being dominant with 63 breeding species (64.28% from the total of the breeding bird fauna). From these, 57 passerine species use to build their nests inside forests, in shrubs and bushes or on the soil, between herbs in open lands, the other 6 passerine species being related to reed beds (*Locustella* sp., *Acrocephalus* sp. and *Emberiza schoeniclus* Linnaeus 1758).

The dry meadows with scattered bushes and shrubs, but also the cultivated lands from Racova Valley territory represent suitable breeding and feeding habitats for some passerines species that use to build their nests between herbs (*Alauda arvensis* Linnaeus 1758, *Galerida cristata* Linnaeus 1758, *Oenanthe oenanthe* Linnaeus 1758, *Anthus campestris* Linnaeus 1758, *Motacilla flava* Linnaeus 1758 or *M. alba* Linnaeus 1758) or inside bushes and shrubs (*Lanius colllurio* Linnaeus 1758, *L. minor* Gmelin 1788, *Saxicola rubetra* Linnaeus 1758, *S. torquata* Linnaeus 1758, *Emberiza calandra* Linnaeus 1758 and *E. hortulana* Linnaeus 1758). In these habitats, we observed also the three species of galliforms (*Perdix perdix* Linnaeus 1758, *Coturnix coturnix* Linnaeus 1758 and *Phasianus colchicus* Linnaeus 1758), all of them being game birds with discreet life and cryptic plumage that make difficult their census. We used the calling activity of males in order to estimate their effectives in the investigated area.

The presence of the Corncrake (*Crex crex*) is one of the most important bio-indicators used to assess the quality of environment in one rural area with large surfaces covered by humid meadows or mosaic of meadows with cultivated lands (wheat, rye, barley and alfalfa). The breeding population of corncrake on Racova Valley was estimated at about 28 – 40 pairs, neither met nor only on the suitable habitats, but also in the forests edge areas from the vicinity of cultivated lands.

The suitable habitats for the riparian bird species occupy small areas – some river banks, clay extraction quarries and some open clay grounds resulted through landslide phenomenon. The most important was met on the south-western side of Pușcași Lake, where we recorded one mixed breeding colony formed by 11 pairs of *Merops apiaster* Linnaeus 1758, 32 pairs of *Riparia riparia* Linnaeus 1758, 8 pairs of *Passer montanus* Linnaeus 1758 and 12 pairs of *P. domesticus* Linnaeus 1758.

Inside the villages, along the principal transect, we identified 9 nests occupied by the white stork (*Ciconia ciconia*). In one nest from Laza village, near Pușcași Reservoir, the pair had four hatchlings every year, starting from 2010 year, excepting the breeding season of 2013 year when there were just three hatchlings.

As we expected, we met the highest diversity during the birds breeding season inside the forest ecosystems, especially in the sector from the south-eastern part of Racova Valley (Pușcași – Poienești-Deal), but also in the forests from Gârceni and Pungești. From the typical forest bird species group, the passerines are dominant through their diversity and effectives, but significant effectives were recorded for the woodpeckers (*Picus viridis* Linnaeus 1758, *Picus canus* Gmelin 1788, *Dedrocopos major* Linnaeus 1758, *D. medius* Linnaeus 1758 and *Jynx torquilla* Linnaeus 1758), respectively, for the pigeons and doves (*Columba palumbus* Linnaeus 1758 and *Streptopelia turtur* Linnaeus 1758).

We recorded four diurnal raptor breeding bird species – two falcons (*Falco tinnunculus* and *F. subbuteo*), respectively, common buzzard (*Buteo buteo*) and European honey buzzard (*Pernis apivorus*), but we cannot exclude the breeding presence of *Clanga pomarina* in the wooden area Pușcași – Poienești-Deal, because we met constantly adult and juvenile birds feeding in the vicinity of Pușcași Lake starting with 2010 spring. From the nocturnal raptor birds group, we observed and recorded calling activity of *Strix aluco* in suitable breeding habitat (forest edge with old trees), while *Asio otus* was recorded with calling activity in forest edges but also in clumps of trees.

On the territory of Racova ValleyPușcași and Pungești reservoirs represent stopover points, breeding and feeding areas for 55 aquatic and semi-aquatic bird species. More than these, there are present also seven passerine species related to the reed beds for the nesting period (warblers – *Acrocephalus sp.* and *Locustella sp.*, bearded reedling – *Panurus biarmicus* Linnaeus 1758 and common reed bunting – *Emberiza schoeniclus*). Another four passerine species were observed feeding around the perimeters of the reservoirs: *Hirundo rustica* Linnaeus 1758, *Delichon urbicum* Linnaeus 1758, *Riparia riparia*, *Motacilla alba* and *Motacilla flava*.

As we can see in Table 1, the aquatic and semi-aquatic breeding bird species present a low diversity on Racova Valley territory, being represented by small breeding effectives. We recorded just some pairs of *Anas platyrhynchos* and two rails species that present varying breeding effectives from one year to other: *Gallinula chloropus* Linnaeus 1758 and *Fulica atra* Linnaeus 1758. We cannot exclude the breeding presence of *Anas strepera*, species with negative trend in Romania. The most important groups through its diversity and effectives are represented by grebes (*Podiceps cristatus* Linnaeus 1758, *P. nigricollis* Brehm 1831 and *Tachybaptus ruficollis* Pallas 1764), terns (*Sterna hirundo* Linnaeus 1758 and *Chlidonias hybrida* Pallas 1811) and gulls (*Larus cachinnans* and *Chroicocephalus ridibundus*) that form a mixed breeding colony on Pușcași Reservoir. The species *Podiceps cristatus* and *Chlidonias hybrida* are dominant, their effectives recording an obviously positive trend, especially if we compare the populations recorded during the summers of 2013 – 2014 with that from 2010 – 2011 summers.

From the group of herons, we did not exclude the breeding presence of *Ardeola ralloides* Scopoli 1769, *Nycticorax nycticorax* Linnaeus 1758 and *Egretta garzetta* Linnaeus 1766 on the tail area from Pușcași Reservoir. Between the wader species, we recorded two certainly breeding species (*Vanellus vanellus* Linnaeus 1758 and *Charadrius dubius* Scopoli 1786), respectively, one probable breeding species (*Himantopus himantopus* Linnaeus 1758).

In the meadow forest along the Racova River, nearest the tail of Pușcași Reservoir, we recorded like breeding species two woodpecker species (*Picus viridis* and *Dendrocopos major*) and different passerines like *Oriolus oriolus* Linnaeus 1758, *Sylvia* sp., *Hippolais icterina* Vieillot 1817, *Luscinia* sp., *Poecile palustris* Linnaeus 1758, *Parus major* Linnaeus 1758, *Cyanistes caeruleus* Linnaeus 1758, *Sturnus vulgaris* Linnaeus 1758, etc.

The autumn migration begins during the first part of August in the area, when some breeding bird species in the forests and woodland areas leave this region (*Cuculus canorus* Linnaeus 1758, *Streptopelia turtur* etc.). In fact, starting even from July, numerous typical forest bird species form small or larger flocks, assembling juvenile and adult birds, and begin to rove searching more abundant food resources, swinging between the forest skirts and nearest agricultural lands, sometime touching the limit of the villages (warblers – *Sylvia* sp., flycatchers – *Ficedula* sp., redstarts – *Phoenicurus* sp., and finches – *Fringilla* sp. and *Carduelis* sp.). In the ending August, some bird species can bring together tens and hundreds individuals, forming the flocks before the migration start (for example, *Sturnus vulgaris*). Most of the bird species typical for the forests and woodlands still search their food inside the forests perimeter.

During this period the birds present a very intensive mobility, including the sedentary species, searching food in order to accumulate a thick grease stratum necessary to survive in the wintering time, respectively, for the flying efforts during the migration period. Practically, the birds present daily movements on large distances, flying from the overnight, resting and refuge sites (woodland surfaces, bushes, shrubs, etc.) to the open lands, where can find various and rich food resources. The typical forest birds were met wandering in small groups between the forest skirts and the nearest open lands (dry meadows, agricultural lands), using the food resources generated through the crop harvesting and appeared in the herbal vegetation ending periods (fruits, seeds).

While inside the forests and in the open lands perimeter the diversity of birds becomes lower every month beginning with late August; the aquatic and semi-aquatic bird groups present the highest annual diversity during the autumn migration period, due the arrival of the passage species that breed in northern territories. Very different from the spring migration time, when the birds quickly leave this area in order to arrive in their northern breeding territories, during this passage period, the birds stay for longer time, sometimes even for ten – twelve days, feeding in the rich wetlands around Pușcași and Pungești Reservoirs, accumulating lipid reserves necessary for the long flying to the southern wintering areas.

Starting from August, the aquatic and semi-aquatic bird species appear in larger or smaller flocks, especially, on Pușcași Reservoirs, forming mixed feeding flocks on the sector from the reservoir tail area. The waders and herons appear in flocks of tens individuals, while the gulls are present in flocks of tens to hundreds individuals. The ducks arrival begins in late August, but from September, the ducks become dominant inside the aquatic bird species through their diversity and effectives till the end of November.

Due to the importance of some bird species for the biodiversity monitoring schemes and ecological management plans development/implementation, we present the conservation status of the recorded bird species in Table 1, very important being the species that are included in the Annexes of the Birds Directive. So, the bird species included in Annexe 1 like species that need special conservation measures concerning their habitats in order to ensure their survival and the reproduction in their distribution range, while those included in Annexe 2 can be object of hunting without threatening the aim to maintain long-term stable populations on the territory of the European Union.

During our study period, we recorded 36 bird species from Annexe 1 of the Birds Directive, 15 of these being included also in the Red Book of Vertebrates from Romania (BOTNARIUC & TATOLE, 2005), other 42 species being present in Annexe 2 of the Birds Directive, three of them being included in the Red Book of Vertebrates from Romania, too.

We must mention the presence of 16 regular breeding and another five probable or irregular breeding bird species in Annexe 1 of the Birds Directive. Between these, we notice the presence like breeding bird species for two big size raptor bird species (*Clanga pomarina* and *Pernis apivorus*), but also of the corncrake (*Crex crex*), protected species in the whole distribution range.

We cannot forgot to mention the presence of some breeding species that present negative trend on the territory of the European Union like *Emberiza hortulana*, *Ficedula albicollis* Temminck 1815, *F. parva* Bechstein 1792, *Upupa epops* Linnaeus 1758 or *Jynx torquilla*, but also of shrikes (*Lanius minor* and *L. collurio*), which present concentrated breeding populations in our country.

On the bird fauna list of Racova Valley, we recorded 21 species that are included in the Red Book of Vertebrates from Romania, most of them being vulnerable species. The passage species group is well represented (*Tadorna tadorna* Linnaeus 1758, *Aythya nyroca* Gűldenstädt 1770, *Bucephala clangula*, *Nyctocorax nycticorax* și *Ciconia nigra* Linnaeus 1758); five species (*Ciconia ciconia*, *Pernis apivorus*, *Crex crex*, *Streptopelia turtur* and *Upupa epops* Linnaeus 1758) are regular breeding species and another two (*Ardeola ralloides* and *Clanga pomarina*) are probably breeding species in the investigated territory.

We notice the passage presence of *Hieraaetus pennatus*, endangered species in Romania and of 8 threatened bird species – from these, *Jynx torquilla* and *Corvus corax* breed in the woodlands from the Racova Valley territory, *Egretta garzetta* and *Himantopus himantopus* could breed on the tail of Pușcași Reservoir, while *Netta rufina* Pallas 1773, *Ardea alba* Linnaeus 1758 and *Circus pygargus* are passage bird species, *Falco peregrinus* being winter visitor in this area.

CONCLUSSIONS

The bird fauna list of Racova valley territory comprises 157 bird species, the highest diversity being recorded during the spring migration period (133 bird species in prevernal aspect, March - April).

The breeding bird fauna includes 97 regular breeding bird species and 9 probable or irregular breeding bird species; the biggest diversity was recorded in the woodlands and vicinity of forest edges.

The reservoirs from the investigated territory – Pușcași and Pungești – represent stopover points and feeding territories during the migration time, while the suitable habitats for the breeding season cover small surfaces. Normally, the lakes are frozen during winter period, so, the aquatic birds winter here just during the mild winters.

The greatest effectives of aquatic and semi-aquatic bird species were recorded during the migration time (March, respectively, October - November).

From the observed bird fauna, 36 species appear in Annexe 1 of Birds Directive, 16 of them being breeding species in the area and other 5 species could breed in this territory.

42 bird species appear in Annexe 2 of Birds Directive.

21 species from the recorded bird species are included in the Red Book of Vertebrates from Romania, like vulnerable species (12), threatened species (8) or endangered species (one).

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THE ECOLOGICAL DISTRIBUTION OF THE BIRDS FROM THE AREA OF THE INTERNATIONAL AIRPORT CRAIOVA (0–13 KM) AND THE RISK DEGREE THAT BIRDS MAY REPRESENT FOR AIR TRAFFIC

RIDICHE Mirela Sabina, MUNTEANU Dan

Abstract. In our study, we present an image of the avifauna reported within the perimeter of the I. A. C. and its adjacent surroundings (0-13 km), including the distribution of the bird species on types of habitats/biotopes identified within the analysed perimeter, their relation to the living environment, as well as the risk degree birds may represent for air traffic. On the whole, we identified 138 species belonging to 18 systematic orders; according to their specific biotope, they are distributed as it follows: 9 species are typical of grasslands and agroecosystems, 71 species are typical of forest areas (forests and shrubs), 51 species are typical of aquatic areas, 3 species are synanthropic (depending on human settlements) and 4 species are eurytopic, relatively similarly distributed in many biotopes. The highest risk factor for air traffic is represented by the bird species characteristic of forests and shrubs (*Phasianus colchicus, Buteo buteo, Columba palumbus, Sturnus vulgaris, Corvus frugilegus, C. monedula,* etc.), followed by the aquatic bird species (*Ardea cinerea, Anas platyrhynchos, Larus* sp. ș.a.) and the synanthropic ones (*Columba livia domestica, Hirundo rustica, Delichon urbicum*).

Keywords: bird fauna, biotopes, International Airport Craiova (I. A. C.).

Rezumat. Distribuția ecologică a păsărilor din zona Aeroportului Internaţional din Craiova (0–13 km) și gradul de risc pe care păsările îl ridică pentru traficul aerian. În studiul nostru prezentăm un tablou al avifaunei semnalate în perimetrul A. I. C. şi în zonele adiacente acestuia (0-13 km), cuprinzând distribuţia speciilor de păsări în tipurile de habitate/biotopuri din arealul analizat, relaţia acestora cu mediile de trai, precum şi gradul de risc pe care păsările îl ridică pentru traficul aerian. În ansamblu am consemnat un număr de 138 de specii încadrate în 18 ordine sistematice şi repartizate, după aparteneța la biotopul specific, astfel: 9 specii sunt tipice pentru habitatele de pajişti şi agroecosisteme, 71 de specii sunt tipice suprafeţelor forestiere (păduri şi tufărişuri), 51 de specii sunt tipice zonelor acvatice, 3 specii sunt sinantrope (dependente de aşezările omeneşti), iar 4 specii sunt euritope, cu răpândire relativ egală în mai multe biotopuri. Cele mai multe ameninţări legate de traficul aerian provin din partea speciilor de păsări tipice pentru pădure şi tufărişuri (*Phasianus colchicus, Buteo buteo, Columba palumbus, Sturnus vulgaris, Corvus frugilegus, C. monedula* etc.)., urmate de speciile de păsări acvatice (*Ardea cinerea, Anas platyrhynchos, Larus* sp. ș.a.) și cele sinantrope (*Columba livia domestica, Hirundo rustica, Delichon urbicum*).

Cuvinte cheie: avifauna, biotopuri, Aeroportul Internațional Craiova. (A. I. C.).

INTRODUCTION

Craiova municipality is located within the Romanian Plain, respectively Oltenia Plain, on the left bank of the Jiu River and represents the largest and the most important urban settlement from south-western Romania. The city is 227 km away from the country capital, Bucharest, and 68 km from the Danube.

The International Airport Craiova (I. A. C.) is situated in the eastern part of Craiova, 7 km from the city centre, at an altitude of 191 m above the sea level (http://ro.wikipedia.org/wiki/Craiova#cite) – Fig. 1. The adjacent area of the I.A.C. is located in the Teslui hydrographical basin, in the eastern and north-eastern part, while its western and south-western part belongs to the Jiu hydrographical basin.

The Teslui River has a tributary, namely the Ghercești Valley, which springs from the immediate proximity, north of the Airplane Factory (located in the western part of I. A. C.) and flows into the Teslui at the southern limit of the settlement with the same name. A quite large retention pond was built on this tributary. Immediately south of Craiova – Balş – Slatina highroad, starting from the eastern end of the main track of the airport, there appears a torrential valley that goes eastwards. This valley intersects many furrows with intermittent water that get dry during summer.

In the Jiu basin, west of the airport, there are located some torrential valleys (they spring from the high part of the plain and cross the river terraces) and Doctorului Lake (Doctor's Lake) (located on the high terrace), while in the southwest, the main torrential valleys that cross the Jiu terraces are: Fetei Valley (Girl's Valley), Bătrână Valley (Old Valley), Izvorului Valley (Spring Valley); along this last valley, there are 11 reservoirs that are known as Preajba-Făcăi lacustrine complex.

Being located at the southern limit of Olteț Piedmont and the northern limit of Leu – Rotunda high plain, the I. A. C. and its adjacent area presents mainly typical luvisols and some small areas with preluvisols. On the high terrace of the Jiu, located in the western part of the airport, psamosoils predominate (BADEA et al., 2011).

The climate is temperate continental, specific to plain areas, with sub-Mediterranean influences. Due to its location in the south-west of the country, Craiova area undergoes the influence of the baric centres situated over the Mediterranean Sea, while in winter, there is also present the influence of the East-European Anticyclone (MARINICĂ, 2006).

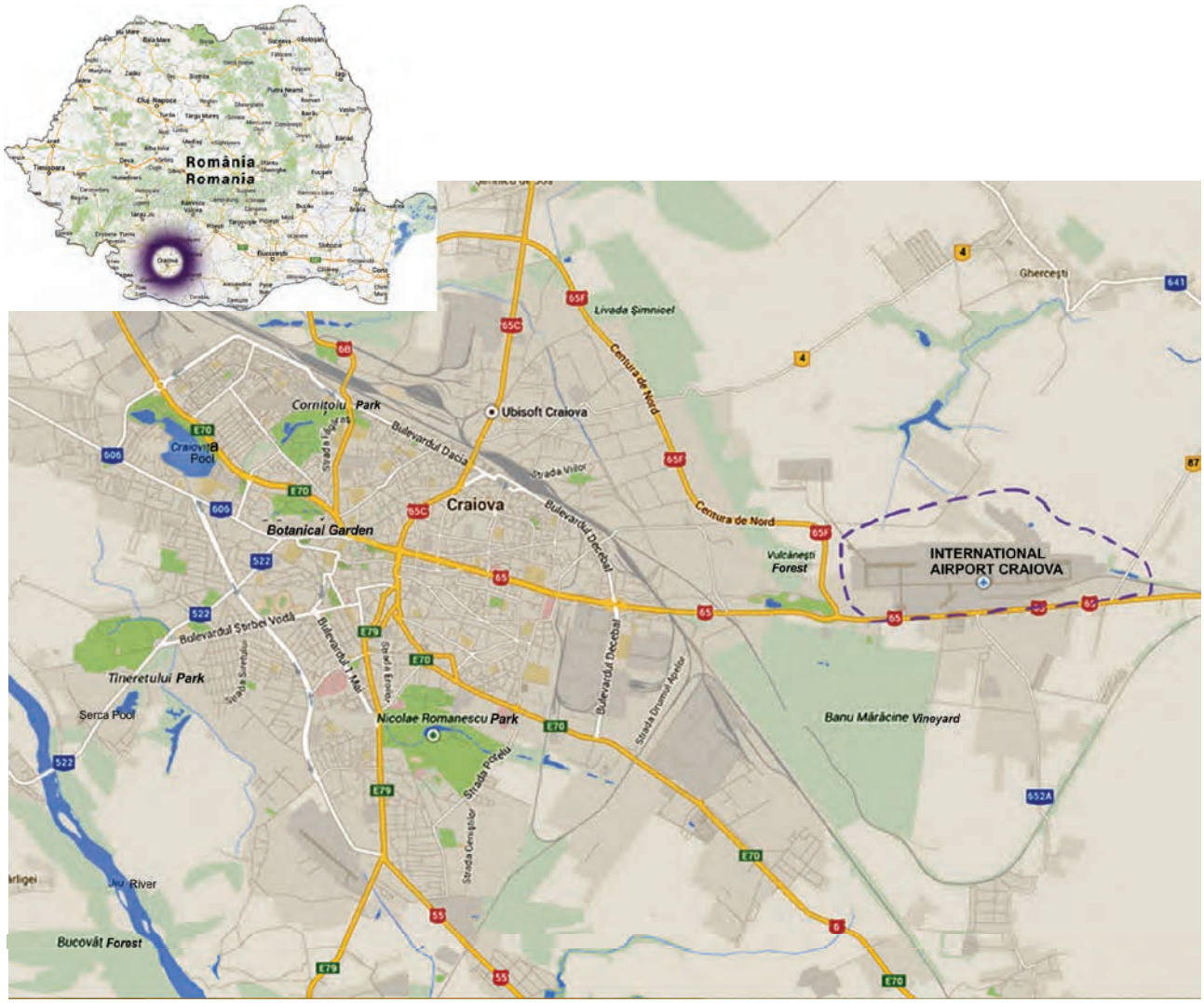

Figure 1. Location of the I. A. C. (https://www.google.ro/maps).

The physical-geographical characteristics of the territory the I. A. C. is located within, as well as the anthropogenic interventions that led to the development of the urban area of Craiova and, implicitly, of this objective, generated specific types of habitats/biotopes, which, on a distance of 13 km adjacent to the airport, are mainly components of artificial ecosystems: agroecosystems and urban ecosystems. However, within the analysed area, there still can be found some natural/semi-natural biotopes, some forested fields or aquatic and semi-aquatic surfaces represented by the green areas located in the city, such as ”Nicolae Romanescu” Park, ”Tineretului” Park, ”Cornițoiu” Park, the Botanical Garden ”Al. Buia” or in its proximity – the forests of the suburban area from Pârşani, Şimnicu de Sus, Şimnicu de Jos, Preajba – Făcăi lacustrine complex, the floodplain of the Jiu, etc. All the aforementioned areas are at a distance of 5-7 km from the I. A. C.

Although intensely anthropized, we considered the analysed territory should be studied from the avifauna viewpoint as it is populated by a high number of birds the activity of which may influence the safety of airplanes landing or taking off from the airport. As air traffic becomes more intense, the issue of the risks birds may generate is of general interest (THORPE, 1990) and it has already been approached by other specialists from our country (PETRESCU, 2002).

MATERIAL AND METHODS

As field research materials we used binoculars (Zeiss Jena 10x50 and Bushnell 12x40), bird guide (BRUUN et al., 1999) and a photo camera (Sony 15 x); for the scientific processing of the obtained data (systematic, ecological, phenological affiliation) we used the specialized literature: SZABÓ-SZELEY & BACZÓ, 2006; CĂTUNEANU et al., 1978; MUNTEANU et al., 2002; MUNTEANU, 2012. In order to render an adequate general image of the avifauna in the area we used the data obtained from direct observations, as well as the data mentioned in specialized literature (BĂLESCU, 2000, 2002, 2013; BĂLESCU & RIDICHE, 2001; RIDICHE, 2011).

The avifauna investigation methods were the direct observations made in fixed points (observation points were chosen so as to cover much of the I. A. C. area and surroundings) or in movement, on predetermined transects, by

walking. All the species recorded visually or auditory along the transect were noted in the observation file. The observations were made from mid-January to December 2014 (one to two monthly trips at various points); we also made intensive observations on the nesting bird species in April, May, June.

RESULTS AND DISCUSSIONS

Within the research area (perimeter of the I. A. C. and its surroundings on a distance of 13 km) we identified the following types of biotopes/habitats: grasslands and agroecosystems/cultivated lands, woodlands with trees and shrubs/bushes, wetlands (pools, flooded meadows, swampy terrains, fens, canals, watercourses: brooks, rivers, floodplains, etc.) and human settlements. Each of these habitats is populated by a diversified avifauna represented by 3 categories of bird species: typical species (dependent on the respective biotope through food and reproduction needs), accessory species (they only use the trophic resources of the respective biotope, have a short, temporary presence in the area) and eurytopic species, largely spread, present in many types of biotopes where they satisfy their feeding and nesting needs.

There was identified a total number of 138 species belonging to 18 systematic orders (Table 1). According to the biotope that better corresponds to the morphological adaptations and vital needs (food and reproduction), the main avifauna communities are grouped as it follows:

1. Avifauna characteristic of grasslands and agroecosystems;
2. Avifauna characteristic of woodlands (forest and shrub birds);
3. Avifauna characteristic of wetlands (aquatic avifauna);
4. Avifauna characteristic of human settlements (synanthropic avifauna).

Table 1. Overview for the avifauna of the perimeter of the International Airport Craiova (I.A.C.) and its adjacent areas (0-13 km).

No.	SPECIES	Observations			Biotope				Phenological type					Risk for air traffic
		Perimeter of I.A.C.	0-3 km	3-13 km	I	II	III	IV	R	PM	SV	WV	P	
I	ORD. PODICIPEDIFORMES													
1	*Tachybaptus ruficollis*	-	-	x	-	-	**t**	-			*****	*****		
2	*Podiceps cristatus*	-	-	x	-	-	**t**	-			*****		*****	
3	*Podiceps nigricollis*	-	-	x	-	-	**t**	-			*****		*****	
II	ORD. PELECANIFORMES													
4	*Phalacrocorax carbo*	-	-	x	-	-	**t**	-			*****	*****	*****	(XXX)
5	*Phalacrocorax pygmaeus*	-	-	x	-	-	**t**	-			*****		*	(XXX)
III	ORD. CICONIIFORMES													
6	*Botaurus stellaris*	-	-	x	-	-	**t**	-			*****			
7	*Ixobrychus minutus*	-	-	x	-	-	**t**	-			*****			
8	*Nycticorax nycticorax*	-	-	x	-	-	**t**	-			*****			
9	*Ardeola ralloides*	-	-	x	-	-	**t**	-			*****			
10	*Egretta garzetta*	-	x	x	-	-	**t**	-			*****			X
11	*Ardea alba*	-	-	x	-	-	**t**	-			*		*	
12	*Ardea cinerea*	x	x	x	+	-	**t**	-			*****		*	X
13	*Ardea purpurea*	-	-	x	-	-	**t**	-			*****			
14	*Ciconia nigra*	-	-	-	-	**t**	+	-			*****		*	(X)
15	*Ciconia ciconia*	-	x	x	+	-	**t**	+			*			X, XXX
IV	ORD. ANSERIFORMES													
16	*Cygnus olor*	-	-	x	-	-	**t**	-		*				(X, XXX)
17	*Anser anser*	-	-	x	+	-	**t**	-		*				(X, XXX)
18	*Anas crecca*	-	-	x	-	-	**t**	-				*****	*****	(XX)
19	*Anas platyrhynchos*	-	x	x	-	-	**t**	-		*****		*****	*****	XXX
20	*Anas acuta*	-	-	x	-	-	**t**	-					*****	(XXX)
21	*Anas querquedula*	-	-	x	-	-	**t**	-			*****		*****	(XX)
22	*Anas clypeata*	-	-	x	-	-	**t**	-					*****	(XXX)
23	*Aythya ferina*	-	-	x	-	-	**t**	-		*		*	*****	(XXX)
24	*Aythya nyroca*	-	-	x	-	-	**t**	-			*		*****	(XXX)
25	*Aythya fuligula*				-	-	**t**	-				*		(XXX)
26	*Mergus albellus*	-	-	x	-	-	**t**	-				*		(XXX)
V	ORD. ACCIPITRIFORMES													
27	*Circus aeruginosus*	-	-	x	+	-	**t**	-			*		*	(X)
28	*Accipiter gentilis*	-	-	x	+	**t**	+	-	*					(X)
29	*Accipiter nisus*	-	x	x	+	**t**	+	-				*	*	
30	*Accipiter brevipes*	-	-	x	+	**t**	+	-			*		*	
31	*Buteo buteo*	-	x	x	+	**t**	+	-	*			*	*	X
32	*Buteo rufinus*	-	-	x	**t**	-	-	-			*		*	(X)
VI	ORD. FALCONIFORMES													
33	*Falco tinnunculus*	x	x	x	+	+	+	+		*		*	*	XX
34	*Falco vespertinus*	-	-	x	+	**t**	+	-			*			
35	*Falco subbuteo*	-	?	x	+	**t**	+	-			*			
36	*Falco peregrinsus*	-	-	x	+	**t**	+	-	*			*	*	(X)

VII	ORD. GALLIFORMES													
37	*Perdix perdix*	?	x	x	**t**	-	-	-	*					XXX
38	*Coturnix coturnix*	-	x	x	**t**	-	-	-			*			
39	*Phasianus colchicus*	x	x	x	+	**t**	-	-	*					X
VIII	ORD. GRUIFORMES													
40	*Rallus aquaticus*	-	-	x	-	-	**t**	-			*****		*****	
41	*Gallinula chloropus*	-	-	x	-	-	**t**	-		*****		*****	*****	
42	*Fulica atra*	-	x	x	-	-	**t**	-		*****		*****	*****	
IX	ORD. CHARADRIIFORMES													
43	*Himantopus himantopus*	-	-	x	-	-	**t**	-			*****			
44	*Recurvirostra avosetta*	-	-	x	-	-	**t**	-			*			
45	*Charadrius dubius*	-		x	-	-	**t**	-			*		*	
46	*Vanellus vanellus*	-	x	x	-	-	**t**	-			*		*	XX
47	*Calidris minuta*	-	-	x	-	-	**t**	-					*	
48	*Scolopax rusticola*	-	-	x	-	+	**t**	-					*	
49	*Philomachus pugnax*	-	-	x	-	-	**t**	-					*	
50	*Tringa ochropus*	-	-	x	-	-	**t**	-					*	
51	*Larus ridibundus*	-	x	x	-	-	**t**	+		*		*	*	
52	*Larus cachinnans*	-	x	x	-	-	**t**	+	*				*	
53	*Larus canus*	-	-	x	-	-	**t**	-				*		
54	*Sterna caspia*	-	-	x	-	-	**t**	-					*	
55	*Chlidonias hybrida*	-	x	x	-	-	**t**	-			*		*	XX
56	*Chlidonias niger*	-	-	x	-	-	**t**	-			*		*	
57	*Chlidonias leucopterus*	-	-	x	-	-	**t**	-			*		*	
X	ORD. COLUMBIFORMES													
58	*Columba livia domestica*	x	x	x	+	-	-	**t**	*					XXX
59	*Columba palumbus*	-	x	x	-	**t**	-	+			*		*	X, XXX
60	*Streptopelia decaocto*	x	x	x	+	**t**	-	+	*					X, XXX
61	*Streptopelia turtur*	-	-	x	+	**t**	-	-			*			
XI	ORD. CUCULIFORMES													
62	*Cuculus canorus*	-	x	x	+	+	+	-			*			
XII	ORD. STRIGIFORMES													
63	*Tyto alba*	-	-	x	+	**t**	-	+	*					
64	*Athene noctua*	-	x	x	+	**t**	-	+	*					
65	*Asio otus*	-	-	x	+	**t**	-	+	*					
66	*Strix aluco*	-	-	x	+	**t**	-	+	*					
XIII	ORD. CORACIIFORMES													
67	*Alcedo atthis*	-	-	x	+	+	**t**	-		*		*		
68	*Coracias garrulus*	-	x	x	+	**t**	-	-			*			
69	*Merops apiaster*	-	-	x	+	**t**	-	-			*			
70	*Upupa epops*	x	x	x	+	**t**	-	-			*			
XIV	ORD. PICIFORMES													
71	*Picus canus*	-	-	x	-	**t**	-	-	*					
72	*Picus viridis*	-	-	x	-	**t**	-	-	*					
73	*Dryocopus martius*	-	-	x	-	**t**	-	-	*					
74	*Dendrocopus major*	-	x	x	-	**t**	-	+	*					
75	*Dendrocopos syriacus*	-	x	x	-	**t**	-	+	*					
XV	ORD. PASSERIFORMES													
76	*Galerida cristata*	-	x	**x**	**t**	-	-	-	*****					
77	*Alauda arvensis*	-	x	x	**t**	-	-	-		*				
78	*Hirundo rustica*	x	x	x	+	+	+	**t**			*			XX
79	*Riparia riparia*	-	-	x	+	+	-	-			*			
80	*Delichon urbicum*	x	x	x	+	+	-	**t**			*****			XX
81	*Anthus campestris*	x	x	x	**t**	-	-	-			*			
82	*Motacilla flava*	-	x	x	**t**	-	+	-			*			
83	*Motacilla alba*	-	x	x	+	+	+	+			*			
84	*Bombycilla garrulus*	-	-	x	-	**t**	-	-				*		
85	*Troglodytes troglodytes*	-	x	x	-	**t**	-	-		*			*	
86	*Prunella modularis*	-	-	x	-	**t**	-	-	*					
87	*Erithacus rubecula*	-	-	x	+	**t**	-	+			*	*		
88	*Luscinia luscinia*	-	x	x	+	**t**		+			*			
89	*Luscinia megarhynchos*	-	-	x	+	**t**		+			*****			
90	*Phoenicurus phoenicurus*	-	-	x	-	**t**	-	+			*			
91	*Turdus merula*	-	x	x	+	**t**	-	+		*				
92	*Turdus pilaris*	-	x	x	-	**t**	-	+				*		XX
93	*Turdus philomelos*	-	-	-	+	**t**	-	-			*			
94	*Turdus viscivorus*	-	-	x	-	**t**	-	-		*				
95	*Locustella luscinoides*	-	-	x	+	-	**t**	-			*			
96	*Acrocephalus schoenobaenus*	-	-	x	+	-	**t**	-			*			
97	*Acrocephalus palustris*	-	-	x	+	-	**t**	-			*****			
98	*Acrocephalus scirpaceus*	-	-	x	+	-	**t**	-			*			

99	*Acrocephalus arundinaceus*	-	-	x	+	-	t	-			*			
100	*Hippolais icterina*	-	x	x	+	t	-	+			*			
101	*Sylvia curruca*	-	-	x	+	t	-	+			*			
102	*Sylvia communis*	-	x	x	+	t	-	-			*			
103	*Sylvia borin*	-	-	x	+	t	-	-			*			
104	*Sylvia atricapilla*	-	-	x	+	t	-	-			*			
105	*Phylloscopus collybita*	-	x	x	+	t	-	-			*		*	
106	*Phylloscopus trochilus*	-	x	x	+	t	-	-			*			
107	*Muscicapa striata*	-	-	x	+	t	-	-			*			
108	*Ficedula albicollis*	-	-	x	-	t	-	-			*			
109	*Parus lugubris*	-	-	x	-	t	-	+	*					
110	*Parus ater*	-	-	x	-	t	-	+	*					
111	*Parus caeruleus*	-	x	x	-	t	-	+	*					
112	*Parus major*	x	x	x	+	t	-	+	*					
113	*Sitta europaea*	-	-	x	-	t	-	-	*					
114	*Certhia* sp.	-	-	x	-	t	-	-	*					
115	*Oriolus oriolus*	-	x	x	+	t	-	-			*			
116	*Lanius collurio*	x	x	x	+	t		-			*			
117	*Lanius minor*	x	x	x	+	t	-	-			*			
118	*Garrulus glandarius*	-	x	x	+	t	-	+	*					
119	*Pica pica*	x	x	x	+	t	-	+	*					X
120	*Corvus monedula*	x	x	x	+	t	-	+	*					XX
121	*Corvus frugilegus*	x	x	x	+	t	-	+	*					XXX
122	*Corvus cornix*	-	x	x	+	t	-	-	*					X
123	*Sturnus vulgaris*	x	x	x	+	t	-	+		*			*	XX
124	*Passer domesticus*	x	x	x	+	t	-	+	*					XX
125	*Passer hispaniolensis*	-	-	x	+	t	-	-			*			
126	*Passer montanus*	x	x	x	+	t	-	+	*					XX
127	*Fringilla montifringilla*	-	x	x	+	t	-	+					*	XX
128	*Fringilla coelebs*	-	x	x	+	t	-	+	*		*			XX
129	*Carduelis chloris*	-	x	x	+	t	-	+	*					XX
130	*Carduelis carduelis*	-	x	x	+	t	-	+	*					XX
131	*Carduelis spinus*	-	-	x	-	t	-	+					*	
132	*Carduelis cannabina*	-	-	x	-	t	-	-		*				
133	*Pyrrhula pyrrhula*	-	-	x	-	t	-	-					*	
134	*Coccothraustes coccothraustes*	-	-	x	-	t	-	-	*					
135	*Emberiza citrinella*	-	-	x	+	t	-	-	*					
136	*Emberiza hortulana*	-	-	x	t	+	-	-			*			
137	*Emberiza schoeniclus*	-	-	x	-	-	t	-		*			*	
138	*Emberiza calandra*	x	x	x	t	-	-	-	*					X

Legend:

Biotope/habitat **I** – The avifauna of grasslands and agroecosystems, **II** – The avifauna of woodlands (forests and shrubs), **III** – The avifauna of wetlands (aquatic avifauna), **IV** – The avifauna of the human settlements (synanthropic/anthropophilic); **t** = typical species (addicted to a type of biotope/habitat, through the feeding and nesting needs); **+** = accessory species (which use only the trophic resources given by the respective biotope, having a short, temporary presence).

Phenological type: R – resident; PM – partially; SV – summer visitors; WV – winter visitors; P – passage visitors.

Risk for traffic**:** X – large and/or medium-sized birds flying solitary or in small groups (2 - 5 individuals); XX – small or medium-sized birds flying in flocks (tens/hundreds of individuals); XXX – large or medium-sized birds flying in flocks, (…) – potential risk if airplanes fly at low altitude.

A synoptic picture of the avifauna groups identified by us in the biotopes within and in the proximity of the I. A. C., as well as the number of the species that may represent a risk factor for air traffic for each biotope is rendered in Fig. 2:

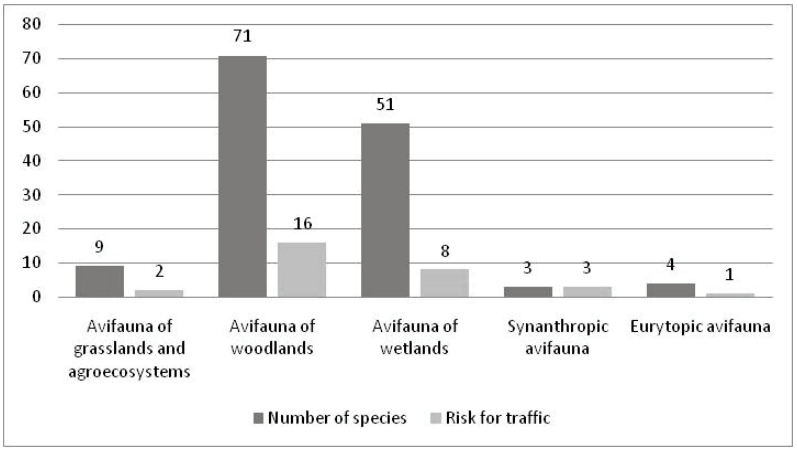

Figure 2. Graphic distribution of the bird species within the area of the I. A. C. (0-13 km), according to the habitat type and risk factor for air traffic.

It can be easily noticed that the best representation within the territory is held by the bird communities characteristic to forest biotopes (71 species), followed by aquatic and semiaquatic species (51 species) and by the ones specific to agroecosystems and seminatural or artificial grasslands (9 species); the most numerous threats related to air traffic come from the bird species typical of forests and shrubs, followed by aquatic and synanthropic species.

Details regarding the ecological situation of the aforementioned bird communities and their impact upon air traffic are further rendered.

1. Avifauna characteristic of agroecosystems and grasslands.

This avifauna is met either on the plots covered by agricultural crops or a rare and poor vegetation (xerophilic and xeromesophilic grasslands) with shrubs of dog-rose (*Rosa canina*), blackthorn (*Prunus spinoasa*), European dewberry (*Rubus caesius*), etc. Such habitats can be found within the perimeter of the I.A.C. as well as in its adjacent surroundings and they have the greatest share within the studied territory. The avifauna specific to these habitats comprises 34 species, 9 of which are typical species and 25 are accessory species. Two of the typical species (*Anthus campestris* and *Emberiza calandra*) were signalled within the perimeter of the I. A. C; these and another 5 species (*Perdix perdix, Coturnix coturnix, Galerida cristata, Alauda arvensis* and *Motacilla flava*) were noticed in the immediate proximity of the airport (0-3 km), and another 2 species (*Buteo rufinus* and *Emberiza hortulana*) were reported only at a distance of over 5 km (Fig. 3).

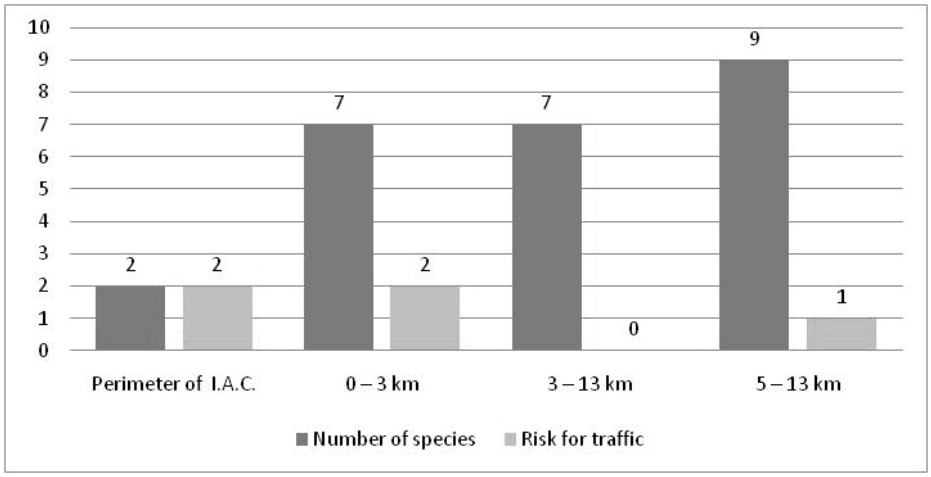

Figure 3. Graphical distribution of the bird species typical of the agroecosystems and grasslands from the area of the I. A. C. (0-13 km).

Of the 9 species typical of agroecosystems and semi-natural or artificial grasslands, *Perdix perdix* and *Emberiza calandra* pose a risk to aircraft due to the gregarious behaviour they manifest from autumn until spring, when they start breeding and flocks break up; if the altitude at which aircrafts flying at over 5 km from the I.A.C. is lower (i.e. approximately 500-1,000 m), *Buteo rufinus* represents a potential risk of collision due to the great flying height.

Most of the accessory species comes from the forest and shrub biotopes located in the areas adjacent to the I. A. C.; three are characteristic to the aquatic biotopes (*Ardea cinerea, Ciconia ciconia, Vanellus vanellus)* and one species (*Falco tinnunculus*) is eurytopic.

2. Avifauna characteristic of woodlands.

Within the analysed territory, the most important surfaces covered by forest vegetation, both as area and floristic value, are represented by the forests located in the suburbs of Craiova (Pîrşani, Şimnicu de Sus, Şimnicu de Jos, etc.) and the so-called "green spaces" from the urban area – "Nicolae Romanescu" Park (about 96 ha), "Tineretului" Park (about 51 ha), "Cornițoiu" Park (about 25 ha), the Botanical Garden "Al. Buia" (about 17 ha) - CIOBOTEA et al., 1999. The distance between these forested surfaces and the I. A. C. is over 5-7 km.

The closest areas covered by woody vegetation are the ones located in the western and south-western vicinity of the airport track, respectively inside the former military unit, and, little westwards, the recreation area "Hanul Doctorului" (Doctor's Inn). The vegetal associations present in these areas (trees and spontaneous or acclimatized shrubs, unmowed vegetation) developed and extended sufficiently enough to attract a quite varied specific fauna. The vegetal formations from the forests are vertically arranged (trees with a rich canopy, shrubs and herbaceous layer), so that, within forest ecosystems, birds have a wider variety of habitats, and, consequently, greater possibilities of feeding and nesting, as it follows:

- forest preferred by different species, such as: *Buteo buteo, Falco* sp., *Asio otus*, *Columba palumbus, Dendrocopos* sp., *Picus.* sp., *Upupa epops, Certhia* sp., *Sitta europaea, Garrulus glandarius, Pica pica, Corvus frugilegus,* etc.;
- deciduous forest undergrowth, clearings, forest edges, orchards, coppices are nesting sites for many Passeriformes: *Erithacus rubecula, Luscinia* sp., *Sylvia* sp., *Hippolais* sp., *Ficedula* sp., *Muscicapa striata, Emberiza citrinella,* etc.
- bushes and isolated trees represent nesting places for *Lanius* sp., *Corvus cornix*, etc.

Consequently, the structure of the forest and shrub avifauna is a more complex one both as number of typical species and number of individuals, which is higher than in other biotopes. On the whole, within the forest areas studied by us, we identified 78 species, 71 of them being typical, while the rest comes from the avifauna of the other biotopes.

From the phenological point of view, in the community of forest and shrub birds, there is an almost equal rapport between sedentary/sedentary-migratory species and migratory species (summer visitors). There are 5 species that nest in the forests from higher altitudes (mountain forests) and populate the forested surfaces from our study area as winter visitors (*Accipiter nisus, Bombycilla garrulus, Turdus pilaris, Fringilla montifringilla, Carduelis spinus*). Although they have a temporary presence induced by the search for food resources during the cold season, we shall not consider them as accessory species to the forest and shrub biotopes from the areas adjacent to the I. A. C, but we shall analyse them as typical species having the same morphological and physiological adaptations.

Of the 71 species specific to the forest surfaces from the adjacent area of the I. A. C., it can be noticed that 12 bird species (*Phasianus colchicus, Streptopelia decaocto, Upupa epops, Parus major, Lanius collurio, L. minor, Pica pica, Corvus frugilegus, C. monedula, Sturnus vulgaris, Passer montanus, P. domesticus*) were reported within the perimeter of the airport, where they were in search for food. The same species together with other 23 species were reported in the area located in the immediate proximity of the airport (0-3 km), while the rest of the species appeared at more than 3 km away from the airport (Fig. 4).

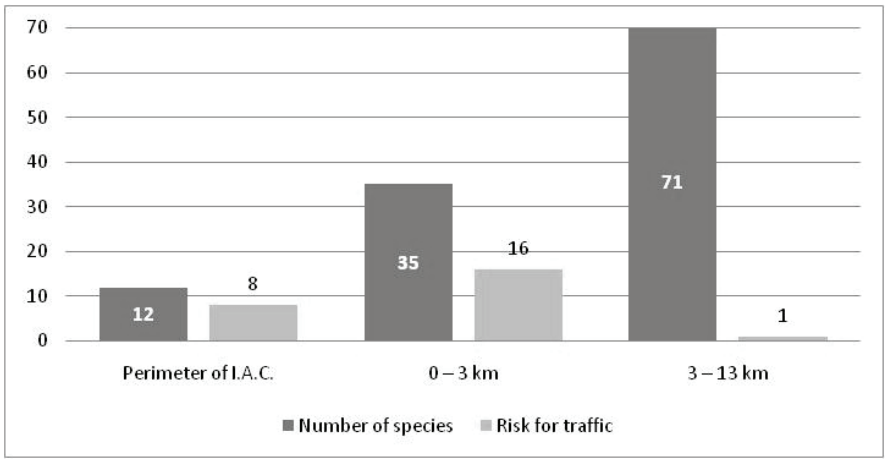

Figure 4. Graphical distribution of the bird species typical of the woodland ecosystems (forests and shrubs) from the area of the I. A. C. (0-13 km).

With regard to the risk for air traffic, we estimate that maximum 16 of the species characteristic to studied forest areas may represent a threat to the aircraft safety. It is about the large-sized species that fly high or the species with gregarious behaviour that live within or in the immediate proximity of the airport (0-3 km): *Phasianus colchicus, Buteo buteo, Columba palumbus, Streptopelia decaocto, Turdus pilaris, Pica pica Corvus frugilegus, C. cornix, C. monedula, Sturnus vulgaris, Passer montanus, P. domesticus, Fringilla montifringilla, F. coelebs, Carduelis chloris, C. carduelis*.

Another 3 species, such as *Ciconia nigra, Accipiter gentilis* and *Falco peregrinus* may represent a potential risk factor because they soar at great height, even if they were reported rarely and at great distance from the I. A. C. This risk appears only if airplanes fly at low altitude (below 500-1,000 m) for more than 5 km from the airport.

The accessory species that use the trophic resources offered by the surfaces covered by a rich forest vegetation in the study area belong to many ecological categories: three species are eurytopic (*Falco tinnunculus, Cuculus canorus, Motacilla alba*), two come from the anthropogenic biotope (*Hirundo rustica* and *Delichon urbicum*), one species belong to greenswards *(Emberiza hortulana)* and another one is an aquatic species (*Alcedo atthis*).

3. Aquatic avifauna from the areas adjacent to the I. A. C. (0-13 km.).

The most significant and attractive wetlands for avifauna are located outside the municipality of Craiova: Preajba – Făcăi Lacustrine Complex (5-7.5 km south-south-west of the I. A. C.), the Jiu River and floodplain (9-11 km and 11-13 km south-west of the I. A. C.); there are also some wetlands inside the city: Craioviţa Pool (5-7 km south-west of I. A. C.), Şerca Pool from "Tineretului" Park (7-9 km west of I. A. C.).

In the areas located in the proximity of the I. A. C., less than 3-5 km, there are other permanent or temporary aquatic surfaces (pools, brooks, swampy and/or flooded areas), but their surface or avifaunistic value is insignificant i.e. Ghercești Pool/Valley, Cârcea Pool.

The main biotopes/habitats from wetlands are:

- paludous aquatic vegetation (bulrush, reed), populated by water rail, rail and moorhen (Ord. Gruiformes.), some species of Passeriformes (warblers - *Acrocephalus* sp., common reed bunting - *Emberiza schoeniclus*), and among the birds of prey, we mention the marsh harrier - *Circus aeruginosus*;
- the shore and bank areas, preferred by limicolous species (Ord. Charadriiformes), are often visited by herons and egrets (Ord. Ciconiiformes) and by the white wagtail (*Motacilla alba*) belonging to Passeriformes;

- the water surface / the proper aquatic environment, populated by grebes (*Podiceps*), ducks (*Anas, Aythya*), gulls (*Larus*), terns (*Sterna*) and marsh terns (*Chlidonias*);
- the swampy fields and hydrophilous meadows, populated by certain waders species (*Vanellus vanellus*), greylag goose (*Anser anser*), some ducks (*Anas*), etc.;
- the coppices, preferred by the woodcock (*Scolopax rusticola*);
- the steep shore, nesting places for the common kingfisher (*Alcedo athis*) and the sand martin (*Riparia riparia*).

The composition of the aquatic avifauna identified by us is very different according to the season; consequently, we shall take into account both nesting and possible nesting aquatic species (sedentary, partially migratory species and summer visitors) and the non-breeding aquatic species (passage species and/or winter visitors). In case of the last ones, even if they have a temporary presence induced by feeding needs during the spring-autumn migrations or in winter, we shall not consider them as accessory species, but they will be analysed as typical species having the same morphological and physiological adaptations. The total number of species reported within the wetlands from the studied perimeter is 65, 51 of them being typical aquatic species and 14 accessory species.

From the phenological point of view, within the community of aquatic nesting birds, there predominate the summer visitors, followed by the partially migratory species and, then, sedentary species.

With regard to the distribution, it can be noticed that only one aquatic species was reported within the perimeter of the I. A. C., namely *Ardea cinerea*. This species together with 7 other species (*Egretta garzetta, Ciconia ciconia, Anas plathyrhynchos, Vanellus vanellus, Larus ridibundus, L. cachinnans, Chlidonias hybrida*) were reported in the area located in the immediate proximity of the airport (0-3 km), while the rest of the species were reported at more than 3 km from the airport (Fig. 5).

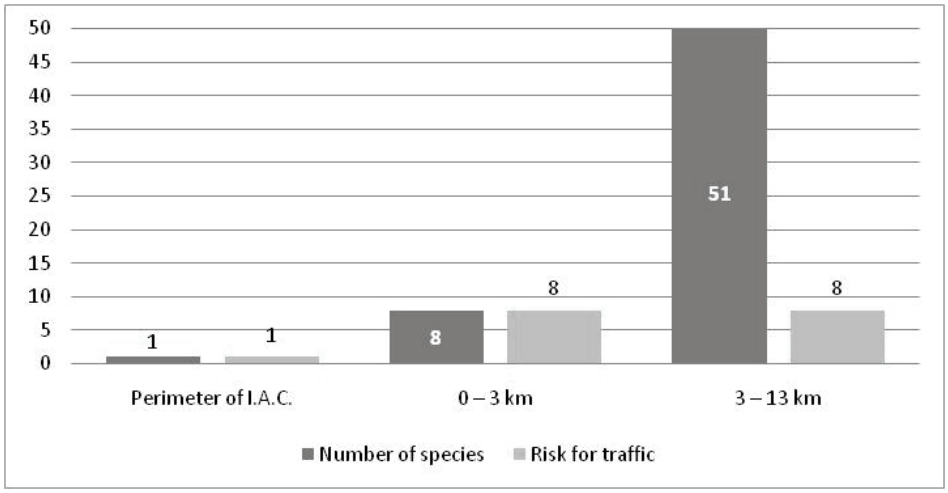

Figure 5. Graphical distribution of the bird species typical of the wetlands from the area of the I. A. C. (0-13 km).

All the species reported in the neighbourhood of the I. A. C. may represent a risk factor for air traffic as they are mostly large-sized species or manifest a gregarious behaviour, flying in flocks that may put in danger the safety of airplanes that take off or land.

The species *Cygnus olor, Anser anser, Circus aeruginosus, Phalacrocorax* sp., different anserine species (*Anas* sp., *Aythya* sp., *Mergus* sp.), as well as other non-nesting aquatic species, mostly distributed in wetlands located at more than 5-7 km from the airport, may also represent a risk factor as they fly in flocks at great height, but only in case the airplanes getting close to the airport, less than 5 km, fly at low altitude, below 1,000-2,000 m.

The accessory species that visit the wetland biotopes are mostly woodland species (*Ciconia nigra, Accipiter* sp., *Buteo buteo, Falco* sp.), some are eurytopic species and only one species is synanthropic.

4. Synanthropic/strictly anthropophilic avifauna

Human settlements (rural and urban) are spaces entirely modified by people. From the avifauna viewpoint, these habitats are heterogeneous being populated less by synanthropic species, dependent on the anthropogenic environment through their nesting needs, and more by numerous species that come from other biotopes (accessory species). The factors that trigger the composition of the anthropophilic avifauna are: optimum nesting places; diversity and availability of the trophic resources; safety from predators.

All strictly synanthropic species that populate the perimeter of the I. A. C. and its immediate proximities (*Columba livia domestica, Hirundo rustica, Delichon urbicum*) may represent a risk factor for air traffic as they fly rapidly during daytime, in flocks that may put in danger the safety of the airplanes that take off or land (Fig. 6).

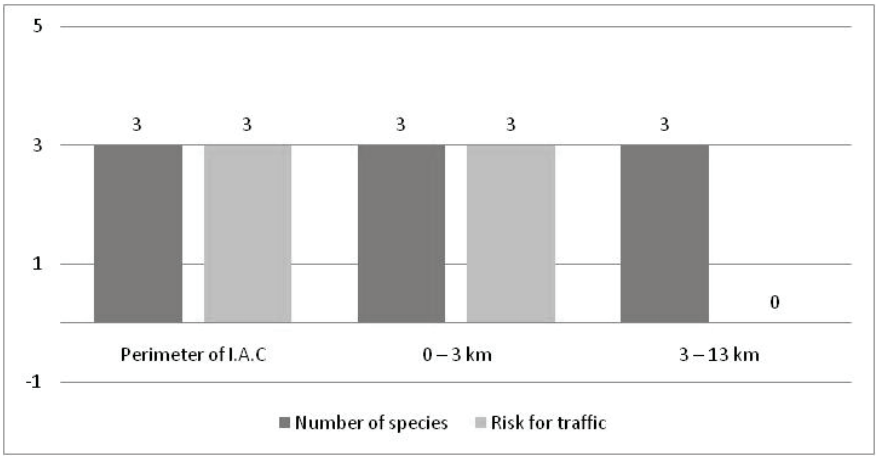

Figure 6. Graphical distribution of the synanthropic bird species from the area of the I. A. C. (0-13 km).

Most of the accessory species from the anthropogenic environment are forest species, two of them are aquatic species (*Ciconia ciconia* and *Larus cachinnans*) and one species is eurytopic (*Falco tinnunculus*). These accessory species became synanthropic as they easily adapted to living within human settlements; they build their nest in different locations, such as: constructions (high voltage pylons, bridges, eaves, cracks in walls) and trees located in the vicinity of human settlements and, sometimes, they even use the trophic resources resulted from human activities.

5. **Eurytopic avifauna includes widespread species**, nesting in diverse biotopes, at different distances from the airport: *Falco tinnunculus, Cuculus canorus, Motacilla alba, Riparia riparia*. The only eurytopic species that may represent a risk factor for air traffic is the common kestrel that soars and uses warm air currents, rising with them at a great distance from the ground. It was often seen while searching the open lands from a viewpoint (i.e. pillars of the fences surrounding the airport) or when overflying the ground, at heights of 10-20 m, executing episodic stationary observation flights for identifying potential prey.

CONCLUSIONS

Within the studied biotopes, located in the proximity of the I. A. C., up to a distance of 13 km, we identified 138 bird species belonging to 18 systematic orders and distributed, according to the specific biotopes, as it follows: 9 species are typical of grassland and agroecosystem habitats, 71 species are typical of woodlands (forest and shrubs), 51 species are typical of aquatic areas, 3 species are synanthropic (dependent on human settlements) and 4 species are eurytopic, relatively uniformly distributed in many biotopes.

- Of the 9 species typical of grassland and agroecosystem habitats, two species may represent a risk factor for air traffic, namely *Perdix perdix* and *Emberiza calandra* because of their gregarious behaviour manifested from autumn until spring; *Buteo rufinus*, reported at a great distance from the airport (more than 5 km) may also trigger a potential risk of collision as it soars at great height.
- Of the 71 species typical of woodlands (forests and shrubs), maximum16 may represent a danger for aircraft safety. It is about the large-sized species that fly high or about the species characterized by a gregarious behaviour that permanently live within the airport or in immediate proximity (0-3 km): *Phasianus colchicus, Buteo buteo, Columba palumbus, Streptopelia decaocto, Turdus pilaris, Pica pica Corvus frugilegus, C. cornix, C. monedula, Sturnus vulgaris, Passer montanus, P. domesticus, Fringilla montifringilla, F. coelebs, Carduelis chloris, C. carduelis*. Other 3 species, such as *Ciconia nigra, Accipiter gentilis* and *Falco peregrinus* may represent a potential risk as they soar at great height, even if they were reported at a greater distance from the I. A. C. (more than 3-5 km). This risk appears only if the airplanes getting close to the airport, less than 5 km, fly at low altitude, below 500 m-1,000 m.
- Of the 51 species typical of wetlands, 8 species (*Egretta garzetta, Ardea cinerea, Ciconia ciconia, Anas plathyrhynchos, Vanellus vanellus, Larus ridibundus, L. cachinnans, Chlidonias hybrida*) reported in the area located in the immediate proximity of the airport (0-3 km) may represent a risk factor for the aircraft safety as they are mostly large-sized birds that fly at great height or manifest a gregarious behaviour, flying in flocks, putting in danger the safety of the airplanes that take off or land. Other 14 species, such as *Cygnus olor, Anser anser, Circus aeruginosus, Phalacrocorax* sp., different duck species (*Anas* sp., *Aythya* sp.) may represent a risk factor because they fly at great height, even if they were reported at greater distance from the airport (more than 5-7 km). This risk appears only if the airplanes getting close to the airport, less than 5 km, fly at low altitude, below 1,000 m-2,000 m.
- All the 3 strictly synanthropic species (*Columba livia domestica, Hirundo rustica, Delichon urbicum*) that populate the perimeter of the I. A. C. and its neighbourhoods may threaten the safety of aircraft that take off or land as they fly rapidly, in flocks during daytime.
- Of the eurytopic species, only one (*Falco tinnunculus*) may represent a risk factor for airplanes as it soars and uses warm air currents, rising with them at a great distance from the ground.

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Myotis myotis AND *Myotis blythii* (MAMMALIA: CHIROPTERA) PREFERENCE FOR THE USE OF PIATRA CRAIULUI CAVES DURING THEIR MATING AND HIBERNATION PERIODS

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Abstract. The aim of our study was to identify the underground shelters used by the bat species *Myotis myotis* and *M. blythii* in Piatra Craiului massif of Piatra Craiului National Park. We verified 40 natural and artificial underground cavities (thirty three caves and seven abandoned mine galleries situated at an altitude between 770 - 1761 m) from the 813 caves mapped in the park. From these 40 shelters, the species *M. myotis* and *M. blythii* were found in eight caves and one mine gallery. The most important wintering shelters in the park are Colțul Surpat Cave and Zărnești mine quarry. Peștera cu Lilieci Cave from Peștera village is an important shelter cave for the mating of *M. myotis* and *M. blythii*. Most published data on these two species are on the qualitative aspects, giving data on the presence or absence of the bat species. Our study comes with new data about these species on the territory of Piatra Craiului National Park. In this paper, we report data on a cave that has not been investigated so far in terms of bat fauna (Arșiței Cave) and we complete the list of bat species for Peștera Decolmatată Cave and Vacilor Cave.

Keywords: bats, Piatra Craiului, Carpathians, Romania.

Rezumat. Preferințele speciilor *Myotis myotis* și *Myotis blythii* (Mammalia: Chiroptera) pentru utilizarea peșterilor din munții Piatra Craiului în perioadele de împerechere și hibernare. Scopul studiului a fost identificarea adăposturilor subterane utilizate de speciile *Myotis myotis* și *M. blythii* în masivul, respectiv, Parcul Național Piatra Craiului. Au fost verificate 40 de cavități subterane naturale și artificiale (33 de peșteri și 7 galerii de mină, situate la altitudini între 770 – 1761 m) dintre cele 813 cavități cartate în parc. Dintre aceste 40 de adăposturi, speciile *M. myotis* și *M. blythii* au fost întâlnite în opt peșteri și o galerie de mină. Cele mai importante adăposturi de hibernare din parc sunt Peștera Colțul Surpat și Mina din cariera Zărnești. Peștera cu Lilieci din satul Peștera constituie un adăpost de împerechere important pentru speciile urmărite. Majoritatea datelor despre aceste două specii, publicate până în prezent, sunt doar calitative, urmărind prezența sau absența speciilor. Articolul vine cu completări despre aceste specii pe teritoriul Parcului Național Piatra Craiului. Prezentăm date despre o peșteră care nu a mai fost cercetată până în prezent din punct de vedere al faunei de lilieci (Peștera Arșiței) și completăm lista speciilor de lilieci pentru Peștera Decolmatată și Peștera Vacilor.

Cuvinte cheie: lilieci, Piatra Craiului, Carpați, România.

INTRODUCTION

The study area comprises the territory of Natura 2000 site ROSCI0194 Piatra Craiului (15,867 ha), including the territory of Piatra Craiului National Park (14,773 ha), the last being located in the Eastern Southern Carpathians, polarized on the limestone ridge of Piatra Craiului Mountains. The relief has altitudes between 699 m - 2,238 m. The investigated territory consists in a complex karst system with predominant deciduous, coniferous and mixed forests, i.e. Dacian beech forests (Symphyto-Fagion), beech forests Luzulo-Fagetum type, *Picea abies* forests in the acidophilus mountain region (Vaccinio-Piceetea). The limestone Ridge of Piatra Craiului Mountains is about 20 km length. The caves are numerous, but most of them are short or poorly developed. The total length of the 836 known caves is about 14,640 m, with an average length for one cave about 17.5 meters.

The Special Conservation Area includes 788 caves, as follows: 54 caves - scientific reserves (27 caves located in the northern sector in the Bârsa basin, 27 caves in southern sector, the catchment area of the Dâmbovița), 734 caves considered natural reserves (43 caves situated in Prăpăstiilor Valley sector, 86 caves in Seacă Valley - the Brusturetului Gorges sector, 86 caves the Dâmbovicioarei Gorges sector, 176 caves in the Small Gorges of the Dâmbovița, 343 in the Great Gorge of the Dâmbovița). The protected landscape area covers 48 caves (18 caves in the northern sector: the Small Bârsa Valley - Magura and 30 caves on the southern sector: Sbârcioara-Turcu valleys, Măgura, Peștera and Moeciu villages). From all these, 13 caves measure 5 - 10 m length, 686 caves have 10 - 20 m length, 117 caves have 20 - 50 m length, 13 caves between 50 and 100 m length, 5 caves between 100 and 500 m length and two caves measures more than 500 m in length. 514 caves are located between 700 and 1000 m altitude, 177 caves located from 1000 to 1200 m altitude, 63 caves between 1200 and 1500 m altitude, 56 caves located from 1500 to 1800 m altitude and 26 caves between 1800 m and maximum altitude (CONSTANTINESCU & DOBRESCU, 2006).

From all these caves listed before, GHEORGHIU & MURARIU (2006) selected 113 caves with bat fauna potential and verified 16 of them. We have re-inventoried some of these 113 caves (40 natural and artificial underground cavities, most with a minimum length of 30 m) in order to identify the species group *Myotis myotis/blythii*. According to the published data, *M. myotis* was observed in Colțul Surpat Cave and Peștera cu Lilieci Cave from Peștera Village (summer and winter roost), Dâmbovicioara Cave (hibernation roost), Zărnești quarry mine gallery and Stanciului Cave (hibernation roost), but also some ultrasound detection contacts are known in Călineț's Padina, Șpirla

Valley, Avenul de sub Colții Grindului Cave, Garofița cottage from Brusturetului valley and Prăpăstiile Zărneștilor Gorges. Like the sister species, *M. blythii* has been observed in the same shelters and habitats (GHEORGHIU & MURARIU, 2006). Some of these data were republished, with additions of parasitological data collected from the encountered species (GHEORGHIU, 2006; MUNTEANU & GHEORGHIU, 2007). MURARIU (2003) mentions this species within the territory of Piatra Craiului National Park, without specifying the locations of his observations. Other authors found *M. myotis* in Dâmbovicioara Cave, Peștera cu Lilieci Cave from Peștera village, Ulucelor Cave, Zărnești quarry mine gallery and Stanciului Cave, (GHEORGHIU & MURARIU, 2006; GHEORGHIU et al., 2003; NAGY et al., 2003, 2005, 2010; BARTI et al., 2006; Jère & Barti (pers. comm.). Over 500 individuals of the species *M. myotis* and *M. blythii* were estimated in Avenul de sub Colții Grindului Cave, at an altitude of 2020 m, the authors assuming that the most of hibernating effectives in this cave belong to the species *M. blythii*, (GHEORGHIU et al, 2003). According to the article, we could not assume this hibernacula estimation, because all the observations, were done in the period May-September by the exploration team members to the depth of 99 m. Since then, in a romanian-bulgarian caving expedition on 20th of June 2006, the bats were counted, being 20 individuals on the depth of 340 m (Kiten Topalov pers. comm., expedition team member). The last information regarding the presence of this species here *M. myotis* / *M. blythii* was given by Cristina Stika (one of the speleologist of the exploration team), from the 22nd of September 2010, that took photograph for us of all the 5 individuals of this species at a depth of 60 m. There is no evidence that Avenul de sub Colții Grindului Cave is a hibernacula, because, in winter, the access to this cave is dangerous and no one climb down into it.

MATERIALS AND METHODS

The study was achieved between November 2012 and February 2015. The field observations were undertaken in order to include all the aspects of these species during two years (population size, composition of the species, their conservation status, etc.). In order to identify the species in the summer shelters or during the hibernation period, the two species were considered together, to avoid confusion due to their similar morphological characters. During the mating period, when we captured them with mist nets, we took into account their morphological characters, (DIETZ & VON HELVERSON, 2004). To measure the microclimate conditions inside the shelters, we used a thermo-hygrometer (Extech Instruments), an anemometer and barometer (Sunartis - Mingle Instruments, GmbH D-47877 Europe, Willich Model: BKT381). For weighing bats we used a 50g Pesola scale and to capture them, ECOTONE monofilament nets.

RESULTS AND DISCUSSION

We checked 33 caves and 7 mine galleries (two of them could not be crossed entirety due the lack of adequate equipment). The total length of the inventoried underground cavities summarizes 2534 m and the total length of the interest cavities represents about 8.5 % of the total area of underground cavities of studied area (1738 m long).

1. **Colțul Surpat Cave** is situated at an altitude of 850 m, on the right side of the Small Gorges of the Dâmbovița and measured 540 m length, consisting in a large access gallery and two branched galleries (MUNTEANU & GHEORGHIU, 2007). The access to the cave is easily arranged by stairs near the road side that connects Podu Dâmboviței with Săticul de Sus villages. Due the facilitated access, the protection system was vandalized and the presence of tourists and locals is obviously. On the map (figure 1), the location of the cave is marked with a star and number eight. The cave was monitored in the last 15 years by the Romanian Bat Protection Association members (NAGY et al., 2003, 2005, 2010; BARTI et al., 2006). The cave has the status of natural reserve and area of special conservation.

We found the maximum number of the sibling species *M. myotis/blythii* in the cave at the end of the hibernation period, respectively, 91 individuals (the 28th of March, 2014, table 1). They gathered in the last autumn and left the hibernacula in May. This cave seems to be an important mating place as well in the area of these species.

2. **Peștera Decolmatată Cave.** The cave is also known as Badgers Cave. It is located on the right side of the Dâmbovița valley, at an altitude of 785 m. The cave is 87 m long and has 1 m unevenness. On the map, the location of the cave is marked with a star and number 10. No interest in terms of bat fauna, only one individual of the species *M. blythii* being observed in hibernation at the end of December. The shelter is not used in the rest of the year. There is no data in the published literature regarding the species *M. myotis* and *M. blythii* in Peștera Decolmatată Cave. The cave is situated in the special conservation area and has the status of a natural reserve.

3. **Arșiței Cave** is located on the right side of the Dâmbovița valley at an altitude of 815 m. This cave measures 26 m length. On the map, the location of the cave is marked with a star and number 24. The cave is used mainly for hibernation, in this period being seen 4 species of bats, while during the year, only occasionally. There are no published data about bat species in this cave. Arșiței Cave is located in the special conservation area and has the status of natural reserve.

Table 1. The inventory results of *M. myotis* and *M. blythii* species group.

No.	Underground shelter	Coordinates N	Coordinates E	Altitude (meters)	No. of individuals/ Species	Date
1	Colțul Surpat Cave	45.420603°	25.192647°	780	*2 M. myotis/blythii* 57 *M. myotis/blythii* *87 M. myotis/blythii* *91 M. myotis/blythii* *22 M. myotis/blythii* *1 M. myotis* *22 M. myotis/blythii* *42 M. myotis/blythii* 2 *M. blyhtii*	September 14, 2013 October 30, 2013 November 17, 2013 March 28, 2014 April 21, 2014 August 20, 2014 December 21, 2014 February 8, 2015 February 8, 2015
2	Peștera Decolmatată Cave	45.422737°	25.190942°	785	1 *M. myotis/blythii*	December 29, 2014
3	Arșiței Cave	45.410781°	25.174011°	815	*1 M. myotis/blythii*	November 22, 2014
4	Vacilor Cave	45.450952°	25.217620°	980	*1 M. myotis*	December 22, 2014
5	Dâmbovicioara Cave	45.44419°	25.22262°	900	*2 M. myotis/blythii*	November 22, 2014
6	Peștera cu Lilieci Cave from Peștera village	45.507594°	25.292383°	950	3 ♂♂ și 1♀ adults *M. myotis* 1 ♂ *Myotis blythii* 1 *M. myotis*	August 18, 2014 August 18, 2014 August 18, 2014
7	Uluce Cave	45.410156°	25.261177°	972	*2M. myotis/ blythii* *2M. myotis/ blythii* *2M. myotis/ blythii* *3M. myotis/ blythii* *3M. myotis*	November 16, 2013 March 15, 2014 September 28, 2014 November 22, 2014 December 15, 2014
8	Stanciului Cave	45.506901°	25.194565°	1705	16 *M. myotis* *17 M. myotis/ blythii*	October 26, 2013 February 8, 2015
9	The gallery mine from Zărnești quarry	45.539709°	25.297466°	927	1 ♂ *M. myotis* 14 *M. myotis/blythii* 14 *M. myotis* 10 *M. myotis/blythii* *6 M. myotis/ blythii* *1 Myotis blythii*	August 18, 2014 October 30, 2014 November 2, 2014 December 01, 2014 January 24, 2015 January 24, 2015

4. **Vacilor Cave**, also known as ”Peșteruca din Plai” (GHEORGHIU & MURARIU, 2006), is located on the right side of Piatra Craiului Ridge, on Dâmbovicioara Gorges sector, the right side of Peșterii Valley, at an absolute altitude of 980 m. This cave measures 26 m length. The cave is used as a shelter for cattle. It may be the reason the bats stay rarely inside the cave. We observed one individual of *M. myotis* hibernating inside the cave. This species was not mentioned in the literature so far. On the map, the location of the cave is marked with a star and no. 7.

5. **Dâmboviciara Cave** is located on the southern slope of Piatra Craiului Massif, on the left side of Dâmbovicioara valley, 1 km away from Dâmbovicioara village (MUNTEANU & GHEORGHIU, 2007). The dimension of the cave is 558 m length, four or five meters width and a few branches, being developed on a single gallery. The unvisited part of the cave has the status of a natural reserve, while the visited sector was arranged for tourism purposes. The cave is located in the special conservation area and it is closed to the public access; the visit is possible just in the presence of one guide. On the map, the location of the cave is marked with a star and no. 1. Apparently, the cave did not gather the requirements of these hibernating species; only two individuals were observed at the beginning of the hibernation period, in the visited sector of cave.

6. **Bats Cave from Peștera Village** is located in the north of Rucăr-Bran passage, on the eastern slope of Bisericii Hill, at an altitude of 950 m. On the map, the location of the cave is marked with a star and number 19. The cave is located in the protected landscape area. It has no restrictions on visitation on its entire length of 162 m (MUNTEANU & GHEORGHIU, 2007). DUMITRESCU et al. (1962 – 1963) reported the species *M. myotis* and a nursing colony of *Myotis myotis*; MURARIU (2003), GHEORGHIU & MURARIU (2006) mentioned the presence of both species during the active season and during the hibernation period. We found this species at the beginning of the mating season. On the 18th of August 2014, the flying activity of bats was relatively low (three males and a female of *M. myotis*, one male of *M. blythii*) from a total of seven individuals captured within 5 hours and 45 minutes, belonging to three species (Table 1). The mist net was placed on the shelter entrance from 9:00 p.m. to 2:45 a.m. The climatic conditions were: 14.4 °C, 87% H, clear sky (Table 2). The first which came into the mist net from outside were two males of *M. myotis*. They were captured about an hour and a half after the mist net was placed; the other bats were captured after midnight. The mist net was packed away an hour after catching the last bat. In the early and mid-hibernation period we have not observed any of these species. The explanation may probably due to uncontrolled tourism and constant disturbance.

Table 2. Cave microclimate and external weather conditions on the inventory date.

Cave	Date	Cave microclimate	External weather conditions
Arșiței Cave	September 15, 2014	Not evaluated	Not evaluated
	November 22, 2014	5:30 p.m.: 10.1 ^{0}C, 100%H	cloudy
Bat Cave from Peștera village	August 28, 2014	10 ^{0}C; 89.7%H	9:30 p.m.: clear, 903 hPa, 14.4 ^{0}C; 87%H
	December 30, 2014	3:15 p.m.: 4^{0}C; 100%H	3:15 p.m. -10 ^{0}C ; snow, clear
Peștera Decolmatată Cave	August 21, 2014	5:25 p.m.: 16 ^{0}C; 89%H, airflow: 0 Bf	5:25 p.m.: 29 ^{0}C ; 47.4%H, airflow: 0 Bf.
	December 30, 2014	11:03 a.m.: 4.2^{0}C; 97-100%H, airflow: 0 Bf	11:03 a.m.: -10 ^{0}C, sun, snow
Vacilor Cave	December 22, 2014	11:35 a.m., 2.7 ^{0}C; 81.2%H	11:35 a.m.: 1^{0}C ; 77%H
Uluce Cave	March 15, 2014	3:15 p.m.: Corridor: 5.3^{0}C, vestibular zone: 7.7 ^{0}C.	3:15 p.m.: 9.8 ^{0}C at the entrance of the cave; humidity not evaluated.
	September 25, 2014	7.8 ^{0}C; 88.1%H	9:05 p.m.: clear sky, 6 ^{0}C; 67%H, 915 hPa
	November 22, 2014	6:30 p.m.: 2.2 ^{0}C, 88.4%H	6:30 p.m.: 1 ^{0}C, 98%H
	February 8, 2015	6:30 p.m.: 9.5 ^{0}C, 60.6%H	-7 ^{0}C, 55%H.
Colțul Surpat Cave	September 14, 2014	9 p.m.: 10.8 ^{0}C; 94.4%H	Not evaluated
	April 21, 2014	5:50 p.m.: 7 ^{0}C; 92%H	Not evaluated
	February 8, 2015	5:20 p.m.: 8 ^{0}C; 87.1%H	5:20 p.m.: -5 ^{0}C, 56.1%H
Stanciului Cave	October 26, 2013	9:50 p.m.: 5 ^{0}C; 86.5%H	9:50 p.m.: 2 ^{0}C, 68.4 %H
	February 8, 2015	3 p.m.: -1.6 ^{0}C; 77.1%H, airflow: 0 Bf	3 p.m.: -8.7 ^{0}C; 77.1%H, airflow: 0-1Bf
The gallery mine from Zărnești quarry	August 27, 2014	9:00 p.m.: 7.3 ^{0}C; 97%H, airflow: 0Bf	9:00 p.m.: clear 11 ^{0}C; 98%H, airflow: 0Bf
	December 20, 2014	2:20 p.m.: 9 ^{0}C; 65%H	2:20 p.m.: 4 ^{0}C; 64%H

7. **Stanciului Cave** is situated on the western slope of the limestone ridge Piatra Craiului, between a pathway and Marele Grohotiș. On the map, the location of the cave is marked with a star and number 18. The cave is about 95 m length, has the status of natural reserve and is situated in the special conservation area. Initially it was considered an important wintering shelter for some bat species, including the group *M. myotis/blythii* (MUNTEANU & GHEORGHIU, 2007; GHEORGHIU & MURARIU, 2006). On the cave visit time (after a 15 months interval) we found that the cave roosts a small number of bats, all belonging to the group *M. myotis/blythii*. The reason can be attributed to the disturbance caused by tourists' entering, camping and firing overnight inside the cave. The shelter is used by bats during the mating period.

8. **The gallery mine from Zărnești quarry** is also known as the "Tunelul de la Carieră" (GHEORGHIU & MURARIU, 2006); it is situated on the right side of Prăpăstiilor valley and was a prospecting gallery. The gallery has about 250 m length and an accentuated state of degradation, with down ceiling sections (MUNTEANU & GHEORGHIU, 2007). On the map, the location of the mine is marked with a star and number 32. From the all checked mine galleries, this is the only one where we found the sibling species, probably because the access to the entrance is more difficult and is rarely disturbed by tourists or local people than others, it is larger and the microclimate is suitable for hibernation. During the mating period, the gallery is apparently out of interest for the bats, although the flight and feeding activity of several species was intense out of the entrance in the mine gallery. The mist net was placed at 9:00 p.m., at 5 m from the entrance, inside the gallery, to be more difficult to be detected, and was closed half past four hours later, because of the few captured bats: four individuals belonging to four species. From these, a male *M. blythii*, the only individual in the group *M. myotis /blythii* came inside around 11:00 p.m. In winter, we observed 10 to 14 individuals of *M. myotis* and *M. blythii* in hibernation. Outside the hibernation period, the bats stay there just occasionally.

9. **Uluce Cave** is classified as protected area. Although situated on the territory of Leaota site, about 5 km from the National Park boundary, the cave was checked to see if the cave roosts important colonies of bats. On the map, the location of the cave is marked with a star and number 25. Here, we observed four species, including the group *M. myotis/blythii*.

The other natural and artificial underground galleries where we have not found these species are marked with numbers: 2, 3 – Dâmbovicioara Valley caves; 4 – Peștera Uscată Cave from Rea Valley; 5 – Peștera cu Apă Cave from V. Rea; 6 – Hoților Cave; 7 – Vacilor Cave; 9 – Tunelul cu Cabluri (mine gallery); 11 – Gallery mine no. 1 over Peștera Decolmatată Cave; 12 – Gallery mine no. 2 over Peștera Decolmatată Cave; 13 – cave on the right side of the Dâmbovița Valley; 14 – Tunelul cu Lilieci (mine gallery); 15, 16 – caves over Tunelul cu Lilieci; 17 – Peștera de sub Pietricica Cave; 20, 21 – The caves no 1 and 2 from the left side of the Dâmbovița Valley (Sătic village, AG); 22 – Dracilor Cave; 23 – Dobreștilor Cave; 26 – The Cave from Cheii Valley; 27 – Cave no. 1 from the Great Gorges of the Dâmbovița; 28,29 – Cave no. 2 and 3 from the Great Gorges of the Dâmbovița Valley; 30 – Cave no. 4 from the Great Gorges of the Dâmbovița Valley; 31 (marked with arrow) – Miresii Cave; 33 – Doranca Cave; 34 – Colții Chiliilor Cave; 35 – Mine Gallery no. 2 Zărnești; 36 – Mine Gallery no. Zărnești; 37 – Avenul din Colții Grindului Cave; 38 – The Big Cave from Ulmului Valley; 39, 40 – Caves from Ulmului Valley.

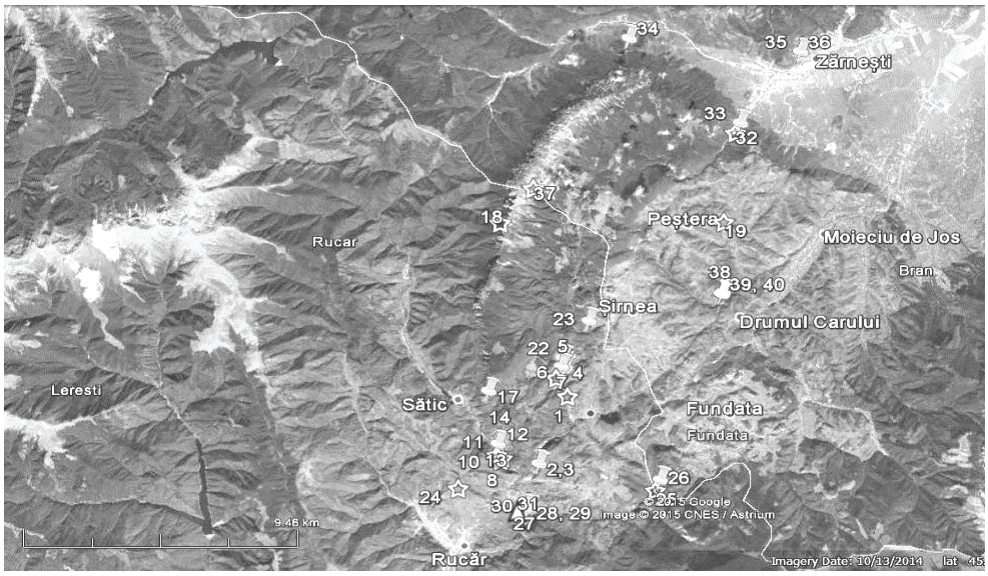

Figure 1. Locations of underground shelters (Map in Google Earth).

Note: Starred markings: shelters where we observed the species *M. myotis/blythii*; thumbtack markings: shelters verified where the species was not observed; arrow markings: possible maternity colony.

CONCLUSIONS

The species *M. myotis* and *M. blythii* were found in nine underground shelters (eight caves and one abandoned mine gallery) from a total of 40 natural and artificial underground shelters checked in the area of Piatra Craiului Mountains. The shelter microclimate measured under bat colonies were between -1.6°C and 9,5°C and between 60.6 % H and 88.4 % H. One of the most important sites of hibernation of *M. myotis/blythii* species group known in Piatra Craiului National Park are now Colţul Surpat Cave and the Mine of Zărneşti quarry. The bat effectives inside Colţul Surpat Cave grow in winter; so, it is possible that this cave is an important collector shelter for the entire area between Făgăraş Mountains, Piatra Craiului National Park, Iezer-Păpuşa massif, Dâmboviţa valley and Rucăr-Bran couloir. The mine gallery is one of the most important hibernacula in Piatra Craiului massif, but unfortunately it is affected by the collapse of the ceiling. We contribute with new data regarding the bat species *M. blythii* in Peştera Decolmatată Cave, *M. myotis* in Vacilor Cave and the species group *M. myotis/blythii* in Arşiţei Cave. These species were not mentioned before in these caves. It seems that the rest of the investigated caves do not meet the requirements of microclimate or space.

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AMYLASES AS BIOLOGICALLY ACTIVE SUBSTANCES PRODUCED BY BACTERIAL STRAINS COLLECTED FROM POLLUTED AREAS

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Abstract. Amylases are among the most important enzymes, with applications in food, pharmaceutical and textile industries. The present study aimed to render the ability of bacterial strains isolated from environments contaminated with heavy metals or petroleum products to synthesize amylases. Three of the strains studied are able to synthesize amylases; two of them belong to the genus *Pseudomonas* and one was classified in the genus *Bacillus*. Enzymatic activity of these three bacterial strains (*Pseudomonas* sp. HM2, *Pseudomonas* sp. OP16 and *Bacillus* sp. OP3) is favourable and *Bacillus* strain sp. OP3 may represent the object of new applicative studies.

Keywords: biologically active substances, bacteria, amylases.

Rezumat. Amilazele ca substanţe biologice active produse de tulpini bacteriene prelevate din zone poluate. Amilazele sunt printre cele mai importante enzime, cu aplicabilitate în industriile alimentară, farmaceutică şi textilă. Prin prezentul studiu s-a urmărit capacitatea unor tulpini bacteriene izolate din medii contaminate cu metale grele sau cu produşi petrolieri de a sintetiza amilaze. Trei dintre tulpinile luate în studiu au capacitatea de a sintetiza amilaze, două dintre acestea aparţinând genului *Pseudomonas,* iar una fiind afiliată genului *Bacillus.* Activitatea enzimatică, la cele trei tulpini bacteriene (*Pseudomonas* sp. HM2, *Pseudomonas* sp. OP16 şi *Bacillus* sp. OP3) este favorabilă, tulpina de *Baciluss* sp. OP3 pretându-se la noi studii cu potenţial aplicativ.

Cuvinte cheie: substanţe biologic active, bacterii, amilaze.

INTRODUCTION

Amylases are among the most important enzymes (NAIDU & SARANRAJ, 2013); those amylolytic enzymes are of great significance in food, textile, paper, fermentation, pharmaceutical and sugar industries (KUNAMNENI et al., 2005; WINDISH & MHATRE, 2012).

Amylases can be found in plants, animals, and microorganisms (BEN MASSOUD et al., 1999; OSFAR & TRI, 2011). Amylases can be obtained from: yeast, bacteria, actinomycetes and several fungi (DAMODARA et al., 2012). Among bacterial sources, we can mention: *Bacillus* genus with *B. subtilis, B. stearothermophilus, B. licheniformis* and *B. amyloliquefaciens,* and some bacteria of the genus *Rhodothermus, Lactobacillus* (MONTEIRO DE SOUZA & MAGALHÃES PÉROLA, 2010), *Pseudomonas stutzeri* (MAALEJ et al., 2014).

MATERIAL AND METHODS

The biological material consisted in 25 bacterial strains isolated from areas contaminated with petroleum products and heavy metals.

The selection of the bacterial strains, which have the potential to synthesize amylases, was made on average with starch nutrient agar medium, for 48 hours at 28 °C. After incubation, the plates were flooded with Lugol solution; if starch hydrolysis occurs, a yellow hollow appears around the colonies (LAZĂR et al., 2004).

The bacterial strains were submitted to the protocol for determining the Gram appurtenance, using Gram microbiology technique (LAZĂR et al., 2004); taxonomic identification was made using Biologic GN2 and GP2 micro plates. Micro plates were inoculated at 28 °C for 24 hours, according to the manufacturer's recommendations (Biologic, Inc).

Enzymatic activity was determined after the method described by LAZĂR et al. (2004), using the spectrophotometric method, reading the samples values at 580 nm.

Bacterial cell was cultivated on liquid nutrient agar medium and incubated at 28 °C on a rotary shaker (150 rpm), for five days.

Amylases activity by Zymography was made by gel on a thin 2 % agarose and 1 % soluble starch in Millis-Q water. In the gel were carried holes, which was added 8 µl supernatant. The gel was incubated at 60 °C for 60 minutes and then flooded with Lugol.

RESULTS AND DISCUTIONS

All bacterial strains were cultivated by starch nutrient agar medium, at 28 °C for 48 hours. After flooding plates with Lugol solution, only 5 bacteria strains gave positive reaction (Fig. 1), which means that 40 % of the strains have the ability to synthesize amylases.

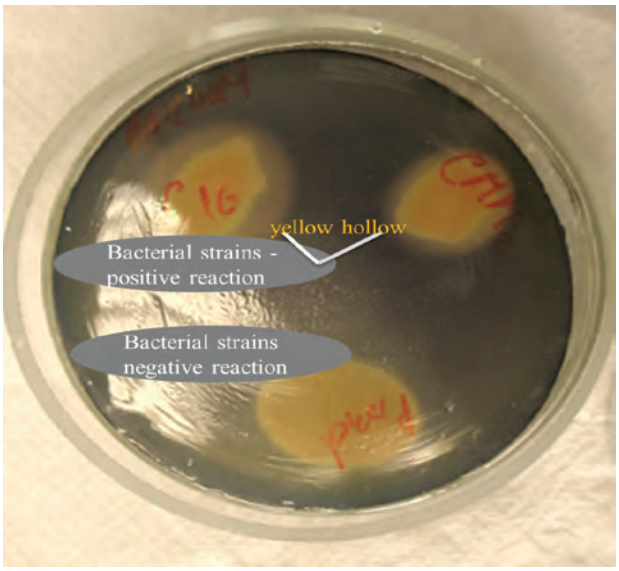

Figure 1. Amylases - synthesis by the bacterial strains.

The five amylolytic bacteria have been identified by using Biologic Systems. Because two bacterial strains were Gram-negative and three Gram-positive, it was used Biologic CN2 micro plates for Gram negative bacteria and CP2 micro plates for Gram positive bacteria. The results based on this biochemical tests indicated that two strains belong to the genus *Pseudomonas* and three were classified in the genus *Bacillus*. It is known that amylases are mainly derived from the genus *Bacillus* (MONTEIRO DE SOUZA & MAGALHÃES PÉROLA, 2010).

After having established the affiliation of the amylolytic bacterial strains, we can note: *Pseudomonas* sp. HM2, *Pseudomonas* sp. OP 16, *Bacillus* sp. OP 3, *Bacillus* sp. OP 9, *Bacillus* sp. OP 6 (indicative: HM - heavy metals, OP - oil pollution and experimental number).

Following the evaluation of enzymatic activity (Table 1), enzymatic activities was identified in three of the five bacterial strains studied at the first screening. All five strains have amylolytic activity.

Table 1. Enzyme activity of amylolytic bacterial strains.

UE (enzyme activity unit)					
Bacterial strains	24 h	48 h	72 h	96 h	120 h
Pseudomonas HM2	2.514	5.88	4.22	10.02	10.88
Pseudomonas OP16	1.961	6.55	7.352	14.35	11.6
Ps. aeruginosa	0.05	0.21	0.01	0.001	0.09
Bacillus OP 3	2.53	9.099	21.71	24.03	22.01
Bacillus OP 9	0.412	0.3814	0.21	0.21	0.02
Bacillus OP 6	1.141	0.511	0.41	0.43	0.39

The bacterial strains *Pseudomonas* sp. HM2, *Pseudomonas* sp. OP16 have a low enzyme activity compared with the strain *Bacillus* sp. OP3 which has an enzymatic activity similar with other strains of the genus *Bacillus* (OSFAR & TRI, 2011).

Bacillus sp. OP9 and *Bacillus* sp. OP6 do not show enzymatic activity similar to *Ps. aeruginosa*, a negative control; this bacterial strain cannot metabolize starch.

These results prompted us to test the enzymatic activity of the supernatant by zymography method (Fig. 2).

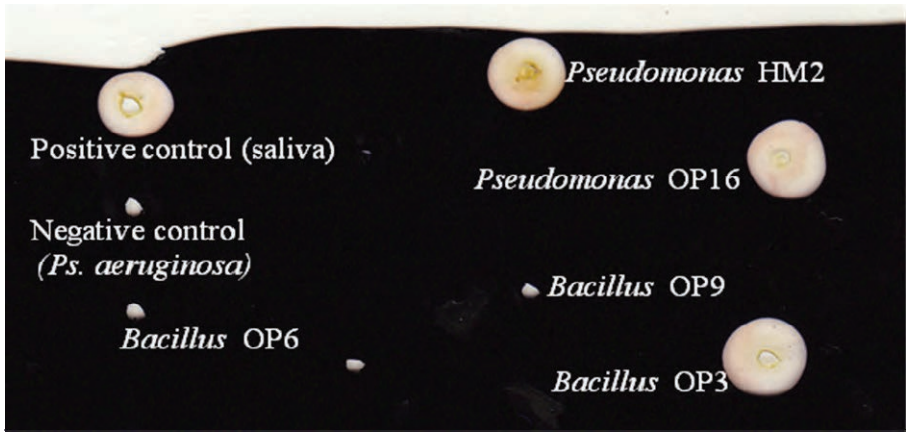

Figure 2. Amylase activity by Zymography.

The results of amylase activity by zymography of the bacterial strains confirm previous data; *Bacillus* sp. OP 9 and *Bacillus* sp. OP 6 strains do not have enzymatic activity.

CONCLUSIONS

There have been isolated from contaminated environments, three bacterial strains: *Pseudomonas* sp. HM2, *Pseudomonas* sp. OP16 that are dependent on enzymes for metabolising carbohydrates of the starch type. Bacterial strains, *Bacillus* sp. OP3 show a higher enzyme activity compared with the other two bacterial strains (*Pseudomonas* sp. HM2, *Pseudomonas* sp. OP16).

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STRUCTURAL AND FUNCTIONAL CHARACTERISTICS OF MICROORGANISMS INVOLVED IN PROCESSES OF METAL IONS CONTROLLED BIOREDUCTION IN ORDER TO RECONSTRUCT BIOCENOTIC STRUCTURES

CISMAŞIU Carmen Mădălina, CIOBOIU Olivia, CÎRSTEA Doina Maria, PAHONŢU Janina Mihaela, ŞTEFĂNESCU Mugur Cristian

Abstract. The extreme environments represent a particular relevance to the study of ecological and evolutionary relations between microorganisms. The positive interactions in polluted environments with inorganic substances are particularly significant in case of the degradation of recalcitrant substances or metabolites; they are products of the solubilisation of the various compounds of the habitat, by making them available for other organisms. The implications of acidophilic heterotrophic microorganisms in the development of metal removal processes prevent the accumulation of heavy metal ions in the trophic chains and persistence in nature. The effects of pollution translate into changes in the flora and fauna. The negative impact of heavy metals may be increased by some environmental conditions. It was found that at a certain concentration of heavy metallic ions, temperature increase reduced by half of the fish survival times. This study was focused on the isolation of acidophilic bacteria as pure cultures and the reduction of heavy metallic ions from environments contaminated with organic compounds using autotrophic and heterotrophic microorganisms isolated from mining waster waters and tailings preloaded from representative areas in Romania.

Keywords: mining effluents, anions, organic substances, amylases.

Rezumat. Caracteristicile structurale şi funcţionale ale microorganismelor implicate în procese de bioreducere controlată a ionilor metalici în vederea reconstrucţiei structurilor biocenotice. Mediile extreme prezintă o importanţă deosebită pentru studiul relaţiilor ecologice şi evolutive dintre microorganisme. Interacţiunile pozitive în medii poluate cu substanţe anorganice sunt deosebit de importante în cazul degradării substanţelor recalcitrante sau a metaboliţilor; sunt produsele solubilizării diferiţilor compuşi ai habitatului, făcându-le disponibile pentru alte organisme. Implicaţiile microorganismelor heterotrofe acidofile în dezvoltarea proceselor de îndepărtare a metalelor previne acumularea ionilor metalici în lanţurile trofice şi persistenţa în natură. Efectele poluării determină schimbări în floră şi faună. Impactul negativ al metalelor grele poate fi intensificat prin anumite condiţii de mediu. S-a constatat faptul că, la o anumită concentraţie de ioni metalici creşterea temperaturii reduce la jumătate timpul de supravieţuire a peştilor. Acest studiu a fost axat pe izolarea bacteriilor acidofile în cultura pură şi reducerea ionilor de metale grele din medii contaminate cu substanţe organice utilizând microorganisme autotrofe şi heterotrofe izolate din ape reziduale industriale şi steril minier din zone reprezentative din România.

Cuvinte cheie: efluenţi minieri, anioni, substanţe organice, amilaze.

INTRODUCTION

In Romania, the wastewater coming from copper ore operating and processing activities is collected in a settling pond or lake, through a series of effluents that start both in the surface exploitation area of the copper sulphide ores and from the flotation where these ores are processed. In this pond, as a result of a natural process of bioleaching due to the sulfur- and iron oxidizing bacteria, there occurs a drastic decrease in pH and an increase in the concentration of heavy metals (CISMAȘIU, 2009).

The activity of optimization has been materialized through a series of laboratory experiments which mainly rely on microbial cells affinity for certain surfaces. The best known microbial restraint methods are: a) inclusion in inert materials (exp. agar); b) adsorption on an inert solid material; c) immobilization by affinity links between biological molecules; d) cell immobilization via covalent or coordinative bonds with materials other than the inert ones. Among the materials used as immobilization supports we can mention: the agar, the molecular sieves, the activated carbon, the volcanic tuffs, the ion exchange resins, the zeolite, the silica gel. In case of using ion-exchange resins we can get a bacterial cell separation out of a mixture (consortium) based on affinities different from some anion or cationic ion exchangers. The anionic ion exchange resins at neutral pH adsorb the Gram- bacteria and desorbs the Gram + bacteria, while the cationic ion exchanger adsorb the Gram + bacteria and desorbs the Gram + bacteria at low pH. Also, the most used neutral supports for immobilizing the whole bacterial cells are: the activated carbon, the molecular sieves, the volcanic tuffs, the ceramics and the agar (BAKER & BANFIELD, 2003; CISMAŞIU, 2001; CISMAȘIU et al., 2010).

The bacterial biofilm is defined as a microbial population included in a matrix adherent to the surfaces or interfaces of some solid supports in liquid medium. The physiological cooperation is the main advantage of this structure. Cellular joining and exuberant production of polysaccharide matrix create specific microclimate conditions for each of the biofilm bacteria. The biofilm is a community that works in a coordinated way, so it is more efficient than the mixed populations of floating planktonic microorganisms. The submerged biofilters method is used in order to speed up the water depollution. By this method, the water mass is passed through filters made of different materials in granular form. Bacterial biofilms are formed on the surface of these granules (DJUKIC & MANDIC, 2006; CISMAŞIU, 2009).

The behaviour of primary producers (macrophytes, phytoplankton and periphyton) initiates the concentration of biogenic substances, turning them into mass plant material source of energy for consumers. In these processes, much of the accumulated stock of material and energy in all trophic levels and the links are in revert to the chain circuit by primary producers. In this context, they have the main role of bacterial populations, which converts organic mass degradation resulting from dead plants and animals and elemental substances in the circuit resumes. In these circumstances a large part of the organic mass have accumulate in the benthal form of the degraded organic material – detritus. In this ecosystem, gastropod populations have an important role among consumers, which constitute a factor of accumulation and transfer of mass and energy by the consumers of higher order – fish (CIOBOIU, 2014).

MATERIAL AND METHODS

1. The microbial system of the field target

Acidophilic heterotrophic microorganisms, due to their ability to adsorb and concentrate heavy metallic ions from industrial waste waters into the cells, could represent a performance source of bacteria in biotechnological processes in order to eliminate the metallic ions (CISMAȘIU, 2001; 2009).

The researches on the biocenotic structures of the vegetable and animal populations in the chain of lakes of the Valley Preajba have revealed essential peculiarities of the organization and functioning of these ecosystems (CIOBOIU, 2002; BREZEANU et al., 2011).

Water samples were collected (250 ml) in sterile bottles to determine the chemistry using the DR 2000 spectrophotometer analysis and sediment samples from the reservoir habitat Preajba Valley (Oltenia Plain) were analysed for determining the levels of chromium, nickel, zinc, lead, cadmium, copper, manganese, and iron using flame atomic absorption spectrophotometer Avanta GBC, 5378 SN.

Samples are taken in containers of clean inert material (glass, plastic and paper); after sampling, shredded organic material in the mortar dries to about 70 ^{0}C. There were also determined, by the same method, the concentrations of heavy metals in *Viviparus acerosus* shells, the dominant species in the lakes, especially downstream (Fig. 1).

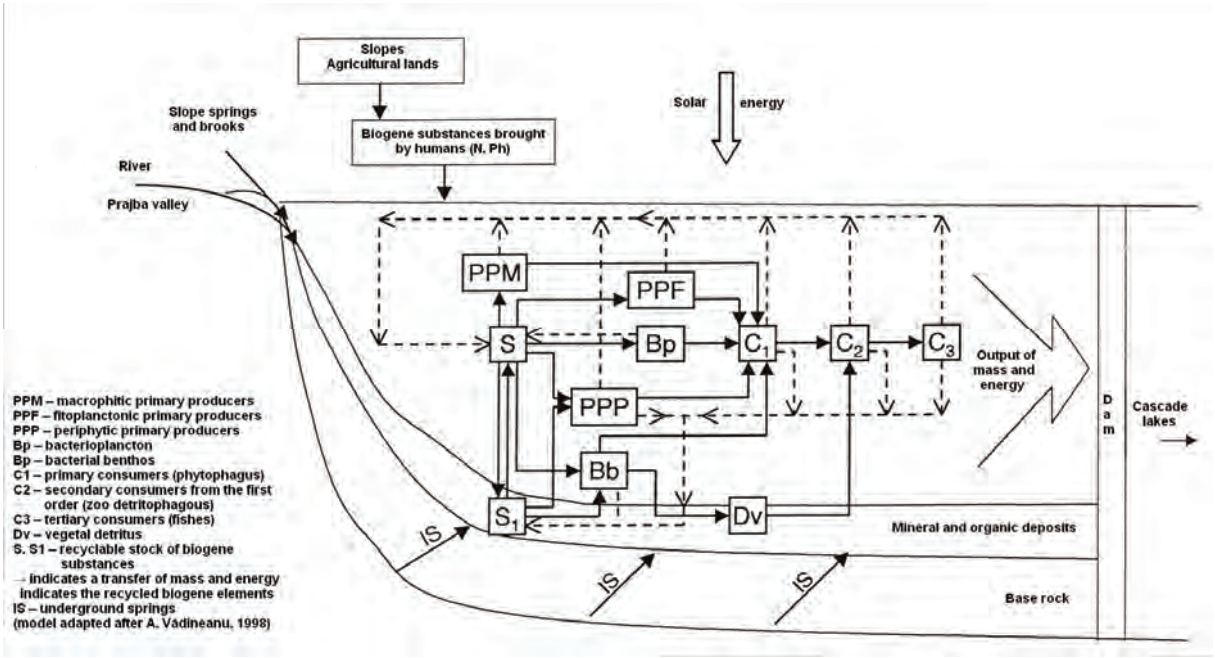

Figure 1. Scheme of the homomorphous model of the functional structures specific to the small reservoirs from Preajba Valley (Oltenia Plain) (after BREZEANU et al., 2011).

2. Selection of the field test

In laboratory conditions, the tolerance study of the bacterial cultures to different concentration of Cu^{2+}, $Zn^{2+}$and Ni^{2+} permitted the selection of strains and populations, which show an increased resistance to these ions towards improving the biosorption processes. Several studies have shown significant variations regarding the assimilative capacity of heavy metallic ions between different genera, species and even among strains of the same species (CISMAȘIU, 2010).

Mineralization made in order to shift the metals in solution is achieved in Ethos microwave type D, power 1000W, equipped with Teflon tubes, programmable and occurs as follows:

- weigh approximately 0.5g, 1g dry organic material, graded and placed in Teflon tube;

- 3 ml of nitric acid 65%, 2 ml HCl and 1 ml hydrogen peroxide 37% in the tube and then left standing a few minutes;

- mineralized samples filtered through quantitative filter paper, each fresh acid extract is collected in one 25 ml; volumetric flask, add 5 ml of each sample added 5ppm standard gauge, and adjust the volume with distilled water;

- aspirate the standard solutions in ascending order of concentration and blank (zero) to construct the calibration curve, the following wavelengths type atomic absorption spectrometer Avanta (GBC) equipped with flame burner for air/acetylene lamps determined corresponding hollow cathode metals (Table 1).

Table 1. Synoptic data of wavelength for some heavy metals determined.

Metallic ions determinates	**λ (nm)**
Pb^{2+}	217
Cd^{2+}	228.8
Cu^{2+}	324.7
Ni^{2+}	232

RESULTS AND DISCUSSION

In natural and human environments the acidophilic microorganisms exist in the form of mixed populations, interacting with each other, both positively and negatively. Their presence is highlighted more by metabolites (the most obvious are the reddish deposits rich in ferric iron) and not by the accumulation of biomass; in others it is the reverse. The latter is seen in the formation of gelatin macro structures - "acid filaments", widespread in all sites in the world (especially in underground areas).

Biosorption or biofixation is a process that unfolds rapidly and the differentiations occurring in the ability of microorganisms to fix different metal ions depend on the specificity of the microorganisms to different metal ions, on the cell wall composition and structure, as well as on the ion exchange reaction that occurs in the cell wall. For extracellular accumulation of metal ions from the industrial effluents, especially for those coming from the extraction and processing of minerals, the microbial biotechnologies such as biosorption or bioaccumulation processes are based on microbial systems, live or killed (dried), free or immobilized on various adsorbents.

Acidophilic bacteria were tested for their efficiency in order to improve reduction processes of metal ions in different physic-chemical environment characteristics such as pH, temperature, organic and inorganic substratum on their development and extracellular enzymatic activities. Our results indicate the maximum hydrolysis activities of organic substances from bacterial cultures belonging to the *Acidiphilium* genus which was determined in selective medium with 0.3% organic compounds and pH 3.0 in the first 7 days of incubation at 28^0C; these features are correlated with physic-chemical terms of mining sites (Figs. 1-4).

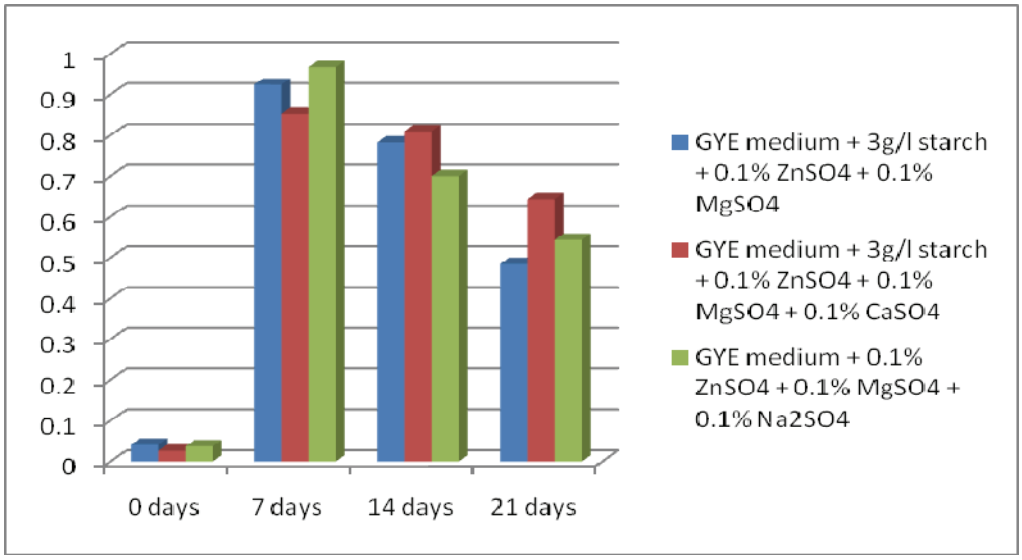

Figure 1. The development of the *Acidiphilium* population in GYE medium with 0.1% $ZnSO_4$ in the presence of environmental cations (Ca^{2+}, Mg^{2+} and Na^{+}) at 3g/l starch.

In spatially organized ecosystems, the degree of cooperating between cooperative microorganisms depends on the concentration and diffusion gradients of dissolved substances, such as nutrients and metabolites. Based on the results of the physic-chemical characterization of samples taken from the mining effluents, it was considered that this study is necessary. It is about the optimization of the biosorption process of the metal ions contained in mining effluent samples, using industrial water samples from the tailings pond, which has a much higher degree of pollution in sulphates and heavy metal ions such as iron, copper, zinc, nickel (Figs. 1-2).

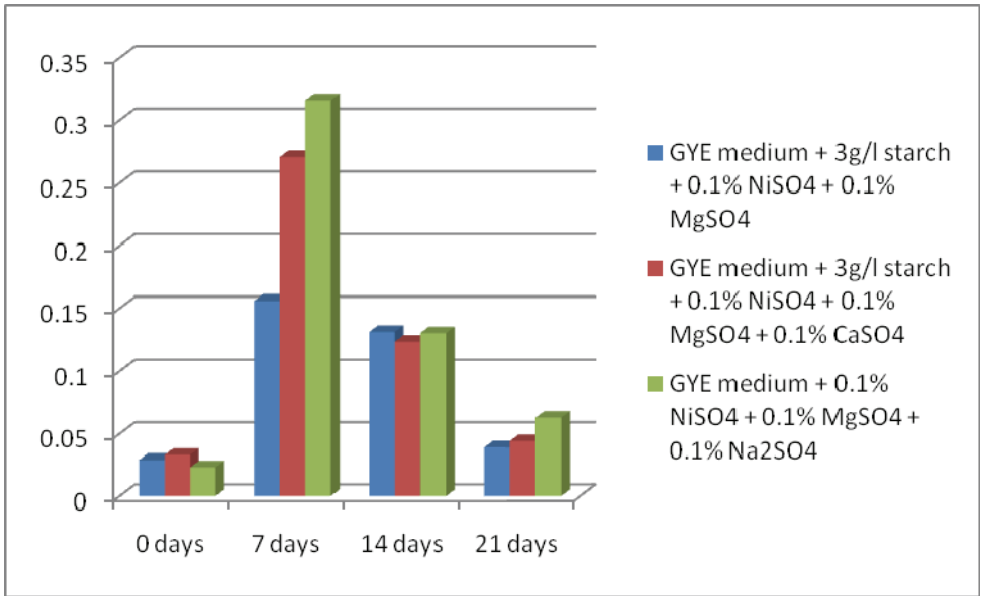

Figure 2. The development of the *Acidiphilium* population in GYE medium with 0.1% $NiSO_4$ in the presence of environmental cations (Ca^{2+}, Mg^{2+} and Na^{+}) at 3g/l starch.

The main microorganisms involved in the bioaccumulation processes of heavy metallic ions from industrial waste waters are acidophilic heterotrophic bacteria, which form a heterogeneous group of bacteria belonging to the *Acidiphilium* genus. From this point of view, these bacteria isolated from polluted environment are able to take up heavy metallic ions from the studied area through some mechanisms such as: the formation of organic acids, the reactions of reduction, the excretion of organic complexion agents (Figs. 3-4).

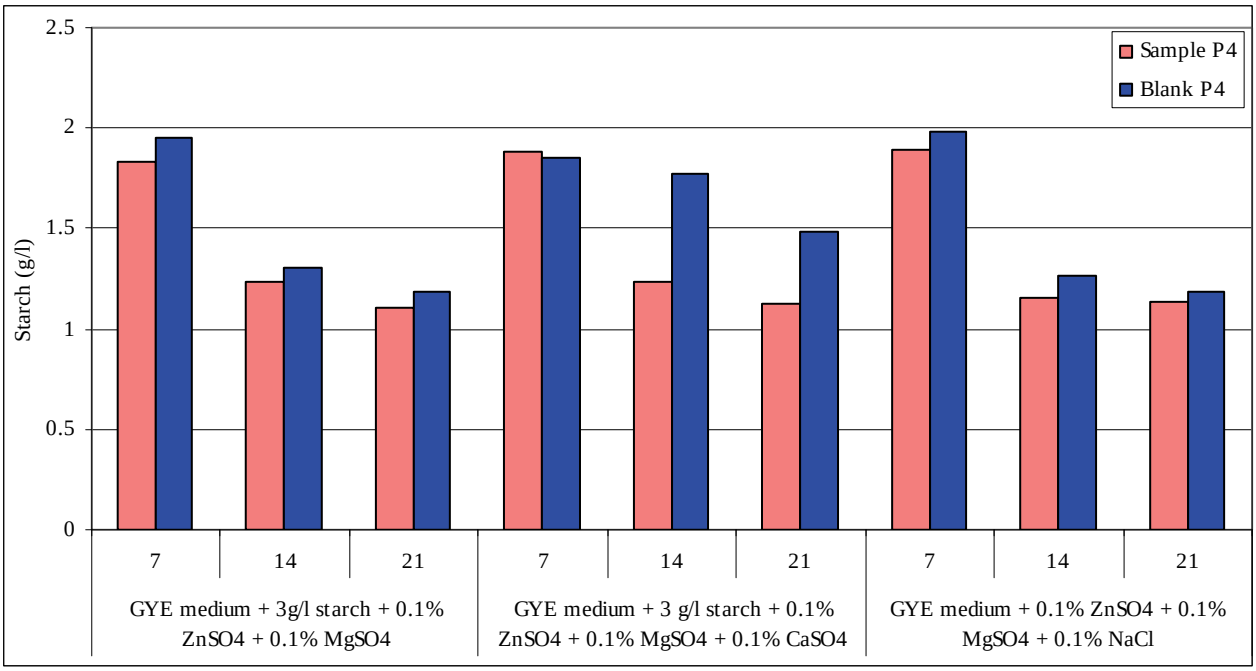

Figure 3. The starch degradation activity of the *Acidiphilium* population in GYE medium with 0.1% $ZnSO_4$ in the presence of environmental cations (Ca^{2+}, Mg^{2+} and Na^{+}).

Studies have shown that water and sediment samples taken from areas situated downstream the tailings pond contain a richer and more diverse microflora compared to the mine effluent that is collected in that tailings pond. The results of the microbiological analysis correlate with the physic-chemical characteristics of the water and sediment samples from the mining effluents, meaning that the mining effluent collected in the tailings pond is much more polluted with metal ions, with a more acidic pH value, compared to the one taken from a creek located at a distance of 3-5 km downstream (Figs. 1-4).

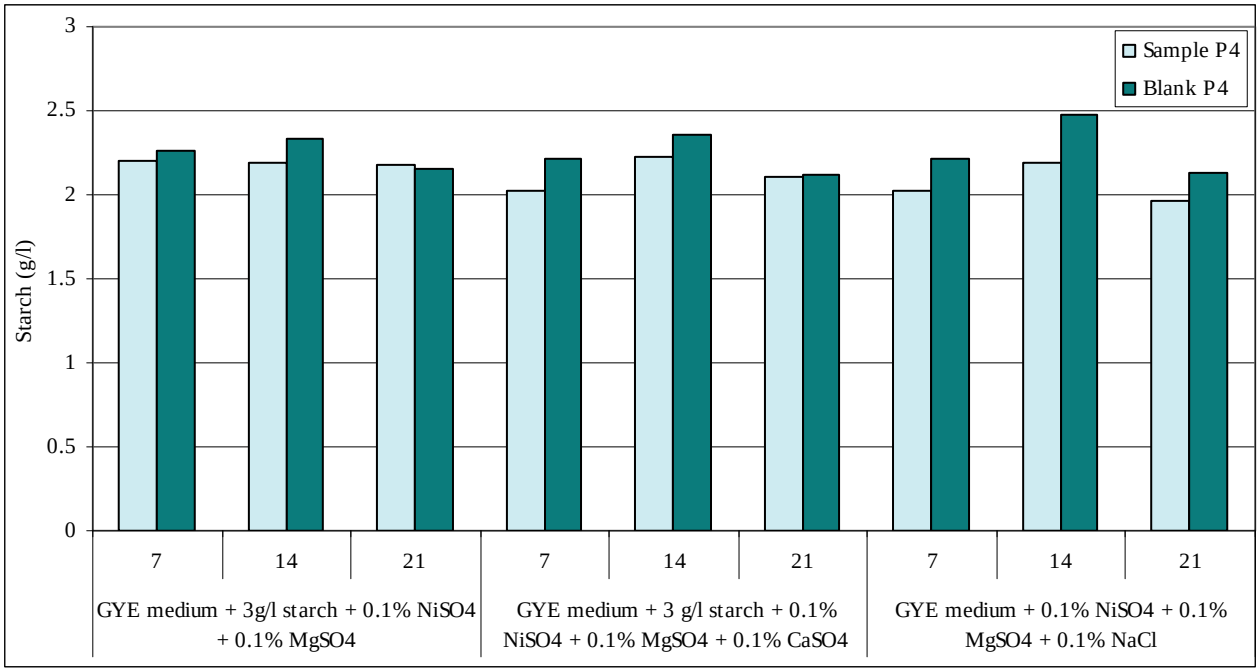

Figure 4. The starch degradation activity of the *Acidiphilium* population in GYE medium with 0.1% $NiSO_4$ in the presence of environmental cations (Ca^{2+}, Mg^{2+} and Na^{+}).

It was felt that the essential elements that determine the development of the planktonic and benthic communities are hydrologic factor such as the Preajba River and adjacent springs on the one hand and on the other trophic factor determined by nutrient intake. These two elements, hydrological factors and other nutrients in terms of stimulating factors (solar energy, temperature, etc.) trigger the mechanisms that lead to the establishment of trophic structures and relationships, transfer of material and energy in the ecosystem. Pb^{2+} and Cd^{2+} are not considered essential for life, but they are concentrated in some aquatic organisms in the aquatic environment.

We found significant differences between the concentrations of heavy metals in water and aquatic organisms present in those waters (Fig. 5). The concentrations of Pb^{2+}, Cd^{2+}, Cu^{2+}, Zn^{2+}, Mn^{2+} and Fe^{3+} in the reservoirs of the Preajba Valley found below the limit of detection. Also, pH values range from 7.29 to 8.64 (slightly alkaline range) in accordance with bicarbonates content (414-695 mg/l). Among cations, there stands primarily calcium (Ca^{2+}) the origin of which is considered in the sedimentary rocks of the basin lakes and the amendments applied within farmlands. Ions of calcium, magnesium with carbonates, bicarbonates and sulfates present in the waters of the lakes, are due to higher hardness of the total water (over 30 degrees German).

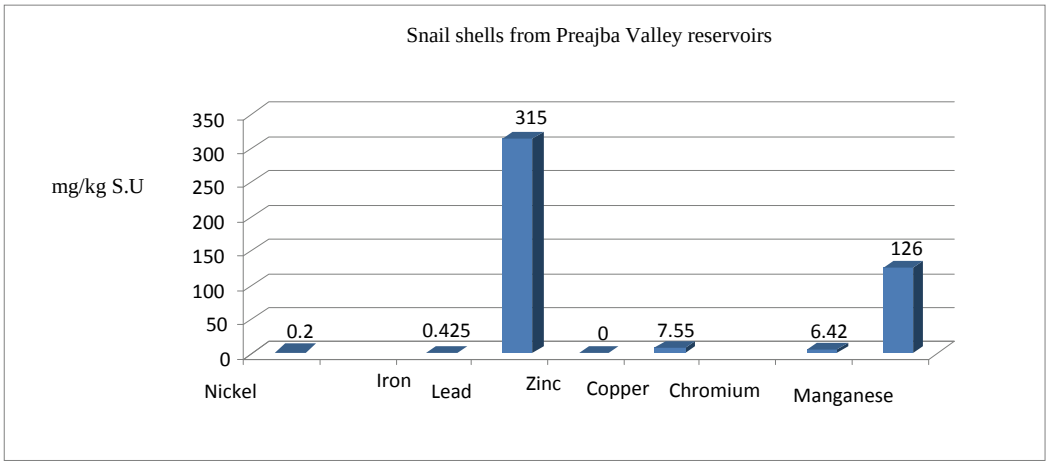

Figure 5. Concentrations of heavy metallic ions from snail shells of *Viviparus acerosus*.

Water chemistry varies in relation both with natural springs and streams and anthropogenic nutrient loads carried by rainwater coming from the neighbouring agricultural areas (CIOBOIU & PLENICEANU, 2005). The chemical composition of eutrophic water ecosystems is specified; the concentrations of the nutrient medium (NO_3^- and PO_4^{3-}) is 18.5 mg / l or 7.9 mg / l (CIOBOIU & CHICIUDEAN, 2003). In terms of the quality requirements for surface

waters, the small reservoirs from the Preajba river falls into the category II (bicarbonate - sulphate - calcium - magnesium) which means if can be used for fish farming (apart from Salmonids) and tourist and recreational purposes (CIOBOIU & BREZEANU, 2009; CISMAŞIU et al., 2010).

Positive interactions are cooperative relationships that increase the growth speed of the associated organisms. They prevail in low-density populations and when the growth speed is below the optimum. Colony forming provides not only aggregation of individual organisms, but also a more efficient use of available resources. Overall, the accumulation of products with inhibitory activity and the antagonism phenomena contribute (together with the quality and quantity changes of nutrients) to the appearance of changes in the microorganism community structure, underlying the succession of populations in an ecosystem (BAKER & BANFIELD, 2003; DJUKIC & MANDIC, 2006; CISMAŞIU, 2012).

It can be concluded that bioaccumulation is heavily dependent on the quantity of metal present in the living environment of sediment. We hypothesized that such patterns of accumulation and transfer HM in biota can be used as a fingerprint for the detection and characterization of biochemical risk of environmental pollution in a specific area (DALLINGER et al., 2001; NIANZHI, 2003; NICA et al., 2012).

CONCLUSIONS

The cooperating interactions have a great ecological importance, especially in extreme situations. The formation of colonies of microorganisms is probably an adaptation based on cooperative interactions in population. The production of extracellular enzymes by some members of the colonies makes the substrates available to all the population members.

Productions of organic and inorganic acids alter the natural environment, which becomes inaccessible to susceptible microorganisms. One example is the productions of organic acids by the acidophilic heterotrophic bacteria belong to the *Acidiphilium* genus, which lowers the pH value of mine draining water at 2.5-4.5. These waters prevent the growth of both acid-sensitive microorganisms in the water courses in which they are discharged and the microorganisms themselves in that habitat. In the metallic ions biosorption process there can occur both mediated metabolic phenomena and no metabolic phenomena, depending on the chemical and physiological reactions involved in reduction processes. These reactions depend on the physiological conditions of the cells, on the chemical state of the metal ions in the impact with the microbial cells, and all of these are strongly influenced by the chemical conditions of the environment and the presence of other metals.

The natural communities of microorganisms consisting of a great variety of species that live in common, frequently as dense populations, are relatively stable and difficult to disrupt. The indigenous microorganisms oppose the imbalance produced by ecological temporary changes (exp. discharge of wastewater into the soil or natural water). In reducing this imbalance to the normal values there occur homeostasis processes taken by predators. Our study illustrates the efficiency of degradation of inorganic substances under the enzymatic activity of acidophilic microorganisms in the presence of the above mentioned experimental conditions for biocenotic structures reconstruction of representative miming areas in Oltenia Region. Because freshwater snails can accumulate higher concentrations of Cu^{2+} and Cd^{2+} than the average, they are generally recognized as "macroconcentrator" HMS for these species. By ranking the 18 species identified in lakes according to the biomass, it was found that the percentage is higher in the populations of *Viviparus acerosus*, 147 g/m^2 to 649 g/m^2, this species representing a reference factor in the accumulation of heavy metals.

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THE ROLE OF PLANKTON COMMUNITIES IN THE FUNCTIONAL CAPACITY OF THE DANUBE DELTA ECOSYSTEMS – A LONG TERM STUDY

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Abstract. The paper aims to emphasize the long-term changes in the structure and ecological processes of planktonic communities in shallow lakes of the Danube Delta Biosphere Reserve as well as the consequences on the flows of goods and services these lakes offer to socio-economic systems. Under the eutrophication pressure, profound changes in biodiversity and energy flow were observed as compared to the reference period. The balance between submerged macrophytes and phytoplankton characterized the natural status of the Danube Delta lakes (1975 – 1980). This was changed by the eutrophication process with consequences on the entire food web structure. Phyto and zooplankton species richness decreased with 50%, with effects on the quality and quantity of production, as well as on the nutrient recycling rate. In Roşu Lake (a representative shallow lake used as case study), the phytoplankton and zooplankton biomass increased 50 and 8 times, respectively, due to increased nutrient supply and changes of micro/macro filter feeders ratio. A low level of increasing (1.7 times) has been recorded for the bacterioplankton biomass. The maximum impact of eutrophication (hypertrophic period) is characterized by the energy input via phytoplankton exclusively. Nutrient recycling rates by phytoplankton and zooplankton decreased 11 and 1.1 times, respectively as a result of structure and trophic relationship changes. Shift in the submerged macrophytes/phytoplankton ratio affected the composition of organic substrate with consequences on the bacterioplankton communities. Since 1991, due to economic changes in the Danube basin, a trend of trophic state recovery of lakes has been registered, first observed at the level of phytoplankton communities. The responses at the level of phytoplankton communities consisted in increased nutrient recycling rates (without reaching the maximum capacity from the reference period). Till 2001, zooplankton kept the decreasing trend started in 1975, whereas bacterioplankton registered significant values of nutrient-recycling that indicate the prevalence of degradation processes in the detriment of accumulation in self-biomass.

Keywords: energetic supply**,** nutrient storage, Danube Delta, eutrophication, ecosystem services.

Rezumat. Rolul comunităților planctonice în asigurarea capacității funcționale a ecosistemelor din Delta Dunării - studiu de lungă durată. Lucrarea își propune să scoată în evidență schimbările pe termen lung în structura și procesele ecologice ale comunităților planctonice din lacuri de mică adâncime din Delta Dunării, ca și consecințele acestora asupra fluxului de servicii furnizate de lacuri sistemelor socio-economice. Sub presiunea eutrofizării, au fost observate schimbări profunde în biodiversitate și fluxul de energie, comparativ cu perioada de referință. Statusul natural al lacurilor din Delta Dunării (1975 – 1980) era caracterizat de un echilibru între macrofitele submerse și fitoplancton. Acesta a fost schimbat cu consecințe asupra întregii structuri a rețelei trofice. Bogăția specifică a fito și zooplanctonului a scăzut cu 50%, cu efecte asupra calității și cantității producției, ca și a ratei de ciclare a nutrienților. În lacul Roșu (lac reprezentativ de mică adâncime), biomasa fito și zooplanctonului a crescut de 50, respectiv 8 ori, din cauza rezervei crescute de nutrienți și a schimbărilor dintre raportul micro/macro filtratorilor. O rată mai scăzută de creștere (1,7 ori) s-a înregistrat în cazul biomasei bacterioplanctonului. Impactul maxim al eutrofizării (hipertrofia) este caracterizat de un input de energie exclusiv pe calea fitoplanctonului. Rata de ciclare a nutrienților de către fito și zooplancton a scăzut de 11, respectiv 1,1 ori, ca rezultat al schimbărilor în structura și relațiile trofice. Schimbarea raportului macrofite/fitoplancton a afectat compoziția substratului organic cu consecințe asupra bacterioplanctonului. Din 1991, datorită schimbărilor economice din Bazinul Dunării, a fost înregistrată o tendință de revenire a stadiului trofic al lacurilor, în primul rând observat la nivelul comunităților planctonice. Răspunsurile au constat în creșterea ratei de ciclare a nutrienților (fără a se atinge nivelul capacității maxime din perioada de referință). Până în anul 2001, zooplanctonul menține tendința descrescătoare începută în 1975, în timp ce bacterioplanctonul înregistrează valori semnificative ale ratei de ciclare a nutrienților, aceasta indicând prevalența proceselor de degradare în detrimentul celor de acumulare în biomasa proprie.

Cuvinte cheie: oferta energetică, stocare de nutrienți, Delta Dunării, eutrofizare, servicii ecosistemice.

INTRODUCTION

The research conducted in various types of ecosystems of the planet have no other purpose than to point out the characteristics of the impact of changes in the structure and functionality of trophic levels at spatio – temporal scale. Practically all aquatic ecosystems have been damaged by anthropogenic activities. Aquatic ecosystems are responsible for a wide variety of functions valuable to human society.

The various stressors have reduced both the quantity and quality of habitat for fish and wildlife and damaged aesthetic values important to tourism, as well. These trends are accompanied by the extinction or endangering of aquatic organisms and reduce many beneficial water uses, including drinking, swimming, and fishing (CAIRNS, 2006). These important services are provided by plankton communities in the aquatic ecosystems.

Danube Delta is a dynamic and heterogeneous complex of systems with different successional stages. The water systems (lakes, ponds, natural waterways, river arms) and wetlands represent 67-81% of the 442 300 ha of the Romanian delta (CRISTOFOR et al., 1994).

The plankton is part of the self-supporting ecological systems (natural, semi-natural and anthropogenic) and produces a wide range of services by absorbing and concentrating the radiant solar energy and cycling of the mineral elements.

The deciphering of the functional capacity and the mechanisms that realize the productivity of aquatic ecosystems involves the establishment of the principles that govern the rates of energy flow, the flow of nutrients and the control mechanisms in the field of stability (POSTOLACHE, 2006; RÎȘNOVEANU et al., 2008).

The functional capacity is defined as the extent to which a part of a wetland fulfills a specific function (VĂDINEANU et al., 1998; VĂDINEANU, 2004). The functional analysis is broadly the method to evaluate the provision of goods and services of the natural capital.

The estimation of the functional capacity of aquatic ecosystems requires the knowledge and understanding of the dynamics of plankton communities in turn modulated by controlling factors. We may state that changes in the specific composition, structure and function of phytoplankton act as a modulator for the behaviour of the whole food-web.

The development of knowledge on the role of the biodiversity components - populations (species, guilds or trophic levels) and communities contributes to the understanding of the functional capacity of ecosystems (functions and associated service fluxes).

In the evolution of the Danube Delta shallow lakes, significant structural and functional changes occurred in the planktonic communities, following the trophic state dynamics. As compared to the reference period, under the eutrophication pressure, profound changes in biodiversity and energy flow were observed.

The submerged macrophytes/phytoplankton ratio characterizing the natural status of the Danube Delta lakes (1975 – 1980, mesotrophic status) was altered by the acceleration of eutrophication process (1981 – 1995, eutrophic/hypertrophic status), with consequences on the entire food-web structure (MOLDOVEANU et al., 2010; ZINEVICI et al., 2004). The phyto- and zooplankton species richness decreased by 50%, impacting the production and nutrient recycling rates. The maximum impact occurred during the hypertrophic period, when the energy input was realized exclusively by the planktonic producers. These changes affected the flow of goods and services provided to the socio-economic systems.

The aim of the study was to emphasize the long-term changes in the ecological processes of planktonic communities and the impact on the flow of goods and services offered to socio – economic systems. The objectives were: energy flow assessment, assessment of nutrient storage capacity, evaluation of nutrient production, estimation of nutrient recycling rate.

MATERIAL AND METHODS

Study site and sampling

The Danube Delta Biosphere Reserve is located at 45°0′ N latitude, 29°0′ E longitude in the eastern part of Romania. The sampling campaigns were carried out in 1975 – 2001 period, in an extensive way, seasonally (Spring, Summer and Autumn) or monthly, on the water column, from Lake Roșu (Fig. 1). Lake Roșu is located at 45°05′21.81″ N latitude, 29°56′76. 42″ E longitude. It is the most representative freshwater lake of maritime delta, with an area of 1,445 ha, a water volume of 21.7 mil. cm and an average depth of 3 m.

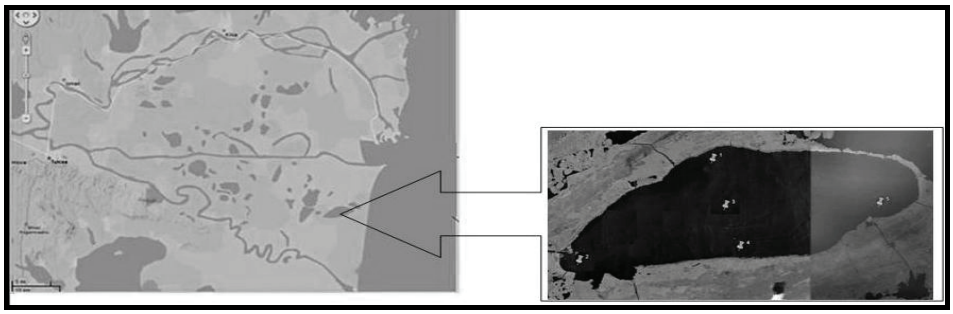

Figure 1. The map of the Danube Delta and sampling points of Lake Roșu (adapted after Google Earth).

Methods

The phytoplankton samples were collected without filtering, in 0.5 L bottles, preserved with 4% formaldehyde solution. The zooplankton samples were collected by filtering 50 litres of water using a Patalas-Schindler device (5 L) on water column through a 65 µm Ø mesh network, and preserved with 4% formaldehyde solution. Plankton species investigations: by inverted microscope using specific keys.

The phytoplankton and zooplankton biomass was assessed by volumetric and gravimetric measurements. The bacterioplankton biomass was estimated by direct counting and biovolume estimation.

The phytoplankton and bacterioplankton production was measured by Winkler method. The zooplankton production was achieved by the methods of Galkowskaja (Rotatoria), Ilkowska-Stankzykowska (for planktonic larvae of Lamellibranchia); Winberg, Pečen and Shushkina (Copepoda and Cladocera) described in EDMONDSON, 1974; EDMONDSON & WINBERG, 1971. The plankton content of nutrients (C, N, P) was assessed using conversion coefficients (WALVE & LARSSON, 1999; WINBERG, 1971).

RESULTS AND DISCUSSIONS

Although the provision of resources and services is an emergent property of the ecosystem, the achievement of ecological functions is related to direct or indirect contribution of many species/populations. Ecological processes supported by species/populations make the connection between biological diversity and ecosystem services. A key issue in determining the relative role of each species, in achieving specific functions and associated flow of services is to quantify the relative contribution of processes involved in the particular conditions.

There are multiple relationships between biodiversity and ecosystem services. In Table 1, there are presented the services provided by plankton starting from the classical ecosystem functions and the involving of biodiversity in shaping the ecosystem services.

In the eutrophication period, phyto and zooplankton species richness decreased with 50%, with effects on quality and quantity of production, as well as nutrient recycling rate. In Lake Roşu, the phytoplankton and zooplankton biomass increased 50 and 8 times, respectively, due to increased nutrient supply and changes of micro/macro filter feeders ratio. A low level of increasing (1.7 times) was recorded for the bacterioplankton biomass. During that period, the primary productivity increased 4 times and that of zooplankton 7 times by comparison with the reference state. In the new conditions, primary production efficiency (NPP/GPP) decreased from 80% in 1977 to 47% in 1986.

The energy offer of the three types of planktonic communities is consistent with that outlined in other lakes of the Danube Delta, with changes from one stage to another, due to the pressure of eutrophication. The energy supply of plankton expressed as biomass (kcal.m^{-3}) and production (kcal.m^{-3}/ 90 days), was considered part of the supply of the ecosystem services. It is basically the amount of energy made available by plankton to other trophy levels in the ecosystem. The supply of energy of the planktonic communities has a significant rising during the maximum impact of the eutrophication period; the phytoplankton had the prevailing role in the whole studied period (Table 2).

Table 1. The conceptual frame concerning the relationship between biodiversity and ecosystem services supply to Socio-Economic Systems.

The function of ecosystem	**TDM (tropho-dynamic-modules)**	**Services**	**The relationship between Biodiversity and Socio-Economic Systems (SES)**
Production	Phytoplankton Zooplankton Bacterioplankton	Biomass	BDV→SES
Regulation		Nutrient circulation Water quality	BDV→SES
Support		Biodiversity conservation	Genetic resources
Informational		Bioindicators Ecotourism Scientific and managerial information	Structural and functional parameters of TDM

During the reference period (1977 - 1978), the predominant role of primary producers in the ecosystems was hold by macrophytes. The gross productivity of phytoplankton was low, the turnover ratio was 1.54 and net primary production efficiency 80% (expressed by the ratio of net primary production/gross primary production), (theoretically this ratio can vary widely, 40% - 90%) (BOTNARIUC & VĂDINEANU, 1982; BOTNARIUC, 1999). These values demonstrate the natural state of the ecosystem, with a good efficiency of accumulation of net primary production, the organic substances usable by succeeded trophic levels.

The situation has radically changed since the 1980^{s}. In the year 1986, high values of productivity were registered; the index P/B had the lowest value (0.19). In these circumstances, although the ecosystem productivity increased, the net primary production efficiency decreased by almost half (47%) compared to 1977.

Table 2. Energetic supply of plankton communities.

Period	**1975-1980**				**1985-1990**				**1995-2001**			
Plankton communities	Phyto	Zoo	Bact	**Σ**	Phyto	Zoo	Bact	**Σ**	Phyto	Zoo	Bact	**Σ**
Biomass (Kcal c.m.$^{-1}$)	1.54	0.51	0.84	**2.89**	38.47	4.16	0.93	**43.56**	20.81	1.25	1.88	**23.94**
Production (Kcal c.m.$^{-1}$/day)	1.47	0.06	0.18	**1.71**	6.40	0.45	0.41	**7.26**	6.15	0.11	0.84	**7.10**

The storage capacity of nutrients in the planktonic communities was increased in the hypertrophic period by 15 times (364.67 → 5,437.84 mg c.m.$^{-1}$) (Table 3).

Table 3. Nutrients storage capacity of plankton communities.

Plankton communities (mg c.m.$^{-1}$/day)	1975-1980			1985-1990			1995-2001		
	C	N	P	C	N	P	C	N	P
Phytoplankton	154	30.80	3.08	3847	769.40	76.94	2081	416.20	41.62
Zooplankton	51	12.75	1.32	416	104.00	10.81	125	31.25	3.25
Bacterioplankton	84	21.00	6.72	93	23.25	7.44	188	47.00	15.04
Σ	289	64.55	11.12	4356	896.65	95.19	2394	494.45	59.91

Nutrient transfer through the planktonic communities revealed an upward trend in comparison with the reference period (from 210.93 → 892.75 mg c.m.$^{-1}$/day) (Table 4).

Table 4. Nutrient production of plankton communities.

Plankton communities (mg c.m.$^{-1}$/day)	1975-1980			1985-1990			1995-2001		
	C	N	P	C	N	P	C	N	P
Phytoplankton	147	29.40	2.94	640	128.00	12.80	615	12.00	12.30
Zooplankton	6	1.50	0.15	45	11.25	1.17	11	2.75	0.28
Bacterioplankton	18	4.50	1.44	41	10.25	3.28	84	21.00	6.72
Σ	**171**	**35.40**	**4.53**	**726**	**149.50**	**17.25**	**710**	**146.75**	**19.3**

The input of energy in the ecosystem is due exclusively to phytoplankton (50%); the zooplankton has a low efficiency in directly energy uptake from phytoplankton (0.69%), accessing detritobacterial path (ZINEVICI et al., 2004); the DOM and POM compartments are overloaded with energy and most of it remains unused and is deposited in sediment (Fig. 2). In this type of ecosystem the "microbial loop" (bacteria - heterotrophic nanoflagellates - ciliates) has a special role in the flow of energy through the ecosystem (HART & STONE, 2000). Heterotrophic microbial communities represent a "drainage place" in which the energy contained in MOD representing 74% of the POC is transformed (through decomposition and mineralization) and a part of it returns to higher levels.

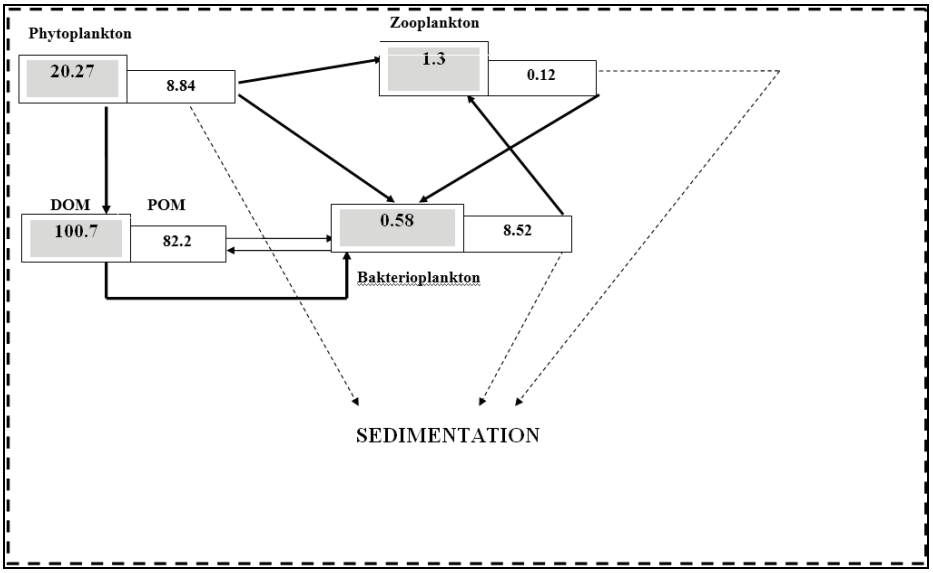

Figure 2. The diagram of energy flow in Lake Roșu (1999-2001)
grey boxes - biomass (kcal cm^{-1}); white boxes - production (kcal cm^{-1}/day).

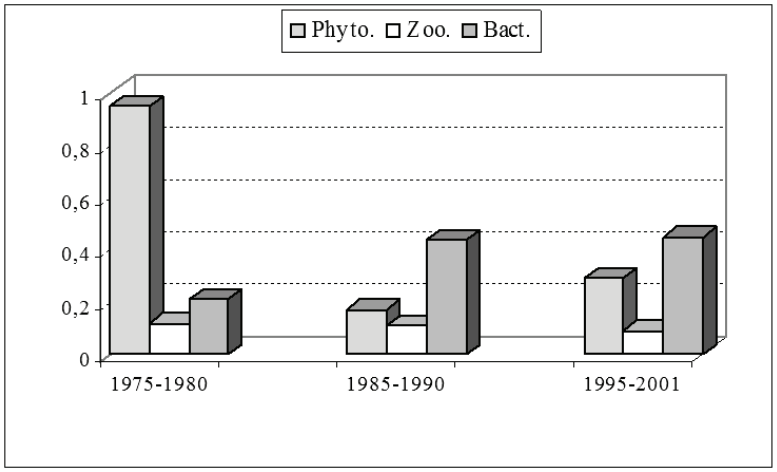

Figure 3. Nutrient cycling rate (P/B) in plankton communities.

Nutrient cycling rate, initially provided by the phytoplankton, is taken up by the bacterioplankton in the eutrophication period (Fig. 3). The replacement rate of biomass ("turnover rate") shows the speed of production, the replacement of mineral elements and the compensation of losses within a certain time (BOTNARIUC, 1999). The planktonic producers play a key role in nutrient cycling in the water, followed by decomposers; the zooplankton occupied the last place (PINTO-COELHO et al., 2005; WALVE & LARSSON, 1999; WETZEL, 1983; WINBERG, 1971).

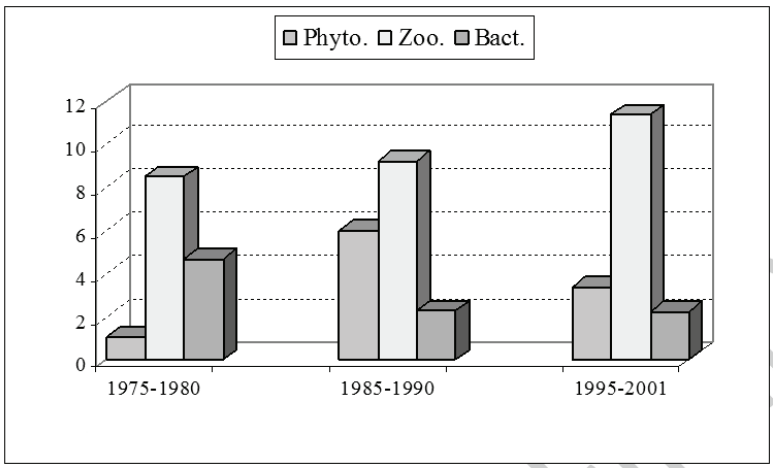

Figure 4. Nutrient cycling time (B/P) in plankton communities.

The phyto and bacterioplankton have a short time of generations which sustained well the cycling rate in comparison with the zooplankton (Fig. 4).

CONCLUSIONS

The phytoplankton played the prevailing role in the whole studied period in terms of energy. This fact leads to imbalances in the whole ecosystem.

The zooplankton has a low efficiency in directly energy uptake from phytoplankton, the DOM and POM compartments are overloaded with energy and most of it remains unused and is deposited in sediment.

Healthy ecosystems carry out a diverse array of processes that provide both goods and services to humanity. Over time and due to numerous destructive factors, the ecological services of plankton in the Danube Delta ecosystems have changed dramatically.

The ecosystem processes (productivity and nutrient recycling) result directly from the diversity of the biotic communities, which is in turn determined by the species composition and diversity.

These findings are especially useful for the administrative and policy makers in order to implement the suitable measures for the conservation of the Danube Delta, an inestimable complex of ecosystems.

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THE INFLUENCE OF HYDROPOWER FACILITIES ON THE ARGEŞ RIVER WATER QUALITY

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Abstract. Having a vast hydrographic system, with a discharge potential and located in a place that has all the forms of relief, the Argeș catchment area is, in the present moment, one of the most complex hydroelectric facility from all the pool rivers in the country. The research was conducted in 2014 on the Argeș River, downstream of Zigoneni, Budeasa and Golești hydroelectric reservoirs (which are among the largest reservoirs of the Arges catchment area). The following physico-chemical parameters were determined: oxygen regime (CO, BOD_5, COD-Cr, COD-Mn), nutrients regime (NH_4, NO_2, NO_3, orthophosphates), general ions (sodium, calcium, magnesium, total iron, total manganese, chlorides, sulfates) placing the water in the 1st and 2nd category of quality. In terms of seasonal variation of the saprobic index of phytoplankton, zooplankton, phytobenthos and macrobenthos there was determined that these sections are included in the β-mezosaprobic zone and in the 2nd class of quality.

Keywords: Argeș river, hydrotechnical reservoir, physico-chemical parameters, biological indices, pollution.

Rezumat. Influența obiectivelor hidroenergetice asupra calității apei râului Argeş. Ca urmare a faptului că prezintă un sistem hidrografic vast, cu potențial de revărsare, localizat în toate formele de relief, râul Argeș este în prezent unul dintre cele mai complexe râuri amenajate hidroenergetic. Cercetările au avut loc în 2014 pe râul Argeș, în aval de lacurile de acumulare Zigoneni, Budeasa și Golești (care reprezintă unele dintre cele mai mari lacuri de acumulare de pe râul Argeș). Au fost determinați următorii indicatori fizico-chimici: regimul de oxigen (CO, CBO_5, CCO-Cr, CCO-Mn), regimul nutrienților (NH_4, NO_2, NO_3, ortofosfați), ionii generali (sodiu, calciu, magneziu, fier total, mangan, cloruri, sulfați), conform cărora apele se încadrează în categoria I și a II-a de calitate. Din punct de vedere al variației sezoniere a indicelui saprob al fitoplanctonului, zooplanctonului, fitobentosului și macrobentosului s-a stabilit că aceste secțiuni se încadrează în zona β-mezosaprobă și în clasa a II-a de calitate.

Cuvinte cheie: râul Argeș, acumulare hidrotehnică, indici fizico-chimici, indicatori biologici, poluare.

INTRODUCTION

In our country the activity of protection and preservation of the water quality is regulated by a series of laws and regulations, including: The Environmental Protection Law (137/1995) as amended by Law 294/2003; Water Law (107/1996), as amended by Law 310/2004; Law 112/2006 and Law 458/2002 on drinking water quality; Order 161/2006 regarding the approval of the regulations on surface water quality classification in order to determine the ecological status of water courses.

Currently, as a member of the European Union, Romania has to harmonize the water policy with the one at the European level, being important the Framework Directive of the European Parliament and of the Council 2000/60/EC, whose fundamental objective is to conserve the existing healthy ecosystems and to rehabilitate the affected anthropogenic ecosystems of the EU countries until 2015. At the same time, the Directive aims to achieve a "good status" for all water bodies in Europe, so that all citizens enjoy similar living conditions in terms of water (VARDUCA, 2000; PĂTRU et al., 2006).

The main purpose of the construction of dams is to provide water reserves for irrigation, power generation, water supply for cities, etc. The effects of river engineering upon the environment are numerous, profound, both positive and negative. Quantifying these effects is more difficult because most often they occur simultaneously and in their analysis several criteria must be taken into consideration. The main analysed anthropogenic pressures are considered the point sources of pollution (industry, human settlements and agriculture), diffuse sources of pollution, hydromorphological pressures, accidental pollution and gravel pits. These pressures can lead to the change of physico-chemical composition of water, causing also the biocoenoses change (ROȘU, 1980; RĂDOANE & RĂDOANE, 2003; SAVIN, 2001; MITITELU, 2010).

The experts that take into account especially the negative elements of the impact of dams on the environment consider that: the changes done to the environment through the construction and operation of large dams cause irreversible degradation of natural ecosystems; dams have a profound impact on natural biodiversity of the affected areas (GÂȘTESCU & ZĂVOIANU, 2000; BREZEANU et al., 2011); the variability in water level downstream the dams profoundly affect the related biocoenoses; the lack of passages specifically designed for fish migration cause a decrease in fish stocks changing the structure of ichtyofauna; most dams are more vulnerable to eutrophication than the natural water courses.

In recent years, due to the industry development, a series of pollution incidents have produced, a fact reflected by the changed physico-chemical indicators of water from reservoirs. From the point of view of biological and bacteriological properties one can appreciate that they deteriorate in lower areas.

MATERIAL AND METHODS

In this paper, three reservoirs on the upper Arges River were studied. In the Arges catchment area, there are 38 reservoirs from which 7 with complex use, the most important being Vidraru, followed by Zigoneni, Vâlcele, Budeasa, Goleşti, Mihăileşti.

In 2014, we have studied Zigoneni, Budeasa and Goleşti reservoirs (Fig. 1).

Zigoneni reservoir has a total volume of 13.300 million cubic meter; energetic useful volume 8.150 million cubic meter; the reservoir surface 182 ha; the length of the reservoir 3.10 km; the headroom 27.00 m (Fig. 2).

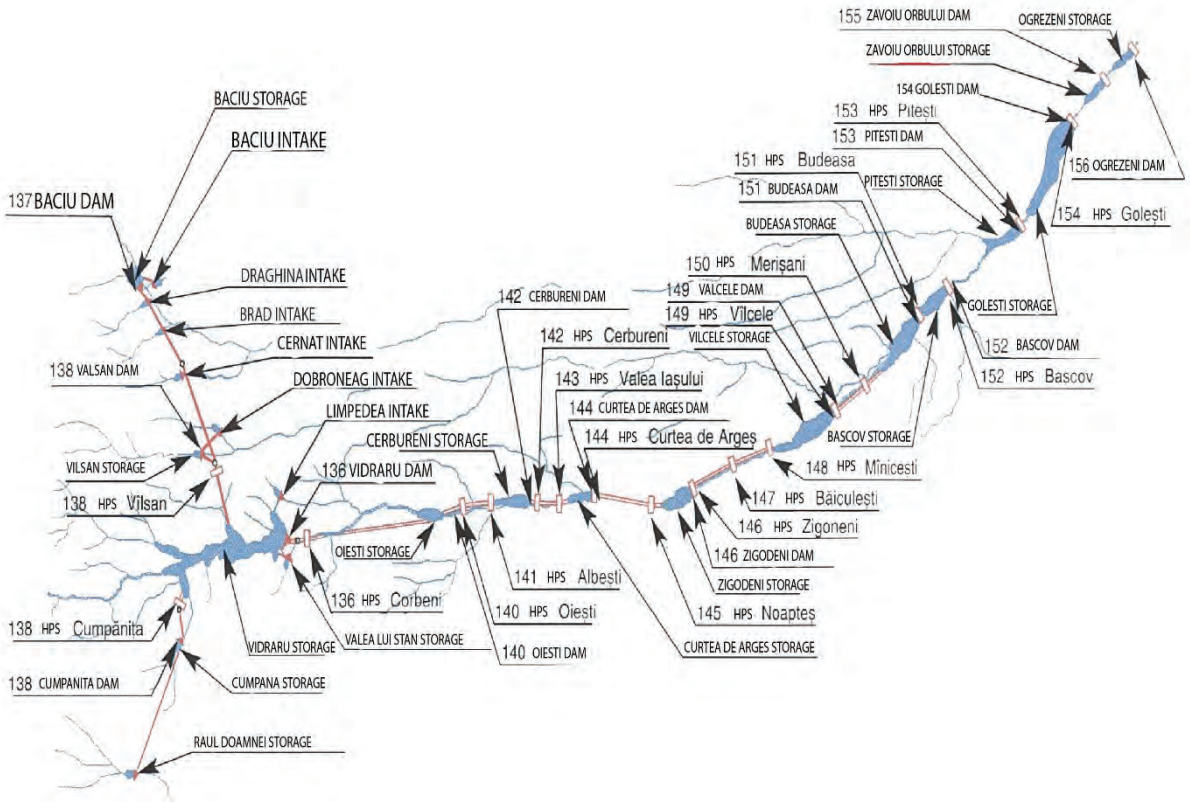

Figure 1. The Equipment Scheme of the Argeş River (MARCU, 2014).

Figure 2. Zigoneni Reservoir (adapted after Google Maps).

Budeasa reservoir has a total volume of 25 cubic KM; the length of the reservoir is 5.5 km, the height of the dam is 33 m (Fig. 3).

Figure 3. Budeasa reservoir (adapted after Google Maps).

Goleşti reservoir is the largest on the Argeş river after Vidraru; it has an area of 646 ha, a total volume at normal retention level of 45 million m^3, a length of 5.15 km and a maximum depth of 16.5 m (Fig. 4).

Figure 4. The Goleşti Reservoir (adapted after Google Maps).

This paper aimed at highlighting some physico-chemical parameters and structuring the biocoenoses considering the accidental discharge of potentially polluting substances (petroleum) by OMV Petrom, S. C. Arpechim S. A. Pitești, S. C. Conpet S. A., S. C. Automobile Dacia SA units, etc.

To assess the physico-chemical water quality overall, there were calculated the following indicators: the oxygen regime (CO, BOD, COD-Cr, COD-Mn), the nutrients scheme (NH_4, NO_2, NO_3, orthophosphates) the filterable dry residue, general ions (sodium, calcium, magnesium, total iron, total manganese, chlorides, sulfates, hardness). The values obtained were compared with the values stipulated by Order no. 161 of 16 February 2006. The determinations were carried out in accordance with current regulations, using both mobile kits for water sample collection (for current measurements, but also for biological measurements) and accessories for measurements in situ or ex situ (Figs. 5; 6).

Figure 5. Kit for water sample collection equipped with suction-lift pump.

Figure 6. Portable kit for determining the water analysis in situ.

RESULTS AND DISCUSSION

The determination of oxygen regime.

To establish the oxygen regime of water there were analysed spatial and temporal peculiarities of oxygen regime indicators: dissolved oxygen, biochemical oxygen demand and chemical oxygen demand. The evolution of these parameters was observed in the catchment area, in the three studied sectors. The oxidation processes are designed to provide the necessary energy for the biochemical processes, which are vital to the maintenance of aquatic life. The degree of pollution of a river is measured by the oxygen content. A good water quality should be nearly saturated with dissolved oxygen. The microbiological activity leads to a reduction in oxygen content in the presence of these oxidizable materials.

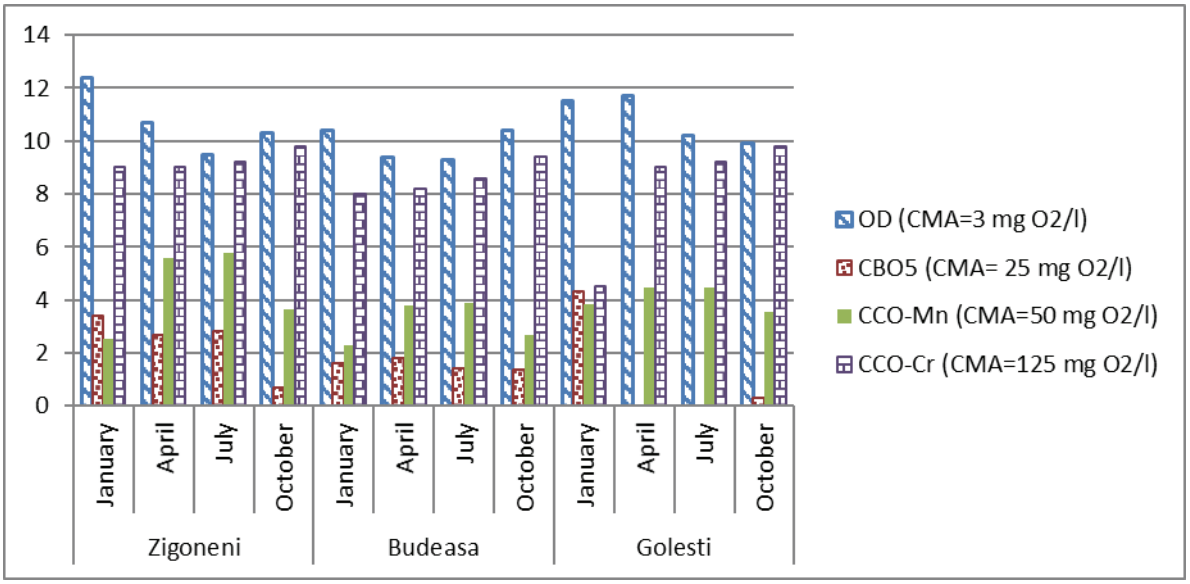

Figure 7. The chemical indicators of the oxygen regime.

The dissolved oxygen is a key indicator in determining water quality. The average amount of dissolved oxygen ranges between 3.9 mg O_2/l at Budeasa and 11.7 mg O_2/l at Golești in April. There are observed higher values during the summer months (Fig. 7).

The biochemical oxygen demand (BOD) (TRUFAȘ & TRUFAȘ, 1975) indicates how much of this gas is necessary for the decomposition of organic material present in the rivers. The performed determinations showed lower values (1.4 mg/l at Budeasa, during summer) and higher than 4 mg/l at Golești during winter, which makes the water be included in the 1st category of quality.

The chemical oxygen demand COD-Mn is the power of permanganate oxidation and corresponds to the amount of oxygen consumed by substances in the water with a reducing role without interfering with the living materials (GÂȘTESCU & RUSU, 1980). The determined values are lower at Budeasa reservoir, regardless of the season, compared to the other two reservoirs, where the average values range between 4.07 and 4.37 mg / l COD-Cr and show similar variations for COD-Mn.

The hardness is the presence of calcium and magnesium cations in water (PIȘOTA & ZAHARIA, 2001, cited by VIȘAN, 2010). We see that in all cases the hardness ranges between 4.7 average value for Budeasa and 6.17 for Zogineni reservoir.

The nutrients or secondary ionic constituents regime.

The minor ions are evidenced by: nitrates, nitrites, ammonia and iron. It can be concluded that on the whole catchment area, there can be distinguished in some way the vertical zoning of ionic constituents the concentration of which increases, in general, from upstream to downstream.

In terms of ammonium, nitrates, nitrites, iron and orthophosphates, they placed the water in the 1st category of quality (NH_4 value does not exceed 0.2 mg N/l; NO_2 records values of 0.104 mg N/l at Golești, exceeding 10 times the maximum limit, MAC = 0.01 mg N/l). Regarding the nitrogen, significant contents were recorded at Budeasa reservoir (1.51 mg N/l) and at Golești reservoir (1.61 mg N/l), which is why those waters were included in the 2nd category of quality (Fig. 8). The orthophosphates show significant values in all the studied reservoirs, the water being included into the second category of water quality. These nitrates and orthophosphates cause a slight increase of eutrophication of the studied waters.

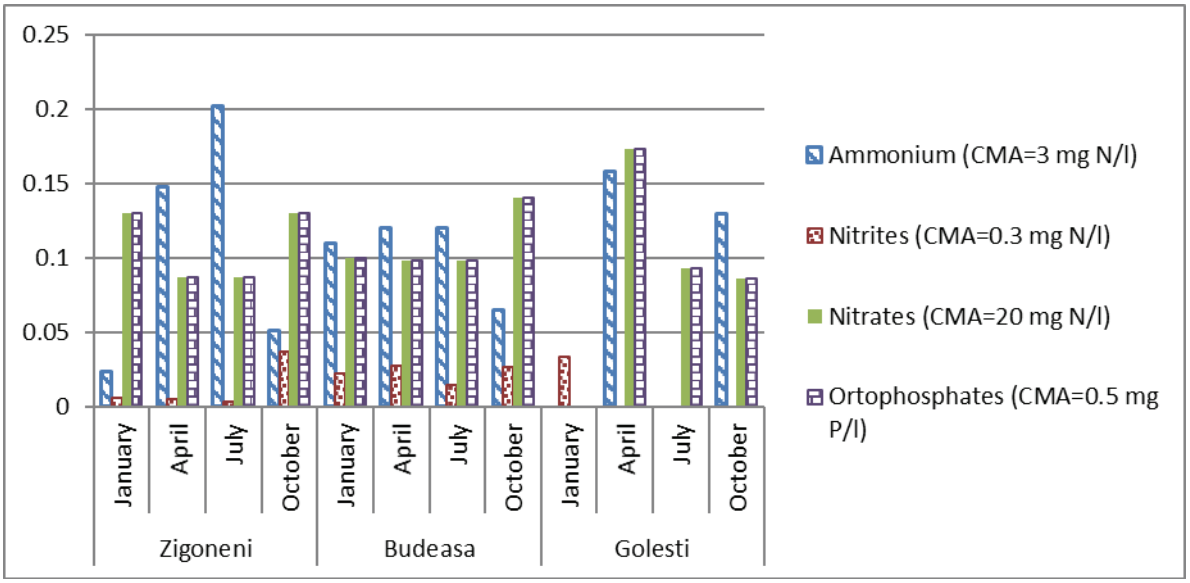

Figure 8. The nutrients content.

The general ionic constituents are represented by calcium cations (Ca^{++}), Magnesium (Mg^{++}), sodium (Na^{+}) and sulfate anions (SO_4-), chlorine (Cl^{-}), which do not exceed the maximum allowable concentration, which include the three studied reservoirs within the 1st quality category (Fig. 9).

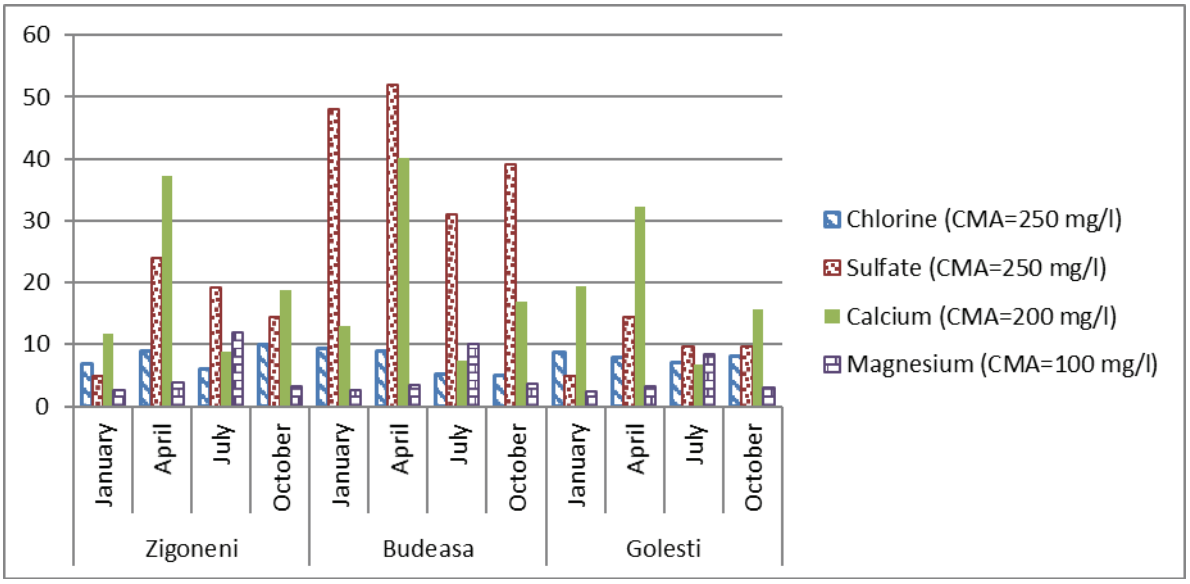

Figure 9. The ions content.

The hardness is the presence of calcium and magnesium cations in the water bodies of the studied catchment area, which determine the hardness degree. In the studied catchment area, the total average water hardness values of the main water ranged between 4.8 and 5 German degrees. These values correspond to waters which may be included into the category of soft (4-8° G), semi-hard (8-12° G) and quite hard (12-18° G) waters (PIŞOTA & ZAHARIA, 2001) (Fig. 10).

The fixed residue is determined by the presence of dissolved mineral salts in the river water. For this parameter the water from the studied reservoirs is included in the 1st category of quality.

The content of Na, Mn ions does not exceed the admitted MAC, the water being included in the 1st category of quality (Fig. 10).

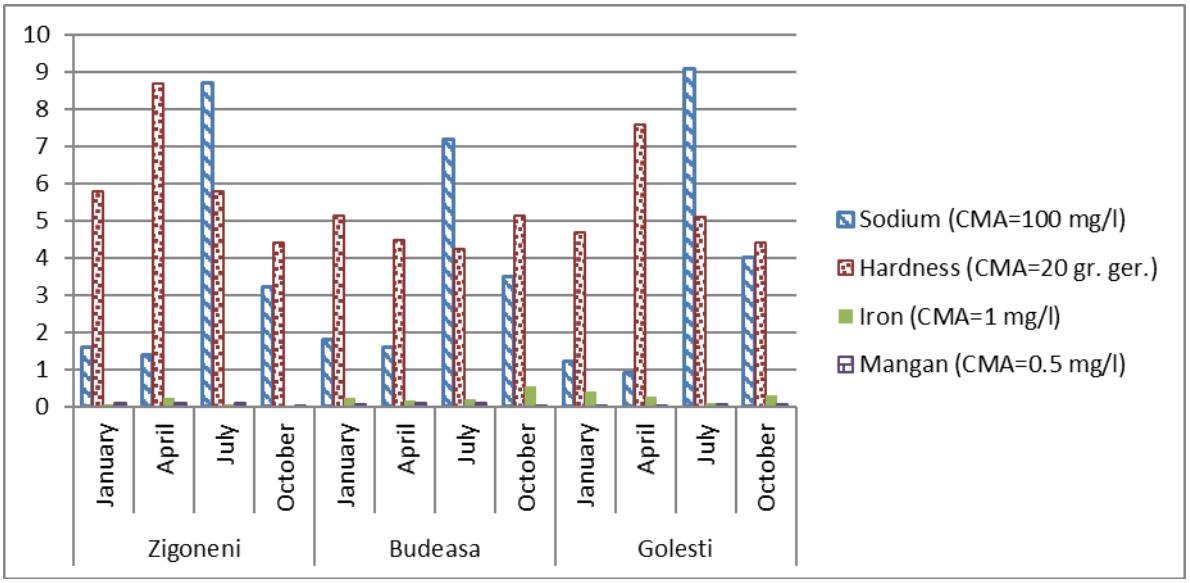

Figure 10. The ions content.

In the period 2010-2013, there occurred phenomena which generated emergencies (floods, accidental pollution, drought). The highlighting of the specific biological peculiarities was made in 2014 by studying the main water and biotic communities. This study was conducted as a result of pollution in 2013 due to the discharge of petroleum products (fuel oil) from OMV Petrom and S. C. Arpechim S. A., a situation solved quickly. In 2014, samples were taken seasonally from the representative sections for the evolution of such phenomena from an aquatic ecosystem: from the upstream dam (Zigoneni, Budeasa, Goleşti). The samples were collected from the surface horizon.

From the point of view of ecological status, the studied waters are characterized by a very good status in the upper sectors of the Argeș River and satisfactory in the lower sector, in the south-east area of Pitești. The variation of the saprobic index of the phytoplankton shows higher values at Goleşti (<2.5) compared with Budeasa, where it recorded > 1.87 (Fig. 11).

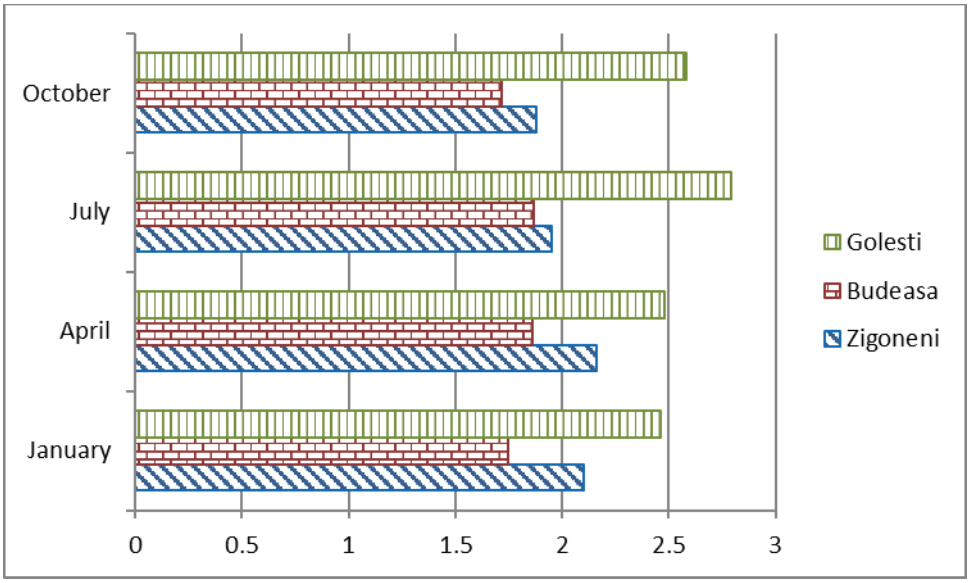

Figure 11. The seasonal variation of the saprobic index of phytoplankton.

The saprobic index of zooplankton shows the same trend at Goleşti (<2.5) and decreasing at Zigoneni (> 1.83) and Budeasa (> 1.16) (Fig. 12).

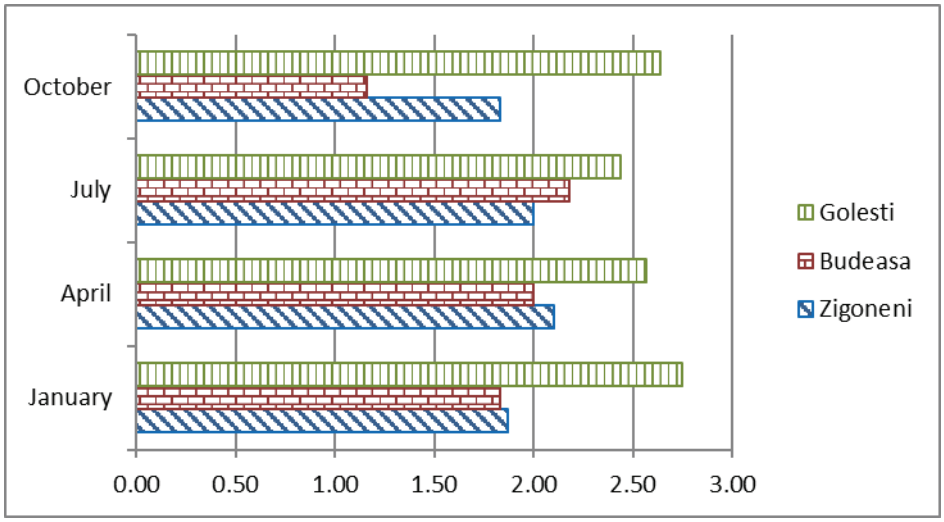

Figure 12. The seasonal variation of the saprobic index of zooplankton.

The saprobic index of phytobenthos exceeds 2.3 at Golești and it is below 2 at Zigoneni and Budeasa (Fig. 13).

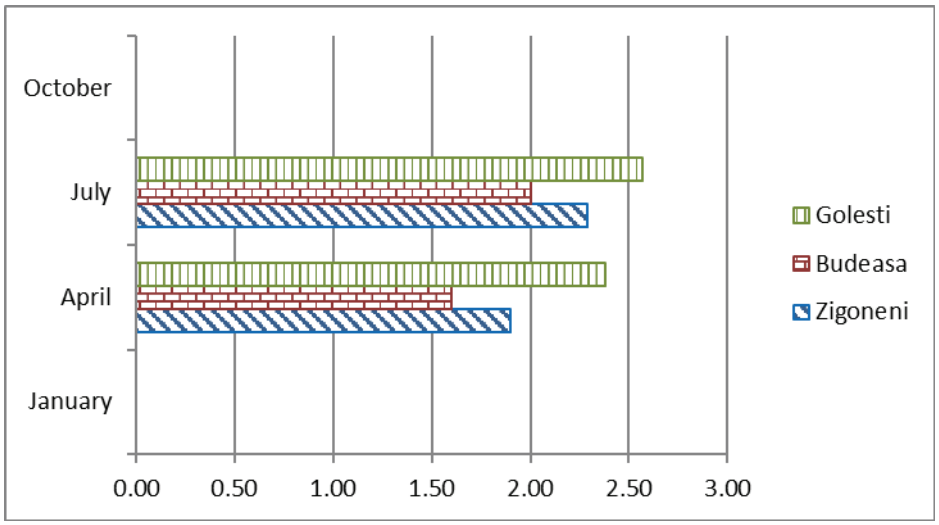

Figure 13. The seasonal variation of the saprobic index of phytobenthos.

The saprobic index of macrobenthos exceeds 3.1 at Golești and the lowest values were recorded at Budeasa (1.67) (Fig. 14).

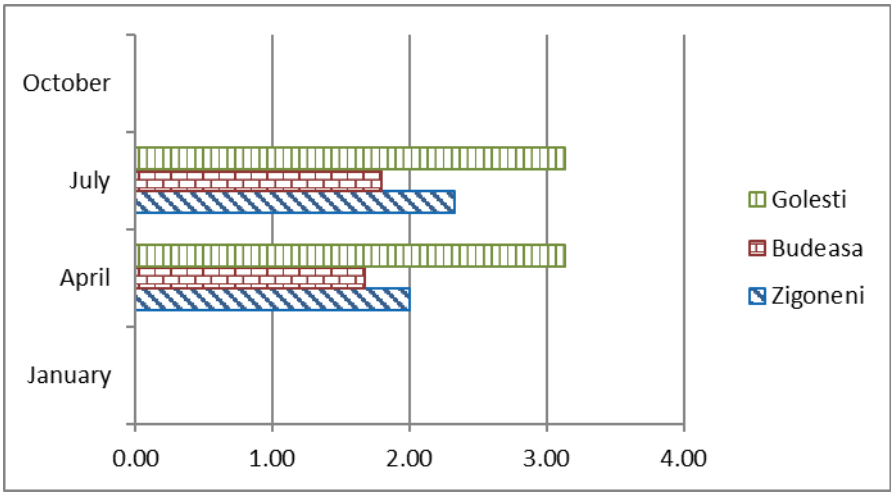

Figure 14. The seasonal variation of the saprobic index of macrobenthos.

Regarding the quality of water reservoirs in the county, the expertise shows that most of them were included within the limits of the 1st quality category with a trophic degree characteristic to oligo-mesotrophic types.

In terms of biological and bacteriological perspective, the degree of relative cleanliness shows that the water from the majority of the Argeş catchment area reservoirs is included in the area of β-saprobe from the saprobity viewpoint, a water of good quality (ZĂVOIANU, 1999; VARDUCA, 2000).

CONCLUSIONS

By their particular importance in the context of current concerns of the environmental policies, the water resources deserve attention and interest in the scientific research.

The studies conducted on the 3 reservoirs of the Arges river lead to the appreciation of the fact that there are no significant pollution sources today.

The water by the determined physico-chemical and biological values is included in the 1st and 2nd category of quality (with exceedings for the nitrates and orthophosphates).

The continuous monitoring and increasingly severe measures will increase the level of civic consciousness of the population, which is reflected in the reduction of anthropogenic pollution risk.

The reconsideration of the water quality in human communities will restore the biotopes and biocoenoses and the development of relations between macrophyte coenoses and other compartments: the biotic and zooplankton, with beneficial effects for the whole ecosystem.

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THE INTRASPECIFIC VARIABILITY OF SOME CYTOTAXONOMIC FEATURES IN *LUZULA LUZULOIDES* POPULATIONS (FAM. JUNCACEAE)

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Abstract. In this paper it was analysed the variability of some cytotaxonomic features of the mature leaves, depending on altitude and genotype, in two *Luzula luzuloides* subspecies (Juncaceae family), which vegetate in the North of Oltenia (Romania). The investigations were performed in six populations belonging to *Luzula luzuloides* ssp. *luzuloides*, from 400 – 1900 m altitude, and four populations of *L. luzuloides* ssp. *rubella*, from 1650 – 2228 m altitude. As cytotaxonomic features there were used the size of epidermal cells (length and width), and stomata (length and density), being performed 50 measurements for each feature, at the ten populations. The statistical data processing was made with the STATISTICA 10 software, ANOVA/MANOVA. The analysis of some cytotaxonomic (microhistological) features in on two subspecies of the species *Luzula luzuloides* (*Luzula* genus): *L. luzuloides luzuloides* and *L. luzuloides rubella* pointed out a significant intraspecific variability. Between the two subspecies, there were observed minor differences regarding the structure of the two epidermis (upper and lower). Statistical analysis revealed a higher intraspecific variability in *L. luzuloides luzuloides* populations, in comparison with *L. luzuloides rubella* ones, due to genotype, but with a major contribution of the various environmental conditions. In both epidermis (upper and lower), the cells length is significantly influenced by the environment, less by genotype, while the cell width, the stomata size and density have a certain genetic determinism. This fact can be the explanation of the significant differences for these characters between the two subspecies.

Keywords: *Luzula luzuloides luzuloides, L. luzuloides rubella;* cytotaxonomic features (epidermal cells and stomata), genotype and altitude effect.

Rezumat. Variabilitatea intraspecifică a unor caractere citotaxonomice în populaţii de *Luzula luzuloides* (Fam. Juncaceae). În această lucrare a fost analizată variabilitatea unor caractere citotaxonomice la frunzele mature, dependent de altitudine și genotip la două subspecii de *Luzula luzuloides* (Fam. Juncaceae), care vegetează în nordul Olteniei (România). Investigaţiile au fost efectuate în şase populaţii de *Luzula luzuloides* ssp. *luzuloides*, de la 400 m – 1900 m altitudine şi patru populaţii de *L. luzuloides* ssp. *rubella*, de la 1650 m – 2228 m altitudine. Drept indici citotaxonomici au fost folosite mărimea celulelor epidermale (lungime şi lăţime) şi stomatelor (lungime şi densitate) fiind efectuate 50 măsurători pentru fiecare caracter, la zece populaţii. Valorile biometrice au fost prelucrate statistic cu programul STATISTICA 10, ANOVA/MANOVA. S-a remarcat o variabiliatate intraspecifică semnificativă, în urma analizei caracterelor citotaxonomice a celor două subspecii ale speciei *Luzula luzuloides* (genul *Luzula*). Intre cele două subspecii au fost observate diferenţe minore, în ceea ce priveşte structura celor două epiderme (superioară şi inferioară). Analiza statistică a relevat o variabilitate intraspecifică mai mare la populaţiile de *L. luzuloides luzuloides*, în comparaţie cu cele de *L. luzuloides rubella*, datorată pe de o parte genotipului, dar cu o contribuţie majoră a condiţiilor de mediu diferite. Lungimea celulelor din ambele epiderme este influenţată semnificativ de mediu, mai puţin de genotip, în timp ce lăţimea celulelor, dimensiunea şi densitatea stomatelor au un determinism genetic cert. Acest fapt poate fi explicaţia diferenţelor semnificative înregistrate pentru aceste caractere, între cele două subspecii.

Cuvinte cheie: *Luzula luzuloides luzuloides, L. luzuloides rubella,* caracteristici cito-taxonomice (celule epidermale şi stomata), efectul genotipului şi al altitudinii.

INTRODUCTION

The *Luzula* genus belonging to *Juncales* order, *Juncaceae* family, the perennials plants spread especially in the temperate regions, the Arctic and higher elevation areas in the tropics. In Romania flora, there are 11 species (four with two subspecies) and two genotypes with an uncertain presence (*L. sieberi* and *L. nivea*), (CIOCÂRLAN, 2009). The recent researches performed about the genus *Luzula*, conduct to some taxonomic modifications (KIRSCHNER & KAPLAN, 2001; BAČIČ et al., 2007; ROMO & BORATINSKI, 2011). Thus, in KIRSCHNER and KAPLAN's opinion (2001), *Luzula alpinipilosa* represents a new combination. The *Luzula* taxa are very similar morphologically, few qualitative and quantitative features being registered between them (KIRSCHNER, 2002). *Luzula* is a monocot genus with holocentric chromosomes.

Luzula luzuloides (Lam.) Dandy et Wilmott [sin. *L. nemorosa* (Poll.) E. Meyer; *L. albida* (Hoffm.) DC] is a perennial species, native to Central Europe, from the Balkans to Fennoscandia. Frequently, it vegetates in subalpine (juniper) level and in evergreen oak. This species has also been introduced to the British Isles and other parts of Europe and to the north-eastern and eastern United States. After the inflorescence shape and tepals colour, two subspecies were described.

Luzula luzuloides ssp. *luzuloides*, with lax inflorescence, whitish tepals, met in the oak forest zone (evergreen oak and beech sublevel).

Luzula luzuloides ssp. *rubella* (Hoppe ex Mert. et Koch) Holub [sin. ssp. *cuprina* (Rochel) Chrtek et Křisa], with inflorescence ± contracted and reddish tepals, spread in boreal (spruce fir) and subalpine level (juniper tree) level.

The morphological features of the two subspecies were reviewed by KIRSCHNER (2002). A detailed presentation of the chromosomes and genome size in this genus was reviewed by MALHEIROS & GARDI (1950),

NORDENSKIÖLD (1951), MADEJ & KUTA (2001). A comprehensive study performed on seven *Luzula* ssp. by BOZEK et al. (2012) concluded that "*Luzula* exhibits considerable genomic flexibility and tolerance to large, genome-scale changes". Then, it can be considered that is a genus in evolution, very interesting from the genetic point of view. The two subspecies belonging to *Luzula luzuloides* species are diploid (2n=12 AL), having a primary karyotype: *Luzula luzuloides rubella* (GARCIA-HERRAN, 2001); *Luzula luzuloides luzuloides* (MADEJ & KUTA, 2001).

In the present paper, there were analysed some cytotaxonomic features of the epidermal cells from the mature plants (at flowering), represented through the shape and size (length and width) of the epidermal cells, as well as the stomata length and density.

MATERIAL AND METHODS

Biological material. The cytotaxonomical investigations were performed on ten *Luzula luzuloides* populations, six belonging to *Luzula luzuloides* ssp. *luzuloides* genotype and four to *Luzula luzuloides* ssp. *rubella*. These populations vegetate at different altitudes in the same geographical region, namely the mountain region from the North of Oltenia, the Carpathian Mountains (Romania). The altitude was higher for *L. luzuloides* ssp. *rubella*, in comparison with *L. luzuloides* ssp. *luzuloides* (Table 1). There were collected whole plant specimens (5 for each location) during the interval June – July.

Table 1. Harvesting area altitude.

Species	Location	Altitude (m)
Luzula luzuloides ssp. luzuloides	Coşava peak	1900
	Balota sheepfold, Furnicelu saddle	1850
	Polovrăgeni valley	900
	Slătioara, Măgura Slătioarei hill	767
	Roeşti, Ciocâltei village	450
	Comăneşti hill	400
Luzula luzuloides ssp. *rubella*	Urdele peak	2228
	Ursu peak	2124
	Balota sheepfold, Furnicelu saddle	1850
	Rânca Mountain	1650

Work method. The biometrical observations were effected on the mature plants (at flowering stadium), being analysed the shape and the size (length and width) of the epidermal cells, as well as the stomata length and density, from both sides of the leaf. Fragments of epidermis (1 cm^2) were carefully removed from the middle of the leaf blade. The biometrical observations were performed on fresh slides, with a ZEISS micrometre at a NIKON optical microscope. For every feature there were performed 50 observations, to 5 collected plants for each population. The data were statistically processed with STATISTICA 10 soft (ANOVA/MANOVA, DUNCAN test, correlations).

RESULTS AND DISSCUSIONS

Epidermal cells shape and size.

Epidermal cell shape.

The shape of the cells on the two sides of the leaf presented differences in the two *Luzula luzuloides* subspecies. The upper epidermis is made up of rectangular cells, covered with a thick cuticle, the right walls having a constant width in *L. luzuloides* ssp. *rubella* or slightly wider at the middle cell part in *L. luzuloides* ssp. *luzuloides* (Figs. 1a, 2a). The lateral walls, usually with perpendicular position on the cell length, present a slightly rounded edge (Figs. 1a, 2a). The stomata are absent on the upper epidermis.

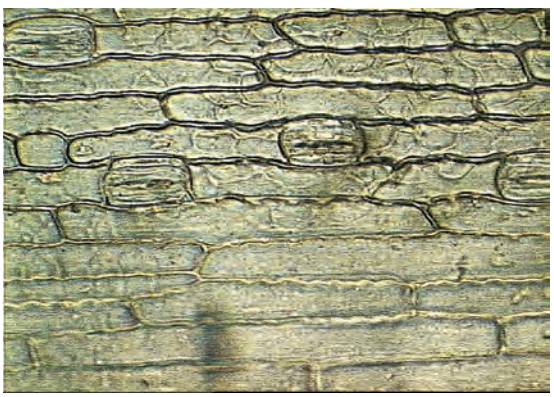
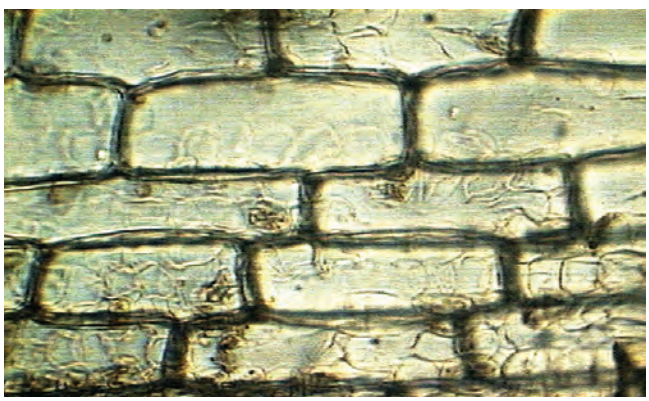
a.  **b.** 

Figure 1. *Luzula luzuloides* ssp. *luzuloides*. Slătioara, Măgura Slătioarei hill, 767 m altitude (a. lower epidermis; b. upper epidermis).

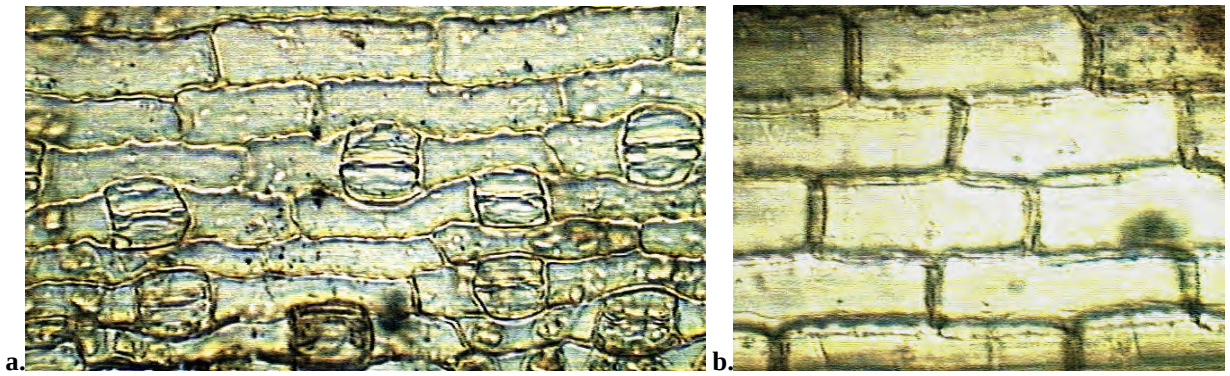


Figure. 2. *Luzula luzuloides* ssp. *rubella*. Ursu peak, 2124 m altitude (a. lower epidermis; b. upper epidermis).

The lower epidermis, in two subspecies, is made up of epidermal cell rows with stomata, which alternate with cells rows without stomata (Figs. 1b, 2b).

Between the analysed *Luzula* populations, there were recorded differences regarding the number of the cell rows with or without stomata, which alternate, as well as the number of the epidermal cell situated among two stomata from the same row. These differences depend on genotype, altitude, leaf size, the cytotaxonomic feature, a/o (Table 3; Figs. 3-6). An exception was observed in *L. luzuloides* ssp. *luzuloides* populations collected from the lowest altitude (400-450 m), in which the cell rows without stomata are absent (Fig. 5). Similarly, in other *Luzula* species, on the lower epidermis, it was reported the presence of the rows with and without stomata (*Luzula wahlenbergii* and *Luzula piperita*, HÄMET-AHTI, 1965). The cell size from the upper epidermis is bigger in comparison with the cell size from the rows with stomata.

The size of epidermal cells.

The analysis of variance revealed that the dimensions of the epidermal cells and stomata are significantly influenced by the altitude of the site, subspecies (with some exceptions), as well as by the interaction of both factors.

The length of the cells in both epidermis (upper and lower) is a character influenced significantly by the environmental factor, while the width of the cells has also a genetic determinism (Table 2). Thus, it can be explained the higher intraspecific variability for cell size in *L. luzuloides luzuloides*, species spread from 400 to 1900 m altitude, from hills to alpine regions (in habitats with very different environment conditions), in comparison with *L. luzuloides rubella*, which vegetates in regions over 1500 m altitude. Duncan test shows the significance of the differences between populations and underlines this intraspecific variability (Figs. 3-5).

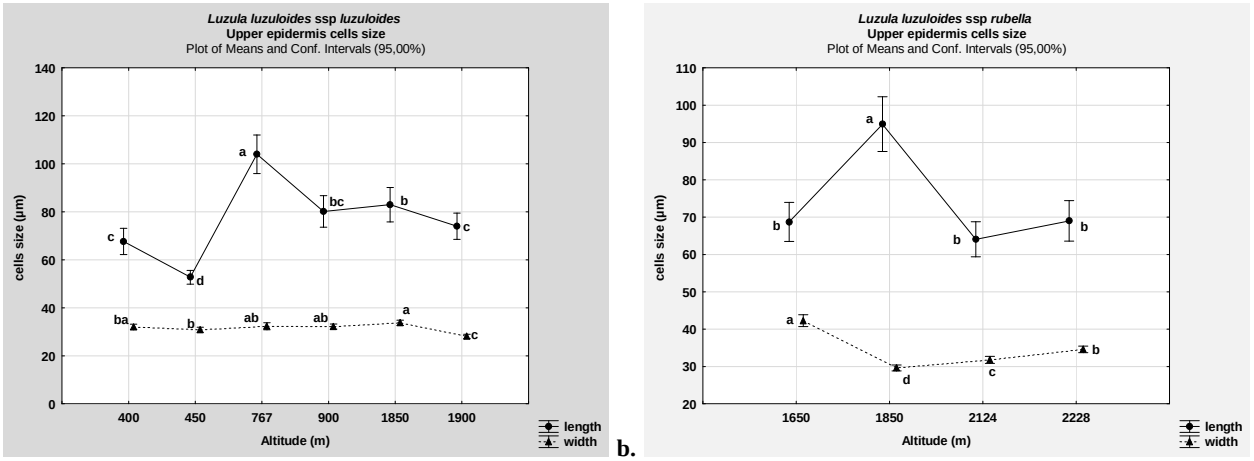
Table 2. Analysis of Variance (Fisher test) for the main features of the epidermal cells.

Character	**Factor**	**Analysis of Variance (1 = altitude ; 2 = genotype) (Marked effects are significant at p < 0.05000; n =500)**		
		F	P	Sign.
Upper epidermis cell length	1	**28.2750**	**0.000000**	***
	2	1.18819	0.276576	(-)
	1x2	**26.6766**	**0.000000**	***
Upper epidermis cell width	1	**46.6007**	**0.000000**	***
	2	**32.76842**	**0.000000**	***
	1x2	**48.5559**	**0.000000**	***
Lower epidermis cell length (rows of cells with stomata)	1	**6.8669**	**0.000000**	***
	2	1.06882	0.302050	(-)
	1x2	**6.4969**	**0.000000**	***
Lower epidermis cell width (rows of cells with stomata)	1	**23.8597**	**0.000000**	***
	2	**7.03591**	**0.008417**	**
	1x2	**22.5116**	**0.000000**	***
Stomata length	1	**164.9352**	**0.000000**	***
	2	**69.73360**	**0.000000**	***
	1x2	**148.7899**	**0.000000**	***
Stomata density	1	**60.7311**	**0.000000**	***
	2	**88.20021**	**0.000000**	***
	1x2	**57.5189**	**0.000000**	***
Lower epidermis cell length (rows of cells without stomata)	1	**6.9307**	**0.000001**	***
	2	0.04693	0.828682	(-)
	1x2	**7.3611**	**0.000000**	***
Lower epidermis cell width (rows of cells without stomata)	1	**60.2178**	**0.000000**	***
	2	1.58371	0.209460	(-)
	1x2	**93.2826**	**0.000000**	***

Table 3. The variability of some cytotaxonomic features of epidermal cells and stomata (mean values in µm) in the populations from two *Luzula luzuloiudes* genotypes.

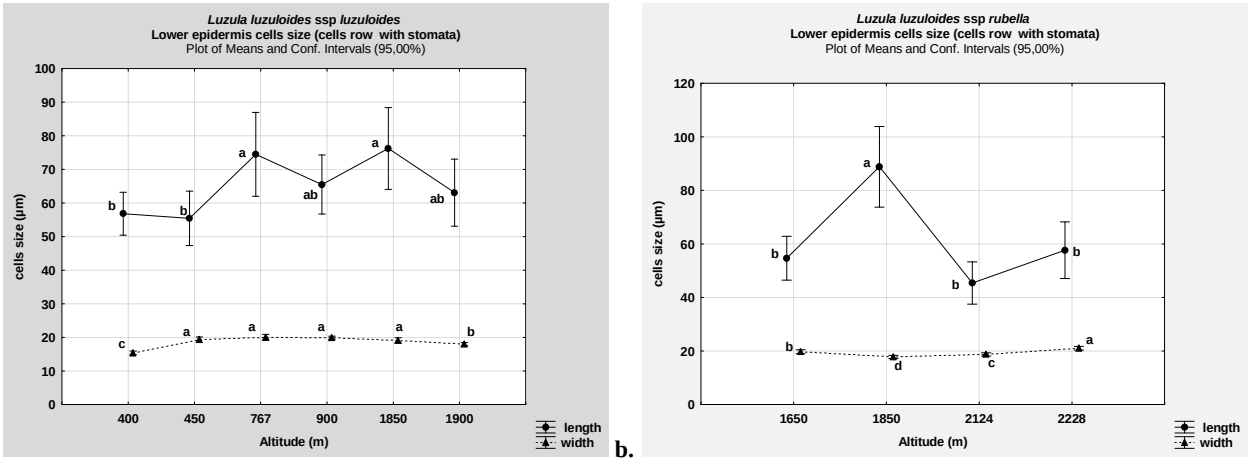
Genotype	Cell length	Cell width	Stomata length	Stomata density[c]
Luzula luzuloides ssp *luzuloides*				
Upper epidermis	52.8 – 104.0	28 – 32.3	-	-
Lower epidermis[a]	55.4 – 76.3	15.5 – 20.0	28 - 38	50 - 146
Lower epidermis[b]	115.8 – 163.0	18.5 – 23.4		
Luzula luzuloides ssp. *Rubella*				
Upper epidermis	64.0 – 95.0	30.0 – 42.0	-	-
Lower epidermis[a]	45.0 – 89.0	18.0 – 21.3	30 - 42	120 - 204
Lower epidermis[b]	123.0 – 152.0	15.5 – 26.0	-	-

Legend: [a] – rows of cells with stomata; [b] – rows of cells without stomata; [c] – number of stomata per mm^2.



a. b.

Figure 3. Upper epidermis cell size in *Luzula luzuloides* ssp. *luzuloides* (a) and *Luzula luzuloides* ssp. *rubella* (b).



a. b.

Figure 4. Lower epidermis cell size (rows with stomata) in *Luzula luzuloides* ssp. *luzuloides* (a) and *Luzula luzuloides* ssp. *rubella* (b).

Table 4. The significance of the differences between the means for the main characters of cells and stomata in the two *L. luzuloides* ssp.

Species	Upper epidermis		Lower epidermis			
	Cell length (µm) Mean ± St.dev.	Cell width (µm) Mean ± St.dev.	Cell length (µm) Mean ± St.dev.	Cell width (µm) Mean ± St.dev.	Stomata length (µm) Mean ± St.dev.	Stomata density/mm^2 Mean ± St.dev.
Luzula luzuloides ssp *luzuloides*	76.93 ± 22.5 **a**	31.53 ± 3.5 **b**	65.26 ± 27.3 **a**	18.61 ± 2.4 **b**	32.28 ± 4.1 **b**	106.6 ± 40.3 **b**
Luzula luzuloides ssp. *rubella*	74.18 ± 19.5 **a**	34.54 ± 5.6 **a**	61.64 ±33.0 **a**	19.32 ± 2.1 **a**	36.60 ± 4.8 **a**	153.1 ± 44.3 **a**

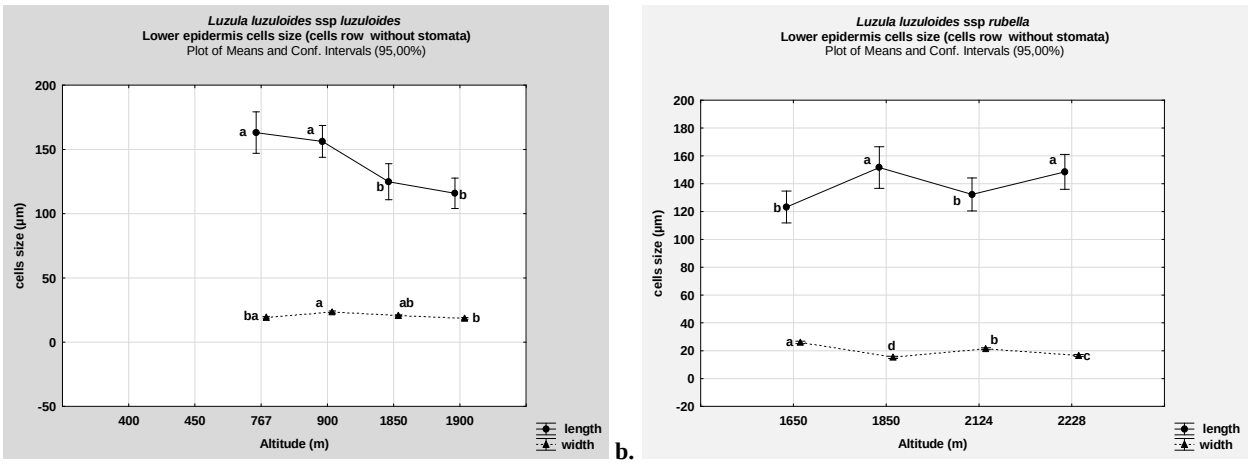


Figure. 5. Lower epidermis, cell size (cell row without stomata) in *Luzula luzuloides* ssp. *luzuloides* (a) and *Luzula luzuloides* ssp. *rubella* (b).

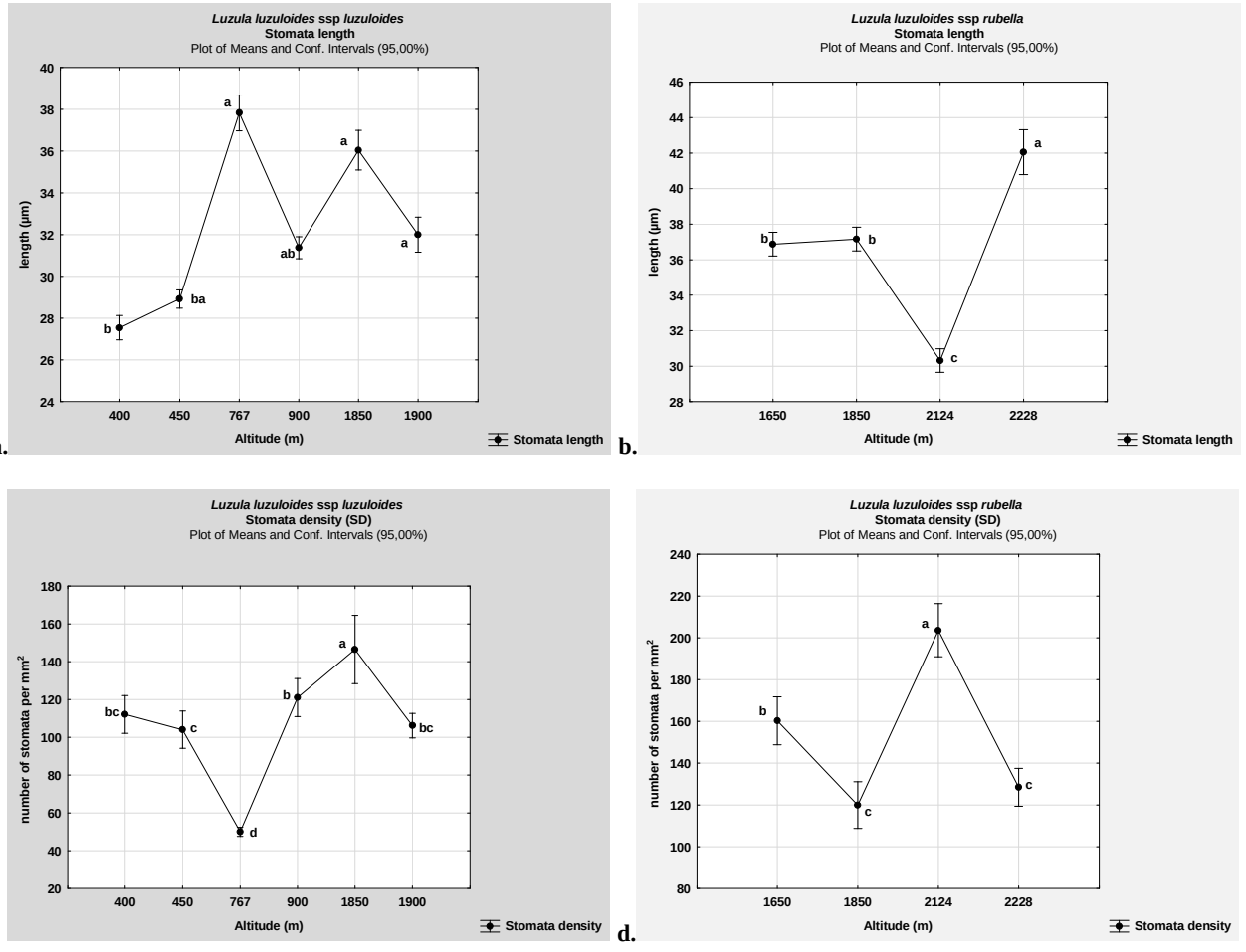


Figure 6. Lower epidermis, stomata length and density in *Luzula luzuloides* ssp. *luzuloides* (a. stomata length; c. stomata density) and *Luzula luzuloides* ssp. *rubella* (b. stomata length; d. stomata density).

The highest values of the epidermal cells, on both sides of the leaf, were recorded at the plants which are native from the station situated at an altitude slightly higher as compared to the extreme values for the two subspecies: 767 m for *L. luzuloides luzuloides* and 1850 m for *L. luzuloides rubella* (Figs. 3-5). Generally, the epidermal cell and stomata size, recorded significantly higher values in the *Luzula luzuloides rubella* subspecies, except the cell size from the rows without stomata (Table 4).

The implication in taxonomy of different cytotaxonomic features was reported by different specialists: AGBAGWA & NDUKWU (2007) in *Cucurbitaceae*; in sub-tropical species (AHMAD et al., 2010; PĂDURE in

Nepeta sp. (2006, flower and inflorescence); *Persicaria* sp. from Pakistan (YASMIN et al., 2010); also, MUSTAPHA (2000) uses the same leaf feature (epidermal cell and stomata size) in an experiment performed in *Urginea indica*. In previous researches, CORNEANU & POPESCU (1981) point out the presence of some structural features of the epidermal cells, confirming the plant allegiance in two related *Fritillaria* species (*F. meleagris* and *F. orientalis* [sin. *F. montana* and *F. tenella*]). A similar situation was presented in the *Dianthus* genus (SANDA, 1972; SIMEANU & CORNEANU, 1978; CORNEANU & SIMEANU, 1980).

Analysing some morphological features at three *Luzula* genotypes spread in the Northern Hemisphere, HÄMET-AHTI (1965) established that these three are distinct genotypes. In monocotyledons, STEBBINS & KHUSH (1961) analysed the stomata complex and its bearing in phylogeny. The 192 analysed species (belonging to 49 families) were classified in four categories. The *Juncaceae* family with the two genera (*Juncus* and *Luzula*), is in the first category, having 4 or more subsidiary cells surrounding the guard cells. As a synthesis, CARRIÈRE (2002) performed a list with the arctic vascular plants which can be identified through the use of some microhistological features.

The size and stomata density.

Stomata length is dependent both on environment conditions and genotype (Table 2). In *L. luzuloides luzuloides*, the variability of this character is lower than in *L. luzuloides rubella* (Table 3; Fig. 6a, b). The difference calculated between the mean values of the stomata length registered in the two subspecies is significant, *L. luzuloides rubella* recorded the highest value (36.60 ± 4.8 µm), (Table 4). In the *L. luzuloides luzuloides* populations, native at lower altitudes (under 500 m), there were recorded lower values for stomata length in comparison with the values recorded in the populations which vegetate at higher altitudes; the highest value was recorded in the population from 767 m altitude. This population manifests the greatest adaptation to the environment (on the basis of the stomata and epidermal size values).

Stomata density is dependent mainly on genotype and less on environment, even both factors have a significant influence on this character (Table 2; Figs. 6c, d). The differences registered between populations, as well as between subspecies are statistically significant (Table 4; Figs. 6c, d). The intraspecific variability of the character is also high. In *L. luzuloides rubella* the stomata density recorded a significant higher value (153.1 ± 44.3/ mm^2 **a**) in comparison with *L. luzuloides luzuloides* (106.6 ± 40.3/mm^2 **b).**

CHMURA et al. (2005) established that the concentration of different atmosphere components is dependent on altitude and other variables. The paleontological studies pointed out different values of the CO_2 concentration in different geological eras of our planet. In a review, ROYER (2001) analysed the relationship between atmospheric CO_2 concentration and stomata density (SD) or stomata index (SI), using 285 previously published SD and 145 SI responses to variable CO_2 concentrations from a pool of 176 C3 plant species. ROYER (2001) reported "a positive relationship between CO_2 and SD/SI in only 12% of cases. Thus, CO_2 appears to inversely affect stomata initiation, although the mechanism may involve genetic adaptation and, therefore, is often not clearly expressed under short CO_2 exposure times". In *Luzula luzuloides* populations analysed in the present paper, it can be established a correlation between stomata density and altitude of origin for the two species. In this case, the stomata density on leaf surface can present a genetic determinism.

Table 5. Correlations.

Variable	Correlations (Marked correlations are significant at p <0.05000; N=500)							
	UE cell length	UE cell width	LE[a] cell length	LE[a] cell width	Stomata length	Stomata density	LE[b] cell length	LE[b] cell width
Altitude	**-0.3874**	-0.0118	-0.1242	-0.1184	0.1114	**0.5211**	**-0.2442**	**-0.2779**
	p=0.000	p=0.856	p=0.055	p=0.067	p=0.085	**p=0.000**	**p=0.000**	**p=0.000**
Ssp.	**-0.2627**	**0.2978**	**-0.1301**	0.0215	**0.2665**	**0.4654**	-0.0140	-0.0813
	p=0.000	**p=0.000**	**p=0.044**	p=0.741	**p=0.000**	**p=0.000**	p=0.829	p=0.209
UE cell length	1.0000	**-0.2483**	**0.1765**	**-0.1584**	0.1224	**-0.4305**	**0.1741**	**-0.1923**
	p= ---	**p=0.000**	**p=0.006**	**p=0.014**	p=0.058	**p=0.000**	**p=0.007**	**p=0.003**
UE cell width		1.0000	**-0.1281**	**0.2527**	**0.2286**	**0.1576**	-0.0355	**0.4508**
		p= ---	**p=0.047**	**p=0.000**	**p=0.000**	**p=0.015**	p=0.584	**p=0.000**
LE[a] cell length			1.0000	**-0.1330**	0.0905	**-0.1894**	0.1246	**-0.1893**
			p= ---	**p=0.039**	p=0.162	**p=0.003**	p=0.054	**p=0.003**
LE[a] cell width				1.0000	**0.2676**	-0.0581	**0.1802**	0.1203
				p= ---	**p=0.000**	p=0.370	**p=0.005**	p=0.063
Stomata length					1.0000	**-0.2251**	**0.1502**	**-0.2954**
					p= ---	**p=0.000**	**p=0.020**	**p=0.000**
Stomata density						1.0000	**-0.1813**	**0.2429**
						p= ---	**p=0.005**	**p=0.000**
LE[b] cell length							1.0000	-0.0765
							p= ---	p=0.,237
LE[b] cell width								1.0000
								p= ---

Legend: UE = Upper epidermis; LE = Lower epidermis; [a] – rows of cells with stomata; [b] – rows of cells without stomata.

Correlations between different features.

The analysis of the correlations between different cytotaxonomic features of the leaves, as well as their values depending on genotype or altitude, evidenced the environmental conditions influence on the microhistological features. Their existence underlined their value in the genotype characterization (Table 5).

There were recorded positive correlations between: the length of the epidermal cell, in the upper epidermis – the length of the epidermal cell, in the lower epidermis; the cell width in the upper epidermis – the cell width in the lower epidermis; stomata size and density. Negative correlations were registered between: the cell length – the cell width; stomata length – stomata density.

The two factors: altitude (environment) and subspecies (genotype), involved in variability are significantly correlated with the analysed characters. Altitude is positively correlated with stomata density and is negatively correlated with the length of the epidermal cell, in the upper epidermis, as well as with the size of the lower epidermis cells (rows without stomata). The genetic determinism of the stomata size and density is shown again by the very significant correlation between subspecies and these characters (r =0.2665, for stomata length; r = 0.4654 for stomata density). Thus, in the characterization of these genotypes, the microhistological features present a great importance, similarly to the morphological features.

CONCLUSIONS

The analysis of some cytotaxonomic (microhistological) features in on two subspecies of the species *Luzula luzuloides* (*Luzula* genus): *L. luzuloides luzuloides* and *L. luzuloides rubella* pointed out a significant intraspecific variability.

Between the two subspecies, there were observed minor differences regarding the structure of the two epidermis (upper and lower). The populations of *L. luzuloides rubella* as well as *L. luzuloides luzuloides*, which vegetate at higher altitude (over 500 m) presented in lower epidermis cell rows with stomata, which alternate with cell rows without stomata. This particularity was not found in the populations collected from lower altitude.

Statistical analysis revealed a higher intraspecific variability in *L. luzuloides luzuloides* populations, in comparison with *L. luzuloides rubella* ones, due to genotype, but with a major contribution of the various environmental conditions.

In both epidermis (upper and lower) the cell length is significantly influenced by the environment, less by genotype, while the cell width, the stomata size and density have a certain genetic determinism. This fact can be the explanation of the significant differences, for these characters, between the two subspecies. All these observations supported statistically, proved the genomic flexibility of a species in evolution.

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PLANT SPECIES DIVERSITY FROM PAUL VALLEY (THE AMPOI RIVER CATCHMENT, ALBA COUNTY, ROMANIA)

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Abstract. The plant species diversity of grasslands was studied from the former time due to the usage of the grasslands mainly as pastures for grazing and hay productions. In the Transylvanian region, Paul rivulet flows into the Ampoi River, a tributary of the Mureș River. Paul catchment area was affected over time due to atmospheric deposition from Zlatna extracting plant. The plant species diversity in the investigated plots varied and is correlated with overgrazing impact and natural soil structure rather than to soil pollution. The species number varied in relation to the season when the inventory was performed, the degree of the anthropogenic impact, natural substrate, slope and aspect (exposition). However, the local coverage of these species varied greatly with respect to the anthropogenic impact in the area and these species were not uniformly distributed in all investigated plots but achieved dominance in few plots. The grasslands of Paul catchment can be included within the category of sub-steppic calciphilous grasslands, recorded from Trascău Mountain. The phytocoenoses are dominated by species with xerophytic characters but including numerous mesophytic species, resulting in a heterogeneous species composition. There is great heterogeneity of micro-habitats within plots with, for example, abrupt transition from xerophilous vegetation to hygrophilous vegetation as a result of changes in the substrate (calcareous, acidic, argillous, etc.) or gradient and aspect (exposition) within a small area.

Keywords: species diversity, grasslands, Romania.

Rezumat. Diversitatea speciilor de plante de pe Valea lui Paul (Bazinul Ampoiului, judeţul Alba, România). Diversitatea speciilor de plante care formează pajiștile a fost studiată din cele mai vechi timpuri datorită utilizării pajiștilor în principal ca pășuni și fânețe. În Transilvania, pârâul Paul se varsă în râul Ampoi, care este la rândul lui tributar al râului Mureș. De-a lungul timpului, bazinul hidrografic al pârâului Paul a fost afectat de depunerile atmosferice datorate fabricii de extragere a metalelor din Zlatna. Diversitatea speciilor de plante din ploturile investigate variază și este corelată cu impactul suprapășunatului, a structurii naturale a substratului și mai puțin cu poluarea solului. Numărul de specii variază în raport de sezonul când s-au realizat inventarierile, gradul impactului antropic, substratul natural, panta și expoziția. Gradul de acoperire al speciilor variază mult depinzând de impactul antropic din zonă, speciile nefiind uniform distribuite în toate ploturile investigate, atingînd dominanța numai în câteva ploturi. Pajiștile din bazinul pârâului Paul pot fi incluse în categoria pajiștilor substepice calcifile din Munții Trascău. Fitocenozele sunt dominate de specii cu caracter xerofit dar includ și numeroase specii mezofite, ducând la o compoziție heterogenă a speciilor. Există un grad mare de heterogenitate a microhabitatelor în ploturi, de exemplu există o tranziție abruptă de la vegetația xerofilă la cea higrofilă ca rezultat al schimbărilor substratului (calcaros, acid, argilos etc.), pantei sau expoziției pe o arie mică.

Cuvinte cheie: diversitatea speciilor, pajiști, România.

INTRODUCTION

Grasslands around the world are subject to diminishing their distribution due to human land use changes (DIXON et al., 2014) prior to the 1950s in temperate grasslands (M. E. A. 2005). The European grasslands are an integrate part of pastoral and mixed-farming systems and have traditionally been used for haymaking, livestock grazing, or both (LIFE III, 2008). In Romania, around 1960s, natural grasslands used to have a surface of 4.3 million ha, most of them being situated in hilly and mountainous regions, in forestry and subalpine zones (CSÜRÖS & RESMERIȚĂ, 1960). In the present days, according with the Presidential Comity for Public Politics and Agricultural Development, 23.84 million ha representing the total surface of Romania comprise 62 % agricultural land from which 66.3% represent arable land and 29.2% natural grasslands. The natural grasslands are distributed: 50% in mountainous and alpine areas, 40% in hilly areas and 10% in plain area (C. N. S. R. 2014).

The survey on grassland ecosystem services (HÖNIGOVÁ et al., 2012) specify that natural and semi-natural grasslands provide ecosystem services framed in classes: provisional services (food, water, raw material, genetic, medicinal and ornamental resources), regulating services (air quality and climate regulation, moderation of extreme events, regulation of water flows, waste treatment, erosion prevention, maintenance of soil fertility, pollination, biological control), habitat services (maintenance of life cycles of migratory species, maintenance of genetic diversity), cultural and amenity services (aesthetic information, opportunities for recreation and tourism, inspiration for culture, art and design, spiritual experiences, information for cognitive development). The global hydrological cycle is modified by grasslands thus influencing the quality of the water passing through them (MCGILLOWAY, 2005).

The most comprehensive work regarding the geobotanical studies and productivity of the Romanian grasslands were done by PUȘCARU-SOROCEANU et al. (1963) highlighting that the pastures and hay fields are the most important areas especially in the mountainous regions where the semi-natural grasslands form a prevailing economic zone.

In Alba County belonging to central region of Romania, many phytosociological studies had been performed in different areas: Jidovu Massif (HODIȘAN, 1969), Cetii stone from the Apuseni Mountains (GHIȘA et al., 1965), Trascău depression (GERGELY, 1964), cliffs grasslands (GERGELY, 1967) and mountainous steppe grasslands

(GERGELY 1970a) from the northern side of Trascău Mountains, Breaza Massif (HODIȘAN et al., 1971), Feneșului Gorges (HODIȘAN, 1965), Mamut Massif (HODIȘAN et al., 1970). Based on studies of plant species communities from Transylvania (CSÜRÖS & RESMERIȚĂ, 1960; CSÜRÖS & CSÜRÖS-KÁPTALAN, 1966; CSÜRÖS-KÁPTALAN, 1967) and the Apuseni Mountains (CSÜRÖS & POP, 1965; GHIȘA et al., 1970; CSÜRÖS & FURDUI, 1974) and their ecological requirements, the plants associations were characterized focusing on ecological indexes.

The semi-natural grassland belonging to the European temperate zones comprises habitats with extreme species richness at small scale (HABEL et al., 2013). Spatial patterns of species diversity change over multiple scales, from quadrat level toward landscape level (HERBEN et al., 1999; HOFMANN et al., 2005). The information about vegetation is extracted from phytosociological relevés, as basic data on species co-occurrence in a particular time and space (KORZENIAK, 2013). Csürös stipulated in 1970 that changes in land use, transformation of grasslands due to direct anthropogenic impact (*i.e.* deforestation, grazing, *etc*.) and especially indirect impact (pollution, lad slide, *etc*.) converged toward intensification of the disappearance of some areas or reduction of their distribution areas, thus increasing major changes in the structure of plant communities and their integrative habitats. GERGELY (1970b) line out that the steppic mountainous plant associations vegetating on the slopes (i.e. Trascău Mountains) are deteriorated by overgrazing during the vegetation period. Through trampling the soil by domestic animals (herds), especially along the contours, the vegetation cover is destroyed thus intensifying the erosion process. Also the distribution areas of the plant association diminish, some associations being gradually and naturally replaced with others. For instance, *Cariceto (humilis)-Brachypodietum pinnati transsilvanicum* association dominates the slopes but is distributed on small areas. Following the anthropogenic impact, within this association, there were installed in small patches the degraded association *Andropogonetum ischaemi* showing a regressive succession of the vegetation.

Our goal has been to produce tools that include erosion control and metals-buffering services provided by grassland plants as factors within Strategic Environmental Assessment (SEA, 2001) and Environmental Impact Assessment (EIA, 2014) of projects, plans and policies implemented in catchments with current and past mining and smelting activities (ASPABIR, 2012). The first step for achieving our goal is to investigate the plant species diversity from plot level to catchment level.

MATERIAL AND METHODS

In the Transylvanian region, the Ampoi Valley stretches along the course of the Ampoi River, penetrating deep into the heart of the Apuseni Mountains and making its way through Vlădeasa, Trascău and Metaliferi Mountains (Fig. 1). As well as these areas of great biodiversity value, the Ampoi Valley also crosses the region where mining activities have had the greatest impact on the environment. In Zlatna area, during the communist period, atmospheric deposition of heavy metals had a great impact on both grasslands and forests. The plant Zlatna started to function in 1747, extracting copper-and lead-bearing ores that were also rich in gold and silver (CLEPAN, 1999).

Figure 1. The locations of the plots in Paul rivulet catchment area (blue line – the rivulet valley) (from Google Earth, accessed: March 24, 2015).

This plant was modernised in 1988 and functioned till 2003. The dispersion chimney of the plant (220 m height) created atmospheric pollution not only in the immediate area but also at big distances. Paul rivulet flowing from Trascău Mountain is a tributary of the Ampoi River situated close to the dispersion chimney and its catchment area was affected over time due to atmospheric deposition from Zlatna plant. People from this area use the grasslands for grazing and hay productions; thus, there is also an overgrazing impact on the grasslands. Both these big impacts highly modified the vegetation cover and structure leading to frequent landslides, areas without vegetation, modified water regime, etc.

In 2013, we set up 12 investigation plots 50 m^2 at different altitudes (468-972 m) in relation to the different degrees of soil pollution, altitude and slope (Fig. 1). In every plot, we recorded the species composition and coverage of the vegetation (%) in 25 subplots, each of 10 m^2.

In order to assess the diversity aspects, the natural conditions and also the anthropogenic impact among the different grasslands, the data set were statistically processed. Species diversity (Shannon index), dominance (Simpson's index) and evenness (E index) were calculated using the procedures BioDiversity Pro 2.0, PAST (HAMMER et al., 2001) and XLSTAT software. The graphical representation of the diversity differences among the plots were highlighted using K-dominance analysis based on species abundance. Multi-dimensional scaling (MDS) analysis gives an overview of the abundance distribution in the 12 plots.

RESULTS AND DISCUSSIONS

The species diversity in the plots varied between a minimum of 30 species (plot 5 at 602-616 m altitude) and a maximum of 88 species (plot 4 at 531-543 m altitude) and was correlated with overgrazing impact and natural soil structure rather than to soil pollution (Table 1). These two plots were situated in close proximity, within the same area of the rivulet catchment.

Table 1. The total coverage (m^2) of the diverse grasslands components inside the plots with 2500 m^2 area.

Plot number	Total number of species	Total vegetation	Rosettes/offsprings	Skeletal	Bryophytes	Soil without vegetation
1	65	2,202.4	86.4	8,8	123.8	78.6
2	60	1,885.2	125.3	-	68.6	420.9
3	73	1,853.1	122.5	-	219	305.4
4	85	1,832.3	130.2	-	96.4	441.1
5	28	1,809.8	82.4	-	158.7	449.1
6	70	2,083.2	182.5	-	47	187.3
7	52	2062.6	68.6	-	34	334.8
8	58	2,174.1	80.4	-	116.8	128.7
9	43	2,334	17.7	-	40.8	107.5
10	48	2,180.2	97.4	19,6	14.8	188
11	63	2,249.4	41.7	-	51.4	157.5
12	49	2,408.2	11.7	-	35.7	44.4

Those plots with a low number of species typically had a shallow soil with the bedrock near the surface (skeletal and substrate without vegetation) and were also overgrazed and trampled by sheep and goats. In contrast, high species number was associated with well-structured deep soil in meadows that the private owners mow for hay and forbade the passing and grazing of the animals. The exposure of the bryophytes and especially soil without vegetation shows the destruction of the vegetation cover on big areas determining the high variation in space and time of the grasslands from the entire catchment region. Without an adaptive management applied by local stake-holders, corroborated with the natural variation of geomorphology of the catchment, the grasslands might shrink starting from plot level toward bigger areas (erosion, land slide, etc.).

Evidence from Shannon evenness, Shannon-Weaver diversity and Simpson dominance indexes indicate that in the areas with low species diversity there is a dominance of one or two species with individuals unequally distributed within and between plots. Simple correlations of these indices show that in those vegetation communities studied, species abundance and equitability play an important role in Shannon-Weaver diversity variation ($R=0.723$, $p<0.01$) (Table 2).

Table 2. Diversity indices of studied plant communities.

Indices	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
Shannon_H	3.27	2.96	3.01	2.89	1.74	2.78	2.63	2.61	2.48	3.00	3.10	2.86
Evenness_e^H/S	0.40	0.33	0.36	0.21	0.20	0.22	0.26	0.24	0.25	0.38	0.38	0.36
Dominance_D	0.07	0.07	0.07	0.10	0.25	0.14	0.11	0.11	0.12	0.07	0.06	0.08

Most of the species recorded are xerophytic, hemicryptophyte and perennial. The species number recorded in 12 studied plots varied in relation to the season when the inventory was performed, the degree of the anthropogenic impact, natural substrate, slope and aspect (exposition). Those species with the overall highest coverage percentage were *Agrostis capillaris, Festuca rubra, Nardus stricta, Rumex acetosella* and *Trifolium pratense*, very similar to that of apparently unaffected grasslands elsewhere on Trascău Mountain. However, the precise local coverage of these species varied greatly with respect to the anthropogenic impact in the area (overgrazing and pollution) and these species were not uniformly distributed in all investigated plots but achieved dominance in few plots (Fig. 2). MDS distribution showed that plot 1 and 7 are very different in spite of high diversity indices because of the aggregated distribution of plant species. The total coverage of bryophytes, skeletal and soil without vegetation (Table 1) determine the irregular distribution of plant species at micro-site level due to natural or anthropogenic impact.

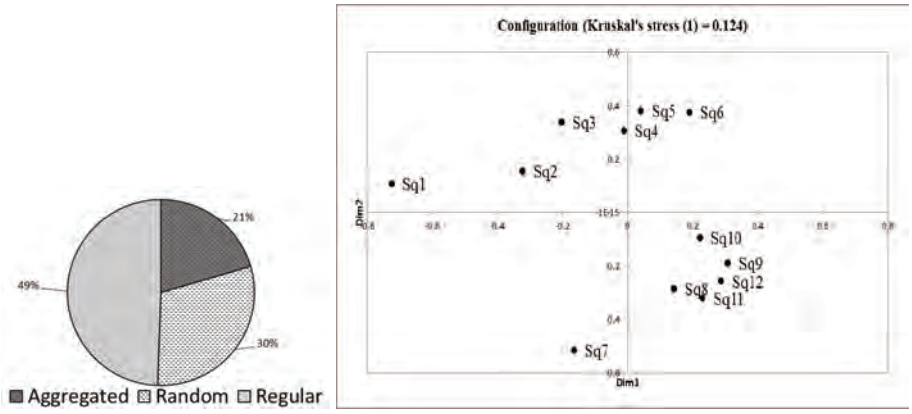

Figure 2. The distribution types of the inventoried species (left) and MDS distribution based on relative coverage similarity of the species in the investigated plots noted with 'Sq' (right).

The grasslands of Paul catchment can be included within the category of sub-steppic calciphilous grasslands, recorded from Trascău Mountains. The processes of soil formation influence the dynamics of vegetation cover. Once the soil substratum has accumulated, grasslands with a good vegetation cover replace the grassland type's characteristic of shallower soil areas (GERGELY, 1970b). The phytocoenoses are dominated by species with xerophytic characters but including numerous mesophytic species, resulting in a heterogeneous species composition.

From the total number of species, most of them are perennials (78 %) and hemicryptophytes (62%) showing that the species from the studies grasslands developed strategies for surviving in time and space (Fig. 3), most of them being short due to the grazing and trampling impact of domestic grazers (mainly sheep and goats) (Fig. 4).

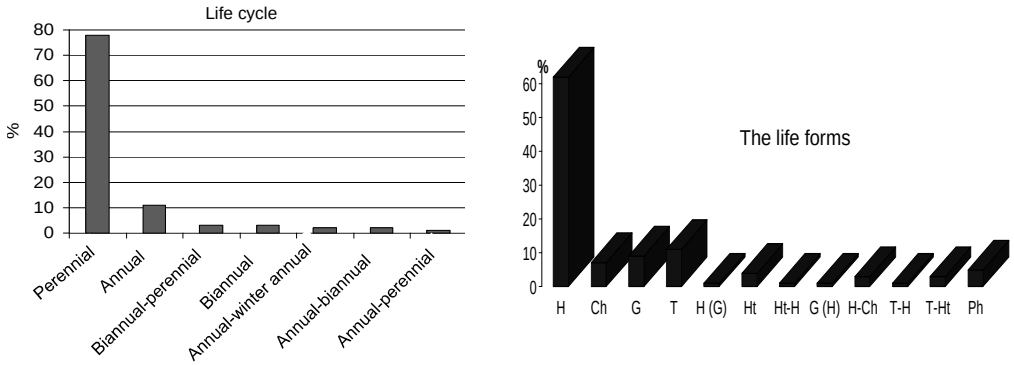

Figure 3. The life cycle (left) and life forms (right) of the inventoried plant species from the rivulet catchment area.

The traits of an organism represent distinct and quantitative properties; measured at the individual level, they are used at the species level, being very important for the understanding of local ecology of every site. The height of the plant species, their morphology/architecture, the depth reached by their roots, type of the roots, etc. define the habitats and control the ecological processes (KLIMEŠOVÁ & KLIMEŠ, 2013). The dominance of perennials and hemicryptophytes is revealed at the micro-site (plot) level but also at the catchment level. The height of the plant species is determined by the grazing and trampling, the highest individuals being found near shrubs, being protected by the influence of animals. Some micro-habitats are species-rich and the catchment species diversity is high and similar with other grasslands from Trascău Mountain with analogous anthropogenic impact. The intensity of the impact is changed due to the management applied by local stake-holders.

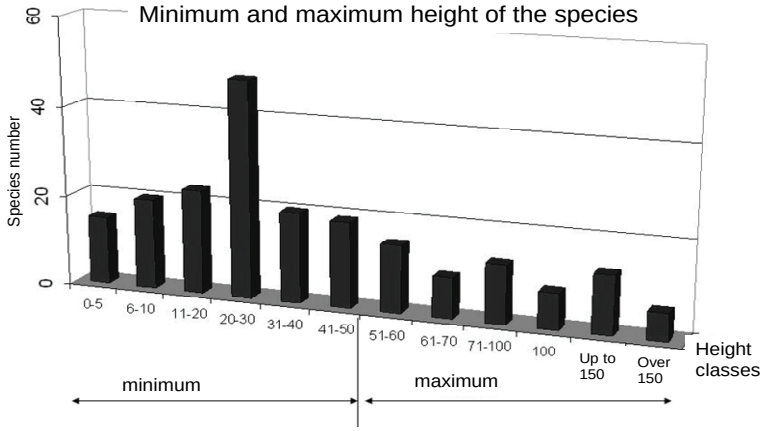

Figure 4. The minimum and maximum height of the recorded species.

CONCLUSIONS

The grasslands from Paul rivulet catchment are semi-natural grasslands managed by local stake-holders (grazing, mowing). There is great heterogeneity of micro-habitats within plots with, for example, abrupt transition from xerophilous vegetation to hygrophilous vegetation as a result of changes in the substrate (calcareous, acidic, argillous, *etc.*) or gradient and aspect (exposition) within a small area.

The grassland types are present in patches, those used for hay production are scattered among grasslands where overgrazing has led to destruction of the vegetation cover resulting in landslides in areas with more or less steep slopes.

Despite Zlatna plant ceasing to function in 2003, the heavy metal concentration in the soil remains high and, together with natural and other anthropogenic factors, determine a very varied species diversity and coverage in the grasslands from Paul catchment.

The applied management is very important for the species diversity in space and time and for the maintenance and distribution of the grasslands from Paul catchment especially due to increased historical soil pollution. Corroborated with other types of impacts it may results in grasslands disappearance.

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ECOLOGICAL STRUCTURE AND FUNCTIONS IN ANTHROPOGENIC COENOSES

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Abstract. The aim of this paper is to identify the general characteristics of structure and functioning of coenoses from a few anthropogenic habitats: sterile dumps, sterile ponds, afforestations. Ten sites were studied; four of them are natural habitats and their analysis is necessary for comparisons. The analysis of data is directed to epigeic invertebrate fauna but it is also commented the vegetation status, for a better reflection of the structure and functions of these coenoses. In anthropogenic habitats both vegetation and invertebrate fauna differ as structure and functioning in comparison with the adjacent natural areas and the slow evolution of vegetation influences the other coenotic components. The determining factor of this situation is human pressure: either the substrata are radically modified or the level of primary producers is drastically controlled by humans, or both.

Keywords: sterile dumps, sterile ponds, afforestation, structure and functions of coenoses.

Rezumat. Structură şi funcţii ecologice în cenoze antropogene. Această lucrare are ca scop identificarea trăsăturilor structurale şi funcţionale generale a cenozelor din câteva categorii de habitate antropogene: halde de steril, iazuri de decantare şi păduri plantate. Au fost studiate zece habitate dintre care patru naturale, pentru comparaţii. În analiza datelor am pus accentul pe fauna de nevertebrate epigee dar comentăm şi statusul vegetaţiei, pentru o mai bună ilustrare a structurii şi funcţiilor cenozelor. Atât vegetaţia cât şi fauna de nevertebrate din habitatele antropogene diferă mult structural şi funcţional în comparaţie cu zonele naturale adiacente, iar evoluţia lentă a vegetaţiei influenţează celelalte componente biotice. Factorul determinant în zonele antropogene studiate este amprenta umană: fie substratul este radical modificat, fie nivelul producătorilor primari este drastic controlat de om, sau ambele situaţii.

Cuvinte cheie: halde de steril, iazuri de decantare, împăduriri, structura şi funcţiile cenozelor.

INTRODUCTION

With the development of human society, both needs and human activities have multiplied and diversified, most of them with negative effects on our living environment. Speaking of ecological systems, we see lately a growing rate of degradation of the natural ecosystems and consequently, the emergence of ecological structures with strong anthropogenic footprint.

We refer to those ecological structures that are radically modified by man through its activities, especially at the level of two components: soil / substrate and vegetation. In light of these changes, we consider anthropogenic systems:

- Crops, vineyards and orchards – these have controlled vegetation and much reduced as diversity (up to the monospecific level) and the soil is altered due to agricultural practices (e.g. ploughing, fertilizing, applying herbicides, pesticides, etc.);
- Industrial landfill (waste material derived from mining activities, mining and mineral extraction, etc.); it comes to the dumps and tailing dams. These areas have usually a radically modified substrate which is not ground, but a substrate exclusively mineral, sometimes loaded with pollutants (such as heavy metals), which causes drastic changes in the structure of the primary producers compartment and hence, other biotic elements and the function of the ecological structure as a whole.

It is natural to ask ourselves how far - structurally and functionally - are these areas compared to the adjacent natural ecological structures and, if possible, on this basis, to conclude whether it is more efficient to restore these areas or let renaturation working on our behalf to remedy the environmental damages.

For this, we studied only anthropogenic areas (waste dumps and tailings ponds) which are either in the process of revegetation or environmentally restored.

We analysed the structure of epigeic invertebrate fauna (structure of numerical dominance, constancy classes, diversity, the degree of similarity) and as part of functions, aspects of vegetation cover and trophic relationships between invertebrate groups, as an expression of the flow of matter and energy at the local level.

MATERIAL AND METHODS

For purposes of this paper there were selected sets of data from previous studies carried out in the above mentioned areas, comparable as the period of the year in which they were made and working method.

The epigeic invertebrate fauna was collected using pitfall traps (10 sample units each site) located at about 5 m distance each other and filled with a mixture of 4% formaldehyde and liquid detergent solution (1: 1 vol.).

The epigeic invertebrates were identified at the over-specific (Order rank or superior). As BIAGGINI et al. (2007), we consider useful and fair this approach.

Beyond the empirical processing (structural indicators), to highlight the differences between datasets we used tests and statistical programs (one-way anos, NMDS) based on the decision that the distribution of non-normal data requires the use of non-parametric tests. Also, for setting the existence (or not) of correlations (in case of trophic relationships), we used Excel function for the r coefficient of linear correlation.

The analysed sites

Site 1 – Bârlii sterile dump (Retezat National Park).
Geographical position: W Romania;
Type: sterile material resulting from the construction of a tunnel (adduction) in the perimeter of Râul Mare-Retezat hydropower plant and stored on a meadow;
Status: Technogenic area which is four years after experimental revegetation process with a mixture of perennial herbaceous plant seeds (grasses) (PAUCĂ-COMĂNESCU et al., 1999; PUIA et al., 2001).

Site 2 – natural mixed forest, adjacent to site 1.

Site 3 – Ciurila sterile dump (Retezat National Park);
Type: sterile material resulting from the construction of a tunnel (adduction) in the perimeter of Râul Mare-Retezat hydropower plant and stored on the right side of Ciurila spring;
Status: technogenic area which is 45 years after the last deposit of sterile material; under renaturation.

Site 4 – natural mixed forest, adjacent to site 3.

Site 5 – Valea Mică flotation pond;
Geographical position: W. Romania, close to Zlatna town (Alba County);
Type: sterile material (stored on a meadow), resulted from the technological process of extracting metals (Cu, Zn, Fe, etc.) nearby the Factory S.C. Ampellum – Zlatna S. A.;
Status: flotation pond; non-active technogenic area (abandoned) for about twelve years; under renaturation.

Site 6 – Valea Mică natural meadow adjacent to site 5.
Geographical position: W. Romania, close to Zlatna town (Alba County);
Type: natural habitat, adjacent to site 5.

Site 7 – Boşneag flotation pond.
Geographical position: W. Romania, close to Moldova Nouă town (Caraş-Severin County);
Type: sterile material (stored on a meadow), resulted from the technological process of extracting metals (Cu, Zn, Fe, etc.) at the nearby factory (Moldomin S. A.);
Status: flotation pond; four years after the ecological restoration process ended.

Site 8 - Lunca Dunării flotation pond.
Geographical position: W. Romania, close to Moldova Nouă town (Caraş-Severin County);
Type: sterile material (stored on a meadow), resulted from the technological process of extracting metals (Cu, Zn, Fe, etc.) at the nearby factory (Moldomin S. A.), adjacent to site 7;
Status: flotation pond; ten years after the ecological restoration process ended.

Site 9 – Adea deciduous forest plantation.
Geographical position: (W. Romania, Arad County);
Type: forest plantation;
Status: four years old forest plantation.

Site 10 – Adea natural forest.
Geographical position: (W. Romania, Arad County), adjacent to site 9.
Type: natural habitat;
Status: natural deciduous forest of 110 years old.

Processes of restoration and reforestation

In site 1 it was used a mixture of perennial herbaceous plants seeds (PAUCĂ-COMĂNESCU et al., 1999) to stabilize, at least superficially, the mineral substrate and to induce at the substrate level the accumulation of organic matter.

In sites 7 and 8 the sterile material has undergone to a restoration process consisting in covering the sterile with a layer of soil allochthonous (15-20 cm thick) from an adjacent meadow and then planting seedlings of willow, seabuckthorn, acacia, etc.; these species were elected after previous tests (as growing and adaptation).

RESULTS AND DISCUSSIONS

The structure of numerical dominance, constancy classes, diversity, similarity

Starting from the numerical abundances, we found that most of the analysed sites (grouped in categories of the same type, e.g. sterile dams, tailings ponds or plantation vs. adjacent natural forest) show significant differences (Table 1).

Table 1. Structural characteristics of the coenoses in the studied sites.

	Nr. of superior taxa	N/u.p.	% eudominant + dominant	% subrecedent + recedent	% euconstant + constant	% accessory + accidental
Site 1	17	93.4	29.41	52.94	58.82	23.53
Site 2	14	46.5	14.28	71.43	50	14.28
Site 3	13	22	23.07	69.23	38.46	46.15
Site 4	15	60.37	20	80	33.3	33.3
Site 5	13	161.75	23.08	53.85	61.53	30.77
Site 6	12	218.37	41.67	41.66	75	16.67
Site 7	19	112.9	31.58	52.63	57.9	15.79
Site 8	18	103	33.3	50	55.55	16.67
Site 9	18	34.2	22.2	38.89	33.34	16.67
Site 10	15	49	40	60	46.66	46.66

In sites 1-2 (Bârlii), the epigeic invertebrate fauna inhabiting the sterile dam and from the adjacent natural forest is similar as number of over-specific taxa. The structure of epigeic invertebrate populations exhibits close values (and similar taxonomical composition associated to these values) for the eudominant and dominant groups. The structural ecological superiority of the adjacent natural forest is due to the high percentage of euconstant taxa plus the percentage also high of the relative constant taxa (Table 2).

Table 2. Structural characteristics of the coenoses from sites 1 and 2.

	D	% D Coleoptera	%D ACS+ACD	Similarity (%)
Site 1	1.9945	7.51	1.36	80
Site 2	1.7232	18.34	2.55	

D = Shannon-Weaver index of diversity
%D = proportion of Coleoptera from D
%D ACS+ACD = proportion of accessory and accidental groups.

The differences in structure (p= 0.0001) and degree of similarity between the two conenoses are shown in Figure 1.

At Ciurila (sites 3-4), both on the sterile dump and in the adjacent natural forest, there was registered a similar number of invertebrate taxa but their numerical abundances is higher in the forest. The epigeic invertebrates on the sterile dam are present in a lower percentage as constant and euconstant groups, while in the natural adjacent forest, the balance between the (eu)constant groups on one side and the accessory and accidental groups on the other side (as proportions) ensures the plasticity and dynamic balance of the natural ecosystem (Table 3).

The differences in structure (p = 0.0005) and degree of similarity between the two coenoses are shown in Figure 2.

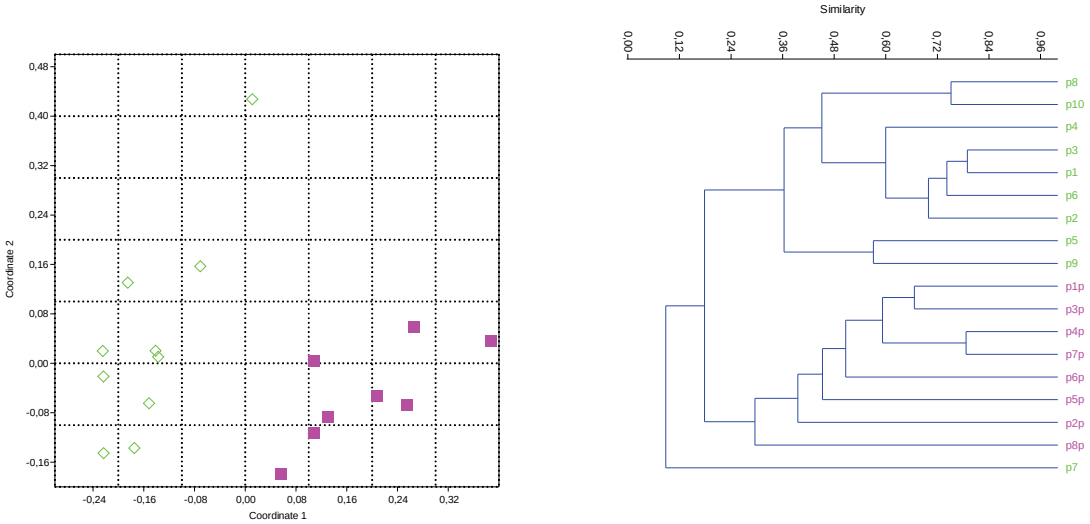

Figure 1. The differences (left) and degree of similarity (right) between the epigeic invertebrate communities of sites 1 and 2 (diamond = sterile dam coenoses; square = natural forest coenoses).

Table 3. Structural characteristics of the coenoses from sites 3 and 4.

	D	% D Coleoptera	%D ACS+ACD	Similarity (%)
Site 3	1.8366	5.96	8.93	78.57
Site 4	1.7524	19.54	13.96	

D = Shannon-Weaver index of diversity; %D = proportion of Coleoptera from D; %D ACS+ACD = proportion of accessory and accidental groups.

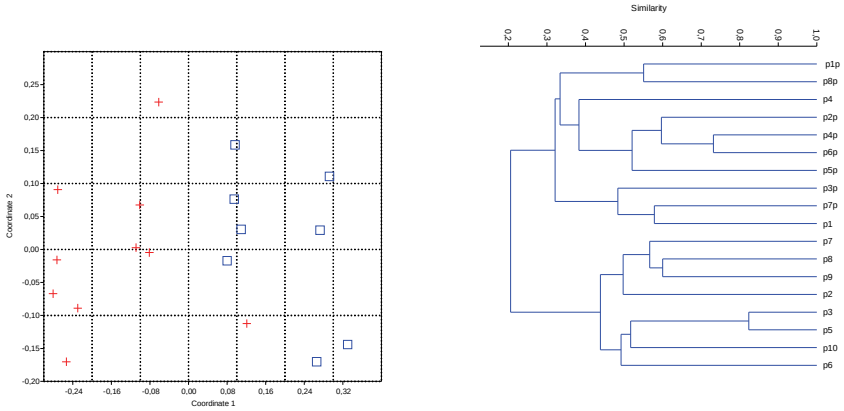

Figure 2. The differences (left) and degree of similarity (right) between the epigeic invertebrate communities of sites 3 and 4 (cross = sterile dam; square = natural forest).

As in previous cases, in sites 5-6 (Valea Mică), there was found a similar number of over-specific invertebrate taxa and higher numerical abundances of the invertebrate community inhabiting the natural meadow. On the flotation pond, the proportion of euconstant and constant invertebrate groups is similar to those of the meadow. Also, on the flotation pond it was noticed a smaller difference between the proportion of euconstant and constant invertebrate groups and of accessory and accidental ones in comparison with the situation existing on meadow, where, to the (eu)constant taxa is added the percentage of relative constant ones (Table 4).

Table 4. Structural characteristics of the coenoses from sites 5 and 6.

	D	% D Coleoptera	%D ACS+ACD	Similarity (%)
Site 5	1.0681	20.02	9.29	80
Site 6	1.7159	8.23	0.69	

D = Shannon-Weaver index of diversity
%D = proportion of Coleoptera from D
%D ACS+ACD = proportion of accessory and accidental groups of invertebrates.

The differences (p = 0.0002) and the degree of similarity of the coenotic elements from sites 5 and 6 are shown in Figure 3.

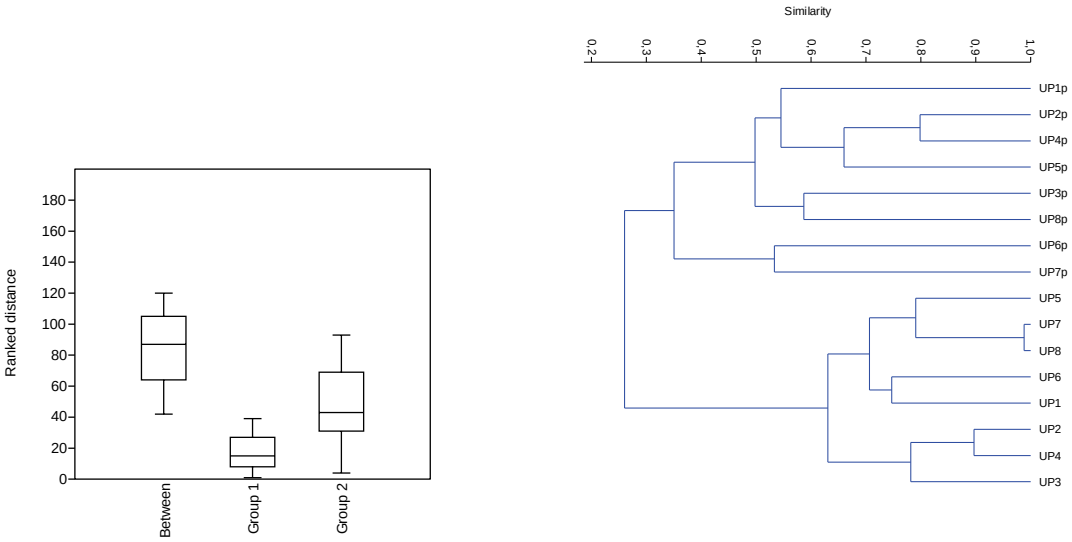

Figure 3. The differences (p = 0.0002) (Bray-Curtis, left) and degree of similarity (right) between the epigeic invertebrate communities of sites 5 and 6 (Valea Mică).

On the flotation ponds from Boşneag and Lunca Dunării (sites 7-8) the epigeic invertebrate communities are almost identical in taxa number and their proportions in the structure of numerical dominance and as classes of constancy.

According to the analysis of data (Fig. 4), there is not a certain distribution of taxa and of the structural elements depending on ecological gradients existing in sites 7 and 8. Also, no significant differences between the structure of the two invertebrate communities were noticed (Table 5).

Table 5. Structural characteristics of the coenoses from sites 7 and 8.

	D	% D Coleoptera	%D ACS+ACD	Similarity (%)
Site 7	2.1773	16.12	0.58	91.9
Site 8	2.1766	16.28	0.95	

D = Shannon-Weaver index of diversity
%D = proportion of Coleoptera from D
%D ACS+ACD = proportion of accessory and accidental groups.

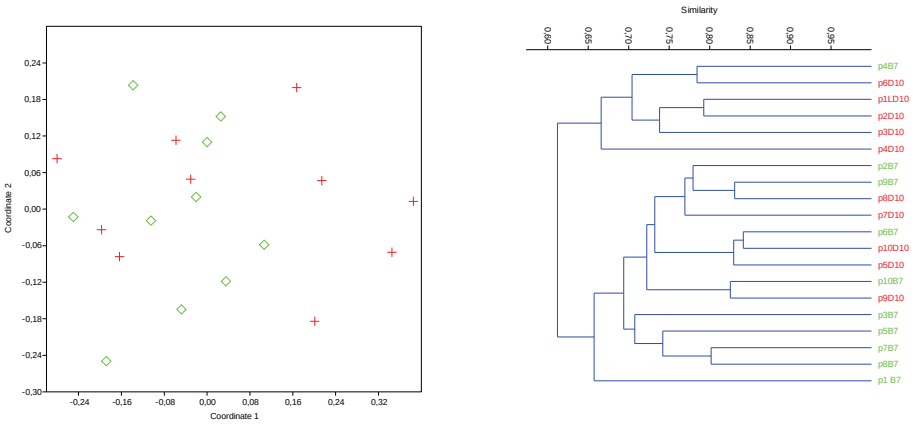

Figure 4. The differences (p = 0.2127) (left) and degree of similarity (right) between the epigeic invertebrate communities of sites 7 and 8 (Boşneag and Lunca Dunării) (diamond = Boşneag; cross = Lunca Dunării).

Between the forest plantation and the adjacent natural forest (sites 9-10) there is a great similarity as number of over-specific invertebrate taxa and structure of numerical dominance; the differences are given by the higher proportions of the euconstant taxa present in the natural forest (Annex 1).

Table 6. Structural characteristics of the coenoses from sites 9 and 10.

	D	% D Coleoptera	%D ACS+ACD	Similarity (%)
Site 9	1.8896	1.04	3.57	84.85%
Site 10	1.3024	19.73	5.743	

D = Shannon-Weaver index of diversity
%D = proportion of Coleoptera from D
%D ACS+ACD = proportion of accessory and accidental groups

Because in terms of efficiency the analysis of epigeic invertebrate fauna was made only in part at the species level (Coleoptera: Carabidae), the diversity will be discussed at the over-specific level (Fig. 5).

In many papers, including COLEMAN's (2004), it is demonstrated (based on studies) that ground beetle fauna exhibits a higher diversity on the forested sterile dumps in comparison with the barren ones and also this diversity is higher on older forested dumps. It seems that the degree of cover of the vegetation layer does not influence directly the ground beetle fauna (except the phytophagous species) and the influence of canopy layer is due to the microclimatic characteristics it determines and to the formation of litter layer.

SCHWERK et al. (2006) found that on the sterile dumps forested with birch, the changes in ground beetle communities are rather stochastic and not a result of the ecological succession.

SCHWERK & ABS (2001) mention that the slow ecological succession on the sterile dumps is due to the low rate of soil formation and hence, the slow evolution of the conenoses as a whole.

PRACH & PISEK (2001) stated that the succession may be relied on spontaneous restoration projects, except in extreme cases, when it comes to toxic substrate. "Letting a site to allow spontaneous processes to revegetated is quite advantageous if the site in question is small and surrounded by natural vegetation. Spontaneous succession is cheap and revegetated sites typically exhibit greater natural value" they said.

HODAOVÁ & PRACH (2003) also stated that the vegetation on the restored sterile dumps develops in a different way than that colonizing naturally the sterile dumps. In the last case is about a higher specific diversity in more advanced successional stages in comparison with the restored sites.

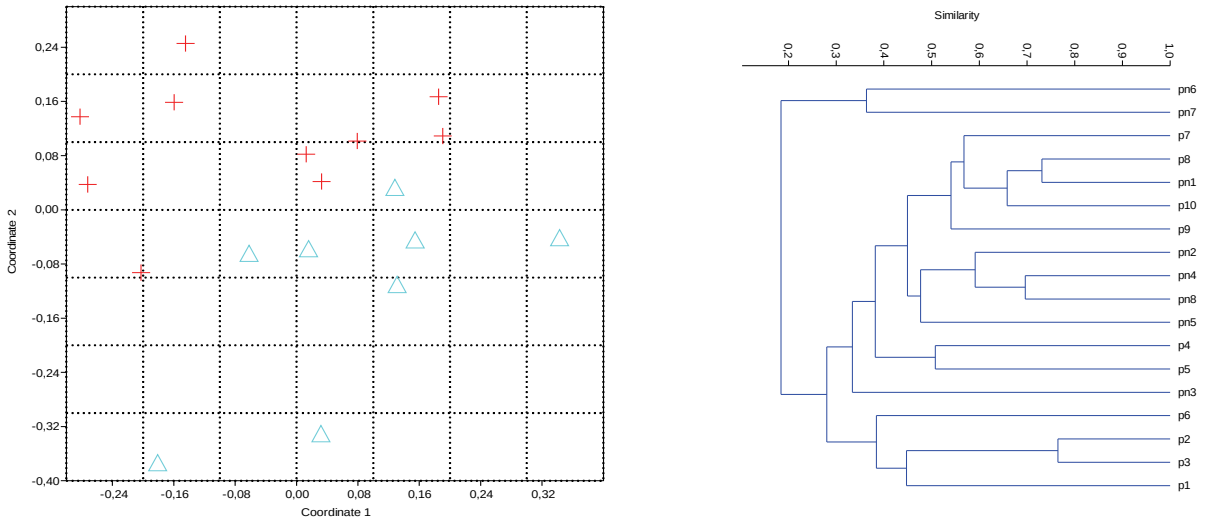

Figure 5. The differences (p = 0.0034) (left) and degree of similarity (right) between the epigeic invertebrate communities of sites 9 and 10 (cross = Adea plantation; triangle = natural forest).

Functional characteristics

In this paper, the functional characterization of the studied conenoses will be not performed by numerical estimates of vegetation and invertebrates biomass, but indirectly by the estimation of the degree of the vegetation cover (herbaceous layer and canopy layer) and by the numerical densities of epigeic invertebrates and also, by the trophic relationships between some predator groups (spiders, chilopoda, opiliones, predator ground beetle species) and the potential prey, as a reflection of the flux of matter and energy through the local coenoses.

About vegetation, it appears (Table 7) that both the woody and herbaceous vegetation is less represented in sites where processes of revegetation take place (sites 1, 3 and 5) compared with the restored ones (sites 7 and 8). Among dumps, that one at Bârlii (site 1) has a unique status of the herbaceous layer, at least reported to the age of the heap (four years old) thanks to the impulse of the initial experiments (seeding of the substrate), followed by the spontaneous processes of revegetation.

Also, on the flotation ponds (sites 5, 7, 8), at the vegetation level, it is noticed the difference in favour of those ecologically restored (sites 7, 8).

About the forest plantation we could say that it is different both in comparison with the plantations made on the flotation ponds and in comparison with the natural adjacent forest (Table 7). For details about the vegetation of Boşneag and Lunca Dunării, see DIHORU (2001).

At the epigeic invertebrate communities level, the trend is similar to the vegetation, since phytophagous invertebrate groups depend on vegetation and hence the higher trophic levels. This state of fact is reflected by the existence of trophic relationships between few invertebrate groups and their local trophic offer.

Because most of over-specific taxa are heterogeneous as trophic status, we chose to quantify / verify the existence of trophic relations between several groups of invertebrates (spiders, predatory ground beetles, centipedes, opiliones) and their food supply.

From the analysis undertaken is noticed that on the sterile dumps (sites 1, 3) there exist differences in the existent trophic relationships between predators and prey, but in comparison with the adjacent natural habitats (sites 2, 4). To be more specific, on Bârlii sterile dump (site 1), among invertebrate predator we analysed, only the predator ground beetle species established trophic relationships with mites and dipterans. The other groups (spiders, centipedes, opiliones) use in a smaller proportion the local source of food and thus, their relation with the predator ground beetles is not a competitive one.

In the natural forests adjacent to the sterile dumps (sites 2 and 4), all the groups of predators we studied established 3-5 trophic relationships with their food source and among them, no competitive relations were noticed (positive values of r).

Among the flotation ponds, on the site 5, where revegetation processes take place, the predators have trophic relations with different groups of food and thus they are not in competition for food.

Table 7. Some functional characteristics of the investigated conenoses.

	Age (years)	Status	% cover of herbaceous layer	% coverage of canopy	Nr. of predator groups	Nr. of predator -prey relationships
Site 1	4	renaturation	± 40	< 10	4	3
Site 2	> 100	natural	100	100	3	12
Site 3	45	renaturation	± 50	70	3	3
Site 4	> 100	natural	80	100	4	12
Site 5	± 15	renaturation	± 20	0	2	2
Site 6	n.a.	natural	100	0	2	0
Site 7	4	restoration	100	70-75	4	4
Site 8	10	restoration	100	80-85	4	11
Site 9	4	plantation	40	50	2	2
Site 10	110	natural	80	100	3	5

On the flotation ponds ecologically restored (sites 7 and 8), on the "younger one" (site 7), only the predator ground beetles and spiders have real trophic relations with the local source of food and among these predators there are no trophic interactions because they consume different categories of food.

In the forest plantation (site 9), only spiders and opiliones have obvious trophic relations with the local source of food, but they consume different groups of prey and thus, as in previous similar situations, they do not compete for food (Annex 2).

Talking about plantations, the NMDS analysis show (Fig. 6) the obvious difference between the forest plantation from site 9 and plantations made on sterile substrate (sites 7 and 8).

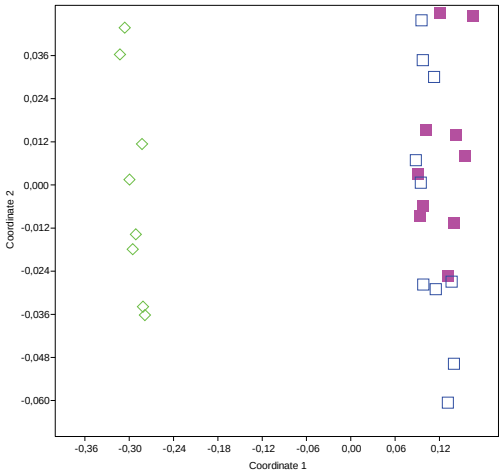

Figure 6. The differences (p = 0.0001) between the epigeic invertebrate communities of sites 5, 7 and 8 diamond = site 5, squares = sites 7 and 8).

CONCLUSIONS

Data analysis reflects obvious structural differences both between sites with anthropogenic conenoses and in comparison with the natural ones.

Although the similarity of taxonomical composition is very high among the sites studied, differences are given by their numerical abundances, which determine on the one hand the structure of dominance and persistence of taxa in local coenoses local (classes of constancy) and secondly, trophic relations (partially analysed).

From the structure point of view, each category of anthropogenic conenoses, no matter their age, is far from the status of natural one, and by comparison, the conenoses where the renaturation takes place, have a slower development in comparison with those ecologically restored, but in favour of diversity and stability (in time, of course), because nature choose the ways and makes things working, not humans (as in case of the restored sites).

About taxonomical biodiversity, like BREMER & FARLEY (2010) and BROCKERHOFF et al. (2008), we concluded that forest plantations (woody species) have a high potential to support the development of herbaceous layer and zoofauna, but with the help of three factors: the substrate type, reforestation formula, the right management post-reforestation.

As functions, it is clear that all the conenoses inhabiting sterile areas, renaturated or restored ecologically, bear, as a dimension of their functionality, the footprint of 3 essential elements: the type of substrate (soil or sterile), vegetation type (natural colonization or plantation) and their age.

Like other specialists before us, we conclude that if there are no economic emergencies to make productive the sterile dumps or flotation ponds by reforestation, it is more desirable the renaturation, both as costs and ecological significance, and thus, in time, the anthropogenic areas become similar to natural ones, both as structure and functioning.

In both situations – restoration and renaturation – the success of the development of the local coenoses depends on the close vicinity of the natural habitats and the lack of the anthropogenic stress (PRACH & HOBBS, 2008).

We mention again that these conclusions are partial, due to the limited approach of the theme. Further studies are necessary, at larger scale and more parameters investigated, to obtain a more complex image of the structure and functioning of these conenoses.

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Annex 1.

TAXA	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Site 8		Site 9		Site 10	
	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	Site	F%	D%	F%
GASTROPODA	0.11	10	4.03	100	0	0	0.62	37.5	0	0	0	0	0.17	20	0	0	1.16	40	0	0
OLIGOCHAETA	0	0	0.54	12.5	0	0	0.62	12.5	0	0	0	0	0.09	10	0.1	10	0	0	0.25	12.5
ACARINA	1.17	40	49.2	100	22.7	70	33.77	100	0.31	13	1.26	50	3.1	100	4.37	100	38.21	100	33.9	75
OPILIONES	10.92	100	0	0	23.2	70	23.81	87.5	0	0	0	0	0.44	40	0.58	30	0.29	10	1.02	50
ARANEAE	4.28	80	3.5	75	2.73	30	2.69	62.5	5.64	100	6.7	100	12.04	100	21.9	100	3.5	50	5.36	87.5
CRUSTACEA Isopoda	0	0	1.34	62.5	3.18	10	0.83	50	0	0	0	0	3.19	70	3.49	60	8.16	80	0.25	12.5
COLLEMBOLA	18.95	90	6.18	62.5	0	0	4.55	12.5	5.02	100	38.1	100	17.71	100	12.1	100	11.95	80	9.7	87.5
THYSANOPTERA	0.21	10	0	0	0	0	0	0	0.08	13	0.06	12.5	0	0	0	0	0.29	10	0	0
MYRIAPODA-Chilopoda	4.71	60	2.42	50	0.45	10	0.62	25	0	0	0.11	12.5	0.53	30	0.58	40	0	0	0.25	12.5
MYRIAPODA-Diplopoda	1.5	40	2.42	50	0	0	3.72	62.5	0	0	0	0	1.15	70	1.16	40	1.46	50	0.51	25
HETEROPTERA	0.11	10	0.27	12.5	0.45	10	0	0	0.15	25	0	0	0.62	50	0.68	30	1.75	50	0.25	12.5
HOMOPTERA -Aphididae	0.85	60	0.8	37.5	1.36	10	1.86	37.5	0.31	38	0	0	2.65	90	3.2	80	2.62	50	0	0
HOMOPTERA - Cicadoidea	0.43	40	0	0	0	0	0	0	1.47	100	7.44	75	1.5	80	1.16	70	10.2	70	1.27	25
HYMENOPTERA var.	7.38	80	0.8	25	5.91	60	0.21	12.5	0	0	0	0	9.83	100	7.86	100	3.79	50	2.04	62.5
HYMENOPTERA - Formicidae	8.35	90	2.95	62.5	4.5	60	0.83	25	2.78	75	11.2	100	11.07	100	15.1	100	3.5	50	17.3	87.5
BLATTODEA	0	0	0	0	0.45	20	0	0	0	0	0.63	62.5	0	0	0	0	4.08	60	0	0
ORTHOPTERA var.	2.35	80	0	0	0	0	0	0	1.08	63	4.64	100	0.62	40	0.68	50	0.29	10	0	0
ORTHOPTERA - Gryllidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.21	50	0	0
DERMAPTERA	0	0	0	0	0	0	0	0	66.6	100	0	0	0.26	30	0.1	10	2.04	40	15.6	100
DIPTERA	33.12	90	6.45	100	31	100	1.65	37.5	12.6	100	24.9	100	8.68	100	8.54	100	0	0	0	0
LEPIDOPTERA	0.21	10	0	0	0.91	10	0.21	12.5	0.15	13	0.34	25	0.09	10	0.1	10	0	0	0.25	12.5
ZYGENTOMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLEOPTERA	5.35	80	19.1	100	3.18	40	24.01	100	3.78	100	4.58	100	26.26	100	27.3	100	3.5	60	12.2	100

Annex 2.

LINEAR CORRELATIONS	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Carabus sp.-Gastropoda	-	0.339	-	-0.238	-	-	0.976	-	-	-0.218
Carabus sp.-Oligochaeta	-	0.801	-	0.504	-	-	-0.162	-	-	-
Carabidae-Gastropoda	-	-	-		-	-	0.863	-	-	-
Carabidae-Oligochaeta	-	-	-	0.629	-	-	0.248	-	-	-
Carabidae-Acarina	0.814	0.881	-	0.236	-	-0.333	0.083	0.387	-	-
Carabidae-Isopoda	-	-0.609	-	0.862	-	-	-0.308	0.171	-	-
Carabidae-Collembola	0.168	0.144	-	0.282	0.212	-0.218	-0.143	0.105	-	-
Carabidae-Aphididae	-	-0.132	-	0.734	-	-	-0.078	0.085	-	-
Carabidae-Diptera	0.593	0.702	-	0.356	-0.522	-0.343	-0.589	0.224	-	-
Araneae-Gastropoda	-	0.562	-	-0.269	-	-	0.198	-	0.153	-
Araneae-Oligochaeta	-	0.681	-	0.709	-	-	-0.347	-	-	-0.218
Araneae-Acarina	-0.125	0.809	-0.235	-0.054	-	0.18	0.255	0.7645	0.367	0.092
Araneae-Isopoda	-	0.808	-0.196	0.625	-	-	0.579	0.864	0.49	0.278
Araneae-Collembola	0.299	0.139	-	0.078	0.842	-0.148	0.024	0.674	0.831	0.224
Araneae-Aphididae	-	0.024	-0.196	0.714	-	-	0.079	0.585	-0.374	-
Araneae-Diptera	0.023	0.71	0.531	-0.251	0.024	-0.332	0.422	0.857	0.037	0.143
Chilopoda-Gastropoda	-	0.484	-	-0.046	-	-	-0.049	-	-	-
Chilopoda-Oligochaeta	-	0.796	-	0.0882	-	-	-0.196	-	-	-0.143
Chilopoda-Acarina	-	0.683	-0.109	0.221	-	-	0.133	0.611	-	0.827
Chilopoda-Isopoda	-	0.686	-0.111	0.538	-	-	0.128	0.669	\	-0.143
Chilopoda-Collembola	0.147	-0.068	-	0.339	-	-	-0.18	0.331	-	0.644
Chilopoda-Aphididae	-	-0.26	-0.111	0.916	-	-	0.106	0.358	-	-
Chilopoda-Diptera	0.019	0.378	0.841	-0.185	-	-	0.255	0.686	-	0.834
Opiliones-Gasteropoda	-		-	0.074	-	-	0.373	-	-0.272	-
Opiliones-Acarina	-0.193	-		0.504	-	-	0.169	0.706	0.302	-0.519
Opiliones-Isopoda	-	-	-0.146	0.582	-	-	-0.361	0.601	0.723	-0.378
Opiliones-Collembola	-0.116	-	-	0.744	-	-	-0.466	0.804	-0.045	-0.682
Opiliones-Aphididae	-	\	-0.146	0.506	-	-	-0.108	0.034	0.029	-
Opiliones-Diptera	0.724	-	-0.246	0.105	-	-	-0.254	0.351	0.099	-0.161
Carabidae-Araneae	-0.198	0.788	-	0.643	-0.131	0.299	0.035	0.155	-	-
Carabidae-Chilopoda	0.588	0.7801	-	0.732	-	-	-0.084	-0.185	-	-
Carabidae-Opiliones	0.843	-	-	0.233	-	-	0.466	0.466	-	-
Araneae-Chilopoda	0.179	0.683	0.784	0.711	-	-	-0.183	0.738	-	-0.126
Araneae-Opiliones	-0.193	-	-0.329	0.35	-	-	-0.163	0.432	-0.041	-0.335
Chilopoda-Opiliones	0.677	-	-0.241	0.157	-	-	0.146	-0.064		-0.378

RESEARCH REGARDING THE INFLUENCE OF CERTAIN PESTICIDES ON SOME PHYSIOLOGICAL INDICES AT *Carrasius auratus gibelio* Bloch 1758

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Abstract. Many researches in the field of biological effects of pollution are directed towards detection of functional changes of the animal body amid the action of some chemical agents resulting from industrial technological processes or used in agriculture, that are then collected by inland waters. In this study we determined the variation of some physiological indices, such as oxygen consumption, respiratory rate, blood glucose and erythrocytes under the action of the insecticide Calypso 480 SC and Decis 50 EW la *Carassius auratus gibelio* Bloch. The highest variations in the physiological indices in percentage terms were reported in: oxygen consumption, which increased by 116.69% in 24 hours compared with the control value, recording the value 119.834 ml oxygen/kg/hour as compared to 55.302 ml oxygen/kg/hour at the concentration of 0.00015 ml/l Decis 50 EW and blood glucose, where the values increased significantly by 106.45%, as well as 100% at the concentrations of 0.02 and 0.025 ml/l Calypso 480 SC.

Keywords: pesticides, physiological indices, exposure time, concentration, poikilothermic.

Rezumat. Cercetări privind influenţa anumitor pesticide asupra unor indici fiziologici la *Carrasius auratus gibelio* Bloch 1758. Numeroase cercetări în domeniul efectelor biologice ale poluării mediului sunt orientate spre decelarea modificărilor funcţionale ale organismului animal pe fondul acţiunii unor agenţi chimici rezultaţi din procesele tehnologice industriale sau utilizaţi în agricultură, care sunt colectaţi apoi de către apele interioare. În prezentul studiu s-a determinat variaţia anumitor indici fiziologici, cum ar fi: consumul de oxigen, ritmul respirator, glicemia şi numărul de eritrocite, sub acţiunea insecticidului Calypso 480 SC şi Decis 50 EW la *Carassius auratus gibelio* Bloch. Cele mai mari variaţii ale indicilor fiziologici din punct de vedere procentual au fost semnalate la consumul de oxigen, care a crescut cu 116,69% la 24 de ore comparativ cu valoarea martor înregistrând valoarea de 119,834 ml oxigen/kg/oră faţă de 55,302 ml oxigen/kg/oră la concentraţia de 0,00015 ml/l Decis 50 EW şi glicemie unde valorile au crescut semnificativ cu 106,45%, respectiv 100% la concentraţiile de 0,02 şi 0,025 ml/l Calypso 480 SC.

Cuvinte cheie: pesticide, indicifiziologici, perioada de expunere, concentraţie, poikiloterme.

INTRODUCTION

Worldwide, there are used between 5 and 10 million tons of pesticides (integrated in approximately 1000 formulas) with a total value of 16.3 million dollars; of this amount, about 70% are used in agriculture and the remaining 30% in other activities (including household consumption, among others) (REPETTO, 1995; OSSUNA et al., 1997).

Despite today's technology development and emergence of the second and the third generations of pesticides, all these products present, inherently, a certain degree of toxicity to living organisms. Unfortunately, the selectivity of "target" species is not well establishedand the "non-target" species are frequently affected due to the similarity of physiological and / or biochemical systems to those of the "target" species.

It is estimated that only 0.1% of the pesticides applied on an agricultural area reach the "target" organisms, while 99.9% are dispersed in the surrounding environment, representing a potential risk to neighbouring ecosystems (REPETTO, 1995).

Because fish are good indicators of water pollution level compared to other aquatic organisms, so that most researches on the assessment of toxicity of various chemicals were conducted on different species of fish.

In case of fish exposure to pesticides, GRAY & SÖDERLUND (1985) reports a series of physiological and biochemical responses, such as cardio-respiratory changes, as well as blood chemical parameter changes (increased glucose, lactate, epinephrine, norepinephrine, oxygen consumption).

Fish change their energy metabolism in the meaning of consuming a higher amount of energy to alleviate toxic stress (FERRANDO & MOLINER, 1992), which results in the improvement of oxygen use on hypoxia and even anoxia conditions.

The information in the specialized literature shows that fish were the most researched in terms of haematology (MOTELICĂ et al., 1965).

Regarding haematological indices, we find out from the specialized literature that the erythrocytes at the trout poisoned for 96 hours with cypermethrin in concentration of 3.14 μg/l did not change significantly (VELISEK et al., 2006).

Of a particular interest in the field of biological effects of water pollution are, during the past few years, the researches made to reflect the physiological changes in the aquatic organisms under the action of various chemical organic and inorganic agents (PORA & NIŢU, 1952; WOHLSCHLAG et al., 1968; McLEOD & PRESSAH, 1973).

The lack of results on the change of certain physiological indices at the crucian under the action of insecticides Calypso 480 SC and Decis 50 EW motivated us to make different researches on some physiological parameters such as oxygen consumption, respiratory rate, erythrocytes and blood glucose.

MATERIAL AND METHODS

In the researches, there were used specimens of the *Carassius auratus gibelio* originating from Oești, Cerbureni, Budeasa and Cătească lakes, weighing 3-20 g.

The preparation of the experimental animals was made in such a way that, prior to experimentation, an "acclimation" will be achieved (FRY, 1967) for each lot at such temperature (for 1 week) (AT = ET).

During the performance of the experiments, temperature was 18-20 ^{O}C and lighting was 8-12 hours.

Thus, in all cases, there have been avoided possible influences of some factors indifferent for the goals of such an experiment. It was particularly avoided the "negative" influence (in the sense of a "hypometabolic" effect) of low concentrations of oxygen dissolved in water, the oxygen consumption being provided (in preliminary "optimization" determinations) not to exceed 25-30% of the total amount existing at the beginning of the experiment.

The specimens used in different experimental variants were selected and sorted by weight categories, in order to avoid, or, on the contrary to highlight the effect of individual factor of body weight. Choosing specimens and establishment of experimental groups were made with great care and were used only healthy and proper-looking fish.

The specimens were divided into the following lots:

- Control group consisting of 10 specimens
- Group 1 consisting of 10 specimens treated with the insecticide Calypso 480 SC with a concentration of 0.025 ml/l;
- Group 2 consisting of 10 specimens treated with the insecticide Calypso 480 SC with a concentration of 0.02 ml/l;
- Group 3 consisting of 10 specimens treated with the insecticide Calypso 480 SC with a concentration of 0.15 ml/l;
- Group 4 consisting of 10 specimens treated with the insecticide Decis 50 EW with a concentration of 0.00015 ml/l;
- Group 5 consisting of 10 specimens treated with the insecticide Decis 50 EW with a concentration of 0.00012 ml/l;
- Group 6 consisting of 10 specimens treated with insecticide Decis 50 EW with a concentration of 0.0001 ml/l;

For each specimen of the 7 groups there were determined the oxygen consumption and respiratory rate at 24, 48, 72, 96, 168 and 336 hours and, after that, erythrocytes were counted and blood glucose was determined.

The determination of oxygen consumption was performed through Winkler classical method or confined space method (PICOȘ & NĂSTĂSESCU, 1988).

The measurement of the respiratory rate was achieved by a procedure indicated by PORA & NIȚU (1952) during the restraint of fish for carrying out the Winkler method (PICOȘ & NĂSTĂSESCU, 1988); successive determinations of this index were performed (using a timer), until three similar values have been obtained (their arithmetic average representing their respiratory rate at that time).

The determination of the blood glucose was done using an Accutrend GCT device, allowing the measurement of its value in blood drop sampled from the caudal artery (PICOȘ & NĂSTĂSESCU, 1988), in a very short period of time.

The determination of erythrocytes was performed using a Thoma counting chamber through the method described by PICOȘ & NĂSTĂSESCU (1988), from blood taken from the caudal artery.

RESULTS AND DISCUSSION

The analysis results registered at oxygen consumption amid the action of insecticide Calypso 480 SC in concentrations of 0.025, 0.02 and 0.015 ml/l towards the control are shown in figure 1.

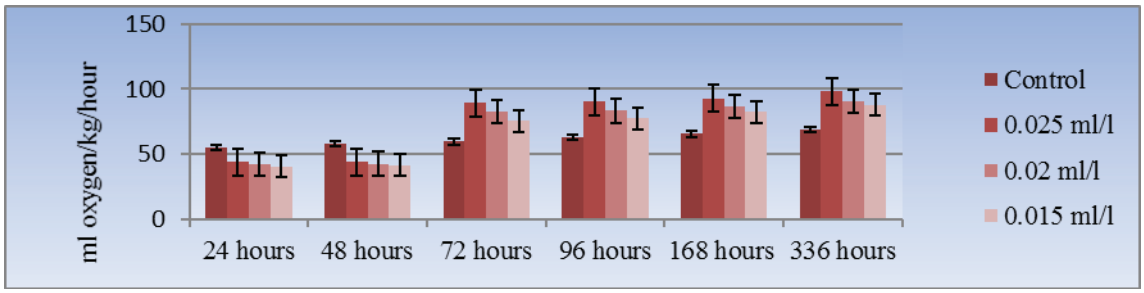

Figure 1. The influence of Calypso insecticide on the oxygen consumption at *Carassius auratus gibelio* Bloch.

At the concentration of 0.025 ml/l Calypso, oxygen consumption increased by 49.88% for 72 hours compared to the control value recording the value of 89.332 ml oxygen/kg/hour compared to 59.601 ml oxygen/kg/hour.

Studying the variation of oxygen consumption at the concentration of 0.02 ml/l Calypso, it is noted an increase in the oxygen consumption value of 31.85% to 168 hours compared with the control value of 107.778 ml oxygen/kg/hour compared to 69.16 ml oxygen/kg/hour.

Increases in oxygen consumption under the influence of insecticides are highlighted in the reference literature at the crucians exposed to the action of insecticide Talstar One on the first three concentrations tested (0.000625, 0.00125 and 0.0025 ml/l water); thus, there were identified increases of oxygen consumption in the first step

(PONEPAL et al., 2010) – its duration ranging between 96 and 24 hours after exposure, the most important intensification of energy metabolism being registered 24 hours after the exposure to the insecticide in the concentration of 0.0025 ml/l water (45.2% higher compared to the value registered prior to the introduction of fish in the toxic area) .

Reviewing the results registered in case of another index - respiratory rate, we find out that under the action of Calypso insecticide towards the control group, it decreases significantly at all concentrations of the insecticide researched (Fig. 2).

The lowest value of the respiratory rate was 48 breaths/minute in 48 hours, at the concentration of 0.015 ml/l towards the control value of 77.66 breaths/minute (Fig. 2).

The respiratory rate decreased by: 38.2% (48 breaths/minute towards the control value of 77.66 breaths/minute) at 0.015 ml/l after 48 hours, 34.33% (51 breaths/minute towards the control value of 77.66 breaths/minute) at 0.025 ml/l after 48 hours and 33.05% (52 breaths/minute towards the control value of 77.66 breaths/minute) at 0.02 ml/l after 48 hours.

These decreases of the respiratory rate are considered to be caused by the mucus placed on the gill, as a reaction to a toxic substance (SCHAUMBURG et al., 1967).

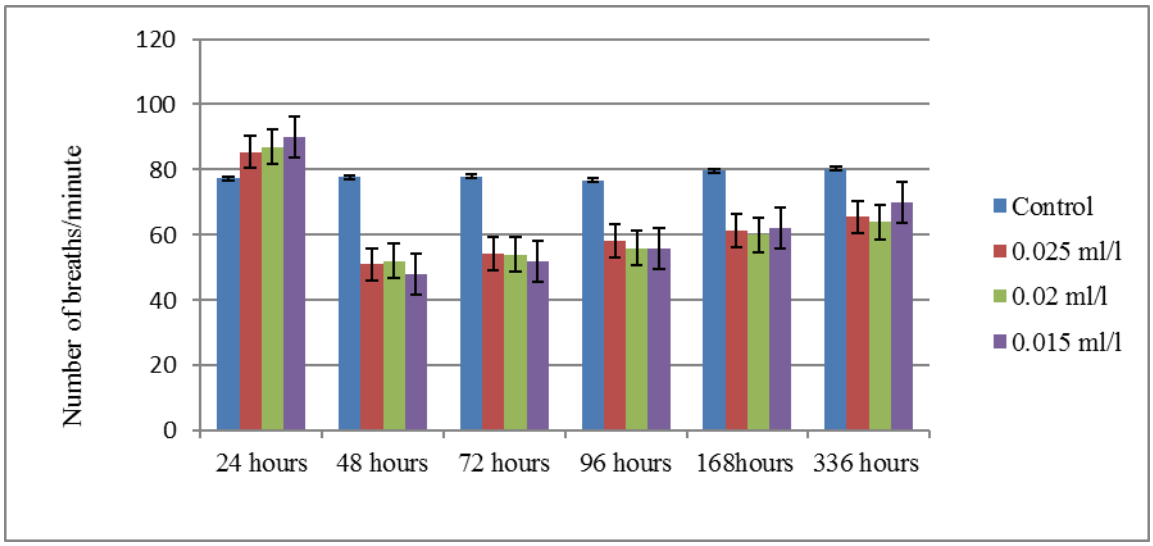

Figure 2. The influence of Calypso 480 SC insecticide on the respiratory rate at *Carassius auratus gibelio* Bloch.

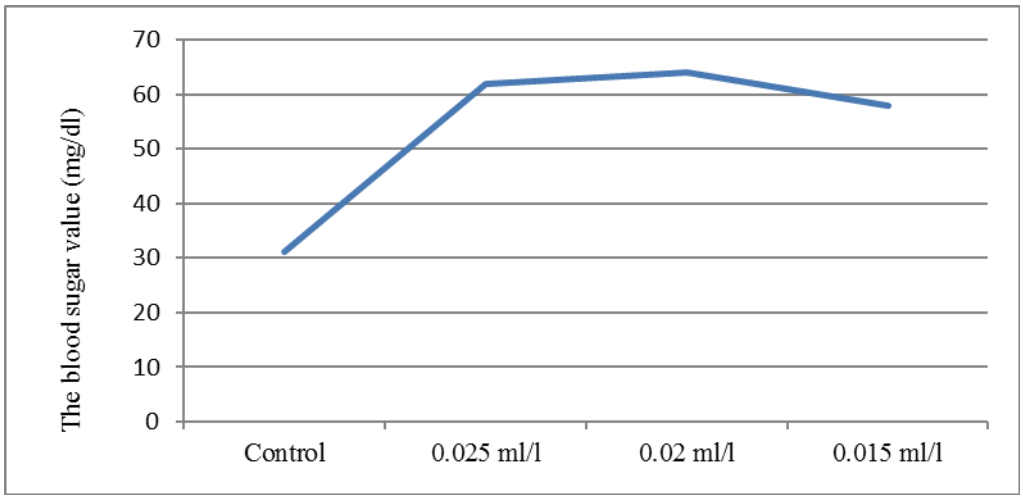

Figure 3. The influence of Calypso 480 SC insecticide on the blood sugar at *Carassius auratus gibelio* Bloch.

The blood glucose values shown in figure 3 reveal some interesting facts; we find out that, under the action of the insecticide Calypso 480 SC, the blood glucose values are significantly increased at the concentrations of 0.02 and 0.025 ml/l by 106.45%, as well as 100%.

Hyperglycaemia at fish in stress conditions was reported by many authors to different species (BLANCHARD et al., 1993; WINBERG & NILSSON, 1993).

Increases of blood glucose levels were also reported by VELISEK et al. (2009) to trout, as a response to metabolic stress induced by the action of the insecticide Talstar 10 EC.

Returning to the erythrocytes, we notice in (Fig. 4) that, under the action of the insecticide Calypso 480 SC, a significant decrease in the erythrocytes to all concentrations takes place, so that the lowest value is 255,000 erythrocytes /ml erythrocytes, 36.25% lower than the control value (400,000 erythrocytes/ml) at the concentration of 0.025 ml/l.

Decrease in the erythrocytes at the carps intoxicated with pyrethroid insecticides (permethrin and cypermethrin) was also developed by SVOBODOVA et al. (2003) and DORUCU & GIRGIN (2001), being attributed to the dysfunction of haematopoiesis.

Further, the same physiological indices will be established to the specimens exposed to the action of the insecticide Decis 50 EW, at the concentrations mentioned in the experimental protocol.

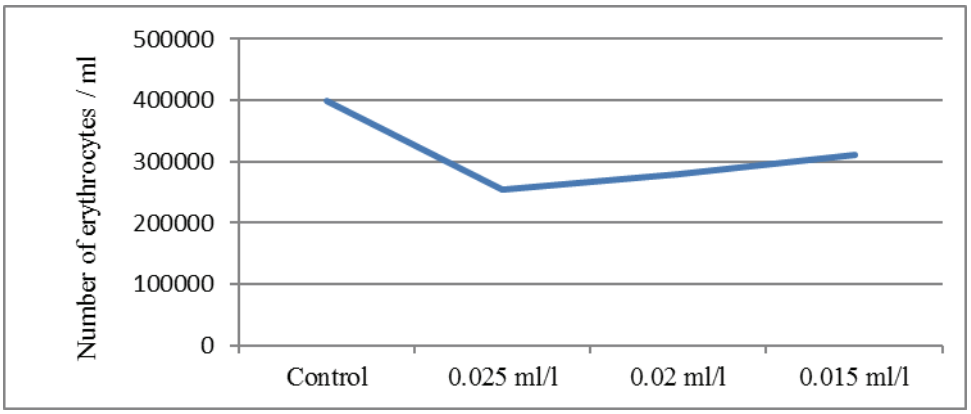

Figure 4. The influence of Calypso 480 SC insecticide on the number of erythrocytes at *Carassius auratus gibelio* Bloch.

Taking into discussion the results registered in the oxygen consumption against the action of the insecticide Decis 50 EW in concentrations of 0.00015, 0.00012 and 0.0001 ml/l compared to the control group, it is found a significant increase in the oxygen consumption at the concentration of 0.00015 ml / l and 0.00012 ml / shown in figure 5).

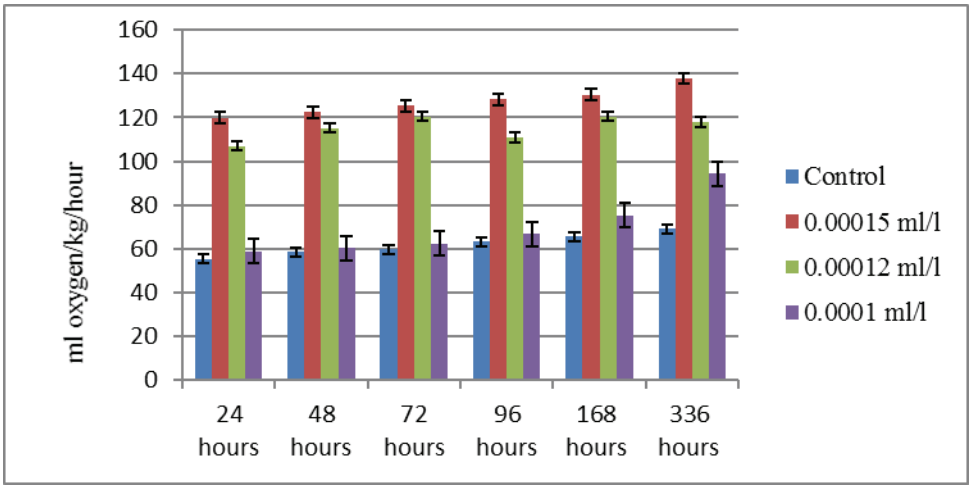

Figure 5. The influence of Decis 50 EW insecticide on the oxygen consumption at *Carassius auratus gibelio* Bloch.

At the concentration of 0.00015 ml/l Decis 50 EW, the oxygen consumption increased by 116.69% at 24 hours compared to the control value of 119.834 ml oxygen/kg/hour compared to 55.302 ml oxygen/kg/hour.

A pretty significant increase in the oxygen consumption, but lower than that in the concentration of 0.00015 ml/l was also detected at the concentration of 0.00012 ml/l Decis 50 EW where the percentage increase was 97.25% at 48 hours (oxygen consumption value registered was 15.242 ml oxygen/kg/hour compared to the control value of 58.423 ml oxygen/kg/hour).

The concentration of 0.0001 ml/l Decis 50 EW has not significantly influenced the consumption of oxygen.

Increases in oxygen consumption under the influence of insecticides are highlighted in the reference literature at the specimens exposed to the action of the insecticide Talstar One on the first three concentrations tested (0.000625, 0.00125 and 0.0025 ml/l water); there were revealed increases of oxygen consumption in the first step (PONEPAL et al., 2010) – its duration ranging between 96 and 24 hours after the exposure, the most important intensification of energy metabolism being registered 24 hours after the exposure to the insecticide in the concentration of 0.0025 ml/l water(45.2% higher compared to the value registered prior to the introduction of fish in the toxic area).

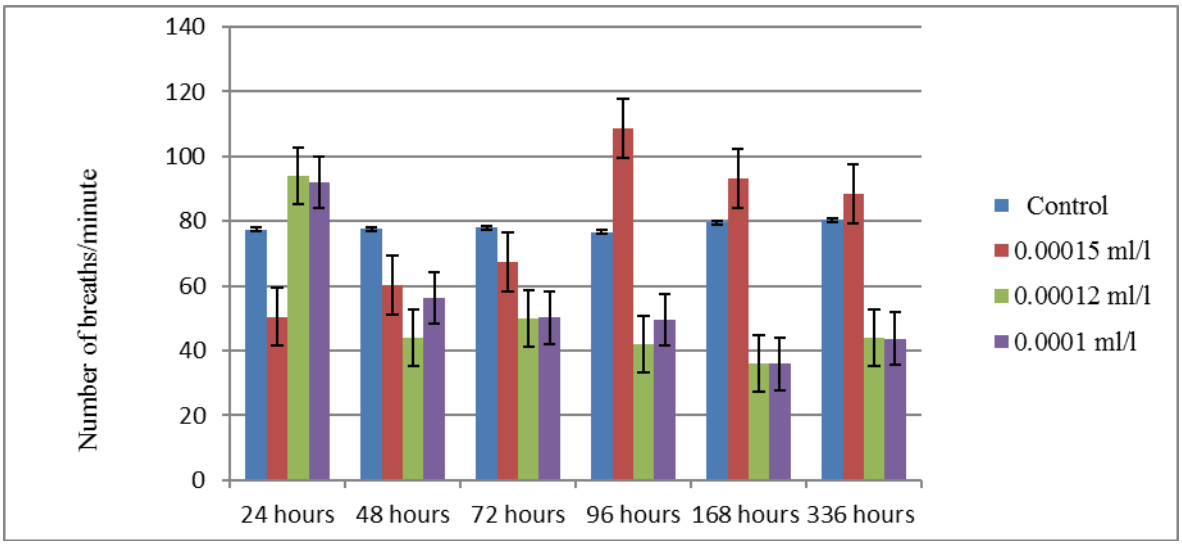

Figure 6. The influence of Decis 50 EW insecticide on the respiratory rate at *Carassius auratus gibelio* Bloch.

Following the analysis of figure 6, we find that, under the action of the insecticide Decis 50 EW at the concentration of 0.00015 ml/l, there was a decrease in the respiratory rate in the first 72 hours, the lowest value (50.5 breaths/minute) being recorded within 24 hours of immersion (34.7% lower than the control value of 77.33 breaths/minute). Then, from 96 to 336 hours, the respiratory rate values were much higher than the control value (the highest value being recorded to 96 hours, 41.89% higher). At the other concentrations of 0.00012 and 0.0001 ml/l, the respiratory rate increased significantly at 24 hours and then from 48 to 336 hours, it significantly decreased; the lowest value is 35.88 breaths/minute at 0.0001 ml/l Decis 50 EW, approximately 54.96% lower compared to the control value of 79.66 breaths/minute.

Such decreases of the respiratory rates are considered to be caused by the mucus placed on the gill, as a reaction to a toxic substance (SCHAUMBURG et al., 1967).

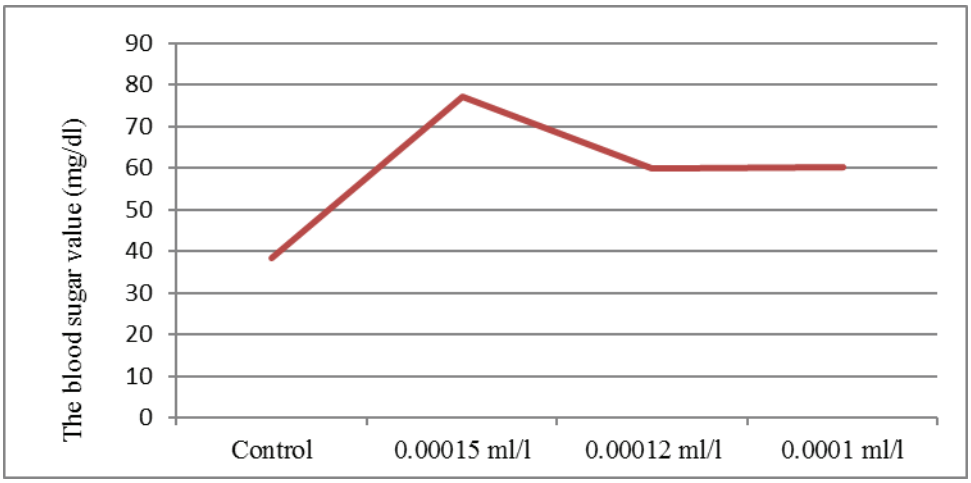

Figure 7. The influence of Decis 50 EW insecticide on the blood sugar at *Carassius auratus gibelio* Bloch.

From the data collected and arranged in the diagram shown in figure 7, it results that he insecticide Decis 50 EW in all concentrations tested, significantly increase the blood glucose.

Thus, DAVIES et al. (1994) reports increases in the plasma glucose at the Galaxias maculates species exposed to a concentration of 4.4 mg/l acephate and at the *Oncorhynchus mykiss* species exposed to a concentration of 0.2 mg/l of the same compound.

The highest value compared to the control one (38.33 mg/dl) was registered to the concentration of 0.00015 ml/l, of 77.16 mg/dl, approximately 101.30% higher.

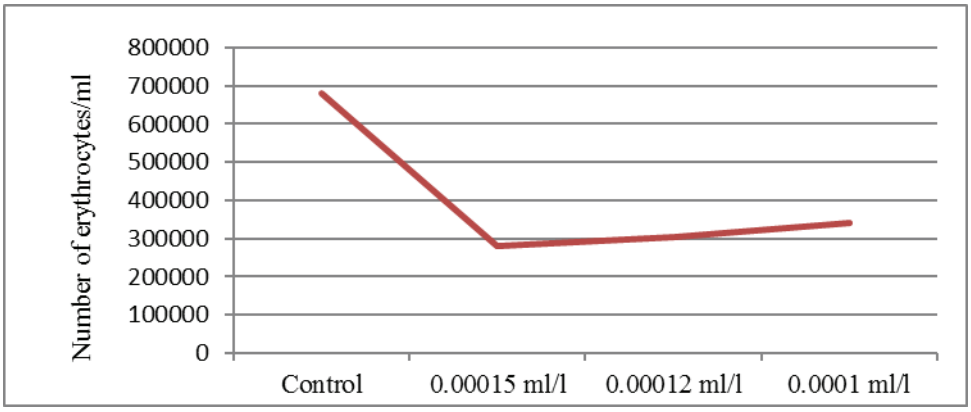

Figure 8. The influence of Decis 50 EW insecticide on the number of erythrocytes at *Carassius auratus gibelio* Bloch.

As sown in figure 8, Decis 50 EW significantly decreased the erythrocytes towards the control value (680,000 erythrocytes/ml) at all experimented concentrations, so that the lowest registered value was 280,000 erythrocytes/ml of blood, about 58.83 % lower at the concentration of 0.00015 ml/l.

After 14 days of exposure of *Perca fluviatilis* and *Alburnus alburnus* specimens at the action of Talstar One insecticide in concentration of 0.000625 mg/l, the erythrocytes decreased significantly compared to the control groups (PONEPAL et al., 2010; PONEPAL, 2011).

Correlating the results registered at the oxygen consumption against the action of investigated chemicals, it is found that, in the experiments performed, the increase in the oxygen consumption is finally correlated to the decrease in the respiratory rate.

Correlating the results to the erythrocytes against the action of Calypso 480 and Decis 50 EW, it is found that, in the experiments made, the insignificant changes and decrease in the erythrocytes is finally correlated to the increase in the oxygen consumption.

Studying the results recorded for blood glucose against the action of investigated chemicals, it is found, in the experiments performed, the increase in the blood glucose especially for Calypso and Decis.

CONCLUSIONS

Increase in the oxygen consumption under the action of the insecticides Decis 50 EW and Calypso 480 SC indicates a direct action on the nerve centres, so that, at the concentration of 0.00015 ml/l Decis 50 EW, oxygen consumption increased by 116.69% in 24 hours compared to the control value of 119.834 ml oxygen/kg/hour as compared to the value of 55.302 ml oxygen/kg/hour and it can also be associated to the decrease in the erythrocytes due to the stress caused by them, where it can be noticed that Decis 50 EW significantly decreased the erythrocytes compared to the control value (680,000 erythrocytes/ml) at all experienced concentrations, so that the lowest value registered was 280,000 erythrocytes/ml blood, approximately 58.83% lower at the concentration of 0.00015 ml/l.

Decrease in the respiratory rate may be due to the direct action on the nerve centres and excess of mucus located on the gill, as a reaction to the action of insecticides. The lower respiratory rates were caused by the insecticide Decis 50 EW where, during the interval of 48-336 hours, they significantly decreased, the lowest value being 35.88 breaths/minutes at 0.0001 ml/l of Decis 50 EW, approximately 54.96% lower compared to the control value 79.66 breaths/minutes.

Increased blood glucose under the action of both insecticides can be considered a reaction to the metabolic stress induced by Calypso 480 SC and Decis 50 EW, where values increased significantly by 106.45% and 100% at concentrations of 0.02 and 0.025 ml/l Calypso 480 SC and, at the concentration of 0.00015 ml/l of Decis 50 EW, the blood glucose value increased by approximately 105.26%.

ACKNOWLEDGEMENTS

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ECOTOURIST RESOURCES – PREMISE FOR THE ECONOMIC DIVERSIFICATION OF SETTLEMENTS IN THE DANUBE FLOODPLAIN (DOLJ COUNTY)

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Abstract. The Danube Floodplain (Dolj County) comprises a mosaic of semi-aquatic, aquatic and terrestrial biotopes, which explains the high diversity of flora and fauna. The limitation or the degradation of specific habitats required conservative approaches that led to the official recognition and establishment of natural reserves (Gighera halophile meadow, Zăval Forest), to which there are to be added three Sites of Community Importance (The Danube at Gârla Mare - Maglavit, Ciuperceni - Desa, The Jiu Corridor) and five Special Protection Areas for birds (Maglavit, Calafat - Ciuperceni - Dunăre, Bistreţ, the Jiu-Danube Confluence and Dăbuleni Sands) within the framework of NATURA 2000 European Ecological Network. The biological diversity, paralleled by the existence of protected areas in the Danube Floodplain could represent an important ecotourist resource for the area under study; moreover, they constitute the source of significant opportunities for local development through the proportion of ecological tourism and of agritourism, the endurance of traditional fishing activities, the broadening of leisure activities in the area of the fishing ponds, as a true alternative for increasing the revenues. Starting from the characteristics of an ecotourist destination and the requirements of local development, there have been identified several directions that would orient the activity for ecotourism growth in Dolj settlements located along the Danube: the harmonisation of local policy concerning ecotourism development, constitution and improvement of specific infrastructure, elaboration and diversification of ecotourist supply, rising public awareness and promotion of ecotourist offer.

Keywords: the Danube Floodplain, ecotourist resources, Natura 2000 European Ecologic Network, local development.

Rezumat. Resursele ecoturistice – premiză pentru diversificarea economică a aşezărilor din Lunca Dunării (judeţul Dolj). Lunca Dunării (judeţul Dolj) include un mozaic de biotopuri semiacvatice, acvatice şi terestre, ceea ce explică şi compoziţia foarte variată a florei şi faunei. Restrângerea sau degradarea habitatelor specifice au impus demersuri conservative concretizate în declararea rezervaţiilor naturale (Pajiştea halofilă Gighera, Pădurea Zăval), la care se adaugă trei situri de importanţă comunitară (Dunărea la Gârla Mare - Maglavit, Ciuperceni - Desa, Coridorul Jiului) şi cinci arii de protecţie specială avifaunistică (Maglavit, Calafat - Ciuperceni - Dunăre, Bistreţ, Confluenţa Jiu-Dunăre şi Nisipurile de la Dăbuleni) din cadrul Reţelei Ecologice Europene Natura 2000. Biodiversitatea şi existenţa ariilor protejate din Lunca Dunării pot reprezenta o resursă ecoturistică importantă pentru aria analizată, constituind sursa unor semnificative oportunităţi de dezvoltare locală, prin promovarea turismului ecologic şi a agroturismului, continuarea practicării activităţilor de pescuit, dezvoltarea activităţilor recreative în perimetrul bazinelor piscicole ca o alternativă la creşterea veniturilor. Pornind de la caracteristicile unei destinaţii ecoturistice şi necesităţile de dezvoltare a zonei analizate, au fost identificate mai multe direcţii de acţiune pentru dezvoltarea ecoturismului în cadrul localităţilor dunărene din judeţul Dolj: armonizarea politicii locale cu privire la dezvoltarea ecoturismului, dezvoltarea infrastructurii specifice, crearea şi diversificarea ofertei ecoturistice, creşterea nivelului de conştientizare publică şi promovarea ofertei ecoturistice.

Cuvinte cheie: Lunca Dunării, resurse ecoturistice, Reţeaua Ecologică Europeană Natura 2000, dezvoltare locală.

INTRODUCTION

At the turn of the new millennium, we can no longer speak of rural societies, but rather of rurality to describe the European rural space, which is no longer a place confined to agricultural activities, but it includes multi-sectoral activities (EC, 2007). Despite the changing character of the rural space, there are still varied and heterogeneous structures of rural areas even within the European Union, ranging from consumption countryside and diversified regions with strong secondary sector or strong private services sector making a patchwork in the western part of EU to agrarian regions in the east, showing numerous characteristics of the socio-economic process of 'depletion' (COPUS, 2011).

Many of the Romanian rural areas fall under the latter category, with a high share of primary activities, poor infrastructure and declining population. Still, some of them have the advantage of a picturesque environment, vibrant local culture and traditions, and could capitalize these particular elements to diversify away from the traditional primary activities. Tourism, under various forms, is praised by various European programmes and international researchers as one of the activities that can greatly contribute to the rural development.

One such form is ecotourism, defined by the International Ecotourism Society as a *responsible travel to natural areas that conserves the environment and improves the well-being of local people,* since it has registered one of the highest increase, with an average of 20 to 34% / year beginning with the 1990, in 2004 increasing at a rate three times higher than the tourism industry as a whole and it is among the sectors that will gain momentum in the next decades. Although there are over 80 different definitions of ecotourism (DOWLING & FENNEL, 2003), they all point to three elements having a relationship with ecotourism, i.e. Activities related to nature, outdoor adventure and cultural experiences in the countryside or in the wilderness. In Romania in particular, the definition of ecotourism accepted by the National Authority for Tourism in partnership with the Ecotourism Association in Romania and the National Institute for Research and Development in Tourism implies the existence of at least one protected area as a criterion for the designation of an ecotourism destination.

The International Union for Conservation of Nature (IUCN), World Nature Organization and the European Federation of National and Natural Parks see ecotourism as a useful tool for safeguarding the cultural and natural assets following some special protection policies. Ecotourism implies a direct and personal experience in nature, and it is based on the use of geomorphological, biological, physical and cultural characteristics.

According to IUCN, in order to include a tourist activity in the ecotourism framework, it must satisfy the following nine requirements:

- to promote positive environmental ethics and to improve participants' activity;
- not to damage the resources – it does not include the consumption or erosion of natural environment (consequently, hunting and sport fishing can be mostly included in the adventure tourism and not in the ecotourism);
- the facilities and services that are supplied must not be presented as main attractions, but together with the ecosystem of which they are a part;
- to be oriented towards the environment (where it takes place), not towards the people;
- to lead to advantages for the wildlife and the environment;
- to provide authentic experiences within the natural environment. Visiting the zoological gardens does not represent an ecotourist experience (even if they can contribute to the development of a person's interest towards ecotourism). The info centres can be considered components of an ecotourist activity only if, by this means, people are led towards an authentic experience in nature, such as the marking of ecotourist routes;
- to actively involve local communities in the tourist activities, so that they would benefit from the tourism;
- to scale the success and the tourist satisfaction degree in accordance with the level of acquired knowledge and/or appreciation, not according to the entertainment level;
- to involve significant preparation and solid knowledge on the part of the leaders (guides, amateurs), as well as on that of the participants.

Considering the global urbanization trend, triggering the fragmentation and even destruction of natural habitats, as well as the effects of the climate changes, it is estimated that areas featuring a rich biodiversity will become ever more attractive destinations (BŐSZE & MEYER, 2014). The most important component of an ecotourism product is the intrinsic quality of the landscape and wild fauna (TERZIEVA et. al., 2009), since it is the biodiversity resource base which mainly attracts an ecotourist to a particular destination (UNEP, 2002).

There are three main categories of ecotourism attractions: flagship attractions (which may provide the main reason for visiting an area), complementary attractions (which give added value to the area and encourage a longer stay for the tourist), and supporting attractions (the physical facilities and tourist services found in that place) (UNEP, 2002). The two first categories correspond to the natural and cultural heritage of the area. The latter category facilitates visitation to the area.

Tourism activities that take place within protected natural areas have a significant economic contribution to the local economy. A research conducted by BANN & POPA (2012) that evaluated five of the most important protected areas (PA) from Romania estimates the value of the tourism and recreational activities within these PAs to be around 110 million Euros in 2010. According to the Ecotourism Association in Romania, up to 80-90% of the money spent by ecotourists remain in the area where the tourism program takes place, with multiple benefits for the rural settlements. The development of activities such as wildlife watching, bicycle rides and sustainable fishing should be considered as good opportunities, since they attract nature lovers and, at the same time, provide quality fish for restaurants and guest houses (BŐSZE & MEYER, 2014).

STUDY AREA

The study area of the present paper overlaps the local administrative units (LAU 2, according to Eurostat, 2014) located in Dolj County, along the Danube, in south-western Romania, respectively between 43°42' and 44°09' N and 22°58' and 24°13' E. The researched administrative area covers a total surface of about 173,337 hectares, ca. 50 percent of it laying in the floodplain of the Danube and of its main tributaries, while the rest belongs to the terrace plains (Fig. 1).

Southwards, the Danube marks the administrative limit with Bulgaria (Figs. 1; 2), this being a permeable border, which enables the joint ecotourist and scientific capitalization of the natural and anthropic resources located on both banks of the great river.

The Danube course that stretches between Cetate and Dăbuleni settlements is part of the south-Pontic sector and it is generally adapted to the contact of the Romanian Plain and the Pre-Balkan Tableland. The northern limit of the Danube Floodplain is marked by the settlements located at the geomorphologic contact between this unit and the neighbouring terrace, or on the terrace flat: Cetate, Maglavit, Calafat, Salcia, Ciuperceni, Rast, Negoi, Catane, Bistreț, Cârna, Măceșu de Jos, Gighera, Zăval, Ostroveni, Bechet, Călărași, Dăbuleni. Along this leading line, there are sectors on which the important altitude differences between floodplain and terrace distinctively mark the geomorphologic limit, at the same time offering the privilege of great belvedere points for tourists (such as in the area of Cetate - Hunia - Maglavit - Basarabi – Calafat settlements). On other sectors, this limit is almost impossible to decipher, one of the main reasons being the significant presence of Aeolian sands that often induce a waved landscape, with dunes and inter-dune ponds (such as in the Ciuperceni - Rast – Bistreț area). Some of the tributaries of the Danube (the Deznățui, the Balasan,

etc.), among which the Jiu is the most important in the sector, extend the floodplain of the great river with their own, which creates important environmental corridors that can be attractive for ecotourism.

The archaeological discoveries and the historical documents highlight the economic importance - sometimes even strategic character - of the riverine space; the diverse ecosystem services provided by the Danube Floodplain and ponds explain the ancient habitation of the space under study. The present permanent settlements located in the Cetate - Dăbuleni sector are distributed in 19 LAUs. The deeply rural character of the region is obvious at this level, which is dominated by communes (16), to which there are to be added two towns (Bechet, Dăbuleni) and a municipality (Calafat). The network of settlements comprises 34 villages and 3 urban settlements (Fig. 2).

In 2011, the population of the area totalled 97,716 persons (*National population and housing census/RPL 2011*). Around 29,000 persons, i.e. 30 percent of the total population, were theoretically urban citizens. The analysis of the demographic potential of the rural settlements displays the dominance of average villages (44 percent of total), while the demographic size of the urban settlements divides them into small towns (Calafat – 13,482 inhabitants, Dăbuleni – 12,182) and very small towns (Bechet – 3,657 inhabitants) (*RPL 2011*) (Fig. 2).

The socio-economic activities of the area are generally reflected by the land use, which highlights a clear difference between The Danube terrace plain (with prevalent agricultural use of the land, within small and average exploitations) and the Danube Floodplain (where extended surfaces in semi-natural regime still exist, especially in the sector located westward of Ghidici settlement; moreover, some of the human-induced elements that changed the natural landscape could be used in tourism activities: dikes, channels, forest vegetation, etc.). In 2011, out of the total surface of the 19 LAUs located along the Danube in Dolj County, about 121,771 hectares (i.e. 70 percent) were included in the agricultural domain, while the rest of 51,566 hectares was represented by land without agricultural use, especially by forest areas and aquatic surfaces that could trigger the development of various forms of tourism.

The economic functions of the settlements under analysis carry important information on their capabilities for sustainable capitalisation of the local resources. With about 65 percent to 90 percent of the occupied population struggling in agriculture, the communes of the sector display dominant and marked agricultural functions, the socio-economic problems of this deeply rural space being accentuated, for example, by the high proportion of inhabitants dependent on social support (about 6 percent of the total were unemployed persons registered at the end of 2011). Among the rural settlements, only Poiana Mare displays values slightly under 70 percent of the population occupied in agriculture, while 9 of the 16 rural LAUs account for corresponding values above 80 percent. The three towns of the sector also face economic problems, such as the lack of economic dynamics, agro-industrial functions, low attractiveness, high unemployment rates, etc.), as well as poverty and population ageing. Thus, Calafat is characterised by mixed economic functions, displaying some advancements towards the tertiary sector (the latter concentrating ca 48 percent of the active population, followed by the primary sector, with 27 percent); Bechet, with too little justification raised at urban status almost ten years ago, keeps dominant agricultural functions, also with a slight transition towards the tertiary activities (51.4 percent of the active population was comprised in the primary sector in 2011); with 59 percent of the active inhabitants working in agriculture, Dăbuleni preserves an even more accentuated rural character.

The demographic indicators show that in the future, if no adequate measures are developed and implemented for the sustainable capitalization of local resources, the labour market will continue to be affected by the migratory flows originating in the sector, subsequently leading to even more significant socio-economic issues.

In this framework, it is not to be neglected the importance of the investments in the human capital and in the development of ecotourism, as a premise for economic diversification and for local sustainable development. Agriculture may gradually lose its significance while tourism and nature conservation will become more important. In the future, recreation, tourism and the protection of nature could become decisive factors in determining land use and in maintaining quality of life in the area. Ecotourism could also be ideally combined with floodplain restoration.

From the viewpoint of the general transportation infrastructure (Fig. 2), there are to be noticed at least two elements. Firstly, on road, the area under study is easily reachable from all important urban centres of Oltenia (relevant examples are offered by the connection of the regional pole - Craiova Municipality - with Bechet and with Calafat by means of the national roads DN 55 and DN 56/E79 respectively). The main modernised ways - the national roads - generally follow the floodplain – terrace contact (Dăbuleni - Bechet - Calafat - Cetate: DN 54A, 55A, 56A). The more important roads that penetrate the floodplain are DN 55 (Bechet - Bechet Port), DJ 561D (Rast – Rast Port), DJ 533 (Poiana Mare - Desa - Ciupercenii Noi - Ciupercenii Vechi - Calafat). Besides these directing lines, the transportation network that crosses the floodplain mostly consists of unpaved or partially modernised roads. Secondly, the presence of the two important customs stations over the Danube (at Bechet and Calafat) enables the connections of the area with the south-eastern Europe.

Taking into consideration a different type of infrastructure that is characteristic for the area, i.e. the flood-control dykes built along the Danube and its main tributaries, as well as those constructed with partitioning purposes, it must be stated that these civil engineering structures could receive complex functions after special improvement works and under technical monitoring conditions. Besides its main hydraulic function, this network could be capitalised in the framework of various ecotourist activities: bicycle lanes, thematic routes for pedestrians, etc.

The tourist infrastructure is presently limited and certain local accommodation units are not present in the official statistics. Tourist housing structures are located in the settlements of Cetate (a hotel), Calafat (2 hotels and a hostel), Bechet (a hotel and a guesthouse) and Zăval (bungalows and camping, but with limited accessibility and virtually no promotion).

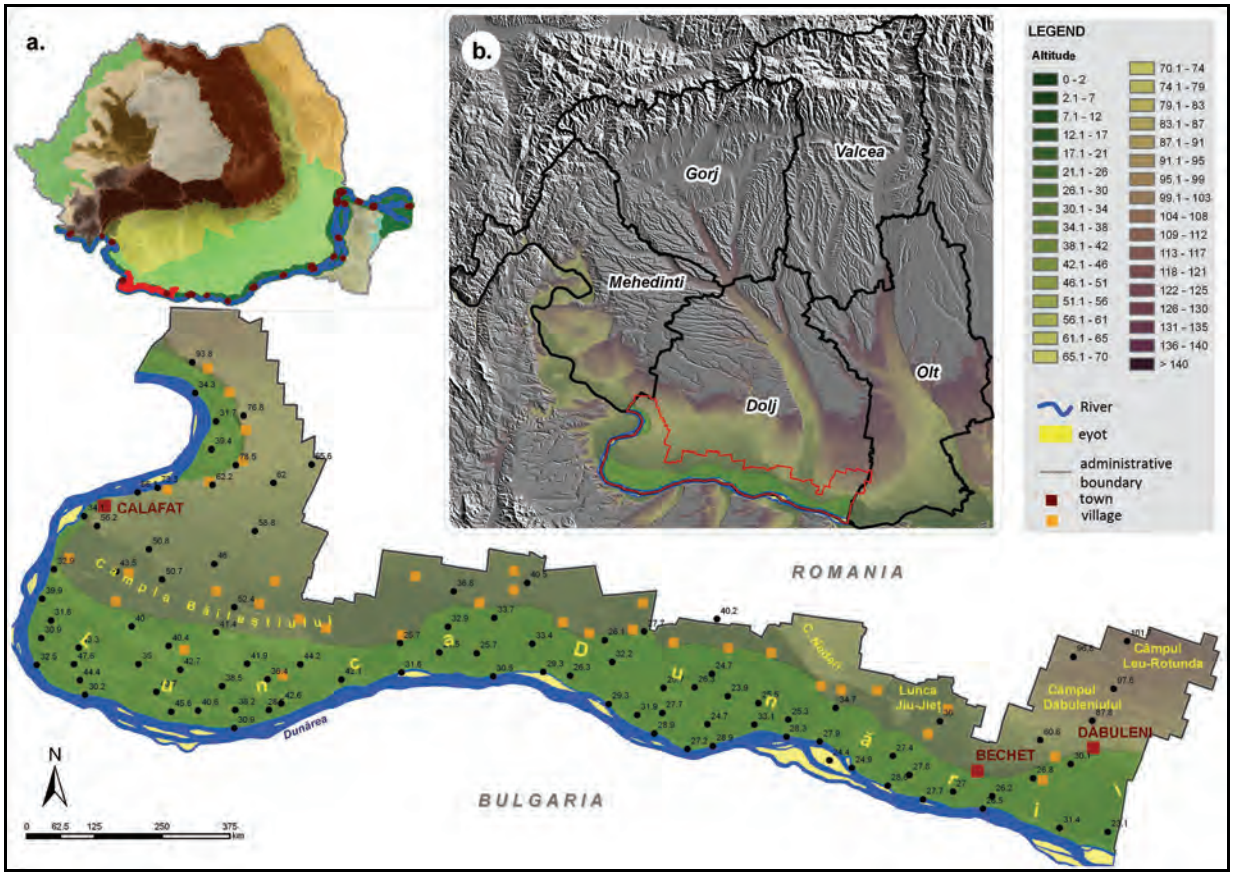

Figure 1. Location and main hypsometric features of the study-area.

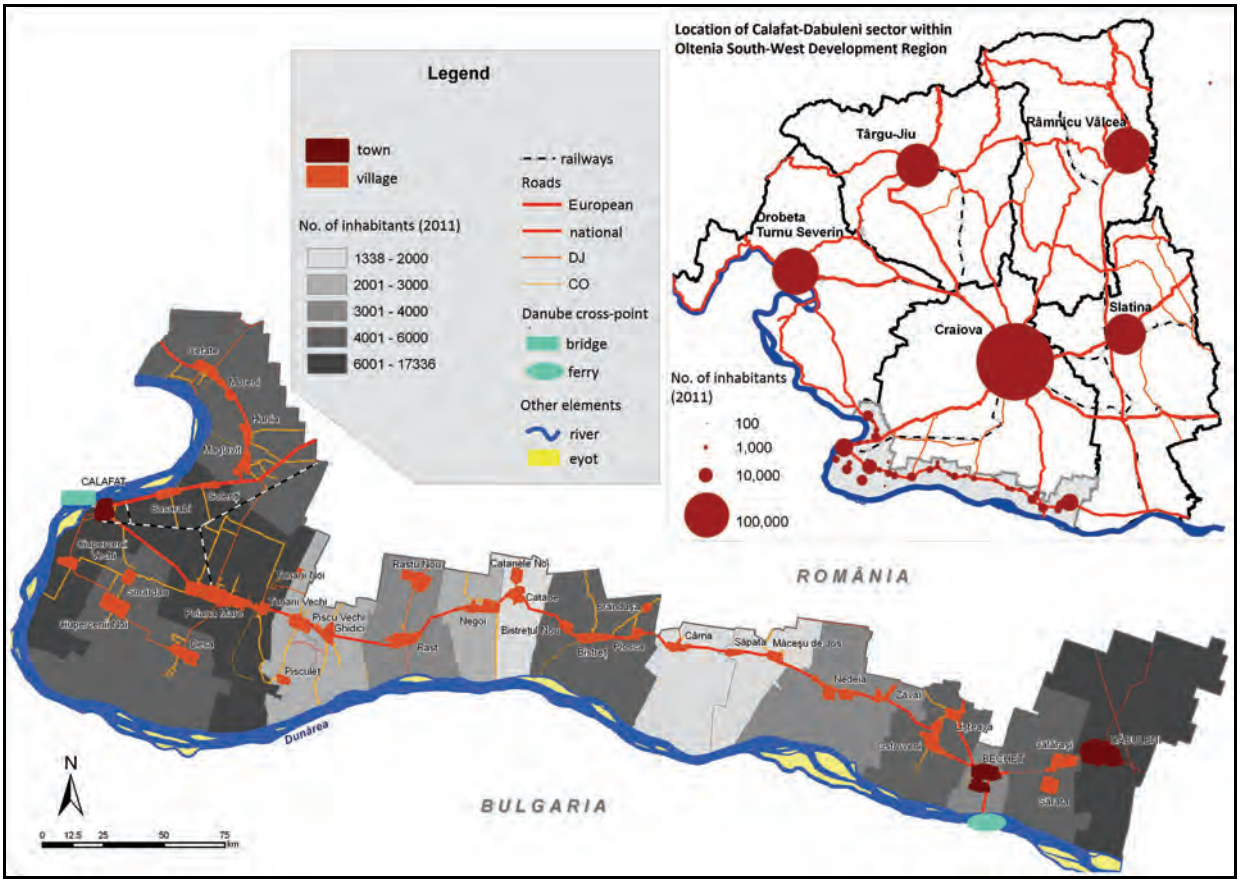

Figure 2. Main characteristics of the settlements and infrastructure network in the Cetate – Dăbuleni sector.

DATA AND METHODS

Considering the limits of the study area, a methodological explanation is required. Among the permanent settlements of the area, only two, i.e. Desa and Pisculeţ, are located in the proper floodplain, while the Danube islets of the sector do not present permanent human habitation forms. Consequently, most of the built area of the settlements falls outside the floodplain, but the extension of their estates and, thus, of their ecological footprint within the riverine unit, as well as the important role played by the Danube in the habitation dynamics required their inclusion in the present analysis. The geographical position of the towns situated in close connection with the Danube axis, sometimes extending within the floodplain or even up to the banks of the great river enabled their development as important contact points between the territories located north and south of the Danube and, during their history, as landmarks in the fluvial transportation and commerce. In this framework, the present paper will follow the borders of the LAU 2 along the Danube, underlining, within the qualitative study, the differences between the floodplain and the neighbouring units. The statistical data reflect the situation at administrative level, but their analysis underlined the characteristics of the Danube Floodplain in relation with the factors or the processes under study.

The analysis of the natural and human-induced tourist potential of the Danubian space was conducted on the basis of the spatial and qualitative data provided by available cartographic materials (topographical and thematic maps, satellite imagery), of the information extracted from the databases of field organisations (Romanian Ministry of Environment, National Institute for Heritage etc.), which have been compared and completed with terrain observations conducted between 2008 and 2014.

The use of basic GIS techniques enabled the transition from the individual analysis of the tourist resources to the comprehensive vision required in the achievement of useful hypotheses for the ecotourism development; thus, the potential resources can be transformed into important ecotourist attractions. In order to better understand the real possibilities for ecotourism development, as well as the advantages triggered by this type of activity upon the local stakeholders, the present study took into consideration the present demographic and socio-economic context of the area (information selected from the INS database and subsequently completed through field observations and documentation, in order to limit the inconsistencies between sources).

RESULTS AND DISCUSSIONS

1. The natural tourist resources

The great variety of forms and aspects displayed by the Danube Floodplain creates true geographical individualities at local level. Result of the complex fluvial, aeolian and geomorphologic interactions that were strongly modified through anthropogenic insertions, the present microrelief of the Danube Floodplain represents less a genuine tourist resource, but rather a local feature that offers great opportunities for the development of ecotourist activities in the area. In this context, the complex network of dykes especially built eastwards of Ghidici could be used for various forms of tourism: bird watching, sport fishing, bicycle routes around the lakes, along the Danube, within the seminatural areas, etc. A road on top of the existing dikes would offer attractive views on the Danube and its banks, being a link in the European Danube bicycle route. In an integrated approach, not only the improvement of flood control is pursued but at the same time also the improvement of other functions like ecology, agriculture and tourism.

From the relief viewpoint, several sub-units display different characteristics in the area:

I. Cetate - Calafat sector develops on a general north-south direction. The Danube Floodplain, together with the characteristic ponds (Fântâna Banului, Maglavit, Golenţi) were formed in an old fluvial meander. The contact of the floodplain with the terrace slope is very steep, which leads to important altitude differences. The eastern unit is represented by the Băileşti Plain, with rising altitudes towards north, reaching more than 90 meters north of Cetate.

II. Calafat - Dăbuleni sector displays a clear east – west orientation. The Danube Floodplain acquires significant and more homogenous extensions, its uninterrupted surface being almost entirely located on the left side of the great river; northwards of the floodplain, the territory of the LAUs under study overlaps the Desnăţui Plain (the Băileşti Plain and the Nedeia Field) and the Romanaţi Plain (the Dăbuleni Field).

The northern part of the study area displays a relatively homogenous and quite dull aspect, characteristic of the terrace plains (sometimes interrupted by the presence of sand dunes) with dominant agricultural land use (cereals). The lower part, corresponding to the Danube Floodplain is much more heterogeneous and interesting from the morphologic viewpoint, which leads to the differentiation of several distinct units:

- Calafat - Ciuperceni - Rast subunit, where the floodplain displays the most intense Aeolian sands accumulation in dune and inter-dune formations that sometimes shelter ponds isolated from the Danube.

- Rast - Gighera subunit, where the significant positive micro-relief diminishes considerably (more extended sandy areas are located southwards of Bistreţ and Nedeia settlements), appearing characteristic lake depressions (Bistreţ and Călugăreni lakes are the most important such elements that outlasted the draining activities). Southwards of Gighera there are to be found mineral springs with relevant therapeutic potential, which are not capitalised at present.

- the Jiu river - Bechet subunit corresponds to the alluvial fan of the most important tributary of the Danube in the sector. The units prolongs the Danube Floodplain and preserves traces of the former riverbeds of the Jiu, out of which only the Jieț is preserved as an active stream.

- Bechet - Dăbuleni subunit is marked by the presence of the aeolian micro-relief (generally, mobile or semi-fixed dunes).

III. A distinct sector is that of the ***Danubian islets and beaches***, which catch the interest through the number of accumulation forms within the riverbed, through the dimensions acquired by some of them and through their general dynamics and potential capitalization. There is to be noticed the increased density of accumulation forms within the riverbed downstream of Calafat (more than 10 islets and numerous fluvial beaches). Alluvia accumulation on the secondary river branches is also quite a frequent process, sometimes giving rise to temporary ponds, such as that located near the former Ghidici islet (BADEA et al., 1969). Among the most significant Romanian islets in the sector, there are to be noticed: Ostrovul Mare (Calafat), Acalia (Ciupercenii Noi - Desa), Pietriș (Desa – Poiana Mare), Vană (Rast), Copaniţa (Gighera), Păpădia (Dăbuleni); each of these units extends on more than 10 hectares and they generally represent a space where the human influence is much reduced as compared with the northern territories.

The main tourist resources of the space under study are represented by the Danube and the complex network of channels and ponds (Fig. 3), where sport fishing and other ecotourist activities (boat rides, bird-watching, trails for nature interpretation, etc.) can be developed.

After the intensive landscape changes mostly realised during the 20th century, numerous floodplain lakes were limited or even totally drained. Nevertheless, the hydrography of the floodplain remains attractive, as this unit shelters the most extended lake in Dolj County (Bistreț Lake, 2,000 hectares, Fig. 4), as well as other natural lakes of significant dimensions (Golenţi - Fig. 5, Maglavit, Fântâna Banului). Other hydrographic components that represent important potentialities for ecotourism are located in the semi-natural areas, such as Calafat - Ciuperceni - Desa – Pisculeț, where the floodplain unit preserves many of its original characteristics, including an important number of ponds and significant wetlands: Manginița, Jdegla, Arcear, Lată - Fig. 6, Lungă, Cărămizilor, Țarova Ponds and many others.

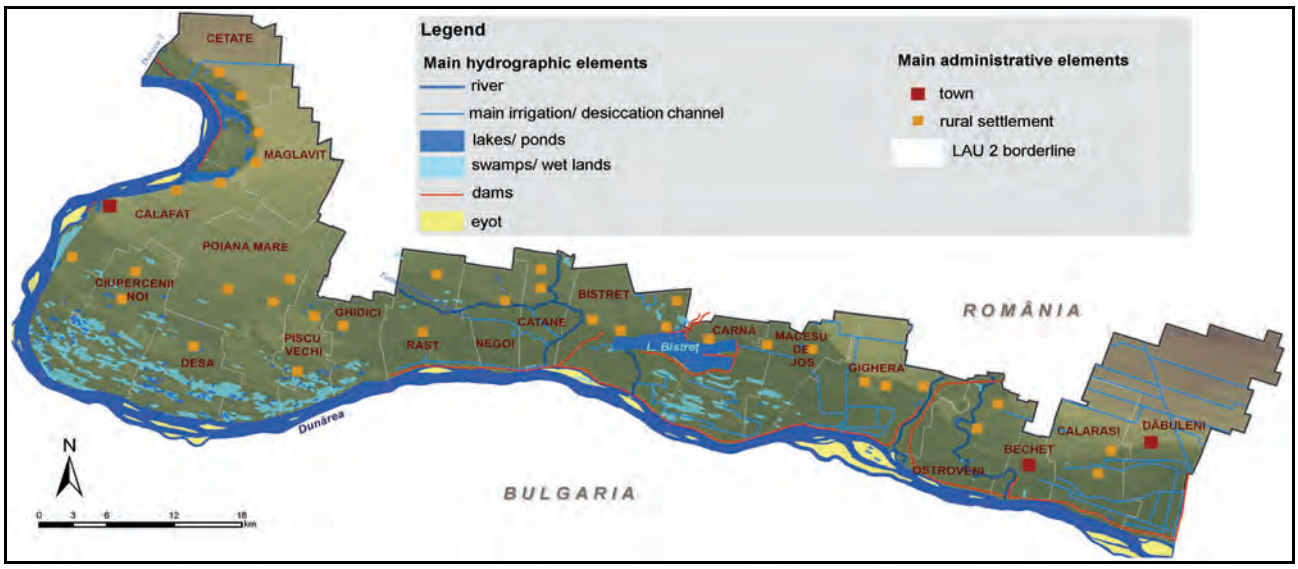

Figure 3. Main hydrographical characteristics of the Cetate – Dăbuleni sector.

Figure 4. *Philomachus pugnax* on Bistreț Lake (original).

Figure 5. Golenţi Pond, Calafat (original).

Figure 6. Wide Pond, Desa (original).

An essential part in ecotourism development could be played by activities conducted inside the natural protected areas that cover almost half of the study area. During the last decades, the initiatives regarding the protection and preservation of the biological diversity were more numerous and they were impelled by the *Convention on Biological Diversity*, adopted in 2002 and by the implementation of the *European Directives concerning Nature Conservation*, at the level of the 28 member states, including Romania after 2007.

The Danube Floodplain comprises a mosaic of semi-aquatic, aquatic and terrestrial biotopes, which explains the high diversity of flora and fauna. The limitation or the degradation of specific habitats required conservative approaches that led to the official recognition and establishment of natural reserves (according to *Law 5/2000* concerning the territorial planning – Section III – *Protected areas*, subsequently modified and completed): *Gighera Halophile Meadow, Zăval Forest, Cetate Meadow from the Danube Floodplain, Ciuperceni-Desa, Black Pond, Wide Pond*, to which there are to be added three Sites of Community Importance (*the Danube at Gârla Mare - Maglavit, Ciuperceni - Desa, The Jiu Corridor*) and five Special Protection Areas for birds (*Maglavit, Calafat - Ciuperceni –the Danube, Bistreţ, the Jiu-Danube Confluence* and *Dăbuleni Sands*) within the framework of NATURA 2000 European Ecological Network..

The exceptional natural capital of the Danube Floodplain required the necessity to protect extensive areas by including them in this network (Fig. 7). These national or European preservation efforts were doubled by Dolj County Council Decisions that rendered the status of natural protected areas to forest surfaces: *Braniştea – Bistreţ Greyish Oak Forest, Ciurumela Tunari - Piscu Vechi Forest, Nisipeni – Ciuperceni Forest, Cioace – Desa Forest, Başcov Forest, Calafat*). The Danube floodplain lies along the migration route of various species of aquatic birds, some of them pertaining to the world natural heritage (RIDICHE, 2011; RIDICHE & BOTOND, 2011). These particular species, as well as the entire protected areas, could form the flagship attractions of the area.

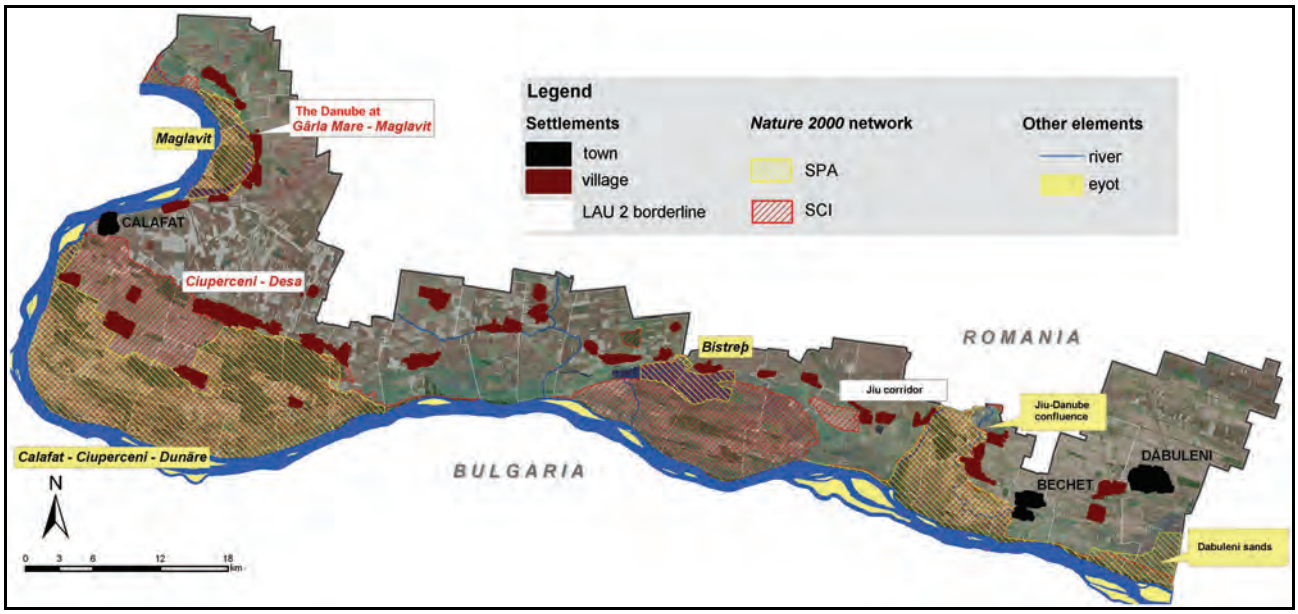

Figure 7. Components of NATURA 2000 Ecological Network within the Cetate – Dăbuleni sector.

Taking into consideration the principles that stood as fundament for the organisation of this network at European level, as well as the specificity of the sites located within the Cetate – Dăbuleni sector, it can be stated that Natura 2000 is the source of significant opportunities for local development, i.e.:

- the promotion of an ecological tourism, of the agritourism based on local traditions and ecological products;
- to continue the activities conducted on the fish ponds, by observing the measures implemented for the protection of aquatic fauna and especially of birds;
- the tourist activities conducted in the precincts of water bodies could constitute an alternative for increasing the revenues (including the sustainable management of the fish ponds);
- European and national financing funds can be accessed in order to develop and improve the general and ecotourism infrastructure (accommodation units, access lines, fauna, especially bird observatories, information panels and centres, etc.).

The existence of species and habitats with good conservation status, even on areas with strong human impact, certifies that the sustainable management of natural resources is not incompatible with human activities (LAZĂR et al, 2007).

The field observations highlight the value of these sites and underline the fact that, in order to obtain good results in the area of environmental conservation, as well as in that of ecotourist capitalization, the protected areas require the achievement of information centres, the placing of informative/warning panels in key-spots, bird observatories near the wetlands with important avifauna agglomeration, well-marked visiting trails, thematic routes, camping places with the necessary facilities, such as those for garbage collecting or fireplaces, etc. Presently, the facilities to enjoy the various tourist opportunities are very limited.

The study area displays an important natural potential for ecotourism. The Danube scenery, lakes and wetlands are unique, but are hardly known or safely accessible. The construction or improvement of access ways on the Danube dikes would definitely improve the accessibility and attract more tourists. Romanians are generally not attracted and foreign tourists, bicycling the extended Danube trail, now bypass the area in the absence of sufficient data or required infrastructure. The establishment of lodging facilities (campings, guesthouses, hotels) and promotion of agritourism should be considered a prerequisite.

2. Cultural attractions

Following the long existence of population in the area, there are various cultural attractions for ecotourists, historical sites, old churches included in the national heritage list (Fig. 8), museums and human activities being the most important attractions for ecotourists, that could represent the complimentary attractions to encourage a longer stay of tourists in the area. One significant archaeological site is found at Cârna, the archaeological findings from here forming the theoretical base for the research about the Neolithic period and the Bronze Age (AVRAM et al., 2004). This archaeological site (necropolis including 114 incinerator tombs) is considered the most representative necropolis for Gârla Mare culture (CIMEC, 2015).

In the past, the villages from the Danube valley were famous for the Oltenian carpets (called by the locals *chilim*) and for mat knitting. One workshop that still manufactures chilim using traditional methods and is successful on the international market is located in Bechet; it is called *Art in the countryside.* Traditional handicrafts and art should be kept alive by supporting and encouraging the young people to learn these crafts and thus be able to sell their products (mats, bags, carpets etc.) to the tourists, as well as to the guesthouses and restaurants in the area. If the area could be properly promoted and if it would become an ecotourist destination, these traditional handicrafts would bring significant economic benefits for the locals involved.

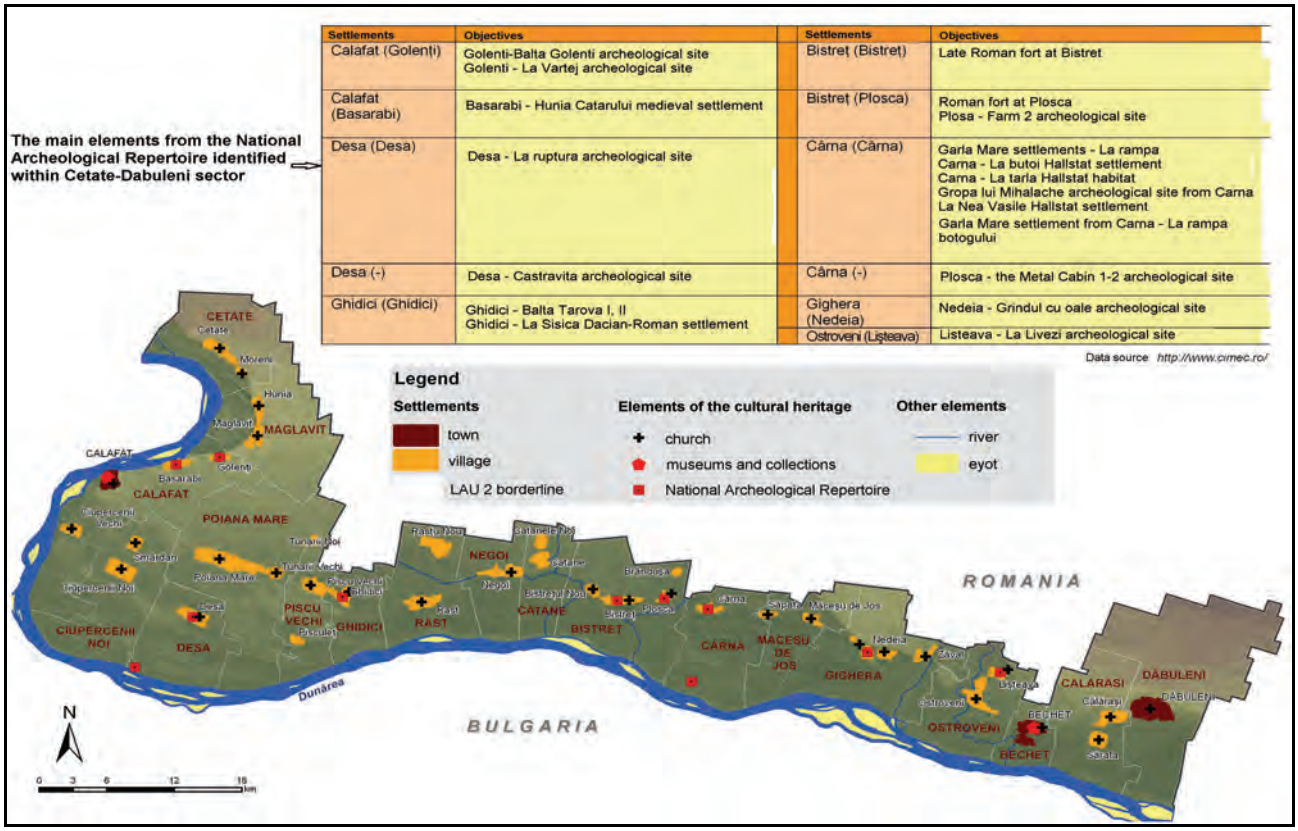

Figure 8. Main elements of the cultural patrimony within the Cetate – Dăbuleni sector.

3. Direction lines for ecotourism development

Although the rural periphery cannot survive from tourism alone (STASTNA et al., 2015), the international experience has proven that the existence of natural protected areas favours the diversification of small and medium businesses, providing a source of income for the local communities (SCHEYVENS 1999; WUNDER, 2000; STEM et al. 2003, HE et al., 2008). Taking into account the characteristics of an ecotourism destination and the development necessities of the analysed area, there were identified the following directions for actions within the Danube floodplain.

- ***Harmonizing the local policy for the development of ecotourism***

In order to have a real chance to become an ecotourism destination, the settlements within the Danube floodplain should act together, in a coherent manner, to integrate the principles of ecotourism in the development plan of each settlement, but more important, for the entire area. This is quite opportune, since there is already a local development group – Calafat *Local Fishing Group*, that has contracted several projects aimed at ecotourism development and promotion. In this case, specific urbanism rules should be adopted with the specific purpose to preserve the local construction style and uniform signalling of tourist sights in the area.

- ***Development of specific infrastructure***

It is highly necessary to stimulate the entrepreneurial interests to develop the ecotourism infrastructure parallel to the increasing awareness of local communities regarding the importance and value of local traditions and authentic culture for the creation of a highly attractive ecotourism destination.

There are no accommodation facilities in the rural area under study except for Cetate and the towns. None of the existing facilities is in line with the local style (neither the architecture, nor the interior design or gastronomy). The only exception might be Cetate Cultural Port, called by the locals *Dinescu's manor*. In each settlement included in the ecotourism network, there should be identified several houses that keep the local style, that should be reconsolidated and transformed into accommodation facilities, acting also as a *living museum* of the area. Since in the past the semi-buried earth-huts were characteristic for the area, we think that building some earth-huts as *eco-lodges* can be a significant advantage for the touristic image of the Danube floodplain.

Particular attention should be paid to the infrastructure needed for information, visits, nature interpretation, development of active tourism activities. Thus, thematic routes are needed for protected areas; museums, traditional houses, craftsmen workshops for carpet weaving, mat and bags knit, *in situ* exhibitions of traditional art for cultural activities; proper development of the cycling route that overlaps Euro velo 6, trail marking and signalling, rent-a-bike centres for cyclotourism.

- ***Increase the public awareness about ecotourism concept,*** the importance of ecotourism development and the relevance of local traditions and unspoiled nature for ecotourism

Both the local communities and the decision-making actors should first understand the principles and trends of ecotourism, the ecotourist profile and what he is searching for, in order to correctly put in practice these concepts. Consequently, informative documents, work groups and information campaigns are highly desirable.

- ***Creation and diversification of ecotourism offer***

So far, tourism offer in the area is quite poor, aiming only fishing activities. In order to be able to assert itself as ecotourism destination, the area should diversify the ecotourism offer, by:

- planning and fitting some thematic routes for one-day journeys – nature expeditions for students and other visitors, in small guided groups, to study the terrestrial/ aquatic flora and fauna;
- conceiving some activities to capitalize and protect the green areas, cultivate medicinal herbs;
- initiate a working camp for volunteers and local specialists to manufacture souvenirs from local natural materials, to mark trails or to plant trees;
- planning and proper signalling of bicycle lanes since the area overlaps the Danube EuroVelo 6 corridor;
- boat rides on the Danube and Jiu, photo-safari, ecological pick-nicks, fruit picking, summer schools for learning the traditional crafts in the area such as basket and mat knitting, carpet weaving (Oltenia chilim);
- involve school eco-clubs and tourism associations to plan and capitalize the attractive natural and man-made attractions. These eco-clubs should exist in each school from the settlements where there are Nature 2000 sites, in order to encourage positive attitudes towards the environment.

Tourism service providers from the settlements that make up Calafat Local Fishing Group Association, that aims at diversifying the economic activities, should be also involved in the development of ecotourism products, such as thematic trails, ecological meals, traditional cultural events. Moreover, the local communities should be encouraged to get involved in this action, to offer some specific services such as accommodation and meals for tourists, show customs and traditional crafts such as weaving and knitting.

- ***Proper promotion of the area***

The tourist offer, no matter how diversified and irrespective of the quality of experiences tourists may have, will bring few tourists unless it will be properly targeted to the market, so as to reach directly the segment of tourists that are keen of this form of tourism.

CONCLUSIONS

Considering the existence of the Nature 2000 sites that are found within the Danube floodplain in the southern part of Dolj county, the existence of other reserves as well as the legal framework for the environment protection, the existence of a national strategy for ecotourism development and the identification of the tourism sector as an economic priority of the national strategies of sustainable development, we consider there are favourable premises for ecotourism development in the study area.

The sustainable use of the natural resources and biodiversity of the Danube floodplain could bring significant benefits for the local communities and authorities as well, since ecotourists are looking for untamed nature and cultural authenticity, and not least, contact with local communities. All these elements are still found in the settlements from the southern part of Dolj county; the challenge, therefore, is to support the development of ecotourism, while respecting the need for nature preservation and authenticity.

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AT THE BIRTH CENTENARY OF PROFESSOR NICOLAE BOTNARIUC

GOMOIU Marian-Traian

Abstract. In the framework of the 22nd Edition of the **International Scientific Conference "Museum and Scientific Research",** organized by the Department of the Natural Sciences Museum of Oltenia, Craiova, in collaboration with Dolj County Council (September 10-12, 2015, Craiova, Romania), the author proposes that the participants have a moment of meditation in honour of the birth centenary of Professor Nicolae Botnariuc - eminent representative of the Romanian biology. This is a particularly fortunate occasion to celebrate the centenary and to pay tribute to this remarkable scholar, as a sign of gratitude we bear, we - colleagues, disciples, friends, who form the scientific community studying the nature surrounding us, surveying the living world problems. The first part of the presentation is a chronicle of Professor Nicolae Botnariuc's life and work. The second part highlights certain aspects of the book "*Life in the Delta"* published by the Professor more than half a century ago, a book which has remained immortal, like many of the great naturalists' travel journals. The author of the presentation considers that *"Life in the Delta"* is a book revealing more than a real literary talent; it is more than a book popularizing science to young people. *"Life in the Delta"* is a book addressing all people, which introduces the reader with rare mastery into the paradise of scientific knowledge and makes him aware of the delta assets with tact and patience. It is a captivating book that challenges your curiosity and brings you closer to nature, which stimulates your mind to find out what is going on around us, wherever we are. *"Life in the Delta"* is equally a scientific treatise and a captivating literary work; it is like a "sheet for the mind, heart and literature" about nature. How inspired was the Professor and what a suggestive guiding principle he chose when he inscribed Charles Darwin's words as the motto of the work: *"I sometimes think that overall and popular presentations are almost as important for the progress of truth as original works"*. The author concludes with a few quotations from *"Life in the Delta"*, which are vivid illustrations of Professor Nicolae Botnariuc's remarkable scientific thinking.

Keywords: biological biography, Romanian Professor Nicolae Botnariuc, the Danube Delta, biodiversity, habitats and population descriptions.

Rezumat. La centenarul naşterii Profesorului Nicolae Botnariuc. În cadrul celei de a 22-a Ediţii a **Conferinţei Ştiinţifice Internaţionale „Muzeul şi cercetarea ştiinţifică",** organizată de Secţia de Ştiinţele Naturii a Muzeului Olteniei Craiova, în colaborare cu Consiliul Judeţean Dolj (10-12 septembrie 2015, Craiova, România) autorul propune participanţilor un moment de meditaţie în onoarea aniversării centenarului naşterii Profesorului Nicolae Botnariuc – eminent reprezentant al biologiei româneşti. Este un prilej deosebit de favorabil de a celebra centenarul naşterii şi de a-l omagia pe acest remarcabil savant, ca semn al recunoştinţei pe care i-o purtăm, noi cei care formăm comunitatea ştiinţifică a celor ce studiază natura care ne înconjoară - colegi, discipoli, prieteni. Prima parte a prezentării reprezintă o cronică a vieţii şi operei Profesorului Botnariuc. Partea doua a prezentării are în vedere sublinierea unor aspecte din cartea *„Viaţa în Deltă"*, pe care Profesorul a publicat-o cu peste o jumătate de secol în urmă, dar care a rămas nemuritoare, aidoma multor jurnale de călătorie ale marilor naturalişti. Autorul prezentării consideră că *„Viaţa în Deltă"* este o carte care evidenţiază mai mult decât un real talent literar, este mai mult decât o carte adresată tinerilor şi în care se popularizează ştiinţa. *„Viaţa în Deltă"* este o carte adresată tuturor, care te introduce cu o rară măiestrie în paradisul cunoaşterii ştiinţifice, al expunerii şi explicării acestuia, pentru conştientizarea cititorului, cu tact şi răbdare. Este o carte captivantă care te reţine la aflarea istoriilor până la capăt, care îţi deschide curiozitatea şi te apropie de natură, care îţi stimulează gândirea pentru a afla ce se petrece în jurul nostru, oriunde ne-am afla. *"Viaţa în Deltă"* este, în egală măsură, un tratat ştiinţific şi o operă literară captivantă, alertă; este parcă o „Foaie pentru minte, inimă şi literatură" despre natură. Cât de inspirat a fost şi ce principiu director sugestiv şi-a ales profesorul luându-şi ca motto al lucrării sale vorbele lui Charles Darwin: *„Mă gândesc uneori că expunerile generale şi populare sunt aproape tot atât de importante pentru progresul adevărului ca şi lucrările originale"*. În încheierea prezentării autorul citează câteva fraze din *„Viaţa în Deltă"*, care reprezintă valoroase reflecţii ale gândirii ştiinţifice a Profesorului Nicolae Botnariuc.

Cuvinte cheie: biografie biologică, Profesor Nicolae Botnariuc, România, Delta Dunării, biodiversitate, habitate şi descrierea populaţiilor.

In this traditional scientific meeting – The 22nd Edition of the International Scientific Conference "The Museum and Scientific Research", organized by the Department of the Natural Sciences Museum of Oltenia Craiova in collaboration with Dolj County Council (September 10-12, 2015, Craiova, Romania) I invite you to a moment of meditation in honour of the birth centenary of Professor **Nicolae Botnariuc** - eminent representative of the Romanian biology.

The Professor was a great man of rare modesty, a biologist from the gallery of the great personalities of the Romanian biology, an avid lover of nature, of the world of our waters.

Professor Nicolae Botnariuc has given us - students, colleagues, friends, admirers, a lesson of life, a lesson of work, a lesson of achievements in many directions:

■ prodigious teaching and research career at the University of Bucharest and the Romanian Academy; formed many generations of students and doctoral students, trained biologists, to whom he delivered lectures with the latest information in the field;

■ scientific activity carried out in several biological fields, interlinked by research (ecology of continental waters) by systemic concepts and methods applied in biology; his whole work has led to important generalizations in general biology, which contributed to strengthening modern evolutionary theory;

■ active supporter of systematic and modern taxonomy, correlating the morphological and anatomical study of species with the study of phylogeny and ontogeny, ecology and ethology, including the spatial distribution of species in the past and at present;

■ has contributed substantially to the protection and conservation of a rich range of natural habitats from the mountains to the Danube Delta, following the tradition inherited from Emil Racoviță, Grigore Antipa and Alexandru Borza.

On the occasion of the birth centenary of Acad. N. Botnariuc, the Department of Biological Sciences of the Romanian Academy organized at the Romanian Academy on the 12th of March 2015, the homage Session **"The Personality and Work of Academician Nicolae Botnariuc**", where the following presentations were made:
• **Acad. Cristian Hera**: Academician Nicolae Botnariuc - a great zoologist and biologist Romanian;
• **Acad. Maya Simionescu**: Prof. Nicholas Botnariuc - a life dedicated to the "science of life";
• **Prof. dr. Dan L. Danielopol**: The centenary of Academician Nicolae Botnariuc - an evocation of his scientific contribution to modern debates on evolutionism;
• **Prof. dr. Marian Traian Gomoiu**: Pages of Prof. Botnariuc opera - Delta fascination;
• **Prof. dr. Adrian Bavaru**: Effects of global warming on biodiversity;
• **Prof. dr. Octavian Popescu**: Pluricelularity in the frame of biological systems evolution - Acad. Nicolae Botnariuc vision;
• **Dr. Dumitru Murariu** - Biological sciences philosophy in the work of academician Nicolae Botnariuc.

Today, I would like to highlight some data which mark the great scientist's life and work, then we will have the pleasure to listen to the presentations of two distinguished colleagues who had the fortunate opportunity to be with the Professor every day in the unusual conditions of the first Romanian Trans-African Expedition, from Dakar to Mombasa (1970-1971):
• **Prof. dr. Coman Nicolae** - Remembering the first Romanian Trans-African Expedition (1970-1971);
• **Prof. dr. Neculce Dragoș** - Through Some forests in Africa, West India (Goa), the Caribbean and Central America, in the context of climate perturbations.

Prof. Nicolae Botnariuc - Biographical data and scientific work (the data are based on the literature – TATOLE, 2005; CONSTANTINESCU, 2010; NEGREA & NEGREA, 2010):
• born on **March 13, 1915** at Râșcani, Bălți, Bessarabia. Homeland on the Podolian Plateau, Răuț River Basin, was a real point of interest for the future scientist; the student was attracted by local fauna and also the rocks in the area;
• attended and graduated from "Ion Creangă" Râșcani;
• **1936-1938** - attended Bucharest Polytechnic School;
• **1942** - obtained the diploma, being a brilliant student at the Faculty of Natural Sciences of the University of Bucharest, which had a host of eminent professors, among them Ion Popescu Voiteşti (1876-1944), Ion Atanasiu (1892-1949) Andrei Popovici-Bâznoșanu (1876-1969), Gh. Th. Dornescu (1898-1980) and Constantin Motaș (1891-1980);
• **1943** - assistant at the Laboratory of Animal Morphology;
• **1946** - defended his doctoral thesis published a year later in "Notationes Biologicae" under the title *"Contributions à la connaissance des Phyllopodes Conchostracés de Roumanie"*;
• **1948** - published his *„Contributions à la connaissance du développement des Phyliopodes Conchostracés"* in „Bulletin Biologique de la France et de la Belgique"; research focused on discovering and describing a **new type of larva**, which he called **heilophora**;
• **1948** - associate professor, then professor and head of the Department of Biology - a position he held until his retirement (1983); taught students the subjects General Biology and Ecology;
• **1962** - was appointed Dean of Biology - a position he held until 1972;
• **1942-1983**, performed a rich didactic activity, crowned with the success of his students, for whom he was a real mentor.

Through his activity at the Faculty of Biology and the Romanian Academy, Professor Nicolae Botnariuc also stands out as a genuine scientist:
• **1949** - became editor of the series "Fauna of Romania" of the Romanian Academy;
• **1964** - was appointed corresponding member of the Romanian Academy;
• **1976** - appointed Chairman of the Committee for the Protection of Natural Monuments, President of the Romanian National Committee for the "Man and Biosphere" Program, chief editor of the journal "Protection of Nature and Environment";
• **1970** - led the first Romanian scientific expedition across Africa (Botnariuc Nicolae, Dragoș Neculce, Nicolae Coman and Valeriu Cimpoeru), crossing 12 countries and travelling 18,000 kilometres;
• **1981** - active member of the "International Council for MAB / UNESCO Coordination Program";
• **1990** - full member of the Romanian Academy and Chairman of the Department of Biological Sciences for a term of four years. He was appointed honorary member of the Academy of Sciences of Moldavia;
• **2001** (October 17) - He was awarded the title of Doctor Honoris Causa of the University "Alexandru Ioan Cuza" Jassy.

In the field of zoology, Prof. Botnariuc, based on systematic and modern taxonomy, focused on crustaceans - concostraceea since faculty years (1941); together with T. Orghidan he finished the volume ***"Phyllopoda"*** in "Fauna of Romania" (1953) and published together with Victoria Cure the ***"Manual of Chironomidae larvae Identification"***

(1999), organisms which play an important role in the trophic cycles of continental waters. It is worth mentioning his work on evolution, phylogeny and classification of brachiopoda, based on Henig's cladistic method (1980).

Professor Botnariuc's scientific interest focused on the ecological study of inland waters of Romania, especially the Danube Delta floodplain: regular waters population dynamics (1953) study of horizontal distribution of zooplankton in Tăul Şurianu (1954-1956) and hydrobiological study of Lake Gâlcescu (1957); Crapina-Jijila lakes (1956-1960), (1961-1975).

The work had as its area of interest, among others, primary plankton, macrophytes, bivalves and gastropods, energetic and trophic structure. Another noteworthy aspect was the development of concepts on hydrobiology as, for example, the index of transparency.

Through his research work, Nicolae Botnariuc has brought an important contribution to modern evolutionary theories.

Evolutionary biology was a constant area of interest for Prof. Botnariuc: issues of evolution, variability, the role of environmental factors and completeness in the living world being among the first studies of this type in Romania. Nicolae Botnariuc approached the general theory of systems, was concerned with the evolution of ideas in the field of general biology and the history of biology trends in Europe and America, focused on issues concerning intra- and inter-specific relationships between organisms and environment, the factors of species evolution, the organization of living matter according to the systems theory, the explanation of the adequate and adaptive nature of variability, the issue of hyperthelia, the integrality of biological systems, etc.

Selective publications referring to general biology:

- "The species problem and the discussion around it" (**1957**);
- "The idea of evolution in the study of living nature and the issue of evolution factors" (**1960**);
- "Some aspects of intra- and inter-specific relationships at animals" (**1960**);
- "The organization levels of the living matter" (**1964**);
- "Some theoretical aspects of completeness issue in biology" (**1964**);
- "Adaptation and fitness - essentially two particular biological phenomena" (**1966**);
- "General Principles of Biology" (**1967**);
- "The self-regulating nature of evolution" (**1970**);
- "Concept and systemic method in general biology" (**1973**, **1976**);
- "General Biology" (**1974** and **1982**);
- "Evolutionism at the present time and in the future" (**1980**);
- "Some problems of current evolutionism" - reception speech at the Romanian Academy (**1992**);
- "Evolutionism at a deadlock?"(**1992**);
- "Evolution of supraindividual biological systems" (**1999** and **2003**).

In his work **"*Evolution of supraindividual biological systems*"**, Professor Nicolae Botnariuc describes the interdependence of ecology and evolution, noting that in the evolutionary process there are two issues that arise ***in the analysis of relationships between biological hierarchies - taxonomic and systemic***. The book abounds in the presentation of numerous fundamental concepts: knowledge of biological systems, self-organization, deterministic chaos, fractal nature, role of symbiogenesis in the evolution process, evolution as system assimilation, role of the intertaxonic relationships in the emergence and evolution of pluricellularity, evolution of populations in terms of organizational development, evolution at invertebrata and vertebrata, ecological succession, natural evolution, ecosystem process etc.

Starting with Professor Botnariuc's numerous statements, full of lessons and challenges, we could develop approaches. But as stated by Acad. N. Botnariuc in his reception speech at the Romanian Academy ***"Some problems of current evolutionism"***, *"now we avoid getting into older or newer traps posed by the controversial issues of theoretical biology"*... Let me quote a few statements from the Professor's work.

First, let me reproduce some general theoretical considerations from Professor Botnariuc's scientific work:

■ "Evolution, strictly speaking, is characteristic of the systems at population level - species, entities, representing at the same time the focal point of selection".

■ "Biocoenosis integrated into the ecosystem is the one that modulates the selection process in terms of the compatibility of population existence and of fulfilling its effective role in the transfer processes of energetic and informational material within the definite ecosystem in which they take place".

■ "Given the well-established principle in the general theory of systems, according to which the whole is more than the sum of its components and the new, emerging features, characteristic of the whole, cannot be reduced to the subsystems attributes or to their sum, we can say that evolution and selection appear as emerging traits resulting from the interaction of systems at different levels (individual, population, biocoenotic) of the organizational hierarchy integrated into ecosystem structure".

■ "Through its two-way characteristic, the transfer of inter-specific environmental information has a crucial role in the material and energetic transfer, and thereby, in the selection deployment (modulation). By phenotypes, there are selected the most appropriate genotypes to the given conditions and thus changes take place in intra-population

genetic information, leading to the transformation and divergence of populations. Thus, the transfer of environmental information becomes a way of transforming genetic information and the organization of the biocoenotic level system becomes a factor of transformation and genesis in taxonomic hierarchy".

■ "In the Darwinian concept, the evolution of species was the result of interaction between several factors, in a closely logical succession - variability, overpopulation, struggle for existence, natural selection - leading to species transformation. It is worth emphasizing the symbolic, metaphorical, sometimes declared character of some of these concepts. Overpopulation comprised the issues posed by population abundance and variation; the struggle for existence contained all relationships with the biotic and abiotic environment".

Prof. Nicolae BOTNARIUC - *"Life in the Delta"*

I confess that it was difficult for me to decide which book to choose out of the entire scientific work of Professor Nicolae Botnariuc, which includes over 150 works of fundamental importance. Finally, I chose ***"Life in the Delta"***, a jewel of writing, worth being in every home, worth being read by everybody, by people who share common concerns and interests, not only by biologists.

"Life in the Delta" is a book highlighting more than a real literary talent; it is more than a piece of writing which popularizes science to young people.

"Life in the Delta" is a real book which introduces the reader with a rare mastery into the paradise of scientific knowledge and, with tact and patience, makes him aware of the surrounding natural assets; it is a captivating literary book that urges us to be patient, to be close to nature, to think over what is happening around us, wherever we are.

It is a book that should be read by everyone; personally, I consider this book Professor Nicolae Botnariuc's spiritual Delta.

How inspired the Professor was and what a suggestive guiding principle he chose when he took Charles Darwin's words as a motto for his work: *"I sometimes think that general and popular presentations are almost as important as original works for the progress of truth".*

Quotations from the book *"Life in the Delta"*

■ "The book of nature cannot be easily read. It requires thorough preparation, patience, perseverance, imagination, passion and courage. These are not always enough. It requires the help of other sciences, technology, which provide the necessary means for research in biology".

■ "...The life of the Delta as a whole, as a unit, cannot be understood scientifically unless we know first the main elements that make up this whole ... We encounter delta plants and animals in many other places of the country and the world. But what is characteristic of our Delta are just the associations of such creatures (biocoenoses), the combination of their life together and in the climatic, hydrologic, geographic conditions of the delta. And these phenomena cannot be understood unless we know at least the most common creatures of the delta and how their life goes on".

■ "...The Delta is a special corner of nature, where in the endless combination of land and water, the lives of countless aquatic and terrestrial creatures intertwine through links infinitely complex".

■ "...The Delta, like any natural phenomenon cannot be understood and cannot be studied as it should be unless you look into its evolution and development, and all our evidence, all materials we collect must reflect this process. So, in order to gather our evidence - chemical, biological, hydrological – we must choose the places, moments, conditions generally the most characteristic, the most significant for the evolution process of the delta. Then, the link between them will become clear and this will be the very link between the parts of the delta in evolution".

■ "...The associations of creatures (hence the biocoenoses) were formed during their long history by mutually adapting to one another. This adaptation is so strong that these species have become necessary to each other".

■ "...Of all the ties that bind together the creatures of a biocoenosis, the most important are those where each individual ensures its food - so food ties… an immutable law prevails in nature - each species lives at the expense of other species. This law is sure to reign in the Delta too; so, knowledge of feeding links is of utmost importance. It not only reveals the links between living creatures, sometimes completely unexpected links, but also gains some aspects of great practical importance to people".

■ "...Predatory fish and ichthyophagous birds depending on life, place and other conditions have specialized in the destruction of non-aggressive fish at different moments of their ontogeny, in certain proportions, at certain ages, for certain species, for different physiological states of non-aggressive or predatory species. It is a mechanism of smoothness, precision, flexibility and complexity that man cannot achieve under normal conditions".

■ "...The Delta creatures should not be assessed by people only by their direct role in economy. We must look into their mutual links, their links with the environment, their needs, and then even insignificant species in the delta life... become interesting and important through their role as 'indicators' of water health".

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REMEMBERING THE FIRST ROMANIAN TRANS-AFRICAN EXPEDITION (1970-1971)

COMAN Nicolae, NECULCE Dragoș, POPA Sever, CATARANCIUC Ion

Abstract. The participation in an expedition in Africa is, I believe, the dream of any biologist. From dream to reality it is however a long way. By tenaciously pursuing the idea, hard preparation and a little luck, we succeeded. We aimed at a route for crossing the continent from west to east on a strip of land lying right and left the Equator, through wetlands and dry areas. The expedition would pass through 12 countries: Senegal, Mali, Upper Volta (now Burkina Faso), Niger, Nigeria, Cameroon, Chad, Central Africa, Zaire (now Congo-Kinshasa), Rwanda, Uganda, Kenya. The team consisted of 8 people: Professor Nicolae Botnariuc, dean of the Biology Faculty in Bucharest – scientific leader of the expedition, Dragoș Neculce – zoologist, Nicolae Coman – botanist, Valeriu Cimpoieru – biologist, John Cataranciuc – engineer, Constantin Ludu – trial technician, Liviu Ungureanu – filmmaker, Sever Popa – doctor. Crossing the continent was to be accomplished with two cars TV (Tudor Vladimirescu) and an ARO-M61 with a prototype trailer. The objectives of the expedition were: knowledge and collecting samples of flora and fauna; testing Romanian cars; knowing the people we were about to meet, their history and culture; presentation of our country through conferences, media interviews, publications, etc.; documentary filmmaking, photo slides and other materials. After loading the materials for the expedition in Cluj, departure took place on the 10th of November with the destination Rijeka port, where we boarded the Yugoslavian ship Bohinj. After a month of sailing we disembarked in the port of Dakar, Senegal. We collected samples around the capital, Saint Louis, located at the mouth of the Senegal River in the ocean, and within Tamba-Counda reserve. Then, we went upstream the Senegal River, on unexplored roads, at an average speed of 70 km a day and reached Bamako, the capital of Mali, on New Year Eve. There we reached the Niger River, which we followed, passing through its inner delta, and then we entered the Upper Volta area. Stifling heat and a terrible drought accompanied us when crossing the 3 Volte (White, Black and Red). The dusty road led us to the capital of Niger, Niamey, city located on the bank of the Niger River. Nigeria is the first country where English was spoken, with left-hand traffic. From the north-eastern Nigeria we crossed to Cameroon going across the Chary river floodplain, and afterwards we arrived at Fort Lamy, the capital of Chad. The biologists, led by Professor Botnariuc, were very content with the activity from Lake Chad and they succeeded in collecting the living *Spirulina* alga from the northeast of the lake. Central Africa welcomed us with its equatorial forests where we met the first tribes of pygmies. To enter Zaire we had to build a raft of canoes and crossed the Oubangui River, the main tributary of the Congo River. For a month, we went through the real equatorial area of Africa visiting its most important parks (Albert, Ruwenzori, Niragongo, lakes Albert, Edward, Kivu with rich fauna and flora). We crossed quickly Rwanda, the land of 1000 Hills, cattle-breeders and tea growers, getting into Uganda, where we camped on the shore of Lake Victoria and visited the wonderful botanical garden from Entebe. Moving westwards, following mountain roads, but this time asphalted roads, we entered the twelfth country – Kenya, where we visited a number of parks located in the Rift area, but also Nairobi and Tsavo parks. After exactly 100 days after leaving the Atlantic Ocean we arrived at the Indian Ocean. Luckily, we met Bucharest motor ship in the port of Mombasa and we embarked going home together with the collected materials, friendships and unforgettable impressions of the admirable continent - Africa. After a stopover in Kuwait, the ship went to India where iron ore was loaded and, two months later, it arrived in the port of Constanța, where we unloaded the cars that had taken us across the great continent.

Keywords: First Romanian-Trans-Africa expedition.

Rezumat. Rememorări din prima expediție românească transafricană (1970-1971). Participarea la o expediție în Africa este cred, visul oricărui biolog. De la vis la realitate este însă cale lungă. Prin urmărirea cu tenacitate a ideii, prin tenacitate, pregătire și cu puțin noroc, noi am reușit. Ne-am propus un traseu de traversare a continentului de la vest la est pe o fâșie de teren situată la dreapta și la stânga Ecuatorului, prin zone umede și uscate. Expediția urma să treacă prin 12 țări: Senegal, Mali, Volta Superioară (azi Burkina Faso), Niger, Nigeria, Camerun, Ciad, Africa Centrală, Zair (azi Congo-Kinsasha), Ruanda, Uganda, Kenya. Colectivul expediției era alcătuit din 8 persoane: profesorul Nicolae Botnariuc, decanul facultății de Biologie din București – conducătorul științific al expediției, Dragoș Neculce – zoolog, Nicolae Coman - botanist, Valeriu Cimpoieru – biolog , Ioan Cataranciuc – inginer, Constantin Ludu – tehnician de încercări, Liviu Ungureanu – cineast, Sever Popa – medic. Traversarea continentului urma să se realizeze cu două mașini TV (Tudor Vladimirescu) și un ARO-M61 cu o remorcă prototip. Obiectivele expediției au fost: cunoașterea și colectarea eșantioanelor de floră și faună; testarea mașinilor de producție românească; cunoașterea popoarelor pe care urma să le întâlnim, a istoriei și culturii lor; prezentarea țării noastre prin conferințe, interviuri în mass media, publicații, etc.; realizarea de filme documentare, diapozitive și alte materiale foto. După ce au fost încărcate la Cluj materialele expediției, plecarea a avut loc la 10 noiembrie cu destinația Rijeka unde ne-am îmbarcat pe vasul Yugoslav Bohinj. După o lună de navigație debarcăm în portul senegalez Dakar. Recoltăm materiale în jurul capitalei, la Saint Louis situat la vărsarea fluviului Senegal în ocean, precum și în rezervația Tamba-Counda. Urcăm apoi de-a lungul fluviului Senegal, pe drumuri neumblate, cu o viteză medie de 70 km pe zi și ajungem în ajun de an nou la Bamako, capitala Republicii Mali. Aici întâlnim fluviul Niger pe cale-l urmăm, trecând și prin delta sa interioară și pătrundem în Volta Superioară. Căldura înăbușitoare și o secetă cumplită ne însoțește și la traversarea celor 3 Volte (Albă, Neagră și Roșie). Drumul plin de praf ne conduce la capitala Republicii Niger, Niamey, oraș așezat și el pe fluviul Niger. Nigeria este prima țară de limbă engleză, cu circulația pe stânga. Din nord-estul Nigeriei trecem în Camerun traversând zona inundabilă a fluviului Chary, după traversarea căruia ajungem în Fort Lamy, capitala Ciadului. Biologii, în frunte cu profesorul Botnariuc sunt foarte bucuroși de activitatea pe lacul Ciad, din nord estul căruia au recoltat și alga *Spirulina* vie. Africa Centrală ne întâmpină cu pădurile sale ecuatoriale unde am întâlnit primele triburi de pigmei. Pentru a intra în Zair am fost nevoiți să construim o plută de pirogi cu care am traversat fluviul Oubangui, principalul afluent al Congoului. Timp de o lună de zile am circulat în adevărata zonă ecuatorială a Africii vizitând marile parcuri (Albert, Ruwenzori, Niragongo, lacurile Albert, Eduard, Kivu cu o bogată faună și floră). Țara celor 1000 de coline – Ruanda, a crescătorilor de vite și a cultivatorilor de ceai am traversat-o repede, intrând în Uganda unde ne-am așezat tabăra pe malul lacului Victoria, vizitând minunata grădină botanică de la Entebe. Înaintând spre vest pe drumuri de munte, dar de data aceasta asfaltate, intrăm în cea de a douăsprezecea țară – Kenya unde am vizitat o serie de parcuri din Rift precum și parcurile Nairobi și Tsavo. După exact 100 de zile de la părăsirea Oceanului Atlantic am ajuns la Oceanul Indian. Spre norocul nostru, în portul Mombasa am întâlnit motonava București pe care ne-am îmbarcat ducând spre

țară materialele adunate și prietenii și impresii de neuitat din admirabilul continent - Africa. După o escală în Kuweit, motonava a plecat în India unde a încărcat minereu de fier și înconjurând continentul african, după două luni a ancorat în portul Constanța unde am descărcat mașinile care ne-au purtat de-a latul marelui continent.

Cuvinte cheie: Prima expediție Românească Trans-Africană.

It has passed nearly half a century since this expedition, yet unique in Romania. The work for processing the biological materials sampled during the expedition continues even in the present. Memories, faded in a way, are however still alive. In the few pages of this article, I will try to highlight the importance of this achievement. I start by rendering a small fragment from the beginning of the volume that I published in 1975 in Dacia Publishing House, Cluj-Napoca, entitled "From the Atlantic to the Indian Ocean", dedicated to the eight members of the expedition.

'A typical working day in a laboratory can sometimes turn suddenly into an exceptional one that would leave a deep mark imprinted in your consciousness, would dominate your thoughts, modify your plans and program, in other words, would get you out of the rhythm you used to consider natural, normal, throwing yourself into adventure'. Here, I remember that day. One day in March 1968, which is far away but, time did not alter my memories, did not erase the emotion I felt at that moment together with the accompanying surprise, amazement, disbelief, temptation, fascination of the idea that made me dream with open eyes.

- An expedition? Whose? Where? Who organizes it?

Dragoș Neculce, I worked with in the laboratory, had received, from ROMTRANS, the permission to transport a truck for the expedition in Alexandria, Egypt. There followed two years of dreams, thoughts, assiduous preparations of a Trans-African expedition of about 13,000 km from west to east. Slowly, the team gathered – 4 biologists (professor Nicolae Botnariuc, Dean of the Faculty of Biology of the University of Bucharest, Dragoș Neculce, a zoologist, Valeriu Cimpoieru, a biologist that worked for TVR Bucharest (The Romanian National Television) and the undersigned as a botanist); from ARO Câmpulung Factory (the engineer Ioan Cataranciuc, chief of the prototype division and Constantin Ludu, a test technician); as a filmmaker, the engineer Liviu Ungurenu, Head of the Film Laboratory of the University from Cluj-Napoca and doctor Sever Popa from the Institute of Medicine and Pharmacy from Cluj. Each of us prepared in his field by gathering materials, necessary tools and equipments or just by reading about the route, tropical diseases, history, culture and biogeography of the countries which we would pass through. Dragoș and I mainly dealt with visas, approvals, food, weapons, boats, clothing, suitable footwear, etc., etc. The acquired knowledge and the political events of the time made us decide certain changes of the previously established route and of the program of the expedition. The fights around the Suez Canal forced us to reverse the route and start from Dakar in Senegal and finish in Mombasa, Kenya. The African roads with many unstable bridges or small ferries that were manually manoeuvred by wooden rods did not ensure a good forward, so we gave up the truck opting for two TV (Tudor Vladimirescu) cars and an ARO-M 461 with trailer. Two years after we started the preparation for the expedition, we were ready for the African adventure. Instead of Constanța port we chose Rijeka port from Yugoslavia, where we boarded the ship 'Bohinj'; after a month of sailing (with stops in Syracuse - Greece, Livorno - Italy and Marseille - France) we reached Cape Verde and together with our cars we disembarked in Dakar, capital of Senegal. We were about to cross 12 countries (Senegal, Mali, Upper Volta (now Burkina Faso), Niger, Nigeria, Cameroon, Chad, Central Africa, Zaire (now Congo Kinshasa), Rwanda, Uganda and Kenya, respectively the port of Mombasa at the Indian Ocean, where we were to return home.

The route planned along a strip of land north and south of the equator would pass through the main types of relief and vegetation, as one objective of the expedition was to test the Romanian cars in dry and wet climates. Among other objectives of the expedition we mention taking samples of the flora and fauna (mainly small fauna), which was to be investigated in the country; making photo materials (slides, photos, black-and-white as well as colour documentary films); we also wanted to popularize Romania with its beauties and the culture of the Romanian people; we wanted to know as much as possible the achievements and culture of the numerous peoples we were about to visit.

We said therefore goodbye to the friendly crew of the ship Bohinj and remained at a berth in Dakar port. We were afraid that we would have problems obtaining a visa, but the surprise came from elsewhere. We were not allowed to leave the port without the guarantee of an institution or of a person with a good financial situation that we would not sell our cars in Senegal. At our insistence and with the officials' willingness we managed to obtain a visa, new triptychs for the cars and the guarantee signed by the Soviet ambassador that we would not sell our cars. We did so succeed to get out of the port and we made the first camping on the African soil near the great north lighthouse. There was a great surprise when, at dawn, we were awaken by gunshots and bursts of machine-guns. We had camped in a gulch at the shore of the ocean on a military training field of the French troops.

We started to take the first biological samples, activity continued in Saint Louis, the former capital of Senegal, located at the mouth of the Senegal River. On the strip of sand between the river and the ocean, thousands of kilograms of salted fish got dry in the sun. On the left of the road, there was the fishermen's immense cemetery with some new graves covered by old fishing nets to keep the vultures from desecrating the rest of the dead. An image that can never be forgotten.

Upon our return to Dakar, we visited the university and, in particular, the faculty of sciences, where there were made research studies to obtain gold from ore using microbial oxidation and tested different methods to cure leprosy.

We left Dakar and, after we stopped at a company that obtained salt by evaporating ocean water, we visited the first national park - Tamba - counda, which disappointed us in terms of the variety and density of animals. We understood that it was a newly established park with some animals, such as lions, brought from certain zoological parks from France.

Following an earth road parallel to the railway track passing from Senegal to Mali, we got to Kidira, a village situated on a main tributary of the Senegal River – the Faleme River, which we intended to cross to enter Mali. Here, a new surprise – the absence of a ferry, and the river was quite deep; so, we could not drive through the river. The only possibility was to cross the river on the railway bridge. We found two bogies in the station and we intended to assemble a platform on which to carry the cars across the river and get them in Mali. The head of the railway station did not allow us to do this because the telegraph was broken and he could not know when the train would come from Mali. One day later, a train came from Dakar and it had a free platform which we used to carry the two TV cars and 5 members of the expedition. The other car, ARO and the trailer were supposed to go with the next train, if it had a free platform. After two days, the ARO and the other members of the team (Cataranciuc, Neculce and Coman) entered Mali, a country which supposedly we had visa for. (When we left the country we had two visas for Mali and Central Africa, but they expired until we got there).

The train passed through the savannah and, using wood as a fuel, at a sign of the stoker, people got off the train to gather wood and brought it to the engine. We arrived at Kayes. The thermometer indicated 36°C in the shade. A chief accompanied by two workers came at the platform. 'They will help you with the cars – says the chief - but today it is going to cost you more because it is Christmas.' 'Well, but you are Muslims' - I say. 'Yes, yes, but you are Christians.' And they left. In the evening, the chief came with another two workers. 'They are going to unload you. Pay them too. '

From Kayes we went upstream the Senegal River on a road, which, according to a native, had not been used by cars in the last 11 years. The local people used the train to reach Bamako – the capital of the country.

It was an extremely difficult road. When crossing certain dry valleys (wadi) we all pushed our cars. We drove 71 km in 7 hours. It took us several days to reach the capital of Mali, located on the banks of another river, the Niger. We camped at the outskirts of the city, in a mango grove, where we greeted the New Year. We were annoyed that we could not get a visa for Nigeria, and, for crossing over the Sahara desert to Lake Chad, we had neither land navigation instruments nor suitable cars capable to cross over the dunes as they were heavily loaded. It seemed we would have to go back to the Atlantic Ocean. Fortune smiled on us. A diplomatic car with the flag of Yugoslavia passed near us. Instinctively, we greeted happily. The car stopped and a man asked us: 'I saw the flag on your car. Where are you from, Chad or Romania?'

'We are Romanians' we answered. In a few minutes, the entire street was blocked by curious people and, thus, we were invited inside the precincts of the embassy of Yugoslavia. While eating (it was the first of January), we found out that our host was Zdravko Pečar, the ambassador of Yugoslavia in Mali. When he found out about our problem, he told: 'The ambassador of Nigeria is my friend as we hunt together. I shall help you obtain the visa as you are neighbours and friends, but, if you had been Stalinists as you used to be, I would not have helped you.' Indeed, the next day, the ambassador of Nigeria gave us the passports with an eight-day visa, the necessary time to cross the country which was still experiencing the Biafra war.

After completing the visits to the ministries and other officials, we left Bamako, going along the Niger River towards its delta, a true granary of the country, where we stop for a while in Segou and Mopti ancient cities. After coming out of the inner delta, the red-dusted lateritic road took us through the dry savannah up to the border crossing point Fo with the Upper Volta (now Burkina Faso). After completing the customs formalities (visas, entry tax payments, customs control), here we were in the third country of our expedition. We drove for about 100 km to Bobo-Diulassou, where we hoped to find a market with tropical fruits. To our disappointment, we found only two bunches of green onion.

We crossed the three Volta (Black, White, Red), going towards the capital, Ouagadougou. We camped before reaching the capital in the dry landscape. Besides us, there camped another caravan, a camel caravan, led by Tuaregs. They came from Abidjan (Ivory Coast) carrying, in the Sahara Desert, cola nuts, a bitter and astringent fruit that reduces both hunger and thirst, qualities much prized by the inhabitants of the desert. In the market of the capital, we changed some of the food brought from home (beans, dehydrated vegetables, biscuits, salt) unloading a little our poor cars. Instead, we got bananas, oranges, mango, papaya.

The official language was French in Senegal and Mali, although in Burkina Faso, there lived less than 2,500 French people. We were welcomed by the officials, ministry of education, even television, where the professor gave an interview on our expedition objectives. He was asked some interesting questions, such as: What do you think about modern science?; What is the role of biology in the development of society?; How do you see the compatibility between science and religion? And more.

As there was no news from home at the post office waiting for us, we went north-eastwards, back on the red lateritic dusty roads. The savannah was dry with rare and stunted baobabs. At Kanchari, a border crossing point of Upper Volta, formalities were quick and we entered Niger, but only after 36 kilometres, there appeared the border guards of the fourth country of our route. Heat and drought were high. Vegetation was represented by thorny bushes, 2-3 meters high. Finally, red dust. In the evening, we met again the Niger River, on the banks of which it is situated the capital - Niamey. Niger was the driest country on our route. Its northern border was established on the Tropic of Cancer, in the heart of the Sahara desert.

We camped right on the river bank among the doum palms, the ones with dichotomous branching. We were pretty tired and irritated. We arrived at the post office after closing time, the campsite was full of sand and manure from the

thousands of animals brought there for watering, and mosquitoes by the thousands. We went to bed dreaming about taking a bath the next day. The next day we changed the campsite, then made all the necessary formalities at various institutions in the capital. We found out that the market was poor and the inhabitants got hostile when seeing cameras. However, there was a rich vegetation within the floodplain of the river and a wide variety of fresh fish sold by local fishermen.

From Niamey we went eastwards, but not before sending the correspondence and the package for the television to the country. The harsh lateritic roads and the overloading of our cars made the wheel rims crack. We soldered them, but for safety, Nelu Caratanciuc wrote a letter to request two rims to his colleague, Moloiu, the representative of the Romanian car company in Nigeria. It was to meet with the representatives of the company in front of the police station in the town of Kano.

A month after our departure from Dakar we had crossed 4 countries and were at the border of the fifth – Nigeria, where we camped in the dry savannah in order to cross the border in the next morning. During the night, we were lucky to participate in a local holiday dedicated to the end of the harvest season in a Hausa settlement. In the morning, we reached the border crossing point from Dan-Issa. It was a market day. The Nigerians brought for sell a great amount of millet. In the yard of the customs building, five women, four of them carrying babies tied at their back, crushed the millet in large wooden troughs, while the policemen, their husbands, were sitting on a tree trunk and listening to music to a transistor.

6 km after entering Nigeria, it appeared a panel where it was written 'Nigeria Republic' and 'keep left'. Thus, we drove on the left, but not without emotions. Three long and thorough controls waste several hours of our time. (The guns were in a special compartment. It was not the case to make them visible). By noon, we reached Kano and asked for the police station.

- Which police? The state or federal police? We were asked by the policeman. We chose, at random, the federal police and stopped in front of the building. There came the representatives of the company sent by Moloiu. We were all arrested and forced to enter the yard of the police station together with our cars. In the end, the superintendent of the federal police clarified the problem and freed us after apologizing. We required permission for camping in the yard of the police station as there was running water. We were in the northeast of the country. The roads were narrow but asphalted. We passed by plantations of mango, papaya, unirrigated millet and barley crops. During our stop at Potiskum to get fuel for our cars, three persons suffering of lepers got close begging. One of them was on foot, while the other two were riding on donkeys. They had awful injuries; they had lost their fingers and toes. On our road we saw many leper colonies, but it seemed that there were many sick people living outside.

We went to a border crossing point towards Cameroon located in a swampy area, where the road was proper only during the dry season. At the edge of the settlement of Gamburu, the border crossing point was just a hut with three walls covered with straw. We crossed the river on a narrow bridge and we were in Cameroon. We were nervous because we did not have a visa for this country, but it was not a problem. The strip of land from the northern extremity of Cameroon is 85 km wide, full of pools where local people fish nice specimens. Sorghum, millet and rice are cultivated among pools. At that time, as it was the dry season and the region was full of cattle raised by the Fulani people that we saw passing on horseback, armed with spears, bows and swords.

We arrived at Fort-Fureau, which was situated on the left bank of the Chari River. Across the bridge, it was Fort Lamy (presently N'Djamena), the capital of Chad Republic. Near the customs, a red Renault stopped near us and a thin young person with a short beard got out of the car. 'Do you speak French?' And he presented himself as Dejeux. He was the French entomologist that we were supposed to look for at ORSTOM research institute, an old collaborator of professor Botnariuc. He invited us to follow him and we arrived at ORSTOM, where he lived together with his wife. After we served refreshments and beer, they proposed to set our camp at their holiday house, located right on the bank of the river. We gladly accepted their proposal. The next day, all the biologists got the ARO car and visited the laboratories of the research institute. We talked about the alga Spirulina and expressed our wish to obtain it alive and put it on culture media we had already brought from Romania. They cannot clarify the issue. The algologist had only the dry alga as it was preserved by the local people for consumption. The other members of the team went to the post office and to the local authorities, where Cimpoieru and Ungureanu obtained the authorization to record the parade of the delegates of the 15 member states of AMU (The Afro-Malagasy Union) near the tribune.

At the holiday house of Dejeux family, the biologists together with Cataranciuc and Ungureanu prepared for a trip of about 50 km to Lake Chad. We went by ARO and we also had the trailer with a small boat. The lake, during the dry season had a surface of only 10,000 km^2, but, by the end of the rainy season, it may reach a surface of 18,000 km^2. The Chari River flowed into the lake through a 5-6 km-wide mouth. It is the same situation with the Logone River.

On our way to Lake Chad we met numerous delegations of the tribes from the north of the country coming for AMU festivities. They rode fully armed wearing their parade costumes. All of them gladly greeted us and we did the same. At a certain moment, our car crossed over a black band. It was a very voracious species of ants. The Africans use their claw as stiches. In the proximity of the lake, we met numerous birds near the pools from the floodplain. Among these bird species, we remarked the beautiful crested cranes and flocks of Guinea fowl. (Luckily for us, Nelu brought his hunting weapon).

We camped right on the shore. The professor was impatient. He ran to wash his hands in the clear and warm water of the lake. 'All my life I have wanted to get to Lake Chad'- he declared full of strong emotions.

We started sampling the biological material. The fishermen let us choose the specimens we wanted. Among the variety of species, we remarked genuine living fossils, like the Dipnoi fish. We asked about *Spirulina*. Mustafa, a

former driver, offered himself to guide us; thus, Nelu, Dragoș and I left by ARO without the trailer to look for the alga. Mustafa knew that the alga could be found in the salty pools located in the northeast of Chad Lake but he did not know the way there. It was normal as the sand dunes looked the same. We hired a guide who led us to Kanumbu tribe, near the northern border of Chad. The chief of the tribe agreed to lead us but on our way we hired the fourth guide who finally helped us reach the pools and we gathered *Spirulina* alive in some small jars. It was quite crowded in the car as, besides the seven of us, Mustafa bought two sheep. We succeeded to go back to Sangaria the next day, where the Professor and Liviu were waiting for us. Two days later, we returned to the capital, where the AMU festivities had not finished yet. The algologist from ORSTOM received the alive *Spirulina*.

We said goodbye to our new acquaintances and left southwards along the Logone River towards the Central African Republic. The first 150 km of the road were asphalted and thus it was easy. We left behind the vegetation characteristic to the dry savannah and, as we went further, it was replaced by tall grasses. Along the rivers there appeared gallery forests which got wider forming real equatorial forests.

Before entering Banqui, the capital of Central Africa, we cooled in the clear waters of a river. There was the only Romanian embassy on our route. (The pottery and the Romanian handmade objects were for this embassy). The people there received us gladly but also a little scared. Without a prior experience, they had reached the heart of Africa. They asked us a lot of questions about health state, food, etc.

The president of Zaire, Mobutu Sésé Séko Kuku N'gbendu Wa Za Banga wanted to meet the members of the Romanian expedition. As the way to Kinshasa by plane cost more than our entire expedition, we decided Dragoș should go alone, while the others remained there to study certain areas along the Oubanqui River, where the capital was located. This river, which is as wide as the Danube, is the main tributary of the Congo River. The staff of the embassy recommended us to visit Boali falls, which were indeed impressing. On the Lobaye River we had the opportunity to meet Pygmy tribes for the first time.

After Dragoș's return from Kinshasa, we left along the Oubanqui River aiming to enter Zaire Republic. We went pretty slowly as the road was extremely difficult. It was easy to see that we were near the equator. The streams cut deep valleys all over the place and most of the bridges were made up of 4-5 tree trunks which were not very solid. In a place like this, we found a notification written on a piece of paper. 'Damaged bridge', but we saw the notification after we had crossed the so-called bridge. Another two cars, an English and a French one, joined us, so we were a real caravan.

At Bangassou, we had an unpleasant surprise. The ferry was broken. We tried to repair it but it was not possible. The ferry was on the Congolese border. There were about 2,000 km to the first bridge. We decided to cross the five cars on a raft made of canoes. The fishermen helped us (but of course, after paying them). We put together 6 canoes tied in 3 pairs and above them tick wood boards. It took us two days to enter Zaire.

After 74 km through the equatorial forest, we arrived at Monga, where it was the border crossing point. Jeremez, the chief of the customs, saw the word Walter on our passports. 'What is this?' He asked. 'It is the brand of the gun', said the professor. When he saw the guns he stopped us.

The cars that left before (the ARO was the last car) came back as they were not allowed to cross by ferry without Jeremez's signature. We were arrested. Jeremez, who got into our car together with his motorbike, led us. We drove for 3 days to Bondo, where we were forced to camp on a football field. During the night, we got wet as it heavily rained. The next day, Jeremez brought our passports and took his motorbike. The chief scolded him for leaving the post at the border. The security staff from Bondo gave us a sealed envelope to hand over the security in Kisangani. (The National Directorate of Documentation was called Security). Three days later, the staff in Kisangani allowed us to leave. We followed the great Congo River and then left it to reach Epullu Station, where we met animals specific to the equatorial forest. We remarked the okapia, a giraffid artiodactyl mammal. The American anthropologist that led the research station presented us the results of his work with the pygmy population from the region.

We crossed through real virgin equatorial forests within the basin of the Congo River. We were really impressed. The luxuriant vegetation, in 4-5 layers, filtered the sun light so that, at the soil level, there was a greenish semi-obscurity. Due to the increased humidity, I experienced problems with plant drying that I had to put them into alcohol before pressing.

The road slowly climbed on the mountain up to Bogoro, where the English explorer Stanley stayed for almost a year. We reached the great Rift, a crack in the Earth crust, almost 1,000 m deep. From the steep slope we saw the great Lake Albert located within the national park with the same name, a park that covered a distance equal to that from Cluj to Ploiești. On the shore of the lake, at Kiseny, we received the permission for our biologists, Botnariuc, Dragoș and Coman, to participate in night fishing on the lake. We were accompanied by an officer of the national security as the lake was a border area with Uganda, where it had been a coup not long before.

The tug, accompanied by seven fishing boats, began working. In the morning, the boats were towed and we all came back at the shore. We chose a wide variety of fish, among which I remarked a several kilos electric eel. We left Lake Albert going south towards the Ruwenzori Mountains. Because of the daily rains the road was slippery and full of boulders. The cars of our English and French companions could no longer follow the hard road where we drove with no more than 15 km per hour. We friendly said goodbye to each other and we started to climb towards the summit of Ruwenzori and its peak, Margareta, which could be seen among the clouds. At Mutwanga, at more than 2,000 m altitude, we found the representatives of the national park. Starting from that point, there was no longer a road. We could only climb on mountain trails. In order to climb and return, there were necessary about 5-6 days; unfortunately,

we had to give up as the rainy season from the east of the continent was about to start. Until then we had to reach the asphalted road from Uganda. Otherwise, we would have had to stay until the end of the rainy season, as the earth roads of Tanzania were impassable.

We went down to the 74 km-long Semliki River, which brought the water from Lake Eduard to Lake Albert, forming the Nile Albert, one of the springs of the great river. At a crossroads, a panel mentioned that Ishango was the most beautiful place on the planet. One meter-tall grasses waved among the acacia trees with their large crowns or around the 4-5 meters-tall euphorbias. In the tall grass, we saw different kinds of antelopes and zebras, phacochere wild boars, while on the silty shores, there appeared the snouts of the hippos, which after feeding all night, usually lie down in the mire or swim in the river. A multitude of birds (pelicans, storks, gulls) were flying above the water. Two Waterbuk males (as big as the Carpathian deer) were fighting disturbing the harmony. We got the first two buffalos out of the bushes so that Liviu could video shoot them. It was a pity that, from place to place, one could see the white bones of the hippos and elephants that had been shot by poachers during the fights in Congo.

We met the first herd of elephants and, on a panel it appeared the sign 'Priority to the elephants.' We stopped to take a picture that immortalized our crossing over the Equator. The next day, accompanied by the armed guard of the park, with the tripod installed on our ARO car, we drove the entire day taking pictures and video shooting the tens and hundreds of wild animals. At Copile, on the shore of Eduard Lake, fishermen tried to protect their fish from the audacious pelicans that wanted to take it directly from the boat with their enormous beaks; on the contrary, the marabou birds, with their red gular sac, waited patiently to receive something (Fig. 10). At the shore, we noticed herds of antelopes, buffalos and elephants that came for watering. We would have liked to stay a little longer, but we did not have time; thus, we hurried eastwards and, from Kibati, we climbed one of the active volcanos – Niragongo, but after we passed by the hot springs of the Rutshuru River.

Kibati welcomed us with rain, but, the next day, the sky cleared and we started climbing early in the morning. Sever and Dragoș took also the monkey babies that they had been taking care of since visiting Central Africa. We climbed from the equatorial forest up to the alpine meadow. At the edge of the crater, at more than 3,400 m, we admire the 6 smoking spots inside the crater. We could not take pictures and shoot for more than 15 minutes because of a snow storm. Niragongo, as well as the other two volcanoes from its proximity, Mikeno and Karisimbi, got covered by a snow layer. The next day, we arrived at Goma, on the shores of Kivu Lake, and, after we had welded some small holes in the gas tank of ARO, we pass at Giseni, which was a lovely Rwandese resort.

We entered the tenth country, the country of the one thousand hills. The local people were hard-working and they cultivated every plot of arable land or took care of their beautiful reddish cattle. One of the main crops was tea, together with pyrethrum they used to obtain a strong insecticide.

Following a road used by tea planters we reached the border of Uganda. The guard opened the barrier (after paying him) and we arrived in the eleventh country. The joy did not last long because, being dark, we got stuck with our first car in a muddy area with hot springs. We spent the night there because we could not get the car out of mud. The next day, helped by a bus and the people travelling by it, we succeeded to get our car out of the mud. Covered in red mud we entered directly in the yard of the police station from Kabale. It was a Sunday morning but the policemen sent after the person in charge with the visas who was attending the mess at the nearby church.

We had 10 days to cross Uganda. We were extremely happy. The rainy season had already started, but it did not matter. We were driving on an asphalted road. We did not stay much in the capital city Kampala as we had to be attentive after the recent coup especially after the first car 'the ambulance' had been stopped by the police. We were lucky they did not find the doctor's gun.

'What would have happened if they had found it?'

'They would have shot you and then sent their apologies to the Romanian Government'. We were told afterwards by the chief of the Romanian commercial representation in Kenya.

We stopped and camped at Entebe on the shores of Victoria Lake where we took samples.

We visited the nearby botanical garden, one of the most original institutions of this kind in the world. Although we were caught by a torrential rainfall during the night, as it may happen only at the Equator, in the morning we left eastwards. We crossed the Nile Victoria near Owen falls, where the fast water was used to produce electric power. In the evening, we camped within the high plateau at more than 2,800 m altitude. It was really cold. There were 9°C outside, but in tents, it was a little better. We were sitting around the cooking machine waiting for the soup to boil, when we suddenly heard radio Iași. It was the first and the last news from home.

In the morning, we crossed again the Equator. The temperature was 9°C. The altitude 3,090 m. We were again in the southern hemisphere. The road was getting down among forest plantations, most of them of coniferous brought from Mexico, Canada, Australia. We crossed the border to Kenya, the twelfth country. The asphalted road reached the Rift Valley, the great foredeep of the continental shield, which shelters a chain of lakes, most of them sodic.

The first lake is Nakuru, the one which is a real sanctuary of flamingos the number of which is estimated to 1.5 million specimens. Along the Rift, which we fallowed to the capital, Nairobi, we met numerous wild animals (antelopes, zebras, giraffes, ostriches, etc.).

We admired and took photos of the animals while driving as we were in a hurry to meet the staff of the Romanian commercial representation who received us very warmly. Nairobi has a modern centre resembling a European city. We were already used with driving on the left and the crowded traffic in the city did no longer represent

a problem. The city was founded in 1899 when the Englishmen built the railway that connected Mombasa port to Kampala. In the area of the future city, the workers discovered the springs of the Athi River and called the place Nairobi, namely good water. The media praised the qualities of our cars.

Just at the margin of the city, there was Nairobi National Park, with numerous wild animals, which we visited. The park was separated from the city through an electric fence, but there was not a fence in the south and, thus, a large part of the animals migrated to Tanzania, in search of grass after the rainy season.

We said goodbye to our fellow citizens and went to Mombasa visiting the last big park of the continent, Tsavo, situated at the foot of the great volcanic Mount Kilimanjaro.

Finally, we saw in the horizon the silhouettes of the coconut trees. We reached the Indian Ocean exactly one hundred days after we had left the Atlantic shores.

The group of the Romanian geologists from GEOMIN, who were in Mombasa to open an iron mine, gladly welcomed us. GEOMIN had its headquarters exactly on the shore and we were able to work very well in the reef, where we collected a substantial amount of oceanic species.

Luckily, there was a Romanian ship in the port, 'Bucharest' that carried sugar. Commander Rădulescu agreed to take the cars and expedition members, but the ship was not going to return directly home. It had to go first to Kuwait and then to India to take iron ore for Constanța port; the route surrounded the African continent. We agreed to embark.

After boarding formalities ended, we made our last journey on African soil in heavy rain. The cars were put on the deck. A roaring of the siren, a sign of our departure. Gathered on the deck, we watched wistfully the detachment from the shore of the continent, its people and wonderful places, but unforgettable memories and lasting friendships had already been built.

We were guests on the ship 'Bucharest' for two weeks, until we stopped in Kuwait; from there, the members of the team left for Bucharest by plane, via Athens, except for Dragoș, who accompanied the ship until its arrival in Constanța. Two months later we gathered again and, with our cars, full of the red dust of Africa, went for Cluj, the end of our journey.

The samples gathered during the expedition were processed by the University of Cluj, the University of Bucharest, the Biology Institute of the Romanian Academy and the Antipa Museum. There were made photo albums and slides for schools, documentary films, etc., etc.

46 years have already passed and the echoes of this first Romanian Trans-African expedition have not yet extinguished.

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THROUGH SOME FORESTS IN AFRICA, WEST INDIA (GOA), THE CARIBBEAN AND CENTRAL AMERICA, IN THE CONTEXT OF CLIMATE PERTURBATIONS

NECULCE Dragoş

Abstract. The paper represents a biological briefing of the author's travels through some tropical forests from an environmental perspective. It begins with the Romanian Trans-African Expedition, starting point of his biological journey, and arrives at the Costa Rican forest, trying to draw some parallels. At the same time, the presentation is a tiny tribute to tropical forests, so important in global climate regulation, but unfortunately underestimated and subordinated to immediate economic interests. The author's sincere thanks to the organizing team of this conference, because it gave him the opportunity to present the paper and to meet the former members of the Romanian Trans-African Expedition, a major action performed with enthusiasm and minimal financial expenses.

Keywords: tropical forests, mangrove, rainforest, Romanian Trans-African Expedition, climate perturbation.

Rezumat. Prin unele păduri din Africa, India de Vest (Goa), Caraibe şi America Centrală, în contextul perturbărilor climatice. Lucrarea constituie o scurtă schiță biologică din perspectiva mediului ambiant, pe baza expedițiilor efectuate de autor prin unele păduri tropicale. Aceste investigații au început cu Expedția Română Trans-Africană şi au ajuns în pădurile din Costa Rica, evidenţiind unele paralele. În acelaşi timp, autorul adresează sincere mulţumiri colectivului care a organizat această Conferinţă, deoarece ea oferă posibilitatea de a prezenta aceasta lucrare si reîntâlnirea cu membrii Expedției Române Trans-Africane, o acţiune majoră executată cu entuziasm şi cheltuieli financiare minime.

Cuvinte cheie: păduri tropicale, mangrove, reîmpădurire, Expedția Română Trans-Africană, perturbări climatice.

The Romanian Trans-African Expedition and the Museum "Gr. Antipa" Expedition in Tanzania were held almost 50 years ago, when climate disturbances had begun to worry the international community. The gradual desertification of the Sahel was one of the main elements that triggered international interest. The idea then emerged of the possible influence of human activity on the planetary-scale climatic changes. The euphoria of limitless openness and unorganized development of mankind, the recovery after World War destruction, began to shake. Initially shy, environmental science began to impose itself in the face of the harsh reality. It was not classical ecology, but a combination of natural sciences with economics, demography, social sciences.

The two Romanian scientific missions, I took part in, conducted in the midst of this world-wide environmentalist effervescence, gave us the opportunity to cross several African ecosystems already subject to anthropogenic pressures. Forests, we saw a few during the Trans-African expedition, but in Tanzania the mission focused more on coral fauna, so we only saw them in the terrestrial coastal region. I then continued exploring forests in Western India (Goa), the Caribbean, Florida and Central America.

The **Mangrove forest.** In my early school years, I was reading passionately about this amphibian ecosystem, very interesting for the interface particularities, with multiple adaptations of biocoenotic components (Pl. I, Figs. 1; 2).

Aerial root networks provide excellent shelter for juvenile fish, crustaceans and molluscs, essential for feeding local populations; moreover, all these root networks strengthen coastal land and provides protection from hurricanes and big waves (including tsunamis). The tsunami that hit Bali in 2004 did the most damage where the mangrove forests had been replaced with beaches and in 1990 India and Bangladesh escaped the monsoon floods due to new mangrove forest plantations (Belt Iberica 2013). Research in Malaysia has shown that mangrove ecosystems, across the globe, are the largest natural well of atmospheric CO_2 capture and contribute to the reduction of the the greenhouse effect by – 110 Kg/ha/day (GONG & ONG, 1990; FAO, 1994; 2010).

The surface of mangrove forest soil is like a sponge, full of crabs galleries (*Uca* especially). Crabs (Pl. I, Fig. 3) are essential to the existence of the forest (CORCORAN et al., 2007; LINDQUIST et al., 2009). They break up freshly fallen organic matter, creating mounds of carbon-rich microhabitats, maintaining a microflora favourable to edaphic fungi.

Although the mangrove forests are particularly important for biodiversity and regulating the climate, they are threatened to disappear. This ecosystem, one of the most sensitive, decreased by 35% in the last 30-50 years (FELLER et al., 2010).

Their enemies: overfishing crabs for market, timber extraction for firewood or construction, pollution (mangroves are very sensitive) and the expansion of shrimp trade (replacing forests with temporary ponds for aquaculture).

During my travels I have often seen affected mangrove forests and crabs for sale (even in Senegalese markets).

The importance of mangrove forests included them in the topics that will be addressed by the UN Conference on climate in December 2015 in Paris – "**2015 – Mangrove Year**".

The mangrove forests I visited (Pl. II, Fig. 4), circum-Atlantic (African – Senegalese, Caribbean, and Central American) or Indo-West Pacific (Tanzania – Rufiji, India – Goa) were affected either by exploitation or by pollution.

In India, in 1971, the whole coast of Goa was contaminated with iron-ore from the exporting of thousands of tonnes of ore by ships. In Florida and Central America they were affected by domestic pollution.

The mangroves encountered by the Romanian Trans-African Expedition were an ecosystem developed in a salt marsh that was formed in a dried tributary of the Senegal River (NDONG, 1995) (Pl. II, Fig. 5). This kind of mangrove ecosystem is created by the occasional flooding with seawater of dry riverbeds during the high tide. The salt marsh mangroves have *Rhizophora*, crabs and "Atlantic mudskipper" fish, *Periophthalmus barbarus* (Pl. II, Fig. 6). This amphibious fish, with peduncle eyes, for view in both media, and fins serving also as feet, is very quick. The fish had a behaviour different from the one of the other *Periophthalmus* subsequently encountered on the trip. It was able « to predict » our action (us trying to catch it) and, a fraction of a second before, jump 1-2 cm farther. We were 8 people with nets around a small puddle and we were not able to catch even one. We could only collect one thanks to a rifle and the hunting ability of Cataranciuc.

The **Tropical dry forest** (Pl. II, Figs. 7; 8) is an inter-tropical plant and animal association, deciduous or semi-deciduous, dependent on two seasons (dry and rainy) – BRINSSON, 1977; BULLOCK et al., 2009. Its climate is most favourable for human life, agriculture, livestock farming, and urban development, for which reason the forest is the most exposed to deforestation. This ecosystem contains 42% of the inter-tropical vegetation of the planet (MURPHY & LUGO, 1995).

However the dry forest is often subject of climate perturbations. The Romanian Trans-African Expedition encountered the north of this forest in southern Senegal and in northern Nigeria. We only saw a forest gallery, like the one in Niokolo Koba National Park (Pl. III, Fig. 9). This forest was in some places exploited in an artisanal way, a few larger trees cut by individual farmers (Pl. III, Fig. 10), or, in others, more affected by the advancing of the Sahel and savannahs, which had drastically reduced the number of the park animals. The forest of Costa Rica is a typical dry tropical forest, the largest of its kind in Latin America (JRS Biodiversity Found 2012).

The forest looks like a checkerboard due to fragmentation (Pl. IV, Fig. 11). Until 2000, its development was aimed exclusively at agricultural export. Forest land now occupies only 2% of what it did before the Spanish colonization. Gradually, the forest has been subjected to the pressure of human activity. All generations of settlers cleared to expand or to make pastures but the fertility of soil obtained in this way is lost after only two generations (HERNÁNDEZ et al., 2005).

In the rainy season, tropical storms produce runoffs, landslides and floods, in the dry season winds increase the dryness effect (Banco de occidente, 2006) (Pl. IV, Fig. 12). In terms of biodiversity, fragmented ecosystems act as archipelagos: the largest are biodiversity hotspots (Banco de occidente, 2006). The forest fragmentation reduces available habitats for flora and fauna, eliminating species that require more territory, resulting in a selection and changing of former biocoenosis.

Lands we visited years ago, where we had noticed that the process had started, are now worsening continuously. Ecosystems change. In Africa, there is a tendency for dry tropical forests to turn into savannah-shrubs (XIV AETFAT Congress, 1996), and in Central America, despite efforts to create buffer zones, fragmentation continues. The increase in water deficiency in fragmented tropical forests installs meso-xerophilic conditions and leads to cacti "infiltration" (Pl. IV, Fig. 13). Cacti can be found in many dry tropical forests of Costa Rica and Nicaragua.

The first are semi-epiphytic cacti: seeds, delivered by bird droppings on branches of large trees, germinate and develop roots that descend on the trunks and penetrate into the ground. The roots are grouped into root bundles, e.g. *Strophocactus* or *Hylocereus*, (cactus of "dragon fruit"). (Pl. IV, Fig. 14)

The forest fragmentation impacts ecosystem productivity. Floral resource reduction greatly influences the biology of the pollinators and the efficiency of the pollination, acting on plant breeding and the mating system of the populations. The main pollinators, bats *Glossophaga*, *Leptonycteris* and *Micronycteris* suffer from guidance problems and confuse yards for deforested area often falling prey to domestic animals (QUESADA et al., 2014). Kevin shows a *Glossophaga* bat, disoriented and saved *in extremis* from dogs in our yard (Pl. IV, Figs. 15; 16). The bat is quiet and asleep, a moment often fatal.

Large trees can also be found in the Mesoamerican dry forest, as vestiges of former forests covering 90% of the territory. Large trees have no special value in the furniture industry, but are very useful in fixing CO_2 and matter transfer: *Ceiba pentandra, Paquira quinata*. These, among others, are the subject of **replacement with commercial species** which would bring rapid income, such as oil-palm *Elaeis guineensis.* (Pl. IV, Figs. 17; 18)

Cutting of native trees to replace them with plantations of trees intended for the furniture industry (teca or melina) (Pl. V, Fig. 19).

Fragmentation and wind (sometimes very strong), resulting from massive tree cutting, expose the remaining trees to uprooting and to many fires (Pl. V, Fig. 20). It is undeniable that, from one year to the other, the climatic situation in the deforested areas of the tropical dry forest deteriorates; this can be seen not in a rise in temperature, but especially in the arrival of sometimes very strong gusts of wind.

Increasingly more Central American countries, like Costa Rica and Nicaragua, seek to capitalize on this by installing wind fields (Pl. V, Fig. 21).

On several occasions I saw **the rain forest**. It encompasses more than half of the global biodiversity, the richest biome in biodiversity. On 1 ha of forest there can grow 100 or more different species of trees and wildlife. Diversity is very high. Overall, the rainforest is an important natural carbon shaft: stock more carbon than they release, taking a large amount of CO_2 from the greenhouse effect. They also play an important role in water balance and form a physical barrier in the path of drafts. The tropical rainforest actively intervenes in the Earth's climate.

The felling of large trees for valuable wood, mining, large development projects, in other words massive deforestation, makes FAO estimates the deforestation rate as being 13 million ha/y, 15 ha/ minute, **a risk of total loss by 2030** (*Jardin botanique nationale de Belgique, 2014*).

The **Romanian Trans-African Expedition** encountered its first rainforest near Bangui (capital of the Central African Republic; Pl. VI, Fig. 22). It was a ***low altitude rainforest***, with thin trees that are fast growing and can reach up to 50 m high. This band of forest continued to Boali Falls, to the team's, especially Nicu COMAN's, satisfaction and excitement (COMAN, 1975).

This rainforest accompanied us along the northern Congo basin (Pl. VI, Fig. 23). Denser than in the Central African Republic, but also with large trees (many *Ceiba pentandra*) with buttresses. It was hard to photograph because of the darkness caused by the density of the trees and canopy. We could hear and feel bustling life up high, but it was inaccessible to our vision.

In Ituri forest (**hill rainforest**; Pl. VI, Fig. 24) the Romanian Trans-African Expedition reached the research and development resort EPULU, specialized in studying and saving a living fossil (Pl. VI, Fig. 25), the okapi (*Okapia johnstoni*), ancestor of the giraffe. The okapi, hidden in the depths of the forest, were known to pygmy tribes and Europeans rediscovered the species in 1901.

The **mountain rainforest**, with trees rarely exceeding 50 m in height, is the type of forest that I saw along the African Rift (in the Romanian Trans-African Expedition) and then in the Caribbean and in Central America (Pl. VI, Figs. 26; 27).

In Africa (Virunga – R.D. Congo) and the Caribbean (Commonwealth of Dominica), a bamboo forest grows at the edge of the mountain rainforest (Pl. VII, Fig. 29).

The presence of bamboo could be a reliable source of sustainable development. This grass (*Poaceae*) has special qualities, its strength, elasticity, specific weight, in addition to increasing the capacity of soil formation through its system of rhizomes. Being called "vegetal steel", bamboo has been used for thousands of years in construction and is still used today. With very rapid growth, the plantation is almost maintenance free. It is an excellent plant for reforestation of desert or eroded grounds; bamboo is green, durable, robust and cost-effective. One hectare of bamboo captures 62 tonnes of CO_2 per year and regenerates after cutting in 3 to 5 years, while a plantation of young trees captures only 15 t CO_2 per year and regenerates after 30 years. Many countries that have this resource exploit it, and the ones that have it and do not exploit usually demonstrate a lack of expertise. Several times I was given this reply when trying to present its advantages; I am a big supporter of using bamboo (NASSAR et al., 2011).

In the mountain rainforest of Dominica, I often saw *bromeliaceae* on trees (Pl. VII, Fig. 28). At the base of the leaves, the plant gathers rainwater, making a little "pond" with a rich biocoenosis containing many water oligochaetes. In Central America, I saw a peculiar variant of mountain rainforest, the **cloud forest**. Everything is caught in fog and fine rain falling on all sides. It is not rain from the clouds (the sky is clear) but the water that comes out is from the ground and the sweat of vegetation.

Tropical deforestation seriously threatens the health of the planet. The role of tropical forests in gas exchange, in the cycle of matter, in atmospheric CO_2 storage and bioremediation are well known. It also has an increasingly more needed role in shielding against hurricanes and destructive waves (e.g. tsunamis). Finally, the need to replenish them for the global climate balance is recognized. The greatest connoisseur in the life of the rainforests, Dr. Francis Halé, estimates that natural recovery after massive deforestation may take 600 years, so the urgency of the situation requires reforestation by planting. All kinds of technologies have been tested, most of them targeting ways that provide fast recovery (fast growing species that provide also industrial recovery). More harmful than actual tree cutting is the conversion of tropical ground soil into plantation soil. Also, there is the monoculture problem. Dr. Akira Miyawaki, director of the Japanese Centre for International Ecological Studies came with a truly ecological concept:

« **NO MANAGEMENT = BEST MANAGEMENT »**

Plant native trees with extensive root system, with a quantity of local edaphic biocoenosis and leave time and selection to act. This concept comes after successfully planting 40 million trees in 15 different countries and official recognition that these forests saved from flooding hundreds of millions of hectares of land. Sebastiao Salgado, in Brazil, using a similar strategy, has succeeded in "rehabilitating" lands of significant size in Minas Gerais.

Coordinated action by the UN climate comity, the recent establishment of the interdisciplinary organization **FUTURE EARTH** with its international headquarters in Montréal (Canada) and holistic approaches to the environmental issues give greater hope to the tropical forests of our planet (NECULCE, 2013).

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Plate I

Figures 1, 2. Mangrove thickets.

Figure 3. Mangrove crabs.

Plate II

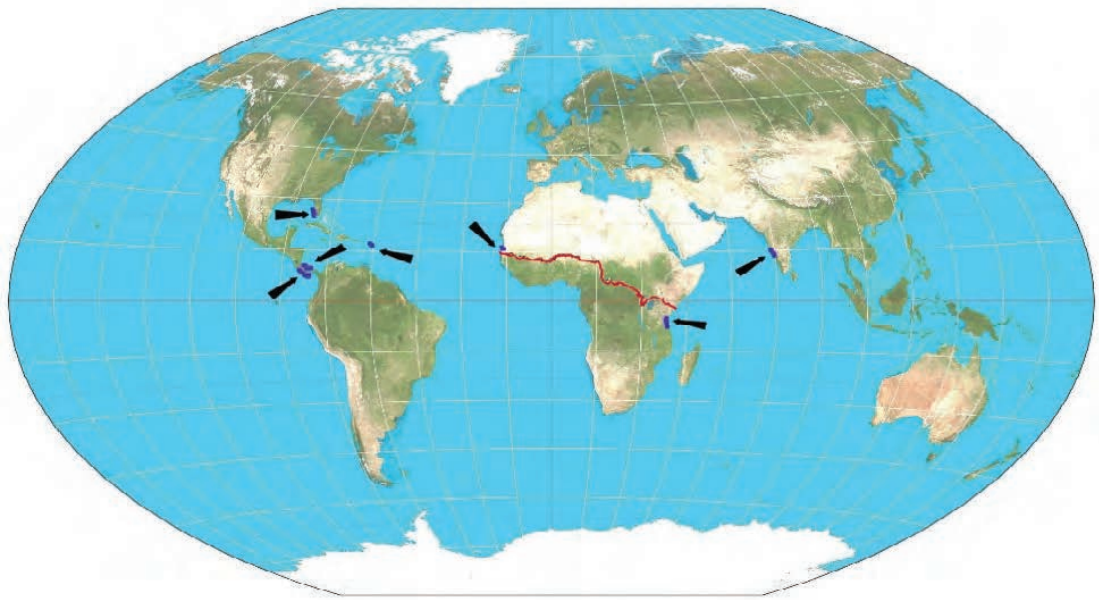

Figure 4. Visited mangrove sites.

Figure 5. Pond with Periophthalmus, Senegal.

Figure 6. *Periophthalmus barbarus*, Senegal.

Figure 7. Dry tropical forest, Caribbean.

Figure 8. *Nephila claviceps*, in the dry tropical forest of the Caribbean. The thread of the web is stronger than steel and is excellent for neuronal regeneration in mammals; it is antibacterial and does not trigger immune rejection.

Plate III

Figure 9. Gallery forest, Senegal (Niokolo-Koba).

Figure 10. Ebony tree chopped down to make room for pastures, Senegal.

Figure 11. Forest fragmentation, Costa Rica.

Figure 12. Deforested land, transformed into pastures; it doesnot retain rain water anymore and starts degrading, Costa Rica. The deforested terrain is exposed to winds and dryness.

Plate IV

Figure 13. Cacti in a dry tropical forest, Costa Rica, Nicaragua.

Figure 14. At the limit of the forest, semi-epiphytic cacti start growing on trees (*Hylocereus* –pitahaya cactus, which bears the comestible dragonfruit).

Figures 15, 16. Disoriented *Glossophaga* bat saved in the yard by Kevin.

Figures 17, 18. Cutting down of secular native trees to replace them with *Elaeis guineensis* plantations, Costa Rica.

Plate V

Figure 19. Part of a native-tree-deforestation zone.

Figure 20. Dry tropical forest, pastures and wildfires induced by drought.

Figure 21. Wind farms, Guanacaste CR and Nicaragua.

Plate VI

Figure 22. Outpost of the tropical rainforest in Bangui (Central African Republic).

Figure 23.Tropical rainforest in the Great African Rift (Virunga).

Figures 24, 25. Ituri forest and one of the residents of Epulu Station and Okapi.

Figures 26, 27. Tropical rainforest in the Caribbean.

Plate VII

Figure 28. Bromeliaceae in the tropical rainforest of Dominica.

Figure 29. Bamboo forests at the edge of the tropical rainforest in Africa and Central America.

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